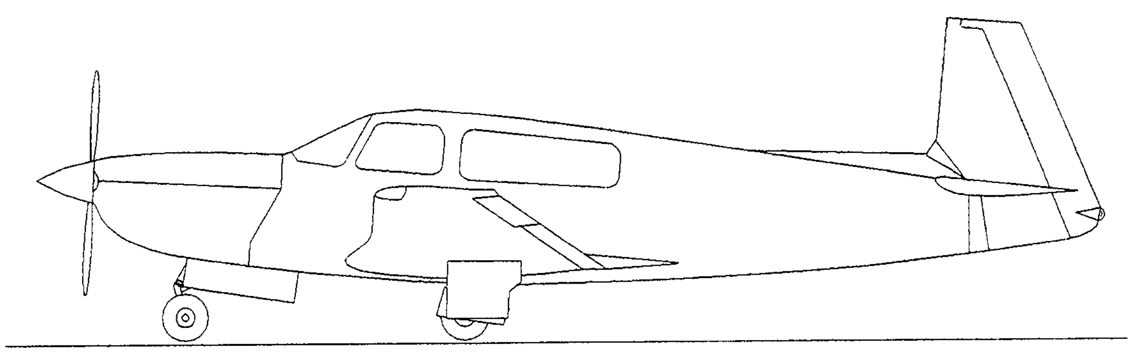
Mooney M20R

SERVICE AND MAINTENANCE MANUAL



MOONEY AIRCRAFT CORPORATION
LOUIS SCHREINER FIELD, KERRVILLE, TX 78028

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WARNING: Manufactured with 1,1,1 Trichloroethane substances which are determined to harm public health and environment by destroying ozone in the upper atmosphere.

This warning applies to placards manufactured at Mooney Aircraft Corporation facility and installed on the Mooney Aircraft Model(s) addressed in this publication.

WARNING: Manufactured with 1,1,1 Trichloroethane substances which are determined to harm public health and environment by destroying ozone in the upper atmosphere.

This warning applies to certain adhesives procured form vendors and utilized on the applicable Mooney Aircraft Model(s) addressed in this publication.

LOG OF REVISIONS

Always destroy superseded pages when you insert revised pages.

DATE OF REVISION	SECTIONS AFFECTED	DATE OF REVISION	SECTIONS AFFECTED
OCTOBER, 1998	TITLE PAGE		
	LOG OF REVISIONS		
	INTRODUCTION		
	CHAPTER 5		
	CHAPTER 8		
	CHAPTER 21		
	CHAPTER 24		
	CHAPTER 27		
	CHAPTER 28		
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	CHAPTER 77		
	CHAPTER 79		
	CHAPTER 91		

NOTE:
A list of effective pages will appear at the beginning of each chapter.

INTRODUCTION

This manual provides servicing and maintenance information for the Mooney Model M20R, Serial Numbers 29-0001 and ON. Maintenance actions that refer to a limited number of aircraft will be designated by serial number of applicable airplanes.

The Part Number's of replacement or repair parts should be identified using the Illustrated Parts Catalog applicable to Model and S/N of aircraft being worked on. The correct P/N can be ordered through any Mooney Service Center. See Section 91 for exceptions on Electrical Components.

The format and contents of this manual are prepared in accordance with GENERAL AVIATION MANUFACTURER'S ASSOCIATION (GAMA) Specification No. 2. The manual is supplemented with wiring schematics for the various model year airplanes,as necessary. These are located in envelopes at the back of the manual texts pages.

NOTE

Revisions or reissues of this manual are not automatically provided to manual holders. Holders of these and other Mooney Technical Publications should complete the information on the "YELLOW CARD" located at the front of the Title Page and send to Mooney Aircraft Corporation, P.O. Box 72, Kerrville, TX., 78029-0072, Attn: Service Parts Department.

Notification is sent to known manual holders when another manual is prepared to replace the subscription and advises that no more revisions will be sent out. The new manual will require a new subscription service. If additional Technical Publications are desired, contact the above department at Mooney Aircraft Corporation at (210) 896-6000, ext. 271.

Correspondence concerning maintenance or part numbers on an airplane should contain the aircraft model number and serial number. The serial number appears on the identification placard located on the aft end, left hand side of the tailcone below the horizontal stabilizer.

ASSIGNMENT OF SUBJECT MATERIAL

The content of this publication is organized at four levels:

Group
Chapter (System)
Section (Sub-system)
Subject (Unit)

GROUP

These are primary divisions of the manual that enable broad separation of content, ie., Airframe systems VS Powerplant systems. These groups are identified by tabs.

CHAPTER (System)

The various groups contain major systems information such as flight controls, landing gear, etc. The systems are arranged numerically per GAMA recommended number assignment, It is suggested, for example,that "Fuel" be identified with the Chapter number "28". The sequence of numbers, **28**-00-00, refers to the General information of the Fuel Systems.

SECTION (Sub-System)

The major systems of an aircraft are broken down into sub-systems. These sub-systems are identified by the second element of the sequence of numbers, ie., 28-**20**-00. The element -20- indicates the distribution portion of the fuel system.

SUBJECT (Unit)

The individual units within a sub-system may be identified by a third element of the sequence of numbers, ie.,28-20-**01**. This number is assigned by the manufacturer and may or may not be used depending upon the complexity of the maintenance action recommended.

APPLICATION OF NUMBERING SYSTEM

Mooney Aircraft Corporation is in the process of revising all applicable maintenance technical publications to GAMA format. When this effort is completed any publication concerning maintenance of aircraft will conform to this basic numbering system. Any person wishing information concerning the Fuel Distribution System would refer to the pages identified as ,28-20-00, in any maintenance oriented publication. These pages will be numbered sequentially within each system breakdown in the current Mooney series of aircraft. As Mooney aircraft models become more complex the page numbers may be sequentially numbered within sub-systems.

The table of contents in the front of each Chapter will provide a list of systems and/or subjects covered in the Chapter. For example:

28-00	General
28-10	Storage (Tanks, vents, repair, etc.)
28-20	Distribution (Boost pumps, fuel lines, etc.)
28-40	Indicating (Sender Units, quantity gauges, etc.)

If there is a reason to distinguish between LEFT HAND or RIGHT HAND fuel quantity sending units then the number would be expanded to 28-40-01 (Left Hand) and 28-40-02 (Right Hand). This concept will apply to any expanded information throughout the publications.

SUPPLEMENTARY PUBLICATIONS

The following list of Manufacturers and/or publications can provide servicing and maintenance information on components of the Mooney, Model M20R. No avionics equipment Manufacturers or publications are listed due to the many configurations that can be installed in the aircraft. These can be obtained from the repair stations for a particular avionics manufacturer.
Any publications available from Mooney Aircraft Corporation are listed in the Parts Price List and are available through any Mooney Service Center. Most manufacturer/vendor publications are not availabel through Mooney Aircraft Corporation, these should be obtained from the applicable Manufacturer/Vendor.
As publications on various components become available, they will be added to the list below.

VENDOR ADDRESSES -- PUBLICATIONS

ENGINE PUBLICATIONS

The following maintenance publications can be obtained through Teledyne Continental Motors, Aircraft Products, P.O. Box 90, Mobile, Alabama, USA, 36601, Attn: Accounts Receivable (Prepaid only).

Overhaul Manual for Teledyne Continental Motors Aircraft IO-550 Engine Models, Form X30568A.
Illustrated Parts Catalog for Teledyne Continental Motors IO-550 series aircraft engines, Form X30569A.
Maintenance & Operators Manual for Teledyne Continental Motors IO-550 aircraft engines, Form X30565.
Service Bulletins - Specify model of engine for which maintenance data is desired when ordering.
Fuel Injector Manual, Form X30593A

ACCESSORY PUBLICATIONS

PROPELLER

McCauley Propellers - Obtain publications from McCauley Accessories Division, 3535 McCauley Drive, Vandalia, OH.,45377.

Service Manual - No. 761001 for McCauley C400 series constant speed propellers.

MAGNETO

Teledyne Continental Motors, Aircraft Products, P.O. Box 90, Mobile, Alabama, USA, 36601, Attn: Publications Dept., for TCM (Bendix), Type S6RN-25 Series magnetos.

ALTERNATOR

Alternator Service Instructions, Form X30531-3, Teledyne Continental Motors, Aircraft Products, P.O. Box 90, Mobile, Alabama, USA, 36601, Attn: Publications Dept.

STARTER

Service Manual, Teledyne Continental Motors, Aircraft Products, P.O. Box 90, Mobile, Alabama, USA, 36601, Attn: Publications Dept

FUEL PUMP (Engine Driven)

Teledyne Continental Motors, Aircraft Products, P.O. Box 90, Mobile, Alabama, USA, 36601, Attn: Publications Dept

IGNITION SYSTEM

Master Service Manual, TCM Ignition Systems and Components, Form X40000, Teledyne Continental Motors, Aircraft Products, P.O. Box 90, Mobile, Alabama, USA, 36601, Attn: Publications Dept

SPEED BRAKES

Precise Flight, Inc., 63120 Powell Butte Rd., Bend, OR 97701, Telephone: (503) 382-8684

CHAPTER - SECTION - TITLE -- INDEX GUIDE

CHAPTER

05

TIME LIMITS/ MAINTENANCE CHECKS

CHAPTER 5

TIME LIMITS/MAINTENANCE CHECKS

TABLE OF CONTENTS

CHAPTER 5

TIME LIMITS/MAINTENANCE CHECKS

LIST OF EFFECTIVE PAGES

CHAPTER SECTION SUBJECT	PAGE	DATE
5-Effectivity	1/2BLANK	10-98
5-Contents	3/4BLANK	10-98
5-00-00	5	6-94
5-10-00	6	10-98
5-20-01	7	10-98
5-20-01	8	6-94
5-20-01	9	6-94
5-20-01	10	10-98
5-20-02	11	10-98
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5-20-06	13	10-98
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5-00-00 - GENERAL

AIRCRAFT DESCRIPTION. The M20R series of aircraft are four place, high-performance, normally aspirated, single-engine, low-wing monoplanes. The all-metal airframe has a tubular-steel cabin frame covered with nonstructural aluminum skins, a semi-monocoque tailcone, and a full-cantilever, laminar-flow wing. Control surfaces have structural spar construction with stressed skins riveted to the spars and ribs. Dual control wheels accompany the conventional flight controls. The pilot's rudder pedals have toe brakes linked to individual hydraulic cylinders that supply pressure to the hydraulic disc brakes on each main gear wheel. Removable, co-pilot rudder pedals are standard equipment. The tricycle landing gear, having a steerable nose wheel controlled by rudder pedal action, is fully retractable. The wide-span trailing-edge wing flaps are electrically operated. For stabilizer trim, the entire empennage pivots vertically about its attaching points.

5-00-01 - LANDING GEAR SYSTEM

The electric landing gear system has a steerable nose wheel. Single disc self-adjusting hydraulic brakes are featured on the main gear. Gear position lights, a warning horn and a gear position indicator on the floorboard are standard equipment. Bungee springs that preload the the retraction mechanism in an over-center position lock the gear down. An air pressure actuated safety switch in the electrical system prevents electric gear retraction on takeoff until a safe flying speed is attained. A gear throttle warning horn sounds when the manifold pressure is less than a pre-set value with the landing gear up. The electric gear retraction system has a manual extension system connected to the gear actuator that permits manual lowering of the gear in the event of an electrical malfunction. Landing gear doors fully enclose the wheel wells to reduce sound levels and increase performance.

5-00-02 - FLIGHT CONTROL SYSTEMS

The dual flight control systems can be operated from either the pilot or co-pilot seat. All flight controls are conventional in operation, using pushpull tubes to link the control surfaces to the control wheels and rudder pedals. Formica guide blocks maintain control tube alignment and dampen vibration. An interconnect spring mechanism links the aileron and rudder systems to assist in control coordination. The standard co-pilot's rudder pedals are removable. A dual brake installation is optional for the co-pilot's position. The manual or electric trim system sets the horizontal stabilizer angle of attack.

5-00-03 - WING FLAP SYSTEM

Wing flaps are electrically actuated and are controlled by a spring loaded "up-off-down" switch on the center console.

5-00-04 - ELECTRIC POWER SYSTEM

1. The Master Switch and power relay control the electrical power system, comprised of a 100 AMP, 28 Volt, alternator and two 10 AMP HR, 24 Volt, batteries. The alternator system has an overvoltage protective relay and an overvoltage annunciator light. Circuit breakers or circuit breaker switches protect the electrical wiring and equipment from overloads.
Standard electrical equipment includes: 2-100 watt landing lights, 2-100 watt taxi lights, navigation lights, interior lights,instrument panel/glareshield lights, gear and stall warning system, an electrical fuel boost pump, an electric starter, an electric gear retraction/extension system, with manual extension override, an electric trim system (optional) and an electrical flap system.

5-00-05 - INSTRUMENTS

All flight instruments are in the shock-mounted Flight Panel. Engine instruments are in the co-pilot's panel. The pitot system provides air pressure to operate the airspeed indicator. The instrument static pressure system has two static air pickup ports (one on each side of the tailcone) that open to the atmosphere. An alternate static source is provided on center console. The instrument panel/glareshield lighting systems have manual dimming mechanisms.

5-00-06 - CABIN HEATING & VENTILATING SYSTEMS

The heater muff encasing the exhaust system is the cabin heat source. Hot air from the heater muff, mixed with ambient air, controls cabin temperature. Air routed from the main heater duct system to nozzles at the windshield base defrosts the windshield. An optional defrost blower motor system is available.

5-00-07 - FUEL SYSTEM

The fuel system has sealed, integral wing tanks in the forward, inboard section of each wing. Vents at the aft, outboard top corner of each tank vent through a NACA scoop on the lower wing surface. Fuel sump drains are at the lowest point in each tank. The electric fuel pump is in the bottom left forward section of the fuselage, aft of the firewall. The engine-driven fuel pump mounts on the engine crankcase. Two fuel quantity transmitters in each tank are wired in series to fuel quantity gauges in the engine cluster gauge. The Master Switch, left side of the pilot's panel, activates the fuel quantity indicating systems. The optional visual sight gauges are for partial fueling of wing tanks..

A "low fuel" warning annunciator light for each tank is activated when usable fuel quantity goes below 2 1/2 gallons.

5-10-00 - TIME LIMIT COMPONENTS

It is recommended that overhaul or replacement of components should be accomplished not later than the specified period of operation for that component or in accordance with manufactures service data or airworthiness directives.

The specified overhaul time limits, if applicable to a component, do not constitute a guarantee that the component will reach that time limit without requiring maintenance.

NOTE
"ON CONDITION" items are to be repaired, replaced or overhauled when inspection or performance reveals an unserviceable condition.

5-10-01 - OVERHAUL, MAINTENANCE AND REPLACEMENT SCHEDULE

ITEM	RECOMMENDED OVERHAUL, MAINTENANCE OR REPLACE TIME LIMITS
Landing Gear	
Actuator No-Back Spring	1000 Hours
Avionics Products (Eaton)	See SI M20-52A
Plessey - (GEC)	See SI M20-92A
All other Components	On Condition
Powerplant	
Engine	2000 Hours
Propeller	2000 Hours or 6 years (refer to mfg's. repair data)
Magnetos -TCM	500 Hours (refer to TCM repair/inspection data)
Induction Air Filter	500 Hours or Annually (recommended)
All other Components	On Condition
Fuel & Oil System	
Fuel Selector Valve (Airight or Christopher Tool)	On Condition
Flexible Hoses (All, except Teflon & as below)	7 years or Engine O/H, whichever occurs first.
All other Components (includes Teflon hoses)	On Condition
Instruments	
Vacuum Regulator Garter Filter	100 Hours
Filters - Vacuum Pump	500 Hours (CV1J4 Filter - On Condition)
Filters - Gyro Instruments	500 Hours or Annually
Other Components	On Condition
Electrical System	
All Components	On Condition
Flight Controls	
All Components	On Condition
Miscellaneous Systems	
Vacuum Pump, Primary	On Condition or 500 Hrs. & @ Engine O/H
Stand-by Vacuum Pump/Clutch	200 Hours (Inspect Drive Coupling)
E.L.T. Battery	2 Years or 1 Hour Total Use
Oxygen Cylinders	
* Lt. Wt. Steel Cylinders	5 yrs.(O/H) / 24 years or 10,000 recharge cycles - Replace
* Composite Cylinders	3 yrs.(O/H) / 15 years or 10,000 recharge cycles - Replace
Scott Oxygen Regulator	6 years-overhaul; 3 years-test
Air Conditioning Components.	See Section 21-58-00 for specific maintenance and servicing times.
All Other Components (Excluding Avionics)	On Condition (See NOTE above)
Avionics	Refer to Manufacturers Publications

* Hydrostatic Test Required @ 3 year intervals.

NOTE
Components should be inspected and serviced at regular intervals per the servicing, lubrication and inspection chart of this manual.

5-20-00 - SCHEDULED MAINTENANCE CHECKS

Inspection Intervals. Perform a 25, 50, or 100-hour inspection of the aircraft, components and engine at recommended intervals as outlined in the following paragraphs.

NOTE

Aircraft operated in a salt air environment are considered high risk for corrosion damage, and should be cleaned and inspected at frequent intervals. Refer to AC 43-4.

5-20-01 - INSPECTION CHECK POINTS

The general points to be covered during inspection are grouped in accordance with the nature and function of the items discussed.

1. Moving Parts shall be inspected and checked as applicable for: proper operation, security of attachment, sealing, cleanliness, lubrication, servicing, safetying, adjustment, tension, travel, condition of hinges, binding, excessive wear, cracking, corrosion, deformation, and any other apparent damage.

2. Metal Parts shall be inspected, as applicable, for: security of attachment, condition of finish and/or sealant, distortion, fatigue cracks, welding cracks, corrosion, and any other apparent damage. The tubular frame structure should be inspected during each annual inspection for any signs of corrosion or damage.

3. Fuel, air, oil and hydraulic oil lines and hoses shall be inspected as applicable for: cracks, dents, kinks, deterioration, obstruction, chaffing, improper bend radius, and insecure installation. Replace or correct if any of these conditions exist. **Hose clamp installations on fuel and hydraulic** systems between systems or between systems and the engine shall be **torqued to 25 inch pounds. Hose clamp installations on blast tubes, air ducts, vacuum lines, drain and vent** lines shall be **torqued to 15 inch pounds**.

4. Pipe Threads - Tightening and torque procedures. Lubricate pipe threads as follows:

Oxygen Lines - Use only MIL-T-5542 thread compound or Teflon thread seal tape on threads of valves, connectors, fittings, parts or assemblies which might come in contact with oxygen. The thread compound must be applied sparingly to the first three threads of the male fitting only. No compound is to be used on the coupling sleeves or on the outside of the tube flares. Extreme care should be exercised to prevent the contamination of the thread compound or teflon tape with oil, grease or other lubricant.

Fuel, Hydraulic, Air, Oil Lines - Use "Parker Thread Lube" or equivalent on male fittings only. Apply lubricant, omitting the first two threads, sparingly and carefully.

Engine Fittings - Use only aircraft engine oil to lubricate fittings threaded directly to engine.

Vacuum Lines - No lubrication is to be used. Check manufacturers instructions when installing components. Refer to Section 37 for maintenance procedures on vacuum system.

Tapered Threads - Use Teflon Threadseal Tape.

(1) Continue to tighten until fitting is correctly positioned but do not overrun or backoff.

(2) If leaks are detected, tighten one full turn more.

(3) If leaks persist, the parts should be disconnected and rejected; replace with new components.

5. Bolts and nuts in critical areas shall be inspected for: fretting, wear, damage, stretch, proper torque, (Figure 5-2) and safetying.

6. Electrical wiring shall be inspected as applicable for: loose, corroded, and broken terminals; chaffed, broken, and worn insulation; insecure installation; heat deterioration; and any other apparent damage.

7. Filters and screens shall be removed, cleaned and inspected for contamination or damage that would require replacement.

TORQUE VALUES

See Following Tables.

FLARE NUT TORQUE VALUES- Tighten to minimum torque value for appropriate size as shown (Figure 5-1).

CAUTION
These torque values are derived from oil-free cadmium-plated threads.

FITTING SIZE	ALUMINUM TUBING		STEEL TUBING	
	TORQUE - INCH POUNDS			
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
-3			30	70
-4	40	65	50	90
-5	60	80	70	120
-6	75	125	90	150
-8	150	250	155	250
-10	200	350	300	400
-12	300	500	430	575
-16	500	700	550	750
-20	600	900		
-24	600	900		

FLARE NUT TORQUE
FIGURE 5-1

METRIC BOLTS, SCREWS & NUTS

Failure of threaded fasteners due to over-tightening can occur by bolt shank fracture or by stripping of the nut and/or bolts thread. A bolt or screw assembled with a nut of the appropriate class is intended to provide an assembly capable of being tightened to the bolt proof load without thread stripping occurring.
The torque value to be set for a particular size of screw is dependent upon:
1) Material of the screw.
2) Parent material (steel, non-ferrous metal or plastic).
3) Whether the screw is untreated or plated.
4) Whether the screw is dry or lubricated.
5) The depth of the thread.

TIGHTENING TORQUES - Untreated Hardware (Black Finish) *Friction Coefficient 0.14*

NOMINAL DIAMETER (Coarse Thread)	5.6	8.8	PROPERTY CLASS	10.9	12.9
	Nm/ft.lb.	Nm/ft.lb.	TORQUE Ma	Nm/ft.lb.	Nm/ft.lb.
M 3	0.60/0.44	1.37/1.01		1.92/1.42	2.30/1.70
M 4	1.37/1.01	3.10/2.29		4.40/3.25	5.25/3.87
M 5	2.70/1.99	6.15/4.54		8.65/6.38	10.4/7.6
M 6	4.6/3.3	10.5/7.7		15/11	18/13
M7	7.6/5.6	17.5/12.9		25/18.4	29/21.3
M8	11/8.1	26/19		36/26	43/31
M10	22/16	51/37		72/53	87/64
M12	39/28	89/65		125/92	150/110
M14	62/45	141/103		198/146	240/177
M16	95/70	215/158		305/224	365/269
M18	130/95	295/217		420/309	500/368
M20	184/135	420/309		590/435	710/523
M22	250/184	570/420		800/590	960/708
M24	315/232	725/534		1020/752	1220/899
M27	470/346	1070/789		1510/1113	1810/1334
M30	635/468	1450/1069		2050/1511	2450/1806
M33	865/637	1970/1452		2770/2042	3330/2455
M36	1111/819	2530/1865		3560/2625	4280/3156
M39	1440/1062	3290/2426		4620/3407	5550/4093

(METRIC TORQUE TABLES CONTINUED)

NOMINAL DIAMETER (Fine Thread)	8.8 Nm/ft.lb.	PROPERTY CLASS TORQUE Ma	10.9 Nm/ft.lb.	12.9 Nm/ft.lb.
M8 x 1	27/19		38/28	45/33
M10 x 1.25	52/38		73/53	88/64
M12 x 1.25	95/70		135/99	160/118
M14 x 1.5	150/110		210/154	250/184
M16 x 1.5	225/165		315/232	380/280
M18 x 1.5	325/239		460/339	550/405
M20 x 1.5	460/339		640/472	770/567
M22 x 1.5	610/449		860/634	1050/774
M24 x 2	780/575		1100/811	1300/958

TIGHTENING TORQUES - Electrically Zinc Plated Hardware - *Friction Coefficient 0.125*

DIAMETER (Coarse Thread)	5.6 Nm/ft.lb.	8.8 Nm/ft.lb.	PROPERTY CLASS TORQUE Ma	10.9 Nm/ft.lb.	12.9 Nm/ft.lb.
M3	0.56/0.41	1.28/0.94		1.80/1.33	2.15/1.59
M4	1.28/0.94	2.90/2.14		4.10/3.02	4.95/3.65
M5	2.50/1.84	5.75/4.24		8.10/5.97	9.70/7.15
M6	4.3/3.1	9.9/7.3		14/10.3	16.5/12.1
M7	7.1/5.2	16.5/12.1		23/16.9	27/19.9
M8	10.5/7.7	24/17.7		34/25	40/29
M10	21/15	48/35		67/49	81/59
M12	36/26	83/61		117/86.2	140/103
M14	58/42	132/97		185/136	220/162
M16	88/64	200/147		285/210	340/250
M18	121/89	25/202		390/287	470/346
M20	171/126	390/287		550/405	660/486
M22	230/169	530/390		745/549	890/656
M24	295/217	675/497		960/708	1140\840
M27	435/320	995/733		1400/1032	1680/1239
M30	590/435	1350/995		1900/1401	2280/1681
M33	800/590	1830/1349		2580/1902	3090/2278
M36	1030/759	2360/1740		3310/2441	3980/2935
M39	1340/988	3050/2249		4290/3163	5150/3798

NOMINAL DIAMETER (Fine Thread)	8.8 Nm/ft.lb.	PROPERTY CLASS TORQUE Ma	10.9 Nm/ft.lb.	12.9 Nm/ft.lb.
M8 x 1	25/18		35/25	42/30
M10 x 1.25	49/36		68/50	82/60
M12 x 1.25	88/64		125/92	150/110
M14 x 1.25	140/103		195/143	235/173
M16 x 1.5	210/154		295/217	350/258
M18 x 1.5	305/224		425/313	510/376
M20 x 1.5	425/313		600/442	720/531
M22 x 1.5	570/420		800/590	960/708
M24 x 2	720/531		1000/737	1200/885

METRIC CONVERSION FACTOR: One Nm(Newton Meter) = .7375 Foot Pound;
One Foot Pound = 1.355818 Nm

AN/MS STANDARD BOLT, NUTS TORQUE TABLES

FINE-THREAD SERIES

NUT/BOLT SIZE	TENSION-type AN( ) BOLTS AN365/AN310 NUTS	SHEAR-type AN( ) BOLTS AN364/AN320 NUTS	TENSION-type NAS( ) BOLTS AN365/AN310 NUTS	SHEAR -type NAS( ) BOLTS AN364/AN320 NUTS
8-36	12-15	7-9		
10-32	20-25	12-15	25-30	15-20
1/4-28	50-70	30-40	80-100	50-60
5/16-24	100-140	60-85	120-145	70-90
3/8-24	160-190	95-110	200-250	120-150
7/16-20	450-500	270-300	520-630	300-400
1/2-20	480-690	290-410	770-950	450-550
9/16-18	800-1000	480-600	1100-1300	650-800
5/8-18	1100-1300	600-780	1250-1550	750-950
3/4-16	2300-2500	1300-1500	2650-3200	1600-1900
7/8-14	2500-3000	1500-1800	3550-4350	2100-2600
1-14	3700-5500	2200-3300	4500-5500	2700-3300
1 1/8-12	5000-7000	8000-4200	6000-7300	3600-4400
1 1/4-12	9000-11000	5400-6600	11000-13000	6600-8000

COARSE-THREAD SERIES

8-32	12-15	7-9
10-24	20-25	12-15
1/4-20	40-50	25-30
5/16-18	80-90	48-55
3/8-16	160-185	95-100
7/16-14	235-255	140-155
1/2-13	400-480	240-290
9/16-12	500-700	300-420
5/8-11	700-900	420-540
3/4-10	1150-1600	700-950
7/8-9	2200-3000	1300-1800

TORQUE VALUES
(Units are Inch-pounds) Figure 5-2

Reference: Federal Aviation Agency Advisory Circular No. 43.13-1A, p. 118

Recommended Torque Values for Nut-Bolt combination
(Units are inch-pounds)

1. Be sure nut and/or bolt threads are clean and dry(unless Mfg. states otherwise).
2. Run bolt down near contact with washer or bearing surface and check "friction drag torque" required to turn bolt/nut.
3. Add "friction drag torque" to the recommended torque value from Figure 5-2. This value is considered "Final Torque Value".

(FRICTION DRAG TORQUE + REC'MD TORQUE = FINAL TORQUE).

CAUTION
DO NOT REUSE LOCKNUTS IF THEY CAN BE RUN UP FINGER TIGHT.

5-20-02 - AIRCRAFT FILE INSPECTION

Aircraft 100-hour and annual inspections cover, in addition to examining the aircraft proper, a review of the status of compliance with current Federal Aviation Regulations. This review includes inspection of the Airplane Flight Manual, Aircraft Log Book, Engine Log Book, Propeller Log Book, Registration Certificate, Airworthiness Certificate, Weight & Balance Record, Engine Service Information, Aircraft Radio Station License (if applicable), FAA Airworthiness Directives, and Mooney service documents.

5-20-03 - ENGINE FUNCTIONAL CHECK

Prior to a scheduled 100-hour or annual inspection, and/or 25 hours after installation of new or overhauled engine, wash down the engine and engine components. Then perform an engine runup in accord with procedure recommended in the Airplane Flight Manual. Make a record of all malfunctions and abnormalities. After the engine runup, complete a differential (hot engine) compression check. To verify correction of malfunctions and abnormalities, perform a second engine runup and a flight test after completing the inspection.

5-20-04 - FIRST 25-HOURS INSPECTION - (Non-Repetitive)

The, one time, 25-hour inspection consists of a visual inspection of the propeller, engine, and aircraft general condition, including a preflight inspection as outlined in the Airplane Flight Manual. The inspection does not require removal of all access panels or disassembly of components; however, it should include completion of all lubrication & service requirements. The inspection should be extensive enough to detect any damage or maladjustment which might jeopardize flight safety. After the first 25 hours of a new or overhauled engine operation, refer to paragraph 5-20-05 for the recommended engine inspection.

1. Visually inspect propeller, spinner, and engine cowling; remove cowling.
2. Inspect and clean induction air filter if aircraft has been operating under dusty conditions. Check operation of alternate air door.
3. Inspect engine compartment for evidence of fuel, oil or exhaust leaks.
4. Inspect security and condition of equipment installed on engine.
5. Inspect fuselage, wing and empennage for external evidence of damage. Pay particular attention to scratches and dents.
6. Inspect windshields and windows for crazing, cracks, and scratches.
7. Inspect control systems for binding, excessive freeplay, and damage.
8. Inspect pitot and static systems for possible obstructions.
9. Inspect aircraft exterior for security of bolts, screws, etc.
10. Inspect and service batteries.

5-20-05 - 50-HOUR INSPECTION - (Repetitive)

The 50-hour inspection includes all requirements of the 25-hour inspection, plus the necessary removal of inspection doors, panels, or fairings. After the first 25 hours of operating time, a new, re-manufactured, or newly overhauled engine should be given a 50-hour inspection including replacement of the lubricating oil and filter.

1. Engine Inspections. (Refer to engine manufacturer's service data for oil change frequency)
   A. Drain engine oil sump .
   B. Remove and clean suction oil strainer; reinstall strainer and plug. Safety wire strainer plug.
   C. Remove and replace the full-flow oil filter cartridge.
   D. Remove and clean fuel injector fuel strainer.
   E. Service engine oil sump with proper type, grade, and amount of lubricating oil.
   F. Inspect engine intake and exhaust systems for evidence of leakage, looseness or damage.
   G. Inspect spark plug elbows and shielding nuts for security.
   H. Inspect cylinders for evidence of overheating.

   Engine Installation Inspections.
   I. Inspect baffles for secure anchorage, close fit around cylinders, and freedom from cracks.
   J. Inspect engine controls for full travel, freedom of movement, and security.
   K. Drain and clean fuel strainer (Gascolator).
   L. Visually inspect fuel and oil lines for security of connections and evidence of leakage or damage.
   M. Visually inspect induction air system; check operation of alternate-air door (refer to paragraph 71-62-00).
   N. Inspect engine mount bolts @ firewall & Lord isolator mounts for security and condition.
2. Propeller.
   A. Inspect propeller hub and spinner for general condition, looseness, and/or oil leakage.
   B. Inspect blades for nicks and cracks. Repair any discrepancy prior to next flight.
3. Cabin.
   A. Inspect brake and parking brake control systems for proper operation and fluid level.
   B. Inspect trim system and indicator for free operation and travel.
   C. Inspect cabin and baggage doors for damage, proper operation, and sealing.
   D. Lights - Inspect cabin interior, instrument panel, glareshield, position, anti-collision and landing and taxi lights.
   E. Inspect fuel selector valve, gascolator, and boost pump for proper operation.
   F. Inspect oxygen system, plumbing and attachments (if installed).
4. Landing Gear.
   A. Inspect tires for cuts, blisters, wear and proper inflation.
   B. Inspect shock discs for proper extension at aircraft static weight.
   C. Inspect hydraulic brake system for disc or pad wear, disc warpage, hydraulic fluid level and proper installation.
5. Wings.
   A. Inspect surfaces and tips for damage.
   B. Inspect ailerons, aileron attachments, and bellcranks for damage and proper operation.

C. Inspect flaps and attachments for damage and proper operation. Cycle flaps, observe travel and any evidence of binding.

D. Lubricate controls per Section 5-20-07, if necessary.

6. Fuselage and Empennage.

A. Inspect stabilizer, elevators, fin, and rudder for damage, proper operation and proper attachment.

B. Lubricate controls per Section 5-20-07, if necessary.

C. Check Trim System for proper operation.

7. See Section 5-20-07 for any repetitive 50 hour inspections and component service guides.

5-20-06 - 100-HOUR INSPECTION (or ANNUAL INSPECTIONS)

(Refer to Fig. 5-3)

The 100-hour (or annual) inspection is a thorough, searching inspection of the entire aircraft. Preparation for the inspection includes the thorough cleaning of A/C exterior, engine and engine compartment, removal of all fuselage, wing, and empennage inspection doors, cover plates, and fairings at all systems attach, hinge, and bearing locations (including wing and empennage to fuselage mating points). Operating limit replacements (See Section 5-10-01) and special testing of components is to be included at this interval, when applicable. Comply with applicable FAA Directives, Airworthiness Directives Notes (AD's), and applicable Mooney or Vendor **mandatory** Service Bulletins and Instructions. Check for aircraft conformance to FAA Specification 2A3 for M20R Model aircraft.

Recommended 100-hour/annual and special inspection requirements are outlined in the following paragraphs:

1. **ENGINE INSPECTION.** Prior to the inspection, remove engine cowling and propeller spinner. Wash engine and engine compartment down. Then perform an engine runup in accord with 100 hour procedure recommended in TCM Engine Maintenance and Operators Manual. To verify correction of malfunctions and abnormalities, perform a second runup and flight test after the 100-hour/annual inspection engine set-up.

A. Complete a differential (hot engine) compression check (Ref. TCM SB M84-15 or current rev.): clean and gap or replace spark plugs, if necessary.

B. Inspect engine for evidence of fuel and oil leakage. Inspect oil cooler. Inspect oil and fuel hoses for condition and security.

C. Drain engine oil sump; remove, inspect and clean oil suction screens; reinstall and safety. Remove full-flow oil filter cartridge; replace with new cartridge and safety. It is recommended that old filter be opened up to check for metal particles & foreign matter. Check crank case breather lines for obstruction. Safety wire oil filter installation.

D. Refill engine oil sump with the proper type, grade, and quantity of lubricating oil.

E. Inspect fuel injector, fuel line connections for security and condition and fuel nozzles (Ref TCM SB).

F. Remove and inspect gascolator strainer, reinstall strainer. Inspect fuel lines and connections: pressure check fuel system with mixture control at IDLE CUTOFF and BOOST PUMP "ON".

G. Inspect all air ducting and connections in cabin heating air systems for leaks. Leak check all exhaust/manifold connections and engine exhaust manifolds (SEE Para. 5-20-06, 1, Q, R & S below).

H. Remove and clean induction air filter (replace at 500 Hrs). Inspect alternate air door and magnet for security and operation. Inspect all air ducting and connections in the induction air system for leaks.

I. Check magnetos for grounding and synchronization (timing to engine); inspect magneto points for condition, clearance, and internal timing. Inspect distributor block for erosion and cracks. Inspect cam follower felt for proper lubrication, and remove excessive oil from breaker compartment. At 500 hours inspect magneto per TCM/magneto maintenance manual. Repair or replace components, if required.

J. Inspect baffles for secure anchorage, cracks, holes, deformation, and for close fit around cylinders. Inspect cylinders for burned paint and cracked and broken fins. Inspect baffle sealant.

K. Inspect accessory case, starter, alternator, vacuum pumps hoses, firewall and fittings for security and damage.

L. Inspect tubular engine mount for cracks, damage and corrosion; inspect all bolts and rubber isolation mounts for security and condition.

M. Inspect engine and propeller controls for free operation, full travel, proper connection (security) of cable housing swage at the HEAD tube and security of attachment.

NOTE

Cablecraft control cables are lubricated for the life of the control cable. DO NOT REMOVE seals or lubricate control cable.

N. Inspect propeller governor for evidence of leakage and mounting security.

O. Inspect engine for proper set-up. (See TCM Service information for IO-550-G engine and Section 71-00-50.

P. Inspect battery cables, electrical wiring, and ignition harness for condition, secure anchorage, loose terminals, and burned or chaffed insulation.

Q. Inspect batteries, battery mount areas, and vent system for condition and corrosion. Inspect blast tube for obstruction. Flush battery mount areas with soda solution to neutralize corrosive action, if necessary.

R. Inspect exhaust system for cracks, looseness and for evidence of leakage. Replace or repair damaged area. Replace or repair muffler if any internal damage is found.

S. Inspect exhaust stacks for burned areas, cracks, distortion and looseness.

T. Inspect airconditioning compressor installation, belts,connections (if installed). Reference SECTION 21-58-00.

U. Inspect studs, nuts, bolts, etc. For damage and proper torque.

V. Inspect exhaust couplings, seals, clamps and slip-joints for cracks, deformation, leaks and security.

W. Inspect and re-install cowling.

2. **PROPELLER INSPECTION.**

A. Remove spinner (if not already removed).

B. Inspect security of propeller installation.

C. Inspect hub studs/nuts/bolts for proper torque (ref. 61-00-20,5,6), security and damage.

D. Inspect hub components for damage and leaks, and blades for cracks and nicks. Repair prior to next flight.

E. Inspect Anti-Ice boots for security or damage in accordance with McCauley Manual No. 830415, Section 4.

F. Inspect spinner and bulkhead for cracks and condition.

G. Inspect spinner & bulkhead for snug fit between propeller hub cylinder and rear bulkhead. Use shims as necessary for snug fit.

3. **LANDING GEAR and RETRACTION SYSTEM INSPECTION.**

A. Inspect tires for proper inflation, cuts, blisters, slippage and excessive wear. Replace with new, approved, tire(s), if necessary.

CAUTION

Always run at least 5 complete Landing Gear Retraction Cycle checks after any tire has been removed and/or replaced, before flying the aircraft.

B. Inspect wheels for cracks, distortion, misalignment, corrosion and bolt failure. Inspect condition of felt seals and bearings; re-pack bearings at 250 hour intervals.

C. Inspect brakes for disc and pad wear, and disc warpage (Ref. Section 32-40-04).

D. Inspect hydraulic reservoir for proper fluid level.

E. Inspect hydraulic brake lines and hoses for leakage, dents, cracks chafing, kinks and security.

F. Inspect parking brake system for proper engagement and release.

G. Check shock disc gap on main and nose landing gear leg assemblies. (Ref. 32-81-00)

Jack aircraft, as recommended in paragraph 7-10-00, for the following inspections:

H. Hard landing inspection (ref. 32-82-00)

I. Inspect nose gear for cleanliness and damage. Inspect nose gear retraction tube bungees for sheared or broken roll pins.

NOTE

Maximum allowable towing damage on leg assembly is 1/32 inch dent. No repair is allowed on heat treated landing gear components.

J. Inspect nose wheel steering mechanism for adjustment, alignment, corrosion, and lubrication.

K. Inspect main gear for cleanliness and damage.

L. Inspect landing gear retraction linkage, bellcranks, pivots and bearings for wear, damage, distortion, misalignment, corrosion, cleanliness, and lubrication.

M. Inspect landing gear actuator for security of mounting, cleanliness, and indication of overheating and damage. Check motor operation and brush wear.

N. Perform landing gear operational check per Section 32-30-01.

4. **FUEL SYSTEM INSPECTION.**

A. Inspect fuel tank exterior for evidence of fuel seepage and stain.

B. Drain tank and inspect tank interior when seepage is evident.

C. Inspect fuel tank drains for leakage, sediment, and water contamination.

D. Inspect fuel-tank vents for obstruction.

E. Inspect fuel selector valve for proper tank selection, smooth operation and any leakage when in OFF position.

F. Inspect gascolator for leakage; inspect sump for sediment, water and other contamination.

G. Inspect electric boost pump for leaks, security of mounting, adequate fuel pressure, switch operation, and condition of wiring and electrical connections.

(1) Check electric boost pump for proper operation by "T ing" into line with a calibrated fuel pressure gauge. High boost operation should result in a 15 P.S.I. reading (mixture full RICH, throttle-IDLE).

H. Inspect fuel quantity gauges and transmitters for security of mounting and condition of wiring and electrical connections.

I. Inspect fuel tank filler port for cleanliness, cap security, and condition of servicing placards. Inspect fuel filler cap O'rings for condition and replace if needed (Reference Section 28-00-01).

5. **EXTERIOR INSPECTION.**

A. Inspect fuselage exterior surfaces for corrosion, damage, loose and popped rivets, dents, oilcans(stretched skins), scratches, cracks and deteriorated paint.

B. Inspect windshields and windows for cracks, crazing, scratches, condition of sealant, and security of installation.

C. Inspect wings, flaps, and ailerons for corrosion, damage, loose or popped rivets, dents, scratches, cracks, condition of attaching points, lubrication, freedom of operation, free-play, travel, and balance weight attachment.

D. If installed, inspect Airframe De-Ice (TKS) components for damage, leakage & operation per SECTION 30-12-00 through 30-12-02.

E. Inspect Speed Brake cartridges for damage or wear. Check for proper operation. (Ref. 27-96-01)

F. Inspect empennage for corrosion, damage, loose or popped rivets, free-play, dents, scratches, cracks, condition and lubrication of hinge points, attachment of balance weights and freedom of operation, manually and electrically.

G. Inspect cabin door and door frames for damage, corrosion, nicks, dents, hinge security and lubrication.

H. Inspect cabin door lock mechanism for lubrication and proper engagement. See Section 52-11-00 for rigging procedures.

I. Inspect baggage door and baggage compartment for damage, corrosion, warpage, hinge security, condition to door frame and door seals, condition and operation of door locking mechanism and condition of cargo restraints/tiedowns.

J. Inspect ventilating system drain line for obstruction.

K. Inspect landing and taxi lights for security, condition and proper adjustment. See Section 33-43-00 for adjustment procedures.

L. Inspect external Decals/Placards for security.

M. Lightning Strike Inspection, exterior/interior..

6. **INTERIOR INSPECTION.**

A. Inspect seats, seat tracks, and upholstery for cleanliness and mounting security. Inspect seats for condition and operation of position locks. Inspect seat structure for cracks, deformation, corrosion and mechanism lubrication.

B. Inspect safety belts, harness and attaching brackets for cleanliness, condition, latch operation and security of attachment.

C. Inspect for loose equipment, etc. that might restrict control movements.

D. Inspect Oxygen system (if installed) per CHAPTER 35 of this S & M manual.

E. Inspect interior Decals/Placards for security.

7. **INTERNAL INSPECTION.**

A. Open inspection doors and remove access panels and fairings as required.

B. Inspect wing attaching bolts for proper torque and safetying, and evidence of damage and corrosion (interior ABS side panels/carpet will require removal to adequately accomplish this inspection).

C. Inspect forward side of firewall for damage.

D. Inspect tubular structure for corrosion and damage (interior side panels will require removal). (Reference Mooney Service Bulletin M20-208A for specific procedures required annually).

E. Inspect wing ribs and stringers for cracks and evidence of damage and corrosion.

F. Inspect wing spars for damage, distortion, cracks, and corrosion.

G. Inspect electrical wiring, fuel, oil and hydraulic lines and air ducts for security, damage, interference, chaffing and de-bonding.

NOTE

Seal all receptacles and plugs outside cabin environment with Dow Corning #4.

H. Inspect wing interior for foreign material, corrosion, and evidence of fuel leakage.

I. Inspect empennage attachment brackets and hardware for corrosion.

8. **FLIGHT CONTROL INSPECTION.**

A. Inspect control column and control wheels for full travel, proper rigging, free-play, binding, security of mounting, proper lubrication and proper direction of control surface movement with relation to control wheel movement.

CAUTION

All flight control components should be inspected to verify that all moisture drain holes are free of obstructions.

B. Inspect elevator system for damage, corrosion, lubrication, rigging, travel, stop adjustment, condition of all bearings, pivots, bellcranks, & hinges wear on downspring eyes, cable pulley and fittings, security of mounting and proper relation to control movement.

C. Inspect aileron system for damage, corrosion, lubrication, rigging, travel, stop adjustment, condition of hinges, bellcranks, pivots and rod end bearings, link bolt security and proper relation to control movement.

D. Inspect rudder system for damage, corrosion, lubrication, rigging, condition of hinges, bellcranks, pivots and rod-end bearings, link bolt security and proper relation to control movement. Check for free movement of toe-brake pedals and proper rudder and nose wheel travel.

E. Inspect stabilizer trim control system for security and proper adjustment, shaft and stop nuts for proper rigging, trim control wheel for smooth operation, universal joints for free-play and good working order, actuator threads for lubrication, linkage for corrosion, and guide blocks for looseness or excessive wear. See SECTION 27-42-00 for Electric Trim System bearing maintenance.

F. Check flap system for rigging actuator, push/pull tubes for rigging, travel, and stop adjustment. Check flap position indicator for proper operation. Inspect actuator, push-pull tubes, flap rods, interconnects, bellcranks and hinges for corrosion, security, and lubrication.

NOTE

All control rigging inspections should be made with the aircraft jacked and leveled (Per Section 7) and landing gear retracted.

NOTE

Some elevator trim tubes have poly tape wrapped at bulkhead penetrations. If tape shows signs of wear, re-wrap tube with 2" wide Y9265 polyurethane tape (1/2 tape overlap). Trim tubes, without tape, which show signs of abrading bulkhead grommet should be wrapped. See SB M20-185.

MAX. TUBE WEAR-.007 in. wall thickness or .014 in. diameter reduction.

9. **INSTRUMENT/AVIONICS INSPECTION.**

A. Inspect all instrument wiring and plumbing for condition and proper connections.

B. Clean and inspect vacuum filter. Replace garter filter on vacuum regulator.

C. Inspect vacuum regulator at vacuum manifold. Check operation of high-and low-vacuum warning lights or vacuum gage. Inspect Stand-by Vacuum System (Ref. Section 37-40-00)

D. Inspect all instruments for proper pointer indication, range and limit markings, condition of indicator markings, cracked or loose glass, slippage marks, and security of installation.

E. Inspect compass for proper lighting, compensation, security of mounting, liquid leakage and discoloration. **Swing compass at annual inspection and after any new equipment has been installed.** Degaussing tubular structure may be necessary if compass will not compensate within 10°. See Mooney Service Instruction M20-95.

F. Inspect altimeter for scale error, discolored markings, proper pointer readings, setting knob freedom and synchronization of barometric scale with reference markers.

G. Inspect flight panel for security of mounting, condition of shock mounts, freedom from interference with structure and condition of ground straps.

H. Inspect Avionics Equipment for proper operation & security.

I. Inspect Avionics Antennas, wiring, shielding for obvious damage or defects.

J. Inspect pitot head for port obstruction; inspect lines for cracks, dents, kinks, proper bend radius and security of attachment. Drain system and inspect for leaks.

K. Inspect static ports for obstruction and aerodynamic smoothness at port installations. Inspect lines for bends, cracks, dents, kinks, and security of attachment. Drain system and inspect for leaks. Check alternate static pressure source located on flight panel for freedom of valve movement.

10. **ELECTRICAL FUNCTIONAL TEST.**

A. Check operation of navigation lights.

B. Check operation of landing & taxi lights.

C. Check operation of dome lights and cigar lighter.

D. Check operation of anticollision lights.

E. Check operation of instrument and placard lights. Check rheostat travel for dimming without any dropouts.

F. Check operation of pitot head heater (short duration only) by observing ammeter needle flucuation.

G. Check operation of cluster gauge.

H. Check operation of fuel gauges.

I. Check operation of annunciator light press-to-test switch.

J. Check operation of ignition switch, and starter solenoid.

K. Check operation of landing gear position lights (See Section 24-36-00 & 32-60-00) and warning horn (See Section 32-00-00).

L. During post inspection flight, check proper setting/operation of stall warning horn.

M. Check operation of "Prop De-Ice" (if installed). Push switch "ON", observe prop de-ice annunciator for illumination (BLUE light). Observe ammeter for fluctuation during cycle action of timer.

N. Inspect batteries, connection & battery areas for proper installation corrosion and cleanliness.

11. **MISCELLANEOUS/OPTIONAL EQUIPMENT**

A. Inspect any other installed equipment not covered by previous paragraphs for proper operation, attachment and obvious damage or malfunctions.

12. **POST INSPECTION FLIGHT TEST.**

Flight test the aircraft to verify correction of all malfunctions and abnormalities. Make proper entries in aircraft log book.

Wing access covers may vary to some degree between model year aircraft.

Component locations remain basically unchanged.

---- REFERENCE FIGURE 5-3 FOR LOCATION OF THE FOLLOWING COMPONENTS ----

NOTE -- Access covers riveted in place during production need not be removed for routine inspections.

5-20-07 - ACCESS COVER IDENTIFICATION, LUBRICATION AND SERVICE GUIDE

ITEM Number	ITEM DESCRIPTION	LUBRICATION SYMBOL*	INTERVAL (HRS)
1	Flight Instruments		****
	Vacuum Regulator		
	Turn Coordinator		
	Vacuum Filters—Replace at		*** 500
	Control System Adjustments:		
	Control Column Bearing Ball	ψ	100
	Rod End Bearings.	ψ	100
	Universal Joints	Σ	100
	BellcranksΣ		100
2	Engine Cowling	û	100
	Vacuum Pumps	û	***** 500

* See last page of section for lubrication symbol legend.

** No periodic lubricant on Avionics Products #102000-2. If necessary to relubricate, use Aeroshell 22, Mobil 28 or MIL-G-81322 ONLY.

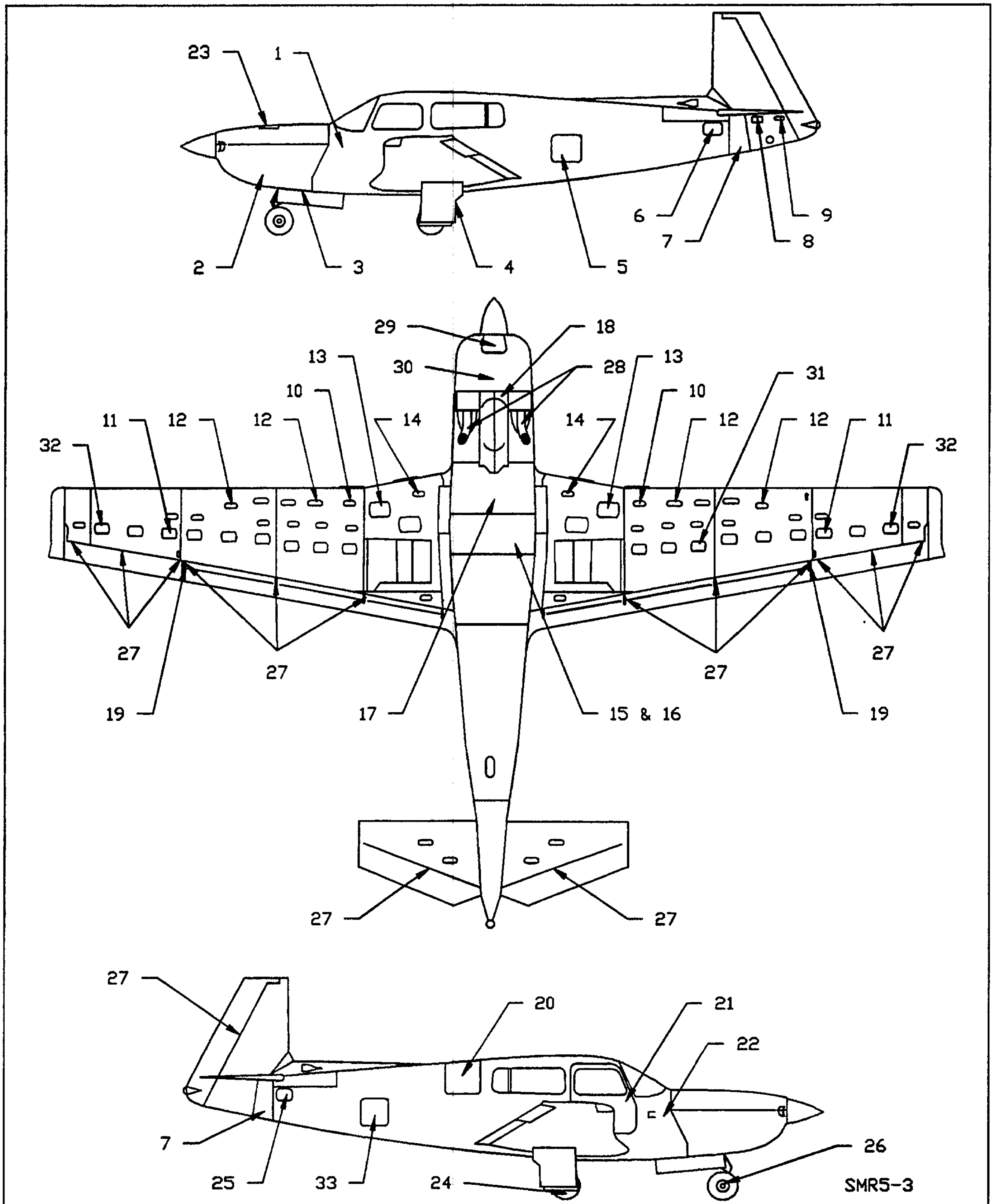
*** Change garter filter on vacuum regulator every 100 hours.

**** Change instrument filters at 500 hours, clean every 100 hours.

***** Inspect Stand-by Vacuum Pump drive coupling every 200 hours. (Refer to Airborne Service Letter No. 34)

ITEM No.	ITEM DESCRIPTION	LUBRICATION SYMBOL*	INTERVAL (HRS)
3	Nose Gear Grease Fittings	Ω	100
	Retraction Tube Rod End Bearings	ψ	100
	Bellcranks	Σ	100
	Bungees	ψ	100
	Gear Door Rod End Bearings	ψ	50
4	Main Gear Grease Fittings	Ω	100
	Retraction Tube Rod End Bearings	ψ	100
	Bellcranks	Σ	100
	Bungees	Σ	100
	Gear Door Rod End Bearings	ψ	50
	Electric Gear Actuator Gear Box**	Ω	AR
	Electric Gear Actuator Ball Screw	@	1000

FIGURE 5-3
ACCESS COVER IDENTIFICATION, LUBRICATION & SERVICE GUIDE



ITEM No.	ITEM DESCRIPTION	LUBRICATION SYMBOL*	INTERVAL (HRS)
5	Elevator & Rudder Controls:		
	Control Tube Rod End Bearings	ψ	100
	Bellcranks	Σ	100
	Batteries		
	Stabilizer Trim Control Shaft:		
	Universal Joints	Σ	100
	Guide Blocks	#	100
	Hydraulic Reservoir	β	50
	Oxygen, High Pressure Fittings	ñ	50
6	Elevator & Rudder Controls:		
	Control Tube Rod End Bearings	ψ	100
	Bellcranks	Σ	100
	Stabilizer Trim Jack Screw/Actuator Brgs	Θ	100
	Variable Downspring System	ψ	100
	Tail Strobe Light Power Supply	û	100
7	Empennage Attach Points	û	100
	Stabilizer Trim Attach Point	û	100
8	Elevator & Rudder controls:		
	Control Tube Rod End Bearings	ψ	100
9	Elevator & Rudder Controls:		
	Control Tube Rod End Bearings	ψ	100
10	Aileron Control Tube Guide Blocks	#	100
11	Aileron Controls:		
	Control Tube Rod End Bearings	ψ	100
	Bellcranks	Σ	100
12	Aileron Control Tube Guide Blocks	#	100
13	Main Gear Retraction	Σ	100
14	Wing Points	û	100
	Control Tube Guide Blocks	#	100
15	Stabilizer Trim Screw & Stops	Θ	100
	Indicator Adjustment Point		
	Stabilizer Trim Chain & Gear	#	100
16	Elevator & Rudder Controls:		
	Control Tube Rod End Bearings	ψ	100
	Bellcranks	Σ	100
	Guide Blocks	#	100
	Flap Indicator Cable	Σ	100
	Electric Flap Actuator Gear Box	Ω	500
	Electric Flap Actuator Ball Screw	ë	100
17	Electric Boost Pump		
	Gascolator	Σ	50
18	Control Systems:		
	Control Tube Rod End Bearings	ψ	100
	Control Yoke (Lower Section)	Σ	100
	NLGr Steering Link Rod End Brgs	ψ	100
	Rudder Pedal Cross Shaft	Σ	100

ITEM No.	ITEM DESCRIPTION	LUBRICATION SYMBOL*	INTERVAL (HRS)
	Rudder-Aileron Bungee	Σ	100
	Hyd. Brake Cylinder Pedal Linkage	Σ	100
19	Aileron Control Tube Rod End Brgs	ψ	100
	Outboard Flap Stops	û.	
20	Baggage Compartment Door:		
	Hinges	Σ	100
	Latches	ç	100
	Lock	õ	100
	Seals	è	100
	Hold Open arm	Ψ	100
21	Cabin Door:		
	Hinges	Σ	100
	Latches	ç	100
	Lock	õ	100
	Seals	è	100
	Hold-Open Arm	Ψ	100
22	Engine Instruments		
	Radios		
	Engine Controls	ψ	100
23	Oil Dip Stick, Oil Filler Tube	∇	AR
24	Wheels & Brakes:		
	Wheel Bearings	Ψ	250
	Brake Pressure Plates Anchor Bolts & Guide Pins	ψ	50
	Shock Discs	û	50
25	Elevator & Rudder Control Stops	û	100
26	Nose Wheel:		
	Wheel Bearings	Ψ	250
	Shock Discs	û	50
27	Control Surface Hinges	Σ	100
28	Exhaust Assy	û	100
29	Air Induction Filter	û	100
30	Cabin Heat Shroud & Ducts	û	100
31	Remote Compass Flux Valve	û	100
32	Strobelight Power Supply (Wing)	û	100
33	ELT (Batteries)	û	100
	Stand-by Vacuum Pump System	û	100
34	ELT ANTENNA (UNDER DORSAL FIN)		AR

LUBRICATION SYMBOL LEGEND

SYMBOL	MIL. SPEC. NO.	DESCRIPTION
Σ	MIL-L-7870	Low Temperature Oil (General Purpose)
Ω	MIL-G-81322	Grease
Ψ	MIL-L-3545	Grease (High Temperature)
β	MIL-H-5606	Hydraulic Fluid (Red)
#	MIL-G-23827	Graphite & MIL-G-3278 Grease or
õ		Powdered Graphite
ψ		Teflon Spray (Tri-Flow) or Equivalent
ç.		Stick Lubricant (Door Ease or Equivalent)
Θ		Aeroshell Grease NO. 7 (On jackscrew and inside Actuator Bearing Housing)
@		Lubriplate 630AA (10% by Volume Molybdenum Disulfide Mixture Permissible)
è		Seal Dressing
û		Inspect
ñ	(MIL-T-27730)	Tape, Tetrafluoroethylene Permacel Tape Corp., New Brunswick, NJ
∇		TCM Spec. MHS-24 ( )

Viscosity Requirements

Above 30 Deg F Ambient, S.L.	SAE 40 or SAE 15W-50
Below 30 Deg F Ambient, S.L.	SAE 30 or SAE 20W-30

NOTE

Mooney Aircraft are delivered with the proper break-in oil; MIL-C-6529, Type II. This oil should be changed, after 25 hours or after oil consumption has stabilized, to oil conforming to TCM Specification MHS-24 ( )

For M20R aircraft S/N 29-0001 & ON - It is recommended to use multiviscosity oil in these aircraft, both mineral & additive oil.

BLANK

CHAPTER

06

DIMENSIONS AND AREAS

CHAPTER 6

DIMENSIONS AND AREAS

LIST OF EFFECTIVE PAGES

TABLE OF CONTENTS

6-00-00 - DIMENSIONS AND AREAS
6-00-01 - AIRCRAFT SPECIFICATIONS

SUBJECT	STANDARD	METRIC/OPT/MISC.
ENGINE		
Engine Manufacturer	Teledyne Continental Motors	
Engine Model	IO-550-G(5)	
No. Cylinders	6	
Rated Horsepower	280 HP	
RPM	2500	
Min. Fuel Octane	100 or 100 LL.	
Fuel Capacity		
Total	95 U.S. Gal.	359.6 Liters
Useable	89 U.S. Gal.	336.9 Liters
** Oil Specification -- TCM Specification MHS-24( )		
Oil Grade-Normal Service	15W50 or 20W50	
Above 30° F(-1° C)Ambient air @ SL	SAE 50	
Below 50° F(10° C)Ambient air @ SL	SAE 30	
Oil Capacity	8 qts.	7.57 Liters
Minimum for Flight Oil Level	4.5 qts.	4.54 Liters

** First 25 hours of operation - mineral (non-detergent) oil or equivalent corresponding to TCM Spec. MHS-24( )

SUBJECT	STANDARD	METRIC/OPT/MISC.
Oil Pressure		
Idle, Minimum-	10 PSI	
Normal Operation	30-60 PSI	
Max. Allowable (cold oil)	100 PSI	
Oil Temperature Max. Allowable	240°F	115°C
Recommended Takeoff-Min	100°F	38°C
Recommended Flight Operation (Cruise)	170 - 200°F	76.6 - 93°C
Cylinder Head Temperature (CHT)		
Max. Allowable	460° F	237° C
Recommended Cruise	170 to 220° F	77 to 104° C
PROPELLER		
Propeller Mfg.	McCauley	
Type	Constant Speed	
Model	3A32C418/G-82NRC-9	
Pitch Angle @ 30 in. Sta.		
LOW 16.1° (+/-)0.2°.		
HIGH 40° (+/-)0.5°		
Diameter	73.0 Inches (185.4 cm)	
Governor	McCauley	
(Optional Propeller N/A at this time		
Type		
Model		
Pitch Angle @ 30 in. Sta.		
LOW		
HIGH		
Diameter		

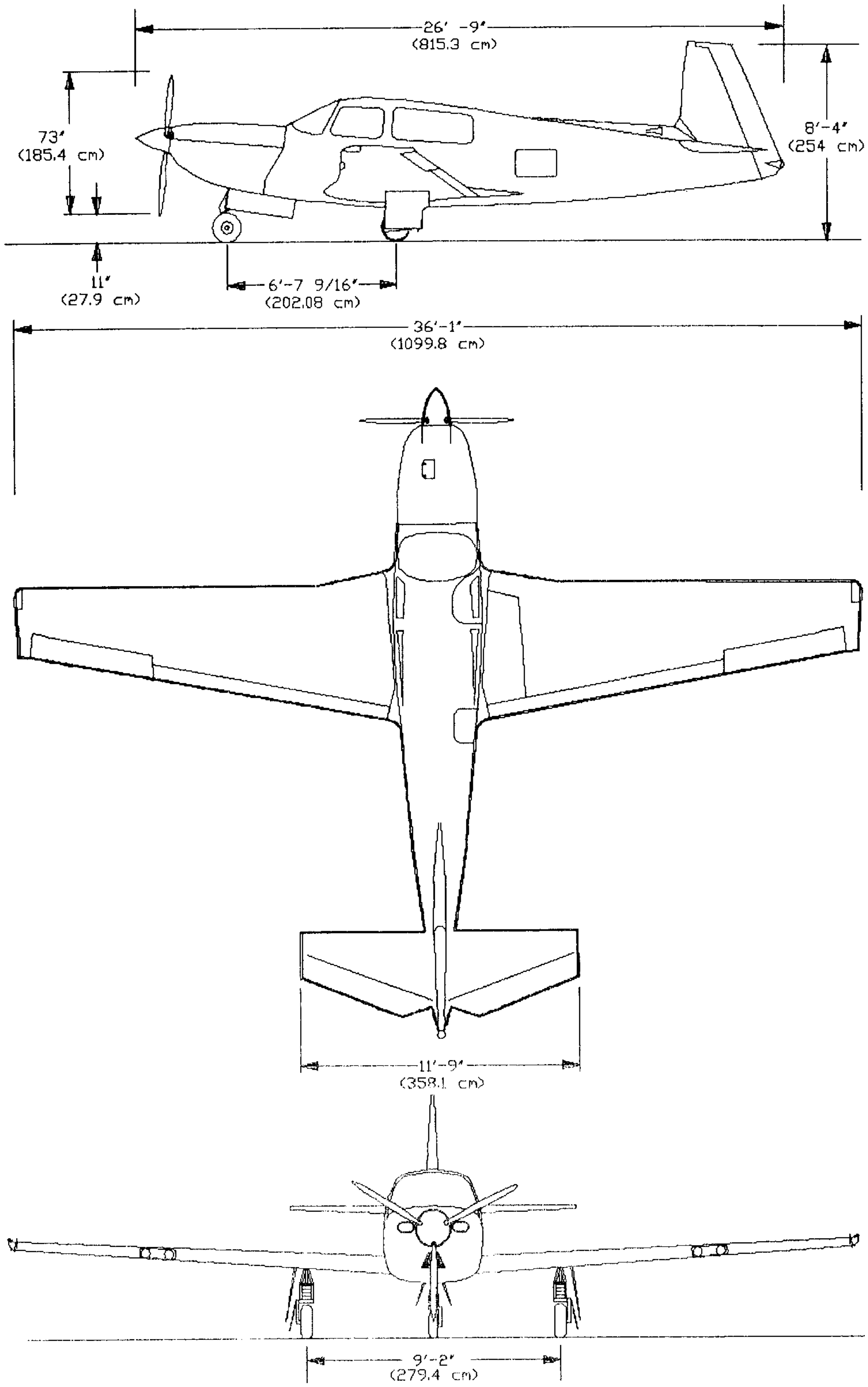
AIRFRAME	STANDARD	METRIC/OPT/MISC
WEIGHTS & LOADINGS:		
A. Approximate Empty Weight	2200 lb.	(998 Kg.)
B. Gross Weight	3368 lb.	(1528 Kg.)
C. Average Useful Load	1168 lb.	(529.8 Kg.)
D. Wing Loading	19.26 Lbs./Sq.Ft.	(94 Kg./sq.m)
E. Power Loading	12.47 lb/hp	(5.66 Kg/hp)
WINGS:		
A. Airfoil At Wing Root	63_2215	
B. Airfoil At Wing Tip	64_1412	
C. Mean Aerodynamic Chord At Wing Sta.94.85	61 in.	241 cm
D. Center-of-Gravity Range	41.0 to 51.0	
E. Geometric Twist (DEG)	1.5 Degrees	
F. Incidence Angle (DEG) From Sta 20. to Wing Tip	2.5 Degrees	
G. Dihedral angle (DEG)	5.5 Degrees	
H. Aspect Ratio	7.448	
I. Taper Ratio (CS/CT)	2.271	
FUSELAGE:		
A. Cabin Dimensions:		
(1) Height	44.5"	113 cm
(2) Width	43.5"	110.5 cm
(3) Length	126"	315 cm
(4) Cabin Door Width	29"	73.4 cm
(5) Cabin Door Height	35"	88.9 cm
B. Baggage Campartment:		
(1) MAX.Loading	120 lbs	54.4 kg
(2) Baggage Space	22.6 Cu. Ft.	0.678 Cu. M.
(3) Baggage Door Width	17"	43.2 cm
(4) Baggage Door Height	20.5"	52.1 cm
(5) Hat Rack Capacity	10 lbs	4.5 kg
C. Landing Gear:		
(1) Type	Tricycle, Retractable	
(2) Operation	Electrical	
(3) Wheel Track	9' 2"	279.4 cm
(4) Wheel Base	6'7 9/16"	202.08 cm
(5) Tire Size—Nose	(6-Ply Rating) 5.00x5	
(6) Tire Size—Main	(6-Ply Rating) 6.00x6	
(7) Tire Pressure—Nose	49 lbs/sq. in.	
(8) Tire Pressure—Main	42 lbs/sq. in.	

6-00-02 - AIRCRAFT DIMENSIONS

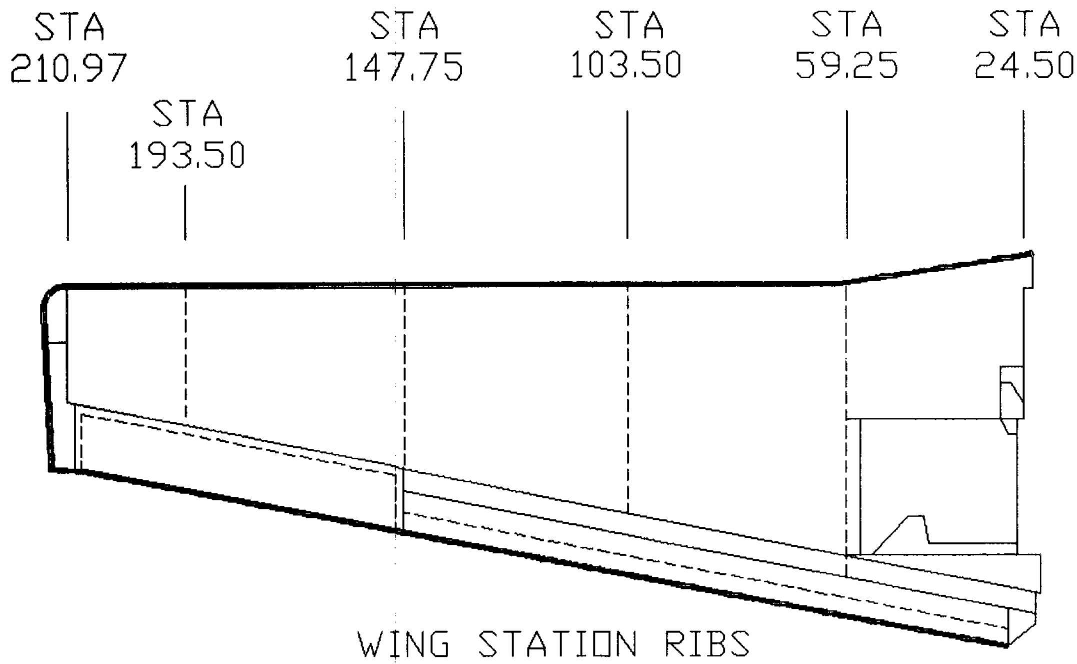
DIMENSIONS:		
A. Wing Span	36'1"	10.998 meters
B. Fuselage Length	26'9"	8.153 meters
C. Tail Height	8'4"	2.54 meters
D. Stabilizer Span	11'9"	3.581 meters
AREAS:		
A. Wing	174.786 sq. ft.	16.24 sq. meters
B. Ailerons	11.4 sq. ft.	1.06 sq. meters
C. Flaps	17.9 sq. ft.	1.66 sq. meters
D. Vertical Fin	7.8 sq. ft.	0.73 sq. meters
E. Rudder	6.25 sq. ft.	0.52 sq. meters
F. Horizontal Stabilizer	21.42 sq. ft.	1.90 sq. meters
G. Elevators	13.0 sq. ft.	1.21 sq. meters

6-00-03 - AIRCRAFT STATIONS

NOTE
The datum line station 0.0 is 13 inches aft of the nose gear trunnion pivot point. (Reference Figure 8-2.)



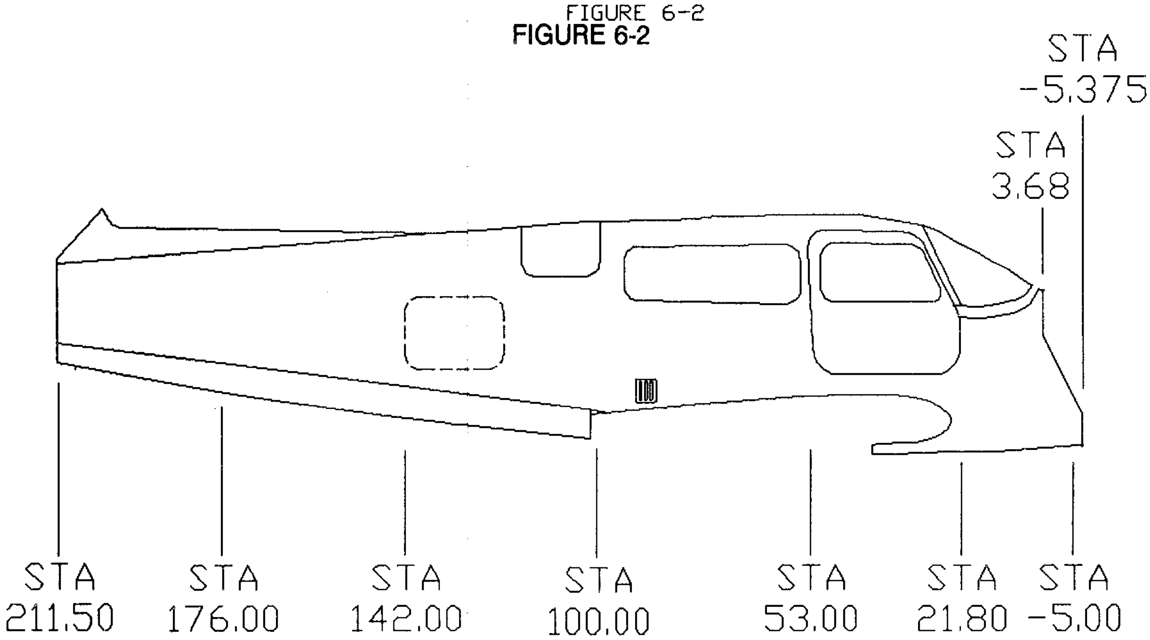
PRINCIPAL AIRCRAFT DIMENSIONS - FIGURE 6-1



WING STATION RIBS

FIGURE 6-2

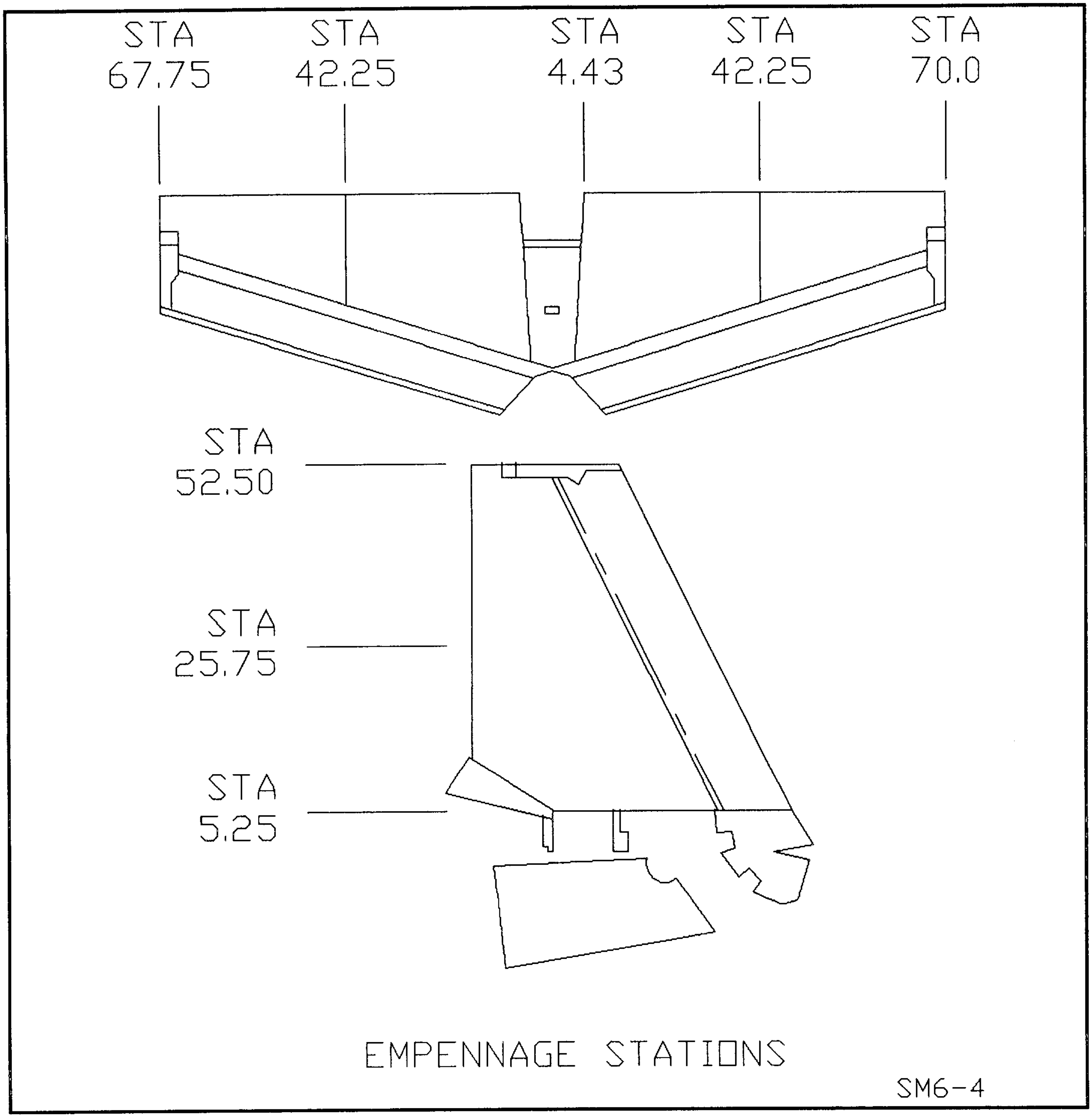
FIGURE 6-2



FUSELAGE STATIONS

SMLMR6-3

FIGURE 6-3



EMPENNAGE STATIONS FIGURE 6-4

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CHAPTER

07

LIFTING AND SHORING

CHAPTER 7

LIFTING AND SHORING

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7-10-00 - JACKING

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

CAUTION
Do not raise the aircraft on jacks, out of doors, when wind velocity is over 10 MPH. Jacks should be on hard surface.

1. Install wing jack points (2) in tiedown mounting holes outboard of each main landing gear. Install Nose Landing Gear jack point (1) (threaded, longshaft jack-point) into threaded receptacle at FUS. STA. -5.51.
2. Use standard aircraft jacks at both wing hoist points (wing tiedown eyebolt receptacles) outboard of the main landig gears and at the nose landing gear (extended shaft) jack point. While holding wing jack points in place, raise jack to firmly contact jack point. Nose landing gear jack point is located under the cowling at Fuselage Station -5.51.
3. Raise aircraft, keeping wings as nearly level as possible.
4. Secure safety locks on each jack.

CAUTION
When lowering aircraft on jacks, bleed off pressure on all jacks simultaneously and evenly to keep aircraft level as it is being lowered.

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

NOTE
It is not recommended to use tail-tie down fitting during jacking process to lift nose wheel off ground.

CAUTION
Do not leave aircraft on jacks for extended periods while a tailstand is in place. The wing jack(s) may bleed down and put excessive loads on the front jack point and tailcone.

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CHAPTER

08

LEVELING AND WEIGHING

CHAPTER 8

LEVELING AND WEIGHING

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8-00-00 - LEVELING

Place a spirit level on the leveling screws above the tailcone access door when leveling the aircraft longitudinally. Level the aircraft by increasing or decreasing air pressure in the nose wheel tire. Level aircraft laterally by placing level across center seat tracks forward of wing spar. Front seats must be in the full forward position when weighing. Use leveling screws on tailcone, above left side battery access door (See Figure 8-2.).

8-00-01 - WEIGHT AND BALANCE

To weigh aircraft, select a level and draft free work area, then:

1. Check for installation of all equipment as listed in the Weight and Balance Record, SECTION VI of POH/AFM.

2. Charlie Weight Installation. The aircraft, as delivered from the factory, has correct ballast added (if any) to compensate for installed equipment. If addition or deletion of equipment, at a future time, affect the weight and balance of the aircraft sufficiently to require a ballast change, the proper Charlie Weight Installation shown on Figure 8-1 is to be used.

NOTE
See Section VI of Pilot's Operating Handbook for Weight and Balance reference data.

3. Ground aircraft and drain fuel tanks per SECTION 12-10-02, 2.

4. Add unusable fuel to each tank, (see Pilot's Operating Handbook for proper quantity of unusable fuel).

5. Fill oil to capacity (8 quarts).

6. Position a 2000-pound capacity scale under each of the three wheels.

7. Level aircraft as described in Section 8-00-00 and center nose wheel.

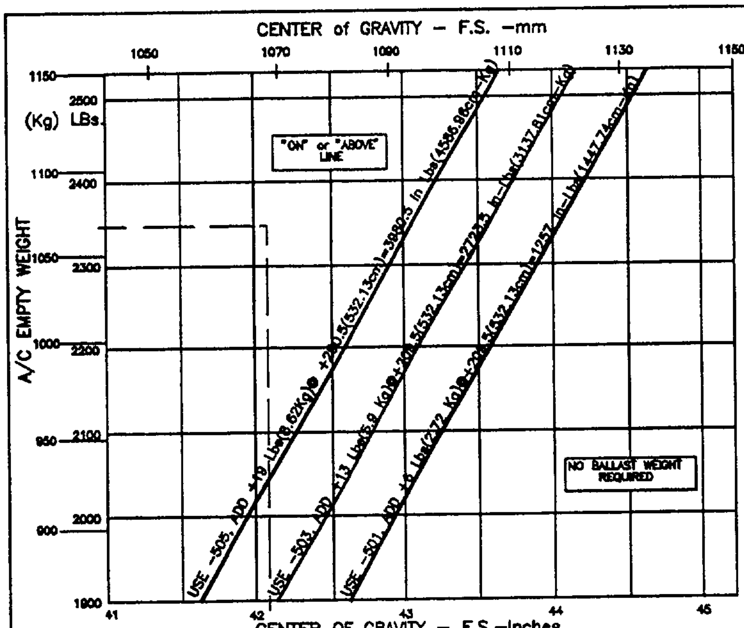
8. Weigh the aircraft.

9. Find reference point by dropping a plumb-bob from center of nose gear trunnion (retracting pivot axis) to floor. Mark point of intersection on floor. Reference Figure 8-2.

10. Locate longitudinal centerline of nose wheel axle and main wheel axles in the same manner. Mark these points on floor.

11. Measure horizontal distance from the reference point to main wheel axle center line (Lm/r).

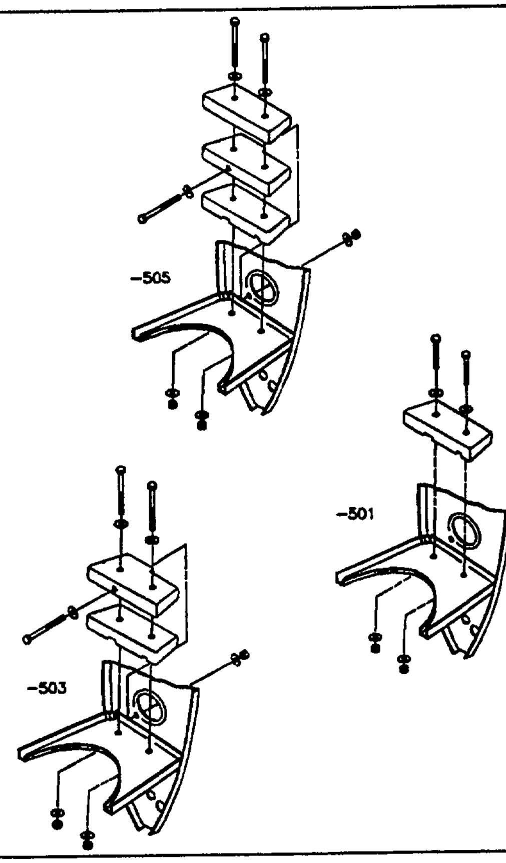
12. Measure horizontal distance from center line of nose wheel axle to center line of main wheel axles (Lm/n).



EXAMPLE: Airplane Empty 1 weighs 2344# with C.G. at 42.15" from chart, this airplane requires –505 Charlie Weight installation. For licence calculate new weight, C.G. & Moment.

Airplane as Weighed	2344 x 42.15	=	98810
+–505 Charlie Weight	+19 x 209.5	=	3981
Licenced Empty Weight	2363#		102791

Licenced Empty Weight C.G. Location = 43.5"



CHARLIE WEIGHT INSTALLATION FIGURE 8-1

13. Record weights and measurements and compute the basic weight and CG as follows:
$L_{C/G} = L_{M/R} - 13 - L_M$

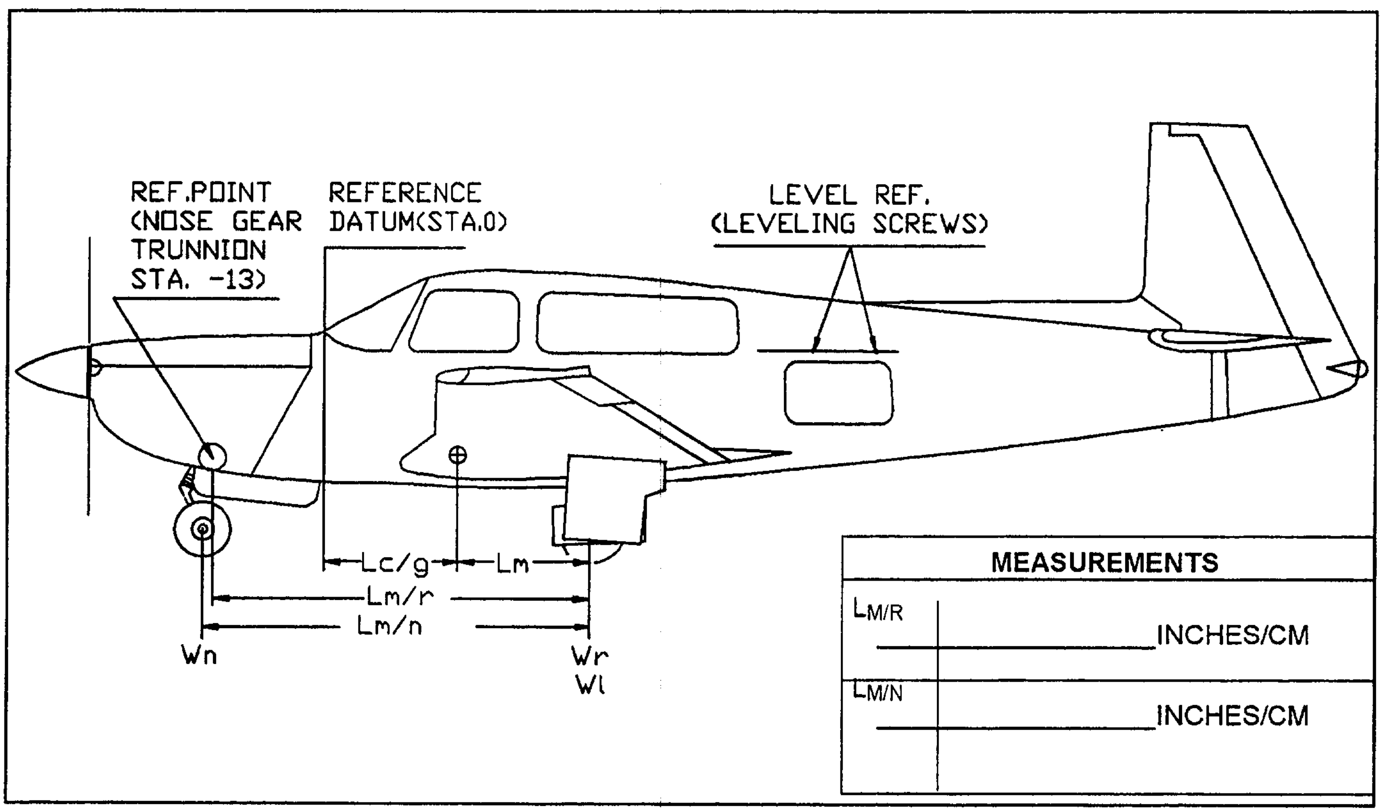
a. CG Forward of Main Wheels

LBS	X	IN.	□	LBS.	=	IN.
Weight @ Nose (W_N)		Distance Between Main & Nose Wheel Axle Centers ($L_{M/N}$)		Total Weight of Aircraft (W_T)		CG Forward of Main Wheels (L_M)

b. CG Aft of Datum (Station 0)

IN.	-	13 IN.	-	IN.	=	IN.
Distance from center Nose Gear Trunnion to Center of Main Wheel Axles (Horizontal) ($L_{M/R}$)		Distance from Nose Gear Trunnion to Datum (CONSTANT)		Result of computation Above (a.) (L_M)		CG (FUS STA) Distance Aft of Datum (Empty Weight CG) ($L_{C/G}$)

NOTE:
Empty weight includes unusable fuel and full oil (8 Qts.) and is computed with gear down and flaps up.



WEIGHT AND BALANCE DIAGRAM - FIGURE 8-2

CHAPTER

09

TOWING AND TAXIING

CHAPTER 9

TOWING AND TAXIING

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9-00-00 - GROUND HANDLING

9-10-00 - TOWING

Use a towbar for moving aircraft. The towbar attaches to nose gear crossbar. One man can move the aircraft provided ground surface is relatively smooth and tires are properly inflated. When no towbar is available, or when assistance in moving aircraft is required, push by hand: (1) on wing leading edges, (2) on wing tips, and (3) on inboard portion of propeller blades adjacent to propeller hub. Towing aircraft by tractor or other powered equipment is NOT RECOMMENDED.

CAUTION

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

CAUTION

Maximum allowable damage to nose gear leg assembly is 1/32 inch dent.

9-20-00 - WARMUP AND TAXIING

Before attempting to warmup or taxi aircraft, ground personnel should be checked out by qualified pilots or other responsible personnel.

1. Start and warmup engine. (Refer to POH/AFM.)
2. Taxi forward a few feet and check brake effectiveness.
3. While taxiing, make shallow turns to test nose gear steering.
4. Check operation of gyro instruments and turn coordinator during turns.
5. Check engine instruments for any sluggish response to engine control movements. Repair any discrepancies found.

9-30-00 - EMERGENCY PROCEDURES

1. Engine Fire During Starting.
   A. Continue cranking engine with starter.
   B. Set mixture control at IDLE CUTOFF.
   C. Turn fuel selector handle to OFF position.
   D. Open throttle to FULL.
   E. Turn Master Switch - OFF
   F. Push cabin heat control - OFF.
   G. If fire is not extinguished, proceed as follows:
      (1) Turn electrical switches OFF.
      (2) Discharge fire extinguisher into engine compartment through nose cowl openings and through lower engine cowl openings.
      (3) Call for fire-fighting equipment.
2. Fuselage or Wheel Well Fire. In case of fire in wheel well (or in cabin or fuselage area), turn all fuel, electrical, and ignition controls to OFF position before evacuating aircraft to extinguish flames.
3. Electrical Fire. Circuit breakers (or circuit-breaker switches), that automatically interrupt flow of power when an overload or short circuit occurs, protect all electrical circuits (except the ignition-starter circuits). In the event of an electrical fire, immediately turn Master and Alternator Field switches - OFF. Make sure only a fire extinguisher approved for electrical fires is used.

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CHAPTER

10

PARKING, MOORING, STORAGE, RTN TO SVC.

CHAPTER 10

PARKING AND MOORING

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10-00-00 - GENERAL

The parking brake is set by applying brakes and pulling out on parking brake control knob. Release parking brake by pushing IN on parking brake control knob.

NOTE
There is no need to depress brake pedals to relieve pressure in brake lines during release of parking brake control.

There are three tiedown points on aircraft, one on each wing, outboard of main gear (tiedown rings are to be threaded into built in receptacles) and tail skid/tiedown fitting at aft end of tailcone.

10-10-00 - PARKING

When parking aircraft, place wheel chocks fore and aft of main wheels. The parking brake should be used for short-duration parking only.

CAUTION
Do not set parking brake when brakes are overheated or when cold weather could freeze moisture and slush accumulation within the brake mechanism. Do not set parking brake when aircraft is tied down. For maximum protection, hangar aircraft during severe weather and high winds.

10-10-01 - STORAGE (FLYABLE)

Outdoor storage requires adequate mooring and tiedown facilities. The following precautionary measures are recommended for keeping aircraft serviceable and ready-to-fly.

1. Refer to paragraph 10-20-00 for mooring instructions.
2. Magneto switches..........OFF
3. Throttle....................CLOSED
4. Mixture...........IDLE CUTOFF
5. Rotate propeller 6 revolutions every seven days; STOP propeller 45 to 90 degrees from original position.
6. Keep fuel tanks filled at least one-half full to minimize moisture condensation. Keep batteries fully charged.
7. Install protective covers over pitot head, engine cowl openings, static ports, etc.
8. Maintain a good wax finish on all exterior surfaces (after 90 days from new paint job).

10-10-02 - STORAGE (PROLONGED)

If the aircraft is to be stored for an extended period of time, the following steps are recommended for protection:

1. Refer to paragraph 10-20-00 for mooring instructions.
2. Tape or cover all openings.
3. Remove batteries, charge fully, and store in a cool place.
4. Raise aircraft to remove weight from tires, and block up wheels.

CAUTION
If weight is not removed from tires, rotate wheels/tires to a new position at least once each 30 days to prevent flat-spotting tires.

5. See appropriate TCM Service Information for engine preservation.

CAUTION
Attach warning placards if preservation procedures make engine inoperable.

10-10-03 - RETURNING TO SERVICE

If aircraft has been stored for an extended period of time, it is advisable to perform a 50-hour periodic inspection after completion of the following preliminary steps:

1. Remove blocks from wheels. Check tire inflation.
2. Check and install batteries.
3. Remove tape and covers from openings.
4. Remove warning placards (if any).
5. Replace engine oil filter.
6. Clean engine oil suction and pressure screens.
7. Clean and check oil pressure relief valve.
8. Clean and check oil temperature bypass valve.
9. Fill engine sump with proper grade of lubricating oil.
10. Clean and reinstall engine air-inlet filter.
11. Check ignition harness.
12. Clean and re-gap spark plugs.
13. Check and clean fuel injector nozzles and screens. Drain oil from fuel injector.
14. Check fuel tank vents for obstruction, and drain sumps to remove moisture and sediment.
15. Complete 50-hour and preflight inspections.
16. See appropriate TCM Service Information for servicing of the engine.

10-20-00 - MOORING

When mooring aircraft out of doors:

1. Head aircraft into the wind.
2. Place chocks fore and aft of each main wheel.
3. Drive stakes in ground approximately three feet outboard of each main gear and to either side of tailskid.
4. Install tiedown rings in wing receptacles, outboard of each main gear. Tie a 600-pound tensile strength rope to each wing tiedown ring and anchor to ground stake. Allow a little slack in each tiedown rope.
5. Tie center of a rope to tail skid tiedown ring and anchor rope ends to ground stakes at either side of tail.
6. For additional security, attach a rope to nose gear and anchor to a ground stake.
7. Lock controls by looping right front seat safety belt through control wheel and drawing belt snug.

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CHAPTER

11

PLACARDS AND MARKINGS

CHAPTER 11

PLACARDS AND MARKINGS

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11-00-00 - GENERAL

FAA required placards and markings.

NOTE

All placards should be inspected for proper location, readability and security during maintenance actions. When an airplane has been painted, inspect all placards to assure that they are not obscured by paint.

11-10-00 - MARKINGS - EXTERIOR PAINT

Exterior paint schemes for various model year aircraft are depicted in M20R Illustrated Parts Catalog.

11-20/30-00 - PLACARDS, EXTERIOR/INTERIOR

All required placards and their locations, both interior and exterior, are listed in Section II of the FAA Approved Flight Manual and Pilot's Operating Handbook (AFM/POH).

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CHAPTER

12

SERVICING

CHAPTER 12

SERVICING

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12-00-00 - SERVICING

12-00-01 - SERVICING INTERVALS

The specified intervals (refer to Chapter 5) are considered adequate to meet average requirements under normal operating conditions. It is advisable, however, to shorten service and maintenance intervals when operating under abnormal environmental conditions, such as extreme temperature ranges, dusty atmospheric conditions, high humidity and moisture, unimproved airport facilities, or unusual operating requirements.

12-10-00 - REPLENISHING

12-10-01 - FUEL TANKS

Keep fuel tanks at least half filled to minimize condensation and moisture accumulation in tanks. (Fuel capacity is given in Chapter 6.)

WARNING
Ground aircraft and fuel service vehicle during refueling. Permit no smoking or open flame within 50 feet of aircraft or vehicle.

WARNING
Each fuel tank is vented to the atmosphere at its outboard aft corner; vent openings are on the lower wing surface. Check vents for obstructions before each flight.

12-10-02 - FUEL DRAINS

A fuel-drain valve is located in the aft inboard corner of each tank to provide for drainage of moisture and sediment. Use the small plastic cup furnished with the flyaway kit to drain fuel sumps. Drain wing tank sumps and gascolator before first flight of the day and after each fuel service to inspect for water and/or contamination. Continue draining until free of water or contamination.

WARNING
After servicing aircraft with fuel, wait at least five minutes for moisture and sediment to settle before draining and checking both, the fuel tank sumps and the fuel selector valve drain.

1. Fuel Gascolator Drain. The fuel gascolator is at the lowest point in the fuel system and has a drain valve operated by a control on the floor in the cabin. To drain the fuel gascolator:

A. Switch fuel selector valve handle to L and pull fuel drain valve control ring for 10 seconds.

B. Switch fuel selector valve handle to R and pull fuel drain valve control ring for 10 seconds.

C. After draining, be sure fuel drain valve control is returned to the closed position and the valve is not leaking outside aircraft.

WARNING
During cold weather operation, frequently check fuel gascolator drain for ice formation by repeating procedures 1., A, B and C above.

NOTE
If conditions conducive to fuel system icing exist, Isopropyl Alcohol may be added to fuel tanks. It is extremely important to thoroughly BLEND the isopropyl alcohol in with the fuel supply in quantities not to exceed 3% of the total, by volume.

2. Defueling. Fuel tanks may be drained by one of several methods: pumping fuel out with electric boost pump, siphoning fuel through the filler ports, or removing tank quick drain valves.

WARNING
Allow no smoking or open flame within 50 feet of the defueling area. Ground aircraft and fuel container during all defueling operations.

A. To defuel aircraft using electric boost pump:

(1) Disconnect fuel line from electric boost pump outlet at the fitting forward of the firewall.

(2) Connect a flexible line to output fitting that will reach fuel receptacle.

(3) Turn fuel selector valve to tank to be drained, and remove filler cap from fuel filler port.

(4) Turn boost pump ON until tank is empty. Repeat steps (3) and (4) to drain other tank.

(5) To completely drain fuel system also drain wing tank sumps and fuel gascolator valve sump until fuel stops running.

NOTE
When defueling using removable tank quick drains, it is only necessary to remove the drains and to operate the gascolator drain.

12-10-03 - ENGINE OIL

Check engine oil level after engine has been stopped long enough for oil to drain back into sump. The oil filler cap access door is located in the top cowling. Any lubricating oils approved by Teledyne Continental Motors (MHS-24) are acceptable for use after break-in period. Approved products and engine oil viscosity requirements are shown in Chapter 5-20-07.

CAUTION
The terms "detergent", "additive", and "compounded" used in this manual are intended to refer to a class of aviation engine lubricating oils to which certain substances have been added to improve them for aircraft use. These terms do not refer to such materials commonly known as "top cylinder lubricant", "dopes" and "carbon remover" which are sometimes added to fuel or oil. These products may damage the engine and therefore, should not be used. Under no circumstances should automotive oil be used, since such oils could cause engine damage.

Oil Recommendations for New-Engine or Newly Over-hauled Engine Break-IN.
New or newly overhauled engines should be operated on aviation grade straight mineral oil during the first 25 hours of operation or until oil consumption has stabilized. The aircraft is delivered from Mooney with proper break-in oil.
OIL and FILTER CHANGING RECOMMENDATIONS - The oil and filter should be changed at 50 hour flight operation intervals. Use TCM filter or approved equivalent (Champion # 48109).
When changing from mineral oil to additive oil, filter should be changed regardless of the operation time. Check screens and filters for sludge or plugging every 10 hours after switching from mineral oil to ashless dispersant (additive) oil.

12-10-04 - OXYGEN SYSTEM (OPTIONAL)

The oxygen cylinder, when fully charged, contains approximately 115 cubic feet of aviators breathing oxygen (Specifications No. MIL-O-27210). Recharging of this oxygen cylinder should be accomplished by using the appropriate Scott recharging fittings to the pressure shown on (Figure 12-1), Pressure vs Temperature Table.

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

AMBIENT TEMPERATURE DEGREES F	FILLING PRESSURE PSIG	AMBIENT TEMPERATURE DEGREES F	FILLING PRESSURE PSIG
0	1650	50	1875
10	1700	60	1925
20	1725	70	1975
30	1775	80	2000
40	1825	90	2050

OXYGEN PRESSURE VS TEMPERATURE TABLE
FIGURE 12-1

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

NOTE
Refer to Section 35-00-00 for periodic bottle pressure check.

Any time fittings are disconnected on the oxygen system, the threads should be treated with tetrafluoroethylene tape (MIL-T-17720). Prior to reconnection, the system should be checked for leaks with leak testing compound (MIL-L-25567). If no leaks are found, wipe system clean and dry.

12-20-00 - SCHEDULED SERVICING

12-20-01 - INDUCTION AIR FILTER

The importance of keeping the induction air filter clean cannot be overemphasized. A clean filter promotes fuel economy and longer engine life. The dry-type filter can usually be washed six to eight times within 500 hours or one year before replacement is necessary.
To clean the dry-type induction air filter:
1. Direct a jet of air from inside of filter out. Cover entire filter area with air jet.

CAUTION
Do not use a compressor unit with a nozzle pressure greater than 100 P.S.I. to clean filter.

2. Inspect for damage or ruptures by holding filter before a light or by holding light bulb inside filter. If damage is evident, replace damaged filter with new filter.

NOTE
If filter shows an accumulation of carbon, soot, or oil, continue with cleaning steps 3 through 5.

3. Soak filter in non-sudsing detergent for 15 minutes. Agitate filter back and forth for two to five minutes to free filter element of deposits.
4. Rinse filter element with a stream of clean water until rinse water is clean.
5. Dry filter thoroughly. Do not use light or air above 180° F. for filter drying.
6. Check alternate air door for proper operation and sealing.
7. Reinstall filter in aircraft. Make sure of proper sealing and security.

12-20-02 - BATTERIES

Service batteries with distilled water to maintain electrolyte above plates. After adding water in freezing weather, charge battery long enough to mix electrolyte and water. Keep battery electrolyte above a specific gravity of 1.225 to avoid freezing.
To service battery(ies):

1. Remove battery caps. Check electrolyte and service battery as required.

CAUTION
Battery gases may be explosive.

2. Check battery mounting area for corrosion and spilled electrolyte. To clean cables, terminals, mounting area and battery case, use a solution of bicarbonate of soda and clean water to neutralize corrosion and spilled electrolyte.

CAUTION
When cleaning, do not allow bicarbonate of soda to enter battery cells - permanent damage will result if soda mixes with electrolyte.

3. Rinse battery with clean water. Wipe clean with a dry cloth.
4. To retard corrosion, coat terminals with petroleum jelly after cleaning and tightening them.
5. Check battery vent line lines for obstructions, line kinks, etc.

12-20-03 - TIRES AND WHEELS

Keep tires at recommended air pressure. (Refer to Chapter 6-00-01.

1. Check tires for wear, cuts and bruises.
2. Check valve stems for evidence of tire slippage or pulling.
3. Check wheels for damage.
4. Check wheel bearings for condition and lubrication.

12-20-04 - BRAKE RESERVOIR

Frequently check brake reservoir for proper fluid level. See Chapter 12-20-05 for location. See Section 5-20-07 for proper fluid.

CAUTION
Do not fill reservoir while parking brake is set.

Use only hydraulic fluid (red), per specification MIL-H-5606. Do not fill reservoir higher than two inches below filler port.

12-20-05 - HYDRAULIC BRAKES (Bleeding)

CAUTION
Fluid in the wheel cylinders may be under high pressure due to heat or expansion. Therefore, be sure parking brake is released prior to beginning hydraulic system servicing.

For best results, use a hydraulic pressure service unit (pressure pot) to back bleed the system through wheel cylinder bleeder valves.
- SINGLE BRAKE SYSTEM (PILOTS SIDE ONLY) -

1. Remove hydraulic fluid reservoir filler plug, and install a suitable fitting for attaching a flexible drain line.
2. Immerse open end of drain line into a hydraulic fluid container or catch container containing MIL-H-5606 fluid.
3. Attach pressurized hydraulic fluid service unit to wheel cylinder bleeder valve and open valve. Hydraulic service unit should be free of air prior to servicing aircraft system.
4. Feed fluid from service unit into brake system. Check for air bubbles at end of drain line immersed in fluid.
5. When fluid is flowing, slowly depress pilot's brake pedal by hand and slowly release. Repeat three (3) to four (4) times.
6. Allow fluid to flow until clear of air bubbles.
7. Close wheel cylinder bleeder valve; remove service line.

NOTE
Brake pedal may need to be pulled back in order for fluid to bleed back into reservoir.

8. To bleed opposite brake, (single brake system only) repeat steps 3 through 7.

- IF DUAL BRAKES AND SHUTTLE VALVE ARE INSTALLED -

1. While pressurized hydraulic fluid service unit is still attached to either wheel cylinder bleeder valve.
2. Loosen co-pilot's brake line at shuttle valve. Provide another catch container.
3. Restrict (stop) outflow from reservoir drain line to catch container.
4. Allow fitting to remain loose until fluid is clear of air bubbles as it drains from shuttle valve fitting into catch container.
5. When clear, tighten co-pilot line fitting and remove restriction from reservoir drain line.
6. Stroke co-pilot's brake pedal several times and allow any purged air to exit through reservoir.
7. Shut off bleeder valve at wheel cylinder; remove fluid pressure unit.

8. To bleed opposite brake, (dual brake system) repeat steps 2 through 8.
9. Remove drain line from reservoir.

- REPLENISH HYDRAULIC RESERVOIR TO OPERATING LEVEL -

1. Lower fluid level in reservoir to two inches below filler port.
2. Reinstall filler plug.
3. Check brake linings for excessive wear and proper installation. Refer to Section 32-40-04 for Brake Removal and Inspection Procedures.
4. Depress brake pedals to check for sponginess. Resistance should be solid and even when brake pedals are depressed.

12-20-06 - CLEANING

Cleanliness is a major prerequisite to adequate inspection and maintenance of an aircraft. Cleanliness enhances the appearance of an aircraft and reduces the probability of corrosion.

1. EXTERIOR

A. Before washing aircraft exterior, cover brake discs, pitot head, and static ports.

B. Flush away loose dirt and mud.

C. Wash exterior with a mild aircraft detergent in cool water and a soft cleaning cloth or chamois. Rinse away soap film.

CAUTION
Do not use so called "mild" household detergents to wash aircraft exterior. Such detergents may damage finish and corrode aluminum components.

CAUTION
Do not apply wax or use pre-wax cleaners during initial paint curing period. Use only mild aircraft detergent and cool water when washing exterior during the first 90 days after repainting.

D. To remove heavy oxidation film, use a pre-wax cleaner.

E. Apply an exterior-finish wax recommended for protection of urethane enamel. Apply a heavy coating of wax to leading edges of wings, empennage, and nose section to reduce drag and abrasion.

CAUTION
When fuel, hydraulic fluid, or other fluid containing dye is spilled on painted surfaces, remove it at once to prevent staining. Flush away spilled battery electrolyte immediately with water. Treat exposed area with bicarbonate of soda solution followed by thorough washing with a mild aircraft detergent solution.

F. Blow moisture away from areas that may trap & accumulate water, IE. engine mount at firewall attach points (inside cupped portion of tubing).

2. WINDSHIELDS, WINDOWS AND DOORS

A. Flush windshield and windows with water prior to wiping. Never wipe while dry.

B. Remove grease or oil with a soft cloth saturated in kerosene.

CAUTION
Never use gasoline, benezene, carbon tetrachloride, acetone, fire extinguisher fluid, de-icer fluid, lacquer thinner, or household window cleaning sprays on windows or windshields. Such solvents will soften or craze the plexiglas surface.

C. Clean windows and windshields with an anti-static plexiglas cleaner.

D. Check door seals for damage that could cause leakage.

E. Check cabin and baggage door mechanism for proper working order.

NOTE
Minor scratches or abrasions may be polished out by using plexiglas re-surfacing kits, ie, Micro-Mesh, available from aircraft accessory suppliers.

3. ENGINE COMPARTMENT Accumulation of dirt and oil within the engine compartment creates a fire hazard and hampers inspection procedures.

A. Wash engine cowling and engine compartment down using a non-flammable solvent.

B. Dry engine cowling and engine compartment after washing.

4. CABIN INTERIOR

Use normal household cleaning practices for routine interior care.

A. Frequently vacuum seats, rugs, upholstery panels and headliners to remove surface dust and dirt.

B. Clean interior components with cleaners shown below. Use soft cloth to apply. Dry with soft, dry cloth.

(1) Leather - Leather cleaner.
(2) Vinyl - Vinyl cleaner.
(3) Izit Leather & Wool window/upper side material
- Woolite (3 parts H_2O to 1 part Woolite)
(4) Carpet - Carpet cleaner (See CAUTION below)

CAUTION
Never apply household cleaners to interior furnishings. Do not use alcohol or strong solvents on interior plastics. When using commercial cleaning and finishing compounds, carefully follow manufacturer's instructions. Never saturate fabrics or carpet with solution which could damage backing and padding materials. To minimize wetting of carpets, keep foam as dry as possible and rub in circles. Use a vacuum cleaner to remove foam. Do not allow carpets to remain damp; dry them thoroughly.

CHAPTER

20

STANDARD PRACTICES (AIRFRAME)

CHAPTER 20

STANDARD PRACTICES - AIRFRAME

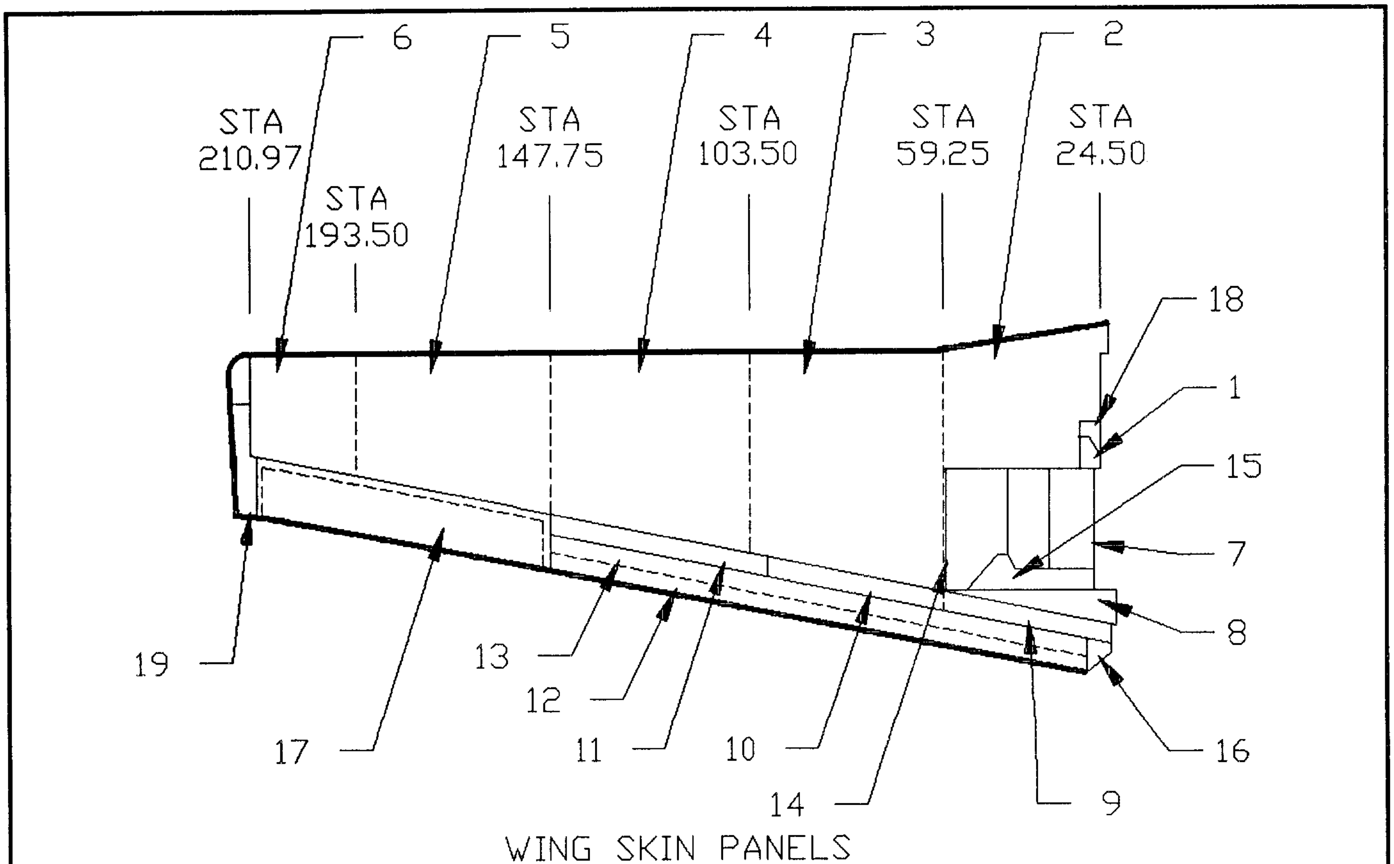
LIST OF EFFECTIVE PAGES

TABLE OF CONTENTS

20-00-00 - GENERAL

This chapter of the manual discusses treatment of metal surfaces for corrosion control and the identification of skin panels for replacement purposes. Those who inspect or repair aircraft should consult FAR 43, Maintenance, Preventive Maintenance, Rebuilding and Alteration and Sub Parts A, D and E of FAR 65, Certification. Advisory Circular 43.13-1( ) outlines inspection and repair practices acceptable to the F.A.A. Administrator.

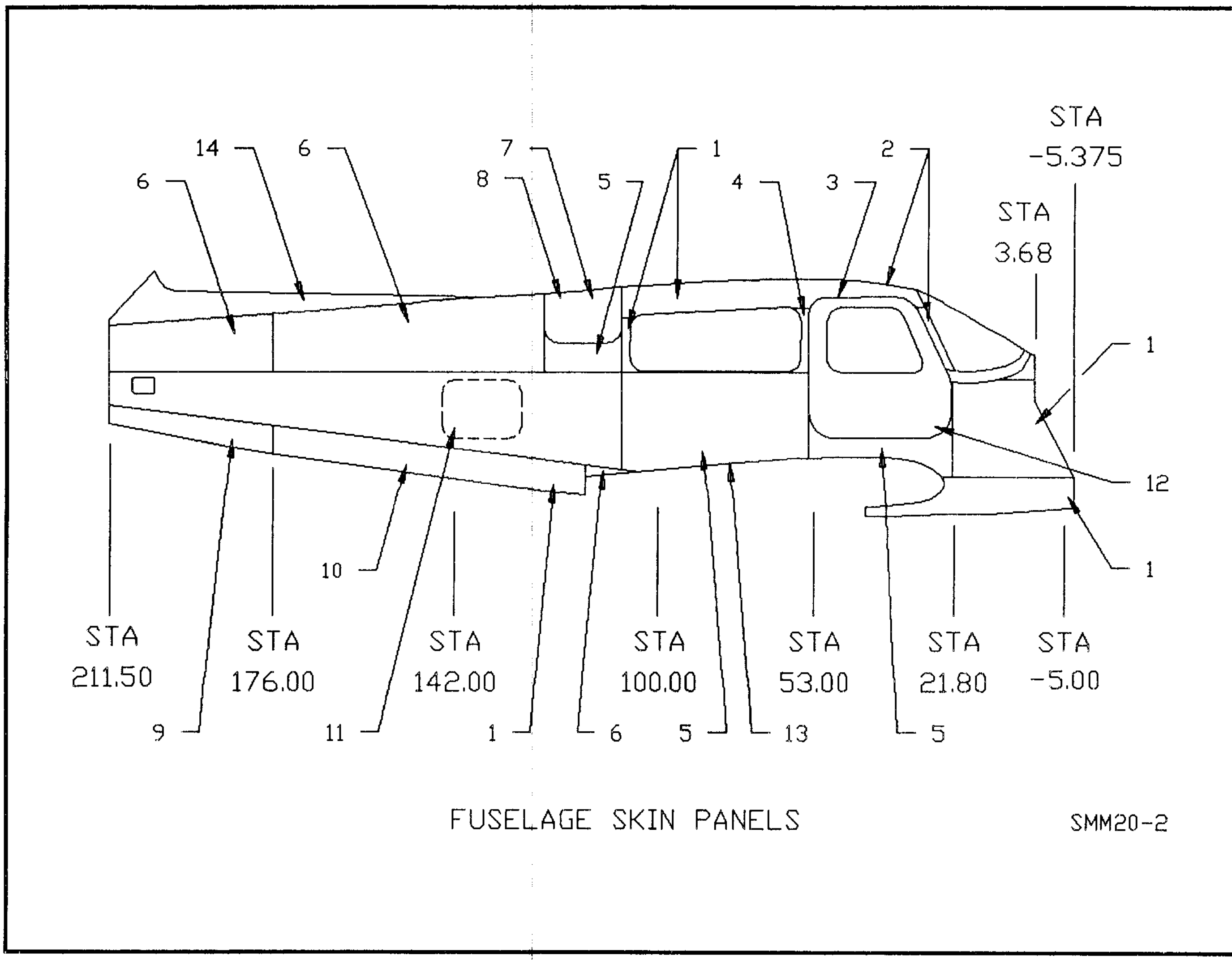
20-00-01 - SKIN SPECIFICATIONS



INDEX NO.	SKIN THICKNESS	MATERIAL	INDEX NO.	SKIN THICKNESS	MATERIAL
1.	0.063	2024 T-3 CLAD	12.	0.025(c)	2024 T-3 CLAD
2.	0.050	2024 T-3 CLAD	13.	0.020(a)	2024 T-3 CLAD
3.	0.040	2024 T-3 CLAD	14.	0.032	2024 T-3 CLAD
4.	0.040	2024 T-3 CLAD	15.	0.040(b)	2024 T-3 CLAD
5.	0.025	2024 T-3 CLAD	16.	0.040(d)	2024 T-3 CLAD
6.	0.025	2024 T-3 CLAD	17.	0.016(a)	2024 T-3 CLAD
7.	0.032	2024 T-3 CLAD	18.	0.050(b)	2024 T-3 CLAD
8.	0.040	2024 T-3 CLAD	19.	Polyester Glass-Fiber Reinforced	
9.	0.025	2024 T-3 CLAD			
10.	0.025	2024 T-3 CLAD			
11.	0.025	2024 T-3 CLAD			

(a) Same thickness on top and bottom.
(b) Top of wing only.
(c) Top aft flap skin (hat section).
(d) Top inboard flap skin.

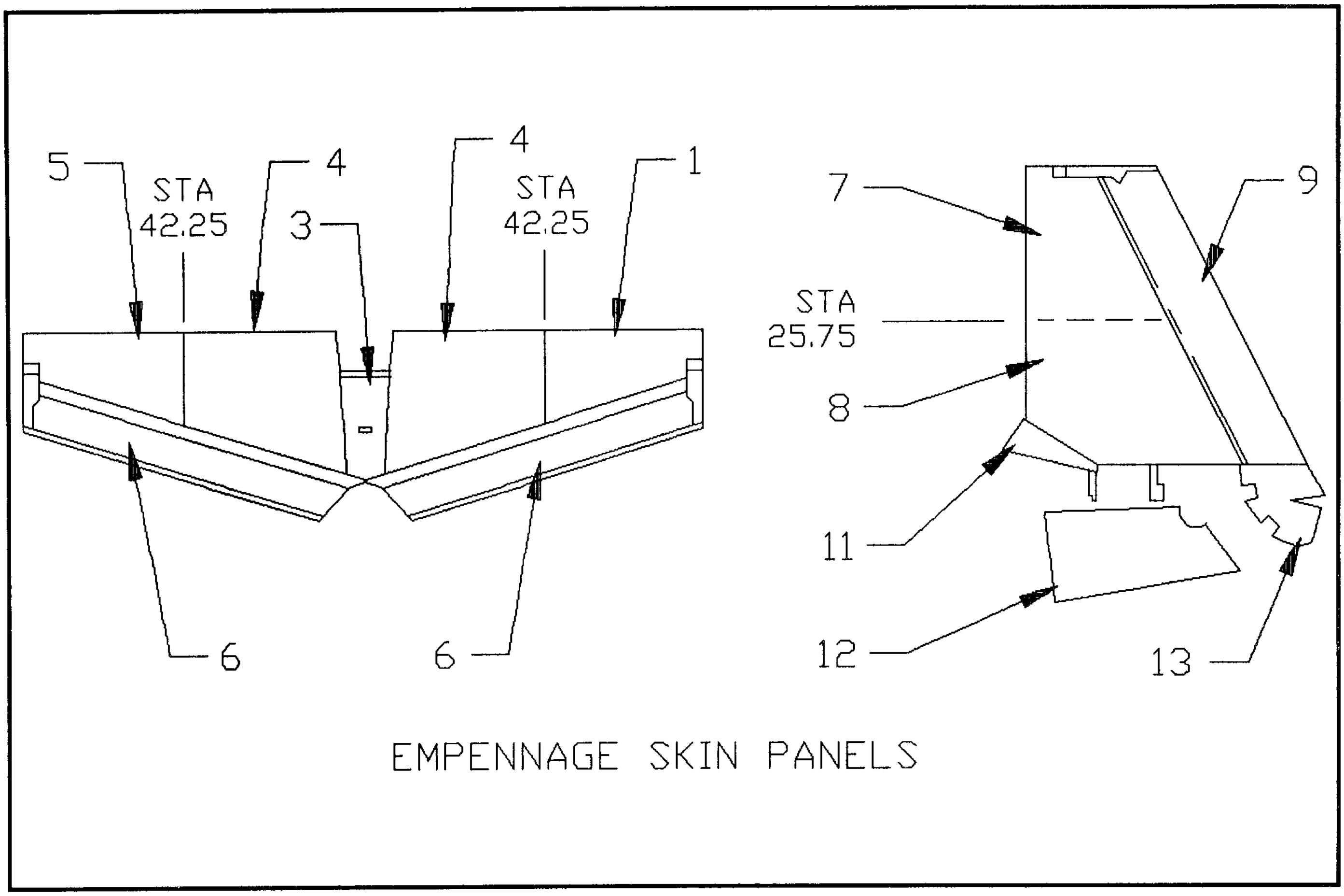
WING SKIN PANELS
FIGURE 20-1



INDEX NO.	SKIN THICKNESS	MATERIAL	INDEX NO.	SKIN THICKNESS	MATERIAL
1.	0.025	2024 T-3 CLAD	10.	0.032	2024 T-3 CLAD
2.	0.040(d)	2024 -0 CLAD	11.	0.032	2024 T-3 CLAD
3.	0.025(c)(b)	2024 T-4 CLAD	12.	0.032	2024 T-3 CLAD
4.	0.025	2024 T-3 CLAD	13.	0.025(a)	2024 T-3 CLAD
5.	0.025(b)	2024 T-3 CLAD	14.	Polyester Glass-Fiber Reinforced	
6.	0.020	2024 T-3 CLAD			
7.	0.025	2024 T-3 CLAD			
8.	0.032(d)(e)	2024 -0 CLAD			
9.	0.025	2024 T-3 CLAD			

(a) Left side only.
(b) Right side only.
(c) 0.032 can be used.
(d) Heat treated to T-42 condition after forming.
(e) Shell.

FUSELAGE SKIN PANELS
FIGURE 20-2



INDEX NO.	SKIN THICKNESS	MATERIAL	INDEX NO.	SKIN THICKNESS	MATERIAL
1.	0.025	2024 T-3 CLAD	8.	0.025	2024 T-3 CLAD
2.	0.025	2024 T-3 CLAD	9.	0.020	2024 T-3 CLAD
3.	0.025	2024 T-3 CLAD	10.	0.032	2024 T-3 CLAD
4.	0.025	2024 T-3 CLAD	11.	Polyester Glass-Fiber Reinforced.	
5.	0.025	2024 T-3 CLAD	12.	0.020	2024 T-3 CLAD
6.	0.020	2024 T-3 CLAD	13.	0.025(a)	2024 T-3 CLAD
7.	0.025	2024 T-3 CLAD			

(a) Heat treated to T-42 condition.

EMPENNAGE SKIN PANELS
FIGURE 20-3

20-00-02 - CORROSION DETECTION & PREVENTION

Most metallic fabrication materials are susceptible to corrosion. Corrosion may occur on aircraft in any climate, but it will be a problem more often in climates where the aircraft is exposed to salt air or high humidity, or where there are industrial contaminants in the atmosphere. The aircraft should be inspected frequently to detect and correct corrosion before serious damage occurs.

Any form of corrosion should be removed at once. If it is necessary to remove paint, only an approved aircraft paint remover such as Eldorado PR-3400, (Eldorado Chemical Co., Inc., 6700 Lookout Road, P.O. Box 32101, San Antonio, TX. 78216) should be used. Paint removing substances left in metal crevices will cause further corrosion. Turco 2662C or 3002 will remove corrosion from aluminum and treat the metal surface in one application. This Section discusses corrosion types and their prevention along with suggested procedures for corrosion protection of internal airframe surfaces.

1. Types of Corrosion - Aluminum

Corrosion normally appears in one or more of four forms. Each type of corrosion can be precluded or controlled by a preventative maintenance program.

A. Chemical Corrosion.

Chemical corrosion normally occurs where battery acid or exhaust gases come in contact with metal surfaces. A few simple precautions will prevent chemical corrosion.

(1) Be sure battery vents are free from obstructions at all times.

(2) Repaint all scratches and worn spots found in areas painted with acid-resistant paint.

(3) If acid is spilled on metal surfaces, flush entire area with sodium bicarbonate and water. The solution should be rinsed away at once and the area dried by driving all water from crevices with an air hose before wiping surface dry with a clean cloth.

(4) Frequently clean exhaust gas deposits from metal surfaces.

B. Local-Cell Corrosion.

On bare metal surfaces, in an early stage development, local-cell corrosion appears as a light, whitish powder deposit. Surface pits warn of advanced local-cell corrosion. On painted surfaces, the first indication of corrosion will be evidenced by paint blistering.

(1) Intergranular Corrosion - Selective attack along grain boundaries of metal alloys is referred to as intergranular corrosion. Aluminum alloys 2024 and 7075 are vulnerable to this type of attack. Aluminum extrusions may contain non-uniform areas, which in turn may result in galvanic attack along grain boundaries. This type of corrosion is difficult to detect in its original stages. When the attack is well advanced, the metal is usually blistered or delaminated. This is referred to as "exfoliation". It is very difficult to completely remove and stop this type of corrosion, and replacement of the affected part is recommended wherever possible.

C. Concentration Cell Corrosion

Corrosion forming under rivet heads, along faying surfaces, at skin to longeron contact surfaces and other similar areas is called concentration cell corrosion. Detection requires close inspection. Rivets must be removed and skin laps must be separated to remove concentration cell corrosion. Use aluminum wool soaked in solvent such as methyl-ethyl-ketone to scour corrosion deposits from the surface before painting both faying surfaces with epoxy-polymide primer and re-assembling.

D. Galvanic Corrosion

Dissimilar metals, such as stainless steel and aluminum, in contact with each other sometimes develop galvanic corrosions. To remedy this form of corosion, separate the parts, remove corrosion, and paint both surfaces with epoxy-polymide primer before reassembling.

2. Corrosion Prevention

A. Thoroughly examine unpainted metal surfaces at inspections and check corrosion when found. Carefully examine seams, lap joints, and crevices where moisture or dirt can collect. Areas exposed to exhaust gases require frequent inspection and cleaning.

B. Corrosion may attack metal even though the surface is painted. Inspect painted areas for a blistered or scaly appearance that warns of corrosion below the paint layer.

C. Use only liquid (non-alkaline) soap to wash the exterior airframe. Cover vent scoops when aircraft is being washed. Rinse aircraft exterior after exposure to salt air or industrial fallout.

D. Since moisture promotes corrosion, thoroughly and frequently inspect areas where water is likely to collect. Use an air hose to drive water from crevices before wiping exterior surface dry after washdown.

E. Hangar aircraft when not in use.

F. If battery acid is spilled on any part of the aircraft, immediately wash the area with a solution of sodium bicarbonate in water. Rinse with clear water and dry with clean towels.

NOTE

ACF-50 or equivalent can be fogged into fuselage, empennage or wing skin areas. It is recommeded that electrical connections and electrical components be protected (sealed off) during fogging procedures.

NOTE

FAA Advisory Circular 43-4 addresses corrosion problems.

3. Epoxy-polymide Painting.

Epoxy-polymide coating of internal airframe surfaces will not eliminate the necessity for periodic inspections. The most likely areas for corrosion to begin are in hidden crevices such as skin laps, under rivet heads or any opening where moisture can collect. Periodic inspection of these areas is most important so that any corrosion which may be present can be detected and treated in its very earliest stages.

When corrosion is detected, it should be treated as follows:

A. Remove all corrosion product (usually white or grey-white powder on aluminum) from the corroded area down to sound metal.

(1) If the base metal is aluminum, clean off the corrosion product by scrubbing with aluminum wool or a non-metallic scouring pad such as the nylon pads made by the Carborundum Company, P.O. Box 277, Niagara Falls, N.Y. 14302.

(2) If the base metal is steel, remove the corrosion product with emery cloth (320 grit or finer) or steel wool.

(3) If the corrosion is too advanced to remove by the light mechanical cleaning methods of (1) and (2), refer to Advisory Circulars 43.13-1( ) and/or 43-4 for alternate methods of cleanup and repair.

(4) Chemical cleaning solutions should be used with extreme caution on both aluminum and steel parts. Such solutions are not recommended for use in areas where they cannot be easily and completely neutralized.

B. Wash all areas to be epoxy coated with a cleaning solvent such as methyl ethyl ketone (MEK), Turco T-657 (Turco Products, Inc., 6135 South Central Ave., Los Angeles, California), lacquer thinner, #3094 wash thinner (Pratt & Lambert, Inc., 25th and N.Y. Avenue, Wichita, Kansas) or similar solvents.

(1) To get a good clean surface for epoxy priming use a clean cloth or piece of cheesecloth and apply one of the solvents noted above. The surface should be wiped dry with a second piece of clean cloth. Do not allow the solvent to dry on the cleaned area as it will redeposit dissolved soil and grime upon evaporation.

CAUTION

Wipe solvents are generally flammable and toxic and should not be used without adequate ventilation and fire precautions.

C. Apply epoxy primer to cleaned area by spray or brush. If area needs to have a finish coat applied it should be applied within time frame specified by epoxy primer manufacturer.

20-00-03 - PAINTING

The exterior is painted with urethane enamel. When exposed to humid salt air or to an atmosphere having corrosive fallout, the aircraft should be hangared when not in use.

1. Paint Repairs.

A. Materials.

(1) Aluminum wool, nylon scouring pads, 320 grit or finer emery cloth or steel wool.

(2) Tack rags.

(3) Wipe solvents such as: methyl-ethyl-ketone, T-657 --(Turco Products, Inc.); #3094 wash thinner --(Pratt & Lambert, Inc.); lacquer thinner or equivalent solvents.

(4) Body putty or aerodynamic filler such as: Flex-Bond --(Taylor & Art Plastics); Flex --(3M Co.);or Cuz polyester body filler #6372 -- (NAPA [Martin Senour Paints]).

(5) Compatible paints for the item (such as steel tubular structure or exterior skin) and for the year and model being repainted. (Refer to Mooney Illustrated Parts Catalog).

(6) Thinners which are compatible with paints being used, both for paint thinning and for burn-down thinners.

B. Cleaning Procedures.

NOTE

Fiberglass components are attacked and deteriorated by products containing the following chemicals: Ketone, aliphatic esters, chlorinated hydrocarbons and slightly softened by most aromatic hydrocarbons.

(1) Fuel Servicing Decal Removal:

(a) Cover the decal with a hot, wet towel for approximately 2 minutes.

(b) Lift one corner of the decal and slowly remove.

(2) Remove all old loose paint by one of the following methods:

(a) On aluminum - for uniformity of finish appearance, the entire skin panel should be prepared for repainting. If the paint is in very bad condition or if a filler is to be used, remove all of the paint by use of lacquer thinner, MEK or similar solvent. Careful application of paint stripper is acceptable. The solvent should be **wiped on** and **wiped off** before it evaporates. If the solvent is allowed to evaporate, it will redeposit the soils and paint that were being carried. Any scouring required should be done at this point. Scouring with nylon pads or aluminum wool may be done dry or wet with one of the wipe solvents listed above. After the old paint, grime, etc. has been loosened and removed, the scoured area should be wiped with a tack rag, and again cleaned with fresh wipe solvent. The part should now be ready for priming and painting.

(b) On steel - Remove all grease, grime, loose paint, etc. by wiping with a wipe solvent and rags. Do not allow the wipe solvent to evaporate. Wipe it dry! Steel parts may be cleaned to bare metal by sanding with emery cloth or steel wool. If the parts are removable, they can be cleaned by sandblasting. Regardless of the scouring method, all parts should be wiped with a tack rag and cleaned with fresh wipe solvent. The part should now be ready for priming and painting.

C. Priming and Painting.

(1) On aluminum - Cleaned and dried surfaces to be painted should be coated with a wash primer conforming to MIL-C-8514 or MIL-P-15328. Read and follow the manufacturer's instructions carefully. The wash primer should be applied to attain a dry film thickness of 0.3 to 0.4 mils (a transparent film). A good wash primer coating is a **must** since the top coating can be only as good as the primer coat. As a general rule the wash primer should dry from .05 to 1.5 hours but not more than 2 hours before application of the top or intermediate primer coat.

When an intermediate epoxy primer coat is applied, it should be mixed very carefully per the manufacturer's instructions. It should be thinned per the manufacturer's instructions and applied to a dry film thickness of 0.8 to 1.0 MILS. The intermediate primer should be allowed to dry a minimum of 0.5 to 1.5 hours depending upon the application temperature and relative humidity. Follow manufacturer's instructions. The intermediate primer coat can be dry-scuffed lightly with No. 400 to No. 600 sandpaper prior to top coat application to provide a higher gloss finish. As many coats of paint as desired may be applied. A higher gloss will be attained if the surface is scuffed lightly and tack rage cleaned between each coat.

(2) On steel - The same general procedure used on aluminum can be applied to steel. However, MIL-P-8585 primer or epoxy primer is recommended for the steel coat. If epoxy primer is used, it should have a wash primer (MIL-C-8514) pre-treatment.

D. Painting.

(1) Apply three coats of white base and/or finish color, allowing three to five minutes between coats depending upon weather conditions. Allow five to ten minutes between coats in cold, dry weather; in humid weather, allow fifteen minutes between coats.

(2) Use a small round watercolor brush trimmed to a point for application of undiluted touch-up paint to small scratches and bare spots. Do not thin acid resistant black paint or exterior finish touch-up paint for brush-on application.

NOTE

M20R aircraft are painted with Pratt-Lambert "Acry-Glo" urethane enamel. Inquiries concerning application of this finish should be directed to: Pratt & Lambert, P.O. Box 2153, Wichita, KS. 67201.

CAUTION

Any flight control surface that is to be repainted should be stripped of all paint prior to repainting. A minumum thickness, cover coat should be applied to flight control surfaces. It is required that repainted control surfaces be removed and rebalanced prior to flight per paragraph 27-91-00.

NOTE

Never use abrasive polish compounds or harsh soaps and detergents on urethane finishes. Once the surface gloss is damaged it cannot be restored by polishing.

CHAPTER

21

AIR CONDITIONING

CHAPTER 21

ENVIRONMENTAL SYSTEMS

LIST OF EFFECTIVE PAGES

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TABLE OF CONTENTS (con't.)

21-00-00 - CABIN VENTILATION SYSTEM

The cabin environmental system consist of three standared ventilating systems that supply heated or fresh air as the pilot or passengers prefer. CABIN AIR, CABIN HEAT and OVERHEAD VENTILATION. The cabin air and heat system controls and vents are located on the console between the pilot and co-pilot seats. Individual fresh air outlets are located on each side of the cabin side panels just forward of the pilots and co-pilots outboard knees. The overhead ventilation system consists of individual outlets (Wemac valves) located between and above each seat position. The aircraft has a flow regulator system with the control knob located above and between the pilot's and co-pilot's head. The systems are basically trouble free but inspection should be made at regular intervals to ensure proper operation.

21-40-00 - HEATING

Heat is supplied to the cabin through flexible hoses connected to a heat distribution box assembly and a muff/shroud assembly located on the exhaust manifold on the engine. It is recommended that the condition of these items be checked each time the cowling is removed. This will provide a continuing check for the prevention of carbon monoxide (CO) in the cabin. Any deteriorated flexible ducts should be replaced. Heat shrouds should be inspected for cracks or other deteriorations and repaired or replaced promptly. It is recommended that inspection of the exhaust system for any leaks or cracks, at each maintenance action, be made and replace components or repair as needed.

21-50-00 - COOLING

GENERAL

The type of cooling system installed in an aircraft operates on a closed vapor cycle concept using refrigerant (R-134a) as the heat absorption media. The (R-134a) Air conditioning System cools the aircraft in the same manner as a cooling system in an automobile or home. However, one major difference in the two systems is that the (R-134a) system contains components which are designed to be light weight, compact, provide high performance and operate at extreme altitudes and ambient temperatures.

REFRIGERANT (R-134a) SYSTEM OPERATION

The concept of air conditioning a room, cabin or cockpit is actually very simple. Figures 21-1 and 21-2 show the refrigerant and electrical schematic for a typical system. The refrigerant is the media which absorbs and rejects the room or cabin heat. By continuous recirculation of the warm cabin air, heat is absorbed in the evaporator module(s) and is rejected to the outside through the system condenser. When the system is turned ON the compressor is connected to the drive belt through an electrically actuated clutch. The compressor compresses the R-134a refrigerant gas to a high pressure. The hot, high pressure gas then passes through the condenser coil where it is cooled and condensed into a warm liquid at constant pressure. The warm liquid is then routed into a receiver-dryer container where the liquid and any remaining gas are separated and any moisture is absorbed. The warm, dry liquid is then directed to the evaporator module expansion valve where the high pressure liquid is expanded to a low pressure. The expansion process creates a super cool gas which passes through the evaporator coil and absorbs heat from the warm cabin air passing over the coils. The warm low pressure refrigerant then enters the R-134a compressor where the process starts all over again.

In addition to cooling cabin air, a refrigerant type system also removes a large percentage of moisture from the air as well as removing dust and pollen particles from the air.

The air conditioning system consist of various components installed in several areas of the aircraft. The Compressor Installation -- located on the rear of the engine accessory case, Switch Installation -- on the cabin lower console, Evaporator Installation -- hat rack, Outlet Duct Installation -- over head of the hat rack, Air Inlet Installation -- tailcone (R/H access panel), Diffuser Assembly -- tailcone (R/H access panel), Condenser Installation -- tailcone (R/H access panel),and Exhaust Duct -- tailcone (R/H rear).

21-51-00 - SYSTEM LEAK CHECK PROCEDURE (R-134a)

Leak check of a refrigerant plumbing system is very important to assure that the system maintains its charge to provide the designed performance and reduce damage to system components. Plumbing systems on aircraft are very hard to keep leak tight due to the type of gas or fluid used, excessive vibration and expansions or contractions due to extreme ambient temperatures and altitudes. Therefore, a periodic check of the system charge is required to determine if any loss or refrigerant has occurred.

1. The system leak check is required whenever the following conditions occur:
   A. New system plumbing installation.
   B. Component replacement in the plumbing system.
   C. Line or hose rupture.

51-51-01 - SPECIAL TOOLS AND/OR EQUIPMENT REQUIRED

The following tools and/or equipment are required to leak check a refrigerant plumbing system.

1. Gaseous dry nitrogen, regulated source (0-500 psig)
2. R-134a refrigerant charging manifold with gauges and hoses
3. Electronic leak detector
4. R-134a refrigerant, 30 lb. cylinder
5. R-134a Refrigerant oil, (Ester RL-500S)
6. Leak check fluid, (soapy solution)
7. Assorted hand tools
8. Hand and eye protection
9. Thread sealant, P/N 55431 (Loctite)
10. Hose adapter (1/2 in. male acme to 1/4 in. female flare)

21-51-02 - LEAK CHECK PROCEDURE

1. Remove, if required, all panels, doors, shrouds, etc. to gain access to component being leak checked.

2. Remove, if required, any enclosures or access doors to expose all tubing, hoses, fittings, etc. to the compressor-condenser module/evaporator module.

3. Verify all aircraft and/or ground power is OFF.

4. Remove service port caps from A/C system. Access to service ports is through Avionics Bay acess panel, LH side of Tailcone.

5. Close all manifold gauge valves and verify hose connections are tight.

6. Connect R-134a refrigerant charging manifold. R-134a service gauges contain quick-connect fittings to minimize refrigerant loss. To install quick-connect, push on firmly until locked (a "clicking" sound is heard). Hold grip ring and pull to remove quick-connect fittings.

7. Connect yellow charging hose to a regulated dry nitrogen source.

NOTE
An adapter is required to connect yellow charging hose to nitrogen source.

8. Regulate nitrogen source to a pressure of 200 PSIG maximum.

CAUTION
Do not exceed 200 PSIG nitrogen pressure during leak check procedure or damage to expansion valve WILL result.

9. Remove all shrouds, panels, flooring and any other covering which prevents access to refrigerant fittings or connections (if required).

10. Verify all plumbing connections are secure.

11. Slowly open high pressure (RED) manifold valve and allow system pressure to increase gradually until a pressure of 200 PSIG is achieved. Allow time for system pressure to equalize across expansion valves and note final system pressure.

CAUTION
During this procedure protective eye wear and gloves should be worn to prevent operator injury.

12. Apply soapy leak check fluid to each connection to locate leaks.

CAUTION
Do not use any leak dye in R-134a system or damage to system may result.

13. Use thread sealant on all male fitting threads (sparingly), staying off the first two (2) threads near sealing surface. A light coating of R-134a refrigerant oil must be applied to flare and/or o-ring to prevent metal galling/o-ring damage.

NOTE
Do not apply oil to fitting threads.

14. Tighten joints as necessary to stop leaks.

CAUTION
Do not over tighten plumbing connections. Stripped threads or cracked flares may result.

15. With system leak tight, turn nitrogen source OFF; disconnect yellow charging hose from nitrogen source and slowly release nitrogen pressure to zero.

CAUTION
Vent system pressure very slowly to assure that compressor oil is not vented with the nitrogen. Do not let air enter the system.

16. Close manifold valve.

21-52-00 - SYSTEM R-134a EVACUATION AND CHARGING PROCEDURE

Charging the refrigerant (R-134a) system is required on new system installations, after an accidental line break, component failure or when the system has excessive leaks. Due to the chemical nature of the refrigerant, every precaution must be taken to protect the service person from accidental exposure to the refrigerant. See service precautions in Section 21-59-00. Only R-134a refrigerant must be used or damage to the system will result. Overcharging the system with refrigerant and/or oil will also result in system damage or reduction in performance and service life.

21-52-01 - SPECIAL TOOLS AND/OR EQUIPMENT REQUIRED

The following tools and equipment are required to charge the refrigerant system:

1. Small hand tools and socket set
2. Vacuum pump, air or electric (0-30 in. hg.)
3. Refrigerant, R-134a, 30 lb. cylinder
4. R-134a charging manifold, with gauges and hoses
5. Thermometer, 0-150° F
6. Inspection mirror, adjustable
7. Service light or flashlight
8. Hand and eye protection
9. Shop towels
10. Refrigerant oil (Ester RL-500S))
11. Scale, 0 - 50 lbs.
12. Reclaim/recycle cart (R-134a)
15. Hose adapter (1/2 in. male Acme to 1/4 female Flare)

21-52-02 - SYSTEM (R-134a) EVACUATION PROCEDURE

Prior to charging the system with refrigerant, the system must be evacuated for a minimum of 45 minutes to remove air and moisture which can cause the system to perform incorrectly if not completely removed from system.

1. Verify power to system is OFF.

2. If required, perform leak check procedure described in Section 21-51-02.

3. Connect charging manifold to service ports (ref. Section 21-51-02, 4 through 6.

4. Connect manifold charging (yellow) hose to vacuum pump and turn pump ON.

NOTE
An adapter may be required to allow vacuum pump hookup.

5. Open both valves on charging hose, quick connect fittings.

6. Open both valves on charging manifold and observe gauges.

NOTE
Low pressure gauge "BLUE", will indicate vacuum on lower range of gauge.

7. Evacuate system for 30 full minutes. System vacuum should attain 25 — 27 in. hg. in 10 to 15 minutes.

8. Close manifold valves and shut vacuum pump OFF. Vacuum in system must not change within 5 minutes.

CAUTION
Any change in vacuum pressure or failure to achieve a minimum system pressure of 29 in. hg. vacuum indicates the presence of a plumbing leak. Repeat leak check procedure; locate and repair all leaks.

9. Disconnect manifold yellow service hose. System is ready for refrigerant charging.

NOTE
Excessive water and/or air in the system will cause pressure to rise/expansion valve freeze-up.

21-52-03 - REFRIGERANT CHARGING PROCEDURE

Charging the system with refrigerant is required on a new system installation or when "topping off" an existing system. There are various methods of charging refrigerant into the air conditioning system. These include using refrigerant recovery/recycle units, using a charging cylinder, and direct charging using a scale. Refer to manufacturers instruction manual for recovery unit handling and operation.

1. Verify that all electrical power to the system is OFF.
2. If required, repeat leak check and evacuation procedures.

CAUTION
Eye and hand protection must be worn during this procedure.

3. Connect manifold charging hose (yellow) to R-134a cylinder shutoff valve and open valve.
4. Crack hose fitting at manifold to purge air from hose. If system refrigerant charge is to be recorded, place refrigerant container on a 0 - 50 lb. scale and record initial weight.
5. Open both manifold gauge valves and allow refrigerant gas to enter system. Continue adding refrigerant until system internal pressure has stabilized.
6. Close manifold valves and verify system internal pressure is 50 PSIG or greater.

NOTE
If internal pressure is not above 50 PSIG, the low pressure cutout switch will not close. To assure an internal pressure of 50 PSIG, the R-134a cylinder must be heated to obtain a charge pressure of 70 - 80 PSIG.
CAUTION
Do not heat R-134a container with open flame or container damage may result and possible injury to operator. Heat with warm water or room temperature. Do not store or heat refrigerant container at temperatures above 125° F.

7. Move aircraft to run-up area.
8. Start aircraft engine. Select "MAX" on airconditioner switch. Idle aircraft engine at 800—900 RPM. Veryify Alternator is charging.

CAUTION
Do not operate system with high pressure (RED) valve open on the charging manifold gauge set.

9. With system operating, observe the system discharge and suction pressure values and refrigerant condition in the receiver-dryer sight glass.

NOTE
A flashlight and inspection mirror are required during the system charging procedure. Excessive bubbles in the sightglass indicate a low refrigerant level.

10. With the R-134a cylinder connected to the charging hose, charging container shutoff valve open and hose purged, slowly open the suction manifold valve (BLUE). The suction pressure will increase to 60-70 PSIG while the R-134a refrigerant enters the compressor.

NOTE
As refrigerant enters the compressor, a slight increase in discharge pressure will be noted (2 - 5 PSIG).

11. Continue to add refrigerant per the above procedure until the sightglass is clear of excessive bubbles when charged on a hot day (95-105° F).

NOTE
A desired sightglass liquid condition is when only occasional bubbles are observed when charging on a hot day (95 - 105° F).

12. Close suction manifold valve (BLUE) and let system operate for 5-10 minutes and then check sightglass. If sightglass is not totally clear, open suction manifold valve and add a small quantity of refrigerant until 98% of bubbles disappear. Close manifold valve and let system stabilize.

NOTE
Letting the system stabilize is required since the expansion valve is trying to stabilize to the preset suction pressure value.
CAUTION
Do not overcharge system or component and system damage may occur. Full system charge is approximately 3.2 lbs. of R-134a.

13. With the system fully charged and operating, observe the suction and discharge pressures. Typical values at various ambient temperatures, with hot cabins, are shown below:

O.A.T. (°F)	SUCTION PRESSURE(PSIG)	DISCHARGE PRESSURE (PSIG)
60-70	28	125 -- 140
80	30	170 + /- 10
95	31	210 + /- 10
105	32	237 + /- 10

NOTE
Whenever possible, the system should be charged on a hot day (90-100° F). If not, "topping off" may be required for ambient conditions.

14. Allow system to operate for 10 minutes and then shutdown.

CAUTION
Do not allow aircraft engine temperatures to exceed limits.

NOTE
After shutdown, both suction and discharge pressures will begin to equalize. Pressures should be equal in 60 - 90 seconds.

15. Close refrigerant container shutoff valve (turn C/W). Record the refrigerant container final weight an calculate system refrigerant charge as follows:

CHARGE (lb.) = W initial (lb.) — W final (lb.)

16. Turn knob on suction and discharge charging hose quick coupler to closed position and disconnect hoses from service ports.

17. Remove yellow charging hose from refrigerant container and store manifold gauge set.

CAUTION
Hand and eye protection must be worn during this operation to prevent subcooled refrigerant from burning eyes or hands.

21-53-00 - EXPANSION VALVE ADJUSTMENT PROCEDURE

Even though the automatic expansion valves are set at the factory there may be times when they must be adjusted to assure proper refrigerant flow at the desired evaporating temperature. This may be due to excessive pressure drop for long suction line runs. Any adjustment must not affect system suction and compressor discharge pressures as outlined in Section 21-52-03, 13. Changing expansion valve settings will also change evaporator air output temperatures.

21-53-01 - SPECIAL TOOLS AND/OR EQUIPMENT

The following tools and/or equipment are required to perform expansion valve adjustment:

1. Assorted small hand tools.
2. Inspection mirror, adjustable
3. Thermometer, 0 - 150° F
4. Flashlight or service light
5. R-134a service manifold and gauge set

21-53-02 - EXPANSION VALVE ADJUSTMENT:

The expansion valve adjustment shall be performed in accordance with, but not limited to the following:

1. Verify that system leak check and refrigerant charging has been performed and system is operating at typical values as outlined in Section 21-52-03, 13.

2. Remove all shrouds, covers or enclosures which prevent access to the evaporator expansion valve adjustment knob.

3. Verify R-134a manifold gauges and hoses are connected to service ports; manifold gauge set valves closed.

4. Open both valves on charging hose quick connect fittings.

5. Remove expansion valves' protective caps.

6. Verify that inlet to evaporator coil and blower ducting are free of any contamination or restrictions which could alter air flow.

7. Start aircraft engine.

8. Select "MAX" on airconditioner switch. Idle engine at 800—900 RPM. Verify Alternator is charging.

9. Close cabin and baggage doors and allow system to operate for 5 minutes.

10. Record compressor suction and discharge pressures and evaporator air inlet and outlet temperatures.

NOTE
Typical temperature difference of evaporator inlet and outlet air is 25+ /- 5° F.

11. If suction pressure is above the values outlined in Section 21-52-03, 13, the adjustment screw of the evaporator expansion valve, which has lowest outlet temperature, must be turned CCW, in 1/2 revolution increments.

12. Adjust other expansion valve of evaporator that has higher temperature by turning adjustment screw CW, in 1/4 revolution increments.

13. Wait 2—5 minutes for valves to stabilize until desired pressure is obtained. or air outlet temperature is lowest possible. Re-adjust as necessary.

14. Verify Engine temperatures and alternator output.

15. Operate system for 5 - 10 minutes after expansion valve adjustment to verify setting. Evaporator outlet temperatures should be within 1—3° F of each other.

16. System contains multiple evaporator modules. See Section 21-53-03, to balance evaporator modules.

21-53-03 - EVAPORATOR BALANCING PROCEDURE:

Evaporator balancing is required on all systems with multiple evaporator modules. This process balances refrigerant flow between evaporators to achieve equal evaporator air outlet temperatures. See Section 21-53-02, 1 through 10 above prior to beginning steps below.

1. Access all evaporator modules and measure/record outlet air temperatures.

2. Adjust expansion valve on the evaporator with the highest outlet air temperature in 1/4 revolution increments, in a CW direction. This will increase the refrigerant flow and reduce the outlet air temperature.

3. Adjust the remaining evaporator, with the lower outlet air temperature, in 1/2 revolution increments in a CCW direction.

4. Allow system to stabilize 2—5 minutes; recheck evaporator outlet temperatures and repeat adjustment procedure if necessary. Evaporator outlet temperatures should be within 1-3° F of each other.

NOTE
Proper evaporator balancing should not result in a change of the compressor suction pressure. Verify system pressures are within values shown in Section 21-52-03, 13.

5. If evaporator outlet temperatures are equal and suction pressure meets Section 21-52-03, 13, servicing is complete. If not, repeat Sections 21-53-02 and 21-53-03.

6. Shut system and aircraft engine OFF. Replace all shrouds, enclosures, ducting as required; remove charging manifold gauges and hose assemblies.

CAUTION
Eye and hand protection should be worn during this operation.

21-54-00 - COMPRESSOR DRIVE BELT INSPECTION & MAINTENANCE PROCEDURE

When the compressor drive belt requires removal and replacement, tension or alignment, the following procedures will apply:

21-54-01 - BELT REMOVAL PROCEDURE

1. Verify all aircraft or ground power is OFF.
2. Remove cowling to gain access to the compressor.
3. Loosen jam nut on adjusting bolt of idler pulley.
4. Loosen slide nut slightly to allow slide to move up and down.
5. Turn adjusting nut out far enough to allow belt removal.
6. Remove belt from all three pulleys.

CAUTION
Do not bend or twist the drive belt excessively during removal or damage may result.

7. Inspect belt for cracks or damage and clean any oil or other contamination from all pulleys and belt.

21-54-02 - DRIVE BELT REPLACEMENT PROCEDURE:

1. Verify belt size and part number (see Illustrated Parts Catalog) before installing or damage may result.

2. Place new belt, or inspected and cleaned belt, over compressor pulley, idler pulley, and drive pulley.

CAUTION
During this procedure, do not sharply bend or twist belt and do not allow belt to rotate on drive pulley flange. Damage to belt may result.

3. After belt is installed, rotate the compressor pulley clockwise (CW) to align belt on pulley. Belt MUST align directly over the compressor pulley. MAGNETO SWITCH -- OFF.

NOTE
If belt is too far forward or aft on the compressor pulley, the idler pulley and drive pulley MUST be adjusted forward or aft to allow belt to align directly over compressor pulley. See Section 21-54-03 for alignment procedures.

4. If belt alignment is GOOD, install belt guard (if removed) and tighten the two compressor mounting bolt nuts.

21-54-03 - DRIVE BELT ALIGNMENT PROCEDURE:

1. STARTER/ACCESSORY DRIVE PULLEY AND COMPRESSOR PULLEY

A. Place alignment gauge (Borrough's Tool No. 8082A or equivalent) around starter/accessory drive sheave/pulley assembly. The extended end of alignment gauge should overlay the upper portion of the compressor sheave outer pulley assembly.

B. The alignment gauge alignment bar must fall within 0.020 inches of the center of the compressor sheave outer pulley groove.

C. If alignment bar is off center of groove by more than 0.020 inches, estimate the number of 0.020 shims necessary to correct the alignment.

D. Remove accessory drive sheave assembly and place as many 0.020 shims, TCM P/N 646064-20, on starter/accessory drive shaft, as required, to achieve the correct alignment between the starter/accessory drive sheave/pulley assembly and compressor sheave outer pulley assembly. When alignment is correct, the extended arm of the alignment tool will fall into the center of the bottom of the compressor outer pulley groove within 0.020 inch.

E. Remove the alignment gauge from starter/accessory drive sheave/pulley assembly.

F. Torque the starter/accessory drive shaft 12 point, self-locking, nut to 450-500 inch pounds. Lubricate threads with clean 50 wt. engine oil prior to starting nut on threads.

G. Full engagement of threads on nut, P/N 649924, is required.

H. Prevent engine rotation during tightening procedures of starter/accessory drive nut.

2. IDLER PULLEY AND COMPRESSOR PULLEY

A. Place alignment gauge (Borrough's Tool No. 8082A) around idler sheave/pulley assembly.

B. The alignment gauge alignment bar must fall within 0.020 inches of the center of the compressor sheave outer pulley groove.

C. If the extended end of alignment bar is off center of groove by more than 0.020 inches, estimate the number of 0.020 shims necessary to correct the alignment.

D. Remove idler sheave assembly and place as many 0,020 shims, TCM P/N 643956-20, between idler sheave and bearing as required to achieve correct alignment between idler and compressor sheave outer pulley. When alignment is correct, the extended arm will fall into the center of the bottom of groove of compressor outer pulley groove within 0.020 inch.

E. Re-install idler sheave assembly and torque screw to 800-850 in. lbs.

3. VERIFICATION OF PROPER ALIGNMENT FOR ALL PULLEYS

A. After torquing of all sheave assemblies, check alignment of all pulleys to verify belt will not run with any misalignment during engine operation.

B. Belt is ready for tensioning. See Section 21-54-04.

21-54-04 - DRIVE BELT TENSIONING PROCEDURE

1. Verify all compressor, starter/accessory drive and idler pulley mounting hardware is tight and belt is properly aligned per Section 21-54-03.

2. Slide idler pulley snugly against belt and tighten adjusting bolt finger tight into its socket.

NOTE
At this stage, idler pulley should be rotatable by hand beneath belt.

3. Tighten adjusting bolt two full turns.

4. Secure adjusting bolt jam nut (275-325 in. lbs.) and idler pulley slide nut (300-350 in. lbs.).

5. Confirm belt tension is 50-70 lbs. by one of the following methods.:

A. Use a direct reading belt tension gauge such as Burroughs Tool No. BT-33-73F. —— or

B. Measure belt deflection under a five (5) lb. load at the center of the longest belt span. Correct deflection is .3 - .4 inches.

NOTE
A spring loaded force gauge is required for this procedure.

6. If belt tension is not within the above tolerance, loosen adjusting screw jam nut and idler pulley slide nut and re-adjust the tension per paragraph B through E., 1 or 2, above.

NOTE
One (1) full turn of adjusting screw results in about a ten lb. change in belt tension.

WARNING
DO NOT OVER TIGHTEN BELT. Improper belt tracking or tension may cause belt damage.

7. After five (5) hours of operation, recheck belt tension and adjust as required to maintain 50-70 lbs belt tension.

21-55-00 - COMPRESSOR ASSEMBLY INSPECTION AND MAINTENANCE PROCEDURE

The compressor assembly requires more inspection than maintenance since field repair with first line technicians is limited. Inspection consists of checking for excessive oil leaks, belt alignment/tension and refrigerant leaks. The compressor should be periodically checked at 500-800 hours of operation in which the following should be performed.

21-55-01 - SPECIAL TOOLS AND EQUIPMENT REQUIRED

1. Small hand tools and socket set
2. R-134a charging manifold, with gauges and hoses
3. R-134a electronic leak detector
4. R-134a refrigerant cylinder
5. Leak check liquid (soapy solution)
6. Hand and eye protection
7. Thread sealant (Loctite # 55431)
8. Dry nitrogen, regulated
9. Isopropyl Alcohol, flush liquid

21-55-02 - COMPRESSOR INSPECTION PROCEDURE

1. Verify aircraft power to system is OFF.
2. Remove cowling to gain access to compressor.
3. Inspect belt for alignment per Section 21-54-03.
4. Inspect belt for tension per Section 21-54-04.
5. Visually inspect compressor pulley for excessive wear, nicks, cracks or looseness.
6. Visually inspect compressor shaft for excessive oil leaks.

NOTE
If excessive oil is found, compressor should be checked for leaks. Use fluid or leak detector as required. If leak is found, compressor should be replaced. If compressor has not been operated for 30-60 days or more, the dynamic shaft seal may have a small leak due to lack of oil on seal surface. Operation of system should eliminate this type of leak. If not, replace compressor.

7. Check all fasteners for looseness. Re-torque as required.
8. Visually inspect drive belt for cracks, wear and excessive oil.
9. Clean all oil and other contaminates from belt with clean shop rag.

NOTE
Checking compressor oil quantity is required only if an excessive amount of oil is observed due to leaks or system has been vented very quickly, thereby causing a loss of oil. An oil check can be made only when system is vented. See Oil Check Procedure, Section 21-55-05.

10. If visual check is good, replace any removed components and secure all fasteners.

21-55-03 - COMPRESSOR REMOVAL

1. Verify aircraft power is OFF.
2. Remove cowling to gain access to rear of engine and compressor.
3. Connect refrigerant manifold gauge and hose assemblies to system service ports.
4. Recover system refrigerant charge per recovery equipment manufacturers operating manual.

5. Loosen belt tension. See Section 21-54-04, reverse procedure.

6. Loosen compressor mounting bolts.

7. Remove belt guard assembly per Section 21-54-01, 3.

8. Remove belt from all three pulleys per Section 21-54-01.

9. Remove system suction and discharge hose connections and cap them off immediately.

WARNING
All systems connections must be capped to prevent water, dust or other contaminates from entering system.

10. Remove compressor mounting hardware and lift compressor from mounting bracket.

21-55-04 -COMPRESSOR REPLACEMENT

If a new or rebuilt compressor is supplied without suction and discharge swivel fittings or pulley, these parts must be removed from the failed compressor and installed on the new compressor. It is recommended that a complete, new, compressor assembly be installed.

NOTE
If failed compressor has contaminated system, a complete cleaning of system is required. Also, the receiver-dryer assembly must be replaced. Flush system with an approved flush agent and purge with dry nitrogen. Also, remove and clean expansion valves.

1. Lift compressor into support bracket and install mounting hardware.

2. Install either new or inspected and cleaned old belt on to all three pulleys per Section 21-54-02.

3. Tighten mounting hardware (temporarily).

4. Verify alignment of belt on all pulleys and align per Section 21-54-03, if required.

5. Loosen compressor mounting nuts (2 each), pull bolts out enough to install belt guard per Section 21-54-02.

6. Tighten belt guard/compressor mounting hardware per Section 25-54-02, 4.

7. Remove compressor suction and discharge fitting caps and connect system hoses.

CAUTION
New compressor is supplied with 10 PSIG nitrogen pressue. Remove caps and vent slowly.
NOTE
Lightly apply R-134a refrigerant oil (RL-100S) on fitting o-ring and at contact surface between tube bead and jam nut. Apply a small amount of thread sealant to male fitting threads (stay clear of first 2-3 threads).

8. Tighten o-ring fitting nuts to 150-200 in.- lbs. DO NOT OVERTORQUE.

9. Connect R-134a service gauges to unit suction and discharge service ports.

NOTE
If failed compressor contaminated system and system was cleaned and purged, additional refrigerant oil may be required. If failed compressor did not contaminate system, no additional oil is required since a new compressor contains the required charge. In either case, the receiver-dryer must be replaced. Oil may be added (max. 3.4 oz.) to compressor from a port on back of compressor if compressor is not installed. Refrigerant oil may be added to compressor suction port if compressor is already installed in aircraft.

10. Leak check system per Section 21-51-00 as required.

11. Charge system per Section 21-52-00 as required.

12. Operate system to verify compressor operation and system performance.

21-55-05 - COMPRESSOR OIL LEVEL CHECK

When replacing the failed compressor containing uncontaminated oil with a new compressor, use the following procedure to add the required oil to the system.

1. Drain and measure oil from the failed compressor.

2. Drain oil from the new compressor in a clean container for reuse.

3. Measure an amount of new oil equal to the amount drained from the used compressor and pour it into the new compressor.

CAUTION
Only an E.S.I. approved oil may be used in this type of compressor.
Do not overfill compressor with oil or system performance will be affected.

21-56-00 - EVAPORATOR MODULE ASSEMBLY INSPECTION AND MAINTENANCE PROCEDURE

Only field serviceable high inspection or maintenance components will be addressed in the evaporator module section.

21-56-01 - EVAPORATOR COIL INSPECTION

The evaporator coil must be inspected every 500-800 operating hours for excessive lint and/or other contamination in the coil fins. Clean as required by using a vacuum or low pressure purge source. Bent coil fins must be combed to straighten.

21-56-02 - CONDENSATE DRAIN AND TUBING INSPECTION

Verify that the evaporator condensate drain and associated tubing is not blocked or tubing kinked. Clean and re-route tubing as necessary.

21-56-03 - COOL AIR DUCTING INSPECTION

Cool air ducting from the evaporator blower should be checked to assure that no excessive air loss is experienced due to loose connections, cracked or kinked hose. Repair as necessary.

21-56-04 - EVAPORATOR MODULE BLOWER MOTOR REMOVAL

The evaporator module blower motor is a low cost item that does not contain replaceable brushes. Therefore, it is recommended that the motor be replaced rather than repaired.

1. MOTOR REMOVAL

A. Verify all power to unit is OFF and all shrouds, enclosures, etc. are removed from around the module/blower assembly.

B. Disconnect power leads to motor.

NOTE
Blower motor is a permanent magnet type and therefore may be wired to rotate either CW or CCW. It is necessary that the motor wires and the associated colors be observed before being disconnected.

C. For motors that rotate CW (looking at the output shaft) the motor RED wire is + 28 VDC and the black wire is ground. For CCW rotation the RED wire is ground and the black wire is + 28VDC.

D. Remove motor wire clamp and disconnect the wire splice from the resistor wire.

NOTE
At this point it is very important to observe the wire colors and connections from the resistor assembly. The resistor RED wire is the low speed control and the ORANGE wire is the high speed.

E. Remove bracket/motor mounting screws and with a putty knife slide between motor and plastic scroll to cut the RTV foam sealant (if required).

CAUTION
Do not damage plastic material or blower wheel.

F. Lift blower motor out of scroll assembly and remove blower wheel.

G. Discard blower motor since brush replacaement is not possible.

2. MOTOR REPLACEMENT

A. Replace the motor wheel on the new motor shaft so the back of the wheel is .25 inches from motor mounting flange. The set screw on the wheel hub must be located on the motor shaft flat section. Use a thread lock sealant and tighten set screw.

CAUTION
During wheel installation, do not bend or smash wheel.

B. Rotate blower wheel on motor shaft to check wobble. Lightly apply a force on wheel O.D. to eliminate any wobble as necessary.

C. Apply a small bead of RTV sealant (or gasket seal if equipped) on the scroll and install the blower wheel and motor with wires in a location near the resistor wires and closest mounting screw.

D. Install all mounting screws and tighten snugly as required.

CAUTION
Do not over-torque mounting screws or thread damage may result.

E. With access through the blower outlet rotate the blower wheel to assure that no rubbing exists.

NOTE
Observe blower wheel blade and verify leading edge is in the direction of rotation.

F. Connect motor and resistor wiring as follows:

(1) CW ROTATION - Motor RED wire is spliced into resistor ORANGE wire, using wire splice. Orange wire runs straight through clamp. Motor black wire (ground) and resistor red wire also run straight through clamp (no splice).

(2) CCW ROTATION - Motor BLACK wire is spliced into resistor ORANGE wire, using wire splice. Orange wire runs straight through clamp. Motor red wire is covered with black heat shrink tube (ground) and along with resistor red wire runs straight through clamp (no splice).

NOTE
Wire color hookup is as follows:
BLACK = GROUND
ORANGE = + 28 VDC, HIGH SPEED
RED = + 28 VDC, LOW SPEED

G. Run all wires through wire clamp an secure with mounting screw and washer.

H. Connect power leads to blower assembly and test for proper operation.

I. Replace all ducting, shrouds, closures, etc. Unit is ready for operation.

21-56-05 - EXPANSION VALVE REMOVAL AND REPLACEMENT

The automatic expansion valve normally does not require replacement. However, in the unlikely event it malfunctions or has a clogged inlet, the following procedures will apply:

1. VALVE REMOVAL

A. The refrigerant system charge must be reclaimed and access to the expansion valves must be achieved.

B. Remove valve inlet tubing and remove valve from coil header tube.

CAUTION
Eye and hand protection should be worn in the event system is still under pressure. Cap all open ports on system.

C. Inspect valve inlet for contamination and clean as required. If no contamination is noted, valve should be replaced if operation was erratic prior to removal.

CAUTION
Do not adjust internal spring setting or valve will not operate correctly.

D. Inspect valve internal works to verify that no contamination exists in the seat or orifice. Clean and purge as necessary.

2. VALVE REPLACEMENT

A. Set new valve adjustment screw to same position as failed valve.

B. Apply thread sealant to valve inlet and outlet port threads (sparingly) and apply a very small amount of refrigerant oil to both valve port flare surfaces.

NOTE
Do not put oil on fitting threads. Apply thread sealant sparingly to male fitting threads staying clear of first 2-3 threads.

C. Install valve in coil header and position as necessary. Tighten connection to 190-195 in.-lbs.

CAUTION
Use backup wrench during tightening and do not over-torque "B" nut.

D. Connect valve inlet port tubing and tighten.

E. Leak check, evacuate and charge system per Sections 21-51-00 & 21-52-00.

F. Operate system and verify valve is performing correctly. Adjust valve, if necessary per Section 21-53-00.

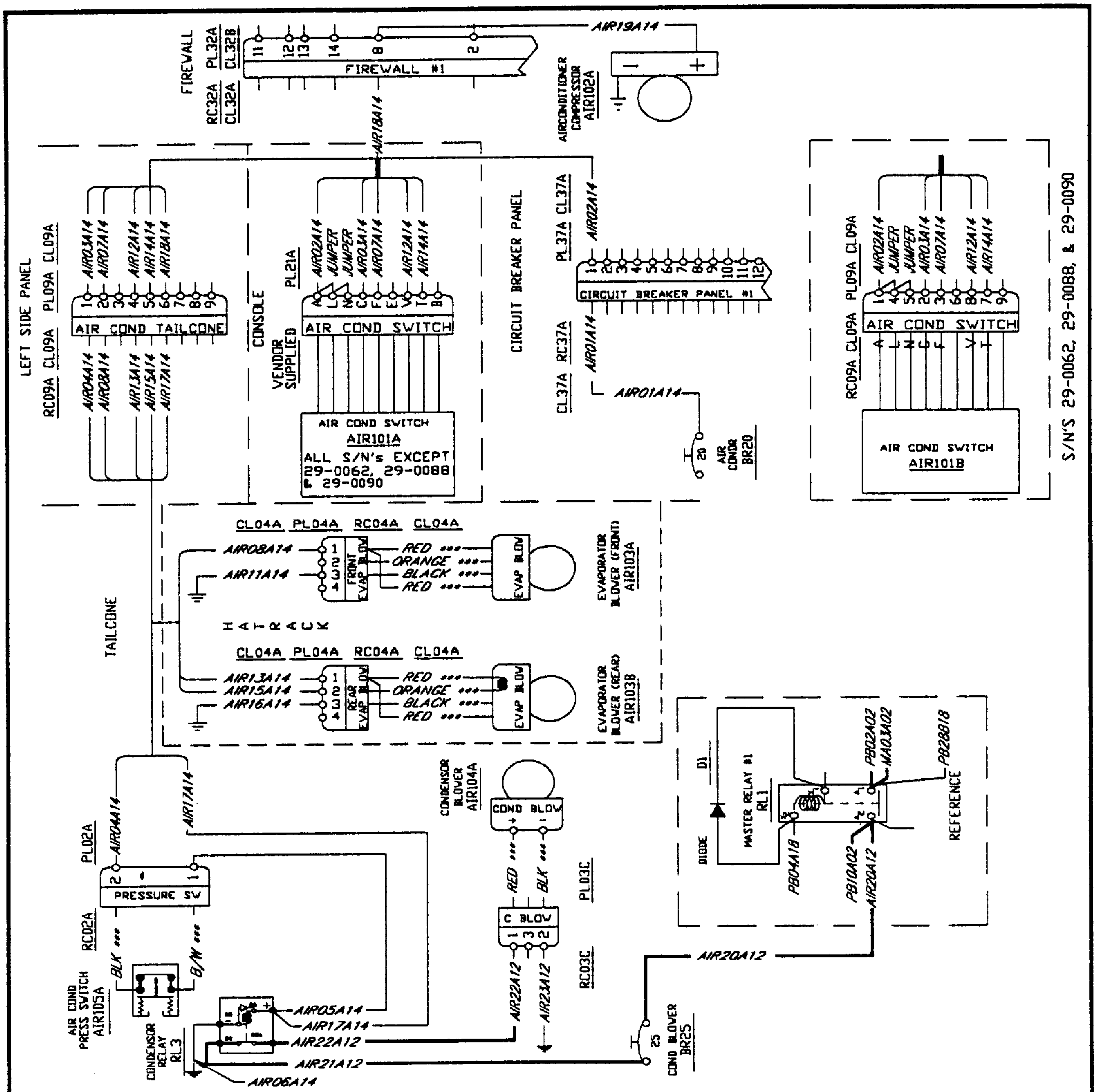

FIGURE 21-1 ELECTRICAL SCHEMATIC - AIRCONDITIONING SYSTEM

ALSO SEE FIGURE AS HORIZONTAL (NEXT)
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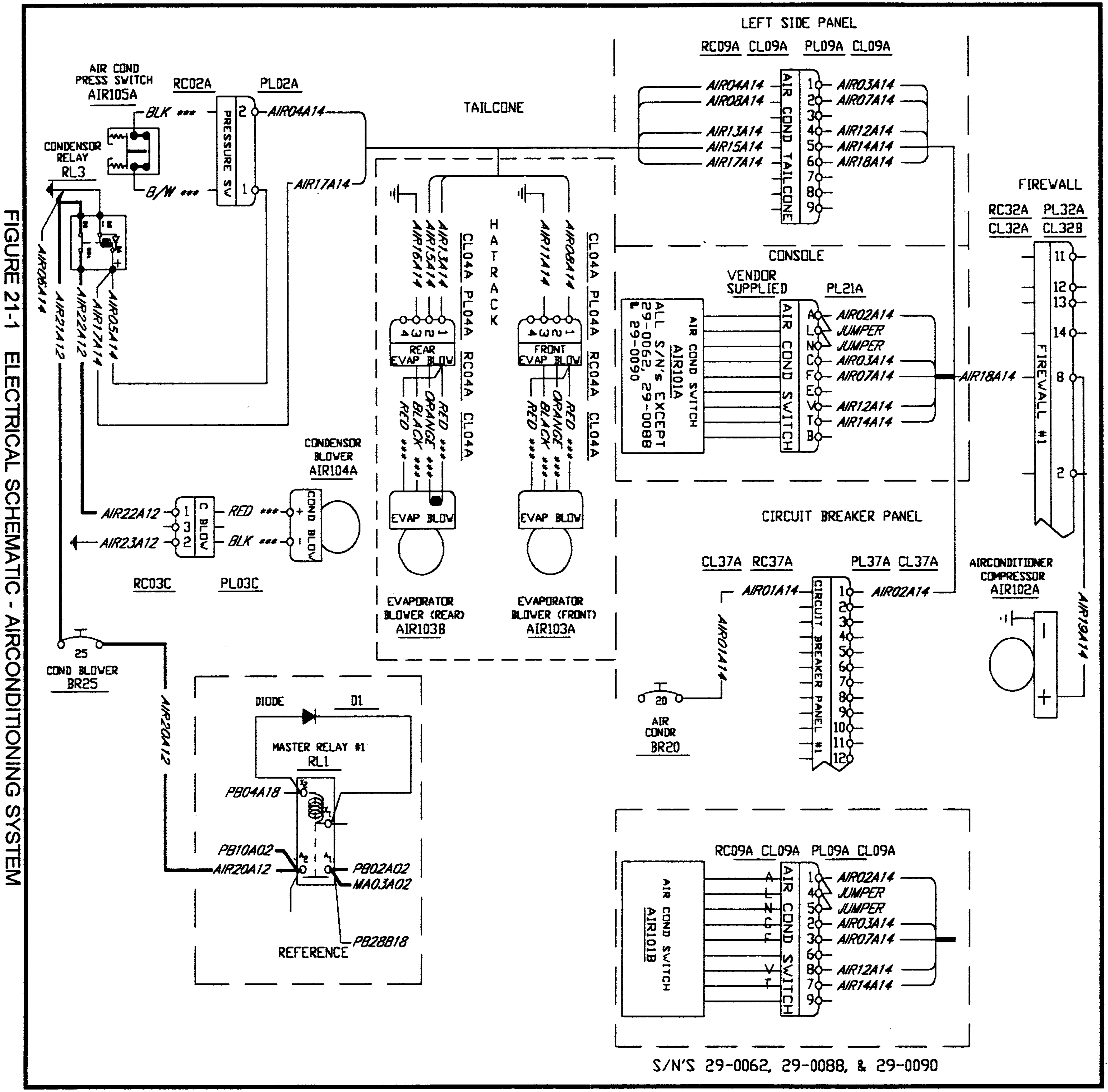

FIGURE 21-1 ELECTRICAL SCHEMATIC - AIRCONDITIONING SYSTEM

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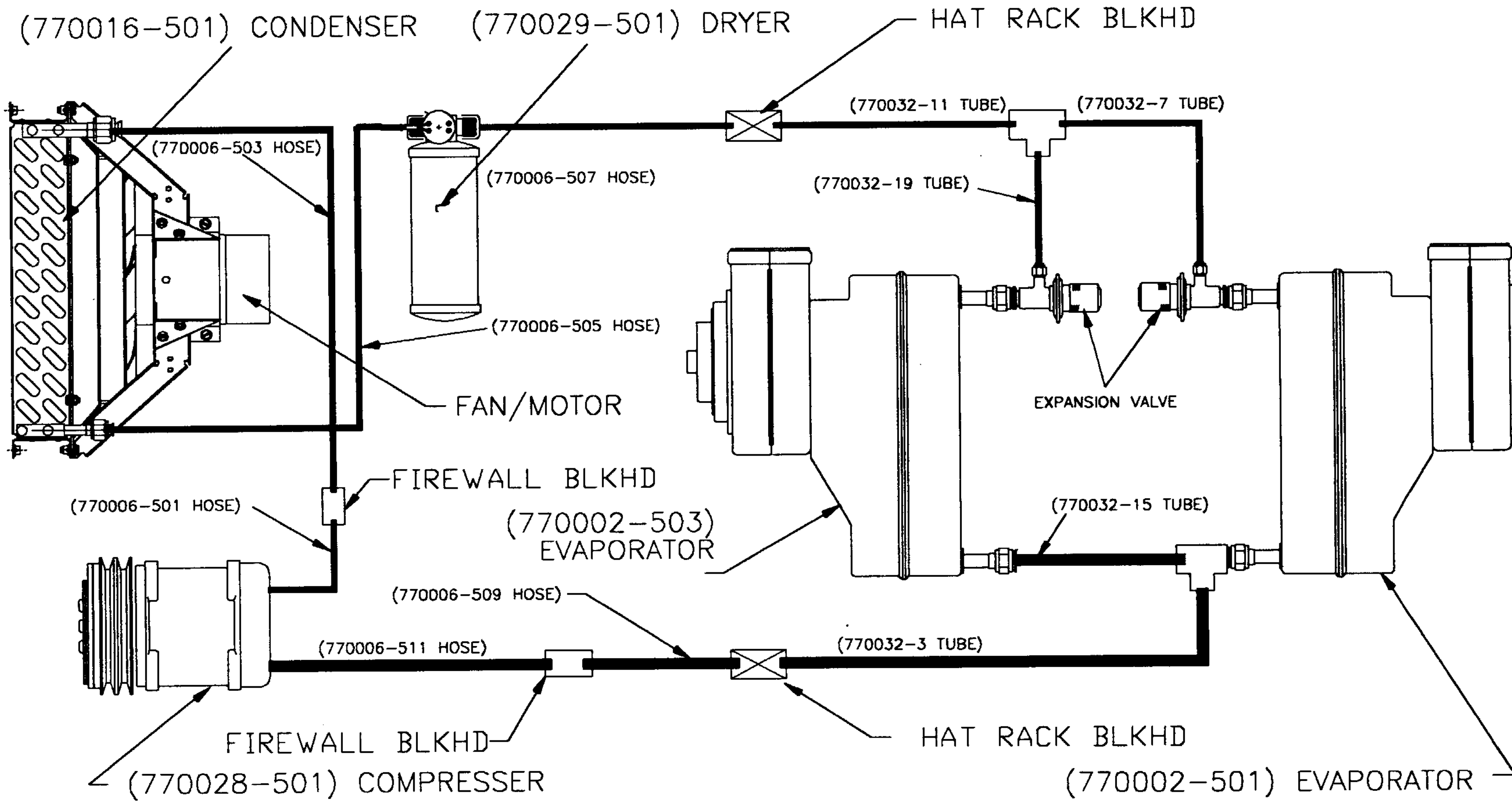

FIGURE 21-2 PLUMBING SCHEMATIC - AIRCONDITIONING SYSTEM

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21-57-00 TROUBLESHOOTING R-134a AIRCONDITIONING SYSTEM

There may be a time when the system does not operate and/or perform in accordance with information contained herein. Therefore, it is necessary for the service personnel to diagnose the discrepancy by troubleshooting the system and its components. To assist in this diagnosis the following troubleshooting list is provided.

NOTE

Refer to electrical and refrigerant schematics, Figure 21-1 and Figure 21-2 respectively.

INDICATION	PROBABLE CAUSE	POSSIBLE SOLUTION
A. No system power	1. Ground power not connected	1. Plug in ground power cart
	2. Aircraft power switch OFF	2. Energize power switch
B. Power ON but system will not operate	1. Aircond. control CB OFF	1. Energize air conditioning C/B
	2. Aircond. CB failed	2. Replace
	3. Aircond. mode SW failed	3. Replace
	4. Relay(s) failed	4. Replace
	5. Failed pressure switch	5. Replace
	6. Failed power contactor	6. Replace
	7. Failed drive motor	7. Replace
	8. Vented system	8. Pressure check, evacuate & charge
	9. Low ambient temperature	9. Normal cutout function
	10. Drive motor fuse blown	10. Replace
	11. Drive motor temp. SW failed	11. Replace switch
	12. Contactor control line fuse blown	12. Replace fuse
C. System operates but does not cool	1. Low refrigerant charge	1. Charge as necessary
	2. Overcharged system cutout	2. Reclaim refrigerant as necessary
	3. Failed compressor	3. Replace
	4. Failed drive motor	4. Replace
	5. Broken belt	5. Replace
	6. Failed expansion valves(s)	6. Replace
	7. Evap. blower switch failed	7. Replace
	8. Evap. blower(s) motor failed	8. Replace
	9. Evap. blower(s) relay failed	9. Replace
	10. Evap. blower(s) C/B - OFF	10. Replace
	11. Relay(s) failed	11. Replace
	12. Evap. module air inlet clogged	12. Remove debris
	13. Exh. valve inlet clogged	13. Remove debris
	14. Excessive moisture in system	14. Replace rec-dryer assy
	15. Excessive oil in system	15. Drain excessive oil
D. Evaporator noisy	1. Wobbly blower wheel	1. Replace
	2. Blower wheel hitting scroll	2. Align
	3. Defective blower motor bearing	3. Replace motor
	4. Loose mounting bracket	4. Tighten
	5. Air inlet clogged	5. Remove
E. Compressor/Condenser Module noisy	1. Loose drive belt	1. Re-tension
	2. Drive belt hitting cover	2. Re-align belt & adjust brkts.
	3. Motor fan hitting shroud	3. Adjust as necessary
	4. Defective compressor	4. Replace
	5. Defective drive pulley	5. Replace
	6. Loose pulley	6. Tighten or replace
	7. Loose mounting hardware	7. Tighten as necessary
	8. Loose hose assembly	8. Secure as necessary
	9. Loose fan blade	9. Tighten or replace

TROUBLESHOOTING (con't.)

INDICATION	PROBABLE CAUSE	POSSIBLE SOLUTION
F. No low evaporator fan speed (hi speed OK)	1. Failed switch 2. Failed resistor 3. Failed relay	1. Replace 2. Replace 3. Replace
G. Compressor/Condenser will not operate	1. C/B failed or OFF 2. Relay(s) failed 3. Pressure switch failed 4. Power contactor failed 5. Low ambient temperature 6. Low refrigerant charge 7. Motor temperature SW failed	1. Turn ON or replace 2. Replace 3. Replace 4. Replace 5. Normal 6. Re-charge system 7. Replace switch
H. No evaporator module air flow	1. C/B OFF 2. C/B failed 3. Mode SW failed 4. Fan speed SW failed 5. Seized motor(s) 6. Blower wheel failed 7. Blocked air outlet duct 8. Blocked air inlet duct 9. Aircraft power not ON 10. Motor temperature SW failed	1. Turn ON 2. Replace 3. Replace 4. Replace 5. Replace 6. Replace 7. Remove debris 8. Remove debris 9. Turn ON 10. Turn ON
I. Evaporator module coil freesing	1. No air flow 2. Expansion valve failed or clogged 3. Expansion valve setting low	1. Turn fan ON 2. Remove debris or replace 3. Reset to obtain 26-30 PSIG suction pressure
J. Pressure switch cycles (high pressure cutout)	1. System over charged 2. Condenser coil inlet air extremely hot 3. Condenser inlet clogged 4. Discharge line clogged or kinked 5. Excessively high ambient temperature	1. Reclaim refrigerant as required 2. Normal condition 3. Remove debris 4. Replace or unkink hose 5. Normal condition

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NOTE

The above system and component failure and/or abnormal operation and possible solutions are only a partial listing of what may occur. The more informed the service personnel are in the operation of the system and its various components will reduce the time to diagnose failures and may add other probable causes to the above list.

21-58-00 - COMPONENT INSPECTION, SERVICING AND/OR MAINTENANCE SCHEDULES.

1. SCHEDULED MAINTENANCE TABLE

CHAPTER 5 normally lists the maintenance/replacement time frames for components. However, since specific air conditioning components have sub-component listings, these components are listed on following page:

TYPE MAINTENANCE	SERVICE HOURS
COMPRESSOR ASSEMBLY (R-134a)	
Leak check, shaft seal	500-800
Bearing inspection.	1000-1500
Bearing replacement	On Condition
Oil level check	On Condition
ATTACHMENT BRACKET/HARDWARE	On Condition -- Inspect @ 100 Hrs.
COMPRESSOR DRIVE BELT	
Visual inspection	500-800
Tension & alignment	800-1000
Replacement	On Condition
RECEIVER-DRYER ASSEMBLY	
Refrigerant charge level	500-800
Replacement	1000-1500 or after compressor failure/line rupture
EXPANSION VALVE	
Adjustment	As Required
Replacement	On Condition
EVAPORATOR BLOWER MOTOR	
Brush inspection	None
Brush replacement	Not replaceable
Service Life.	1500-2000
POWER CONTACTOR	
Inspection	1000
Replacement	On Condition
CONDENSER/EVAPORATOR COIL	
Inspection	500-800
Replacement	On Condition
PRESSURE SWITCH	
Calibration check	1000
Replacement	On Condition
REFRIGERANT SYSTEM	
Performance check.	500-800
Visual inspection	500-800

2. AIR CONDITIONING SYSTEM "OFF SEASON" FUNCTIONAL TESTS

During cold winter months, the system should be operated for a minimum of 15 minutes every two weeks to maintain a thin film of oil on the compressor drive shaft dynamic seal to prevent leakage.

NOTE

If ambient temperature is below 32° F (0° C) the pressure switch may require an electrical jumper to allow the compressor drive motor power contactor to erergize and enable system to operate.

CAUTION

Extended operation of the system at low ambient temperatures could result in major damage of the R-134a compressor.

21-59-00 - SERVICE PRECAUTIONS

1. Refrigerant handling

Always wear eye and hand protection when servicing an airconditioning system. Liquid refrigerant can cause frostbite and/or blindness.

2. Recovery of refrigerant

Do not discharge R-134a refrigerant into the atmosphere. Although its ozone depletion potential is zero, it can have an effect on global warming. In the United States, recovery and recycling are mandated by the Clean Air Act.

Refrigerant recovery/recycling service equipment must be approved for use with R-134a refrigerant. Recycling machines must be approved by Underwriters Laboratories and meet SAE standard J2210 and SAE standard J2099 for refrigerant purity.

3. Ventilation

Keep refrigerants and oils away from open flames. Refrigerants can produce poisonous gasses in the presence of a flame. Work in a well ventilated area nad avoid breathing refrigerant/lubricant vapor mist if accidental discharge occurs.

4. Avoid use of compressed air

Do not introduce compressed air or oxygen into an airconditioning system or refrigerant container. R-134a in the presence of air or oxygen above atmospheric pressure may form a combustible mixture.

BLANK

CHAPTER 24

ELECTRICAL POWER

CHAPTER 24

ELECTRICAL POWER

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CHAPTER 24

ELECTRICAL POWER

LIST OF EFFECTIVE PAGES

24-00-00 - GENERAL

A 28 volt, 100 AMP alternator utilizing a transistorized voltage regulator/over voltage control supplies electrical power. Two 24 volt, 10 AMP HR storage batteries are installed in the tailcone. The alternator, during normal operation, supplies power in conjunction with the selected battery when the Master Switch and Alternator Field Switch is - ON. The circuit breaker panel is on the right subpanel. The electrical system is capable of supplying current for simultaneous operation of multiple radios, anti-collision lights and navigation lights.
A shunt type ammeter (with PUSH for VOLTS) is located on instrument panel.

24-30-00 - D.C. GENERATION

24-31-01 - ALTERNATOR CHARGING SYSTEM MAINTENANCE

1. Alternator Systems Servicing.

When the ammeter shows a discharge at higher RPM, a charging system component (alternator, voltage regulator, circuit breaker or wiring) is malfunctioning. On-the-plane testing should identify which component(s) may be faulty and needs to be removed from the aircraft for bench test and subsequent repair or replacement.
The alternator charging system requires no special attention; however, improper maintenance procedures can damage the alternator and wiring. There are several precautions that must be observed when servicing the alternator system:

A. Be sure the Master Switch is OFF when repairing the alternator or voltage regulator.

B. When auxiliary power or a booster battery is used, be sure cables are connected correctly—positive to positive and negative to negative. DO NOT by-pass the batteries when using Auxiliary Power Source.

NOTE
It is recommended that the approved Auxiliary Power Cable be connected to the booster battery and the plug inserted into the auxiliary power receptacle.

C. When either battery is removed from the aircraft for charging, be sure that the charger is correctly connected. Use the correct charging rate when charging battery, refer to manufacturer's procedures. It is possible to reverse the polarity of a battery by connecting a charger backwards.

CAUTION
Both batteries MUST BE in aircraft for flight.

D. Be sure to check battery polarity by using a voltmeter prior to reinstallation into the aircraft.

E. Do not leave Master Switch "ON" when aircraft is parked.

F. Use an auxiliary ground power unit when trouble shooting electrical accessory equipment or when performing electrical landing gear maintenance and retraction system testing.

2. Alternator System Inspection.

A. Check alternator circuit breaker on the main circuit breaker panel. Reset breaker, if open.

B. Check alternator field circuit breaker on main circuit breaker panel. Reset, if open.

C. Inspect batteries for corroded cable connections; remove and clean cable(s) if corrosion is found.

D. Check charging system wiring and connectors to be sure they are clean and tight.

E. Inspect alternator, voltage regulator, and wiring for damage.

CAUTION
DO NOT ATTEMPT TO POLARIZE ALTERNATOR. Alternator is polarized every time Master Switch is turned ON.

3. Alternator Removal and Installation.

A. Alternator Removal.

(1) Turn Master Switch OFF. Disconnect alternator wiring.

(2) Remove forward, lower baffle below alternator.

(3) Remove attaching hardware and pull alternator drive gear from engine pad.

B. Alternator Installation.

(1) Be sure Master Switch is turned - OFF. Do not turn Master Switch ON until all wiring connections have been secured.

(2) Insert alternator into engine accessory drive pad. Install attaching hardware.

(3) Connect alternator wiring and check wiring connectors throughout system.

(4) Reinstall forward, lower baffle below alternator.

24-31-02 - VOLTAGE REGULATOR MAINTENANCE

The battery charging rate depends upon the battery condition and the voltage regulator setting. With all equipment turned off and the engine running at 2000 RPM or faster, the normal battery charging rate will be 5 to 35 amperes.

1. Excessively **High Charging Rate**. Check the following:

A. Fly aircraft for 15 to 20 minutes; charging rate should slowly drop to 10 amperes or less. A very low battery will take longer to show a drop in charging current.

B. Measure voltage with a voltmeter connected to the bus. At 80° F., voltage should be 27.5 to 31.8 volts. An excessively high voltage regulator setting will cause excessive battery heating and water loss.

2. **Low Charging Rate.** Check battery charging rate (normal rate is not to exceed four amperes). The regulator should not be considered defective because of a low charging rate until:

A. A voltmeter check indicates that voltage at the bus is below requirements.

B. A battery hydrometer check indicates that battery is not fully charged.

3. Hydrometer Reading. If battery electrolyte temperature is below 80° F., subtract four points from hydrometer reading for every 10° F. below 80° F. If battery acid temperature is above 80° F., add four points to hydrometer reading for every 10° F. above 80° F.

= -**EXAMPLE**- =

Hydrometer reading = 1.260
Battery electrolyte temperature = 30° F.
80° - 30° = 50°
5 x 4 = 20 points
Corrected reading 1.260 - 20 = 1.240

HYDROMETER READING	PERCENT OF CHARGE
1.280	100
1.250	75
1.220	50
1.190	25
1.130 or below	Very little useful capacity - Discharged.

= =

Voltage Regulator Adjustment/Alignment.

1. Build test set per Figure 24-1A & material list on next page.
2. Remove Voltage Regulator from aircraft.
3. Drill rivets out to open case to gain access to circuit board for following alignment procedures.
4. Connect test set to Power Sources (See Fig. 24-1A).
5. Connect regulator connector to test set plug. Connect test set clip 1 to voltage regulator C/B TP1. Unsolder jumper between TP1 & TP2 (See Fig. 24-1A).
6. Connect test set clip 2 to regulator TP3.
7. Turn power sources ON. Adjust sense voltage to 28.3 +.2/-0 volts with sense & field switches - ON.
8. Adjust R1 on regulator board, until FLD light on test set just extinquishes. Reduce sense voltage to approximately 27 volts, slowly increase voltage, observe voltage shown when field light extinquishes. Voltage should be 28.3 +.2/-0 volts. If not, repeat adjustment on R1 until voltage is within above tolerance.
9. Adjust sense voltage to 32 +/-.2 volts. Adjust R19 on voltage regulator board until OV light on test set just illuminates. Reduce voltage to 31 volts (OV light should extinguish). Slowly increase voltage, observe voltage when OV light on test set illuminates. Voltage should be 32 +/-.2 volts.
10. Adjust sense voltage to 31 volts; while slowly increasing voltage, verify SCR Trip indicator (light emmiting diode), on test set, illuminates when OV light illuminates. Reduce sense voltage to 27.5 +/-.5 volts; turn FLD Switch OFF; OV light should illuminate. Turn FLD Switch ON and turn Sense Switch OFF. FLD light should extinguish.
11. Turn sense and field switches ON. Adjust sense voltage to 27.5 +/-.5 volts. Press Overcurrent Switch (S3); SCR Trip indicator light should illuminate.
12. Turn all power OFF. Remove clip 1. Reconnect jumper between TP1 and TP2. Solder jumper connections.
13. Turn all power ON. Set sense voltage to 27.7 +/-.f5 volts. FLD light should illuminate. Press Overcurrent Switch (S3); OV Trip lights should illuminate and stay ON after releasing Overcurrent Switch. Turn Field Switch OFF, then ON, OV Trip lights should extinquish. Increase sense voltage to 33 volts. OV Trip lights should illuminate at approximately 32 volts. Reduce sense voltage to approximately 31 volts and verify OV Trip lights are still illuminated. Turn Field Switch OFF, then ON. OV Trip lights should extinquish.
14. Adjust sense voltage to 27.7 +/-.5 volts. FLD light should illuminate. Turn FLD Switch OFF, FLD light should extinquish and OV light illuminate.
15. Turn all switches and power OFF. Alignment is completed.

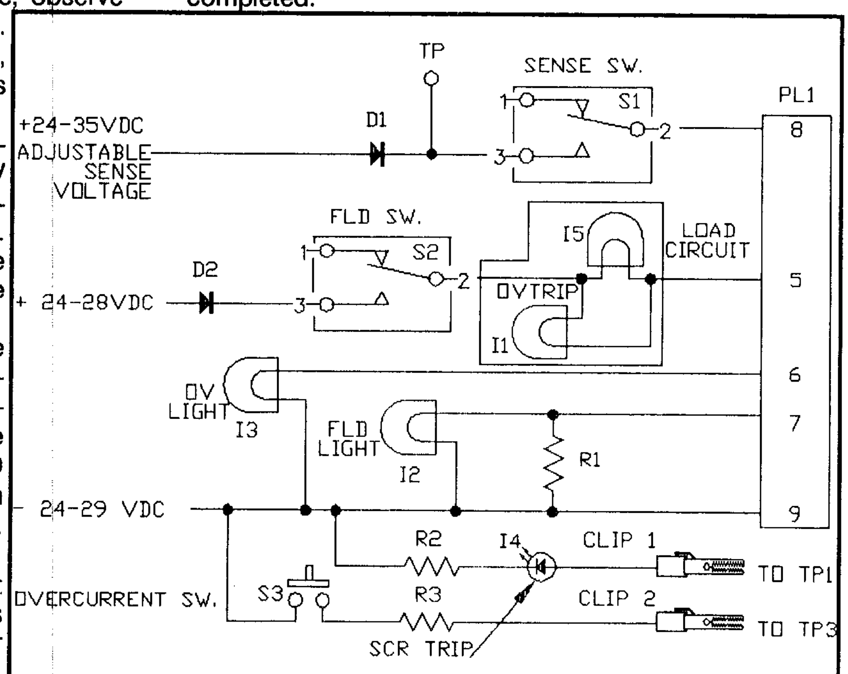


FIGURE 24-1A - TEST FIXTURE FOR VOLTAGE REGULATOR ALIGNMENT

MATERIAL LIST FOR
BUILDING TEST SET

D1=DIODE, 1N2483
D2=DIODE, 10H3P
S1=SW., MST205N(ALCO)
S2=SW., MST205N(ALCO)
S3=SW., MSPS-103C-2
I1,I2 & I3=BULB #327
(SOCKET IN SLOANE 855S-O-U)
I4=SPC TECH LD-R-4-WW
I5=#1818, PARALLEL IN SPC TECH LSL-11-128U SOCKETS(4 ea)
R1=120OHM, 1 WATT RES.
R2=820OHM, 1/4 WATT RES.
R3=1.6K, 1/4 WATT RES.
CLIP=1/2 POMONA, 4233-2

MATERIAL LIST - TEST SET

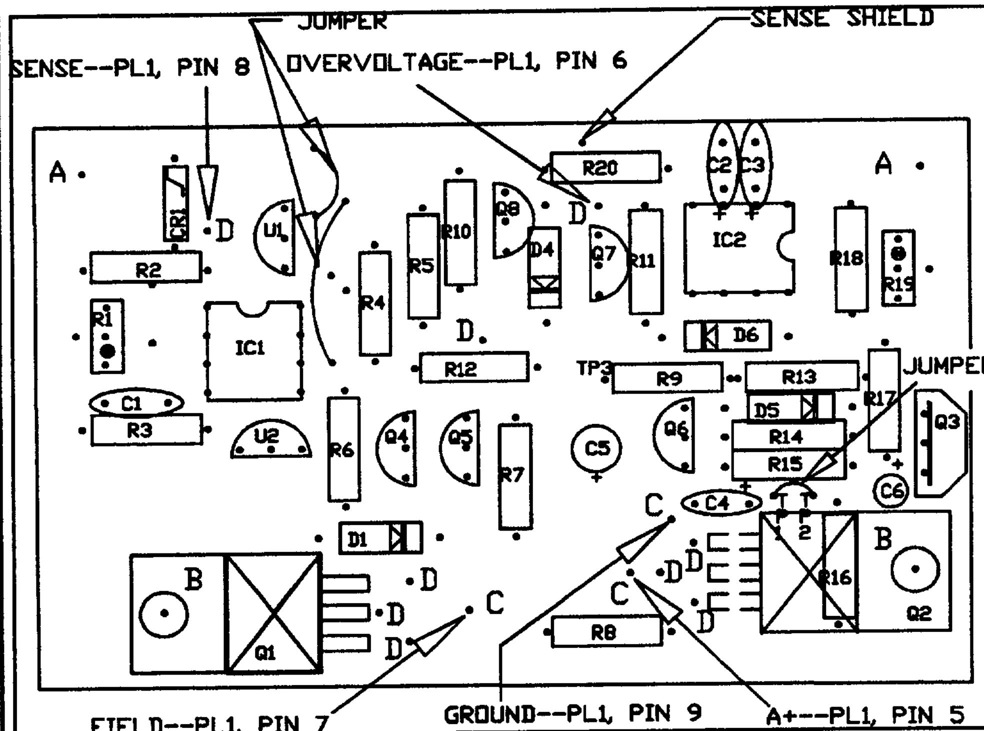


FIGURE 24-1B - VOLTAGE REGULATOR CIRCUIT BOARD/ADJUSTMENTS

24-31-03 -AUXILIARY POWER SYSTEM

An auxiliary power plug and related circuitry is installed to provide an outside source of electrical power to the aircraft (through No. 1 Battery Switch), to charge the No. 1 battery, or to start the engine. The Auxiliary Power Plug guide pin must have A+ voltage connected to it in order to activate the Auxiliary Power Relay. The No. 1 battery can be charged using the approved Auxiliary Power Cable connected to a charge cart capable of regulating the charging current. To prevent battery damage, the charging current should be low (3 - 4 amps) to begin and then increased as the battery voltage capacity is increased. The MASTER SWITCH is not required to be ON for the auxiliary power source to charge the batteries. The No. 2 battery will receive a trickle charge while the No. 1 battery is receiving the primary charging current. During flight, the non-selected battery is receiving a trickle charge from the aircraft alternator to keep it at peak voltage.

A. When auxiliary power or a booster battery is used, be sure cables are connected correctly—positive to positive and negative to negative. DO NOT by-pass batteries when using an auxiliary power source.

B. See paragraph 24-34-00, A for additional information.

NOTE

It is recommended that the approved Auxiliary Power Cable be connected to the booster battery first and the plug then inserted into the auxiliary power receptacle.

24-32-00 - BATTERY MAINTENANCE

CAUTION

Battery gases are explosive.

1. Battery Removal.

A. Turn Master Switch - OFF.

B. Remove tailcone access cover and battery hold downs.

C. Disconnect battery cables, negative lead first, remove battery from aircraft.

D. Install battery in reverse sequence of removal. Use a voltmeter to verify battery polarity before installation.

2. Battery Cleaning and Corrosion Removal.

A. Mix one pound of baking soda (bicarbonate of soda) in one gallon of water.

B. Wash battery mounting area and flush battery with mixture. Do not allow soda water to enter battery cells; permanent damage will result if soda mixes with electrolyte.

C. Rinse thoroughly with clear water; dry the area.

D. Test each cell with a temperature corrected hydrometer. Specific gravity should be 1.265 to 1.280 for a fully charged battery.

E. Check electrolyte level and maintain at split ring.

F. Clean battery terminals with emery cloth, reinstall and tighten cables. Coat terminals and connectors with petroleum jelly to retard corrosion.

24-33-00 - WARNING CIRCUITS

1. Landing gear position lights and warning horn. RED and green landing gear position lights are in the annunciator panel. The gear-down limit switch controls the GREEN gear-down light. Both limit switches control the RED gear unsafe light. The throttle control operates landing gear warning horn (intermittent tone) when the throttle is retarded to within 1/4 in. of IDLE position and the landing gear is still in the UP position. Check gear warning system during flight for proper operation.

2. Pre-stall Warning Circuit. The pre-stall warning horn has a high frequency continuous tone that sounds when airspeed drops to within 4.3 to 8.7 KIAS above stalling speed. A vane in the left wing leading edge actuates the pre-stall warning horn switch. (This vane is made of heat treated steel and any attempt to adjust switch operation point by bending the vane will damage the switch). Refer to Section 27-93-00 for adjustment procedures.

3. High and Low Vacuum Warning Circuit. A switch in the vacuum system controls the vacuum warning light on the annunciator panel. Vacuum below 4.25 IN. Hg. causes the vacuum warning light to FLASH. Vacuum above 5.5 IN. Hg. trips the high-vacuum switch causing the vacuum warning light to illuminate steadily.

4. Low Fuel Warning Circuit. The low fuel indicators will illuminate when a minimum of 2 1/2 gallons usable fuel remains in either left or right hand tank. When it becomes necessary to replace the annunciator panel for any reason other than "low fuel" warning malfunction, the following procedure should be used to set the "low fuel" warning circuits. The calibration transfer standard (I.A.I., P/N 9500324000) is required for this procedure. Adapters can be ordered through Mooney Service Parts through any Mooney Service Center.

A. Calibration Procedures using I.A.I., P/N 9500324000.

(1) Remove glareshield, disconnect plug from rear of annunciator, remove annunciator front panel, and place "Norm-Cal" switch in "CAL" position.

(2) Plug, P/N 9500324000, calibration transfer standard to rear of old annunciator and reconnect harness plug.

(3) Turn Master Switch ON and turn right hand variable resistor on transfer standard slowly counter clockwise until right "low fuel" light just turns on. (If necessary turn variable resistor clockwise to extinguish "low fuel" light). (Do not adjust annunciator calibration screws). Repeat for left "low fuel".

(4) Turn Master Switch OFF and remove old annunciator assembly after disconnection of harness and transfer standard unit.

(5) Install new annunciator and connect calibration transfer standard to annunciator panel and harness plug. Remove front plate and legend on new annunciator panel to expose the NORM-CAL switch and the Left and Right trim potentiometers. (Switch must be in "CAL" position).

(6) Adjust left and right annunciator fuel calibration screws clockwise (not the adapter variable resistors) until "low fuel" lights just turn - ON. (If necessary turn annunciator calibration screw counter clockwise to extinguish "low fuel" light).

(7) Remove calibration transfer standard, reconnect plug to annunciator panel, set switch to "NORMAL170 position, install annunciator front panel and install glareshield.

B. Alternate method for calibration without I.A.I. unit.

If calibration transfer standard, P/N 9500324000, is not available use the following method to calibrate "low fuel" warning:

(1) Remove glareshield and remove annunciator assembly.

(2) Install and connect new annunciator assembly leaving front panel off. (Set switch to "CAL").

(3) Drain fuel from tanks and replace with unusable fuel, plus 2 1/2 gallons in both tanks.

(4) Turn Master Switch ON and adjust calibration pots to position where "low fuel" lamps just turn on for left and right tanks.

(5) Turn Master Switch - OFF, set annunciator "CAL" switch to "NORM" position, install annunciator front and install glareshield.

(6) Refuel aircraft.

5. Alternate Air Light Warning Circuit - Annunciator Panel. The light illuminates on the annunciator panel when the alternate air door has opened for any reason.

6. Hi/Low Voltage Warning Circuit - Annunciator Panel. Remove annunciator top cover. Connect a voltmeter to aircraft bus. Start engine and increase RPM until flashing "VOLTS" light extinguishes. (This should be above 26.6 volts). Add load, such as Pitot Heat & Nav. Lights. Slowly decrease RPM while monitoring voltage until light begins to flash. This should occur between 26.6 & 26.4 volts. Adjust trim pot as necessary to obtain desired result.

NOTE

It may be necessary to adjust trim pot to turn out light at 26.5 volts first. Increase RPM. until light goes out and note voltage. Decrease RPM until light flashes on and note voltage. Light should come on between 26.4 and 26.6 volts.

24-34-00 - POWER PLANT CIRCUITS

1. Starter-Ignition Circuit. The starter-ignition switch has five positions: OFF, R (right), L (left), BOTH, and START. In the OFF position both magnetos are grounded. At the R position the left magneto is grounded. At the L position the right magneto is grounded. At the BOTH position both magnetos are HOT and the ignition system is ON. Turning the ignition switch to start and pushing IN, closes the starter solenoid, engages the starter and allows the impulse coupling to automatically retard magneto until the engine is also at its retard firing position. The spring action of the impulse coupling is then released to spin the rotating magnet and produce the spark to fire the engine. After engine starts, the impulse coupling flyweights do not engage due to centrifugal action. The coupling then acts as a straight drive and the magneto fires at the normal firing position of the engine. The starter-ignition switch is spring loaded to return from START to the BOTH position, when released.

WARNING

Do not turn the propeller when the magnetos are not grounded. Ground the magneto points before removing switch wires or electrical connectors. All spark plug leads can be removed as an alternate safety measure.

CAUTION

Do not operate starter in excess of 15 seconds or re-engage starter without allowing it time to cool.

A. **LOW BATTERY STARTING PROCEDURE.**

A battery that has been discharged to the point where it will not turn the engine over but has sufficient power remaining for other equipment; should NOT have the engine jump started with another power source for two major reasons:

(1) The discharged aircraft battery is not airworthy because it will not have the necessary reserve capacity required to operate the aircraft electrical system and avionics in the event of failure of the charging system during flight.

(2) Active material on the positive plate expands when the battery is discharged and the fast recharge from the higher potential source, battery, altemator, rectifier, etc., will severely damage the battery. A slow charge is recommended prior to flight.

The M20R has a second battery that may be selected as the primary battery for a particular flight. The battery not being utilized will be recharged by a trickle charge from the aircraft altemator's charging system. Therefore, if only one battery is discharged to the point that it will not start the engine the other battery may be selected and the flight continued.

2. Oil and Cylinder Head Temperature Gauge Circuits. Both the oil and cylinder head temperature indicators operate electrically. The oil temperature gauge circuit has a resistance bulb in the oil cooler adapter adjacent to the vern-a-therm valve. Changes in resistance caused by changes in oil temperature alter current flow rate, thereby varying the magnetic field in the indicator coils. The cylinder head temperature indicator connects to a tip sensitive resistance bulb in a cylinder head, normally No. 2 cylinder. Increase or decrease in temperature causes an increase or decrease in bulb resistance, varying the magnetic field in the indicator coils.

3. The oil pressure instrument circuit contains an electrical instrument and a transducer which varies resistance with pressure.

4. Fuel Flow read on the indicator uses an electrical instrument which counts electrical pulses produced by a turbine type fuel flow transducer.

24-35-00 - LIGHTING CIRCUITS

1. Navigation Lights. A circuit breaker/switch on the forward O/H panel controls navigation lights.

2. Landing/Taxi Lights. A pair of split switches on the forward O/H panel control left and right landing and taxi lights located in the wing's leading edge.

3. Cabin Lights. A three-position (Bright, Off, Dim) rocker switch, located in arm rests of side panels, beside each occupant, controls cabin lights.

4. Strobe Lights. A circuit breaker/switch on forward O/H panel controls the white anti-collision strobe lights.

5. Rotating/Flashing Beacon Light. A circuit breaker/switch on forward O/H panel controls optional beacon.

6. Recognition Lights. A circuit breaker/switch on forward O/H panel controls optional recognition lights.

7. Instrument and Radio Lights. Switches are located on the lower co-pilot's control panel for the glareshield and radio lights. The glareshield rheostat also controls the compass light. Lighting is controlled by turning rotary rheostat switch(s) to intensify or dim either light system.

8. Baggage Compartment Lights. A two-position (ON, OFF) rocker switch on forward face of hatrack panel controls this light.

CAUTION

The cabin and baggage interior lights are not connected to the Master Switch circuitry and can be operated with Master Switch in the - Off - position. Care must be exercised to prevent leaving switch(es) ON and discharging one of the batteries.

7. Map Light. A switch/rheostat on top of control wheel controls the map light and brightness. The co-pilots map light is optional.

24-36-00 - LANDING GEAR CIRCUITS

1. Limit switches and relays operate the reversible landing gear actuator motor. A landing gear, air pressure, safety switch, actuated by pitot air pressure, prevents landing gear retraction until a safe flying speed is attained. The landing gear control switch operates actuator motor through the safety switch and relays. When the landing gear control switch is UP and a safe flying speed has been attained, the safety switch closes to activate the control relay and the actuator starts. As the gear reaches the up and locked position, a mechanical up stop opens the limit switch and the actuator stops. When landing gear control switch is placed in the DOWN position, the gear motor down-relay closes and the actuator starts. When the gear reaches the down-and-locked position, a mechanical down stop opens the limit switch and the actuator stops. The gear-up limit switch controls the landing gear un-safe light. The RED light comes on when the gear is in transit. The green light comes on when the gear reaches the down-and-locked position; the gear-down limit switch controls the green gear-down light. The GEAR DOWN annunciator light is dimmed whenever navigation lights are ON.

2. Gear Safety By-Pass Switch. The gear will not retract if airspeed above the set limit has not been attained when the gear handle is placed in the UP position. A waming hom will sound and both "GEAR DOWN" and "GEAR UNSFE" lights will illuminate. PUSH and HOLD the RED BUTTON SWITCH beside the landing gear handle until the gear is up and both lights go OUT. PULL the "GEAR CONT" or "GEAR RELAY" circuit breaker to stop waming hom. Reset circuit breaker prior to extending gear.

24-37-00 - FUEL SYSTEM CIRCUITS

The fuel system has an electric fuel boost pump. The fuel quantity indicating system is comprised of two transmitters in each fuel tank (inboard and outboard) and two fuel quantity gauges (L & R) in the instrument panel.

1. Fuel Pump Circuit. - A single, auxiliary electric boost fuel pump is controlled by two switches. The LOW BOOST switch is utilized for engine starting procedures and to purge fuel vapors from system during high temperature conditions, either heat soak conditions or high OAT.

The HIGH BOOST (guarded switch) is utilized for use if the engine driven fuel pump malfunctions and will provide sufficient fuel for partial power operation of the engine.

2. Fuel Quantity Gauge Circuits. - Changes in fuel level vary fuel quantity transmitter resistance (two in each tank work in series with each other) that operates the fuel quantity gauges. The Master Switch activates the fuel quantity indicating system. Refer to Section 28-43-00 for Adjustment Procedures.

3. Fuel Flow System - A turbine fuel flow transducer is installed in the fuel line between the engine driven fuel pump and the throttle body control of the fuel injector system. The fuel flow indicator, located on the right side of instrument panel, is sent electrical impulses from the transducer to indicate current fuel flow at a given power setting.

24-38-00 - MISCELLANEOUS CIRCUITS.

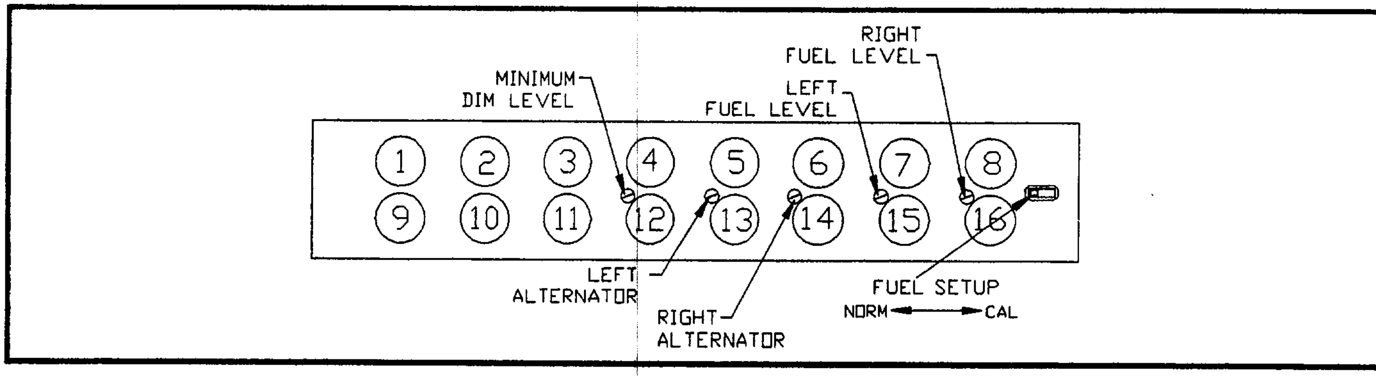
1. Turn Coordinator Circuit. The turn coordinator is a flight instrument which operates from an electrical power source.

2. Heated Pitot Tube. A circuit breaker switch controls the pitot tube heater.

3. Hour Meter. The hour meter operates from the electric tachometer. An optional Hobbs meter may be installed.

4. Cigar Lighter. A cigar lighter is mounted in the right instrument panel.

5. Current Sensor Monitor (Ref. Fig. 24-1C) Effectivity S/N 29-0132 thru 29-TBA)



CURRENT SENSOR MONITOR ADJUSTMENTS -- FIGURE 24- 1C

24-39-00 - TROUBLE SHOOTING CHARTS

24-39-01 - ALTERNATOR TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Alternator over-charges battery; battery uses excessive water.	Faulty regulator.	Check bus voltage with engine running. Observe aircraft ammeter. Ammeter should indicate near zero after ten minutes of engine operation. Replace voltage regulator if defective.
ALT FIELD circuit breaker trips.	Circuit shorted in wiring.	Disconnect lead from pin 5 of regulator, and reset circuit breaker. If circuit breaker trips, check wiring. Repair as required. If breaker does not trip, replace regulator. Reconnect lead to regulator. Turn Alternator Field & Master Switch "ON" and check for 24 volts at pin 5 of regulator. Repair wiring if no voltage is present.
ALT circuit breaker trips.	Short circuit in wiring.	Disconnect lead from "+" post of alternator, and reset ALT circuit breaker. If circuit breaker trips, check wiring between alternator and circuit breaker.
	Short circuit in alternator.	Replace lead to "+" post of alternator.

WARNING: — BE SURE MAGNETO SWITCH IS OFF WHEN TURNING PROPELLER.

TROUBLE	PROBABLE CAUSE	REMEDY
		Rotate propeller by hand to rotate alternator through 360° of travel. If circuit breaker trips, replace alternator.
Alternator will not keep battery charged.	Battery malfunction.	1. Start engine, adjust for 1500 RPM. Ammeter should indicate a heavy charge rate with all electrical equipment turned off. Rate should taper off in 1 - 3 minutes.

- ALTERNATOR TROUBLE SHOOTING (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
Alternator will not keep battery charged. (CON'T.)		A voltage check at the bus should indicate a reading of 28.6 to 28.8 volts. If charge rate tapers off very quickly and voltage is normal, check battery for malfunction. If ammeter shows a low charge rate or any discharge rate, and voltage is low, proceed to step 3.
	Defective wiring.	2. Check voltage at terminal 5, with Alt.Fld. & Master switch "ON". Meter should indicate bus voltage. If voltage is not present, check wiring between regulator and bus.
	Faulty regulator.	3. Remove connector from regulator, start engine. Momentarily jump pins 5 & 7 together on the plug. Aircraft ammeter should show heavy rate of charge. If heavy charge rate is observed, replace regulator. If heavy rate is not observed, proceed to step 5.

CAUTION

Pull Alternator Field C/B. Start engine; while at idle RPM, reset C/B. Slowly increase RPM while monitoring bus voltage. DO NOT EXCEED 28 volts .

TROUBLE	PROBABLE CAUSE	REMEDY
	Defective wiring, regulator to alternator.	4. Check resistance from Fld terminal of alternator to pin 7 of reg. plug. Normal indication is a very low resistance. If reading indicates no, or poor continuity (high resistance), repair or replace wiring from regulator to alternator.
	Defective alternator.	5. Check resistance from case to field of alternator. Normal indication is 3 - 4 ohms. If resistance is high or low, repair or replace alternator. 6. Check resistance from F2 terminal of alternator to alternator case. Normal resistance is high. If resistance is low, repair or replace alternator.

24-39-02 - RESERVED

24-39-03 - BATTERY TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Discharged battery.	Battery worn out.	Replace battery.
	Improper charging rate setting.	Reset charging rate.
	Excessive discharging.	Turn off some equipment when alternator is not charging. Decrease starter usage by using external power, whenever possible.
	Standing too long.	Remove and recharge battery.
	Equipment accidentally left on.	Remove and recharge battery.
	Impure electrolyte.	Replace battery.
	Short circuit (ground) in wiring.	Check wiring.
	Low charging rate.	Adjust voltage regulator.
Cracked cell jars.	Loose hold-down bracket.	Replace battery and secure firmly.
	Frozen battery.	Replace battery.
Compound on top of battery melts.	Charging rate too high.	Reduce charging rate by adjusting voltage regulator.
Electrolyte runs out of vent plugs.	Too much water added to battery and charging rate too high.	Drain battery and keep at proper level; adjust voltage regulator.

- BATTERY TROUBLE SHOOTING (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive corrosion on mounting surface.	Spillage from overfilling.	Flush area with baking soda solution.
	Leaking or clogged vent line. Charging rate too high.	Repair or clean vent line. Adjust voltage regulator.
Battery freezes.	Discharged battery. Water added and battery not charged immediately.	Replace battery. Always recharge battery for 1/2 hour following addition of water in freezing weather.
Leaking battery case.	Frozen electrolyte.	Replace battery.
Reversed battery polarity.	Cables connected backwards on battery or charger.	Battery should be slowly discharged completely, then charged correctly and tested.
Excessive water consumption in all cells.	Charging rate too high.	Correct charging rate.
Excessive water consumption in one cell only.	Cracked jar.	Replace battery.

24-39-04 - STARTER TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Motor fails to operate.	Low battery. Defective, improper, or loose wire connections.	Check and recharge battery if necessary. Refer to electrical wiring diagram and check all wiring.
	Binding, worn, improperly seated brushes or brushes have excessive side play.	Brushes should fit free in brush boxes without excessive side play. Clean binding brushes and brush boxes with a Varsol moistened cloth. A new brush should be run-in until at least 50 percent seated; however, if facilities are not available for running in brushes, seat brush by inserting a strip of No. .0000 sandpaper between brush and commutator with sanded side next to brush. Pull sandpaper in direction of rotation, being careful to keep it in same contours as commutator.

CAUTION: Do not use coarse sandpaper or emery cloth.

TROUBLE	PROBABLE CAUSE	REMEDY
		After seating, thoroughly clean brushes and commutator to prevent excessive wear. Keep motor bearing free from sand or metal particles.
Motor fails to operate (con't.).	Dirty commutator.	If commutator is rough or dirty, smooth and polish with No. 0000 sandpaper. If too rough and pitted, remove commutator and turn down. Blow out all foreign material.

- STARTER TROUBLE SHOOTING (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
	Shorted, grounded, or open armature.	Remove and replace with an armature known to be in good working order.
	Grounded or open field circuit.	Test and repair circuit if possible or replace with new parts.
Slow cranking speed.	Worn, rough, or improperly lubricated motor or starter.	Disassemble, clean, inspect, and relubricate components, replacing ball bearing, if worn.
	Same causes as listed with "Motor fails to operate."	Same remedies.
Excessive motor brush arcing.	Binding, worn, improperly seated brush or brushes have excessive side play.	Repair as outlined above.
	Dirty, rough, pitted, or scored commutator.	Clean as outlined.
Excessive motor brush wear and arcing.	Rough or scored commutator.	Remove and turn down commutator on lathe.
	Armature assembly not concentric.	Reface commutator.

24-39-05 - ANNUNCIATOR TROUBLE SHOOTING

The following is a brief operational analysis which pertains to the I.A.I. annunciator on the Mooney M20R.

1.0 GENERAL

This document is intended to be a guide to assist the service technician in understanding the theory and operation of the International Avionics, Inc. (IAI) Part Numbers, 9500326000 & 9500326001 annunciators. It is not intended to serve as a bench service aid in that the reference designator in the various Figures are not consistent with those found in the actual annunciators. Service literature is available (from International Avionics, Incorporated (IAI), 1611 N. I-35, Suite 428, Carrollton, TX 75006, telephone number (214) 446-1185) to identify the location of a particular component and the exact manner in which the components are interconnected.smr24-1b.gem

The following sections address nine (9) basic circuits which, used singularly or in multiple combinations, comprise the annunciators. These sections are as follows:

Section 2	Power Supply, with Test & Dim Switches
Section 3	Flasher
Section 4	Landing Gear Indicators
Section 5	Left and Right Low Fuel
Section 6	Hi/Lo Vac
Section 7	Alternator/Low Volts/Over Volt
Section 8	Not Used
Section 9	Typical Positive Apply W/Dim
Section 10	Typical Positive Apply W/O/Dim.

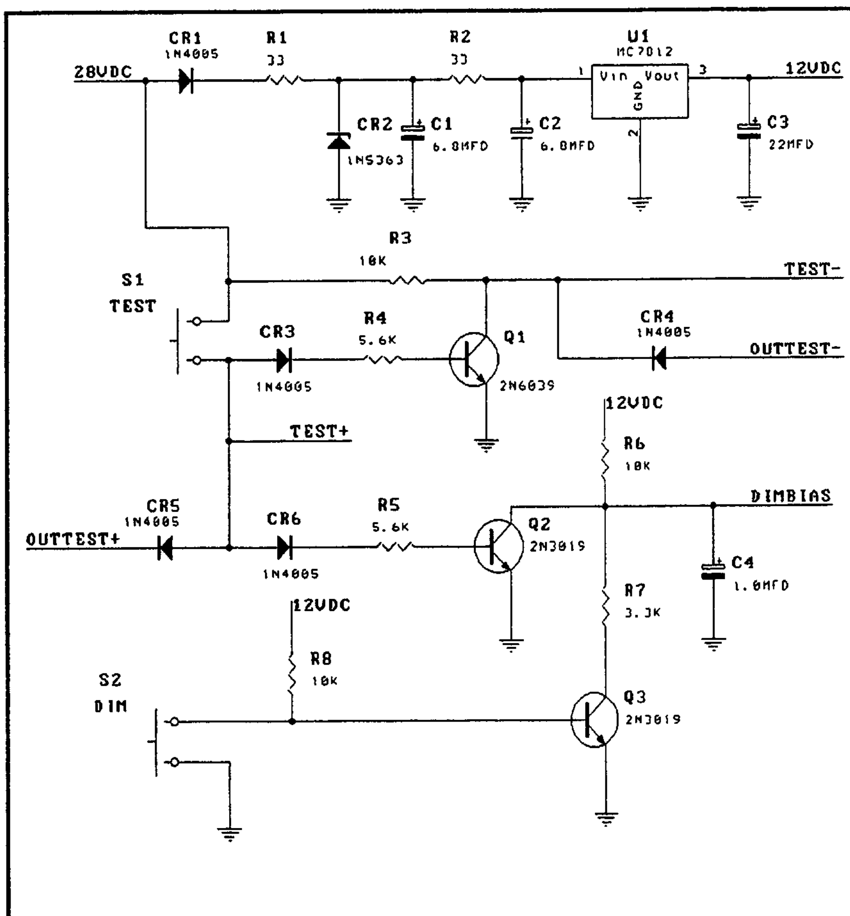


FIGURE 1 - POWER SUPPLY

2.0 POWER SUPPLY

The Power Supply, shown in Schematic Figure 1, provides 12 VDC, reverse voltage protection by means of CR1, spike and overvoltage filtering by means of the low pass network of R1, R2, C1 and C2 with spike clamping provided by CR2. The actual power supply is a 12 VDC, integrated circuit regulator. Output filtering is provided by C2.

The Test Switch, S1, switches unfiltered aircraft 28VDC to the internal test line, identified with the mnemonic "TEST+". This signal, diode isolated by CR5, is also supplied as "OUTTEST+". Additionally"TEST+" is applied to the inverter to supply the internal test line, "TEST-", and the diode isolated "OUTTEST-".

The dimmer circuit, applicable to certain channels, requires a bias source, "DIMBIAS", with a magnitude of 12 VDC to dim the applicable ACTIVE channels, approximately 3 VDC to maintain the dim level of those channels previously dimmed, and near 0 VDC to reset the dimmed channels to a bright condition. The channels having the capability of being dimmed by the above circuitry are channels 3, 4, 6, 7, 8, 14, and 15. Channel 1, Landing Gear, dims by means of a separate circuit and is discussed in Section 4.0 below. With all both the Dim Switch and Test Switch relaxed, transistor Q3 is in saturation and Q2 is off, giving "DIMBIAS" a value of approximately 9 VDC. When the Dim Switch is depressed Q3 comes out of saturation and "DIMBIAS" rises to 12 VDC, and when the Test Switch is depressed Q2 saturates and "DIMBIAS" drops to near 0 VDC. In the event that both switches are depressed simultaneously, the 0 VDC value of "DIMBIAS" will prevail and the dimmed channels, with the exception of Channel 1, are reset to a bright condition.

3.0 FLASHER

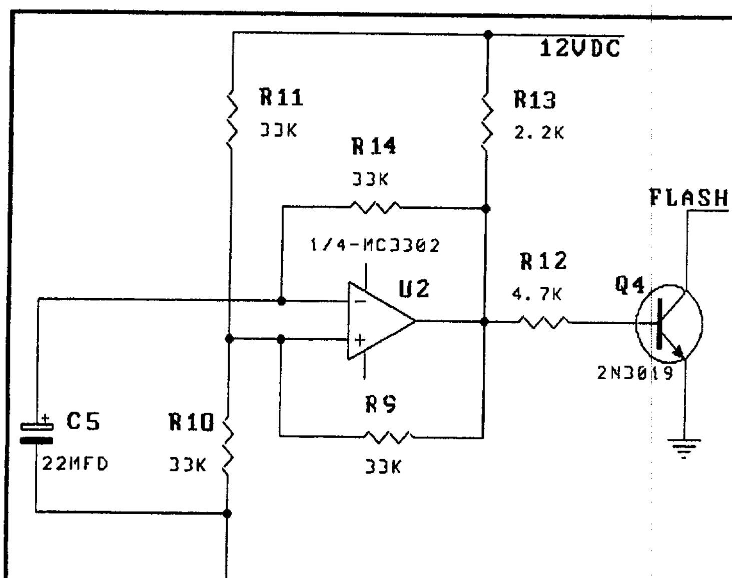


FIGURE 2 - FLASHER

The Flasher, shown in Schematic **Figure 2**, provides the circuit to flash the outputs of the left and right alternator warnings, the low voltage warning and the low vacuum warning. The flasher consists of an astable oscillator driving an NPN common emitter connected transistor, Q4. This allows the open collector of Q4, identified as **FLASH**, to sink the drive from the output amplifiers of the appropriate warning channels.

4.0 LANDING GEAR INDICATORS

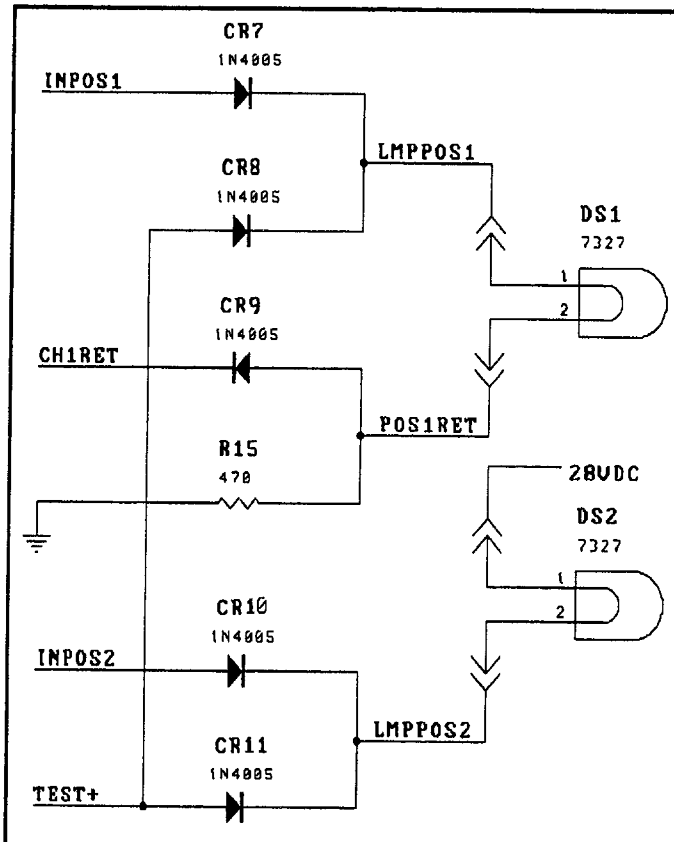


FIGURE 3 - LANDING GEAR INDICATORS

The Landing Gear Indicators, shown in Schematic **Figure 3**, provide the status of the landing gear position, that is, whether the landing gear is Down or not and whether the landing gear is safe or unsafe, unsafe being in transit. The circuit shown is the identical circuit that has been used for many years in the IAI annunciators used on Mooney aircraft. The GEAR DOWN channel is dimmed for night operation; however, in the interest of reliability, the dimming circuit is separate from the dimming technique used on the other dimmed channels. The gear down signal, +28 VDC, is applied through isolation diode CR7, to the **INPOS1** input and **CH1RET** is returned to the Nav Light bus. When +28 VDC is applied to **INPOS1** and the Nav Lights are off, the impedance of this point is very low due to the low filament resistance of the Nav Light bulbs, and GEAR DOWN illuminates at near full brilliance. When the Nav Lights are on, however, **CH1RET** is also +28 VDC and CR9 switches this return path off, the return path for the GEAR DOWN lamp being through R15 to Ground and GEAR DOWN now illuminates at reduced brilliance.

The GEAR UNSAFE channel accepts +28 VDC, **INPOS2**, through isolation diode CR10, illuminates at full brilliance and does not dim. A test signal, "TEST+" is applied to both GEAR DOWN and GEAR UNSAFE through CR8 and CR11 respectively.

5.0 LEFT AND RIGHT LOW FUEL

The Left and Right Low Fuel circuits are shown in Schematic **Figure 4.** The left and the right channels are similar, and only the left channel will be discussed herein. Signals from the junction of the left and right fuel transducers and the left and right fuel quantity gauges are applied, respectively, to each of the inputs **INPOS3** and **IN-**

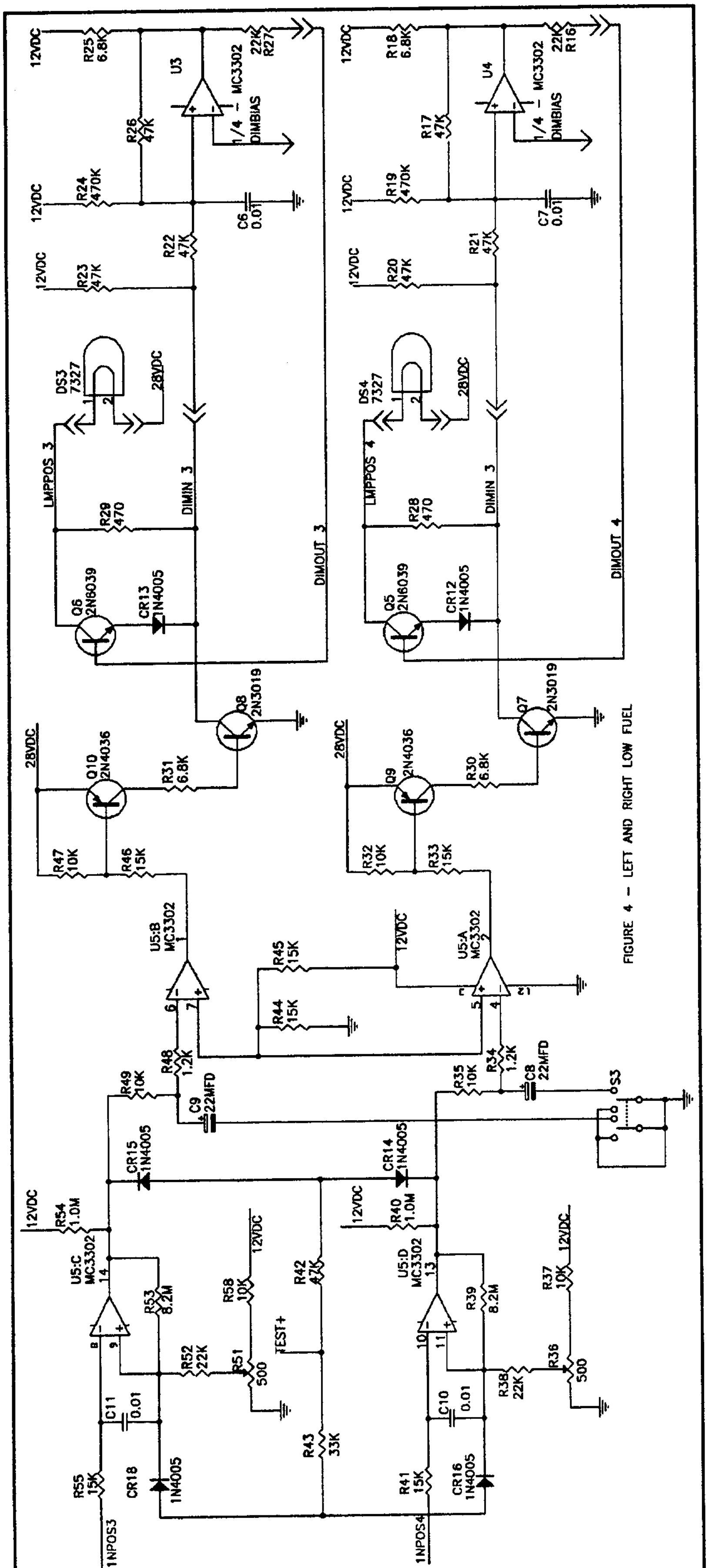


FIGURE 4 - LEFT AND RIGHT LOW FUEL

POS4. This signal is an analog signal that indicates the quantity of fuel measured, the typical low fuel point being on the order of 0.1 volt. The low fuel circuits can, however, annunciate an input up to approximately 0.7 volt.

The input, **INPOS3**, is applied through an isolation resistor R55 to the inverting input of open collector comparator U5:C. The input is compared with the set point effected by the setting of R51, accessible through the front of the annunciator, and, when the input is less than the set point, the comparator's output is allowed to rise by means of the pull-up resistor R54 and the network R48, R49, and C9. Feedback resistor R53 provides a small amount of hysterisis to preclude oscillation at the transition point. The exponentially rising output of U5:C is applied to the inverting input of open collector comparator U5:B and is compared with a reference voltage of approximately 6 VDC. When U5:B switches its output to ground Q10 conducts and drives Q8 into saturation to light the L LOW FUEL channel lamp, DS3.

The Q10 - Q8 network is required to provide the transition between the internal 12 VDC and aircraft +28 VDC. The delay provided by the charge of C9 through R48 and R49 provides filtering to preclude false annunciation in rough air. When the fuel level rises, due to sloshing in the tank and U5:C switches to a low output state, C9 is discharged rapidly through R49. The delay time of the charging network provides a delay in low fuel annunciation of approximately 20 seconds.

A test of the functioning of the low fuel channel is accomplished by applying "TEST+" through R43 - CR18 to the input of U5:C to switch U5:C and applying "TEST+" through R42 - CR15 to accelerate the charging rate of the filter C9, thus reducing the delay to approximately 2 seconds.

In order to calibrate the low fuel channel the set point, R51, is adjusted with the screwdriver adjustment accessible through the front of the annunciator while there is a preset number of gallons in the tank. The time delay must be removed from the circuit by moving S3, accessible through the front of the annunciator, from the NORMAL position to the CALIBRATE position. This opens the return for capacitor C9 and the indication on the L LOW FUEL channel will not be delayed. After calibration is accomplished, restore the time delay by moving S3 from the CALIBRATE position back to the NORMAL position. The position S3 can be determined without removing the front of the annunciator. When the TEST switch is depressed observe the indication of L LOW FUEL and R LOW FUEL. With S3 in the NORMAL position there is a delay of approximately 2 seconds in illumination, but with S3 in the CALIBRATE position there is no delay in illumination.

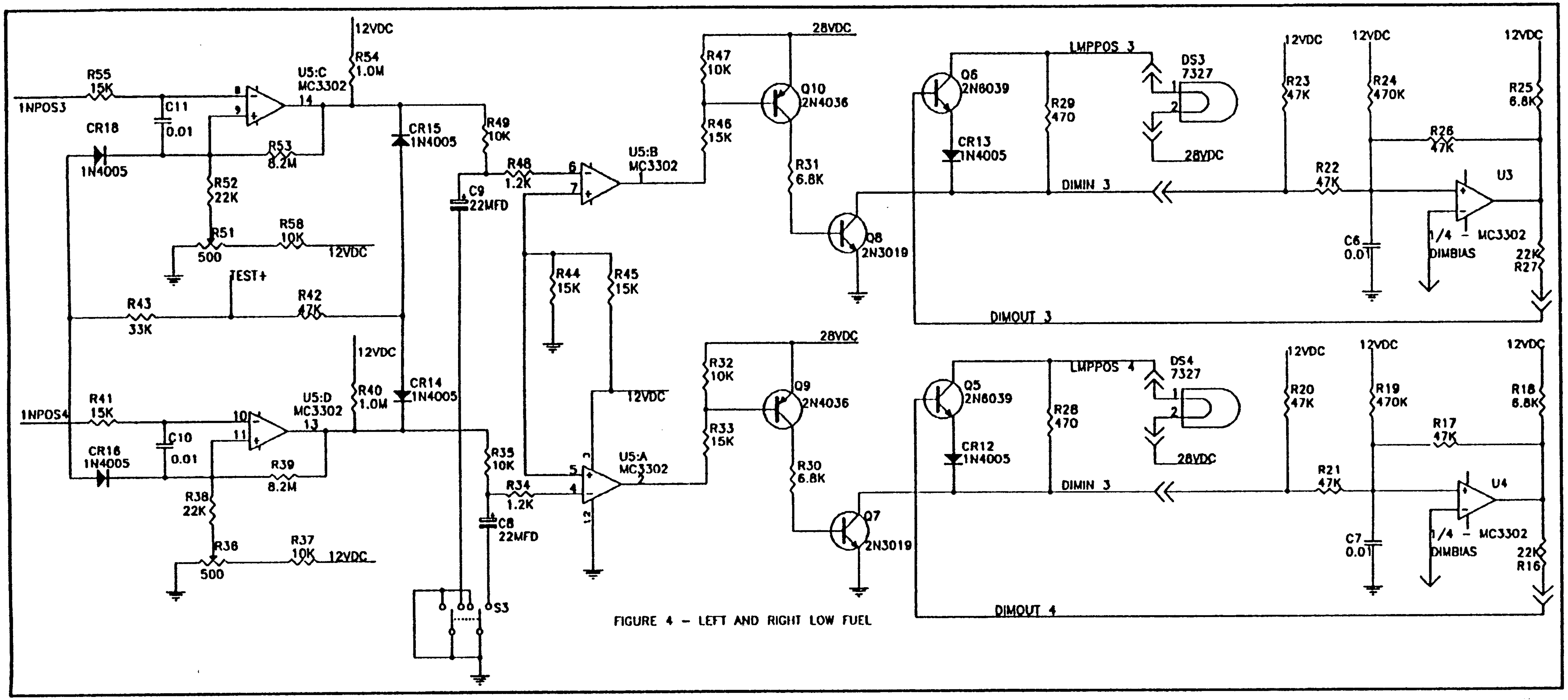


FIGURE 4 – LEFT AND RIGHT LOW FUEL

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15A

Island Enterprises

Up to this point the circuits used to annunciate low fuel are the same circuits that have been used for many years in IAI annunciators used on Mooney aircraft. The method of dimming, however, has been changed and expanded from what has been used in the past. In the past only the low fuel channels dimmed, excluding GEAR DOWN discussed above, while now the dimming has been expanded to include additional 5 channels. From the perspective of the pilot the operation is the same, depress the DIM switch and active channels dim, depress the TEST switch and active dimmed channels return to bright. When a dimmed channel is extinguished and then reactivates it will reactivate bright. The method to accomplish this, however, is considerably different from the past. Each channel to be dimmed is driven by a transistor, in this case Q8 which returns the lamp to ground through two parallel paths. The path to provide a dim indication is through resistor R29 which reduces the brilliance of the lamp.

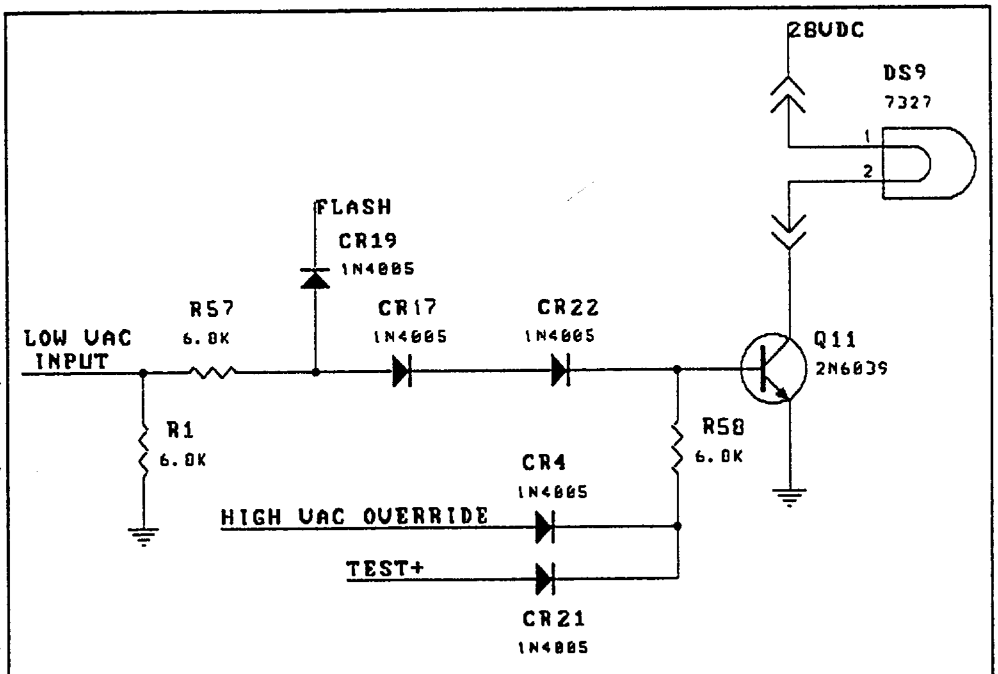

FIGURE 5 - HI/LO VAC

In the bright mode R29 is shorted by Q6 and CR13 which provide a low impedance path to ground. Transistor Q6 is controlled in conduction by a latch composed of U3 and its associated resistors R22, R23, R24, R25, R26 and R27 as well as the signals "DIMBIAS" and "DIMIN3". If the channel is active "DIMIN3" will be near ground and with "DIMBIAS" near 3 VDC, the output of U3 will be high, thus driving Q6 into conduction. When the DIM Switch is depressed momentarily, "DIMBIAS" goes high to 12 VDC and U3 switches its output low and latches through R26. This low output removes the drive from Q6 and DS3 dims. When the TEST Switch is depressed momentarily, "DIMBIAS" goes low and U3 switches its output high, latches through R26, and drives Q6 into conduction. When the channel deactivates, Q8 opens the return to ground and "DIMIN3" rises which returns latch U3 to a high output state.

6.0 HI/LO VAC

The High/Low Vacuum circuits are shown in Schematic **Figure 5**. This channel is designed to accept two + 28 VDC signals, one from a low vacuum sensor and one from a high vacuum sensor. When low vacuum is detected the annunciator will flash and when high vacuum is detected the annunciator will illuminate steady. A + 28 VDC signal applied to **LOW VAC INPUT** will drive Q11 into conduction through the bias network R56, R57, CR17, and CR22, thus illuminating DS9. The signal **FLASH** will, however, remove this drive signal as the flasher cycles, thus flashing DS9. A + 28 VDC signal applied to **HIGH VAC OVERRIDE** will bypass the above network and drive Q11 into conduction regardless of the state of **LOW VAC INPUT**. Similarly "TEST+ " will drive Q11 into conduction regardless of the state of **LOW VAC INPUT**. The channel High/Low Vac does not dim.

7.0 ALTERNATOR/LOW VOLTS/OVER VOLT

The Alternator/Low Volts/Over Volts circuits are shown in Schematic **Figure 6** above. This channel is designed to accept two signals, the + 28 VDC signal **LOVERRIDE** from the overvoltage tripped output on the left alternator regulator, and one signal derived internally that indicates that the aircraft bus voltage is less than 26.5 VDC. When low voltage is detected internally the annunciator channel flashes, and when overvoltage tripped is detected the annunciator channel illuminates steady.

Comparator U6 monitors the aircraft 28 VDC by comparing the voltage at the arm of R68 with the regulated voltage at the junction of R64 and R65. The output of U6, an open collector comparator is normally low. When low voltage is detected the output of U6 rises and drives Q12 into conduction through the bias network R60, CR24, and CR28, thus illuminating DS10. In a manner similar to the Hi/Lo Vac channel, the signal FLASH will remove this drive signal as the flasher cycles, thus flashing DS10. A + 28 VDC signal applied to **LOVERRIDE** will bypass the above network and drive Q12 into conduction regardless of the state of the comparator U6. Similarly "TEST+ " will drive Q12 into conduction regardless of the state of the comparator U6. A + 28 VDC signal applied to **LOVERRIDE** also drives Q12 into conduction regardless of the states of either comparator U6 or U7. Similarly "TEST+ " will drive Q12 into conduction regardless of the states of either comparator U6 or U7.

The channel Left Alternator/Low Volts/Over Volt does not dim.

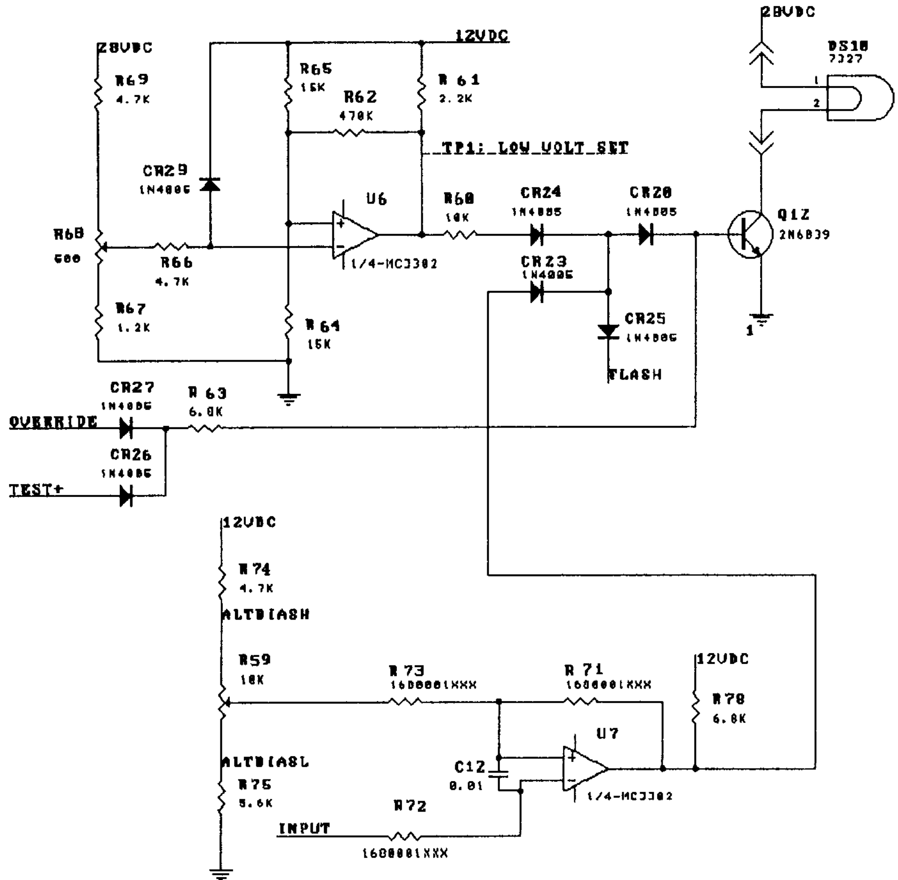

FIGURE 6 – LEFT ALTERNATOR/LOW VOLTS/OVER VOLT

to ground through two parallel paths. The path to provide a dim indication is through resistor R85 which reduces the brilliance of the lamp. In the bright mode R85 is shorted by Q14 and CR34 which provide a low impedance path to ground. Transistor Q14 is controlled in conduction by a latch composed of U9 and its associated resistors R86, R87, R88, R89, R90 and R91 as well as the signals "DIMBIAS" and "DIMINPUT". If the channel is active "DIMINPUT" will be near ground and with "DIMBIAS" near 3 VDC, the output of U9 will be high, thus driving Q14 into conduction. When the DIM Switch is depressed momentarily, "DIMBIAS" goes high to 12 VDC and U9 switches its output low and latches through R87. This low output removes the drive from Q14 and DS-X dims. When the TEST Switch is depressed momentarily, "DIMBIAS" goes low and U9 switches its output high, latches through R87, and drives Q14 into conduction. When the channel deactivates, Q15 opens the return to ground and "DIMINPUT" rises which returns latch U9 to a high output state.

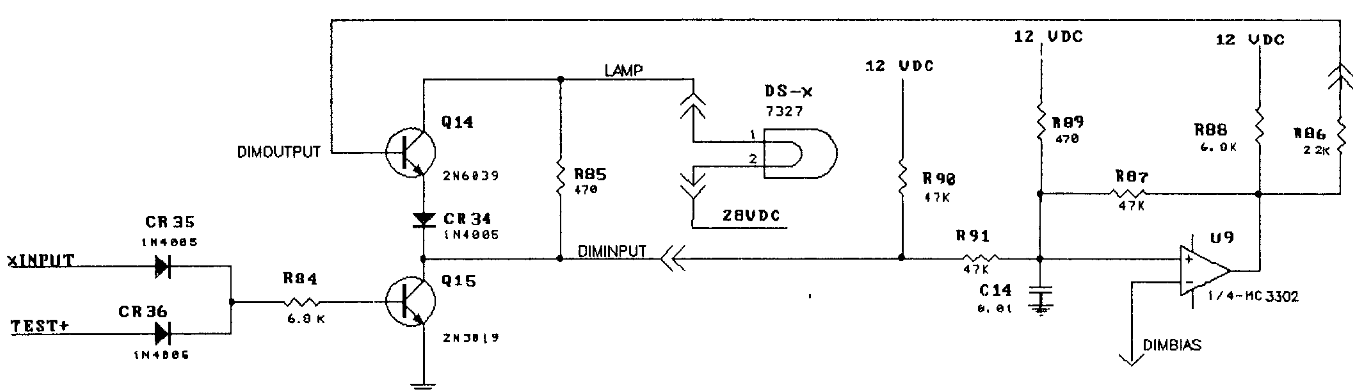

FIGURE 8 – TYPICAL POSITIVE APPLY W/DIM

10.0 TYPICAL POSITIVE APPLY W/O/DIM

A typical Positive Apply, Non-Dimmable circuit is shown in Schematic **Figure 9**. This channel is designed to accept a +28 VDC signal to illuminate an indicator channel, but does not provide for dimming of that channel. The input, **YINPUT**, is applied through CR38 to light DS-Y. "TEST+" is applied through CR37 to also light DS-Y.

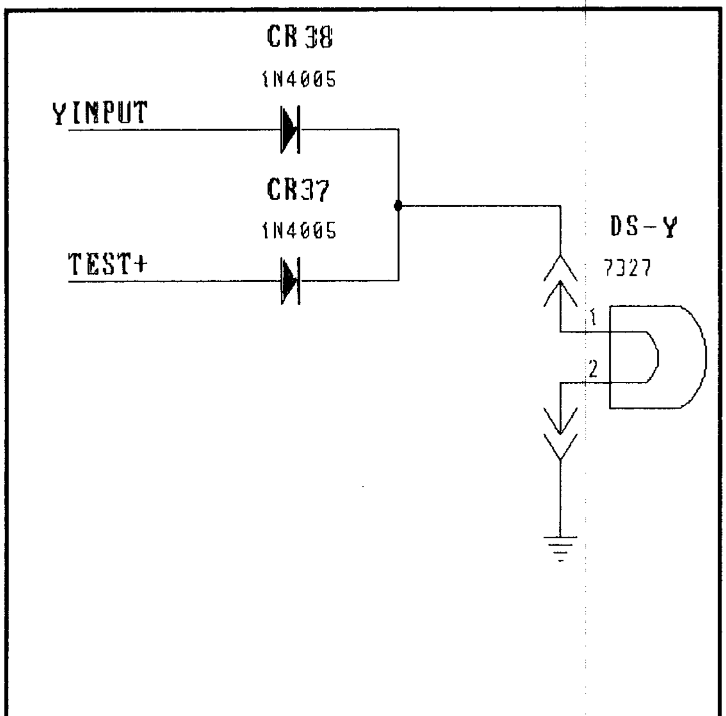

FIGURE 9 - TYPICAL POSITIVE APPLY WO/DIM

24-50-00 - ELECTRICAL LOAD DISTRIBUTION

24-51-00 - POWER DISTRIBUTION SYSTEM

The power bus distributes direct current power to the electrical system from the alternator and from the selected battery through the battery relay. The batteries negative leads attach to a structural ground on the airframe. The Master Switch "ON" closes the relay and supplies power to the aircraft electrical system.

CAUTION

Do not reset a circuit breaker after it has tripped a second time. If necessary to do so to locate the malfunction, be alert for a possible electrical fire. Breakers are "Trip Free" type and cannot be held in the closed position.

CHAPTER

27

FLIGHT CONTROLS

CHAPTER 27

FLIGHT CONTROLS

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CHAPTER 27

FLIGHT CONTROLS

LIST OF EFFECTIVE PAGES

27-00-00 - GENERAL

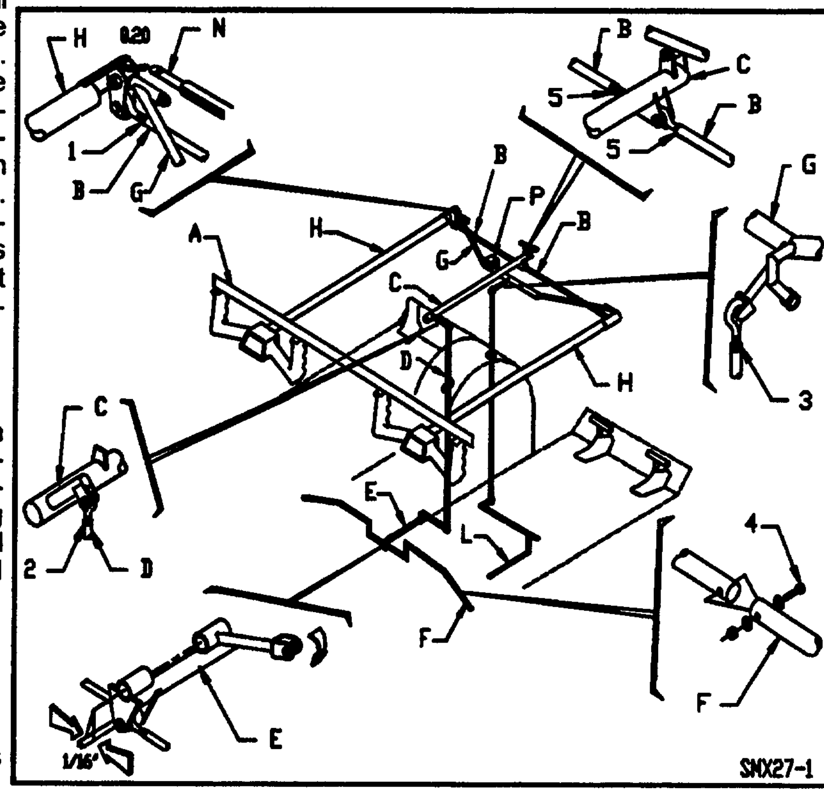
The aircraft has dual flight controls and can be flown from either the pilot or co-pilot seat. Dual pairs of foot pedals control the rudder and nose wheel steering mechanisms. The co-pilot pedals are removable if dual brakes are not installed. Push pull tubes actuate the all-metal flight control surfaces. 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. Electrically actuated wing flap systems are installed on all models. Longitudinal pitch trim is achieved through a trim control system that pivots the entire empennage around the tailcone attachment points.

27-10-00 - AILERON SYSTEM

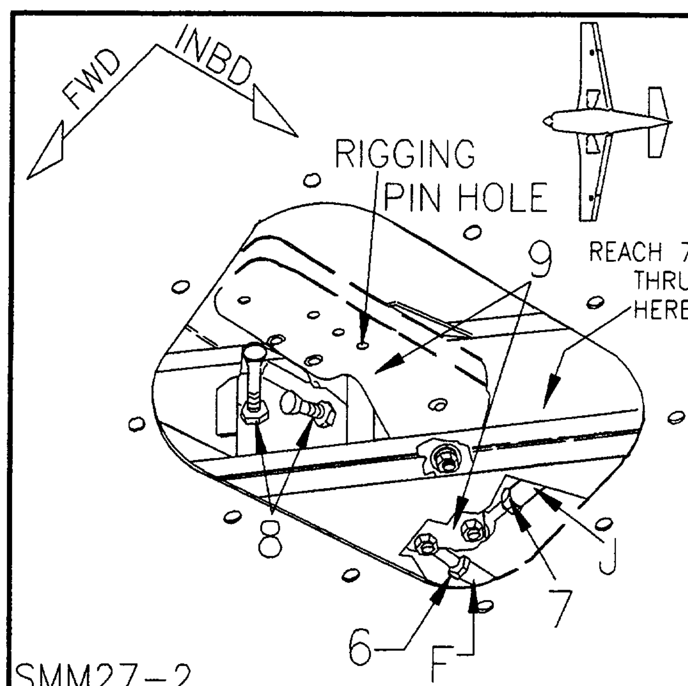
The ailerons are of all-metal construction with beveled trailing edges. Three hinges of machined, extruded aluminum attach the ailerons to the aft wing spar outboard of the wing flaps. The ailerons link to the control wheel through push-pull tubes and bellcranks. Lead counter-weights static balance the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

1. **Aileron Removal and Installation.**
   A. Remove control tube attaching bolt, nut, and washer at aileron horn.
   B. Remove bolts, nuts, and washers from the three attaching hinges.
   C. Remove aileron by pulling it straight aft until hinges are clear; rotate inboard portion down and forward to allow aileron balance weights to clear wing tip.
   D. Reinstall aileron in reverse sequence of removal.
   E. Recheck bolts for security and safety.

2. **Aileron Rigging**.
   A. Level control wheels - (A) **(Fig. 27-1)**.
   B. Install 3/16 dia. rig-pins at:
   (1) Jackshaft (C) **(Figure 27-1)**
   (2) Bellcrank (E) **(Figure 27-1)**
   (3) Bellcranks (9) **(Figure 27-2)** (L.H. and R.H.)
   C. Adjust control tubes (J) @ (7) **(Figure 27-2)** (L.H. and R.H.) to position ailerons at 0 degrees to 2 degrees down. Loosen jam nut (7). Disconnect (J) @ aileron horn. Turn (J) one revolution in direction desired. Reconnect (J) @ aileron horn. Tighten jam nut (7)
   D. Adjust remaining control tubes (F) @ 6, (B) @ 1, & (D) @ 2, **(Figure 27-1)** (L.H. and R.H., if applicable) in order to freely attach to the bellcranks and jackshaft.
   E. Remove rig-pins.
   F. Adjust aileron stops (8) **(Figure 27-2)** per the following procedures:
   (1) Position travel board, GSE030003-200, at W.S. 147.75.
   (2) Adjust static position from 0° to 2° DOWN. (Ref. point is 0° mark on travel board.
   (3) DOWN travel: 8° +/-1° from static position.
   (4) UP travel: 12.5° to 14.5° from static position.

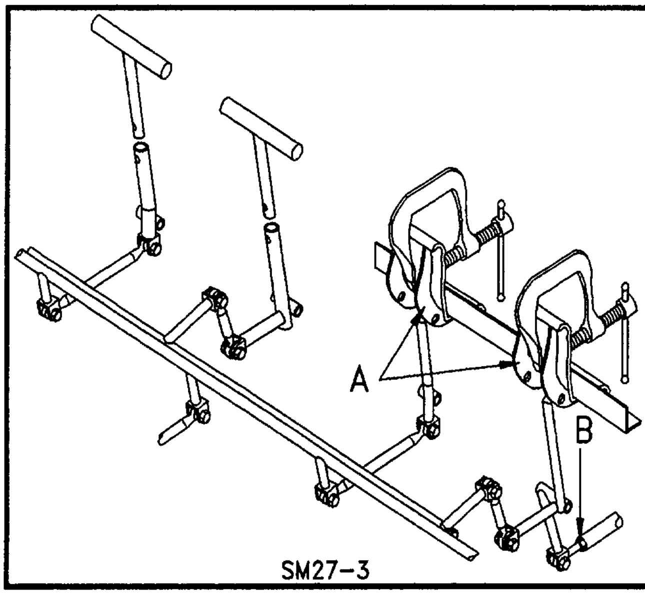


AILERON/ELEVATOR CONTROL WHEEL RIGGING
FIGURE 27-1



AILERON STOP ADJUSTMENTS-FIGURE 27-2

NOTE
Wing station 147.75 is located at skin splice line between flap outboard end and aileron inboard end.

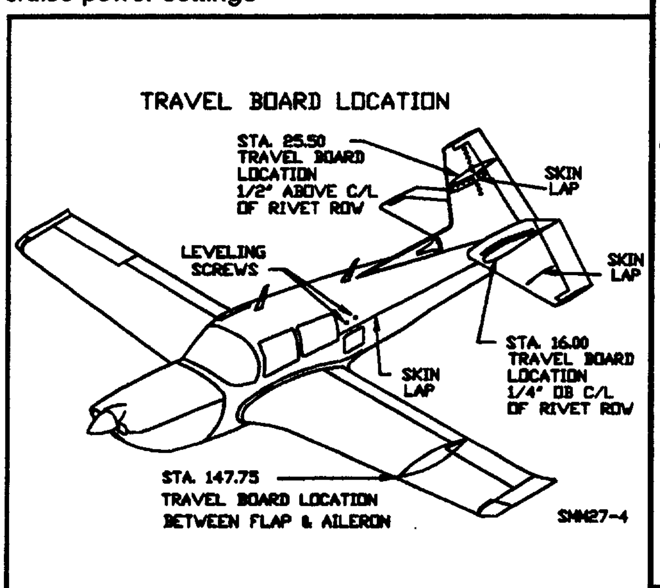


RUDDER PEDAL ADJUSTMENT-FIGURE 27-3

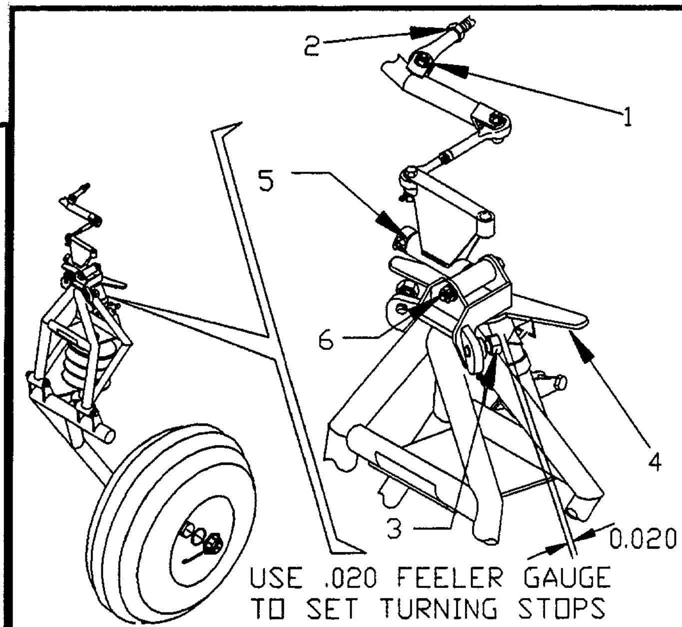
NOTE
The above aileron rigging and adjustment instructions apply to both the left and right ailerons.

27-20-00 - RUDDER AND STEERING SYSTEM

The rudder attaches to the aft vertical fin spar at four hinge points. Push-pull tubes and bellcranks link the rudder to the rudder pedals. A rudder trim system is incorporated into the M20R aircraft for pilot comfort for high power settings during climb and if needed for cruise power settings

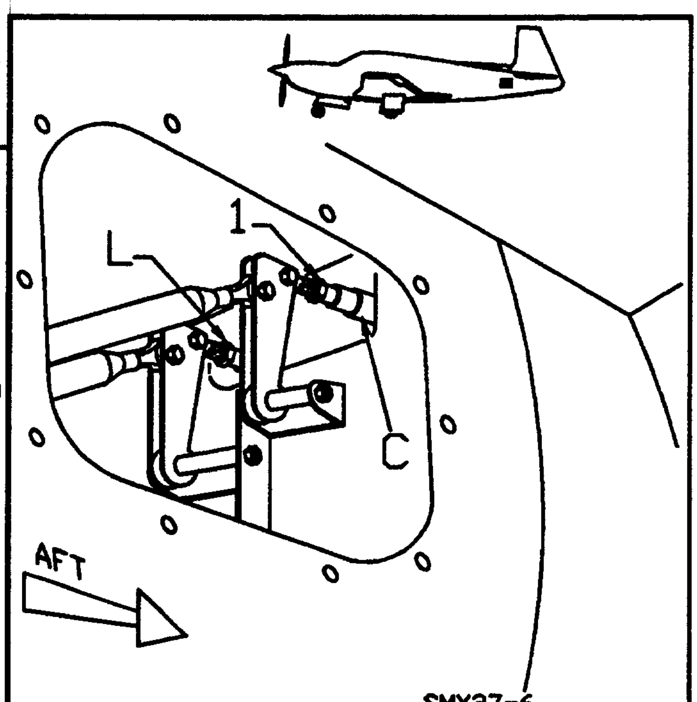


TRAVEL BOARD LOCATIONS-FIGURE 27-4

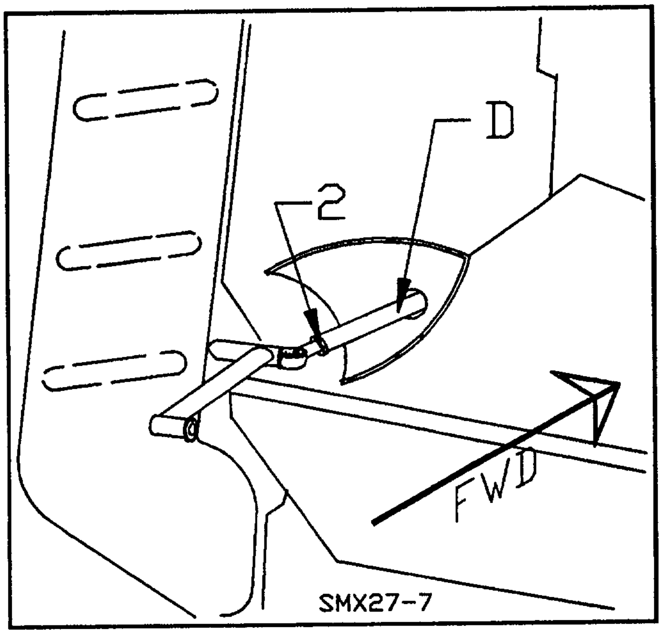


NOSE GEAR STEERING LINKAGE ADJUSTMENT
FIGURE 27-5

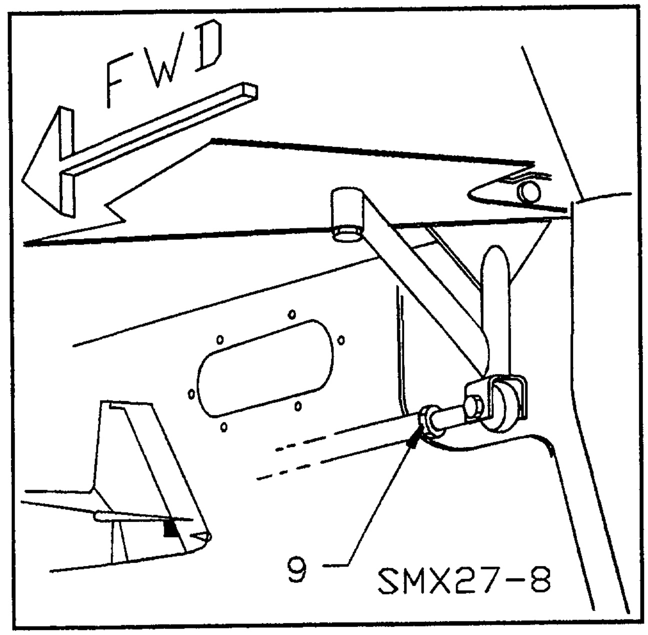
1. **Rudder Removal and Installation.**
   A. Detach rudder push-pull tube from rudder horn.
   B. Remove attaching hardware at rudder hinges.
   C. Remove rudder by pulling it straight aft.
   D. Install rudder in reverse sequence of removal. Recheck attaching bolts for security and safety.



RUDDER & ELEVATOR TRAVEL ADJUSTMENT-
FIGURE 27-6



RUDDER HORN ADJUSTMENT-FIGURE 27-7



ELEVATOR HORN ADJUSTMENT-FIGURE 27-8

2. **Rudder Rigging and Adjustment.**

A. Raise aircraft nose. See SECTION 7-10-00.

B. Set stabilizer trim control in neutral position (stabilizer parallel with aircraft center line).

C. Clamp pilots rudder pedals (A), (**Figure 27-3**), in neutral position.

D. Adjust rod end bearing (B)(Fig. 27-3) approx. 11 turns out to start.

E. Adjust control tube (C) at rear tailcone bulkhead bellcrank, (**Figure 27-6**) approx. 12 turns out as to start.

F. Adjust control tube (D), (**Figure 27-7**), rod end bearing (2) 11 turns out to start.

NOTE

Rudder bellcrank, aft tailcone, should be modified per SI-M20-44.

G. Adjust rod end bearing (B)(Fig. 27-3) to position rudder setting 1° to the right.

H. Unclamp rudder pedals.

I. Adjust rudder stops (M), (**Figure 27-9**), so that rudder travel is 23° (+1/-0 degrees) right and left.

J. After rudder stops (M) are set, rotate rudder thru full range of travel to assure solid contact with stops and that nuts and bolt heads clear stop limiter (R). Stop limiter (R) may be bent to obtain clearances and contact with rudder stops (M), (**Figure 27-9**).

NOTE

On aircraft S/N 25-0824 & ON steering stops (3) Fig. 27-5, should be adjusted so .020 clearance exists between adjustment stop (3) and gear truss assembly (4) (Figure 27-5) when rudder is at extreme left and right travel position.

K. After setting stops, re-tighten all jam nuts, bolts and secure; recheck all travel limits.

L. Center nose wheel by removing nut, washer & bolt (1), (**Figure 27-5**), and adjusting steering idler linkage at (2). Bolts, nuts and washers (5) and (6) must be installed as shown, from rear to front.

NOTE

Measure rudder travel with travel board on rivet line at station indicated on travel board GSE 030005-100, and with longitudinal trim (stabilizer) set in the 0° position. Sta. 26.50 is located 3/4 in. above skin splice on vertical fin.

3. **Allowable Free-Play Limits.**

A. Vertical movement at rudder trailing edge - .08 inches.

(1) If excessive free-play exists check the following areas for wear:

(a) Trim screw jackshaft.

(b) Trim link connecting empennage to trimscrew.

(c) Bolts and brackets attaching empennage to tailcone.

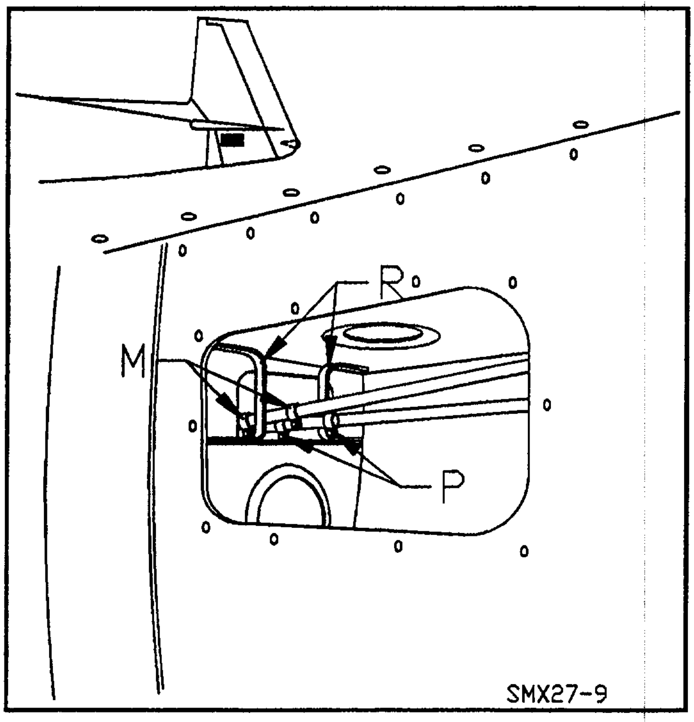
4. **Rudder Torque Tube Removal.** The rudder torque tube should be inspected thoroughly and replaced if any damage is found. Remove shield from front of cabin floorboard that covers torque tube. Remove attaching hardware from hinges and rudder pedal control rods. Carefully remove torque tube by sliding out toward the right side of cabin and through cabin door.

NOTE

Control tube wear allowables. If any portion of the control tube exceeds .007 inch wear per wall or .014 inch reduction in diameter, the tube must be replaced.

27-30-00 - ELEVATOR SYSTEM

Elevator construction is essentially the same as that of the ailerons. Both elevators attach to the stabilizer at four hinge points. Push-pull tubes and bellcranks link the elevators to the control yoke. Lead counterweights static balance the elevators. A lead bob-weight under the instrument panel refines aircraft handling in flight.



RUDDER & ELEVATOR STOP ADJUSTMENT
FIGURE 27-9

1. **Elevator Removal and Installation.**

A. Remove push-pull control tube by taking off all attaching bolts, nuts, and washer.

B. Remove bolts, nuts, and washers from the four attaching hinges.

C. Remove elevator to the rear.

D. Install elevators in reverse sequence of removal. Recheck attaching bolts for security and safety. Set elevators, RH/LH, to be even with horizontal stabilizer. Adjust rod end bearings (9), **Fig. 27-8**, at elevator horn.

2. **Elevator Rigging and Adjustment**

A. Adjust rod end bearing (3), (**Figure 27-1**), at control yoke (G) for control shaft (H) clearance from firewall and control yoke and bob weight (P) clearance from fuselage structure.

B. Level aircraft and set control column in neutral with stabilizer parallel to center line of aircraft.

NOTE
Measure elevator travel from 0 degrees stabilizer thrust line with travel board positioned at stabilizer station 16.00 as indicated on travel board, P/N GSE 030004-503 and with stabilizer at 0 degrees. (See Figure 27-12 and Figure 27-4 for travel board placement.

NOTE
Elevator bellcrank, aft tailcone, should be modified per SI-M20-44.

C. Adjust rod end bearings of control tube (L), (**Figure 27-6**), at rear tailcone bulkhead out approx. 5 turns to start.

D. Adjust elevator horn rod end (9) (LH & RH), (**Figure 27-8**) out 7 to 8 turns to start.

E. Main spar, adjustable rod end bearing is turned out approx. 6 turns to start. To obtain additional elevator travel adjust as required.

F. Set elevator stops (P), (Figure 27-9), in empennage stinger for elevator uptravelof 22° (+0/–2) and downtravel of 22° (+0/–2) .

G. After stops (P) & (M) are set, rotate elevators thru full range of travel to assure positive contact with stops (P) & (M) and that nuts and bolt heads clear stop limiters (R). Stop limiters (R) may be bent to obtain proper clearances and contact with elevator stops (P) (**Figure 27-9).**

H. Rotate stabilizer trim full down to check clearance of bellcrank at wing rear spar. Adjust rod end bearing at rear tailcone bulkhead (C) (Fig. 27-6) if needed for clearance. Recheck elevator UP and DOWN travel.

I. Rotate elevator trim FULL UP to check that UP stop (P) still makes solid contact on stop limiter (R).

J. Re-tighten all jam nuts, attach bolts and secure as necessary; recheck all control tube clearances and travel limits.

27-30-03 - EMPENNAGE FREE PLAY LIMITS

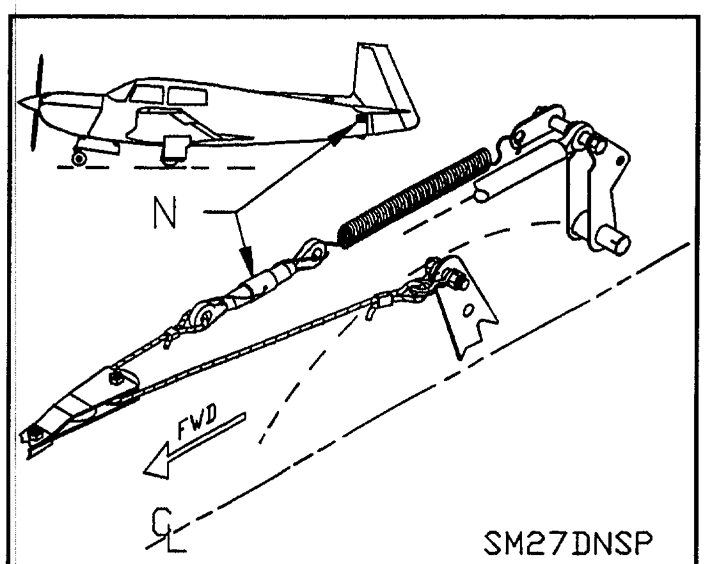
Allowable free play movement of the empennage assembly on the tailcone of the airplane, with the tailcone fixed at the tail skid:

Horizontal stabilizer @ Tip:
0.12 inch max. -- Fore and Aft
0.10 inch max. -- Up & Down

Rudder @ lower trailing edge:
0.08 inch max. -- Up & Down

27-31-00 - VARIABLE DOWNSPRING SYSTEM

A spring hooked into the elevator control system in the tailcone refines the feel of the elevator in flight. A bellcrank and cable tailors the spring tension appropriate to the trimmed position of the stabilizer.



VARIABLE DOWNSPRING-FIGURE 27-10

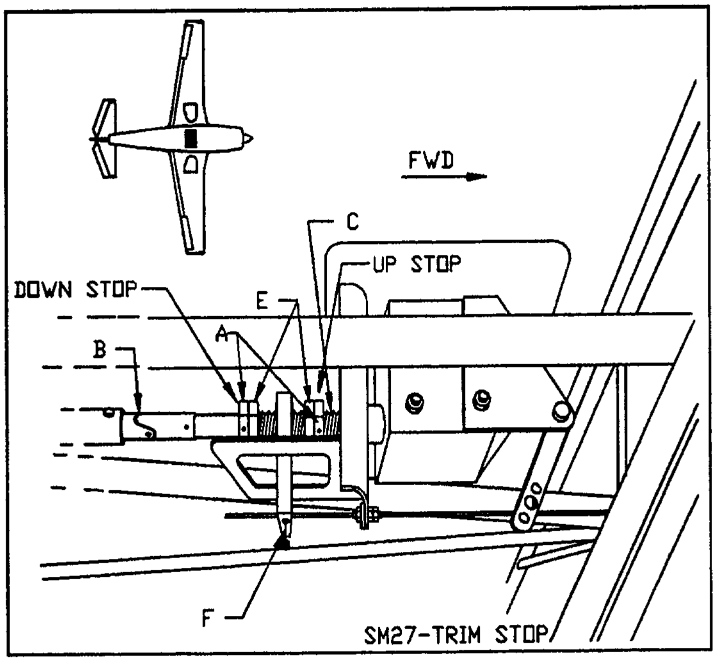
NOTE
Negative stabilizer (- degrees) settings mean that stabilizer leading edge is moved down relative to the thrust line.

1. **Rigging - Variable Down Spring System**

A. Set stabilizer at maximum positive setting and elevators full down. (Figure 27-10

B. Adjust turn buckle for a 14.0 to 16.0 lb. tensiometer reading on cable.

C. Check for positive clearance between cable end and pulley sheave. Tensiometer reading should be 20 lb. maximum.



TRIM CONTROL ACTUATOR RIGGING - FIGURE 27-11

27-40-00 - TRIM SYSTEMS

27-40-01 -STABILIZER TRIM SYSTEM/RIGGING

To provide pitch trim control, the entire empennage pivots around its main hinge points. The system consists of a manually operated actuator that operates a series of torque tubes and universal joints connected to a jack screw on the aft tailcone bulkhead.

NOTE
A "stepped stop nut", with a "jam nut" configuration has been incorporated, This can be retrofitted to all M20R aircraft, if desired. This allows trim screw nut (F) (Fig. 27-11) to contact stepped portion of these two nuts and not bind.

1. **Rigging - Stabilizer Trim System**

The basic rigging, for either configuration, is identical to procedures below except that stepped nut and jam nut require being torqued together with two wrenches prior to jam nut set screw tightened against threaded trim screw. Stepped nuts are required at the nose up and the nose down positions facing trim screw nut (F).

A. **Nose Down Stabilizer** Trim Control Rigging and Adjustment.

(1) Loosen setscrew in stop/jamnut (A) (Figure 27-11), break torque on jam nut/stepped nut (if installed) and turn stop (A) or jam/stepped nut (A & E) clockwise or counterclockwise to align aft edge of stop or jam/stepped nut (A&E) with last thread of trimscrew (C) (**Figure 27-11**). Tighten setscrew and turn trim control wheel to full NOSE DOWN position (trim screw nut (F) against stop (A) or stepped nut (E).

(2) Disconnect torque shaft (B) from trim screw (C), (**Figure 27-11**).

(3). Turn disconnected torque shaft (B) clockwise or counterclockwise until horizontal stabilizer as measured, using the travel board, P/N 030004-503, as shown by (**Figure 27-12**), is within the following limits: +3.8° to +4.2°.

NOTE
Positive (+ degrees) stabilizer degrees mean that stabilizer leading edge is moved up relative to thrust line.

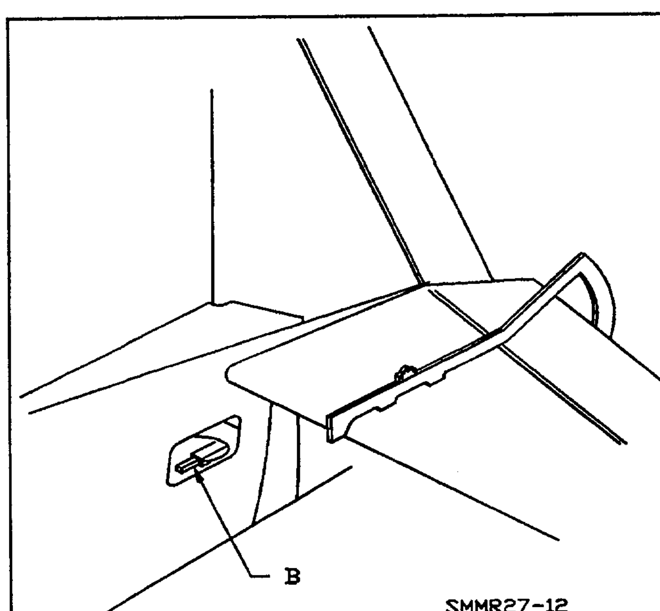
(4) Connect torque shaft (B) to trim screw (C) (Figure 27-12). NOSE DOWN stabilizer trim control rigging is now complete.

B. **Nose Up Stabilizer** Trim Control Rigging and Adjustment.

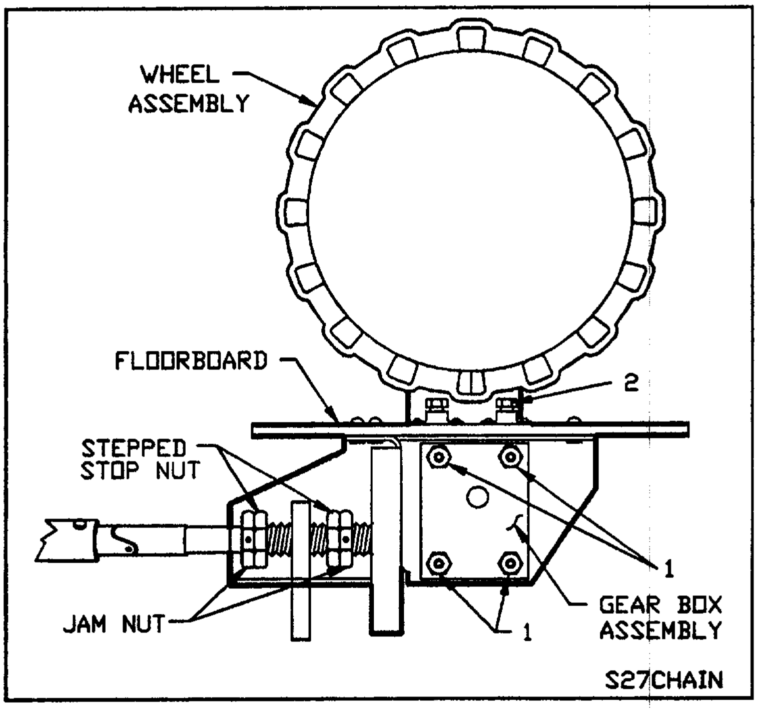
(1). Loosen setscrew in stop or jamnut (A) and turn stop(s) on threaded shaft to move it toward the trim screw gear box. Turn trim control wheel toward NOSE UP position until horizontal stabilizer is within the following limits: -6.5° to -7.0° .

NOTE
Negative stabilizer (- degree) settings mean that stabilizer leading edge is moved down relative to thrust line.

(2) Rotate UP stop or stepped nut (E), (**Figure 27-11**) clockwise or counterclockwise to make contact with trim screw nut (F). Tighten setscrew.



ELEVATOR TRIM ADJUSTMENT - FIGURE 27-12



ELEVATOR TRIM CHAIN ADJUSTMENT-FIGURE 27-13

NOSE UP stabilizer trim control rigging is now complete.

2. **Stabilizer Trim Indicator - Rigging.**
The indicator is connected to the trim control wheel assembly to indicate stabilizer position relative to the aircraft thrust line.

A. Adjust stabilizer trim to FULL DOWN position.

B. Adjust potentiometer, on trim wheel assembly, to illuminate bottom bar on indicator.

C. Run stabilizer trim to FULL UP position.

D. Top bar on display indicator should be illuminated. If not illuminated adjustment to R1 resistor inside indicator housing is necessary.

E. Remove indicator from instrument panel. Leave harness connected. Pull indicator down as far as possible to allow removal of housing cover and access to adjustment.

F. Adjust R1 on A/D board (see Schematic 509) to illuminate top bar on display.

G. Repeat steps B through F until no further adjustments are required.

H. Re-install and secure display indicator into instrument panel.

3. **Stabilizer Free Play Limits**

A Fore and aft movement at stabilizer tip - .12 inches.

B Vertical movement at stabilizer tip - .10 inches.

NOTE
When removing trim screw from empennage, use block of wood cut to fit opening between tailcone and empennage to prop empennage up when trim screw is removed.

4. **Electric Trim.**

A. Clutch torque for the electric trim system should be adjusted for the following settings to operate autopilot systems properly:

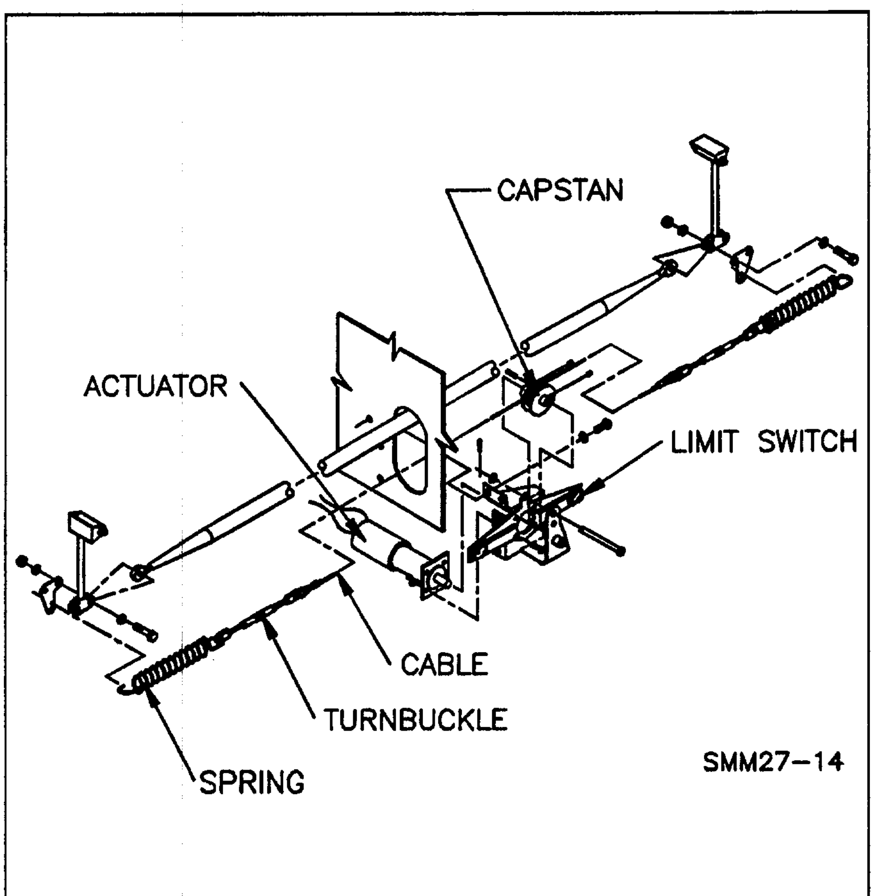
(1) KFC 200 - 21+/- 2 inch lbs.
(2) KAP 100 - 21+/- 2 inch lbs.
(3) KFC 150 - 21+/- 2 inch lbs.
(4) EDO AIRE - 18 inch lbs.
(5) S-TEC - 30 inch lbs.

5. **Stabilizer Trim Chain Adjustment**. (Reference **Figure 27-13**).

A. With four mounting bolts (1) slack, adjust two NAS428-3-4 bolts (2) to obtain maximum tension on chain without causing binding.

27-40-02 RUDDER TRIM SYSTEM/RIGGING

1. **Rudder Trim - Rigging**
Rudder Trim consist of an electric actuator driving a capstan/balancing bellcrank and spring system to compensate for engine/propeller forces during long climbs or takeoff power.



RUDDER TRIM RIGGING-FIGURE 27-14

A. Aircraft should be flight tested and rigged for lateral directional trim prior to rigging of the rudder trim system.

B. Jack aircraft nose wheel off ground.

C. Aileron-rudder interconnect system shall be rigged properly prior to rigging of rudder trim system. (See Section 27-60-00)

D. Deflect and lock rudder at 10° left position. Use Rudder Travel Board GSE 0300005.

E. Remove tailcone battery access cover (left side) and aft fiberglass belly panel to gain access to rudder trim actuator assembly.

NOTE

The following steps are easier to accomplish if the actuator assembly is removed from the aircraft but they can be done while actuator is in its normal operating location.

F. Electrically run actuator for left rudder deflection (depress left sides of both RUDDER TRIM split switches) until limit switch turns OFF actuator motor.(Aft limit switch is for LEFT rudder trim).

G. Wrap cable around capstan five full turns with forward eye of cable ending up 12 inches from forward circumference edge of capstan (See **Figure 27-14**). Aft end of cable will be in proper location for rigging procedure. Temporarily secure cable/capstan position using several wraps of suitable adhesive tape around cable and capstan.

H. Extend and secure both springs to 9.8 inches inside measurement between hooks. Insert spring extender, P/N GSE 030035-501, end caps into spring coils so that the 9.8 inch dimension is maintained. Place the spacer, P/N GSE 030035-005, over spring coils and secure to -503 assembly with MS3367-1-9 straps. Two spring extenders, GSE 030035-503, are required for rigging procedures.

NOTE

Rudder trim actuator assembly will need to be re-installed at this time, if it was removed to accomplish the preceding steps.

I. Attach one end of both springs to brackets on control tube bellcranks at Fuselage Stations 90.0 and 142.0.

J. Separate barrels and eyes of both turnbuckles and attach one eye of turnbuckle to forward spring; screw proper end of turnbuckle barrel to eye from 2 to 5 turns.

K. Start turnbuckle eye attached to forward cable end into barrel. Tighten turnbuckle barrel until tension JUST begins on spring.

L. Repeat steps I. through K. on the aft spring and cable end.

M. Verify that required number of threads are screwed into both turnbuckle barrels.

N. Remove spring extenders from both springs. Remove tape from cable and capstan and rudder lock from rudder.

O. The rudder should be "neutral" at 3 to 5° left rudder.

P. Electrically run actuator for right rudder deflection. The actuator motor should stop when rudder is deflected 23° right. If not, slightly bend the forward limit switch's (RIGHT rudder stop) actuator arm to position right rudder at 23°. Cycle the system and recheck right rudder deflection.

Q. The TRIM LIMITS are: 3 to 5° LEFT; 23° RIGHT.

R. Secure aft turnbuckle and make sure there is no interference between rudder trim mechanism and flight control tubes or bellcranks during cycle or full travel of flight control surfaces.

2. Rudder Trim Indicator - Rigging

A. Use rudder trim switch in aircraft to run rudder trim full right.

B. Adjust potentiometer on motor/cable assembly to illuminate far right bar on display.

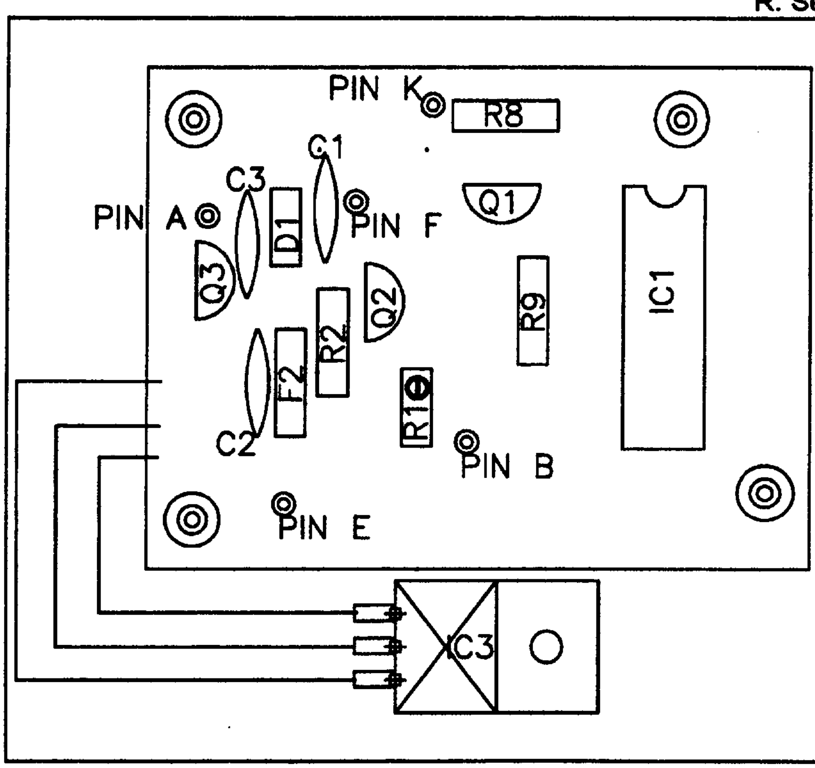
C. Use rudder trim switch in aircraft to run rudder trim full left and adjust R1 on A/D rudder trim board (see Figure 27-14A) to illuminate left bar on display.

D. Repeat steps A through C until no further adjustment is required.

E. Remove rudder travel board; reinstall access cover and belly skin.

F. Flight test aircraft. The rudder trim shall center the turn coordinator ball with no pilot application of rudder during full power climbs at 105 KIAS. If it does not, gain access to forward turnbuckle and tighten for an additional .25 to .38 inch extension of forward spring. Secure forward turnbuckle.

G. Replace access cover(s) and repeat flight check in step 20.



RUDDER TRIM INDICATOR ADJUSTMENT
FIGURE 27-14A

H. Complete log book entry and return aircraft to service or complete any remaining maintenance action.

27-41-00 - StabilizerTrim System Troubleshooting

BINDING	Check control tubes at bulkhead grommets for rub marks. Check Trim Actuator threads for galling or not lubricated, lubricate per Sect. 5.
ELECTRIC	Check BINDING symptoms above.
CLUTCH	Check for proper clutch settings.
SLIPPING	Confirm full bus voltage is avail. at trim motor.

NOTE

Maximum wear on trim tube, where it passes thru bulkhead grommets, is .007 inch per wall or .014 inch diameter.

27-42-00 -ELECTRIC PITCH TRIM SYSTEM MAINTENANCE

If installed, the AlliedSignal (Bendix-King) Electric Pitch Trim System requires periodic maintenance at each annual inspection for carrier bearing added to existing aircraft pitch trim torque tube. If not already installed, an annual service placard, 057-05747-0001, (available from AlliedSignal) MUST be added to the Electric Pitch Trim servo bracket area to call attention to the annual maintenance requirement. Carrier bearing assembly must be inspected and lubricated per the following procedures:

1. Gain access to area by removing electrical bay access cover from left hand side of tailcone. Locate Electric Pitch Trim servo system, just aft of Fuselage Sta. 142 bulkhead. Carrier bearing is located around existing pitch trim torque tube, aft of lower chain sprocket, on aft side of electric pitch trim servo bracket and below electric pitch trim servo motor.

2. Loosen electric pitch trim servo drive chain. Remove four lock nuts which secure carrier bearing block to aft side of electric pitch trim servo bracket. Slide bearing block aft until it is clear of stainless steel sleeve which is secured to existing airplane pitch trim torque tube.

3. Carrier bearing can now be inspected. If carrier bearing or torque tube sleeve show evidence of scoring or wear, replace damaged items with new parts. Bendix-King P/N's are:

BEARING BLOCK ASSY. - 047-04143-000
TORQUE TUBE SLEEVE - 076-00971-000
ROLL PIN (for torque tube sleeve) - 090-00052-0022

When scoring or wear is not present, clean any dried grease and/or dirt from bearing and torque tube sleeve. Relubricate, using MIL-G-23827 or MIL-G-81322 grease. Use a grease needle or other suitable tool to apply grease.

4. Reinstall carrier bearing to aft side of electric pitch trim servo bracket. Re-tension drive chain.

5. Clean any dirt and grease from placard location on forward side of tailcone bulkhead. Install annual service placard (057-05747-0001) on forward, vertical portion of bulkhead, @ fuselage Sta. 142.

6. **If bearing block assembly replacement is required, refer to following procedures:**

Trim torque tube/pitch trim servo assembly should be removed from aircraft to replace bearing block, therefore manual trim wheel and electric trim switch should be flagged so inadvertent movement will not occur.

A. Disconnect universal joint located between tailcone bulkhead, Sta. 142, and pitch trim servo assembly mounting brackets.

B. Disconnect electrical wiring, to servo motor, at connector.

C. Disconnect ELT harness from connector and any other wiring that may interfere with the removal of torque tube assembly from tailcone.

D. Remove nuts, washers, bolts/screws from upper and lower pitch trim servo brackets holding brackets to bulkhead.

E. Carefully lift torque tube/pitch trim servo assembly up and pull aft end of torque tube from trim actuator socket on aft tailcone bulkhead. Support aft end of torque tube if needed.

F. Pull torque tube/trim servo assembly from tailcone through access cover on left side of tailcone.

G. Place torque tube/pitch trim servo assembly on work bench for removal and replacement of bearing block.

H. Remove components carefully until access to bearing block is obtained. Install new bearing block and assemble in reverse sequence.

I. Reinstall torque tube/pitch trim servo assembly into tailcone.

J. After reinstallation and reconnection of all components, electrical and mechanical, it will be essential to check stabilizer pitch trim system rigging in accordance with Section 27-40-01.

27-50-00 - WING FLAP SYSTEM

Push-pull tubes and bellcranks interconnect the flaps. The flaps are operated by an electrical motor driven actuator (1) connected to a jack shaft (2). The jack shaft is connected to actuator bracket (3) (**Figure 27-15**) on each flap just outboard of hinges (4) by a push-pull rod end bearing (5) and hardware. Each flap pivots about four hinges. Travel is controlled by limit switches (6) and (7) and UP stops located at outboard hinges (**Figure 27-15**).

Flap position is indicated in the cockpit through an electrical potentiometer system (8) connected to the jack shaft actuator horn (9).

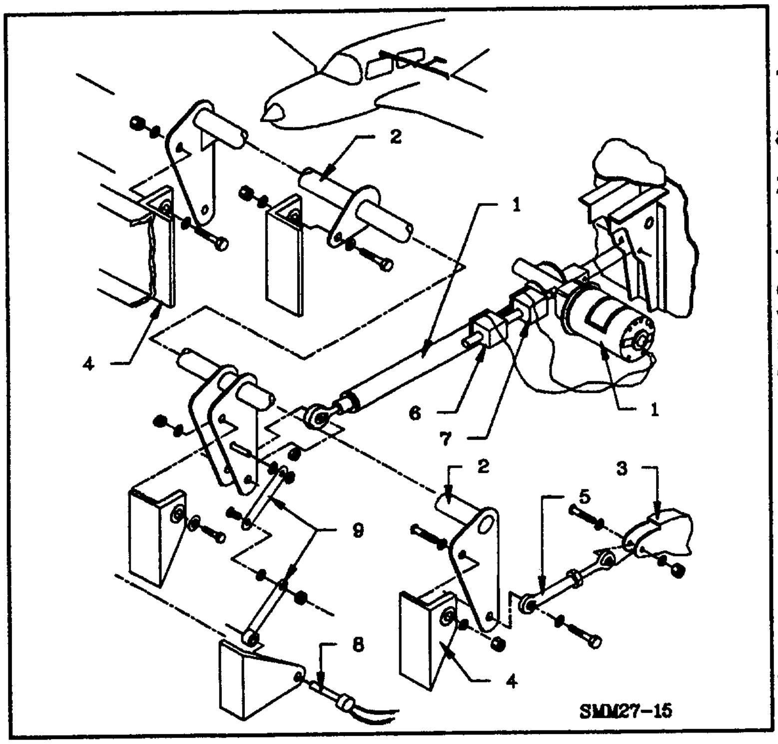
Lubricate the actuator gear box and ball screw at intervals with lubricants prescribed in CHAPTER 5.

— The flap system incorporates a preselect feature which allows flaps to be activated as desired, UP, TAKEOFF or DOWN.

The flap switch is located on console adjacent to the flap position indicator. The flaps can be retracted completely by placing the switch in the UP position or to any selected preselect setting.

1. **Wing Flap Removal and Installation.**

A. Remove wing flap hinge fairing to expose flap push-pull tube.



FLAP ACTUATOR ASSEMBLY & INSTALLATION
FIGURE 27-15

B. Remove bolt, nut, and washer from flap-actuating attachment.

C. Remove bolts, nuts, and washers at flap hinge points.

D. Remove flap by pulling it down and aft.

E. Install wing flaps in reverse sequence of removal. Recheck security and safety of attaching bolts.

2. **Wing Flap Rigging and Adjustment.**

NOTE
Flap deflections are to be measured with travel board GSE 030003 at the station indicated on the travel board. (See Section 27-20-00, Fig. 27-5)

A. Adjust right and left inboard linkage at rod end bearing (1), **(Figure 27-16)** to obtain a flap deflection of 33° (+0° /-2 degrees). Retract flaps to 0° (+/-2°); set flap outboard travel stops (not illustrated) so that flaps align with ailerons in neutral position.

B. The limit switches, #6 & 7, **(Figure 27-15)** should be adjusted so that under flight loads the actuator over run will not allow the flaps to exceed eitherUP or DOWN positions.

C. Extend flaps to TAKEOFF position (10° +/-1°).

D. Adjust switch stack until Bottom Micro-Switch just opens.

E. Top switch will be automatically adjusted.

F. Cycle flaps UP, TAKEOFF & DOWN; verify proper settings at TAKEOFF when going down.

3. **Wing Flap Indicator - Rigging**

A. Position flaps in full DOWN position.

B. Adjust flap potentiometer (8) (Fig. 27-15) on aircraft to illuminate bottom bar.

C. Position flaps in UP position.

D. Adjust R1 on A/D board (see **Figure 27-17**) to illuminate top bar of flap display.

E. Repeat steps A through D until no further adjustment is required.

27-60-00 - AILERON/RUDDER INTERCONNECT SYSTEM

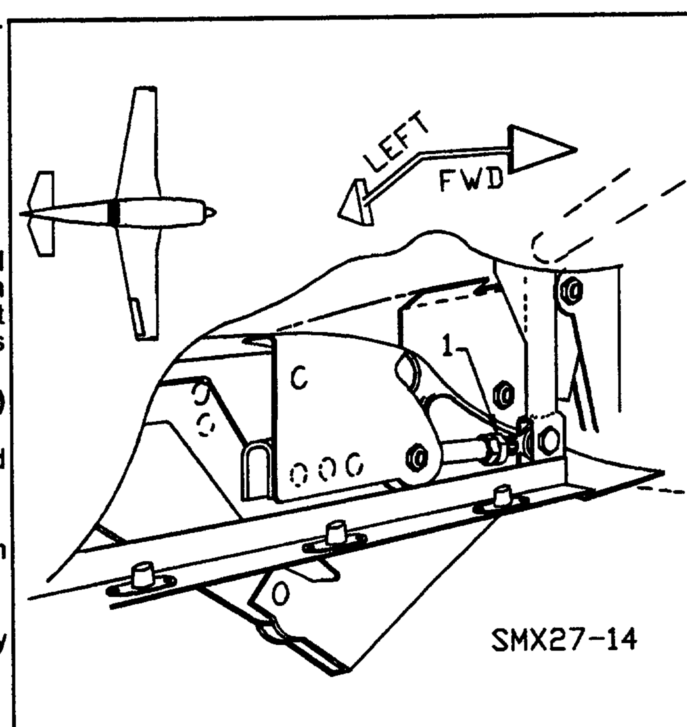
The aileron/rudder interconnect system assist in coordinated maneuvers and reduction of adverse yaw during turns. The system is connected through springs to allow override of either control movement when input separately.

1. **Aileron/Rudder Interconnect System - Rigging**

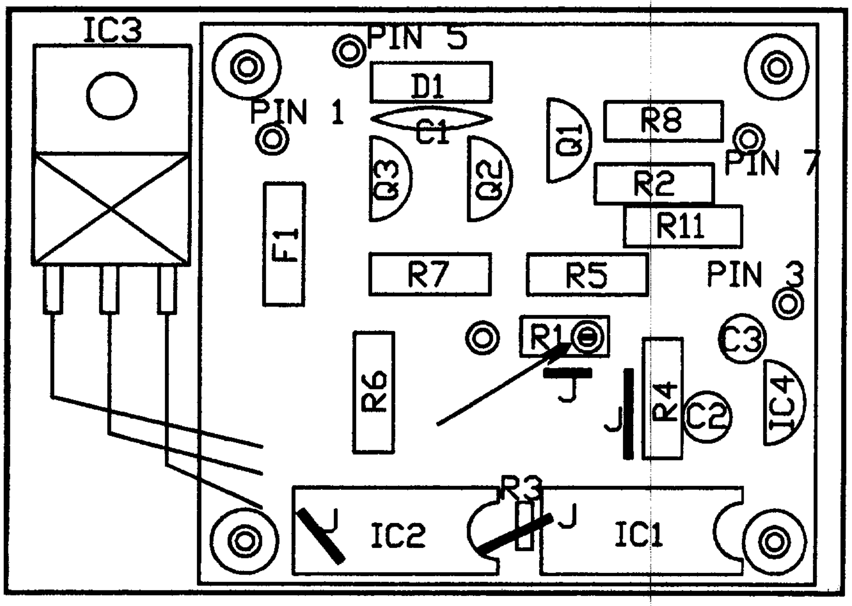
A. With controls in neutral position, position 110002-101 bracket, on center aileron control link, so that the end of 110002-005 bellcrank assembly will be 7.25 in. AFT of 310020 fuselage former.

B. Holding both rudder and aileron controls in neutral position, install springs, P/N 110003-007, on 110002 -005 bellcrank and stops. Position stops on rudder control tube, 915013, so that installed length of each spring is 4.90 inch.

C. Clamp stops & bracket in place. Drill through stop, bracket and into control tube for AN530-4R6 PK screws. Make sure PK screws are in place to secure all three brackets.



WING FLAP ADJUSTMENT - FIGURE 27-16



WING FLAP INDICATOR ADJUSTMENT FIGURE 27-17

27-90-00 - MISCELLANEOUS

27-91-00 - CONTROL SURFACE STATIC BALANCING

Control surface balance must be checked when control surfaces is repaired, altered or repainted. It is recommended that control surfaces be stripped prior to repainting. The control surface balance limits shown in **Figure 27-19** apply to a complete painted control surface only. Complete control surfaces include (as applicable) balance weight, control attachment horn and attaching hardware, static wicks (when installed as optional equipment), and rudder taillight and/or strobe light assembly installed.

Control surfaces must be rebalanced in accordance with the procedures in SECTION 27-93-00.

CAUTION
All control surfaces should be stripped prior to repainting.

27-92-00 - BALANCING EQUIPMENT - STATIC

The design of the balancing fixture is not critical providing the requirements of this section are met.

1. Obtain or otherwise fabricate two (2) knife edge supports approximately one (1) foot in height so that they can be placed on a table and be stabilized to prevent tipping **(See Fig. 27-18)**. The knife edge hinge supports MUST be LEVEL and PERPENDICULAR to the hinge axis of the control surface.

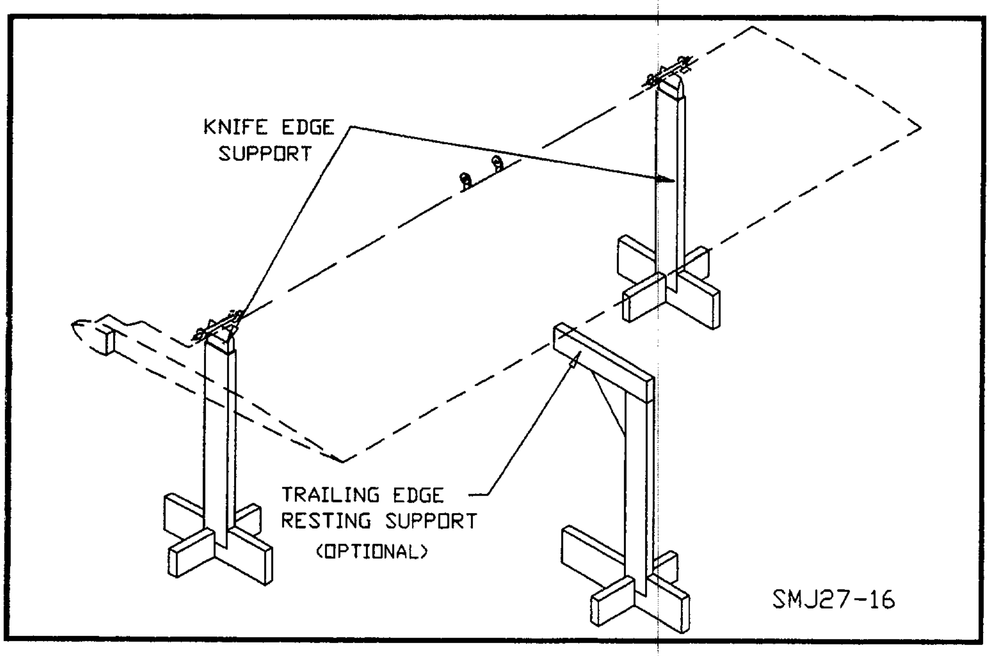
2. Weight Scales:Scales used to record weights must be accurate within 0.02 lbs or 1/2 oz.

27-93-00 - BALANCING PROCEDURE

27-93-01 - DETAIL PROCEDURES - STATIC BALANCING

1. A line drawn through the hinge line support points must be level and perpendicular to the supporting knife edges.

2. The supporting knife edges must be horizontal and parallel to each other within the requirements of step 1. Above.



CONTROL SURFACE STATIC BALANCE DIAGRAM
FIGURE 27-18

NOTE
Ailerons are balanced up-side down on knife edge supports.

3. Elevators and rudders are balanced with the "Control Horn" pointing upward.

4. All control surfaces are balanced with the hinge center line and the tip rib chord line level. Two tooling holes are located in the tip ribs and are on the rib chord line (rib center line). Chordwise level can be obtained by using a spirit level and pins inserted into these tooling holes.

5. Install a 1/4 inch bolt or pin through the inboard and outboard AILERON hinge bracket. Install a No. 10 bolt or pin through inboard and outboard ELEVATOR hinge bearing, and top and bottom RUDDER hinge bearing.

6. Positon and level the control surface on the knife edge hinge supports.

7. Accurately measure control surface load at a measured distance from the hinge axis as far from the hinge axis as possible **(Figure 27-18).** Measurements should be taken in a draft free environment. Calculate the moment (arm times weight) and compare the results with **Figure 27-19**.

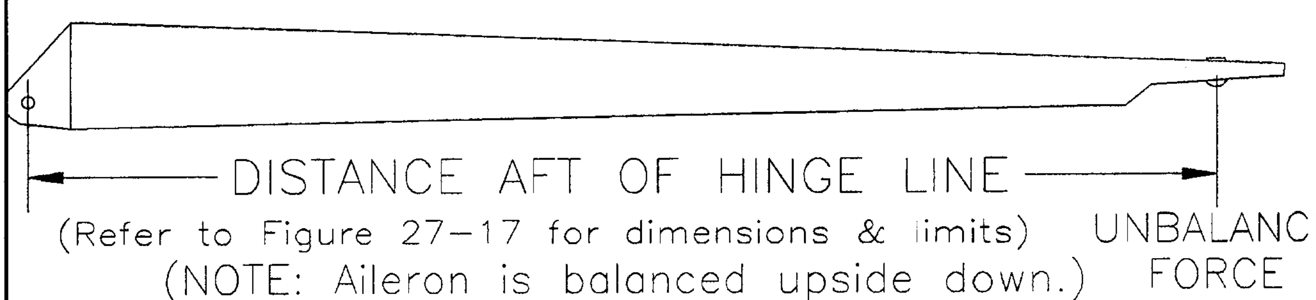
8. Control surfaces MUST BE RECHECKED for balance after any painting, stripping, repair or alteration.

NOTE

If specified moments cannot be met (reference Figure 27-19), heavier balance weights can be obtained through a Mooney Service Center. This approach should be examined before reworking any repair or restripping and repainting the affected control surface. A lighter weight can be produced by shaving existing balance weight.

SURFACE DESCRIPTION	AIRCRAFT EFFECTIVITY	BALANCING MOMENT LIMITS
430026-507 & -508 ELEVATOR	29-0001 THRU 29-TBA	UNDERBALANCE 11.00 IN.# TO 8.50 IN. #
460043-507 RUDDER	29-0001 THRU 29-TBA	UNDERBALANCE 1.50 IN.# TO AN OVERBALANCE 5.0 IN.#
230015-509 & -510 AILERON	29-0001 THRU 29-TBA	UNDERBALANCE 1.40 IN.# TO AN OVERBALANCE 2.0 IN.#

CONTROL SURFACE BALANCE LIMITS - FIGURE 27-19



DISTANCE FROM HINGE POINT TO UNBALANCE POINT - FIGURE 27-20

FIGURE 27-21 NOT USED.

27-94-00 - CONTROL SURFACE TRAILING EDGE

NOTE

Verify flight control rigging is correct before bending trailing edge.

1. Trimming. A special pair of widenose vicegrip pliers are to be used to bend the trailing edges as necessary (See **Figure 27-22**).

A. Aileron. To correct for a left wing-heavy condition, bend right aileron trailing edge down; to correct for a right wing-heavy condition, bend left aileron trailing edge down.

NOTE

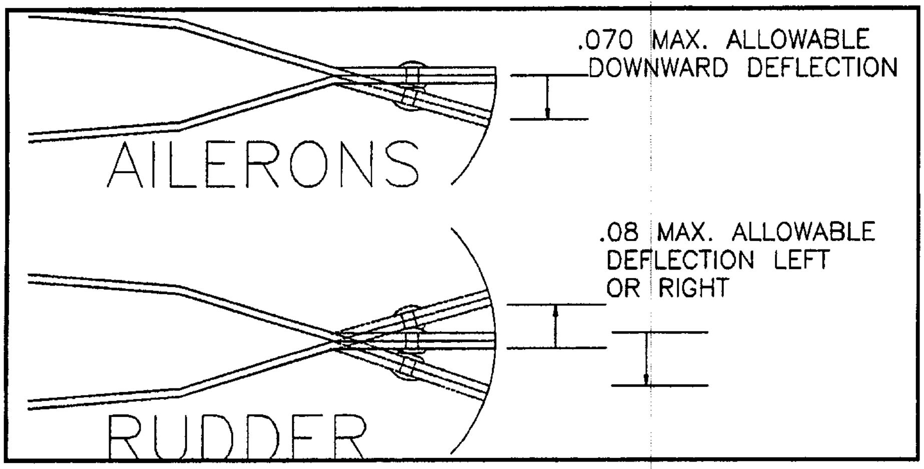
The aileron trailing edge MUST NOT BE BENT UP under any circumstance. Any deformed rivets must be replaced after trimming aileron or rudder trailing edge.

B. Rudder. The rudder trailing edge may be trimmed right or left as required.

C. Elevator. A full span tab is built into each elevator trailing edge and is fixed 7 degrees (+/-) 1/2 degree trailing edge down. No further tolerance is allowed.

27-95-00 - STALL WARNING - MAINTENANCE PRACTICES

1. Stall Warning Switch Removal.



TRAILING EDGE TRIMMING - FIGURE 27-22

A. Remove the screws or rivets attaching the access cover aft of the switch on the lower wing surface.

B. Remove the two adjustment screws which hold the switch to the wing leading edge.

C. Disconnect the two wires from the switch.

2. Stall Warning Switch Installation.

A. Connect the electrical wires to the switch.

B. Position the switch in the opening of the lower wing leading edge, install the two adjustment screws.

C. Replace the access cover securely.

D. Adjust the switch. See STALL WARNING INDICATION SYSTEM ADJUSTMENT.

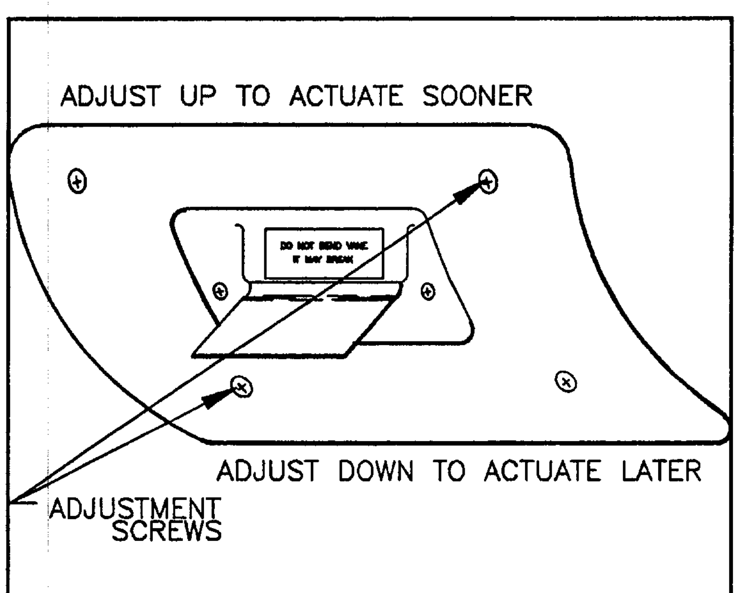
3. Stall Warning Indicating System Adjustment **(Figure 27-23)**. The stall warning switch is adjusted when the airplane is test flown at the factory. Should it require readjusting, proceed as follows: Locate the switch installation on the under surface of the left wing leading edge and loosen the two phillips head screws, one on either side of the vane. If the stall warning has been activating too early, pull the vane BACK and DOWN.

If the stall warning has been activating too late, push the vane up and forward. Moving the vane with the phillips head screws loosened moves the entire unit up or down inside the wing, causing the switch to be closed earlier or later. Retighten the screws after making each adjustment.

NOTE

NEVER TRY TO ADJUST THE SWITCH BY BENDING THE VANE. This part has been heat treated and cannot be bent without damaging or breaking the vane or switch.

As a rule of thumb, moving the vane tip 1/4 inch will change the time the stall warning actuates by about 5 mph of indicated air speed. The only way to test the accuracy of the setting is to fly the airplane into a stall, noting the speed at which the warning horn comes on and the speed at which the full stall occurs. The stall must be made in various configurations, clean, gear and flaps down and power on and power off. It may be necessary to make several alternate adjustments and test flights before the desired setting can be reached. The stall warning should actuate at no less than 5 KTS. nor more than 10 KTS. preceding the stall and shall continue until the stall occurs in power off configuration. The rate of speed reduction shall not exceed one knot per second with the airplane trimmed to 1.5 times the stall speed. The switch setting should be checked and adjusted as necessary whenever a wing or wing leading edge is replaced or extensively repaired, or if a new switch is installed. The switch should require no adjustment in normal service.



STALL SWITCH ADJUSTMENT - FIGURE 27-23

27-95-01 - TROUBLE SHOOTING - STALL WARNING SYSTEM

TROUBLE	PROBABLE CAUSE	REMEDY
Warning system inoperative.	Warning circuit breaker tripped.	If circuit breaker persist in tripping, check for grounded circuit.
	Open circuit.	Check for continuity.
	Defective warning horn switch.	Replace switch.
	Defective warning horn.	Replace horn.
Horn continues to blow.	Defective warning horn switch.	Replace switch.

27-96-00 - SPEED BRAKE SYSTEM

The speedbrake system is currently installed in all M20R aircraft as standard equipment. The manufacturer, Precise Flight, Inc., can provide detail parts and maintenance information for the cartridge assembly. Some of the electrical circuity wiring, relays, C/B, etc. are installed from Mooney drawings.

Components for these are available through your Mooney Service Center.

The relay for the Electric Speed Brake System is located under the rear seat area, on LH bukhead.

The schematics, located in envelopes and the electrical parts list, SECTION 91 of this Service & Maintenance manual cover the electrical system component identification.

27-96-01 - SPEED BRAKE CARTRIDGE - REMOVAL AND RPLACEMENT

1. REMOVAL

A. Remove access panel from under side of wing, directly beneath the cartridge.

B. Disconnect either the vacuum line connection or the electrical connector on the cartridge.

C. Remove screw from bottom of wing just aft of cartridge holding mount strap to bottom of wing.

D. Remove screws from top of wing around top of cartridge slot.

E. Slide cartridge forward to start mount strap through bottom hole, slide cartridge out from bottom of wing.

2. INSTALLATION

A. Reverse removal procedures.

(1) Leave attachment screws loose until proper alignment of cartridge to slots in wing is verified.

(2) Tighten all screws.

(3) Test operation of Speed Brakes on the ground to assure there is no binding either up or down. Airloads on Speed Brakes can cause a slightly different alignment during deployment, therefore it is recommended that a **TEST FLIGHT** be done to test operation of Speed Brake System to verify proper operation. Readjust alignment of cartridge to wing slots until proper operation in flight is obtained.

27-96-02 - MAINTENANCE - SPEED BRAKES

Every 1000 hours the following maintenance procedures are recommended:

1. Remove speedbrake cartridges in accordance with SECTION 27-96-01,1.

A. Visually inspect doubler and mounting hardware for structrual integrity.

B. Visually inspect for chafing on all moving parts.

C. Manually operate the speedbrake doors and feel for smooth operation, both extending and retracting.

D. Inspect cable (on vacuum units) especially around pulleys for fraying.

E. Inspect pulleys (on vacuum units) for any wear or damage.

2. Report any deficiencies to Precise Flight, Inc.

3. Re-install Speed Brakes into wing in accordance with SECTION 27-96-01, 2.

BLANK

CHAPTER

28

FUEL

CHAPTER 28

FUEL

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CHAPTER 28

FUEL

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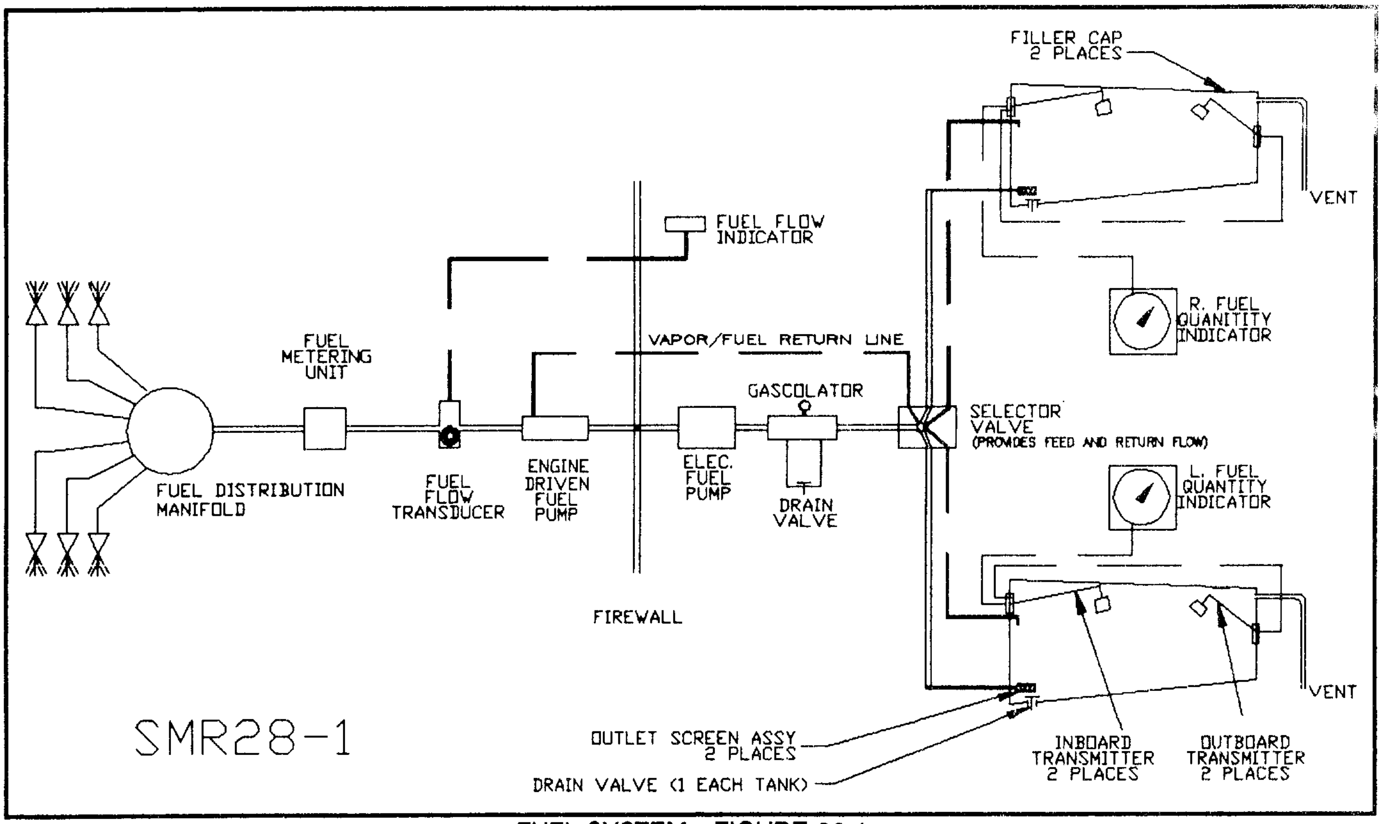
28-00-00 - GENERAL

Internally sealed, integral fuel tanks are in the L & R, forward, inboard sections of the wing. Fuel feeds from either tank to a selector valve through a gascolator, with a low-point drain, through the emergency boost pump to the engine-driven fuel pump and to the fuel injector system on the engine. Fuel quantity indicators are electrically operated with 2 transmitters (inboard and out board) located in each tank.



FUEL SYSTEM - FIGURE 28-1

28-00-01 - FUEL FILLER CAP ASSEMBLY MAINTENANCE

Fuel filler port cap assemblies should be inspected periodically for proper sealing, condition of O-rings and should be serviced occasionally to prevent hard to open or close conditions.

1. The O-ring seal (1) (Figure 28-2) around the cap assembly should be kept clean and free of dirt or grit that might cause abrasive action on seal or mating flange. Occasional lubrication with petroleum jelly or Tri-Flow (Teflon Lubricant) will keep O-ring soft and pliable.
2. The shaft (2) running through center of cap housing, that actuates the rotating lock plate (3) should be lubricated occasionally with Tri-Flow, or equivalent, to prevent binding while opening or closing cap assembly. This should also lubricate the O-ring (4) that seals this shaft.

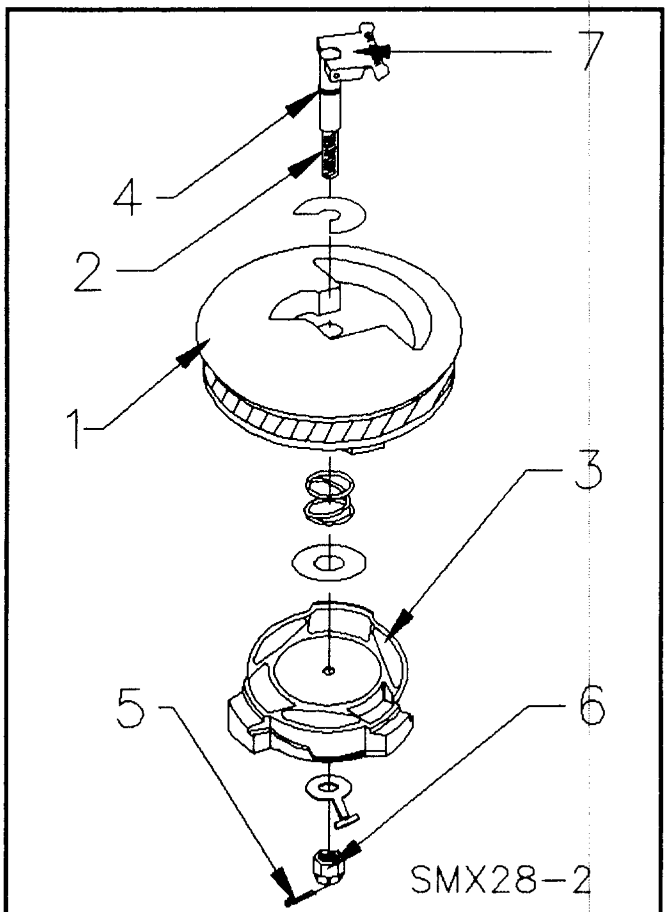
WARNING
Water can enter the fuel tank through a loose fitting or damaged cap. This should be corrected as soon as possible.

3. The sealing capability of each cap assembly should be checked periodically and at each annual inspection. This can be accomplished per the following procedures:

A. Remove cap assembly from wing filler port and inspect O-ring (1) for damage, cracks or brittleness. Remove and replace if needed.

B. Adjust tension of shaft (2) and rotating lock plate (3) by removing cotter pin (5) from nut (6) on threaded portion of shaft (2). Tighten nut (6) so cap assembly handle (7) can be opened, turned and shut with hand pressure and still provide necessary seal of cap assembly to keep water from entering fuel tank.

NOTE
Fuel selector should be in the OFF position before proceeding with paragraph C to pressurize the fuel tanks.



FUEL FILLER CAP ASSEMBLY MAINTENANCE

C. Connect rubber hose to each tank's vent line. Apply **ONLY** one-half pound (1/2 psi) air pressure. Check for fuel cap leaks by soaping circumference and shaft area of filler cap assembly and observing bubbles. Replace O-ring if bubbles are observed and adjustment of lower nut (6) does not stop leak.

CAUTION
Use only one-half pound (0.5 psi) of air pressure in tank.

28-10-00 - STORAGE

28-11-00 - FUEL TANK FIELD REPAIR

This paragraph outlines procedures recommended for repair of integral fuel tanks. Tank repairs should not be attempted until these instructions are fully understood. Refer to Service Bulletin SB M20-230 during resealing of tanks.

1. Approved Materials.
A. Sealants.

WARNING
Sealants are safe only when handled with reasonable care. Avoid ingestion and all contact with the body, especially with open breaks in the skin. Wash hands before eating or smoking. If accelerator contacts the skin, flush area with warm water.

(1) Brush sealant - PR1422-A-1/2 or A-2 or CS3204 A-1/2, A-2 (MIL-S-8802D Class A).
(2) Filleting Compound - PR1422 B-1/2, B-2 or CS3204 B-1/2, B-2 (MIL-S-8802D Class B).
(3) Removable access panel sealant - PR1428-B.
(4) Protective sealant - PR1005-L (MIL-S-4383B).
B. Gloves - Polyethylene
C. Metal cleaning solvent - Turco 657 wipe solvent.
D. Cheese cloth.
E. Turco leak detector or bubble fluid.
F. Methyl ethyl keytone (MEK) (thinner for PR 1005-L).

NOTE
Approved materials may be obtained from your local Mooney Service Center. Sealants may also be obtained from Products Research Co., 5454 San Fernando Road, Glendale, CA. 91209; or Chem Seal Corp., 11120 Sherman Way, Sun Valley, CA. 91352.

2. Handling and Mixing Sealants.
A. Sealant Material Characteristics.
(1) Application life is the time that the mixed compound remains suitable for application. Application life ratings are always based on standard conditions of 75° F. and 50% relative humidity. For every 10° F. rise in temperature, application life and cure time is reduced by half; for every 10° F. drop in temperature, application life and cure time is doubled. High humidity at the time of mixing slightly reduces the sealant application life.
(2) Maximum unopened container life, with sealant at 80 ° F., is six months.
(3) Sealant application life, tack-free curing time, and curing rates are as follows:

CURE RATES

(a) Brushable Type Sealants

CLASS A	Tack-Free Time (HOURS)	CureRate (HOURS)	Application Life (HOURS)
PR1422 A-1/2	10	30	1/2
PR1422 A-2	36	72	2
CS3204 A-1/2	8	30	1/2
CS3204 A-2	24	72	2

(b) Filleting Compound (and on wing walk access panel).

CLASS B	Tack-Free Time (HOURS)	CureRate (HOURS)	Application Life (HOURS)
PR1422 B-1/2	10	45	1/2
PR1422 B-2	36	72	2
CS3204 B-1/2	8	30	1/2
CS3204 B-2	24	72	2
CS3204 B-4	36	76	4

Follow procedures with sealant kits to properly seal tanks.

(c) Access Door Sealant (except on wing walk access panel)

CLASS B	Tack-Free Time (HOURS)	CureRate (HOURS)	Application Life (HOURS)
CS-3330-B	8	16	2
PR1403-G-B2	10	48	2
PR1428-B	8	16	2

(d) BRUSHABLE TOP COAT PROTECTIVE SEALANT

	Tack-Free Time (HOURS(	CureRate (HOURS)	Application Life (HOURS)
PR1005L	1/3	4	---
CS3600	---	---	---

Allow 24 hours cure time prior to refueling tanks. Air must be allowed to circulate through tank access covers.

B. Sealant Mixing

(1) For best results, use kits with proper proportions of base compound and accelerator.

(2) To avoid excessive air entrapment, slowly stir accelerator into base compound. Continue mixing for seven to ten minutes. Scrape sides and bottom of container to include all compound in mixture and to insure uniform blending. Scrape mixing paddle on edge of container to remove unmixed compound. Be sure to use all of the accelerator.

(3) Place small amount of mixture on a clean strip of aluminum and spread sealant. Visually examine sealant film to determine whether accelerator is visible in particle form. If particles of accelerator are visible, continue mixing operation. If course particles of accelerator persist after mixing thoroughly, reject entire mixed batch.

NOTE
Sealant in tube form which have mixing instructions on each tube. Read and comply with these mixing instructions prior to sealant application.

3. Cleaning Surfaces to be Sealed.

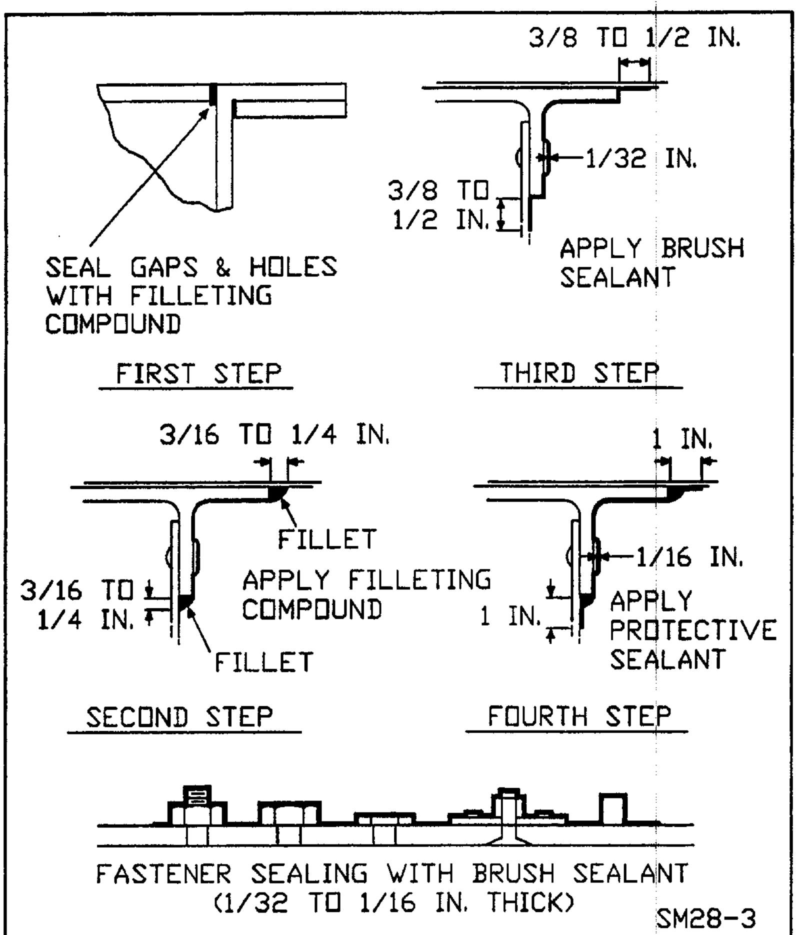
A. Clean metal surfaces to be sealed with Turco 657 Wipe Solvent or Methyl Ethyl Keytone (MEK). Wipe surface dry with clean cloth. Do not allow solvent to evaporate.

B. Allow cleaned, wiped surface to dry five to ten minutes before sealant application.

NOTE
Apply sealant as soon as possible after cleaning/drying. Store and handle parts in a manner that will prevent finger prints, dust, dirt, or other foreign substances from accumulating on surfaces to be sealed.

NOTE
Refer to Mooney SB M20-230 for proper application of sealant and drain holes that are to be left open.

4. Sealant Application. All old sealant must be removed. Use a sharp, non-metallic scraper (Formica or lexan). When sealant has been removed, clean area throughly and reseal tank as follows:



FUEL TANK SEALING - FIGURE 28-3

A. Fillet Sealing.

(1) Be certain that surface to be sealed is totally clean and free from oil, grime, finger prints, etc.

(2) Refer to (Figure 28-3) for typical fillet size.

(3) Join fillets laid on intersection joints to produce a continuous fillet.

(4) Seal all difficult and hard-to-reach areas first to preclude the possibility of their being overlooked or improperly sealed.

B. Filleting Compound Application.

(1) Use a spatula or an extrusion gun with a 1/8 - to 1/4 - inch nozzle opening for laying fillets at edges of all seams. When using an extrusion gun, hold gun perpendicular to seam so that extruded sealant will pack tightly.

(2) Use a spatula to pack sealant firmly in place while working out air pockets. Shape each fillet evenly.

C. Brush Sealing.

(1) Brush sealant (PR 1422-A-1/2, A-2 or CS3204 A-1/2, A-2) over all seams, rivets, nuts, and bolts. A one inch, stiffbristle brush is recommended for sealant application. Force sealant into all gaps with brush strokes parallel to seams. Use a circular brush action to deposit an even coating of sealant around rivets, nuts, and bolts. Coating should be approximately 1/32-inch thick. Use considerable brush action to force sealant into all small crevices and to obtain good adhesion. Air pockets under the sealant, that will open up in the form of holes or voids soon after application, will result from improper application. To repair holes or voids, press sealant in place using a spatula.

(2) When edge of a flange protrudes 0.040 inch or less, or where the seam cannot be clearly defined, apply two 1/32-inch brush coats. Allow first coat to cure about four hours or until it becomes rubbery before applying second coat. The second coat should overlap edges of first coat by about 1/4 inch.

D. Protective Sealant.

(1) Using short, even strokes, brush on a smooth and continuous coat of PR 1005-L over sealant. The protective sealant coat should extend one inch beyond edge of filleting compound.

(2) Allow first protective coat to cure 20 minutes at 75° F., or until tack-free; then apply a second brush coat of PR 1005-L. Make every effort to obtain a completely bubble-free, continuous top coat. DO NOT REBRUSH over areas, as doing so will only cause dragging and will break coating continuity.

E. Upper Wing Tank Access Panel Sealing.

(1) Apply a coat of access door sealant (PR1428-B) to either faying surface using a short stiff bristle brush, spatula, or extrusion gun. If an extrusion gun is used, smooth the sealant with a brush or spatula. Cover the entire faying surface with a sealant coat of sufficient thickness (1/32 to 1/16 inch) to assure extrusion along edges of faying surface when mating parts are assembled. Access panels in wing walk area should be sealed with PRC 1422, Class B filleting compound.

(2) Assemble parts immediately after application of sealant and tighten screws to obtain as near as possible a metal-to-metal contact.

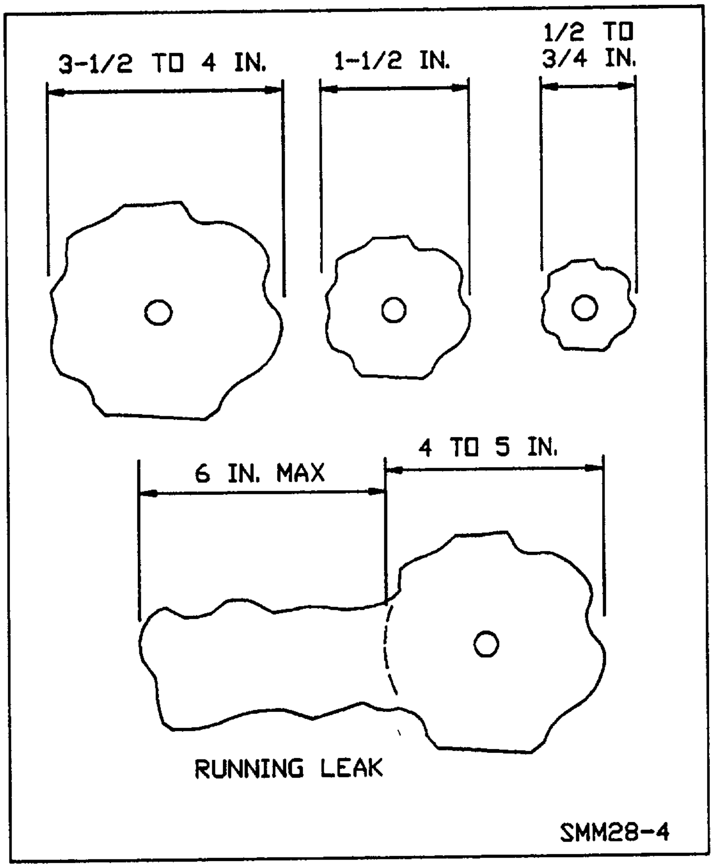
(3) Remove extruded sealant from wing surface after installing fasteners.

28-12-00 - FUEL TANK LEAK REPAIR

1. Leak Description. It is necessary to periodically inspect the fuel tanks. Inspection is particularly important in confined areas of the aircraft that are not exposed to the airstream. Identification and classification of fuel leaks that occur in both confined and open areas is necessary to differentiate between those leaks that require repair before flight and those which do not constitute a flight hazard. The size of the wetted area around a leak is an indication of the leak intensity. All fuel leaks must be recorded by describing location and intensity of leak in the aircraft log book.

2. Classification of leaks as to Intensity and Location. (Refer to Figure 28-4).

A. Intensity Classification.



FUEL LEAK CLASSIFICATION - FIGURE 28-4

(1) Stain—A slow fuel leak that tends to evaporate as soon as it is exposed to air.

(2) Seep—A fuel leak that reappears shortly after area is wiped clean.

(3) Heavy Seep—A fuel leak that reappears immediately after area is wiped clean.

(4) Running Leak—A fuel leak that flows steadily.

B. Slow-to-heavy seeps occuring in open areas, such as wing surfaces exposed to the airstream, are leaks which do not constitute a flight hazard and need not be repaired prior to flight, providing the condition causing leak cannot result in a leak of greater intensity during flight. Seeps considered permissible for flight must be frequently inspected to insure that no increase in intensity has occured.

C. A running leak and any leak in a confined area that is not exposed to the airstream should be repaired before the next flight.

3. Leak Detection.

A. External Leak Detection After Refueling. To be able to trace a leak from where it appears on an outer tank or wing skin to its true source inside the tank, the exact point where fuel is escaping from tank, must be determined.

(1) Use compressed air to blow and evaporate fuel from seams and crevices of leak area. Attempt to define exact point where fuel is escaping from tank.

(2) Small seep leaks can be traced with raw edges of torn paper. The fuzzy edge absorbs fluid and gives a good visual indication of fuel presence when brought in contact with suspected leak points.

(3) After tracing leak to its exterior source, mark location and drain fuel tank.

B. Internal Leak Detection. To make a permanent repair, it is mandatory that the true source of the interior leak be located. The fuel tank is a network of seams and fuel may flow through or along a seam or from one seam to another. Fuel may channel a few inches or several feet to where it appears on external skin surface.

(1) Enter tank through inspection access panels and inspect sealant in general area of outside leak point. Look first for bare seams, rivets, and bolts in difficult-to-seal areas. Inspect sealant for blisters, pin holes, cracks, splits, and loss of adhesion. Mark all suspected flaws with masking tape.

(2) Test each suspected flaw from inside tank using compressed filtered air at 20 to 30 PSI. Hold air nozzle against flaw and closely check outside leak point for evidence of fuel.

(3) After testing each suspected flaw from inside tank as outlined above, and if no leak source can be discovered, apply soapless bubble fluid to exterior and again apply air pressure to flaws from inside tank.

(4) If above tests fail to locate leak source, apply air pressure (10 PSI MAX) to external leak point after removing all traces of fuel from tank and applying soapless bubble fluid to tank interior seams per SECTION 28-13-00.

4. Leak Repair.

A. Temporary Repair of Fastener Leaks. Generally, all leaks in enclosed areas and running leaks in open areas constitute a flight hazard. Fastener leaks of this category may be temporarily repaired by applying a sealant fillet over fastener head on fuel tank exterior. For a temporary repair to be satisfactory, structural integrity must be retained in leak area. To make a temporary fastener-leak repair:

(1) Remove enough fuel from tank to drop fuel level below leaking fasteners.

(2) Clean fastener head and adjacent surface with Turco 657 Wipe Solvent or MEK and dry thoroughly. Fastener head and adjacent metal must be entirely free from paint, dirt, and oil.

(3) Apply a 1/8 inch thick coat of PR 1422 (or CS3204) B-1/2 or B-2 over head and around fastener.

(4) Allow sealant to cure until firm and rubbery.

(5) Refill tank and examine repair periodically. If leak reoccurs, sealant must be removed and area recleaned prior to making another temporary repair.

B. Permanent Leak repair. If leak source is found to be around a rivet or threaded fastener, the repair procedure shall be to restrike rivet or retorque fastener to maximum permitted torque value. Any one rivet may be restruck only one time. If leak continues, replace the rivet.

(1) Repair any sealant damage due to restriking or retorqueing a fastener.

(2) Remove sealant in immediate area of leak source using a sharp non-metallic tool. A chisel-shaped formica tool is recommended. Scarf or taper ends of existing sealant so that new sealant can form a continuous and smooth overlap.

(3) Thoroughly clean repair area using Turco 657 Wipe Solvent or MEK. Wash one small area at a time. To prevent redeposit of oil and dirt on surface, dry with a clean cloth before solvent evaporates. Always pour solvent onto wash cloth to prevent contamination of solvent supply; do not dip cloth into solvent.

(4) Thoroughly dry cleaned area by blowing filtered air over immediate area until there is no possibility of solvent or fuel entrapment under adjacent sealant.

(5) Apply sealant as required for repair (See Figure 28-3). Repaired fillets must be blended into existing fillets with a spatula or an appropriate tool.

(6) Allow all repaired sealant to cure tack-free and apply two brush coats of PR 1005-L to repair area (Refer to paragraph 28-11-00, 4, D).

28-13-00 - SOAPLESS BUBBLE FLUID FORMULA PREPARATION FOR LEAK CHECK

1. Materials.

A. Three ounces of either sodium bichromate, potassium chromate or potassium dichromate.

B. Three and one-quarter ounces Thickening Wax (Carbo Wax 1500).

C. Thirteen ounces Alkaryl Sufonate wetting agent.

D. Distilled water.

2. Solution Preparation.

A. Mix one of the compounds listed in item (A) above with one cup distilled water.

B. Mix item (B) above with one cup distilled water.

C. Mix item (C) above with four to four and one half gallons distilled water until wetting agent dissolves completely.

D. Mix the three ingredients (A), (B) and (C) together and add enough distilled water to make five gallons of solution.

NOTE
Amount of each ingredient may be reduced for a smaller quantity of solution. Solution life is about one week.

CAUTION
Soapless bubble fluid is slightly corrosive and must be completely removed by washing freely with water followed by scrubbing.

CAUTION
When removing lower inboard access panels, caution should be exercised, during removal, so fuel outlet tubes will not be damaged or bent.

28-14-00 - FUEL ADDITIVES

Under certain conditions of temperature and humidity, water can be present in fuel in sufficient quantities to create ice formations within the fuel system. To prevent this, add Anhydrous ISO-PROPYL Alcohol to the fuel supply in quantities not to exceed 3% of total fuel volume per tank.

CAUTION
Ethylene glycol monomethyl ether (EGME) or other additives are not recommended due to potential deteriorating effects within the fuel system.

28-20-00 - DISTRIBUTION

The fuel system is comprised of two fuel pumps, an engine driven, gear type pump and an electrically driven, auxiliary, boost pump. The boost pump is connected to switches on the instrument panel. The boost pump is used to provide fuel pressure for starting and to assist in hot, ground operations to prevent vapor lock.

28-21-00 - FUEL BOOST PUMP REMOVAL AND INSTALLATION

1. Auxiliary Electric Boost Pump Removal.
   A. Remove electrical leads.
   B. Turn fuel selector valve - OFF.
   C. Disconnect inlet and outlet fuel lines.
   D. Remove fuel pump.
2. Reverse the removal procedure for reinstallation.

Refer to SECTION 71-00-51, 4 for Boost Pump Set-Up.

CAUTION
Do not run pump dry for more than 15 seconds.

NOTE
When the aircraft will not be flown for a period of time, refer to Sections 10-10-01,10-10-02 & 10-10-03.

28-22-00 - GASCOLATOR SCREEN CLEANING

Gascolator screen removal and cleaning; (a) Remove belly skin just aft of nose wheel well, (b) Turn fuel selector valve - OFF, (c) Remove safety wire on bottom nut; remove nut, (d) Remove sump and screen by pulling down, (e) Clean screen. (f) Reverse removal process to reinstall. Take care not to damage O-rings, (g) Lubricate O-rings with clean engine oil before installing, (h) Torque nut 10 to 15 in. lbs., (i) Safety wire exactly as original installation.

28-23-00 - FUEL INJECTION SYSTEM

28-24-00 - ENGINE PRIMING

There is no separate priming system on the M20R aircraft. Operating the boost pump switch in the cockpit turns auxiliary fuel pump -ON. The time for running pump, for starting purposes, is dependent upon outside ambient temperature (See POH/AFM Section IV for chart).

28-25-00 - FUEL SELECTOR VALVE REMOVAL & INSTALLATION

The fuel selector valve is located below floor board just aft of console.

1. Drain both fuel tanks.
2. Disconnect inlet lines at valve body.
3. Disconnect outlet line at valve body.
4. Remove handle above floorboard in fuel selector pan.
5. Remove screws that mount valve to tubular structure.
6. Remove valve.
7. Reverse removal procedure to install valve.
8. Leak check fuel system.

28-30-00 - DUMP

The fuel tanks can be emptied for maintenance purposes by (1) removing sump drains in lower panel of each fuel tank and allowing fuel to drain into suitable container or (2) disconnect fuel line at outlet of fuel pump and use boost pump to transfer fuel from both tanks into a suitable storage container.

28-31-00 - FUEL SYSTEM DRAINS

Fuel drains are installed at aft inboard corners of each wing tank and on gascolator, the lowest point in the fuel system. The engine manifold and engine-driven fuel pump drains join at a juncture on right side of engine. A single drain line dumps fuel overboard below cowling. Tank drains are recessed and spring loaded closed. An O-ring at lower flange seals drain valve seat.

28-32-00 - FUEL VENTS

Fuel tanks are vented from outboard upper edge. This vent is routed outboard through wing structure and vented overboard through a NACA vent on lower wing surface. Expansion of fuel takes place inside tank.

NOTE
It is important that fuel tank vent tubes protrude only enough to be flush with lower wing skins.

28-40-00 - INDICATING

28-41-00 - FUEL QUANTITY INDICATING TRANSMITTERS

The fuel quantity indicating system has two fuel quantity transmitters in each wing tank, one on I/B wing tank rib and one on O/B wing tank rib. Each pair of transmitters are electrically connected to its applicable fuel gauge (L or R) in cluster gauge and work in series with each other to indicate fuel quantity.

1. Fuel Quantity Transmitter(s) REMOVAL.

Drain fuel from tank. Reference 28-30-00.

A. I/B Transmitter removal

(1) Remove Pilot or Co-Pilot seat as needed.

(2) Remove interior panel, LH or RH as needed.

(3) Locate & remove transmitter wires.

(4) Remove six screws attaching transmitter to rib doubler.

(5) Remove transmitter from rib.

B. O/B Transmitter removal

(1) Gain access through lower access cover outside of tank area.

(2) Locate & remove transmitter wires.

(3) Remove six screws attaching transmitter to rib doubler.

(4) Remove transmitter from rib.

2. For **REINSTALLATION,** reverse the fuel quantity transmitter removal procedure.

A. A calibrated, certified torque application devise must be used to install the fuel quantity transmitters.

B. Snug each screw, then **TORQUE each screw to 20-25 INCH LBS. In a cross flange-random order.**

C. The torque and screw clamp load will naturally relax as the gasket flows to a normal condition. NEVER RETORQUE JUST TO RESTORE THE 20-25 INCH LBS.

"DO NOT OVER TORQUE"
— DO NOT RETORQUE UNLESS LEAKING —

D. Excessive torque or retorquing may warp or distort the transmitter mounting flange and cause a malfunction.

E. Make certain wire from outboard transmitter goes under head of insulating sleeve against the inboard transmitter flange and not under the mounting screw head.

F. System voltage should NOT BE APPLIED to the transmitter terminal. The exicitation from the fuel quantity indicator must be current and voltage limited and incapable of causing ignition of fuel vapor if transmitter wire is inadvertently shorted to ground.

G. Care must be taken to insure that the bottom nut on the terminal stud is not disturbed when the electrical connection is made. This bottom terminal stud nut torque is factory set to provide the correct terminal stud seal preload.

H. Other nuts on the electrical terminals should be tightened as follows:

#6 - 6 in. lbs./ #8 - 12 in. Lbs./ #10 - 14 in. lbs.

28-42-00 - FUEL QUANTITY INDICATOR

Two fuel quantity gauges are in instrument cluster gauge. These gauges indicate percentage of fuel remaining. Each gauge operates by changes in resistance of two transmitters located in each fuel tank.

28-43-00 - FUEL QUANTITY ADJUSTMENT PROCEDURE

— AIRCRAFT MUST BE LEVEL —
—TO CALIBRATE FUEL GAUGES—

NOTE
See Section 24-33-00 for Low Fuel warning calibration.

28-43-01 - FUEL TANK CALIBRATION PROCEDURES.

ANALOG GAUGES (29-0001 THRU 29-0169)

1. Fuel tanks - EMPTY.
2. Add 3.0 gallons unusable fuel to either tank.
3. Adjust trim pot marked "EMPTY" on each gauge to read "E" to 1/2 needle width below "E". "EMPTY" trim pot is lower hole on fuel gauge.
4. Add 2.50 to 3 gallons (part of additional 11.125 gallons required for 1/4 gauge reading). Adjust "LOW FUEL" warning trim pot in annunciator panel so Low Fuel warning light JUST comes on (See Section 24-33-00. 4 A and B).
5. Add 8.125 or 8.625 gals. for 1/4 gauge reading. Continue adding fuel in 11.125 gallon increments for 1/2 and 3/4 gauge readings. Gauge to read within +/-1 needle width.
6. Finish filling tank until 47.5 gallons total fuel volume is in each wing tank. Gauge should read "F".
7. Trim pot marked "FULL" (upper hole) should be adjusted, if necessary, so each gauge reads "F" +/-1 needle width.
8. Repeat steps 2 through 7 for other tank.

28-43-03 - FUEL QUANTITY GAUGE ADJUSTMENT

ANALOG GAUGES (29-0001 THRU 29-0169)

Individual Fuel Quantity Gauges within Cluster Gauges installed on aircraft have adjustment capability.

1. Loosen screw, lwr, LH face of gauge.
2. Pull gauge from cluster.
3. With "unusable" fuel in tanks, adjust pot marked "EMPTY" so gauge reads "E". If intermediate or "F" indications are out of tolerance as tank is filled, adjust pot marked "FULL" for correct calibration.

-- **DIGITAL GAUGES** -- (29-0170 thru 29-TBA)

1. Level aircraft to 0° pitch and 0° roll. Verify Annunciator NORMAL-CAL switch is in CAL mode.
2. Remove seats & interior lower side panels to access fuel quantity processors LH & RH.
3. Obtain or construct IAI Processor Test Box (Schematic shown in Figure 28-5A) and 9-Pin Test Harness (Schematic shown in Figure 28-5B).
4. Connect Test Box to Fuel Processor (15 Pin connector).
5. Connect 9-Pin Test Harness between Fuel Processor and Fuel Gauge plug.
6. Connect Digital Voltmeter to Test Harness 2 Pin Female Pin Plug (millivolts out).
7. Turn aircraft power - ON (or use Aux. Power Source).
8. Place "EMPTY-FULL" switch (SW1) on Test Box to EMPTY position.
9. Place SW2 switch on Test Box to M20M/R position.
10. Adjust No. 1 Bias to read 170 mv; if unable to read 170 mv, set to read 110mv (see Figure 28-5 for location of No. 1 Bias)
11. Place "EMPTY-FULL" switch (SW1) on Test Box to "FULL" position.
12. Adjust Master Gain Bias to read 818mv (see Figure 28-5 for location of Master Gain Bias).
13. Place Test Box back to "EMPTY" and adjust to 170mv.
14. Place Test Box back to "FULL" and adjust to 818mv.
15. Repeat Steps 9, 10, 11, 12, & 13 as needed to obtain correct values (EMPTY - 170mv; FULL - 818mv). The correct values will converge in 2 - 3 adjustment iterations.

After completion of Step 14, set switch SW1 in Test Box to "LOW FUEL". Wait 2 - 3 minutes for system to stabilize.

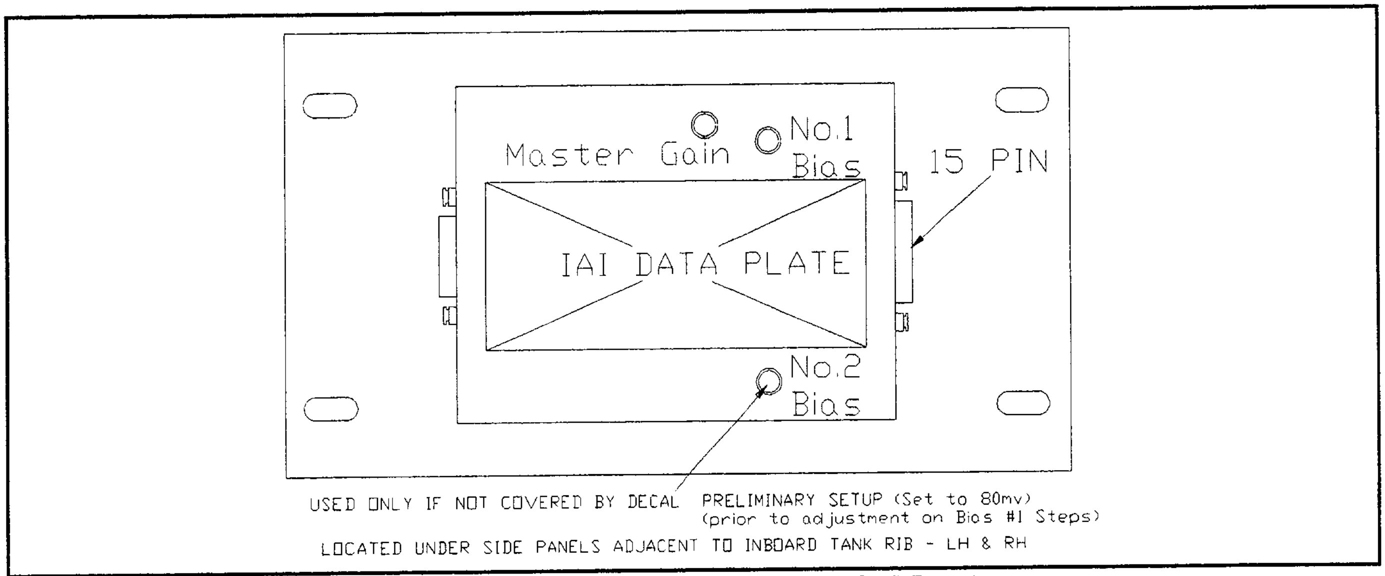
16. Adjust Low Fuel Warning light on IAI Annunciator to illuminate to the Test Box setting. In the "LOW FUEL" position, the millivolts will range between 365mv & 370mv.

NOTE
See Section 24-33-00, 4. A. or B. for detail procedures for adjusting Annunciator Low Fuel Warning for Analog Fuel Gauge systems.

17. Turn power to the aircraft - OFF.
18. Disconnect Test Box from Fuel Processor.
19. Connect aircraft wiring from Fuel Qty. Transmitter to IAI Processor Box. Leave Test Harness connected to other end of Processor Box.
20. Turn power to aircraft - ON.
21. Load unusable fuel (3 gallons); re-adjust No. 1 Bias to read 170mv (if required).
22. Add additional 6 - 8 gallons to tank. Verify Annunciator Low Fuel Warning light is illuminated for the full 6 gallons of additional fuel. The Low Fuel Warning light should extinguish at about 7 gallons useable fuel added.

NOTE
A post setup Test Flight should be conducted to verify that the Low Fuel Warning Light illuminates when approximately 6 gallons fuel remains in the tank as fuel is burned off.

23. After verification that Low Fuel Warning light extinguishes when approximately 7 gallons useable has been added, continue to fuel tank to 44 gallons (FULL) and if required, readjust Master Gain Control to 818mv.
24. Turn power to aircraft - OFF.
25. Remove Test Harness.
26. Repeat Steps 1 through 25 for opposite fuel tank setup.
27. After fuel calibration is completed on both tanks, return "NORMAL-CAL" setting on Annunciator to NORMAL.



FUEL QUANTITY PROCESSOR - FIGURE 28-5

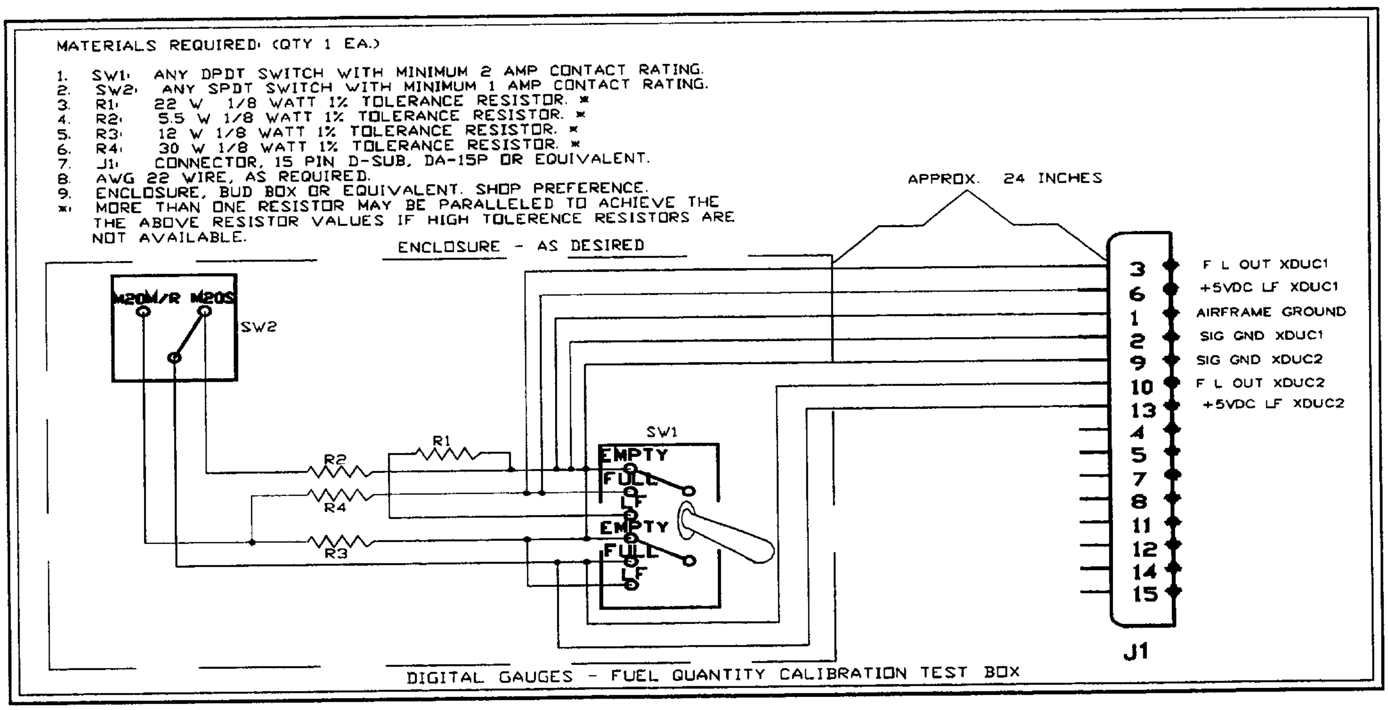


FIGURE 28-5A

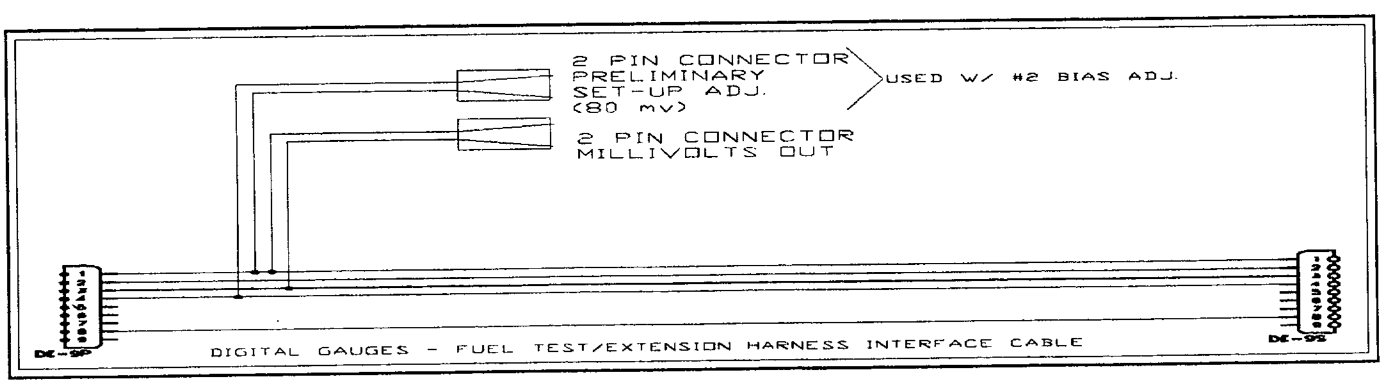


FIGURE 28-5B

NOTE
When removal & replacement of individual DIGITAL FUEL GAUGES are required due to malfunctions, re-calibrate each new fuel gauge to read same as the replaced one in accordance with the adjustment procedures shown in FIGURE 39-4B.

=====================================

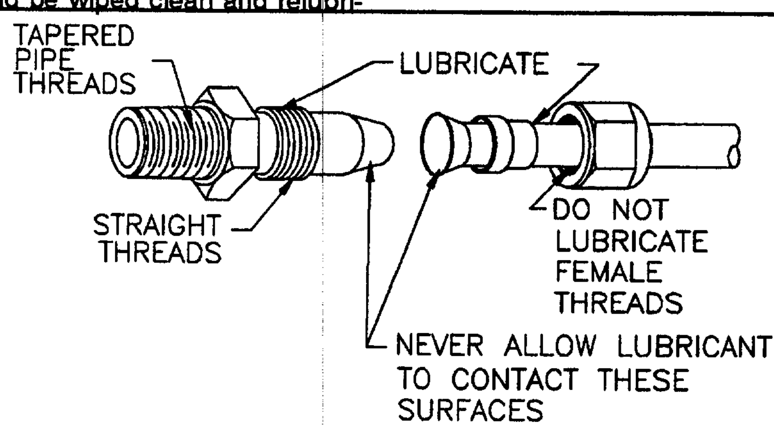
28-90-00 - MISCELLANEOUS

28-91-00 - TROUBLE SHOOTING — FUEL SYSTEM

TROUBLE	PROBABLE CAUSE	REMEDY
Fuel gauge not indicating.	Broken wire.	Check and Repair.
	Faulty transmitting unit.	Replace and adjust.
	Open circuit breaker.	Check and reset.
Fuel gauge indicates full when tanks are not full.	Incomplete ground.	Check ground connection at transmitter.
	Broken wire.	Check and repair.
No fuel pressure indication. (calibrated test gauges connected).	Tank empty.	Check and service tank.
	Defective fuel pump(s).	Check boost pump for proper pressure buildup. Check for obstruction in boost pump screen. Inspect engine fuel pump and check valve.
	Open fuel line.	Repair or replace line.
	Fuel selector in "OFF" position.	Select proper position.
Fuel pressure low or surging. (calibrated test gauges connected)	Obstruction in inlet side of pump. Faulty engine pump.	Check and clear fuel lines. Replace or rebuild pump. Inspect fuel lines and connections for leakage and damage.
	Fuel Selector not in proper position.	Select proper position.
	Air leak in system.	Repair leak.

28-92-00 - FLARED FITTINGS

When installing flared fittings and hoses, make sure threads are properly lubricated with VV-P-236 petrolatum per (Figure 28-5). When previously installed fittings are removed, they should be wiped clean and relubricated before they are reinstalled. Torque all fittings in accordance with flare fitting torque chart, Chapter 5, Figure 5-1.



LUBRICATION OF FLARED FITTINGS - FIGURE 28-5

CHAPTER

30

ICE AND RAIN PROTECTION

CHAPTER 30

ICE PROTECTION

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CHAPTER 30

ICE PROTECTION

LIST OF EFFECTIVE PAGES

30-00-00 - GENERAL

The M20R aircraft incorporates an alternate air system that is designed to open automatically any time the air induction system becomes blocked. This system should be inspected to assure that no heated air is entering the induction system during routine engine operation. (See SECTION 71-62-00 for rigging instructions).

This aircraft includes, as standard equipment, a heated pitot tube assembly. The aircraft may also include as optional equipment: an electrically operated propeller de-ice system and an airfoil anti/de-ice system. Refer to the manufacturers service data for specific maintenance information.

30-10-00 - AIRFOIL ICING PROTECTION

The current airfoil/airframe icing protection system utilizes a thin film of ethylene glycol, to minimize the adherence of ice. The system is compromised of porous, stainless steel, panels fitted to the leading edges of the wing, horizontal and vetical stabilizer. The installation also provides icing protection for the pilot's side of the windshield.

The glycol based de-icing fluid is stored in two interconnected tanks locted under the rear seat. These tanks have a total capacity of 6.0 U.S. gallons and are filled through a filler on the right side of the aft fuselage. Fluid is pumped through nylon lines to proportioning units located in each wing and in the aft fuselage. From these, the fluid is routed to the porous panels and pumped through lazer drilled holes in the panels to flow over the airfoil surfaces. The pilot's side of the windshield is provided fluid through a spraybar fed by a separate pump.

30-11-00 - SERVICING - AIRFOIL ICING PROTECTION

Ethylene Glycol fluid absorbs and retains moisture. Residual fluid that is not washed from the aircraft at recommended intervals can get into skin laps and other faying surfaces and hold moisture. This may eventually dissolve lubricants, and break down corrosion-protection coatings. Solid particles of various foreign materials may attach themselves to the fluid and cause corrosive action of adjacent structural or rotating components.

30-11-01 - WASHING

It is recommended that the aircraft be rinsed with clear water after each flight in which ethylene glycol is used for icing protection. Special cleaning attention should be given to skin lap areas and areas where antennas are mounted if ethylene glycol tends to flow there.

30-11-02 - LUBRICATION

1. Rod End bearings on Flight Controls and Landing Gear systems should be inspected frequently for indication of lubrication being washed off by ice protection fluid. Re-lubricate as needed.

2. Inspect hinge point of all flight control surfaces, landing gear doors, linkages, bellcranks, etc. for indication of lubrication being washed off by ice protection fluid.

30-11-03 - ELECTRICAL

1. Clean electrical circuitry, I.E., contacts, terminals, pins switches, relays, potentiometers, etc. in areas where ice protection fluid flows.

2. Inspect and check operation of electrical components/systems which have circuitry in ice protection fluid flow areas prior to each flight.

30-12-00 - MAINTENANCE - AIRFOIL ICE PROTECTION (TKS SYSTEM)

1. Inspect ice protection system for proper fluid flow at all panels.

2. Check for leaks at all panels with pump in the OFF and ON position.

3. Check system metering pumps (2 each, located under rear seats), for proper operating pressure. Use system Control Panel for valid pressure verification.

A. Select "De-Ice".

(1) The "De-Ice" LED should flash altemating RED/GREEN and the "Anti-Ice" LED should flash RED/OFF as system pressure rises.

NOTE
It may take a few minutes to build to proper operating pressure.

(2) When system pressure is obtained, the "Anti-Ice" LED should extinguish and the "De-Ice LED should show steady GREEN.

(3) Repeat procedure with both metering pumps.

B. Switch OFF for sufficient time for system pressure to fall (approximately 2 minutes).

C. Select "Anti-Ice".

(1) The "Anti-Ice" LED should flash altemating RED/GREEN and the "De-Ice" LED should flash RED/OFF as system pressure rises (approximately 20 seconds).

(2) When system pressure is obtained, the "De-Ice" LED should extinguish and the "Anti-Ice" LED should show steady GREEN.

(3) Repeat procedure with both metering pumps.

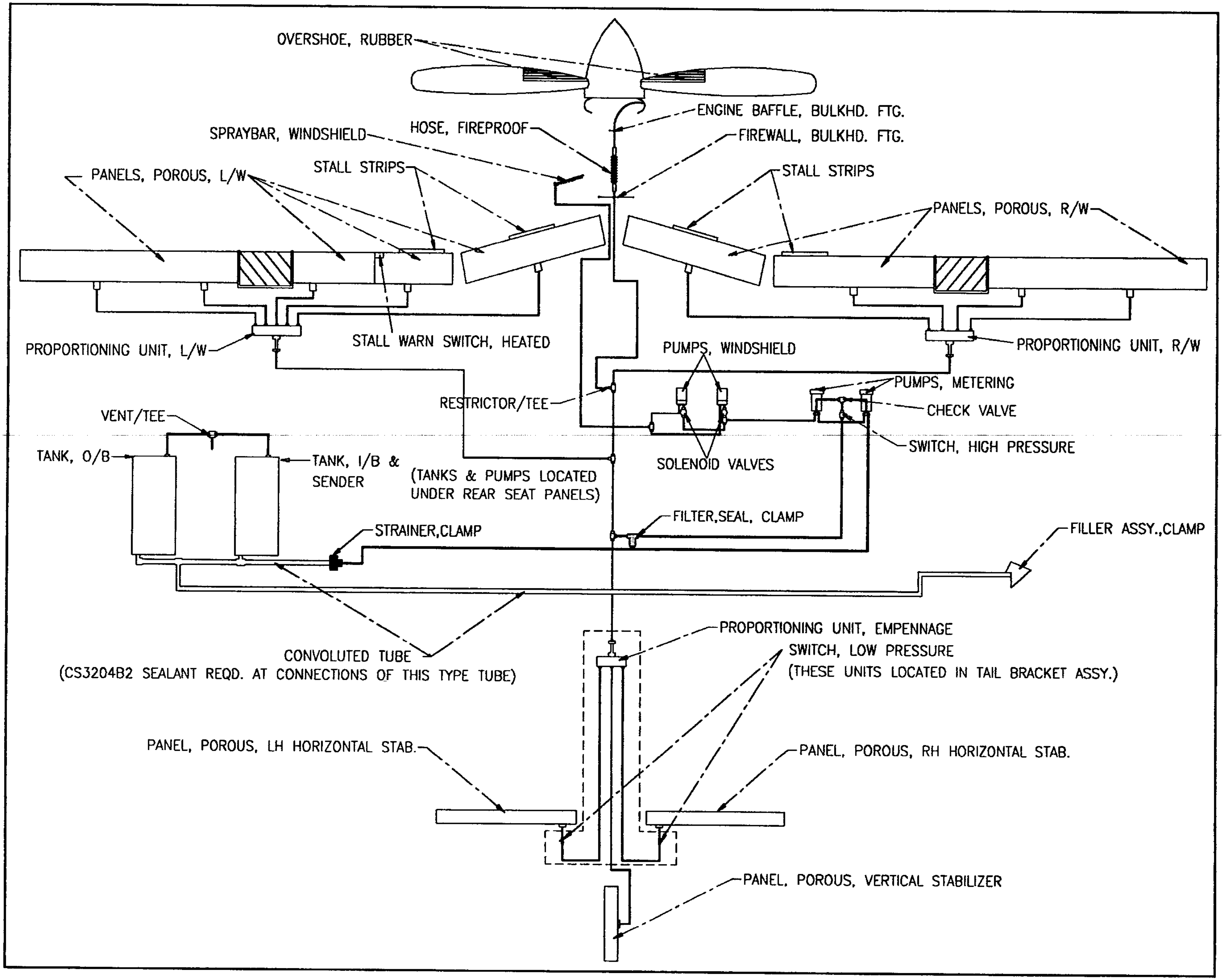
4. Operate Windshield Spraybar on each windshield pump to ensure proper operation and absence of leaks.

5. Filter is located at FUS. STA. 88 under rear seats. Replace as needed. Inspect system filter and replace as needed.

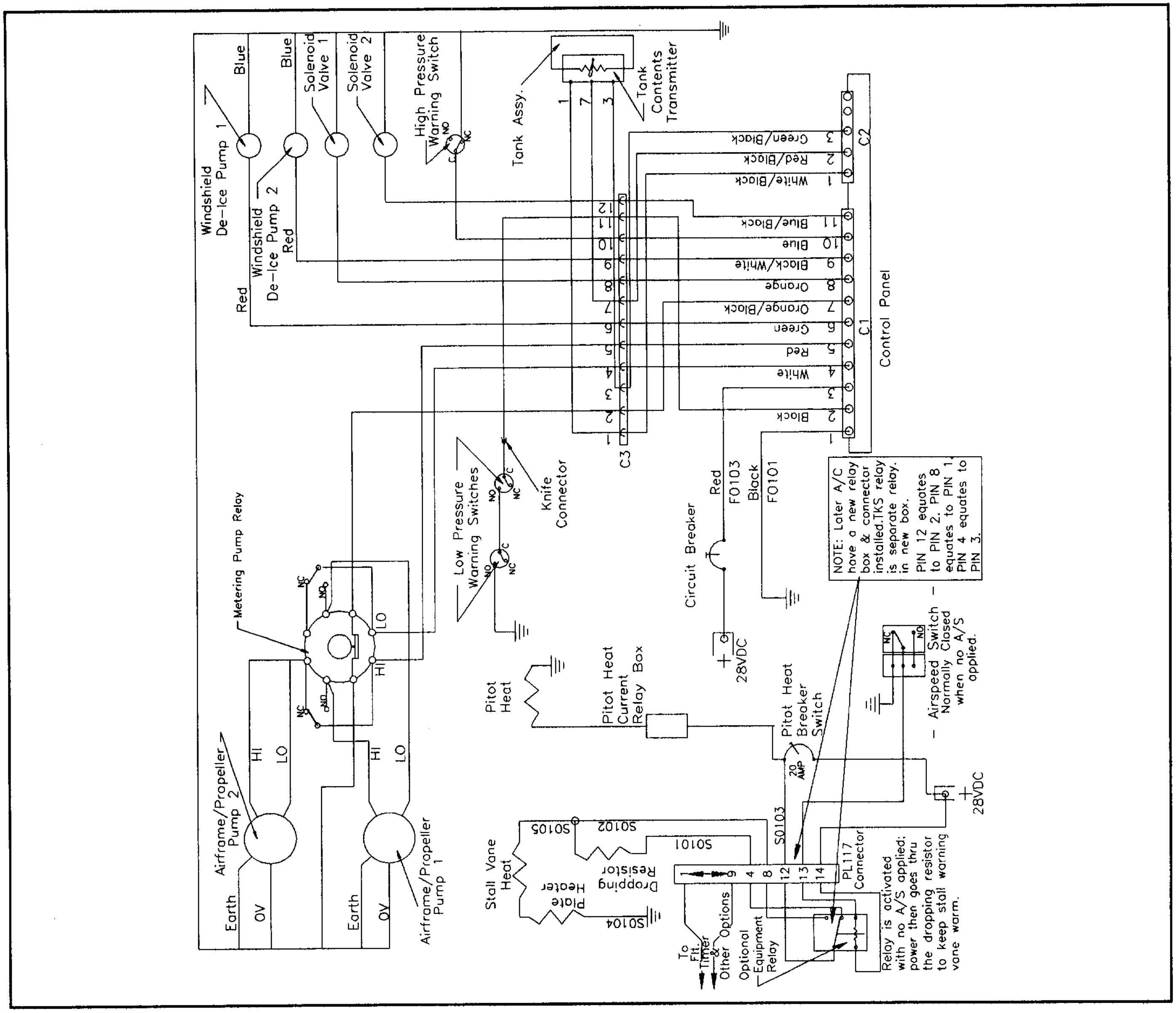
A. The "high pressure" LED will illuminate YELLOW if the filter element requires replacing. It should NOT illuminate during testing but may be tripped ON occasionally during aircraft electrical system switching or during engine start. Cancel by depressing "Reset" switch (use ball point pen tip or similar devise).

B. Test "High Pressure" LED by depressing "Reset" switch. YELLOW LED should illuminate while switch is depressed, but go OFF when "Reset" is released.

5. See ice protection system schematic on next pages.



AIRFOIL ICE PROTECTION FLUID SCHEMATIC - FIGURE 30-1



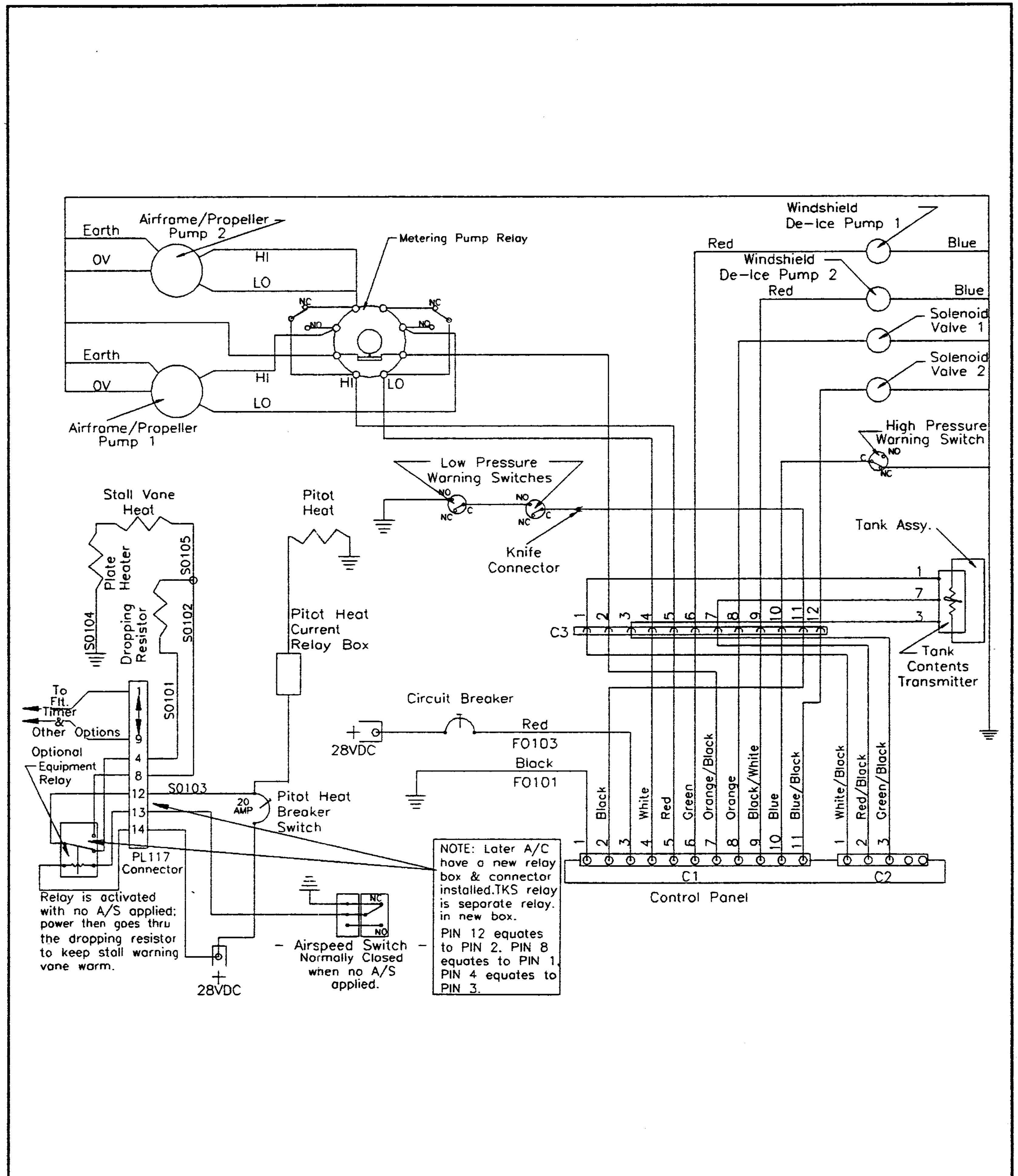
AIRFOIL ICE PROTECTION ELECTRICAL SCHEMATIC - FIGURE 30-2

30-12-01

- TROUBLESHOOTING - AIRFOIL ICING PROTECTION

TROUBLE	PROBABLE CAUSE	REMEDY
AIRFRAME/PROPELLER SYSTEM DOES NOT OPERATE.	Tank contents inadequate	Replenish fluid contents.
	High Pressure Warning LED illuminated	Renew Filter Element
	Pump(s) inoperative	Check electrical power to pump(s) Check pump or control panel
	Low Pressure Warning ON	Check tank contents - Replenish fluid
	Supply lines blocked or leaking.	Check lines for leaks or blockage Check Tank outlet strainer for blockage
NO FLOW FROM OUTLETS OF AIR-FRAME WING PANELS/EMPEN-NAGE PANELS	Supply lines to Proportioning Units restricted	Check supply lines to Proportioning Units for blockages or kinks

ALSO SEE FIGURE AS HORIZONTAL (NEXT)


Airframe/Propeller Pump 2
Earth
0V
HI
LO
Metering Pump Relay
NC
NO
HI
LO
Earth
0V
HI
LO
Airframe/Propeller Pump 1
Windshield De-Ice Pump 1
Red
Blue
Windshield De-Ice Pump 2
Red
Blue
Solenoid Valve 1
Solenoid Valve 2
High Pressure Warning Switch
NO
NC
C
Low Pressure Warning Switches
Knife Connector
Tank Assy.
Tank Contents Transmitter
Stall Vane Heat
Plate Heater
S0105
S0104
Dropping Resistor
S0102
S0101
Pitot Heat
Pitot Heat Current Relay Box
To Flt. Timer & Other Options
Optional Equipment Relay
PL117 Connector
S0103
20 AMP
Pitot Heat Breaker Switch
Circuit Breaker
Red
F0103
Black
F0101
28VDC
28VDC
C3
Black
White
Red
Green
Orange/Black
Orange
Black/White
Blue
Blue/Black
White/Black
Red/Black
Green/Black
C1
C2
Control Panel
Relay is activated with no A/S applied: power then goes thru the dropping resistor to keep stall warning vane warm.
Airspeed Switch Normally Closed when no A/S applied.
NOTE: Later A/C have a new relay box & connector installed. TKS relay is separate relay. in new box.
PIN 12 equates to PIN 2. PIN 8 equates to PIN 1. PIN 4 equates to PIN 3.

Page 7A

- TROUBLESHOOTING - AIRFOIL ICING PROTECTION (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
NO FLOW FROM PROPELLER OUTLETS	Supply lines to Proportioning Units restricted	Check supply lines to Proportioning Unit for blockages or Kinks
	Supply line blockage or nozzle misalignment	Check for blockage or misalignment of nozzle or slinger Check Proportioning Unit for blockage
WINDSHIELD SYSTEM DOES NOT OPERATE	Inadequate Fluid content	Replenish Fluid in tanks
	Pump(s) inoperative	Check pump(s) and pump(s) wiring
	Solenoid Valve(s) Inoperative	Check power to solenoid valve(s) Check Solenoid Valve(s)
HIGH PRESSURE WARNING - LED ILLUMINATES DURING OPERATION	OAT - COLD	
Temperatures below -30° C		No immediate action necessary, monitor operation at warmer temperatures with Anti-Ice selected
Temperatures above -30° C		Renew Filter Element and bleed filter Check system for blockage.
HIGH PRESSURE WARNING - LED ILLLUMINATES WHEN AIRCRAFT BUSS POWERED UP		Connect Pin 10 of connector C1 to ground (C1, pin 1). Check wiring from C1 Pin 10 to High Pressure Warn Switch for continuity Check High Pressure Warn Switch. With no pressure applied, continuity should exist through connections in use.
LOW PRESSURE WARNING - (LED'S FLASH RED)		
When system selected ON		Check System for proper operation. Connect Pin 2 of connector C1 to ground (C1, Pin 1). Check wiring from C1 Pin 2 to Low Pressure Warn Switch(es) for continunity. Check Low Pressure Warn Switch(es). With System operating, circuit should exist through connections in use.
When aircraft buss powered ON.		Check Control Panel for fault. Repair or Replace Control Panel.
CONTROL PANEL/CONTENTS INDICATING SYSTEM FAULT.		
Tank Contents Display Illuminated		Depress High Pressure Reset. Amber LED illuminates: Check Auto-dimmer Setting. Check voltage at Control Panel Output C2 (w/ plug disconnected): Pin 1 = + 5 volts Pin 3 = - 5 volts. Reconnect C2 and check voltages on this connector: Pin 1 = + 5 volts Pin 2 = Signal should vary from 0 volts (tank empty) to + 1.8 volts (approx.) (tank full). Pin 3 = - 5 volts. Repair/Replace Control Panel Check wiring & tank contents Transmitter. Correct wiring or reset potentiometer.

- TROUBLESHOOTING - AIRFOIL ICING PROTECTION (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
CONTROL PANEL FAULT		
LED malfunction =	AMBER (High Pressure Warn)	Does not operate: Check Power to Control Panel. Depress High Pressure Reset: Illuminates = Check Auto Dimmer setting. Does not illuminate = Repair or replace Control Panel. Will not cancel Replace High Pressure Switch
LED malfunction =	GREEN (System Status Ind.)	Does not operate: Check Auto-dimmer setting. Repair or Replace Control Panel. Operates Continously: Repair or Replace Control Panel.
LED Malfunction =	FLASHING RED	Does not operate: Check Auto-dimmer setting. If OK, disconnect cable from Pin 2 of Connector C1. LED's should flash when De-Ice or Anti-Ice selected: If no flash: Check wiring & Low Pressure Warn Switch(es) If NOT OK: Repair or Replace Control Panel. Operates Continously: Check system for restriction/blockage. Replace Low Pressure Warning Switch(es)

30-12-02 - MAINTENANCE PRACTICES

Level I

Daily and/or Preflight - if icing is forecast or expected.
This level of checking is intended to determine the immediate serviceability of the equipment without recourse to the use of tools or special procedures.

Maintenance Practice	Notes
Check security and condition of visible components.	
Switch on electrical power. Check that contents display illuminates and stabilizes at a sensible value within 1.5 minutes. Replenish tank contents if necessary for intended flight.	The time taken for the display to stabilize will depend on the quantity of fluid present in the tank as the display reading will rise from 0 at about 0.1 gallon per second.
Operate Airframe/Propeller system at "De-Ice". Check that both indicator LED;s flash RED then change to a single GREEN (opposite De-Ice) as pressure rises. Check that High Pressure Warning LED does not illuminate.	
Press High Pressure Reset. Check that AMBER LED illuminates while switch is depressed.	
Switch Airframe/Propeller system directly to "Anti-Ice", check that pump speed reduces (audible check) and that GREEN LED, which is illuminated, changes to match switch selection. Check that de-icing fluid flow is evident from visible panels if weather conditions permit. Switch Airframe/Propeller system OFF.	It may not be possible to observe fluid flow if moderate or heavy rain is falling.
Press windshield De-Ice Switch. Check that de-icing fluid is discharged from spraybars.	

Level I Maintenance Practice (con't.)	Notes
Check that wing ice inspection lamp functions.	If night flight.
Switch off electrical power if no longer required.	
Check that fluid flows evenly from active zone of all porous panels.	
Check that fluid is discharged into the propeller slinger ring from the nozzle fitted at the front of the engine crankcase.	
Check aircraft surfaces for ice or snow. Remove all ice or snow from all flying surfaces.	NOTE The TKS ice protection system is not intended to remove frozen deposits while aircraft is on the ground. It is essetial that all critical areas are de-iced before any attempt to T/O is made.

Level II

50 Hour Inspections

This level inspection extends the functions recommended for Level I inspections and includes more comprehensive tests of a qualitative nature.

Maintenance Practice	Notes
Remove Engine cowling. Check security and condition of visible components paying particular attention to those components attached to the engine and spinner.	
Switch electrical power ON. Check contents display illuminated and stabilizes at a sensible value within 1.5 minutes. Replenish tank contents, if necessary.	If in doubt regarding accuracy of indication make calibration check. Indicator is electronically damped and should rise from 0.0, at switch ON, at an average rate of about one display count per second.
Operate Airframe/Propeller system at "De-Ice". Check that both indicator LED's flash RED then change to a single GREEN (opposite De-Ice) as pressure rises. Check that High Pressure Warning LED does not illuminate.	
Check operation of High Pressure Warn. LED by de-pressing High Pressure Reset. The AMBER LED should illuminate while switch is depressed and cancel at switch release.	Note Fluid should be exuded evenly over active zone of porous panels. At high temperatures a "waterline" may be observed at the top os some panels due to insufficient pressure being developed to expel entrained air. This is acceptable unless perform-ance of panel in icin g conditions indicates that this is other than a temporary nature.
Switch Airframe/Propeller system directly to "Anti-Ice", check pump speed reduces (audible) and that GREEN LED which is illuminated changes to match switch selection. Check that de-icing fluid flows from all porous panels and that a jet is directed into the slinger ring from the nozzle at the front of the engine.	
Switch Airframe/Propeller system OFF.	
Press Windshield De-Ice switch. Check that de-icing fluid is discharged from spraybars. Check that no holes are blocked.	
Switch electrical power OFF.	

Level III

Annual Inspections.

At Level III, it is recommended that all Level II Inspections are complied with and that the following inspections are added/included.

Maintenance Practice	Notes
Remove tailcone panels and empennage panels. Check security and condition of component's supply lines and wiring. Pay particular attention to components close to control rods, etc.	
Drain tanks. Remove and clean strainer in tank outlets.	
Refill tanks. Check accuracy of tank contents indicator during refilling process.	The contents indicator does not display actual contents over the entire range. Refer to calibration chart (Figure 30-3).

Level IV

Component Checks.

The following checks are detailed for use in conjunction with SECTION 30-12-01, TROUBLESHOOTING. In cases where components can be checked on the aircraft as an alternative to bench testing, both methods are described.

Maintenance Practice	Procedures
Check fluid delivery rate from Airframe/Propeller Pump.	1. Fill tanks to top of filler tube. Operate pump(s) at De-Ice or Anti-Ice, as required, for a time period. Refill tanks; measure quantity necessary to replenish to original level. Calculate flow rate. Permitted limits are: De-Ice - 280 to 300 ml/min. Anti-Ice - 140 to 150 ml/min. OR 2. Remove Airframe/Propeller Pump. Bench test.
Check High Pressure Warn Switch.	1. Disconnect Nylon Tube from inlet to Filter. Connect pressure gauge (0 - 180 lbf/in^2) (0 to 13 bar) to tube. Use TKS Nylon Tube fittings. Operate Airframe/Propeller pump in a series of short bursts (in order to limit rate of pressure rise) and observe pressure at which High Pressure Warn LED illuminates. Permitted limits are: 75 to 90 lbf/in^2 (5 - 6 bar) OR 2. Remove High Pressure Switch. Bench test.
Check Low Pressure Warn Switch. Note Two Low Pressure Switches are located on tail bracket in empennage assembly. It may be necessary to test both to determine which one is malfunctioning.	1. Remove empennage fairing for access. Disconnect Nylon tube from outlet of suspect pressure switch. Connect a pressure gauge (0 - 5 lbf/in^2) (0 to 3 bar) to the pressure switch outlet (use TKS nylon tube fittings as needed). Disconnect plugs at end of pressure switch pigtails from wiring harness and connect a suitable resistance and continuity measuring device across Pins 1 & 2 of each switch plug. With no pressure present , there should be no circuit through either switch and the resistance should be greater than 10 megohms. Operate Airframe/Propeller pump in a series of short bursts to limit the rate of pressure rise at each switch and observe the pressure at which each operates. This pressure should not be greater than 1.5 lbf/in2 (0,1 bar). With the switch at a pressure above the operating pressure, there is to be a circuit between Pins 1 & 2 with a resistance not greater than 10 ohms. Switch pump OFF and observe pressure when switch resets. This is to be not less than 0.5 lbf/in2 (0,03 bar). OR

Level IV Maintenance Practice (con't.)	Procedures
	2. Remove Low Pressure Switch(es) and bench test.
Check Proportioning Unit(s) [Wing, LH & RH & Empennage]	1. Remove panels necessary to obtain access to suspect Proportioning Unit. Disconnect Nylon tube from outlet of suspect Proportioning Unit. Operate Airframe/Propeller pump(s) and observe fluid flow from outlet. If flow rate is questionable, measure quantity over a timed period.

Panel flow rates are shown in the following chart:

WING PANELS	NORMAL (+ /-20%) (ml/min)	MAXIMUM (+ /-20%) (ml/min)
LH & RH Outboard	18.45	36.9
LH Middle, O/B	9.3	18.6
LH Middle, I/B	5.7	11.4
L/H & RH I/B	10.4	20.8
R/H Middle	15.0	30.0
EMPENNAGE PANELS	NORMAL (+ /-20%) (ml/min)	MAXIMUM (+ /-20%) (ml/min)
LH & Rh Horizontal Stabilizer	11.24	22.48
Vertical Stabilizer	7.0	14.0
PROPELLER	NORMAL (+ /-20%) (ml/min)	MAXIMUM (+ /-20%) (ml/min)
Propeller	17.0	34.0

TKS FLOW RATE CHART

Level IV Maintenance Practice (con't.)	Procedures
Check Porous Panels	1. Remove Access panels for access to applicable ProportioningUnit. Disconnect Nylon tube connecting suspect panel from outlet of Proportioning Unit. Connect suitable pressureable supply of filtered fluid to this tube. Purge tube and panel at a pressure not exceeding 40 lbf/in^2 (2,6 bar). If a blockage exists, it will probably become apparent at this stage. Reduce pressure to 4 lbf/in^2 (0,26 bar) and examine porous region of panel for even fluid coverage. OR 2. Bench test. This is last resort due to having to remove panel from airfoil.
Check fluid delivery from Windshield Pump.	1. Remove panels to gain access to pump(s). Disconnect Nylon tube connecting Pump to Solenoid Valve. Operate pump by pressing "WINDSHIELD" switch on control panel. collect fluid ove a timed period of 5 seconds. The fluid quantity dispensed should not be less than 25 ml. OR 2. Remove Windshield Pump and bench test.

Check Solenoid Valve.
NOTE: - Solenoid Valves have a history of reliability. It is recommended that all other components be checked out prior to further troubleshooting of Solenoid Valves.

1. Check Windshield Pump as detailed above. Reconnect Windshield Pump to Solenoid Valve. Operate pump be pressing "WINDSHIELD" switch on control panel. Fluid should be discharged onto the windshield, if not, disconnect Nylon tube from outlet of Solenoid Valve and repeat test. Fluid should be discharged from outlet of Solenoid Valve. If not, check electrical power at connections to Solenoid valve (See Figure 30-2) when pump is operating. If Solenoid Valve is suspected of not closing, disconnect electrical power to the valve and operate Windshield Pump. No fluid should be discharged from the spraybar (or Solenoid Valve outlet).
OR
2. Remove Solenoid Valve and bench test.

Check Control Panel.

NOTE: - Voltages specified in Procedures are based on a voltmeter with a resistance of at least 10,000 ohms per volt. Readings marked with * will differ if a lower resistance voltmeter is used.

1. Remove screws and pull Control Panel out as far as wiring will allow. Use voltmeter probe to measure voltage at the various pins in connectors C! & C2 on rear panel (Figure 30-2 Schematic)

[1] Aircraft Power ON - all switches OFF
All pins zero volts except:
C1 -3 to be aircraft voltage.
C1 -2 to be 7.5 volts *.
C2 -1 to be + 5 volts.
C2 -2 to be between zero and + 2 volts* (depending on tank contents)
C2 -3 to be - 5 volts.

[2] As [1] but with MAXIMUM selected.
All pins zero volts except:
C1 -3, & -5 to be aircraft voltage.
C1 -2 to be 7.5 volts* initially, changing to zero as pressure rises.
All pins on connector C2 as [1].

[3] As [1] but with NORMAL selected.
All pins zero volts except:
C1 -3, & -4 to be aircraft voltage.
C1 -2 to be 7.5 volts* initially, changing to zero as pressure rises.
All pins on connector C2 as [1].

[4] As [1] but with WINDSHIELD 1 selected.
All pins zero volts except:
C1 -3, -6, & -8 to be aircraft voltage.
C1 -2 to be 7.5 volts*.
All pins on connector C2 as [1].

[5] As [1] but with WINDSHIELD 2 selected.
All pins zero volts except:
C1 -3, -9, & -11 to be aircraft voltage.
C1 -2 to be 7.5 volts*.
All pins on connector C2 as [1].
OR

2. Remove Control Panel and bench test.

Check Control Panel (con't.)

[6] As in [1], but with PUMP 1 selected.
All pins zero volts except:
C1-3 and -7 to be aircraft voltage.
C1-2 to be 7.5 volts*.
All pins on connector C2 as [1].

[7] As in [1], but with PUMP 2 selected.
All pins zero volts except:
C1-3 to be aircraft voltage.
C1-2 to be 7.5 volts*.
All pins on connector C2 as [1].

Check Tank Contents Transmitter.

Remove seat/wing panel(s) to obtain access.
1. Disconnect connector C3. Measure resistance across contents transmitter leads at pins C3 as follows:
All pins to ground > 10 megohms
Pin 1 to Pin 3 = 10,000 ohms (nominal)
Pin 1 to Pin 7 should vary from 1/2 the resistance between Pins 1 & 3 (5,000 ohms nominal) with tank empty to approximately 3000 ohms with tank full.
OR
2. Remove Contents Transmitter and bench test.

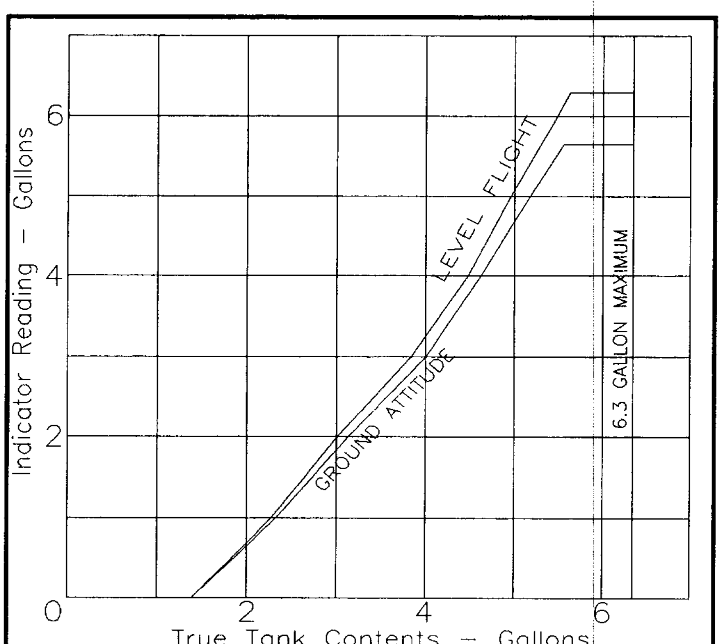


FIGURE 30-3 FLUID INDICATOR CALIBRATION

30-30-00 - PITOT - DESCRIPTION AND OPERATION

A standard heated pitot tube is located on left wing at Wing Station No. 145. The pitot heat circuit breaker switch located on C/B panel, in front of the pilots right knee, supplies power to the pitot tube heating element. A BLUE light will illuminate on annunciator panel when Pitot Heat switch has been pushed ON and current is being drawn by heating element. On some foreign aircraft a RED light will illuminate when pitot heat element is NOT drawing any current and will be OFF when properly operating. When the flight into known icing system is installed the heated pitot tube is a part of the TKS system (same location) but different from the standard heated pitot tube.

30-31-00 - STALL WARNING VANE - HEATED

The stall warning vane is heated when the flight into known icing system is installed on the M20R. See Figure 30-2. The Stall Warning Vane heat is activated when the Pitot Heat switch is selected ON.

30-60-00 - PROPELLER DESCRIPTION & OPERATION

Propeller ice removal is accomplished by either of two methods. If the Airfoil Ice Protection System is installed for flight into known icing, the ethelyne-glycol system is installed. Another configuration is optional, electrically heated de-ice boots bonded to each propeller blade. This system uses airplane's electrical power to heat de-ice boots, in cycles controlled by a timer.

The ON/OFF switch is located on switch panel in front of pilots right knee. The BLUE light," PROP DE ICE", on annunciator panel will illuminate at each cycle (every 90 seconds) the boots are drawing current. The ammeter may show a slight flicker each 90 second interval as timer turns de-ice boots ON/OFF/ON. This is normal operation. The timer is located on the equipment rack in tailcone. De-icer boot replacement should be done per de-ice kit manufacturer's service information.

30-60-01 - PROPELLER DE-ICE

POWER REQUIREMENTS FOR 28 VOLT SYSTEM

TERMINAL C	ON / OFF	90 SECONDS	8 AMPS

TOTAL CYCLE TIME = 3 MINUTES

RECOMMENDED WIRE SIZE CHART

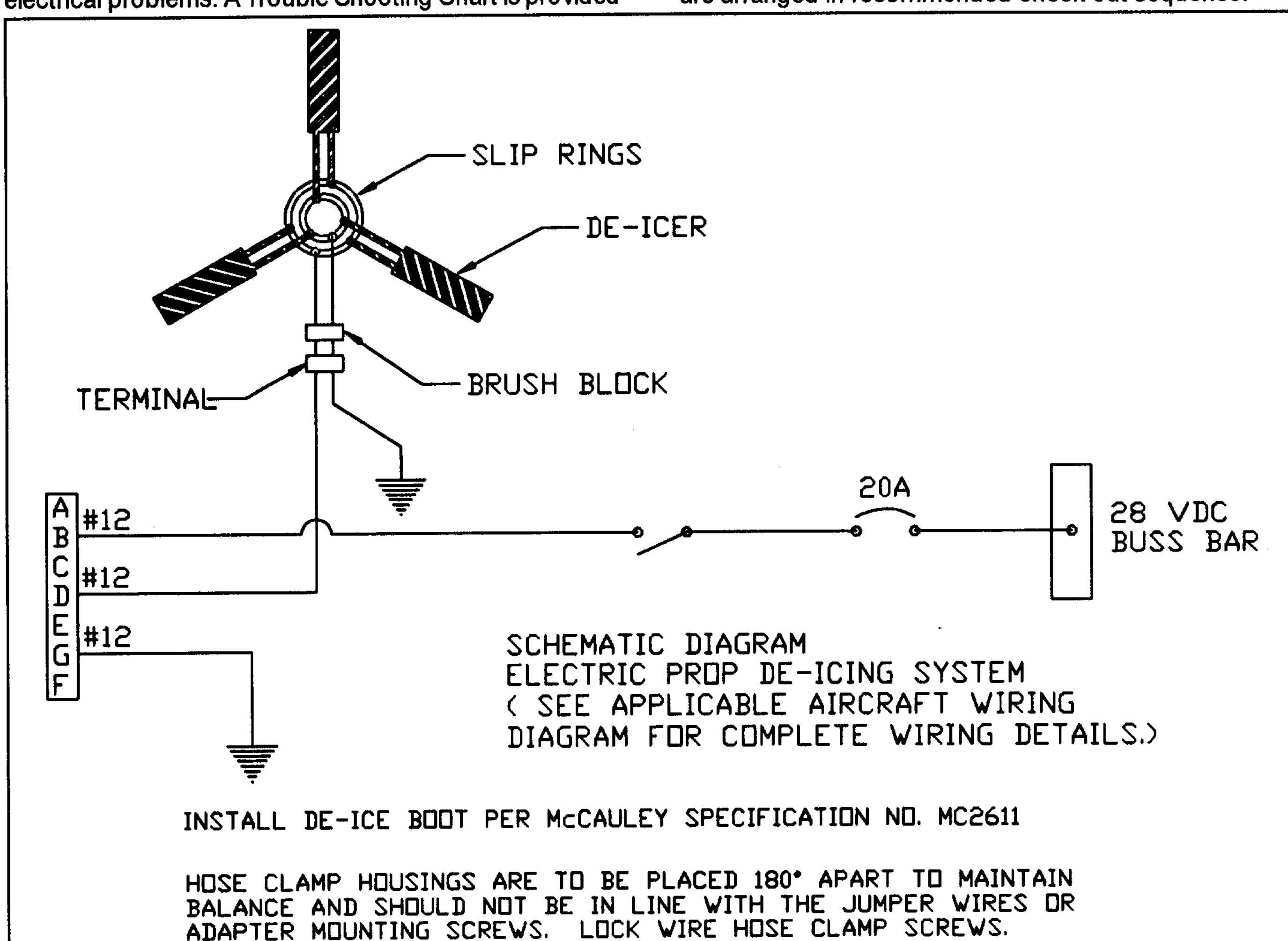
LOCATION	AWG SIZE	MAX LENGTH
BUS BAR TO TIMER	# 14	15'
TIMER TO GROUND	# 18	5'

LOCATION	AWG SIZE	MAX LENGTH
TIMER TO BRUSH MODULE	# 14	15'
BRUSH MODULE TO GROUND SHUNT LEADS	# 20	5'

30-61-00 - SERVICE GUIDE

INTRODUCTION

Whether in flight or during ground testing, the ammeter can be used to determine the general nature of most electrical problems. A Trouble Shooting Chart is provided later in this Section and it is assumed that the user understands normal operating modes of system. (See Section IX of P.O.H.). Read all "Trouble" entries to locate matching conditions of system being checked. The "Probable Cause" and "Remedy" entries pertinent to each trouble are arranged in recommended check out sequence.



PROPELLER DE-ICE SCHEMATIC - FIGURE 30 - 3

30-61-01 - HELPFUL TIPS

1. The Voltmeter reading will be slightly lower when system is operated on battery voltage than when engine is running.

2. Use "heat test" (30-64-00) and "load meter test" (30-62-00) to determine which De-Icers are not operating. Use wiring schematic to trace circuits.

3. Excess current reading on the ammeter may indicate a power lead shorted to ground. Thus, when trouble of this nature is found, it is vital that the grounded power lead be located and corrected.

4. A considerable number of timers have been returned for repair which proved, on test, to be fully operable. Before concluding that the timer is faulty, test it per "De-Icer Timer Check" (30-63-00).

5. For insulation resistance tests, use a "megger" ("Meg" type insulation tester, James G. Biddle Company, Plymouth Meeting, PA.) or other tester having a 500 VDC, 1000 megohm capacity.

6. Defective wiring in propeller mounted components may be indicated by normal current readings in ground checkouts (propellers not rotating) but low current with propellers rotating at cruise RPM.

30-61-02 - TROUBLE SHOOTING CHART - ELECTRIC PROPELLER DE-ICE -

TROUBLE	PROBABLE CAUSE	REMEDY
Buss load meter/ammeter shows 0 current all phases of the timer cycle.	No power from aircraft.	If no voltage into circuit breaker, locate and correct open.
	Tripped circuit breaker.	Locate and correct short before resetting circuit breaker.
	Circuit breaker or switch faulty.	If no voltage at circuit breaker output with voltage at input and circuit breaker does not reset, replace circuit breaker. If voltage is OK at output, check switch in same manner.
	Open Buss load meter/ammeter to timer.	Disconnect harness at timer and check for voltage at harness Terminal B to ground. If none, locate and correct open.
	Open timer to brush assembly.	Disconnect wire harness at brush assembly and check voltage to ground from leads. (See de-icing system wiring schematic for power and ground lead and pin identification.) If low or no voltage, locate and correct open or high resistance in wire harness. Check continuity from Terminal G, or lead to ground; if high resistance is indicated, check ground wire for breakage and ground connections for correctness and tightness. Correct as required.
	Open in De-Icer, De-Icer wire harness or slip ring assembly leads.	Disconnect De-Icer leads and check resistance per manufacturer's service data. If not OK, replace faulty De-Icer boot. If OK, check for (and repair) open in de-ice boot wiring harness leads. Ohmmeter needle must not flicker when leads are stretched or flexed. Replace as required.
	Open on both ground brushes.	Remove brush block assembly and check both ground brushes for continuity between the brush and pigtail lead. If an open is found, repair brush block assembly. If OK, reinstall and check for proper face alignment and brush projection per manufacturer's Service Data.
Buss load meter/ammeter shows normal current part of cycle, zero current rest of cycle.	Open in wiring between timer and brush block assembly.	See "Open Timer to Brush Assembly" above.
	Open in De-Icer or de-ice boot wire harness.	See "Open in De-Icer" above.

TROUBLE (con't.)	PROBABLE CAUSE	REMEDY
	Timer faulty.	Test timer per Section 30-63-00.
	Faulty brush block assembly.	Check for broken brushes and test for opens.
Buss load meter/ammeter shows normal current part of cycle, low current rest of cycle.	Open circuit or high resistance in De-Icer or slip ring assembly leads.	See "Open in De-Icer" above.
	High resistance in circuit with low current.	Check contact of brushes to slip rings per Section 30-66-00; correct as indicated; check wiring from timer to De-Icers for loose or corroded connections or partially broken wiring. Correct as required.
Ammeter shows low current over entire cycle.	Aircraft voltage low under normal operating conditions.	Check voltage into switch.
	Switch, or circuit breaker faulty.	Check voltage up to and out of switch and circuit breaker. If low output is found through any of these items, replace defective component.
	High resistance up to timer.	Check for partially broken wire, or loose or corroded connection in wiring between aircraft supply and timer input. Correct as required.
	High contact resistance in timer.	Test timer per manufacturer's service data.
	One De-Icer element (or wiring connections to De-Icer) in each cycle out.	Perform a heat test on each De-Icer per Section 30-64-00. Replace defective components.
Ammeter shows excess current over entire cycle.	Power lead shorted to ground.	Check power leads from Buss load meter/ammeter to timer, then to De-Icers for evidence of damage or arcing. (See Section 30-60-01). If ground is indicated, locate and correct.
	Timer faulty.	Test timer per Section 30-63-00.
Ammeter indicates normal current part of cycle, excess current remainder of cycle.	Short to ground or short between timer and brush block.	Disconnect leads at brush block & timer, check for short or ground. Repair as required.
	Short between slip rings.	Clean slip ring assembly with MEK.
	Timer faulty.	Test timer per Section 30-63-00.
Ammeter does not "flicker" each 90 seconds.	Timer ground open; timer not cycling.	Disconnect harness at timer and check ground connection with ohmmeter from Terminal G.
	Timer contacts welded together (caused by short in electrical system).	Test timer per Section 30-63-00. If timer is faulty, repair or replace it, but insure that short causing original failure has been located and corrected.
Ammeter flickers between 90 second phase periods.	Loose connection between aircraft power supply and timer input.	Trace wiring from power source to timer input. Insure that good electrical contacts are made at each connection in the circuit.
	Loose or poor connection; timer to De-Icers.	If trouble occurs only part of cycle, determine which De-Icer is affected, check for rough or dirty slip rings causing brush to

TROUBLE (con't.)	PROBABLE CAUSE	REMEDY
		skip. Check circuits for loose or poor connections.
	Timer cycles erratically.	Test timer per Section 30-63-00.
Radio noise or interference with De-Icers on.	Brushes arcing.	Check brush alignment. Check for dirty or rough slip rings. If found, clean, machine or replace slip ring assembly. Check slip ring alignment.
	Loose connection.	See "Buss load meter/ammeter flicks between 90 second periods" above.
	Switch or circuit breaker faulty.	Place jumper wire across switch or circuit breaker; if radio noise disappears, replace switch or circuit breaker.
	Wiring too close to radio equipment or associated wiring.	Relocate De-Icer wiring at least 8" from radio equipment and wiring.
Cycling sequence not correct.	Crossed connections between timer and De-Icers.	Check system wiring against circuit diagram.
Rapid brush wear or frequent breakage.	Brush block out of alignment.	Check brush alignment. Correct as required.See section 3.3.3 of McCauley Manual No. 830415.
	Slip ring wobbles.	Check slip ring alignment with dial indicator per Section 30-69-00.
	Rough slip rings.	Re-machine/re-finish.
	Dirty slip ring surfaces.	Clean slip rings with MEK.
	Brushes arcing.	Check brush alignment.

30-62-00 - NOT USED

30-63-00 - DE-ICER TIMER CHECK

Experience in the field has indicated that often the timer is considered defective when the source of the trouble lies elsewhere. For this reason, the tests should be performed before the timer is removed as defective.

Refer to manufacturer's service data, McCauley Manual No. 830415, Section 4, for test criteria.

TIMING SEQUENCE	TIME ON	AREAS OF PROP DE-ICERS HEATED
Terminal C	90 sec.	All Blades - ON then OFF

30-64-00 - 100 HOUR INSPECTIONS

Refer to manufacturer's service inspection data for these steps. (McCauley Manual No. 830415, Section 4)

CAUTION
Stand clear of propeller, verify magnetos are OFF. Use extreme caution during this procedure.

30-65-00 - CONTINUITY TEST

After removing plug from timer, use ohmmeter to check continuity from:

1. Terminal C to outboard terminal of one prop boot.
2. Terminal G to airframe ground.
3. Ground terminal of one prop boot to ground.

30-66-00 - BRUSH TO SLIP RING RESISTANCE TEST

To check for incorrect resistance or presence of a short or open circuit at brush-to-slip ring contact, disconnect harness at timer and check resistance from each De-Icer circuit lead, Terminal C, to ground with a low range ohmmeter. If resultant readings are not 1.55 to 1.78 ohms, disconnect De-Icer lead straps to measure heater resistance individually. Individual boot resistance should measure between 4.58 and 5.26 ohms. If readings in first check are not within accepted limits but those in second check are, the trouble is probably in brush-to-slip ring area. If readings in second check are also off, the De-Icer concerned is damaged and must be replaced.

30-67-00 - BRUSH ASSEMBLY RESISTANCE CHECK

To check for an open circuit, a short, or high resistance in brush assembly, measure resistance from face of brush to its terminal studs with a low range ohmmeter. If this resistance measures over 0.013 ohms, locate and repair cause of excessive resistance. If resistance is infinite, locate and correct the open circuit or ground, or else replace brush assembly. Check resistance between the three terminal studs. This resistance should not be less than 5 megohms.

30-68-00 - BRUSH BLOCK ASSEMBLY REPAIR

Refer to manufacturer's Service Data, McCauley Manual No. 830415, Section 6.5.1, for this procedure.

30-68-01 - BRUSH REPLACEMENT/ALIGNMENT

Refer to manufacturer's Service Data, McCauley Manual No. 830415, Section 6.5.2, for brush replacement and brush to slip ring alignment.

30-69-00 - ALIGNMENT OF SLIP RING

To check alignment of slip ring assembly, securely attach a dial indicator to engine and place pointer on a slip ring (see Figure 30-4). Grasp propeller blade and rotate it slowly, noting any deviation of slip ring from a "TRUE" plate as indicated on dial indicator. Check that total run-out does not exceed 0.008 inch total indicator reading (TIR).

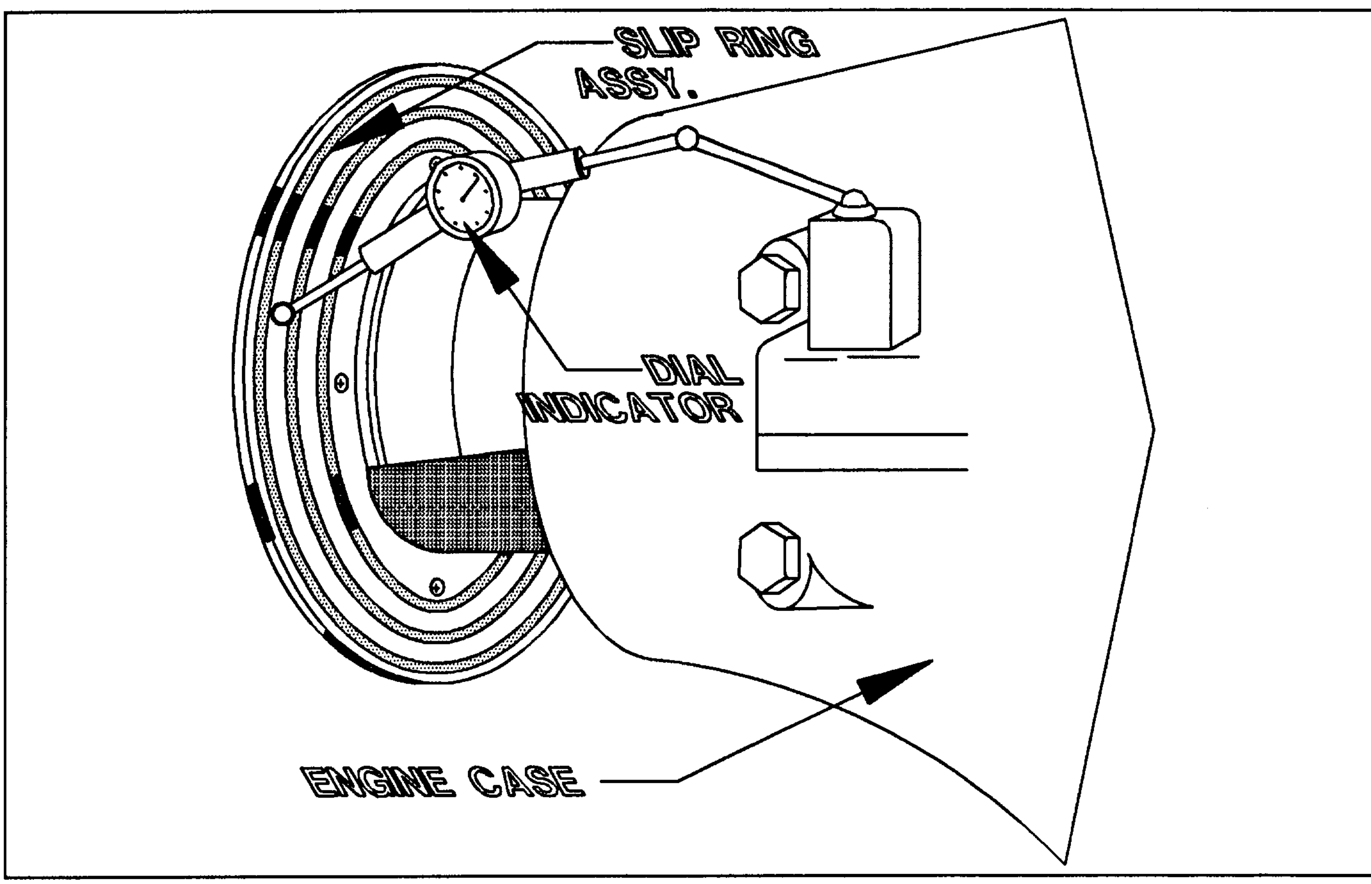
CAUTION
Due to loose fit of some propeller thrust bearings, a considerable error may be induced in readings by pushing in or pulling out on propeller while rotating it. Care must be taken to exert a uniform push or pull on propeller to hold this error to a minimum.

CAUTION
Do not, under any circumstances, attempt to correct run-out of slip rings by shimming assembly or changing torque of mounting screws or bolts.

If slip ring run-out is within limits specified, no corrective action is required. If it is not within limits, check for dirt on ring gear mounting surfaces; clean, and recheck alignment. If run-out is still out of tolerance, refer to manufacturer's service data for machining procedures or return the slip ring assembly to manufacturer.

30-70-00 - SERVICING/CLEANING

Thoroughly cleaning the slip ring area with MEK or standard engine degreaser on a routine basis is recommended. Keeping the brushes free of dirt, oil, grease and carbon build-up will prevent those contaminants from being transferred to the slip ring.



ALIGNMENT OF SLIP RING - FIGURE 30-4

BLANK

CHAPTER

32

LANDING GEAR

CHAPTER 32

LANDING GEAR

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CHAPTER 32

LANDING GEAR

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32-00-00 - GENERAL

The landing gear is operated by an electrical, motor driven, actuator. Travel during the extend and retract cycle is controlled by down and up limit switches located beneath the floorboard under the pilots seat. Power is supplied to actuator through a set of relays actuated by the gear selection switch. The gear selection switch is located at top of instrument panel in front of the pilot. The actuator worm gear ball nut is connected to retract bellcrank which is connected to push-pull retract tubes and bellcranks throughout entire retraction system. An airspeed safety switch is mounted on back of airspeed indicator and incorporated into landing gear electrical circuit to prevent landing gear retraction while on the ground until a safe takeoff speed is reached. A by-pass switch is installed adjacent to the gear selection switch in order to override safety switch circuitry if gear does not retract.

The gear legs are constructed of welded, chrome-molybdenum, tubular steel, heat treated for greater strength and wear resistance. Main gear attaching points have bushings installed in gear mounting box attached to wing spars. The steerable nose gear mounts to the cabin tubular steel frame.

NOTE
Heat treated components should NOT be repaired; replace them.

The main gear wheels have hydraulic disc brakes with a parking brake valve incorporated into system.

Rubber discs in all gear leg assemblies absorb the shock of landing and taxiing.

LANDING GEAR EMERGENCY EXTENSION SYSTEM.

Emergency gear extension is available through a manual override system. This system is built into the actuator unit. The disengage controls are located aft and between front seats.

LANDING GEAR WARNING SYSTEM.

The landing gear warning system provides pilot with an audible warning that landing gear is not down and locked when throttle is retarded and landing gear is still up. The warning system is activated when throttle is retarded approximately 1/4 inch from idle position. When landing gear is down and locked, the electrical circuit is opened and the intermittent horn is stopped. This warning switch is mounted on throttle housing forward of instrument panel and can be adjusted for the proper setting by loosening screw and repositioning switch.

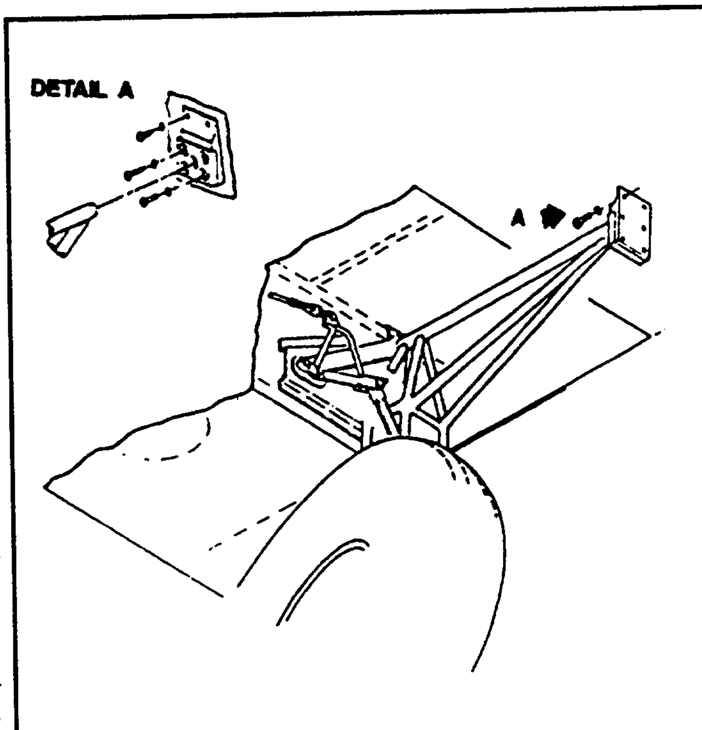
BRAKE SYSTEM.

The brake system is hydraulically operated by depressing brake pedals mounted on pilots rudder pedals. (Dual brake system is optional for co-pilot). Individual wheel brakes are available by depressing either left or right pedal. Parking brake is actuated by depressing both brake pedals and pulling parking brake control cable knob. This cable actuates lever on parking brake valve and traps hydraulic fluid from valve to wheel cylinders, therefore, holding pucks to brake discs. Release parking brake by pushing parking brake knob IN. This releases hydraulic pressure at wheel cylinders and releases brake discs.

32-10-00 - MAIN LANDING GEAR AND DOORS

32-10-01 - MAIN GEAR REMOVAL

1. Raise aircraft on jacks.
2. Partially retract gear as described in Section 32-60-01, para. 1.
3. Disconnect gear door links and brake lines. Cap all lines and fittings.
4. Remove gear door and mud guard (if desired).
5. Detach main gear retracting tube (V), from retracting truss (G), and remove bolts (H) from retracting truss mounting block (Figure 32-11).
6. Remove small skin panel covering aft trunnion bearing.
7. Remove six mounting bolts from rear, gear trunnion shaft mounting block assembly at stub spar.
8. Slide out aft bearing block. (Fig. 32-1)
9. Slide front bearing block aft and remove.
10. Slide gear assembly aft until clear of front bearing, and carefully remove gear assembly from wing.



GEAR REMOVAL - FIGURE 32-1

11. Identify all components removed, and DO NOT inter-mix right and left gear components.

12. DO NOT attempt to repair any heat treated component of main landing gear assembly.

32-10-02 - MAIN GEAR INSTALLATION

1. Lubricate wheel bearings, retraction linkage and fore and aft trunnion bearings prior to installation (refer to Section 5-20-07 for recommended lubricants).

2. Installation of main gear is exact reversal of main gear removal procedure.

NOTE
Torque 510078-001, -003 or -005 bolt to 270 to 300 in. lbs.

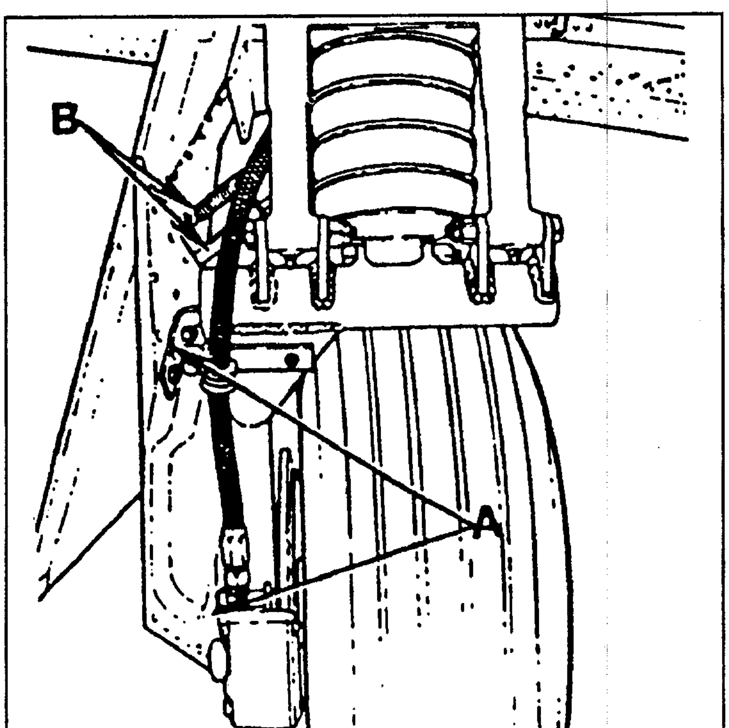
3. Check fore and aft movement of gear in bearing blocks. Maximum allowable movement is .020. Shim excess by inserting shims at rear block.

4. Temporarily attach gear door link rods to gear leg brackets.

5. Retract gear while checking for binding in door linkage and proper contact of gear door edges with wing. DO NOT make final gear door adjustments until gear has been rigged (Ref. 32-30-02).

32-10-03 - MAIN GEAR DOOR RIGGING

1. Raise aircraft on jacks. See Section 7-10-00.



MID-GEAR DOOR ADJUSTMENT POINTS
FIGURE 32-2

NOTE
Gear system must be properly rigged prior to gear door rigging, see Section 32-30-01 and 32-30-02.

2. Normally once doors are installed at factory no further adjustment should be required. However, should **mid-gear** doors be removed for any reason the following rigging procedures should be used when reinstalling them:

A. Disconnect outboard doors at forward and aft linkages (B) (Fig.32-2).

B. Disconnect inboard doors at forward linkage and springs (A) (Fig.32-3).

C. Raise gear electrically to full UP position.

D. Forward leading edge and aft trailing edge of mid gear door should be tight against wing skin. Spacers (A) (Figure 32-2) should be added or removed as required to obtain a good fit with no binding or distortion with gear in UP position. AN960-10 or AN960-416 washers may be used as spacers.

3. Reconnect outboard and mid-gear doors and check that doors are faired with wing skin/wheel well opening and that there is no binding or distortion where links attach to door. Adjust linkage/spacers if required. (Figure 32-2) Extend gear to adjust, then retract to check adjustment.

4. Check main gear overcenter preload torque for proper values. Re-rig entire landing gear system, if necessary.

32-10-04 - INBOARD DOOR RIGGING

1. Adjust inboard door link to close doors with "0" gap. Doors must be closed with gear extended and retracted. If door is not closed in both positions, refer to landing gear rigging procedures in Section 32-30-02. Any adjustment to rod end on main retract tube (L) (**Fig. 32-7**) and rod end on retract tube (V) (**Fig. 32-11**) is at a 2 to 1 ratio, respectively; this adjustment will change rigging values. Re-check preload values.

EXAMPLE: If inboard gear door is open a small amount when landing gear is down, but closed when gear is UP. - Adjust by turning retract tube (V) rod end <u>IN</u> 1/2 turn, and retract tube (L) (**Fig. 32-7**) rod end <u>OUT</u> 1 turn.

EXAMPLE: If inboard gear door is closed with landing gear in DOWN position, but open a small amount with landing gear in UP position. - Adjust by turning retract tube (V) (**Fig.32-11**) rod end <u>OUT</u> 1/2 turn, and retract tube (L) (**Fig.32-7**) rod end <u>IN</u> 1 turn.

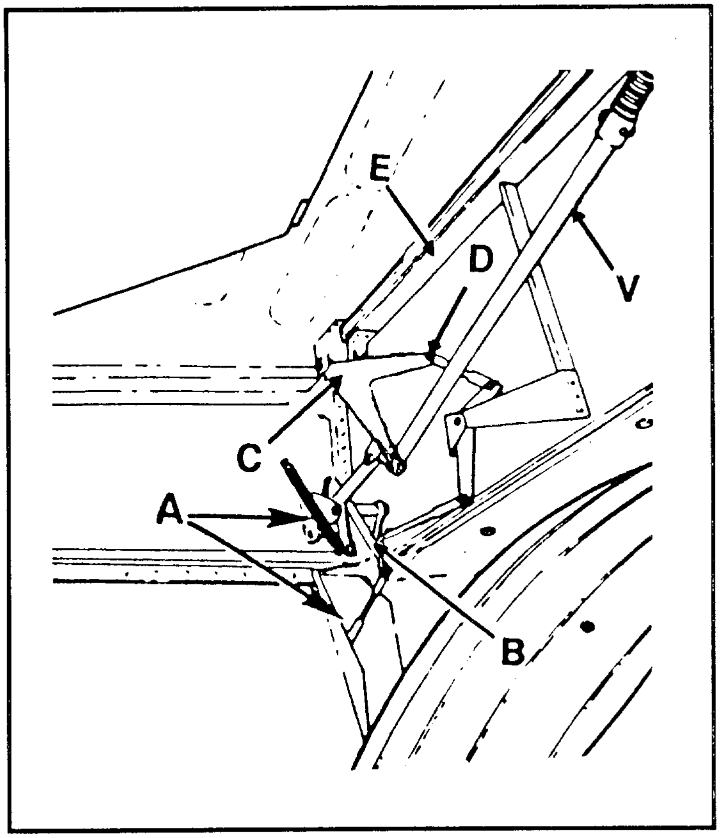
2. Tighten jamb nuts and reconnect springs on inboard gear door bellcrank (A) (**Fig.32-3**).

NOTE
Do not rig doors shut more than necessary as this may result in higher actuator loads than necessary.

3. Adjust outboard door link to close all gap at leading edge of door. If door is rigged too tight, skin will be under stress (concave) at the point where the linkage is attached to door. It could also cause mid and inboard doors to gap open.

4. Cycle gear manually and electrically while inspecting for clearances. Re-check landing gear system rigging values.

5. Remove aircraft from jacks.



MAIN INBOARD GEAR DOOR RIGGING - FIGURE 32-3

6. Return aircraft to service.

NOTE
To remove INBOARD GEAR DOORS, use a sharpened punch less than .093 dia. or a short piece of hinge pin to open crimped hinge assembly pin hole.

32-10-06 INSTALLING ASSIST BUNGEE (560213-501)

1. Retract gear.
2. Pull gear down with emergency extension until main retract bellcrank and rod end bungee line up. Install proper length AN3 bolt through rod end bearing and proper length AN4 bolt through block. Torque nuts and safety.

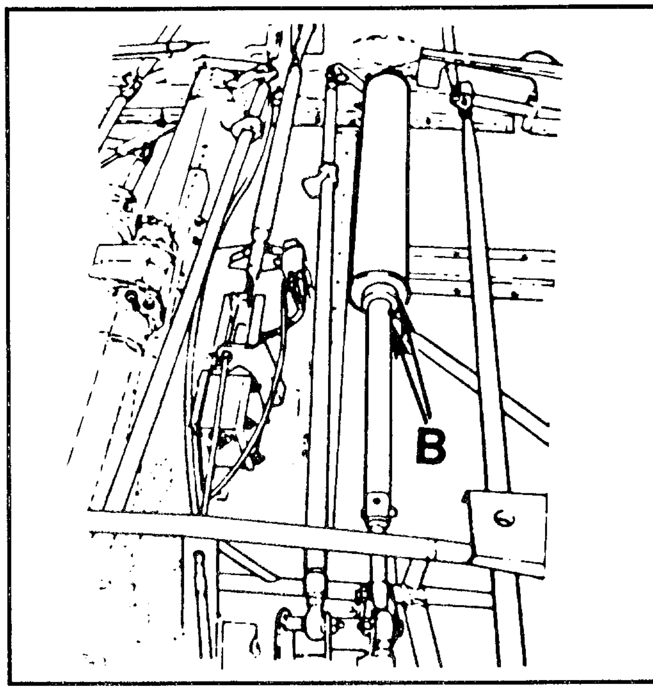
CAUTION
Bump gear up, CAREFULLY, just to take load off 3/16 in. installation pin at (B). Remove pin from (B) (Fig. 32-4).

3. With bungee installed, re-check preload per steps 30 thru 34 of Section 32-30-02.

32-20-00 - NOSE GEAR AND DOORS

32-20-01 - NOSE GEAR REMOVAL.

1. Raise aircraft on jacks per Section 7-10-00.
2. Partially retract gear as described by Section 32-60-01.



ASSIST BUNGEE - FIGURE 32-4

3. Disconnect link (A) on nose gear truss assembly (Figure 32-5).

CAUTION
Eccentric bushings at (J) (Fig. 32-6) may have a flush head screw installed on either side. This flushhead screw and counter sunk eccentric MUST BE re-installed at same locations.

4. Disconnect nose gear steering horn link (B) (Figure 32-5).
5. Remove left and right gear mounting bolts (D) and (E) (Figure 32-5) from tubular structure and nose gear truss assembly.
6. Carefully remove nose gear assembly.
7. DO NOT attempt to repair heat treated components of nose landing gear assembly.

32-20-02 - NOSE GEAR INSTALLATION

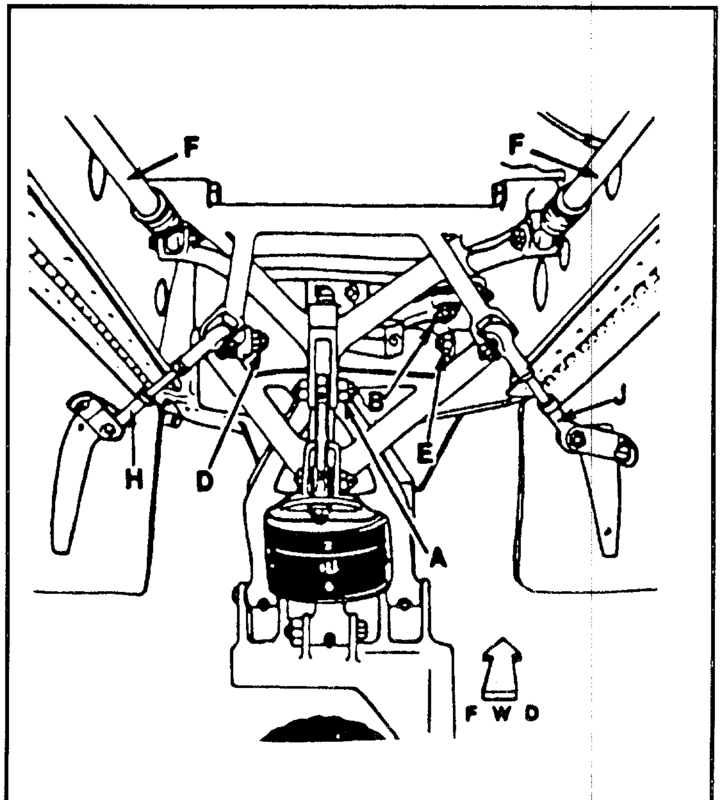
1. Lubricate wheel bearings, retraction linkage and left and right mount bearings.
2. Install gear in reverse order of removal procedure.

32-20-03 - NOSE GEAR DOOR RIGGING

1. Raise aircraft on jacks. (Refer to Section 7-10-00.)

NOTE
Gear system must be properly rigged prior to gear door rigging, see Section 32-30-01.

2. Adjust gear door link rods (H and J Figure 32-5) to obtain proper door fit when closed.
3. To increase or decrease nose gear-up travel in wheel well, adjust eccentrics on trunnion bearings (J), (Figure 32-6) as required.



NOSE GEAR RETRACTION TUBE ADJUSTMENT POINTS - FIGURE 32-5

CAUTION
Nose gear overcenter preload must be re-checked after any adjustment to nose wheel eccentrics.

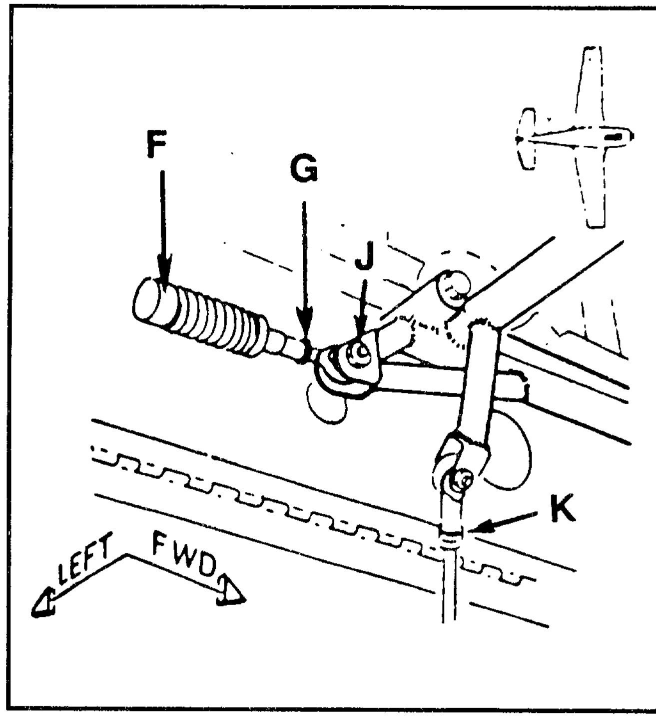
4. Readjust nose gear door linkage as required after eccentrics have been moved. (Figure 32-6, K.)

32-30-00 - EXTENSION AND RETRACTION

32-30-01 - GEAR SYSTEM OPERATIONAL INSPECTION

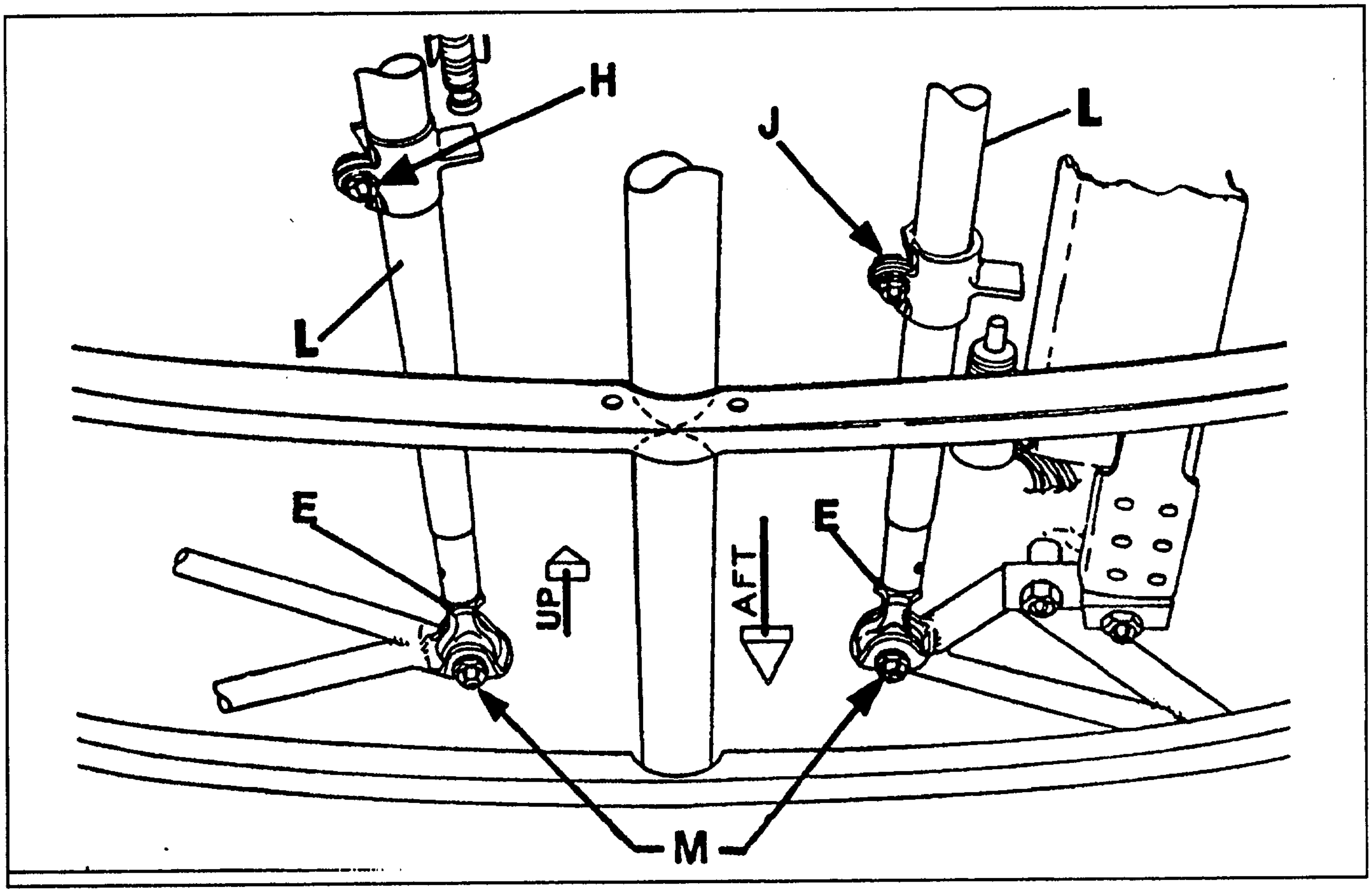
CAUTION
After any abnormal, over gross or hard landing the Gear System Operational Inspection should be done.

1. Raise aircraft on jacks. (See Section 7-10-00).
2. With Master Switch ON and gear switch in UP position apply pressure to pitot tube (see Section 32-60-01). Verify gear retraction occurs at 60 +/-5 KIAS. Allow gear to raise completely. Check for any tire interference as tire enters wheelwell.
3. Close throttle and confirm gear horn sounds.
4. Inspect gear doors for proper closing; lower gear.
5. With zero airspeed place gear switch in UP position. Gear horn should sound regardless of throttle position, both gear position lights and safety bypass switch will illuminate.
6. Push RED gear safety bypass switch and hold IN to partially retract gear.
7. Pull "GEAR ACT" circuit breaker.



NOSE GEAR RETRACTION TUBE & DOOR ADJUSTMENT POINTS -FIG.32-6

8. Check nose gear overcenter preload as follows:
   A. Measure nose gear bungees. (No load) (Fig. 32-8).
   B. Extend gear manually (See Section 32-30-07) stopping extension the moment the GREEN Gear Down Light comes ON. Gear switch in DOWN position.
   C. Measure nose gear bungee springs (Fig.32-8). Deflection from zero load condition in (A) above must be .030 to .070 inches for each bungee.
   D. If spring deflection is not within prescribed limits, adjust tube rod ends (F) (Figure 32-6) in increments of 1/2 turns as required.
9. Check main gear overcenter preload.
   A. Place rigging tool (T) P/N GSE 030007 (Figure 32-11) on retraction truss. Hold tool stationary by placing thumb on rear end of tool (S) and press forward.
   B. Hold 10" torque wrench (R) and place thumb on wing bottom; apply force until joint (4) breaks open slightly, insert shim stock (.005 .008 in. thickness) between link and truss at (P). Release force on wrench.
   C. With fingers on torque wrench and thumb on wing bottom apply force on wrench while maintaining a pulling force on shim stock. Read torque value on wrench at the **exact moment** the shim stock pulls loose. Torque value should be 250 to 280 inch pounds.
   D. Repeat on other main gear.
   E. If preload is not within prescribed limits, proceed to Main Landing Gear Rigging procedures, Section 32-31-02.
   F. If main gear preload needs re-adjusting, the nose gear bungees should be re-checked per 8, (C) above (Fig. 32-8).



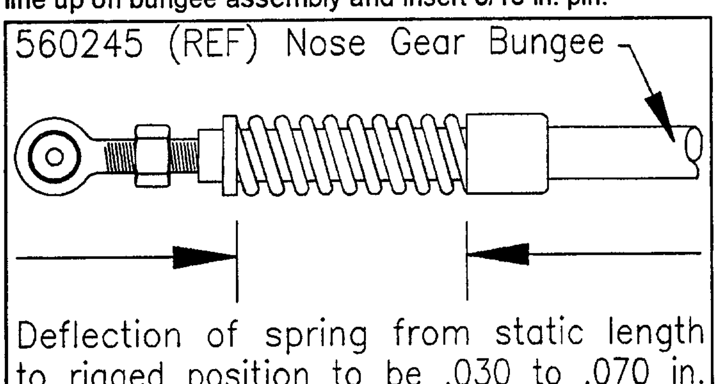
MAIN GEAR RETRACTION TUBE ADJUSTMENT POINTS - FIGURE 32-7

NOTE
When gear overcenter preload check is completed, electrically extend the gear and check the nose gear tube bungee springs to assure they have not compressed completely resulting in no remaining deflection. This would indicate excessive preload or weak bungees.

32-30-02 - MAIN LANDING GEAR SYSTEM RIGGING

1. Raise aircraft on jacks and remove three fiberglass belly access panels.

Assist Bungee Assy Removal (When Required). Retract landing gear until rigging pin holes (B)(Fig. 32-4) line up on bungee assembly and insert 3/16 in. pin.



NOSE GEAR BUNGEE SPRING - FIGURE 32-8

CAREFULLY BUMP gear UP, with the gear safety by-pass switch, until there is zero load on bungee assy rod end. Remove AN3 bolt at rod end and AN4 bolt at block; remove bungee assembly.

2. Pull the landing gear actuator circuit breaker out.

3. Loosen jam nuts (E) on the main retraction tubes (L), Fig.32-7; disconnect tubes at inboard bellcranks (M).

4. In nose gear well, loosen jam nuts (G), Fig.32-6, on nose gear retraction tubes (F).

5. At the main retraction bellcrank (A), Fig.32-12, disconnect the nose gear retraction tubes and the actuator barrel nut at (N), Fig. 32-12.

6. Check dimension from the rod end center to the end of the barrel nut housing on actuator (Avionics Products only, Plessey is non-adjustable) to be 1.25 +.000/-.010. Adjust rod end bearing, if necessary, and secure with set screw and jam nut.

7. Disconnect nose gear doors, outboard main gear doors, and inboard door links. On outboard main gear doors, disconnect springs. On inboard door bellcranks, disconnect springs. Loosen jamb nut (X) on retraction tube (V) (Fig.32-11) and back off pressure on spring (W) by loosening nut (Y). Disconnect retraction tube (V) from bellcrank (C) (Fig. 32-3).

8. Position main retraction bellcrank (A) so center of forward hole in the left outboard arm of bellcrank is 1.56 inches *** from forward face of truss at F.S. 33 (Fig.32-12, Detail A).

NOTE
This dimension * may vary to permit connection of retraction tubes with zero preload at bolt hole.**

9. With main retract bellcrank held in position, turn actuator barrel nut until rod end bearing aligns with hole in bellcrank; install connection bolt at (N), Fig. 32-12.

10. Position bellcrank (C) (**Fig. 32-3**), so center of attach pin (D) on top leg is 1.35 inches from bottom side of spar cap (E). This will be the starting position when landing gear is in down and locked over center, with out any preload set.

11. Adjust retraction tube (V) (**Fig. 32-11**), at rod end, until it will connect to bellcrank (C) (**Fig. 32-3**) with zero preload. Install connection bolt/hardware, leave loose at this time.

12. Adjust rod end on retraction tube (L) (**Fig. 32-7**) so attach hole is aligned with inboard bellcrank at (M). Install connection bolt/hardware.

13. Disconnect retraction tube (V) at bellcrank (C) rod end; position disconnected gear full down and locked over center. **Both LH and RH landing gear should be in this configuration at this time.**

14. PUSH landing gear actuator C/B - IN.

15. Turn MASTER Switch - ON.

16. Extend main gear actuator to fully extended position. Make certain lugs on main retract bell crank do not contact fuselage tubes, floorboard or actuator barrel nut. If there is any contact, run actuator back up slightly.

MECHANICAL DOWN STOP ADJUSTMENT

17. There should be .050 to .100 inch clearance (B) obtained between actuator barrel (C) (**Fig.32-9**) and mechanical down stop (A). Shims (D) (**Fig. 32-9**) may be added to the mechanical downstop (A) (4 max).

=========

18. Run actuator down and recheck retraction bellcrank clearance at F.S. 33.. Check clearance of bellcranks (M) (**Fig.32-7**) and center section.

19. Reconnect retraction tubes (V) (**Fig 32-11**). With main gear fully extended, if necessary, adjust main gear retraction tubes (L) (**Fig.32-7**) so they are connected with zero preload.

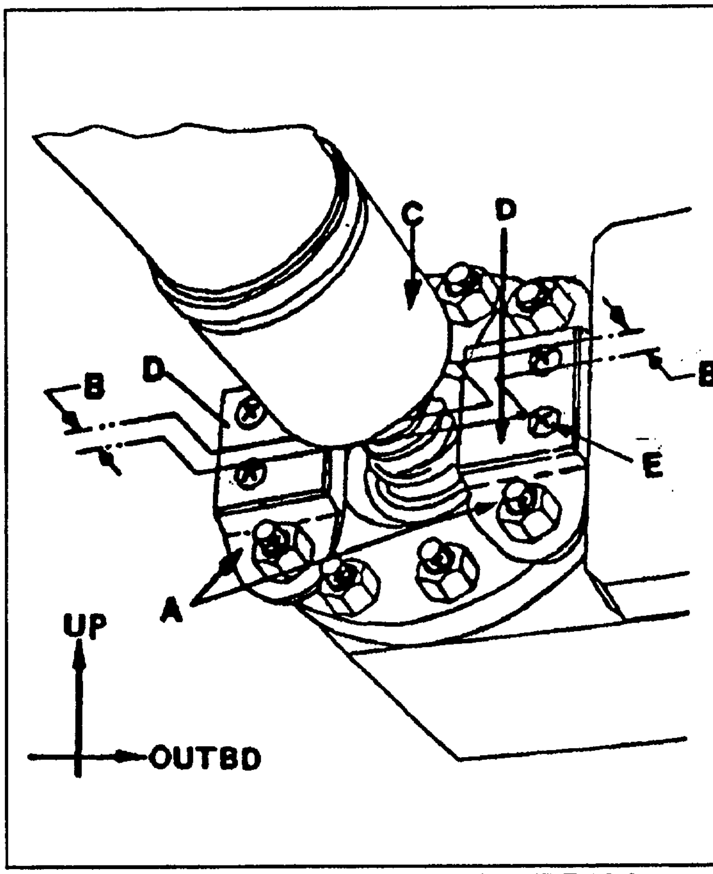
20. Adjust nut (Y) of retraction tube (V) (**Fig. 32-11**) until main gear is preloaded. Preload is correct when a "clean break" can be felt when pushing UP on retraction link (**Fig. 32-11**).

21. NOSE GEAR RETRACTION TUBES ARE TO REMAIN DISCONNECTED at main retraction bellcrank (A), **Fig.32-12**, during remainder of procedures.

22. Place landing gear switch in UP position.

23. PUSH RED gear safety by-pass switch IN intermittently to "BUMP UP" (retract) landing gear until left main tire just contacts bumper bracket which covers bulb stringer in wheel well. Make certain actuator barrel does not contact main retract bellcrank in UP position.

24. Set UP limit switch paddle (striker arm) (H), **Fig.32-7**, so GEAR UP limit switch is just CLOSED and RED "GEAR UNSAFE" light is OFF. Secure striker arm in position.



MECHANICAL DOWN STOP - FIGURE 32-9

LEGEND FOR FIGURE 32-9
=====================

A. 560252-009 Adjustable Stop (use 560252-011 shims)

NOTE
*** Use 1 to 4 560252-011 shims with 560252-009 stop to achieve proper clearance.**

Use one DOWN STOP on each side as required (Pick up existing hdw).

B. .050 - .100 clearance (between down-stop and end of ball nut)

C. Actuator ball nut.

D. 560252-011 shims* (use with 560252-009, maximum of 4).

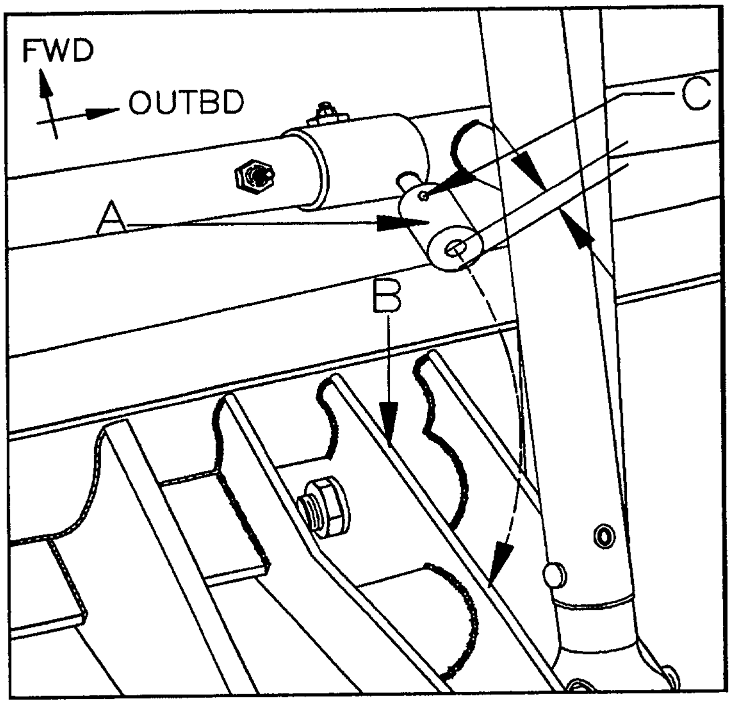
E. AN515-6R screw**

AN936A6 Lock Washer

(Typ. 2 plc.) (use with 560252-009).

** Use .063 longer screws with each additional shim. (Secure screw with Blue Locktite #83-31 grade C).

F. Loosen set screw (C) Fig. 32-10.



MECHANICAL UP STOP - FIGURE 32-10

MECHANICAL UP STOP ADJUSTMENT

25. Loosen set screw (C) **Fig. 32-10**. Adjust mechanical up-stop (A), **Fig. 32-10**, for a clearance of .050 to .070 inches at main retraction truss (B); tighten set screw (C).

26. Reinstall assist bungee per Section 32-10-06.

27. Using emergency gear extension, move gear down until GREEN gear down light **JUST** illuminates.

28. Turn Master Switch - OFF.

NOTE

The left main gear truss will probably lock over center first. Continue to slowly lower gear manually while monitoring comression of bungee spring on retraction tubes (V) Fig. 32-11.
If spring coils are fully compressed, retract tube (V) must be removed from aircraft for modification:
Dismantle bungee portion of tube (V); remove one space washer (Z) and reassemble. Re-install modified retraction tube and complete above overcenter requirement. The removal or addition of spacer washers may be required prior to obtaining final configuration for the retraction tube (V).

29. Place rigging tool (T) **(Fig. 32-11)** P/N 030007-100 on retraction truss assembly (G). Hold tool stationary by pushing at point (S) toward main gear leg.

30. Place 10 inch torque wrench (R) on rigging tool (T) as shown in **Fig. 32-11** and apply an unlocking force to retraction truss.

31. When joint at (4) breaks open slightly, insert shim stock (.005 to .008 in. thickness) between retraction link and truss at (P), then release force on torque wrench.

32. While applying a pulling force on the shim stock, exert an increasing unlocking force with torque wrench.

33. Read torque wrench value at the EXACT moment shim stock pulls loose.

34. Repeat steps 30 through 34 on other main landing gear leg.

35. Use adjusting nuts (Y) on retract tubes (V) to equalize breakaway torque values within 10.0 inch lbs. Adjust torque to 250 to 280 inch lbs.

36. Turn Master Switch - ON.

37. RUN GEAR DOWN ELECTRICALLY AND CHECK THAT TORQUE VALUES DO NOT EXCEED 325 INCH POUNDS USING TORQUE WRENCH/ SHIM STOCK METHOD.

GEAR WARNING ADJUSTMENT

1. Check that landing gear warning light circuit breaker pushed - IN.
2. Check that landing gear actuator circuit breaker is pulled OUT.
3. Turn Master Switch - ON.
4. Set DOWN limit switch paddle (striker arm) (J),Fig. 32-7, so that gear down limit switch is just CLOSED and GREEN "GEAR DOWN" light is ON. Secure striker arm in position.
5. Turn Master Switch -. OFF.

NOTE

The main gear preload torque should not exceed 325 inch lb. using the torque wrench/shim stock procedure after electrical extension.

The main landing gear system is now rigged for the gear down and locked condition.

32-30-03 - NOSE LANDING GEAR RIGGING PROCEDURE

1. Check the eccentric bushings (J), Fig. 32-6, on gear truss assembly to be installed with bolt hole in the upper forward position.

CAUTION

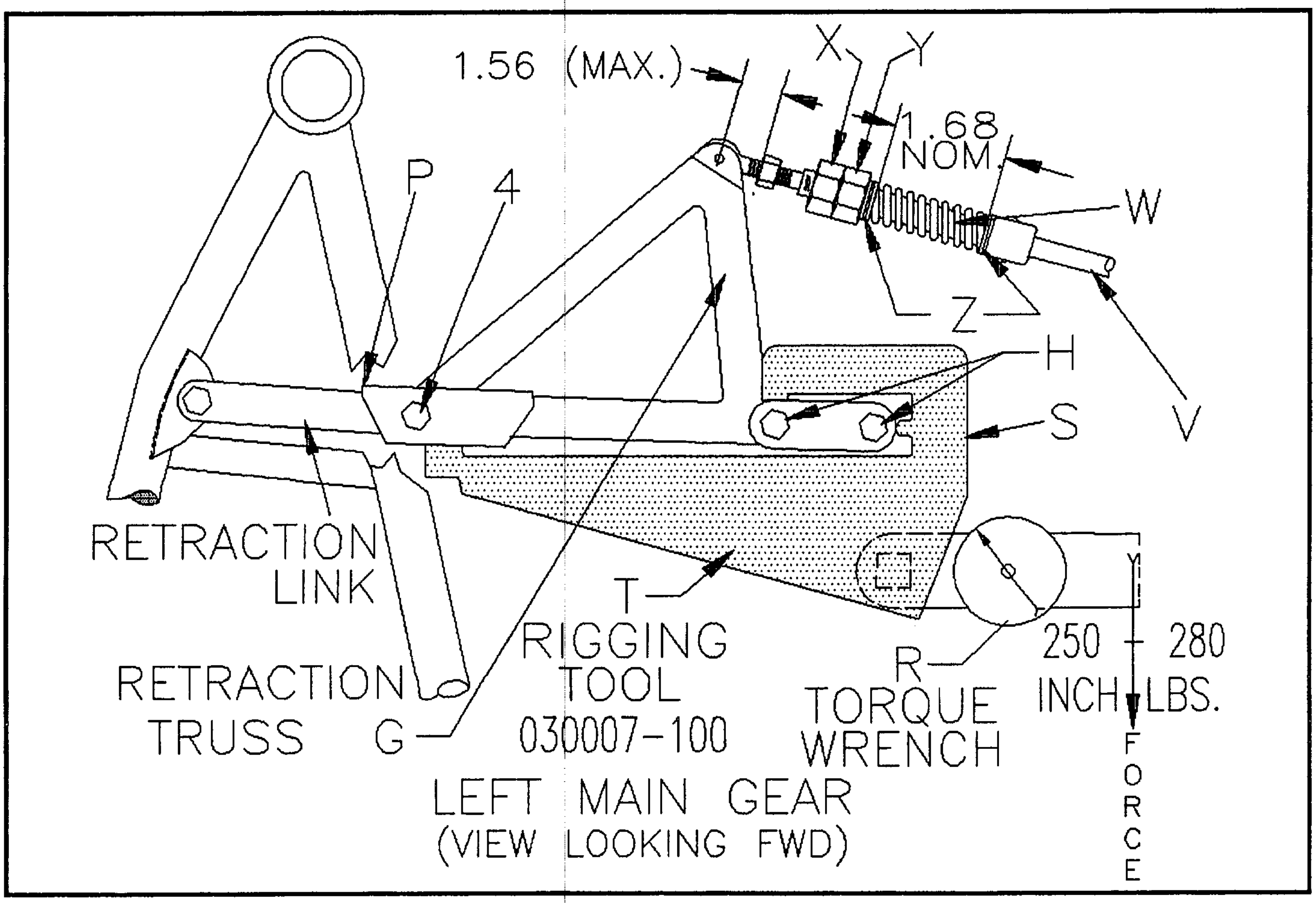
The eccentric bushing, on either or both sides, may be countersunk and have a flush head screw installed to allow clearance of nose gear truss during retraction/extension cycle. This configuration MUST be maintained during any removal/installation action for the truss or eccentric bushing.

2. Adjust nose gear retraction tubes (F), Fig. 32-5, so they can be reconnected to the main retraction bellcrank with zero preload.

NOTE

The eccentric bushings may require rotating to a new position in order to meet zero preload condition.

3. Measure nose gear bungees dimension (P), Fig. 32-8, and record for future reference.
4. Push landing gear actuator C/B - IN.
5. Place landing gear switch in the UP position.



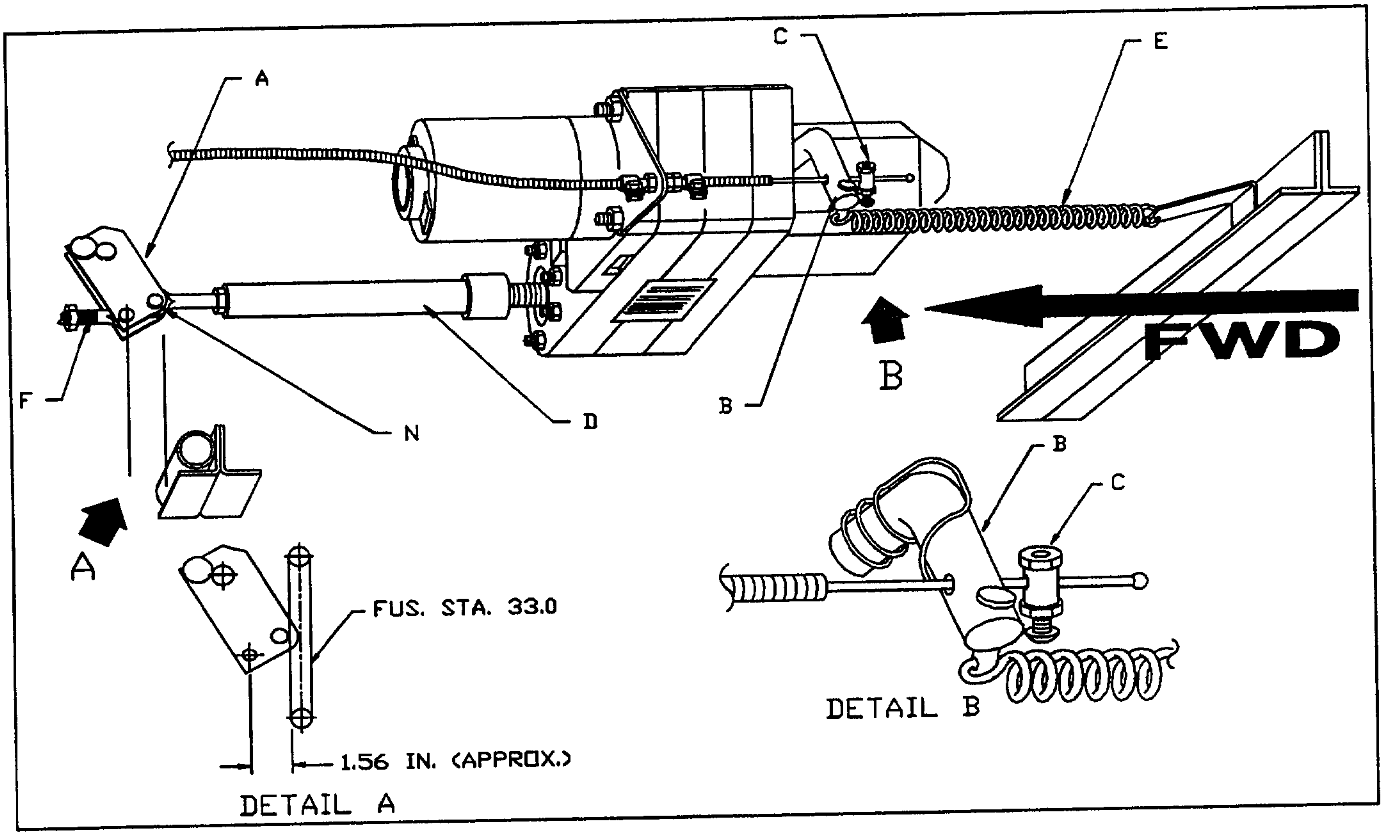
MAIN LANDING GEAR RIGGING TOOL APPLICATION - FIGURE 32-11

6. Turn Master Switch - ON
7. Push RED GEAR SAFETY BY-PASS SWITCH - IN and hold IN to partially retract landing gear; release switch.
8. Turn Master Switch - OFF.
9. Pull landing gear actuator C/B - OUT.
10. Screw each nose gear retraction tube (F), Fig.32-5, IN (clockwise looking toward the front of the aircraft) one (1) full turn, then re-attach to main retraction bellcrank.
11. Place landing gear switch in DOWN position.
12. Push latch (5), Fig. 32-13, FORWARD on manual emergency extension controls (on floorboard).
13. Pull RED lever (1), Fig. 32-13, back and upward to engage manual emergency gear extension system.
14. Pull "T" handle (2) UP (slowly until engaged) and return it to its original position. Continue this procedure, stopping when the gear down light JUST illuminates.
15. Measure nose gear bungee assemblies dimension "P" as shown in Fig. 32-8. If the springs have deflected less than .030 inches or more than .070 inches from the static dimension (as recorded in Step 2), adjust the length of the bungee assembly's to bring the deflection within tolerance.

32-30-04 - EMERGENCY GEAR EXTENSION SYSTEM RIGGING.

DISENGAGE RIGGING:

1. Insert cable through hole in actuator disengage arm, (B) (Figure 32-12).
2. With RED lever (1) (Fig. 32-13) in full disengaged position (down and latched), push actuator disengage arm (B) (FIG.32-12) to full forward position and apply approximately 5 lbs. pull to cable to remove slack.
3. Install D222 wire stop, (C) tighten nut and connect spring (E) to clevis pin, (D).
4. Lift RED lever and pull "T" handle (2) (Fig. 32-13) aside; re-engage RED lever. Check manual extension system to verify that it is fully disengaged by pulling "T" handle; no resistance should be felt. If a resistance is felt check cable routing through pulleys 3 and 4 (Fig. 32-13) to verify whether it is cable routing or actuator resistance.
5. Move RED lever to full UP position; pull "T" handle slowly to verify manual extension system is engaged. Resistance should be felt at once.
6. Replace "T" handle under RED lever and return RED lever to disengage position, (down and latched). Manual extension system is now rigged.



LANDING GEAR ACTUATOR ADJUSTMENTS - FIGURE 32-12

NOTE
Plessey actuators should be lubricated every 2000 cycles with MIL-G- 81322 grease. Run actuator to mechanical extended position. Fill tube cavity with grease via MS15001-1 grease fitting until old grease is purged from screw assembly; remove old grease from and relubricate exposed screw. Run actuator to approximately 0.5 in. or mechanical retract and remove the major excess grease extruded from barrel nut assembly.

32-30-05 - LANDING GEAR ACTUATOR, — CLUTCH SPRING REPLACEMENT

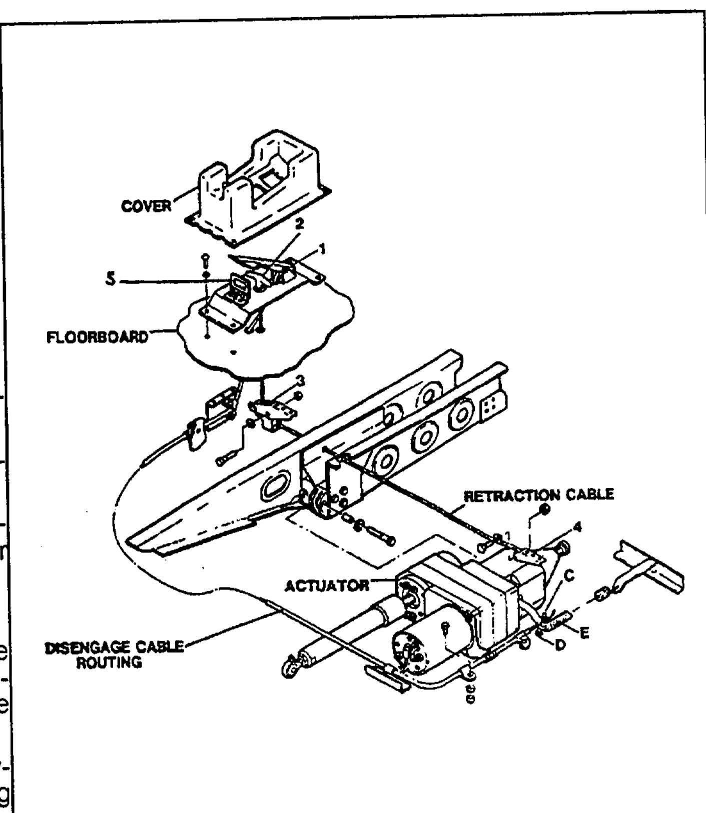
Refer to MAC SI M20-52A for clutch spring replacement at each 1000 hours for EATON actuators.

Refer to MAC SI M20-92 for clutch spring replacement at each 1000 hours for Plessey actuators.

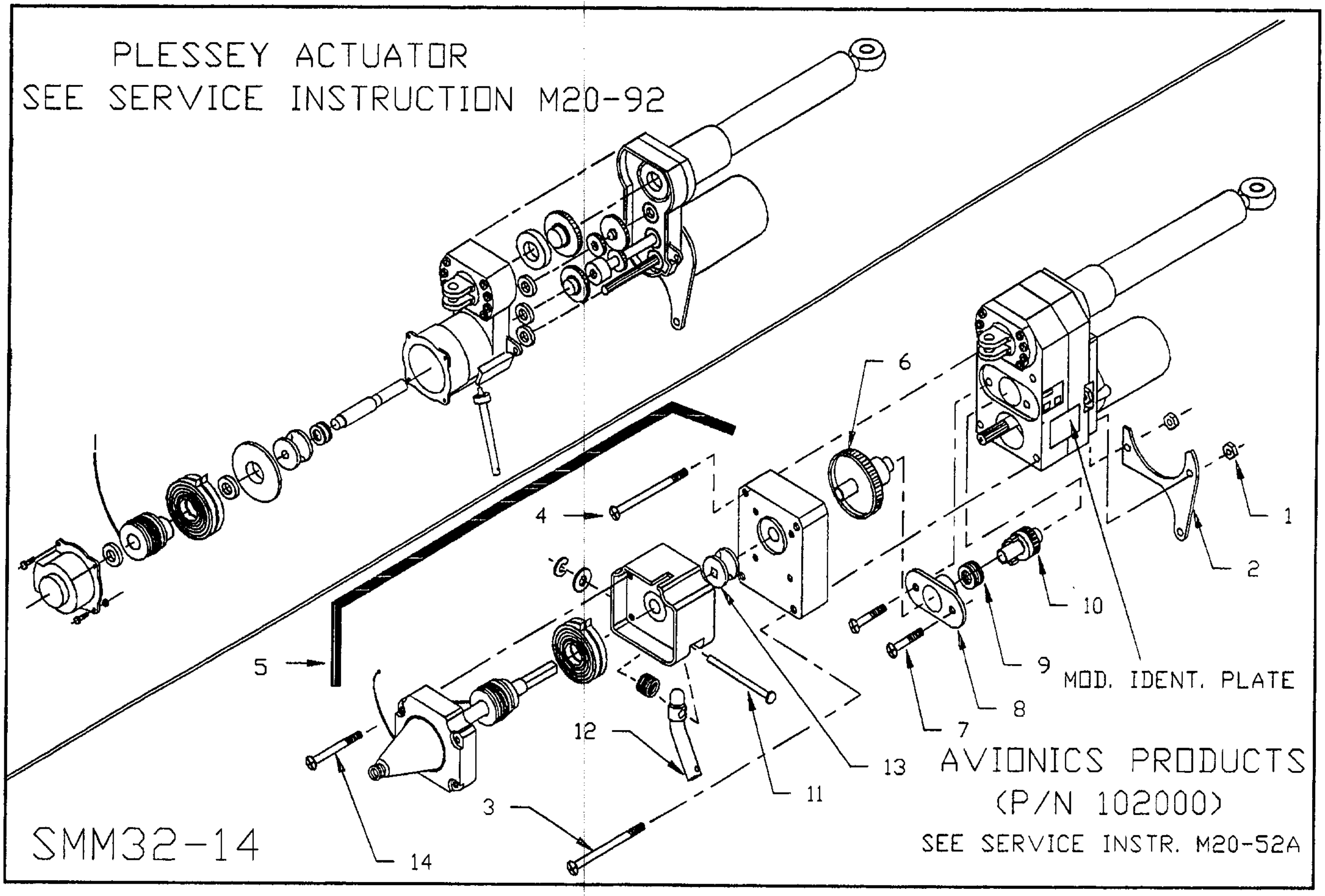
Landing gear actuator clutch spring replacement is mandatory at each 1000 hours of aircraft operation for either actuator.

DISASSEMBLY - (EATON ACTUATOR)

1. Remove two nuts, (1) (Figure 32-14) that retain the cable support bracket (2) and remove bracket and disengage cable intact from actuator body and disengage arm.
2. To avoid stripping screw heads, use impact screwdriver to break loctite thread seals and remove two long screws, (3) & two short screws, (4).
3. With razor or similar tool, slice through identifiction plate and remove recoiler assembly (5).



EMERGENCY GEAR EXTENSION SYSTEM
FIGURE 32-13



LDG. GR. ACTUATOR (EXPLODED VIEW) - FIGURE 32-14

NOTE
Care should be taken not to allow bearings or shims to drop out of clutch housing mount assembly.

6. Remove input gear assembly, (6), from clutch housing (8), by rotating gear and pulling with slight to moderate pressure.

7. Remove two screws (7), and remove housing (8), spring (9), and gear assembly (10) from actuator body.

8. Remove clutch (no-back) spring, (9), from clutch housing using gear assembly (6), as removal tool. Insert (6), into spring from flanged end of housing; rotate CCW and pull slightly.

--- DO NOT rotate CW. Spring can be damaged. ---

CAUTION
Use extreme care to prevent ball bearing from dropping out of recoiler assembly; avoid damage to gear and do not allow dirt to enter clutch housing bore.

9. After disassembly, clean clutch gear thoroughly. Discard removed screws (3) & (4).

10. See 32-30-06 procedure prior to reassembly for additional maintenance, if necessary.

RE-ASSEMBLY

1. Lubricate gear and new clutch spring thoroughly with lube (MIL-G-81322) poly-lube.

2. Using gear assembly (6) as insertion tool, place new clutch spring on cam end of assembly and turning CCW , install spring into clutch housing to abut midpoint. DO NOT FORCE SPRING. While rotating CCW, insert clutch spring into housing bore until fully seated.

3. Withdraw gear assembly (6).

4. Insert clutch gear assembly (10) into clutch spring and housing from cylindrical end of housing, insuring that spring tangs fit into recesses in cam.

NOTE
When clutch spring is properly seated, large input gear (6) can be rotated in either direction and small output gear (10) will follow rotation direction.

5. Lubricate output gear teeth (10) with MIL-G-81322, and install clutch housing, gear and spring assemlby in actuator body by mating (10) gear to the output gear train assembly. To engage gear teeth and fully seat hub into bearing, rotation of gear assembly may be required.

6. Re-install screws (7) to secure clutch housing into actuator body. Use Loctite, Grade A, on threads.

7. Re-insert input gear assembly, (6) into clutch housing and clutch spring assembly until fully seated. Lubricate gear teeth (6) with MIL-G-81322 poly-lube.

NOTE

Clutch assembly can now be verified for proper installation by rotating input gear (6) both CW & CCW. Gears should turn with moderate friction to hand torque. Observe that actuator output screw jack rotates in BOTH directions.

In some instances, the new clutch (no-back) spring "CHATTERS" during electrical extension or retraction cycle. Proper shimming of the no-back clutch housing assembly, items 6, 7, 8, 9, & 10, and bearing with shims is necessary to eliminate the chatter.

8. Disassemble Clutch Housing Mount Assy. from recoiler assembly (5). Do not allow bearing or shims to drop out of clutch housing mount assembly.

9. Normally the existing shims already installed behind bearing will be correct for the new clutch spring. However, due to manufacturing tolerances, it may be necessary to change shim thickness for proper spring adjustment.

10. Three different thickness of shims are available from EATON; P/N 110117-1 (.003 in. thk), 110117-2 (.005 in. thk), 110117-3 (.010 in. thk). Any combination of these shim thicknesses are allowed to obtain the correct rotational torque (inch pounds of rotational torque) of input gear shaft after clutch housing mount assembly is installed (minus recoiler assy portion) and torqued into place.

11. The rotational torque used by EATON for new actuators is 5.0 to 5.5 inch pounds of consistent, running, rotational torque in both the CCW and CW directions. If this recommended rotational torque is not obtained on the first assembly attempt, the clutch housing mount assembly will require removal and shims must be added or removed until the proper rotational torque is obtained. A special "socket" can be made to properly fit the flats on the input gear shaft to use on the Torque Driver.

12. When correct rotational torque has been obtained, re-install recoiler assembly on to actuator assembly.

Flats on gear (6) shaft must line up with the brass manual driv e clutch (13) for proper assembly. Pull manual drive cable slightly to position brass clutch to align with flats on gear shaft (6).

13. Install four new bolts (3) ADS145-10-43 (2 each) and (4) ADS145-10-38 (2 each) and torque to 20 - 25 inch pounds. Bolts are EATON P/N's. Use Loctite Grade A (Catalog number 88-31) on bolt threads.

14. Re-install cable support bracket and lock nuts on -43 bolts. Torque lock nuts to 20 - 25 inch pounds.

15. Retest unit for proper electrical and mechanical operation.

16. Install modification plate adjacent to I.D. plate (@ first 1000 hour replacement only). Mark first block on modification plate with the figure "1" using metal stamp or etching tool. Mark plate at each succeeding clutch spring replacement with the next consecutive number.

17. Reinstall actuator into aircraft and verivy landing gear rigging per SECTION 32-30-02.

32-30-06 - LANDING GEAR ACTUATOR, P/N 102000-1, — RECOILER SPRINGS/ CABLE AND DRUM ASSEMBLY REPLACEMENT

1. Carefully separate pulley housing from recoiler assembly (5) by removing screws (14). Retain pulley on shaft.

2. Slide pulley drum and cable off shaft.

3. Remove two (2) recoiler springs, and two (2) of three (3) spring spacers leaving third spacer in housing. Be certain that spacer is in place before installation of two (2) new recoiler springs and previously removed spacers.

4. Install new recoiler springs placing a spacer between each spring and over top spring.

IMPORTANT - Recheck proper installation of springs.

NOTE

When looking at recoiler assembly with shaft end toward you, the spring tabs in the housing slot should curve to the right as shown (Figure 32-14).

5. Inspect cable for sheathing damage. Replace cable if sheathing is cut or stripped. Measure overall cable length prior to reassembly. Cable length should be 31 1/2" +/- 1/2" long.

6. Slide drum onto shaft and be certain that spring detent on drum engages both recoiler springs by slightly rocking drum end.

7. When full engagement is obtained, wrap cable around drum in a clockwise direction-leaving 2" to 5" of cable free of drum.

8. Align slot in pulley housing with cable and slide pulley housing over cable and drum assembly.

9. Holding housings together, pull properly aligned cable several times to ensure the absence of binding conditions. Measure cable length from side of housing. At full extend, the length of cable should be 29" minimum. In retracted position, cable length should be 5" to 8" long.

NOTE

Cable length in retract position may be adjusted shorter or longer by holding clutch with the finger of one hand (to prevent shaft rotation), and then with the other hand, rotating pulley housing one (1) full turn CW (to shorten) or CCW (to lengthen). Retention of clutch with finger will not allow pretensioning of springs. Slight spring tension should be noted starting at 8" to 10".

10. Bronze clutch (13) should be inspected for damage or wear at slot where gear assemble engages during manual extension of the landing gear.

11. If damaged or worn, remove pin (11) from disengage arm (12) and slide disengage arm out so bronze clutch (13) can be pulled from its driveshaft.

12. Replace bronze clutch and reassemble disengage arm into recoiler assembly.

13. Attach clutch recoiler assembly to actuator gear housing with the four (4) screws removed in 32-30-05 (supplied in clutch spring kit).

32-30-07 - MANUAL EMERGENCY GEAR EXTENSION SYSTEM

The manual emergency gear extension system is used to extend gear only. The controls are in the floorboard aft and between the front seats. To manually extend gear:

1. Landing gear actuator C/B - PULL.
2. Move landing gear control switch to DOWN position.
3. Push latch on manual extension control forward with right thumb.
4. Pull RED lever back and upward (engaging manual extension system).
5. Pull "T" handle UP and return to original position; continue until GREEN, gear-down indicator light is illuminated and/or lines on visual gear position indicator, on floor, aft of console are aligned when viewed from directly above indicator (this will normally take 12 to 20 pulls).

CAUTION
DO NOT operate landing gear electrically with manual extension system engaged. Landing gear actuator C/B will pop out.

CAUTION
DO NOT continue to pull T-Handle after GEAR DOWN light is ON. Actuator may bind on Down Stops.

32-30-08 - FINAL CHECKS

1. Raise and lower landing gear through five complete cycles, pausing after each cycle to check required tolerances and dimensions, and annunciator light indications. Make certain no bungee springs are compressed to solid height and nose gear tire clears top of wheel well a minimum of .25 in. when landing gear is retracted. Make adjustments per above procedures, as required, to correct any deficiencies.
2. Retorque all jam nuts.
3. Re-attach main and nose landing gear door links. Check to see that main and nose landing gear doors are still rigged per paragraph 32-10-03 and 32-20-03.

32-31-00 - TROUBLE SHOOTING - LANDING GEAR SYSTEM

TROUBLE	PROBABLE CAUSE	REMEDY
Incomplete Retraction. Gear retracts to an intermediate position and stops short.	Bind in gear retraction system because gear is out of rig. Malfunction in gear electrical circuit, inoperative actuating motor, or weak battery.	Refer to landing gear rigging procedure. Examine all movable parts for proper lubrication and freedom from binding. Check for actuator worm gear binding and lubricate as needed. Any malfunction can cause the landing gear circuit breaker to trip: therefore check electric circuit for loose connection, broken wires or defective relay switches. Recharge battery.
	Oversized/Stretched tire will not go into wheel well properly.	Replace tire with smaller diameter tire.
Gear will not retract at 61 to 70 KIAS.	Insufficient airspeed. Pressure switch inoperative. Circuit breaker tripped.	Check pitot tube and line for obstructions. Examine pressure switch for proper adjustment and operation. Reset circuit breaker. Does gear retract using override - check system operation.
	Actuator ball nut binding on mechanical DOWN STOPS.	Gear may have been extended manually & ball nut is jammed tight against STOPS on motor; use wrench on ball nut flat to move from STOPS.
Gear will not retract and gear actuator C/B trips.	Manual engage handle in engaged position.	Disengage manual system.
Aircraft does not track or steer properly.	Nose wheel location improper.	See Section 32-50-02.
Gear will extend; green indicator-light will not illuminate.	Lamp burned out in annunciator -GREEN -light circuit.	Push press-to-test on annunciator and replace burned out lamp if needed.
	Down-limit switch inoperative.	Check circuit and/or down-limit switch.
Actuating motor extends gear to an intermediate position.	Same causes as listed with "Incomplete Retraction".	Same remedies as listed with "Incomplete Retraction" above.

TROUBLE	PROBABLE CAUSE	REMEDY
Gear will extend manually, but GREEN indicator light will not illuminate.	Gear switch is not in DOWN position.	Place gear switch in DOWN position.
	Lamp burned out in GREEN indicator light.	Replace burned out lamp.
Manual system will not lower gear.	Actuator internal clutch spring broken (Avionics Products Actuator only).	Replace spring.
	Manual engage arm improperly rigged.	Rig manual engage arm.
	Sheared female spline in drive connector.	Replace drive connector if female spline is stripped.
	Drive connector is out of rig.	Adjust control cable tension of drive connector.
Landing Gear Actuator will not retract nor extend gear.	Any of the above or brushes in motor are worn beyond limits.	Applicable remedy listed above or replace motor or brushes.

32-40-00 - WHEELS AND BRAKES

32-40-01 - MAIN WHEELS

The main wheels have standard brand, 6:00 x 6, Type III, six-ply rated tires with standard tubes. To remove main wheels:

1. Remove MID gear door.
2. Detach dust shield. Remove three screws and washers.
3. Remove 2 bolts from single puck brake caliper; (4 bolts on dual puck caliper).
4. Remove wheel by removing cotter key, nut and spacer from axle. (See Figure 32-15.)
5. Slide wheel off axle.

32-40-02 - MAIN WHEEL DISASSEMBLY/ ASSEMBLY

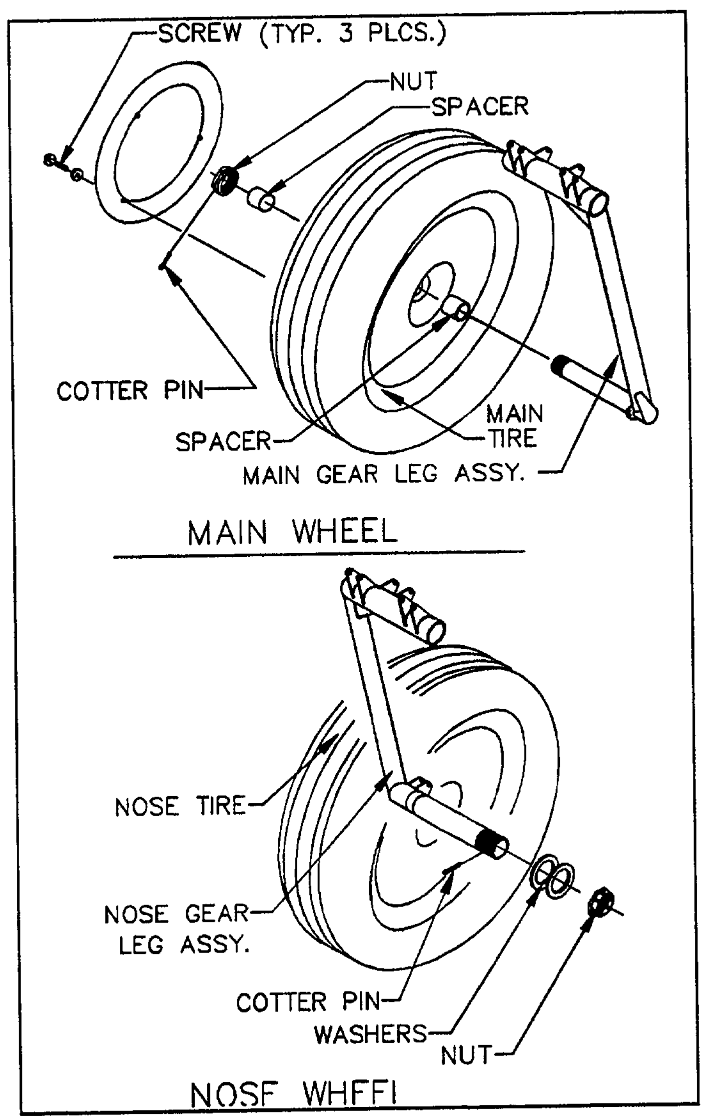
1. Remove snap ring, (10) grease seal rings, (8) and felt seals (9), (See Figure 32-16).
2. Remove bearings (7).
3. Completely deflate tire.

WARNING
Do not loosen wheel half retaining nuts before tire is completely deflated. Failure to observe this warning may result in bodily injury.

4. Remove nuts, washers, and wheel half retaining bolts, (5); remove brake disc (2), separate halves, (3 & 4) and remove tire and tube.

NOTE
Bearing cups are shrink fitted; do not remove them unless necessary for replacement.

5. Clean all wheel parts thoroughly in cleaning fluid (Federal Specification PS-661). Exercise special care in cleaning bearing cones and felt rings to insure thorough cleaning.



LANDING GEAR WHEEL REMOVAL - FIGURE 32-15

6. Inspect all parts for cracks, corrosion, or evidence or wear.

7. Inspect bearing cups and replace if cups are damaged or worn. If necessary to remove bearing cups, heat wheel in boiling water for at least 30 minutes. Then remove cup by tapping evenly.
To install cup, heat wheel half again as above; cool cup with dry ice. Position cup and tap lightly to insure proper seating.

8. Polish small burrs or nicks out of wheel halves with No. 400 grit sandpaper, clean thoroughly, and refinish protective coating as required.

9. Replace bearing cones that show signs of wear or bearing fretting.

10. Repack wheel bearings and lubricate seals with grease. Install bearings, grease seal rings, and felt seals in wheel halves. Secure with snap rings.

11. Position tire & tube on one wheel half; then position other wheel half in tire.

12. Install brake disc (2),Fig.32-16, and wheel half retaining bolts, washers and nuts.

13. Tighten nuts evenly and torque to 150 inch pounds.

CAUTION
Uneven or improper torque may cause bolt or wheel failure.

14. Inflate tire to 42 PSI.

15. Install wheel assembly, bearing spacer, washer, and axle nut. Tighten axle nut until bearing binds slightly, back nut off to nearest castellation, and install cotter pin.

NOTE
When properly installed, the wheel will turn with slight resistance.

16. Install dust shield and IB/MID gear door.

17. Reinstall brake caliper & safety.

18. Remove aircraft from jacks.

32-40-03 - NOSE WHEEL DISASSEMBLY/ASSEMBLY

The standard brand, tube-type, 5:00 x 5, Type III, nose wheel tire is six-ply rated.

1. Nose wheel removal.

A. Remove cotter key, nut, and washer from axle. (Figure 32-15).

B. Remove nose wheel.

2. Installation is in reverse sequence of removal.

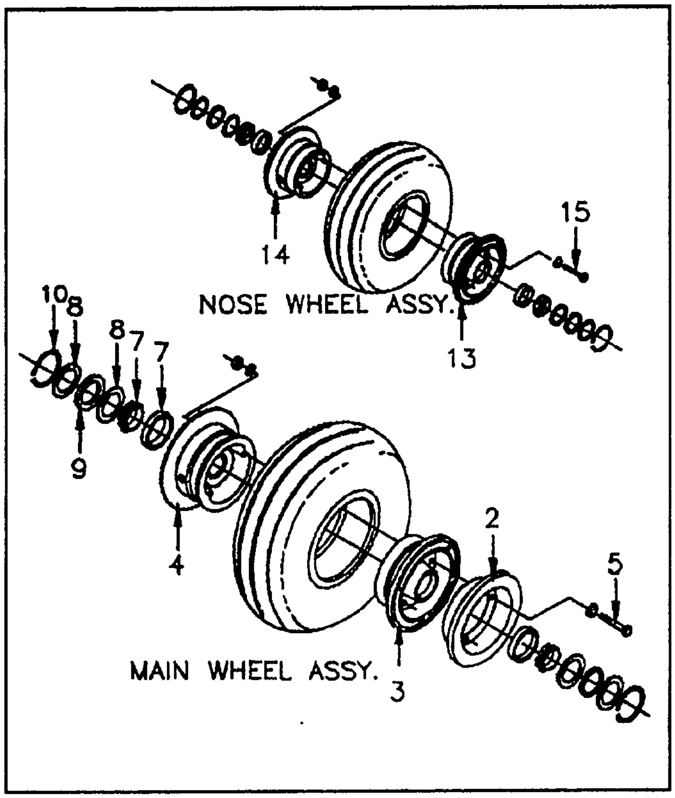
3. Nose wheel disassembly.

A. Completely deflate tire by removing valve core.

B. Remove nuts, washers, and wheel half retaining bolts (15), Fig. 32-16.

C. Separate wheel halves, (13 and 14) and remove tire and tube. Refer to Section 32-40-02 steps 5 thru 10 for wheel inspection.

D. Reassemble nose wheel in reverse sequence of removal. Tighten wheel half retaining bolt nuts evenly and torque to 90 inch-pounds. Inflate tire to 49 PSI.



WHEEL ASSEMBLIES - FIGURE 32-16

CAUTION
When ANY tire and/or wheel assembly is removed or replaced and re-installed, conduct at least 5 complete retraction/extension cycles to verify tires enter and exit wheelwells without interference. [Ref. AC 43.13( ), Chap.8, para. 332, a, (9)]

32-40-04 - BRAKE SYSTEM

NOTE
A/C have dual puck wheel brake cylinders installed.

1. BRAKES - REMOVAL AND INSTALLATION (TYPICAL)

Lining inspection and/or replacement or cylinder repair.

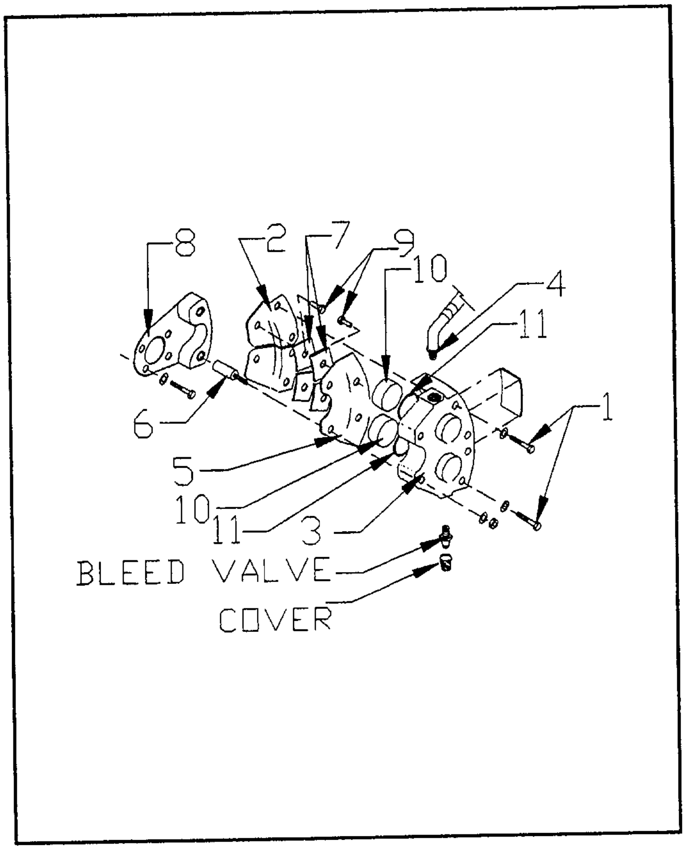
A. Place aircraft on jacks.

B. Remove middle gear doors. Remove safety wire and two AN4H17A bolts (1) attaching back lining plate assembly (2) to brake cylinder assembly (**Figure 32-17**).

C. Visually inspect linings for wear and brake disc for warpage. Brake linings should be replaced when they are worn to a minimum thickness of 1/8 inch. If lining replacement is necessary proceed with steps D thru O. Otherwise reassemble in reverse sequence of disassembly.

CAUTION
Brake disc should be replaced if width is .205 in. or less.

D. Disconnect and cap hydraulic line (4) at brake cylinder assembly. Remove nuts from anchor bolts.



TYPICAL BRAKE ASSEMBLY - FIGURE 32-17

E. Remove pressure plate assembly (Figure 32-17) (5) sliding it off the anchor bolts (6). Note the condition of the anchor bolts. If they are nicked or gouged they should be sanded smooth to prevent binding with the pressure plate (5) or torque plate (8). When the anchor bolts are replaced they should be pressed out. New ones can be installed by tapping them in place with a soft hammer.

F. Drill out rivets (9) attaching linings (7) to back lining plate (2) and the pressure plate (5). Remove piston assembly (10) and "O" ring (11). It is permissible to use compressed air applied to the brake line fitting to remove the piston (10) from the brake cylinder.

G. Clean parts in cleaning solvent (Federal Specification PS-661 or equivalent) and dry with oil-free compressed air.

H. Replace linings with Cleveland 66-30 linings using Cleveland #561-2 rivets. Rivet shanks must be rolled with special tool for proper installation.

I. Inspect brake cylinder bore for scoring. A scored cylinder may cause the "O" ring to leak or cause rapid wear of the "O" ring. A scored brake cylinder should be replaced.

J. Replace AN6230-2 "O" ring (11) with a new one. Do not reuse the old "O" ring.

K. Lubricate cylinder and piston with MIL-H-5606 red hydraulic fluid and assemble components with care to prevent damage to the "O" ring.

L. Service and inspect main wheels as described in SECTION 32-40-02.

M. Reassembly brake cylinder assembly and back lining plate assembly onto the airplane in the reverse sequence of disassembly.

N. Bleed hydraulic system as described in SECTION 12-20-05.

O. Remove aircraft from jacks.

2. **BRAKES - BREAK IN PROCEDURES.**

NOTE

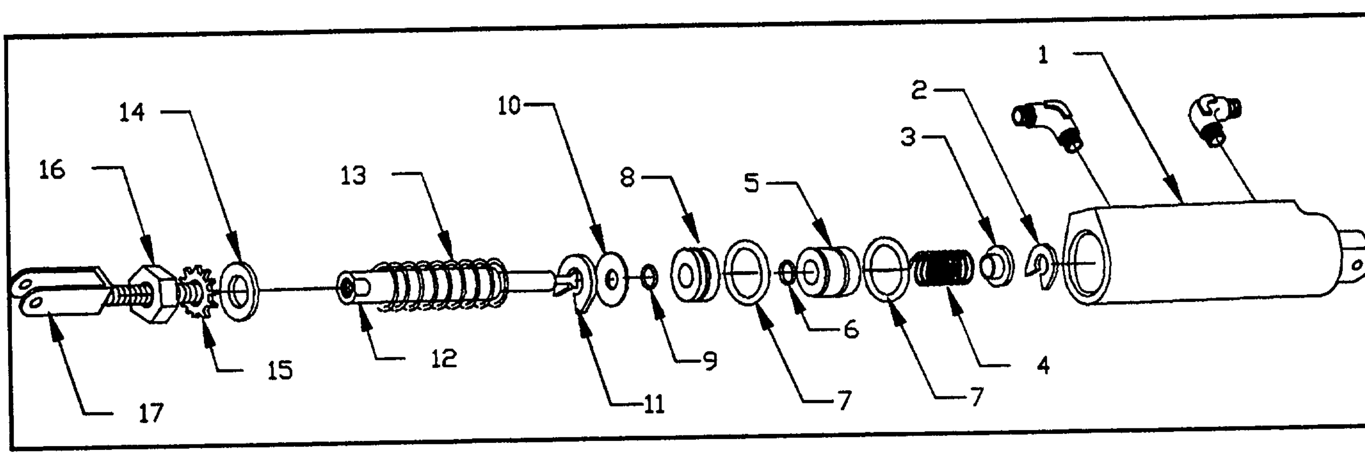
Brake pad conditioning is required to properly cure the resins binding the lining composition together. Excessive heat created prior to conditioning will carburize the lining material and prevent the attainment of maximum braking coefficient.

Proper conditioning may be accomplished as follows:

A. Perform a minimum of six (6) light pedal effort braking applications and two (2) hard stops from 21 to 35 KIAS. Allow the brake discs to partially cool between stops.

The procedure will generate sufficient heat to cure the resins in the lining, but will not cause the material to become carburized due to excessive heat.

3. **MASTER CYLINDER - REMOVAL AND DISASSEMBLY (Figure 32-18)**



MASTER BRAKE CYLINDERS - (PARKER-HANNIFIN) - FIGURE 32-18

NOTE
A/C have large capacity Master Cylinders installed.

A. Remove left hand, lower fuselage skin aft of firewall and exhaust cavity.

B. Disconnect hydraulic cylinder from pedal linkage.

C. Disconnect and cap hydraulic lines.

D. Disconnect hydraulic cylinder from bracket and remove cylinder.

E. To disassemble master cylinder: (Parker-Hannifin) (See Figure 32-18).

(1) Unscrew and remove rod end clevis (17), nut (16) and washers (14 & 15) from piston rod (12).

(2) Remove snap ring (11) from cylinder housing assembly; lift out complete piston rod assembly, (items 2 thru 12). Spring (13) can be removed at this time.

(3) Remove snap ring (2) from end of piston rod assembly.

(4) Remove bushing (3) and spring (4) from end of piston rod.

(5) Remove piston assembly (5) and o-ring (7) from piston assembly and o-ring (6) from piston rod shaft.

(6) Remove end cap (8) and o-rings (9 [ID] and 7 [OD]) from end cap assembly.

(7) Clean all parts with cleaning solvent (Federal Specification No. PS-661).

(8) Inspect cylinder for cracks, scoring, or grooves in bore.

(9) Inspect piston (5) for damage; check for nicks and scratches

(10) Inspect end cap (8) for damage.

(11) Inspect push rod for scoring, grooves, nicks and scratches.

(12) Inspect spring (4) for free height - .500 in. +/-.030.

(13) Replace all faulty parts and all o-rings.

(14) Reassemble in reverse sequence of disassembly. Immerse all parts in hydraulic brake fluid prior to reassembly.

(15) Check piston rod and return spring (13) for proper compression during stroke (9 lbs., (initial) to 32 lbs. (@ 3/4 stroke)).

F. Reinstall master cylinder in reverse sequence of removal.

G. Bleed brake system (refer to Section 12-20-05).

4. PARKING BRAKE VALVE
Removal and disassembly.
(Figure 32-19)

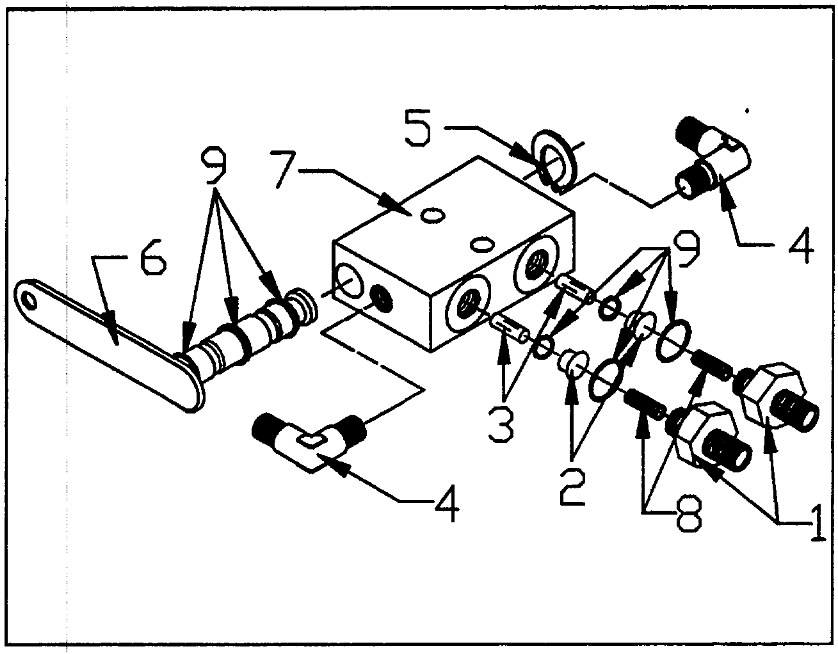
A. Remove forward fiberglass belly skin.

B. Disconnect parking brake control at parking brake valve arm.

C. Disconnect and cap hydraulic lines.

D. Remove parking brake valve.

E. Disassemble parking brake valve: (Refer Figure 32-19).



PARKING BRAKE VALVE - FIGURE 32-19

(1) Remove both fittings (1) from valve housing (7), springs (8) will come out with the fittings.

(2) Remove poppet valves (2) and pins (3), from housing by bumping on table top.

(3) Remove both fittings (4) from end of housing.

(4) Remove snap ring (5) from end of camshaft assembly (6).

(5) Carefully remove camshaft assembly (6) from housing.

(6) Inspect all components for damage, nicks, grooves, etc.

(7) Clean all parts with cleaning solvent (Federal Specification No. PS-661).

(8) Replace all o-rings (9).

(9) Reassemble brake valve in reverse sequence of disassembly.

(10) Connect valve assembly to the hydraulic lines.

(11) Bleed system; service hydraulic reservoir with hydraulic fluid as described in Section 12-20-05.

5. SHUTTLE VALVE - MAINTENANCE

A. No maintenance authorized. Remove and replace shuttle valve assembly.

32-41-00 - TROUBLE SHOOTING - BRAKE SYSTEM

TROUBLE	PROBABLE CAUSE	REMEDY
Solid pedal and no brakes.	Brake lining worn beyond allowable limit.	Replace lining.
Spongy brake.	Air in system.	Bleed brake system.
Pressure will not hold.	Leak in brake system.	Visually check entire system for evidence of leaks.
Parking brake will not hold.	Air in system or leak in system (downstream of parking brake valve).	See remedies above.
	Defective parking brake valve.	Repair or replace the valve.
Brake grabs.	Warped or bent disc.	Replace disc.
	Foreign matter locking disc.	Clean disc and lining.
Brake pedal will not return to neutral position.	Master cylinder shaft or other linkage misaligned.	Check that shaft travels in straight line and not binding in linkage.

32-50-00 - STEERING

32-50-01 - NOSE GEAR STEERING SYSTEM

The nose gear steering system consists of a steering horn on the gear leg linked to the rudder pedals by push-pull tubes and bellcranks. Gear retraction automatically disengages the steering mechanism from the nose wheel. (Section 27-20-00 outlines the nose gear steering rigging.) A centering cam aligns the nose wheel for entry into the wheel well.

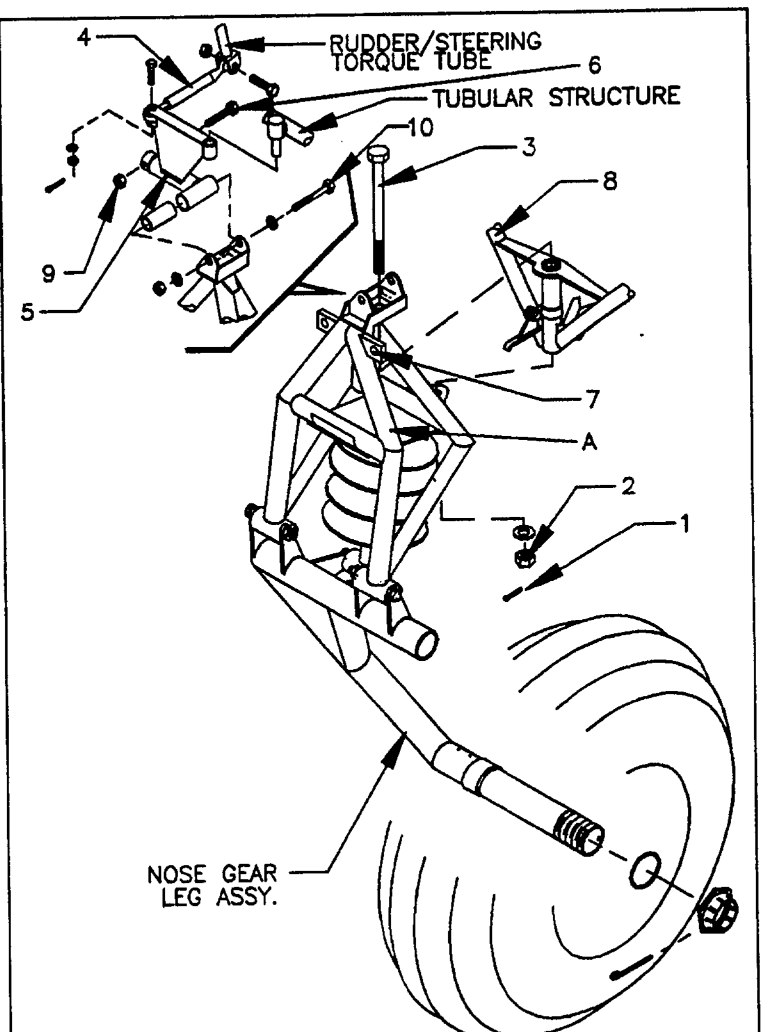
NOTE
Check nose gear leg assembly for towing damage. Replace if any dent exceeds 1/32 inch.

Twin limiter pads and adjustable stops (7), Fig. 32-20, are installed on the nose gear leg assembly (A) to prevent towing/turning damage to the leg assembly.

1. Every 100 hours remove cotter pin (1) (Figure 32-20) and retorque nut (2) to 450-500 inch lbs. Check holes in leg assembly where pivot bolt (3) is located for any wear. If holes are worn, replace leg assembly.

CAUTION
Bolt, washer, nut (9) and (10) (Figure 32-20) must be installed as shown, from rear to front.

2. Rod end bearing (4) (Figure 32-20) should be inspected at least every 100 hours for any damage or bending.
3. Check the steering horn assembly (5) collars and spacers for looseness. Replace any bushings or spacers that are worn.
4. Adjust turn limiter stop bolts (7) to contact cross member (8) of truss assembly (.020 gap permissible) when rudder is at its extreme left and right travel position.



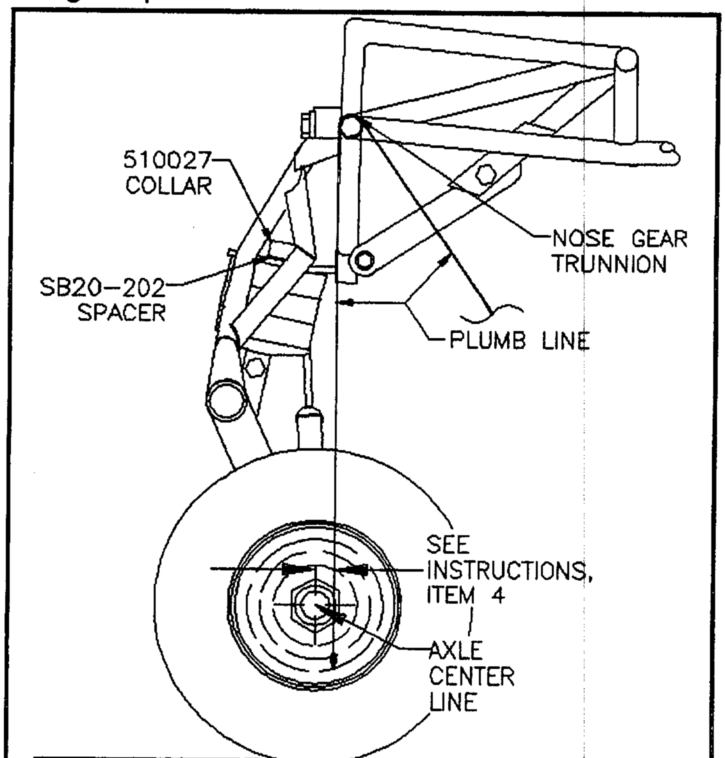
NOSE WHEEL STEERING - FIGURE 32-20

32-50-02 - NOSE GEAR STEERING AND TRACKING

1. Level aircraft as described in Chapter 8.
2. Center nose wheel.
3. Place plumb line over and forward of nose gear trunnion (see Figure 32-21) part number 540001-503.
4. Measure forward from aft edge of plumb line to axle center line. Modification relocating nose wheel should be accomplished if axle position, forward of plumb line, exceeds .06.
5. Add SB M20-202-3 spacer under collar to reposition the axle if required.

NOTE
Some collars have holes drilled off center and may be turned over to change axle position.

6. Run gear through retraction/extension cycle. Check nose gear door and wheel well tire clearances. Re-rig if required.



NOSE WHEEL LOCATION - FIGURE 32-21

32-60-00 - POSITION AND WARNING

32-60-01 - ELECTRIC GEAR SAFETY DEVICES

The gear switch operates the landing gear actuator relay. Pulling the wheel-shaped knob out and moving it to the upper detent raises the gear. However, an airspeed safety switch is incorporated into the electrical system to prevent landing gear retraction while on the ground. To allow gear retraction with the aircraft on jacks; attach a 12-inch length of 3/8 inch pliable rubber hose (surgical tubing) over the pitot head, and pinch the open end with a large cotter pin; roll the tubing with the cotter pin until the compressed air within the twisted tube actuates the airspeed pressure switch. Maintain pressure on the switch until retraction is complete. To adjust the airspeed switch refer to paragraph 32-60-03.

The up-limit switch will stop the gear in its retracted position. Moving the control knob to its lower detent lowers the gear. The down limit switch will stop the gear actuating motor when the proper force is exerted to hold the gears in the down-and-locked position. Refer to Section 32-30-02,7. for proper limit switch rigging. The gear down-and-locked position is indicated by:

1. Illumination of the green gear down annunciator light. The GEAR DOWN annunciator light is dimmed when ever the Navigation Light Switch is ON.
2. The warning horn will not sound with the throttle retarded within 1/4 inch of idle position.
3. The indicator marks will be aligned on the visual gear-position indicator.

CAUTION
When running gear up or down electrically DO NOT use circuit breaker as a switch. Partial retraction or extension may be accomplished electrically as follows:

1. Place Master Switch in OFF position.
2. Move gear switch to GEAR UP or GEAR DOWN as desired.
3. Momentarily actuate Master Switch until gear is in desired position.

32-60-02 - LANDING GEAR WARNING SYSTEM

The landing gear warning system consists of:

1. Landing gear position lights: "GEAR DOWN"-GREEN light on annunciator and WHITE indicator light on floor ; "GEAR UNSAFE" - RED light on annunciator - Gear is in transit, UP or DOWN; GEAR UP - no lights.)
2. A warning horn in cabin is actuated when gear control switch handle is UP and the throttle is less than 1/4 inch from idle position. Check warning horn for volume in flight periodically. Horn will sound if gear is not DOWN and LOCKED even if switch is in DOWN position or if airspeed is below 65 KIAS and gear switch is in UP position.

32-60-03 - AIRSPEED SAFETY SWITCH ADJUSTMENT

Airspeed safety switch, located inside cabin, is mounted on left side of cockpit, forward of pilots left knee. The airspeed safety switch is incorporated into electrical system to prevent landing gear retraction while on the ground and at airspeeds below 60 +/-5 KTS. Additionally the RED gear unsafe light comes on and warning horn sounds when gear control handle is placed in UP position below 60 +/-5 KTS.

The V.E.P. manufactured switches are field adjustable. They should close at 2.8 +/-.4 inches water.

Adjust slotted screw head on center of switch to obtain correct settings.

CAUTION
The airspeed safety switch is designed to operate within a specified range during increasing airspeed only. Due to hysteresis of the switch/diaphragm assembly switch MAY NOT deactivate landing gear circuitry until approximately 49.5 KTS. This could allow landing gear to retract if gear switch is inadvertently placed in UP position during landing roll.

NOTE
Refer to proper electrical schematic when replacing with switches from another manufacturer.

NOTE
Compensation for Pitot Pressure must be included during static system check to prevent rupture of A/S Safety Switch diaphragm.

32-80-00 - MISCELLANEOUS

32-81-00 - LANDING GEAR SHOCK DISC INSPECTION

1. Aircraft with full fuel load and weight on landing gear.

A. **Main gear shock discs**. (Figure 32-22)

(1) Remove dust shield. Check gap between retaining collar (A) and top retaining plate (B). **Allowable gap is 0.00 to 0.85 inches**.

(2) Replace discs when gap exceeds the tolerance. Use a shock disc replacement tool (C), P/N GSE 030011, (old P/N ME121), to remove and install main gear shock discs. Use removable pad from tool as a guide on top of shock link to align discs as they are being compressed.

(3) Careful application of the shock disc replacment tool is recommended during replacement of main gear shock disc to keep from damaging grease fittings.

NOTE
Shock disc retention collar should be installed with the chamfer facing down and forward.

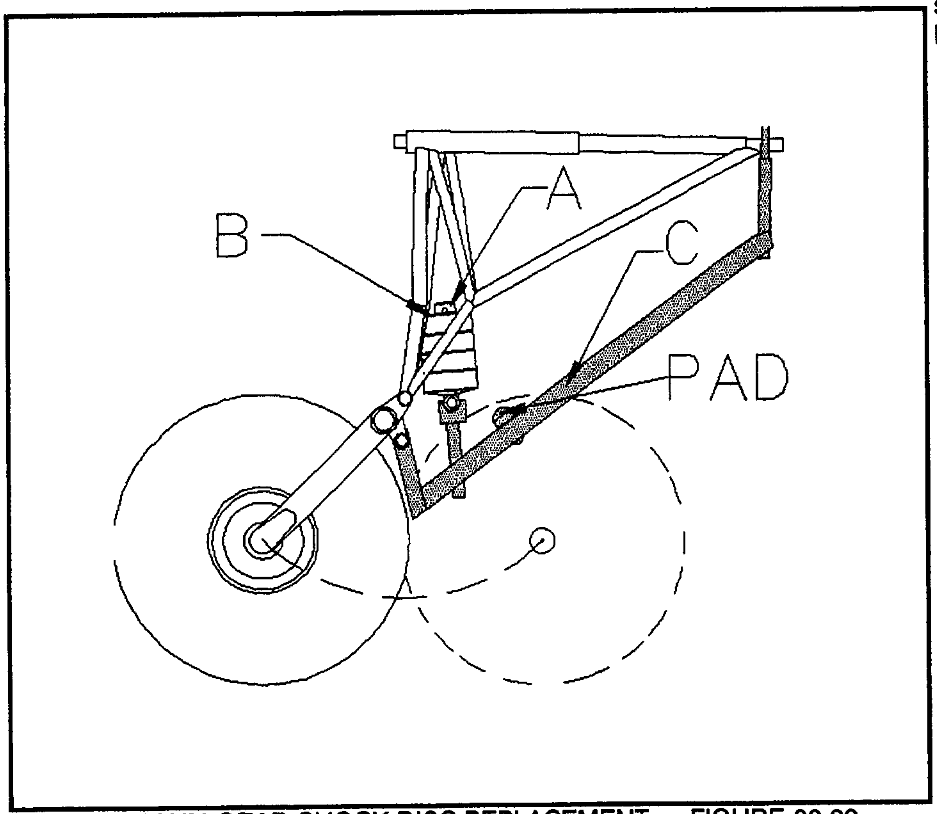
(4) Main landing gear leg assembly axle is to be located to provide a minumum of .23 inches clearance between tire and any component inside wheel well. Alternate collars, P/N 510049-001, -003, -005, -007, -009 or -011 can be substituted for basic dash no. to obtain this clearance. If any interference occurs between tire and other components during retract cycle, next higher dash number collar moves axle approximately .50 inches aft.

B. **Nose Gear Shock Discs.**(See Figure 32-23)

(1) Check for gap between retaining collar (D), and top retaining plate (E). Top retaining plate must be in contact with retaining collar.

(2) Replace shock discs if gap is found. Use shock disc replacement tool (F), P/N GSE 030010, (old P/N ME120), to remove and install nose gear shock discs.
Use removable pad from tool as a guide on top of shock link to align discs as they are being compressed.

NOTE
Dimension (T), (Figure 32-23), is critical to properly locate nose wheel position. Leg assemblies can vary, due to manufacturers tolerances. Dimension (T) in a no load fully extended position should be approximately 3.0 inches. Add spacer under collar (D) per SB M20-202, as needed. See (Figure 32-21), paragraph 30-50-02, for proper steering/tracking rigging.



MAIN GEAR SHOCK DISC REPLACEMENT FIGURE 32-22

2. Raise aircraft on jacks - shocks fully extended.

A. Inspect nose and main gear shocks for evidence of gap between retaining collar and retaining plate. The disc preload must be great enough to maintain complete wheel extension during retraction.

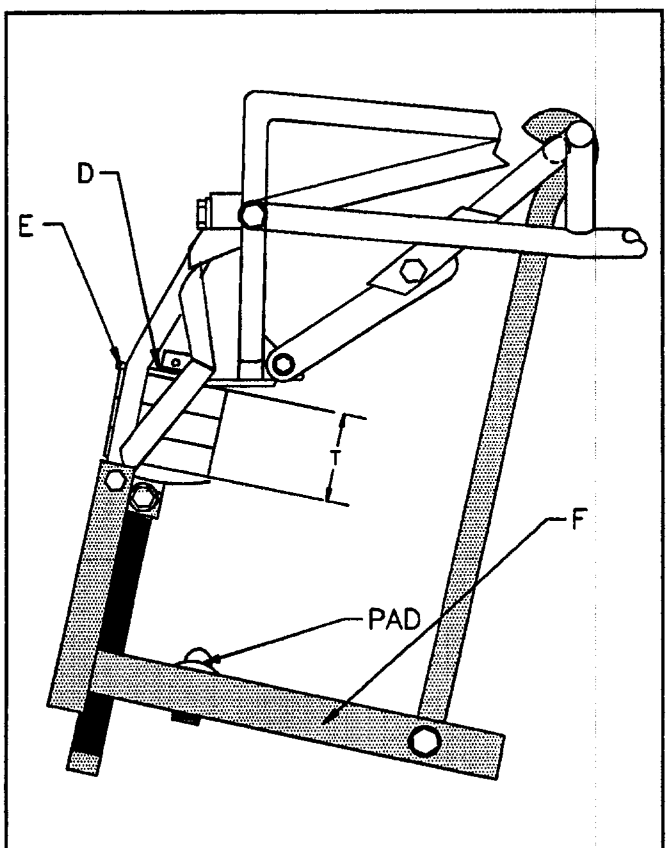
B. Replace shock discs that have lost resilience.

C. Inspect retaining collar and bolt for deformation, wear, and cracks.

D. Replace defective bolt and collar.

CAUTION
Both collar and bolt must be replaced when one or the other is defective.

NOTE
For Nose Gear Steering/Tracking see Section 32-50-02, (Figure 32-21).



NOSE GEAR SHOCK DISC REPLACEMENT
FIGURE 32-23

32-82-00 - RECOMMENDED HARD LANDING INSPECTIONS

The following are areas recommended to be inspected when a "hard landing" or overweight landing has occurred. Since a "hard landing" is a relative term and an overweight landing may have occurred, to advise maintenance personnel when the inspections are to be accomplished.

1. Mud Shield missing or damaged on either or both main landing gear.
2. Main landing gear shock biscuits condition, compressed or extruded rubber.
3. Tail skid damage or damage to bulkhead that attaches tail skid.
4. Propeller strike/marks or other visual damage.
5. Engine or engine mount damage.
6. Nose landing gear leg assembly damage near steering lugs.
7. Pilot/Co-pilot's seat adjustments supports/tubes bent from excessive G-loads.

If any evidence of damage or abnormal visual observations are found, it is recommended that a thorough inspection of all the above areas be done and repairs be made as necessary. contact FAA personnel for incident report requirements.

CHAPTER 33

LIGHTS

CHAPTER 33

LIGHTS

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CHAPTER 33

LIGHTS

LIST OF EFFECTIVE PAGES

33-00-00 - GENERAL-DESCRIPTION AND OPERATION

High intensity strobe lights are standard equipment on M20R aircraft. The lights are located adjacent to the wing tip navigation lights and incorporated in the tail-light assembly. Separate power supplies are utilized for each strobe light and are located in each wing out-board section, mounted on inspection cover, and in-side the tailcone adjacent to the left rear inspection cover. The system is actuated by a 10 amp circuit breaker/switch located on the instrument panel in front of the pilot.

Navigation lights are located on each wing tip; the aft facing navigation light (clear) is located on each wing tip trailing edge. The lights are activated by a 7.5 amp circuit breaker/switch located on instrument panel in front of pilot.

Two 110,000 candle power Landing/Taxi lights, with sealed beam bulbs, are located in LH & RH leading edge section of wing. The lights are activated by two 25 amp, split switches located on forward O/H instrument panel between pilot & co-pilot. The switches are used to illuminate both landing & taxi lights or either one, as needed.

Interior lights are located on overhead panel. The forward cabin overhead lights are located between pilot and co-pilot seats and are actuated by three position switches, (dim, off, bright) located on side panel arm rests, adjacent to each seat. The passenger compartment lights are located above rear seats in overhead panel and are activated by similar, three position, switches located adjacent to each seat on side panel arm rests. A cabin interior light Master Switch is located on pilot's arm rest to control all cabin interior light switches.

NOTE

These cabin lights are connected directly to battery and will illuminate, when pushed ON, with aircraft Master Switch OFF and cabin interior Master Light Switch switch - ON.

A baggage compartment light is located on O/H panel in baggage compartment and activated by switch located on forward edge of Hat Rack. This light is connected directly to battery.

LAMP BULB REPLACEMENT CHART

APPLICATIONS	BULB PART NUMBER
Glareshield Lights	GE 327
Post Lights	GE 327
Map Light	GE 327
Cabin Interior Lights	GE 1818
Trim & Flap Indicator	GE 327
Gear Down Light (Floorboard Indicator)	GE 327
Tail Position Light (WHELEN)	W1290
Wing Tip Position Light (GRIMES)	W1290
Landing/Taxi Light	GE 4596
Recognition Light (molded assy)	01-0770303-00 (Whelen)

33-20-00 - INTERIOR LIGHTS-MAINTENANCE PRACTICES

33-21-00 - CABIN LIGHTS-OVERHEAD LIGHTS (FIGURE 33-1)

33-21-01 - LIGHT BULB REPLACEMENT

1. Carefully slide smooth, flat sharp blade under lip of light assembly flange and pop light assembly out of mounting hole.
2. Disconnect blade terminals from light assembly.
3. Hold light assembly body and rotate bulb holder counter-clock-wise to remove.
4. Pull bulb from bulb holder and replace with new bulb. Reinstall bulb holder.
5. Re-assemble light assembly into mounting hole.
6. Check for proper operation.

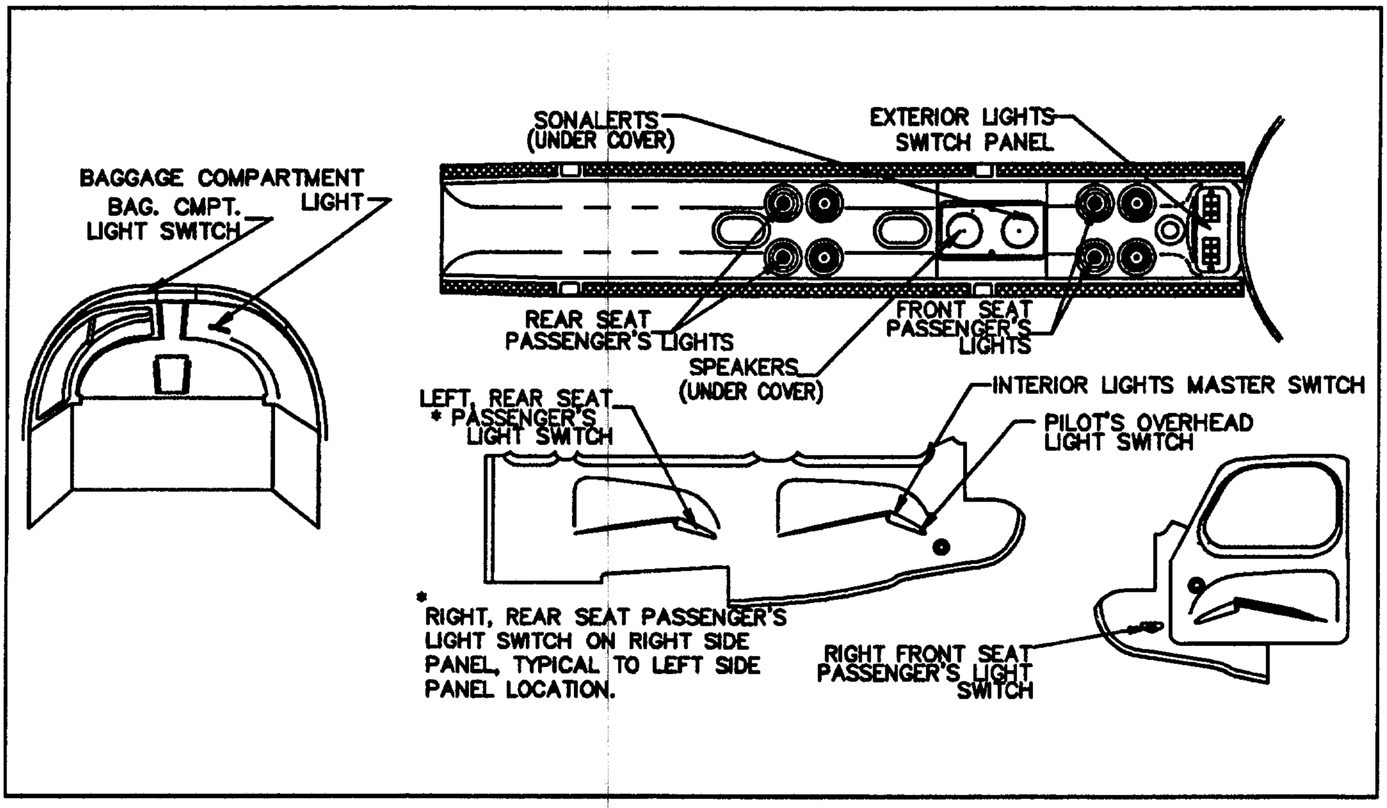
NOTE

The front and rear light bulbs are replaced in the same manner.

33-21-02 -CABIN LIGHT SWITCH REPLACEMENTS

PILOT'S & REAR SEAT PASSENGER'S SWITCHES.

1. Remove cover from arm rest assembly by removing 2 screws holding cover to arm rest (Figure 33-1).
2. Switches are a snap fit and may be removed by pressing snap tabs and pushing switch through cover.
3. Disconnect wire terminals and replace with new switch. Check for proper operation.
4. Reassemble switch assembly into cover by snapping in from top side. Re-install cover into arm rest; secure with 2 screws.



INTERIOR LIGHTS - FIGURE 33-1

CO-PILOT's SWITCH

1. Co-pilot's cabin light switch is located in front of cabin door hinge above co-pilot's right knee.

2. Remove 1 screw above switch. Remove door frame cap. Pull panel away from velcro fastners to access switch.

3. Press snap tab & push switch from panel to remove.

4. Re-assemble in reverse order when complete with maintenance action.

BAGGAGE COMPARTMENT SWITCH

1. Switch is located at rear of baggage door at front, top of hat rack opening. (Figure 33-1)

2. Remove 1 screw inboard of switch. Pull door frame down slightly from velcro fastners to access baggage compartment light switch.

3. Press snap tabs and PUSH switch fhrough panel.

4. Disconnect terminals; replace switch.

5. Re-assemble in reverse order.

33-22-00 - INSTRUMENT/FLIGHT PANEL AND GLARESHIELD LIGHTS

33-22-01 - LIGHT BULB REPLACEMENT

1. Instrument panel lights.

A. Internally lighted instruments are not being considered in this information.

B. Post light bulbs are replaced by pulling hood straight out from post light base and then pulling bulb from this hooded portion.

C. Insert new bulb into hood and push hood back onto post light base.

D. Check for proper operation and hood orientation.

2. Glareshield lights.

A. Remove outer housing by unscrewing from light assembly base.

B. Remove bulb; insert new bulb.

C. Screw outer housing back onto base.

D. Check for proper operation.

3. Map Light

A. Place wrench on flat of exposed metal housing on bulb assembly from receptacle. Unscrew and remove bulb.

B. Replace bulb; screw on bulb retainer and tighten.

33-23-00 - GEAR DOWN INDICATOR LIGHT (FLOORBOARD)

33-23-01 - LIGHT BULB REPLACEMENT

1. Remove lower belly panel to gain access to light assembly.

2. Remove and replace bulb.

3. Check for proper operation.

4. Reinstall belly panel.

33-40-00 - EXTERIOR LIGHTS-MAINTENANCE PRACTICES

33-40-01 - TROUBLE SHOOTING EXTERIOR LIGHTS

TROUBLE	PROBABLE CAUSE	REMEDY
STROBE LIGHTS		
Lights inoperative.	Circuit breaker/switch tripped.	Check for short circuit. Reset circuit breaker.
	Loose connection.	Check and tighten electrical connections.
	Battery defective.	Replace battery or use external power.
	Circuit breaker switch defective.	Check continuity through switch; replace if necessary.
	Faulty power supply.	Replace faulty power supply.
One bulb does not light.	Bulb burned out.	Replace bulb.
	Power supply inoperative.	Replace.
	Fixture not grounded.	Check for good bonding between fixture and structure. Tighten mounting screws.
	Loose connection.	Check all connections in circuit.
	Defective fixture	Replace fixture.
LANDING LIGHTS, NAVIGATION LIGHTS AND TAILLIGHT		
Lamp fails to light.	Circuit breaker/switch tripped.	Check for short circuit. Reset circuit breaker.
	Lamp burned out.	Replace lamp.
	Loose connection or defective wire.	Tighten connections and check wire circuit continuity. Replace or repair wire if necessary.
	Circuit breaker/switch defective.	Check continuity through switch. Replace if necessary.

33-41-00 - HIGH INTENSITY STROBE LIGHTS-MAINTENANCE

The strobe light power supply requires a 28 VDC input across red and black wires. Red is positive and black is negative or common. Voltage for strobe light is supplied through Pin 1 and 3 of power supply connector with Pin 2 as trigger pulse. The strobe light assembly is a potted assembly and cannot be repaired.

TROUBLE SHOOTING AIDS

When no lights are flashing:

1. Check circuit breaker/switch.
2. To determine if power supply(ies) or flashtube(s) problem:
first check input voltage to power supply(ies). Each power supply's red and black line should have 28 VDC. If no voltage is present, check for shorted power leads or tripped circuit breaker.

When one light is not flashing:

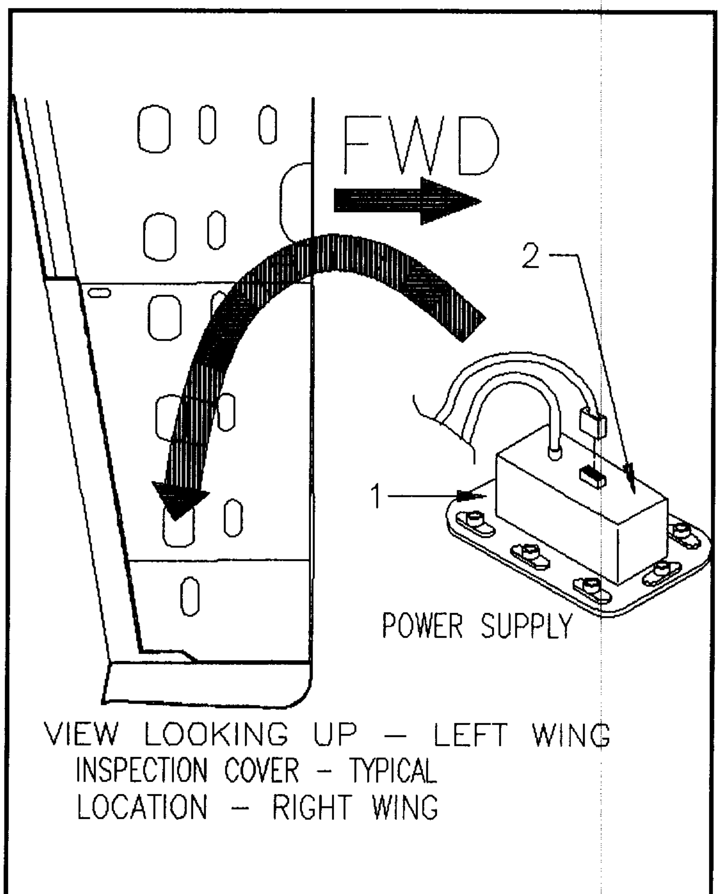
1. To determine if power supply or flashtube problem: first check input voltage to power supply. The red and black line should have 28 VDC. If no voltage is present then check for shorted power leads, blown inline fuses or circuit breaker. If input voltage is present, disconnect connector to flashtube. 400-500VDC should be present across Pin 1 and 3 of power supply. If not, power supply has no output and is defective. Turn Master Switch -OFF, replace power supply.
2. If voltage is present across Pin 1 and 3 of power supply, connect a known good flashtube to power supply. If good flashtube fails to operate, power supply is defective. If good flashtube operates, the old flashtube is defective. Replace flashtube.

33-41-01 - POWER SUPPLY UNIT-REMOVAL OR REPLACEMENT

1. Wing tip strobe power supplies.

A. Gain access to wing tip power supply through bottom inspection cover (1) near wing tip (See Figure 33-2). Power supply (2) is physically attached to this inspection cover (Typical LH & RH).

B. Disconnect wiring connections between switch and power supply.



STROBE LIGHT POWER SUPPLY - FIGURE 33-2

WARNING
High voltage is involved in circuit between power supply and strobe light assemblies. Although a bleed-off resistor is incorporated in power supply circuit, turn control switch, for strobe lights OFF. Allow at least 20 minutes to elapse prior to disconnecting cables at power supply or strobe light assemblies or before handling either of these units in any way. Failure to observe these precautions may result in physical injury from electrical shock.

C. Disconnect wiring harness between power supply and strobe light. (See warning above).

D. Remove screws securing power supply to inspection panel and remove unit.

2. Tail strobe light power supply.

A. Gain access to this unit through inspection cover on aft, left hand side of tailcone. The power supply is physically mounted to this inspection cover.

B. Disconnect wiring connections between switch and power supply.

C. Steps B thru D, and Warning of paragraph 33-41-01, 1, apply for removal of this power supply unit.

33-41-02 - POWER SUPPLY UNIT INSTALLATION

The installation of any power supply(ies) is reverse sequence of removal procedures.

CAUTION
STROBE LIGHT WIRING - An incorrect hook-up of wires, at either the power input or between strobe light assemblies and power supply unit will cause a reversal of polarity that results in serious component damage and failure. Care must be taken to ensure that the red wire is connected to positive power and the black wire to ground.

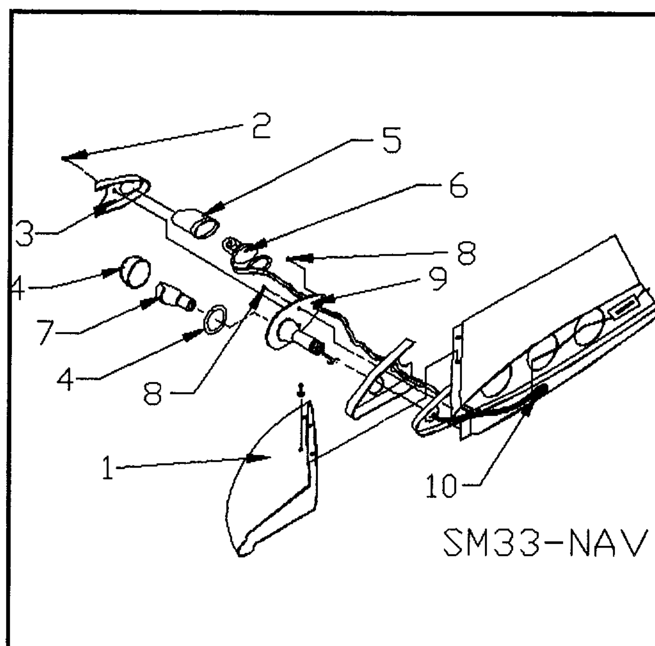
33-41-03 - STROBE LIGHT REPLACEMENT

1. **WING TIP STROBE LIGHT.**

A. Remove wing tip lens (1) (Figure 33-3) to gain access to malfunctioning strobe light.

B. Remove screw (2) holding retainer (3) against navigation/position light lens and gasket (4) and strobe light lens/gasket (5). Remove both lens & gaskets. This will allow strobe light assembly (6) and navigation light bulb (7) to be pulled from mounting plate/socket (9).

C. Remove three screws (8) from mounting plate/socket assembly and pull away from tip rib.



WING TIP LIGHTS - FIGURE 33-3

WARNING
High voltage is involved in circuit between power supply and strobe light assemblies. Although a bleed-off resistor is incorporated in power supply circuit, turn control switch for Strobe Lights - OFF; allow at least 20 minutes to elapse prior to disconnecting cables at power supply or strobe light assemblies or before handling either of these units in any way. Failure to observe these precautions may result in physical injury from electrical shock.

D. Flashtube assembly, as a unit, must be replaced if determined to be bad.

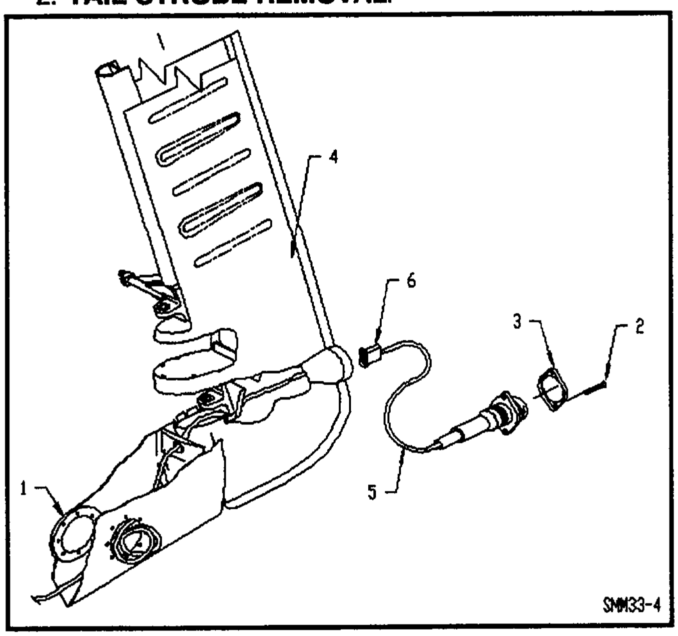
E. Wiring harness plug (10) is connected to wing rib inside wing tip.

F. Electrical plug may be reached through front of wing tip opening when all light assemblies are loosened. Reach between wing tip rib and wing rib to disconnect plug.

G. Extract pins from connector with appropriate tool.

H. Install new strobe light assembly in reverse sequence of removal.

2. **TAIL STROBE REMOVAL.**



TAIL STROBE LIGHT ASSEMBLY - FIGURE 33-4

A. To gain access to wire harness and connections from power supply, rotate round access cover (1) on lower left side of empennage stinger (Figure 33-4) around one screw.

B. Cut Ty-raps at harness coil (1) to allow slack for strobe light assembly and harness to be extended beyond rudder.

C. Remove two screws (3) that secure retainer and strobe light assembly to rudder (4) and pull light assembly out so it clears mounting hole.

D. There is sufficient wire available to pull strobe light assembly out from rudder light mounting hole. See (Figure 33-4). Disconnect light assembly pigtail (5) from connector at (6) and replace assembly if needed.

E. Connect plug from strobe light assembly to harness socket at (6).

F. Secure light assembly with retainer and screws.

G. Check for proper operation.

H. Coil harness at (1) to take up slack.

I. Secure access cover on empennage.

33-42-00 - NAVIGATION/POSITION LIGHTS

33-42-01 - POSITION LIGHT - REPLACEMENT/SERVICE

1. Wing tip position lights. (Figure 33-3).

A. See Section 33-41-03, 1,A & B.

B. Pull lens (red or green) from mounting plate (5) and remove lamp (7).

D. Install new lamp into base.

E. Reassemble light assembly in reverse sequence.

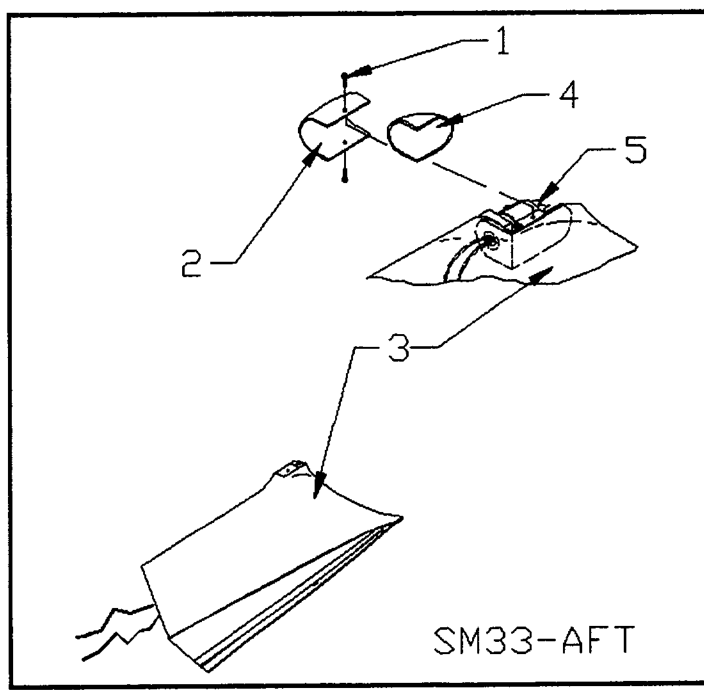
2. Aft Position Light (Figure 33-5)

A. Remove two screws (1) that secure aluminum cover (2) to wing tip (3).

B. Remove clear lens (4) & gasket to gain access to light bulb (5). Loosen safety wire on bulb retainer, if needed.

C. Pull light bulb (with special puller, if needed).

D. Replace with new lamp & reassemble light assembly in reverse sequence of removal.



AFT POSITION LIGHT - FIGURE 33-5

33-43-00 - LANDING/TAXI LIGHTS

33-43-01 - LANDING/TAXI LIGHT ADJUSTMENT PROCEDURES

1. Position aircraft to face a vertical wall with front of nose wheel 7 ft. 6 in. from wall. Position L/H & R/H main landing gear at exact distance from vertical wall, ie. parallel to wall.

2. Place four target crosses (+) on vertical wall at the following positions:

A. Measure 36.5 inches UP on vertical wall from same ground plane aircraft is resting on.

B. At 9.85 feet, left and right, of nose wheel center line.

C. At 12.375 inches further outboard on both left & right side of Step B. target position.

3. Remove access cover behind each landing/taxi light location on wing lower surface.

4. Turn taxi lights ON, exit aircraft, turn adjusting screws until light beams are centered on outboard target crosses (+), left and right.

5. Repeat Step 4 for landing lights, except, center light beams on inboard target crosses, left & right.

6. Turn lights OFF, reinstall access covers.

33-43-02 LANDING/TAXI LIGHT BULB REPLACEMENT

1. Remove access cover (see 33-43-01, 3 above)

2. Carelfully remove electrical plug connection from bulb.

3. Loosen socket head mounting screws to remove retainer.

NOTE
Do not loosen or turn screws that adjust light bulb positioning focus in mounting brackets.

4. Rotate retainer to large slotted holes & pull retrainer from bulb.

5. Pull retainer from access hole.

6. Pull bulb from plate assembly and through access hole.

7. Replace new bulb in reverse order of removal.

8. Verify beam adjustment has not changed (see SECTION 33-43-01).

9. Replace access cover and recheck landing /taxi light operation and focus adjustment.

CHAPTER

34

NAVIGATION

CHAPTER 34

NAVIGATION AND PITOT STATIC

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CHAPTER 34

NAVIGATION AND PITOT STATIC

LIST OF EFFECTIVE PAGES

34-00-00 - GENERAL

All flight instruments are grouped on the shock mounted panel directly in front of the pilot. Flight instruments are operated by: (1) filtered air drawn into an evacuated instrument case, (2) barometric pressure or barometric impact air pressure differences, (3) variations in electric current due to mechanically varied resistance, (4) reference to the earths magnetic field or (5) aircraft electrical power.

The glareshield must be removed and plumbing disconnected on many flight instruments before they can be removed. Remove glareshield attaching screws, center post cover screws. Carefully lift center post cover and glareshield from panel. Disconnect glareshield and compass lights.

Reinstall glareshield in reverse sequence.

34-10-00 - PITOT & STATIC AIR PRESSURE SYSTEM

Static pressure instruments are extremely sensitive to pressure changes, therefore, the pitot and static system must be kept free from moisture and obstructions. Drain pitot and static systems after humid or wet weather. If instrument operation is erratic or inoperative after draining, perform the following:

1. Pitot system leak test.-(Make sure Master Switch is OFF and Gear Control is in DOWN position.)
   A. Slip end of a short rubber hose over pitot tube.
   B. Close open end of hose; slowly roll up hose until airspeed indicator reads 150 MPH.
   C. Clamp hose and hold for one minute.
   D. If airspeed indicator falls more than 9 KIAS, within one minute, check system for leaks and tighten line fittings.
   E. Repeat steps B, C, and D until obtaining less than a 9 KIAS indicator reading drop.

CAUTION

Release air pressure slowly by unrolling rubber tubing. A sudden release of the air pressure may damage airspeed indicator.

2. Pitot system hose inspections.-After pitot system is checked for leaks, inspect hose sections for signs of deterioration. Check all tubing for brittleness, checks or cracks particularly at bends or connecting points. When new hose is installed, recheck system for leaks using PITOT SYSTEM LEAK TEST procedure.
3. Static system cleaning.-Blow low air pressure (10-25 PSI) through lines from disconnected line at airspeed indicator to static ports. Cover each static port separately when blowing to insure that each line is clear. Instrument error or possible damage may result if even one port is clogged with dirt or foreign matter.

CAUTION

NEVER BLOW AIR through the line TOWARD the INSTRUMENT panel; to do so will seriously damage instruments. When blowing back through line from instrument panel, make sure that no air is blown into instruments.

4. Static system leak test.-The static system should be checked for leaks in accordance with instructions in Federal Aviation Regulation 91.171.

CAUTION

To avoid damaging either the airspeed indicator or the landing gear airspeed safety switch an equal pressure should be applied to the pitot side of the indicator while leak testing the static system.

5. Alternate static source.-An alternate static source valve is provided to change the static air source from outside the aircraft to inside the cabin. The valve is located on the lower panel under the pilots control column. Airspeed indicator and altimeter readings will be slightly affected when using the alternate static source.

34-10-01 - HEATED PITOT TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Tube does not heat or clear itself of ice with switch on.	Switch circuit breaker tripped.	Reset circuit breaker.
	Open circuit.	Repair.
	Excessive voltage drop between battery and pitot head.	Check for bad connections in connectors and cables leading to the pitot head.
	Heating element burned out.	Replace pitot head.

34-11-00 - AIRSPEED INDICATOR

Registers airspeed in knots. Air pressure difference between impact air, pitot tube and static air (from static ports on each side of aircraft tailcone) operates airspeed indicator. An electrically heated pitot head prevents ice obstruction in flight.
The airspeed indicator dial markings are as follows:

Radial Red Line -	195 KIAS
Yellow Arc -	174-195 KIAS
Green Arc -	65-174 KIAS
White Arc -	59-110 KIAS

NOTE
See Section 27-95-00 for stall warning systems.

34-11-01 - AIRSPEED INDICATOR TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Instrument pointer does not indicate properly.	Leak in instrument	Check for leak and seal case or static lines.
	Obstruction in pitot tube.	Clean out obstruction.
Instrument pointer oscillates.	Leak in instrument case or in pitot lines.	Check for leak; seal lines.

34-12-00 - VERTICAL SPEED INDICATOR

Converts barometric pressure changes within the static port lines to aircraft ascent or descent rate; readings are in feet per minute.

This instrument has a single needle and two adjoining scales that read from 0 to 2000 feet per minute, top side for ascent rate and bottom side for descent rate. The recessed, slotted screw at lower left of instrument case is used to "zero" indicator when aircraft is on the ground.

34-12-01 - RATE-OF-CLIMB INDICATOR TROUBLE SHOOTING. (VERTICAL SPEED INDICATOR).

TROUBLE	PROBABLE CAUSE	REMEDY
Pointer does not set on zero.	Aging of diaphragm.	Turn setting screw to reset pointer at zero. Tap instrument while resetting.
Pointer fails to respond.	Obstruction in static line. (Includes water)	Disconnect static line from instruments. Apply low pressure air (10-25 PSI max.) to instrument end of static line. Check both static ports for air flow. Depress static drain valve and check for water. Keep depressed until air is free of moisture. Reconnect static line to instruments and leak check.
Pointer oscillates.	Leak(s) in static line.	Disconnect all instruments connected to static line. Check individual instruments and test installation for leaks.
	Defective mechanism.	Replace instrument.

34-13-00 - ALTIMETER

The altimeter operates by absolute pressure and converts barometric pressure to altitude; reading is in feet above mean sea level (MSL). The altimeter has a fixed dial with three pointers to indicate hundreds, thousands, and tens of thousands of feet. Barometric pressure is sensed through static vents. A knob adjusts a movable dial behind a small window (Kollsman) in face of main dial to indicate local barometric pressure. This corrects altimeter reading for prevailing conditions.

34-13-01 - ALTIMETER TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Excess scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism.	Replace instrument.
High reading.	Static pressure system leak.	Eliminate leak in static pressure system.
Setting knob is hard to turn.	Wrong lubricant or lack of lubrication.	Replace instrument.
Inner reference marker fails to move when setting knob is rotated.	Marker out of engagement.	Replace instrument.
Setting knob set-screw is loose or missing.	Excessive vibration.	Tighten instrument screw, if loose. Replace instrument, if screw is missing.
Cracked or loose cover glass.	Excessive vibration.	Replace instrument.
Dull or discolored luminous markings.	Age.	Replace instrument.
Barometric scale and reference markers are out of synchronization with pointers.	Shift in mechanism.	Reset pointers.
Barometric scale and reference markers are out of synchronization.	Slippage of mating parts.	Replace instrument.

34-20-00 - DIRECTIONAL GYRO COMPASS

This vacuum-operated instrument indicates heading reference. The directional gyro rotor is air driven and rotates with its spin axis horizontal. The knob is used to reset basic directional heading. Vacuum pressure (suction) for satisfactory operation is 4.25 +/-.2 to 5.5 +0.0/-.2. Vacuum system filters should be changed each 500 hours or at one year intervals, whichever occurs first. (See Trouble Shooting Chart, for maintenance instructions.)

34-20-01 - DIRECTIONAL GYRO TROUBLE SHOOTING (VACUUM ONLY)

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive drift in either direction.	Dirty air filter (high vacuum indication).	Inspect filter. Replace if necessary.
Excessive vibration.	Test with vibrometer. If vibration amplitude is more than .004 inch, examine shock mountings to see if connections are pulling on instrument.	
Insufficient vacuum.	If vacuum indication is below 4.25 IN. Hg., check as follows:	Correct for insufficient vacuum as follows:
	1. Vacuum regulating valve improperly adjusted.	1. Adjust vacuum regulating valve.
	2. Pump failure.	2. Repair or replace pump.
	3. Vacuum line kinked, leaking, or too long for its diameter.	3. Locate and replace or repair vacuum line, if defective. Check for collasped inner wall of flexible hose.

D/G TROUBLE SHOOTING (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
	Defective mechanism (worn or dirty pivots and bearings.)	Replace instrument.
Dial spins continuously in one direction.	Operating limits have been exceeded.	Reset instrument with aircraft in level flight.
	Defective mechanism.	Replace instrument.

34-21-00 - TURN COORDINATOR

A gyro instrument that indicates control coordination and rate of turn. This instrument is electrically driven.

34-21-01 - TURN COORDINATOR TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Pointer fails to respond.	Foreign matter lodged in instrument.	Replace instrument.
	No electric current.	Check voltage at instrument.
Bar does not set level.	Gimbal and rotor assembly out of balance.	Replace instrument.
	Pitted or worn pivots or bearings.	Replace instrument.
In low temperature, bar fails to respond or responds sluggishly and with insufficient deflection.	Oil has become too thick.	Replace instrument.
	Insufficient bearing clearance.	Replace instrument.
Bar sluggish in returning to level and does not set on level when stationary.	Oil or dirt between damping pistons and cylinders.	Replace instrument.
	Excessive clearance between rotor and rotor pivots.	Replace instrument.

34-22-00 - MAGNETIC COMPASS

The magnetic compass dial, graduated in five-degree increments, is encased in a liquid filled glass and metal case. The unit mounts on top of glareshield. The compass should be swung and compensated at each annual inspection and whenever new electrical equipment is installed.
To compensate for N-S deviation, adjust left screw; to compensate for E-W deviation, adjust right screw.
Degausing of tubular structure may be required if compass cannot be compensated within limits. Carefully go over entire steel structure with degauser, from center to outboard of structure (Left & Right), to remove residual magnetism. It is recommended that an Armature Growler be used to degause steel structure.

NOTE
Refer to S.B. M20-150A, Instruction III, for detailed degausing procedures.

NOTE
Check for outside magnetic influences if excessive compensation is required.

34-22-01 - COMPASS TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive card error.	Compass not properly compensated.	Compensate instrument.
	External magnetic interference.	Locate magnetic interference and eliminate, if possible.
Excessive card oscillation.	Improper instrument mounting.	Align instrument.
	Insufficient liquid.	Replace instrument.
Sluggish card.	Weak card magnets.	Replace instrument.
	Excessive pivot friction or broken jewel.	Replace instrument.
	Instrument too heavily compensated.	Correct excess compensation.
Liquid leakage.	Loose bezel screws.	Tighten screws.
	Broken cover glass.	Replace instrument.
	Defective sealing gaskets.	Replace instrument.
Discolored luminous markings or discolored damping liquid.	Age	Replace instrument.
Defective light.	Burnt out lamp or broken circuit.	Check lamp or wiring continuity.

34-23-00 - ARTIFICIAL (GYRO) HORIZON

The vacuum-powered artificial horizon gyro indicates aircraft attitude relative to straight and level flight. Maintenance is similar to that required for the directional gyro compass.

34-23-01 - GYRO-HORIZON TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Horizon bar does not respond.	Dirty air filter (high vacuum indication).	Examine filter and clean or replace, if necessary.
	Insufficient vacuum resulting from the following:	Correct insufficient vacuum as follows:
	1. Vacuum regulating valve improperly adjusted.	1. Adjust valve.
	2. Pump failure.	2. Repair or replace pump.
	3. Vacuum line kinked, leaking, or too long for its diameter.	3. Locate and repair. Check for collapsed inner wall of flexible hose.
Horizon bar does not settle.	Defective mechanism.	Replace instrument.
	Insufficient vacuum.	Correct for insufficient vacuum as outlined above.

- GYRO HORIZON TROUBLE SHOOTING (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive vibration.	Test with vibrometer. If amplitude is more than .004 inch, examine installation to determine whether flexible hose connections are restricting movement of instrument.	Examine shock mountings and replace, if necessary.
Horizon bar oscillates or vibrates excessively.	Excessive vacuum resulting from the following:	Correct for excessive vacuum as follows:
	1. Dirty air filter.	1. Examine filter and clean or replace, if necessary.
	2. Vacuum regulating valve improperly adjusted.	2. Adjust valve.
	3. Defective mechanism.	3. Replace instrument.
	4. Excessive vibration.	4. Test with vibrometer. If amplitude is more than .004 inch, examine installation to determine whether flexible hose connections are restricting movement of instrument.
	5. Shock mounted panel is contacting structure (inadequate clearance).	5. Examine shock mountings and replace if necessary.

34-90-00 - MISCELLANEOUS INSTRUMENTS

34-90-01 - CLOCK

The digital clock is mounted in upper left side of instrument panel.

34-90-02 - OUTSIDE AIR TEMPERATURE

Provides pilot with free stream outside air temperature in degrees Centigrade.

CHAPTER

35

OXYGEN

CHAPTER 35

OXYGEN

LIST OF EFFECTIVE PAGES

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35-00-00 - GENERAL

The oxygen system is an optional installation for M20R, S/N 29-0001 and ON. The system consists of a 115.7 cubic ft. cylinder located in the tailcone immediately aft of the baggage compartment bulkhead. A reducing valve and altitude compensating valve are connected to cylinder to regulate oxygen flow for a given altitude. Lines connected to altitude compensating valve distribute aviators oxygen to pilot and passengers. The system is activated by the control knob, rotated to open reducing valve. A gauge, located on pilot's arm rest adjacent to control knob, indicates pressure of cylinder. When cylinder is full, pressure will indicate 1850 P.S.I. at 21° C. (70° F.). The system is serviced through an access opening located aft of baggage compartment door. Standard refill fittings are required to fill cylinder with aviators oxygen. (Spec. No. MIL-O-27210).

WARNING
Proper safety measures must be employed while oxygen system maintenance is being performed or a serious fire hazard will be created. Avoid making sparks and keep all burning cigarettes or fire away from vicinity of oxygen. Make sure that your hands, tools, and clothing are clean, particularly with respect to oil or grease, for these will IGNITE upon contact with pure oxygen under pressure.

35-00-01 - RECHARGING PROCEDURES

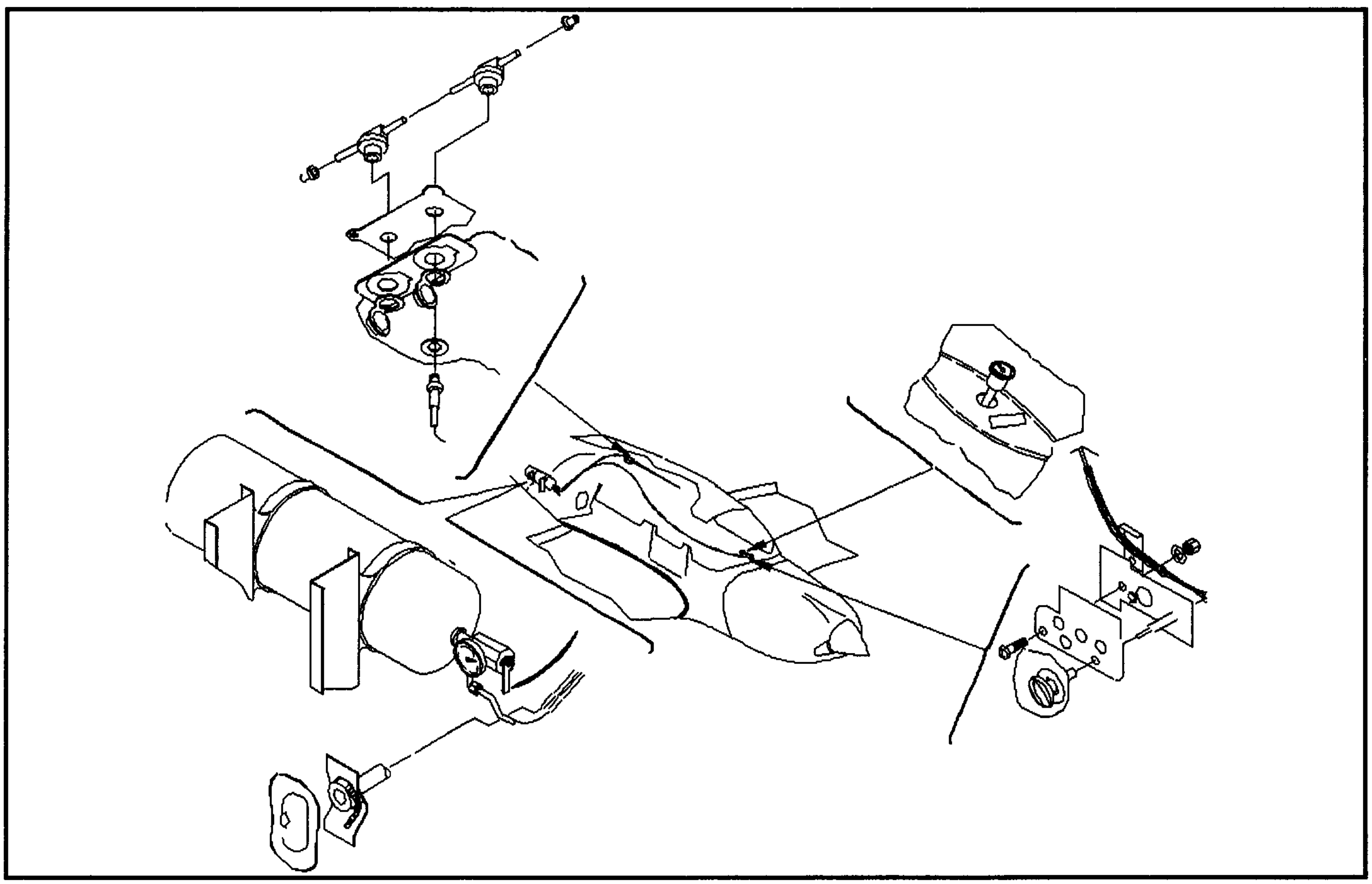
WARNING
Oil, grease or other lubricants in contact with oxygen create a serious fire hazard, and such contact must be avoided when handling oxygen equipment.

WARNING
NO SMOKING when refilling oxygen cylinder.

1.The oxygen cylinder should not be used to less than 100 P.S.I.; contamination may occur to cylinder and valve. The valve must be removed and cylinder cleaned and inspected if this happens.

2. Refill cylinder with aviators oxygen Specification No. MIL-O-27210, through Oxygen Servicing Access Door (1) (Figure 35-1). No special fittings are required for this servicing, however, several types of standard oxygen fittings are in use and a compatible fitting for the Scott Recharging Valve (2) must be used. Mooney P/N 870025-501 oxygen recharge hose assembly is recommended.

3. The cylinder contains 1850 P.S.I. at 21° C. (70° F.) when fully charged. Temperature has an affect on the correct charging pressure; See Section 12-10-04 and (Figure 12-1) for pressure vs. temperature charging pressure.



OXYGEN SYSTEM - FIGURE 35-1

35-00-02 - MAINTENANCE PRACTICES (Ref: AC 43.13-1A,chap. 8, para. 363)

1. The control cable (3) (Fig. 35-1) is attached to actuating arm (4) on reducing valve (5). This cable is routed through various bulkheads along the left side panel to control knob (6) at pilot's position. The control is a push-pull cable assembly that is activated by a rotating knob assembly. The supply gauge (7), located adjacent to this control, indicates pressure of oxygen available in system.

2. The pilot's and co-pilot's outlets (8) and passenger outlets (9) should be inspected for damage and cleanliness during servicing.

3. Inspect individual oxygen masks, and fittings for damage.

4. Oxygen system test procedures. Remove oxygen line from regulator and plug line. Cap open regulator port with clean plastic cap to prevent contamination of regulator. Conduct low pressure system leak test using a 70 +/- 10 PSI oxygen supply plugged into one cabin outlet and a test gauge plugged into another outlet. Apply 70 +/- 10 PSI to system, allow 2 minutes for system to stabilize; remove oxygen supply. Drop in pressure after 15 minutes shall not exceed five PSIG. Remove temporary plug and ensure that cylinder is charged to capacity. Conduct high pressure test using cylinder pressure. Refer to supply gauge on pilot's side wall, note cylinder pressure. There shall be no pressure loss after 30 minutes. If leakage exists, apply MIL-L-25567 leak test solution to suspected areas. After test, wipe clean and dry. Make necessary repairs and retest.

5. Oxygen system purging. Offensive odors may be removed from oxygen system by purging. The system should also be purged any time lines are left open and subject to contamination. Purging is accomplished by connecting a recharging cart to system and permitting oxygen to flow through lines and outlets until any offensive odors have been carried away.

WARNING

Avoid making sparks and keep all burning cigarettes or fire away from vicinity of airplane when the outlets are in use. Inspect filler connection for cleanliness before attaching it to filler valve. Make sure that your hands, tools, and clothing are clean, particularly from grease and oil stains, for these contaminants will IGNITE upon contact with oxygen under pressure.

The following procedures are recommended to purge system:

A. Connect recharge cart to filler valve. Set cart pressure regulator to deliver 50 PSI to system.

B. Plug in oxygen mask at each outlet in cabin.

C. Open cabin door and place control knob in "half open" position.

D. Allow system to purge for one hour. If an offensive odor still lingers, continue purging system for an additional hour. If such odors still remain, replace supply cylinder. After system has been adequately purged, remove masks from outlets, place control knob in "closed" position. Service system as described in 35-00-01.

6. Oxygen cylinder removal. The oxygen cylinder is located in tailcone, aft of baggage compartment bulkhead. Access to cylinder is obtained through access door on left side of aircraft behind left wing.

WARNING

Keep fire, cigarettes and sparks away from vicinity of the oxygen cylinder. Oil and grease will IGNITE upon contact with oxygen under pressure.

A. Place pilot's control knob in "closed" position.

B. Gain access to cylinder through access door.

C. Slowly loosen supply line fittings at cylinder valves, (reference Figure 35-1), to relieve any pressure that may exist in supply lines. After pressure is relieved, remove lines.

D. Disconnect control cable (3) from arm (4) on reducing valve (5).

E. Cap all open lines and regulator openings with clean metal caps.

F. Note orientation of regulator valves and control arm relative to attachment lines and bulkheads, prior to removal.

G. Loosen cylinder retaining clamps (11) , while supporting cylinder. Carefully remove cylinder/regulator assembly from secured position.

7. Oxygen cylinder installation.

A. Place new cylinder/regulator assembly into position in clamps and secure. New cylinder/regulator assembly should be positioned with regulator valves and control arm in same position as old, removed cylinder assembly components.

B. Remove caps from lines. Carefully inspect all connections for damage or any foreign substance before connection to new cylinder and valves.

C. Connect all lines to proper fittings. Connect control cable (3) to arm (4) on reducer valve (5).

D. Charge cylinder, if required, to correct pressure, see recharging table on (Figure 35-2).

E. Place pilot's contol knob to "open" position and plug an oxygen mask into pilot's outlet to check for proper system operation.

F. Repeat this checkout procedure for all outlets.

G. Test system for leaks per leak test check, paragraph 35-00-02, D.

H. Reinstall access door.

NOTE

Oxygen cylinders must be hydrostatic tested in accordance with DOT Code of Federal Regulations,Title 49,chap. 1, para. 173.34. (REFER TO SECTION 5-10-01 ALSO)

NOTE

All oxygen cylinders must be replaced every 10,000 recharge cycles.

NOTE

Maximum life for composite oxygen cylinders is 15 years.

NOTE
Maximum life for light weight steel oxygen cylinders is 24 years.

Filling pressures will vary due to ambient temperature in the filling area and the rise of temperature resulting from compression of the oxygen. Because of this, merely filling to 1850 PSIG will not result in a properly filled cylinder. Fill to pressures indicated on chart, FIG. 35-2, for ambient temperatures.

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

OXYGEN FILLING PRESSURES VS. TEMPERATURES CHART
FIGURE 35-2

BLANK

CHAPTER

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VACUUM

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VACUUM

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37-00-00 - GENERAL

An engine driven, dry air, vacuum pump supplies suction for vacuum operated gyroscopic flight instruments, the Directional Gyro and Artificial Horizon. Air is passed through a filter before entering instruments. A vacuum regulator valve is incorporated to maintain required operating vacuum throughout engine power range. Idle RPM settings will normally not provide adequate vacuum to satisfactorily operate instruments.

A vacuum annunciator light will illuminate (RED) and flash when vacuum drops below setting required to operate instruments. The vacuum annunciator light will illuminate steady (RED) when vacuum exceeds normal regulator settings.

A stand-by vacuum system is standard for the M20R aircraft. This is either installed on an engine accessory pad through an electrically activated clutch assembly or inside the tailcone as a separat electric motor driven/vacuum pump assemlby.

Either standby vacuum system should be activated manually when the "HI/LO VAC" light flashes while operating on the engine driven system. This is done by pushing STBY VAC switch, located on instrument panel, **ON**.

37-10-00 - DISTRIBUTION

37-11-00 - DRY AIR PUMP

A dry air pump (1) (Figure 37-1) requires no maintenance between replacement. Replacement is recommended at 500 hours and at engine overhaul.

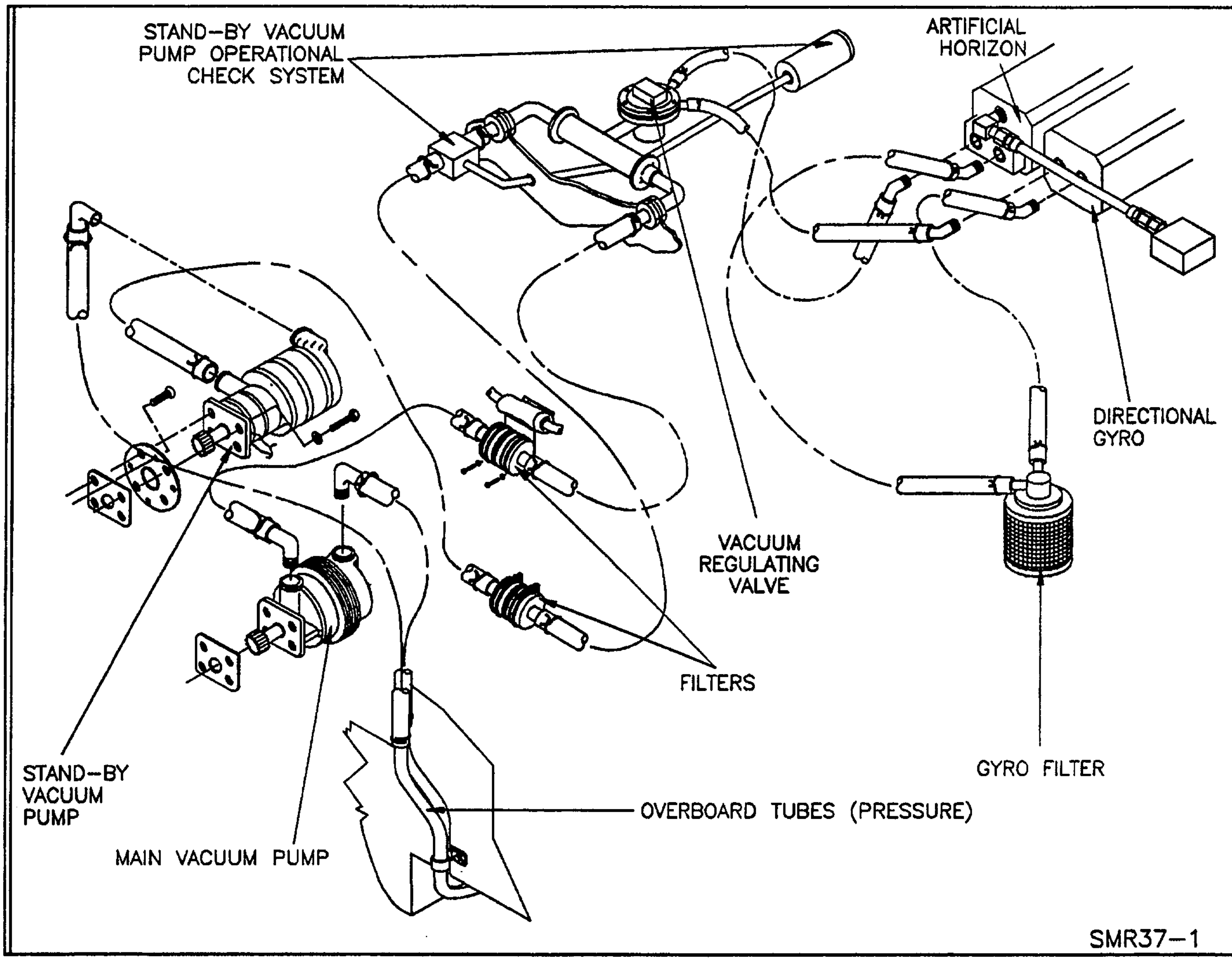
NOTE
Always replace inoperative pump with new air pump.

CAUTION
Always clean pump to filter line and replace filter between pump and firewall when replacing a failed pump to prevent particles from failed pump being ingested by new pump.

37-11-01 - MAINTENANCE PRACTICES

Protection of pneumatic, dry air, pump when cleaning engine compartment is very important.

WARNING
Failure to protect dry air pump from contamination by engine cleaning solvents may result in failure of dry air pump within a short period of operation.



TYPICAL VACUUM SYSTEM - FIGURE 37-1

Prior to washing down engine compartment, the following precautions must be taken for better service life of pneumatic, dry air pump.

1. Dry air pump coupling.

CAUTION
Do not blast air pump coupling area or other pneumatic system components with cleaning solvent under high pressure.

Protect coupling area between pump mounting flange and pump housing by wrapping a protective covering around that area during engine cleaning.

CAUTION
Do not allow protective covering around coupling or filters to become saturated with solvent.

Seals in front frame of housing behind coupling are designed to keep out foreign material such as dirt, dust and light fluid. However, fluid under high pressure can be forced past seals and enter pump.

2. Dry air pump fittings. Before washing engine, check pump fittings for looseness of threaded fittings. Fluid can seep through loose threads and enter pump.

3. Dry air pump discharge hose (vacuum instrument system). Plug end of hose or fitting and flag it with a RED "Remove Before Running Engine" tag, then clean engine.

CAUTION
Remove plug prior to running engine.

37-11-02 - SERVICING

The dry air pump requires no servicing. The internal parts are self-lubricating and require NO ADDITIONAL lubricating.

37-11-03 - REMOVAL

1. Disconnect hoses from dry air pump.
2. Remove main air pump from engine; discard old mounting gasket and locking hardware.
3. Remove fittings from pump. Retain fittings if they are serviceable; clean thoroughly before reusing. Discard twisted fittings and nuts with rounded corners.
4. Pad inspection. Check condition of AND 20000 pad seal. If seal shows any signs of oil leakage, replace seal. Replace seal if there is any doubt as to its serviceability.

37-11-04 - INSTALLATION OF NEW PUMP (Main or Stand-by)

CAUTION
Never install a pump that has been dropped.

1. Consult airframe manufacturer's current parts manual, Airborne's Application List, or the PMA label on pump box to verify that pump is correct model for engine and/or system.
2. Place pump mounting flange in a jaw-protected vise, with drive coupling downward. Protect pump mounting flange with soft metal or wood.

CAUTION
Pump housing should never be placed directly in a vise, since clamping across the center housing will cause an internal failure of carbon rotor.

3. Spray fitting threads with silicone and LET DRY. DO NOT use teflon tape, pipe dope or thread lube.
4. Install fittings in pump. Hand tighten.
5. Use only a box wrench to tighten fittings to desired position. DO NOT make more than one and one half (1 1/2) turns beyond hand-tight position.
6. Install new pump mounting gasket (supplied with new pump). (NOTE: No gasket is required between stand-by pump/clutch assembly and its adapter plate mounting pad.)
7. Always replace ALL locking washers when installing a new pump. Tighten all four (4) mounting nuts - 90 to 110 in. lbs.
8. Prior to reconnecting hoses, inspect inside of hose carefully to make sure it is clean and free of all debris, oils or solvents. Use vacuum or air pressure to clean lines. Remove hoses from aircraft, if necessary.
When hose clearance is tight, making it difficult to reinstall onto pump fitting, spray fitting at hose end with silicone. LET DRY, then install hose by pushing it straight on.

CAUTION
Do not wiggle hose from side to side. Wiggling could cause particles to be cut from hose ID. These particles will damage pump.

CAUTION
Change all filters in system. This must be done or pump warranty may be voided.

37-12-00 - VACUUM REGULATOR

Vacuum regulator (2) (Figure 37-1) is a spring-controlled diaphragm valve for regulating vacuum for aircraft's pneumatic instrument system. Vacuum regulator is located on left firewall, inside cabin, just under glareshield. Adjust vacuum regulator valve according to Section 37-12-05.

37-12-01 - MAINTENANCE PRACTICES

Check general condition of regulator to insure it is secure and in airworthy condition.

37-12-02 - SERVICING

No servicing is required for regulator other than filter replacement. See Section 37-13-00 for details.

37-12-03 - REMOVAL

1. Inside aircraft - underneath instrument panel, remove both instrument lines from vacuum regulator; cap lines to prevent foreign objects from entering system.
2. Engine compartment - remove hoses from vacuum regulator; cap hoses to prevent foreign objects from entering system.
3. Loosen and remove large nuts at firewall on vacuum regulator.
4. Pull regulator aft to remove from aircraft.

37-12-04 - REINSTALL

1. Inside aircraft, insert vacuum regulator through mounting hole in firewall.
2. Install large nut on regulator and tighten.
3. Engine compartment, install hoses from pump to regulator and secure.
4. Inside aircraft, install both instrument lines to regulator and secure.

37-12-05 - ADJUSTMENT

1. Tee calibrated vacuum gauge into system upstream of regulator (see Figure 37-1).
2. Operate engine at a minimum of 1700 RPM. If vacuum regulator is not set at 4.75 +/-0.25 In. Hg., bend locking tab away from thumb adjustment screw. Turning screw IN, will increase vacuum; turning screw OUT, will decrease vacuum. Set vacuum to read 4.75 +/-0.25 In. Hg.

NOTE
After setting regulator, rebend tab back to lock adjusting screw.

37-13-00 - FILTERS

All filters, except vacuum regulator filter are of paper-pleated material design. The vacuum regulator filter is a foam-garter design.

37-13-01 - MAINTENANCE PRACTICES

1. Air filter replacement intervals: (See SECTION 5-10-01)
   A. Vacuum regulator, garter filter - every 100 hours.
   B. Gyro instrument filters - every 500 hours or at least once a year.
2. All filters require routine inspection of condition of element and security of filter in system.
3. All filters must be changed when a new pump is installed.

37-13-02 - SERVICING

Filters require no service except, routine inspections. Replace with new current configuration filters.

Optional instrument filters (if installed) should follow same cleaning and replacement schedule.

37-13-03 - REMOVAL

1. Vacuum regulator garter filter is removed by stretching it over and off regulator frame.
2. The Gyro instrument's filter is mounted on a bracket under instrument panel just forward and to the right of pilot's right knee.
3. Disconnect two hoses coming into filter and remove filter from bracket.

37-13-04 - INSTALLATION

1. Prior to installing a new vacuum regulator filter, check regulator to insure that it is clean from any foreign material.
2. Reinstall new filter in fitting and secure.

CAUTION
Don't over tighten; overtightening will crack rear housing.

37-14-00 - HOSES

The hoses are of aircraft, MIL-H-,type.

37-14-01 - MAINTENANCE PRACTICES

During engine cleaning, protect discharge hose:

1. Plug end of hose and flag it with a red "Remove Before Running Engine" tag, then clean engine.

CAUTION
Remove plug prior to running engine.

Periodic check of all clamps for security is recommended.

37-14-02 - SERVICING

Inspect inside of hose carefully to make sure it is clean and free of all debris, oils or solvents. Use vacuum or air pressure to clean lines. Remove hoses from aircraft, if necessary.

37-14-03 - REMOVAL

Replace old, hard, cracked or brittle hose, particularly on pump inlet. Sections of inner layers may separate, causing pump failure.

37-14-04 - REINSTALL

Where hose clearance is tight, making it difficult to reinstall it onto pump fitting, spray fitting at hose end with silicone. LET DRY, then install hose by pushing it straight on.

NOTE
Do not wiggle hose from side to side. Wiggling could cause particles to be cut from hose ID. These particles would damage pump.

Make certain hoses are connected to correct fittings. Incorrect installation will cause damage to gyro system. Install clamps and secure.

37-20-00 - INDICATING

The indicating system contains a low vacuum warning light, HI/LO VAC in annunciator, which flashes (RED) when vacuum is below 4.25 +/-.2 In. Hg. and a high vacuum warning light, HI/LO VAC in annunciator, which illuminates steady (RED) when vacuum goes above 5.5 (+.2-.0) In. Hg.

37-21-00 - VACUUM SWITCH

The vacuum switch (7), Fig. 37-1, is located on either the Artificial Horizon (3) or Directional Gyro (4).

The illuminating low and high "light ADJUSTMENTS" are done on the switch, NOT on the annunciator panel.

37-21-01 - DESCRIPTION

The switch is a low and high vacuum sensing, adjustable unit.

37-21-02 - MAINTENANCE

Inspect for switch security on instrument and that all wires are secure at switch.

37-21-03 - REMOVAL

Disconnect wires and unscrew from aft instrument housing.

37-21-04 - REINSTALL

Install switch in housing and tighten. Reconnect wires.

CAUTION
Do not over tighten. Over tightening will cause cracking of aft instrument housing.

37-21-05 - ADJUSTMENT

1. Remove switch from instrument. Reinstall wires if removed. Attach poly-vinyl hose, "T" fitting and calibrated gauge to vacuum switch. Connect other end of hose to a vacuum source.
2. Turn aircraft power ON. The "HI/LOW VAC" light should flash.
3. Apply vacuum and adjust source to 4.25 (+/-0.2) In. Hg. Adjust Low setting screw (connector end of switch) to illuminate low vacuum circuit on the annunciator panel.
4. Increase vacuum source to 5.5 (+.2-.0) In. Hg. Punch a small jewelers screw driver through the polyvinyl tube and into fitting where the high setting screw is located. Adjust until the "HI/LO VAC" light on annunciator is illuminated.
5. After you have completed switch adjustment turn aircraft power OFF.
6. Remove switch from hose and gauge.
7. Reinstall switch on Gyro. Reconnect wires.

CAUTION
Crossing electrical wires on vacuum switch will cause annunciator lights to act in reverse.

31-22-00 - VACUUM GAUGE ADJUSTMENT

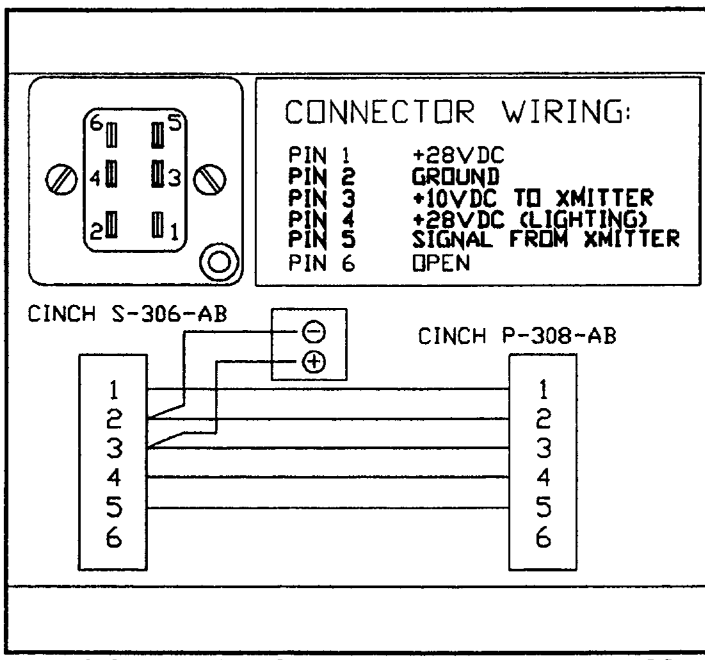
SIGMA-TEC

It is necessary to calibrate the vacuum gauge to the transducer whenever either is replaced; use the following procedures:

1. Remove gauge from cluster.
2. Remove two (2) screws from rear of gauge case and slide case from gauge.
3. Obtain or construct adaptor cable (See Figure 37-2 for schematic).
4. Connect plug end into connector in rear of case.
5. Connect socket end of adaptor cable into gauge connector. The 2 Pin connector is for the DVM.
6. Tee in a calibrated Vacuum Gauge down stream of vacuum regulator.
7. Apply vacuum to aircraft system. Use separate vacuum supply or stand-by vacuum pump.
8. With Digital Volt Meter (DVM) connected to 2 Pin connector on adapter harness, check excitation voltage for 10 VDC. Adjust R2 (vertical adjust screw on top right of C/B on gauge) if necessary
9. Adjust R4 (upper potentiometer in center of C/B, right screw) so gauge reads 3 in. Hg.
10. Set regulator for 5 in. Hg.; adjust R3 (lower potentiometer in center of C/B, left screw) so that gauge reads 5 in. Hg.
11. Repeat Steps 9. & 10. as needed to obtain values.
12. Remove adaptor cable; reassemble gauge to case.
13. Re-install assembled gauge unit into cluster case.
14. Adjust regulator for 4.8 in. Hg.
15. Verify aircraft instrument reads same as calibrated gauge.
16. Remove Calibrated gauge after verification.

DIGITAL - 29-0170 thru 27-TBA

1. See Figure 39-4B for location of adjustment potentiometer.
2. Tee in calibrated Vacuum Gauge down stream of Vacuum Regulator.
3. Apply vacuum to aircraft system. Use separate vacuum supply or stand-by vacuum pump.
4. Adjust vacuum gauge potentiometer to read same as calibrated vacuum gauge.
5. Adjust regulator to 4.8 in. Hg.
6. Verify aircraft instrument reads same as calibrated gauge.
7. Remove Calibrated gauge after verification.

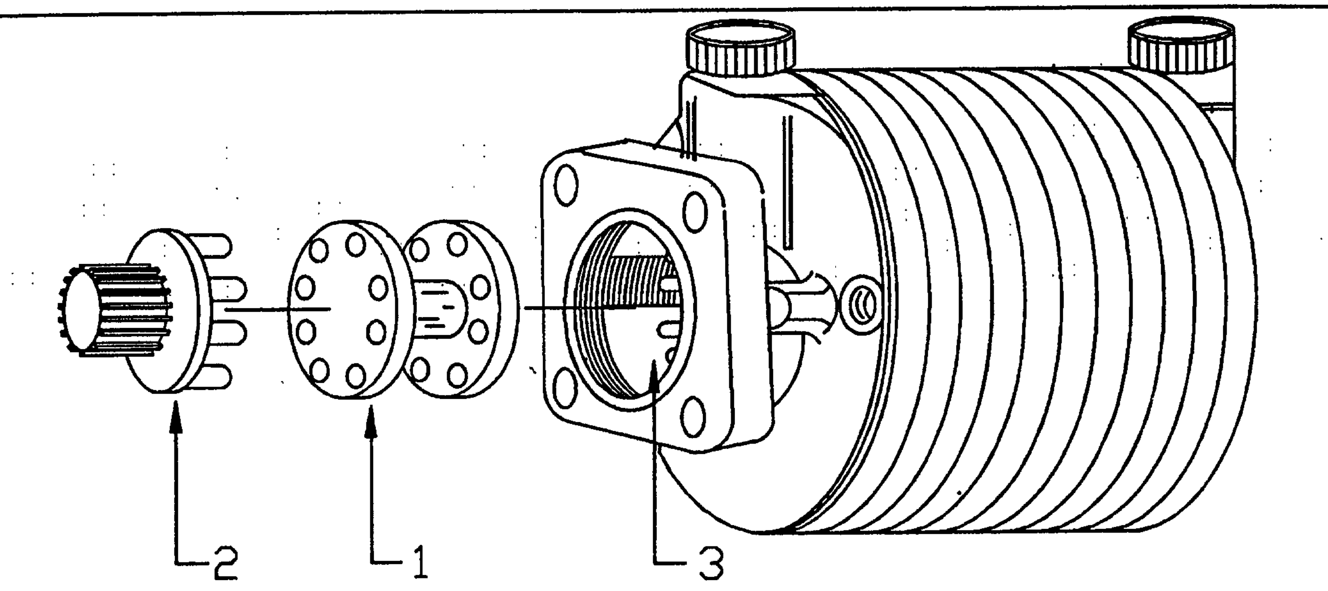


SIGMA-TEC VAC. Addition. ADAPTER HARNESS
FIGURE 37-2

37-30-00 - DRY AIR PUMP REPAIR/REPLACEMENT

37-30-01 - COUPLING INSPECTION AND REPLACEMENT (FIGURE 37-3)

1. Remove vacuum pump from engine in accordance with SECTION 37-11-03.
2. If coupling (1) has sheared, remove engine coupling drive gear (2) from engine gear housing.



DRY AIR PUMP COUPLING INSPECTION/REPLACEMENT - FIGURE 37-3

3. Use screwdriver or similar tool, remove pump drive coupling (1) from coupling drive gear (2) and coupling drive gear (3) being careful not to damage drive pins.

4. Push new drive coupling (1) into place on coupling drive gear (3).

5. Push coupling drive gear (2) into place on pump drive coupling (1).

6. Turn by hand — check for correct rotation of pump.

7. Reinstall pump on engine and test run (refer to SECTION 37-11-04)

8. Make log book entry.

37-40-00 - STAND-BY VACUUM SYSTEM

37-41-00 - CLUTCH DRIVEN - OPERATIONAL PROCEDURES

The Stand-by Vacuum Pump/clutch assembly, incorporated on the M20R, is either a engine mounted standard vacuum pump coupled to an electric clutch assembly or a tailcone mounted, electrically driven, standard vacuum pump to allow operator selected ON/OFF operation, as necessary . The Stand-by Vacuum system is to be used, only as needed, when the main vacuum pump malfunctions. The VAC annunciator light will illuminate (RED), either flashing (low vacuum) or steady (high vacuum) when this situation occurs.
If annunciator is flashing RED, push STBY VAC switch ON and annunciator light should extinguish as stand-by vacuum system takes over for all instrument operations.
If annunciator is steady RED, monitor flight instruments with non-vacuum gauges and continue with flight if feasible, or land and have Vacuum System repaired.

WARNING
Malfunction of main air pump could be caused by some contamination within vacuum system and stand-by vacuum pump/clutch assembly could be affected by the same cause.

Operation of the engine driven, clutch actuated stand-by vacuum pump can be checked when engine is running by the following procedures:

1. Verify indicator RED button on C/B panel is visible.
2. Turn Stand-by Vacuum pump switch - ON.
3. RED indicator button will not be visible if stand-by vacuum pump is operating properly.
4. Turn Stand-by Vacuum pump switch - OFF.

A complete check out and maintenance of entire vacuum system is necessary if either pump experiences a malfunction.

37-42-00 - MAINTENANCE PRACTICES

ENGINE MOUNTED STAND-BY VACUUM SYSTEM

The engine mounted stand-by vacuum pump/clutch assembly is mounted adjacent to main vacuum pump on engine accessory case.

37-42-01 - REMOVAL (Clutch Driven)

1. Disconnect hoses from stand-by vacuum pump/clutch assembly.

2. Remove four (4) nuts and washers attaching stand-by pump/clutch assembly and remove assembly from adapter plate pad. The adapter plate does not require removal.

3. Proceed with inspection of stand-by vacuum pump/clutch assembly per steps in SECTION 37-11-03, steps 3 and 4.

NOTE
If during inspection, the AND 20000 pad seal shows signs of leaking, the adapter plate and drive extension must be removed to allow replacement of pad seal between drive extension and AND 20000 pad. A gasket is also required between drive extension and stand-by pump/clutch adapter plate. No gasket is required between stand-by pump/clutch assembly and adapter plate pad.

37-42-02 - INSTALLATION OF NEW CLUTCH DRIVEN STANDBY VACUUM PUMP ASSEMBLY

1. Refer to SECTION 37-11-04 for installation of new stand-by vacuum pump/clutch assembly. No gasket is required between stand-by pump/clutch assembly and adapter plate pad.

2. Replace stand-by vacuum pump/clutch assembly as a complete unit.

3. Replace all lockwashers. Tighten mounting nuts - 90 - 110 in. lbs.

WARNING
If adapter plate, to mount stand-by pump/clutch assembly, has been removed for any reason, it is necessary to apply Loc-Tite, # 271 on threads of flush head attaching screws (4 each) and torque each screw to 70 inch lbs.

NOTE
Refer to Airborne Service Letter, No. 34, for inspection information on stand-by vacuum pump/clutch assembly drive coupling.

37-43-00 -TAILCONE MOUNTED STAND-BY VACUUM SYSTEM

The tailcone mounted stand-by vacuum pump assembly is to be repaired/serviced in accordance with the particular vendor's procedures.

If no specific maintenance information is available from the manufacturer the following is recommended:

1. Inspect to verify hoses and wires are clear of any obstruction or interference with other components that may chafe hoses or wires.

2. Inspect hose clamps on all fittings to verify tight and secure.

3. Every 100 hour/annual inspection - inspect set screws in motor/air pump coupling for tightness and security.

4. A dry air pump requires no maintenance between replacement. Replacement is recommended at 500 hours operating time. It is recommended that stand-by vacuum system operating time be documented.

5. It is recommended that if the Stand-by Vacuum System is not used regularly, that every 90 days (approximately) the Stand-by Vacuum System should be turned on, in flight, for 20 - 30 minutes to get the pump and drive motor warm enough to dry out any condensation that may have accumulated. The exhaust port of the dry air pump is routed into the housing of the electric motor to assist in purging moisture and debri from the motor assembly.

37-43-01 - OPERATIONAL PROCEDURES

One optional Stand-by Vacuum PumpSystem for the M20R is located in the Tailcone. Its location is standard, but can vary slightly depending on optional equipment installed on aircraft.

The Stand-by pump is to be used only as needed when the main Vacuum pumpmalfunctions. The VAC annunciator light will illuminate (RED) either flashing (low vacuum) or steady (high vacuum) when this situation occurs. If annunciator light is flashing RED, push STBY VAC switch ON and annunciator light should extinguish as stand-by vacuum system takes over for all instrument operation.s. If annunciator is steady RED, monitor flight instruments with non-vacuum gauges and continue with flight if feasible, or land and have vacuum sytem inspected and repaired.

It is recommended that prior to aircraft engine start, the stand-by vacuum pump be turned ON to verify that the vacuum gauge (if equipped) indicates normal operating vacuum and that the gyros spin up and erect. When the engine starts the check valve closes and the stand-by vacuum pump system will not produce enough additional vacuum for any indication on the gauge (if equipped) to be noticeable.

CHAPTER

39

CHAPTER 39

ELECTRICAL PANELS AND COMPONENTS

LIST OF EFFECTIVE PAGES

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39-00-00 - GENERAL

The instrument panel is divided into three basic groupings; (1) Flight Instruments, (2) Avionics/Radio Panel and (3) Engine Instruments and Circuit Breaker Panel. The flight instrument panel is shock mounted. The Radio/Avionics Panel generally, has individual racks for components and are quick removal type. The Circuit Breaker Panel is located in a removable panel, located at the far right of cockpit.

Circuit breaker/switches for standard and/or optional accessories and equipment are located on upper/mid left and bottom of flight instrument panel.

Cluster gauges, containing fuel quantity and engine operating gauges are located to the right of flight and navigation instruments on pilot's instrument panel.

The annunciator is located at the top of Avionics/Radio Panel.

The panel illustration depicted in Figure 39-1 shows a typical installation. Model year improvements, technical improvements or various avionics installations dictate which instrument will be installed in a given location.

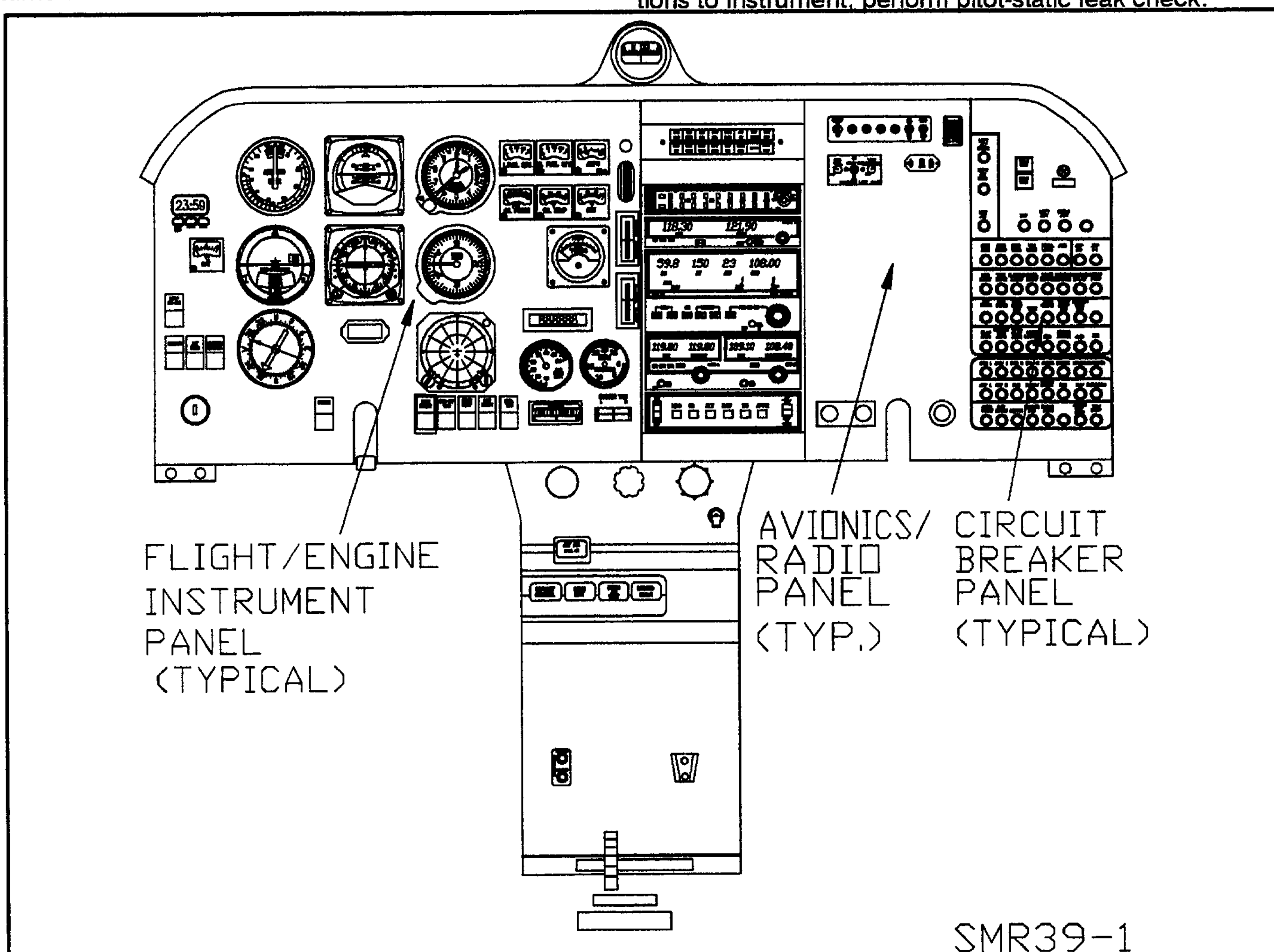
A radio blower is incorporated to cool the avionics package. It is turned on when Radio Master Switch is turned ON.

See Chapter 91 for Electrical System Hardware Charts and Schematics.

39-10-00 - INSTRUMENT AND CONTROL PANELS

39-10-01 - FLIGHT INSTRUMENTS

1. Removal.
   A. Remove screws attaching glareshield and cover plate and carefully lift glareshield to expose wire disconnects for glareshield lights. Disconnect wires and lift glareshield off.
   B. Disconnect plumbing and/or electrical connections from flight instruments to be removed.
   C. Disconnect and remove any post lights.
   D. Remove mounting screws securing instrument to panel.
   E. Remove instrument by sliding it aft from panel.
2. Installation.
   A. Place instrument into proper location on panel.
   B. Insert and secure mounting screws to hold instrument to panel.
   C. Connect post lights.
   D. Connect all plumbing and/or electrical connections to instrument; perform pitot-static leak check.



TYPICAL INSTRUMENTS AND CONTROL PANEL - FIGURE 39-1

E. Position glareshield so electrical connections can be made and secured.

F. Secure glareshield and cover plate with screws.

39-10-02 - AVIONICS EQUIPMENT

Each avionics package installed is basically a customized package to meet requirements of the customer. Wiring harness, any associated plumbing or mechanical mechanisms required for a particular avionics installation, are well secured to prevent any interference with other components. Removal of these avionics components will require evaluation of each installation to determine the proper procedure or sequence to follow.

1. Removal.

Most individual avionics components are mounted in slide out chassis racks. Loosen screw on face of component and slide unit straight aft to remove.

Some components are not mounted in slide out chassis. Removal of these units will require the same sequence as removal of flight instruments in SECTION 39-10-01.

CAUTION
Radio panel must be stacked from bottom to top as units are installed.

2. Installation. Install repaired or new unit in reverse sequence of removal.

39-10-03 - CIRCUIT BREAKER PANEL

The Circuit Breaker Panel is an assembly that can be pulled out as a unit for removal of any switch or circuit breaker.

1. Removal.

A. Remove glareshield - refer to Section 39-10-01.

B. Drill out 3 rivets on outside of airplane (B) (Fig. 39-2). These are located forward of the cabin door hinge and above cabin air inlet scoop, approximately 4 inches below windshield.

C. Remove two screws from face of panel at upper left corner (C) (Figure 39-2).

D. Remove two screws (D) from underneath, near edge of panel face.

E. Remove MS21919DG( ) clamp (E) from steel structure cross brace, underneath panel, forward section, see (Figure 39-2).

F. The panel should now be free to slide aft approximately 4-5 inches. This will allow access to plumbing and electrical connections.

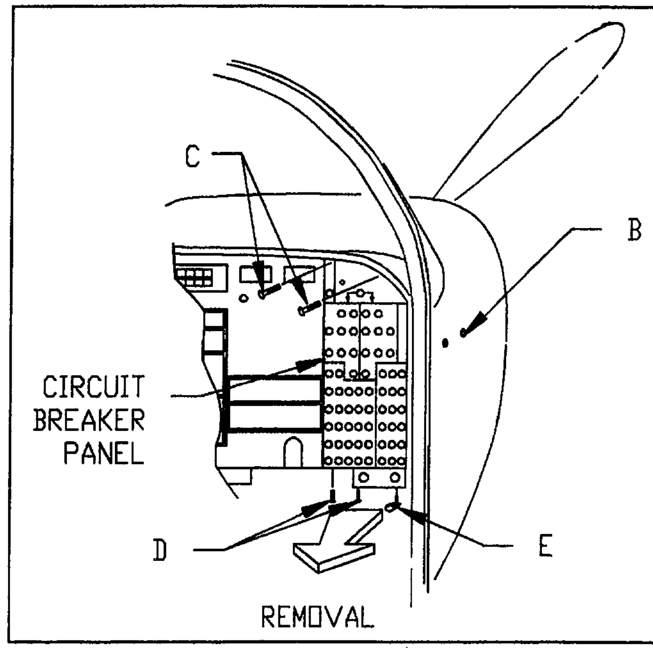
G. Remove plumbing or electrical connections from component that will be removed.

NOTE
In some instances, components, other than the one to be removed, must be removed or at least some wiring or plumbing disconnected to gain access to the desired component.

H. Remove thin lexan glass insulation strip, if required, when removing components.

I. Remove circuit breakers by unscrewing nut from stem on each circuit breaker and push circuit breaker forward through panel.

2. Installation.



CIRCUIT BREAKER PANEL REMOVAL
FIGURE 39-2

A. Installation of new instrument or circuit breaker into panel is accomplished in reverse sequence of removal.

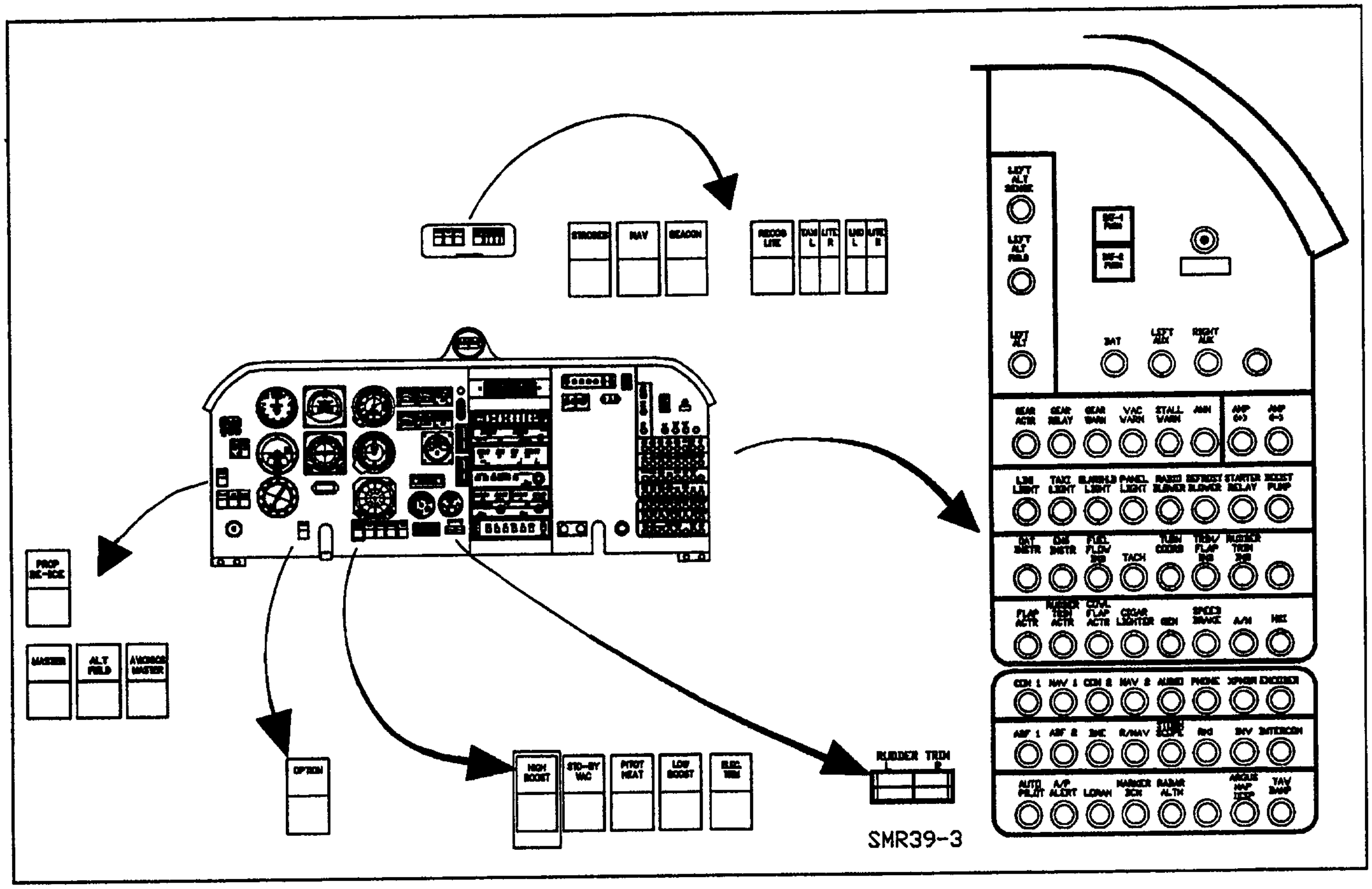
B. Insert lexan insulator sheet in proper location to prevent any short circuits.

39-11-00 - FLIGHT INSTRUMENT PANEL

The flight instrument panel is a shock mounted panel containing various flight instruments for a particular installation group. These instruments vary slightly depending upon avionics package installed. The panel contains circuit breaker/switches, along with Master Switch, which control most systems of aircraft. Refer to Figure 39-3).

Access for maintenance of switches or related wiring is obtained by removing two attachment screws and pushing switch forward through panel. There is a common bus bar on some switches that will require loosening or removal for switch replacement.

CAUTION
Care should be exercised when replacing wiring or switches to ensure proper alignment of terminal connections to prevent shorting between switches.



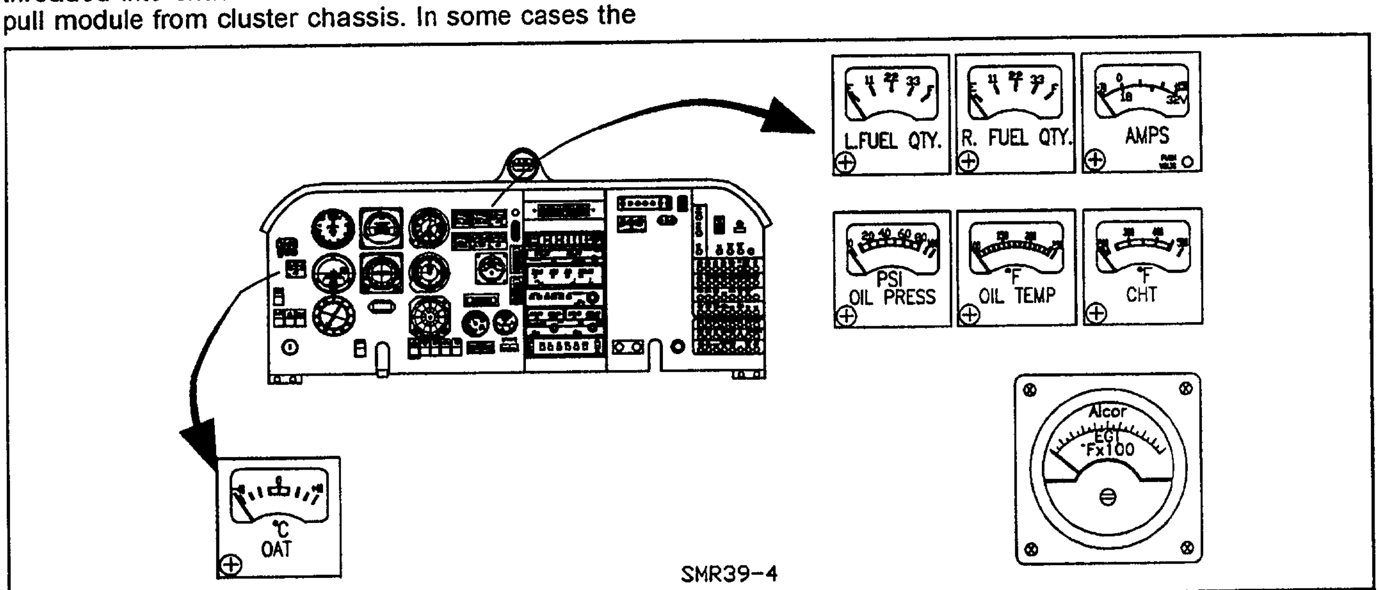
ROCKER/CIRCUIT BREAKER SWITCHES - FIGURE 39-3

39-11-01 - CLUSTER GAUGE

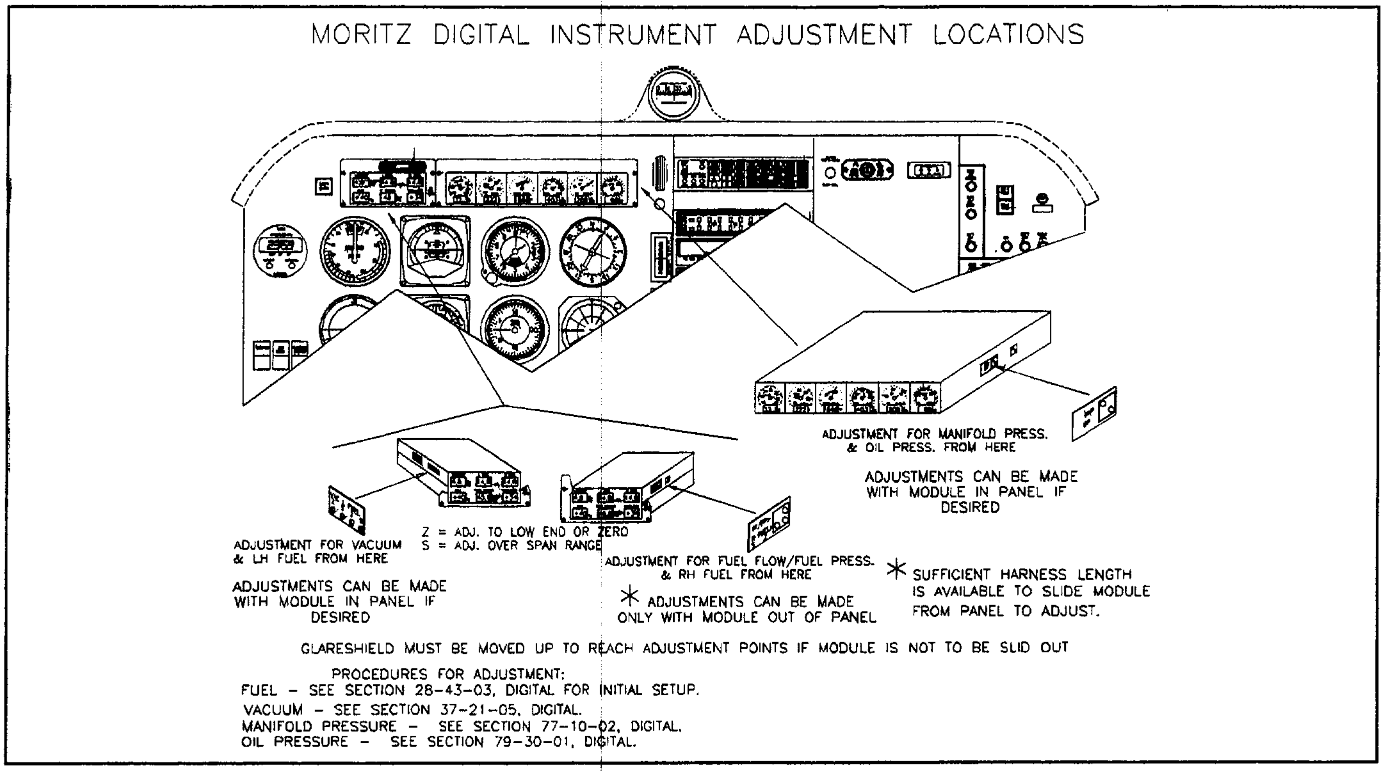
The cluster gauges are located at the top/right of flight panel. Access is obtained by removing glareshield per SECTION 39-10-01. Cluster gauges have the capability of individual module replacement. Remove and replace defective module as follows:

Loosen single screw to the point where it no longer is threaded into chassis. Use screw as the "handle" to pull module from cluster chassis. In some cases the adjacent, more centered, module may need to be removed before one of the edge modules will easily come out.

To remove entire cluster gauge, the wiring harness can be disconnected at connector adjacent to cluster gauge unit. The nuts on terminal studs need to be removed so wire terminals can be pulled from studs to remove modules from cluster gauge chassis.



CLUSTER GAUGE - FIGURE 39-4



MORITZ CLUSTER GAUGE ADJUSTMENT LOCATIONS - FIGURE 39-4B

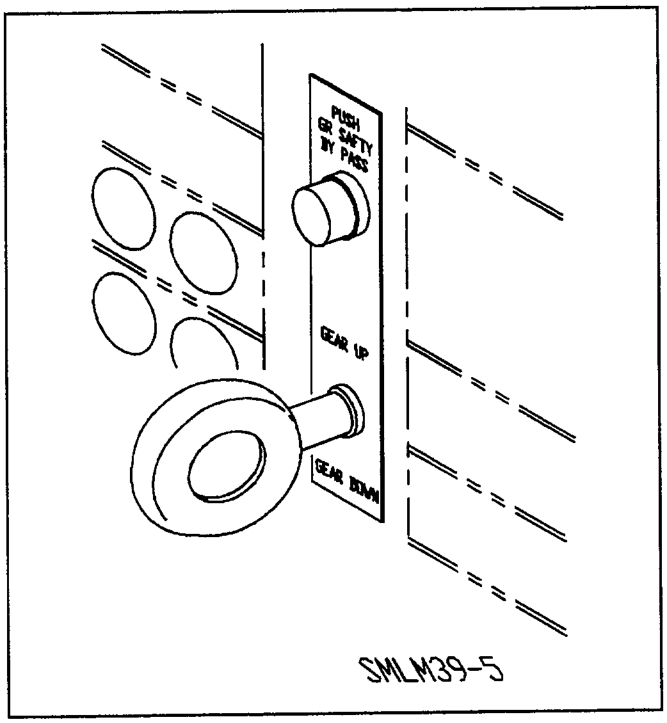
TROUBLE SHOOTING GUIDE FOR CLUSTER GAUGES

PRESSURE INSTRUMENTS	**GAUGE CONDITION**	CHECK FOR THESE POSSIBILITIES
Gauge reads full scale with engine shut down.	Wire between sender and gauge disconnected or open.	Faulty sender, wiring or gauge.
Gauge reads zero when engine is running.	Wire between sender and gauge grounded.	Faulty sender, wiring or gauge.
TEMPERATURE INSTRUMENTS	**GAUGE CONDITION**	**CHECK FOR THESE POSSIBILITIES**
Gauge reads full scale with engine cool or cold.	Wire between sender and gauge grounded.	Defective gauge, wiring or sender.
Gauge reads zero when engine is hot.	Wire between sender and gauge is open or disconnected.	Defective gauge, wiring or sender.
FUEL SYSTEM	GAUGE CONDITION	CHECK FOR THESE POSSIBILITIES
Gauge indicates empty.	Grounded wire between sender and gauge.	Defective sender or wiring. Inoperative gauge. Floats stuck on bottom.
Gauge indicates past full when tank is less than full.	Open sender lead.	Open sender (open resistance element). Sender not properly grounded to airframe. Gauge off calibration. Note: Some clusters are equipped with fuel gauges that have trim pots and may need recalibration.
Gauge indicates 1/2-3/4 when tank is full.	On dual sender systems, the isolated sender may be grounded.	Lead between isolated sender and grounded sender is grounded. Either sender defective. Gauge - off calibration. O/B float stuck on bottom of tank.

39-11-02 - LANDING GEAR SWITCH

The landing gear switch is a two position switch located at the top right side of flight instrument panel. The wheel shaped knob must be pulled aft prior to raising or lowering switch to activate landing gear actuator.

1. Glareshield will require removal to gain access to switch for maintenance action (refer to SECTION 39-10-01).
2. Remove wire connections from back of landing gear switch.
3. Turn wheel shaped knob counterclockwise to remove from stem.
4. Remove nut and washer from face of switch and push switch through panel.



LANDING GEAR SWITCH & LANDING GEAR SAFETY OVERRIDE SWITCH

39-11-03 - LANDING GEAR SAFETY OVERRIDE SWITCH

The landing gear safety override switch is located above landing gear switch. Proper operation of landing gear safety system will not allow gear to retract below 65 +7/-4 KIAS.

CAUTION
Activation of gear safety override switch while aircraft is on ground may cause landing gear to retract.

1. Disconnect wire connectors, approximately 6 inches from switch, by cutting with wire cutters or opening knife disconnects.
2. Loosen nut on stem and hold nut located inside mounting bracket. The RED lens may need to be removed to fully remove switch from panel and bracket.
3. The light bulb, GE 327, can be replaced after glareshield is removed by bending a nail or similar rod (approximately 3/32" diameter) and pushing RED lens OFF to front of panel. Use a small vacuum tube puller or soft nosed instrument to pull bulb from socket.

39-11-04 - CLOCK

The digital clock can be set by using procedures included in POH/AFM, SECTION VII.

39-12-00 - AVIONICS/RADIO PANEL

The avionics/radio panel contains equipment installed per sales order by Mooney Aircraft Corporation and/or other equipment installed by other sources, as the owner desires. The maintenance information contained in this Service and Maintenance Manual describes Mooney factory installations only.

Avionics/radio components are removed and installed according to Section 39-10-02, 1 and 2.

FIGURE 39-5

39-12-01 - ANNUNCIATOR PANEL

The annunciator panel is located at the top of center-most avionics/radio panel and is not mounted with a slide in type chassis. Remove this component by removing two screws holding cover plate in position. Remove glareshield and disconnect electrical harness from back side of unit. Remove screws holding unit in place on panel and remove from firewall side of panel.

LOW FUEL WARNING CIRCUIT CALIBRATION.
Refer to Section 24-33-00 paragraph 4.

39-12-02 - EMERGENCY LOCATOR TRANSMITTER (ELT) SWITCH

The remote ELT switch is located at top of Circuit Breaker Panel. The ELT is located in the tailcone and is accessible by removing radio access panel on left side of aircraft fuselage. The ELT antenna is located on top of tailcone underneath the fiberglass dorsal fin. The unit has a three position switch "ON", "OFF" and "ARM". The correct position of this switch is "ARM". The remote switch is connected in parallel to the ELT circuit and will operate correctly either in "ARM" mode or "ON" mode. Normal operation is in "ARM" position. Place remote switch in "ON" position and tune communication radio to 121.5 Mhz to verify that a warbling tone is heard. Place remote switch back to "ARM" position for normal operation.

CAUTION
Testing of ELT should be conducted only during the first five (5) minutes after any hour and no longer than three (3) audible sweeps.

1. If warbling tone is not heard, replacement of ELT battery or entire unit may be necessary. Follow ELT manufactures instructions for battery replacement.
2. If ELT unit is found to be operating properly and system still will not work correctly through remote ELT switch, repair or replacement of switch or wiring will be required.
   A. To gain access to remote switch and wiring, glareshield will require removal (refer to section 39-10-01).
   B. Remove switch retaining nut and washer. Push switch through face of panel. Disconnect wires, remove and replace defective switch.

C. Reconnect wires and test switch for proper operation.

D. Reinstall glareshield.

NOTE
Other switches located on Avionics Panel can be removed and replaced in similar manner.

39-12-03 - INSTRUMENT/RADIO LIGHT & GLARESHIELD DIMMER CONTROL

Dimmer controls for instrument, radio and glareshield lights consists of two rheostat switches located on lower portion of Avionics/Radio Panel. Rotate either switch to obtain desired light intensity. Test malfunction of either switch with a multi-meter; replace as needed.

39-12-04 - CIGAR LIGHTER

The cigar lighter is located at bottom of Radio Panel immediately to right of co-pilots control column shaft. It is a standard cigar lighter similar to automotive type.

39-20-00 - ELECTRICAL/ELECTRONIC EQUIPMENT RACK

The electrical equipment rack for the M20R aircraft is located in tailcone just aft of baggage compartment bulkhead. Access is gained through large access door in tailcone aft of left wing trailing edge. The batteries, auxiliary power plug receptacle (if installed), and various avionics black boxes are mounted on electrical equipment rack. The ELT is mounted on an accessory rack further aft in tailcone.

39-21-00 - MISCELLANEOUS MAINTENANCE

39-21-01 - EQUIPMENT MAINTENANCE

Refer to SECTION 27-42-00 for Electric Pitch Trim System Maintenance

CHAPTER

51

STANDARD PRACTICES-STRUCTURES

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STRUCTURES

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STRUCTURES

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51-00-00 - GENERAL

The Mooney M20R is an all metal, low wing airplane. The fuselage cabin area is constructed of welded 4130 chrome-molybdenum steel tubular structure. The steel tubular structure is covered with non-structural, aluminum skins fastened to tubular structure by rivets, bolts and screws.

The tailcone is of semi-monocoque type construction and is fastened to the tubular structure with structural bolts.

The wing is a tapered, laminar flow, one piece wing. It is constructed with a one piece, full length main spar. The spar is constructed from tapered cap strips (7075 aluminum) bolted (huck bolts) to webs (2024 aluminum). Aluminum ribs connect main spar to aft stub spar and rear spar. Extruded stringers run full length of wing, spaced chordwise for strength and skin reinforcement. The skins are stretch formed, wrap around, 2024-T3 aluminum ranging in thickness from .025 at the tip to .050 at inboard fuel tanks.

The completed wing assembly is mated to the fuselage tubular structure during final assembly at the Mooney facility. Removal of wing from fuselage structure is essential for most over land type transportation.

The empennage is of similar construction to the wing. A main spar spans entire length of the stabilizer. Ribs connect main spar to stub and rear spar. A stretch formed skin wraps around leading edge ribs and attaches to rear spar on top and bottom.
The elevators are constructed of formed, aluminum skins fastened to a spar extrusion at the leading edge and riveted together at the trailing edge.
The vertical stabilizer is constructed around a fabricated main spar assembly with ribs connecting main and rear spar. A stretch formed, aluminum skin wraps around leading edge ribs and is riveted to rear spar on both sides.
The rudder is constructed of formed aluminum skins fastened to a spar extrusion at the leading edge and riveted together at the trailing edge.

A three piece composite belly skin covers underside of aircraft from exhaust cavity aft to tailcone.

The front seats are installed on rails which are attached to floorboard and structure beneath floorboard.

The M20R has a split type rear seat, using seat cushions in molded wells over wing spars and individually reclining rear seat backs.

51-10-00 - STRUCTURAL REPAIR - GENERAL

This section outlines structural repair procedures for the M20R airplane. It is intended to supplement FAA Advisory AC 43.13-1( ) by showing repair methods specific to Mooney airplanes.

All structural repair must be: in compliance with AC 43.13-1( ) unless specific Mooney factory repairs are recommended, or with the specific approval of a Federal Aviation Administration representative, which is final authority in all repairs. This manual is for general guidance and has no authorized approval status. The PRODUCT SUPPORT DEPARTMENT, Mooney Aircraft Corporation, Kerrville, Texas, should be consulted for special repair procedures when repair of damaged structure is not covered by published instructions.

51-10-01 - FASTENER REPLACEMENT

1. HUCKBOLT INSTALLATION. The Huck Lockbolt is an interference fit fastener used in a rigid joint structure. A loose or slip fit Huckbolt is unacceptable. The recommended limits for Huckbolt holes are:

Huck Fastener	Pre-Drill Size	Drill Size	Hole Limits
2LPH-T5	No. 26 (.147 IN.)	No. 20 (.161 IN.)	.161 to .1635 IN.
ALPPH-T6	No. 18 (.1695 IN.)	No. 13 (.185 IN.)	.185 to .187 IN.
R3001-T6	No. 18 (.1695 IN.)	No. 13 (.185 IN.)	.185 to .187 IN.
2L426H-T5	No. 26 (.147 IN.)	No. 20 (.161 IN.)	.161 to .1635 IN.
R3007-T6	3/16 (.187 IN.)	No. 7 (.201 IN.)	.2005 to .2025 IN

When Huckbolt hole is enlarged beyond above limits but is straight and round, the hole may be considered acceptable, provided that Huckbolt cannot be pressed into hole, with normal hand pressure, to a depth more than 50 percent of heaviest material being secured. Check enlarged hole size at both ends. Select proper Huckbolts to fit the oversize holes.

Oversize Huckbolt holes may be repaired by replacing 2LPH-T5 Huckbolts with ALPPH-T6 Huckbolts or with NAS 623-2 screws and NAS 1021 No. 8 Hex-lock nuts (or equivalent), provided pitch distance is greater than .56 inches and edge distance is greater than .33 inches.

Huckbolts ALPPH-T6 and R3001-T6 may be replaced with R3007-T6 Huckbolts as necessary. Consult Product Support Department, Mooney Aircraft, Corporation, Kerrville, Texas, for factory recommendations when the preceding instructions are inadequate to accomplish repair.

To compensate for material thickness tolerances, Huckbolt lengths may be increased by one dash number from the prescribed length. When a Huckbolt pin of proper length is not available, use pin of next longer length.

To adjust grip length, install a cadmium-plated steel washer .065 inch thick (or a combination of not more than two washers .065 inch and .032 inch thick) under Huckbolt collar. The combined thickness of any two washers shall not exceed .098 inch. Huckbolts or conical Keystone Lock blind rivet heads may be cocked no more than .004 inch. Not more than 20 percent of fasteners in any pattern, nor more than three fasteners in succession, may be cocked.

NOTE
Where access is limited or for replacement/repair, the following substitution is permissible.

HUCKBOLT P/N	SUBSTITUTE P/N (VENDOR)	DESCRIPTION
NAS 1465 or R3001-T5	HL20-5 Pin (Hi-Shear) HL86-5 Collar	Pin-Protruding Tension 160 KSI Ftu
NAS 1466 or R3001-T6	HL20-6 Pin (Hi-Shear) HL86-6 Collar	Pin-Protruding Tension 160 KSI Ftu
NAS 1475 or R3014-T5	HL19-5 Pin (Hi-Shear) HL94-5 Collar	Pin-100 D. Flush Shear - 95 KSI Fsu
NAS 1476 or R3014-T6	HL19-6 Pin (Hi-Shear) HL94-6 Collar	Pin-100 D. Flush Shear - 95 KSI Fsu

NOTE -- HL2086-x-x and HL1994-x-x are P/N's which include Pins and collars. Customer MUST supply diameter and grip data.

PART NUMBER CODE
HL20 - 5 - 8
- 8 ______Grip in 1/16ths" (8/16 = .500) MAX
- 5 ______Nominal Dia. in 1/32nds" (5/32 = .156)
- HL20 ______Pin Part Number

RIVET SIZE	MIN. GAUGE
3/32	.025
1/8	.032
5/32	.040

2. RIVET REMOVAL AND REPLACEMENT.

A. REPLACEMENT-STANDARD SIZE RIVETS, HOLE OVERSIZE. This repair applies only to original aluminum alloy, steel, or monel rivets of 1/16, 3/32, 1/8, and 5/32 inch diameters. Such rivets may be replaced as noted and limited below and in General Limitations, when hole only is oversize.

(1) Protruding Head Joint. If edge distance is a minimum of two times diameter of original rivet, it will be permissible to drill for and install the next standard size larger diameter rivet of the same type and material as original rivet.

(2) Machine Countersink Joint, Method I. If edge distance is a minimum of two times the diameter of the next standard size larger diameter rivet and sheet thicknesses involved are within limits specified for machine countersinking for the next standard size larger diameter rivet, it will be permissible to drill and countersink for and install the next size rivet of the same type and material as original rivet. The following are limits for machine countersinking:

(3) Machine Countersink Joint, Method II. If edge distance is a minimum of two times the diameter of the original rivet, it will be permissible to drill for and install the next standard size larger diameter rivet of the same type and material as original rivet. Do not remachine the countersink. After installation, mill excess head height flush with surface.

(4) Dimpled Joint. If edge distance is a minimum of two times the diameter of the original rivet, it will be permissible to drill for and install the next standard size larger diameter rivet of the same type and material as original rivet. Do not redimple. After installation, mill excess head height flush with surface. This method is subject to same limitations as paragraph 2, A (3).

B. REPLACEMENT-STANDARD SIZE RIVETS, HOLE AND COUNTERSINK OR DIMPLE OVERSIZE. This repair applies only to original countersunk head aluminum alloy rivets of 1/16, 3/32, 1/8, and 5/32 inch diameters. Such rivets may be replaced (as noted and limited below) when the hole and countersink or dimple is oversize.

(1) Machine Countersink Joint. If edge distance is a minimum of two times the diameter of the next standard size larger diameter rivet and countersink depth is not beyond thickness of countersunk sheet, it will be permissible to rework according to paragraph 2, A (3).

(2) Dimpled Joint. If edge distance is a minimum of two times the diameter of the next standard size diameter rivet and all parts are dimpled, it will be permissible to rework the smaller dimples to a size to match the oversize dimple and install the next standard size larger diameter rivet of the same type and material as original rivet. Dimples in 75S-T6 must be hot formed when reworked.

(3) Combined Countersink and Dimpled Joint. If edge distance is a minimum of two times the diameter of the next standard size larger diameter rivet, it will be permissible to rework the smaller countersink or dimple to a size to match the oversize dimple or countersink and install the next standard size larger rivet according to paragraph 2, A (4). Dimples in 75S-T6 must be hot formed when reworked.

C. RIVET HEAD TOLERANCE.

(1) A rivet head will be considered open if .001 feeler gauge can be inserted between head of flush or protruding head rivet and top skin. The top of a flush head rivet must not be below skin surface in which it is installed by a dimension of more than .004.

D. RIVET HOLE TOLERANCE.

(1) An enlarged hole is defined as having an internal diametric dimension, in any direction, which exceeds the sum of the drill diameter normally used, plus ten percent of the diameter of the rivet shank.

(2) The **following table** specifies the maximum acceptable diametric dimensions for various rivet sizes that occur in multiple layer assemblies which are "drilled on assembly".

NOMINAL RIVET SIZE	MAX. ACCEPTABLE DRILL SIZE	DIAMETRIC DIMENSION
AN470AD3 or AN426AD3	#40 (.098 dia.)	.108 in.
AN470AD4 or AN426AD4	#30 (.1285 dia.)	.141 in.

(3) When a hole becomes enlarged beyond acceptble diametric limit and the prescribed rivet cannot be used, the next larger diameter rivet may be used if: (a) four-diameter (4D) rivet spacing is maintained and (b) two-diameter (2D) edge distance is maintained.

3. BLIND RIVET INSTALLATION. Ordinarily, where rivet bucking is impossible, CherryLock (CR-2248 and CR-2249) rivets may be substituted for AD rivets to repair skins and structural members. However, consult Mooney Aircraft Corporation Product Support Department or a representative of the Federal Aviation Administration before using blind-type or hollow rivets in primary structure.

CAUTION

The use of blind rivets normally require more frequent inspection of the area where used. Inspect for evidence of loosening of the rivet(s) or crack development that may cause deterioriation of structural integrity. Solid rivet replacement of blind rivets is recommended at earliest possible maintenance.

Check existing rivet hole size before installing blind rivets. When hole is marginal, use next larger size rivet to assure firm attachment.

4. "AN"- BOLT, NUT AND WASHER INSTALLATION. To compensate for material thickness tolerances, the length of AN bolts may be increased or decreased by one dash number from prescribed length. AN960 regular washers and AN960L thin washers may be used interchangeably for proper bolt and nut installation.

One regular washer or one thin washer may be added to any bolt installation. Washers may be used under the bolthead and/or under the nut. AN365 and AN363 nuts may be used interchangeably. The AN363 nut is acceptable for higher operating temperature installations.

5. HI-SHEAR RIVET INSTALLATION. When a hi-shear rivet pin of the prescribed length is not available, the next longer length pin may be used with cadmium-plated steel washers to adjust pin grip length. The combined washer thickness shall not exceed .096 inch.

6. MS20470-AD4 or MS20426-AD4 rivets may replace spotwelds, (1) per spot. Head side and/or double flush requirements determined by form, fit & function of assembly.

51-11-00 - RESERVED

51-12-00 - FUSELAGE REPAIR

51-12-01 - TUBULAR STRUCTURE REPAIR

Check tubular structure annually for corrosion and damage (Refer to Service Bulletin M20-208B). Interior panels may require removal to gain access to areas which are difficult to inspect.

Refer to AC 43.13-1( ) for general tubular frame repair procedures. Warped or bent tube members can often be straightened; however, all surrounding welds should be dye checked for cracks after tube straightening.

Use proper material when making weld repairs. Welding rod, meeting requirement of specification MIL-R-5632, class 2, is recommended for oxy-acetylene welding. Electrodes meeting requirement of specification MIL-F-5632-A, class 2, MIL-E-23765/1C (TYPE MIL-70S-2) or AWS A5.18-69, class E70S-2 (Linde 65, Linde CMS-38, or Page AS-35) are recommended for inert-gas shielded-arc welding (Heliarc) of non-heat treated parts. Use AISI 4130 condition N steel for replacement and repair of tubes and for making repair sleeves. Replacing a member or subassembly is often advantageous and more feasible than repair. All detail tubes or assemblies needed for replacement can be purchased from SERVICE PARTS DEPARTMENT, Mooney Aircraft Corporation, Louis Schreiner Field, Kerrville, Texas 78028, tele. (830) 896-6000, ext 2092.

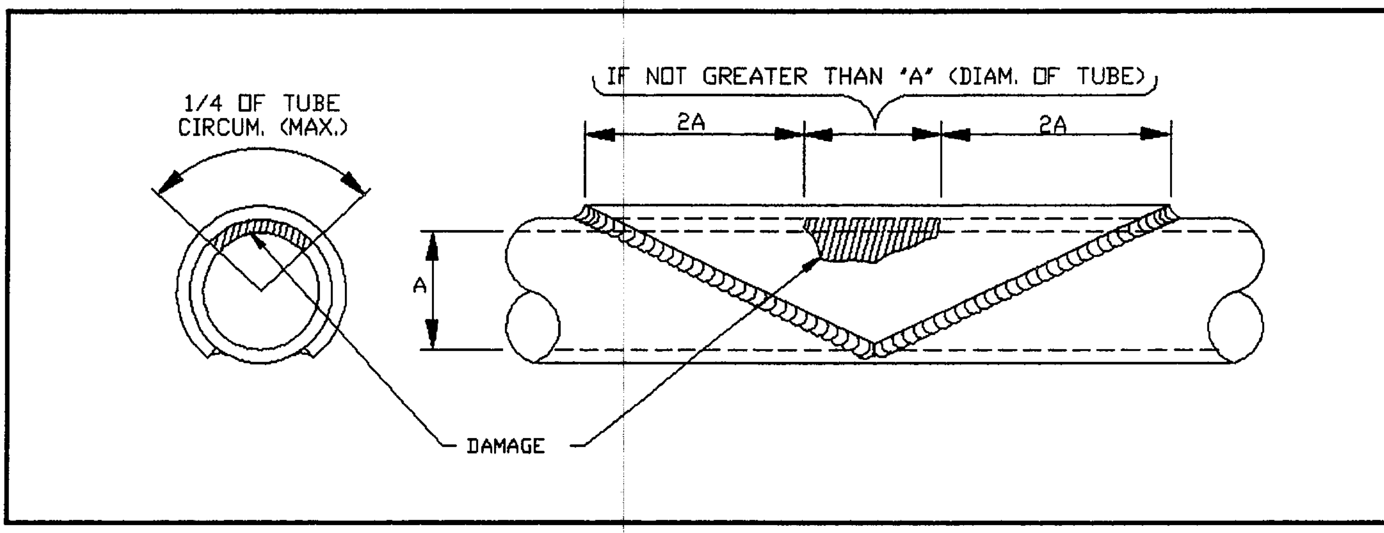
1. WELDED PATCH REPAIR OF LOCAL DAMAGE. Use a welded patch to repair dents, small holes, and cracks no longer than outside diameter of tube and covering a maximum of 1/4 of tube circumference.

Drill out crack, smooth hole edges, weld hole or dent and file repaired surface smooth. Form a patch that will cover twice the diameter of tube from both edges of damaged area and twice the circumferential area of damage as shown in (**Figure 51-1**). Weld patch in place.

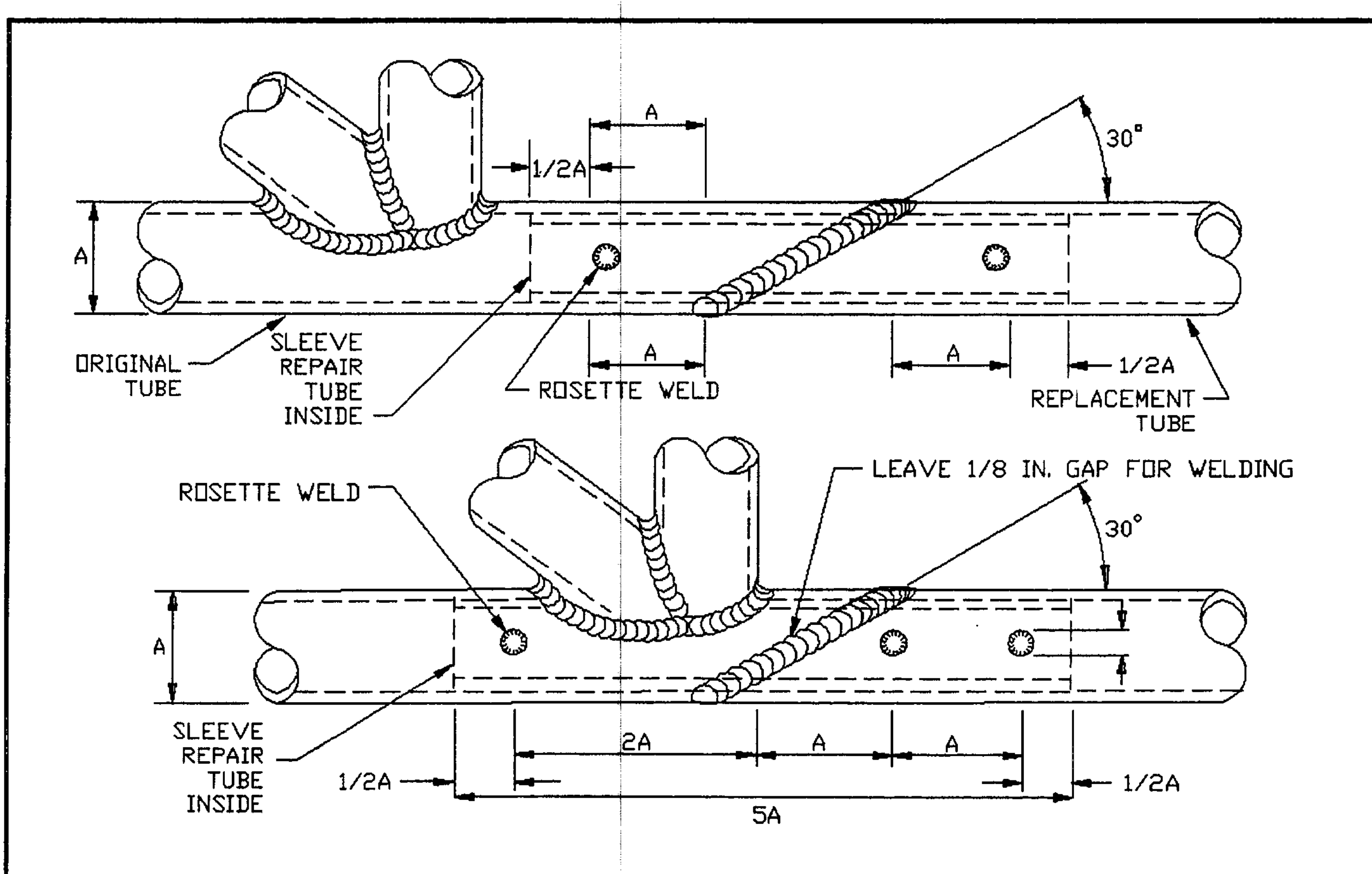
2. INNER SLEEVE SPLICING. Use an inner sleeve splice to partially replace a tube without increasing outside diameter (**Figure 51-2**).

A. Make a 30-degree cut to remove damaged portion of tube; then, remove burr from remaining end.

B. Cut replacement tube of same material (AISI 4130 steel, condition N), same diameter and same wall thickness as original tube.



WELDED PATCH -LOCAL DAMAGE REPAIR - FIGURE 51-1



INNER SLEEVE SPLICING - FIGURE 51-2

C. Select a tube with an outer diameter equal to inner diameter of tube to be repaired and with same wall thickness.

D. Cut tube to length, five times outer diameter of tube to be spliced.

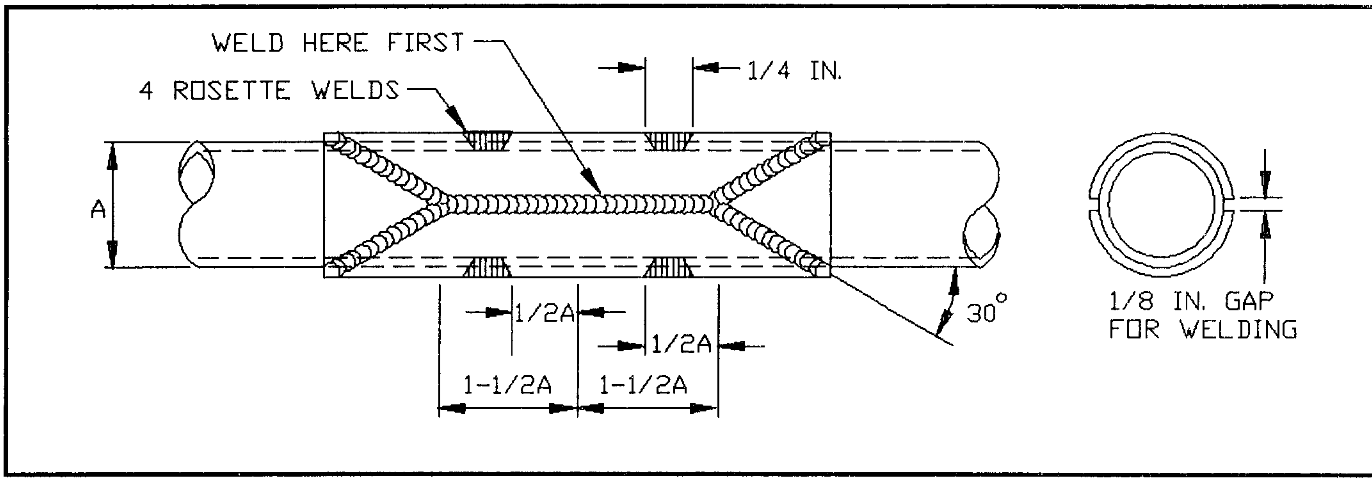
E. Install inner sleeve in tube to be repaired so that its outer end is one and one-half of original tube diameter from nearest end of the diagonal cut; secure in position with a rosette weld on each side at one-half original tube diameter from inner-sleeve end.

F. Install replacement tube over inner sleeve allowing a 1/8 inch gap for welding between original and replacement tubes.

G. Weld inner sleeve to tube stubs through the 1/8 inch gap, forming an overlayed bead across gap.

H. Rosette weld replacement tube to inner sleeve in two or more places.

3. SPLIT-SLEEVE SPLICING. Use split-sleeve splice to repair a damaged tube when parts on each side of the damage cannot be separated to insert an inner sleeve (**Figure 51-3**).



SPLIT-SLEEVE SPLICE - FIGURE 51-3

A. Form split sleeve from steel tube or sheet steel when outside diameter of original tube is less than one inch.

B. Form split sleeve from sheet steel when outside diameter of the original tube is one inch or more.

C. Form split sleeve from same material (AISI 4130 steel, condition N) with at least the same gauge as original tube.

D. Allow a 1/8 inch gap between sleeve halves for welding.

E. Weld parallel edges of sleeve to original tube through 1/8 inch gaps.

F. Weld center of each sleeve half to original tube with two rosette welds spaced one original tube diameter apart.

4. TENSION FITTING REPLACEMENT (**Figure 51-4**).

A. Cut tubes (A) and (B) loose from tension fitting 340034-7, -8 at welds.

B. Cut existing tube (C) at a 30 degree angle seven inches from bottom of tension fitting.

C. Cut a replacement tube (C) at a 30 degree angle and at an appropriate length to position tension fitting. Weld tension fitting in proper position.

D. Drill four 1/4 inch holes for rosette welds, 1.9 inches from center of 30 degree cut.

E. Make an inner sleeve five inches long from 4130 steel tube, condition N, with outside diameter to match inside diameter of tube (C) and with a .085 inch wall thickness.

F. Insert inner sleeve in tube (C) and weld in place as shown (Figure 51-4).

5. REPAIRS FOR WELDED ASSEMBLIES - General. This section does not apply to any control system tubing or assemblies, engine mounts or heat treated steel components (except as stated below).

A. Small holes up to a #20 drill may be closed by welding with the inert gas shielded arc method.

B. Nicks and drill marks that are no longer than 1/8" and do not exceed four percent of wall thickness, in depth, after cleanup may be smoothed out and reprimed. Nicks, holes, and cracks that will clean up with a #20 drill may be drilled and repaired per item A.

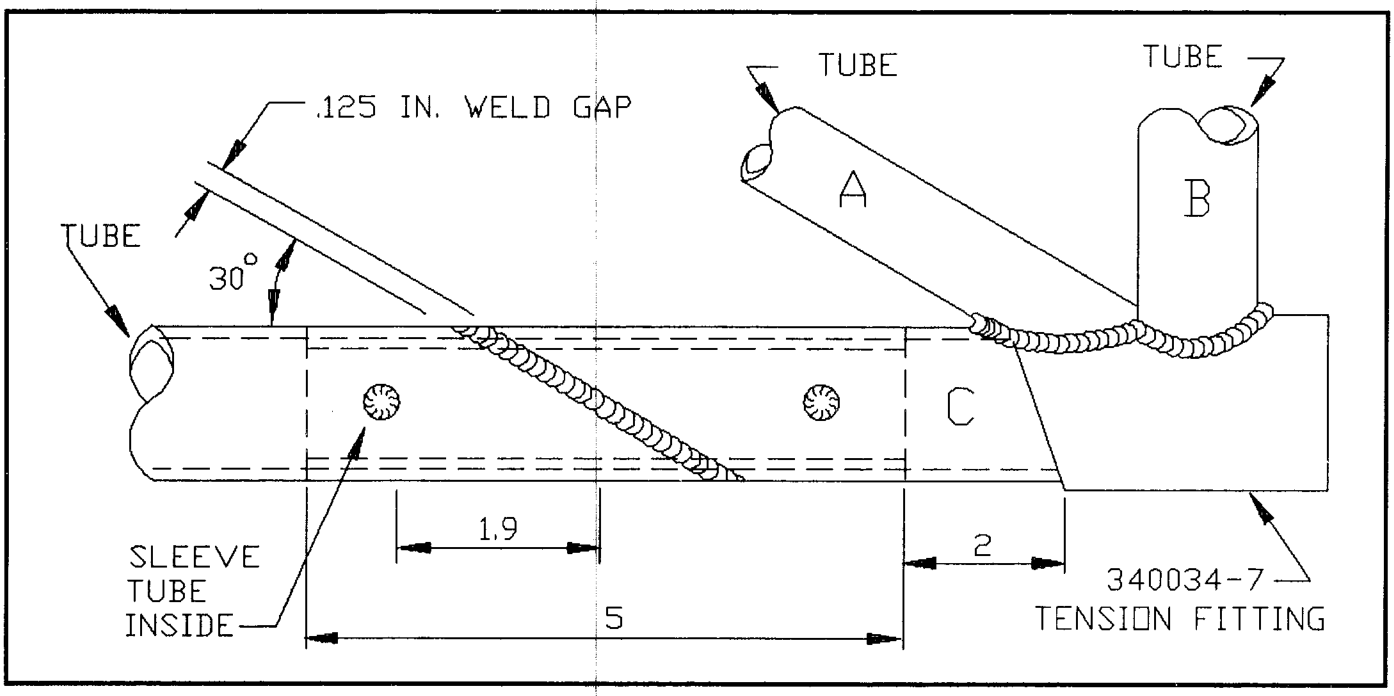
C. The repair of weld beads on heat-treated assemblies may be accomplished without reheat treatment within the following limits.

(1) The repair bead will not exceed .375 in length or 1/3 of total length of weld, whichever is the lesser.

(2) Only one repair per weld bead is allowed.

6. REPAIR OF SPOT WELDS. Failed spot welds on aluminum may be repaired by installing an AD470-4 rivet through weld if damaged area will clean up with a #30 drill.

7. DENTS. Small dents which do not exceed five percent of the diameter of the tube, in depth, and are no longer than one-half tube diameter are acceptable.

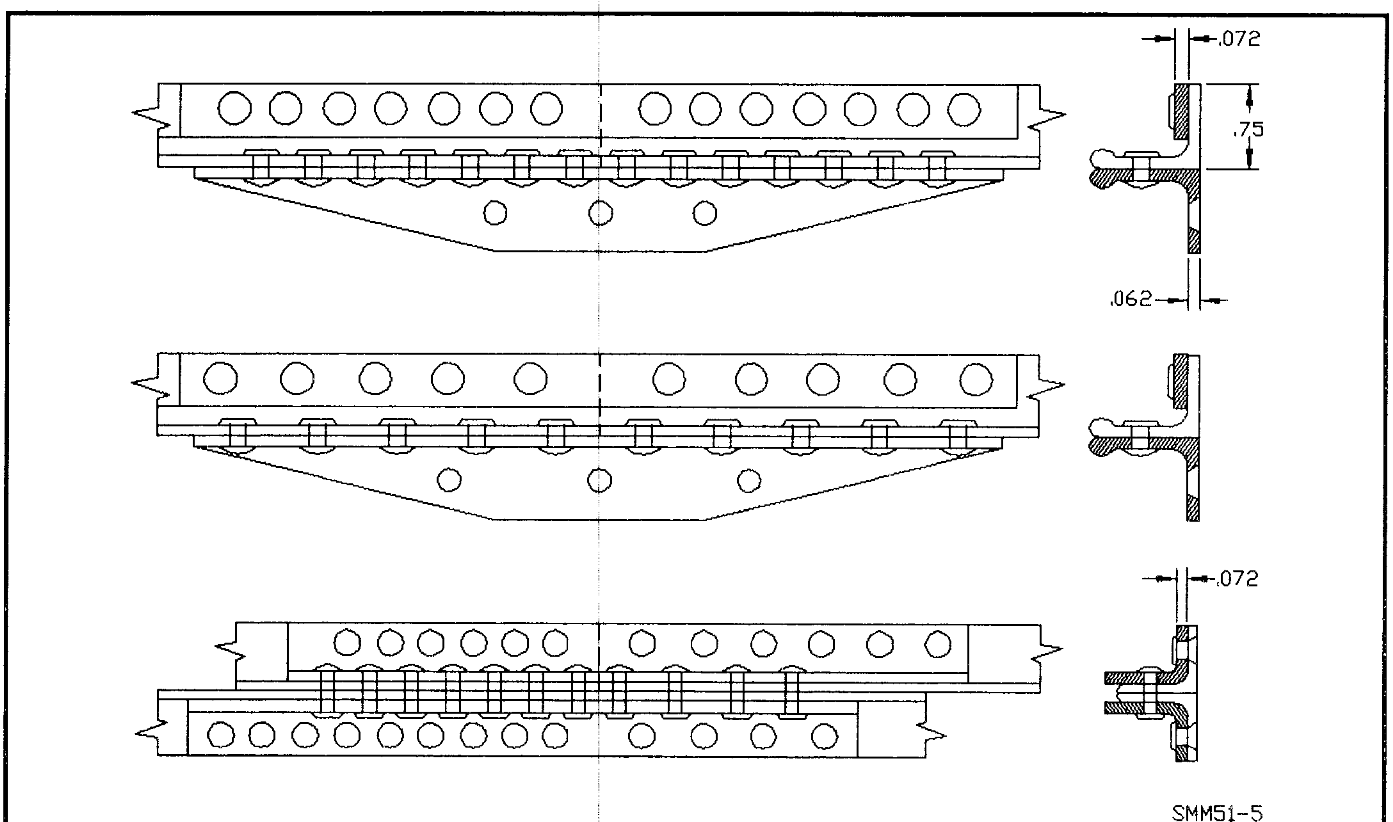


TENSION FITTING REPLACEMENT - FIGURE 51-4

51-12-02 - TAILCONE REPAIRS

1. LONGERON SPLICING. Use procedure outlined in AC 43.13-1( ) for repairing and splicing tailcone longerons. (**Figure 51-5**) shows acceptable methods for splicing longerons. Consult AC 43.13-1( ), Figures 2.28, 2.29 and 2.30 for fastener requirements.

2. TAILCONE STRUCTURAL SKIN REPAIR. Repair minor tailcone skin damage as shown in AC 43.13-1( ),



LONGERON SPLICING - FIGURE 51-5

Figure 2.24. The rivet pattern for stressed skin repairs shall be the same as rivet pattern in skin joint immediately forward of damaged area. Replace severely damaged structural skin panels. Install new skin panels to exactly match original skin installation.

3. NONSTRUCTURAL SKIN REPAIR. The skin covering the M20R aircraft tubular fuselage structure is considered nonstructural. Patches in nonstructural skin are not restricted as to size or shape; however, appearance and possible vibration damage should be considered. Either a flush patch, a plate patch, or a plug patch may be used.

51-12-03 - LANDING GEAR & RETACTION SYSTEM REPAIR

Replace any damaged landing gear or retraction system component with a new part. Repairing landing gear or retraction system components is not recommended. After installing new components, check gear and retraction system rigging as outlined in Section 32-20-02. Before returning aircraft to service, perform a retraction test and operational check of landing gear and retraction system per Section 32-30-01.

51-12-04 - FLIGHT CONTROL SYSTEM REPAIR

Replace any damaged primary control system component with a new part. Repairing primary control system components is not recommended. Use only new hardware when installing new parts. After installation of new parts, check control system travel and rigging as outlined in Chapter 27. Before returning aircraft to service, flight test aircraft for proper control system rigging.

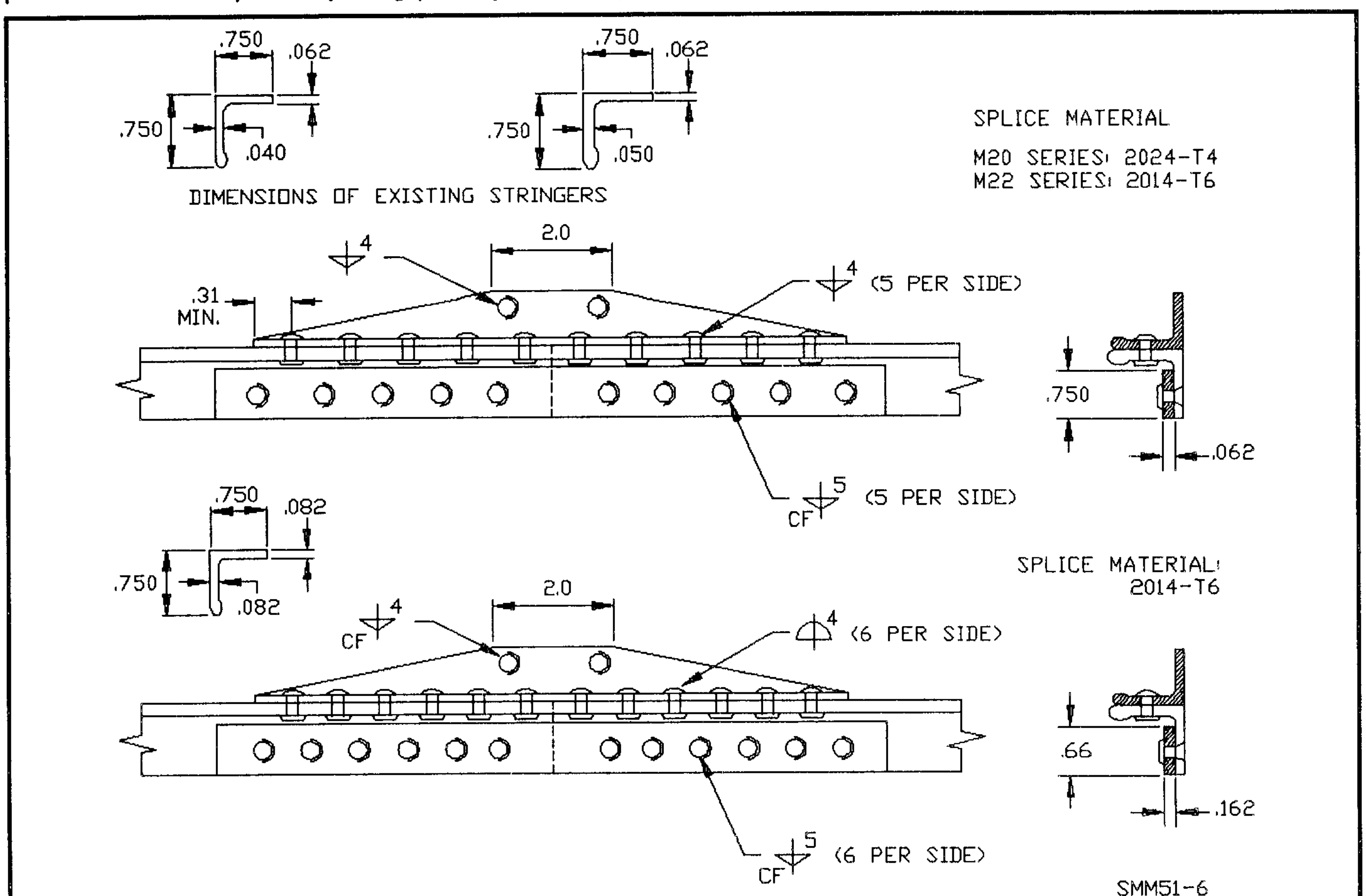
51-13-00 - WING REPAIR

51-13-01 - STRINGER REPAIR

Stringer splicing may require drilling new holes and adding rivets between existing rivets to obtain required total number of rivets. Add extra rivets where distance between existing rivets is greatest. The pitch and edge distance must conform to AC 43.13-1( ) requirements (**Figure 51-6**).

51-13-02 - MAIN SPAR REPAIR

The spar caps inboard of STA 103 are made of 7075-T6 high-strength aluminum. Replacement of spar cap is preferable to repair. However, if a spar cap repair is thought necessary, an exact description of damage, showing location and extent should be sent to PRODUCT SUPPORT DEPARTMENT, Mooney Aircraft Corporation, P.O. Box 72, Kerrville, TX, 78029-0072, to obtain factory recommendations prior to beginning the repair.

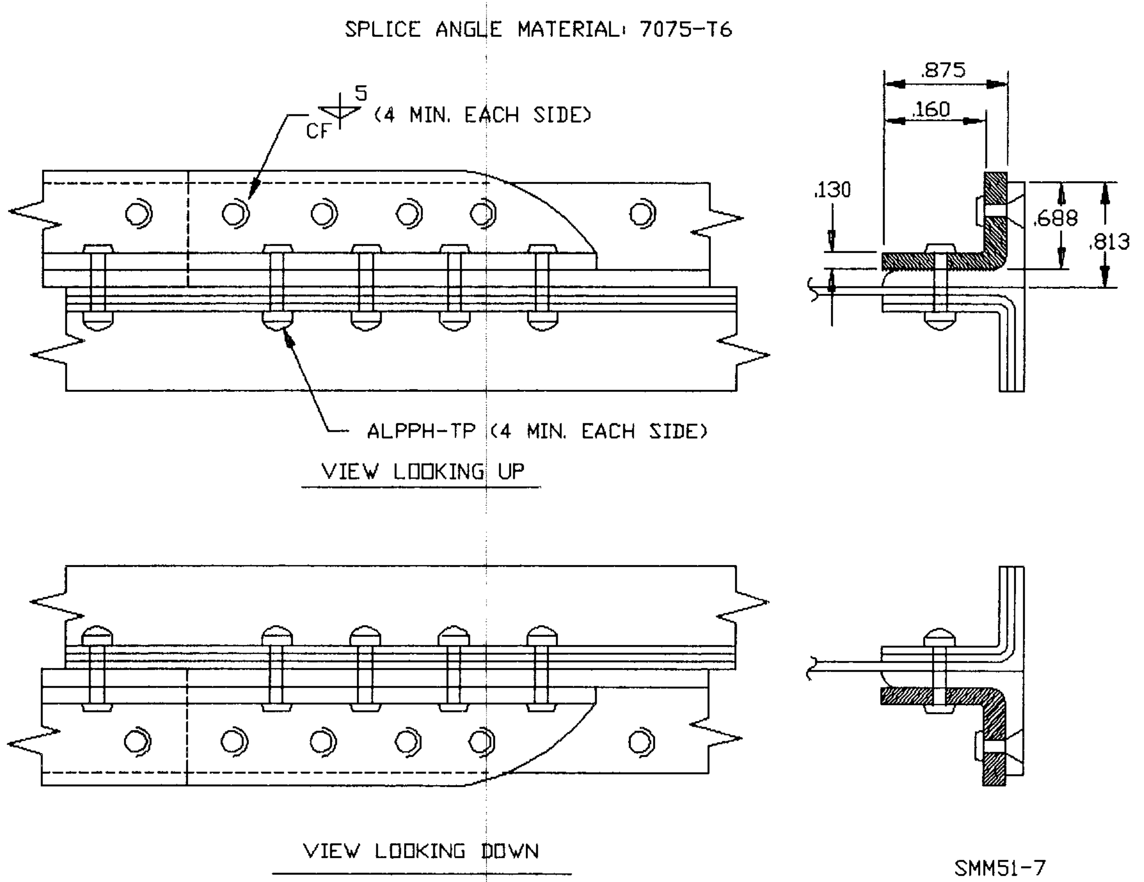


STRINGER REPAIR - FIGURE 51-6

1. SPAR CAP REPLACEMENT. To replace spar cap, remove skin covering area to be repaired. Before removing a large area of wing skin, attach temporary jigs or holding fixtures to wing to prevent wing warpage. When attaching a new spar cap, assure proper interference fit of any replaced huckbolts. During installation of new spar cap, all holes damaged by improper drilling or reaming should be reamed to hole size recommended for oversize huckbolt installation. When installing oversize huckbolts, consult the Huck Fastener Standards Manual for proper tolerances. Use proper length huckbolts. If huckbolt is too long, the huck collar will not swage properly; if the huckbolt is too short, the shank will not completely fill hole.
Repair scratches on spar caps that are not deeper than .003 inch by sanding with No. 400 abrasive paper. Remove no more than .005 inch of material. Inspect sanded area; use dye penetrant to be sure that scratch is completely removed. Clean and prime area where protective coating has been removed.

2. SPAR CAP REPAIR. Spar caps outboard of STA 103 consist of sheet metal angles backed up with aluminum extrusions from STA 103 to near STA 150. Replace or repair damaged extrusions. Do not allow splices in a repaired extrusion to coincide with a spar-web splice when avoidable. Splice sheet-metal angles with an extrusion of equal area, picking up existing fasteners. Add extra fasteners to bring minimum number of fasteners to six AD-5 rivets per side in the vertical flange and nine AD-4 (or six AD-5) rivets per side in the horizontal flange. (**Figure 51-7**).

3. SPAR WEB REPAIR. Repair all damage to spar webs in accordance with AC 43.13-( ). If there is extensive damage to a web that cannot be repaired as outlined in AC 43.13-( ), consult Mooney Aircraft Corporation, PRODUCT SUPPORT DEPARTMENT personnel, giving exact location and extent of damage.



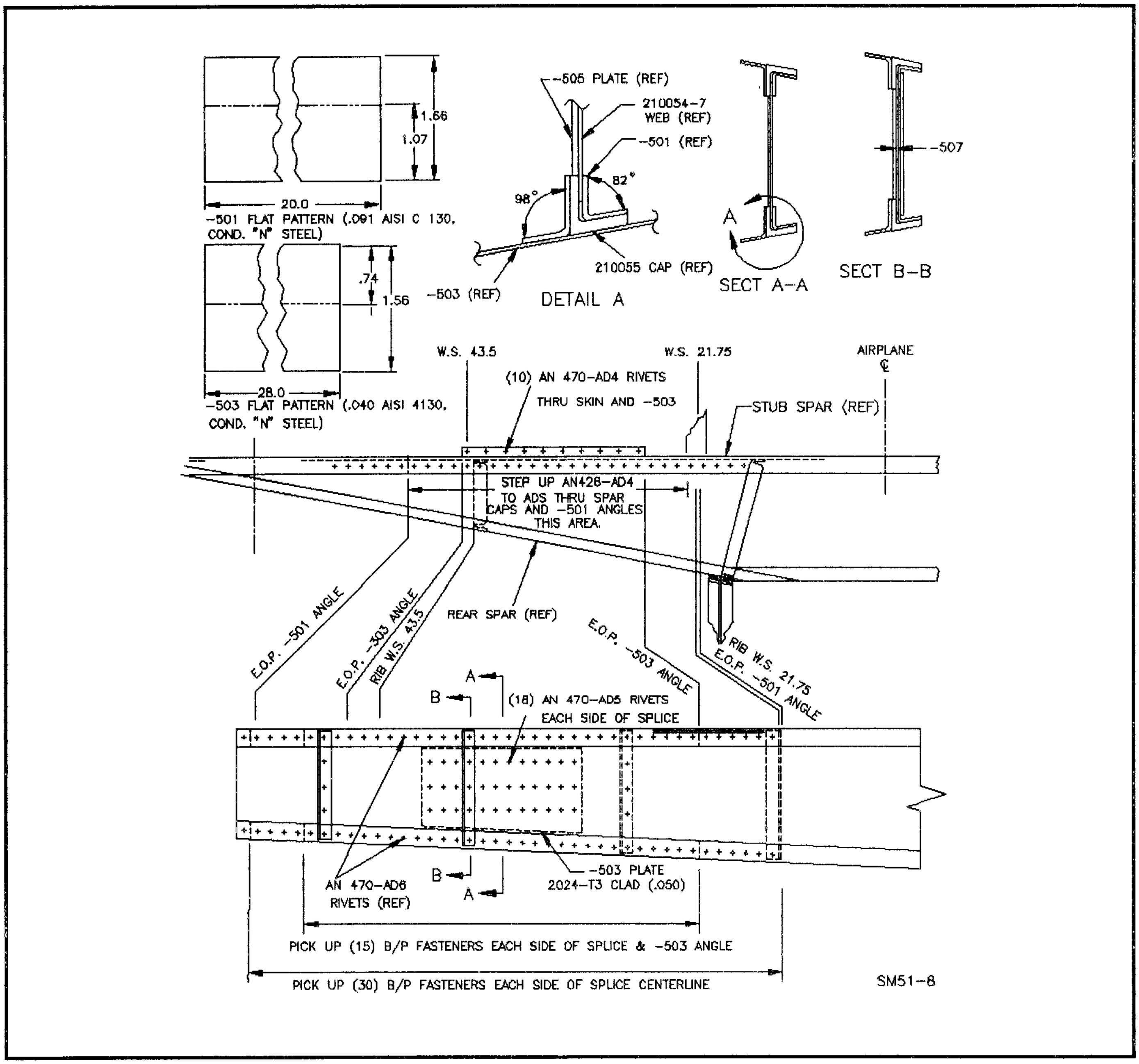
SPAR CAP REPAIR - FIGURE 51-7

RIVET CODE FOR STRUCTURAL REPAIRS

4	MS20470AD4-xx
5	MS20470AD5-xx
4	MS20426AD4-xx
5	MS20426AD5-xx
BP	CR516-xx

51-13-03 - STUB SPAR REPAIR (Stub spar splice at wing STA 34.5 +/-3.0) (Figure 51-8).

1. Cut stub spar halfway between existing rivets as required by damage incurred.
2. Smooth all rough or sharp edges and prime area to be spliced.
3. Locate new outboard section and trim splice to fit with a maximum gap of .020 inch.
4. Fabricate -501 angles to pick up 30 existing fastener holes (30 recommended, but 22 minimum), -503 angles to pick up 15 existing fastener holes (12 minimum), and -505 plate and -507 spacer. (**Figure 51-8**).

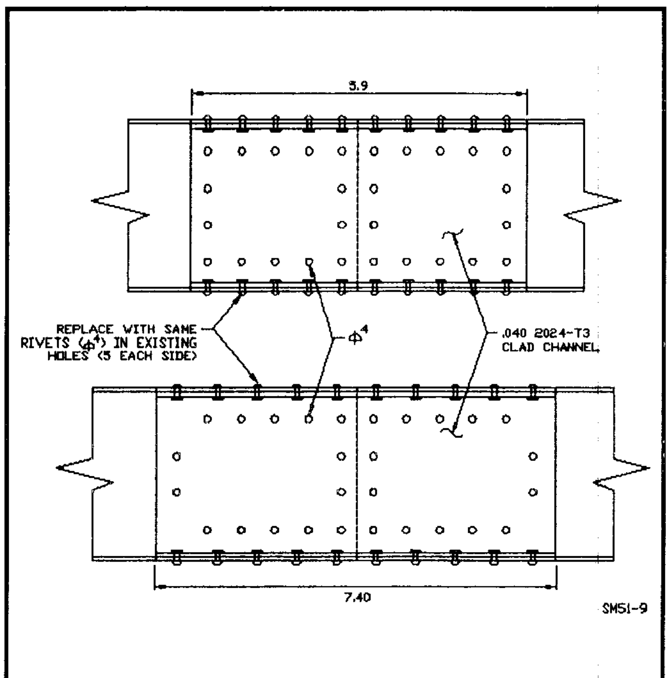


STUB SPAR REPAIR - FIGURE 51-8

Prime angles, plate, and spacer. Rivet parts together using wet primer on all rivets.

51-13-04 - REAR SPAR REPAIR

The rear spar may be spliced between ribs in accordance with AC 43.13-1( ) **(Figure 51-9)**.



REAR SPAR REPAIR - FIGURE 51-9

51-13-05 - RIB REPAIR

Replace ribs that are severely damaged. Minor damage may be repaired as shown **(Figure 51-10)**.

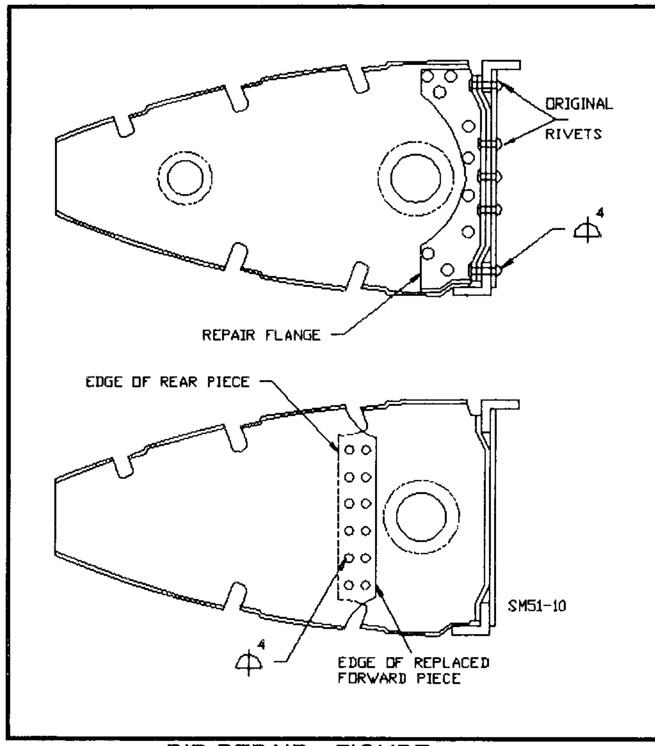
51-13-06 - WING TIP REPAIR

To repair severe damage to wing tip outboard of STA 193.5, it is advisable to replace entire tip skin and rib.

1. Locate new tip rib in exact original tip rib position to prevent wing tip twisting. Use temporary support or locator pins to maintain correct wing tip position.
2. Rivet new tip rib to main and rear spars.
3. Locate new skin, and drill rivet holes through skin to match existing holes in ribs and stringers.
4. Rivet skin to rib at STA 193.5.
5. Roll skin back on lower wing surface to gain access to stringers for rivet bucking. Rivet skin to upper stringers.
6. Rivet skin to tip rib starting at leading edge. Buck rivets as far back as possible.
7. Install cherrylock (CR-2248) blind rivets in places inaccessable for rivet bucking. Add one extra countersunk blind rivet between every other pair of cherrylock rivets.

51-13-07 - WING SKIN PANEL REPAIR

Repair wing skin panels as prescribed in AC 43.13-1( ), unless an entire skin panel is to be replaced. Install



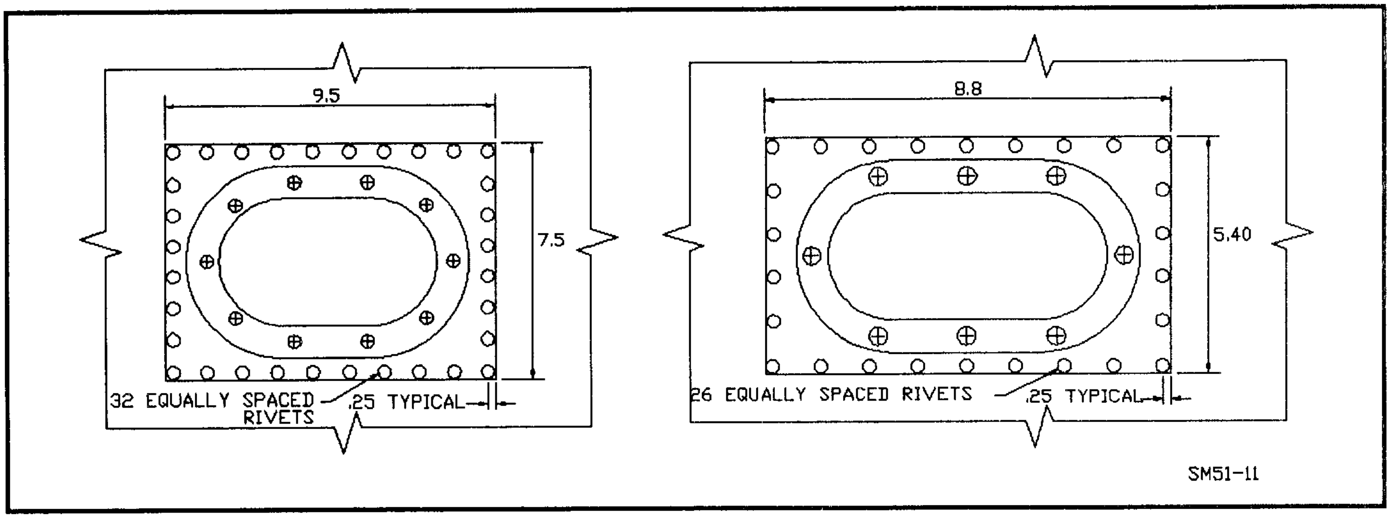
RIB REPAIR - FIGURE 51-10

new skin panels to exactly match original skin installation. Preformed skin panels may be obtained from any Mooney Service Center.

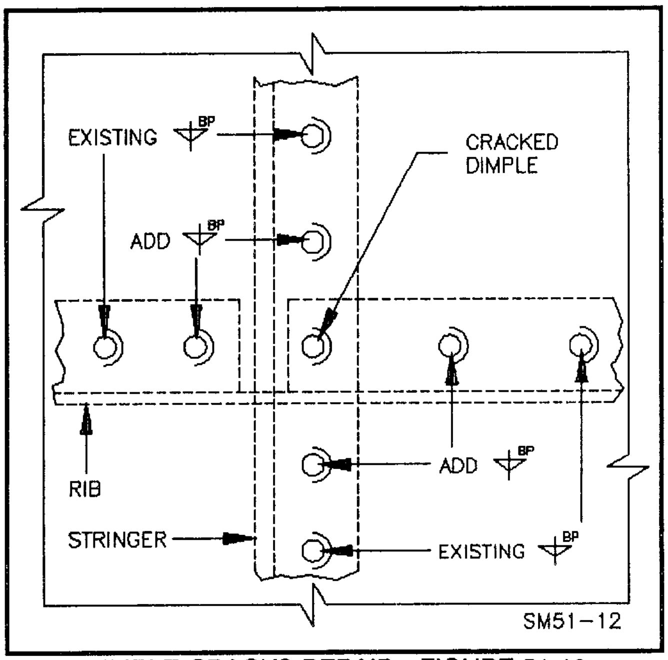
1. Damaged Dimple Repair Around Inspection Holes. **(Figure 51-11)** Repair damaged dimples around inspection holes when: (a) there are three or more cracked adjacent dimples, (b) the crack in one or more of the dimples extends beyond radius of dimple into skin and (c) when there are four or more cracked dimples around an inspection hole.

To repair damaged dimples (a) cut a doubler from same material and gauge as skin to be repaired, (b) drill and countersink 100-degree fastener holes in doubler to match dimpled fastener holes in skin, and (c) install doubler around inspection hole. Use AN426-AD4 rivets when material is .040 inch thick or greater. Drill holes using a No. 30 (.128 IN.) drill as shown in the above illustration. Use AN426-AD3 rivets when material is .032 inch thick or less. Drill holes using a No. 40 (.098 IN.) drill.

2. Repair of Cracks Wholly Within Dimple Radius. **(Figure 51-12)** Surface cracks on inside (bearing) face of dimple that do not extend through material can be repaired by sanding out crack. Cracks in dimples which do not extend beyond dimple radius can be repaired by (a) stop drilling crack with a No. 60 drill and (b) by adding rivets, same size as those in original pattern, to each side of cracked dimple. Maintain four-diameter (4D) spacing and two-diameter (2D) edge distances. When original rivet pattern has rivets on only one or two sides of a dimple, only one or two rivets need be added.



ACCESS COVER REPAIR - FIGURE 51-11



DIMPLE CRACKS REPAIR - FIGURE 51-12

3. Repair of Cracks Extending Beyond Dimple Radius. (**Figure 51-13**) Cracks that extend through face of dimple into surrounding skin can be repaired as follows:

A. Stop drill crack with No. 60 bit.

B. Cut doubler from same material as skin to be repaired. Allow for six rivets at four-diameter rivet spacings with two-diameter edge distances in a circular pattern around cracked dimple.

C. Round corners of doubler, and scarf sandwiched edges to about .010 inch by .250 inch.

D. Drill holes for six rivets (same size as those in original rivet pattern) through doubler and area to be repaired. Dimple 100 degree dimples in doubler.

E. Prime area to be repaired and install doubler with wet primer.

4. Repair of Circumferentially Cracked Dimples. Circumferentially cracked dimples (dimples with cracks that appear as an annular mark around the dimple) can be repaired by installing a conical washer.

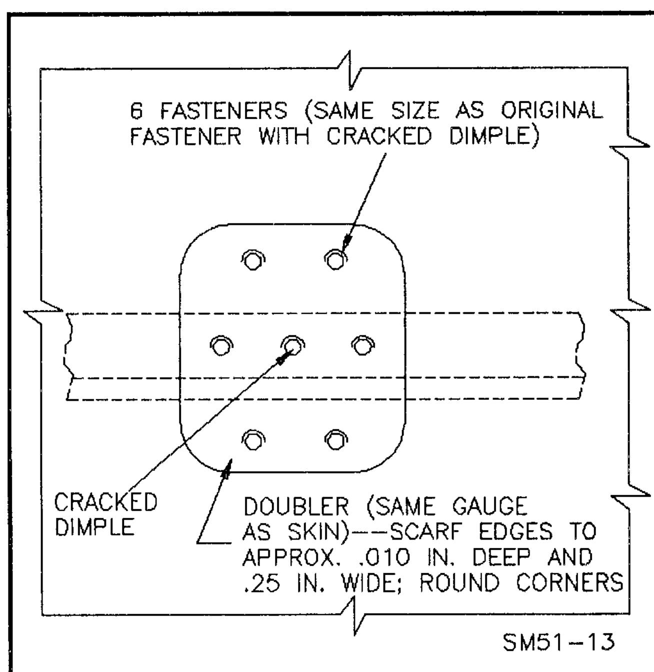
A. Drill through dimple using a drill large enough to remove damaged area.

B. Install doubler as shown in **Figure 51-13.** Wet prime prior to assembly.

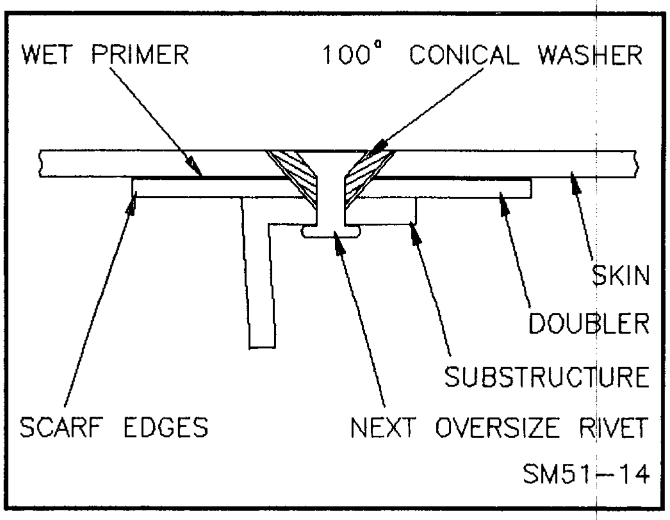
C. Countersink dimple hole in skin allowing countersink to extend into substructure.

D. Install conical washer, use next oversize rivet size. Wet prime washer and adjacent skin and doubler surfaces prior to assembly.

E. Drill remainder of hole to allow installation of next larger diameter rivet than rivets in original pattern.



DIMPLE CRACKS - FIGURE 51-13



OVERSIZE HOLE - FIGURE 51-14

51-14-00 - HORIZONTAL STABILIZER & VERTICAL FIN REPAIR

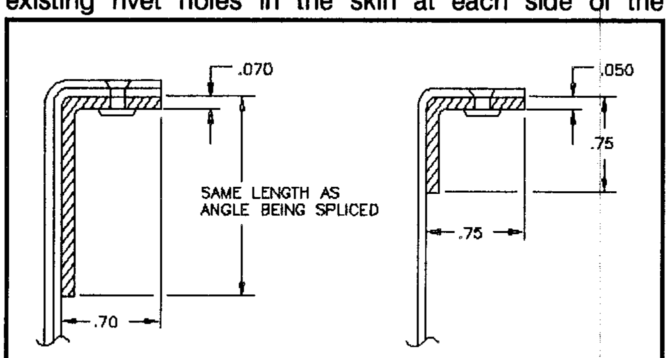
51-14-01 - LEADING EDGE SKIN REPAIR

The horizontal stabilizer and vertical fin leading edge interiors are inaccessable near the tailcone. To repair damage in these areas, cut a standard (3.0 inches by 6.5 inches) access hole in lower side of stabilizer leading edge and close access hole by installing inspection cover P/N 913000-501.

51-14-02 - MAIN SPAR REPAIR OUTBOARD OF STA. 9.00

Repair damage to horizontal stabilizer main spar by straightening damaged area and inspecting it carefully for cracks. If cracks are formed, stop drill or remove cracked area.

1. Repair damage between STA 9.00 and STA 34.0 (**Figure 51-15**) on spar upper flange, and between STA 9.00 and STA 40.0 on spar lower flange with a splice angle formed from .070 AISI 4130 steel, condition N. The splice angle flanges must be as wide as original spar flanges. The splice angle must be long enough to install 11 AD4 rivets through skin and 11 rivets through spar web on each side of damaged area .
Prime splice angle before riveting it to spar. Pick up five existing rivet holes and drill six new holes between existing rivet holes in the skin at each side of the damaged area. Install 22 AD4 rivets through splice angle and skin, and 22 AD4 rivets through splice angle and spar web.



SPAR REPAIR (STA. 9.0 & OUTBD.) - FIGURE 51-15

2. Repair main spar cap damage between STA 34 and STA 48.5 by forming a splice angle from 3/4 inch by 3/4 inch .050 2024-T3 sheet aluminum. (**Figure 51-15**) Pick up five existing holes and drill six new rivet holes between existing holes in the skin on each side of damaged area. Install 11 AD4 rivets through angle and skin and 10 AD4 rivets through angle and web on each side of the damaged area.

3. Repair main spar damage from STA 48.5 outboard by installing splice angles made from .040 2024-T3 material on both side of web using 12 AD4 rivets (6 through skin and 6 through web on each side of damaged area).(**Figure 51-16**)
Pick up three existing holes and drill three new holes between existing holes on each side of damaged area.

4. Repair main spar web damage outboard of STA 34.0, top flange, and STA 48.5, lower flange by forming a splice angle from .050 2024-T3 aluminum. (**Figure 51-17**) The splice angle web flange should be cut to allow sufficient coverage of the damaged area of existing web and long enough to install 6 AD4 rivets on the flange on each side of the damaged area. Pick up 3 existing rivet holes on flange of spar and drill 3 new rivet holes between existing holes. Drill 10 rivet holes through splice angle and web on each side of the damaged web area. The damaged web should be stop drilled or cracked area removed prior to splice angle installation. Prime splice angle and deburr spar web and flange before installing splice.

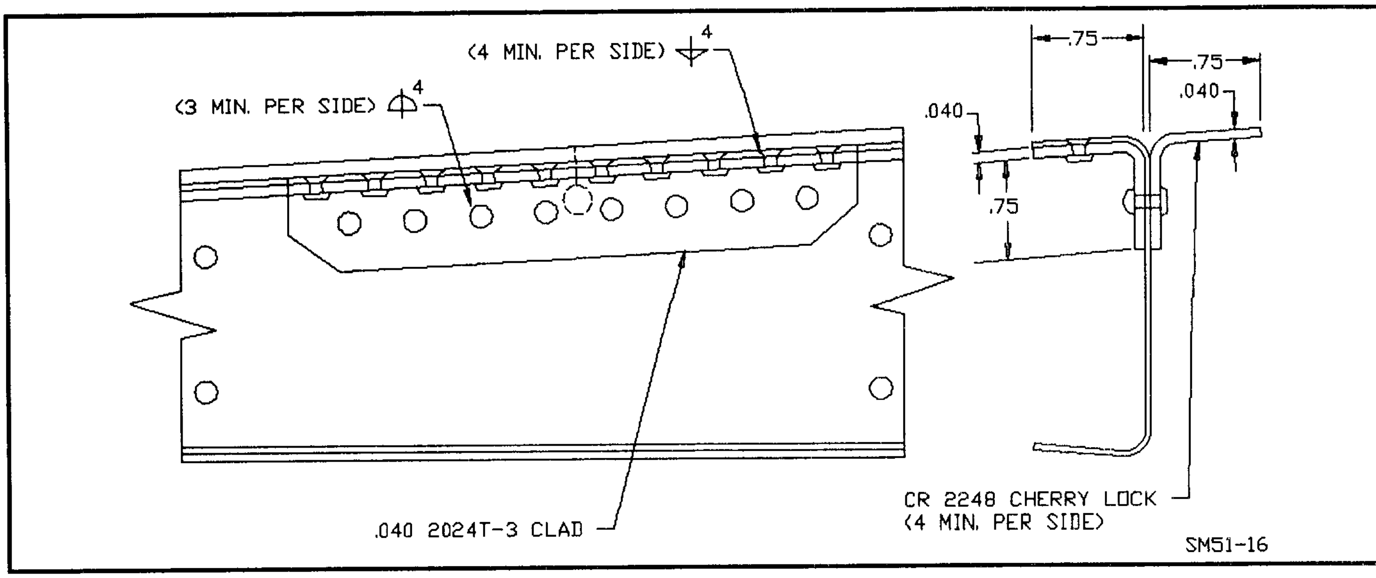
5. Spar webs outboard of STA 48.5 cracked more than 50% of the web height may be repaired (see Figure 51-18). Form a splice plate from .050 2024-T3 aluminum to fit the inside dimensions of the web and flange at the damaged area. Pick up 3 existing rivet holes on top and bottom flange on each side of damaged area and drill 2 new AD4 rivet holes between these existing holes. Pick up all rivet holes on web under splice plate and drill new rivet holes on equal spacing around the damaged area similar to that on Figure 51-18 rivets on each side of damaged area.

51-14-03 - RIB REPAIR

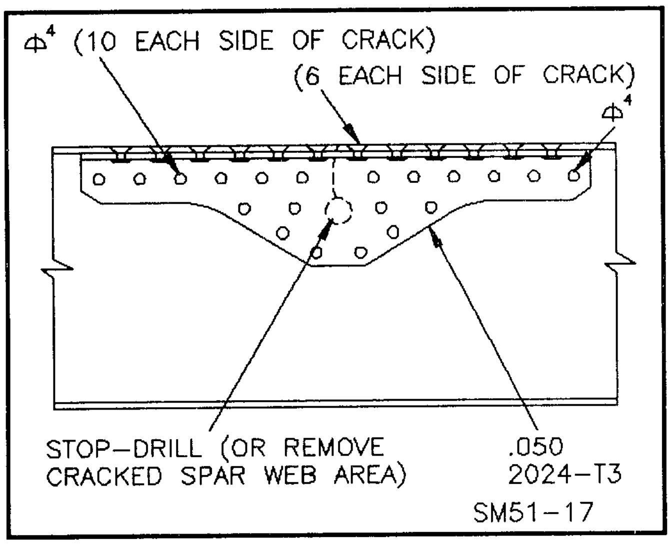
The repair of damaged stabilizer and fin ribs is not feasible in most cases. Damaged ribs should be replaced with new parts.

51-14-04 - REMATING HORIZONTAL STABILIZER TO STINGER

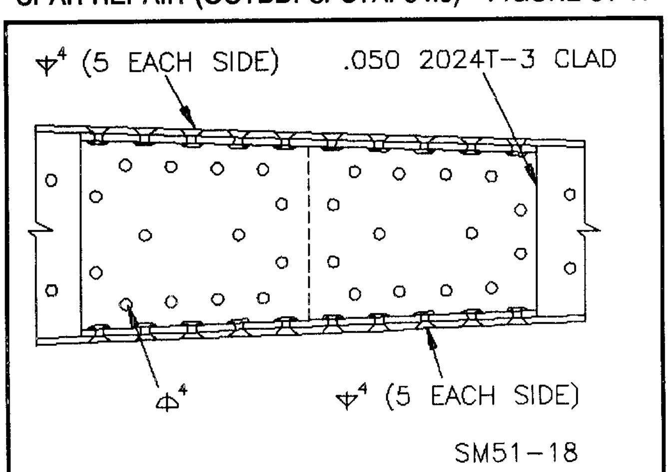
When stabilizer repair necessitates removal from the stinger, remating can be facilitated by using huckbolt substitution information contained in Section 51-10-01. When mating stabilizer to stinger use bent rivet swage set #5 (**Figure 51-19**).



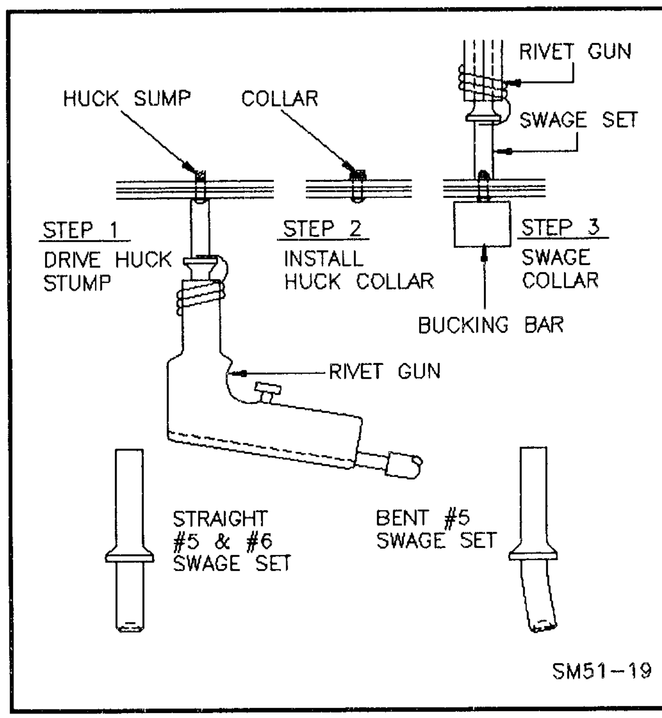
SPAR REPAIR (STA. 48.5 APPROX.) - FIGURE 51-16



SPAR REPAIR (OUTBD. of STA. 34.0) - FIGURE 51-17



SPAR REPAIR - FIGURE 51-18



REMATING HORIZONTAL STABILIZER TO STRINGER - FIGURE 51-19

51-15-00 - FIBERGLASS LAMINATES, REPAIR PROCEDURES

Despite the fact that fiberglass laminates are designed to withstand considerable abuse, occasional repairs will be necessary. It is difficult to cover all the various repair techniques due to such limiting factors as accessibility and the extent of damage. The following outlines those steps which are used to make repairs of the more common type damage to a fiberglass laminate.

1. Materials used for repairs shall be as specified and compatible with the basic resin used in the fiberglass laminate.

Resin - Aerospace Adhesive EA934 Part A
Catalyst - Aerospace Adhesive EA934 Part B
Hysol Division
The Dexter Corporation

Alternates:

Resin - Epoxical #606 Patching Adhesive Resin
Catalyst - Epoxical #606 Patching Adhesive Hardner
United States Gypsum

OR

Resin - Ren Epoxy CG 1304
Catalyst - Ren Hardener CG 1304
Ren Plastics Co.
Lansing, Michigan

Fire retardation - Antimony Trioxide for fire retardation, 5% minimum; 10% maximum by Weight of Resin Content. Must be added to the base resin (cowling and air intake duct assemblies).

The manufacturer's bulletins shall be followed for all mixing ratios and preparation prior to application.

2. General.

A. The configuration of repairs are shown for flat surface areas; for simplicity; however, the same techniques can be used for contoured surfaces. Contoured repairs will require additional considerations and the proper shaping of the backup plates used for clamping the laminates together during the curing cycle.

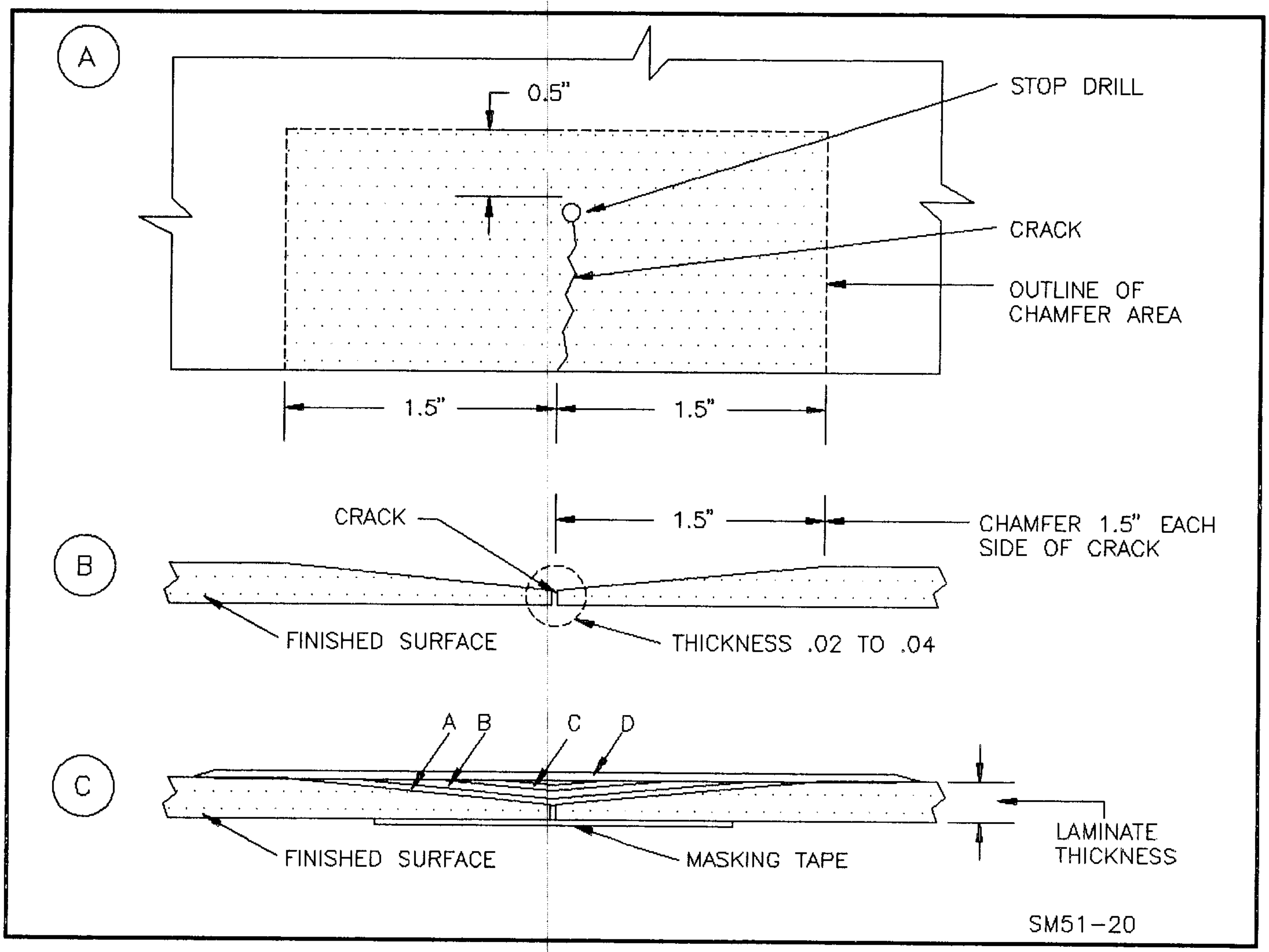
B. The degree of laminate chamfer and size will vary based on accessibility, shape of part and the extent of damage.

51-15-01 - CRACKS, IN SURFACE AREAS

1. Stop drill all cracks per standard aircraft procedure.

2. Remove any loose particles and frayed fiberglass strands from the cracked portion.

3. Prepare surface for repair as shown in (**Figure 51-20, Figure 51-21, and Figure 51-22**).



NON-STRUCTURAL REPAIR - FIGURE 51-20

4. Prior to continuing the repair, all surfaces in the area of the repair must be cleaned of all contaminates by wiping the area with a clean cloth saturated with Methyl-Ethyl-Ketone.

CAUTION
Methyl Ethyl Ketone (M.E.K.) is a flammable liquid and should be used with proper ventilation and the prescribed safety equipment.

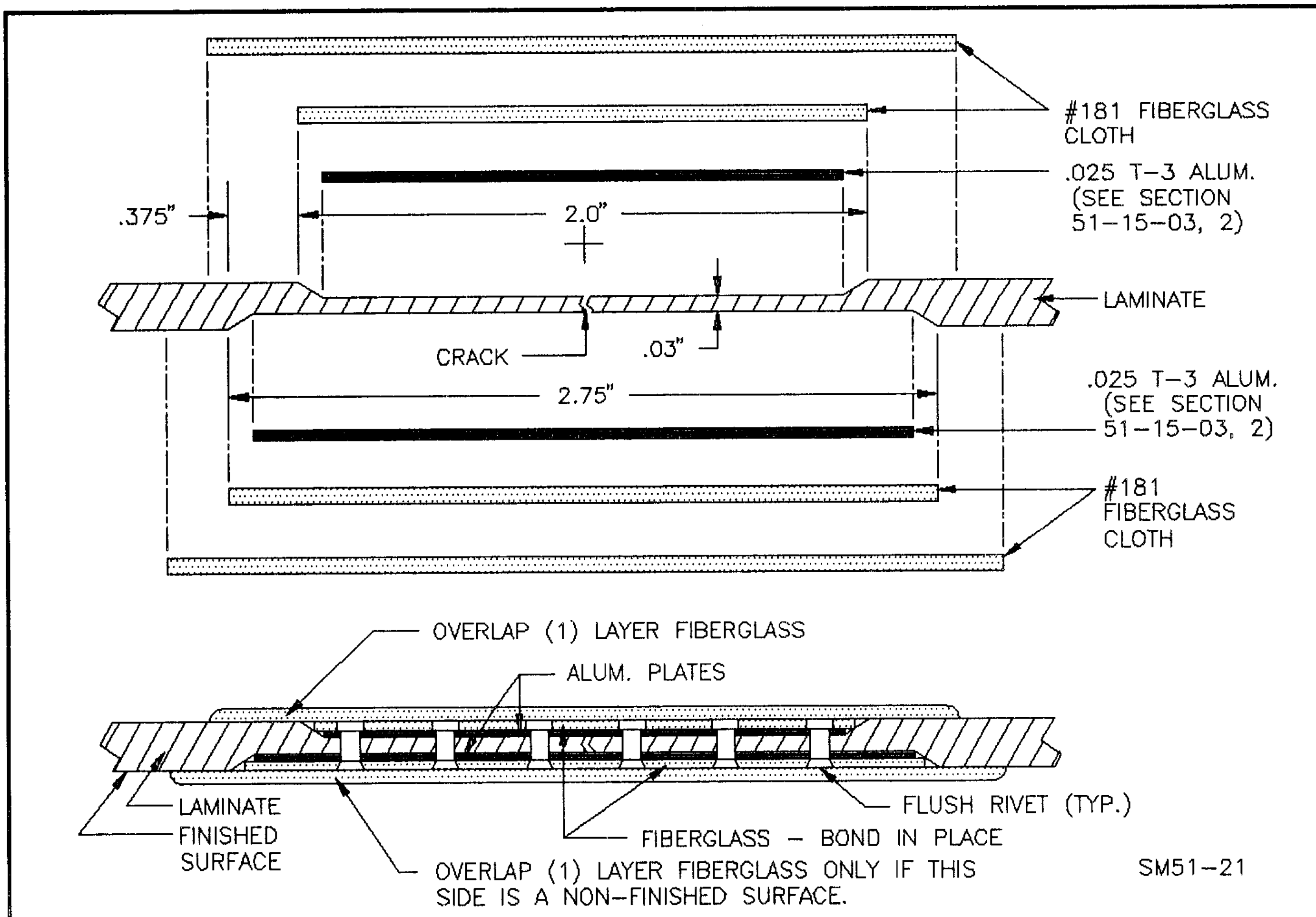
CAUTION
Fiberglass components are attacked and deteriorated by the following products: Ketone, aliphatic esters, chlorinated hydrocarbons, and slightly softened by aromatic hydrocarbons.

51-15-02 - NON-STRUCTURAL REPAIR (FIGURE 51-20)

1. Apply masking tape over crack on finished surface side.
2. Apply wet coat of catalyzed epoxy resin to chamfered surface.
3. Apply one layer of #181 fiberglass cloth saturated with catalyzed epoxy resin (A).
4. Add additional plys of #181 fiberglass cloth, saturated with epoxy resin (B) through (C) or as required to attain original laminate thickness.
5. Apply one additional ply of #181 cloth (D) bridging the total repaired area and bond in place.

51-15-03 - COMMON STRUCTURAL LAMINATE REPAIR (METAL INSERT) (FIGURE 51-21)

1. Cut away laminate per sketch, roughen repair area with 240 sandpaper, clean repair area with M.E.K. - apply a wet coat of catalyzed epoxy resin to surfaces. Then IMMEDIATELY proceed with steps 2 thru 5.
2. Install chemically cleaned .025 T-3 aluminum straps, perforated with #40 holes approximately .35 on center all directions.
3. Apply wet coat of epoxy resin to aluminum straps and apply one or more layers of resin saturated #181 fiberglass cloth to equal the thickness of the original laminate.
4. Lay wax paper over both sides of the repaired area while still wet. This prevents adhesion to the pressure clamp application (paragraph 5).

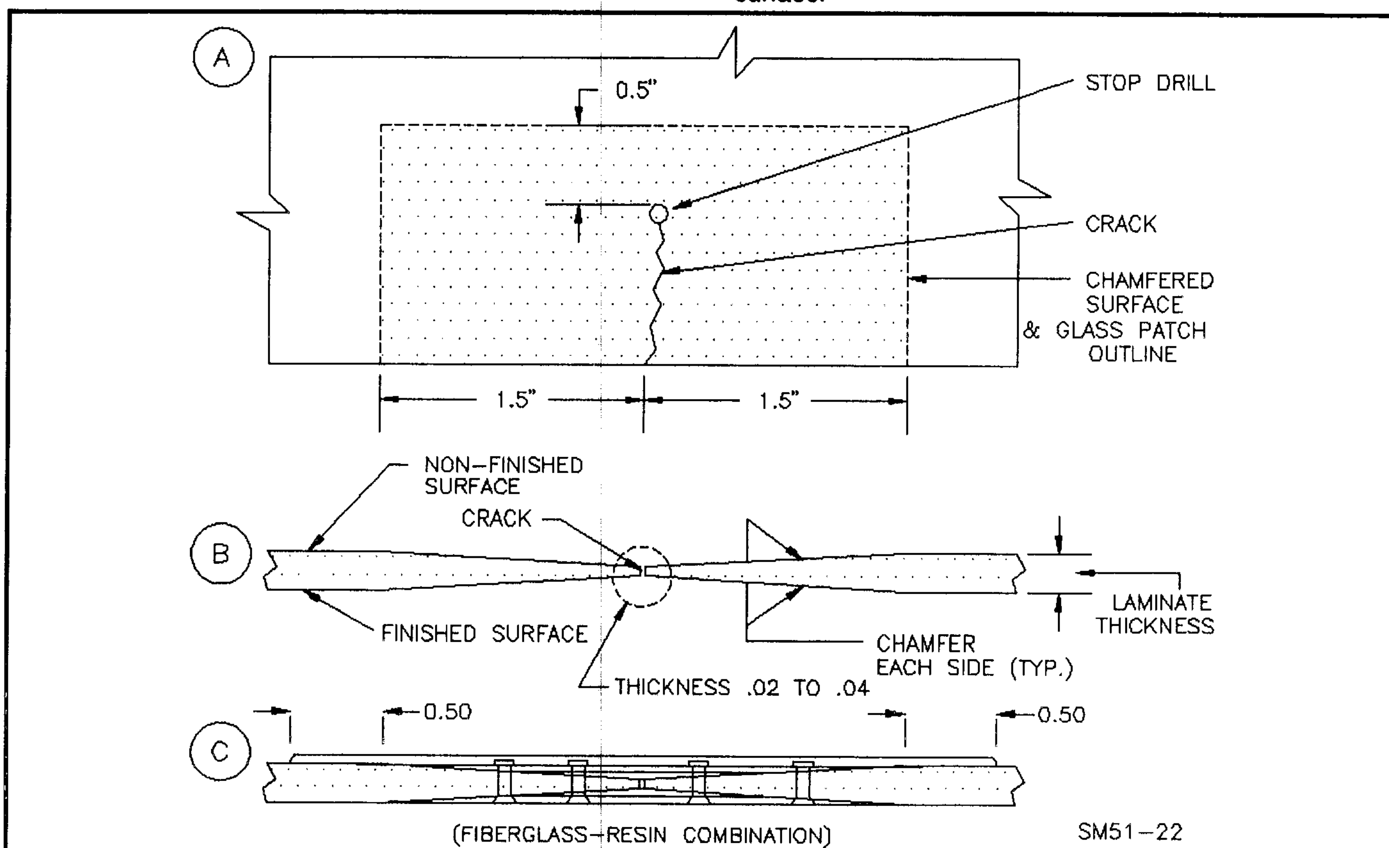


COMMON STRUCT. LAMINATE REPAIR-METAL INSERT - FIGURE 51-21

5. Place rigid aluminum plates on both sides of repair area and clamp into place with "C" clamps. Permit laminated repair to cure.
6. After fiberglass repair has cured, remove clamps and install #3 AN426A rivets. Flush heads to be on finished surface side. Number of rivets and spacing will be determined by size of repair.
7. Apply one additional overlapping layer of #181 fiberglass cloth on non-finished surface and bond in place. Should opposite side be a non-finished surface, an additional layer of fiberglass should be applied to this side.
8. Upon completion of steps 1 thru 7, permit repair to cure before attempting further treatment of appearance surfaces, if required.
9. Appearance surfaces will normally require application of a filler-sealer coating. Appearance area is to be wiped clean, using a clean cloth saturated with M.E.K. prior to applying filler-sealer coating.
10. Mix epoxy resin and catalyst per manufacturers specifications and apply to appearance surface area. Care should be taken to assure as smooth as possible surface in this particular operation.
Permit this surfacing coat to cure prior to any additional applications or further rework.
11. Using #240 sandpaper, sand and blend repaired area to match surrounding surface. Steps 10 and 11 may be repeated to acquire a satisfactory surface finish.

51-15-04 - COMMON STRUCTURAL LAMINATE REPAIR (FIGURE 51-22) (FIBERGLASS-RESIN COMBINATION)

1. Apply wet coat of catalyzed epoxy resin to chamfered surface.
2. Apply one layer of #181 fiberglass cloth saturated with catalyzed epoxy resin.
3. Add additional plys of #181 fiberglass cloth saturated with epoxy resin to attain original laminate thickness.
4. Apply one layer of #181 fiberglass cloth to the non-finished side of laminate, extending 1/2" each side of the chamfer and bond in place.
5. Lay wax paper over both sides of the repaired area while still wet. This prevents adhesion to the pressure clamp application (paragraph 6).
6. Place rigid aluminum plates on both sides of repair area and clamp into place with "C" clamps. Permit laminate repair to cure.
7. After fiberglass repair has cured, remove clamps and install #3 AN426 rivets. Flush head to be on finished surface side. The number of rivets and spacing will be determined by the size of the repair.
8. Upon completion of steps 1 thru 7, allow repair to cure before attempting further treatment of appearance surface.



COMMON STRUCTURAL LAMINATE REPAIR-FIGERGLASS/RESIN-FIG.51-22

9. Appearance surfaces will normally require application of a filler-sealer coating. The appearance area is to be wiped clean, using a clean cloth saturated with M.E.K. prior to applying a filler-sealer coating.

10. Mix epoxy resin and catalyst per manufacturer's specifications and apply to appearance surface area. Care should be taken to assure as smooth as possible surface in this particular operation.
Permit this surfacing coat to cure prior to any additional application or further rework.

11. Using #240 sandpaper, sand and blend repaired area to match surrounding surface. Steps 10 and 11 may be repeated to acquire a satisfactory surface finish.

51-15-05 - FIBERGLASS DELAMINATION REPAIR

1. Delamination or ply separation of a fiberglass product is usually a result of poor bonding of fiberglass layers. Generally, this condition is localized and can be readily repaired by carefully spreading apart plys of delamination, and removing loose particles by blowing clean compressed air into damaged area.

2. Proceed by inserting catalyzed epoxy resin into delamination and then immediately clamp delamination together. Permit repair to cure a minimum of 8 hours before removing clamps.

3. Extensive delamination of a part will be reason for total rejection of part and shall be scrapped per standard practices.

51-16-00 - MISCELLANEOUS

1. Protective Coatings.

A. Parts with protective coatings (such as Conversion Coated or epoxy primer) on which coating is scratched, spotfaced, drilled, or in any way removed must be recoated with epoxy primer.

EXAMPLE: Part is Conversion Coated as detail part. During replacement the part is spotfaced to receive bolt and washer. This part must be primed after spotfacing.

2. Low Pressure, Plastic, or Rubber Line Splices. Static system lines may be lengthened, shortened, or spliced to allow the replacement of sections of damaged lines. The fittings are called out in the Parts Catalog text pages following the illustration depicting the assembly or component in question.
If splices are made, the system must be checked for leaks.

3. Shortening and Lengthening of Tubing, Hoses, and Flexible Ducting. Mooney manufactured assemblies of plumbing, tubing, hoses, and flexible ducting may be modified to allow the use of longer parts of the same size and material to be cut and used as replacements. When the manufactured ends of flexible ducting are removed, the raw edge must be taped with 3M aluminum foil tape.

BLANK

CHAPTER

52

DOORS

CHAPTER 52

DOOR S

LIST OF EFFECTIVE PAGE

TABLE OF CONTENTS

52-00-00 - GENERAL

The cabin door is constructed of an inner and outer aluminum shell fastened together by rivets. It is provided with single operation dual latching mechanisms, 1) a lock pin extends into a mating receptacle in lower door frame, and 2) a jaw type latch clamps a special designed nut in upper door frame to hold door securely in place. The door is hinged at the forward edge by an extruded, aluminum hinge. A guide pin is in door assembly to assist in holding door tightly shut at forward, upper door area. The inner and outer handle are interconnected by adjustable push-pull tubes. This mechanism is spring loaded to an over center position in the latched position for positive security. Adjustment for each push-pull tube is provided to accurately rig latching pin and jaw type latch. Adjustment to the special nut at the top of door frame can be made for proper closure.

The baggage compartment door is constructed of an inner and outer aluminum shell fastened together by rivets. It has dual pin latches that extend into receptacle fittings on both sides of the door frame when exterior handle is closed properly.

The auxiliary exit handle is located inside baggage door. This handle can be operated from inside even if outer handle is locked. A cam mechanism allows a clevis pin to bypass outer handle latch groove and open the two latching pins which hold baggage door closed. (Refer to POH/AFM Section III for specific procedures to operate auxiliary exit handle.) This door is hinged at the top with an extruded piano type hinge.

Hold open arms are attached on doors to assist in holding doors open.

A door lock is provided for both doors. A single key will operate either door lock. Interior panels require removal if door locks are to be removed and replaced.

52-10-00 - CABIN DOOR - MAINTENANCE PRACTICES

1. Removal. The cabin door may be removed to replace or repair door or to replace a damaged hinge.

A. Remove interior panel around forward door frame.

B. Remove hold open arm at door frame. Remove cotter pin and washers from hold open arm shaft. Pull shaft up from doubler plate and clear of door frame.

C. Remove eight (8) screws from outside airplane that hold front portion of hinge in place. There are also three (3) flush rivets that will require removal at this location.

D. Carefully drill center of rivet head with a 1/8th inch drill bit until head pops off and rivet stem can be punched out.

The original door assembly, with hinge attached, is assembled to door frame prior to installation of outer skin. The door is placed into position and hinge held in place on its mounting plate by sealant and locator rivets. (The number of locator rivets may vary). These rivets will be underneath outer skin. After removal of outer rivets and screws, work a putty knife or a thin piece of aluminum between outer skin and hinge and between hinge and mounting plate from inside in order to break sealant bond. During this procedure determination can be made where locator rivets are positioned. Locate these rivets from inside and drill bucked head(s) carefully. DO NOT DRILL THROUGH OUTER SKIN. Attempt to move door and hinge aft and away from attach point after each rivet stem is drilled out. The door and hinge should come free when all sealant bond and rivets are removed.

NOTE
Some aircraft may have "AN" bolts instead of rivets.

2. Door Repair.

A. The door should be repaired, if applicable, according to standard procedures in AC 43.13-1( ).

B. Remove interior door panel, if necessary, to repair door assembly.

3. Installation.

OLD DOOR -- Old door can be relocated by using existing holes. Mounting plate should be thoroughly cleaned of all sealant and foreign material before reinstallation of door.

NEW DOOR -- A new door or hinge will require proper positioning of door to obtain proper sealing.

A. Place door, with new hinge, positioned between outer skin and mounting plate.

B. When door is properly positioned in door frame, mark new hinge for mounting, using existing holes, either from outer skin locations or from hinge mounting plate inside cabin.

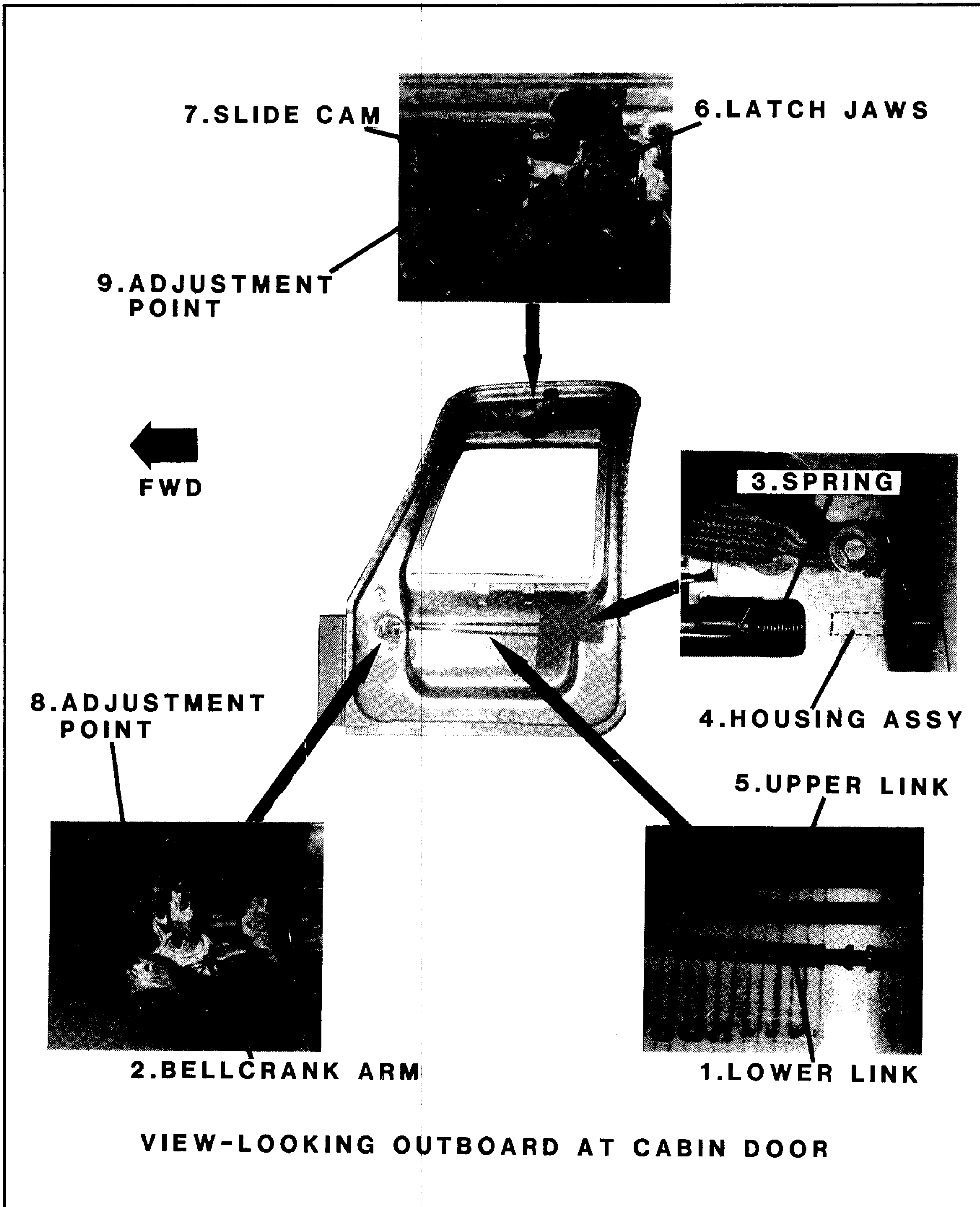
C. Drill new holes in hinge carefully while door is securely in place.

D. Remove door, deburr holes and clean shavings from area.

NOTE
The rivets and rivet holes originally used as locators do not have to be utilized when installing a new door or hinge if proper alignment can be obtained using another method.

E. Apply sealant, PR1428-B, or equivalent, between outer skin and hinge support plate on tubular structure.

F. Reinstall door hinge to mounting plate using eight (8) flat head screws removed earlier and three (3) flat head, AD4 standard (AD5 oversize) rivets.



CABIN DOOR-RIGGING/ADJUSTMENT - FIGURE 52-1

G. Adjust door latching mechanism so door closes and seals during flight. (See door rigging procedures paragraph 52-11-00).

H. Reinstall hold open arm with new cotter pin.

I. Reinstall interior panel to door frame and cabin.

J. Paint door/hinge to match airplane.

52-11-00 - CABIN DOOR RIGGING/ADJUSTMENT PROCEDURES

The cabin door latching mechanism has several adjustment points that may be utilized to obtain proper rigging. (See Figure 52-1). Removal of interior door panel will be required to gain access to adjustment points.

1. Adjust cabin door linkage to satisfy requirements listed below.

A. Latching pin must contact striker plate hole on door frame, the full circumference of pin, when mechanism is in full latched position.

B. Latching pin must clear striker plate when opening or closing door with latching mechanism in full open position.

C. As lower link (1) and bellcrank arm (2), (Fig. 52-1) travel over center, the spring (3), is to be compressed to 1.000 +/-.030.

NOTE
Washers may be added between spring and link or 310294-501 housing assembly (4) to comply with items B and C, (Figure 52-1).

D. The lower link (1) and bellcrank arm (2), in full locked position, should be overcenter a minimum of .3 inches, (Figure 52-1).

NOTE
It is not necessary that lower link (1) contact upper link (5), (Figure 52-1).

E. The outside handle is to be flush with outside skin when mechanism is in full latched position.

F. In full latched position, upper latch jaws (6) must be closed and latch slide cam (7) at the end of its full travel. See adjustment points (8) and (9), (Figure 52-1).

G. In full open position, upper latch jaws must be open and slide cam at end of its full travel.

NOTE
Slide cam (7) moves 1.13 in. from full latched to full open position.

52-12-00 - CABIN DOOR SEAL

The cabin door seal is an extruded rubber seal filled with a soft foam. Unless deformed or torn, seal will provide adequate sealing around periphery of cabin door during flight conditions.

1. Cabin door seal replacement.

A. The seal is held to inner door frame with adhesive.

B. Remove door inner trim panel to gain access to door seal.

C. Pull seal from door frame.

D. Clean area with lacquer thinner to help soften remaining adhesive. Remove excess adhesive.

CAUTION
Care should be exercised to keep lacquer thinner from dripping on wing or any other portion of airplane.

E. Coat cleaned door frame with adhesive (St. Clair #4587).

F. Coat bond area of new seal with adhesive (St. Clair #4587).

G. Let both applications dry until tacky.

H. Carefully place end of seal into position at bottom of door and continue around door until seal is firmly attached. Do not pull tight around corners. Cut off any excess seal.

I. When seal is properly attached, door should close with little effort.

NOTE
Door contour can be altered slightly to conform with cabin contour, if needed, for proper fit and sealing.

52-30-00 - BAGGAGE COMPARTMENT DOOR - MAINTENANCE PRACTICES

1. Removal. The baggage compartment door may be removed to replace or repair door or to replace a damaged hinge.

A. Remove coat hanger and headliner panel located inside and directly under baggage door hinge area.

B. Pull insulation back to clear rivet shanks.

C. Center punch rivet heads holding hinge half to fuselage.

D. Carefully drill rivet heads and punch rivets from holes.

E. Work putty knife or thin piece of aluminum between outer skin and hinge and inner skin frame and hinge to break sealant bond.

F. Remove hinge and baggage door assembly carefully.

G. Clean hinge and hinge mounting area thoroughly of all sealant or foreign material.

2. Repair. The baggage door may be repaired per standard repair procedures in accordance with AC 43.13-1A. Repairs may be made to baggage door on airplane if feasible.

NOTE
If repairs are to be made interior trim panel may require removal.

3. Installation.

OLD HINGE

A. Place repaired baggage door with old hinge into position and cleco securely to assure fit of door; check latching operations.

B. Remove door-assure attachment area is clean of old sealant.

C. Apply sealant, PR1428-B or equivalent, to hinge attachment area between outer skin and inner frame.

D. Reinstall door assembly with old hinge and cleco hinge for proper placement.

E. Install rivets (AD4 standard, AD5 oversize) in all holes.

NEW HINGE

A. Place old door assembly with new hinge or new door assembly and new hinge into position and latch door in place.

NOTE
Hinge mounting area should be clean of old sealant and debris.

B. Push in on door assembly at top, while door is in latched position to properly locate door and seal in door frame.

C. While door is held in place mark holes in new hinge using holes in outer skin as locators.

NOTE
Verify correct position of door prior to drilling holes in hinge.

D. Center punch all holes and carefully drill two end holes. Fasten clecoes in these and recheck door assembly fit, if satisfactory continue drilling all holes.

E. Remove door assembly. Deburr and clean area completely prior to reinstallation of door assembly.

F. Apply sealant (PR1428-B or equivalent) to hinge mounting flange and between outer skin and door frame.

G. Reinstall door assembly and cleco securely in place.

H. Install rivets, (AD4 standard, AD5 oversize) in all holes. Remove clecoes as rivets are being installed to keep door aligned.

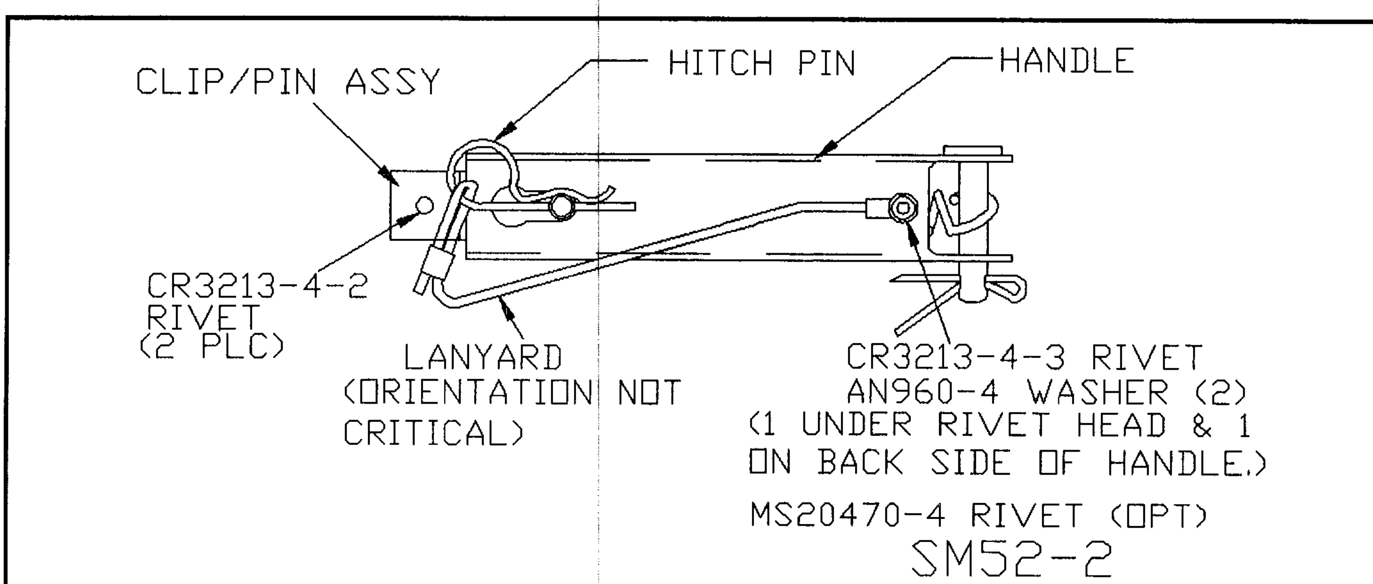
52-31-00 - BAGGAGE COMPARTMENT DOOR - LATCHING MECHANISM

The baggage compartment door has a direct, non-adjustable latching linkage that inserts two pins into hard points in door frame. This latching mechanism can be locked from outside aircraft. An auxiliary exit mechanism is incorporated into this latching mechanism which allows door to be opened, in an emergency, from inside, even if outside handle is locked.

Outside handle has to be unlatched and fully opened to correctly re-engage latching mechanism after use of inside, auxiliary, exit handle. (**Figure 52-2**).

There is a spring attached to clevis pin of latch linkage. This ensures positive re-engagement of clevis pin into cam slot of outside handle for proper actuation of outside latching mechanism.

NOTE
Follow procedures in Pilots Operating Handbook/Airplane Flight Manual (POH/AFM, SECTION III) for re-engagement of mechanism for proper outside handle operation.



BAGGAGE DOOR LATCH MECHANISM - FIGURE 52-2

CHAPTER

53

FUSELAGE

CHAPTER 53

FUSELAGE

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53-00-00 GENERAL

The Mooney M20R forward fuselage is constructed from 4130 chrome molybdenum, tubular steel covered with aluminum skins. The tubular steel sub-assemblies are heliarc welded in fixtures, inspected and then assembled into main cabin fixture and heliarc welded to produce cabin frame enclosure. The assembled, inspected, steel structure is sand blasted and epoxy primed for corrosion protection.

The tailcone bulkheads, formers, skins, etc., are formed from sheet aluminum on either a hydro press or drop hammer. These components, along with stringers, clips, brackets, etc., are positioned together on a fixture and assembled into the aft fuselage assembly. All air ducts, control brackets, tubes and bellcranks, electrical harnesses and antennas are installed into tailcone during this assembly process.

The forward cabin enclosure and tailcone assembly are mated together and this fuselage assembly advances down assembly line to be mated with wing assembly.

53-10-00 - MAIN FRAME

53-10-01 TUBULAR STRUCTURE FRAME

The basic cabin tubular steel (1) enclosure is shown (**Figure 53-1**).

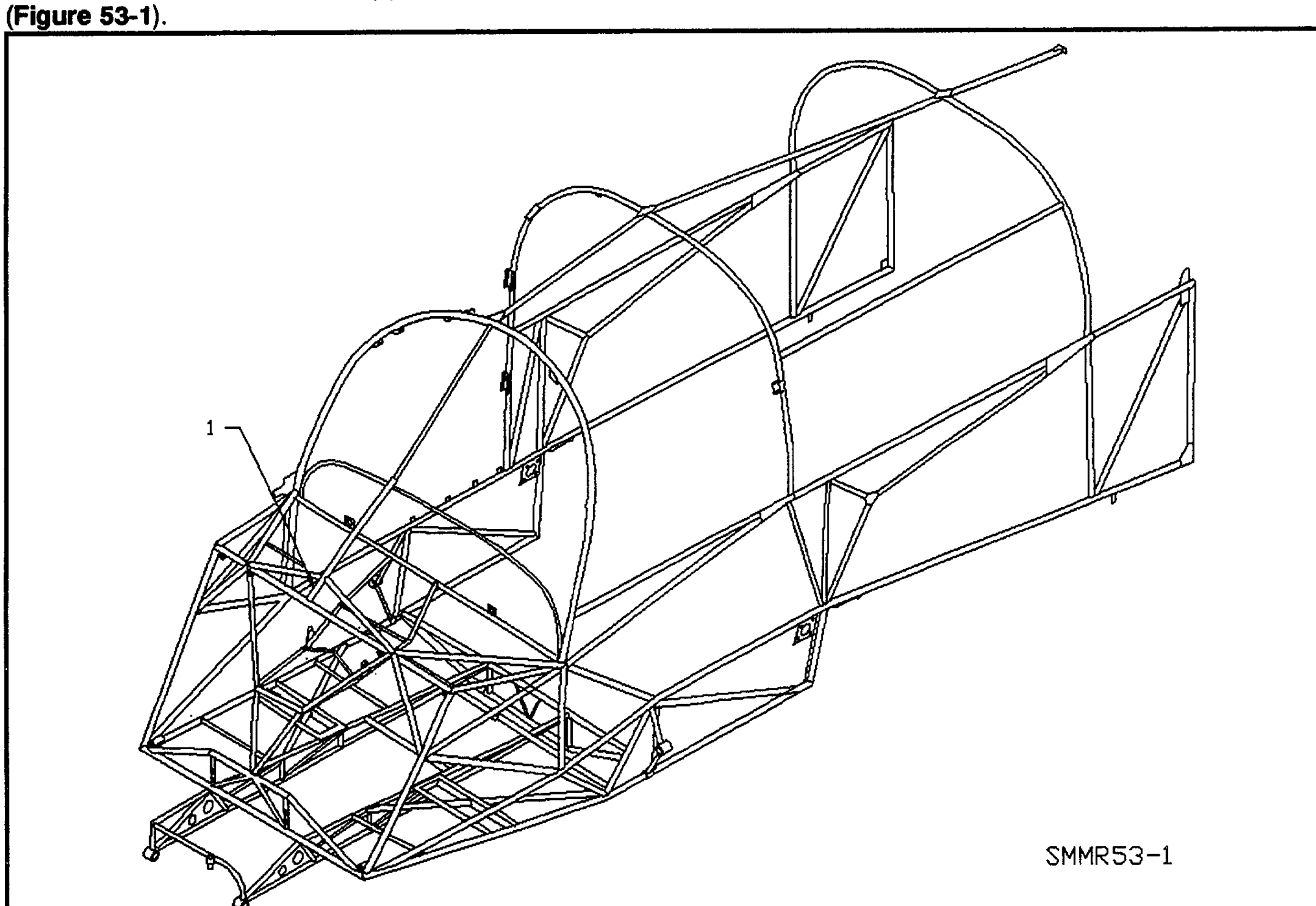
53-10-02 TAILCONE STRUCTURE

The tailcone is of semi-monocoque construction. The internal structure is shown on (Figure 53-2). The forward cabin structure (1) is bolted to tailcone with five structural bolts (8). The tailcone skin (2) is an integral load bearing portion of tailcone assembly. The avionics equipment shelf (3) spans tailcone width to provide rigidity and space for avionics components. The batteries are located in this area also at (5) on both sides to tail cone. The hat rack shelf (4) provides rigidity as well as storage space.

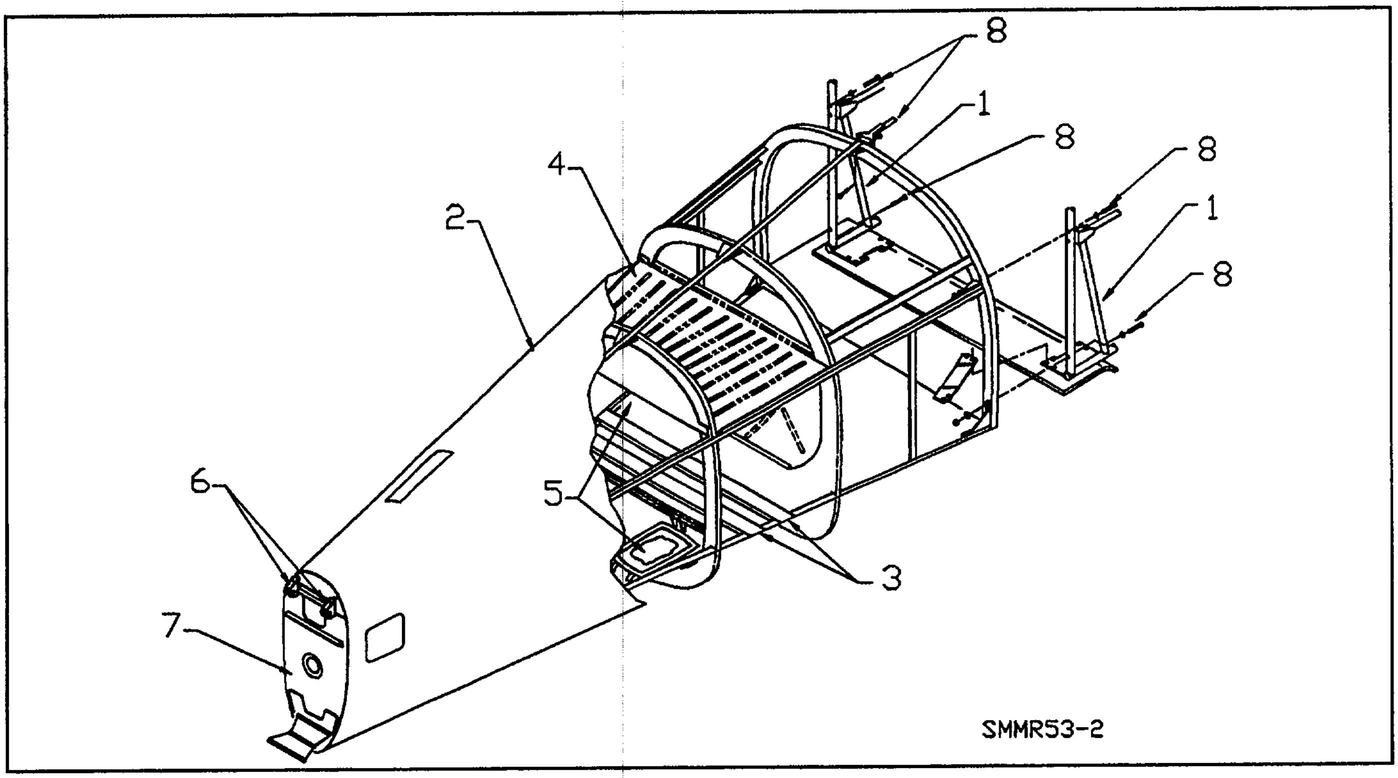
The empennage attach points (6) are attached to rear bulkhead (7) with tabs extended forward and attached to tailcone structure.

53-20-00 FIREWALL

The firewall is .016 stainless steel, attached to forward, 4130 tubular steel structure. Fiberglass insulation and vinyl are placed between firewall and cabin interior to restrict engine compartment heat and noise. All engine compartment/cabin access holes are sealed tight to prevent fire and smoke in cabin. Reference Section 71-30-00 for sealing procedures.



TUBULAR STRUCTURE FRAME - FIGURE 53-1



TAILCONE CONSTRUCTION - FIGURE 53-2

53-30-00 PLATES/SKINS

The fuselage tubular structure is covered with aluminum skins after mating to tailcone. The skins are riveted and bolted to support angles, formers and brackets. These skins are non-structural coverings to form outside contour of forward fuselage section.

The skins, covering tailcone, are an integral part of tailcone structure. Repair or replacement of these skins should be according to AC 43.13-1(*) (* =current rev).

The fuselage assembly and tailcone have panels, covers or doors at various locations to provide access to interior for inspection or maintenance purposes. (See Figure 53-3).

Belly skins are removable to provide access to all components and control systems located below floorboard. See (Figure 53-3) and following Table for component location and identification.

NOTE

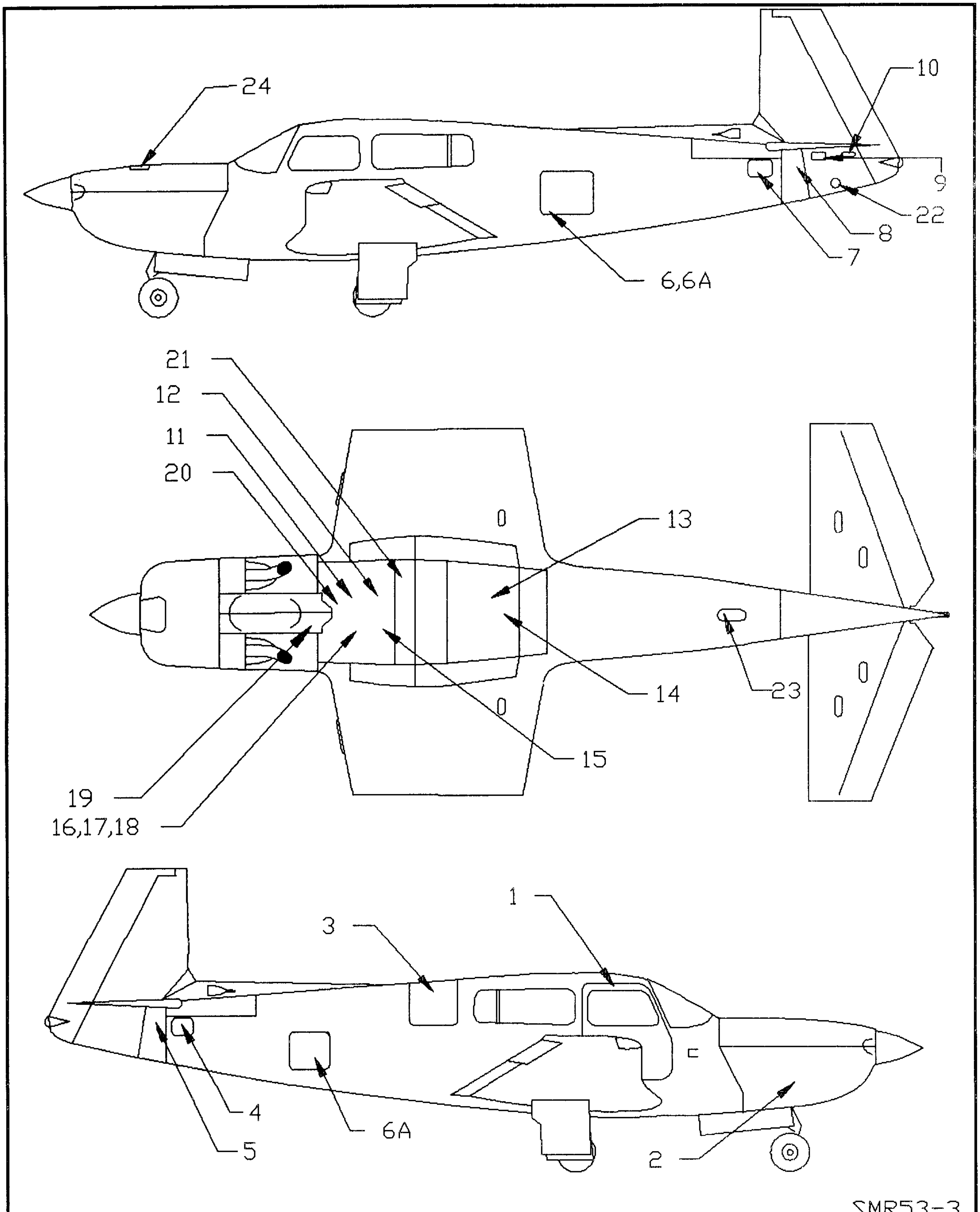
PR 1766-B2 sealant should be used on all fuselage lap joints, where bonded, to provide positive electrical ground plane for electrical systems.

TABLE FOR FIGURE 53-3 - COMPONENT IDENTIFICATION

1. Cabin Door.
2. Engine Compartment.
3. Baggage Door.
4. Elevator/Rudder Control Stops.
5. Empennage Attachment.
6. Avionics Blackboxes, Battery, ELT Access

6A Battery Access.

7. Stabilizer Trim Jack Screw.
8. Empennage Attachment.
9. Elevator/Rudder Controls, Rod End Bearings & Travel Stops
10. Rudder Controls, Elevators & Rudder Bellcranks.
11. Brake Master Cylinders, Electric Fuel Pump.
12. Landing Gear Actuator, Gascolator, Fuel Selector Valve.
13. Landing Gear Retract Tubes, Flap Indicator Cable.
14. Electric Flap Actuator.
15. Stabilizer Trim Screw and Stops.
16. Elevator/Rudder/Aileron Control System
17. Elevator/Rudder/Aileron Control System Bellcranks
18., Control System/Landing Gear Rod End Bearings.
19. Nose Wheel Steering System, Cowl Flap Controls
20. Rudder Torque Tube.
21. Landing Gear Actuator and Retraction Tubes.
22. Tail-Light Harness Connections.
23. Empennage Attachment, Trim Jack Screw.
24. Oil Filler Access



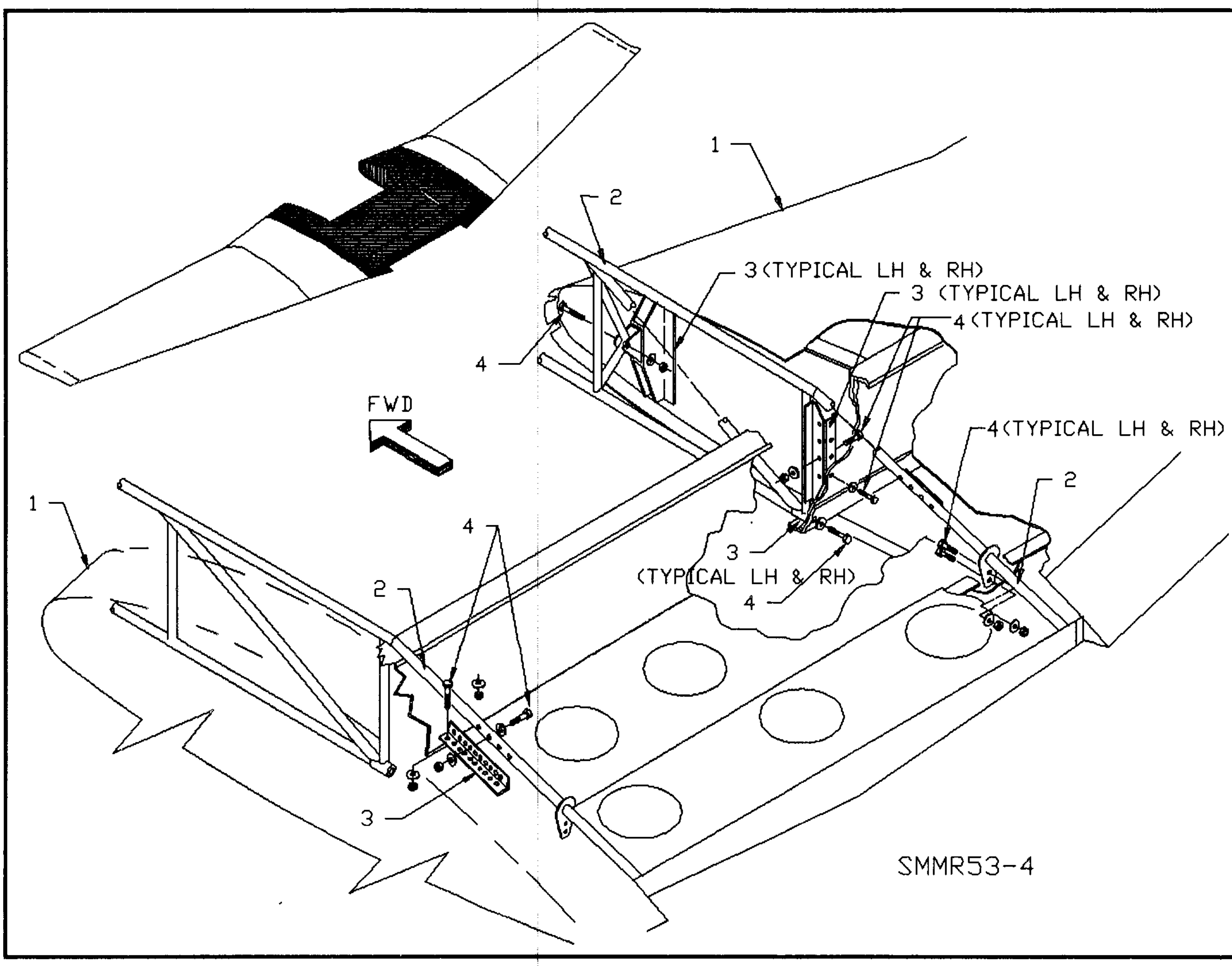
INSPECTION PANELS AND COVERS - FIGURE 53-3

53-40-00 - ATTACH FITTINGS

53-40-01 - WING ATTACH FITTINGS

The wing assembly (1) is attached to fuselage assembly (2) using structural hardware (4); (Figure 53-4).

Various type of fittings (3) are used to properly distribute load between wing and fuselage.



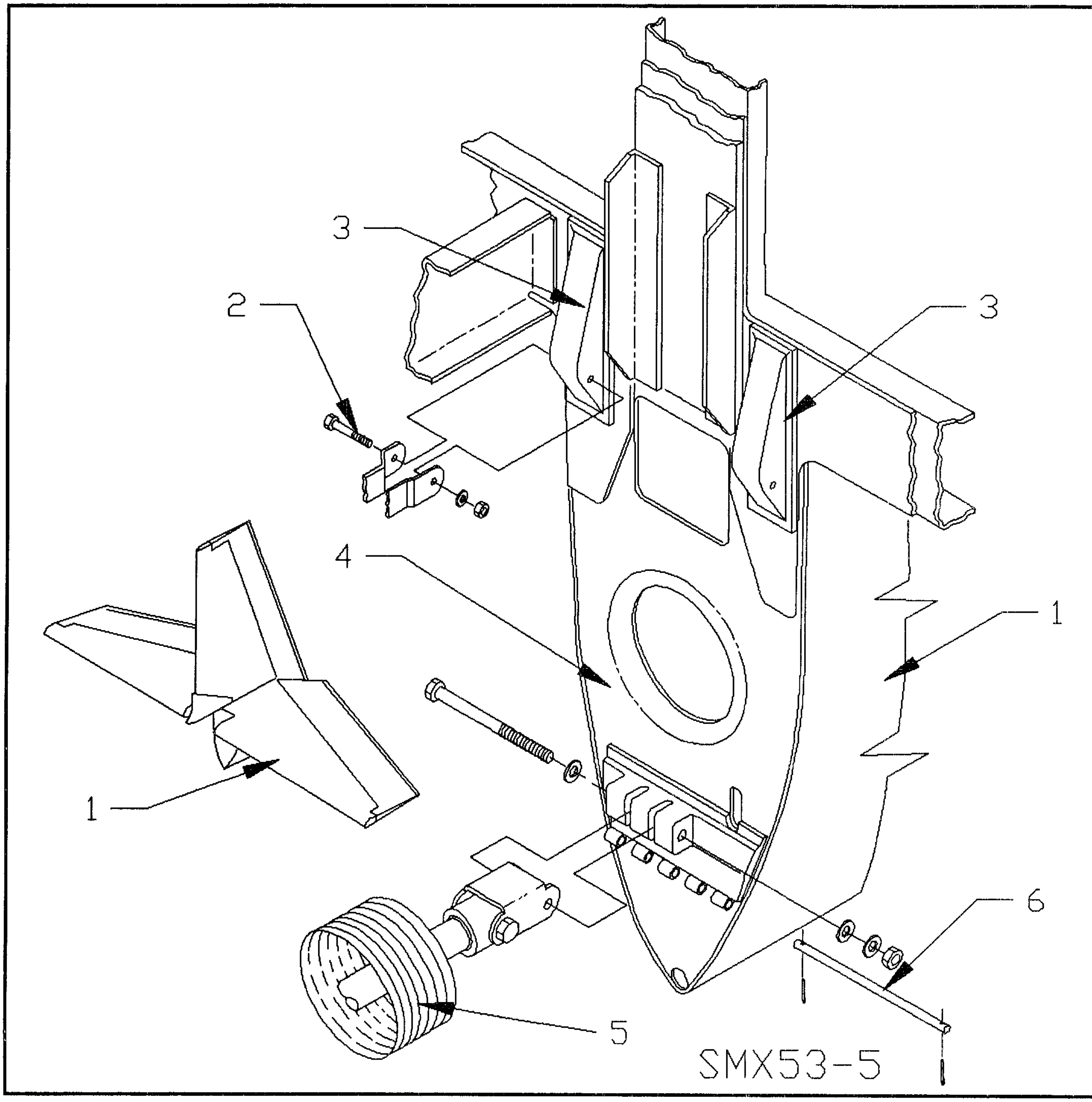
WING/FUSELAGE ATTACH FITTINGS - FIGURE 53-4

53-40-02 - EMPENNAGE ATTACH FITTINGS

The empennage assembly is manufactured as a unit (1), (Figure 53-5) with vertical fin and horizontal stabilizer using common components. This unit attaches to tailcone empennage attach points (1) (Figure 53-6), using two structural bolts (2) (Figure 53-5) passing through two top hinges (3) (Figure 53-5). The bottom attach point (4) (Figure 53-5) on empennage assembly secures stabilizer trim jack screw (5) (Figure 53-5) and (4) (Figure 53-6). Lateral stability of empennage assembly is controlled with an articulated hinge assembly (2) (Figure 53-6) attached to rear bulkhead (3) (Figure 53-6) of tailcone. The hinge attach pin (6) (Figure 53-5) is held in place with a cotter pin at each end.

53-40-03 - MAIN LANDING GEAR ATTACH POINTS

The main landing gear assembly is a welded, heat-treated, 4130 chrome molybdenum steel assembly. The leg assembly (1), Fig. 53-7, is supported at forward end by tension strap fitting (2) attached to wing main spar assembly (3) (Figure 53-7 insert) and provides one of the hard points for main landing gear assembly. The leg assembly (1) is supported at the rear by a bracket (4) attached to stub spar assembly (5). This is rear hard point. The main landing gear truss assembly (6) also attaches to tension strap fitting (2) on main spar. The brass bearing (7) (insert) should be inspected at any scheduled maintenance action for wear.

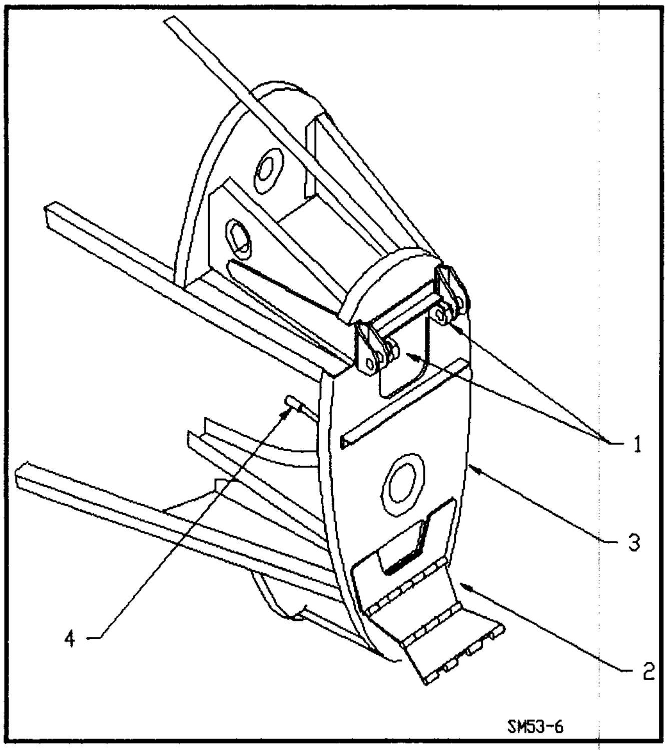


EMPENNAGE ASSEMBLY ATTACH FITTINGS - FIGURE 53-5

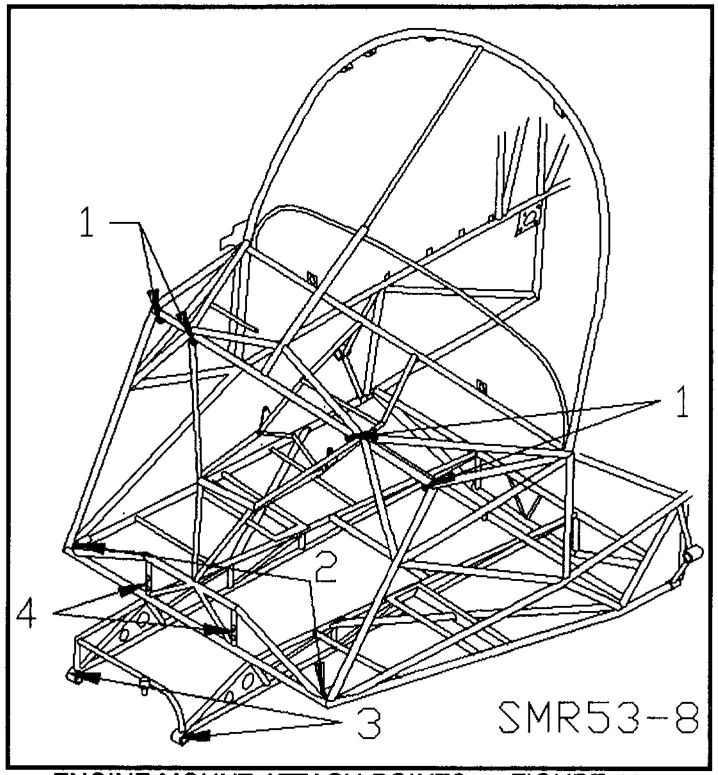
Grease fittings (8) are installed at pivot points of main landing gear assembly for lubrication per Chapter 5. (Reference Figure 53-7).

53-40-04 - ENGINE MOUNT ATTACH POINTS

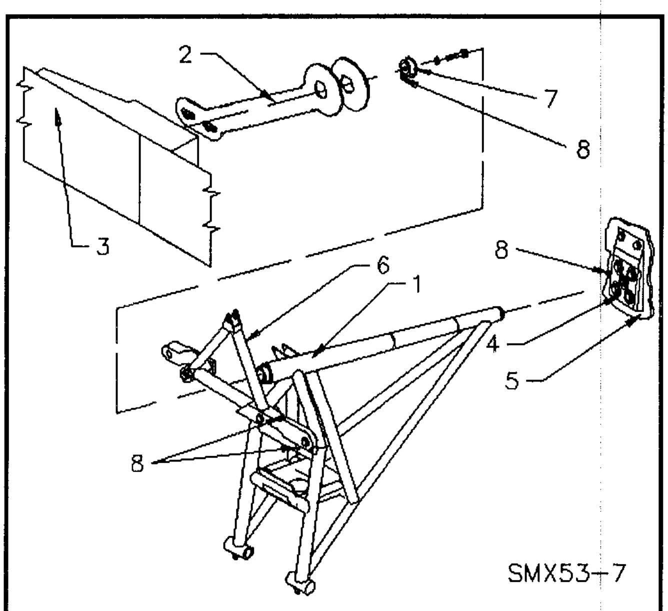
The engine mount is attached to hard points built into forward portion of tubular structure.
The upper and outboard, lower hard points (1) & (2) (Figure 53-8) are for NAS1304 bolts installed for tension loads. Lower hard points (3) are for shear loads and are used in conjuction w/ attachment of nose landing gear lower truss assembly (Figure 53-8). AN6 bolts are installed at this location. Lower hard points (4) are for fittings outside firewall which allow a clevis on each side of engine mount to be attached for shear loads. AN4 bolts are used for this application.



TAILCONE/EMPENNAGE ATTACH POINTS
FIGURE 53-6



ENGINE MOUNT ATTACH POINTS - FIGURE 53-8



MAIN LANDING GEAR ASSEMBLY ATTACH POINTS
FIGURE 53-7

CHAPTER

55

STABILIZERS

CHAPTER 55

STABILIZERS

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55-00-00 - GENERAL

The M20R empennage assembly is a variable incidence tail-plane consisting of a horizontal and vertical stabilizer built as a unit. (Refer to Chapter 53 for attachment of empennage to fuselage.)

The horizontal and vertical stabilizer are constructed of formed sheet metal ribs attached to a forward and aft spar assembly covered with stretch-formed skins. The horizontal stabilizer has a stub spar that spans a portion of stabilizer.

The elevator and rudder are constructed from an extruded leading edge spar assembly covered with stretch-formed skins. The elevators have a fixed tab between skins that run full length of trailing edge.

The elevators and rudder have balance weights permanently installed for stabilization during flight.

55-10-00 - HORIZONTAL STABILIZER

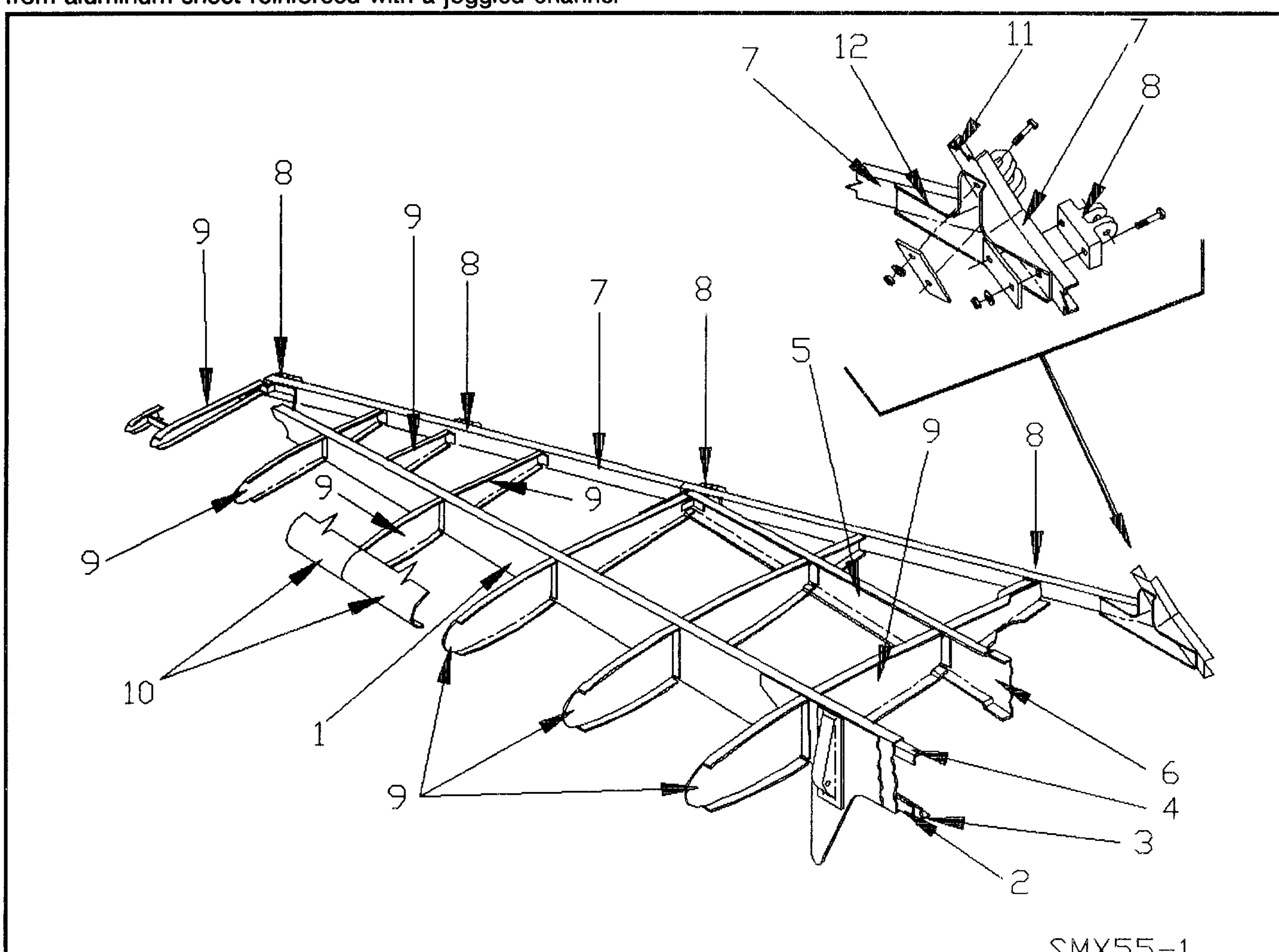
The main spar assembly (1) (**Fig. 55-1**) is formed from aluminum sheet into a channel. Angle doublers (2, 3 and 4) are formed and riveted to main spar (1) through spar web section. Stub spar (5) is a channel formed from aluminum sheet reinforced with a joggled channel (6) at center section. Rear spar (7) is an extrusion, attaching to aft end of ribs, and contains hinge fittings (8) for the elevators.

The ribs (9) are assembled in sections to the front and rear face of each spar assembly to form the air foil. Stretch-formed skins (10) are fastened to ribs, spars and doublers to form complete horizontal stabilizer structure.

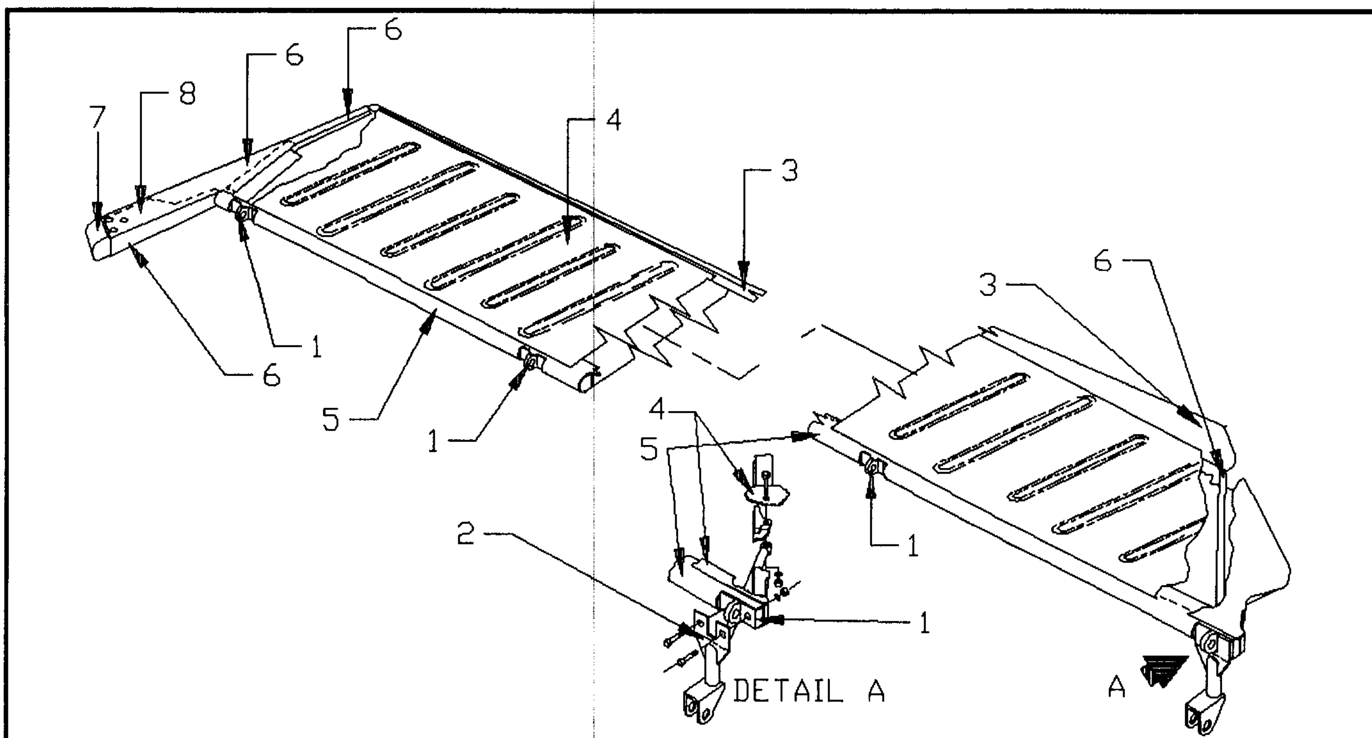
The aft vertical fin spar (11) is attached to horizontal stabilizer structure through bracket (12) which is fastened securely to stabilizer rear spar assembly (7). (Figure 55-1).

55-10-01 - HORIZONTAL STABILIZER - REMOVAL

The fairing located on tailcone, covering gap between tailcone and empennage assembly, will require removal to gain access to empennage attaching hardware. Section 53-40-02 describes attaching points for empennage assembly. Refer to this section for the removal of empennage assembly from airplane.



HORIZONTAL STABILIZER - FIGURE 55-1



ELEVATOR - FIGURE 55-2

55-10-02 - HORIZONTAL STABILIZER - INSTALLATION

Refer to Section 53-40-02 for installation.

55-20-00 - ELEVATOR

Elevators on the M20R consist of left and right hand assemblies attached, through ball bearing fittings (1), to rear spar of horizontal stabilizer (**Figure 55-2**).

The elevator control horn (2) is connected to inboard leading edge of each elevator (R.H. and L.H.). Both control horns are then connected to elevator flight control bellcrank. The full length trim tab (3) may not be re-adjusted from factory installed setting. This is factory set at 7^{o} down.

The elevator skins (4) are stretch-formed for upper and lower surface of elevator. There are no ribs in elevator between inboard and outboard ribs. The skins are attached to leading edge extrusion (5) and ribs (6) with blind rivets. Each formed corrogation is matched on top and bottom skins and rivets are installed for strength and rigidity through each corrogation.

A lead balance weight (7) is installed in each elevator tip with iron rivets or bolts (8). (**Figure 55-2**). See Section 27-91-00 for balancing procedures on elevators.

55-20-01 - ELEVATOR - REMOVAL

Remove AN3 bolts from each control horn and push-pull tube bearing, then remove AN3 bolts and hardware from each hinge fitting on both elevators.

55-20-02 - ELEVATOR - INSTALLATION

CAUTION
Each new, repaired or repainted elevator should be checked for balance per Section 27-91-00.
The elevators are installed in reverse order of removal. Nominal torque values for AN3 bolts are to be used (see Section 5-20-01 for torque table.)

55-30-00 - VERTICAL STABILIZER

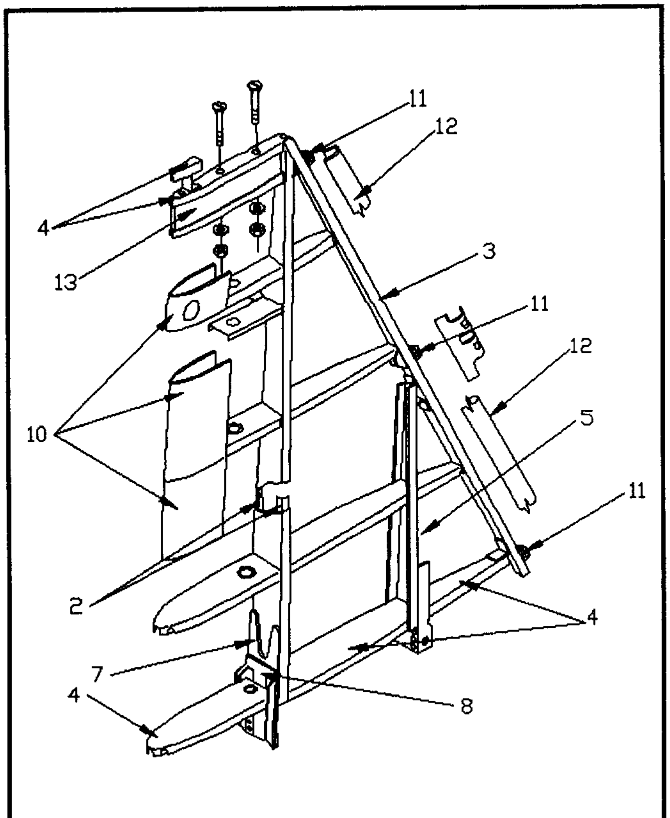
The main spar assembly (1) (**Fig. 55-3**) is formed from aluminum sheet. Formed angle doublers (2) are nested inside main spar channel and riveted to spar web. Rear spar (3) is an extrusion used to attach aft end of sectioned ribs (4). Stub spar (5) is also formed from sheet aluminum. A doubler channel (6) is attached to vertical stabilizer stub and stub spar of horizontal stabilizer. This attach channel is securely bolted to stinger bulkhead brackets. The main spar doublers and angles (7, 8 and 9) provide attach points for stinger and horizontal stabilizer spar. (**Figure 55-3**).

Skins (10) are stretch-formed in 2 sections and riveted to ribs and spar.

The rudder attach fittings (11) are mounted to rear spar extrusion to attach rudder (12). Lead weights (13) are added for dampening.

55-30-01 - VERTICAL STABILIZER - REMOVAL

The vertical and horizontal stabilizer are removed as a unit with stinger assembly. Remove fairing located on tailcone which covers gap between tailcone and empennage. Section 53-40-02 describes attaching points for complete empennage assembly. Refer to this section for removal of empennage assembly from airplane.



VERTICAL STABILIZER ASSEMBLY - FIGURE 55-3

55-30-02 - VERTICAL STABILIZER - INSTALLATION

Refer to Section 53-40-02 for installation.

55-40-00 - RUDDER

The rudder on the M20R is constructed same as the elevator with stretch-formed skins (1) (Ref. Fig. 55-4) riveted to an extruded leading edge (2) and riveted together at trailing edge. The rudder lower skins (3) are drop hammer formed left and right halves, riveted to upper skins, rib assembly (4) and at leading and trailing edge. A stiffener (5) is to support lower rudder ball bearing hinge fitting (6). A weather seal (7) is included in the assembly.

The rudder control horn (8) is attached with center hinge fitting (9) to rear flange of front spar at junction of lower rib assembly (10). A brace arm on horn assembly is attached to fitting (11) on lower rib (10).

The upper hinge fitting (12) is attached to rear flange of front spar just under top rib assembly (13) and balance weight (14), (refer to Figure 55-4).

Balance weight (14) is installed with four bolts (15). See section 27-91-00 for balancing procedures on rudder. Balance weight (16) is installed with two bolts.

55-40-01 - RUDDER - REMOVAL

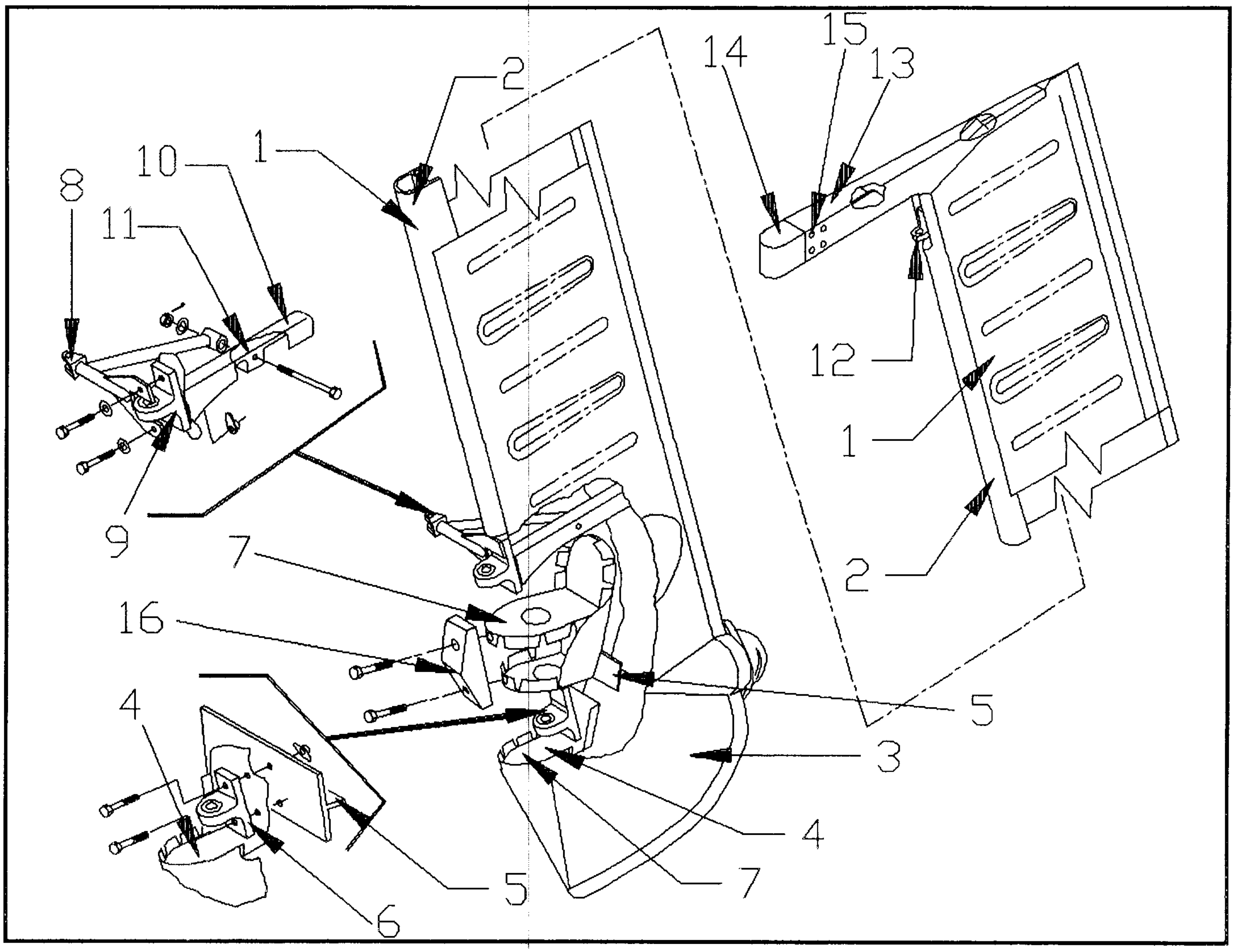
Remove AN3 bolt from control horn and push-pull tube bearing, then remove three AN3 bolts and hardware from each hinge fitting. Disconnect electrical connections per paragraph 33-41-03,2,A thru E.

55-40-02 - RUDDER INSTALLATION

CAUTION

Each new, repaired or repainted rudder should be checked for balance per section 27-91-00, prior to installation.

The rudder is installed in reverse order of removal. Nominal torque valves for AN3 bolts are to be used. (See Section 5-20-01 for torque table).



RUDDER ASSEMBLY - FIGURE 55-4

CHAPTER

56

WINDOWS

CHAPTER 56

WINDOWS

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56-00-00 - GENERAL

The windshield for the M20R is .187 inch thick acrylic, heat formed to contour. The pilot's side window is also .187 inch thick acrylic with a hole cut out to accommodate the .312 inch thick storm window. The storm window is milled to fit the hole and to be flush with outside of pilot's window surface when closed. The other three side windows are .125 inch thick acrylic. All windows are single pane windows.

All windows are heated in an auto-clave to approximately 300° F and placed on a plaster mold to cool while maintaining correct shape.

The windows are tinted for visual comfort, ultra-violet filteration and cooling effect for cabin.

The windows are all sealed to outside skin with PR1428 (B) sealant. Retainers and clips are used around window frame to hold windows in place.

56-00-01 - CLEANING ACRYLIC

A commercial cleaning solution, manufactured for acrylic, may be used to clean routine grit and grime from windows. Follow instructions on commercial cleaner used.

If no commercial cleaner is available these procedures should be followed:

1. Flush windows with water prior to wiping with a clean, soft, cloth, soaked in kerosene.

CAUTION
Never wipe windows when dry.

2. Flush with water after cleaning with kerosene.

CAUTION
Never use gasoline, benezene, carbon tetrachloride, acetone, lacquer thinner, deicer fluid, house hold cleaning fluid or any other questionable fluid to clean acrylic windows. These solvents will soften or craze the surface.

NOTE
Minor scratches or abrasions may be polished out by using acrylic resurfacing kits, ie., Micro-Mesh, available from aviation accessory suppliers.

56-20-00 - WINDSHIELD AND CABIN WINDOWS

The removal and installation of windshield and windows are accomplished in the following paragraphs.

56-21-00 - WINDSHIELD

56-21-01 - WINDSHIELD - REMOVAL

The aluminum retainer (1) at bottom of windshield (2) must be removed by drilling out rivets attaching it to cowl deck (3), (Reference Figure 56-1).

A putty knife or thin aluminum strip will be necessary to work underneath top skin (4) and side post skin (5) to break sealant bond between acrylic and skins.

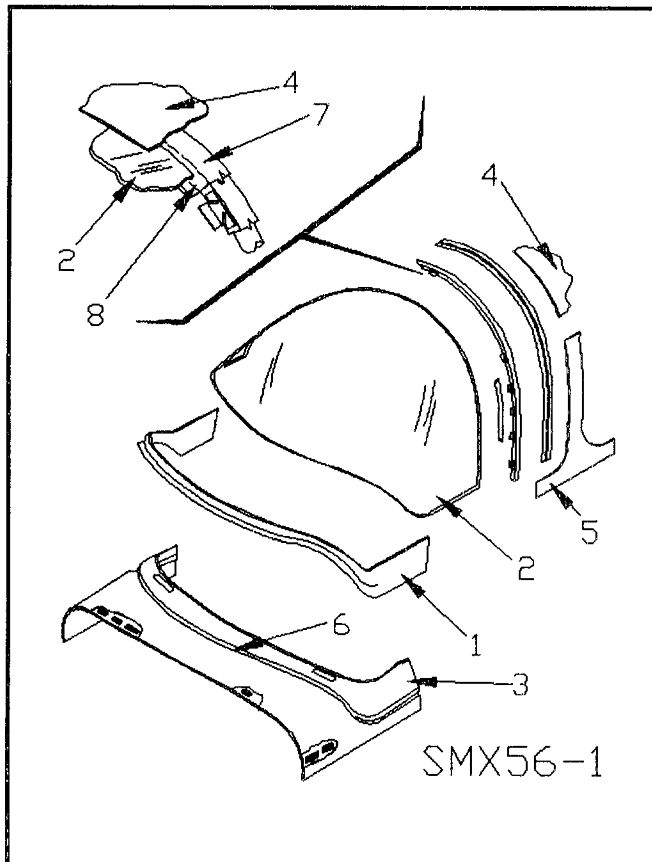
CAUTION
Exercise care during this operation to avoid scratching acrylic. Considerable effort may be required to break the bond.

Carefully pull windshield away from its location starting at lower portion and work it loose as sealant bond is broken around edge of acrylic.

After windshield is removed, all residual sealant must be removed prior to installation of replacement windshield. Careful scrapeing with putty knife and careful application of M.E.K. will assist in removing excess sealant.

56-21-02 - WINDSHIELD-INSTALLATION

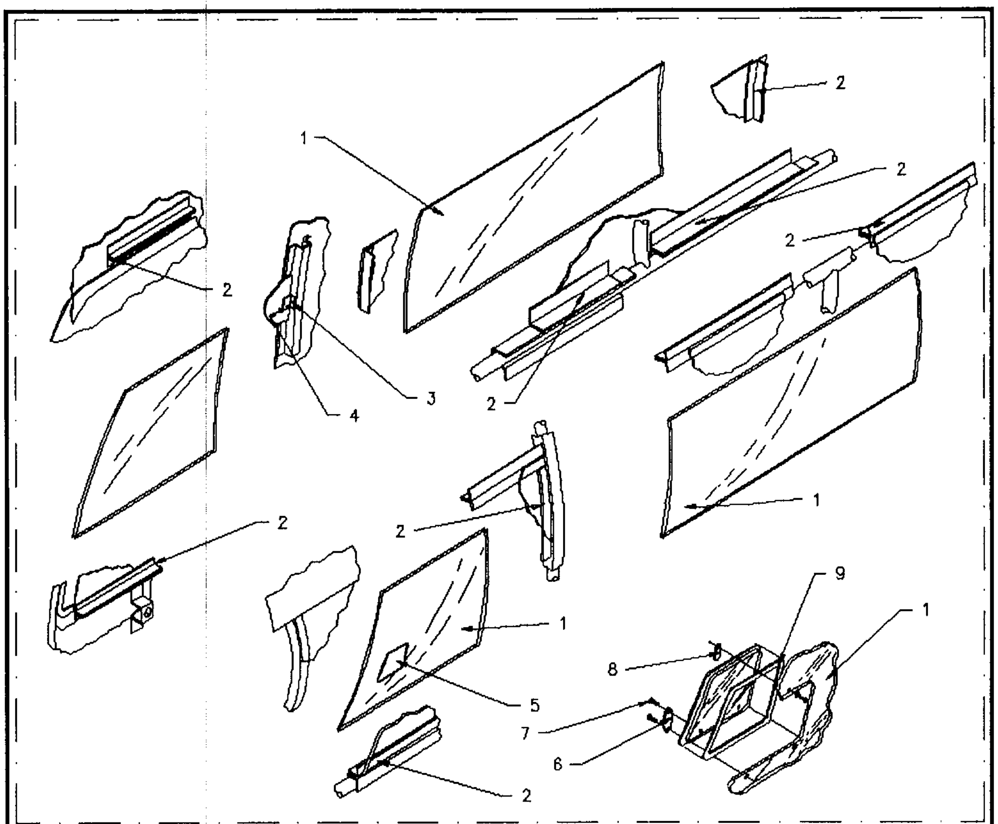
When old sealant is removed, brush M.E.K. or equivalent cleaning solvent, in cavity (8) where new windshield will be located (refer to Fig. 56-1).



WINDSHIELD INSTALLATION - FIGURE 56-1

NOTE
Exercise care with application of these solvents. Damage may result if drops of solvents come in contact with either exterior paint, interior trim or plexiglass.

Apply sealant, PR1428 (B) or equivalent, into cavity (8) until approximately half filled. Apply a bead of sealant along recessed joggle (6) of cowl deck (3), (**Figure 56-1**).
The new windshield being forced into cavity between outer skin (4) and interior retainer (7) will extrude excess sealant. After windshield is in place wipe excess sealant off with a damp clean cloth.
Prior to riveting aluminum retainer (1) into position coat retainer with a uniform thickness of sealant. A positive bond will be made as retainer is riveted into place. Use CR1312-5-2 cherry rivets to reattach retainer (1) to cowl deck (3), (**Figure 56-1**).
After sealant cures, excess may be removed with a sharp razor knife.
Check for water leaks.
Repaint retainer and rivets to match aircraft.



WINDOW INSTALLATION - FIGURE 56-2

56-22-00 - CABIN WINDOWS

56-22-01 - CABIN WINDOWS - REMOVAL

Remove interior trim from window (1) to be replaced. Remove retainers (2) or clips (3) which hold window in position from inside, (**Figure 56-2**).

NOTE
Some retainers are held in place with screws (4) and some with rivets. Drill out rivets carefully.

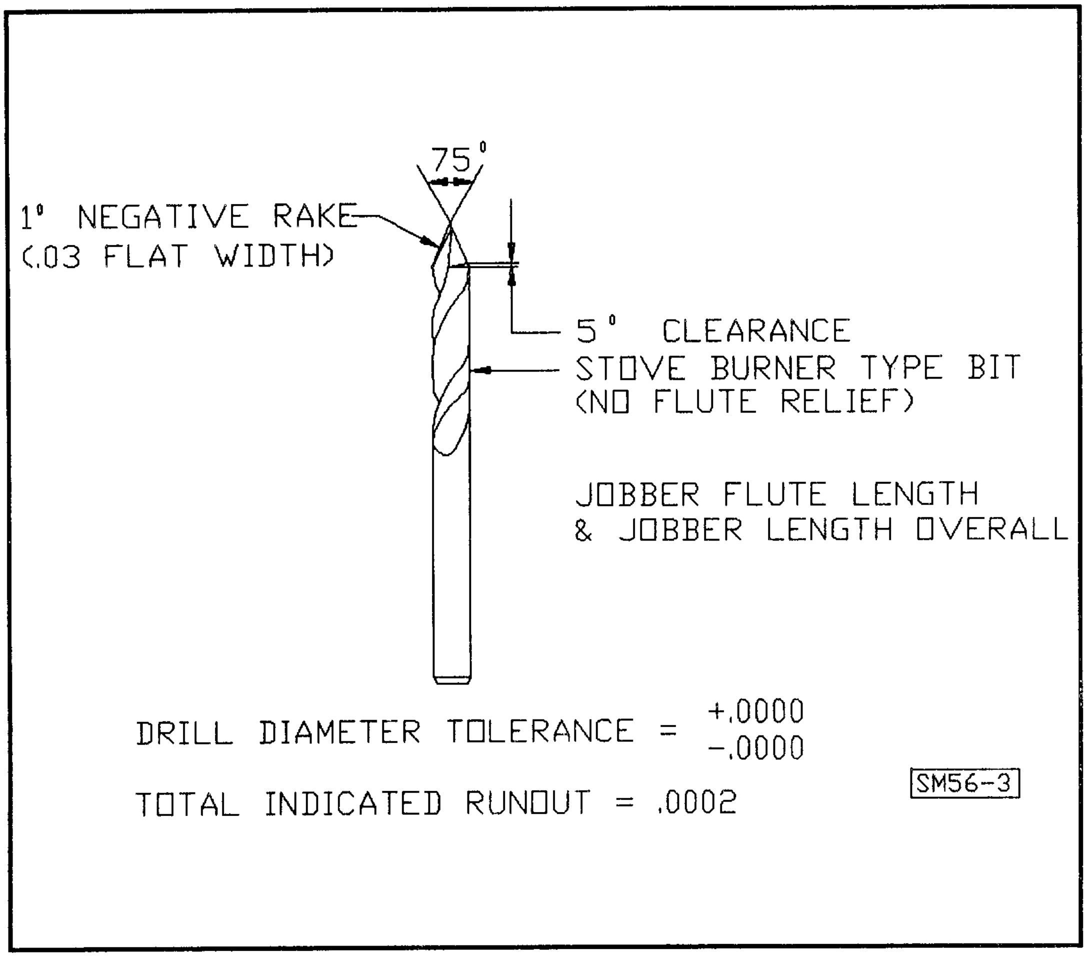
The window will be bonded to outside skin with sealant. Considerable effort may be required to break bond between acrylic and outer skin. Care should be exercised to keep window from twisting and possibly cracking.
Remove window and clean all remaining sealant from skin. Use M.E.K. and a scraper to remove sealant.

56-22-02 - CABIN WINDOWS - INSTALLATION

Remove all old sealant and clean skin area with M.E.K. Place window (1) into position to assure proper fit. Trim if necessary (**Figure 56-2**).
Apply a thick, uniform thickness of PR1428 (B) or equivalent, sealant to both window and skin areas where window (1) will be located. Sufficient sealant should be used so excess sealant is extruded from all edges of windows, both inside and outside, (approximately 5, 3.5 oz. tubes for 4 windows).
Force window (1) into place with retainers (2) or clips (3) and secure retainers and clips with Avex 1601-410 blind rivets or existing screws and hardware (4). The sealant will be forced out and seal window to outside skin. Carefully wipe excess sealant off acrylic before it sets up. After sealant cures excess can be cut off with a sharp razor knife, (Reference Figure 56-2).
Check replaced window for leaks.
Reinstall interior trim panels.

56-23-00 - STORM WINDOW

The storm window (5) is mounted with two aluminum hinges (6), attaching hardware (7) and held closed by a latch (8). A gasket (9) is bonded to the storm window for sealing purposes when closed, (**Figure 56-2**).



ACRYLIC DRILL BIT - FIGURE 56-3

56-50-00 - ACRYLIC DRILLING

Drill bits for acrylic should be ground per (**Figure 56-3**). A slow turning drill bit with light pressures is desirable.

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CHAPTER

57

WINGS

CHAPTER 57

WINGS

LIST OF EFFECTIVE PAGES

CHAPTER SECTION SUBJECT	PAGE	DATE
57-EFF/CONTENTS	1/2BLANK	10-98
57-00-00	3	6-94
57-00-02	4	10-98
57-20-02	5	6-94
57-20-02	6	6-94
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57-50-11	8	6-94

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57-00-00 - GENERAL

The all metal wing is a one piece assembly attached to the fuselage at structural hard points with structural hardware. (See Section 53-40-01). The full span, main spar assembly is connected to stub spar and rear spar assembly by ribs, doublers and skins. The main landing gear forward attach assembly is an integral part of main spar and rear fitting is bolted to wing stub spar assembly. The spar caps are 7075-T6 aluminum and the webs, ribs and doublers are 2024-T3, T4 or T42 aluminum. Repair of these components is covered in Section 51-13-00.

The wing tips are fabricated from fiberglass and house the navigation and strobe lights.

Fuel is contained in wet wing type fuel cells between main spar and baffles forward of spar. The tanks are sealed during manufacturing with current technology sealant. (See CHAPTER 28 for fuel system details).

57-00-01 - WING REMOVAL AND INSTALLATION

The major subassemblies of wing may be removed individually, or wing may be removed as a unit. To remove wing, a fuselage supporting cradle is needed.

1. Wing removal:

A. Remove wing-root fairings and bottom fuselage access panels.

B. Drain all fuel from tanks.

C. Drain brake lines and reservoir. Disconnect hydraulic lines at wing main spar.

D. Remove front and rear seats. Remove the two inspection plates under rear seat area.

E. Jack aircraft per SECTION 7-10-00.

F. Disconnect or remove the following:

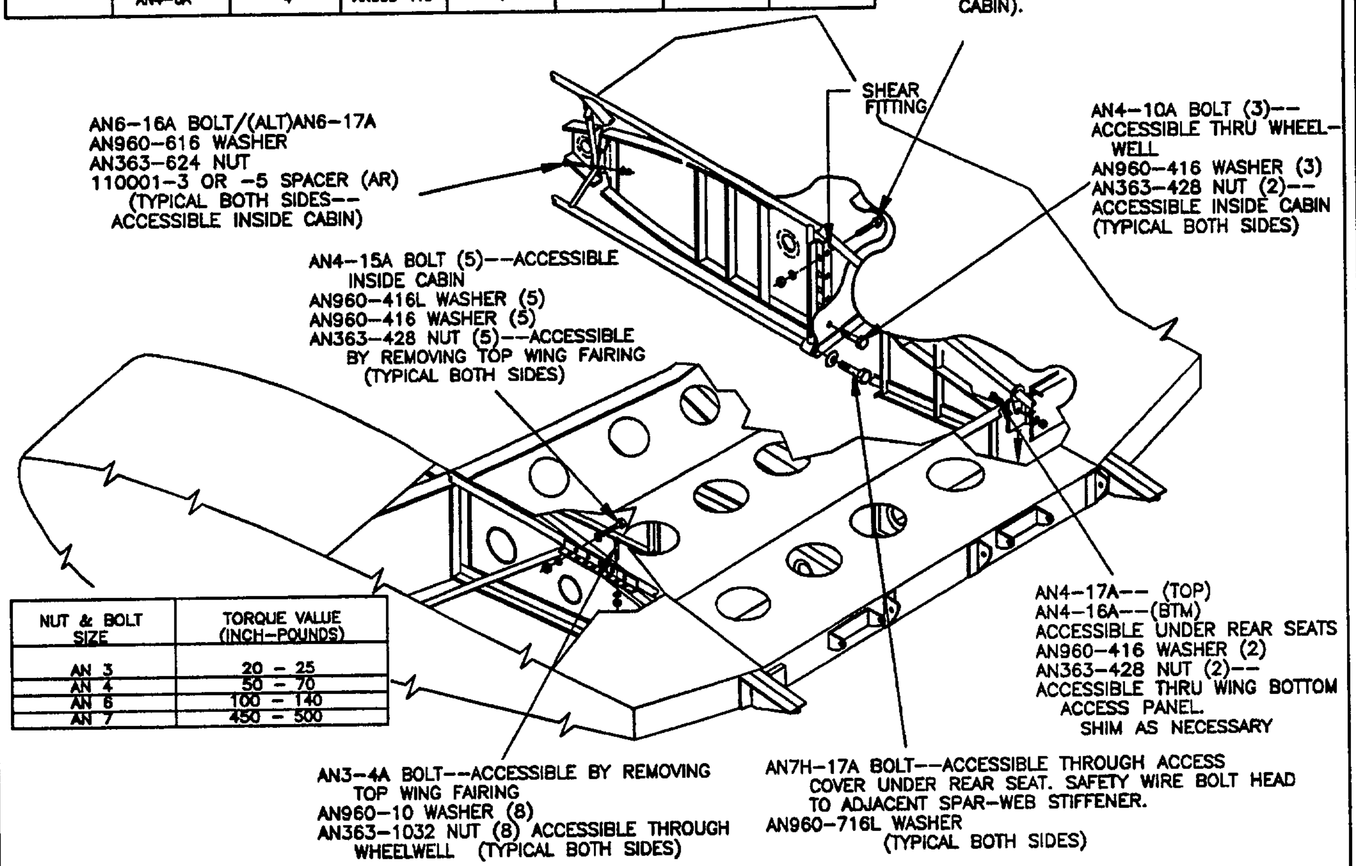
(a) Two landing gear assist springs.

(b) Aileron control tubes at inboard bellcranks.

(c) Trim control tube at STATION 59.3 and 94.5.

(d) Main gear retraction tubes.

SHIM DASH NO.	BOLT	NO. BOLTS REQD. PER SHIM	WASHER	NO. WASHERS REQD. PER SHIM	WASHER (ADDITIONAL)	NUT	NO. NUTS REQD. PER SHIM
310136-7	AN4-5A	4	AN960-416L	8		AN363-428	4
310134-9	AN4-5A	4	AN960-416L	8		AN363-428	4
310134-11	AN4-5A	4	AN960-416L	8		AN363-428	4
310134-13	AN4-6A	4	AN960-416	8	AN960-416L	AN363-428	4
310134-15	AN4-6A	4	AN960-416	8		AN363-428	4
	AN4-6A	4	AN960-416	4		AN363-428	4



NUT & BOLT SIZE	TORQUE VALUE (INCH-POUNDS)
AN 3	20 - 25
AN 4	50 - 70
AN 6	100 - 140
AN 7	450 - 500

WING ATTACHING HARDWARE - FIGURE 57-1

(e) Rudder control tubes.

(f) Elevator control tube.

(g) Elevator and rudder push-pull tubes.

(h) Flap control linkages.

(i) Floorboards at rear attach points.

(j) Belly skin stringer splice angles.

(k) Airspeed indicator line, pitot lines and pitot heater wires (if installed).

(l) Electrical connections for:
Nav/Strobe Lights; Fuel Qty. system; Speedbrakes & TKS system if installed

(m) Hardware shown in (**Figure 57-1**).

CAUTION
Have suitable cradle ready to carry fuselage before removing all mating hardware.

2. Wing installation: Installation of the wing assembly is direct reversal of removal.

3. Verify rigging of all flight controls per SECTION 27.

57-00-02 - STALL STRIP INSTALLATION

1. Position stall strips on wing leading edge so that, during stall recovery, normal use of flight controls should prevent:

A. More than 15° roll.

B. More than 15° yaw.

C. More than 30° pitch below flight level.

2. Place stall strips on leading edge at stations shown on **Figure 57-2**, attach securely with duct tape for test flights. Reposition stall strips, up or down, until aircraft flies to criteria in paragraph 57-00-02, 1, A, B and C. Secure stall strip per installation instructions in **Figure 57-2**.

57-10-00 - MAIN FRAME

The integral fuel cells, shaded area (1) start at wing station 24.5 and continue to rib, station 88.75 (LH/RH) on wing. (**Figure 57-3**). Sealer is applied to all joints on ribs, spar and baffle plates. (See Section 28-11-00 for resealing procedures).

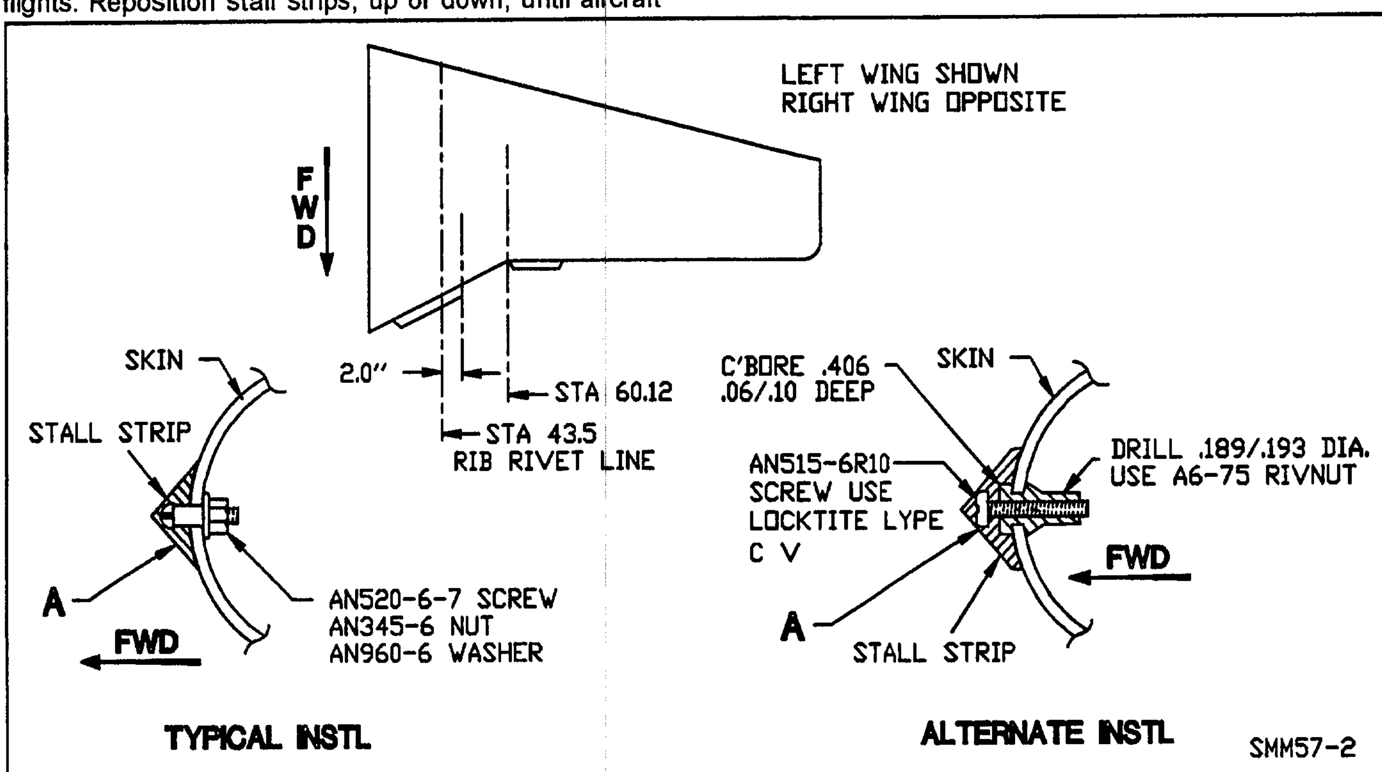
The wing is manufactured in three sections; center section (2), left outboard section (3) and an opposite right outboard section (not shown) (**Figure 57-3**). These three sections are then assembled into one full span wing assembly as final two, LH/RH, skins are installed.

LH & RH spares configuration, wing tip assembly, are available. Each includes completed section, from Wing Station 103.50 and outboard. The assembly includes stringers (4) required to complete splice to old center section. A spar splice plate is required to reinforce spar (5) at it's attachment location. These components, with instructions, are available through any Mooney Service Center.

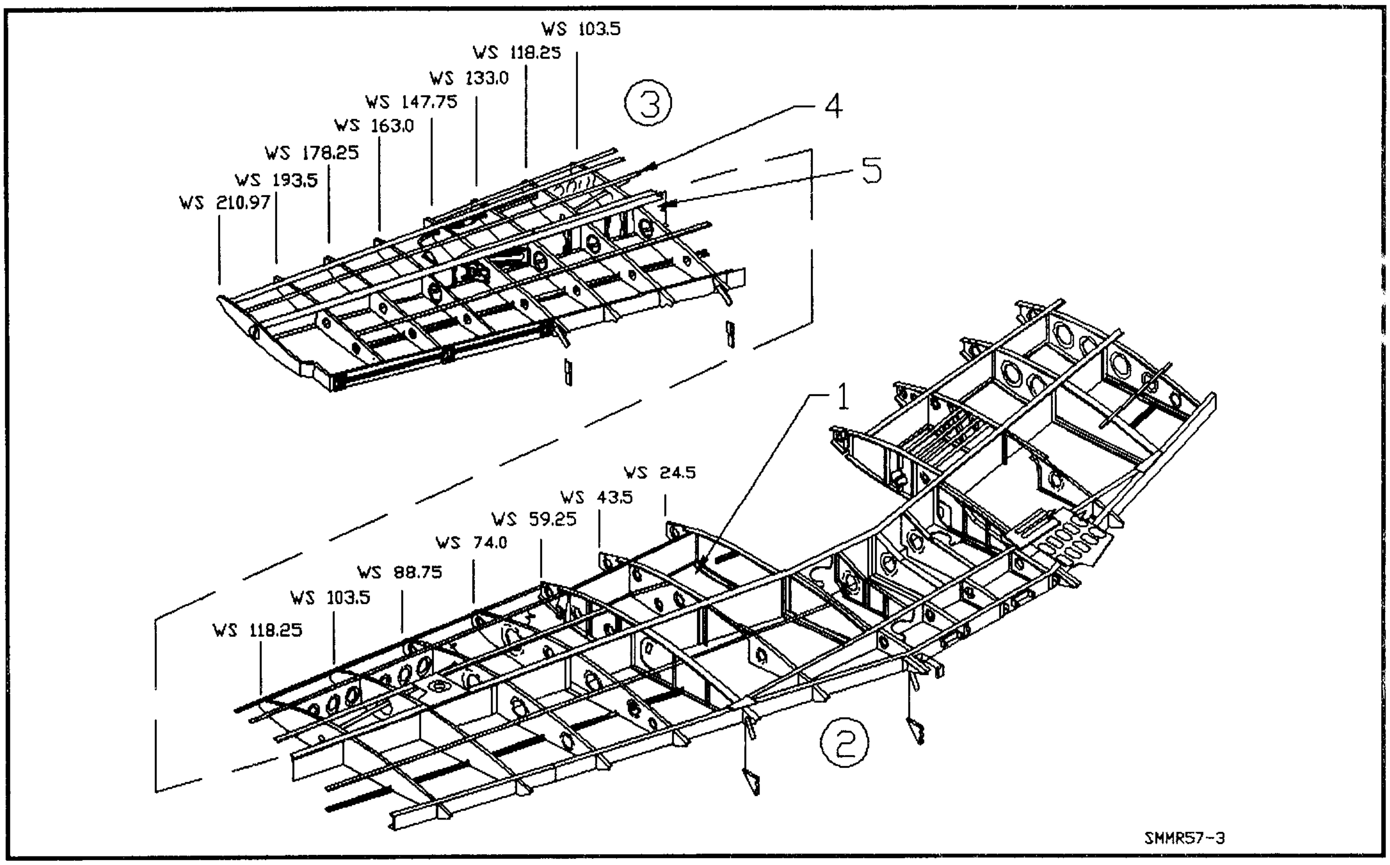
57-20-00 - AUXILIARY STRUCTURES

57-20-01 - JACK POINTS

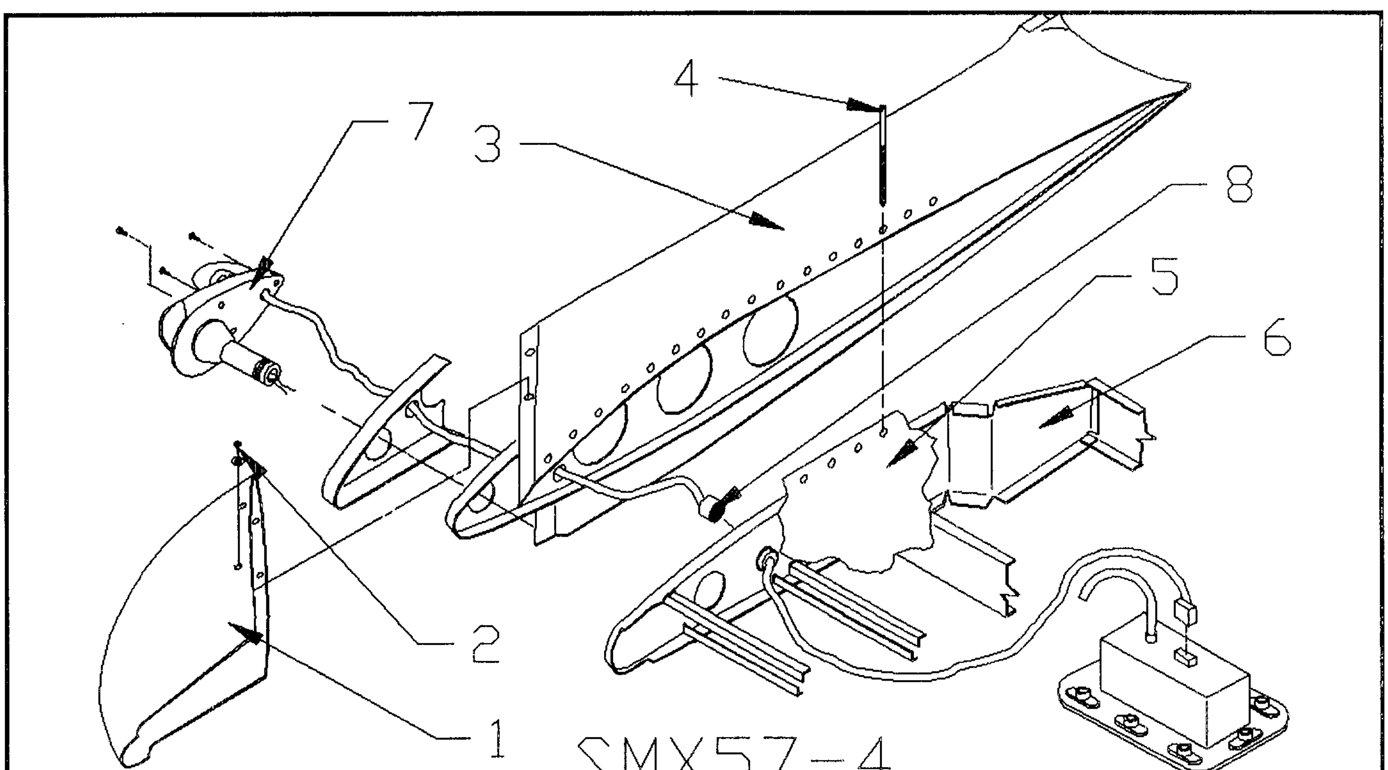
Wing jack points are located on LH & RH lower wing. The threaded wing tie down eyebolt fittings are designed to accept non-threaded jack points. These are located outboard of each main gear. The nose jack point is located aft of left hand cowl flap at Fus. Sta. -5.51. See SECTION 7-10-00 for complete jacking procedures.



STALL STRIP INSTALLATION -FIGURE 57-2



WING STRUCTURE - FIGURE 57-3



WING TIP ASSEMBLY - FIGURE 57-4

57-20-02 - WING TIPS

The M20R wing tips are non-structural, fiberglass components. They are riveted to upper and lower wing skins during final assembly of wing structure.

1. Wing tip removal.

A. Remove navigation/strobe light lens (1) by removing 4 screws and washers (2) that retain lens to wing tip (3) (**Figure 57-4**).

B. Drill out rivets (4) holding tip to upper and lower wing skin (5). Remove all rivet shanks with a punch.

C. Carefully pull wing tip away from wing rib (6) and skins (5). Disconnect strobe and navigation light harnesses at disconnect plug (8) prior to completely removing tip.

NOTE
The strobe or navigation lights can be removed from wing tip either before or after its removal from wing.

2. Wing tip installation.

A. Place new or repaired wing tip in place.

CAUTION
Be sure aileron and aileron balance weights are not restricted in movement, either direction.

B. Secure wing tip and drill holes to match existing wing skins. Use clecoes as holes are drilled into new tip. When all holes are drilled, remove wing tip assembly and deburr.

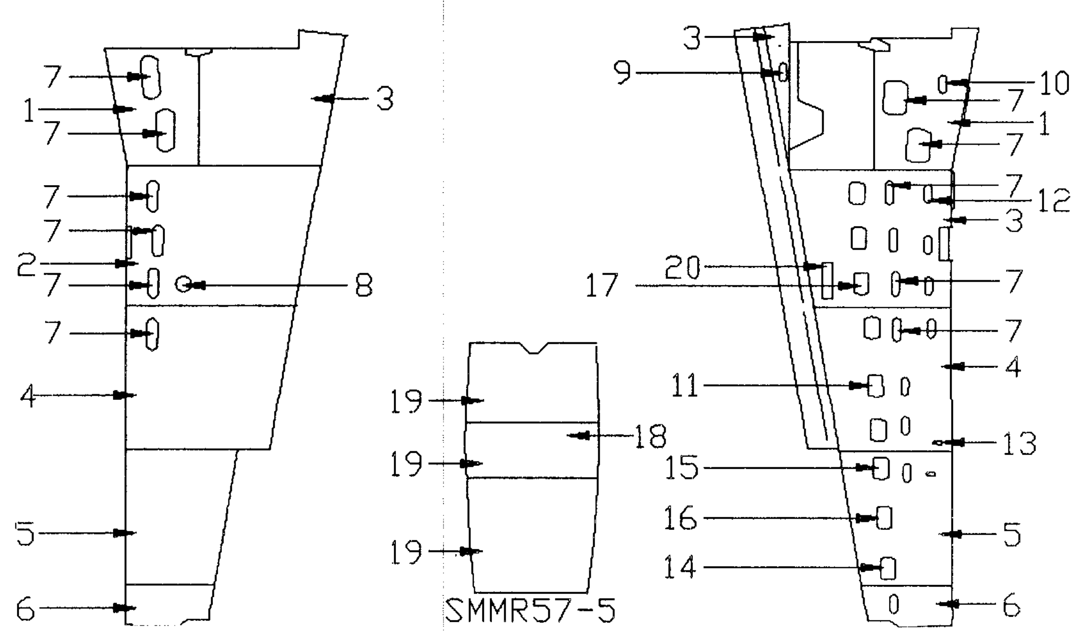
NOTE
Connect strobe and navigation light connectors prior to final attachment of tip.

C. Use Avex 1604-0412 blind rivets to attach wing tip to top and bottom skins.

D. Repaint to match aircraft.

57-30-00 - PLATES - SKIN

The wing access and inspection covers shown in (Figure 57-5) provide maintenance access to components, plumbing and control bellcranks enclosed within wing. They are flush mounted covers and when installed continue aerodynamic contour of wing.



WING SKINS AND INSPECTION COVERS - FIGURE 57-5

LEGEND FOR FIGURE 57-5

1. Wing skin - .050 thickness (Fuel Tank).
2. Wing skin - .040 thickness (Fuel Tank).
3. Wing skin - .040 thickness.
4. Wing skin - .040 thickness.
5. Wing skin - .025 thickness.
6. Wing skin - .025 thickness.
7. Fuel tank access.
8. Fuel tank filler.
9. Control tube guide blocks.
10. Wing - fuselage attach points.
11. OAT probe, right wing only.
12. Control tube guide blocks.
13. Pitot post - left wing only.
14. Strobe light power supply.
15. Aileron bellcrank and control rods.
16. Auto pilot servos.
17. Gyro compass flux valve (left wing only).
18. Main landing gear assist bungee.
19. Elevator and rudder controls - rod end bearings, bellcranks.
20. Descent Rate Control (If installed)

NOTE
Access covers on bottom of wing that require removal for inspection intervals are secured with screws. Any access covers that are riveted in place are required for manufacturing only and NOT for routine inspections.

57-40-00 - ATTACH FITTINGS

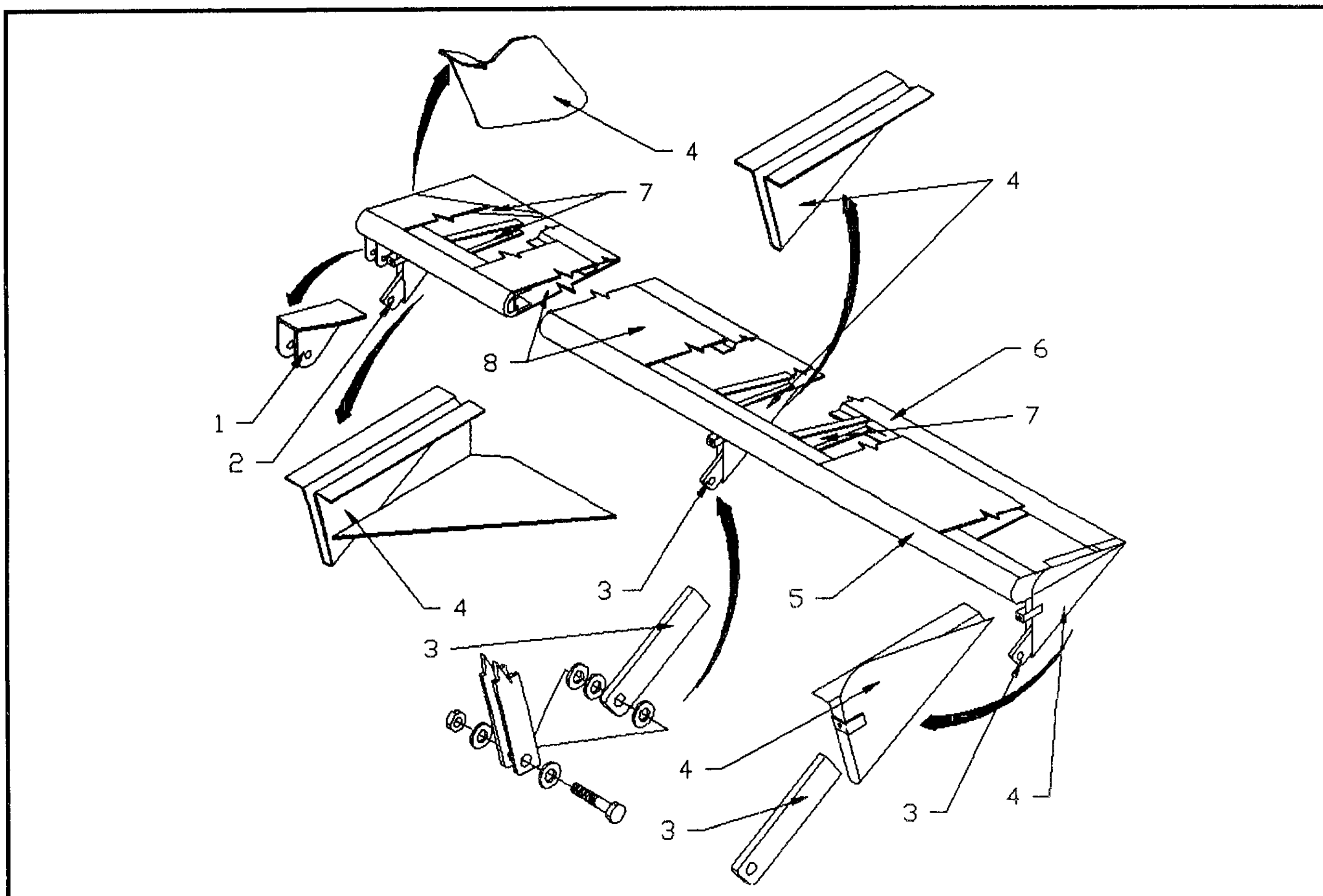
Refer to Section 57-00-01 for wing fuselage attachment.

57-50-00 - FLIGHT SURFACES

Refer to Section 27-90-00 for flight control surface balancing procedures.

57-50-10 - FLAPS

Refer to Section 27-50-00 for maintenance and rigging procedures.
The flap actuator jack shaft is connected by a push-pull, rod end, bearing to flap actuator bracket (1)



FLAP ASSEMBLY - FIGURE 57-6

(**Figure 57-6**) located just inboard of inboard hinge (2). All three hinges (2) and (3) are faired (4) to reduce drag.
Internal structure of flaps consists of: leading edge extrusion (5), trailing edge stiffener (6), ribs (7) and top and bottom skins (8). These components are riveted together into a left hand and right hand assembly.

57-50-11 - FLAP REMOVAL AND INSTALLATION

Refer to Section 27-50-00 for removal and installation procedures.

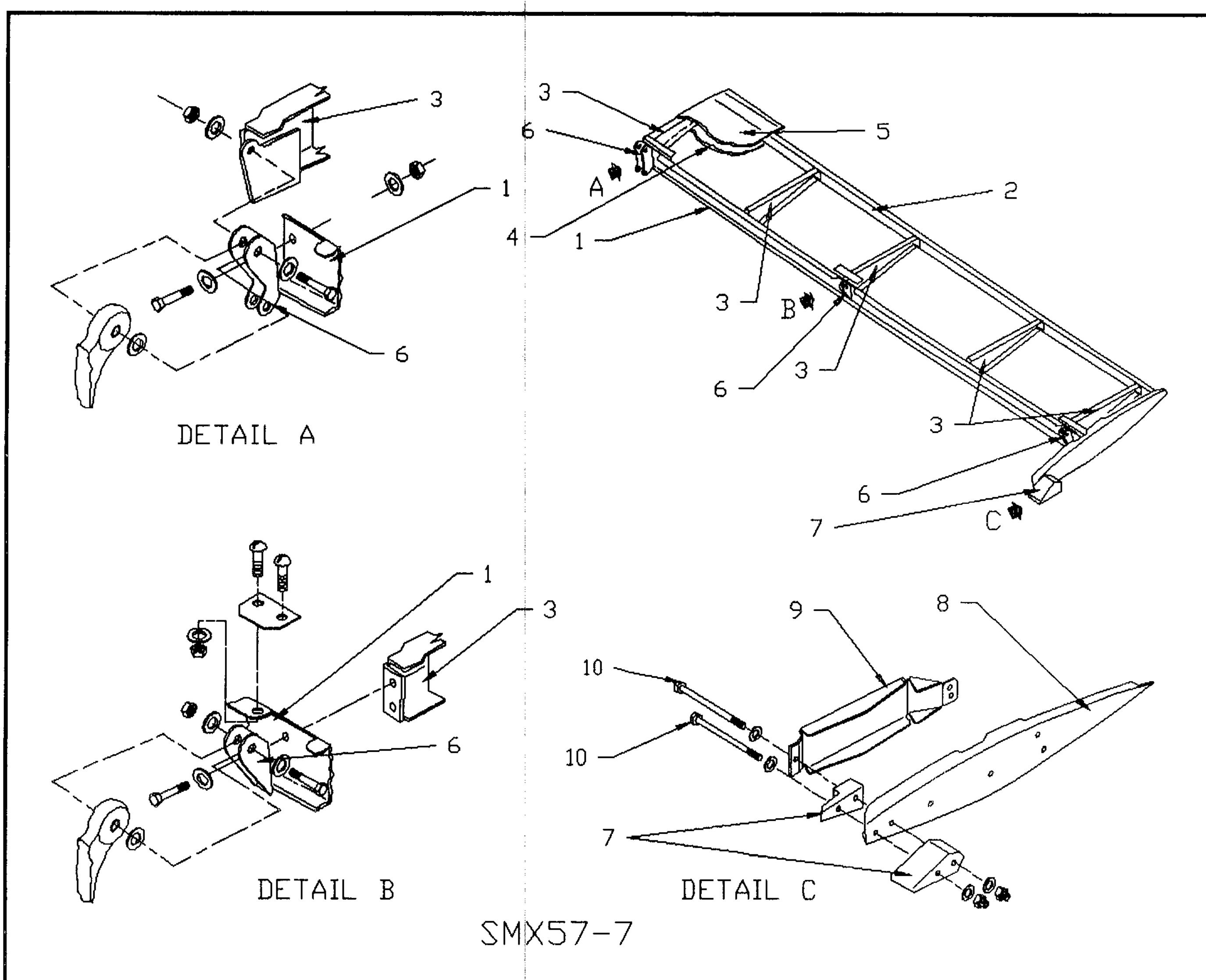
57-50-20 - AILERONS

Refer to Section 27-10-00 for maintenance and rigging procedures.

The ailerons are of all metal construction. The main spar (1), (**Figure 57-7**), is attached to rear spar (2) through ribs (3). These components are riveted together and top and bottom skin (4) and (5) are riveted to this sub-assembly. To complete control surface, hinges (6) and balance weights (7) are installed. The weights (7) are bolted (10) through an outboard rib (8) and bracket (9) on each aileron assembly.

57-50-21 - AILERON REMOVAL AND INSTALLATION

Refer to Section 27-10-00 for removal, installation & balancing procedures.



AILERON ASSEMBLY - FIGURE 57-7

CHAPTER

60

STANDARD PRACTICES (PROP/ROTOR)

CHAPTER 60

STANDARD PRACTICES-PROPELLER

LIST OF EFFECTIVE PAGES

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60-00-00 - GENERAL

The M20R aircraft incorporates a constant speed, variable pitch propeller, controlled by a governor for constant RPM settings at the pilot's discretion.

The propeller diameter is limited to 73 inches to allow sufficient clearance between ground and propeller tip. See Type Certificate Data Sheet for approved propeller models.

Repairs may be made to metal propellers in accordance with AC 43.13-1( ) Chapter 12 and in conjunction with the definitions of FAR 43.

CAUTION

Refer to Teledyne Continental Motors (TCM) maintenance publications for engine inspection procedures after a propeller strike.

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CHAPTER

61

PROPELLERS/ PROPULSORS

CHAPTER 61

PROPELLERS

LIST OF EFFECTIVE PAGES

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61-00-00 - GENERAL

The propeller is a constant speed type which operates by hydraulic pressure opposing natural centrifugal twisting moment of rotating blades and spring force to obtain the correct pitch for the engine load. Engine lubricating oil is supplied to power piston in propeller hub through propeller shaft. The amount and pressure of oil supplied (0-300 PSI) is controlled by an engine driven governor. Increasing engine speed will cause oil to be admitted to piston, thereby increasing propeller pitch. Conversely decreasing engine speed will result in oil leaving the piston, therefore decreasing propeller pitch.

Propeller overhaul shall coincide with engine overhaul, but interval between overhauls shall not exceed 1500 hours. Refer to propeller manufacturers' overhaul manual for complete maintenance action.

NOTE
Approved propeller shops ONLY are authorized for overhaul or major repairs to these propellers. Refer to Federal Aviation Regulations, Part 43, (FAR 43) and Federal Aviation Agency Advisory Circular No. 43.13 ( ) (AC 43.13( ) for definition of major or minor repairs or alternations and who may accomplish them.

61-00-10 - SPINNER DOME AND PROPELLER REMOVAL (TYPICAL)

1. Spinner dome removal (if necessary).

NOTE
It is not necessary to remove spinner when removing propeller assembly.

A. Remove screws and fiber washers (1) from aft spinner bulkhead assembly (2) and screws (3) from each doubler plate (4). (Reference Figure 61-1).

B. Leave doubler plates attached to aft bulkhead.

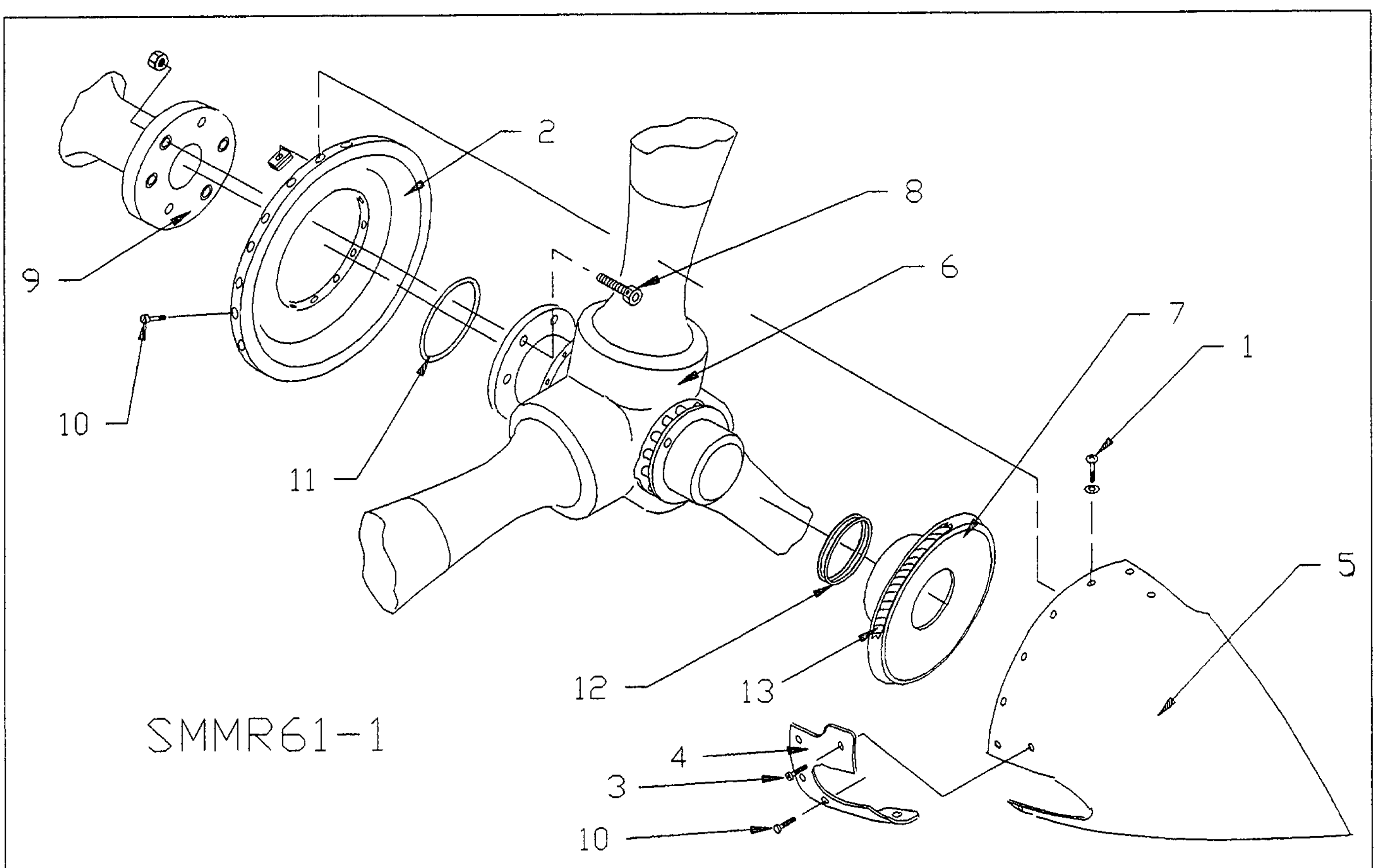
C. Carefully pull spinner dome (5) forward to clear propeller blades and hub (6).

D. Spinner support is shimmed for snug fit inside spinner dome, (as required); note quantity of shims(12) installed for reference when re-installing spinner dome. Spinner dome must fit support (7) snug at each re-install action.

CAUTION
The propeller/spinner installation is dynamically balanced during final manufacturing process. It is mandatory that spinner be re-installed in exact position as removed, unless all weights are removed and a complete rebalancing procedure is accomplished.

2. Propeller removal.

A. Cut safety wire and discard. Loosen nuts (8) attaching propeller to engine, crankshaft, propeller flange (9) about 1/4 inch and pull propeller forward.



SPINNER DOME AND PROPELLER REMOVAL - FIGURE 61-1

NOTE
Propeller nuts will have to be backed off evenly so propeller may be pulled forward (approximately 1/4 inch at a time until all nuts are removed from propeller studs. As propeller is separated from engine crankshaft, oil will drain from propeller and engine crankshaft cavities.

B. Pull propeller from engine crankshaft (9). Use clean rags to cover cavity in crankshaft and hub.

C. If necessary to remove aft spinner bulkhead (2) (Figure 61-1), spinner dome (5) must be removed, refer to 61-00-10. Remove cap screws and washers (10) which attach bulkhead to propeller hub flange. Remove aft bulkhead from propeller flange.

CAUTION
Remove propeller de-ice boot connections (if installed) prior to removing aft bulkhead from propeller assembly.

61-00-20 - PROPELLER INSTALLATION

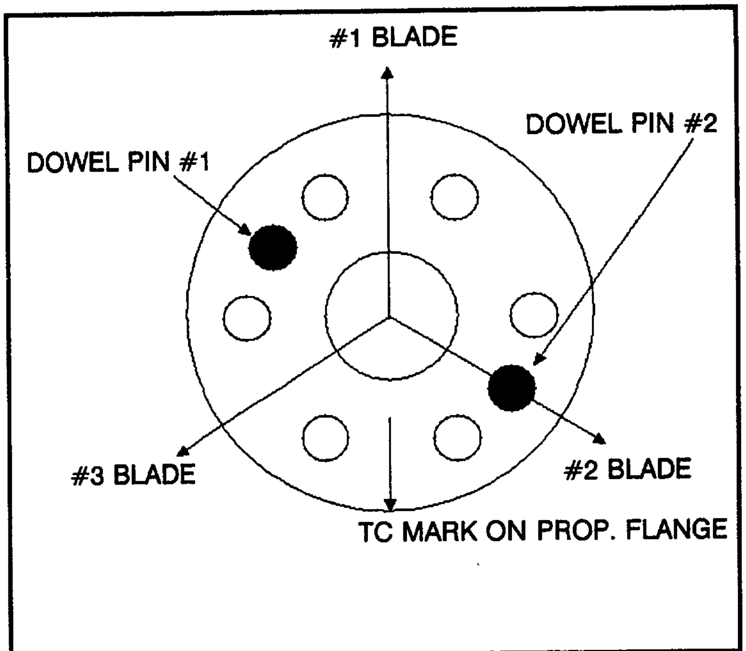
1. If aft spinner bulkhead was removed, re-install, using cap screws and washers (10) in reverse order of removal.
2. Clean propeller hub cavity and mating surfaces of propeller hub.
3. Lightly lubricate new O-Ring (11), (Figure 61-1), and install O-Ring in propeller hub.

CAUTION
Remove all rags or plugs placed in crankshaft or hub during propeller removal.

4. TCM engine has "T/C" marked on propeller flange. This indicates No. 6 cylinder crank location.
5. **Hartzell propellers** have a blade marked that MUST align with No. 6 crank throw. Position marked blade with T/C mark on engine propeller flange. Alignment pins on propeller hub flange MUST slip into alignment holes on engine propeller flange as propeller hub studs are inserted through holes in engine propeller flange. **McCauley propellers** have particular alignment procedures; refer to Figure 61-2
6. Align propeller hub studs with proper holes in engine crankshaft flange; slide propeller studs carefully through propeller flange holes until nuts (8) can be started. Apply A-1637-16 lubricant to threads of studs & nuts. See Figure 61-2 for proper engine propeller flange/propeller hub orientation.

CAUTION
Propeller hub must be aligned with proper alignment pins and holes on crankshaft flange.

5. Tighten nuts (8) evenly; work propeller aft on crankshaft flange. Torque nuts to 45-50 ft. pounds.
6. Safety with .032 wire.
7. Install spinner dome, making sure fiber washers are installed under all screw heads (1).



McCAULEY PROPELLER INDEXING - FIGURE 61-2

NOTE
The spinner support (7) should be shimmed (12) to ensure that it fits snug on propeller dome as spinner dome is being installed.

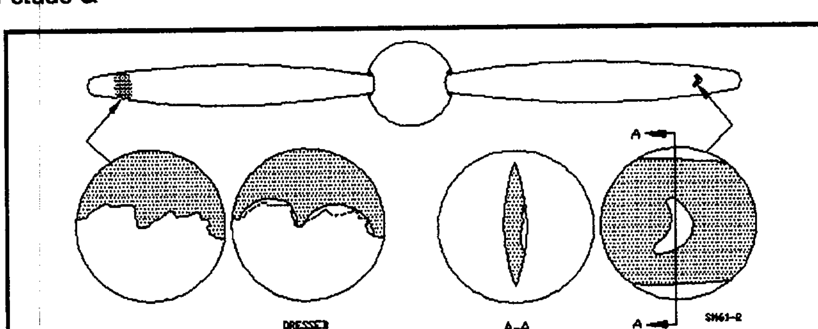
8. Conduct operational and leak check on propeller installation prior to flight.

61-10-00 - PROPELLER ASSEMBLY

No external lubrication is required on standard M20R propellers.
Preflight inspection should be accomplished prior to each flight to determine: if blades have been damaged, if any abnormal looseness is evident between hub and blades or if there is any evidence of oil leakage. Propeller must be repaired if any of above is evident.

61-10-10 - MINOR PROPELLER BLADE REPAIR

1. Minor nicks, dents and gouges may be dressed out by approved personnel. Blend any nicks or gouges into leading edge with smooth curves or generous radii as shown in (Figure 61-3). Repaint area to reduce corrosive action.



PROPELLER BLADE MINOR REPAIRS - FIGURE 61-3

61-20-00 - PROPELLER CONTROLLING

61-20-10 - PROPELLER GOVERNOR CONTROL RIGGING

1. Disconnect propeller governor control rod.
   A. Remove cotter pin, nut, bolt and washers from rod end at propeller governor control arm.
   B. Disconnect control rod from governor control arm.
2. Adjust control arm spring to minimum tension which will return control arm to maximum RPM.
3. Push propeller control in cockpit, full forward. Pull control back approximately 1/8 inch and lock in this position.
4. Place governor control arm against high RPM stop screw.
5. Adjust propeller control rod end to coincide with governor arm position.
6. Attach control rod end to governor arm and replace cotter pin.
7. Operate propeller control from cockpit to verify full travel of control arm in both directions, high RPM to minimum RPM stop.

NOTE
When propeller control rigging is complete, check controls in cockpit to be sure there is 1/8 inch cushion between control knob and adjustment nut on instrument panel. The control should not bottom out when pushed full forward.

CAUTION
Recheck safety wire, security and thread engagement on all engine controls after adjustment, rigging or assembly.

NOTE
Vernier control's friction can be adjusted by loosening lock nut on back side of panel and either tighten nut on front of panel to increase friction or loosen nut to decrease friction. Retighten lock nut on back side to secure cable to panel.

61-20-90 - PROPELLER GOVERNOR TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Leakage:		
Between control shaft and head.	Damaged O-Ring.	Replace with new O-Ring.
Between head and body.	Damaged head and body gasket.	Replace gasket.
Between relief valve plug and body.	Damaged relief valve plug gasket.	Replace gasket.
Between body and base.	Damaged body and base gasket.	Replace gasket.
Between governor base and engine mounting pad.	Damaged governor mounting gasket.	Replace gasket.
	Loose governor attaching nuts.	Retighten nuts.
	Warped engine mounting pad.	Consult engine manual.
Inability to attain proper RPM during static ground run:	Wrong high-RPM governor setting.	Reset governor external, high RPM adjustment screw.
NOTE: T/O RPM should NOT be attainable during static ground run. Proper RPM should be less than 2500 RPM.	Incorrect system rigging.	Adjust control system.
	Low engine power.	Consult engine manual.
	Erroneous reading tachometer or manifold pressure gauge.	Calibrate or replace instruments.

PROPELLER GOVERNOR TROUBLE SHOOTING (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
Inability to attain proper RPM during static ground run: (con't.)	Sticky pilot valve.	Remove head and clean pilot valve with crocus cloth. Maintain sharp pilot valve land corners. Check for straightness of pilot valve; if bent, replace valve.
RPM will not stabilize:	Sludge in governor pilot valve or relief valve.	Disassemble and clean.
	Burrs on pilot valve lands.	Disassemble and clean with crocus cloth.
	Backlash in governor control system.	Re-rig or adjust control system.
	Short control lever making fine speed adjustment impossible.	Re-rig control system.
	Sticky relief valve.	Inspect for burrs, and clean.
	Erroneous reading tachometer.	Calibrate or replace instrument.
	Excessive oil leakage in engine transfer bearing.	Refer to engine manual.
	High propeller friction.	Refer to propeller overhaul manual.
	Governor function upset by malfunctioning engine.	Repair engine for smooth operation.
	Air trapped in propeller.	Cycle propeller from MIN to MAX pitch several times to purge air.
	Sticky pilot valve.	Remove head and pilot valve. Clean away sludge and varnish. Check speeder spring ends for proper settings.
	Bent pilot valve.	Remove head and replace pilot valve.
	Excessive internal leakage in governor.	Check rigging and make necessary part replacements.
Excessive over-speeding:	Wrong governor setting.	Reset governor. Use test rig if available.
	Too rapid throttle opening.	Advance throttle evenly and slowly.
	Damaged or wrong gasket between governor base and engine mounting pad.	Install correct new gasket.
	Sticky governor pilot or relief valve.	Disassemble, clean and check for burrs. Replace bent pilot valves.
	Erroneous reading tachometer or manifold pressure gauge.	Calibrate or replace instrument.

PROPELLER GOVERNOR TROUBLE SHOOTING (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
Inability to attain positive high pitch:	High-RPM screw adjusted too far IN, causing restricted arm travel.	Remove control arm and rotate one serration clockwise. Back out high-RPM screw to required maximum RPM.(One turn equals 27 RPM.)
Surging:	Excessive propeller/bladeseat friction.	Examine propeller hub for cause of friction.

61-40-00 - PROPELLER BALANCING

The propeller/spinner combination assembly is dynamically balanced at Mooney Aircraft Corporation. Any maintenance action to be accomplished on any component of these two assemblies should take this into consideration.

There are many different models of Dynamic Propeller Balancing Equipment, therefore details of proper operation and procedures should be taken from manuals of the specific manufacturer for equipment being used.

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CHAPTER

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POWERPLANT

CHAPTER 71

POWERPLANT

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CHAPTER 71

POWERPLANT

LIST OF EFFECTIVE PAGES

71-00-00 - GENERAL

The M20R (S/N 29-0001 thru 29-TBA) has a Teledyne Continental Motors (TCM) IO-550-G ( ) series engine installed. This is a six cylinder, 280 H.P., fuel injected, normally aspirated engine.

WARNING
Propeller Strike Incidents -- OR Hydraulic Lock -- Refer to TCM SB 96-11 (or subsequent data) for required engine maintenance action.

71-00-10 - ENGINE REMOVAL

It is recommended that engine mount be left on firewall and engine asssembly be removed at isolator attach points.
To assist in installation, identify and tag each part as it is removed. Plug or cap all lines, hoses, and fittings as they are disconnected.

1. Make sure all cockpit switches are - OFF.
2. Turn fuel selector valve OFF.
3. Remove engine cowling (See Section 71-10-00).
4. Disconnect battery ground cables.
5. Remove propeller (refer to section 61-00-10).
6. Drain engine oil sump.
7. Disconnect the following:
   A. Vacuum lines from both pumps.
   B. Cabin heat ducts (at engine).
   C. Fuel vent lines, from engine mount and airframe.
   D. Oil temperature bulb connections.
   E. Oil pressure line connections.
   F. Manifold pressure line from firewall.
   G. Cylinder head temperature bulb connections.
   H. Breather hose, from engine mount and lower airframe.
8. Disconnect the following control linkage:
   A. Throttle control.
   B. Propeller governor control.
   C. Mixture control.
9. Disconnect ignition switch wires from magnetos.

WARNING
Ground magneto breaker points.

10. Disconnect fuel flow wires from fuel flow transducer.
11. Disconnect engine ground strap.
12. Remove upper induction tube to access forward lifting eye.
13. Disconnect alternator and starter wires.
14. Disconnect exhaust headers at engine cylinders.
15. Disconnect fuel lines, inlet and outlet, at engine fuel pump.
16. Shore up fuselage at tail skid; use shoring stand to prevent tail from dropping after engine is removed.
17. Attach chain to forward and aft lifting eyes at top of crankcase. Slightly lift engine to relieve weight from engine mounts. Remove engine mount bolts from bed mount/isolators.
18. Slowly raise engine. Be sure all lines, hoses and wires are free.

71-00-20 - ENGINE INSPECTION & REPAIR

For specific engine inspection and overhaul instructions, consult engine manufacturer's overhaul manual and service instructions.

71-00-30 - ENGINE INSTALLATION

Reverse engine removal procedure for installation.

NOTE
Reinstall engine shock mounts/spacers in same position as they were originally installed. Refer to paragraph 71-20-00 for sequence of assembly.

1. Engine installation torque values are as follows:
   A. Spark plugs-300 to 420 inch lbs.
   B. Hose clamps-15 to 25 inch lbs.
   C. Engine shock mount bolts-450 to 500 inch lbs.
   D. 1/4 inch upper engine mount to fuselage bolts-50 to 70 inch lbs.
   E. #10-32 lower engine mount attach block to fuselage-20 to 25 inch lbs; 1/4 inch lower mount bolt torque-50 to 70 inch lbs.
2. Re-inspect to see that:
   A. Propeller and spinner are properly torqued.
   B. Engine mounting bolts are properly torqued.
   C. Engine controls are properly rigged and safetied. (Recheck rod-ends for proper threadgrip length.)
   D. Oil drain plugs are tightened and safetied.
   E. Oil sump is filled to eight quarts.
   F. Spark plugs are tight and ignition harness is properly installed.
   G. Magneto ground wires are properly installed and safetied.
   H. Oil temperature bulb/connections are tight and safetied.
   I. Oil pressure relief valve plug is safetied.
   J. Cylinder head temperature connections are secure.
   K. Starter cable connection is secure.
   L. Alternator wiring is secure.
   M. Exhaust system is secure.
   N. Vacuum lines and connections are secure.
   O. Fuel connections are tight and pressure checked.
   P. Manifold pressure lines are tight.
   Q. Oil pressure lines are tight and pressure checked.
   R. Fuel injection lines are tight and pressure checked.
   S. Oil filter is installed and secure.
   T. Induction manifold is secure.
   U. All lines, hoses and wires are properly anchored.
   V. Induction air filter is installed and secure.
   W. Engine cooling baffles are in place and secure.
   X. Engine area is free of loose objects, tools, etc.
   Y. Cowling is installed and secure (See SECTION 71-11-00).

71-00-40 - ENGINE GROUND OPERATION CHECKOUT

1. **Pre-starting procedure** (with aircraft headed into wind):

A. Turn ignition switch — OFF.

B. Check magneto ground connections.

C. Check engine oil level.

D. Check fuel quantity.

E. Operate all controls through full range to check for binding.

F. Check baffles and cowling for security.

G. Drain fuel sumps and gascolator; check for sediment and water.

H. Place wheel chocks and set parking brake.

2. **Starting procedure (NORMAL STARTS):**

A. Set propeller governor control: FULL FWD. (HIGH RPM).

B. Turn fuel valve ON to desired fuel tank.

C. Set mixture control: FULL RICH.

D. Open throttle control approximately 1 inch.

E. MASTER SWITCH — ON

F. Push boost pump switch for 3-5 seconds until positive indication of fuel flow is obtained.

G. Clear propeller area.

H. Start engine. Check oil pressure. If no oil pressure (min. 10 PSI) is indicated within 30 seconds, shutdown engine and troubleshoot oil system. Refer to TCM maintenance publications for procedures.

I. Set throttle for idle, 600/700 RPM, for one minute, then advance throttle slowly to 900/1000 RPM for engine warmup.

3. **Ground run and warmup**.

Always head aircraft into wind during warmup. Always select high RPM blade-angle setting when ground running engine. Never idle for extended periods at low RPM (low RPM will foul spark plugs). Operate with mixture control at FULL RICH (leaning is permissable depending on ground elevation); maintain RPM in 900/1000 RPM range during warmup and ground run.

A. Warmup engine until temperature indications are normal. Monitor cylinder head and oil temperature instruments for overtemperature.

B. Check magnetos at 1700 RPM with propeller at high RPM blade angle. Switch ignition-starter switch from BOTH to RIGHT to check magneto drop. Switch back to BOTH until RPM returns to normal. Switch from BOTH to LEFT and check magneto drop. Return switch to BOTH. Magneto drop should not exceed 150 RPM (normal is 75 RPM drop) on either magneto (drop should be within 50 RPM of each other). A smooth drop off past normal is usually a sign of too lean or too rich mixture. If no drop in RPM, check for open or broken P-leads.

4. **Cold Starts**:

Same procedures as Normal Starts, except more boost may be necessary. After engine starts, it may be necessary to operate Boost pump intermittently to prevent engine from stopping.

5. **Flooded Engine Starts**:

A. Mixture - Idle Cut-Off

B. Throttle - 1/2 Open

C. Magneto/Start Sw. - START position

D. When engine starts, return Magneto/Start Sw. to BOTH. Retard throttle. Slowly advance mixture to FULL RICH. Adjust as needed for elevation.

6. **Hot Starts**:

Same procedure as Normal Starts, except:

A. Mixture - FULL LEAN

B. Throttle - Full OPEN

C. Boost Pump - ON (15 to 20 seconds) then OFF.

71-00-50 - ENGINE SET UP PROCEDURE

It is recommended that the IO-550-G(5) engine installed on the Mooney M20R aircraft be set up according to the following instructions and in conjunction with TCM's IO-550-G Maintenance and Operator's Manual, P/N X30565 and TCM Overhaul Manual, P/N X30568A, Section 73-10-01, and appropriate TCM Service Bulletins.

CAUTION
Watch for rotating propeller during engine adjustment.

71-00-51 - FUEL INJECTOR ADJUSTMENT

For operation in normal or low ambient temperature conditions, adjust idle pressure, speed and mixture as follows:

Check magnetos; if magneto drop is normal, proceed with following adjustments.

1. **INSTALL TEST GAUGES/FITTINGS**

A. Install fitting adapter cover, P/N 050006-501, on right hand footwell, replacing standard cover plate.

B. Remove cap from unmetered fuel tee on right side of throttle body (Fig. 71-1, item 6).

C. Install a 0 - 60 PSI, calibrated, pressure gauge (vented to atmosphere) to tee, using a suitable length of hose. (Gauge should be readable in .25 PSIG increments in the 0 - 10 PSIG range)

D. Purge air from test hose by loosening fitting at gauge. Turn auxiliary fuel pump (LOW BOOST switch) ON until a stream of fuel runs from fitting, retighten fitting, then turn auxiliary fuel pump OFF.

E. Remove cap from manifold valve (flow divider) (Figure 71-1, item 2). Connect fuel pressure hose between this port and one fitting on RH footwell. Connect another hose from cabin side of fitting to pressure port on test gauge assembly. (This test gauge should be pre-calibrated in pounds per hour fuel flow per TCM metered fuel pressure vs. fuel flow chart in TCM publication, X30565, page 13-9)

F. Install "T" fitting between manifold pressure line and firewall fitting. Reconnect manifold pressure line to firewall fitting. Connect a test hose from "T" fitting to another fitting on RH footwell. Connect another hose from cabin side of this fitting to a calibrated, manifold pressure, test gauge assembly. (This gauge can be a 2 in 1 gauge assembly with the metered pressure vs. fuel flow gauge used in (E) above.)

G. Turn auxiliary fuel pump (LOW BOOST switch) ON. Position throttle and mixture controls - full forward. Loosen hose fitting on pressure port of test gauge until a stream of fuel runs from fitting, retighten fitting, then turn auxiliary fuel pump OFF.

2. IDLE FUEL PRESSURE

Check and adjust idle fuel pressure as follows:

A. Back off idle speed adjusting screw two turns (Fig. 71-1, item 3).

B. Start engine and warm up at 1500 to 1800 RPM until oil pressure is in GREEN ARC, CHT is in lowr one-quarter of GREEN ARC and oil temperature is 160 - 180° F.

C. While maintaining 650 RPM, using cockpit throttle control, set idle fuel pressure at 9 PSI by adjusting low unmetered pressure adjustment screw (Fig. 71-1, item 1) located on engine pump centerline. Mixture control must be full rich and test gauge (installed in step 1, B above)held at approximately same level as engine driven fuel pump. (Clockwise adjustment of screw increases pressure).

NOTE
Lightly tap fuel pump after each adjustment.

3. IDLE MIXTURE

Check and adjust idle mixture as follows:

CAUTION
Do not adjust idle mixture without first determing that idle pump pressure is correct.

A. Operate engine at 1500 to 1800 RPM until CHT is in lower one-quarter of GREEN ARC and oil temperature is 160 to 180° F.

B. Reduce engine speed and stabilize it at 650 RPM using cockpit throttle control.

C. Slowly, but postively, move mixture control from full rich to idle cut off. Engine speed shall increase 50 +/-25 RPM before beginning to drop toward zero.

D. If engine speed increase is less than 25 RPM, adjust idle mixture to enrichen. If engine speed increase is more than 75 RPM, adjust idle mixture screw to leaner mixture. Mixture adjustment screw (Fig. 71-1, item 4), turn clockwise to lean).

Recheck idle mixture to insure it is within specified limits. Recheck idle pressure.

NOTE
Lightly tap fuel metering valve after each adjustment.

NOTE
Any readjustment to idle pressure or mixture may cause change to other readings. Recheck all specified readings.

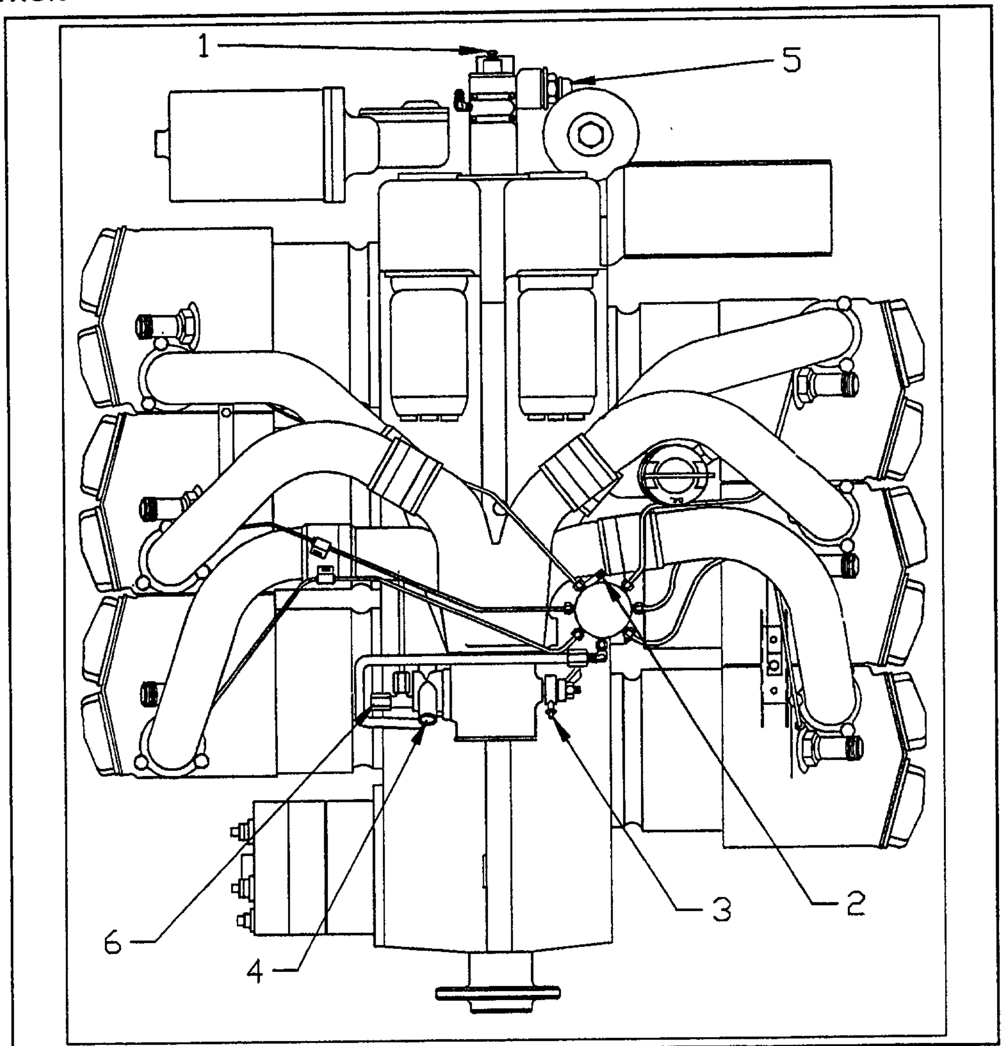


FIGURE 71-1 - ENGINE SET-UP AND ADJUSTMENT POINTS

LEGEND FOR FIGURE 71-1

1. UNMETERED FUEL PRESSURE
2. FUEL MANIFOLD VALVE, TEST FITTING
3. IDLE SPEED ADJUSTMENT SCREW (below full open stop adjustment)
4. IDLE MIXTURE, (CW = LEAN)
5. FULL POWER FUEL FLOW ADJUSTMENT, (CW = INCREASE)
6. UNMETERED FUEL CAP.

4. LOW BOOST PUMP PRESSURE ADJUSTMENT

Adjust low boost pump voltage regulator as follows:

A. Engine OFF.

B. Pressure gauge installed for unmetered fuel pressure.

C. Mixture - full rich position.

D. Throttle - full power position.

E. Master Switch and Low boost switch - ON.

F. Adjust boost pump voltage regulator to establish 6 PSI unmetered fuel pressure. (Clockwise to increase pressure). Low boost pump regulator is located adjacent to voltage regulator on passenger side of console, under instrument panel. Adjustment hole is accessible from outboard side of box.

5. **FULL POWER PERFORMANCE**

Check and adjust full power performance as follows:

A. Adjust fuel flow to 137 pounds per hour with throttle set at full power, mixture control in full rich position. (Fig. 71-1, item 5)

NOTE
Mixture and propeller controls must be full forward.

NOTE
Lightly tap fuel pump after each adjustment.

B. Recheck idle pressure setting as specified in 2 above and adjust as required.

C. Recheck 100 percent power fuel flow as specified in 5. A. and adjust as required.

CAUTION
Do not exceed 2500 RPM under any circumstances during the full power adjustment process.

6. **IDLE SPEED**

Check and adjust idle speed as follows:

A. Operate engine at 1500 to 1800 RPM until CHT is in lower one-quarter of GREEN ARC, and oil temperature is 160 to 180°F (maintain CHT during adjustment).

B. Reduce engine speed and stabilize at 750 RPM.

C. Adjust idle speed adjusting screw (Fig. 2, item 3) until contact is made with throttle arm stop.

NOTE
Fuel flow will vary with temperature changes. Temperature variations from NACA STANDARD DAY temperature causes approximately .7 lbs./hr. fuel flow change with each 1° C. variation (minus if hotter, plus if colder).

If RPM changes appreciably after making idle mixture adjustment during the succeeding steps, readjust as necessary.

71-00-52 - ENGINE SET-UP — CONTROL RIGGING

Check all fuel lines, reference lines, gauge lines and electrical connections for proper routing and security of fittings.

1. **CHECK AND ADJUST ENGINE CONTROL RIGGING**

A. Operate each engine control through full range of travel; check for smooth operation and contact of stops at each end of travel.

B. Check each control at instrument panel for .06 to .12 inch cushion, with control pushed full forward.

CAUTION
Do not force vernier controls by turning knobs.

NOTE
Any vernier control which tends to creep can be tightened by loosening housing nut at back of panel and tightening face nut on pilot's side of panel.

C. Adjust controls by adjusting rod end on forward end of control. If additional adjustment is required, control arm may be repositioned to adjust throttle or mixture. Additional adjustment may be obtained on propeller governor by loosening six screws on governor head and rotating governor head to obtain required adjustment.

D. Tighten all screws and resafety, if required.

2. **PROPELLER RPM ADJUSTMENT**

A. Verify that propeller governor will allow engine to operate at 2500 +0/-25 RPM. Adjust high RPM stop screw on governor head as required to obtain 2450 to 2500 RPM. Recheck control cable assembly cushion as specified in Step 71-00-52, A, (2) above.

B. Run engine until 170° to 180° oil temperature is obtained. Slowly apply full throttle (propeller and mixture full forward). RPM should not exceed 2500 RPM for any long duration, short duration overspeed (2600 RPM transcient) is acceptable until governor reacts and controls to 2500 RPM maximum.

3. **CLEAN UP**

After all flight checks and adjustments are complete, remove test gauges, reinstall cap an plug on throttle body and manifold valve and conduct a leak check of all connections. Ensure all hoses are correctly reconnected. Remove footwell fitting adapter and replace with footwell cover adapter.

71-00-60 - FUEL INJECTION SYSTEM MAINTENANCE

For specific injection system inspection and overhaul instructions, consult TCM's Overhaul manual, Form X30568A, Section 73-10-06, and applicable Service Instructions for the IO-550-G engine.

71-00-70 - STARTER SYSTEM MAINTENANCE

Inspect and service starter per TCM's maintenance manuals and Service Instructions.

CAUTION
Do not operate starter in excess of 30 seconds; allow cooling time before re-engaging.

71-00-80 - ENGINE MIXTURE CONTROL RIGGING

1. Disconnect mixture control from mixture control arm on fuel pump.

A. Remove cotter key.

B. Remove nut, bolt and washers from clevis and mixture control arm.

C. Position fuel pump mixture control arm approximately center of travel arc.

D. Push Vernier control button IN and position Mixture Control approximately mid-way in its travel.

2. Reverse disconnect procedure to reconnect Mixture Control to mixture control arm on fuel pump.

A. Check for full travel and required cushion.

B. If additional cushion is necessary loosen locknut on control rod end and adjust control arm rod as required to obtain cushion.

C. Check security of bolt, nut, etc..

71-00-90 - STARTER TROUBLE SHOOTING

See Section 24-39-04 for procedure. TCM's OVERHAUL MANUAL AND OPERATORS MANUAL, Form X30565, should be consulted.

71-10-00 - COWLING REMOVAL

71-10-01 - TOP COWLING

1. Remove screws from top cowling.
2. Unlatch cam locks (1/4 turn fastners) along each side.
3. Unlatch cam locks on aft edge of top cowling, just ahead of windshield.
4. Carefully lift top cowling OFF.

71-10-02 - BOTTOM COWLING

1. Unlatch cam locks located on bottom of cowling, and around exhaust cavity fairings, LH & RH. LH exhaust cavity fairing can be removed, RH exhaust cavity fairing can be left supported by the attached drain valve fitting & hose, if desired.
2. Unlatch cam locks around NACA duct on lower, right, forward end of lower cowl.
3. Unlatch cam locks around induction air inlet duct at forward center of lower cowl.
4. Unlatch cam locks on aft sides of bottom cowling, while supporting cowl.
5. Carefully lower cowling clear of spinner and remove from aircraft.

71-11-00 - COWLING INSTALLATION

NOTE

Check condition of tape on firewall flange where cowling will rest. Polyethylene tape, P/N 5421(UHMW) (3M), 1 in. wide is recommended. This will decrease streaking during wet weather operations.

71-11-01 - BOTTOM COWLING

1. The bottom cowling is installed "first" in reverse sequence of removal.

71-11-02 - TOP COWLING

1. The top cowling is installed in reverse sequence of removal.

71-12-00 - ENGINE COWL FLAPS

Not applicable to Mooney M20R aircraft.

71-20-00 - ENGINE MOUNTS

The M20R engine mount is a welded, bed type, dynafocal mount assembly constructed of 4130 chromemoly steel tubing.

MOONEY M20R ENGINE MOUNT INSTALLATION

Rubber shock mounts are installed in a specific sequence for proper dampening of engine and propeller power pulses.

The following sequence of assembly must be observed.

1. Assembly sequence for M20R engine mount isolators installation.
2. All positions are looking from cockpit forward and down from top of engine.
3. All assembly sequences are from bottom to top of stack.

-- M20R ENGINE ISOLATOR STACK UP SEQUENCE --

LEFT FRONT

Bolt	NAS1307-50
Washer	600364-7
Heat Shield	600429-503
Lord Mount	J9612-43
Engine Mount Sequenced in at this point.	
Spacer, Bolt	J10931-2
Lord Mount	J9612-42
Heatshield	600394-7
Engine is Sequenced in at this point.	
Engine Mount Adapter	TCM

RIGHT FRONT

Bolt	NAS1307-50
Washer	600364-5
HeatShield	600394-5
LordMount	J9612-43
Engine Mount Sequenced in at this point.	
Spacer,Bolt	Y16440-2-497
Lord Mount	J9612-44
Washer	600364-7
Heatshield	600394-7
Engine is Sequenced in at this point.	
EngineMount Adapter	TCM

-- M20R ENGINE ISOLATOR STACK UP SEQUENCE -- (con't.)

LEFT REAR

Bolt	NAS1307-50
Washer	600364-7
HeatShield	600394-5
Washer	600364-5
Lord Mount	J9612-44
Engine Mount is Sequenced in at this point.	
Spacer, Bolt	Y16440-2-497
Lord Mount	J9612-43
HeatShield	600394-7
Engine is Sequenced in at this point.	
Engine Mount Adapter	TCM

RIGHT REAR

Bolt	NAS1307-50
Washer	600364-7
HeatShield	600394-5
Washer	600364-5
LordMount	J9612-44
Engine Mount is Sequenced in at this point.	
Spacer,Bolt	Y16440-2-497
Lord Mount	J9612-43
HeatShield	600394-7
Engine is Sequenced in at this point.	
EngineMount Adapter	TCM

TORQUE ISOLATOR MOUNTING BOLTS TO 450 - 500 INCH LBS.

71-30-00 - FIRESEALS

Firewall fireseals and grommets, if removed and replaced for any reason, should be re-sealed after routing cable(s) or wire assembly(ies) from engine compartment into cockpit area. After installation, cover cable or wire and grommet underneath fireseal with Coast, Pro-Seal 700 on engine side of firewall.

71-60-00 - AIR INTAKES

The engine cooling air intakes and exits are calculated for optimum cooling requirements and minimum drag. Normal engine operating temperatures are at optimum to facilitate engine efficiency.

The engine induction air intake is a fiberglass duct that picks up impact air and routes it through replaceable air filter to engine.

The air intake system includes an alternate air intake system that is automatically operated any time primary induction air becomes blocked. A manual operation control is provided also. An amber, ALT AIR light, on annunciator panel, will illuminate any time alternate air door is open.

71-61-00 - INDUCTION AIR DUCT REPLACEMENT

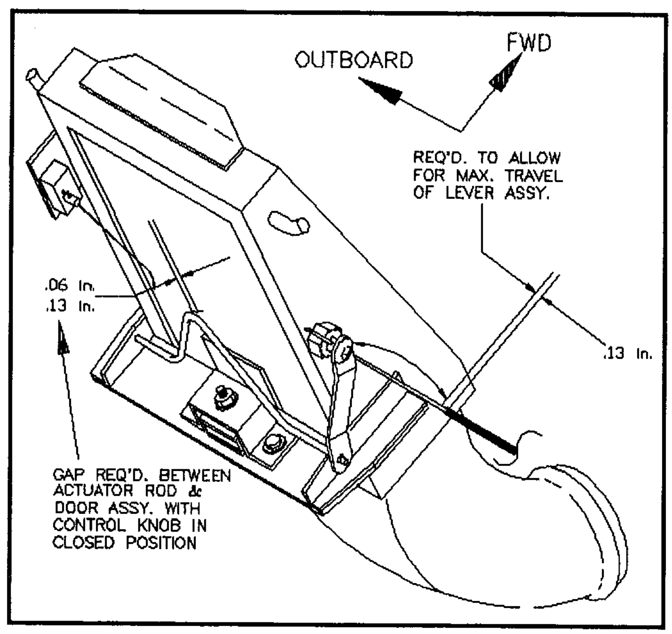
When induction air duct must be replaced, it is essential that duct be securely fastened to air filter housing to prevent interference with cowling.

NOTE

Apply continuous bead of sealant approximately .06 in. high to all sealing flanges of induction air assembly when air filter housing has been removed and is to be re-installed on induction air assembly.

71-62-00 - ALTERNATE AIR DOOR RIGGING

1. Clamp housing of alternate air intake control assembly at bracket on alternate air box so housing extends only .13 inches beyond clamp. This will allow maximum travel of alternate air door lever assembly. **Figure 71-2**.
2. The alternate air lever assembly should be rigged so .06 to .13 gap remains when alternate air box door is held closed with magnetic catch assembly.
3. The annunciator light switch is mounted on alternate air box and should be rigged to extinguish light with bottom of door .25 in. (max.) from fully closed.
4. Check opening force of door. It should take between 4.5 and 7.5 pounds to open door. Take readings at approximate location of magnetic catch assembly.



ALTERNATE AIR DOOR RIGGING - FIGURE 71-2

CHAPTER

72

ENGINES

CHAPTER 72

ENGINE

LIST OF EFFECTIVE PAGES

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72-00-00 - GENERAL

Refer to Teledyne Continental Motors (TCM), IO-550-(G) engine Maintenance & Operators Manual, Form X30565, and Overhaul Manual, Form X30568A, for detailed information on the IO550-G(5) engine installed in the Mooney M20R.

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CHAPTER

73

ENGINE FUEL AND CONTROL

CHAPTER 73

ENGINE FUEL SYSTEMS

LIST OF EFFECTIVE PAGES

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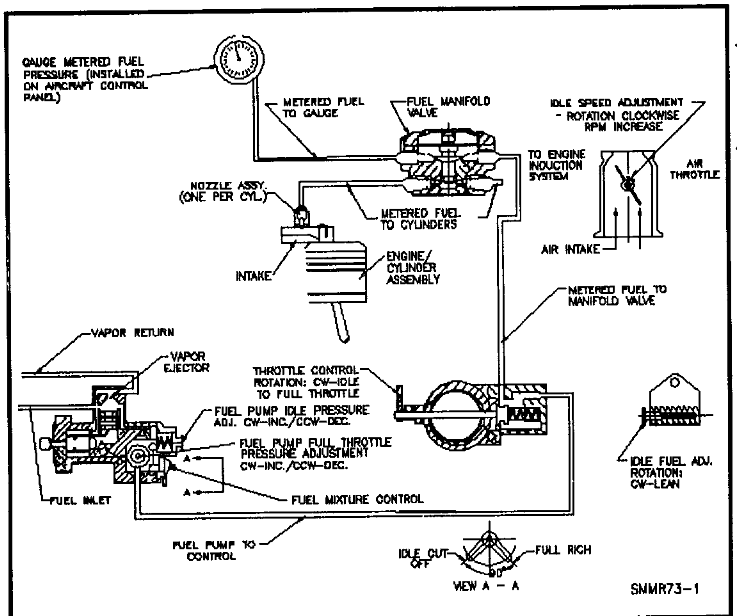
73-00-00 - GENERAL

The engine and its accessories are certificated under Teledyne Continental Motors (TCM) Type Certificate. Refer to Teledyne Continental Motors (TCM) Maintenance & Operators Manual, Form X30565, or Overhaul Manual, Form X30568A, for specific instructions.



M20R FUEL SYSTEM SCHEMATIC FIGURE 73-1

73-10-00 - DISTRIBUTION

Engine Fuel System Schematic **(Fig. 73-1)**

73-20-00 - CONTROLLING

See Section 71-00-50 for engine Set Up and Idle/Mixture Adjustments.

73-30-00 - FUEL FLOW INDICATING

A turbine type fuel flow transducer and matching indicator are installed on the M20R aircraft.

73-31-00 - FUEL FLOW SYSTEM - GENERAL SYSTEM DESCRIPTION

The Fuel Flow Totalizer system, utilizes the latest in microcomputer technology and components. The fuel flow system is designed to maximize the efficiency of fuel system management by displaying fuel consumption rate (fuel flow) of engine and precise amount of fuel engine has consumed. This information may be displayed in one of the following formats, US Gallons, Pounds, or Liters depending on switch or contact arrangement (**Figures 73-2, 73-3 or 73-4**).

One of two systems may be installed. Either system consists of a panel mounted instrument and a fuel flow transducer located between fuel control unit and flow divider.

The system is designed for use in single engine, fuel injected aircraft having no more than 60 GAL/HR continuous consumption or 78 GAL/HR Intermittent consumption. (Take Off power).

73-31-01 - PANEL MOUNTED INSTRUMENT

The panel mounted instrument contains all system electronics and can be divided into following groups:

FT-101 SYSTEM

1. DISPLAY - The display uses one mini-lamp and four seven segment incandescent digits that are fully sunlight readable. Display dims automatically during night and low light flight conditions.
2. MICROPROCESSOR - The microprocessor, in the FT-101, contains a crystal controlled oscillator which controls all timing and computing functions for precise fuel flow and totalizing computations.
3. POWER SUPPLY - The FT-101 power supply is a high speed switching regulator type for optimum efficiency and lowest possible power drain on aircraft's electrical system.
4. MEMORY - The FT-101 microprocessor continuously stores and updates totalized fuel quantity in a random access memory chip. The Total Fuel Used quantity is retained during aircraft shut down by connecting FT-101 memory wire to aircraft battery through a memory switch. Drain on aircraft batteries is small due to low power CMOS memory chip which uses only 3.5 milliamps at 24 VDC.
5. INTERNAL SWITCH ARRANGEMENT - The programming switch block (**Figure 73-3**) located inside the FT-101 panel mounted unit has several arrangements to change data readout, if desired. Switches S1 and S2 (**Figure 73-2**) should not be changed unless transducer "K" factor of a replacement transducer differs from original unit's "K" factor (See Section 73-31-02, 3, for "K" factor description).

Switches S3 thru S7 can be positioned in various arrangements to change fuel flow readout to gallons, pounds or liters as the situation may require, (**Figure 73-2**).

FT-101 SWITCH ARRANGEMENT

K-FACTOR	SWITCH ARRANGEMENT	
SWITCH No.	S1	S2
L	ON	ON
M	ON	OFF
H	OFF	ON
HH	OFF	OFF

FT-101 SWITCH ARRANGEMENT (con't.)

FUNCTION	SWITCH ARRANGEMENT				
SWITCH No.	S3	S4	S5	S6	S7
GALLONS	ON	OFF	OFF	NA	NA
POUNDS	OFF	ON	OFF	NA	NA
LITERS	OFF	OFF	ON	NA	NA

FT-101 TRUTH TABLE
FIGURE 73-2

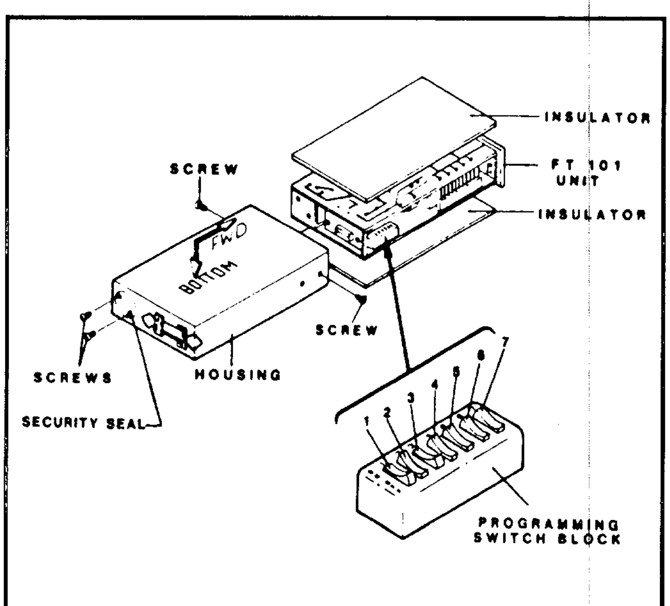
FT-101A (HOSKINS) SYSTEM

1. Basically same as Ft-101.
2. Refer to SDI Operators or Maintenance Manual for specific data.
3. See Figure 73-3 for FT-101A Switch arrangement.

K-FACTOR ADJUSTMENT - FT 101A

SWITCH NUMBERS	S1	S2	S3	S4	S5	S6	S7
(1111) LOW LOW LOW	CLOSED	OPEN	OPEN	X	X	N	X
(2222) LOW LOW	OPEN	CLOSED	OPEN	X	X	O	X
(3333) LOW	CLOSED	CLOSED	OPEN	X	X	T	X
(4444) MEDIUM	OPEN	OPEN	CLOSED	X	X	U	X
(5555) HIGH	CLOSED	OPEN	CLOSED	X	X	S	X
(6666) HIGH HIGH	OPEN	CLOSED	CLOSED	X	X	E	X
(7777) HIGH HIGH HIGH	CLOSED	CLOSED	CLOSED	X	X	D	X
FUNCTIONS							
GALLONS	X	X	X	OPEN	OPEN		CLOSED
LITERS	X	X	X	CLOSED	OPEN		OPEN
POUNDS	X	X	X	OPEN	CLOSED		OPEN

FT-101A SWITCH ARRANGEMENT - FIGURE 73-3



FT-101 SWITCH ARRANGEMENT - FIGURE 73-4

SHADIN SYSTEM

The -L option is a fuel management system designed to provide information relative to actual flight conditions without any manual data entry, except for initial fuel on board. It is connected to engine fuel flow transducer for fuel flow data and the Loran (or GPS) receiver for navigation data.
The system provides:
Specific Range: NM/gal. or NM/10 lb. of fuel burned. Optimum cruise speed can be obtained by selecting power setting which yields highest NM/gal.
Fuel to Destination:System calculates fuel necessary to reach destination as selected on Loran (GPS) receiver by multiplying Fuel Flow by ETE to destination.
Fuel Reserve: System calculates amount of fuel which will be available onboard when aircraft reaches destination, as indicated on Loran-C (GPS) receiver waypoint. This feature provides pilot with necessary data to evaluate reserve fuel situation based on accurate data early enough to take necessary action.

Endurance: System calculates time left to fly in hours and minutes based on fuel on board and fuel consumption.
Fuel Remaining: System keeps track of fuel remaining on board.
Fuel Used: System keeps track of fuel used since last fuel entry.
Not Enough Fuel: System will flash display digits when rotary switch is in Fuel to Destination position and fuel to destination is more than fuel remaining. Fuel remaining display digits will show a negative sign (-) followed by amount of fuel short to reach destination.
Fuel Reserve will be Used: System will flash display digits when rotary switch is in either Fuel to Destination or Reserve Fuel. This warning is intended to alert pilot that prevailing conditions will require use of the 45 minute Fuel Reserve or part of it.
Fuel Flow: System provides digital readout of fuel flow per hour to one/tenth of a gallon.

SHADIN SYSTEM COMPONENTS

System consists of three basic units:

1. Fuel Flow Transducer -
2. Loran (GPS) receiver (not part of Shadin system)
3. Indicator: (which includes)
   - Microprocessor
   - Interface
   - Display
   - Display Controls

SHADIN SYSTEM MEMORY

System includes a non-volatile memory for retaining basic settings and Fuel Remaining and Fuel Used during power shut down.

TEST FUNCTIONS AND ERROR MESSAGES

Press "TEST" button. Program checks hardware and display. If test is successful, "good" is displayed; if not "bad" is displayed and system is to be considered unserviceable until corrective action is taken.
When "test routine" is completed, system will display the following:

1.Software basic # and revision level.

2.K factor setting in flow window (pulse count per gallon). This number MUST match pulse count stamped on fuel flow transducer, otherwise errors will occur.

3.Display units (Gal., LB 5.8), part of checking internal settings.

4.Loran-C (GPS) distances as shown on Loran-C (GPS) receiver to check Data Interface Integrity. If system is not capable of reading Loran-C (GPS) data, the word "LbAd" will be displayed.

REPLACEMENT OF SHADIN SYSTEM COMPONENTS

Replacement of either flow flow transducer or display unit must have new units set to same K- factor as old unit. Transducers are pre-set by manufacturer and display unit must be set to agree with transducer setting. Refer to table below:

Transducer Configuration	K-Factor	Indicator Setting
Aerosonic Transducer	3 (85000 pulses/gal.)	3 or 85000
Floscan Transducer	L	82000
	M	85000
	H	87000

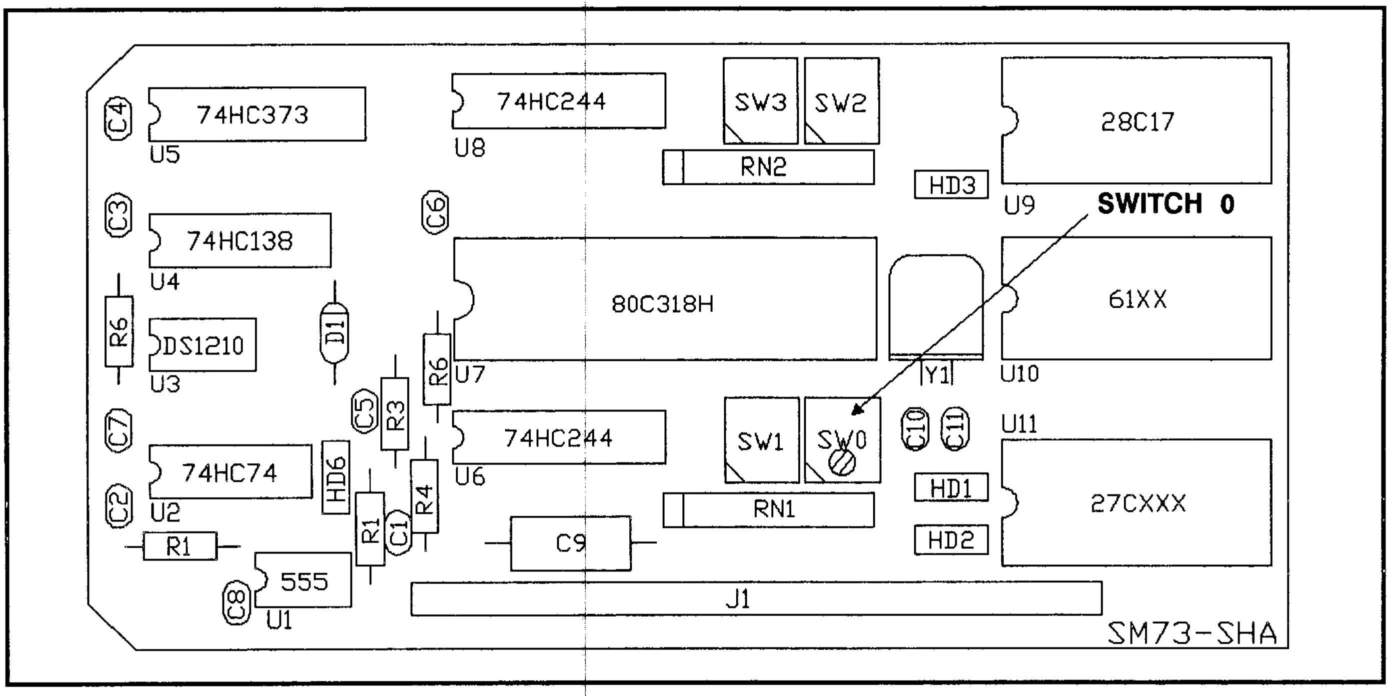
To change K-Factor in Shadin Miniflo display unit:

1. Remove can from indicator
2. Locate switch "0". (Ref. **Figure 73-5)**
3. Set switch to one of the following positions:

K-Factor	Sw. #	Display will read
K-0	B	88.0
K-1	A	87.0
K-2	9	86.0
K-3	8	85.0
K-4	7	84.0
K-5	6	83.0
K-6	5	82.0
K-7	4	81.0
K-8	3	80.0
K-9	2	79.0

73-31-02 - FUEL FLOW TRANSDUCER

1. The turbine fuel flow transducer, mounted in engine fuel line, measures flow of fuel. Transducer is rated for continuous operation to 60 gallons per hour. In addition, the transducer is accurate down to 0.6 gallons per hour.
2. Transducer supplies Fuel Flow Totalizer with a pulse signal from a self contained opto-electronic pickup. A neutrally buoyant rotor spins with liquid (fuel) flow between V-jeweled bearings. Rotor movement is sensed when notches in rotor interrupt an infra-red light beam between a light emitting diode and a phototransistor.
3. Transducer design is fail safe; complete rotor blockage cannot interrupt fuel flow. Transducer life expectancy is 1500 hours.



SHADIN FUEL FLOW CIRCUIT - FIGURE 73-5

NOTE
Transducers are categorized by number of pulses per second output for a given GPH flow rate ("K Factor"). This will be noted as: L, M, H, or HH scribed on end of Serial Number. For accurate readings, replacement transducers should have same "K" factor as units being replaced. Specify "K" factor code when ordering new transducers.

4. Fuel flow transducer removal.

A. Remove top and bottom cowling from aircraft. See Section 71-10-00 for procedures.

B. Remove safety wire from firesleeve around turbine transducer and unwrap firesleeve to expose transducer.

C. Cut and remove ty-raps from insulator sleeves on knife disconnects of electrical wires.

D. Slide insulation sleeving up on electrical wire harness.

E. Disconnect knife disconnects.

F. Loosen nuts on tubes at fittings prior to loosening nuts on attaching bolts.

G. Loosen and remove nuts, washers and bolts from transducer and bracket.

H. Disconnect flare nuts from transducer fittings. Transducer should now be free for removal. Note position (orientation) of fittings on old transducer.

I. Cap all lines to prevent contamination.

5. Fuel flow transducer (replacement) installation.

NOTE
"K" factor of replacement transducer should match "K" factor of replaced unit. Refer to "NOTE" following Section 73-31-02, paragraph 3 for detailed explanation.

A. Note position (orientation) of fittings on old transducer and place them in similar position on new transducer.

B. Connect nuts of lines to fittings, leave them snug, not tight.

C. Connect new transducer to bracket using bolts, washers and nuts.

CAUTION
Make sure lines are not being put into a bind or twist when securing transducer to bracket.

D. Tighten all fuel lines and bolts to secure transducer.

E. Connect knife disconnects and slide insulating sleeving over connections. Secure sleeving with ty-raps.

F. Leak check all fuel connections by pressurizing fuel lines with boost pump. Correct any leaks or discrepancies.

G. Wrap firesleeving over transducer and secure into position with safety wire.

NOTE
Installation of new transducer may affect engine fuel flow adjustment. It is recommended that procedures of Section 71-00-50 be followed to assure engine is set up for proper operation.

H. When all adjustments have been made and all connections checked for security, install cowling per Section 71-10-00.

73-31-03 - GENERAL OPERATING PROCEDURES

-- FT-101/101A

1. Turn aircraft Master Switch - ON. When aircraft electrical system is activated, the FT-101/101A display will flash zeros (000.0). Flashing is reminder for pilot to reset or check Fuel Used by pressing either RESET or USED/TEST button. Once RESET or USED/TEST button is depressed, display will stop flashing and read current fuel flow.

After starting aircraft's engine, the FT-101/(A) will continuously display fuel flow. Total Fuel Used may be displayed by pressing and holding USED/TEST button on right of instrument. Total Fuel Used will be displayed as long as USED/TEST button is depressed (or for 2 seconds), whichever comes first. This number may be reset to zero (0.0) by depressing and holding RESET button for at least 1 second.

2. The totalizer function may be used as a single flight totalizer or as a long term totalizer. Both methods are explained below.

A. SINGLE FLIGHT TOTALIZER. Aircraft should be topped with fuel before each flight so total usable fuel will be known. Turn aircraft Master Switch - ON. Push and hold reset button, located on left of instrument, for at least 1 second. RESET button has a one/half second delay to prevent accidental reset.

On starting engine, FT-101/(A) will begin displaying fuel flow. Total fuel used may be checked by depressing USED/TEST button.

B. LONG TERM TOTALIZER. Turn aircraft Master Switch - ON. On activating aircraft electrical system, FT-101/(A) will flash zero (000.0) fuel flow. Depress and hold USED/TEST button. FT-101/(A) will display total fuel used from previous flights. DO NOT push RESET button! On starting engine, FT-101/(A) will display fuel flow and continue counting fuel used, up to 999.9 gallons, 9999 pounds, or 9999 liters, depending on internal setting.

73-31-04 - TEST FUNCTION

A test function is provided in the FT-101/(A), so pilot may verify that all digits are functioning prior to each flight. To use test function, depress and hold USED/TEST button two times within one second and FT-101/(A) will display all eights (888.8).

73-31-05 - TROUBLESHOOTING FT-101/101A FUEL MANAGEMENT SYSTEMS

Troubleshooting any FT-101/(A) type fuel management systems should be approached in a systematic manner. All problems can be put in one to five categories:

- Improper operation due to lack of knowledge about system.
- Inoperative computer or main instrument.
- Inoperative transducer.
- Improper wiring.
- Improper transducer installation.

1. **MEMORY LOSS -**

A. Loses memory when Master Switch is turned - OFF.

(1) Check "Fuel Flow Memory" Switch - ON.

(2) If switch is ON, check clock for operation.

(3) If clock inoperative, replace fuse at battery.

(4) If no problem found, remove connector from unit, check Pin 9 for bus voltage.

(5) If voltage present, replace FT-101/(A).

B. Memory scrambles when engine starts. Exchange FT-101/(A) for modified unit.

2. **DOES NOT INDICATE**

A. No display.

(1) Remove connector from indicator. Check Pin 1 of harness connector for bus voltage. Check Pin 8 for airframe ground. If OK, change indicator.

B. Displays zeros (with engine running)

(1) Remove cowling for access to transducer. Remove insulating sleeving from connections on all wires. Check BLACK wire for A/F ground. Check RED wire for bus voltage. Check WHITE wire for 2-3 volts with no fuel flow and increasing to near bus voltage at full flow.

(2) If no increase in voltage is seen on WHITE wire as flow increases or if too high a voltage indication is seen with no flow, change transducer.

(3) If RED wire does not have bus voltage, check wiring from transducer to Pin 3 of indicator.

(4) If BLACK wire is not grounded, check wiring from transducer to Pin 6 of indicator.

3. **ERRATIC INDICATIONS**

A. Check wiring for loose connections.

B. Check wiring for intermittent shorts.

C. Check transducer for foreign particles.

D. If all checks OK, replace transducer.

4. **INACCURATE READINGS**

A. Check transducer K-factor. The letter "L","M","H", or "HH" inscribed after the serial number.

B. Remove indicator from instrument panel and case. Check switch settings and correct to match transducer.

NOTE

Each switch setting changes reading by approximately 2%. If settings are OK, replace transducer.

CAUTION

Whenever transducer or indicator is replaced, care must be taken to set indicator switches to match transducer.

If after making these checks you still do not isolate problem or do not find a problem, contact Product Support Department, Mooney Aircraft Company for further assistance.

73-40-00 - FUEL INJECTOR-GENERAL

The fuel injection system is supplied with engine from TCM. It is of a multi-nozzle continuous flow type. Changes in air throttle position, engine speed or combination of both, cause changes in fuel flow. A manual mixture control and a pressure gauge, indicating metered fuel flow, are provided for precise leaning at any combination of altitude and power setting. Fuel Flow is directly proportional to metered fuel pressure, therefore, determination of power settings and fuel consumption can be accurately predicted.

The fuel control assembly contains a metering valve and mixture control valve. The metering valve is linked to air throttle valve lever which is linked to throttle control. Them mixture control valve is linked to cockpit mixture control. Excess fuel is bypassed back to tank being used.

TCM Maintenance and Operators Manual, Form X30565, dated August, 1990 or subsequent revision should be used for operation, installation or adjustment of fuel injection system.

73-50-00 -DRUCK TRANDUCER TEST

Refer to Section 79-40-00 for Druck Transducer Test Procedures.

73-60-00 -ENGINE DRIVEN FUEL PUMP - INFORMATION

Refer to TCM Maintenance and Operators Manual, Form X30565, dated August, 1990 or subsequent revision for inspection or maintenance of engine driven fuel pump.

73-60-01 -AUXILIARY FUEL PUMP, LOW BOOST - SET-UP

See Section 71-00-51,4 for procedures.

CHAPTER

74

IGNITION

CHAPTER 74

IGNITION

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74-00-00 - GENERAL

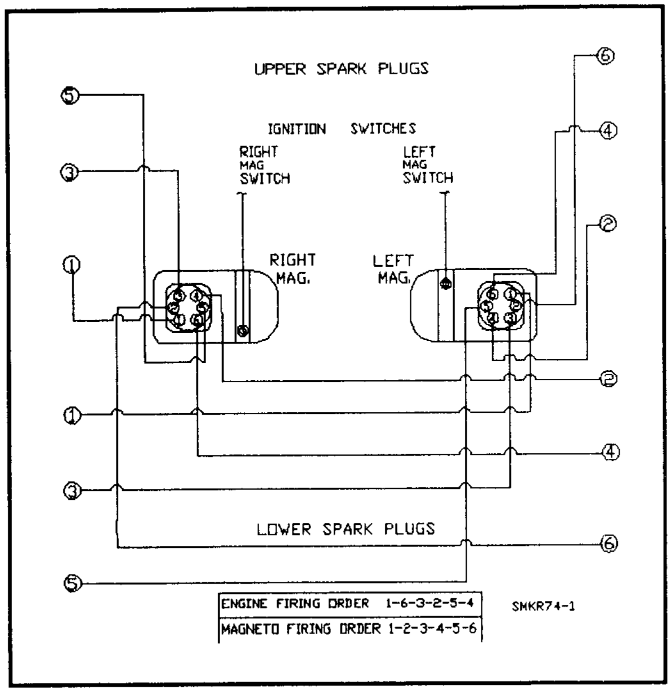
The IO-550-G series engines are equipped with Bendix S6RN-25 Series magnetos. The left magneto incorporate an impulse coupling that retards spark for starting. When engine starts, centrifical force, on counter weights, hold latch pawls away from stop pins. The magneto then will fire at its advanced firing position.

The magneto/starter switch combines both ignition and starting functions. Turn key clockwise through R, L and BOTH to START position; push forward on key while in START and starter relay is energized. Release of key, after engine starts, will return switch to BOTH position where both magnetos are operative.

In OFF position, both magnetos are grounded. At R position, left magneto is grounded and at L position, right magneto is grounded.

74-10-00 - ELECTRICAL POWER

74-10-01 - IGNITION SYSTEM TROUBLE SHOOTING



IGNITION WIRING DIAGRAM - FIGURE 74-1

TROUBLE	PROBABLE CAUSE	REMEDY
Failure to start or hard starting.	Ignition Switch OFF or grounded switch wires.	Turn Switch ON. Check for grounded wires.
	Magneto impulse coupling not operating properly.	Refer to TCM Maintenance and Overhaul Manual, Form X30568A, SECTION 74.
	Spark plugs fouled, improperly gapped or loose.	Remove and clean spark plugs. Adjust to proper gap. Install and tighten to specified torque.
	Magnetos improperly timed to engine.	Check magneto timing to engine. Refer to TCM manual, Form X30568A, SECTION 74.
	Shorted Condenser	Replace Condenser.
	Magneto internal timing incorrect or timed for opposite rotation.	Install correctly timed magneto. Reference TCM Manual, Form S30568A Section 74, for timing procedures
Engine roughness (Idle).	Loose, fouled or improperly gapped spark plugs.	Tighten Spark Plugs. Clean spark plugs. Adjust spark plug gap. Install new spark plugs.
	Weak Condenser	Replace Condenser
Engine Roughness (Above Idle RPM)	Loose or improperly gapped spark plugs.	Tighten to specified torque. Adjust to proper gap.
	High tension leak in ignition harness.	Check plug leads for deterioration.
	Weak or burned out condenser as evidenced by burned or pitted breaker points.	Replace points and condenser.

- IGNITION SYSTEM TROUBLE SHOOTING (con't.)

TROUBLE	PROBABLE CAUSE	REMEDY
Sluggish Operation and/or Excessive RPM drop.	Fouled or dead spark plugs.	Clean spark plugs. Replace dead spark plugs.
	Improperly gapped spark plugs.	Adjust to proper gap.
	Magnetos out of time with spark plugs.	Refer to TCM manual, Form 30568A, SECTION 74 for timing procedure.
	Damaged magneto breaker points or condenser.	Replace points and condenser

NOTE

Aircraft which are flown at higher altitudes during normal flight operations require more frequent maintenance on ignition components than aircraft flown at lower altitudes.

74-20-00 - ENGINE FIRING ORDER

Engine firing order is 1-6-3-2-5-4 (**Figure 74-1**). Observe position of No. 1 cable terminal in magneto outlet plate in relation to magneto case. As viewed from distributor end, magneto rotor turns counter-clockwise, passing in succession, terminals of spark plug cables in engine firing order. Cables are connected to magnetos so right magneto fires upper plugs on right side and lower plugs on left side. The left magneto fires upper plugs on left side and lower plugs on right side. The magneto cases, spark plugs, cables and connections are shielded to prevent radio interference.

NOTE

It is recommended that all spark plugs be removed, inspected, cleaned, re-gapped and reinstalled in the same cylinder but in a different spark plug hole every 100 hrs. Replace spark plugs after 400 Hrs. of operation.

74-30-00 - SWITCHING

The Magneto/Starter Switch is connected to magneto grounding wires ("P" leads) of both magnetos. Turning this switch from "BOTH" to "OFF" or from "R" to "L" to "OFF" will ground out both or either magneto. (See Section 74-00-00 for grounding sequence.)

RELIABLIITY: With proper installation and compliance with prescribed maintenance procedures Magnetos should last life of engine before overhaul or replacement is required.

CHAPTER

76

ENGINE CONTROLS

CHAPTER 76

ENGINE CONTROLS

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76-00-00 - ENGINE CONTROLS

76-10-00 - ENGINE CONTROLS RIGGING

See Section 71-00-52 for Engine Controls Rigging/Adjustments

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77

ENGINE INDICATING

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ENGINE INDICATING

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77-00-00 - GENERAL

Engine indicating instruments and their sending units, transducers, probes, etc., must be operating properly to prevent engine damage.
It is recommended that all engine indicating components be checked at each 100 hour or annual inspection to verify proper operation. Calibrated instruments may be "Tee'd" into particular systems for comparison checks between them and aircraft's instruments.

77-00-01 - RANGES

Power plant instruments operate electrically through variations in resistance caused by pressure or temperature changes, by variations in current output caused by varying engine RPM or alternator output, or by pressure from engine induction system.

S/N 29-0001 through 29-0169

1. OIL TEMPERATURE GAUGE.

A. GREEN arc — 170° F to 220° F
B. YELLOW arc — 220° F to 240° F
C. RED line — 240° F.

2. OIL PRESSURE GAUGE.

A. RED Radial — 10 PSI
B. YELLOW arc — 10 to 30 PSI
C. GREEN arc — 30 to 60 PSI
D. YELLOW arc — 60 to 100 PSI
E. RED line — 100 PSI MAX.

3. TACHOMETER.

A. GREEN arc — 2000 to 2500 RPM
B. RED line — 2500 RPM

4. CYLINDER HEAD TEMP. GAUGE (CHT).

A. GREEN arc — 250° F to 420° F.
B. YELLOW arc — 420° F to 460° F.
C. RED line — 460° F.

5. MANIFOLD PRESSURE GAUGE.

A. Normal range — 0.0 to 30.0 In. Hg.
B. RED line — NONE

S/N 29-0170 through 29-TBA

1. OIL TEMPERATURE GAUGE

A. GREEN arc --- 170° F to 240° F
B. YELLOW arc --- 100° F to 170° F
C. RED line --- 240° F

2. OIL PRESSURE GAUGE

A. RED Radial --- 10 PSI
B. YELLOW arc --- 10 to 30 PSI
C. GREEN arc --- 30 to 100 PSI
D. RED line --- 100 PSI MAX.

3. TACHOMETER

A. GREEN arc --- 2000 to 2500 RPM
B. RED line --- 2500 RPM

4. CYLINDER HEAD TEMP. GAUGE (CHT)

A. GREEN arc --- 250° F to 460° F
B. RED line --- 460° F

5. MANIFOLD PRESSURE GAUGE

A. Normal range --- 0.0 to 30.0 In. Hg.
B. RED line --- NONE

NOTE

The oil pressure relief valve seat may be honed to improve low idle oil pressure.

77-10-00 - POWER INDICATING

77-10-01 - TACHOMETER

The tachometer indicating system is a fully solid state electronic system that senses engine RPM by magneto rotation speed. A Hall-effect sensor is installed on magneto bleed source. This sensor is excited by 12 volts DC provided by tachometer indicator. The "Hall-effect" sensor incorporates a switching transistor that is actuated by north to south pole switching of main rotor magnet within magneto. The switch HIGH (+5 VDC) to switch LOW (GRD) creates a square wave frequency output from 0 to 75 HERTZ which is monitored by the electronic tachometer. Because the sensor does not rely on magneto output pulses for generating signals. The magneto may be disabled and still maintain signal output from the hall effect sensor.

The electronic tachometer is a micro-processor controlled, stepper motor. The micro-processor receives square wave frequency signal from Hall-effect sensor and computes relative position of pointer. The micro-processor then generates pulsed signals to drive stepper to its precomputed position. A DC activated solenoid engages gear train drive to locate pointer in its respective position. Upon loss of +28 VDC input, solenoid deactivates and disengages drive train, thus returning pointer to below 500 RPM.

Power for tachometer indicating system is provided to Pin A of tachometer. Power requirement is 28 VDC with a typical current drain requirement of 250 milliamps.

TACHOMETER TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
No permanent or intermittent indicator reading.	C/B out (IGN/CIG LTR)	Reset C/B.
	Broken wire	Check & repair wiring. Faulty instrument. Replace instrument.
Pointer Oscillates excessively.	Connector pins/receptacles not making good contact.	Clean connector pins/receptacles w/non-conductive cleaner.
	Mag. timing too wide between mags.	Retime magnetos.
	Isolation resistors at mag. switch increased in resistance value.	Replace resistors.

77-10-02 - MANIFOLD PRESSURE

Manifold pressure is an indication of engine power affected primarily by throttle setting. The instrument is cali brated in inches of mercury (Hg) and indicates pressure in induction air manifold. Manifold pressure varies somewhat with pitch attitude in flight and therefore small oscillations may occur in flight, particularly in turbulent air.

MANIFOLD PRESSURE TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive error at existing barometric pressure.	Pointer shifted.	Replace instrument.
Excessive error when engine is running.	Line leaking.	Tighten line connection.
Sluggish or jerky pointer movement.	Improper damping adjustment.	Adjust damping screw.
Broken or loose cover glass.	Vibration or excessive pressure.	Replace glass and reseal case.
Dull or discolored luminous markings.	Age.	Replace instrument.
Incorrect reading.	Moisture or oil in line.	Disconnect lines and purge with air.

77-10-03 - FUEL FLOW INDICATING SYSTEM

Refer to SECTION 73-30-00 for this data.

77-20-00 - TEMPERATURE INDICATING

77-20-01 - EXHAUST GAS TEMPERATURE (EGT) INSTRUMENT

A thermocouple, attached to an exhaust stack, or all exhaust stacks - optional, sends an electrical signal to EGT instrument. As exhaust gas temperature rises, the thermocouple sends an electrical current through field coils of instrument, moving pointer to indicate temperature rise.

77-20-02 - CYLINDER HEAD TEMPERATURE

The cylinder head temperature (CHT) instrument provides operator with an indication of how hot or cool cylinders are operating during flight. A resistance type temperature probe is installed in the hottest running cylinder, currently #2. An optional system provides a probe in each cylinder to provide monitoring of each cylinder's temperature.

77-20-03 - OIL TEMPERATURE

Refer to SECTION 79-30-02.

77-30-00 - PRESSURE INDICATING

77-30-01 - OIL PRESSURE

Refer to SECTION 79-30-01.

CHAPTER

78

EXHAUST

CHAPTER 78

EXHAUST

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78-00-00 - GENERAL

The exhaust system's headers and exhaust pipes are made from 321 CRES steel. They are designed to optimally scavenge the cylinders exhaust gases during normal engine operation. Inspections for cracks, burns, etc. are required during each maintenance activity and recommended before each flight.

78-10-00 - EXHAUST SYSTEM INSTALLATION

1. EXHAUST PIPE HEADERS TO ENGINE.

A. Place new exhaust gaskets in position on the LH & RH engine exhaust flange studs.

B. Place either LH or RH header pipe into position on engine cylinder exhaust flanges. Be careful during this procedure to ensure that the exhaust gaskets remain in proper position on each cylinder exhaust flange.

NOTE
Attach new headers with existing exhaust flange stud nuts. (If nuts have been damaged, replace them with new nuts, (P/N 643967, available from TCM).

Leave exhaust flange stud nuts loose so header is movable.

C. Lubricate outside of inner and inside of all outer slip joints on headers and the outside of header pipe flanges and inside of muffler pipe flanges with Hi-temp anti-seize compound, C5-A (Fel-Pro) or equivalent.

D. Have someone assist with the placement of the muffler assembly into the already installed header flange.

E. Assemble muffler assembly into other header pipe; position header onto the aircraft engine exhaust flanges. Be careful during this procedure to ensure that the exhaust gaskets remain in proper position on each cylinder exhaust flange.

NOTE
Slide upper clamp assembly on LH muffler tube before final muffler/exhaust pipe installation.

F. When muffler and headers are attached to engine, **flange nuts snug but not torqued**, check that the muffler is free to move laterally, left to right, with moderate push/pull force. This insures that header and muffler pipes are aligned properly.

NOTE
Proper lateral movement may be obtained by loosening the cylinder exhaust stud/flange nuts and gently re-positioning the header assemblies (at the upper flanges) inboard or outboard as the situation requires. The stud/flange nuts can then be re-tightened and the lateral muffler movement checked again.

G. When free movement of muffler is obtained, torque exhaust flange stud nuts -- 100 to 110 inch lbs. Recheck for freedom of movement after nuts have been torqued.

H. Attach tailpipes to each exhaust pipe ball joint flange (3 bolts/springs/nuts at each ball joint flange) with hardware provided in kit.

I. Orientate each tailpipe and muffler exhaust pipe so the continuing plane of both are approximately parallel at the ball joint connections. Verify the LH tailpipe exhaust end is 1.5 + /- 0.5 inches from LH nose gear door assembly and the exhaust opening is not pointed toward nose gear door.

J. Tighten bolts/nuts on ball joint flanges. Spring will begin to compress prior to castellation on nuts reaching the hole in bolt. Continue tightening until one of the nut castellations reaches the complete hole. Install cotter pins in all bolts & nuts.

K. Re-hang tailpipes with hanger assemblies attached to the firewall supports and the O/B bolt attaching the exhaust cavity close-out fairing.

L. Slide clamps up or down the tailpipe assemblies until both hanger assemblies on LH & RH tailpipes are straight when a light downward load is applied on the end of each tailpipe assembly.

M. Tighten all clamp hardware to secure hanger installations on LH & RH tailpipes.

3. EGT PROBE INSTALLATION/SECURITY

A. EGT probe clamp assembly should be safety wired after positioning and tightening of clamp to prevent possible loosening due to engine operation.

78-30-00 - EXHAUST SYSTEM SERVICING

1. CLEANING

To properly inspect exhaust system, components must be clean and free of oil, grease, etc. Clean as follows:

A. Spray engine exhaust system components with a suitable solvent (Stoddard Solvent), allow to drain and wipe dry with clean cloth.

WARNING
Never use highly flammable solvents on engine exhaust systems.

WARNING
Never use a wire brush or abrasives to clean exhaust systems or mark on system with lead pencils.

2. VISUAL INSPECTION OF COMPLETE SYSTEM
A thorough inspection of engine exhaust system will detect any breaks or cracks causing leaks which might result in loss of efficiency, loss of engine power or engine compartment fire. Inspect per following procedures:

NOTE
This inspection should be conducted when engine is cool.

A. Inspect exhaust stacks for burned areas, cracks and looseness. Insure that attach bolts are properly torqued. Exhaust flange stud nuts are to be torqued to 100-110 inch lbs.

B. Inspect exhaust clamps for cracks, looseness and proper security.

NOTE
During inspection, particular attention should be given to condition and security of flanges, spot welds, slip joints and welded areas.

78-40-00 - PERIODIC REPLACEMENT COMPONENTS

It is recommended that all exhaust system pipes, clamps and miscellaneous mounting hardware be replaced at engine overhaul time (2000 Hours). However, thorough inspection of all components should be made any time exhaust system is removed from engine for component replacement. The inspection should be made in the interest of preventive maintenance.

CHAPTER

79

OIL

CHAPTER 79

OIL

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79-00-00 - GENERAL

The oil system is a wet sump, pressure type system. The engine sump has a 8 quart (U.S.) capacity. Servicing of the oil quantity is provided through an access door located on top of engine cowling.

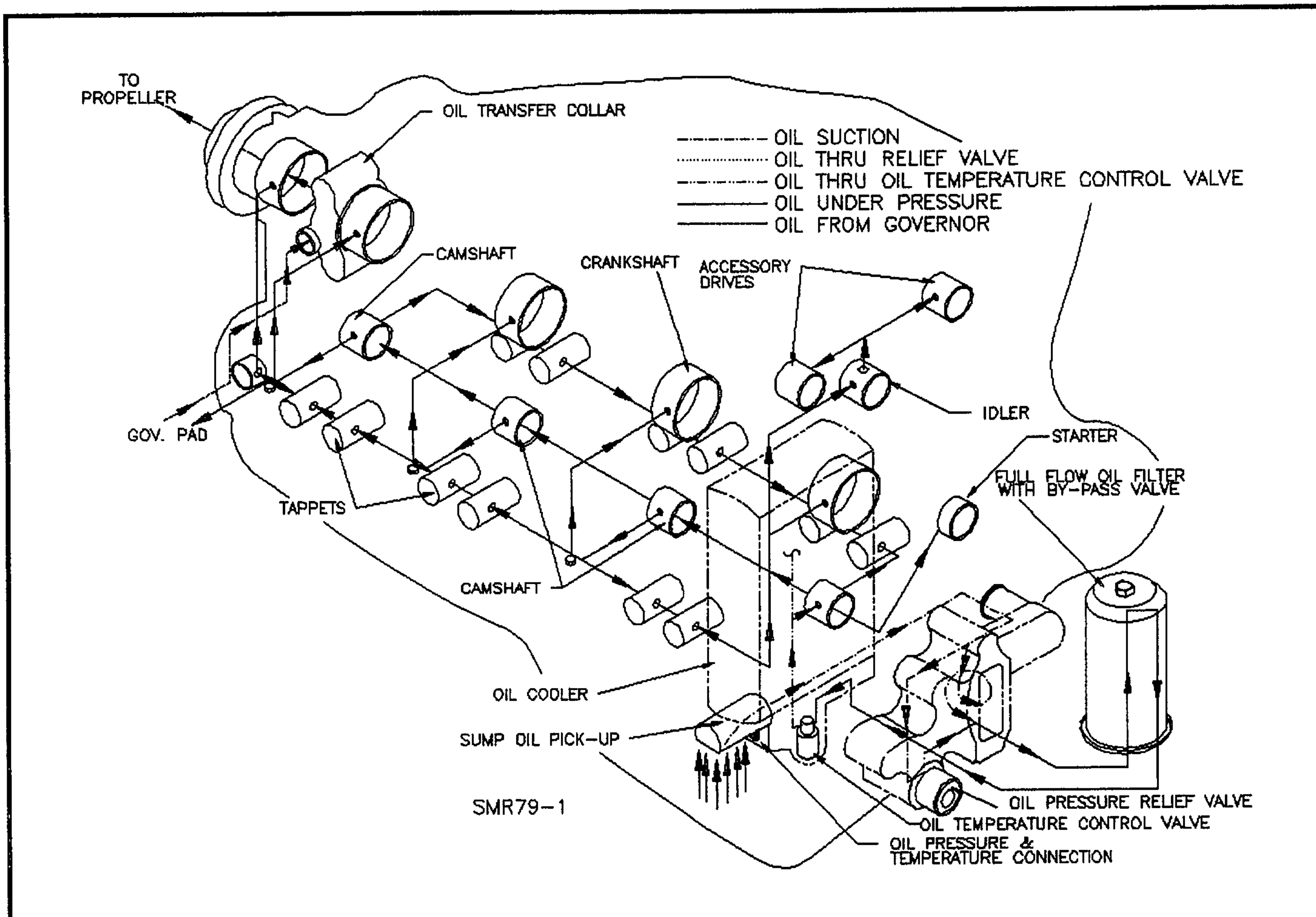
Aircraft are delivered with proper non-detergent, mineral oil (MIL-C-6529 Type II). This oil should be changed at 25 hours or when oil consumption has stabilized. The replacement oil should conform to TCM Specification MHS24. Routine oil change interval is 100 hours, however if operating in a dusty environment the interval should be more often.

NOTE
A new, remanufactured or newly overhauled engine should have oil and filter changed at 50 hours of operation after changing to detergent oil, then begin 100 hour oil change interval.

NOTE
Refer to Section 5-20-07 or TCM Maintenance & Operations Manual, Form X30565, 8/90 or later , Section 9.2 for approved oil products.

79-00-01 - OIL FILTER REMOVAL

The engine oil filter, TCM P/N, 649923, should be replaced each 50 hours and at every oil change (**Figure 79-1**).



LUBRICATION DIAGRAM - FIGURE 79-1

1. Remove top and bottom cowling (see Section 71-10-00).
2. Cut and remove safety wire on filter.
3. Loosen the spin off oil filter and remove.

79-00-02 - OIL FILTER INSTALLATION

1. Position new filter on adapter.
2. Tighten per instructions on filter.
3. Safety wire filter.
4. Perform leak check prior to flight.
5. Reinstall lower and upper cowling (see Section 71-11-00).
6. Connect and secure electrical and mechanical connections for cowling installation.

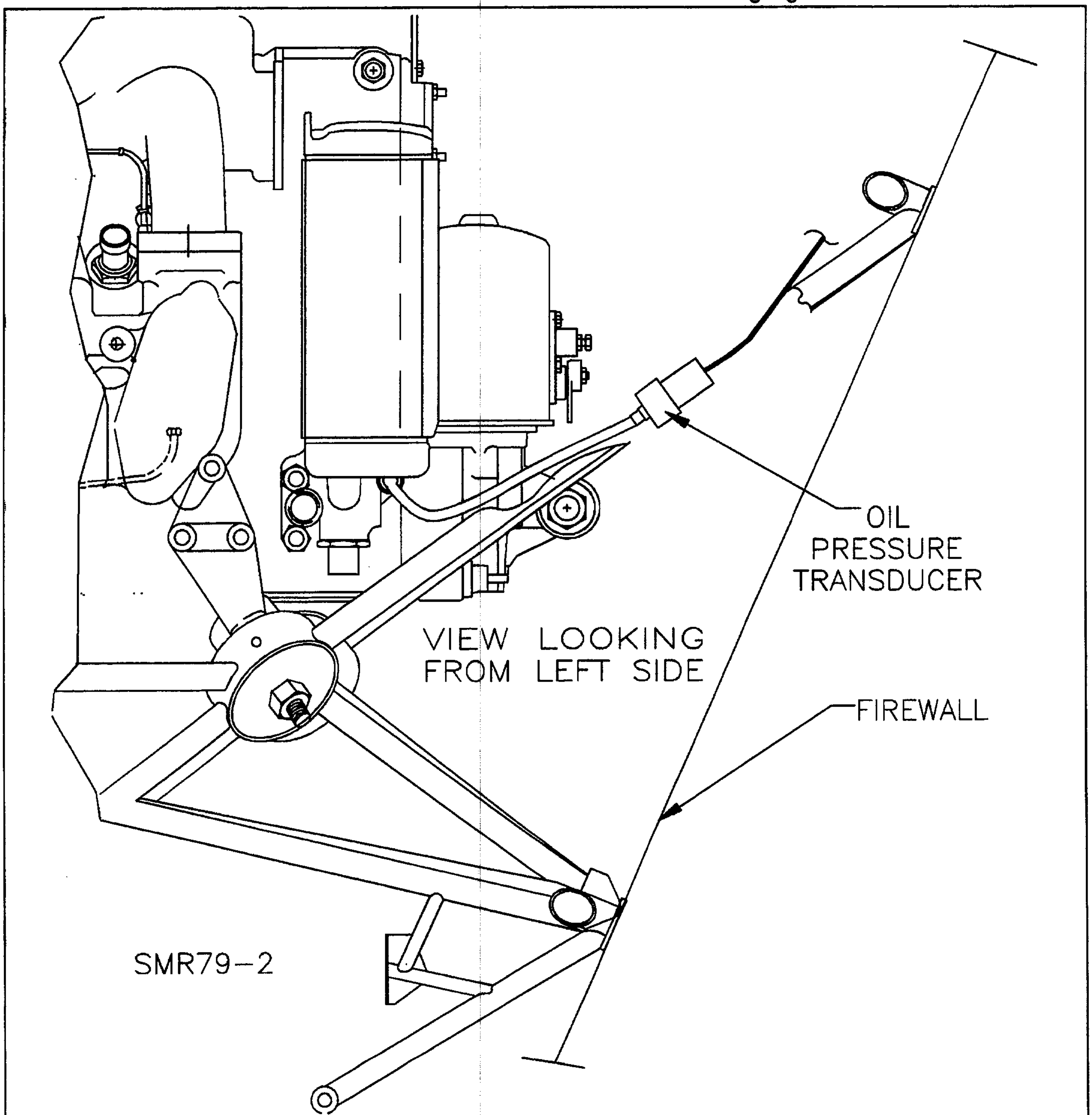
79-20-00 - DISTRIBUTION

The oil system on the I0-550-(G) engine is internal within engine (See Fig. 79-1) except for oil pressure transducer plumbing. This portion of system contains pressure hoses and fittings (refer to Figure 79-2).

79-30-00 - INDICATING

79-30-01 - OIL PRESSURE

Oil pressure indicating is provided through a pressure transducer plumbed into engine oil system, see (Figure 79-2). Pressure variations change resistance within transducer and this signal drives oil pressure gauge located within cluster gauge.



OIL PRESSURE TRANSDUCER - FIGURE 79-2

DIGITAL (29-0170 THRU 29-TBA)

Ref. Figure 39-4B for Moritz Oil Pressure gauge adjustment location.

1. Tee in Calibrated OP gauge upstream of Transducer.
2. Adjust face of Moritz gauge Z (zero) and S (span) so value is same as Calibrated reading.
3. Remove Calibrated Gauge and check for leaks.

79-30-02 - OIL TEMPERATURE

The oil temperature gauge is an electric unit receiving its signal from a temperature bulb, located below oil cooler. The probe resistance changes as oil temperature changes and this varies readout on oil temperature gauge.

79-40-00 - DRUCK TRANSDUCER TEST PROCEDURES

CAUTION
This unit is for troubleshooting only. DO NOT ATTEMPT TO CALIBRATE WITH THIS UNIT.

The Druck Transducer Test Box, P/N GSE 030036, can be used to simulate fuel and oil pressures in the Mooney Model M20R.

To use unit for troubleshooting, box is connected to aircraft harness in engine compartment, by disconnecting appropriate Druck transducer electrical connector and connecting test box in its place.

Push aircraft Master Switch - ON (insure engine gauge circuit breakers are in) and adjust box to approximate pressure desired. The engine gauge should read this approximate pressure.

If pressure reading is correct:

1. Verify Oil/Fuel pressure to Druck transducer with mechanical pressure gauge.
   a. If correct, probable failure is Druck transducer.
   b. If incorrect, troubleshoot oil/fuel system.

If pressure reads incorrectly, zero or pegged condition:

1. Sigma Tek gauge, M20R - S/N 29-0001 thru 29-TBA)
   a. Check wiring for continunity between engine compartment connector and Sigma Tek cluster.
   b. If wiring is correct, probable failure is in Sigma Tek gauge module or cluster.

79-50-00 -OIL SYSTEM TROUBLESHOOTING

Troubleshooting chart is provided as a guide. Review probable causes, compare other troubleshooting charts for inter-related symptoms. Items are presented in sequence of complexity, not necessarily in order of probability.

TROUBLE	PROBABLE CAUSE	REMEDY
High Oil Temperature Indication.	Low oil supply.	Replenish oil supply.
	Oil Cooler air passages clogged.	Clean thououghly.
	Oil Cooler core plugged.	Remove oil cooler an flush thoroughly.
	Thermostat damaged or held open by solid matter.	Remove, clean valve and seat. If still inoperative, replace.
	Oil viscosity too high.	Drain and refill with correct seasonal weight oil. (See Chapter 5)
	Prolonged ground operation.	Limit ground operation to a minumum.
	Malfunctioning gauge or bulb unit.	Check wiring. Check bulb unit. Check gauge. Replace malfunctioning parts.
Low oil pressure Indication.	Low oil supply. Oil viscosity too low.	Replenish. Drain and refill with correct seasonal weight oil.
	Foam in oil due to presence of alkaline solids in system.	Drain and refill with fresh oil. Flush oil cooler.
	Malfunctioning pressure pump.	Replace oil pump.
		Malfunctioning pressure gauge.
		Check gauge. Clean plumbing. Replace if necessary.
	Weak or broken oil pressure relief valve spring.	Replace spring. Adjust pressure to 30-60 PSI by adjusting screw.

BLANK

CHAPTER

80

STARTING

CHAPTER 80

STARTING

LIST OF EFFECTIVE PAGES

CHAPTER SECTION SUBJECT	PAGE	DATE
80-Effectivity/Contents	1/2BLANK	5-94
80-00-00	3	5-94
80-10-00	4	5-94

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80-00-00 - GENERAL

The airplane is equipped with a 24 volt starter supplied with engine package. The starter is located on engine case at rear of engine.
When ignition switch is placed in "Start" position, current is supplied through main bus to energize starter solenoid which in turn connects battery to starter.

80-00-01 - STARTER TROUBLESHOOTING

1. Refer to Section 24-39-04.

80-00-02 - STARTER MAINTENANCE

1. Inspect and service starter per TCM Starter Motor Service Manual. (TCM Aircraft Products, PO Box 90, Mobile, AL 36601, Attn: Publications Department.)
2. Lubrication - No lubrication is required on starter motor except at overhaul.

CAUTION
Do not clean starter in any degreasing tank or grease dissolving solvents. Avoid excessive lubrication. Use only kerosene or Varsol.

80-00-03 - STARTER REMOVAL

1. Remove upper and lower cowling (See Section 71-10).
2. Disconnect electrical wiring from starter terminals.
3. Remove nut and washer from studs on adapter mounting pad.
4. Remove starter and O-ring from adapter.

80-00-04 - STARTER INSTALLATION

1. Before installation, clean any rust corrosion or dirt from mounting surface of starter motor.
2. Check all ground straps connections for tightness.
3. Install new O-ring on starter flange.
4. Position starter on mounting pad.
5. Install attaching nuts and washers.
6. Torque nuts 220.0 to 260.0 inch lbs.
7. Connect electrical wiring to starter terminals.
8. Check starter mounting flange for oil leakage before cowling is installed.
9. Install cowling.

80-00-05 - STARTER BRUSHES

Starter brushes should slide freely in holder and make full contact on commutator. Brushes should be replaced when they have worn to 1/4 inch in length. Brush tension should be 32 to 40 ounces as measured with spring scale hooked under brush spring and pulled in straight line opposite force exerted by spring. Read tension just as spring leaves brush.

80-10-00 - CRANKING

The starter solenoid is located on cabin side of firewall. The solenoid is energized by placing ignition/magneto switch in START position. Battery current is then directed to starter. The aircraft are equipped with a "START POWER" annunciator light. This light illuminates "RED" when starter switch is in start position or when starter switch or starter solenoid has malfunctioned and starter is engaged while engine is running. This malfunction should be corrected before engine is started again.

BLANK

CHAPTER

81

TURBINES

CHAPTER 81

TURBINES

LIST OF EFFECTIVE PAGES

CHAPTER SECTION SUBJECT	PAGE	DATE
81-EFF/CONTENTS	1/2BLANK	4-95
81-00-00	3	4-95
81-00-00	4	5-94

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81-00-00 - GENERAL

No turbines/turbochargers are installed on the M20R aircraft by Mooney Aircraft Corportion.

BLANK

CHAPTER

91

CHARTS

CHAPTER 91

ELECTRICAL WIRING DIAGRAMS

LIST OF EFFECTIVE PAGES

CHAPTER SECTION SUBJECT	PAGE	DATE
91-Effectivity/Contents	1/2BLANK	10-98
91-00-00	3	6-94
91-00-02	4	10-98
91-20-00	5	10-98
91-20-00	6	6-94
91-20-01	7 thru 20	10-98
91-30-00	21	10-98

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91-00-00 - GENERAL

The electrical system hardware lists and related schematics are sequenced in this section by serial number effectivity. The chapter is divided into the following sections:

-Electrical Systems Schematic Notes
-Wiring Identification System
-Electrical System Hardware Charts (By Effectivity)
-Electrical Schematics (By Effectivity)

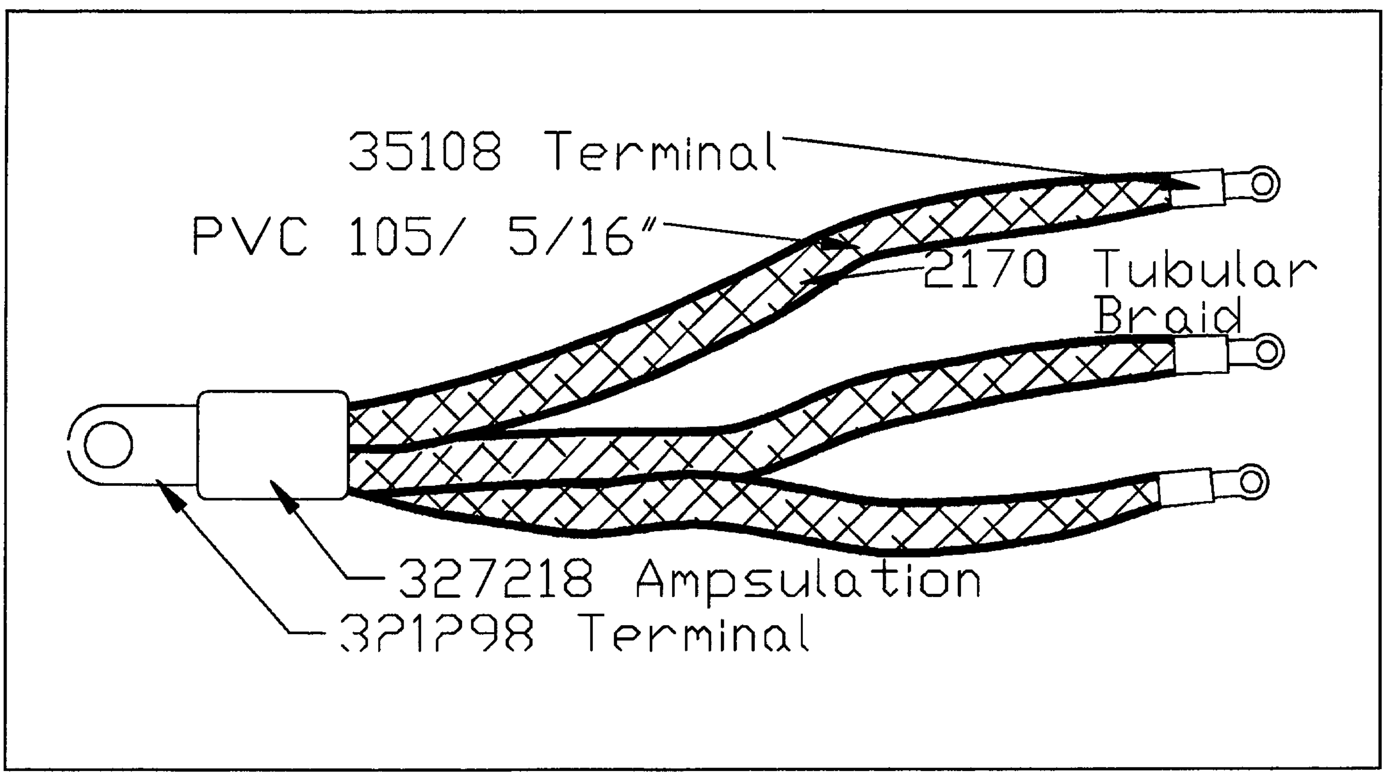
- -

91-00-01 - ELECTRICAL SYSTEMS SCHEMATICS NOTES

1. All electrical wiring, assemblies, and installtions must be in accord with FAR 43 and AC 43.13-1( ).
2. All splices must be "AMP" disconnect or equivalent.
3. All circuit breakers are trip-free.
4. All terminals are Spec. MS25036 (or equivalent or they must be soldered.)
5. All terminals must be preinsulated or must be insulated with "Ampsulation" (or equivalent).
6. Wires without dash numbers are furnished by the manufacturer and are included with the equipment.
7. The symbol "- -" indicates a knife disconnect.
8. Optional equipment may be installed as required.

9. Wires denoted by === === === symbols to be twisted counter clockwise with a minimum of three (3) wraps per foot.
10. "F" denotes ground through frame (no wires).
11. All knife disconnect splices to be insulated with PVC105 and securely string tied with airtex no. 417 cord.
12. All wire sizes are minimum sizes acceptable.
13. Use 913127 bus bars as necessary for various configuration changes and manufacture interconnecting bus using no. 2170 tubular braid covered with PVC105/5/16" (both Alpha Wire Co.) and terminated with AMP terminals of appropriate sizes.

EXAMPLE:



EXAMPLE - FIGURE 91-1

91-00-02 - WIRING IDENTIFICATION SYSTEM

The Mooney Aircraft Corporation wiring/equipments identification system used in current production aircraft deletes the Model Number annotation. The purpose of this is to standardize the identification of a system function/component for all model of aircraft. The functional groups are basically the same as earlier identification numbers. These new functional groups apply to schematic drawing 800304 & 800383. The new functional groups are as follows:

CR	—	First two/three letters	—	Circuit Function
04	—	First set of numerals	—	Wire Sequence
A	—	Single letter in series	—	Configuration
20	—	Last two numerals in series	—	Wire Size

CODE/COMPONENT or SYSTEM (CIRCUIT FUNCTION) - 800304 & 800383 SCHEMATIC DRAWING

ACT/SWITCH ACTUATOR
BL/BULBS
BS/RELAY BASE
BUS/BUSS BARS
C/CAPACITORS
CB/DEFROSTER BLOWER
CC/COWL FLAPS, ELECTRIC
CF/WING FLAPS
CL/CLAMPS
CM/CURRENT MONITOR
CR/RUDDER TRIM
CT/STABILIZER TRIM
CV/STANDBY VACUUM
D/DIODES
DA/AMMETER
DB/TURN COORDINATOR
DC/CHT
DD/OAT
DF/FUEL QUANTITY
DG/ENGINE INSTRUMENTS
DH/OIL TEMPERATURE
DJ/OIL PRESSURE
DK/FUEL PRESSURE
DL/ELECTRIC TACHOMETER
DM/HOUR METER
DP/PITOT HEAT
DR/TIT
DT/EGT
DV/FUEL FLOW
DG/LANDING. GEAR, ELEC.
ELT/ELT
F/FUSES
FH/FUSEHOLDER
FON/PHONE
JM/IGNITION, MAGNETO
L/LIGHT BULBS
LB/BEACON
LENS/ANNUNCIATOR LENS
LH/LAMP HOLDER
LL/LANDING LIGHTS
LN/NAVIGATION LIGHTS
LP/PANEL LIGHTS
LR/RECOGNITION LIGHTS
LS/STROBE LIGHTS
LT/TAXI LIGHTS
MA/AUXILIARY POWER
MB/AVIONICS MASTER
MC/CIGAR LIGHTER
ME/CLOCK
MI/MICROPHONE
MP/PROPELLER DE-ICE
NF/BOOST PUMP
PA/ALTERNATOR POWER
PB/BATTERY POWER
PL/PLUGS, ELECTRICAL
PS/START POWER
R/RESISTORS
RB/RADIO BLOWER
RC/RECEPTACLES, ELECTRICAL
RL/RELAYS
SB/SPEEDBRAKE
SPKR/SPEAKER
SW/SWITCHES
VR/VARISTOR
WS/STALL WARNING
WT/ANNUNCIATOR WARNING

91-00-03 - ABBREVIATIONS - EQUIPMENT LIST

The abbreviations to the electrical system hardware charts are necessary due to space limitations in the fields of the computer.

Airspeed - A/S
Alternator - Altnr
Circuit Breaker -Ckt. Bkr. or C/B
Console - Cnsl
Control - Cntrl
Coordinator - Coordtr
Cylinder - Cyl
Down - Dn
Electric - Elec
Flight - Flt
Glareshield - Glrshld
Landing - Ldg
Left - L or L/H
Lights - Lts
Panel - Pnl
Pilot - Plt
Placard - Plcd
Radio - Rad
Receptacle - Recpt
Regulator - Regltr
Remote - Rem
Resistor - Res
Rheostat - Rheo
Right - R or R/H
Safety - Sfty
Selector - Sel
Switch - Sw
Transducer - XDCR
Transmitter - XMTR
Transistor - XSTR
Warning - Wrn

91-20-00 - SERIAL NUMBER VS. SCHEMATIC'S

Refer to the Electrical Schematic (located in the envelope(s) at the back of this manual) that depicts the Serial Number configuration of the aircraft being serviced. The S/N's vs. applicable schematics are shown below:

A/C SERIAL NUMBER	MAC DRAWING P/N LIST	(SCHEMATIC NUMBER)
29-0001 thru 29-0012	800306	800304(R1)Master(Rev.W)
29-0013 thru 29-0065		800304(R2)Master(Rev.W)
29-0066 thru 29-0070	(Rev. N-2)	800304(R3)Master(Rev.W)
29-0071 thru 29-0086		800304(R4)Master(Rev.X)
29-0087 thru 29-0104		800304(R5)Master(Rev.Y)
29-0105 thru 29-0112	800306	800304(R6)Master(Rev.Z)
29-0113 thru 29-0130	(Rev. N-2)	800304(R7)Master(Rev.AA)
29-0131 thru 29-0143	800306	800383(R1)Master(Rev.G)
29-0144 thru 29-0156,	(Rev. N-2)	800383(R2)Master(Rev.M)
29-0158 thru 29-0169		800383(R2)Master(Rev.M)
29-0170 thru 29-0182,		800383(R3)Master(Rev.R)
29-0184 thru 29-0199		800383(R3)Master(Rev.R)
29-0183		800383(R4)Master(Rev.R)
29-0200 thru 29-TBA		800383(R5)Master(Rev.R)

NOTE

The Electrical System Hardware Chart(s) contained on the following pages depict all electrical components for up to the current model year aircraft. Each schematic may not call out all system code numbers, therefore,

IT IS ESSENTIAL THAT THE CORRECT SCHEMATIC FOR S/N OF AIRCRAFT BEING SERVICED BE USED.

The correct Vendor and/or Part Number will be depicted where the applicable electrical equipment identifier is hown on the following hardware charts. Order replacement or repair part numbers for electrical components from the following electrical system hardware charts that are applicable to the aircraft model & S/N being worked on.

91-20-01 -ELECTRICAL SYSTEM HARDWARE CHARTS — (PART NUMBERS FOR SCHEMATICS) :

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91-20-01 - ELECTRICAL EQUIPMENT HARDWARE CHART

S/N 29-0001 THRU 29-0130 – SCHEMATIC DRAWING NO's. 800304 (R1) THRU (R7)
S/N 29-0131 THRU 29-TBA – SCHEMATIC DRAWING NO's. 800383 (R1) THRU (R3)

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
AC101A	SWITCH, AIR COND.	MOONEY	880067-501	
AC102A	COMPRESSOR, AIR COND	MOONEY	770028-501	
AC103A	BLOWER, EVAP., FRONT	MOONEY	770002-501	
AC103B	BLOWER, EVAP., REAR	MOONEY	770002-503	
AC104A	BLOWER, CONDENSER	MOONEY	770016-501	
AC105A	SWITCH, AIR COND. PRESSURE	MOONEY	770029-501	
AC106A	CONNECTOR, AIR COND	CORY COMP.	CSLT-21PA	
---	/CONTACTS	CORY COMP.	CB017-5S	
ACT1/AT101A	ACTUATOR	MICRO SWITCH	JE-5	
ACT2/AT102A	ACTUATOR	MICRO SWITCH	JV-5	
ACT3/AT103A	ACTUATOR	MICRO SWITCH	JV-26	
ACT4/AT104A	ACTUATOR	MICRO SWITCH	MCD-2711	
ACT5/AT105A	ACTUATOR	MICRO SWITCH	JE-17	
ACT6/AT106A	ACTUATOR	MICRO SWITCH	JV-82	
AIR101A	SWITCH, A/C	MOONEY	880067-501	
AIR102A	COMPRESSOR, A/C	MOONEY	770028-1	
AIR103A	EVAP. BLWR (FRT)	MOONEY	770002-501	
AIR103B	EVAP. BLWR, (REAR)	MOONEY	770002-503	
AIR104A	CONDENSER BLWR	MOONEY	770016-501	
AIR105A	SWITCH, A/C PRESS.	MOONEY	770029-501	
BL1	BULB	GE	1818	
	/HOLDER FOR BL1	HH SMITH	1930	
BL2	BULB	GE	1816	
	/HOLDER FOR BL2	HH SMITH	1930	
BL3	BULB (NAV-T/L)	WHELEN	34-022-8030-85	
BL4	BULB (NAV-T/L)	WHELEN	34-021-2030-85	
BL5	BULB (CONSOLE)	GE	327	
	(ALT)	GE	385	
BL6	BULB (COMPASS)	GE	327(AV RED)	
BL7	BULB (POST LIGHT)	GE	330	
BL8	BULB (ANNUNCIATOR)	CHI. MIN.	CM7-7730	
BL9	BULB (ANNUNCIATOR)	CHI. MIN.	CM7-7327	
BR1	CIRCUIT BREAKER (1A)	KLIXON	7277-2-1	
BR2	CIRCUIT BREAKER (2A)	KLIXON	7277-2-2	
BR3	CIRCUIT BREAKER (3A)	KLIXON	7277-2-3	
BR5	CIRCUIT BREAKER (5A)	KLIXON	7277-2-5	
BR7.5	CIRCUIT BREAKER (7.5A)	KLIXON	7277-2-7.5	
BR10	CIRCUIT BREAKER (10A)	KLIXON	7277-2-10	
BR15	CIRCUIT BREAKER (15A)	KLIXON	7277-2-15	
BR20	CIRCUIT BREAKER (20A)	MECH PROD	4200-002-20	
BR25	CIRCUIT BREAKER (25A)	MECH PROD	4200-002-25	
---	(ALT)	ETA	483-G533-J1M1-B2S0Z-25A	
BR30	CIRCUIT BREAKER (30)	MECH PROD	700-001-30	
BR35	CIRCUIT BREAKER (35A)	ETA	41-2-S14-LN2-35A	
BR40	CIRCUIT BREAKER (40A)	ETA	41-3-S34-LN2-40A	
BR50	CIRCUIT BREAKER (50A)	ETA	41-2-S34-LN2-50A	
BR70	CIRCUIT BREAKER (70A)	ETA	41-3-S14-LN2-70A	
BRSW3	C/B-SWITCH	KLIXON	7270-5-3	
BRSW7.5	C/B-SWITCH	KLIXON	7270-5-7.5	
BRSW8	C/B-SWITCH	KLIXON	7270-5-8	
BRSW10	C/B-SWITCH	KLIXON	7270-5-10	
BRSW15	C/B-SWITCH	KLIXON	7270-5-15	
BRSW25	C/B-SWITCH	KLIXON	7270-5-25	
BS1/BS101A	RELAY, BASE	MAGNACRAFT	70-303	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
BU2A/BUS2A	BUSS BAR (2 PLC)	MOONEY	913127-033	
BU2B/BUS2B	BUSS BAR (2 PLC)	MOONEY	913127-097	
BU2C/BUS2C	BUSS BAR ( )	MOONEY	913127-099	
BU2D	BUSS BAR (2 PLC)	MOONEY	913127-075	
BU2E	BUSS BAR (2 PLC)	MOONEY	913127-065	
BU3A/BUS3A	BUSS BAR (3 PLC)	MOONEY	913127-087	
BU3B/BUS3B	BUSS BAR (3 PLC)	MOONEY	913127-059	
BU3C/BUS3C	BUSS BAR (3 PLC)	MOONEY	913127-073	
BU4A/BUS4A	BUSS BAR (4 PLC)	MOONEY	913127-069	
BU4B/BUS4B	BUSS BAR (4 PLC)	MOONEY	913127-089	
BU4C/BUS4C	BUSS BAR (4 PLC)	MOONEY	913127-005	
BU4D	BUSS BAR (4 PLC)	MOONEY	913127-053	
BU5A/BUS5A	BUSS BAR (5 PLC)	MOONEY	913127-093	
BU5B/BUS5B	BUSS BAR (5 PLC)	MOONEY	913127-077	
BU5C/BUS5C	BUSS BAR (5 PLC)	MOONEY	913127-085	
BU5D/BUS5D	BUSS BAR (5 PLC)	MOONEY	913127-019	
BU6A/BUS6A	BUSS BAR (6 PLC)	MOONEY	913127-035	
BU6B/BUS6B	BUSS BAR (6 PLC)	MOONEY	913127-079	
BU7A/BUS7A	BUSS BAR (7 PLC)	MOONEY	913127-081	
BU8A/BUS8A	BUSS BAR (8 PLC)	MOONEY	913127-095	
BUS8B	BUSS BAR (8 PLC)	MOONEY	913127-083	
BW3	SWITCH-C/B (3A)	KLIXON	7270-5-3	
BW7.5	SWITCH-C/B (7.5A)	KLIXON	7270-5-7.5	
BW10	SWITCH-C/B (10A)	KLIXON	7270-5-10	
BW15	SWITCH-C/B (15A)	KLIXON	7270-5-15	
BW25	SWITCH-C/B (25A)	KLIXON	7270-5-25	
C1/CA101A	CAPACITOR	MALLORY	CGS302V-050R2C	
CA102A	CAPACITOR (1000 PF)	NEWARK	18F2711 TYPE 5GAD10	
CAP1	CAP, WHITE	MICRO SW	15PA90-8W	
CAP2	CAP, BLACK	ALCO SW	C-22	
CAP3	CAP, DUST	MATRIX SCIENCE.	M83723/60-122RC	
CB101A	BLOWER, DEFROST	MOONEY	640317-503	
CC101A	MOTOR, COWL FLAP	MOONEY	880050-505	
CC102A	INDICATOR, COWL FLAP	MOONEY	880242-505	
CC103A	SWITCH, COWL FLAP	MOONEY	880052-517	
CC103B	SWITCH, COWL FLAP (M20J)	MICRO-SWITCH	12TW1-10	
CC103C	SWITCH, COWL FLAP	MOONEY	880052-129	
CF101A	ACTUATOR, FLAP	MOONEY	750105-501	
CF102A	INDICATOR, TRIM/FLAP	MOONEY	800242-501	
CF103A	TRIM/FLAP ASSY	MOONEY	800376-501	
CF104A	INDICATOR, TRIM/FLAP	MOONEY	800391-502	
CF108A	SWITCH, FLAP	C-H	8906K3149	
CL03A	CLAMP, 3/14/16/28 PIN	AMP	206070-1	
CL03B	CLAMP, 3 PIN	AMP	M85049-41-4A	
CL03C	CLAMP, 3 PIN		MS3057-4A	
	(ALT)		MS3057-4B	
CL04A	CLAMP, 4/8 PIN	AMP	206062-1	
CL04D	CLAMP, 4 PIN	BENDIX	10-101971-8-3	
CL05A	CLAMP, 5 PIN		MS3057-6A/B	
CL05B	CLAMP, 5 PIN	DEUTSCH	BVDSREC02SR	
CL06A	CLAMP, 6 PIN		MS3057-16A/B	
CL07A	CLAMP, 7 PIN		MS3057-12B	
---	/SLEEVE		MS3420	
CL09A	CLAMP, 9 PIN, LT. CONT. BOX	AMP	206966-1	
CL09B	CLAMP, 9 PIN	AMP	P/O 126-222	
CL09C	CLAMP, 9 PIN		DE-24657	
—	/LOCK RETAINER		DE-51224-1	
—	/LOCK RETAINER (ALT)		D110278	
---	/LOCK RETAINER (ALT)		D-20419-16	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
CL09D	CLAMP, 9 PIN		DE19977-5	
—	/LOCK, RETAINER		DE51224-1	
CL15A	CLAMP, 15 PIN		DA51210-1	
—	/LOCK, RETAINER		DA51220-1	
CL15B	CLAMP, 15 PIN		DA19977-1	
CL17A	CLAMP, 17 PIN		DB51212	
—	/LOCK, RETAINER		DB51221-1	
CL25A	CLAMP, 25 PIN		DB51212	
—	/LOCK, RETAINER		DB51221-1	
CL25B	CLAMP, 25 PIN		DB19977-2	
—	/LOCK, RETAINER		DB51221-1	
CL25C	CLAMP, 25 PIN		DB24659	
—	/LOCK, RETAINER		D20418-2	
CL32A	CLAMP, 32 PIN		M85049/52-1-22N	
CL32B	CLAMP, BOOT		MS3420-14	
	(ALT)		MS3420-16	
CL37A	CLAMP, 37 PIN		206138-1	
CL37B	CLAMP, 37 PIN		DC19977-3	
—	/LOCK, RETAINER		DC51222-1	
CM1/CM101A	CURRENT MONITOR	MOONEY	800221-505	
CR101A	SWITCH, RUDDER TRIM (WHT)	MOONEY	880052-519	
CR101B	SWITCH, RUDDER TRIM (BLK)	MOONEY	880052-119	
CR102A	MOTOR, RUDDER TRIM	MOONEY	880050-503	
CR103A	INDICATOR, RUDDER TRIM	MOONEY	800242-503	
CT101A	SWITCH, ELEV TRIM	MOONEY	930023-233	
CT102A	INDICATOR, ELEV TRIM	MOONEY	800242-519	
CT103A	MOTOR, ELEV TRIM	S-TEC	01165-0-T14	
CT104A	INTERFACE, TRIM	MOONEY	800313-501	
CT105A	INDICATOR, ELEV. TRIM	MOONEY	800391-501	
CV101A	C/B-SW, STAND-BY VAC,WHT	MOONEY	930023-233 (15A)	
CV101B	C/B-SW, STAND-BY VAC,BLK	MOONEY	930023-333	
CV102A	PUMP, STAND-BY VACUUM	AEROSAFE	820904-2	
CV103A	PUMP, STAND-BY VACUUM	AEROSAFE	820904-1	
CV104A	C/B-SW, STAND-BY VAC,WHT	MOONEY	930023-247 (3A)	
CV104B	C/B-SW, STAND-BY VAC,BLK	MOONEY	930023-347	
CV105A	CLUTCH/PUMP, STD-BY VAC	AIRBORNE	28C214-CW-2	
D1	DIODE		1N2483	
—	(ALT)		1N5060	
—	(ALT)	GE	3720GE	
D2	DIODE	SARKES-TARZ.	10H3P	
—	(ALT)	ECG	5854	
—	(ALT)	NTE	5854	
D4	DIODE BRIDGE	FAGOR	FB5001	
D5	DIODE BRIDGE	FAGOR	FB5006	
DA101A	AMMETER SHUNT	EMPRO	MLA-70A-100MV	
—	(ALT)	JANCO	8406-70	
DA101B	AMMETER SHUNT	EMPRO	MLA-150A-100MV	
—	(ALT)	JANCO	8406-150	
DB101A	TURN COORDINATOR	UNITED INST.	9013 CODE N.5	
—	(ALT)	ASTRONAUTICS	303990-028MSC	
—	(ALT)	ELECT. GYRO	1394T100-3Z	
—	(ALT)	UNITED INST.	9114 CODE N.21	
DB102A	TURN COORDINATOR	UNITED INST.	9112 CODE N.9	
DC101A	PROBE, CYLINDER #1		MS24482-1	
—	(ALT)		AN5546-1*	
		* USE AN4076-1 ADAPTER.		
---	(ALT)	NORWICH	102-00007	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
DD101A	INDICATOR, O.A.T.	MOONEY	880059-159	
DD102A	O.A.T. PROBE	MOONEY	880004-501	
DD103A	SOCKET, 4 PIN	CINCH-JONES	S--304-CCT	
DF101A	FUEL XMTR, LH/RH I/B	MOONEY	610242-003	
DF102A	FUEL XMTR, LH O/B	MOONEY	610243-003	
DF103A	FUEL XMTR, RH O/B	MOONEY	610243-001	
DF104A	FUEL XMTR, LH/RH O/B	MOONEY	610242-005	
DF105A	TRANSMITTER, FUEL	AVAQ SYST.	9450563001	
DF106A	ARM, FLOAT, RH, I/B	AVAQ SYST	9400563102	
DF107A	ARM, FLOAT, RH, O/B	AVAQ SYST	9400563104	
DF108A	ARM, FLOAT, LH, I/B	AVAQ SYST	9400563101	
DF109A	ARM, FLOAT, LH, O/B	AVAQ SYST	9400563103	
DF110A	TRANSDUCER	AVAQ SYST	9450563002	
DF111A	PROCESSOR	AVAQ SYST	9450563003	
DG101A	IND., INSTRUMENT MODULE	MOONEY	880059-507	
DG102A	IND., INSTRUMENT MODULE	MOONEY	880059-511	
DG103A	IND., INSTRUMENT MODULE #2	MOONEY	880059-513	
DG104A	IND., INSTRUMENT MODULE #1	MOONEY	880059-505	
DG105A	IND., INSTRUMENT MODULE	MOONEY	880059-517	
DG106A	IND., INSTRUMENT MODULE #1	MOONEY	880059-519	
DG107A	IND., INSTRUMENT MODULE	MOONEY	880059-523	
DG108A	IND., INSTRUMENT MODULE #2	MOONEY	880059-525	
DG109A	IND., INSTRUMENT MODULE	MOONEY	880059-521	
DG110A	D/A CLUSTER	MOONEY	880093-501	
DG111A	D/A CLUSTER	MOONEY	880093-503	
DG112A	DIGITAL CLUSTER	MOONEY	880093-505	
DG113A	DIGITAL CLUSTER	MOONEY	880093-507	
DG114A	D/A CLUSTER	MOONEY	880093-509	
DH101A	PROBE, OIL TEMP	MOONEY	880061-501	
DH102A	PROBE, OIL TEMP		MS28034-1	
DI101A	DIODE		1N2483/1N5060	
---	(ALT)	GE	3720-GE	
DI102A	DIODE	SARKES TARZ	10H3P	
---	(ALT)	ECG	5854	
---	(ALT)	NTE	5854	
DI104A	DIODE BRIDGE	FAGOR	FB5001	
DI105A	DIODE BRIDGE	FAGOR	FB5006	
DJ101A	TRANSDUCER, O/P (M20J)	DRUCK	PDCR 821-0662-100	
—	(ALT) (M20J)	KULITE	APT-154-1000-100PSIG	
---	(ALT)	PATRIOT	KA21-014-100G	
DJ101B	TRANSDUCER, O/P (M20M)	KULITE	APT-201-1000-100G	
DK101A	TRANSDUCER, F/P	DRUCK	PDCR-821-0662-30	
—	(ALT)	KULITE	APT-153-1000-30PSIG	
DK102A	TRANSDUCER, F/P	DRUCK	PDCR-920-U143-50 PSID	
---	(ALT)	KULITE	APT-155-1000-50D	
—	(ALT)	PATRIOT	KA21-016-50G	
DL101A	IND., TACH	MOONEY	880039-515	
—	(OPTIONAL)	B&D	0520-003	
DL102A	SENSOR, TACH	B&D	0400-004	
DL103A	IND., TACH	MOONEY	880039-517	
—	(OPTIONAL)	B & D	0520-006	
DL104A	TACH SENSOR	B & D	(SLICK MAGS) 0402-102	
DL104B	TACH SENSOR	B & D	(BENDIX MAGS) 0402-104	
DL104C	TACH SENSOR (ALT. DL104B)	B & D	0406-004 *	3
DL104D	TACH SENSOR (ALT. DL104A)	B & D	0406-003 *	3
DL105A	INDICATOR, TACHOMETER	MOONEY	880039-519	
DL106A	INDICATOR, TACHOMETER	MOONEY	880039-523	

* INSTALLED ON IO-550 ENGINE BY TELEDYNE CONTINENTAL MOTORS.

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
DL107A	SENSOR, TACH	J-P INSTR.	(SLICK MAGS) 420809	
DL108A	SENSOR, TACH	J-P INSTR.	(BENDIX MAGS) 420807	
DM101A	HOUR METER	MOONEY	880035-507	
DM102A	HOUR METER	MOONEY	880035-505	
DM103A	HOUR METER	HOBBS	15006	
—	(ALT)	DATCON	SG-70	
DM104A	HOUR METER	HOBBS	85000	
—	(ALT)	HOBBS	15000	
DP101A	C/B, PITOT HEAT	MOONEY	930023-205	
DP101B	C/B, PITOT HEAT	MOONEY	930023-305	
DP101C	C/B, PITOT HEAT	MOONEY	930023-353	
DP102A	HEATED PITOT	AERO INSTR	PH502-24	
—	(ALT)		AN5812-1	
DP103A	PITOT, HEATED	AERO INSTR	PH502-12	
—	(ALT)		AN5812	
DP104A	PLUG, 2 PIN		AN3115-1	
DP105A	SOCKET		AN3116-1	
DR101A	PROBE, TIT	MOONEY	880055-503	
DR101B	PROBE, TIT	MOONEY	880055-505	
DT101A	IND., EGT	ALCOR	46361	
DT101B	IND., EGT	ALCOR	OEM-46161	
DT102A	SWITCH, EGT,(4 POSITION)	ALCOR	OEM-80825	
DT103A	PROBE, EGT	MOONEY	880005-505	
—	/ALTERNATE	ALCOR	86255	
DT104A	TRAY, LIGHT (28VDC)	ALCOR	41338	
DT105A	TRAY, LIGHT (14V)	ALCOR	41337	
DU105A	TRANSDUCER, MAP	KULITE	APTE-251-1000-25A	
—	(ALT)	PATRIOT	KA21-015-25A	
DV101A	INDICATOR, FUEL FLOW	MOONEY	880034-501	
—	INDICATOR, FUEL FLOW (OPT)	MOONEY	880034-503	
—	INDICATOR, FUEL FLOW (OPT)	MOONEY	880034-505	
DV101B	INDICATOR, F/F (GALS)	SHADIN	912021	
—	INDICATOR, F/F (LBS) (OPT)	SHADIN	912023	
—	INDICATOR, F/F (GALS)(OPT)	SHADIN	912041	1
—	INDICATOR, F/F (LBS)(OPT)	SHADIN	912043	1
—	INDICATOR, F/F (LITERS)(OPT)	SHADIN	912047	1
—	INDICATOR, F/F (GALS)(OPT)	SHADIN	912081	2
DV102A	TRANSDUCER, FUEL FLOW	MOONEY	880030-501	
—	(OPTIONAL)	MOONEY	880030-503	
DV102B	TRANSDUCER, F/F	SHADIN	680501B	
EG101A	ACTUATOR, LDG GR	MOONEY	880037-507	
—	(ALT)	MOONEY	560254-503	
—	(ALT)	MOONEY	560254-507	
EG102A	ACTUATOR, LDG GR	MOONEY	880037-501	
—	(ALT)	MOONEY	560254-501	
EG103A	ACTUATOR, LDG GR	MOONEY	560254-505	
EG104A	SWITCH, LDG GR. A/S SAFETY	MOONEY	880013-507	
ET101A/ELT101A	SWITCH, ELT PANEL	ARTEX	110-416	
ET102A/ELT102A	TRANSMITTER, ELT	ARTEX	453-0150	
ET103A	CABLE ASSY, REMOTE	AMERI-KING	4500041	
ET104A	REMOTE UNIT ASSY	AMERI-KING	450004	
—	REMOTE UNIT ASSY	AMERI-KING	450004-1V/1H	
ET105A	ELT ASSY, MAIN	AMERI-KING	AK-450	
F1/FU101A	FUSE, 1 AMP	LITTEL	313001	
F2/FU102A	FUSE, 5 AMP-3AG-SLO-BLO	LITTEL	313005	
F3/FU103A	FUSE, 10 AMP SLO-BLO	LITTEL	313010	
F4/FU104A	FUSE, 5 AMP	McGRAW-EDISON	FM01-5A	
FU105A	FUSE, .50 AMP	McGRAW-EDISON	FM01-.50A	
FU106A	FUSE, 2 AMP	LITTEL	313002	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
FH1/FH101A	HOLDER, FUSE	LITTEL	155020	
—	(ALT)	LITTEL	155120	
FH2/FH102A	HOLDER, FUSE	McGRAW-EDISON	FHN42W	
FN101A/FON1	PHONE JACK	SWITCHCRAFT	C-11	
—	/WASHER	SWITCHCRAFT	S-1028	
—	/WASHER	SWITCHCRAFT	S-1029	
FN102A/FON2	PHONE JACK	SWITCHCRAFT	C-112B	
—	/WASHER	SWITCHCRAFT	S-1028	
—	/WASHER	SWITCHCRAFT	S-1029	
FU101A	SEE F1/FU101A SERIES LISTING ON PREVIOUS PAGE			
JE101A	IGNITION CONTROL	LASAR (SLICK)	CD-1001-02	
JE102A	CABLE	LASAR (SLICK)	CH1001-XX	
JE103A	MAGNETO, LEFT	SLICK (LAZAR)	CD-4771	
JE104A	MAGNETO, RIGHT	SLICK (LAZAR)	CD-4770	
JM101A	SWITCH, MAGNETO	BENDIX	10-357210-9	
—	/PLACARD	BENDIX	10-187-468	
—	/TERMINAL LUG	BENDIX	10-126656	
JM101B	SWITCH, MAG. (W/CONN.)	JANCO	97-2273-1	
JM102A	MAGNETO	BENDIX	D4LN-2021	
—	(ALT)	BENDIX	D4LN-3000	
—	(ALT)	LYCOMING	LW-682555-11	
JM103A	PLUG, MAGNETO	BENDIX	10-382698	
JM104A	MAGNETO	SLICK	6244	
JM105A	MAGNETO, LEFT	SLICK	6261	
JM106A	MAGNETO, RIGHT	SLICK	6260	
JM107A	SWITCH, IGNITION	TCM	10-357240-1	
JM108A	MAGNETO, LH	SLICK	6393	
JM109A	MAGNETO, RH	SLICK	6350	
JM110A	IGNITION, PULSAR	MOONEY	800315-501	
JM111A	MAGNETO, L & R	BENDIX	S6RN-25-10	
---	(ALT)	TCM/BENDIX	10-79020-10	
JM112A	MAGNETO, LH	SLICK (LASAR)	CD-4771	
JM112A	MAGNETO, RH	SLICK (LASAR)	CD-4770	
JM	MAGNETO, LH	SLICK	4372 (Rev.C)	
JM	MAGNETO, RH	SLICK	4370 (Rev.C)	
JM113A	MAGNETO, L & R	TCM	640896-1	
---	(ALT)	BENDIX	10-79020-120	
L1	BULB, 28V	GE	464-T-3 ¼	
L2/LA102A	BULB, 14V	GE	168-T-3 1/4	
L3/LA103A	BULB	GE	385	
L4/LA104A	BULB, 14V	GE	330	
L5/LA105A	BULB	CHI. MINI.	CM7-7330	
L6/LA106A	BULB	CHI. MINI.	CM7-7327	
L7/LA107A	BULB	GE	370	
L8/LA108A	BULB	GE	1816	
L9/LA109A	BULB	GE	327 (AV RED)	
L10/LA110A	BULB, 28V	GE	327	
L11/LA111A	BULB	GE	1818	
L12/LA112A	BULB	GE	1495	
LA101A	BULB, 28V	GE	400	
LA113A	BULB	GE	4596	
LA114A	BULB	PAC. PREC.	P28028	
LA115A	BULB	MOUSER ELEC.	351-5003	
LB101A	C/B, BEACON, ROTATING	MOONEY	930023-243	
LB101B	C/B, BEACON, ROTATING	MOONEY	930023-343	
LB102A	LIGHT, ROTATING BEACON	WHELEN	WRML-24	
—	/ADAPTER	WHELEN	WRML-65	
LB102B	LIGHT, ANTI-COLLISION (RED)	WHELEN	90033-19	
LB102C	LIGHT, ANTI-COLLISION (WHITE)	WHELEN	90033-20	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
LC101A	LIGHT CONTROL BOX	MOONEY	800268-509	
LE107A	ANNUNC. LENS (USA)	MOONEY	880048-633 (M20J)	
LE108A	ANNUNC., LENS (FRANCE)	MOONEY	880048-635 (M20J)	
LE109A	ANNUNC. LENS (USA)	MOONEY	880048-625 (M20R)	
LE110A	ANNUNC. LENS (FRANCE)	MOONEY	880048-627 (M20R)	
LE111A	ANNUNC. LENS (USA)	MOONEY	880048-629 (M20R)	
LE112A	ANNUNC. LENS (FRANCE)	MOONEY	880048-631 (M20R)	
LE113A	ANNUNC. LENS (USA)	MOONEY	880048-605 (M20K)	
LE114A	ANNUNC. LENS (FRANCE)	MOONEY	880048-607 (M20K)	
LE115A	LENS	MOONEY	880089-001 (M20K)	
LE116A	LENS	SLOAN	855-SE-C	
LE117A	LENS	MOONEY	880089-003 (M20J)	
LE119A	LENS, MASTER WARN	MOONEY	150080-6097	
LENS1/LE101A	ANNUNC. LENS (USA)	MOONEY	880048-613 (M20J)	
LENS2/LE102A	ANNUNCIATOR LENS (FRANCE)	MOONEY	880048-615 (M20J)	
LENS3/LE103A	ANNUNCIATOR LENS (USA)	MOONEY	880048-617 (M20K, M20M)	
LENS4/LE104A	ANNUNCIATOR LENS (FRANCE)	MOONEY	880048-619 (M20K, M20M)	
LENS5/LE105A	ANNUNCIATOR LENS	MOONEY	880048-621 (M20T)	
LENS6/LE106A	ANNUNCIATOR LENS	MOONEY	880048-623 (M20T)	
LG101A	C/B, LOGO LIGHT	MOONEY	930023-357	
LG102A	LIGHT, LOGO	WHELEN	A730-1-28	
LH1/LH101A	LAMP HOLDER	MOONEY	914083-1	
LH2/LH102A	LAMP, HOLDER	DIALIGHT	270-1930-0171-702	
LH3/LH103A	LAMP HOLDER	WHELEN	A-350-CN-CL-BK-SH-28	
LH4/LH104A	LAMP HOLDER	SLOAN	855S-O-U	
—	/WASHER, LOCK, INT. TOOTH		MS35334-21	
—	/WASHER, LOCK, INT. TOOTH	ALLEN BRADLEY	M2898	
LH5/LH105A	LAMP HOLDER	INSTRUMENTS	0211-128	
LH6/LH106A	LAMP HOLDER	INSTRUMENTS	BA28-24-BW3	
LH7/LH107A	LAMP HOLDER	SIGMA TEC	1V-192-971	
LH8/LH108A	LAMP HOLDER	HH SMITH	1930	
—	(ALT)	LEECRAFT	7-05	
—	(ALT)	ALLIED	931-3103)	
—	(ALT)	SPC	LSL-11-128U	
—	(ALT)	NEWARK	81N2561)	
LH9/LH109A	LAMP HOLDER	HH SMITH	1925	
LH10/LH110A	LAMP HOLDER	WHELEN	01-0770437-00	
LH11/LH111A	LAMP HOLDER, CABIN UTILITY	TEK-LITE	LC-28-5	
—	(ALT)		MS1745-51A	
LH12/LH112A	LAMP HOLDER, BAGGAGE LT	WHELEN	01-077-0142-04	
LH113A	LAMP HOLDER	MOUSER ELECT	351-0003	
LL101A	SWITCH, LANDING LT	MOONEY	880052-521	
LL101B	SWITCH, LANDING LT	MOONEY	880052-121	
LL102A	LIGHT, TAXI/LDG, LH/RH (28V)	GE	4596	
LL103A	LIGHT, TAXI/LDG, LH/RH (14V)	GE	4509	
LN101A	C/B, NAV LIGHTS	MOONEY	930023-251	
LN101B	C/B, NAV LIGHTS	MOONEY	930023-351	
LN102A	LIGHT ASSY,,NAV-TAIL (WING)	MOONEY	800051-501	
LN102B	LIGHT ASSY, NAV-TAIL (WING)	MOONEY	800051-509	
LP101A	DIMMER CTRL BOX(28V/14V)	MOONEY (ELEC)	800299-501	
LP102A	DIMMER CTRL BOX(28V)	MOONEY	800299-503	
LP103A	DIMMER CTRL BOX(14V)	MOONEY	800299-505	
LP104A	PANEL,SW.,O/H LITE ASSY	MOONEY	150085-005	
LP105A	INVERTER, PLACARD (O/H)	ERG	LPS28-3-3P	
LR101A	C/B, RECOGNITION LIGHT	MOONEY	930023-231	
LR101B	C/B, RECOGNITION LIGHT	MOONEY	930023-331	
LR102A	RECOGNITION LIGHT	MOONEY	880049-501	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
LS101A	C/B, STROBE LIGHT	MOONEY	930023-237	
LS101B	C/B, LIGHTS, STROBE	MOONEY	930023-337	
LS102A	POWER SUPPLY, STROBE	WHELEN	01-0770329-00	
LS102B	POWER SUPPLY, STROBE	WHELEN	01-0770329-01	
LS103A	STROBE/NAV LITE ASSY(LH/WG)	WHELEN	01-0770054-12	
LS104A	STROBE/NAV LITE ASSY(RH/WG)	WHELEN	01-0770054-13	
LS105A	STROBE/TAIL LIGHT ASSY	MOONEY	470013-501	
LS106A	POWER SUPPLY (TAIL)	WHELEN	A413A-HDA-DF28	
	LIGHT, STROBE (DUAL)	WHELEN	A413A-HDA-CF	
LT101A	SWITCH, TAXI LIGHT	MOONEY	880052-523	
LT101B	SWITCH, TAXI LIGHT	MOONEY	880052-123	
LT102A	TAXI LIGHT LT/RT	G.E.	4596	
MA101A	RECEPTACLE, AUX POWER		AN2552-3A	
---	(ALT)		MS3506-1	
MB101A	C/B-SWITCH, AVIONICS MASTER	MOONEY	930023-213	
MB101B	C/B-SWITCH, RADIO MASTER	MOONEY	930023-313	
MC101A	CIGAR LIGHTER	MOONEY	800336-503	
MC102A	CAP & TETHER	CASCO	216550	
MC103A	LIGHTER, SOCKET	CASCO	216510	
---	/WITH WIRE	CASCO	200402	
ME101A	CLOCK	MID-CONT	MD-89	
—	(ALT)	PORSCHE	944.641.213.00	
ME102A	CONN, 4 PIN	MID-CONT	6016177	
—	/WITH PINS	MID-CONT	6016125	
—	CONN, 4 PIN (OPT)	PORSCHE	944.612.217.00	
—	/WITH PINS	PORSCHE	999.652.351.12	
MIC1/MK101A	JACK, MICROPHONE	SWITCHCRAFT	C-12B	
—	/WASHERS	SWITCHCRAFT	S-1028	
—	/WASHERS	SWITCHCRAFT	S-1029	
MP101A	C/B-SW, PROP DE-ICE	MOONEY	930023-245	
MP101B	C/B-SW., PROP. DE-ICE	MOONEY	930023-345	
MP102A	TIMER, PROP DE-ICE	B.F. GOODRICH	3E1899-1	
MP102B	TIMER, PROP DE-ICE	McCAULEY	B-45018	
MP103A	TERMINAL BLOCK	McCAULEY	C-40521	
NF101A	C/B-SW, LOW-BOOST PUMP	MOONEY	930023-211	
NF101B	C/B-SW., BOOST PUMP	MOONEY	930023-311	
NF102A	PUMP, BOOST	WELDON	A8163B	
—	(ALT)	WELDON	8163B	
NF103A	PUMP, BOOST	WELDON	8163A	
—	(ALT)	WELDON	A8163A	
NF104A	PUMP, BOOST	WELDON	10054B	
NF105A	PUMP, BOOST	WELDON	A10051D	
NF106A	PUMP, BOOST	WELDON	A8152-B	
NF108A	REGULATOR, FUEL BOOST PUMP	MASSEY	VR536	
NF108B	REGULATOR, FUEL BOOST PUMP	MOONEY	800270-523A	
NF109A	C/B-SW, HI-BOOST PUMP	MOONEY	930023-219	
NF110A	GUARD ASSEMBLY	MOONEY	930028-501	
PA101A	REGULATOR, VOLTAGE	MOONEY	800270-501/A	
—	(ALT)	AMERICAN PROD	DGR-2	
—	(ALT)	ELECTRODELTA	VR-802	
PA102A	SWITCH, ALT FLD (DUAL)	MOONEY	880052-525	
PA103A	SWITCH, ALT FLD (SINGLE)	MOONEY	880052-503	
PA104A	ALTERNATOR	LYCOMING	LW-14367	
—	(ALT)	PRESTOLITE	ALU-6421-LS	
PA105A	ALTERNATOR	LYCOMING	LW-15404	
—	(ALT)	PRESTOLITE	ALY-8420	
PA106A	ALTERNATOR, RH	TCM	649280	
—	(ALT)	TCM	649719	
—	/GEAR ASSEMBLY	TCM	649123	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
PA107A	ALTERNATOR	ELECT. SYST.	ES 4009-LS	
—	/INSTALL KIT (REF 600180)	LYCOMING	05K-21065	
PA108A	FILTER	MOONEY	880014-501	
—	(ALT)	MOONEY	800307-501	
PA109A	SENSOR, CURRENT	MICRO SW	CSLA1GE	
PA110A	REGULATOR, VOLTAGE	MOONEY	800270-503	
PA111A	SENSOR, CURRENT (110 A)	KLIXON	7235-1-110	
PA111B	SENSOR, CURRENT (175 A)	KLIXON	7236-1-175	
PA112A	ALTERNATOR (100A)	TCM	649304	
PA113A	MONITOR, CURRENT	MOONEY	800287-501	
PA114A	ALTERNATOR, LH	TCM	649172	
---	(ALT)	TCM	649283	
PB101A	BATTERY	GILL	G-243	
PB102A	SWITCH, MASTER	MOONEY	880052-501	
PB102B	SWITCH, MASTER	MOONEY	880052-101	
PB103A	SWITCH, BATTERY -- 1/2	MOONEY	880052-527	
PB103B	SWITCH, BATTERY -- 1/2	MOONEY	880052-127	
PB105A	BATTERY, MAINT. FREE	CONCORDE	RG24-11M	
PB105B	BATTERY, MAINT. FREE	CONCORDE	RG24-15	
PL01A	PLUB, 1 PIN	AMP	1-480349-0	
PL02A	PLUG, 2 PIN	AMP	1-480318-0	
PL02B	PLUG, 2 PIN	MOLEX	03-06-1023	
PL02C	PLUG, 2 PIN (FEMALE)	DEAN	7022	4
PL02D	PLUG, 2 PIN		MS3106A24-9S	
PL03A	PLUG, 3 PIN	AMP	1-380303-0	
PL03B	PLUG, 3 PIN	AMP	206037-2	
PL03C	PLUG, 3 PIN		MS3106A10SL-3S	
PL03D	PLUG, 3 PIN		MS3106A28-6P	
PL03E	PLUG, 3 PIN	ARRAY CONN.	PWF06F08-33A	
---	SOCKET (ALUMEL)	CDI	01-2020-245	
---	SOCKET (CHROMEL)	CDI	01-2020-244	
PL04A	PLUG, 4 PIN	AMP	206060-1	
PL04B	PLUG, 4 PIN		MS3106A32-17S	
PL04C	PLUG, 4 PIN	AMP	1-480424-0	
PL04D	PLUG, 4 PIN	ARRAY CONN.	PW06F8-4S	
PL05A	PLUG, 5 PIN		MS3106A14S-5S	
PL05B	PLUG, 5 PIN	DEUTSCH	BVD06EO205SN	
PL06A	PLUG, 6 PIN	MATRIX SCIENCE	MS3106A28-22S	
PL07A	PLUG, 7 PIN		MS3106A20-15S	
---	(ALT)		MS3106R20-15S	
PL08A	PLUG, 8 PIN	AMP	205838-1	
PL09A	PLUG, 9 PIN	AMP	206708-1	
PL09B	PLUG, 9 PIN	AMPHENOL	126-222	
PL09C	PLUG, 9 PIN		DE-9S	
PL09D	PLUG, 9 PIN	MOLEX	03-06-2092	
PL09E	PLUG, 9 PIN	AMP	206485-1	
PL14A	PLUG, 14 PIN	MOONEY	930021-1	
PL14B	PLUG, 14 PIN	MOONEY	930021-513	
PL14C	PLUG, 14 PIN	AMP	206043-3	
PL15A	PLUG, 15 PIN		DA15S	
PL16A	PLUG, 16 PIN	AMP	206037-1	
PL17A	PLUG, 17 PIN		DBM17W2S	
PL20A	PLUG, 20 PIN	MOONEY	930021-501	
PL20B	PLUG, 20 PIN	POSITRONICS	CC148-003-0.00	
PL20C	PLUG, 20 PIN	POSITRONICS	CC149-003-0.00	
PL25A	PLUG, 25 PIN		DB25S	
PL25B	PLUG, 15 PIN	AMP	205208-1	
PL25C	PLUG, 25 PIN	POSITRONICS	MD25F20JVL0	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
PL26A	PLUG, 26 PIN	MOONEY	930021-505	
PL28A	PLUG, 28 PIN	AMP	205839-3	
PL32A	PLUG, 32 PIN****	MATRIX SCIENCE	M83723/86R2232N	
	****USE MS3420-14 OR -16 BOOT WITH CONNECTOR.			
PL34A	PLUG, 34 PIN	MOONEY	930021-507	
PL34B	PLUG, 34 PIN	MOONEY	930021-515	
PL37A	PLUG, 37 PIN	AMP	206150-1	
PL37B	PLUG, 37 PIN		DC37S	
PL104A	PLUG, 104 PIN	POSITRONICS	GMCT104F0TH000	
PS101A	C/B, STARTER SOLENOID	KLIXON	7277-2-10	
PS102A	C/B, STARTER SOLENOID	KLIXON	7277-2-5	
PS103A	STARTER	PRESTOLITE	MHB-4016	
—	(ALT)	LYCOMING	LW-15572	
PS104A	STARTER	TCM	646275	
—	(ALT)	TCM	637847	
PS105A	STARTER	B & C SPEC.	BSC206-149	
RB101A	BLOWER, RADIO	KING	071-4037-01	
R1/RS101A	RESISTOR (20 OHM/10W)	DALE	RH-10-20 OHM	
R2/RS102A	RESISTOR (5 OHM/10W)	DALE	RH-10-5 OHM	
R3/RS103A	RESISTOR,MAPLIGHT (500 OHM)	MOONEY	919029-501	
R4/RS104A	RESISTOR (100 OHM)	NEWARK	09F976	
R5RS105A	RESISTOR (7.5 OHM)	DALE	RH-50-7.5 OHM	
R6/RS106A	RESISTOR (1K OHM/2W)	ALLEN-BRAD.	RC42-GF102J	
R7/RS107A	RESISTOR (5K OHM)	ALLEN-BRAD.	WA2-G056S502UA	
—	(ALT)	SPECTROL	149-11-502	5
—	(ALT)	BOURNS	3862C-282-502A	
—	(ALT)	NEWARK	12F9905R 5.0K	
R8/RS108A	RESISTOR (150 OHM/3W)	CLAROSTAT	VC3D	
—	(ALT)	OHMITE	23J	
R9/RS109A	RESISTOR (3.9K OHM/ 1/2W)	OHMITE	N/A	
R10/RS110A	RESISTOR (3.0K OHM/ 1/2W)	OHMITE	N/A	
R11/RS111A	RESISTOR (1 OHM/25W)	DALE	RH-25-1 OHM	
R12/RS112A	RESISTOR (70 OHM/10W)	DALE	RH-10-70 OHM	
R13	RESISTOR (10.0K OHM/1W)	OHMITE	N/A	
RS113A	RESISTOR (15.0K OHM/1/4W)	OHMITE	N/A	
RS114A	RESISTOR, DUAL (5.0K OHM)	ALLIED	753-8059	
RS115A	RESISTOR (1.6K OHM/1/2W)	OHMITE	N/A	
RS116A	RESISTOR (1.0K OHM/1/8W)	OHMITE	N/A	
RB101A	BLOWER, RADIO	KING	071-4037-01	
RC01A	RECEPTACLE, 1 PIN	AMP	1-480351-0	
RC02A	RECEPTACLE, 2 PIN	AMP	1-480319-0	
RC02C	RECEPTACLE, 2 PIN (MALE)	DEAN	7021	4
RC02D	RECEPTACLE, 2 PIN		MS3100-24-9P	
RC03A	RECEPTACLE, 3 PIN	AMP	1-480305-0	
RC03B	RECEPTACLE, 3 PIN	AMP	206036-2	
RC03C	RECEPTACLE, 3 PIN	AMP	206207-1	
RC03D	RECEPTACLE, 3 PIN		MS3100-28-6S	
RC04A	RECEPTACLE, 4 PIN	AMP	206153-1	
RC04B	RECEPTACLE, 4 PIN		MS3100-32-17P	
RC04C	RECEPTACLE, 4 PIN	AMP	1-480426-0	
RC05B	RECEPTACLE, 5 PIN	DEUTSCH	BVD04E0205PN	
RC06A	RECEPTACLE, 6 PIN	MATRIX SCIENCE	MS3100C-28-22P	
RC08A	RECEPTACLE, 8 PIN	AMP	205841-2	
RC09A	RECEPTACLE, 9 PIN	AMP	206705-2	
RC09B	RECEPTACLE, 9 PIN	AMP	206705-1	
RC09C	RECEPTACLE, 9 PIN		DE9P	
RC09E	RECEPTACLE, 9 PIN	AMP	205486-1	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
RC12A	RECEPTACLE, 12 PIN	MOLEX	03-06-2122	
RC14A	RECEPTACLE, 14 PIN	MOONEY	930021-2	
RC14B	RECEPTACLE, 14 PIN	AMP	203540-1	
—	(ALT)	POSITRONIC	G14000H000-1265.0	
RC14C	RECEPTACLE, 14 PIN	AMP	206044-1	
RC15A	RECEPTACLE, 15 PIN		DA15P	
RC16A	RECEPTACLE, 16 PIN	AMP	206037-1	
RC16B	RECEPTACLE, 16 PIN	AMP	206036-1	
RC20A	RECEPTACLE, 20 PIN	MOONEY	930021-502	
RC20B	RECEPTACLE, 20 PIN	POSITRONICS	GMCT20M0T0000	
RC26B	RECEPTACLE, 26 PIN	MOONEY	930021-506	
RC28A	RECEPTACLE, 28 PIN	AMP	206152-1	
RC32A	RECEPTACLE, 32 PIN	MATRIX SCIENCE	M83723/83K2232N	
RC34A	RECEPTACLE, 34 PIN	MOONEY	930021-508	
RC34B	RECEPTACLE, 34 PIN	AMP	204814-1	
—	(ALT)	POSITRONICS	SK2114	
RC37A	RECEPTACLE, 37 PIN	AMP	206151-1	
RC104A	RECEPTACLE, 104 PIN	POSITRONICS	GMCT104M0000Z0	
RL1/RL101A	RELAY, BATT. (28V/200A)(OBS)	C-H	6041H-202	
—	(ALT) (OBS)	C-H	6041H-202A	
—	(ALT)	KISSLING	26.57.01	
—	(ALT (PREFERRED))	KISSLING	26.57.02	
RL2/RL102A	RELAY, BATT. (14V/200A)	C-H	6041H-105A	
RL3/RL103A	RELAY	KISSLING	26.64.01	
RL4/RL104A	RELAY	KISSLING	26.64.21	
RL5/RL105A	RELAY, LDG. (28V/50A)	C-H	6041H-220	
—	(ALT)	KISSLING	26.72.03	
—	/BRACKET (2 EA)	MOONEY	800375-001	
RL6/RL106A	RELAY (28V/100A)	C-H	6041H-53	
RL7/RL107A	RELAY, (14V/200A)	C-H	6041H-105R	
RL8RL108A	RELAY	MAGNACRAFT	W67RCSX-3	
RL9/RL109A	RELAY	KISSLING	28.08.01	
RL10/RL110A	RELAY	P & B	VF4-15-H11	
—	SOCKET	P & B	VCF4-1002	
—	TERMINAL	P & B	26A1348C	
RS101A SERIES	SEE R1/RS101A LISTINGS ON PREVIOUS PAGE			
SA101A	ALTERNATOR, STAND-BY	B & C	BC410-1	
—	HOUSING, CONNECTOR	B & C	12-003	
—	TERMINAL (1/4")	B & C	14-026	
SA102A	CONTROLLER, STBY. ALT.	B & C	BC203-2	
SA103A	SWITCH, STD-BY ALT/EMER.BUS	MOONEY	880052-531	
SB101A	C/B, SPEEDBRAKE	KLIXON	7277-2-3	
SB102A	SWITCH, S/B,CNTRL WHL	PRECISE FLT	01265	
SB103A	RELAY, SPEEDBRAKE	PRECISE FLT	01384	
SB104A	DIODE		1N2483/1N5060	
—	(ALT)	GE	3720-GE	
SB105A	MOTOR, SPEEDBRAKE	PRECISE FLT	01532	
SB106A	SWITCH, SPEEDBRAKE	PRECISE FLT	01505	
SB107A	SOLENOID, CLUTCH	PRECISE FLT	01678	
SB108A	INTERFACE, SPEEDBRAKE	MOONEY	800314-501	
SPK1/SP101A	SPEAKER, ALERT	ARCHER	40-1333C	
SPK2/SP102A	SPEAKER, CABIN	ARCHER	40-1325	
—	(ALT)	BLAUPUNKT	PCx352	6
SPK3	SONALERT	MALLORY	SC628	

ELECTRICAL EQUIPMENT CHART

CODE	DESCRIPTION	VENDOR	PART NO.	NOTES
SW1/SW101A	SWITCH	MICRO	1SE1-T	7
---	(ALT)	SAINT	ZS-1009	
SW2/SW102A	SWITCH, DEF. BLWR.	CHERRY	E51-50B	
SW3/SW103A	SWITCH, LIMIT, RUD.TRIM	MICRO	V3-1	
SW4/SW104A	SWITCH, UP LIMIT, LDG	MICRO	DT-2R-47	
---	(ALT)	SAINT	ML-1409	
SW5/SW105A	SWITCH, DN LIMIT, LDG	OTTO	P6-24014	
—	(ALT)	MICRO	1CH116-6	
SW6/SW106A	SWITCH, CABIN LTS	CARLING	RC911-VBBOW	
SW7/SW107A	SWITCH	MOONEY	880013-507	
SW8/SW108A	SWITCH, LDG	C-H	8906K2875	
SW9/SW109A	SWITCH, MIC-KEY	ALCO	MPE-106F-C-22-9	
—	(ALT)	C-H	SA1RV20	
SW10/SW110A	SWITCH, CHT	GRAYHILL	71AD30-02-2-AJN	
SW11/SW111A	SWITCH, FLAP	C-H	8906K4731	
SW12/SW112A	SWITCH, CABIN LTS(MASTER)	CARLING	RA911-VBBOW	
SW13/SE113A	SWITCH (ALT)	MICRO	12TW1-10	
—	/CAP, WHITE	MICRO	15PA90-8W	
—	(ALT)		MS27753-38	
SW14/SW114A	SWITCH, F/F MEM.	C & K	7101K	
SW15/SW115A	SWITCH, LDG, OVERRIDE	NKK	DLB241-W01-L3C/ AT506M/AT503MB	
—	/BUTTON/LOCK RING/LOCK WASHER/HEX NUT (2 EA) (NKK)			
—	(ALT) SWITCH	C-H	SB1DDX492-2	
—	/LOCK RING	C-H	29-761	
—	/LOCK WASHER	C-H	16-886	
—	/HEX NUT (2 EA)	C-H	15-966-6	
---	(ALT) SWITCH	TSCHUDIN	504102	
---	/LENS	TSCHUDIN	464115	
---	/BULB	TSCHUDIN	590002	
SW16/SW116A	SWITCH, VAC. HI/LO	MOONEY	880012-501	
SW17/SW117A	SWITCH	CARLING	TILC64-1S-WHFN	
SW18/SW118A	SWITCH	MOONEY	880062-501	
SW19/SW119A	SWITCH	CARLING	TIGM64-1S-WHFN	
SW20/SW120A	SWITCH		MS35058-22	
SW21/SW121A	SWITCH, MIKE KEY	CROUZET	83-450-001	
SW22/SW122A	SWITCH, SPDBRK	CROUZET	83-452-504	
SW23/SW123A	SWITCH	ALCO	MPE106F	
SW124A	SWITCH	T.B.D.	T.B.D.	
SW25/SW125A	SWITCH	NKK	MB2085SB1W01-EA	
SW126/SW126A	SWITCH	EATON	1501-11E	
SW127A	SWITCH, MASTER WARN	OMRON	A3BA-7011-1	
---	SW., WITH LENS	OMRON	A3BA-520R	
---	SW., WITH LEGEND	OMRON	A3BA-5202	
---	SW., WITH BULB	OMRON	A3B-028	
VC101A	VOLTAGE CONVERTER, 28V-14V	TERRA	MLC28-5	
---	(ALT)	TERRA	C28-5	
VR1/VR101A	VARISTOR	GE	V47ZA05	
WM101A	MASTER WARNING	MICRO SWITCH	DSK-104-GYR	
WM102A	MASTER WARNING	MICRO SWITCH	DSB-11-RRRR-LR2	
WS101A	ALERT, STALL WARN/GR WARN	IAI	950D309-000	
---	(ALT)	IAI	950D519-000	
WS103A	SWITCH, STALL WARNING	MOONEY	800364-509	
WT101A	ANNUNCIATOR	MOONEY	880048-501	
WT101B	ANNUNCIATOR	MOONEY	880090-XXX	8
WT102A	ANNUNCIATOR	MOONEY	880048-503	
WT103A	ANNUNCIATOR	MOONEY	880048-507	
WT104A	ANNUNCIATOR	MOONEY	880048-509	

NOTES:

1. SHADIN MODEL NO. INTERFACE WITH II MORROW APOLLO, ARNAV AND NORTHSTAR LORAN SYSTEMS.
2. SHADIN MODEL NO. INTERFACE WITH BENDIX/KING KLN-88 OR KLN90 SERIES.
3. B & D TACH SENSOR'S P/N 0406-004 IS 9/16 " DIAMETER FOR BENDIX MAGNETOS. 0406-003 IS 11/16 " DIAMETER FOR SLICK MAGNETOS.
4. PL02C & RC02C MAY BE PURCHASED FROM DEAN AS P/N 7020.
5. SEAL BACK OF POTENTIOMETER WITH DOW CORNING #738 ELECTRICAL SEALANT AFTER WIRES ARE SOLDERED TO TERMINAL. (MOONEY CODE #225905)
6. NOTE 3 USE TO REPLACE ARCHER 40-1325 FOR SPARES.
7. SEAL BACK OF SWITCH WITH DOW CORNING #738 ELECTRICAL SEALANT AFTER WIRES ARE SOLDERED TO TERMINALS (MOONEY CODE #225905) WHEN USED AS "THROTTLE SWITCH-GEAR WARNING".
8. ANNUNCIATOR P/N WILL BE DETERMINED BY OPTIONS INSTALLED, SEE 880090 FOR DETAILS.

RESERVED FOR FUTURE ENTRIES

91-30-00 - ELECTRICAL SYSTEM SCHEMATICS

CAUTION
USE SCHEMATIC APPLICABLE TO SERIAL NUMBER OF AIRCRAFT BEING SERVICED.

ELECTRICAL SYSTEM SCHEMATICS

SCHEMATIC	M20R EFFECTIVITY	BLOW-UP FICHE NO.	ITEM NO.
800304 (R1)	29-0001 thru 29-0012	AMOB362	A
800304 (R2)	29-0013 thru 29-0065	AMOB362	E
800304 (R3)	29-0066 thru 29-0070	AMOB362	I
800304 (R4)	29-0071 thru 29-0086	AMOB362	M
800304 (R5)	29-0087 thru 29-0104	AMOB362	Q
800304 (R6)	29-0105 thru 29-0112	AMOB362	U
800304 (R7)	29-0113 thru 29-0130	AMOB363	A
800383 (R1)	29-0131 thru 29-0143	AMOB363	E
800383 (R2)	29-0144 thru 29-0156 29-0158 thru 29-0169	AMOB363	I
800383 (R3)	29-0170 thru 29-0182 29-0184 thru 29-0199	AMOB363	M
800383 (R4)	29-0183	AMOB363	Q
800383 (R5)	29-0200 thru 29-TBA	AMOB363	U