Owen Sound Flight Services

Technical Ground Training

General

Engine

- Avco Lycoming
- normally aspirated
- air cooled
- horizontally opposed
- carburetor equipped
- four cylinder
- 150 rated BHP at 2700 RPM

Propeller

- McCauley
- Model 1C160/DTM7553
- 2 blades
- Fixed Pitch
- 75 inch Diameter

Fuel

- 80/87 Minimum Grade Aviation Fuel (Red)
- 100/130 Aviation Grade Fuel (Green). (Max. lead content of 4.6 cc per gallon)
- 100 Low Lead (Blue). (Max. lead content of 2 cc per gallon)
- When using higher octane fuels, low lead AVGAS should be used to reduce lead contamination
- Standard Fuel Tanks
- Total capacity: 42 gallons
- Total usable: 38 gallons

Oil

- MIL-L-22851
- Oil Capacity: Sump= 8 quarts, Total=9 quarts
- Recommended viscosity
  - SAE 50 above 16° C
  - SAE 10W30 or SAE 30 between -18 °C and 21°C
  - SAE 10W30 or SAE 20 below -12 °C

Maximum Certified Weights

Maximum Certificated Weights

- Take off, Normal Category: 2300 lbs
  Utility Category: 2000 lbs
- Landing, Normal Category: 2300 lbs
  Utility Category: 2000 lbs
- Weight in Baggage area
  - Baggage Area 1: (station 82 to 108) 120 lbs.
  - Baggage Area 2: (station 108 to 142) 50 lbs.
  - **Maximum combined weight for area 1 and 2 is 120 lbs**

  Utility Category: Baggage Compartment and rear seat must not be occupied

Limitations

	SPEED	KCAS	KIAS	REMARKS
V_{NE}	Never Exceed Speed	158	160	Do not exceed this speed in any operation.
V_{NO}	Maximum Structural Cruising Speed	126	128	Do not exceed this speed except in smooth air, and then only with caution.
V_A	Maneuvering Speed: 2300 Pounds 1950 Pounds 1600 Pounds	 96 88 80	 97 89 80	Do not make full or abrupt control movements above this speed.
V_{FE}	Maximum Flap Extended Speed	86	85	Do not exceed this speed with flaps down.
	Maximum Window Open Speed	158	160	Do not exceed this speed with windows open.

Airspeeds

MARKING	KIAS VALUE OR RANGE	SIGNIFICANCE
White Arc	41 - 85	Full Flap Operating Range. Lower limit is maximum weight V_{S_0} in landing configuration. Upper limit is maximum speed permissible with flaps extended.
Green Arc	47 - 126	Normal Operating Range. Lower limit is maximum weight V_S with flaps retracted. Upper limit is maximum structural cruising speed.
Yellow Arc	126 - 160	Operations must be conducted with caution and only in smooth air.
Red Line	160	Maximum speed for all operations.

Power Plant Limitations

- Maximum Power: 150 BHP
- Maximum Engine Speed: 2700 RPM
- Static RPM full throttle (Carb heat off): 2300 to 2420
- Maximum Oil Temperature: 118° C (245 °F)
- Oil Pressure, Minimum: 25 psi
  Maximum: 100 psi

Power Plant Instrument Markings

INSTRUMENT	RED LINE MINIMUM LIMIT	GREEN ARC NORMAL OPERATING	YELLOW ARC CAUTION RANGE	RED LINE MAXIMUM LIMIT
Tachometer At Sea Level	---	2200 - 2500 RPM	---	2700 RPM
At 5000 Ft.	---	2200 - 2600 RPM	---	2700 RPM
At 10,000 Ft.	---	2200 - 2700 RPM	---	2700 RPM
Oil Temperature	---	100°-245°F	---	245°F
Oil Pressure	25 psi	60-90 psi	---	100 psi
Carburetor Air Temperature	---	---	-15° to 5°C	---

Figure 2-3. Power Plant Instrument Markings

Center of Gravity Limits

Center of Gravity Limits (Normal Category)

- Forward: 35 inches aft of datum at 1950 lbs. or less, straight line variation to 38.5 inches aft of datum at 2300 lbs.
- Aft: 47.3 inches aft of datum at all weights
- Reference datum: Front face of firewall

Center of Gravity

Center of Gravity Limits (Utility Category)

- Forward: 35 inches aft of datum at 1950 lbs. or less, straight line variation to 35.5 inches aft of datum at 2000 lbs.
- Aft: 40.5 inches aft of datum at all weights.
- Reference datum: Front face of firewall

Load Factor Limits

- Normal Category
  - Flaps up: +3.8g, -1.52g
  - Flaps down: +3.0g
- Utility Category
  - Flaps up: +4.4g, -1.76g
  - Flaps down: +3.0g

Placards

This airplane must be operated in compliance with the operating limitations as stated in the form of placards, markings, and manuals.

MAXIMUMS

	Normal Category	Utility Category
MANEUVERING SPEED (IAS)	97 knots	97 knots
GROSS WEIGHT	2300 lbs.	2000 lbs.
FLIGHT LOAD FACTOR		
Flaps Up	+3.8, -1.52	+4.4, -1.76
Flaps Down	+3.0	+3.0

Normal Category - No acrobatic maneuvers including spins approved.
Utility Category - Baggage compartment and rear seat must not be occupied.

NO ACROBATIC MANEUVERS APPROVED
EXCEPT THOSE LISTED BELOW

Maneuver	Recm. Entry Speed	Maneuver	Recm. Entry Speed
Chandelles	105 knots	Spins	Slow Deceleration
Lazy Eights	105 knots	Stalls (except whip stalls)	Slow Deceleration
Steep Turns	95 knots		

Altitude loss in stall recovery -- 180 feet.
Abrupt use of controls prohibited above 97 knots.
Spin Recovery: opposite rudder - forward elevator - neutralize controls. Intentional spins with flaps extended are prohibited.
Flight into known icing conditions prohibited. This airplane is certified for the following flight operations as of date of original airworthiness certificate:

DAY - NIGHT - VFR - IFR

(2) Forward of fuel selector valve:

BOTH TANKS ON FOR TAKEOFF & LANDING

(3) On the fuel selector valve (standard tanks):

BOTH - 38 GAL. ALL FLIGHT ATTITUDES LEFT - 19 GAL. LEVEL FLIGHT ONLY RIGHT - 19 GAL. LEVEL FLIGHT ONLY OFF

On the fuel selector valve (long range tanks):

BOTH - 48 GAL. ALL FLIGHT ATTITUDES LEFT - 24 GAL. LEVEL FLIGHT ONLY RIGHT - 24 GAL. LEVEL FLIGHT ONLY OFF

(4) Near fuel tank filler cap (standard tanks):

FUEL 80/87 MIN. GRADE AVIATION GASOLINE CAP. 21 U.S. GAL.

Near fuel tank filler cap (long range tanks):

FUEL 80/87 MIN. GRADE AVIATION GASOLINE CAP. 26 U.S. GAL.

(5) Near flap indicator:

AVOID SLIPS WITH FLAPS EXTENDED

(6) In baggage compartment:

120 POUNDS MAXIMUM BAGGAGE AND/OR AUXILIARY PASSENGER FORWARD OF BAGGAGE DOOR LATCH 50 POUNDS MAXIMUM BAGGAGE AFT OF BAGGAGE DOOR LATCH MAXIMUM 120 POUNDS COMBINED FOR ADDITIONAL LOADING INSTRUCTIONS SEE WEIGHT AND BALANCE DATA

(7) On the instrument panel near over-voltage light:

HIGH VOLTAGE

Emergency Procedures

- Refer to Emergency Checklist in Aircraft

Amplified Procedures

Landing without Elevator Control

- Trim for horizontal flight (60 KIAS, Flaps 20) using throttle and trim control
- Do not change elevator trim setting; control glide angle by adjusting power
- At flare-out, elevator trim should be adjusted toward full nose up, power adjusted so plane will rotate to attitude for touchdown
- Close throttle at touchdown

Fires

Refer to checklist in aircraft

Emergency Operation in Cloud

- In event of vacuum system failure during flight in marginal weather, heading indicator and attitude indicator will be disabled.
- Turn co-ordinator will have to be relied on.

Emergency Descent through Cloud

1) Apply full rich mixture
2) Use full carburetor heat
3) Reduce power to set up a 500 to 800 ft/min rate of descent
4) Adjust elevator trim for a stabilized descent at 70-80 KIAS
5) Monitor turn coordinator and make corrections with rudder alone
6) Keep straight by referring to compass
7) Upon breaking out of cloud, resume normal cruising flight

Spiral Dive Recovery in Cloud

1) Close throttle
2) Stop the turn by using coordinated aileron and rudder
3) Cautiously apply elevator back pressure to reduce speed to 80 KIAS
4) Adjust the elevator trim control to maintain an 80 KIAS glide
5) Keep straight using rudder
6) Apply carburetor heat
7) Clear engine occasionally, but avoid using enough power to disturb the trimmed glide
8) Upon breaking out of cloud, resume normal cruising flight

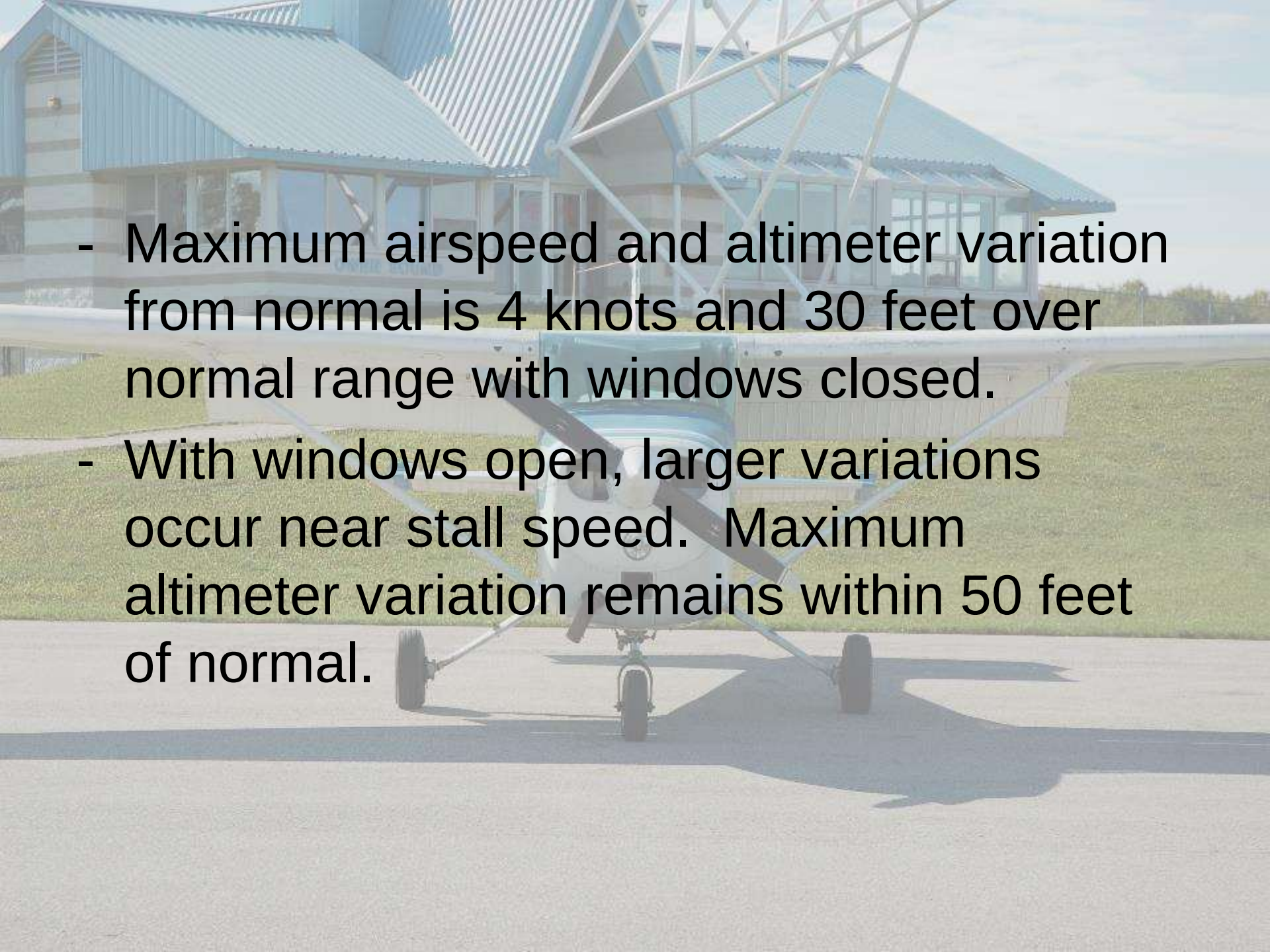
Flight into Icing Conditions

Flight into icing conditions is prohibited

- Inadvertent encounter is best handled using checklist procedures
- Best procedure is to turn back or change altitude to escape icing conditions.

Static Source Blocked

- If erroneous readings of static instruments suspected, alternate static source valve should be pulled on.
- If aircraft not equipped with alternate static source, cabin pressure can be supplied to static instruments by breaking glass of VSI
- Using alternate static source, indicated airspeed should be adjusted during climb and approach according to alternate source airspeed calibration table in section 5.



- Maximum airspeed and altimeter variation from normal is 4 knots and 30 feet over normal range with windows closed.
- With windows open, larger variations occur near stall speed. Maximum altimeter variation remains within 50 feet of normal.

Spin Recovery

1) Retard throttle to idle
2) Place ailerons in neutral position
3) Apply and hold full rudder opposite to the direction of rotation
4) Just after the rudder reaches the stop, move the control wheel briskly forward far enough to break the stall
5) Hold these control inputs until rotation stops
6) As rotation stops, neutralize rudder, and make a smooth recovery from resulting dive.

Rough Engine Operation or Loss of Power

Carburetor Icing

- Gradual loss of RPM and eventual engine roughness may result from formation of carburetor ice
- To clear ice, apply full throttle and pull carburetor heat knob full out until engine runs smoothly
- Remove carburetor heat and readjust throttle
- If conditions require continued use of heat, use minimum amount of heat necessary to prevent ice from forming and lean mixture for smoothest running engine

Spark Plug Fouling

- Slight engine roughness in flight may be caused by one or more spark plugs becoming fouled by carbon or lead
- May be verified by briefly changing ignition switch from both to L or R.
- An obvious power loss in single ignition operation is evidence of spark plug or magneto problems
- Lean mixture to recommended lean setting
- If problem does not clear up in several minutes, determine if a richer mixture will produce smoother operation
- If not, proceed to nearest airport for repairs using BOTH position unless extreme roughness dictates the use of a single ignition position

Magneto Malfunction

- Sudden engine roughness or misfiring is usually evidence of magneto problems
- Switching from BOTH to L or R will identify which magneto is malfunctioning
- Select different power settings and enrichen mixture to determine if continued operation on BOTH is practicable
- If not, switch to the good magneto and proceed to nearest airport for repairs

Low Oil Pressure

- If low pressure is accompanied by normal temperature, there is a possibility the pressure gage or relief valve is malfunctioning
- A leak in the line to the gage is not cause for immediate precautionary landing, but landing at nearest airport would be advisable for inspection.
- If loss of oil pressure is accompanied by a rise in temperature, there is good reason to suspect imminent engine failure
- Reduce engine power and select a suitable field
- Use only minimum power required to reach field

Electrical Power Supply System Malfunction

- Refer to checklist in aircraft

Normal Procedures

Review Checklists in Aircraft

Speeds for Safe Operation

Takeoff, Flaps Up:	
Normal Climb Out	70-80 KIAS
Maximum Performance Takeoff, Speed at 50 feet	59 KIAS
Enroute Climb, Flaps Up:	
Normal, Sea Level	80-90 KIAS
Normal, 10,000 Feet	70-80 KIAS
Best Rate of Climb, Sea Level	78 KIAS
Best Rate of Climb, 10,000 Feet	68 KIAS
Best Angle of Climb, Sea Level	64 KIAS
Best Angle of Climb, 10,000 Feet	62 KIAS
Landing Approach:	
Normal Approach, Flaps Up	60-70 KIAS
Normal Approach, Flaps 40°	55-65 KIAS
Short Field Approach, Flaps 40°	60 KIAS
Balked Landing:	
During Transition to Maximum Power, Flaps 20°	55 KIAS
Maximum Recommended Turbulent Air Penetration Speed:	
2300 Lbs	97 KIAS
1950 Lbs	89 KIAS
1600 Lbs	80 KIAS
Maximum Demonstrated Crosswind Velocity:	
Takeoff or Landing	15 KNOTS

Engine Start - Priming

-Warm temperatures 1-2 primes

-Cold temperatures up to 6 primes

-Extremely cold temperatures it may be necessary to continue priming while cranking

-If engine is warm, no priming will be required

Engine Start

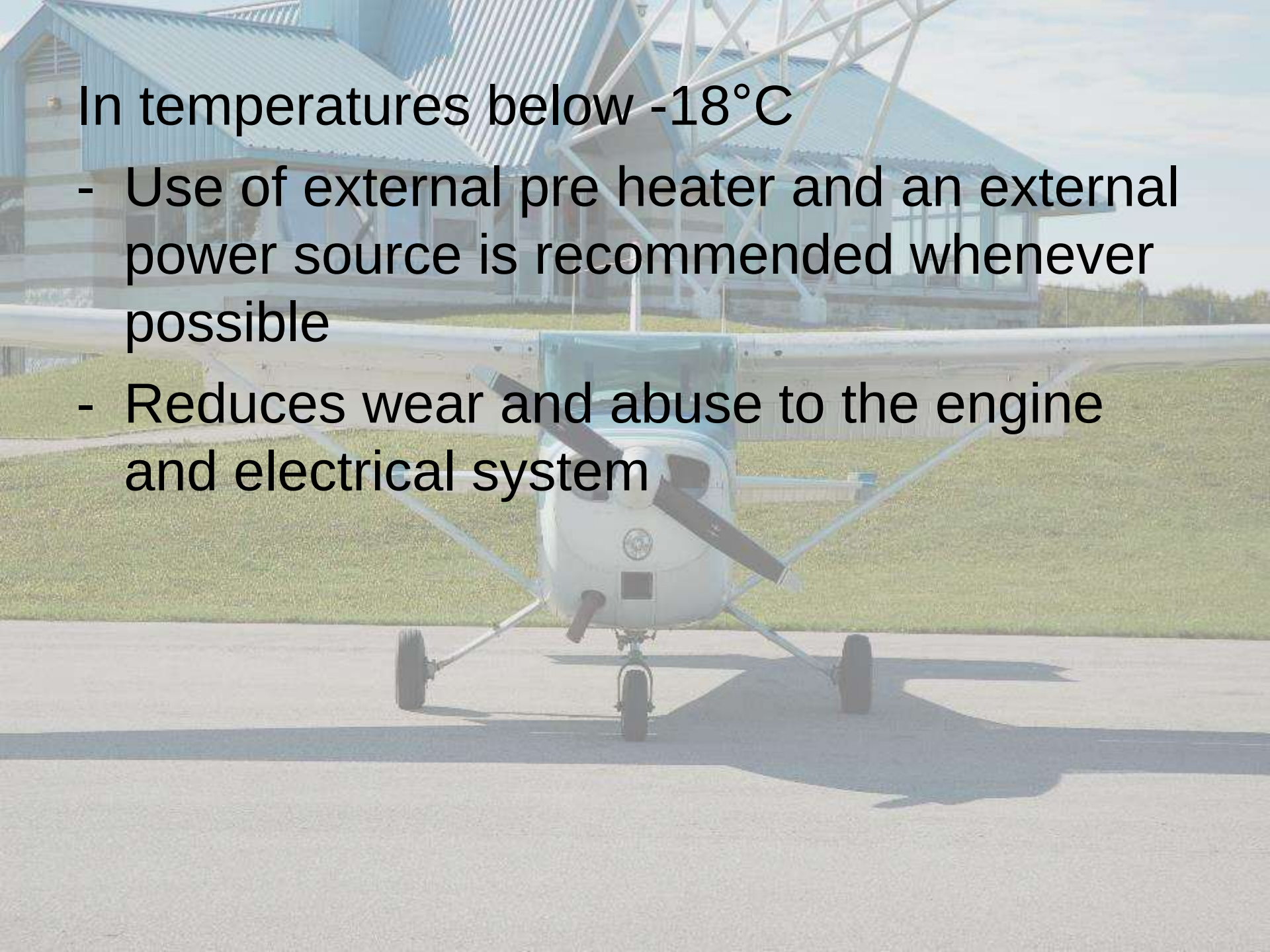
- Intermittent firing followed by puffs of black smoke from exhaust indicates overpriming or flooding
- To clear excess fuel from combustion chamber
  - Set mixture control to full lean
  - Set throttle to full open
  - Crank engine through several revolutions with starter
  - Repeat starting procedure without any additional priming

- If engine is underprimed (most likely in cold weather) it will not fire at all, and additional priming will be necessary
- As soon as cylinders fire, open throttle slightly to keep it running
- After starting, if no oil pressure is registering within 30 seconds in summer (twice that long in very cold temps), stop engine and investigate.

Cold Weather Operation

- Prior to starting in cold weather, it is advisable to pull prop through several times by hand to break loose or limber the oil, thus conserving battery energy

- Note: When pulling prop through, treat it as though ignition is turned on



In temperatures below -18°C

- Use of external pre heater and an external power source is recommended whenever possible
- Reduces wear and abuse to the engine and electrical system

Cold Weather Starting Procedures

With Pre-heat

1) Igniting OFF and throttle closed, prime engine 4-8 strokes as prop. is being turned over by hand
2) Propeller Area – Clear
3) Master Switch – On
4) Mixture – Full Rich
5) Throttle – Open 1/8 inch
6) Ignition Switch – Start
7) Release Ignition Switch to BOTH when engine starts
8) Oil Pressure - Check

Cold Weather Starting Procedures

Without Preheat:

1) Prime engine six to ten strokes while the propeller is being turned by hand with throttle closed. Leave primer charged and ready for stroke
2) Propeller Area – Clear
3) Master Switch – ON
4) Mixture – Full Rich
5) Ignition Switch – Start
6) Pump throttle rapidly to full open twice. Return to 1/8 inch open position
7) Release ignition switch to BOTH after engine starts
8) Continue to prime engine until it is running smoothly, or alternately pump throttle rapidly over first ¼ of total travel
9) Oil Pressure – CHECK
10) Pull Carb. Heat knob full on after engine has started. Leave on until engine is running smoothly
11) Lock Primer

- If engine does not start during first few attempts, or if the engine firing diminishes in strength, it is probable that the plugs have been frosted over. Preheat must be used before another start is attempted.
- CAUTION: Pumping throttle may cause raw fuel to accumulate, creating fire hazard in event of back fire. If this occurs, maintain cranking action to suck flames into engine. An outside attendant with fire extinguisher is advised for cold starts without preheat.

- During very cold temperatures, no indication will be apparent on the oil temperature gage prior to take-off.
- After a suitable warm up period (2 to 5 minutes at 1000 RPM), accelerate the engine several times to higher engine RPM
- If engine accelerates smoothly and oil pressure remains normal and steady, the airplane is ready for take off.

Cold Weather Flight Operation

- Takeoff is normally made with carb. heat off. Avoid excessive leaning in cruise.
- Carb. heat may be used to overcome any occasional engine roughness due to ice.
- When operating in temperatures below -18°C, avoid using partial carb. heat.

Weight & Balance and Performance

- See Weight & Balance ground school power point / performance ground school power point.

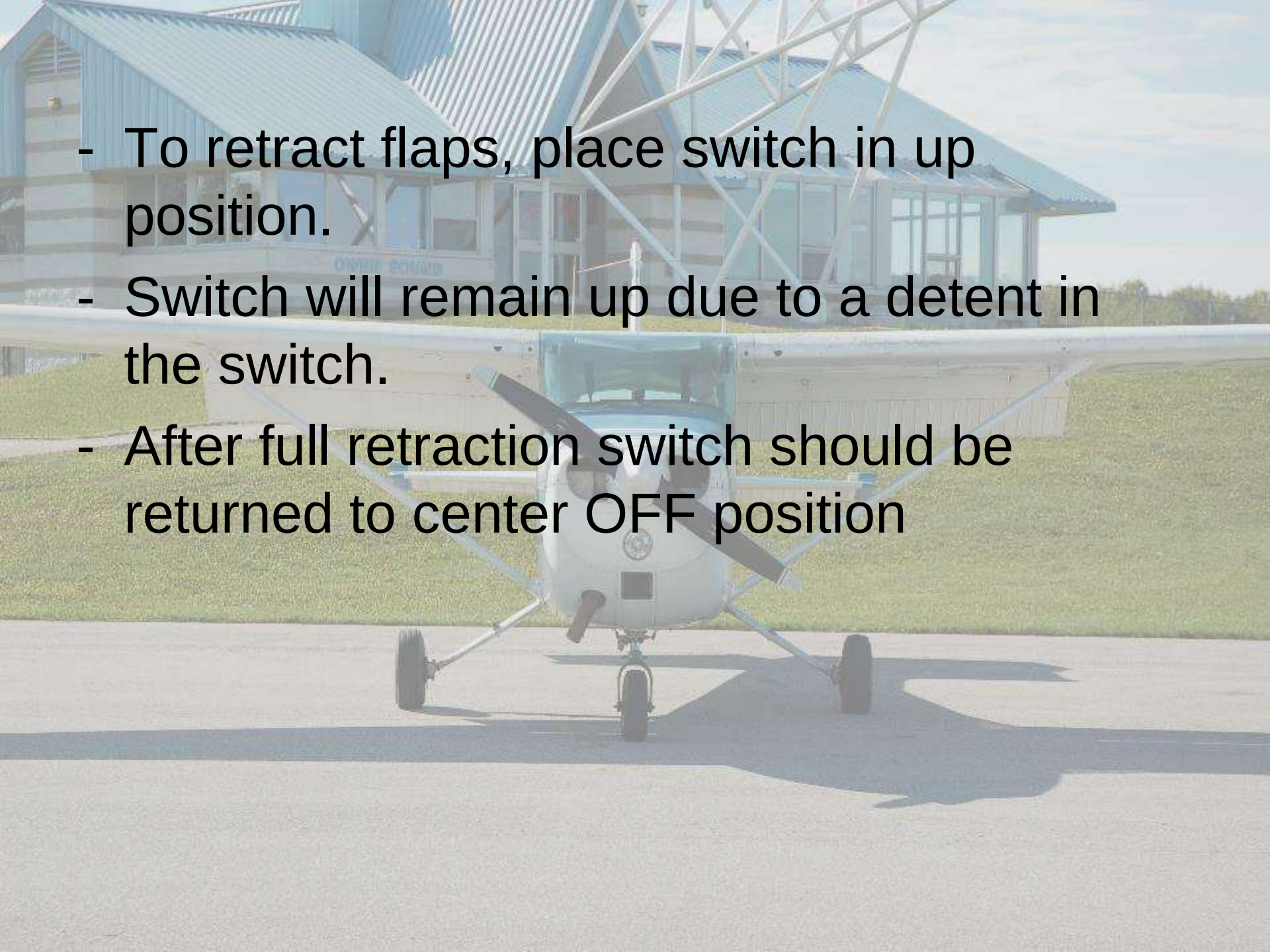
Cessna 172 M Systems

Ground Control

- When rudder pedals depressed, a spring loaded steering bungee will turn nose wheel through an arc of approx. 10° either side of center.
- By applying either brake, the degree of turn may be increased up to 30° each side of center.
- Minimum turn radius using differential braking and nose wheel steering is approx. 27 feet 5 ½ inches

Wing Flap System

- Single slot type
- Electrically operated by motor in right wing
- Flap position controlled by switch on instrument panel
- Flap position is electrically indicated by an indicator on instrument panel
- To extend flaps, switch must be held down until desired degree of extension
- After flaps reach full extension or retraction, limit switches will automatically shut off flap motor



- To retract flaps, place switch in up position.
- Switch will remain up due to a detent in the switch.
- After full retraction switch should be returned to center OFF position

Landing Gear System

- Tricycle type with steerable nosewheel
- Shock absorption provided by spring steel main landing gear struts and the air/oil nose gear shock strut.

- Baggage compartment
- Seats, seatbelts
- Doors
- Control locks

Demonstration in the aircraft

Engine

General

- Horizontally opposed, four cylinder, overhead valve, air cooled, carbureted engine with a wet sump oil system
- Model # O-320-E2D, rated at 150 horsepower at 2700 RPM
- Static RPM of 2300 – 2420 at full throttle with carb. heat off
- Accessories include starter and belt driven alternator on front of engine, dual magnetos and a vacuum pump mounted on accessory drive pad on rear of engine

Engine Controls

- Throttle located on lower center instrument panel
- Full forward position throttle is open
- Full aft position throttle is closed
- Friction lock located at base, rotate clockwise to increase friction
- Mixture knob mounted next to throttle, and is red
- Rich position is full forward
- Idle cut off is full aft
- To adjust mixture, depress lock button and move control

Engine Instruments

- Engine operation monitored by oil pressure gage, oil temperature gage and tachometer

Oil Pressure Gage

- Operated by oil pressure
- Direct pressure oil line from engine delivers oil at engine operation pressure to gage
- Minimum idling pressure is 25 psi (red line)
- Normal operation range is 60 to 90 psi (green arc)
- Maximum pressure is 100 psi (red line)

Oil Temperature

Oil Temperature

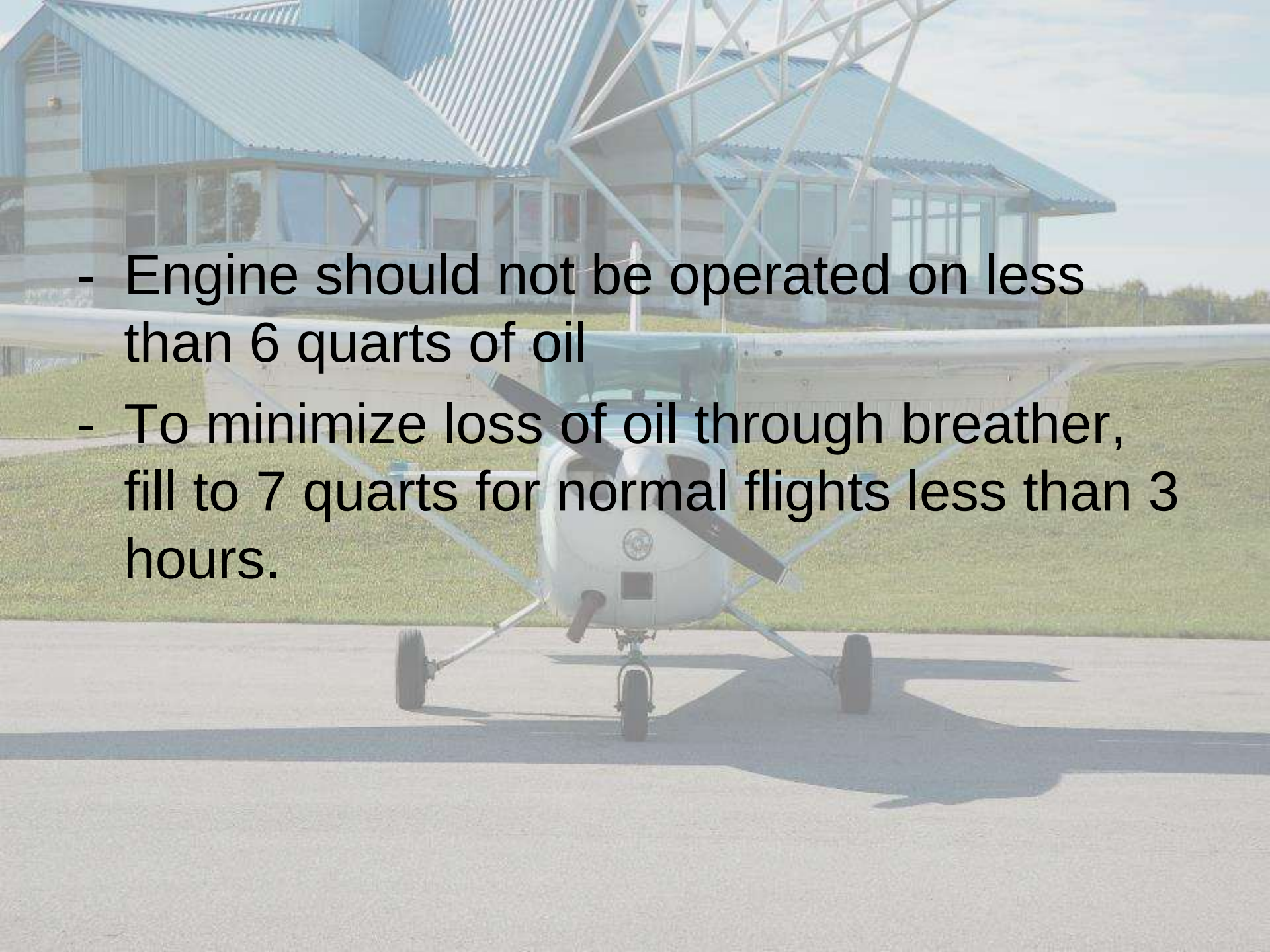
- Operated by an electrical resistance type temperature sensor
- Oil temperature limitations were covered in limitation section

Tachometer

- Engine driven mechanical tachometer
- Calibrated in increments of 100 RPM and indicates both engine and prop. RMP
- Normal operation range (stepped green arc) 2200 to 2700 RPM
- Normal operating range upper limit is 2500 RPM at sea level
- 2600 RPM at 5000 feet
- 2700 RPM at 10 000 feet
- Max. (red line) at any altitude is 2700 RPM

Engine Oil System

- Oil supplied from a sump on the bottom of the engine
- Oil drawn through oil suction strainer screen into engine driven oil pump
- Oil cooler includes a bypass valve, if oil is cold it bypasses cooler and flows into oil filter
- Filtered oil enters a pressure relief valve which regulates oil pressure by allowing excessive oil to return to sump
- Balance of pressure oil circulated to various engine parts for lubrication
- Residual oil returned to sump by gravity flow



- Engine should not be operated on less than 6 quarts of oil
- To minimize loss of oil through breather, fill to 7 quarts for normal flights less than 3 hours.

Ignition Starter System

- Ignition provided by two engine driven magnetos, and two spark plugs in each cylinder
- Right magneto fires lower right and upper left spark plugs
- Left magneto fires lower left and upper right spark plugs
- Normal operation is conducted with both magnetos due to more complete burn with dual ignition

- Ignition provided by rotary type switch
- Switch labeled clockwise OFF, R, L, BOTH, and START
- Engine should be operated on BOTH, R and L are for checking purposes and emergency use only
- When switch rotated to spring loaded START position, starter is energized and starter will crank engine
- When switch is released, it automatically returns to BOTH position

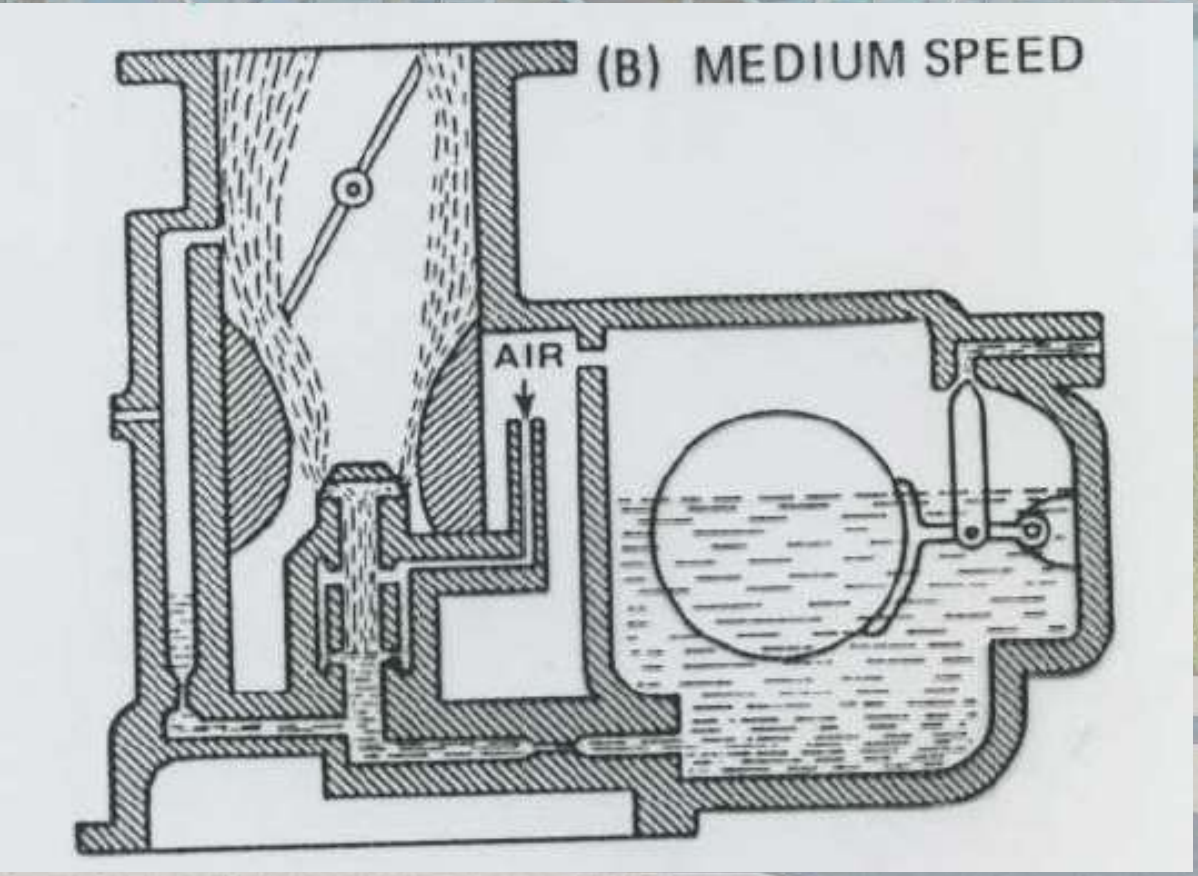
Air Induction System

- RAM air enters through an intake in lower front of cowling
- Intake covered by air filter to remove dust and debris from induction air
- Airflow passing through filter enters airbox and then travels into carburetor and is then ducted to cylinders
- In event of carburetor ice or intake filter becomes blocked, alternate air can be obtained from a shroud around an exhaust riser
- Alternate air obtained by the carburetor heat control on instrument panel
- Use of full carburetor heat at full throttle will result in a loss of approx. 100 to 225 RPM

Carburetor and Priming System

- Carburetor is up draft, float type, fixed jet mounted on bottom of engine
- Equipped with enclosed accelerator pump, simplified fuel passages to prevent vapor locking, an idle cut off mechanism and manual mixture control
- In carburetor fuel is atomized, proportionally mixed with intake air, and delivered to cylinders.
- Proportion of atomized fuel to air controlled by mixture control

Carburetor



Primer

- Manual primer is a small pump
- Draws fuel from strainer when plunger pulled out
- Injects into cylinder intake ports when pushed back in
- Equipped with a lock that must be rotated left or right after being pushed in

Cooling System

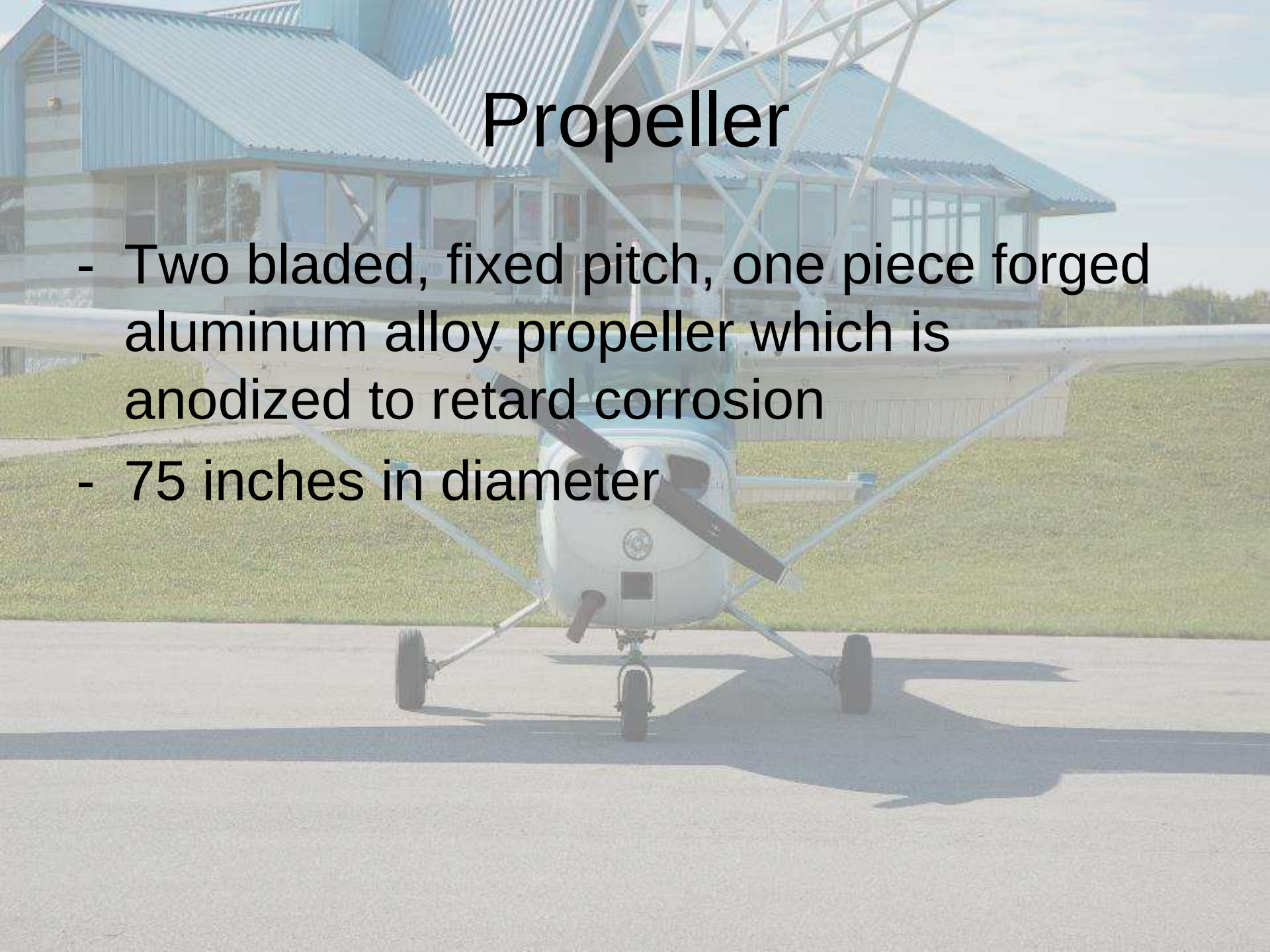
- Ram air for engine cooling enters through two intake openings in front of engine cowl
- Air directed around engine by baffles
- Then exhausted through an opening at the bottom aft edge of cowling
- No manual cooling system control is provided

Winterization Kit

- Consists of two baffles which attach to the air intakes in the cowling nose cap
- Restrictive cover plate for the oil cooler air inlet in the right rear vertical engine baffle
- Equipment should be installed for operations in temperatures consistently below -7°C (20°F)

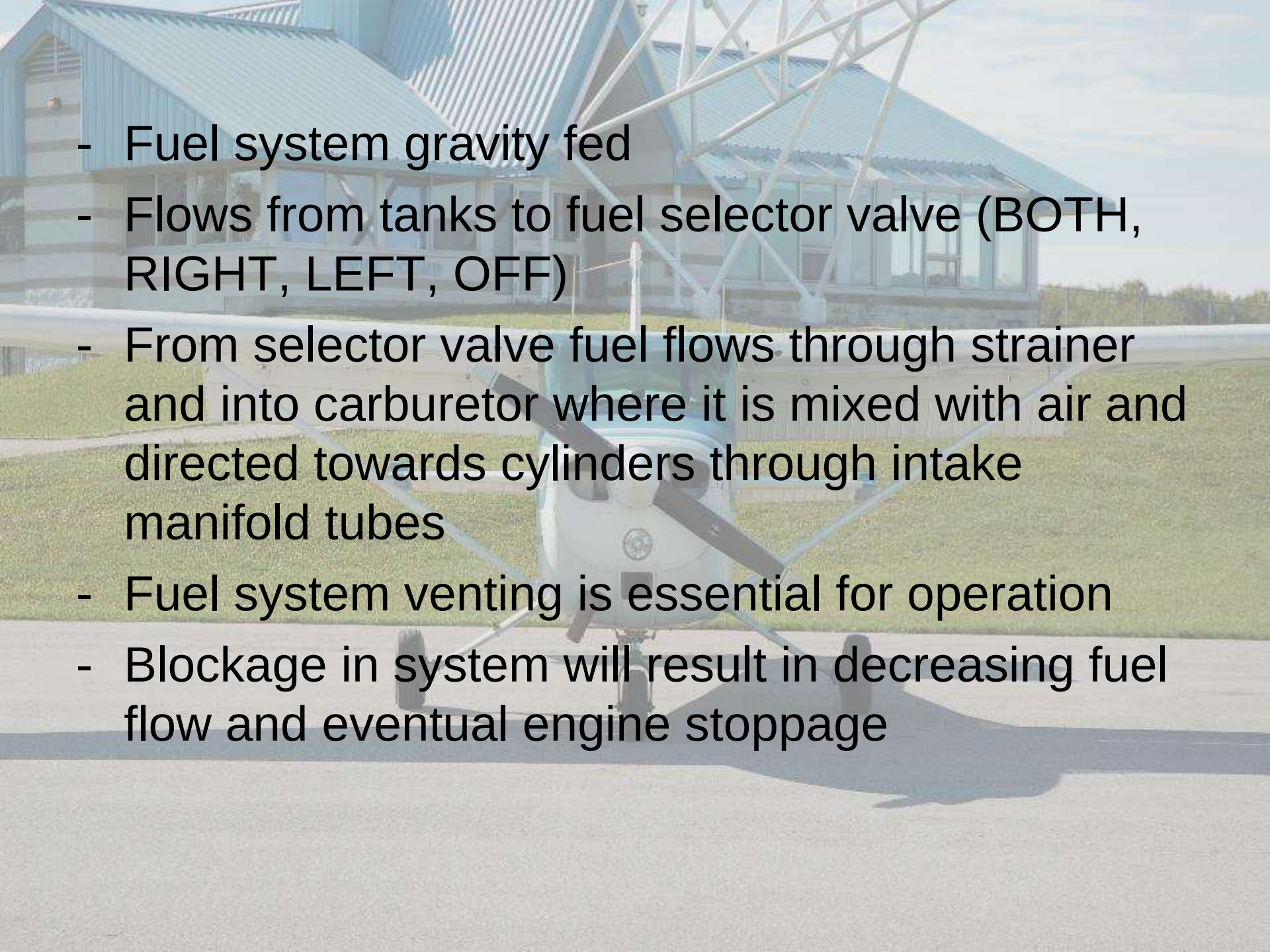
Propeller

- Two bladed, fixed pitch, one piece forged aluminum alloy propeller which is anodized to retard corrosion
- 75 inches in diameter

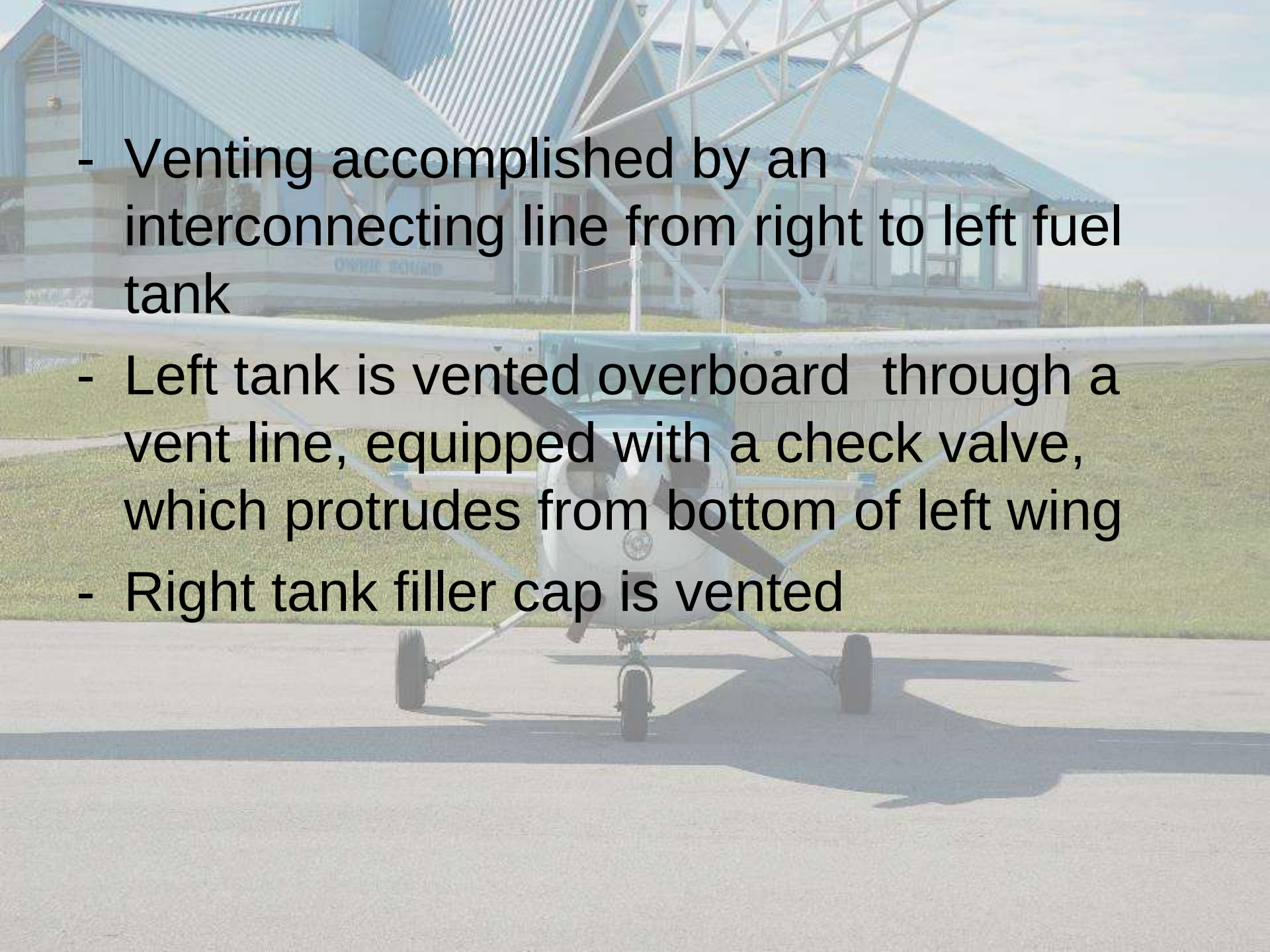


Fuel System

- OSFS Cessna 172 Model M aircraft are equipped with standard fuel system (as opposed to long range)
- System consists of two vented fuel tanks, a four position selector valve, fuel strainer, manual primer and carburetor.
- Standard fuel tanks:
  - 42 gallons total (21 gallons each tank)
  - 4 gallons unusable fuel (2 in each tank)
  - 38 gallons usable fuel (19 gallons each tank)



- Fuel system gravity fed
- Flows from tanks to fuel selector valve (BOTH, RIGHT, LEFT, OFF)
- From selector valve fuel flows through strainer and into carburetor where it is mixed with air and directed towards cylinders through intake manifold tubes
- Fuel system venting is essential for operation
- Blockage in system will result in decreasing fuel flow and eventual engine stoppage



- Venting accomplished by an interconnecting line from right to left fuel tank
- Left tank is vented overboard through a vent line, equipped with a check valve, which protrudes from bottom of left wing
- Right tank filler cap is vented

Fuel Quantity

- Fuel quantity measured by two float type fuel quantity transmitters (one each tank)
- Fuel gages are electrically operated
- When indicator shows empty, approximately 2 gallons remain in standard tank (unusable)
- Indicators are unreliable during skids, slips or unusual attitudes

Fuel Selector

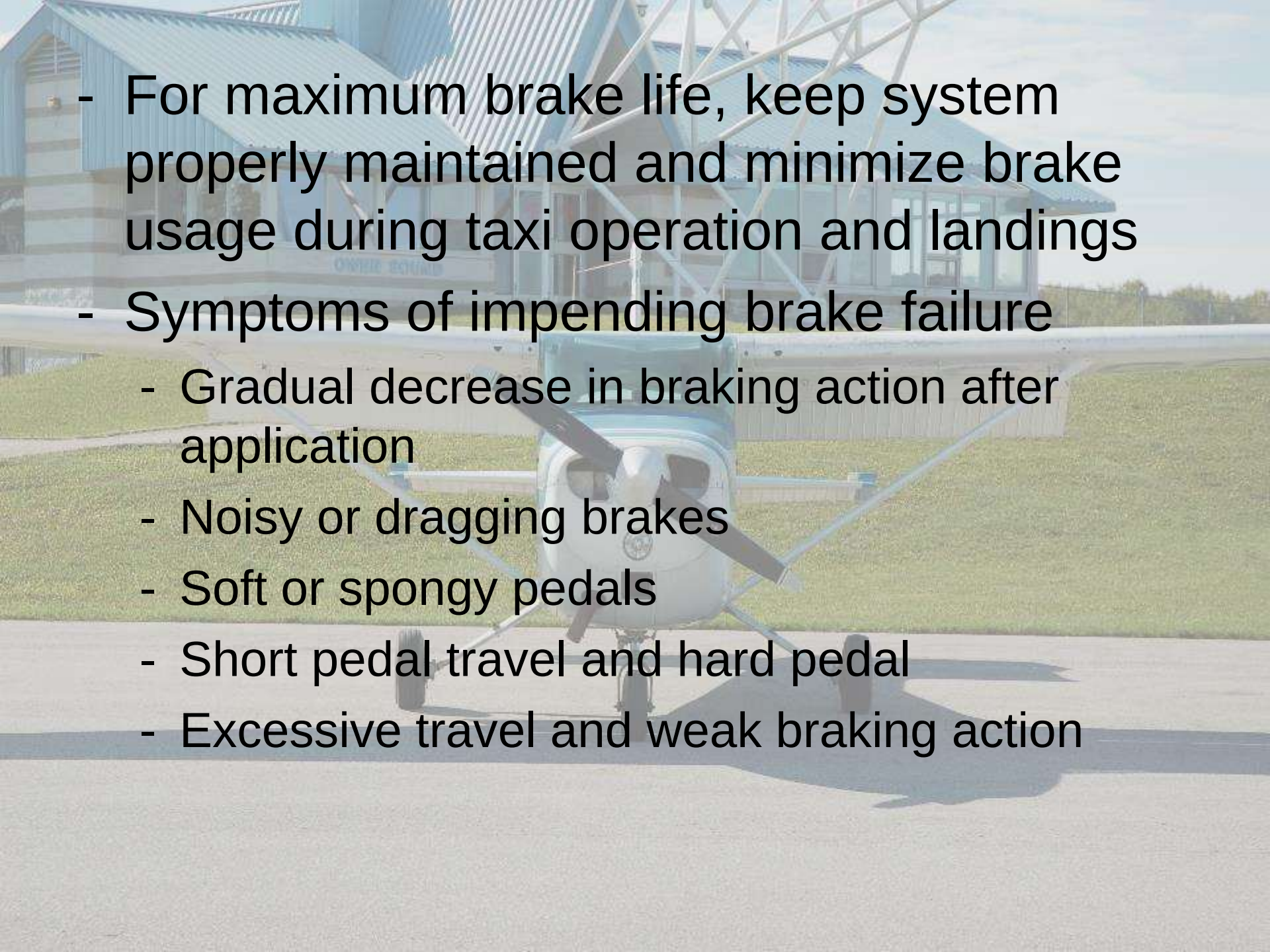
- Fuel selector valve should be in BOTH for takeoff, climb, landing and maneuvers that involve prolonged slips or skids.
- LEFT or RIGHT tank operation is reserved for cruising flight
- NOTE: With low fuel (1/8 tank or less), a prolonged steep descent (1500 feet or more) with partial power, full flaps and 70 KIAS or greater should be avoided due to possibility of uncovering fuel tank outlets. If starvation occurs, leveling the nose should restore power within 20 seconds

- NOTE: When fuel selector in BOTH position in cruise, unequal fuel flow from each tank may occur if wings are not maintained level. Wing heaviness can be alleviated gradually by turning the selector handle to the tank in the “heavy” wing
- NOTE: It is not practical to measure time required to consume fuel in one tank, and after switching to opposite tank, expect an equal duration from remaining fuel. Fuel tanks interconnected by a vent, therefore sloshing of fuel between tanks can be expected.

- Fuel system equipped with drain valves to provide a means to examine fuel for contamination and grade
- System should be examined before first flight of every day and after each refueling
- Fuel can be checked by using sample cup to drain fuel from the wing tank sumps, and by using the fuel strainer drain under the belly on the right side of the engine cowling.
- Fuel tanks should be filled after each flight to prevent condensation

Brake System

- Single disc, hydraulically actuated brake on each main landing gear
- Each brake is connected, by hydraulic line, to master cylinder attached to each of the pilots rudder pedals
- Operated by applying pressure to top of pilots side or co pilots side rudder pedals
- To apply parking brake, set brakes with rudder pedals, pull handle (located under left side of instrument panel) aft and rotate 90 degrees



- For maximum brake life, keep system properly maintained and minimize brake usage during taxi operation and landings
- Symptoms of impending brake failure
  - Gradual decrease in braking action after application
  - Noisy or dragging brakes
  - Soft or spongy pedals
  - Short pedal travel and hard pedal
  - Excessive travel and weak braking action

- If any of these symptoms are present, brake system needs immediate attention
- If during taxi or landing, braking action decreases, let up on brakes and then re-apply the brakes with heavy pressure
- If brakes become spongy or pedal travel increases, pumping pedals should build pressure
- If one becomes weak or fails, use other brake sparingly while using opposite rudder, as required, to offset the good brake

Electrical System

- Electrical energy supplied by a 14 volt, direct current system
- Engine driven, 60 amp alternator
- 12 volt, 25 amp hour battery located on left side of firewall
- Power supplied to all electrical circuits through a split bus bar
- One side contains electronic systems circuits, the other having general electrical system circuits

- Both sides of bus are on at all times, except when either an external power source is connected or starter is turned on
- At these times, a power contactor is automatically activated to open circuit to electronic bus
- Isolating electronic circuits in this manner prevents harmful transient voltages from damaging the transistors in the electronic equipment

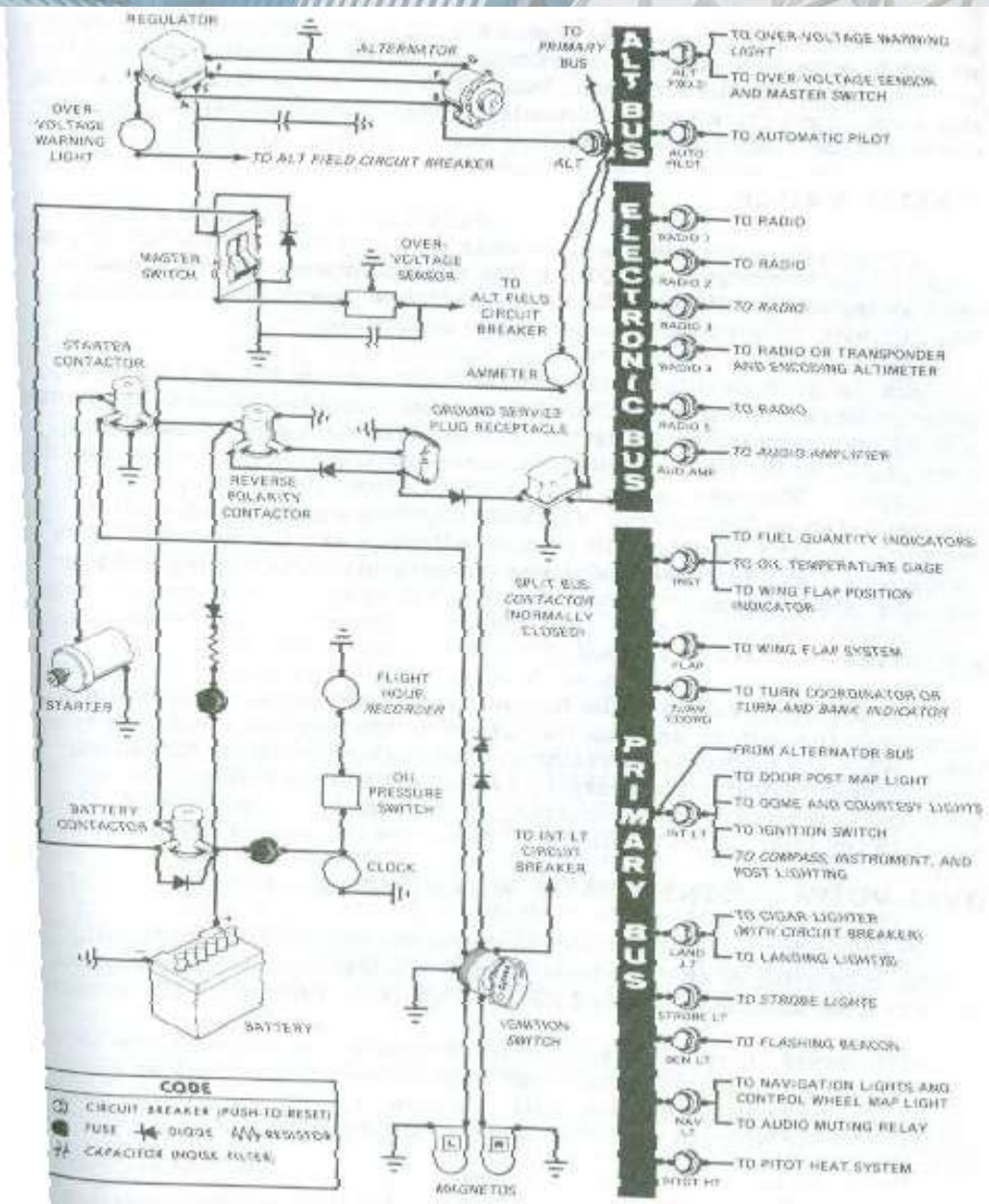


Figure 7-7. Electrical System

Master Switch

- Split rocker type switch
- On is up position, off is down position
- Right half labeled BAT, controls all electrical power to airplane
- Left half labeled ALT, controls the alternator
- Both sides of switch should be used simultaneously
- BAT side can be turned on separately on ground to check equipment

- ALT side of switch, when placed OFF, removes alternator from electrical system
- With ALT in OFF position, entire load is placed on the battery
- Continued operation with alternator off will reduce battery power low enough to open battery contactor, remove power from the alternator field, and prevent alternator restart

Ammeter

- Indicates flow of current, in amperes
- Indicates flow from alternator to battery or from battery to the electrical system
- When engine operation with master switch on, ammeter indicates the charging rate applied to battery
- If alternator not functioning or electrical load exceeds alternator output, ammeter indicates the battery discharge rate

Over-Voltage Sensor and Warning Light

- Airplane equipped with an automatic over voltage protection system
- System consists of over voltage sensor, and a red warning light, labeled HIGH VOLTAGE, adjacent to the ammeter
- In the event of an over voltage condition:
  - Sensor automatically removes alternator field current and shuts down alternator
  - Red warning light turns on, indicating the alternator is not operating and battery supplying all electrical power

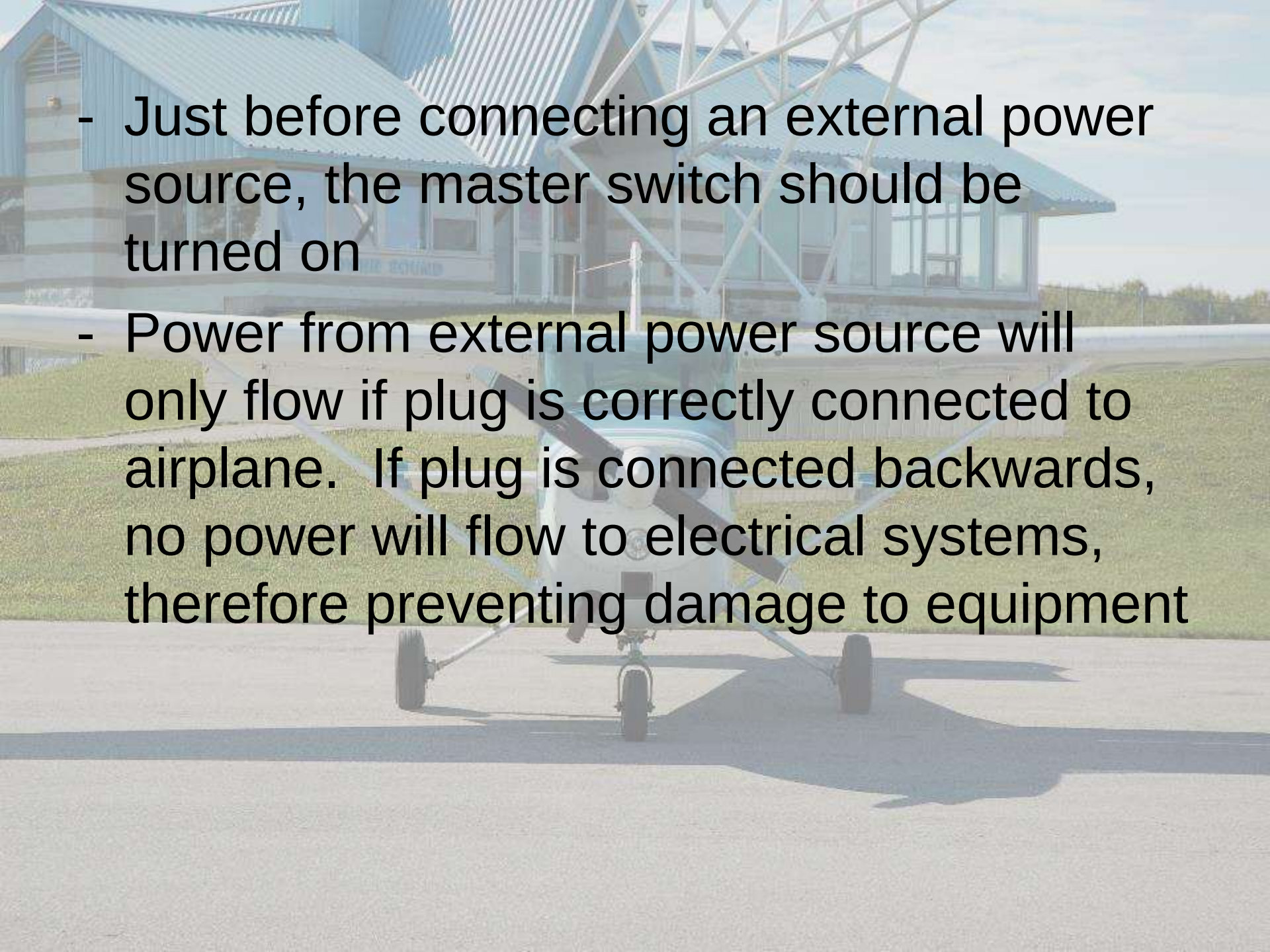
- Over voltage sensor may be reset by turning master switch off and back on
- If warning light does not illuminate, normal alternator charging has resumed
- If light does illuminate, a malfunction has occurred, and flight should be terminated as soon as PRACTICAL
- Light may be tested by momentarily turning off ALT side of master switch and leaving BAT turned on

Circuit Breakers and Fuses

- Most of the electrical circuits in plane protected by “push-to-reset” circuit breakers.
- Exceptions are the battery contactor closing circuit, clock and flight hour recorder circuits
- Above have fuses mounted near the battery
- Cigar lighter protected by a manually reset circuit breaker on the back of lighter, and by the LAND LT circuit breaker

Ground Service Plug Receptacle

- Ground service plug receptacle may be installed to permit use of external power for cold weather starting
- Receptacle located behind a door on the left side of fuselage near aft edge of cowling
- Note: External power source can not be used as a source of power when checking electronic components.

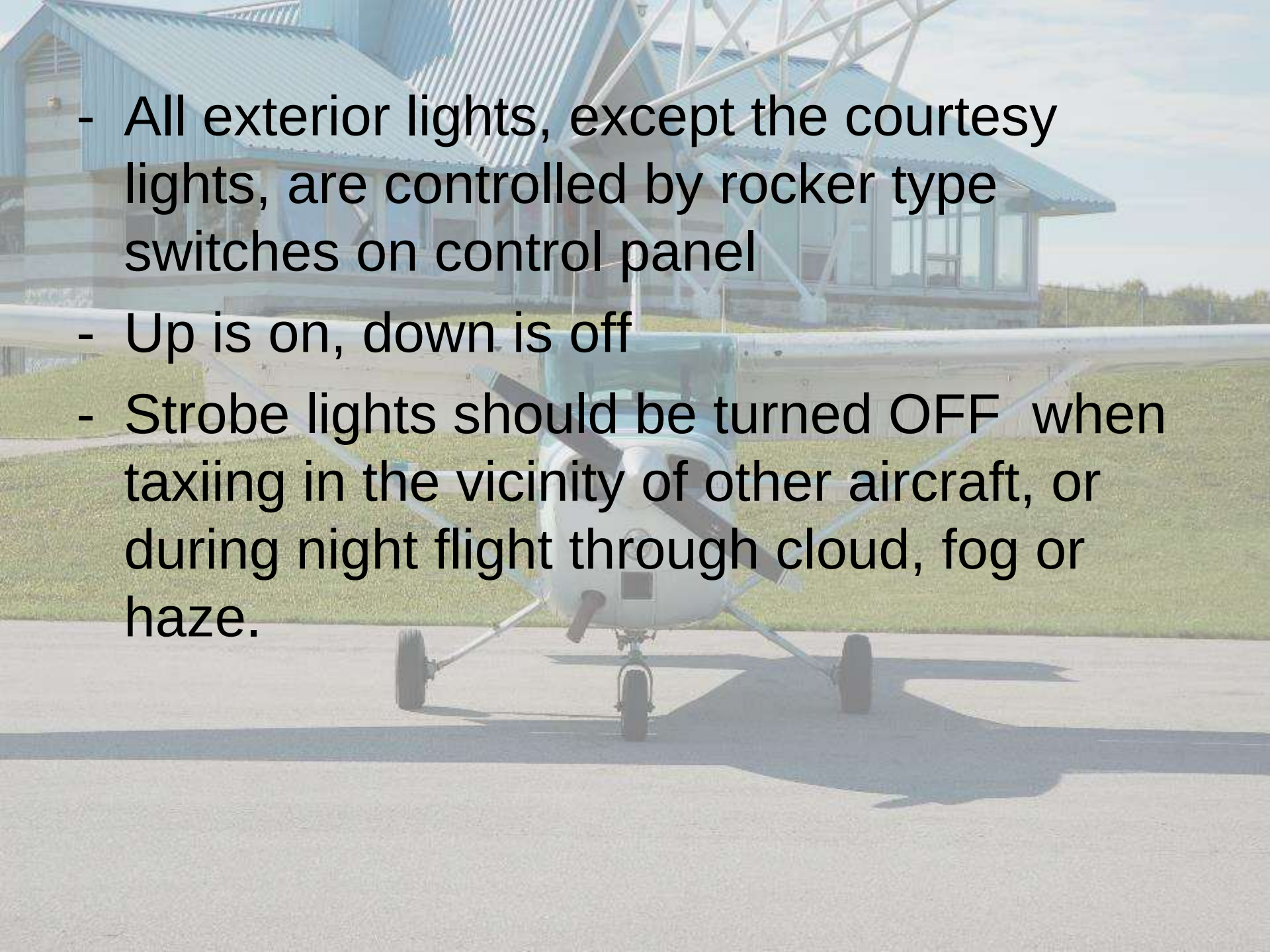


- Just before connecting an external power source, the master switch should be turned on
- Power from external power source will only flow if plug is correctly connected to airplane. If plug is connected backwards, no power will flow to electrical systems, therefore preventing damage to equipment

Lighting Systems

Exterior Lighting

- Consists of navigation lights on wings and top of rudder, landing light/taxi light located in cowl nose cap and a flashing beacon located on tail.
- Additional lighting include strobe light on each wing tip (EFZ and OSM only)
- One courtesy light is installed under each wing
- Courtesy lights are operated by the dome light switch on the overhead console



- All exterior lights, except the courtesy lights, are controlled by rocker type switches on control panel
- Up is on, down is off
- Strobe lights should be turned OFF when taxiing in the vicinity of other aircraft, or during night flight through cloud, fog or haze.

Interior Lighting

- Instrument and control panel flood lighting consists of a single red flood light in the forward part of the overhead console
- To use flood light, rotate the PANEL LT rheostat control knob clockwise to desired light intensity
- Compass light intensity is controlled by the PANEL LT rheostat control knob
- Cabin dome light, in aft part of overhead console, is operated by a switch near the light

- Doorpost map light available, and is near the top of the left forward doorpost
- Light controlled by a switch below the light
- Most probable cause of a light failure is a burned out bulb
- In event that any lighting systems fail, check appropriate circuit breaker
- If breaker has opened, and there is no obvious indication of short circuit (smoke or odor), turn off light switch, reset breaker, and turn switch on again. If breaker opens again, do not reset.

Heating, Ventilating and Defrosting System

- Temperature and volume of airflow into cabin is regulated by use of push-pull Cabin HT or Cabin AIR control knobs
- For ventilation, Cabin AIR knob should be pulled out
- To raise temperature, pull cabin HT knob out
- Maximum heat is available with the Cabin HT knob pulled out and Cabin AIR knob pushed full in

- When no heat is desired, Cabin HT knob should be pushed full in
- Two knobs control sliding valves in defroster outlet and permit regulation of defroster airflow
- Adjustable ventilators supply additional air, one near each upper corner of the windshield, and two ventilators are available for the rear cabin to supply air to rear seat passengers

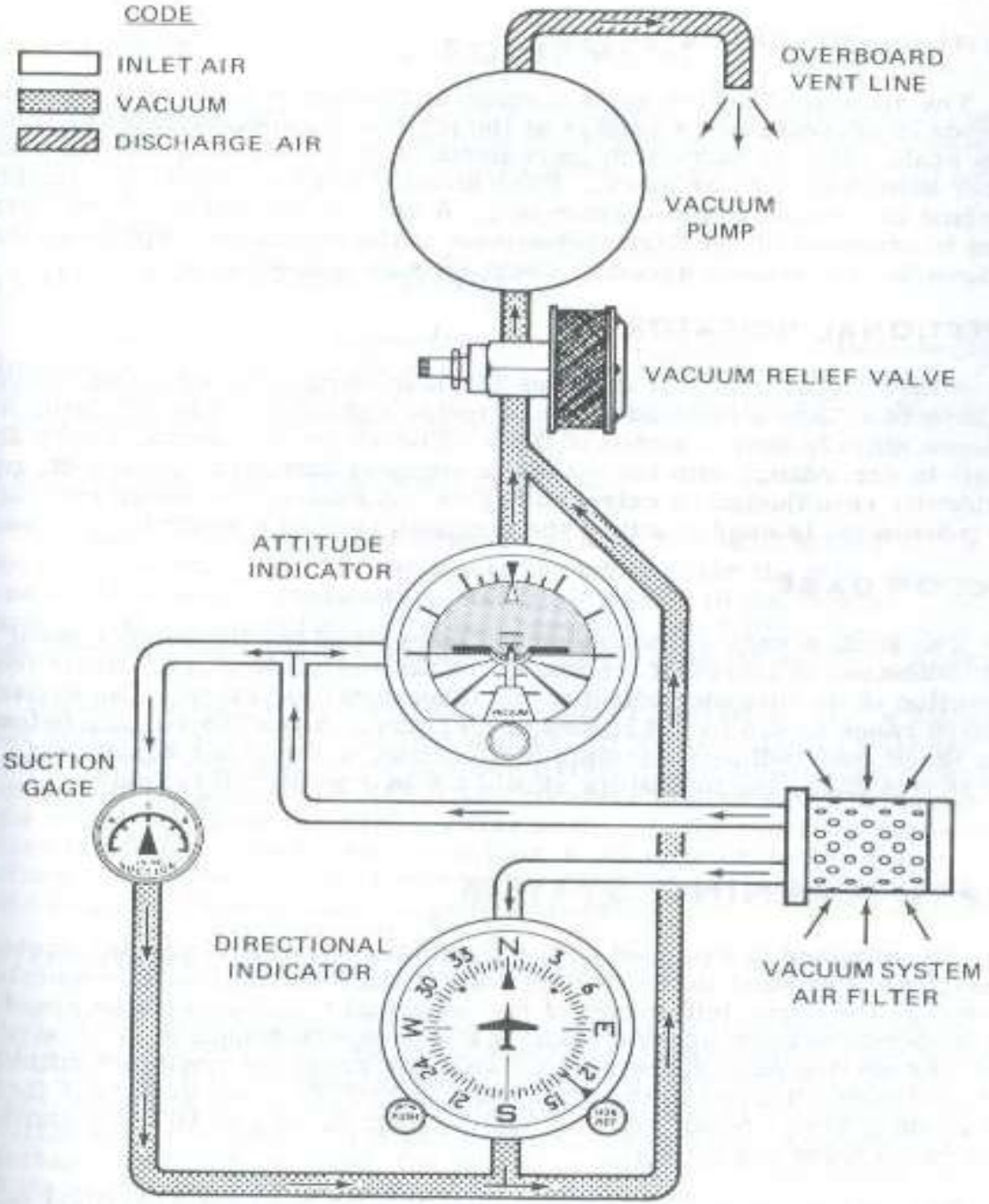
Pitot Static System and Instruments

- Heated pitot system consists of a heating element in pitot tube, a rocker type switch labeled Pitot HT on the instrument panel, and a 10 amp circuit breaker
- When pitot heat is on, element in tube is heated electrically to maintain proper operation in possible icing conditions.
- Pitot heat should be used only as required

- A static pressure alternate source valve may be installed adjacent to the throttle for use when the external static source is malfunctioning
- Valve supplies static pressure from inside cabin instead of the external static port
- If erroneous instrument readings suspected due to water or ice, the alternate static source valve should be pulled on
- Pressures within cabin will vary with open ventilators and window. Refer to Sections 3 and 5 for the effect of varying cabin pressure on airspeed and altimeter readings

Vacuum System and Instruments

- Engine driven vacuum system provides suction necessary to operate Attitude Indicator and Heading Indicator
- System consists of vacuum pump mounted on engine, vacuum relief valve, vacuum system air filter on aft side of firewall and suction gage
- Suction gage indicates in inches of mercury the amount of suction available
- Desired range is 4.6 to 5.4 inches of mercury
- Reading below this range may indicate system malfunction, and indicators should not be considered reliable


CODE
INLET AIR
VACUUM
DISCHARGE AIR
OVERBOARD VENT LINE
VACUUM PUMP
VACUUM RELIEF VALVE
ATTITUDE INDICATOR
SUCTION GAGE
DIRECTIONAL INDICATOR
VACUUM SYSTEM AIR FILTER

Stall Warning System

- Pneumatic type stall warning system consisting of an inlet in the leading edge of the left wing and an air operated horn near the upper left corner of the windshield
- As plane nears stall, low pressure created over leading edge of wings draws air through the warning horn
- Audible warning 5 to 10 knots above stall in all flight conditions

Radio Operations

Review Default Radio Setting Guide on following pages to recall proper settings for radio operations.

Default Radio Setting

Squelch Switch rotate counter clockwise all the way.

This controls how loud you must speak before you are able to hear yourself in your headset. When you are flying, you may want to turn to 9 o'clock position to get rid of static noise.

Intercom Volume Switch to 9 o'clock position.

This controls the volume of the voices within the aircraft. If your passengers can't hear you speak, it is possible that this is too low. This knob has no effect on the volume level of any radio calls.

Intercom System (ICS) Green Light on "All"

This button allows you to isolate only your headset (ISO), isolate the front seats (CRW) or to be able to hear everyone (ALL)

XMT (Transmit) Green Light on COM2

In this picture, Com1 radio is OFF and Com2 radio is turned ON, therefore Com2 XMT Button light should be on as shown. If Com1 light is on, but Com2 radio is on, you will not be transmitting anything. Ensure the same light is on, as the radio you have turned on.

Com 1

Com 2

RCV (Receive) Green Light On Com2

The same light that is on for transmit (XMT) needs to be on for receive (RCV) or you will not be able to hear radio calls made on the frequency.

Tuning Knob

Flip Flop Button

Volume Knob to 2 O'clock Position

This knob controls the volume that you hear all radio calls. The 2 o'clock position corresponds to about 50% volume.

Frequency Set Correctly for Airport

Set freq with **Tuning Knob**. *Push* **Flip/Flop** *button to move freq to left side. Ensure freq set.*

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RCV (Receive) Green Light On Com2

The same light that is on for transmit (XMT)

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Com 2

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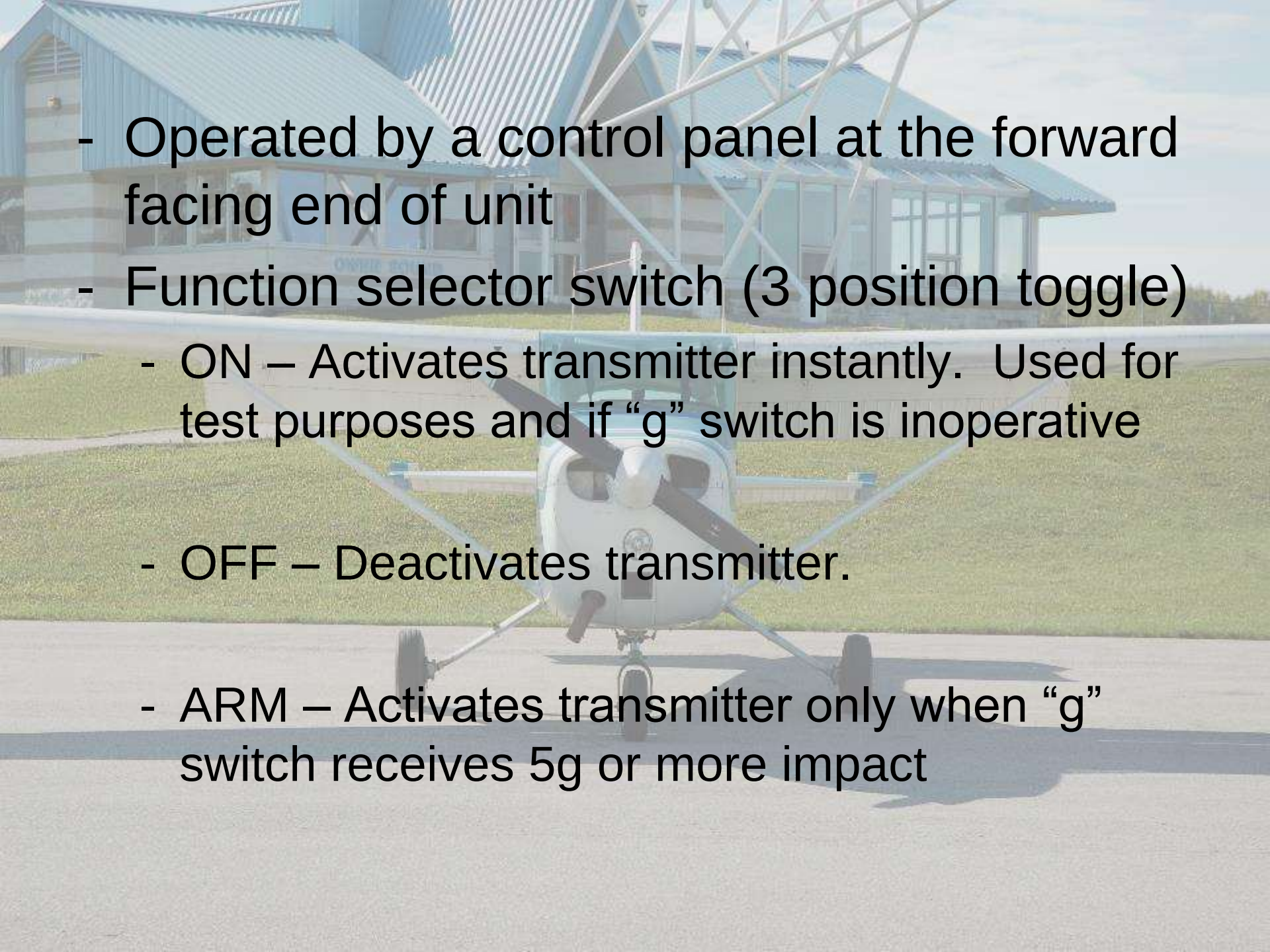
ELT

- Self contained dual frequency radio transmitter and battery power supply
- Activated by an impact of 5g or more
- Emits omni directional signal of frequency of 121.5 MHz and 243.0 MHz
- ELT mounted behind the baggage compartment wall in tailcone
- To gain access, remove baggage compartment wall



- Operated by a control panel at the forward facing end of unit
- Function selector switch (3 position toggle)
  - ON – Activates transmitter instantly. Used for test purposes and if “g” switch is inoperative
  - OFF – Deactivates transmitter.
  - ARM – Activates transmitter only when “g” switch receives 5g or more impact