Aircraft Systems Descriptions
Section VII

Systems

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Intentionally Blank

Express

GENERAL

Having constructed your Express from a kit, you are probably quite knowledgeable of its general construction and physical characteristics. Herein are included general systems descriptions applicable to all airplanes. Your system may be slightly different if you have added your own "bells & whistles" and account should be made thereof. A "notes" section is added at the end of sections for your entries in this regard. During construction, you should make certain that any modifications made are of aircraft quality and preferably Express Design Inc. approved. A review by experienced EAA members in your area is at least prudent.

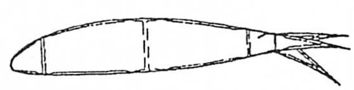
AIRFRAME

Your Express is constructed of the highest aircraft quality materials. Accordingly, your construction techniques should match that quality. Following the assembly manual should cover most if not all your questions concerning the various techniques involved.

Materials

The wings are fabricated of high temperature prepreg E-glass skins over a polyurethane core of various densities. The wings, empennage and fuselage major parts are room temperature cured. These are similar to many modern commercial construction methods, and materials meeting such standards regarding traceability and fire resistance, and the manufacturing facilities equipment generally meet FAA requirements. In addition, the resin systems used are low in styrene and are safer to handle and use than are most other systems. Read and obey all material handling warnings at all times.

FLIGHT CONTROLS



The aircraft is conventional in its control configuration. As with some other aircraft its modern Natural Laminar Flow wing airfoil is as NLF-1

(0215), design. This allows the use of flap positions from 0° to +30° for cruise to landing flap positions. The ailerons and elevators use push-pull tubes and cables with bearing mounts and rod end bearings providing smooth controls. The rudder control is via stainless steel cables. The flaps are fully electric. A single flap motor drives a linear actuator and operates the flaps thru push-pull tubes also with rod end bearings.

Trim Controls

Aileron trim is provided via a fixed trim tab on the right or left aileron. During your initial flights you will determine which wing is "heavy". This heaviness is generally due to minor variations in wing incidence from left to right and is normal for almost all aircraft including the Express. A tab, 5/8 inches (chord) by 4 inches (span), with a maximum of 20° deflection should be the largest required. It is placed on the lower side of an aileron such that it tends to move that aileron up to provide the required trim. Adjustments to this tab to eliminate any wing heaviness
4 during flight should be made only when fuel is equal in each wing. Subsequent to this adjustment, alternating the wing fuel quantity usage during cruising flight should maintain suitable aircraft trim conditions.

Rudder Trim

The Express can also be fitted with a fixed rudder trim of the same design as used on the aileron. This tab should be adjusted such that at your normal cruise condition (power and altitude) the "ball" is centered.

NOTE

Some builders may have installed manual or power rudder and/or aileron trim systems. When such a system(s) is installed an item should be added to the preflight checklist to center or adjust the trims to a takeoff position.

Elevator Trim

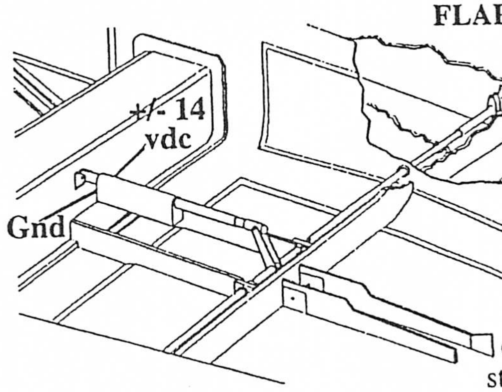
The Express is fitted with a simple and effective system to trim the pitch forces out of the control system. The preferred (over a servo control) system is a manual one where a spring force is added to the elevator control push-pull tube. A lever arm is moved forward or aft to apply the spring force on the forward elevator push-pull tube. As with the aileron trim, this will require flight tests to define the proper position and markings accordingly.

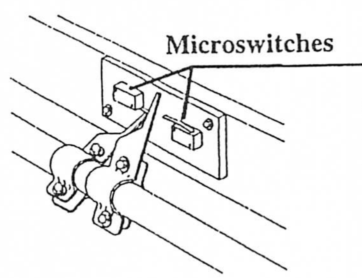
GROUND CONTROL

The Express is controlled on the ground using differential braking of the toe brakes located on the upper portion of the rudder pedals. A little caution for the first few times in the aircraft is all that is required to get the feel of this simple and light weight approach. Over-the-nose visibility is such that this approach is easily mastered. Initial use of the brakes during taxiing should be cautious but positive to "set" the pads and disks. Brakes should be used sparingly during takeoff roll obviously, and rudder control can be expected to begin after about 35 kts indicated airspeed.

The standard Express is fitted with six inch wheels with 600x6 tires on the main and nose gear, and generally should be operated on hard surface airports or smooth sod.

FLAPS





The flaps are electrically operated by a single electric two-way motor. The motor drives a jack screw which in turn extends and retracts the flaps. The figure below shows the flap system in schematic form. The flaps retract to a faired condition due to the airfoil design. The standard technique for establishing "approach" flaps is to time the application of the down flap power. Full up and full down are determined by the settings of microswitches which deactivate the motor. Power for the flap motor comes from the primary electrical buss.

LANDING GEAR - FG

The main landing gear is of composite construction on the early kits and steel of the later version. It is recommended that the steel version be retrofitted. The former, while adequate, should be considered only that, and care taken accordingly. The potential for severe damage to the aircraft following a gear failure suggests this as one of the first upgrades to be considered. The steel gear on the other hand makes the aircraft a truly ground and flight worthy machine.

LANDING GEAR - RG

The Moriah RG landing gear is of conventional design, and fully retractable. Its operation is electric, simple, and reliable. As design details become firm this section will be expanded.

BAGGAGE COMPARTMENT

6 The baggage compartment is located directly behind the passenger seats. Its capacity must be noted on a placard, but should never exceed 250 pounds. The aircraft weight and balance may limit the maximum baggage to less than the maximum stated herein. A "ski" shelf may also be installed, and if so it is limited to a maximum of 15 pounds due to its significant effect on the aircraft CG. On the Loadmaster, the version of the aircraft with a cargo pod, the pods' load can be varied to maintain the aircraft within its proper limits. It should be noted, however, that it also makes it possible to over-load the aircraft, and thus care is called for when loading your Loadmaster with this exciting and innovative approach.

All baggage carried on any aircraft should be secured for every flight. Even a flight in smooth air could encounter clear air or wake turbulence or require an evasive maneuver which could change loose baggage into control jamming debris and become a serious hazard to the flight anywhere from a nuisance to being catastrophic.

ANTICIPATE THE LIKELIHOOD OF NEGATIVE g FLIGHT CONDITIONS FOR EVERY FLIGHT

SEATS, BELTS & SHOULDER HARNESS

Your aircraft is fitted with seat belts and hopefully shoulder harnesses. The seat cushions are used to fit you into the plane and serve two purposes. First and foremost the seat cushions should be safe. Safe cushions provide proper back and seat support in case of emergencies, that is, in case of an accident they should not be so soft as to not provide support under high g conditions. They should not support combustion, nor give off toxic fumes when subjected to fire or an ignition source. Of course in addition they should also be comfortable so that a backache is not a part of every flight. Always adjust your seat belt to secure you into the seat firmly for takeoff and landings. The pilot (or one pilot) should always have a secure belt in flight - immediate control of the aircraft at all times must be possible.

The shoulder harness is perhaps your greatest cockpit lifesaver for takeoff and landing emergencies. Always use it if you have it or install it if you don't. As with a seat belt, only a snug shoulder harness works for you to the best advantage. Make sure any uninitiated passengers know how to secure and release their belts without relying on you.

DOORS, WINDOWS and EXITS

Your aircraft is fitted with a single door, hinged on the right side of the cabin, with a supporting mechanism. It lifts up and forward providing clear access to the cockpit. The weight of the door is offset by springs which make it virtually weightless. It is secured in the closed position by a latch with a safety device to prevent inadvertent opening. A lock can be located at the mid-door frame.

Access to the baggage compartment is provided thru the cockpit and over the seat backs. A smaller baggage door can also located on the right side of the fuselage. This is a structural area and account for that mustif you install such a door.

Ingress and egress of personnel from the cockpit is via the single door. In case of an emergency forced landing the door latch should not be loosened until after coming to a complete stop. For further information and discussions consult the emergency section of this handbook.

CONTROL LOCKS

The normal control lock for the aircraft is the use of a seat belt secured over one or both of the controls. If the aircraft is kept outside, some protection over and above simple tiedowns may be called for should severe weather be in the forecast. Additional protection can be provided by battens for the control surfaces such as 3" by 4" by 3/8" padded boards. These are slipped over the ailerons, rudder and elevators and
8 when installed will keep tailwind airloads from mechanically loading the surfaces abnormally. Wheel chocks and tiedowns go without saying. Another technique that can be used if high winds are expected involves the use of spanwise spoilers on the wings such as 1-2" diameter sandbags. In all cases be sure to secure such devices in a manner that precludes their coming free and causing damage that they are designed to preclude.

ENGINES

General Information

The aircraft is generally fitted with a certified engine of 200 HP or more, and a controllable pitch propeller. With this powerplant the aircraft is an extremely efficient aircraft. The larger engines, up to 285 HP, when combined with a controllable pitch propeller represent a logical extension resulting in a superb cross-country machine. The airframe supports both Lycoming and Continental engines.

These engines are FAA certified aircraft powerplants of 4 and 6 opposed cylinders, generally air cooled, and provided with magneto ignition, a starter and generator. The simplicity of these powerplants aids in their reliability providing they are given the care such a mechanical device requires. Since this is your only source of power for flight, it only makes sense to give it that extra bit of care so that it can in turn take care of you - hour after hour.

Engine Controls

There are basically two variations to these engines. They can be fitted with carburetors or fuel injection (the latter is highly recommended), and they can utilized fixed pitch or controllable pitch propellers. Four controls are provided for engine operation as generalized below. You must know your particular system and its operation.

Magnetos: All recommended engines are equipped with dual magnetos which are shorted in the OFF position. Generally one mag fires the top plugs the other the lower set however other arrangements are also used. It is mandatory that operation of the mags be checked prior to each flight. An rpm drop of approximately 100 rpm will be experienced when operating at moderate power levels (approximately 1700 rpm) on one mag only. The engine speed variation between running on the left and then the right mag should not exceed 150 rpm. Operation on both left and right magnetos should be smooth or the flight should be aborted and the problem resolved. The propeller should never be rotated on the ground without assuming that the mags are "hot". The OFF position should be checked for operation while at idle rpm prior to each shutdown by momentarily switching to the OFF position and noting that the engine begins to quit. Return the switch to BOTH. Normal shutdown is then accomplished from idle by putting the mixture control into the cut-off position and allowing the engine to run dry of fuel.

Throttle: All engines control the amount of airflow to the engine, restricting it with a butterfly (throttle) valve in the intake system. Full throttle allows unrestricted airflow into the engine resulting in manifold pressures up to 29.92 inches of mercury (or more if supercharged, or maintaining that pressure to some altitude if turbocharged), resulting in maximum power output. Smooth handling of the throttle will result in prolonged engine life due to reduced thermal shock, and increased passenger comfort (and confidence!). Smooth does not preclude rapid, however, as is required during a stall recovery or missed approach. These require positive response, i.e. smooth and rapid throttle movements, just not slammed. Should a fixed propeller be installed, the throttle also controls engine rpm.

<u>Propeller</u>: Controllable propellers also have a propeller speed control which controls the engine rpm and maintains it at a level set by the pilot. Maximum engine rpm at maximum throttle settings are required for takeoff as this results in maximum propeller thrust. Cruise power settings use reduced engine rpm and commensurate manifold pressures as defined by the engine charts for your particular engine. Rpm control is analogous to an automobile transmission, i.e. high rpm = low gear,
10 low rpm = overdrive. The result is a much more efficient aircraft.

<u>Mixture</u>: Fuel/air ratio is also controlled to compensate for the large air density changes due to operation from sea level to high altitudes. The mixture control reduces the fuel quantity provided to the engine from "Rich" to "Lean" to maintain the correct fuel-air ratio as air density decreases with high temperatures and increased altitudes. In the simplest systems the engine can be leaned to "smooth operation, plus slightly rich". A more precise technique is to lean to fuel flow versus power curves from the engine handbook, or even more precisely yet, based on measured exhaust gas temperature of one or more cylinders. The latter provides maximum fuel economy and extended engine life. Takeoff is at full rich at all times except for some high altitude and/or hot day conditions. Leaning for climb power settings can be started at 4000 to 5000 feet msl. The use of EGT for controlling engine operation most efficiently will pay for itself by fuel savings alone. Reduced maintenance, increased reliability and increased engine life will add to those savings.

Engine Instrumentation

Oil. Oil, the life blood of the engine, is of prime concern. Oil quantity is only measurable prior to flight and is a mandatory item in the checklist. Perhaps the most important measurement during operation is oil pressure. Oil temperature is another valuable measurement. Proper oil type and viscosity per the engine manufacturers' recommendation must be used. This is particularly important for the breaking in of a new or overhauled engine. This phase of an engine (or a cylinders) life requires a mineral oil (non detergent) and the use of high and variable power settings for the first few hours of operation. For specifics see the manufacturer's engine operating manual for *your* engine.

RPM. Fixed pitch propellers have blade angles and configurations such that with full power being developed by the engine statically, the rpm is limited to less than the engines allowable maximum rpm. High speed descents at high power settings with a fixed pitch propeller will allow overspeeds of both the engine and the airframe, both dangerous situations, thus rpm needs to be monitored and limited by reduced throttle settings.

Controllable propellers limit rpm by changing the pitch of the blades to keep the engine at the rpm set by the pilot which are under levels which will overstress their blades and the engine as well. Oil pressure is generally required to control the blade pitch, thus maneuvers resulting in oil pressure loss (zero or negative g's) are to be avoided lest rpm control is lost and an engine is destroyed or worse.

CHT. Cylinder head temperature is a measure of your engines' cooling airflow and a measure of an adequately warm engine to accept full power for takeoff. Since the Express is tightly cowled, high power settings at low airspeeds (slow climb speeds for example) should always be monitored for high CHT readings. Excessive levels will result in damage due to detonation and/or reduced engine life due to poor lubrication or both. Poor cooling can also result from improper baffles, bird nests in the engine compartment, etc. and must be avoided. A CHT for each cylinder is ideal as it allows optimum monitoring of the newly installed engine as well as tracking of the engine thru its overhaul life. Maintenance problems can be caught as a symptom, before becoming a disease.

EGT & Engine Monitors. A measure of optimum fuel/air ratio is available by sensing the temperature of the exhaust gasses. Operating the engine at or near its peak temperature means that you are operating at the near optimum fuel/air ratio. Gas temperatures are kept within limits indirectly by establishing the proper mixture for that power setting. A direct measurement of EGT is common and many devices are available toward this end. Some measure only a single cylinder (thought to be the hottest of course), others measure each cylinder, others the gases downstream in their combined flow path. Some measure both EGT and CHT and have alarms. Since an EGT is both a monitor of engine health, and a ;means of proper mixture setting it is highly recommended and will pay for itself in the long run by reduced fuel consumption and engine maintenance as well as extended life. An added benefit of these multiple sensors systems is that trouble shooting
12 is enhanced significantly and deteriorating situations can be seen early and caught before mechanical damage occurs or dangerous in-flight situations develop. These systems are ideal for insuring that your new aircraft is properly baffled and sealed at the start and remains so throughout its life.

Manifold Heat. Carbureted engines require a system to add heat to the intake air to eliminate ice which forms in the carburetor throat where the fuel is vaporized. This fuel vaporization can lower this area, which is near the throttle valve, from 70°F to below freezing where condensation can form, freeze, and restrict airflow to the engine. This reduction in airflow enriches the mixture excessively and lowers the volume thus reducing power output. This can result in complete stoppage of the engine if not caught and melted with the application of heat. The "Carb heat" valve is adjustable, i.e. can be partially "ON", however use in this mode should be rare and only when used in conjunction with a carburetor air temperature gauge. It should be put full ON until the engine returns to close to normal power, then placed in COLD. With the application of this heated air an additional reduction in power will be noticed initially due to the less dense air being supplied to the engine. If ice is present the power (and engine smoothness) will then increase to something less than full, returning to normal when COLD is again selected. Since we don't normally have humidity gauges, an indication of humidity should be obtained from the preflight weather briefing and from the clouds enroute. Ice can be an insidious visitor, forming slowly, almost imperceptibly slowly or rapidly requiring an equally fast response to preclude engine stoppage - beware. Carburetor heat operation should be checked before every flight during engine run-up following the mag check. A noticeable rpm reduction will be experienced with the application of heat while at the mag check power setting.

Engine Starting

Starting of the aircraft is simple. The aircraft is equipped with an electric starter which cranks the engine to provide air, one of the three basic requirements (air, fuel and ignition). Fuel is introduced by several applications of the prime pump prior to cranking. After cranking is initiated the magneto switch is put to "both" providing the final ingredient, ignition. The mixture control is then put in the full rich position after the engine fires on prime fuel.

<u>Fuel Injected Engines.</u> In these engines the fuel in generally sprayed into the intake manifold at/or near the intake valves and are thus far less prone to ice formation. This area is much warmer, and there is no temperature drop in the area of the throttle valve to cause problems. The key operative word is LESS prone. Air, heavily laden with moisture, visible or invisible can form in the intake manifold just as on the aircraft wings and thus cause blockage of air. These engines must have an alternate air source to preclude engine stoppage. This "alternate air" valve can be manual or spring loaded and thus automatic. Its source is usually the engine compartment which is somewhat warmed. Know your system and check its operation often. This alternate air is seldom

filtered, so operation on the ground or at low altitudes should be limited. It is prudent to occasionally check it for normal operation, i.e. closed until opened manually or opened only by low manifold pressure. After the engine starts, adjust the rpm to approximately 1000 rpm and monitor oil pressure. If no oil pressure is indicated within 30 seconds, shut down and determine the cause. This time may be slightly longer under abnormally cold conditions or with the improper grade of oil in the engine. Under cold conditions it is highly desirable to warm the engine and its oil prior to starting to minimize engine wear and ease starting. Very cold temperatures will also increase the normal oil pressure and following starts the engine rpm should be kept at idle or slightly above until oil pressure starts returning to normal.

WARNING

The Express does not lend itself to hand starting (propping) due to its low profile and tricycle gear. This practice is very dangerous.

Accessories

14 All engines are equipped with an alternator as a source of electrical power to charge the battery and operate various items during flight. Proper operation of the charging system is evident if the running system voltage is between 14.2 and 14.8 volts dc. Since a charged lead-acid battery has a voltage of 12.1 to 12.4 volts the battery should be continuously charged while the engine is running. If no voltage measurement is available, an amp meter may show discharge (-) at low rpm conditions (indicating that current for operating the aircraft equipment is coming from the battery) and charge (+) at higher engine rpm's indicating that the power is coming from the alternator and that the battery is being charged. Alternators will normally show + on an ammeter even at idle while a voltmeter will show 14+ volts.

Another accessory you may have installed is a vacuum pump for operating certain flight instruments such as gyro's. Its operation may be assessed by the level of vacuum it maintains. This should generally be between 4.3 and 5.9 inches of mercury. For IFR flying a small gauge is available for monitoring this vacuum and is highly recommended. Vacuum pump failures, like many others occur at just the wrong time and are often insidious as the gyro may just slowly wind down to become useless at the least, dangerous at the worst.

Fire Detection/Extinguishing

No built-in fire detection is provided nor is an extinguishing system. It is prudent to carry a small fire extinguisher in your aircraft. It should be checked regularly just as any extinguisher, and kept handy in case of need. Starting an over primed engine is the most likely time you may need the unit. If the engine backfires and catches fire, continue cranking in an attempt to draw the fire back into the engine where it belongs. If the radio is on, advise of your situation. If this short cranking fails to cure the problem or cranking is not possible for any reason, introduce the contents of the extinguisher into the engine compartment via the cooling air inlets and remaining clear of the aircraft. While the aircraft is made of fire resistant materials and its fumes are essentially non-toxic, it is nonetheless a flying fuel tank and must be treated as such.

Abnormal Operation

After a few hours of operating your aircraft you will become familiar with its operation from its flight controls to the engine. It is good practice to keep written notes of how it is operating so that you can spot changes. These changes may be toward stabilizing or deteriorating indications and heed watching. From the engines standpoint, oil consumption for example will be high on a new engine, decrease rapidly over the first 15 to 50 hours of operation and then stabilize. From this point it will remain stable for many hours until the rings begin to wear. Then a slow increase in oil consumption and decrease in power will be noted for a given power setting. Should piston rings begin to stick, an increase in consumption will generally be noted and corrective actions or repairs can be effected in a timely manner. Continuous monitoring (and recording) of engine parameters such as oil pressure, CHT, EGT (individual and spreads) along with airspeed, altitude, temperature and power setting for example will be rewarded by an intimate knowledge of your engine, as well as reduced maintenance and vastly increased reliability. No small reward for a single engine machine.

PROPELLERS

Your *Express* may be fitted with a number of different propeller/engine combinations. The controllable propellers provide improved takeoff and cruise performance. Care of any propeller is vitally important as it is a very highly stressed component. Loss of even a portion of a blade can be catastrophic in flight. Nicks and scratches in the blades or hub cause stress risers and cannot be neglected. Hub areas in particular require professional prop shop attention. The repaired shape of any blade "ding" should result in an airfoil similar to the original contour to remain as close as possible to the same "lift" as before thus retaining the same thrust load on each blade. In addition the repair must result in the nick being fully removed and the blade surface polished. Give your propeller care, respect its overhaul periods, and it will pull you thru many hours of flight. A note of caution. Many combinations of aircraft/engine/propellers result in a resonant vibration which is noted as a red line or small arc within the operating range of the tachometer. These resonances are found in the propeller by using an instrumented propeller in flight and evaluating the results over ranges of aircraft speed, altitude and power settings. The *Express*, being new, has not yet completed such tests. Prudence dictates that you be aware of such a potential and avoid any "rough" operating ranges.

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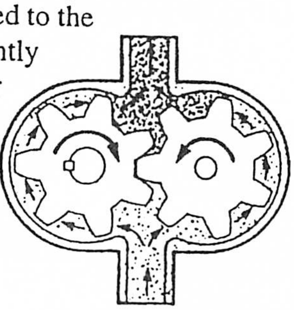
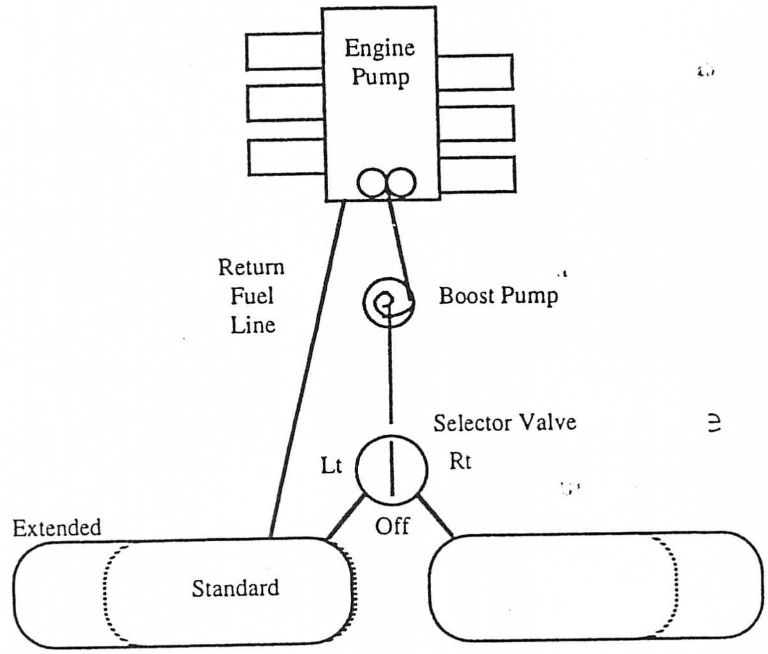
FUEL SYSTEM

The standard aircraft has a very simple fuel system. The engine driven pump (a positive displacement type device) is used to pull fuel only from the left or right main wing tank. Fuel is pulled by this engine pump thru a filter and/or gascolator, ships plumbing, and thru a boost pump (a non-positive displacement device), thru an OFF/Left/Right valve and from a main tank. Each main tank is fed fuel from the extended range tanks (outboard wing bays) if installed, by gravity. Each main tank should have a screen at its outlet and be routed to the selector valve. The boost pump is independently operated by the pilot and should be on for operation under 1000 feet AGL. A typical boost pump uses a propeller or centrifugal type impeller. An engine driven pump (shown here) is a positive displacement device with a pressure relief by-pass (not shown here).



The boost pump insures adequate fuel pressure to prevent vapor lock at the high flow rates required for takeoff or go-around conditions and is especially important on hot days or with a hot engine compartment where vapor lock is a real potential. In the basic system the pilot uses the left/right selector valve to maintain roll trim. The figure below shows a typical schematic of the fuel system.



BRAKE SYSTEM

The brake system is installed on the pilots (left) side. Steering of the craft on the ground is by the use of differential braking. The rudder pedals incorporate independent toe brake cylinders operating "Cleveland" type disk brakes on each main wheel. If adjustable rudder pedals are installed the pedal/brake assembly can be mounted on a slide plate, adjusted relative to the sub floor. When the pedal position is adjusted using the slide plate the rudder cable adjusters (perforated metal plates) must also be adjusted.

Brakes should be checked each time you leave the ramp prior to taxiing. Care should be used to not ride the brakes unnecessarily by using only enough power to maintain taxi speed. Also, you should get into the habit of checking your brakes on downwind before landing. To do so, simply depress each pedal to verify a "firm" pedal. Your initial flights in the aircraft, like any new aircraft, will require extra caution until you become familiar with the aircraft.

ELECTRICAL SYSTEM

The **basic electrical system** consists of an alternator, a voltage regulator and a battery. The alternator provides power to the main electrical buss and the battery. The recommended configuration is with an avionics buss separately controlled by an avionics master switch. From this main buss, power is supplied to the flap motor, the instruments and the lights. It should be noted that the magneto circuits are independent of the electrical system and each other.

18 Since the Express is a composite design, all circuits require the use of a return wire leading to "ground". The use of a ground buss is recommended with it being located near the firewall and battery, requiring only one relatively large ground wire to the battery and one "hot" wire to the starter. The power to the starter is controlled by a relay. It is generally advisable to have the starter on a separate switch to allow the engine to be spun up for starting prior to turning the mags on to prevent damage to the starter engagement gears from "kick back" however a switch which incorporates the starter after the mags are on (spring loaded to the BOTH position) is acceptable.

Flap Electrical System

The wing flaps are electrically operated and fed off the main electrical buss. The linear actuator (essentially a two-way electric motor driving a jack screw) is located under the cabin floor. Attached to the aft shear web is the limit switch assembly with the full up and full down limit switches. These determine the extreme flap positions by means of the switch trigger arms mounted on the flap connecting tubes. Partial flaps are obtained by simply timing the actuation of the switch. For example, the "count" of five will generally result in approach flaps. If desired, a mark can be placed on the extended flap visible to the pilot to aid in reaching a consistent position quicker. The simplicity of the system is apparent in the schematic shown.

Aircraft Lighting

The variability of owner-built aircraft can result in unique systems. Electrical circuits typically would include map lights, landing lights, navigation lights, strobes, panel lights and such. Each would be powered off the main buss, have appropriately sized circuit breakers, have their own switch (or rheostat) and, as was indicated earlier, their own ground return wire.

Avionics

The avionics should be operated off a separately powered buss to allow the whole set of avionics to be turned off and on at one time. Their lighting systems are integral and with this configuration it is possible to leave only one unit (comm or nav) on should an electrical failure occur in flight making the most effective use of the remaining battery power.

NOTE

It is recommended that the avionics buss be "cold" during engine starts to preclude any electrical surge from affecting the avionics suite.

HEATING, VENTILATING & DEFROSTING

Cockpit heating is provided by fresh intake air which is routed over an air-to-air heat exchanger heated by the exhaust gases. Since the exhaust gases are toxic and of high pressure relative to the colder ram air, they tend to leak into the fresh air side of the heat exchanger. It is **imperative** therefore that this system be checked regularly to preclude introduction of these exhaust gases into the cabin. These gases contain carbon monoxide which significantly reduces the ability of the blood to carry O_2, which seriously degrades judgment, night vision, etc.

Defrosting is accomplished by routing some or all of the warmed air to the windshield if the warm air plumbing is configured with this arrangement.

Ventilation is obtained from two flush mounted air intake scoops which direct the outside air into the cockpit, one on each side wall. During ground operation the door can be left partially open until takeoff however, caution must be used in windy conditions as the door has a large area and can result in very large forces due to gusts or prop/jet blasts. The door can never be opened in flight, all latches must remain locked, the exception being when a **safety latch only** can be released on final approach to an emergency landing. See Emergency Procedures, Section III).

PITOT PRESSURE SYSTEM

The Express is normally fitted with a standard (Piper type) heated Pitot probe mast on the lower side of the left wing. If your flights have the potential of below freezing temperatures, flight in IMC conditions, or
20 precipitation the heat should be used, and a preflight check of the heaters' operation made during the walkaround. This check can be made by turning the master switch on, and the Pitot heater for a few seconds (less than 10 typically) and then feeling the probe for warmth. The preflight should also check that the probe has not become plugged and that the cover has been removed.

NOTE

The probe heater can never be left on except in flight.

Over heating and loss of the element will occur.

STATIC PRESSURE SYSTEM

Static port location

The static port is located on the Pitot mast. If the aircraft has been outside for some time or following inclement weather the ports should be checked for obstructions and general cleanliness. The static holes should be flush, sharp edged holes. If a static drain has been incorporated it should be checked for accumulated water as this will introduce error to the altimeter reading. More information on the flight test verification of this static source can be found in the preceding Section V.

VACUUM SYSTEM

The vacuum system is powered by an engine driven vacuum pump. Its operation is vital to many gyro instruments and its performance is indicated by a pressure gauge. The gauge can be one which indicates the pressure value, or a small red or green flag, or both. Either is acceptable, however the gauge may provide an indication of gradually decreasing pump capability or a leak in the system and thus provides some warning of system failure.

IN CLOSING....

The Express is an exceptionally fine family friendly and serious aircraft. It is the responsibility of the owner/pilot to know and care for it in a professional manner to reap the full benefits, pleasure, and safety from the machine. The more you know about its systems the safer you and your passengers will be and the more you will appreciate its inherent design. Get to know it and it will serve you well and faithfully.

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