Monticello Flying Club Pilot Transition Manual

Mooney M20F

This manual is based primarily on research from multiple sources and the practical use of the Club's specific aircraft. A few excerpts are from the MOONEY PILOT PROFICIENCY PROGRAM developed by the MOONEY AIRCRAFT PILOT ASSOCIATION SAFETY FOUNDATION. This entire manual is for non-profit educational purposes and in no way supersedes the information in the POH.

You should thoroughly read through the POH, its supplements, the club's aircraft checklist, and all of the equipment manuals prior to reading this document.

The pilot in command must also become familiar with all available information concerning each flight, the airworthiness and legality of the airplane, and the pilot's competency, currency and authority for the flight.

Remember, the pilot in command is solely responsible for making all decisions concerning the flights and in each instance has the responsibility for the safe operation of the aircraft.

Revised: 9/17/2019

INTRODUCTION

This document is meant to assist with a Club member's transition to flying a Mooney. This document in no way should take the place of a thorough check out with a Club approved CFI. Additionally, **Club members are expected to take an active role in continuing education related to Club aircraft, aviation safety, and general aviation knowledge.**

ADDITIONAL RESOURCES

Along with the POH, you are strongly encouraged to review these additional resources (and other resources) prior to operating the aircraft.

Garmin 430W trainer - http://www8.garmin.com/support/download_details.jsp?id=3531
Garmin 430 video - https://www.youtube.com/watch?v=RRU8vVIe-cQ
Garmin 430W video - http://www.youtube.com/watch?v=kRQT9eybjao
Electronics Int. (CGR-30P) YouTube videos: https://www.youtube.com/user/buyeiinc/videos
ForeFlight Videos – https://www.youtube.com/watch?v=3q5JHpb8wm0
Plane/Equip Manuals - http://www.monticellofc.org/aircraft/N3275F.html (bottom of page)

Great article on use of mixture: http://www.avweb.com/news/pelican/182084-1.html
Great article on manifold pressure: http://www.avweb.com/news/pelican/Pelicans-Perch-15-Manifold-Pressure-Sucks-182081-1.html
Great article on variable props: http://www.avweb.com/news/pelican/Pelicans-Perch-16-Those-Marvelous-Props-182082-1.html
Great article on putting these together: http://www.avweb.com/news/pelican/Pelicans-Perch-19-Putting-It-All-Together-182085-1.html

M20 SERIES HISTORY AND OVERVIEW

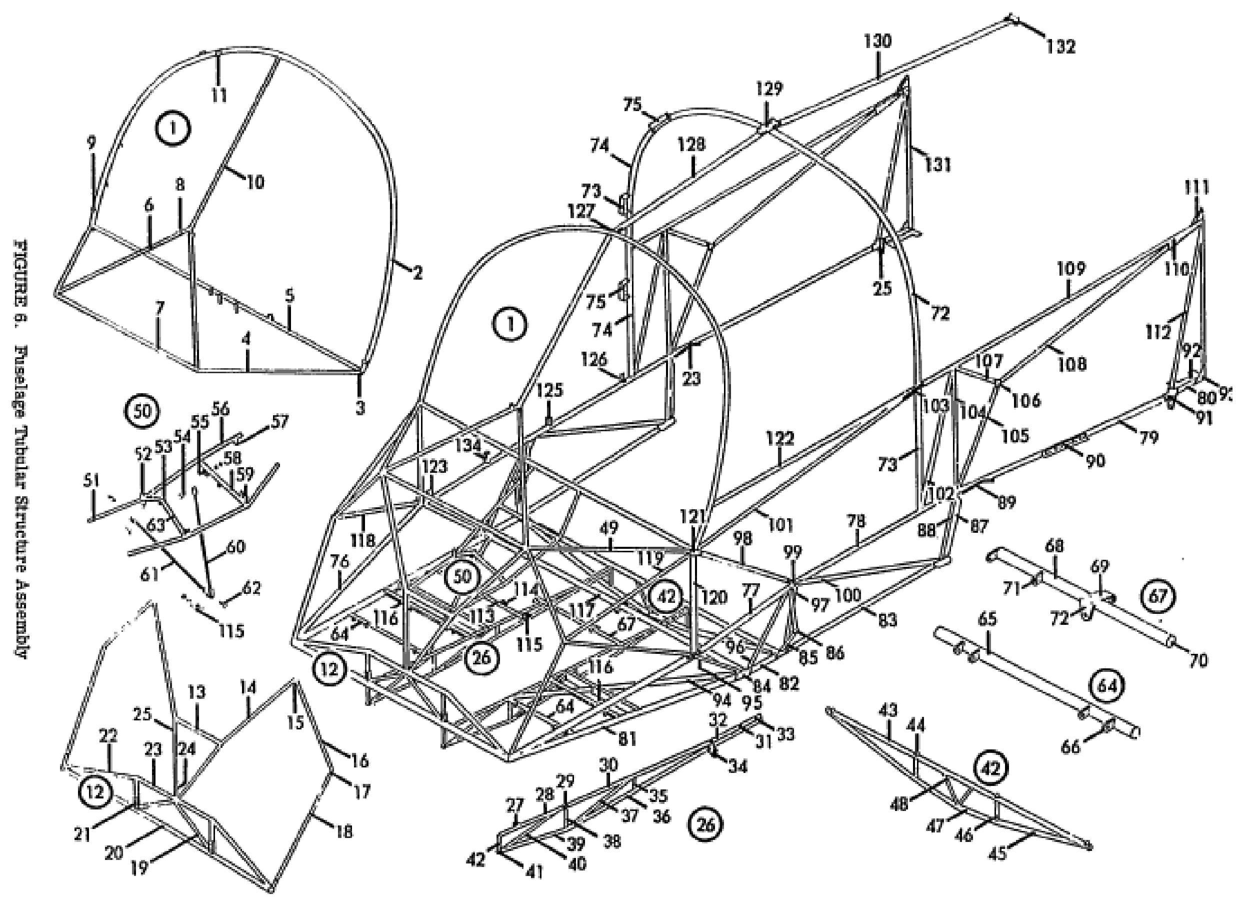
The Mooney model has a very interesting history from wooden tails to one of the first pressurized singles. To see a full description of the progression of the Mooney, go to http://en.wikipedia.org/wiki/Mooney_M20

TABLE OF CONTENTS

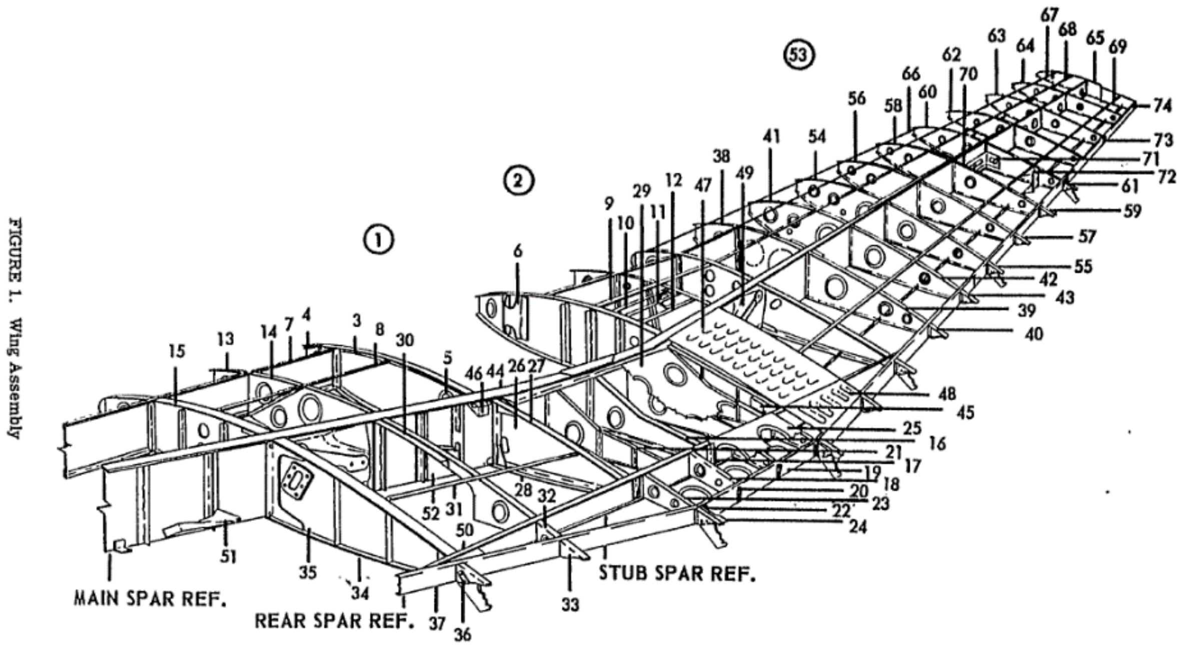
CHAPTER 1: SYSTEMS

GENERAL DESCRIPTION

M20 series aircraft are four-place high-performance single-engine low- wing monoplanes. The all-metal airframe has a tubular-steel cabin frame covered with nonstructural aluminum skins, a semi-monocoque aft fuselage, and a full-cantilever laminar-flow wing.



M20 Series Tubular Cabin Frame



M20 Wing Structure

The spar is a single piece spar running from end to end under the rear seats with the ribs attached to the spar. The original fuel tanks were part of the structure, but have since had fuel bladders added.

Control surfaces have extruded-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

Landing Gear System

The standard landing gear system in all models through 1968 was manually operated. Immediately after construction, the Club's aircraft had its manual landing gear replaced with an electric gear system.

Rubber discs in the gear leg assemblies absorb the shock of taxiing and landing. Single-disc self-adjusting hydraulic brakes are featured on the main gear. There are only toe breaks on the pilot side rudder pedals. An airspeed-actuated safety-switch in the pitot system prevents electric gear retraction on takeoff until a safe flying speed is attained (Note: This airspeed safety switch is fundamentally different from a squat switch). A gear-throttle warning horn is operated by a detent switch on the throttle which sounds when the throttle is set for ~12 inches or less of manifold pressure and the landing gear up.

The landing gear system has a steerable nose wheel. The nose gear steering system consists of a steering horn on the gear leg linked to the rudder pedals by push-pull tubes and bell cranks. Gear retraction automatically disengages the steering mechanism from the nose wheel and a centering cam aligns the nose wheel for entry into the wheel well.

The gear position is indicated in several ways. There is a red in-transit light that lets you know when it is in transit, and there is a green down light. The red in-transit light will go out when the gear is fully retracted. These lights have an aperture closure for dimming, so if these lights do not come on, the first thing to do is rotate the light to ensure the aperture is open. There is also a gear position indicator window (see image below) between the front seats that is unique to the Mooney. When the red lines line up, as shown below, the gear is down.

Gear Position Indicator Window

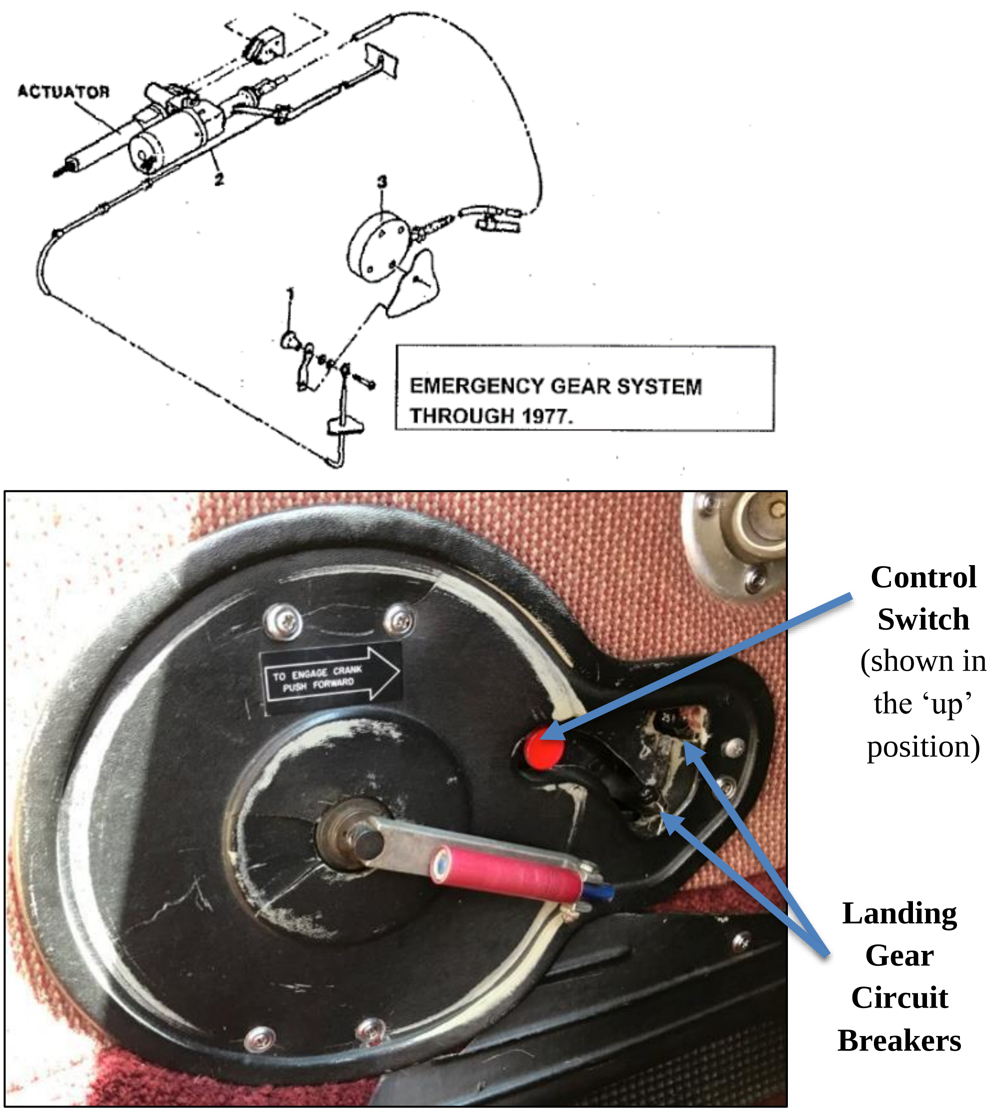
LANDING GEAR CIRCUIT BREAKERS

There are two landing gear system circuit breakers located next to the emergency crank handle (to the left of the pilot's knees – see photo below). The 25amp breaker is for the gear motor. The smaller breaker is for the relay. If the 25amp breaker trips, you should manually lower the gear and return for landing (see next paragraph). Only reset the breaker if the manual extension fails and then only operate the gear to get them down. Resetting the breaker risks expensive damage to the gear motor.

MANUAL LANDING GEAR EXTENSION

The electric gear retraction system has an emergency manual extension system connected to the gear actuator to permit manual lowering of the gear in the event of an electrical malfunction. Never use the manual system to retract the gear. Mooney used two different systems (see diagram) with essentially similar operation from the cockpit. Use of either manual extension system is summarized below:

1. Pull the landing gear actuator circuit breakers located next to the extension handle.
2. Move landing gear control switch to DOWN position.
3. Unlatch manual extension handle.
4. Crank the handle clockwise until green GEAR DOWN indicator light comes ON and/or the lines on the visual gear position indicator on the floor aft of the console are aligned when viewed from directly above the indicator.



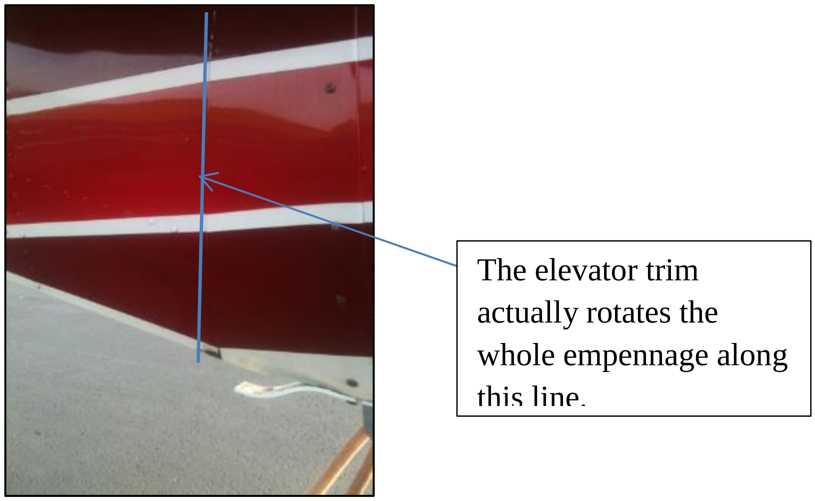
Emergency Gear System Diagram (top)
& Photo of the Control Switch, Crank, and Circuit Breakers (bottom)

FLIGHT CONTROL SYSTEMS

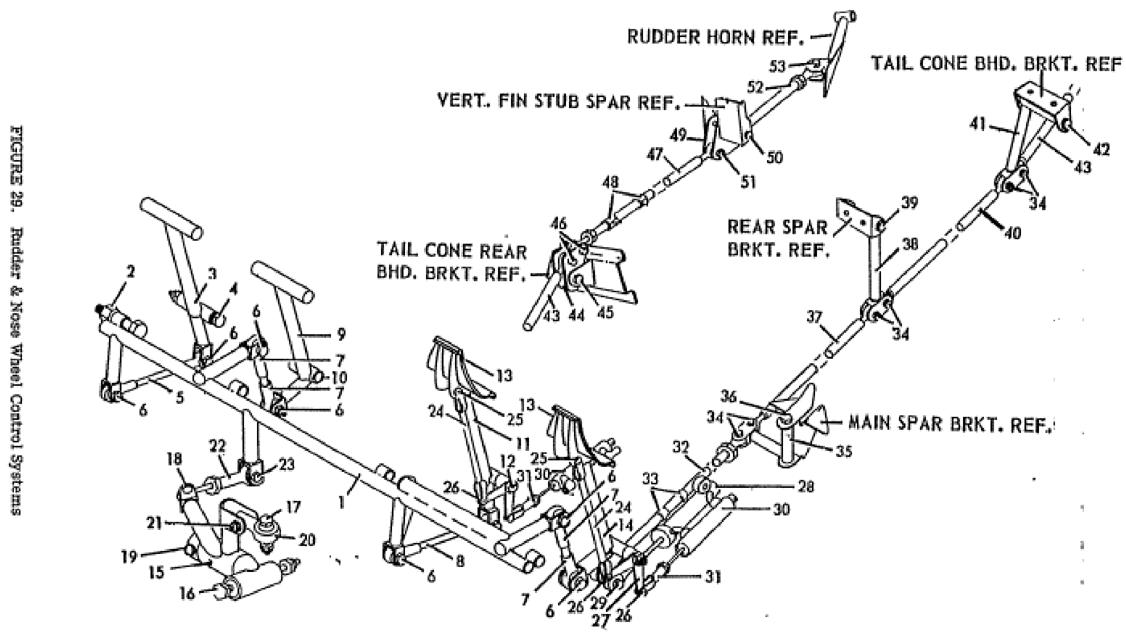
The dual flight control systems can be operated from either the pilot or copilot seat. All flight controls are conventional in operation, using push-pull tubes to link the control surfaces to the control wheels and rudder pedals. Formica guide blocks maintain control tube alignment and dampen vibration. An interconnect bungee spring mechanism links the aileron and rudder systems to assist in control coordination. The co-pilot's rudder pedals are removable.

ELEVATOR TRIM

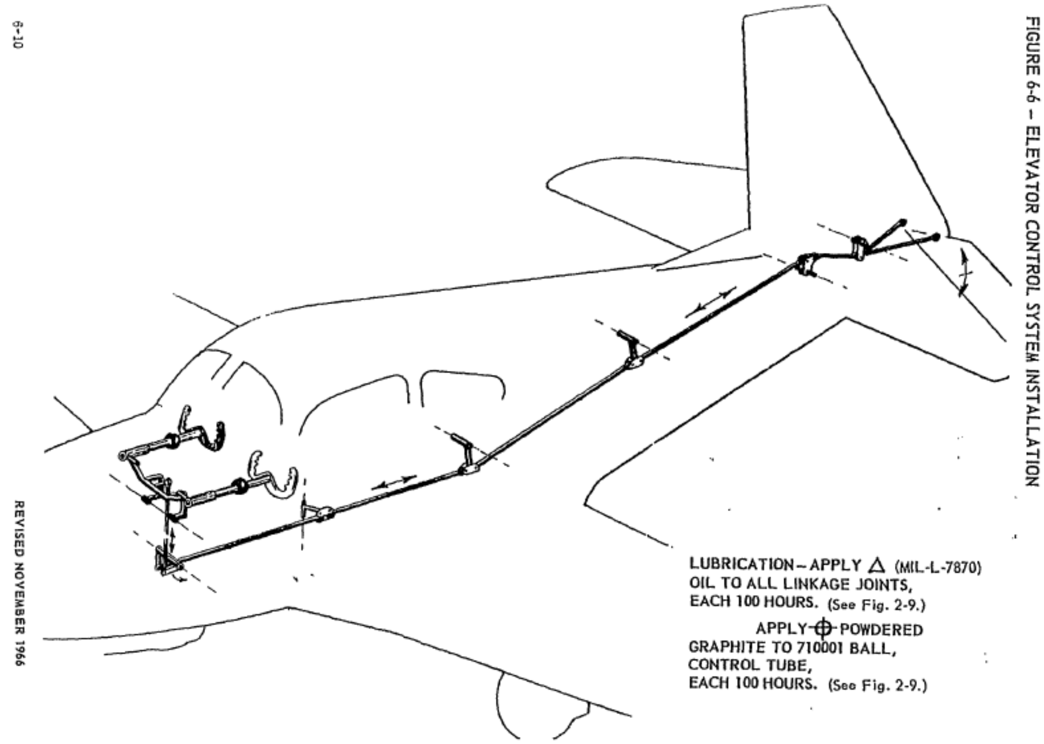
You will notice that there is no trim tab on the airplane. Instead, the elevator trim wheel in the cockpit rotates the entire empennage (right picture, above) to set the stabilizer angle of attack around a hinge located aft of the battery compartment. The trim wheel is on the floor between the pilot and co-pilot’s seats.



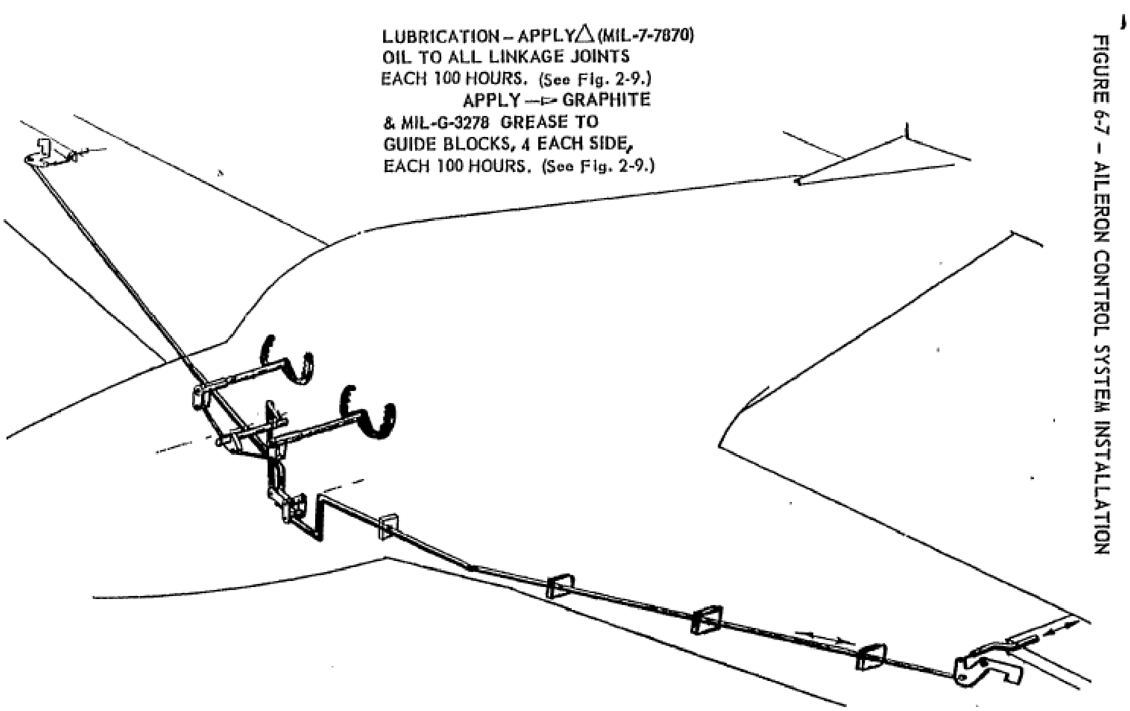
The trim wheel rotates the whole empennage around a hinge



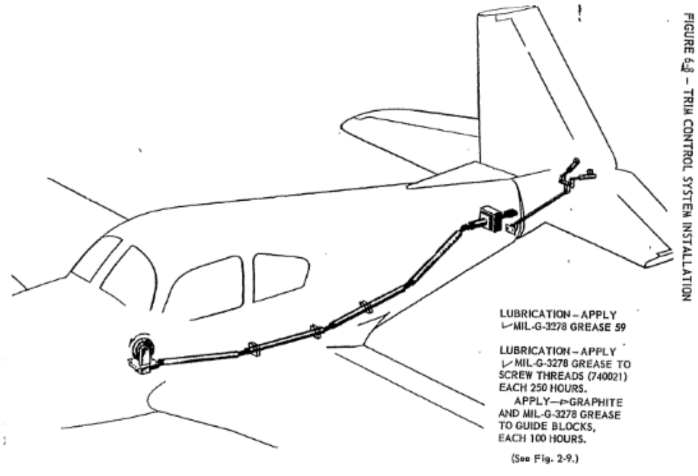
Rudder Control System

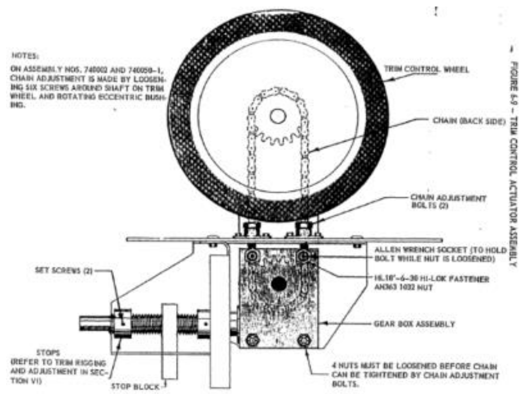


Elevator Control System



Aileron Control System





Elevator Trim Control System

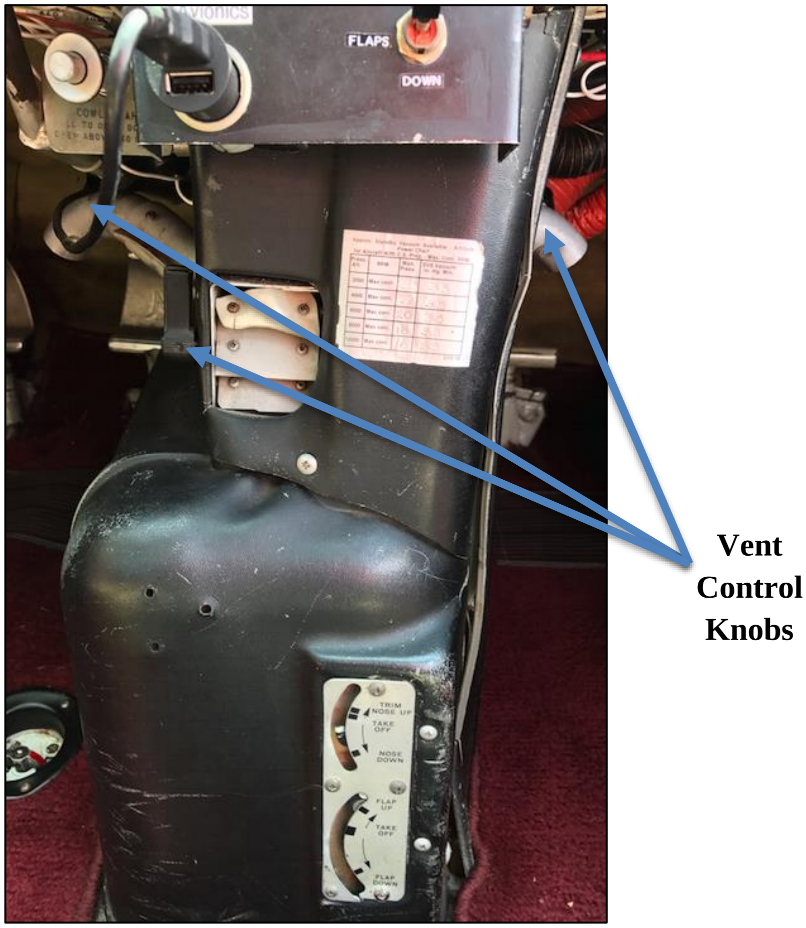
FLAP SYSTEM

This aircraft originally had a hydraulic flap system that was replaced with an electric flap system. The switch is located on the center console next to the lighter adapter. There is an “up” and “down” position with a neutral or off position in between. The switch is not spring loaded in the up position, so if you move it to the up position it will stay in the up position. It is, however, spring loaded in the down position, so flap extension will stop upon releasing the switch or reaching the full flaps down position. A deliberate 3-second count extends the flaps to roughly 15^{o} (approach setting), and roughly 11 seconds will bring the flaps from full up to full down.

CABIN HEATING AND VENTILATION

Pulling out the cabin air knob allows air from inside the engine cowl to enter a mixing box located on the engine side of the firewall. Pulling out the cabin heater knob allows air that has passed over the exhaust muffler to enter this mixing box. Air leaving the mixing box is routed to nozzles at the right shin of the pilot, the left shin of the co-pilot, just below the cigarette lighter on the center console (see photo below), and the windshield base. These nozzles (with the exception of those at the windshield base) have louvers to control the airflow. The nozzles at the windshield base are primarily for defrost. For maximum defrost, you must partially close the lower louvers in order to force more hot air to the windshield. Be careful as too much hot air on the windshield may damage the windshield.

Twist knob openings at the left knee of the pilot and right knee of the co-pilot provide outside air to the front cabin. A manually operated overhead air scoop provides additional outside-air ventilation mostly to the back seat occupants, and controls for these vents are located on the ceiling.



Pedestal between the pilot and co-pilot
to show the cabin heat and air vents and control knobs

INSTRUMENTS

All flight instruments are located in the shock-mounted flight panel. Engine instruments are in the CGR-30P display. The CGR 30 records all engine data and about once a month we load the data to www.savvyanalysis.com. E-mail maintenance@monticellofc.org to get the password to view our data. The CGR-30 uses an initial value and the in-flight fuel flow to calculate a fuel level on the CGR-30. If the initial fuel level is not properly set or the fuel flow meter fails, the CGR-30 will not provide accurate fuel level. The digital fuel gauge however does provide direct measurement of the fuel level in each tank. This is a much more accurate representation. Pitot system ram air pressure operates the airspeed indicator. The instrument static pressure system has air pickup ports, which are open to atmospheric pressure, on each side of the empennage, and this static pressure operates the altimeter and contributes to the airspeed reading. There is no alternate static air source, so you would need to break the vertical speed indicator glass in case of blockage to obtain an alternate static air source (in an emergency). The HSI and attitude indicator operate off of an engine driven vacuum pump, and the turn coordinator and electric compass (lower center of the pilot-side panel) are driven by the electrical system. The panel-mounted electric compass is tied to a remote compass in the tail of the aircraft and supplements the standard compass mounted at the top of the windshield. A dimmer knob located on the ceiling *above the pilot's head* manually dims the instrument panel/radio lights, and red spotlights are controlled using the knob *above the co-pilot's head*. Make sure to turn the instrument lights off after a night flight to prevent the bulbs from burning out. Because you want digital screens to be dim at night, there is a separate dimmer located below the fuel gauge that controls the brightness for the CGR 30 and fuel gauge.

Auto-Pilot System

This aircraft originally had a wing leveler system (Positive Control) but that has been replaced with an S-TEC System 30 Auto Pilot that provides a steering, heading, and tracking (GPS) modes. The autopilot on-off master switch is located just below the ignition switch. The System 30 is combined with the turn coordinator and thus is rate based (as opposed to gyro based). This means that the autopilot will still function in the event of a vacuum or pitot system failure. If you become disoriented during a vacuum system failure, switching the autopilot on to level the wings could be a lifesaver.

There is also a GPS Steering system (GPSS) run by a separate switch on the left side of the pilot panel that switches the input to the HDG mode on the System 30 between the Heading Bug (HDG) and the Garmin 430W (GPSS). With the System 30 in HD mode and the GPSS in GPSS mode, the autopilot will fly the flight plan that is in the 430W. If the GPSS is in HDG mode, the autopilot will fly the heading bug when HD mode is selected. *The Lo and Hi TRK modes are not currently connected.*

There is an autopilot disconnect switch on the pilot's control yoke. Also located on the yoke is the altitude hold engage/disengage switch. In altitude hold mode (which will only operate when a directional control mode is active), indicators on the turn coordinator will indicate whether trim up or down is required by the autopilot system. Since the aircraft is not equipped with electric trim, the pilot must manually adjust the trim settings per the autopilot's guidance in order to maintain altitude. Additionally, like many other autopilots in GA aircraft, the system will attempt to hold altitude to the point of a stall if insufficient power is supplied, so manual power and trim adjustments must be made by the pilot to compensate. These adjustments are particularly important when using the autopilot to hold altitude and course during a manual gear extension (expect to add power and trim as the gear comes down).

There is a lot more critical information in the autopilot manual, which is located on the club's website. Reading this manual and practicing autopilot use in good weather can familiarize you with its operation so that you can comfortably use it during IFR flight to reduce your workload. If you plan to use the autopilot during flight, you must check the disconnect function as part of the pre-take off systems check.

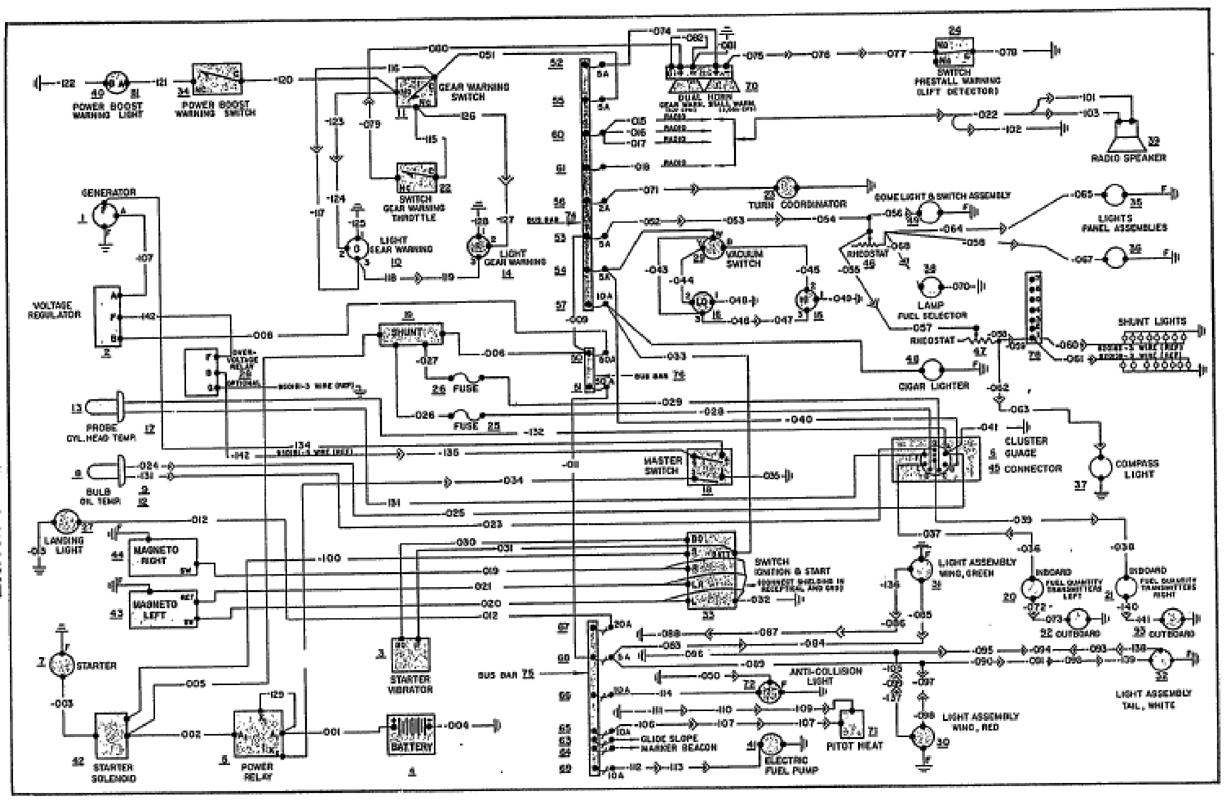
Electric Power System

The master switch and power relay control the electrical power system, which is composed of a 50-amp 12-volt generator (no alternator), a voltage regulator, and a 35 amp-hour battery. One thing to note with a generator is that it will not provide power at low RPM (the amber low voltage light on the annunciator panel will illuminate), so watch the ammeter when waiting for a clearance, troubleshooting something, or waiting for other aircraft to depart. The battery is located in the tail and can be accessed via a door on the left side of the fuselage.

Circuit breakers and circuit breaker switches protect the electrical wiring and equipment from overloads. All of the light switches have internal breakers, so if a light switch will not stay up, it is an indicator that the breaker has tripped. There are two sets of breakers. The ones located in a straight line directly to the right of the co-pilot yoke are on the primary bus, meaning that they are not controlled by the avionics switch. This includes Comm 2. In the event of a generator failure or smell of smoke, you can reduce the load by turning off the avionics switch while maintaining everything on the main bus. The ones arranged above this row are on the avionics switch that is located next to the flap switch. To protect these more expensive avionics, the avionics switch should be off during engine start.

Included in the electrical system are the navigation lights, interior lights, combined gear/stall warning system, an electric fuel boost pump, electric starter, electric gear retraction system, and an electric flap system. After night flights it is important to make sure the panel and interior lights are turned off because they are not visible during the day.

FIGURE 51. Electrical System (1967 & ON M20F)



Electrical System Schematic

FUEL SYSTEM

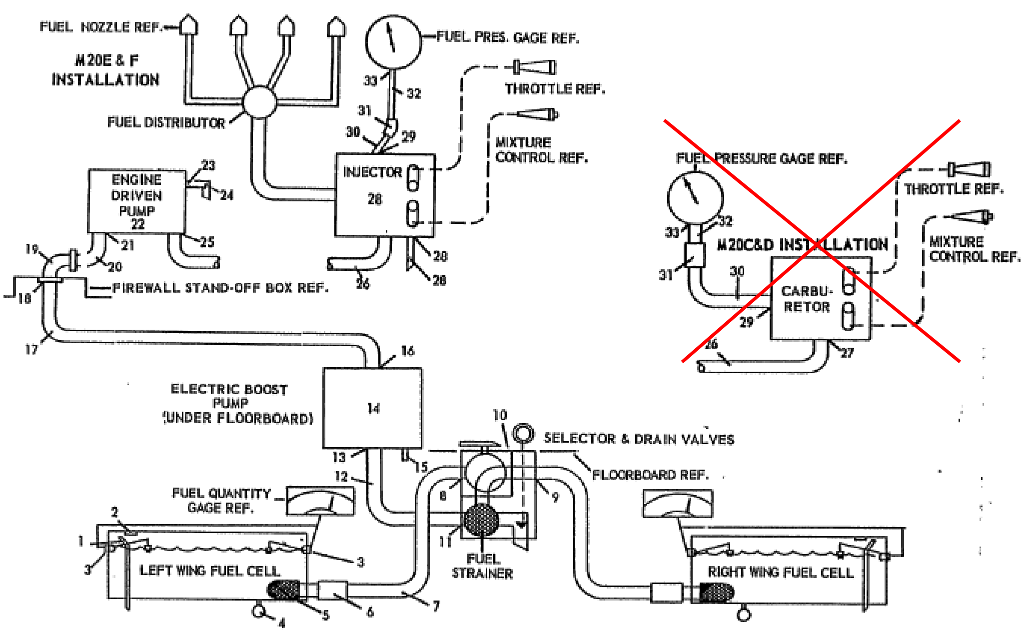
The fuel system has internally sealed, integral wing tanks in the forward, inboard section of each wing. Because of frequent leaks in this type of tank system, our aircraft had fuel bladders added to the tanks. This prevents leaks, but reduced the fuel capacity by 9.2 gallons, resulting in a total capacity (now) of 54.8 gallons, and added 26 pounds of weight. Additionally, there have been some problems with water getting into these bladder systems so an AD was issued requiring each tank to be sumped for 4 seconds each.

Vents at the aft outboard corner of each tank extend downward through the lower wing surface. There is a piece of metal in front of each vent to reduce the risk of ice forming in the vent. These tank vents are also designed to be a tube-within-a-tube, which helps to prevent freezing. These fuel vents allow for overflow and fuel tank ventilation, and they should be checked for obstruction during pre-flight inspection.

Fuel sump drains are located at the lowest point in each tank. Fuel feeds from either tank to a valve through a gascolator integral with valve and low-point drain. The selector valve (see picture in Chapter 5) is located between the pilot's legs along with a selector sump ring that is pulled up to drain the sump for each tank at the selector. This point is the lowest point in the fuel system. The selector goes from 'left' to 'off' (pointing at pilot) to 'right'. While you do have to go through 'off' position to switch tanks, there is sufficient fuel in the lines to prevent this from stopping the engine as long as it is done in a reasonable amount of time.

The electric fuel pump is in the bottom left forward section of the fuselage just aft of the firewall. Fuel feeds from either tank through the selector valve to the electric pump then to the engine-driven fuel pump and to the fuel injector system on the engine. Fuel quantity transmitters in each tank are wired to fuel quantity gauges. The aircraft master switch turns on the fuel quantity indicating systems.

FIGURE 37. Engine Fuel System



Fuel System Schematic

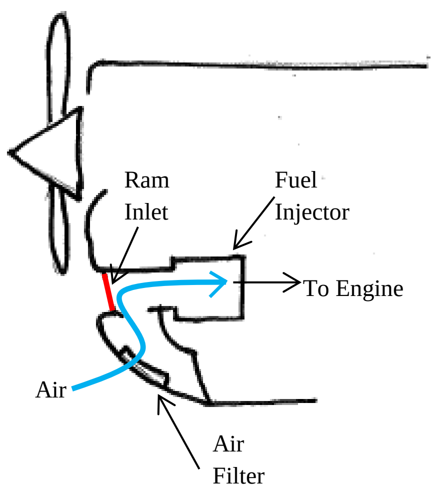
On our aircraft, a Bendix RSA-5AD1 fuel injection system uses measured airflow in a stem-type regulator to convert the air pressure into a fuel pressure. This fuel pressure differential is applied across the fuel metering section of the fuel injector, making fuel flow proportional to airflow. The injection system is composed of the injector, flow divider, air-bleed nozzles, and associated lines and fittings.

The Lycoming fuel injection controls on M20E, F and J models do not include an engine primer. Fuel will be sprayed into the intake manifold whenever a fuel pump is operating and the mixture control is open. Thus proper positioning of the mixture knob is critical for insuring the engine is properly primed but not flooded.

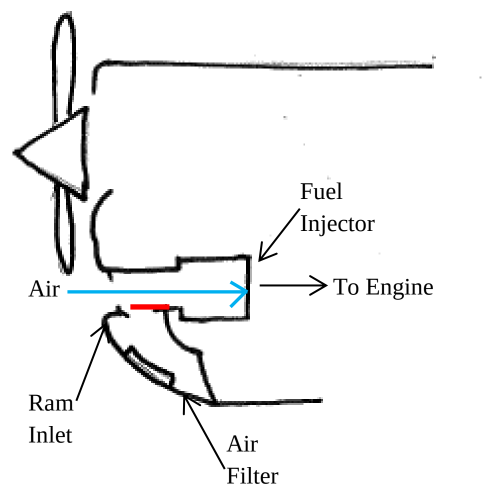
Ram-Air System

The ram-air feature was incorporated with the 200 horsepower engine in M20E and later models, including M20J production through 1991. It provides a 1" manifold increase by allowing engine induction air to partially bypass the induction air filter (see schematics below). Use of ram-air must be strictly limited to clean, dust-free air, as the engine operates on direct unfiltered air when the ram air control is pulled on. RAM air must also not be operated in clouds below 40°F due to the risk of freezing at the injection ports.

If the ram-air is on while the landing gear is down, the ram-air annunciator light will illuminate, reminding you that you should close the ram air door. Do not wait for this light; close the door just prior to starting the descent. Should the induction air filter clog, a spring-loaded door in the induction system will open by induction vacuum to allow bypass air to enter the engine.



Ram Closed



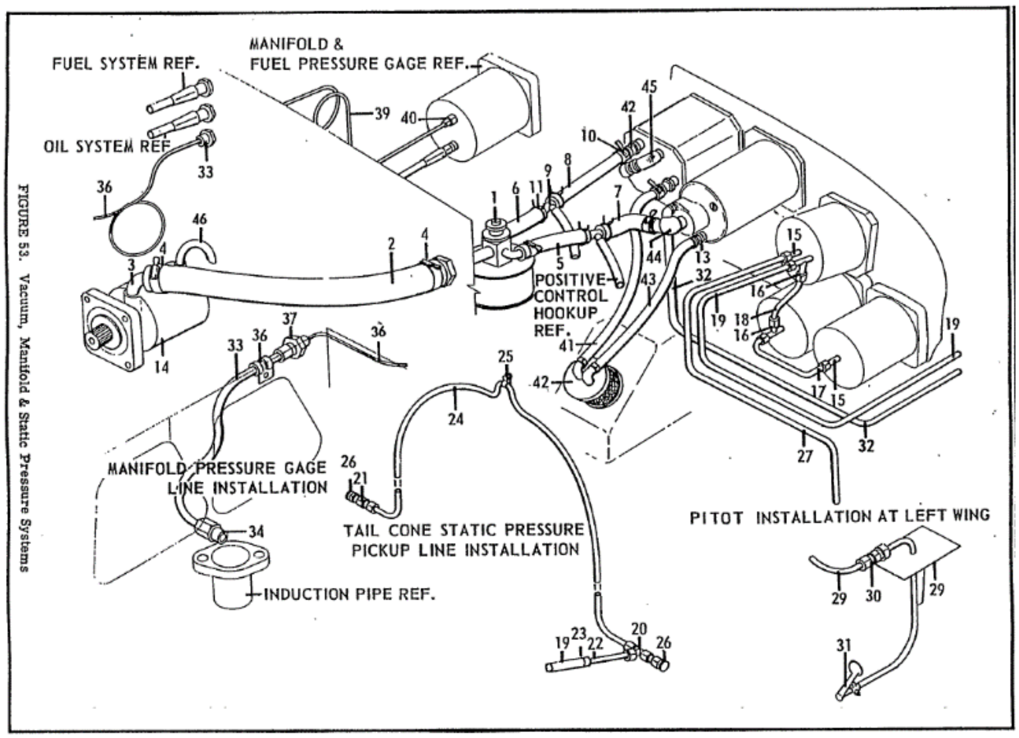
Ram Open

Instrument Vacuum and Standby Vacuum Systems

An engine driven, dry air vacuum pump supplies suction for the vacuum operated gyroscopic flight instruments (the directional gyro in the HSI and the attitude indicator). The air is passed through several filters before entering the instruments. A vacuum regulator valve is incorporated to maintain the required operating vacuum throughout the engine power range. A red vacuum annunciator light will flash when the vacuum drops below the 4.25 ± 0.2 in Hg suction that is required to operate the instruments. The vacuum annunciator light glows steadily when vacuum exceeds the normal setting of 5.5 ± 0.2 in Hg. Idle RPM settings will normally not provide adequate vacuum for satisfactory instrument operation, so the low vacuum light may illuminate while the engine is at idle.

If the primary system fails, as indicated by a “low” vacuum annunciator light, then the pilot can activate the standby system by pulling the knob above the co-pilot’s knees. This knob opens a valve to pull vacuum pressure off of the #3 cylinder. When the engine is running at manifold pressures below atmospheric (approximately 30”), suction is created by the cylinders (this suction pulls air into the engine). The standby vacuum uses this suction to run the instruments.

Accordingly, the standby vacuum system will not operate at manifold pressures near or above standard pressure (approximately 30”), because the cylinder is getting all the air it needs from the fuel injector and thus is not creating a vacuum. This detail is important to remember if shooting an approach in IMC while using the standby vacuum. If you execute a missed approach and increase engine manifold pressure above 30”, you will lose standby vacuum pressure and your DG and artificial horizon will slowly wind down. Anticipate this situation and rely on your altimeter, turn coordinator, and VSI until you have sufficient altitude to safely reduce manifold pressure below 30”. When you activate the standby vacuum, the “low” vacuum light will go out, but the standby light on the annunciator panel will stay lit.



Instrument Vacuum System

The vacuum system also operates the aircraft step. The step will retract automatically when sufficient vacuum is produced by the vacuum pump.

CHAPTER 2. WEIGHT AND BALANCE

This section addresses a critical flight planning area, the determination of payload (passengers and baggage) and usable fuel loading.

M20 SERIES REFERENCE DATUM

For all Mooney's, the reference datum plane is at fuselage station 0.00. On "long fuselage" models M20F, M20G, M20J, and M20K, fuselage station 0.00 is 5.00 in. aft of the centerline of the nose gear support bolts. The leading edge of every Mooney wing is 33.00 in. aft of fuselage station 0.00. This detail explains why short, long, and longer fuselage Mooney's all have similar CG ranges when expressed as "inches aft of datum." With its 10 in. longer fuselage, the M20F wheelbase also increased 5 in.

WEIGHT AND BALANCE RECORDS

In 1974, Mooney issued an AFM addendum for 1967 and earlier Mooney's covering weight and balance, providing original equipment, additional charts and a sample weight and balance. All additional and removed equipment has since been captured in log book updates to this original weight and balance.

You are required by the FAA to ensure that the aircraft is properly loaded for each flight. One way to do this is to follow the steps outlined in the POH/AFM addendum and complete the chart provided in the addendum. The current Empty weight of N3275F is 1740.95 and the arm is 46.17". Note that because of the fuel bladders, usable fuel has been reduced to 27.4 gal/tank (54.8 total). With a maximum takeoff weight of 2740 lbs, that gives a useful load (not including fuel) of 999.05 lbs and a payload (with full tanks) of 670.25 lbs. There is also a weight and balance spreadsheet for instructional purposes found on the club website.

Since the club only fills the tanks to within an inch of the top, you will be right at maximum gross weight with four FAA full sized (170lb) adults on board. You can also carry less fuel by either paying the FBO to remove fuel, or by calling the previous member flying the aircraft and request them not fill up the tanks. Otherwise the club policy is to **keep the tanks within an inch of the top** in order to keep the bladders wet but to also prevent venting of fuel. Again, it is your responsibility to calculate fuel and passenger weights and complete the weight and balance calculations.

CHAPTER 3. AIRSPEED LIMITATIONS

Airspeed control, one of the most important flying skills, is especially important in Mooney operations. This section is designed to aid in understanding and flying proper airspeeds through a review of terminology, maneuvering speed, and other airspeed limitations.

M20 SERIES: SUMMARY OF AIRSPEED LIMITATIONS

Va – Max. Maneuvering 135 MPH– straight and level (not shown)
(reduce by 6 MPH for every 200 lbs under max weight)
Vfe – Max. Flaps Extended 105 MPH (top of white arc)
Vge – Max. Gear Extended – 120 MPH (not shown)
Vlo – Max. Gear Operating – 120 MPH – raising and lowering
Vne – Never Exceed – 200 MPH – even in smooth air (red line)
Vno – Max Structural 174 MPH – only in smooth air (top of green arc)

WARNING!
DO NOT EXTEND FLAPS IN TURBULENCE.
GEAR MAYBE LOWERED, BUT ALWAYS SLOW TO GEAR OPERATING SPEED.

IMPORTANT SPEED CHART

1. Vso, Power off stall, gear down, flaps 33°	62 MPH
2. Vs1, Power off stall, gear down, flaps 15°	64 MPH
3. Vs, stall, gear and flaps up	68 MPH
4. Normal takeoff	65-75 MPH
5. Normal takeoff 50' agl	80 MPH
6. Best rate, Vy, clean, full throttle, 2700 rpm, sea level/10,000'	113/102 MPH
7. Best angle,Vx, clean, full throttle, 2700 rpm, sea level	94 MPH
8. Normal landing 50' agl	80 MPH
9. Short field landing 50' agl	74 MPH
10. Balked landing, flaps 33º, gear down	80 MPH
11. Normal climb, 26"/2600 rpm	115-120 MPH
14. Max glide range, 2740 lbs, windmilling/stopped	105/100 MPH

See the POH for details on recommended combinations of manifold pressure and RPM at various altitudes and their influence on aircraft performance.

CHAPTER 4. AIRCRAFT PERFORMANCE

GENERAL

This section considers another critical flight planning activity, the proper use of information contained in the aircraft performance charts to optimize performance and protect the aircraft from damage.

THE PILOT OPERATING HANDBOOK (POH)

First a little background. In the 1960s, the M20F OWNER'S MANUAL was issued with 96 pages, still with a separate loading schedule to be consulted for weight and balance data. Mooney Owners Manuals and Pilot Operating Handbooks contain the following advice, which we would all do well to heed:

> "...It is important that you - regardless of your previous experience - carefully read the handbook form cover to cover and review it frequently."

TAKE OFF PERFORMANCE

Take off performance can be obtained using the chart in the POH. These charts are calculated based upon actual flight tests, using average piloting techniques, the airplane and engine in good condition, and the engine power control system properly adjusted. The charts make no allowances for varying levels of pilot technique, proficiency or environmental conditions. The pilot must evaluate the effect of soft runways, winds aloft, or airplane configuration changes.

Keep in mind that to use these charts you must first calculate your weight and balance and calculate the density altitude at your departure. Remember as well to figure on 1.5 gallons of fuel burn for start/taxi/run up/takeoff.

The worst-case scenario (per the charts) would require 2,395 ft to clear a 50 ft obstacle. So if you are taking off from a runway that is shorter than this, you need to pay close attention to the takeoff charts to ensure that you can depart under those conditions. Don’t be afraid to abort a takeoff that is not progressing as you expected before it is too late to do so. Also, maintaining the best angle of climb airspeed of 94 MPH is critical for obstacle clearance on short-field takeoffs. Succumbing to the temptation to raise the nose to get over an obstacle can quickly put you on the wrong side of the power curve – fly the POH performance speeds. Keep in mind that density altitude affects performance.

CRUISE PERFORMANCE

Cruise performance can be directly obtained from the charts found in the POH. **The aircraft should not be continuously operated above 75% power** and remember that these tables are based on aggressive leaning of the mixture. It is also important to remember that these are true airspeeds (TAS) not indicated airspeeds (IAS) or ground speeds (GS). You must adjust the TAS according to pressure altitude and temperature to determine calibrated airspeed (CAS), which should be close to the indicated airspeed (IAS) read off the airspeed indicator. Furthermore, ground speed calculations must include the effect of winds aloft.

Descent Performance

The original 1967 Mooney POH does not have a descent chart. It is important to avoid unnecessary engine shock cooling during descent (while taking full advantage of the reduced fuel burn available). **Avoid shock cooling the engine** by decreasing propeller speed to the lowest allowable cruise rpm and subsequently making several gradual reductions in manifold pressure.

Pay close attention to the CGR-30P during descent to avoid shock cooling. Refer to the CGR-30P manual for details on using that instrument.

Pay attention to the RPM restrictions on continuous operation, but the general technique of descending with low rpm/moderate MP rather than higher rpm/lower MP, will help eliminate piston ring flutter and maintain higher cylinder head temperatures.

Landing Performance

Landing performance can be determined from the POH. According to the charts, in the worst-case scenario (full weight, high density altitude) the landing distance is 2,175ft. If you are landing on a field shorter than this you should calculate your landing distance from the chart. Also note that the airspeed upon crossing the runway threshold is lower for short-field operations compared to normal operations. Keep in mind that density altitude affects performance.

CHAPTER 5. OPERATIONS PARTICULAR TO MOONEY AIRCRAFT

PREFIGHT

There are few things particular to a Mooney on the prefight inspection. Please take note of these items and pay particular attention to them during the pre-flight inspection.

FUEL-LEVEL

Standard club practice is to fill both fuel tanks to 1 inch below the top of the tank following each flight. So as you approach the plane, the first thing you should do is look in the tanks to verify the tanks are full. If they are not full (either due to pilot error or failure of the FBO to process the order) and you need more fuel, we have an account at Signature at CHO and off field all fuel charges should be billed directly to the club credit card found in the aircraft's flight bag).

The bladders in the fuel tanks result in a situation where traditional dip-stick techniques are not reliable for determining fuel quantity in our aircraft. This situation is why the club has adopted the practice described above. Also, when fueling the aircraft, you will notice that the bladders will expand as the tanks fill. As such, it is recommended to slow the rate of fueling as the level of fuel reaches the top of the tank. In most cases, the bladders will expand at a slower rate than the fueling rate. Quickly fueling a tank up to the top of the tank without allowing time for the bladder to expand could result in taking on less fuel than expected.

Finally, you need to make sure the fuel caps are tight. Check the tightness of the fuel caps by pushing down on one of the outer edges of the fuel cap. If it moves around, then it is not tight, which can allow fuel to leak out and water to leak in. To tighten the cap, remove it, turn it upside down, and then rotate the bottom clockwise. Tighten the cap such that it does not move around when it is locked in place, but do not tighten it so much that you cannot fully push down the metal locking tab.

After verifying the aircraft is fueled to the level you want, then the next step is to verify the flight log.

FLIGHT LOG

It is critical for billing purposes that you accurately record your flight time and fuel use. You do this by turning on the master switch and hitting the S button on the CGR 30 until you get to the screen that has the tach time and the screen that has the fuel level. If the fuel level on the CGR-30 does not match the fuel level on the digital fuel gauge ("Full" is 27.4gal in each tank), then you need to adjust the CGR-30. This is a simple procedure that you can watch here: https://www.youtube.com/watch?v=bSKvHGEveqk . Once the CGR 30 matches the digital fuel gauges, a good idea is to either write down or take a photo of the starting tach time and fuel level and then at the end of the flight, the ending time and fuel so that you can fill out the online flight log after the flight.

FUEL STRAINING

On the floor of the pilot side are the fuel selector and filter sump ring (below). Place the selector on the first tank and pull the ring solidly for a count of four, switch tanks, and repeat. To sump the tanks, there is one sump point at each wing root. As mentioned previously, you need to sump each tank for 4 seconds. The sump cup found in the tail of the aircraft has a water screen on it. It is certified for pouring the fuel back into the tank after sumping as long as all the fuel you are returning passes through the screen (the screen will actually prevent the water from going back in the tanks). Do not let the returning fuel go through the large open holes in the cup cap.

Fuel Selector Knob and Strainer Ring

Tow Bar and Towing

The nose gear strut is precariously positioned in such a way that over steering the nose gear can cause expensive damage if the strut is forced against the retract bar. Gradual sweeping turns and bringing the plane forward or back to straighten the nose gear in successive turns is essential to prevent this damage. It is also important to remind line crews of this. There is an indicator on the front of the nose gear strut to help you avoid over turning the strut.

If over turned, this bar will damage this bar. Inspect as part of pre-flight.

Steering Limit Indicator

Loading and Unloading Passengers

The best way to load passengers is to push the front seats to the rear and then load the pilot. Next, pull the co-pilot seat full forward and load the rear passengers. Then push the co-pilot seat full back, push the controls forward, and then load the co-pilot last.

Shutting the door is different than most aircraft, you **DO NOT SLAM IT**. Gently bring the door mostly closed, *push the handle forward to open the latch*, pull the door snug, then while holding it snug, rotate the handle to the back of the plane.

ADJUSTING THE SEATS

The front seats are slid forward and back by pulling up on the bar along the front of the seat. The seat back can be reclined or set straight up by rotating the silver knob at the bottom of the back rest while leaning slightly forward until it is in the desired position.

The rear seats can either be folded down for more baggage storage or reclined for passenger comfort. Either is accomplished by pushing down on the red handle found on both sides of the rear seats (see picture on left).

STARTING THE ENGINE

The checklist gives a full description of the steps to start the engine. The engine is fuel injected with no primer. You prime the engine by turning on the fuel pump with the mixture at idle and the throttle half in and then pushing in the mixture to full rich for 3-8 seconds before returning it to idle. Typically, more priming is needed on colder days. On warm days or with a warm engine, it is often helpful to turn the fuel pump off prior to engaging the starter.

The article on mixture at the beginning of this guide is very informative for starting this aircraft.

The ignition system is a shower of sparks system, so make sure to turn the ignition to 'start' and then push in the ignition. On 'start', you will hear a chattering noise, which is perfectly normal (for more on shower of spark systems, see this helpful discussion: http://www.donmaxwell.com/publications/MAPA_TEXT/Shower%20of%20Sparks/Shower%20of%20Sparks.htm). As the engine catches, gradually push in the mixture until the engine catches., agressively lean the engine promptly after starting to prevent spark plug fouling.

On cold days, the engine should be pre-heated using with the built-in oil sump heater or blown pre-heat air. *See the aircraft use rules for more details*. It is important to recognize that cold weather is particularly hard on engines, so pay attention to checklist details for cowl flap use in cold weather and promptly reduce RPM after starting the engine to allow the oil to warm-up.

TAXIING

Mooney props sit closer to the ground so you need to apply extra caution when applying breaking and when taxiing over uneven ground. As with towing, avoid sharp turns, allowing for sweeping turns.

You should lean the engine during ground operations except when large amounts of throttle are needed to get up a hill or while doing a run-up. Like most engines, this one tends to run so rich that, without leaning, spark plug fouling is a real risk during a long taxi or while awaiting takeoff clearance. The risk with leaning on the ground is that a takeoff with a lean mixture can cause severe engine damage so *you must make absolutely sure the engine is full rich (except in high density altitudes) prior to run-up and take off*. You can avoid this risk by leaning during taxiing all the way to just rich of the engine running ruff. That way if you do try to go high power on the engine while lean, it will shut off well before you would damage the engine. Keep in mind too that the generator only charges the battery above about 1100 RPM. So if you have a long wait for a clearance, you may need to run the engine up a little to keep the battery charging.

ENGINE RUN-UP

The steps for the run-up are covered in the checklist. Cowl flaps should be open and mixture should be rich at this point per the checklist. To avoid damaging counterweights and cylinders, increasing the throttle from idle should be done gradually (over a few seconds). Mag checks are done at 1700 RPM and prop cycle is done at 2000 RPM. Like any other complex aircraft, the propeller should be exercised to get fresh oil into the prop governor. Unlike aircraft that have a feathering prop, only one cycle of the prop should be sufficient. Make sure to not to let the RPM drop more than 300 RPM during prop cycle to prevent engine damage.

During run-up the CGR-30P engine monitor can provide very important information on the operation of the engine. If you get a rough running engine on either mag, pay attention to the CGR-30P engine temperatures. A bad/fouled plug will show a significant EGT drop on that cylinder. If multiple cylinders drop EGT significantly, it might be an indicator of a troubled magneto, and the flight should be terminated. Fouled plugs are caused by lead deposits, which require higher temperatures to burn off. Leaning the mixture and running up the engine can clear lead deposits. *If you encounter magneto problems, write down the trouble magneto and cylinder temperature information to save the club maintenance troubleshooting*.

TAKEOFF

After checking the trim setting on the center console, advance the throttle slowly to avoid engine damage while holding the aircraft (with the brakes if necessary on a short field). The takeoff configuration is partial flaps, 15°, used with maximum available power.

The pilot should "lighten the nose wheel" (except in strong cross winds) on the takeoff run. The aircraft has a tendency to rock steep nose up if you try to truly rotate off of the field. You really just slightly get the nose off the field at rotation speed, lower the nose slightly without remaking contact, and then let the mains fly off the field.

Rotation speed for calm/steady days is 65 MPH and on gusty days is 75 MPH. The short field/obstacle rotation airspeed is 75 MPH. Stopping distance is only slightly less than takeoff roll distance, so if you have not left the ground by midfield, then immediately abort the takeoff. Once airborne, slowly lower the nose to achieve Vx (94 MPH) or Vy (113 MPH). If obstacle clearance is not a factor, a Vy climb reduces the engine temperatures and is, thus, desirable.

As a safety note, Vx is the optimal point on the power curve. Thus after achieving Vx, you should NEVER go back below Vx. If you allow airspeed to go below Vx, your drag quickly increases and it actually takes significantly more energy to get the aircraft back up to speed. Thus no matter how fast the end of the field or the trees are approaching do not pitch up more than Vx. This can be deceiving because the climb view out of the windscreen is significantly lower than in a Cessna 172. Thus you might think your nose is too low to out climb an obstacle, but Vx never lies.

Once there is no remaining usable runway, *apply the brakes to stop wheel rotation*, raise the gear, and once the obstacle is cleared or you reach 700 ft AGL, raise the flaps. Raising the gear and flaps will require significant nose trim. Be ready for this change and apply liberally.

Initial Climb

After clearing all obstacles, climb should be made at full power and with the propeller pulled back to 2600 rpm. On hot days, after clearing all obstacles, the nose should be lowered (to increase speed) and power reduced to around 26" to *ensure the hottest cylinder does not to exceed 400^{o}F*. Not exceeding 400oF is very important for the life of our engine.

Cruise Climb

The transition from initial climb to cruise climb requires only a reduction in pitch attitude and re-trim (for a better visibility and higher speed climb) followed by a power reduction (never below 1,000 ft AGL) to the POH recommended power setting.

Climb at POH power levels, since engine cooling is dependent upon both the recommended fuel flow and airspeed. While climbing, always monitor engine cylinder head and exhaust gas temperatures for operation "in the green". The cruise climb is an optimum performance maneuver, requiring use of the proper airspeed, combined with the lowest possible drag configuration, which will yield sufficient engine cooling.

Cruise

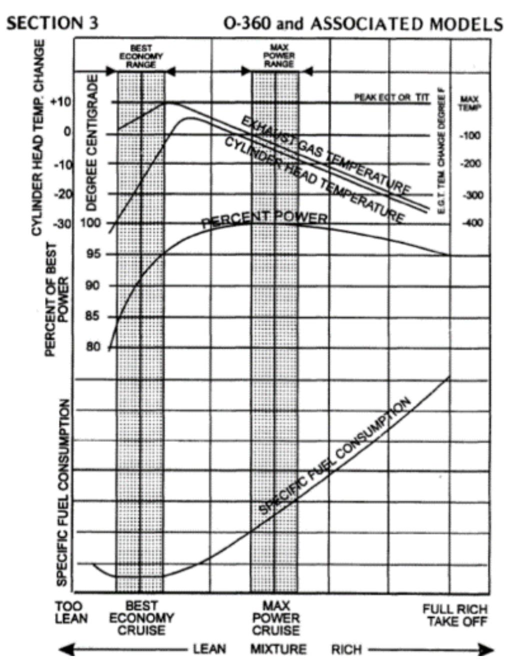
In making the transition from climb to cruise, lower the nose enough to maintain altitude, close cowl flaps (if applicable, engine temperatures permitting and below 150 MPH), accelerate to cruise airspeed, *then* set cruise power you want. There are several ways to set cruise power settings, but in all cases, cruise should be kept below 75% rated power as indicated on the CGR30. The simplest and best way is to leave the throttle at climb power and just reduce the propeller RPM to 2300. You can then add or reduce throttle to achieve the tradeoff between airspeed and fuel burn you want, but again staying below 75% horse power. Do not exceed a difference of 4 between RPMx100 and MP (ie 2200/26"). There can be some vibrations at lower RPM and if you are uncomfortable with those, just increase the RPM slightly and reduce MP to get the % horsepower you want.

The engine allows for a wide range of MP and RPM settings, but in a few of our tables there have been some settings that are eliminated for continuous ops. The original propellers had trouble with harmonic oscillations that prevented continuous operations at low MP's. This aircraft has a new scimitar prop. The only restriction on this propeller is that there shall be **No continuous operations above 24″ between 2350 and 2550 rpm.** This is placarded on the panel and these settings are indicated on the table in the aircraft book. The CGR-30P engine monitor will give a master caution indicator (flashing yellow light on the annunciator panel) when the prop speed is set between 2350 and 2550 rpm (yellow arc). This indication can be canceled by pressing the 'E' button on the CGR-30P, but this indicator is a reminder to make sure that MP is at or below 24" when the propeller speed is set in that range.

Once you have established your cruise power and mixture, it is a good idea to go to the fuel endurance screen on the CGR 30 (by pushing the S button) and confirm that your fuel endurance is sufficiently greater (half hour minimum) than your estimated time enroute on the Garmin 430W.

LEANING THE AIRCRAFT IN CLIMB AND CRUISE

It is important for multiple reasons to lean the aircraft in cruise (prevent plug fouling, better engine performance, reduce detonation risk). The key number for leaning is the EGT on the hottest cylinder. The CGR 30 will show you the EGT on the hottest cylinder at the bottom of all screens. At or above 75% horse power, Lycoming recommends leaning to 150 degrees rich of peak (our club does not allow for running lean of peak). Below 75% power, Lycoming allows you to run the aircraft at peak EGT, but we still recommend going no leaner than 100 degrees rich of peak. There are two ways to figure out peak EGT. The first is that through our various flights, we have found peak EGT at 75% power to be slightly above 1500 degrees. So 150 rich would be somewhere between 1350 and 1400 degrees. There is a lag between changes in mixture and EGT changes, so as you get close to your desired EGT, you have to make your mixture changes more and more gradual to ensure you don't go over your desired EGT. Thus in climb, as soon as you pull back to the 26"/2600 climb power setting, you can start leaning until the hottest EGT gets to 1350 (again slowing down your leaning as you get closer to 1350). As you climb, the air gets thinner so your fuel/air mixture gets richer. So as you climb, you will have to continue to lean the engine to stay around 1350 EGT. Once you get to cruise and pull the propeller back to 2300 or less RPM, the fuel/air mixture will also lean so you will have to adjust the mixture again once in cruise. You will notice that as you lean out the engine, the RPM and horse power will increase because the engine prefers to run closer to its peak EGT. If you want to be real precise, the second way to find peak EGT is using the CGR 30 Rich of Peak (ROP) function once in cruise. The procedure to do this is found in the checklist and the CGR 30 manual. If in either case you start to find the EGT's decrease as you continue to lean or the engine starts to become rough, that means that you have gone past peak EGT. Immediately enrichen the mixture back to around 1200 degrees and start leaning again. Below is a chart directly from the Lycoming Operating Manual that is very informative:



Engine Leaning Information

HIGH ALTITUDE CRUISE

Mooney's are capable of reaching altitudes in excess of altitudes that require supplemental oxygen and that have other complicating factors. The listed ceiling for our aircraft is approximately 17,000 ft. The FAA states that supplemental oxygen must be used by the crew when operating for more than 30 minutes between 12,500 and 13,999 ft. That is what is required. However, keep in mind that your physical health condition can amplify the effects of hypoxia and hypoxia can affect night vision as low as 5,000 ft, so you personally might need supplemental oxygen below 12,500 ft. Additionally, ducking below 12,500 ft for a few minutes doesn't restart the clock. Above 14,000 ft, the crew must use supplemental oxygen at all times. The following websites have some good additional information on hypoxia and other physiological factors: https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hypoxia.pdf & http://tfmlearning.fly.faa.gov/publications/atpubs/AIM/Chap8/aim0801.html.

Some Club members own supplemental oxygen systems that may be borrowed, but that is done completely independently of the club. The club requires members to follow the FAR's related to these issues and, if required, use a FAA approved supplemental oxygen system with a pulse oximeter. The club recommends following the advice on the above link for use of oxygen below 12,500 ft and there are non-approved oxygen systems that can supplement flight below 12,500 ft.

An additional issue that may arise at altitudes above the freezing level is ice blockage of the fuel injection and air induction systems. If you experience engine problems above the freezing level, it may be worth getting below the freezing level when practical and if the engine has stopped, attempting a restart a minute or two below the freezing level if practical.

ENROUTE DESCENT

A well planned descent can "buy back" much of the fuel used in the climb, along with pleasing airspeeds, fuel economy and improved engine life. Reduce power by decreasing engine RPM to 2100. Maintain cruise MP during the descent, with reductions to no less than 55% BHP. As you descend, the air gets thicker so your mixture get leaner. However, do not just slam the mixture to full rich. Just watch the EGT's while you descend to make sure that you don't go past 1400 EGT (or 100 degrees rich of peak).

The easiest way to plan your descent is to look at the GPS ETA and allow 2 minutes/1000' of altitude that you have to lose so that you get a 500'/min descent. So if you are at 9,500' and the field at destination is 500', you will want to start your decent when your ETA is 18 minutes. As long as you descend at an airspeed slower or equal to your cruise, you will arrive at the pattern altitude prior to reaching the airport. The Garmin 430W GPS also has a VNAV mode that will identify 'top of descent' for you based on settings that you input – see the GPS manual for details.

It is recommended to use a lower RPM with higher MP within the allowable limits. The lower RPM puts backpressure on the pistons, prevents piston ring float and keeps temperatures up. By maintaining a higher CHT, we prevent shock cooling, oil congealing, and spark plug fouling.

LANDINGS

The gear warning horn is supposed to sound when the throttle is pulled back to around 12" MP if the gear is not down. Do not rely on this because these horns can fail and will not work if there is an aircraft electrical failure. It is a good idea to test the gear horn during your descent to landing by momentarily pulling the throttle to idle.

There are several particular risks during landing in a Mooney. The first is carrying excess speed on approach. This will either result in touchdown on all three wheels and then screeching of tires as heavy braking is initiated before sufficient weight has been transferred to the landing gear or the plane is held off for a touchdown at the proper speed resulting in a lengthy float in ground effect which can be disastrous in gusty winds or crosswinds. To avoid this, use the airspeeds found in the checklist and do a go around if you find yourself too fast over the runway. If you do find yourself floating or even ballooning, fight the temptation to shove the control wheel forward. This action usually results in a prop strike or nose gear damage. Either go around or if there is sufficient runway, let it float and add power if necessary to prevent excessive sink from the ballooning. Finally, the Mooney sits closer to the ground, so your flare will be closer to the ground.

The second concern is porpoising. The gear base is shorter so if excessive speed is carried to a rapid landing with little float, the main gear may strike the runway forcing the nose gear to rapidly follow, and thus porpoising. To avoid this, maintain the appropriate approach speed for the conditions without carrying too much speed.

Landing speed should be 1.3 Vso for normal landings and 1.2 Vso for short field. For 33° flaps, 0° bank, and max gross weight, Vso is 62 MPH, so normal landings should be conducted at 80 MPH at the threshold and short-field should be conducted at 75 MPH at the threshold. These can be slightly decreased for lighter than max weight, but there is no chart for this, so it is safer to just fly these speeds no matter the weight if field length allows. The standard technique of controlling airspeed with aircraft pitch attitude, and rate of descent with power should be used for Mooney approaches and go-arounds.

As in any complex aircraft, make sure you are ready for a go around while on final (prop full forward, mixture rich (in most cases), and cowl flap open).

NOTE: Touch-and-go landing practice is not recommended for retractable gear aircraft. Use full stop or stop-and go landings only.

Go-arounds

A properly executed go-around requires establishing a positive vertical rate, and safely transitioning from a low-power/descending/gear and flaps down configuration to a high-power/climbing/clean configuration. The go- around requires simultaneous application of power and pitch inputs to maintain the same airspeed as that flown on short final. As the go-around is initiated, Mooneys in landing trim require ample nose down trimming and right rudder to offset the high "P factor". Flaps may be set to the takeoff position, and with a positive rate of climb (ROC) the gear is retracted. Finally, accelerate to Vy (best ROC) and retract the flaps.

Shutdown and Securing the Aircraft

There are multiple steps outlined in the checklist, but let’s highlight a few. First, after a night flight, make sure the instrument panel lights are turned off. It is hard to tell that these lights are on during the day, and running them during the day burns out the bulbs. Next, make sure to remove the iPad and Stratus 2 from their cradles, place them in the small black bag, and return them to the storage locker. With the Stratus 2, make sure to hold the cradle to the ceiling while removing the box so that no unnecessary pressure is placed on the headliner.

Make sure to e-mail a photo of any off-field fuel receipts to billing@monticellofc.org and put the paper copy of the receipt in the small black bag. Either write down or take a photo of your ending tach time and fuel level so that you can enter it into the online flight log.

Close all exterior vents (top vent and the ones next to your knees) to prevent bugs and water from entering the plane. If the aircraft is parked outside, install the intake plugs and pitot tube cover. Additionally, particularly during the spring, install the foam plugs in the tail of the airplane to prevent birds from nesting. Finally, when installing the cover back on the plane, be very careful with the antenna on top and the OAT probe on the pilot side window. Make sure to loop the straps through the landing gear and behind the gear doors as shown below instead of over the gear doors. Running it over the gear doors can damage the doors.

Secure the front strap of the plane cover under the gear strut and the middle strap behind the gear doors to prevent gear door damage

Cleaning and General Care of the Aircraft

The windshield should be cleaned using Lemon Pledge and one of the microfiber cloths found in the black bag baggage compartment. Two microfiber cloths are located in the bag, and they have clips on them indicating that one is for the windshield and one is to be used to clean the leading edge. When the windshield microfiber cloth is sufficiently dirty, it then becomes the leading edge cloth, and a new cloth is used for the windshield.

Remove all personal belongings and trash from the airplane. Aim to leave the airplane in better shape than you found it. A little bit of effort goes a long way in terms of keeping the plane in good shape.

Refuel the airplane per club policy (fill both tanks to 1 inch below the top). Complete the flight-log. Notify the club maintenance officer if any anomalies or squawks need to be reported.

Winter Operations

Operations are the same as done with most aircraft. The engine will generally require more priming during cold weather operations, so allow the fuel pump to run a little longer during priming.

There is an oil sump heater on this aircraft with the plug tied to the oil filler neck and during the winter there will be an extension cord in the back of the plane. When the field temperature is below 32°F, plug in the sump heater into a plug outlet an hour prior to engine start. While using the sump heater, leave the cowl plugs in and place the folded over aircraft cover over top of the cowl to help trap the heat in the engine compartment. Alternatively, the engine may be pre-heated using blown pre-heat air. Consult the club aircraft use rules for more details.

Once started, reduce engine RPM and let the engine warm up on the ramp prior to moving to the run-up area. Monitor the oil temperature closely. Cold weather operation can be hard on an engine, so we need to do whatever we can to minimize wear.

Install the cowl plugs soon after shut down to allow for gradual cooling. As with all aircraft, do not take off with visible frost or ice on the wings. During the winter a brush will be in the plane for brushing off snow and frost. Be gentle on the paint job and **never, ever scrape ice off of the windshield or surfaces**. If there is ice on the wings/windshield, you can ask the FBO to move the plane into their hanger for heating. It takes about a half hour to melt moderate ice in the hanger. Make sure to dry up any water around the control surfaces so that it doesn't refreeze and prevent control movement.

Finally, occasionally check (particularly while using cabin heat) the carbon monoxide detector on the panel to make sure carbon monoxide is not entering the cabin.

Night Operations

For night operations, make sure to check all lights during preflight. The knobs on the ceiling control the panel and red (spot) lights. One knob controls the panel lights, and the other controls the red lights (this configuration may seem counter-intuitive at first). The dimmer knob will get hot; this is normal.

Operating the iPad and Stratus 2

The club has installed these items to improve situational awareness, but again, they are not allowed for use as primary flight instruments. Additionally, it is critical that you not allow these to distract you from your primary responsibility of operating the aircraft. There are many videos on how to best operate this equipment on YouTube and the manuals can be found on the Club's aircraft page and in the iPad Foreflight program. The best way to prevent these from distracting you is to become thoroughly proficient with them prior to operating them in flight. Both items are plugged in via USB cable to the lighter adapter splitter under the panel on the pilot's side. They should always be plugged in during flight and unplugged after flight.

IFR Specific Procedures

Approach Level/Holding

The transition from cruise-descent to approach level or holding requires only setting a holding power setting and re-trimming to maintain altitude. The cruise rpm combined with 18" MP should yield about 120 MPH (105 kts) in level flight. Adjust MP to maintain airspeed; a change of 1" MP affects airspeed about five knots. For those who prefer a 105 MPH (90 kts) approach, that would require about 15" MP setting. Lean the aircraft as necessary to ensure smooth operation and save fuel, especially if holding.

IFR/ILS Descent

Perhaps the simplest configuration is the IFR/ILS descent from the approach level configuration, which requires only that we lower the gear at glide slope intercept or the non-precision FAF. This will result in a 500 FPM descent at the same airspeed with little change to either power or trim. Pitch attitude will be about 3 degrees nose down. So if you like to fly your approach at 120 MPH (105 kts), fly this speed until the FAF, and then lower the gear at FAF to start your decent. If you prefer a 105 MPH (90 kts) approach, reduce the MP to about 16” (the gear horn will sound) and slow the aircraft to 105 MPH just prior to the FAF. Then at the FAF, just lower the gear to start your decent. Pitch attitude for a 105 MPH approach will be just about level.

To adjust your descent to stay on slope, *each inch of MP equals 100'/min,* so adjusting descent is just a matter of adjusting MP. If you want to add 15 degrees of flaps during the approach, just add 1” MP to make up for the additional drag. If you need to level off at an intermediate fix or at the MDH, just add 5" MP and trim for 105 MPH. When you are ready for full flaps (runway in sight, landing ensured), just add the flaps and trim for level attitude, which will slow you to the normal landing (entering ground effect) speed of 80 MPH. It is good exercise during your IFR practice approaches to occasionally carry 105 MPH all the way to the DH to get used to this transition.

This is all for a normal length runway. If your approach is to a short runway, keep in mind that you will need to slow to 75 MPH for landing so you will need to reduce MP by a further 1” when you put in full flaps in order to slow to 75 MPH.

IFR/Non-Precision Approach

As always, pitch controls airspeed and throttle controls altitude. If you set up the airspeed and MP as described above at the FAF, just lower the gear at the FAF and then further reduce the manifold pressure (each inch of MP equals 100’/min) to achieve the desire additional decent rate. Thus if you want 800’/min decent rate at 105 MPH (90 kts), set the MP to about 15” and slow to 105 MPH just before the FAF, then at the FAF lower the gear and reduce MP by 3” to 12” to get the additional 300’/min. Just prior to reaching each step altitude or the MDA, add back this 3” plus the 5” to stop the 500’/min decent, which in the case will be 20”. Once you reach the MAP and if you don’t see the runway environment, go missed as described below.

IFR Circling Approach

If executing a circling approach, power should be 18" MP, pitch attitude +3 degrees, and aircraft slowed to 105 MPH. Descent is not initiated, and flaps are not extended until on base leg in a position for a normal landing. If visual contact is lost, execute the Missed Approach. In a straight-in approach, extend flaps, and trim to maintain a level pitch attitude to attain 80 MPH, 500'/min descent till single story height. *Then close throttle,* and hold the nose off to a +6 degree pitch.

Missed Approach

Implement the missed approach by setting climb power, gradually raising the wing flaps if extended, establish a positive rate of climb and retract the gear, re-trim as required and adjust cowl flaps if necessary.

Remember the essentials; establish climb power, retract flaps, bring the pitch attitude up 8 degrees, when a positive rate of climb is established *then* retract the gear, and fly the proper missed approach procedure. It is good piloting to remember the initial heading and altitude of the missed approach while on the descent so that you do not need to look at the plates while retracting the flaps and gear.

CHAPTER 6. MOONEY ACCIDENT INFORMATION

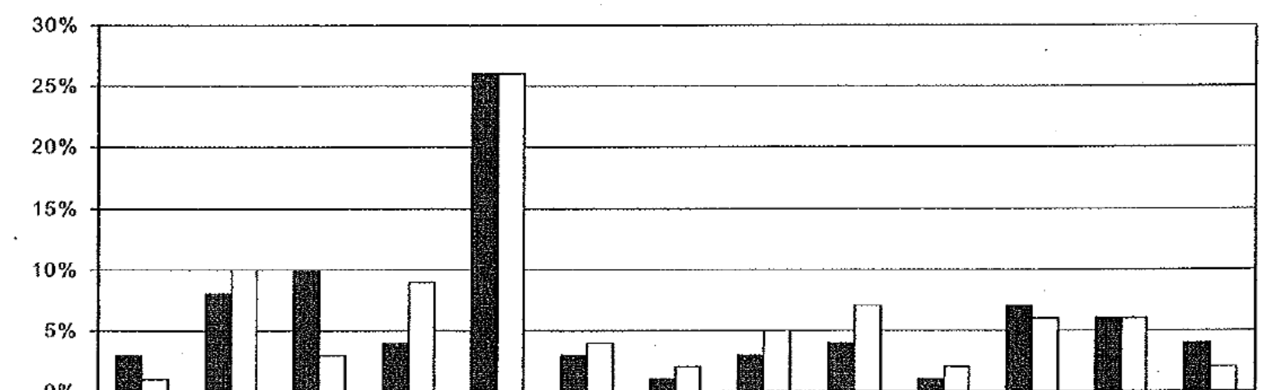
OVERVIEW- MOONEY ACCIDENTS

This information is adapted from the Mooney Association's manual with information provided by the AOPA Air Safety Foundation and NTSB.

Material in this chapter is based on a detailed study of 392 Mooney accidents that occurred from 1982 through 1991. National Transportation Safety Board (NTSB) findings were analyzed to determine the primary causes of these accidents and relate them to pilot experience, ratings, judgments and actions. Relevant instructional areas have been identified.

Shown below are the primary causes and percentage distributions of the 156 accidents and 309 fatalities/serious injuries.

MOONEY M20 SERIOUS ACCIDENTS: PILOT CAUSE



	Preflight	TakeOff	Climb	Fuel	Weather	Cruise	Descent	VFR Appr.	IFR Appr.	Missed Appr.	Maneuver	Landing	Other
looney	3%	8%	10%	4%	26%	3%	1%	3%	4%	1%	7%	6%	4%
omp. A/C	1%	10%	3%	9%	26%	4%	2%	5%	7%	2%	6%	6%	2%

Source: AOPA Safely Foundation

MOONEY SERIOUS ACCIDENTS - PRIMARY CAUSE!

	Accidents		Fatal/Serious Injuries		Aircraft Damage: Destroyed		Substantial	
Cause	%	#	%	#	%	#	%	#
Preflight	3%	4	1%	4	0%	0	4%	1
Takeoff/Initial Climb	8%	12	9%	27	9%	11	0%	0
Climb	10%	16	8%	25	11%	14	4%	1
Cruise - Fuel Exhaustion/Starvation	4%	6	4%	11	3%	4	8%	2
Cruise - Weather	26%	40	28%	86	31%	40	0%	0
Cruise - Other	3%	4	5%	15	2%	2	8%	2
Descent	1%	2	1%	2	2%	2	0%	0
Approach - VFR	3%	5	4%	11	2%	3	8%	2
Approach - IFR	4%	7	4%	12	5%	6	4%	1
Go-Around/Missed Approach	1%	2	1%	3	1%	1	4%	1
Maneuvering/Low Level Flight	7%	11	8%	24	9%	11	0%	0
Landing Gear Extension/Retraction	1%	2	1%	4	2%	2	0%	0
Landing - Hard	1%	2	1%	3	0%	0	8%	2
Landing - Long	1%	1	0%	1	0%	0	4%	1
Landing - Short	1%	1	0%	1	0%	0	4%	1
Landing - Other	2%	3	2%	5	1%	1	8%	2
Other Causes	4%	6	3%	8	5%	6	0%	0
Subtotal: Pilot	79%	124	78%	242	81%	103	67%	16
Powerplant/Propeller	5%	8	6%	19	6%	8	0%	0
landing Gear/Brakes/Wheel	1%	1	0%	1	0%	0	4%	1
Fuel System	2%	3	2%	6	1%	1	8%	2
Electrical/Ignition	2%	3	1%	4	1%	1	8%	2
Vacuum System/Instruments	1%	1	1%	2	1%	1	0%	0
Subtotal: Mechanical/Maintenance	10%	16	10%	32	9%	11	21%	5
Subtotal: Other/Undetermined	10%	16	11%	35	10%	13	13%	3
Grand Total: All Causes	100%	156	100%	309	100%	127	100%	24

Note: All figures rounded to nearest %
Source: AOPA Safety Foundation

PILOT PROFILES

A survey of Mooney pilots conducted by Plane and Pilot (September 1990 issue) showed that the median M20 aircraft annual hours flown were 138. Median pilot total and Mooney hours logged were 1611 and 400. This information is in general agreement with the following data from the FAA Office of Management Systems that shows hours flown vs. accidents. The average Mooney aircraft was flow for 121 hours.

M20 SERIES HOURS FLOWN vs. **ACCIDENTS 1991**

Aircraft Registered	6,463
Active Aircraft	5,861
Total Fleet Hours	709,000
Hours per Aircraft	121
Yearly Accidents (1982-1991)	35
Accidents per 1,000 Hours	0.05
Hours per Accident	20,257

PILOT TIME-IN-TYPE SERIOUS ACCIDENTS HISTORY

Pilot experience is a powerful variable in aircraft accidents. As is true with most aircraft, both the M20 and comparative group witness fewer accidents as pilots gain experience in the particular model. Mooney places well compared to similar retractable gear aircraft. The M20 has 9% fewer accidents in the first 100 hours of a pilot's time than the comparative aircraft.

ACCIDENT DATA BY PRIMARY CAUSE

In the following sections we present discussions of each primary cause, together with the associated pilot profile as suggested by the data. At the end of this chapter, detailed summary data tables are presented for each prime cause.

ADVERSE WEATHER

- Weather and unfavorable environments (IMC/Turbulence/Night Conditions) were the leading cause of accidents and fatalities, 16% and 48% respectively. While weather is related to one sixth of the total accidents, it causes half of the fatalities. Coincidentally, the percentage of total injuries associated with weather accidents is only 8%.
- Most adverse weather accidents fall into 2 roughly equal groups: VFR rated pilots who enter instrument meteorological conditions, and IFR rated pilot indiscretions during turbulence, IFR descents and approaches. The few remaining accidents were caused by induction system, carburetor heat, and vacuum system misuse or malfunction.
- The pilot profile for adverse weather accidents is characterized by high total time, average Mooney time, low recent time, with 57% holding an instrument rating.

JUDGMENT

- Judgment applies to decisions and actions after the preflight, but not the impact of adverse weather effects. These preventable accidents accounted for 14% of the total, 18% of the fatalities and 16% of the injuries: Drugs/alcohol, low level "buzzing", improper mountain operations, and power line impact by both IFR and VFR pilots accounted for the fatalities and half the injuries. Additional injuries resulted from high density altitude operations, hand propping and downwind takeoffs.
- Pilots displaying poor judgment had above average total and Mooney times, low recent time and 52% were instrument rated.

IMPROPER MAINTENANCE

- Faulty engine and propeller accidents caused 45% of maintenance related accidents and 67% of fatalities.
- The profile for this category shows average total and Mooney hours, but low recent time.

LOSS OF CONTROL

- Control loss occurred primarily in crosswind conditions during landing, go-around, take off or initial climb. Improper landing flare technique induced loss of control, with a resultant hard landing or porpoise. Control loss accidents were 12% of the total, causing 3% of fatalities and 13% of injuries.
- The pilot profile for loss of control situations shows low total time, lower than average Mooney time, low recent time, and only 26% were instrument rated.

AIRSPEED MANAGEMENT

- Poor airspeed management was responsible for 11% of all accidents and 5% of fatalities. Most airspeed accidents were long landings or overshoots, which caused over half of the injuries but no fatalities. Landing stalls and failure to establish a positive rate of climb accounted for all fatalities. Go-around stall accidents, generally induced by improper pitch trim, accounted for most of the remaining injuries.
- The pilot profile for airspeed accidents is distinctive: less than average total time, very low Mooney time, and low recent time. Of this pilot group 40% were IFR rated.

GEAR MISMANAGEMENT

- Gear mismanagement accidents included failure to extend or verify gear down and locked, and a few premature gear retractions during takeoff. This category comprised 8% of total accidents but only 2% of fatalities. However, by conservative estimate there were at least another 250 incidents (involving less than substantial damage to the aircraft) of gear up landings. Somewhere in the world, a Mooney is landed with the gear retracted about once every week.
- The pilots who landed gear up had average total and Mooney hours, and low recent time. IFR ratings were held by 43% of this pilot group.

FUEL MISMANAGEMENT

- Fuel mismanagement caused 7% of total accidents and only 2% of fatalities, an apparent tribute to the emergency landing abilities of the pilots. This accident invariably involved failure to switch tanks, or running both tanks dry.
- The fuel mismanagement pilot profile shows above average total time, average Mooney time, and very low recent time. Only 37% had IFR ratings.

IMPROPER PREFLIGHT

- Improper preflight was a direct contributor to 6% of all accidents, 4% of fatalities, and 6% of injuries. Failure to discover/correct fuel contamination is the most significant problem.
- Other preflight omissions which led to accidents include checks of fuel quantity, pitot static drains, baggage door inner latch, magnetos, and pitot covers.
- Pilots deficient during preflight had average total time, above average Mooney time, low recent time, with 50% IFR rated.

Other Causes

- This category, including midair and taxi collisions and bird/vehicle/deer strikes, was responsible for 5% of total accidents, 4% of fatalities and 4% of injuries.
- The pilot profile includes very high total time, average Mooney time, and low recent time. IFR ratings were held by 47% of the pilots involved.

Undetermined Causes

- Undetermined causes were responsible for 7% of all accidents, 6% of fatalities and 7% of injuries, and included suspected power loss, control loss, midair collision, fuel flow interruption, and gear failure.
- Accidents of undetermined causes were experienced by pilots with above average total time, average Mooney time and low recent time. Of these pilots 55% held IFR ratings.

M20 SERIES ACCIDENT SUMMARY- 1982-1991

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Adverse Weather	47	77	10	20	27
Judgment	42	27	21	20	22
Improper Maintenance	42	15	19	21	21
Loss of Control	35	5	17	26	9
Airspeed Management	31	8	13	19	12
Gear Mismanagement	23	2	7	13	10
Undetermined	20	9	10	9	11
Fuel Mismanagement	20	3	17	13	7
Improper Preflight	18	7	10	9	9
Other	16	7	7	8	7
Total All Causes	294	160	131	159	135

	TOTAL HRS	*TOTAL M20*	*M20 90 DAY*
Median Pilot Hours	851	140	8

Primary Accident Cause: ADVERSE WEATHER

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR*	*IFR*
VFR Rated Pilot in IMC	14	28	1	14	0
VFR Operations in IMC	12	16	6	2	10
IFR/VFR Opns, Turbulence	9	18	0	2	7
Descent Below DH/MDA	*5*	7	2	0	5
Climb in IMC	4	6	0	2	2
Induction System Icing	2	1	1	0	2
Vacuum Loss in IMC	1	1	0	0	1
Total All Discrepancies	47	77	10	20	27

	TOTAL HRS	*TOTAL M20*	*M20 90 DAY*
Median Pilot Hours	1308	160	10

Primary Accident Cause: JUDGEMENT

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Unsuitable Runway	12	0	6	8	4
Drugs/Alcohol	9	14	2	4	5
Low Level Flight	5	7	2	1	4
High Density Altitude	5	0	6	2	3
Hand Starting	4	0	3	2	2
Mountain Operations	3	5	1	0	3
Approach/Power Lines	3	1	1	3	0
Closing Door	1	0	0	0	1
Total All Discrepancies	42	27	21	20	22

	TOTAL HRS	*TOTAL M20*	*M20 90 DAY*
Median Pilot Hours	1006	250	10

Primary Accident Cause: IMPROPER MAINTENANCE

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Engine/Propeller	18	10	5	5	13
Wood Wing	1	4	0	1	0
Gear/Brakes	8	0	1	7	1
Fuel System	6	1	6	4	2
Oil System	6	0	5	3	3
Spark Plugs	2	0	2	0	2
Flight Controls	1	0	0	1	0
Total Discrepancies	42	15	19	21	21

	TOTAL HRS	*TOTAL M20*	*M20 90DAY*
Median Pilot Hours	926	161	15

Primary Accident Cause: LOSS OF CONTROL

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Landing/Cross Wind	21	2	8	15	6
Take Off/Cross Wind	5	3	0	4	1
Hard Landing	8	0	5	7	1
Take Off/Autopilot	1	0	4	0	1
Total Discrepancies	35	5	17	26	9

	TOTAL HRS	*TOTAL M20*	*M20 90DAY*
Median Pilot Hours	420	125	10

Primary Accident Cause: AIRSPEED MANAGEMENT

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Landed Long	19	0	7	11	8
Take Off/Rate of Climb	3	4	1	2	1
Landing Stall	2	4	0	l	1
Go-Around Stall	5	0	5	3	2
Take Off/Flap Retraction	2	0	0	2	0
Total All Discrepancies	31	8	13	19	12

	TOTAL HRS	*TOTAL M20*	*M20 90DAY*
Median Pilot Hours	759	61	4

Primary Accident Cause: GEAR MISMANAGEMENT

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Extension/Check	20	2	7	12	8
Early Retraction	3	0	0	1	2
Total Discrepancies	23	2	7	13	10

	TOTAL HRS	*TOTAL M20*	*M20 90DAY*
Median Pilot Hours	845	140	11

Primary Accident Cause: UNDETERMINED

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Power Loss?	10	0	9	6	7
Lost Control ?	4	8	0	2	2
Midair Collision ?	1	1	0	0	1
Fuel Flow?	1	0	1	0	1
Gear Failure ?	1	0	0	0	1
Total Discrepancies	20	9	10	9	11

	TOTAL HRS	*TOTAL M20*	*M20 90 DAY*
Median Pilot Hours	1032	140	7

Primary Accident Cause: IMPROPER PREFLIGHT

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR*	*IFR*
Fuel Contamination	12	5	5	6	6
Baggage Door Latch	1	2	1	0	1
Oil Quantity	1	0	4	1	0
Fuel Quantity	1	0	0	1	0
Pitot Cover Not Removed	1	0	0	1	0
Pitot Static System	1	0	0	0	1
No Magneto Check	.	0	0	0	1
Total All Discrepancies	18	7	10	9	9

	TOTAL HRS	*TOTAL M20*	*M20 90 DAY*
Median Pilot Hours	840	265	6

Primary Accident Cause: FUEL MISMANAGEMENT

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Tank Selected/Exhausted	20	3	17	13	7
Total All Discrepancies	20	3	17	13	7

	TOTAL HRS	*TOTAL M20*	*M20 90 DAY*
Median Pilot Hours	1150	130	5

Primary Accident Cause: OTHER

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Midair Collision	5	5	3	3	2
Unauthorized Pilot	1	1	0	0	0
Incapacitation	1	1	1	0	1
Impact by Vehicle	1	0	3	0	1
Taxi/Roll Collision	5	0	0	3	2
Passenger Interference	1	0	0	1	0
Airstrike/Bird	1	0	0	1	0
Groundstrike/Deer	1	0	0	0	1
Total Discrepancies	16	7	7	8	7

	TOTAL HRS	*TOTAL M20*	*M20 90 DAY*
Median Pilot Hours	1930	150	8

M20 SERIES ACCIDENT BY PHASE

PRIMARY CAUSE	*ACCIDENTS*	*FATALITIES*	*INJURIES*	*VFR RATING*	*IFR RATING*
Landing	137	2	62	80	57
Descent	61	81	27	30	31
Takeoff	28	8	15	16	12
Approach	20	8	11	8	12
Maneuver	18	28	7	6	12
Cruise	15	24	2	11	4
Standing	*5*	0	4	2	3
Taxi	*5*	0	2	3	2
Unknown	3	6	0	2	1
Climb	2	3	1	1	1
Total All Phases	294	160	131	159	135

	TOTAL HRS	*TOTAL M20*	*M20 90 DAY*
Median Pilot Hours	851	140	8

M20 SERIES ACCIDENT BY FLIGHT PHASE

FLIGHT PHASE	***ACCIDENTS***	***%ACCIDENTS***	***FATALITIES***	***%FATALITIES***
Landing	137	46	2	**1**
Descent	61	21	81	51
Takeoff	28	9	8	5
Approach	20	7	8	5
Maneuver	18	6	28	17
Cruise	15	5	24	15
Standing	5	2	0	0
Taxi	5	2	0	0
Unknown	3	1	6	4
Climb	2	1	3	2
Total	**294**	**100**	**160**	**100**

SUMMARY

The "AOPA Safety Foundation" undertook this study. The original study contains a number of accident reports from the National Transportation Safety Board (NTSB). Since the time that this study was written the "World Wide Web" has become natural resource for data of all sorts. We would encourage pilots to use the Internet for further research on more resent accidents. In addition to NTSB reports are data from the "National Aeronautics and Space Administration" (NASA). NASA and their research staff base the data from NASA on safety issues that are reported by pilots on the NASA form and studies performed. NASA also produces a monthly safety bulletin. In the future the MAPASF will conduct a study, under a grant from the FAA, on Mooney accidents.

NTSB: http://www.ntsb.gov/Aviation

NASA: http://www.olias.arc.gov/asrs