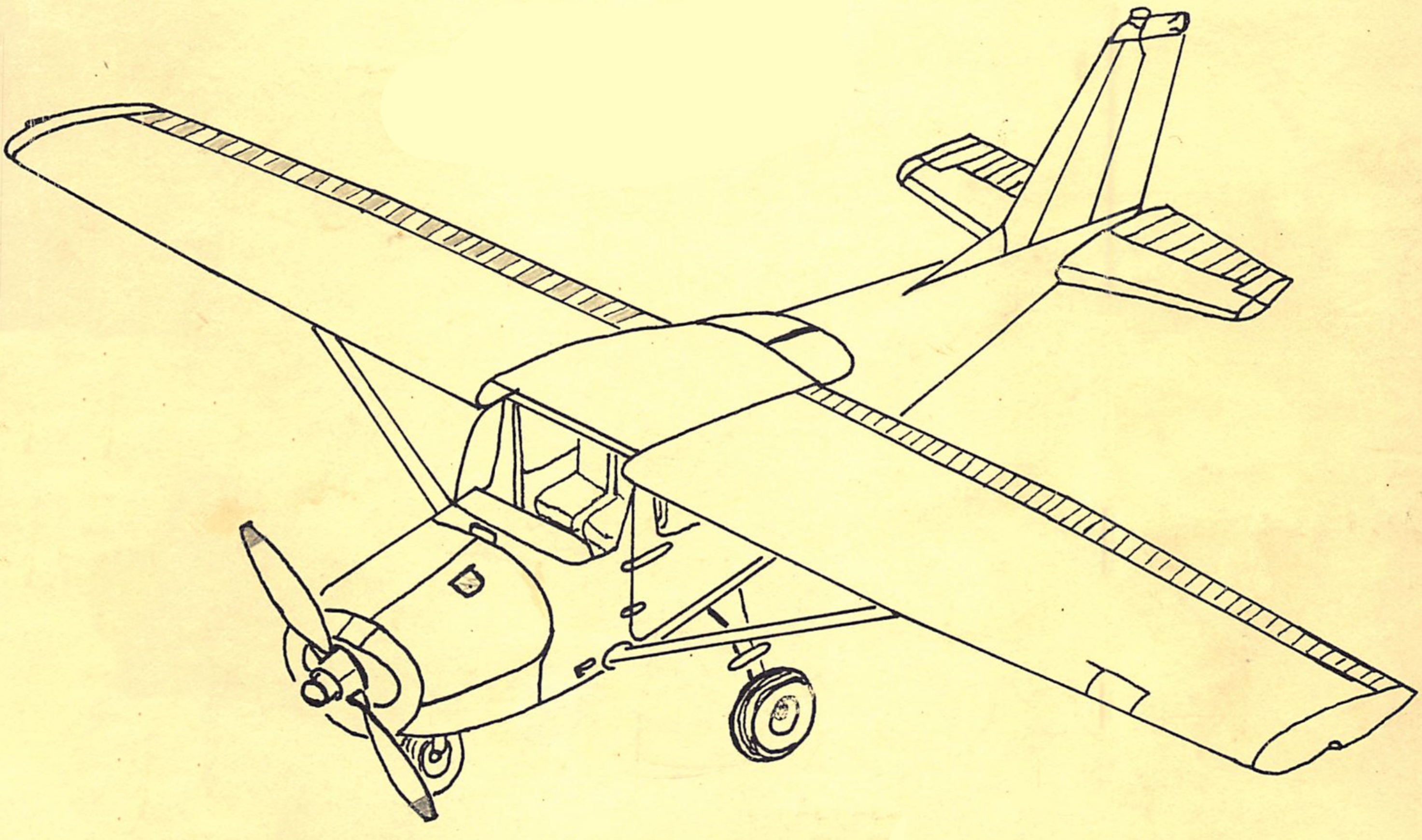
PILOT'S OPERATING HANDBOOK

CESSNA R172E (T-41B)



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CESSNA R172E

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DESCRIPTION

Section I — INTRODUCTION

2-1. GENERAL.

2-2. The purpose of this chapter is to describe the aircraft and its systems and controls which contribute to the physical act of operating the aircraft. It does not contain descriptions of auxiliary systems, covered elsewhere in this manual.

2-3. This chapter contains descriptive information and does not describe procedures for operation of the aircraft. These procedures are contained within appropriate chapters throughout the manual. This chapter also contains the emergency equipment that is not part of an auxiliary system. The chapter is not designed to provide instructions on the complete mechanical and electrical workings of the various systems; therefore, each is described only in enough detail to make comprehension of that system sufficiently complete to allow for its safe and efficient operation.

Section II — AIRCRAFT SYSTEMS AND CONTROLS DESCRIPTION

2-4. THE AIRCRAFT.

2-5. The T-41B is an all-metal, four-place, single-engine, strut-braced, high-wing monoplane which is designed for general utility and training purposes. Distinguishing external features of the aircraft are the high wing, a cabin rear window, tricycle landing gear with one-piece spring-steel main landing gear struts, and a sweptback vertical stabilizer.

2-6. DIMENSIONS.

2-7. Overall aircraft dimensions are listed below. Minimum ground turning radius of the aircraft (with application of brakes) is 29 feet, 7 inches (figure 2-1).

Overall aircraft dimensions are as follows:

Wing span	36 feet, 2 inches
Length	26 feet, 4½ inches
Height (vertical stabilizer to ground)	8 feet, 10½ inches
Tread (between centerlines of main wheels)	7 feet, 2 inches

2-8. GROSS WEIGHTS.

2-9. Maximum take-off and landing gross weight for Normal Category operation is 2500 pounds. Maximum take-off and landing gross weight for Utility Category operation is 2200 pounds.

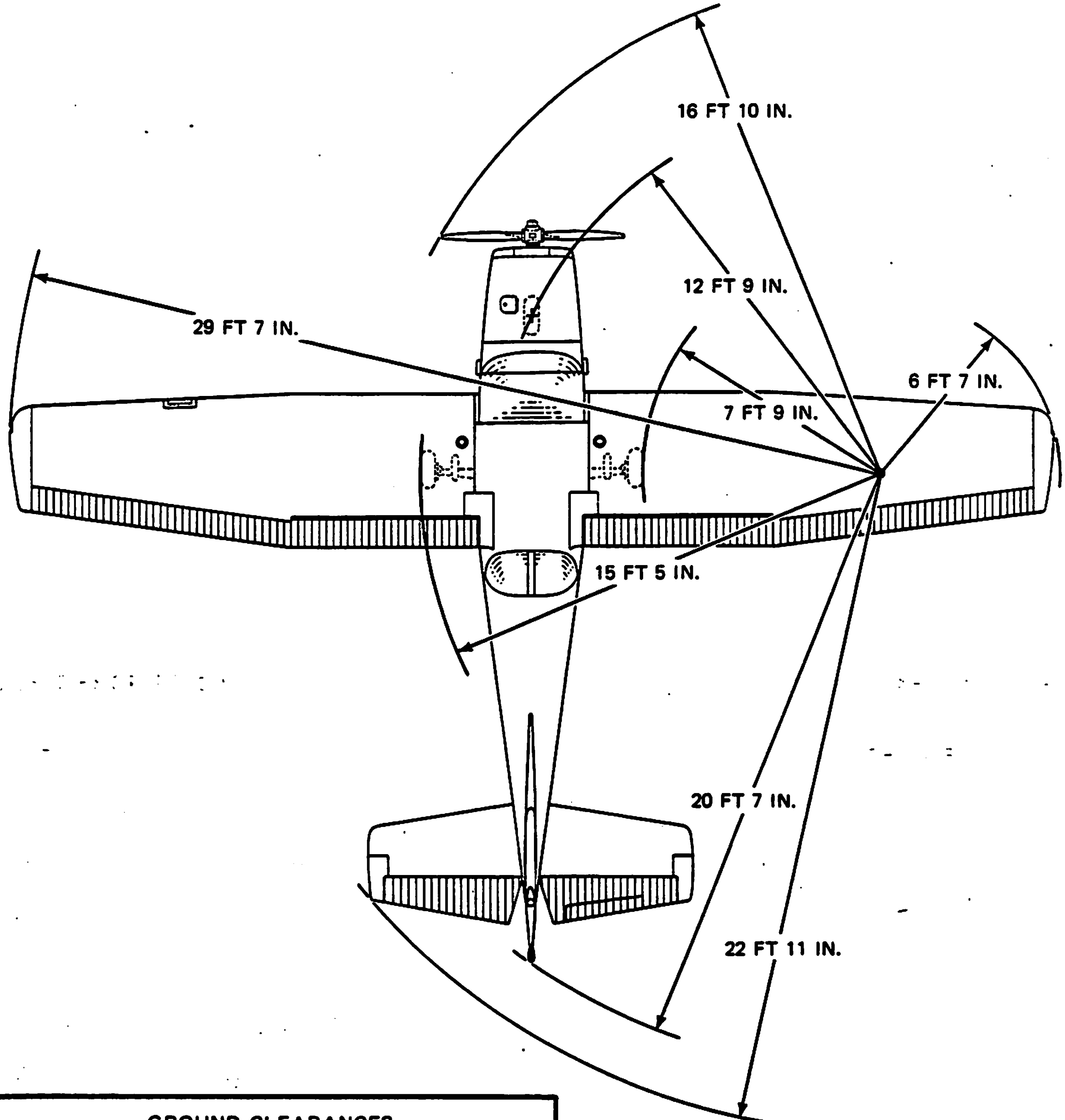
2-10. ENGINE.

2-11. GENERAL.

2-12. The aircraft is powered by a horizontally-opposed six-cylinder, overhead-valve, air-cooled, fuel-injection engine with a wet-sump oil system. The engine, Model IO-360-D, is rated at 210 horsepower at 2800 RPM. Engine controls, consisting of a throttle and mixture control, are mounted on the lower switch and control panel (figure 2-4).

2-13. FUEL INJECTION.

2-14. The engine is equipped with a fuel injection system. In this system, fuel is pumped by an engine-driven fuel pump and mixture control unit to a fuel and air throttle unit where the fuel is directed to a fuel distribu-



GROUND CLEARANCES	
Propeller (Minimum)	11 IN.
Wing Tip	6 FT 3 IN.
Vertical Stabilizer	8 FT 10½ IN.

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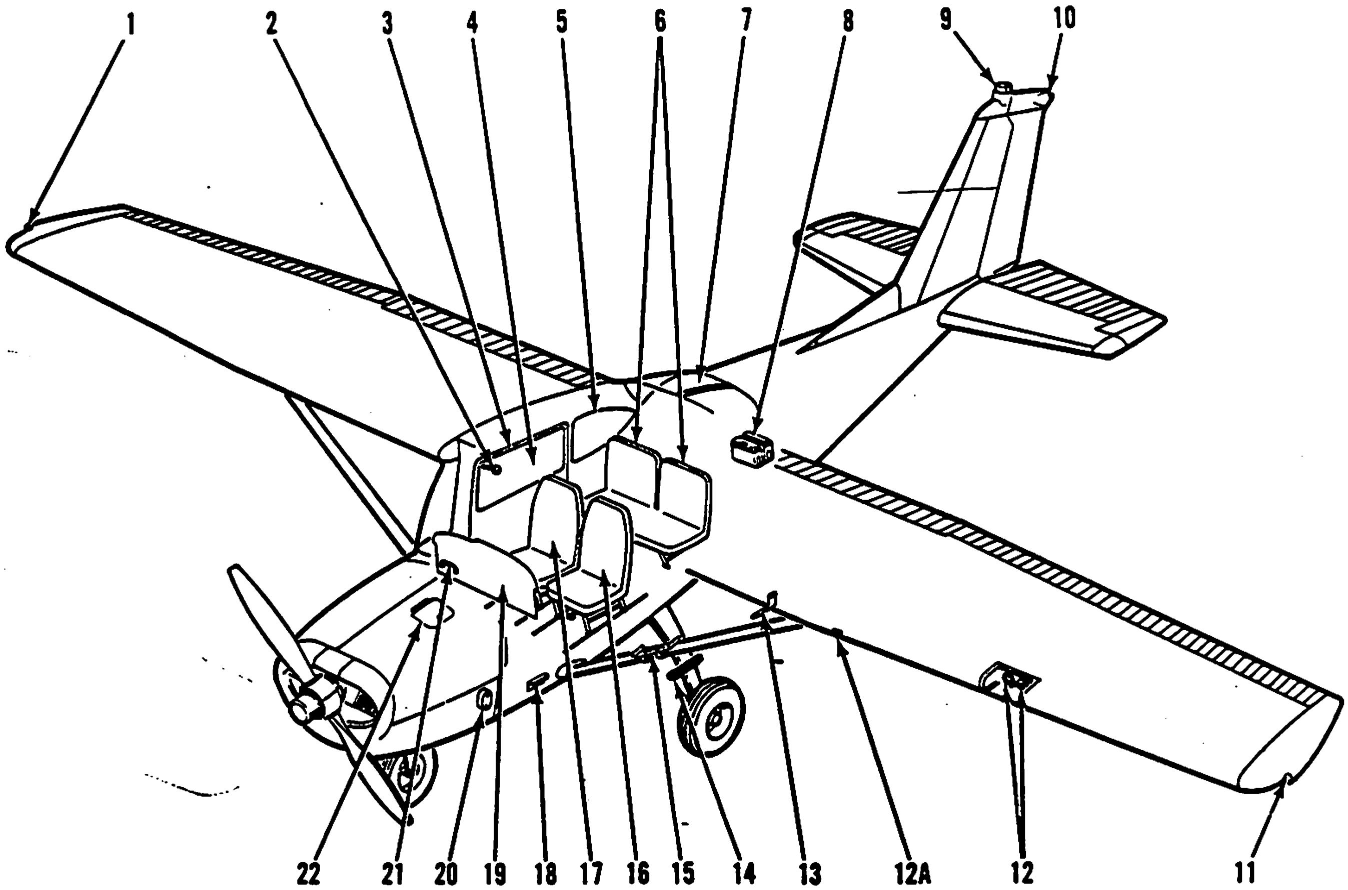
Figure 2-1. Turning radius and ground clearance.



EQUIPMENT NOT ILLUSTRATED FOR CLARITY	
Operator's manual	Aircraft tow bar
Flight controls lock	Pilot's checklist
First aid kit (1)	Power computer
Fire extinguisher	Hoisting rings

1. Right wing navigation light
2. Free air temperature gage
3. Cabin door (both sides)
4. Cabin door window (both sides)
5. Cabin rear side window (both sides)
6. Rear seats
7. Cabin rear window
8. Battery
9. Rotating beacon
10. Tail navigation light
11. Left wing navigation light
12. Landing and taxi lights
12A. Stall warning port
13. Pitot tube
14. Entry assist step
15. Fueling step
16. Pilot's seat
17. Copilot's seat
18. Fueling step
19. Instrument panel
20. External power receptacle
21. Refueling assist handle
22. Engine compartment access door

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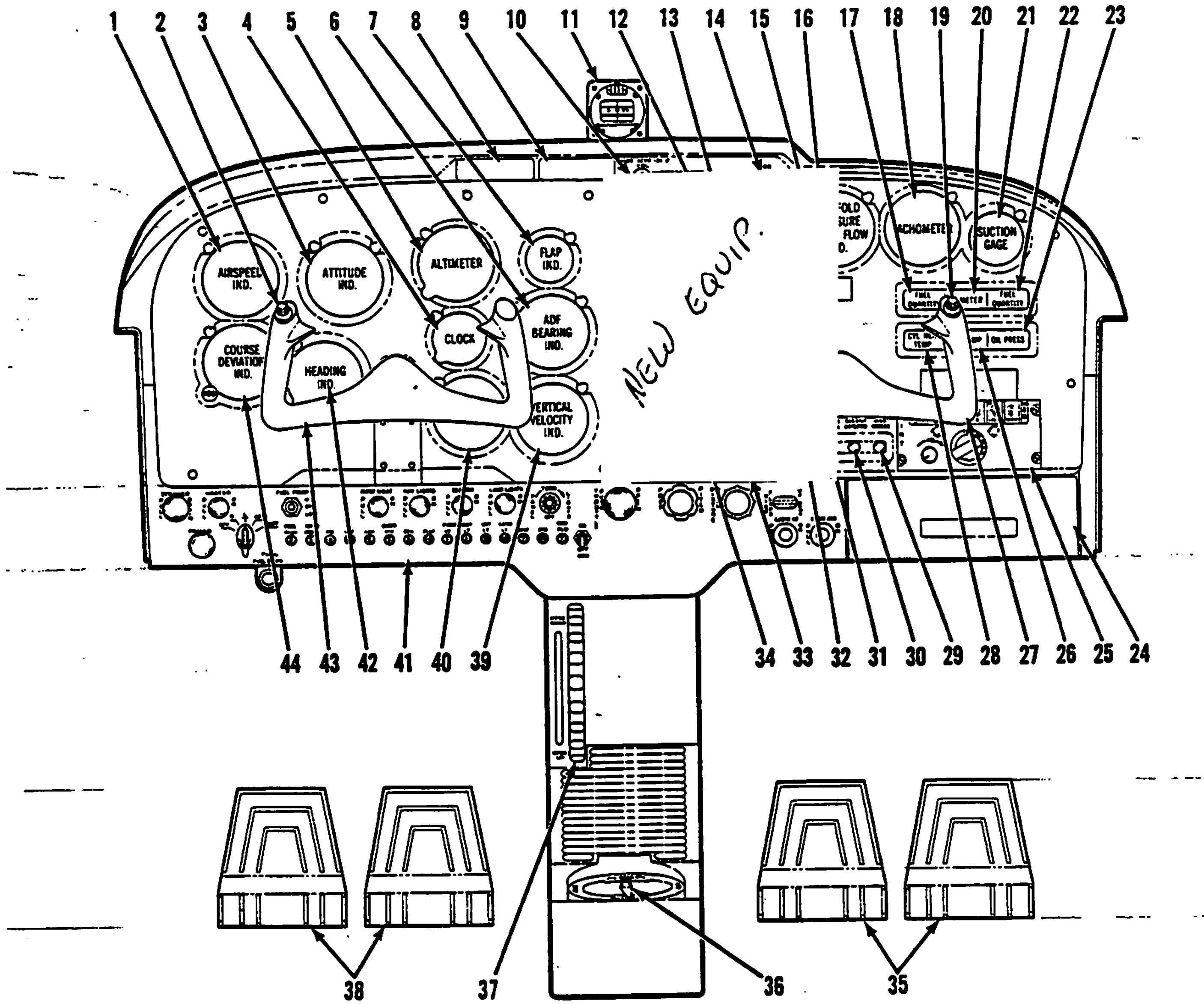
Figure 2-2. General arrangements (typical).



1. Airspeed indicator
2. Pilot's control wheel microphone switch
3. Attitude indicator
4. Clock
5. Altimeter
6. ADF bearing indicator
7. Flap position indicator
8. Aircraft identification placard
9. Compass correction card
10. BEI 901C emergency transceiver on-off/volume control knob
11. Magnetic compass
12. Pilot's interphone-audio control panel (figure 5-4)
13. FM communication-navigation set (figure 5-5)
14. VOR-HOMING switch (figure 5-5)
15. Manifold pressure/fuel flow indicator
16. Fuel flow placard
17. Left tank fuel quantity indicator
18. Tachometer
19. Copilot's control wheel microphone switch
20. Ammeter
21. Suction gage
22. Right tank fuel quantity indicator
23. Oil pressure gage
24. Map compartment
25. Copilot's interphone-audio control panel (figure 5-4)
26. Oil temperature gage
27. Copilot's control wheel
28. Cylinder head temperature gage
29. Over-voltage warning light
30. Engine chip detector warning light
31. Right tank low fuel warning light
32. Left tank low fuel warning light
33. ADF radio set (figure 5-7)
34. VHF/AM communication-navigation set (figure 5-6)
35. Copilot's rudder pedals
36. Fuel selector valve control knob
37. Elevator trim tab control wheel
38. Pilot's rudder pedals
39. Vertical velocity indicator
40. Turn and slip indicator
41. Lower switch and control panel (figure 2-4)
42. Heading indicator
43. Pilot's control wheel
44. Course deviation indicator

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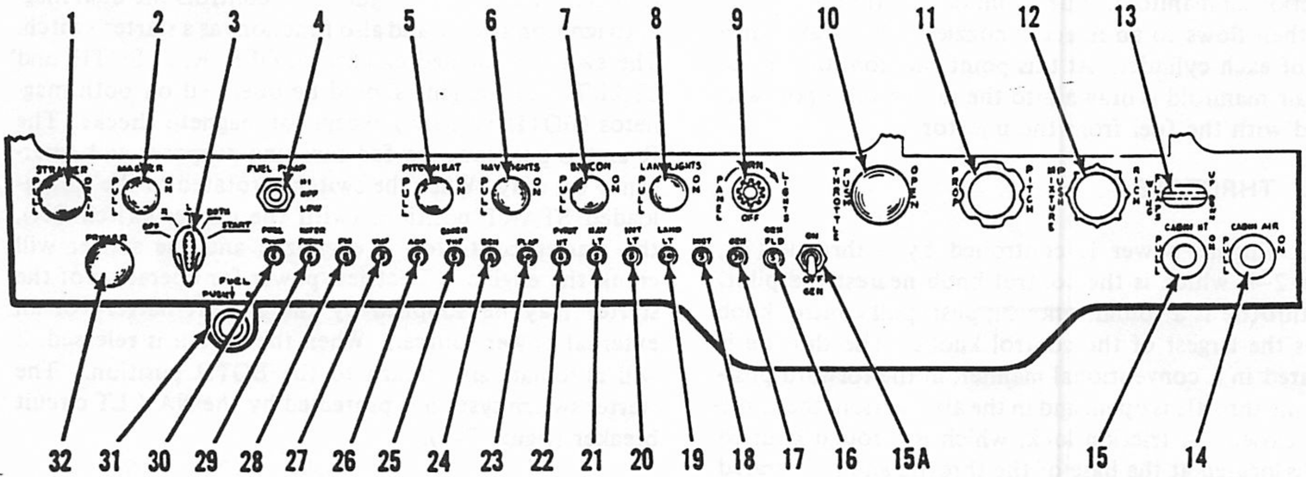
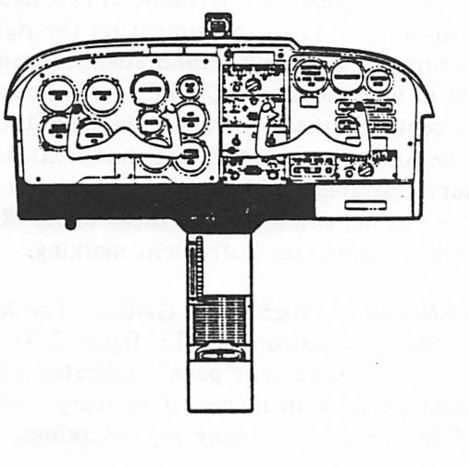
Figure 2-3. Instruments and controls (typical).





1. Fuel strainer drain knob
2. Master switch
3. Ignition/starter switch
4. Auxiliary fuel pump switch
5. Pitot heat switch
6. Navigation lights switch
7. Rotating beacon switch
8. Landing lights switch
9. Instrument panel post lights and radio lights rheostat control knob
10. Throttle
11. Propeller control knob
12. Mixture control knob
13. Wing flap switch
14. Cabin air control knob
15. Cabin heat control knob

15A. Alternator (GEN) switch

16. Alternator field circuit breaker
17. Alternator circuit breaker
18. Instrument circuit breaker
19. Landing lights circuit breaker
20. Interior light circuit breaker
21. Navigation lights circuit breaker
22. Pitot heat circuit breaker
23. Wing flap circuit breaker
24. Rotating beacon circuit breaker
25. Emergency VHF radio circuit breaker
26. ADF radio circuit breaker
27. VHF radio circuit breaker
28. FM radio circuit breaker
29. Interphone-audio circuit breaker
30. Auxiliary fuel pump circuit breaker
31. Fuel shutoff valve control knob
32. Manual engine primer

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Figure 2-4. Lower switch and control panel (typical).

tion manifold, and simultaneously, air is directed to the induction air manifold. Fuel from the distribution manifold then flows to an injector nozzle in the intake valve port of each cylinder. At this point, air from the induction air manifold is drawn into the intake valve port and mixed with the fuel from the injector.

2-15. THROTTLE.

2-16. Engine power is controlled by a throttle (10, figure 2-4) which is the control knob nearest the pilot. The throttle is a round, smooth, push-pull control knob and is the largest of the control knobs. The throttle is operated in a conventional manner; in the forward position, the throttle is open, and in the aft position, the throttle is closed. A friction lock, which is a round knurled disk, is located at the base of the throttle and is operated by rotating the lock clockwise to increase friction or counterclockwise to decrease it. A throttle switch allows the auxiliary fuel pump to operate at one of two speeds, depending on throttle position, when the auxiliary fuel pump switch is in the LOW position.

2-17. MIXTURE CONTROL.

2-18. The mixture control (12, figure 2-4), which is nearest the copilot, is a red knob with sharp points around the circumference and is equipped with a pushbutton in the end of the knob. The rich position is full forward, and full aft is the idle cut-off position. The control may be moved forward by rotating the knob clockwise and aft by rotating the knob counterclockwise. For rapid or large adjustment, the knob may be moved forward or aft by depressing the lock button in the end of the control and then positioning the control as desired.

2-19. ENGINE COOLING.

2-20. Air for engine cooling enters through an opening located in the cowling nose cap. The cooling air is directed by baffling around the cylinders, and is exhausted through an opening in the lower aft portion of the cowling. The intake and exhaust openings in the cowling are always open and cannot be controlled from the cockpit.

2-21. IGNITION SYSTEM.

2-22. Engine ignition is provided by two engine-driven magnetos, and two spark plugs in each cylinder. The right magneto fires the upper right and lower left spark plugs, and the left magneto fires the upper left and lower right spark plugs. Normal operation is with both magnetos due to the more complete and thorough burning of the fuel-air mixture with dual ignition.

2-23. IGNITION/STARTER SWITCH. A rotary ignition/starter switch (3, figure 2-4) controls the dual magneto ignition system and also functions as a starter switch. The switch is labeled clockwise, OFF, R, L, BOTH, and START. The engine should be operated on both magnetos (BOTH position) except for magneto checks. The R and L positions are for checking purposes and emergency use only. When the switch is rotated to the spring-loaded START position, (with the master switch ON), the starter contactor is energized and the starter will crank the engine. (Electrical power for operation of the starter may be supplied by the aircraft battery or an external power source.) When the switch is released, it will automatically return to the BOTH position. The starter switch system is protected by the NAV LT circuit breaker (figure 2-7).

2-24. ENGINE PRIMER.

2-25. A manually-operated, plunger-type engine primer (32, figure 2-4) is located on the lower switch and control panel. To operate the primer, unlock the primer plunger by turning the knob until it pops out part way, then slowly pull the knob full out and push it full in. This action is termed "one stroke of the primer".

2-26. ENGINE INSTRUMENTS.

2-27. TACHOMETER. The tachometer (18, figure 2-3) is a mechanically-operated instrument on the right side of the instrument panel, and is calibrated in revolutions-per-minute in increments of 100 RPM. An hour meter below the center of the tachometer dial records elapsed engine time in hours, tenths, and hundredths. The tachometer is operated by a tachometer drive unit on the back of the engine, and a flexible drive shaft. Refer to Chapter 7 for tachometer instrument markings.

2-28. MANIFOLD PRESSURE GAGE. The left half of a dual-indicating instrument (15, figure 2-3), on the right side of the instrument panel, indicates induction air manifold pressure in inches of mercury. Refer to Chapter 7 for manifold pressure gage markings.

2-29. FUEL FLOW INDICATOR. Fuel flow is indicated by the right half of a dual-indicating instrument (15, figure 2-3) on the right side of the instrument panel. The fuel flow indicator is a fuel pressure gage calibrated to indicate the approximate gallons per hour of fuel being metered to the engine. Refer to Chapter 7 for fuel flow indicator markings.

2-30. OIL PRESSURE GAGE. The oil pressure gage (23, figure 2-3), located on the right side of the instrument panel, indicates engine oil pressure in pounds per square inch. The gage is operated by oil pressure from the engine through a direct pressure line. Oil pressure gage markings are illustrated in Chapter 7.

2-31. OIL TEMPERATURE GAGE. An oil temperature gage (26, figure 2-3), on the right side of the instrument panel, indicates engine oil temperature in degrees Fahrenheit. The gage is operated on a Bourdon tube principle and temperature is registered through the expansion of liquid contained in a capillary tube which is connected to the engine near the oil cooler. Refer to Chapter 7 for instrument markings.

2-32. CYLINDER HEAD TEMPERATURE GAGE. The cylinder head temperature gage (28, figure 2-3), on the right side of the instrument panel, indicates engine cylinder head temperature in degrees Fahrenheit. The gage is controlled by an electrical-resistance type temperature bulb which receives its power from the aircraft electrical system. Refer to Chapter 7 for instrument markings.

2-33. ENGINE CHIP DETECTOR LIGHT. An amber light (30, figure 2-3), on the lower right side of the instrument panel labeled ENG CHIP DETECTOR, is provided to warn the pilot of oil contamination and possible engine failure. The light is a press-to-test type, and is connected to a chip detector sensor located in the engine oil sump. The sensor is an electrically insulated gap immersed in the engine oil and functioning as a normally-open switch. If a large metal chip or a mass of smaller metal particles bridge the sensor gap, a circuit is completed which illuminates the ENG CHIP DETECTOR light. The chip detector circuit is protected by the 5-ampere circuit breaker labeled INST (18, figure 2-4), on the lower switch and control panel.

2-34. PROPELLER.

2-35. The aircraft is equipped with an all-metal, two-bladed, constant-speed, governor-regulated propeller. Propeller operation is controllable by means of a propeller control knob which is mechanically linked to the engine-driven propeller governor on the engine. A setting introduced into the governor establishes the engine speed to be maintained, and the governor then controls flow of engine oil, boosted to high pressure by the governing pump, to or from the piston in the propeller hub. Oil pressure acting on the piston twists the blades toward high pitch (low RPM). When oil pressure from the governor to the propeller piston is relieved, centrifugal force, assisted by an internal spring, twists the blades toward low pitch (high RPM).

2-36. PROPELLER CONTROL KNOB.

2-37. Control of engine RPM is accomplished by operation of the propeller control knob (11, figure 2-4) on the lower switch and control panel. Placing the propeller control knob in the full forward position decreases the blade angle and provides the highest engine RPM setting. Moving the control knob aft progressively increases the propeller blade angle and decreases engine RPM. Moving the control knob forward or aft to adjust RPM is accomplished by rotating the knob clockwise to increase RPM, or counterclockwise to decrease RPM. If large or rapid RPM changes are required, depress the lock button on the control knob and position the control forward or aft as desired.

2-38. OIL SUPPLY SYSTEM.

2-39. Oil for engine lubrication and propeller governor operation is supplied from a sump on the bottom of the engine. The capacity of the engine sump is 8 U.S. quarts (9 quarts if oil filter is installed). Oil is drawn from the sump through a low pressure filter screen into the engine-driven oil pump. From the pump, oil is forced through a high pressure screen (oil filter if installed) to a thermostat in the oil cooler. The thermostat opens and allows oil to bypass the cooler when the oil is cold. When the oil is hot, the thermostat closes causing the oil to be forced through radiator passages in the cooler, thus controlling oil temperatures. Oil is then circulated to various engine parts for lubrication and is returned to the sump by gravity flow. Also, engine oil is routed to the propeller governor to provide control pressures to the propeller.

2-40. An oil filler cap and an oil dipstick are located above and aft of the oil cooler, near the rear of the engine. Both the filler cap and dipstick are accessible through an access door in the engine cowling. Do not operate the engine on less than 6 quarts of oil. To minimize loss of oil through the breather, fill to a minimum of 7 quarts for normal flights of less than 3 hours. For extended flight, fill to 8 quarts (dipstick indication only). For engine oil grade and specifications, refer to figure 2-10.

2-41. FUEL SUPPLY SYSTEM.

2-42. Fuel is supplied to the engine by two tanks, one in each wing. Fuel flows by gravity from each wing tank to a fuel selector valve, fuel reservoir tank and fuel shutoff valve. Fuel then flows through a fuel strainer and a bypass in the auxiliary fuel pump (when not in operation) to the engine-driven fuel pump and mixture unit. Vapor and excess fuel from the engine-driven fuel pump

TANK	NUMBER	USABLE FUEL ALL FLIGHT CONDITIONS	ADDITIONAL USABLE FUEL (LEVEL FLIGHT)	UNUSABLE FUEL (LEVEL FLIGHT)	TOTAL FUEL VOLUME EACH
LEFT WING	1	23 gallons	2.5 gallons	0.5 gallons	26.0 gallons
RIGHT WING	1	23 gallons	2.5 gallons	0.5 gallons	26.0 gallons
NOTE: Based on standard day conditions and 6.0 pounds per U.S. gallon.					

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Figure 2-5. Fuel quantity data.

and mixture unit are returned to the wing tanks via the reservoir tank. From the engine-driven fuel pump and mixture unit, fuel is delivered to the engine through a fuel and air throttle unit and a fuel distribution manifold. Refer to figure 2-10 for fuel grades, specifications, and alternate fuel grades. Refer to figure 2-5 for fuel quantity data.

2-43. FUEL SELECTOR VALVE.

WARNING

Take-off and landing must be accomplished with the fuel selector in the BOTH position to prevent inadvertent take-off or landing on an empty tank.

2-44. The fuel supply system of this aircraft is equipped with a three-position fuel selector valve. The fuel selector valve control knob (36, figure 2-3), near the bottom of the control pedestal, is labeled LEFT, RIGHT, and BOTH. Placing the selector valve knob in the LEFT, RIGHT, or BOTH position permits fuel to flow from either left, right, or both fuel tanks to the engine. The selector valve knob is mechanically connected to the fuel selector valve under the floorboard.

2-45. FUEL SHUTOFF VALVE.

2-46. A fuel shutoff valve is located in the fuel line between the fuel reservoir tank and the fuel strainer, and provides a means of shutting off the fuel supply to the engine. The shutoff valve is actuated by a push-pull control knob labeled FUEL PUSH ON (31, figure 2-4), on the lower switch and control panel, which is connected to the valve by a flexible shaft. To allow fuel flow to the engine, push the control knob full in. To stop the flow of fuel to the engine, pull the control knob full out.

2-47. AUXILIARY FUEL PUMP SWITCH.

2-48. The auxiliary fuel pump switch is a toggle-type, three-position switch (4, figure 2-4) on the left side of the lower switch and control panel. The down position of the auxiliary fuel pump switch, labeled LOW, operates the pump at one of two possible speeds depending on throttle position. With the throttle at a cruise setting and the auxiliary fuel pump switch in the LOW position, sufficient fuel flow is provided for cruise flight operation with a failed engine-driven fuel pump. When the throttle is moved toward the closed position, the auxiliary fuel pump flow rate is automatically reduced, preventing an excessively rich mixture during periods of low engine power operation. With the switch in the LOW position, the pump will supply sufficient flow for vapor suppression during taxi and flight operations in hot climates.

2-49. The up position of the switch, labeled HI, operates the auxiliary fuel pump at its maximum output. The switch is spring-loaded to OFF from this position and must therefore be held in the HI position to obtain this output. This position is used for engine starting, engine operation if the engine-driven fuel pump should fail during take-off or other very high power operations, or for vapor purging in very hot weather.

NOTE

If the auxiliary fuel pump switch is accidentally turned on (with the master switch on) with the engine stopped, the cylinder intake ports will be flooded.

2-50. The auxiliary fuel pump is not to be used while the engine is running during normal operations, because, with the engine-driven fuel pump functioning, a fuel/air ratio somewhat richer than that for best power is produced. However, for vapor elimination, the auxiliary fuel pump may be used with the engine running and the switch in the LOW position if the mixture is leaned as required to prevent an excessively rich mixture.

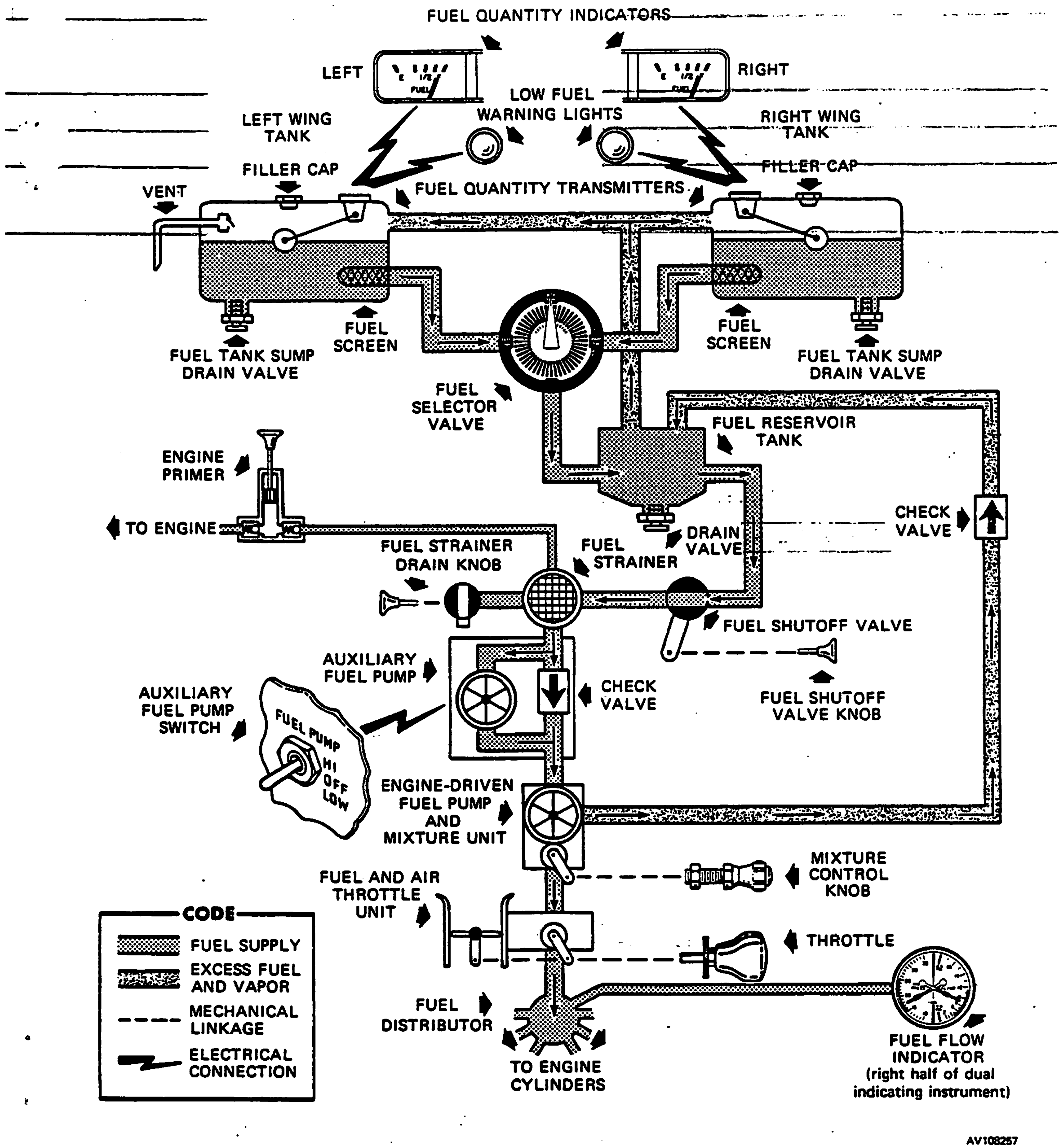


Figure 2-6. Fuel system.

2-51. To ensure a prompt engine restart in flight after running a fuel tank dry, switch to the tank containing fuel and hold the auxiliary fuel pump switch in the HI position momentarily (3 to 5 seconds).

2-52. If the propeller should stop (possible at very low airspeeds) before the tank containing fuel is selected, place the auxiliary fuel pump switch in the LOW position and advance the throttle promptly until the fuel flow indicator registers approximately 1/2 way into the green arc for 1 to 2 seconds duration. Then retard the throttle, turn off the auxiliary fuel pump, and use the starter to turn the engine over until a start is obtained.

2-53. FUEL STRAINER DRAIN KNOB.

2-54. A fuel strainer drain knob is provided for quick, convenient draining of water and sediment that may have collected in the fuel strainer. The strainer drain knob is located on the left side of the lower switch and control panel (1, figure 2-4), and the fuel strainer is located in the engine compartment. Before the first flight of the day and after each refueling, the spring-loaded strainer drain knob should be pulled out for about four seconds to clear the fuel strainer of possible water and sediment. The drain valve will automatically close when the drain knob is released.

NOTE

To assure that the drain valve has closed, press the drain knob full in.

2-55. FUEL TANK SUMP AND FUEL RESERVOIR DRAIN VALVES.

2-56. Each wing fuel tank and the fuel reservoir is equipped with a drain valve. The valves are located in the sump area of each wing tank, and in the bottom of the reservoir tank. Wing fuel tank drain valves extend from the lower wing surface outboard of the cabin doors, and the reservoir tank drain valve extends from the right side of the belly of the aircraft. These drain valves are incorporated to facilitate fuel inspection and sump drainage. To drain fuel, press the valve until the desired amount of fuel has been drained, and then release the valve. Observe that the valve has closed and is not leaking.

2-57. FUEL QUANTITY INDICATORS.

2-58. The fuel quantity indicators (17 and 22, figure 2-3) are electrically-operated instruments located on the right side of the instrument panel. The indicators are labeled FUEL, and fuel quantity is indicated by register marks labeled E, 1/2, and F. The indicators work in conjunction with fuel level transmitters in both wing fuel tanks, and register tank fuel level readings whenever the master switch is turned on. The indicators should be read in stabilized level flight with the slip indicator centered.

2-59. LOW FUEL WARNING LIGHTS.

2-60. Two low fuel warning lights (31 and 32, figure 2-3) are located on the right side of the instrument panel, and are labeled LOW FUEL LH TANK and LOW FUEL RH TANK. The lights will illuminate when the fuel level transmitter float in the respective fuel tank drops to the nine gallon level. An illuminated light indicates that there is approximately six gallons of usable fuel (all flight conditions) remaining in the respective tank. The low fuel warning lights are the press-to-test type and may be checked when the master switch is turned on.

NOTE

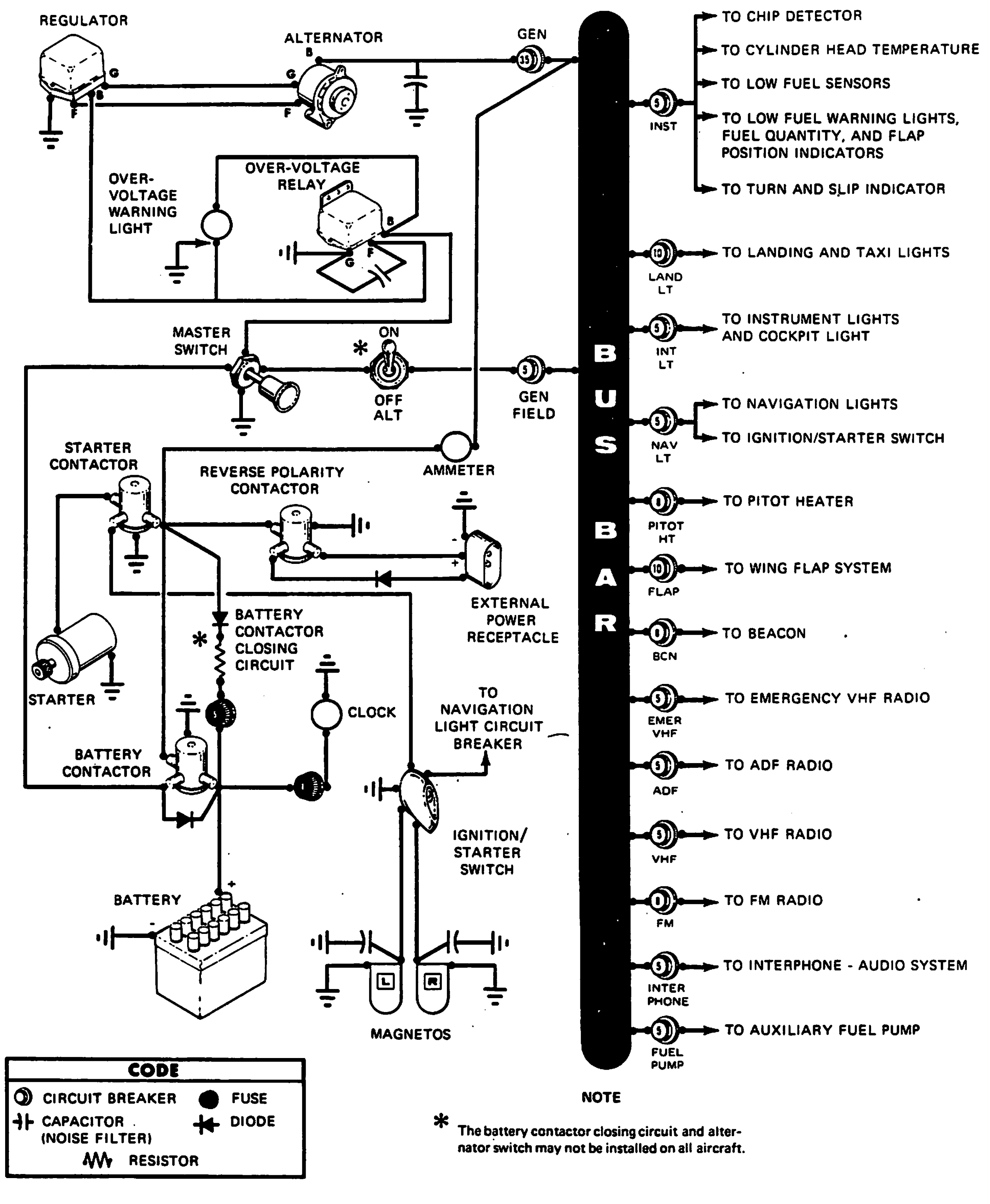
During turning flight, or in rough air, the low fuel warning lights may flicker.

2-61. ELECTRICAL POWER SUPPLY SYSTEM.

2-62. Energy for the aircraft 28-volt DC electrical power supply system (figure 2-7) is supplied by a 38-ampere, engine-driven alternator. A 24-volt battery is mounted aft of the baggage compartment and is equipped with a quick-disconnect fitting. The original lead-acid battery may be replaced by a NI-CAD battery on some aircraft. The battery serves as a standby power source and supplies power to the system when the alternator is inoperative, or the system load exceeds alternator output. The alternator will supply power to the aircraft electrical system whenever the master switch and alternator switch (if installed) are turned on and the engine is turning approximately 1000 RPM or greater. Electrical system switches (figure 2-4) consist of toggle-type and push-pull switches.

2-63. EXTERNAL POWER RECEPTACLE.

2-64. An external power receptacle (20, figure 2- 2), protected by a reverse polarity contactor, is located behind an access cover just forward of the firewall on the lower left side of the engine cowl. It is a 28-volt standard AN type receptacle, and is used to plug in a DC ground power unit for starting the engine or for electrical equipment ground checks.



NOTE

* The battery contactor closing circuit and alternator switch may not be installed on all aircraft.

Figure 2-7. Electrical system (typical).

CAUTION

If external power is applied to the system due to a fully discharged battery, and the aircraft is not equipped with a battery contactor closing circuit, maintenance personnel must jumper the battery contactor and ensure that the master switch is turned ON prior to connecting external power. This will connect the battery into the system and enable it to absorb transient voltage which otherwise might damage electrical equipment.

2-65. Some aircraft are equipped with a battery contactor closing circuit (figure 2-7) consisting of a 5-ampere fuse, resistor and diode. In the event of a fully discharged battery, the battery contactor closing circuit will automatically close the battery contactor when an external power source is connected and the master switch is turned ON. If the aircraft is not equipped with a contactor closing circuit, the battery contactor must be jumpered to close the contactor and provide power to the battery. If the battery contactor is not closed by a contactor closing circuit or by jumpering, no power will be applied to the battery and there will be no alternator output.

2-66. MASTER SWITCH.

2-67. A switch for controlling the battery contactor and alternator field circuit is located on the lower switch and control panel. The push-pull type switch (2, figure 2-4) is labeled MASTER, and is ON when pulled out and off when pushed in. When the switch is placed in the ON position, a battery contactor closes the circuit between the battery and the aircraft's electrical system and applies power to the alternator field circuit. If the alternator circuit should fail, all electrical equipment can be operated from the battery circuit. The length of time the battery circuit can be utilized in this manner depends on the condition of the battery and the amount of equipment in use. However, operation of this type should be kept to a minimum with only essential equipment turned on and a landing effected as soon as practical. Placing the master switch in the off position opens the circuit between the battery and the aircraft bus; in addition, field excitation power to the alternator is removed. Alternator field excitation on some aircraft is controlled by a separate alternator switch. If the aircraft is equipped with an alternator switch, both the master switch and the alternator switch must be turned on for normal operation. On aircraft equipped with the alternator switch, a placard will be located above the master switch and reads as follows: GEN. ON AFTER ENGINE START - GEN. OFF BEFORE ENGINE STOP.

2-68. ALTERNATOR (GEN) SWITCH.

NOTE

The alternator (GEN) switch should not be placed in the OFF position during flight except in an emergency. Placing the switch in the OFF position removes the alternator from the system, placing the electrical load on the battery. If an emergency does occur, reduce the load on the battery and terminate the flight as soon as practical.

2-69. An alternator (GEN) switch (figure 2-7) is installed on some aircraft. The toggle-type switch, labeled ALT, is ON in the up position and OFF in the down position. The function of this switch is to apply or remove power to the alternator field circuit. When the alternator switch is installed, both the master switch and alternator (GEN) switch must be turned ON to provide alternator operation. If either switch is turned OFF, alternator function will cease.

2-70. CIRCUIT BREAKERS AND FUSES.

2-71. Push-to-reset type circuit breakers are installed to protect most electrical circuits in this aircraft. The circuit breakers are mounted on the lower switch and control panel (figure 2-4) and are labeled according to their function and amperage. The clock circuit, protected by a one ampere fuse near the battery, and the battery contactor closing circuit which is protected by a five ampere fuse near the battery, are the only circuits not protected by circuit breakers. If a malfunction creates an electrical circuit overload, the breaker protecting that circuit will pop out and interrupt the circuit. The breaker cannot be reset immediately. This type of circuit breaker, when tripped, must cool before it can be reset. If the breaker trips after being reset, do not attempt to reset it again. In the event the circuit breaker protects more than one circuit, turn off all associated equipment, allow the breaker to cool, then reset it. Turn the equipment back on one item at a time, allowing time for an overload to occur again. When the breaker trips again, the last item turned on is probably causing the overload. Turn the malfunctioning equipment off, reset the breaker, and utilize the remaining equipment.

2-72. AMMETER.

2-73. The ammeter (20, figure 2-3) on the right side of the instrument panel, indicates a charging or discharging condition. The face of the instrument is marked DIS (left of center) and CHG (right of center). The ammeter indicates the flow of electricity, in amperes, from the alternator to the battery or from the battery to the aircraft electrical system. With the engine operating and the master switch turned ON, the ammeter will indicate the charging rate applied to the battery. In the event the alternator ceases to function or electrical system load exceeds the output of the alternator, the ammeter will indicate the discharge rate of the battery.

2-74. OVER-VOLTAGE WARNING LIGHT.

2-75. A press-to-test over-volt warning light (29, figure 2-3), labeled OVER-VOLTAGE, is located on the lower right side of the instrument panel. The light, which is red in color and cannot be dimmed, will illuminate anytime electrical system voltage exceeds approximately 32 volts. An over-voltage relay (figure 2-7) causes the light to illuminate and simultaneously shuts off the alternator. Refer to Chapter 4 for corrective measures to be taken in the event of an over-voltage condition.

2-76. FLIGHT CONTROL SYSTEM.

2-77. The aircraft's flight control system consists of conventional rudder, elevator, and aileron control surfaces. These surfaces are manually operated from the cabin through mechanical linkage using a control wheel for the ailerons and elevator, and rudder/brake pedals for the rudder. Flight controls are provided for the pilot and copilot. A trim tab is installed on the elevator and is controlled, through mechanical linkage, by a trim tab control wheel.

2-78. CONTROL WHEELS.

2-79. Elevator and aileron control surfaces are controlled by the pilot's and copilot's control wheels (43 and 27, figure 2-3) which extend from the lower left and right sides of the instrument panel. Both control wheels are equipped with a microphone switch (2 and 19, figure 2-3) on the outboard grip of each control wheel. The switches operate the radio transmitters and the interphone-audio system.

2-80. RUDDER PEDALS.

2-81. The rudder pedals (38 and 35, figure 2-3), provided for both pilot and copilot, operate the rudder, nose wheel steering, and the brakes. Forward and aft movement operates the rudder and the nose wheel steering. Braking is accomplished by rotating the pedals.

2-82. ELEVATOR TRIM TAB CONTROL WHEEL.

2-83. An elevator trim tab control wheel (37, figure 2-3) is located on the control pedestal under the instrument panel, and provides manual adjustment of the elevator trim tab. The control wheel is labeled NOSE UP, TAKE-OFF, NOSE DOWN. A small pointer at the left of the control wheel, indicates the position of the trim tab. Forward rotation of the control wheel will move the pointer to the NOSE DOWN position. Conversely, aft rotation will move the pointer to the NOSE UP position. Moving the pointer to the triangular mark labeled TAKE OFF provides normal take-off trim.

2-84. CONTROLS LOCK.

2-85. A controls lock is used to lock the elevator and aileron control system in a neutral position and prevent damage to these systems by wind buffeting while the aircraft is parked. The lock consists of a flat metal flag attached to a steel pin. To lock the controls, align a hole in the top of the control wheel shaft with a hole in the control shaft collar on the instrument panel and insert the pin in the aligned holes so that the metal flag extends over the ignition/starter switch and master switch and prevents inadvertent starting of the aircraft with the controls locked.

2-86. WING FLAP SYSTEM.

2-87. Slot-type wing flaps, installed on the trailing edge of the wings, are electrically operated and extend from the inboard edge of each aileron to the wing-fuselage junction. During extension or retraction, the flaps are operated by an electric motor driven jackscrew actuator which drives cables and a combination of bellcranks and push rods to transmit motion to the flaps. Wing flap extension or retraction is indicated in degrees of travel by a flap position indicator on the left side of the instrument panel. The wing flap switch is located on the lower switch and control panel. Depressing the switch extends the flaps, and raising the switch retracts the flaps. No emergency wing flap actuation system is provided. The circuit is protected by a 10-ampere circuit breaker (23, figure 2-4) labeled FLAP, on the lower switch and control panel.

2-88. WING FLAP SWITCH.

2-89. Wing flap operation is controlled by a three-position momentary-on switch (13, figure 2-4), labeled WING FLAP, on the lower switch and control panel. Its positions are UP for flap retraction, center is off, and

DOWN for extension. The flaps may be extended to any degree from 0^{o} to 40^{o} by holding the wing flap switch in the DOWN position until the flap position indicator indicates the desired amount of extension. When released, the switch will automatically return to the off (center) position. Retraction of the flaps is accomplished by holding the switch in the UP position until the flaps have retracted the desired amount. The switch, when released, will return to the off position. Refer to Chapter 7 for flap extension airspeed limitations.

2-90. WING FLAP POSITION INDICATOR.

2-91. Wing flap position, from 0 degrees (fully retracted) to 40 degrees (fully extended), is indicated on the flap position indicator (7, figure 2-3) located on the upper left side of the instrument panel. The indicator is electrically operated and is calibrated in increments of 10 degrees.

2-92. LANDING GEAR SYSTEM.

2-93. The aircraft is equipped with tricycle-type fixed landing gear incorporating a steerable nose wheel and two main wheels. The main wheels are attached to flat leaf spring type landing gear struts and each main wheel is equipped with an independently operating disc brake assembly. The nose wheel is attached to an air/oil shock strut and is equipped with steering arms and a shimmy dampener. Refer to figure 2-10 for tire pressures.

2-94. STEERING SYSTEM.

2-95. Maneuvering the aircraft on the ground is accomplished through use of the nose wheel steering system. The steerable nose wheel is controlled by the rudder pedals through mechanical linkage equipped with a spring mechanism that absorbs shock loads. Application of the left rudder pedal will turn the nose wheel to the left, and the right rudder pedal will move the wheel to the right. With use of the rudder pedals only, nose wheel deflection is 10^{o} left or right of center. A combination of differential braking and full application of the rudder pedal will provide a maximum nose wheel deflection of 30^{o} left or right of center. When the weight of the aircraft is lifted from the nose gear, the nose wheel steering is automatically locked, with the nose wheel centered, by the torque link on the nose gear strut.

2-96. BRAKE SYSTEM.

2-97. Each main landing gear wheel is equipped with a single-disc hydraulic brake actuated by a master cylinder (14, figure 2-8) which is attached to a rudder pedal. The system is designed with a complete braking system for each main wheel to provide the aircraft with a differential braking capability. When the aircraft is parked, both main wheel brakes may be set by utilizing the parking brake which is operated by a handle ~~under~~ the left side of the lower switch and control panel.

2-98. BRAKE (RUDDER) PEDALS.

2-99. The aircraft's brakes are operated by either the pilot's or copilot's rudder pedals (15, figure 2-8 and 23, figure 2-9) which are connected by mechanical linkage. Each of the pilot's rudder pedals is connected to a brake master cylinder. When pressure is applied to the top of the rudder pedals, the master cylinders transmit hydraulic pressure to the wheel cylinders which actuate the wheel brakes.

2-100. PARKING BRAKE HANDLE.

2-101. When the aircraft is parked, or prior to engine runup, both main wheel brakes may be set by applying the parking brake. To apply the brake, pull aft on the parking brake handle, under the left side of the lower switch and control panel, and rotate it 90^{o} down to lock it. To get maximum brake effectiveness, pump the brake master cylinders up with the rudder pedals and hold pressure on them while pulling the handle aft and locking it. The parking brake is released by rotating the handle 90^{o} to the left, then pushing it forward.

2-102. INSTRUMENTS.

2-103. The following part of this section will cover only those instruments which are not considered part of a complete system, such as the fuel system, engine system, etc. All of the flight instruments (figure 2-3) are located on the left side of the instrument panel directly in front of the pilot. These instruments are the airspeed indicator, attitude indicator, heading indicator, altimeter, clock, turn and slip indicator, and vertical velocity indicator.

2-104. PITOT STATIC SYSTEM AND INSTRUMENTS.

2-105. The pitot-static system supplies static pressure to the airspeed indicator (1, figure 2-3), altimeter (5, figure 2-3), and the vertical velocity indicator (39, figure 2-3). It also supplies ram air to the airspeed indicator. The system consists of a single electrically heated pitot head (13, figure 2-2) attached to the lower surface of the left wing, static air pressure ports attached to the skin on the left and right sides of the aft fuselage, and associated system plumbing.

CAUTION

The pitot heat switch must always be turned off while the aircraft is on the ground, to prevent over-heating.

2-106. The heating element in the heated pitot head is turned on or off by a push-pull switch, labeled PITOT HEAT PULL-ON, on the lower switch and control panel. Pulling the switch out (ON) causes the element in the pitot head to heat, maintaining proper operation in possible icing conditions. When pitot heat is not required, the switch should be pushed in (off position).

2-107. AIRSPEED INDICATOR. The airspeed indicator (1, figure 2-3) is operated by ram air and static air pressures provided by the pitot and static air systems. Airspeed is indicated in miles-per-hour (outer dial) and knots (inner dial). Never exceed, caution, normal operating, and flap operating ranges are indicated on the face of the instrument in red, yellow, green, and white markings. Refer to Chapter 7 for operational limitations.

2-108. VERTICAL VELOCITY INDICATOR. The vertical velocity indicator (39, figure 2-3) depicts level flight and the aircraft's rate-of-climb or descent in feet-per-minute. The indicator is actuated by atmospheric pressure change supplied by the static source of the pitot-static system.

2-109. ALTIMETER. The altimeter (5, figure 2-3) is a barometric type instrument which operates on static pressure from the pitot-static system. A knob on the lower left corner of the indicator provides adjustment of the instrument's barometric scale to the proper barometric pressure reading.

2-110. TURN AND SLIP INDICATOR.

2-111. The turn and slip indicator (40, figure 2-3) is a gyroscopically operated instrument. The instrument is powered by 24 volts DC and its electrical circuit is protected by the 5-ampere INST circuit breaker (18, figure 2-4) on the lower switch and control panel.

2-112. VACUUM SYSTEM AND INSTRUMENTS.

2-113. An engine-driven vacuum system provides the suction necessary to operate the gyro-operated attitude and heading indicators. The system consists of a vacuum pump (and oil separator) mounted on the engine, a vacuum relief valve and vacuum system air filter on the aft side of the firewall below the instrument panel, and a suction gage on the right side of the instrument panel.

2-114. ATTITUDE INDICATOR. The attitude indicator (3, figure 2-3) gives a visual indication of flight attitude. The indicator is non-tumbling through 360° of roll and up to ±85° of pitch change from level flight. Bank attitude is presented by a pointer at the top of the indicator relative to the bank scale which is marked in increments of 10°, 20°, 30°, 60°, and 90° either side of the center mark. Pitch attitude is presented by a miniature aircraft in relation to the horizon bar. A knob at the bottom of the instrument is provided for in-flight adjustment of the miniature aircraft to the horizon bar for a more accurate flight attitude indication.

2-115. HEADING INDICATOR. The heading indicator (42, figure 2-3) displays aircraft heading on a compass card in relation to a fixed simulated aircraft image and index. The indicator is non-tumbling through ±85° of roll and ±85° of pitch from a level flight attitude. Power for the instrument's gyros is supplied by the aircraft vacuum system. Since the gyros in the heading indicator will precess slightly, the compass card should be set in accordance with the magnetic compass just prior to take-off and occasionally re-adjusted on extended flights. A knob located on the lower left edge of the indicator is used to adjust the compass card to correct for any precession.

2-116. SUCTION GAGE. Suction available for operation of the attitude and heading indicators is indicated by a suction gage (21, figure 2-3) calibrated in inches of mercury, on the upper right side of the instrument panel. The desired suction range is 4.6 to 5.4 inches of mercury, and is marked on the face of the gage with a green arc.

2-117. MAGNETIC COMPASS.

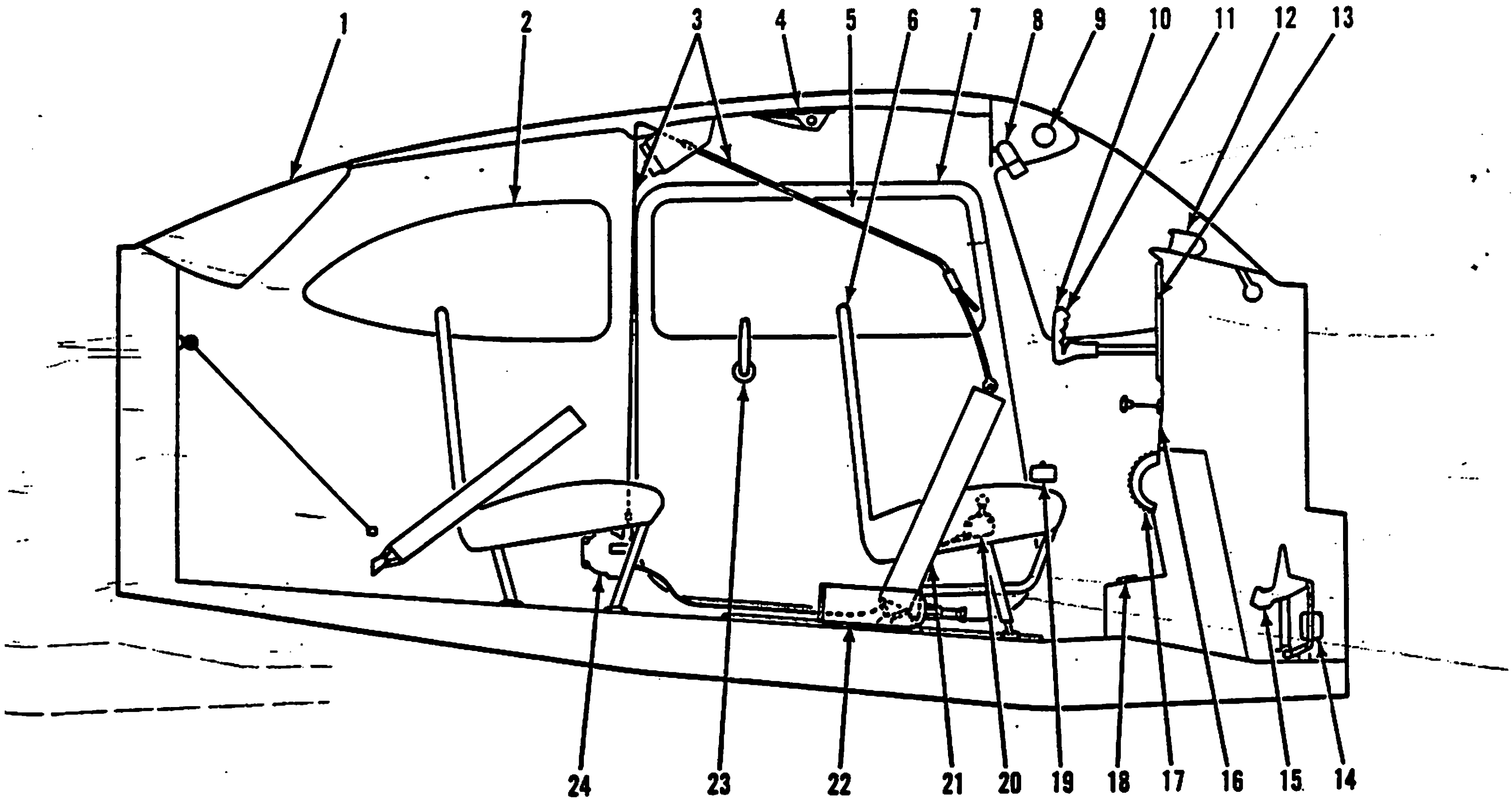
2-118. A magnetic compass (11, figure 2-3) is mounted above the center of the instrument panel on the cowl deck. The instrument has integral lighting for night operations. The compass correction card (9, figure 2-3) is mounted in the instrument panel glare shield just below the compass.

2-119. FREE AIR TEMPERATURE GAGE.

2-120. A free air temperature gage (2, figure 2-2) is mounted through the upper center portion of the windshield and is calibrated in Fahrenheit and Celsius.

2-121. STALL WARNING SYSTEM.

2-122. A pneumatic stall warning system is installed on this aircraft. The system consists of a stall warning port in the leading edge of the left wing, a reed-type horn in the upper left side of the cabin, and associated plumbing.



1. Cabin rear window
2. Cabin left rear side window
3. Pilot's shoulder harness
4. Cockpit light and instrument panel flood light
5. Left cabin door window
6. Pilot's seat
7. Left cabin door
8. Map light
9. Pilot's wing-mounted ventilator
10. Pilot's control wheel microphone switch (on left grip)
11. Pilot's control wheel
12. Magnetic compass
13. Instrument panel (figure 2-3)
14. Brake master cylinders (pilot's rudder pedals only)
15. Pilot's rudder pedals
16. Lower switch and control panel (figure 2-4)
17. Elevator trim tab control wheel
18. Fuel selector valve control knob
19. Left emergency door release handle
20. Pilot's inertia reel locking lever
21. Pilot's seat belt
22. Fire extinguisher
23. Left cabin door handle
24. Pilot's shoulder harness inertia reel

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Figure 2-8. Cabin left side (typical).

As the aircraft approaches a stall, a low pressure condition is created over the leading edge of the wings. This low pressure creates a differential pressure (vacuum) in the stall warning system which draws air through the warning horn, resulting in an audible warning at 5 to 10 MPH above stall in all flight conditions.

2-123. EMERGENCY EQUIPMENT.

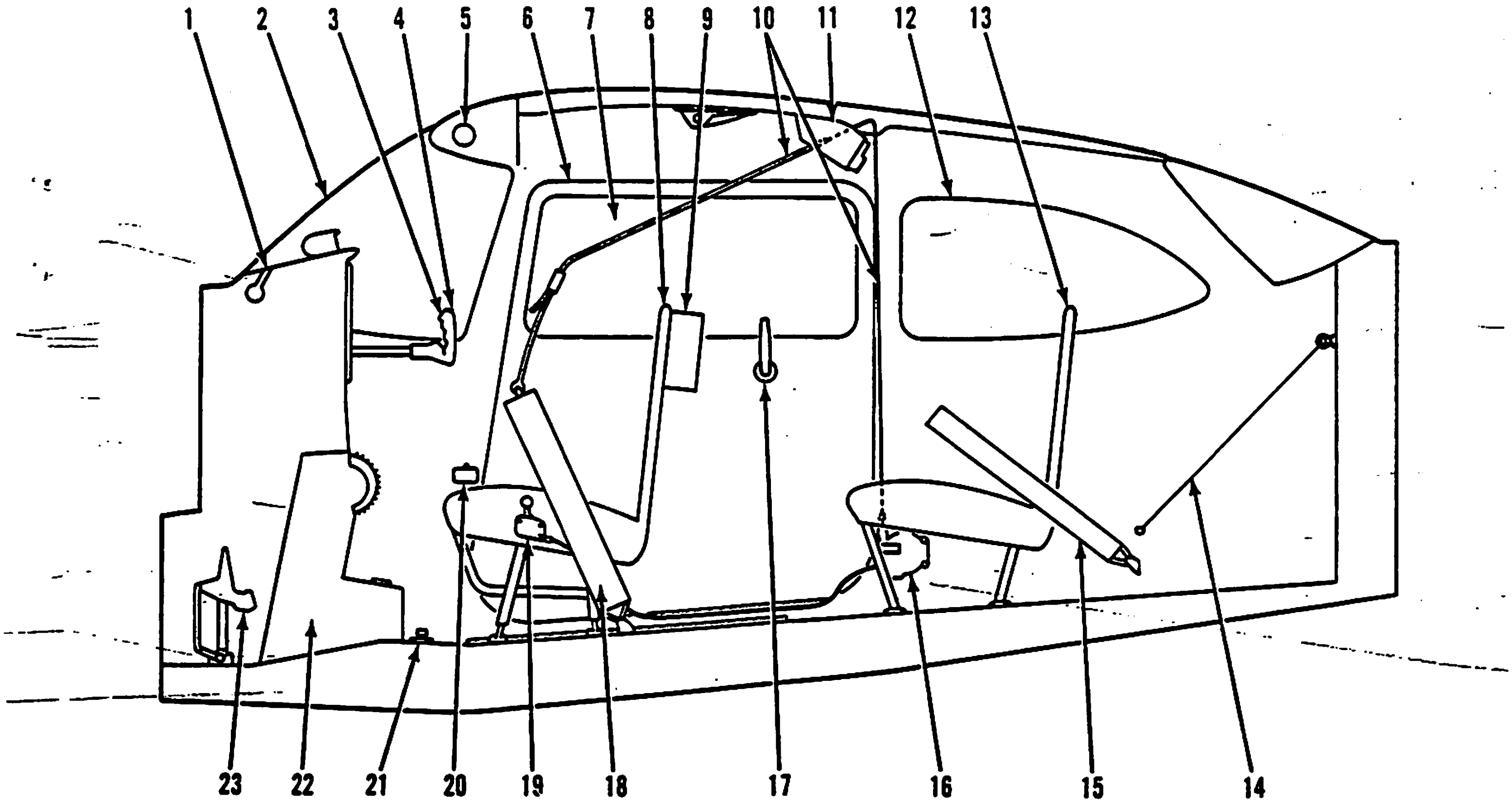
2-124. The following information covers all emergency equipment, except that which forms part of a complete system. For operation of emergency exits and for location of all emergency equipment, refer to Chapter 4, figure 4-2.

2-125. FIRE EXTINGUISHER.

WARNING

Repeated or prolonged exposure to high concentrations of monobromotrifluoromethane (CF_3Br) or decomposition products should be avoided. The liquid should not be allowed to come in to contact with the skin, as it may cause frost bite or low temperature burn.

2-126. A hand operated, monobromotrifluoromethane (CF_3Br) type fire extinguisher (22, figure 2-8) is mounted between the pilot and copilot's seats by a bracket with a retaining strap and latch. The extinguisher should be



1. Defroster outlet
2. Windshield
3. Copilot's control wheel
4. Copilot's control wheel microphone switch (on right grip)
5. Copilot's wing-mounted ventilator
6. Right cabin door
7. Right cabin door window
8. Copilot's seat
9. First aid kit
10. Copilot's shoulder harness
11. Observer's interphone-audio control panel
12. Cabin right rear side window
13. Rear seats
14. Baggage net
15. Rear seat belt
16. Copilot's shoulder harness inertia reel
17. Right cabin door handle
18. Copilot's seat belt
19. Copilot's inertia reel locking lever
20. Right emergency door release handle
21. Copilot's microphone foot switch
22. Control pedestal
23. Copilot's rudder pedals

Figure 2-9. Cabin right side (typical). AV108260

used with care in the limited area of the cabin due to the relatively high charging pressure and forceful stream emitted by it.

2-127. EMERGENCY DOOR RELEASE HANDLES.

2-128. Emergency door release handles (19, figure 2-8 and 20, figure 2-9), on both front door posts, are provided to mechanically disengage the door hinges and allow jettison of both cabin doors. If a cabin door must be jettisoned, open the door, grasp the emergency door release handle, and pull firmly inboard, disengaging the hinge pins from the hinges. The door will then leave the aircraft.

2-129. FIRST AID KIT.

2-130. The aircraft is equipped with a first aid kit (9, figure 2-9). The kit is located near the top of the copilot's seat back.

2-131. ENTRANCE DOORS.

2-132. Entry to, and exit from the aircraft is accomplished through either of two cabin doors (7, figure 2-8 and 6, figure 2-9), one on each side of the fuselage at the pilot's and copilot's positions. Both doors are equipped with an exterior door handle, conventional interior door handle, and an openable window.

2-133. CABIN DOOR WINDOWS.

2-134. Both cabin doors are equipped with windows (5, figure 2-8 and 7, figure 2-9). The windows are hinged at the top and are spring-loaded to the open position. Self locking over-center latches hold the windows in the closed position. To open a window, press the release button on the over-center latch and rotate the latch 90° up. The window will then swing outward. When closing the window, use the handle located in the lower forward corner of the window; then rotate the latch to secure the window.

2-135. EXTERIOR DOOR HANDLES.

2-136. The exterior door handles on this aircraft are near the aft edge of each cabin door, just below the door window. The flat rectangular handles are recessed into the door surface and rotate outward. To open a cabin door, grasp the exposed edge of the handle and pull outboard.

2-137. INTERIOR DOOR HANDLES.

2-138. The interior cabin door handles (23, figure 2-8 and 17, figure 2-9) are three position handles located below each cabin door window near the aft edge of the door. A placard located at the base of each handle indicates the three positions, which are OPEN, CLOSE, and LOCK. Before flight, place the door handles in the LOCK position by rotating them aft. This locks and seals the doors. To open either door, rotate the handle to the OPEN position. The handle is spring-loaded to return to the CLOSE position.

2-139. SEATS.

2-140. FRONT SEATS.

2-141. The pilot's seat (16, figure 2-2) and copilot's seat (17, figure 2-2) are mounted on individual sets of tracks, and are adjustable forward, aft, and vertically. The seat backs are adjustable through three reclining positions. Move either seat forward or aft by lifting up on the adjustment lever (under the left front corner of the pilot's seat and right front corner of the copilot's seat). Seat height adjustment is made by turning an adjustment crank clockwise to raise the seat, and counterclockwise to lower it. The crank is under the right front corner of the pilot's seat, and under the left front corner of the copilot's seat. The back of either seat may be adjusted forward or aft by lifting up on the reclining lever and positioning the seat back. The lever is on the aft right side of the pilot's seat, and the aft left side of the copilot's seat.

2-142. SEAT BELTS AND SHOULDER HARNESSES.

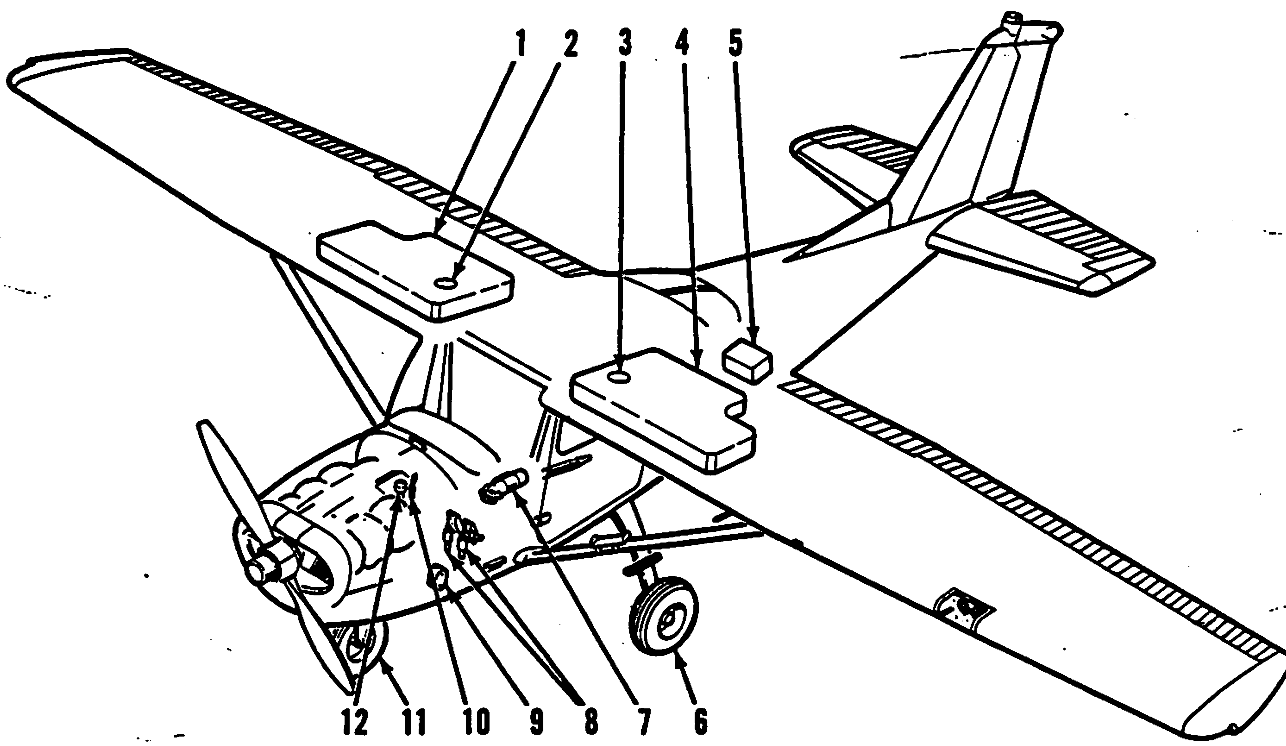
2-143. Seat belts, shoulder harnesses, and inertia reels are provided for both the pilot and copilot. Each seat belt (21, figure 2-8 and 18, figure 2-9) is connected to a fitting attached to the aircraft structure aft of the seat. The shoulder harnesses (3, figure 2-8 and 10, figure 2-9) are attached to inertia reels (24, figure 2-8 and 16, figure 2-9) which are located on the cabin side walls just aft of the rear door posts near floor level. A control lever (20, figure 2-8 and 19, figure 2-9) on the left side of the pilot's and copilot's seats governs operation of the inertia reels. When the control lever is placed in the AUTOMATIC position, the shoulder harness will permit free forward and aft movement. However, any sudden forward movement will lock the reel and permit only aft movement. To unlock the reel, place the lever in the MANUAL position, then back to the AUTOMATIC position. Placing the control lever in the MANUAL position will lock the shoulder harness at any desired position. With the lever in the MANUAL position, the reel will allow aft movement only.

2-144. AUXILIARY EQUIPMENT.

2-145. The heating, ventilating, and defrosting systems, anti-icing system, lighting equipment, and miscellaneous equipment are discussed in Chapter 6.

ITEM	DESIGNATIONS		REMARKS
	COMMERCIAL	MIL SPEC NO.	
FUEL: RECOMMENDED ALTERNATE	AVGAS 115/145 AVGAS 100/130	MIL-G-5572 MIL-G-5572	PURPLE GREEN
OIL: ASHLESS DISPERSANT	SAE 30	MIL-L-22851 TYPE III	*CHANGE EACH 25 HRS. USE BELOW 30°F.
-	SAE 50	MIL-L-22851 TYPE II	*CHANGE EACH 25 HRS. USE ABOVE 30°F
HYDRAULIC FLUID:		MIL-H-5606	
FIRE EXTINGUISHER FLUID:	MONOBROMOTRI-FLUOROMETHANE (CF_3Br)	MIL-E-52031	
TIRE PRESSURES: MAIN NOSE	24 PSI 26 PSI		

*When a full-flow oil filter is installed, the oil change interval is extended to 50 hours.



1. Right wing fuel tank
2. Right wing fuel tank filler
3. Left wing fuel tank filler
4. Left wing fuel tank
5. Battery
6. Main gear tire
7. Fire extinguisher
8. Brake master cylinder
9. External power receptacle
10. Oil dipstick
11. Nose gear tire
12. Oil filler cap

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Figure 2-10. Servicing.

NORMAL PROCEDURES

Section I — INTRODUCTION

3-1. GENERAL.

3-2. This chapter contains the procedures required to insure safe and efficient operation of the aircraft. Steps are included in checklist form covering the flight from the time it is planned until it is completed and the aircraft is left properly parked and secure. The flight envisioned in this chapter is considered to be accomplished under normal conditions. The checklist includes all steps necessary to insure safe flight under normal daytime, night, and instrument conditions. Information pertaining to weather operations has been held to the minimum checklist requirement. Details and discussions of weather operation are covered by Chapter 10. Instructions for the operation of auxiliary equipment and controls are contained in Chapter 6. Complete flight characteristics are covered in Chapter 8.

3-3. CHECKLISTS.

3-4. AMPLIFIED AND CONDENSED CHECKLISTS.

3-5. The checklists used by the pilot include amplified normal and emergency procedures and the normal and emergency procedures in condensed form. The amplified procedures are contained in Chapter 3 and 4 respectively and include all explanatory material, Warnings, Cautions, and Notes. The condensed versions of the normal and emergency procedures are issued as a separate publication (TM 55-1510-212-CL). The amplified and condensed procedures follow the same check numbers, although the condensed procedures omit all explanatory text with the exception of an occasional Warning, Caution, or Note.

3-6. CHECKS.

3-7. Checklists include items required for day, night and instrument flights on a common checklist with annotative indicators preceding those required to be accomplished only for night (N) and for those required to be accomplished only for instrument flight (I). The symbol (O) is used to indicate that the procedure is applicable if the particular equipment is installed. The symbol ★ indicates that the detailed procedure for this step is included in the performance checks section, located at the back of the checklist.

3-8. THRU-FLIGHT CHECK.

3-9. When the aircraft is flown by the same flight crew in regularly scheduled operations, or when assigned tactical or administrative missions requiring intermediate stops, it is unnecessary to perform all the checks. Under these conditions, only a portion of the normally required preflight checks are necessary to assure safe operation. An asterisk (*) precedes each check that must be performed during thru-flight operations. Items not marked with an asterisk may be checked at the discretion of the pilot. The Before Take-Off check, and subsequent checks, must be completed in their entirety.

Section II — FLIGHT PROCEDURES

3-10. PREPARATION FOR FLIGHT.

3-11. The preparation for flight includes flight planning, special problems due to the assigned mission, and crew briefing. The pilot should assure that all information in this manual, applicable to the proposed mission, is complied with.

3-12. FLIGHT RESTRICTIONS.

NOTE

The aircraft is restricted to visual flight conditions. Instrument flight conditions will be flown on an emergency basis only.

3-13. The maximum, cautionary, normal, and minimum operational ranges indicated by instrument markings and placards represent limitations required for safe and efficient operation of the aircraft. Refer to Chapter 7 for a detailed description of aircraft and engine limitations and restrictions.

3-14. FLIGHT PLANNING.

3-15. The performance data contained in Chapter 14 is provided to assist in determining fuel consumption, airspeed, power settings, ranges etc., as required to accomplish the proposed mission and obtain the best possible performance from the aircraft.

3-16. TAKE-OFF AND LANDING DATA CARD.

3-17. For a discussion of the take-off and landing data card and the proper means of filling it out, refer to Chapter 14, Performance Data.

3-18. WEIGHT AND BALANCE.

3-19. Refer to Chapter 7 for weight and center-of-gravity limitations, and to Chapter 12 for information to be used in weight and balance computation. Before each mission, make the following checks:

1. Determine the take-off gross weight and check that the center of gravity (CG) is within limits.

2. Check that required oil, fuel, and special equipment is sufficient for the mission to be accomplished.

3-20. PREFLIGHT CHECK.

3-21. The preflight check is performed in accordance with procedures in the following paragraphs. Figure 3-1, Exterior Check, illustrates the approximate path to be followed while using these procedures to assure complete inspection and readiness of the aircraft.

3-22. BEFORE EXTERIOR CHECK.

* 1. Publications – checked. Check DA Form 2408-13 and availability of Operator's Manual (-10), Checklist (-CL), locally required forms and publications.

2. l.

3. Fire extinguisher – checked.

4. Emergency door releases – checked. Visually check release handles for condition and security.

*5. Fuel selector – BOTH. Check fuel selector valve in detent.

6. Trim tab – TAKE-OFF.

* 7. Parking brake – set.

CAUTION

If high or gusty winds are present, and the flight controls are unlocked, control surfaces may be damaged by buffeting.

* 8. Flight controls – UNLOCKED

9. Fuel shutoff valve – ON.

* 10. Ignition switch – OFF.

11. Fuel strainer – drain. Pull out strainer drain knob for about four seconds to clear fuel strainer of possible water and sediment. After draining, check to ensure that the drain knob is pushed in and the flow is stopped completely.

12. Master switch – ON.

13. Pitot heat – checked. Check for slight deflection of ammeter needle to verify operation, then OFF.

14. Landing Lights - Checked.

15. Rotating beacon – ON/check operation. Check illumination and rotation.

(O)16. Alternator – ON.

17. Warning lights (4) – checked. Check for illumination when pressed to test.

(O)18. Alternator – OFF.

19. Fuel quantity – checked. Check quantity shown on each indicator against requirement of anticipated flight.

★ 20. Auxiliary fuel pump – checked. Set mixture to idle cut-off and throttle open to three-fourths travel. Set auxiliary fuel pump switch to LOW, close throttle, and listen for fuel pump speed change to lower operation. Turn fuel pump OFF promptly to avoid flooding the engine.

(N)21. Lighting systems – checked. Check illumination of all interior and exterior lights.

22. Master switch – OFF.

23. Cargo – secure.

3-23. EXTERIOR CHECK.

3-24. LEFT LANDING GEAR.

1. Brake assembly – checked. Check brake lines for damage or signs of leakage, and brake linings for wear.

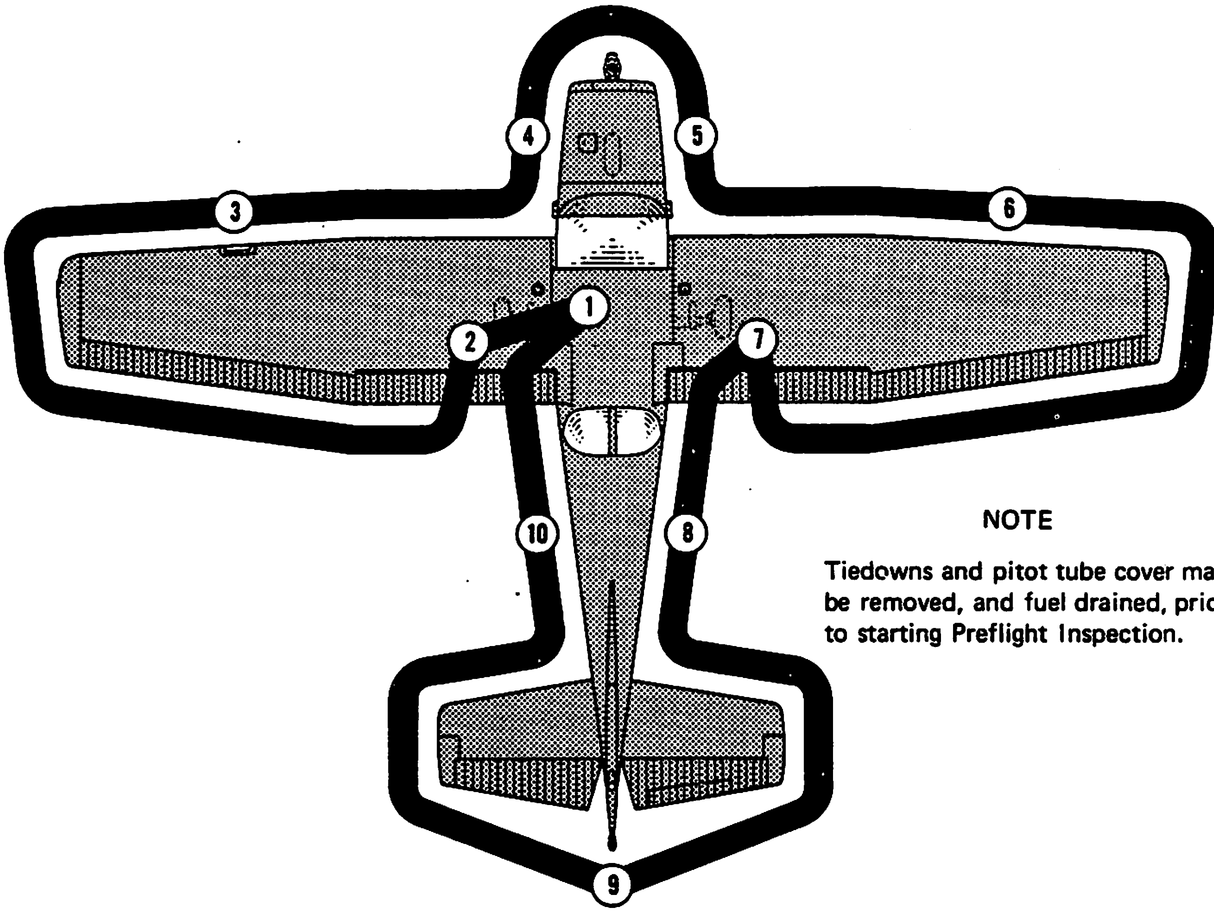


Figure 3-1. Exterior check

2. Wheel assembly and strut – checked. Check for condition.

* 3. Tire – checked. Check for cuts, bruises, wear, and proper inflation.

* 4. Chock – removed.

3-25. LEFT WING.

1. Fuel tank – drain. Depress drain valve for about four seconds to clear fuel tank sump of possible water and sediment.

2. General condition – checked. Check for skin damage and loose rivets. In cold weather, remove even small accumulations of frost, ice, or snow.

3. Controls – checked. Check freedom of movement (in proper direction), and hinge attachments for security.

4. Wing tip and navigation light – checked. Check for general condition and security.

5. Landing lights – checked. Check window for security and cleanliness.

* 6. Tiedown – released.

7. Stall warning port – checked. Check free of obstructions.

8. Fuel vent – checked. Check free of obstructions.

* 9. Pitot tube – checked. Remove cover and check for obstructions, alignment, and security.

10. Strut – checked. Check for strut damage and security of strut fairings and fueling step.

11. Door hinge pins – checked. Check for security in door hinges and attachment to release cables.

* 12. Fuel tank – checked. Check fuel level visually, then check fuel filler cap secure.

3-26. ENGINE AND PROPELLER.

* 1. Oil quantity and cap – checked. Check oil level. Then check oil filler cap secure, oil cooler free of obstruction, and filler door closed and latched.

2. Cowling – checked. Check for damage and fasteners secure.

3. Propeller – checked. Check for nicks, security, and oil leaks.

4. Fuel strainer – checked. Check visually to ensure that strainer drain valve is closed after draining.

3-27. NOSE LANDING GEAR.

* 1. Tiedown – released.

* 2. Tire – checked. Check for cuts, bruises, wear, and proper inflation.

3. Nose gear assembly – checked. Check strut, torque links, and shimmy dampener for general condition, cleanliness, and leakage. Visually check strut for bottoming and/or low condition.

NOTE

Do not check strut air pressure with a gage unless the inflation appears inadequate, since repeated checks before each flight would result in loss of proper inflation.

(O) 4. Fuel reservoir tank – drain. Press drain valve (located on bottom of fuselage just aft of firewall) for about four seconds to clear fuel reservoir of possible water and sediment.

3-28. RIGHT WING.

1. General condition – checked. Check for skin damage and loose rivets. In cold weather, remove even small accumulations of frost, ice, or snow.

* 2. Fuel tank – checked. Check fuel level visually, then check fuel filler cap secure.

3. Door hinge pins – checked. Check for security, in door hinges and attachment to release cables.

4. Strut – checked. Check for strut damage and security of strut fairings and fueling step.

* 5. Tiedown – released.

6. Wing tip and navigation light – checked. Check for general condition and security.

7. Controls – checked. Check freedom of movement (in proper direction), and hinge attachments for security.

8. Fuel tank – drain. Press drain valve for about four seconds to clear fuel tank sump of possible water and sediment.

3-29. RIGHT LANDING GEAR.

1. Brake assembly – checked. Check brake lines for damage or signs of leakage, and brake linings for wear.

2. Wheel assembly and strut – checked. Check for condition.

* 3. Tire – checked. Check for cuts, bruises, wear, and proper inflation.

* 4. Chock – removed.

3-30. FUSELAGE – RIGHT SIDE.

1. General condition – checked. Check for skin damage and loose rivets.

2. Static port – checked. Check free of paint, dirt, or other obstructions.

3. Antennas – checked. Check for security of attachment and broken wire.

3-31. EMPENNAGE.

1. General condition – checked. Check vertical fin and dorsal and horizontal stabilizer for security, skin damage and loose rivets.

2. Controls and trim tab – checked. Remove rudder gust lock, if installed, and check control surface freedom of movement. Check security of elevator and rudder hinge bolts and elevator trim tab push rod connections. Check trim tab for take-off position.

3. Navigation light – checked. Check for general condition and security.

* 4. Tiedown – released.

3-32. FUSELAGE-LEFT SIDE.

1. General condition – checked. Check for skin damage and loose rivets.

2. Static port – checked. Check free of paint, dirt, or other obstructions.

*3-33. INTERIOR CHECK.

1. Right seat, belt, and harness (solo flight) – secured.

2. Passenger briefing – complete. This will include but is not limited to the following: Emergency exit procedures and location of emergency equipment.

3. Cabin heat and air – as required.

3-34. BEFORE STARTING ENGINE.

* 1. Seat, belt, and harness – adjusted. Check seat stop pin securely in seat rail locking hole and seat belts and harness for proper routing to ensure they are secure.

2. Cockpit light – OFF.

3. Free air temperature gage – checked.

4. Compass – checked.

5. VOR-HOMING switch – VOR.

6. Pilot's interphone and audio control panel – set.

7. Radios – OFF.

* 8. Mixture – RICH.

* 9. Propeller – INCREASE rpm.

* 10. Throttle – closed.

11. Circuit breakers – checked.

12. Light switches – OFF.

13. Pitot heat – OFF.

14. Primer – LOCKED.

15. Map light switch – OFF.

16. Flight instruments – checked.

17. Engine instruments – checked. Check for static readings.

18. Copilot's interphone and audio control panel – set.

*3-35. STARTING ENGINE.

1. Master switch – ON.

(N) 2. Navigation lights – ON (Steady).

NOTE

During night operations, the navigation lights should be turned on prior to starting the engine and remain on until engine shutdown is complete.

3. Rotating beacon – ON.

4. Auxiliary fuel pump switch – HI.

5. Throttle – Open to obtain 8-10 gal/hr fuel flow; then reduce to 1 inch open.

6. Auxiliary fuel pump switch – OFF.

7. Propeller – clear. Make sure propeller area is clear.

CAUTION

Continuous cranking should not exceed 30 seconds. If the engine fails to start, release ignition switch and allow the starter to cool for 30 seconds before attempting another start.

8. Ignition switch – START. Release to BOTH when engine starts.

NOTE

The engine should start in two to three revolutions. If it does not, increase the fuel flow by turning the auxiliary fuel pump switch momentarily on HI and crank for two to four additional revolutions. If it still does not start, set the mixture to idle cut-off, and crank until the engine fires or for approximately 15 seconds. If still unsuccessful, start again using the normal starting procedure after allowing the starter motor to cool.

9. Throttle 1000 rpm – set.

NOTE

To avoid overheating the engine, a portion of the warmup time should be spent in taxiing to the runup or take-off position.

10. Oil pressure – checked. Check in green arc within 30 seconds.

(O) 11. Alternator – ON.

*3-36. BEFORE TAXIING.

1. Radios – ON, checked. Check all navigation equipment required for mission.

2. Taxi clearance – as required.

3. Clock – set.

4. Altimeter – set.

5. Parking brakes – released.

*3-37. TAXIING.

CAUTION

Taxiing over loose gravel or cinders should be done at low engine speed to avoid abrasion and stone damage to the propeller tips and the leading edges of the horizontal stabilizer.

1. Brakes – checked. Test brakes on initial roll when starting to taxi.

NOTE

Steer aircraft with rudder pedals, using brakes only for sharp turns. Do not use more power than is necessary to keep the aircraft rolling, and avoid riding the brakes since this causes unnecessary brake wear. Utilize all controls as necessary to maintain directional control and balance in strong, gusty winds.

2. Flight instruments – checked. Check settings and operation.

3-38. ENGINE RUNUP.

CAUTION

Since the engine is closely cowled for efficient in-flight engine cooling, turn the aircraft into the wind, if possible, to avoid overheating during prolonged engine operation on the ground.

* 1. Nose wheel – centered.

* 2. Parking brake – set.

* 3. Throttle 1000 rpm – set.

★ * 4. Magneto groundout – checked. At 1000 RPM. turn ignition switch to L position, then R position, and observe that engine continues to operate. Then turn ignition switch to OFF momentarily and observe that the engine completely ceases firing. Return the switch to BOTH.

* 5. Engine instruments – checked.

★ * 6. Magnetos – checked. At 1800 rpm, first move ignition switch to R position and note rpm. Next move switch back to BOTH to clear the other set of plugs. Then move switch to L position, note rpm, and return to BOTH position. The rpm drop should not exceed 150 rpm on either magneto and the difference between the two magnetos operated individually should not be more than 50 rpm.

NOTE

If there is a doubt concerning operation of the ignition system, rpm checks at higher engine speeds will usually confirm whether a deficiency exists.

★ * 7. Propeller – checked. With power set to 1800 rpm and propeller control at INCREASE rpm, pull propeller control to DECREASE rpm and check for an rpm drop. A large rpm drop is not necessary. Return control to INCREASE rpm.

(I) 8. Suction gage – checked. Check within 4.6 - 5.4 inches Hg.

★ 9. Mixture – checked. At 1000 rpm, move mixture control toward lean. Maximum increase is 25 rpm.

★ 10. Idle speed – checked. Check for 650 -700 rpm with throttle closed.

* 11. Throttle 1000 rpm – set.

12. Flaps – checked. Check at all settings and return to zero setting.

*3-39. BEFORE TAKE-OFF

1. Flight controls – checked. Check for full travel and proper response.

2. Fuel selector – BOTH. Check fuel selector valve in detent.

3. Trim – set. Set to take-off position.

4. Flight and engine instruments – checked.

5. Flaps – as required.

6. Mixture – as required.

7. Propeller – INCREASE rpm.

(I) 8. Navigation radios – set.

9. Take-off clearance – as required.

10. Windows and doors – as required.

11. Parking Brakes - released.

3-40. LINEUP.

1. Heading indicator – set. Set for agreement with magnetic compass.

(I) 2. Pitot heat – as required. Use whenever flight is conducted in visible moisture.

(O) 3. Transponder – as required.

3-41. TAKE-OFF.

WARNING

Avoid wake turbulence. Allowing three to five minutes before take-off behind a heavy aircraft or helicopter is advisable. When necessary to take-off behind a heavy aircraft or helicopter, and conditions permit, take-off well before the lift-off point of the departing aircraft and climb above its flight path.

3-42. Taking off in accordance with the following techniques will produce the results shown in Chapter 14. Before starting the take-off run, determine the point after which the aircraft cannot be normally stopped in the event of a malfunction. Refer to Chapter 4 for emergency procedures during take-off.

3-43. NORMAL TAKE-OFF.

CAUTION

Full-throttle runups over loose gravel are especially harmful to propeller tips. When take-offs must be made over a gravel surface, advance the throttle slowly. This allows the aircraft to start rolling before high rpm is developed, and the gravel will be blown back of the propeller rather than pulled into it.

NOTE

It is important to check full-throttle operation early in the take-off run. Any signs of rough engine operation or sluggish engine acceleration is good cause for discontinuing the take-off.

3-44. Normal take-offs are accomplished with wing flaps up, full throttle, and 2800 rpm. Initially, the control wheel should be in the neutral position, and power should be applied by smoothly increasing the throttle to full OPEN. As the throttle is advanced, monitor oil pressure and fuel pressure indications to insure that the engine is operating properly. Directional control should be maintained throughout the take-off roll primarily by use of the rudder pedals. Keep heels on the floor to avoid dragging the brakes. For maximum engine power, the mixture should be adjusted during the initial take-off roll to the fuel flow corresponding to the field elevation (as defined on the fuel flow placard located beneath the fuel flow indicator). The power increase is significant above 3000 feet and this procedure should always be used for field elevations greater than 5000 feet above sea level. When the aircraft reaches 60 MPH, apply slight elevator back pressure to lift the nose wheel and allow the aircraft to fly off smoothly.

3-45. MINIMUM RUN/OBSTACLE CLEARANCE TAKE-OFF.

3-46. Perform minimum run take-offs using 20° wing flaps. To take-off, hold the brakes while applying full throttle, adjust mixture, then release the brakes and allow the aircraft to accelerate. Keep heels on the floor to avoid dragging the brakes during acceleration. Maintain a slightly tail-low attitude throughout the take-off run. Lift the aircraft off the ground as soon as practical in a tail-low attitude and then level off immediately to accelerate to a safe climb speed. This procedure is also applicable for take-off from soft fields. In an obstacle clearance take-off with 20° wing flaps, maintain 60 MPH until the obstacle is cleared. Leave flaps down until clear of the obstacle, then level the aircraft and accelerate to a normal climb speed while slowly retracting the flaps.

NOTE

Flap deflections greater than 20° are not recommended for take-off under any circumstances.

3-47. CROSSWIND TAKE-OFF.

3-48. Take-offs into strong crosswinds should be performed with the minimum flap setting necessary for the field length, to minimize the drift angle immediately after take-off. Maintain directional control as in a normal take-off, applying aileron as necessary to maintain wings level. Leave the nose wheel on the runway until a speed slightly higher than normal has been attained. Then pull off the ground in a positive manner to prevent possible settling back to the runway while drifting. When clear of the ground, make a coordinated turn into the wind to correct for drift.

3-49. AFTER TAKE-OFF.

1. Flaps – UP. Retract wing flaps (if used) after a safe altitude and airspeed have been reached.

(N) 2. Landing lights – OFF.

3. Climb power – set. Retard throttle to 25 inches of manifold pressure and set propeller control to 2600 rpm.

3. Mixture – set. Adjust mixture control for approximately 13 gal/hr. fuel flow.

3-50. CLIMB.

3-51. Normal climbs are performed at 100 MPH with flaps up, 25 inches of manifold pressure, 2600 rpm, and approximately 13 gal/hr. fuel flow. Maximum performance climbs are performed at best rate-of-climb speeds ranging from 95 MPH at sea level to 87 MPH at 10,000 feet using full throttle, 2800 rpm, and the mixture leaned in accordance with the fuel flow placard located beneath the fuel flow indicator. If an obstacle dictates the use of a steep climb angle, the best angle-of-climb speed of 75 MPH should be used with flaps up, full throttle, and 2800 rpm. For additional climb data, refer to Chapter 14.

NOTE

Steep climbs at these low speeds should be of short duration to improve engine cooling.

3-52. CRUISE CHECKS.

3-53. Normal cruising is done at power settings up to 75% power. Refer to Chapter 14 for power settings required for cruise at various altitudes.

3-54. DESCENT.

1. Throttle – adjusted.

2. Mixture – adjust. Periodically adjust for smooth engine operation.

3-55. BEFORE LANDING.

1. Fuel selector – BOTH. Check fuel selector valve in detent.

2. Mixture – RICH. If engine becomes rough due to excessive richness at altitude, lean for smooth operation.

NOTE

If field length is marginal and field elevation is above 5000 feet, one should preset the mixture control for the proper fuel flow in the event of a possible go-around at full power. This is best accomplished prior to entering the traffic pattern by momentarily applying full power and adjusting the mixture setting to the placard fuel flow for the field elevation.

3. Landing lights – ON.

3-56. LANDING CHECK.

1. Propeller – INCREASE rpm.

2. Mixture – RICH.

3-57. LANDING.

WARNING

Avoid wake turbulence. Allowing three to five minutes before landing behind a heavy aircraft or helicopter is advisable. When necessary to land behind a heavy aircraft or helicopter, and conditions permit, keep above the approach path of the landing aircraft and touch down past its point of touch down.

WARNING

Slips are prohibited when using over 30° of flap during landing approaches due to a possible downward pitch encountered under certain combinations of airspeed and sideslip angle.

3-58. Landing in accordance with the following techniques will produce the results shown in Chapter 14. Refer to Chapter 4 for emergency procedures during landing.

3-59. NORMAL LANDING.

3-60. The normal landing is accomplished from a rectangular pattern, and should be planned to provide maneuvering to the final approach using moderate bank angles. Proper planning and execution will permit reduction in the angle of bank as the aircraft nears the final approach. The turn to final should be completed at an altitude and distance from the runway which will ensure a power-off approach at the desired flap setting. If a flaps-up landing is to be made, an airspeed of 85 MPH should be maintained in the pattern and final approach; with flaps down, use airspeeds of 75 MPH. On final approach, adjust the rate of descent to arrive over the runway threshold at an altitude and airspeed which will permit a gradual increase in pitch attitude for touchdown on the main wheels. Attempting to touchdown at an excessive airspeed will result in a three-point or nose wheel first landing, which may cause a bounce. Ensure that the nose wheel is smoothly lowered to the runway prior to losing elevator effectiveness. Maintain directional control using nose wheel steering, aileron, and asymmetrical braking as necessary. The flaps may be retracted during the landing roll out to increase brake effectiveness.

NOTE

Retraction of flaps significantly reduces lift, placing more weight on the main wheels for more effective braking.

3-61. OBSTACLE CLEARANCE/MINIMUM RUN LANDING.

3-62. For an obstacle clearance/minimum run landing, approach at a steep angle with 40° flaps, using only enough power to reach the obstacle at approximately 60 MPH. After the obstacle is cleared, retard the throttle, readjust glide attitude for 60 MPH, rotate for landing flare, and land on the main wheels first. Immediately after touchdown, lower the nose wheel and apply heavy braking while retracting the wing flaps.

3-63. CROSSWIND LANDING.

3-64. When landing in a strong crosswind, use the minimum flap setting required for the field length. Use a wing-low, crab, or a combination method of drift correction and land in a nearly level attitude. Hold a straight course with the steerable nose wheel and occasional differential braking, if necessary. Prompt retraction of flaps will keep the aircraft solidly on the runway. Refer to Chapter 14 for crosswind limitations.

3-65. LANDING ON SLIPPERY RUNWAYS.

3-66. Landing the aircraft on slippery runways requires no special technique. Touchdown should be made close to the end of the runway in order to utilize all the available runway length. Use the lowest safe touchdown speed with full flaps since excessive landing speeds will result in greater stopping distances. If the brakes are applied hard and suddenly, wheel skidding will result, decreasing brake effectiveness and directional control. For maximum brake effectiveness after all three wheels are on the ground, retract the flaps, apply brakes without sliding the tires, and hold full nose-up elevator. Use the steerable nose wheel for directional control. If skidding occurs, reduce or release brake pedal pressure and use the steerable nose wheel to regain directional control.

3-67. PORPOISING.

NOTE

Avoid landing on the nose wheel first with excessive speed as porpoising may result.

3-68. Porpoising is a condition encountered during landing, wherein the aircraft bounces back and forth between the nose wheel and the main gear after initial ground contact. Pilot control inputs and reaction times can aggravate the condition. To avoid a porpoise, land on the main gear first. If a porpoise is encountered, immediately position control wheel to and hold slightly aft of neutral to establish the normal take-off attitude and simultaneously advance the throttle to take-off power. This will dampen the oscillations and the aircraft will become airborne. At this time, the pilot should immediately decide whether to land on the remaining runway or execute a go-around.

3-69. GO-AROUND.

NOTE

The decision to go-around should be made as early as possible in order to provide an adequate margin of airspeed and altitude.

1. Power – maximum allowable. Immediately advance throttle to full OPEN.

2. Flaps – UP. Immediately retract wing flaps to 20° until a safe airspeed has been attained, then slowly retract to full up position.

3. Climb power – set. Retard throttle to 25 inches of manifold pressure and set propeller control to 2600. rpm.

4. Landing lights – OFF.

3-70. AFTER LANDING.

3-71. After landing checks should be performed immediately after turning off the runway. Priority during the after landing roll should be placed on directional control.

1. Landing/Taxi light – as required.

2. Flaps – UP.

3. Pitot heat – OFF.

4. Radios – as required.

3-72. ENGINE SHUTDOWN.

1. Nose wheel – centered.

NOTE

The nose wheel cannot be straightened with the rudder pedals after the aircraft is stopped.

2. Parking brake – set.

3. Throttle 1000 rpm – set.

4. Radios – OFF.

5. Magneto groundout – checked. At 1000 rpm, turn ignition switch to OFF momentarily and observe that the engine completely ceases firing. Return the switch to BOTH.

(O) 6. Alternator switch – OFF.

7. Mixture – idle cut-off.

8. Ignition switch – OFF.

9. All switches – OFF.

3-73. BEFORE LEAVING AIRCRAFT.

CAUTION

The controls lock will only lock the ailerons and elevator in neutral position. If high winds are anticipated, a separate gust lock will be required to secure the rudder and prevent damage caused by severe buffeting.

1. Controls – LOCKED.

NOTE

Make appropriate entries in DA Form 2408-13 to include any limits that have been exceeded during the flight. Entries must also be made, when in the pilot's judgement, the aircraft has been exposed to unusual or excessive operations such as hard landing, etc.

2. DA Form 2408-12 and -13 – completed.

3. Windows and doors – closed.

4. Aircraft – secured. Install the pitot tube cover, chock the wheels, and tie down the aircraft, if required.

EMERGENCY PROCEDURES

Section I — INTRODUCTION

4-1. GENERAL.

4-2. This chapter covers the procedures to be followed in meeting emergencies (except those associated with auxiliary equipment) that can reasonably be expected to be encountered. To provide for easier cross referencing, the procedural steps in this chapter are numbered to coincide with the corresponding numbered steps in the Pilot's Checklist (TM 55-1510-212-CL).

NOTE

The urgency of certain emergencies in this chapter and in the Pilot's Checklist requires immediate and instinctive action by the pilot. The most important single consideration is aircraft control, and all procedures are subordinate to this requirement.

4-3. EXTENT OF COVERAGE.

4-4. Emergency operation of the auxiliary equipment will be included in this chapter only if it affects the safety of flight. All other emergency operation of auxiliary equipment is covered in Chapter 6.

Section II — ENGINE

4-5. ENGINE FAILURE.

4-6. Engine failures fall into two main categories; those occurring instantly, and those with ample indication prior to failure. The instant failure is rare and usually occurs only if ignition or fuel flow fails completely. Most engine failures are gradual and afford the alert pilot ample indication that he may expect a failure. An extremely rough-running engine, loss of oil pressure, excessive cylinder head temperature under normal flight conditions, and fluctuating RPM are indications that a failure is imminent. When indications point to an engine failure, the pilot should land as soon as practicable.

4-7. DURING TAKE-OFF RUN (ABORT).

CAUTION

If a malfunction occurs when there is sufficient runway for stopping, do not attempt a take-off.

1. Throttle – CLOSED.

2. Braking – as required.

NOTE

If an engine malfunction occurs when the remaining runway is insufficient for stopping, turn as necessary to avoid obstacles. Get clear immediately after the aircraft has come to a stop.

4-8. IMMEDIATELY AFTER TAKE-OFF.

WARNING

At low altitude, land straight ahead, changing direction only enough to miss obstacles. Do not try to turn back to the field unless sufficient altitude is available. Making a crash landing straight ahead with the aircraft under control is better than turning back and taking a chance of losing control.

1. Throttle – CLOSED.

2. Land – straight ahead.

4-9. DURING FLIGHT.

1. Airspeed –85 MPH. (74 KTS)

2. Fuel selector – BOTH. Check fuel selector valve in detent.

3. Mixture – RICH.

4. Propeller – INCREASE rpm.

5. Fuel pressure – checked. If insufficient fuel pressure, turn auxiliary fuel pump switch to HI.

4-10. ENGINE RESTART DURING FLIGHT.

NOTE

The engine should not be restarted unless it can be determined that it will be reasonably safe to do so.

4-11. If sufficient altitude is available to attempt a restart, proceed as follows:

1. Fuel selector – BOTH. Check fuel selector valve in detent.

2. Mixture – RICH.

3. Propeller – INCREASE rpm.

4. Throttle – closed.

5. Auxiliary fuel pump switch – HI.

6. Throttle – Open to obtain 8-10 gal/hr fuel flow; then reduce to 1 inch open.

7. Auxiliary fuel pump switch – OFF.

8. Ignition switch – START (if the propeller has stopped windmilling).

4-12. CHIP DETECTOR WARNING LIGHT.

4-13 Illumination of the chip detector warning light provides a visual indication of possible impending engine failure due to oil contamination by engine wear or material failure. Even though a loss of power may not be experienced when the light comes on in flight, a landing at the nearest airport should be made.

1. Engine instruments – monitor.

2. Land as soon as practical.

4-14. LOW/TOTAL LOSS OF OIL PRESSURE.

4-15. If low oil pressure is accompanied by normal oil temperature, there is a possibility the oil pressure gage or oil pressure relief valve is malfunctioning. A leak in the line to the oil pressure gage could also cause a drop in pressure but this is not necessarily cause for an immediate precautionary landing because an orifice in the line will prevent a sudden and complete loss of oil from the engine sump. However, a landing at the nearest airport should be made to inspect the source of trouble. If a total loss of oil pressure is accompanied by a rise in oil temperature, there is reason to suspect an engine failure is imminent. Reduce engine power immediately and select a suitable forced landing field. Leave the engine running at low power during the approach, using only the minimum power required to reach the desired touchdown spot.

4-16. SPARK PLUG FOULING.

4-17. An engine roughness in flight may be caused by one or more spark plugs becoming fouled by carbon or lead deposits. This may be verified by turning the ignition switch momentarily from the BOTH position to either L or R position. An obvious power loss in single ignition operation is evidence of spark plug or magneto trouble. Assuming that spark plugs are the more likely cause, lean the mixture slightly for cruising flight. If the problem does not clear up in several minutes, determine if a richer mixture setting will produce smoother operation. If not, proceed to the nearest airport using the BOTH position of the ignition switch unless extreme roughness dictates the use of a single ignition position.

4-18. MAGNETO MALFUNCTION.

4-19. A sudden engine roughness or misfiring is usually evidence of magneto problems. Switching from BOTH to either the L or R ignition switch position will identify which magneto is malfunctioning. Select different power settings and enrichen the mixture to determine if continued operation on both magnetos is practicable. If not, switch to the good magneto and proceed to the nearest airport.

4-20. ENGINE SHUTDOWN IN FLIGHT.

4-21. In the event it is desired to shut down the engine in flight, follow the normal shutdown procedure.

4-22. MAXIMUM GLIDE.

4-23. In the event the engine fails during flight and cannot be restarted, maximum gliding distance can be

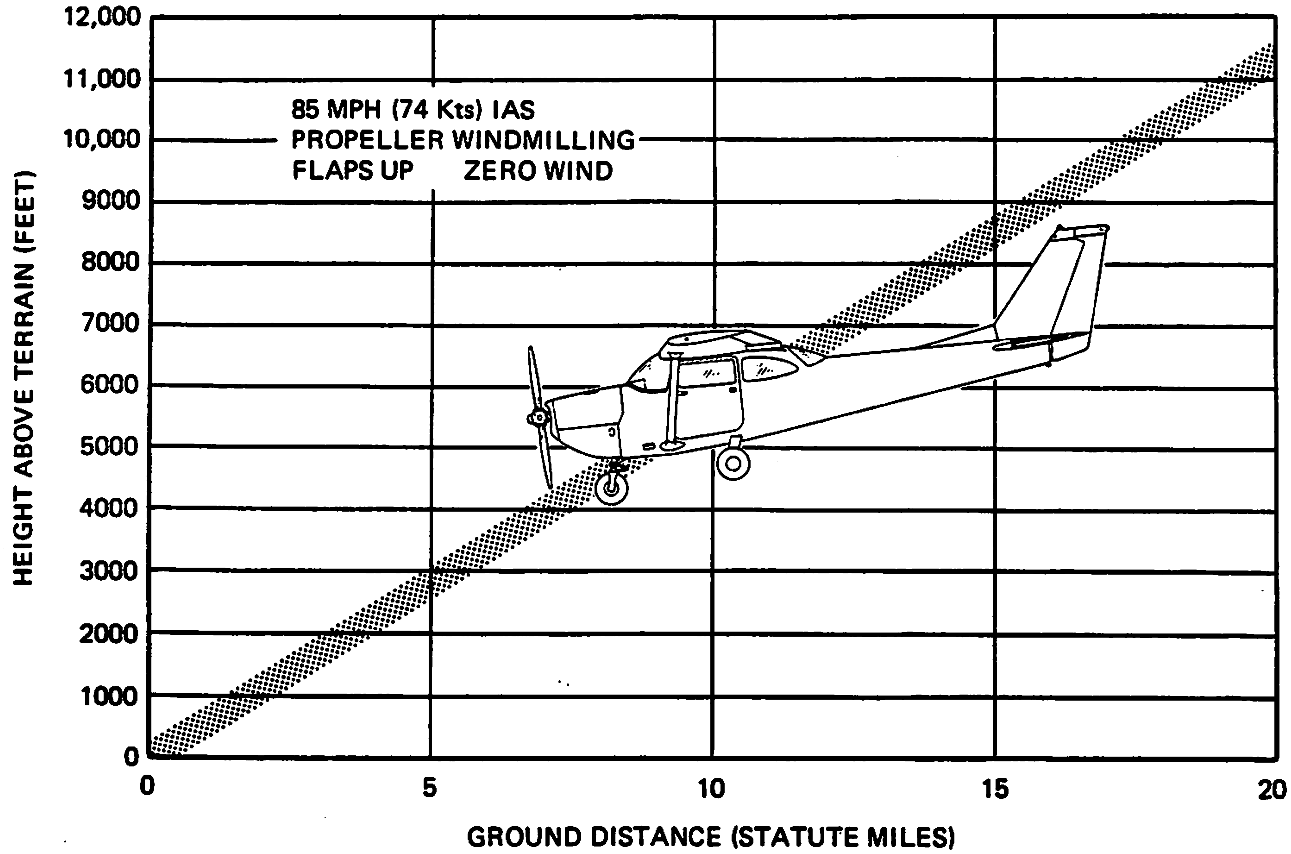


Figure 4-1. Maximum glide distance

obtained by maintaining 85 MPH with wing flaps up and the propeller windmilling. Refer to figure 4-1, maximum glide distance.

NOTE

Do not attempt to stop the propeller from windmilling. The altitude lost trying to stop the propeller more than offsets the additional performance gained with the propeller stopped.

4-24. LANDING WITH ENGINE INOPERATIVE.

4-25. If all attempts to restart the engine fail, and a forced landing is imminent, select a suitable field and prepare the aircraft for landing. Shut off fuel flow to the engine by pulling the mixture control to idle cut-off and pulling the fuel shutoff valve knob full out. Turn off all switches except the master switch. Use normal landing approach speeds, extending flaps as necessary within gliding distance of the field. Unlatch the cabin doors prior to final approach, and turn off the master switch before touchdown. Land the aircraft in a slightly tail-low attitude, and apply heavy braking while holding full-up elevator.

Section III — PROPELLER

4-26. PROPELLER FAILURE.

CAUTION

Prompt corrective action is essential to prevent engine failure due to excessive rpm.

4-27. If a failure of the propeller governor occurs and the propeller goes into low pitch (high rpm), resulting in a runaway propeller, proceed as follows:

1. Throttle – reduce power. Maintain rpm

within operating limit (2800 rpm).

2. Airspeed – reduce. Pull aircraft into a climb to decrease airspeed and increase load on the propeller.

3. Propeller – DECREASE rpm. Attempt to restore governing.

NOTE

If, after moving the propeller control through the full range of travel, control is not regained, reposition the propeller control to full INCREASE, adjust the throttle to maintain rpm within limits, and land as soon as practicable. Propeller failure resulting in high pitch (low rpm) is rare; however, if this type of failure occurs, use power required to maintain flight. With loss of oil pressure, the propeller will go to low pitch (high rpm).

Section IV – FIRE

4-28. ENGINE FIRE.

4-29. ENGINE FIRE DURING START.

4-30. Improper starting procedures involving the excessive use of auxiliary fuel pump operation can cause engine flooding and increase the chances of an engine fire. This is sometimes experienced in difficult starts in cold weather. In the event of an engine fire, proceed as follows:

1. Auxiliary fuel pump – OFF.

2. Throttle – OPEN.

3. Ignition switch – START. Continue cranking the engine; the fire may be sucked through the engine and extinguished.

4. Mixture – idle cut-off (if fire is not extinguished).

5. Ignition switch – OFF.

6. Master switch – OFF.

7. Fuel shutoff valve – OFF.

8. Exit aircraft.

4-31. ENGINE FIRE DURING FLIGHT.

WARNING

Do not attempt to restart the engine after the fire goes out. Make an emergency landing or bail out.

1. Mixture – idle cut-off.

2. Fuel shutoff valve – OFF.

3. Ignition switch – OFF.

4. Master switch – OFF.

5. Glide speed – 120 MPH. (104 KTS)

6. Cabin heat and air knobs – IN. Close to prevent smoke from entering the cabin.

4-32. FUSELAGE FIRE.

WARNING

Monobromotrifluoromethane (CF_3Br) is very volatile, but is not easily detected by its odor. Although nontoxic, it must be considered to be about the same as other freons and carbon dioxide, causing danger to personnel primarily by reduction of oxygen available for proper breathing. During operation of the hand fire extinguisher, ventilate personnel areas with fresh air. The liquid should not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns.

WARNING

If fire cannot be extinguished, land as soon as possible or bail out.

1. Master switch – OFF.

2. Cabin heat and air knobs – IN. Close off all air sources that might aggravate the fire.

3. Fight the fire.

NOTE

The portable fire extinguisher agent can be directed on most cabin fires without moving from the pilot/copilot position.

4-33. WING FIRE.

WARNING

Perform a sideslip to keep flames away from the fuel tank and cabin, and land as soon as possible. Bail out, if necessary.

4-34. There is little that can be done to control a wing fire except to shut off all electrical systems that may be contributing to the fire, or which could aggravate it. Slipping the aircraft away from the burning wing may help.

4-35. ELECTRICAL FIRE.

4-36. Circuit breakers isolate most electrical circuits and automatically interrupt power to prevent a fire when a short occurs. If electrical power is essential, as during instrument flight, an attempt to identify and isolate the shorted circuit may be feasible. This can be accomplished as follows:

1. Master switch – OFF.

(O) 2. Alternator switch – OFF. Turn off all remaining switches (except ignition switch).

3. Isolate defective circuit.

NOTE

Check condition of circuit breakers to identify faulty circuit if possible, and leave faulty circuit deactivated. Then turn on the master switch and individually turn each circuit on again, allowing a short time delay before proceeding to the next, until the shorted circuit is identified. If the shorted circuit cannot be identified and isolated, remove power from all electrical equipment and land as soon as practicable.

4-37. SMOKE AND FUME ELIMINATION.

4-38. Rid the cabin of smoke and fumes when it is certain that the fire is out and will not be aggravated by drafts.

1. Cabin heat – OFF.
2. Cabin air – OFF.
3. Upper air vents – OPEN.
4. Pilot's window – OPEN (below 100 MPH). (87 KTS)

Section V – FUEL SYSTEM

4-39. FUEL SYSTEM FAILURE.

4-40. LOSS OF FUEL PRESSURE.

4-41. A loss of engine power in flight may result from loss of fuel pressure due to a failure of the engine-driven fuel pump. If this should occur during the high power climb after take-off, the auxiliary fuel pump switch should be held in the HI position until a safe altitude is reached. Then power should be reduced to a low cruise power setting and the switch placed in the LOW position until the airplane has completed a safe landing. If an engine-driven fuel pump failure occurs in cruising flight, the auxiliary fuel pump switch should be placed in the LOW position and a landing should be planned at the nearest suitable airport. A power setting of 65% or less should be selected during the flight to the airport to assure smooth engine operation. If higher power settings are needed, the switch must be held manually to the HI position to maintain adequate fuel flow. If this results in rough engine operation, lean the mixture as required for smooth operation.

1. Mixture – RICH.
2. Auxiliary fuel pump – as required.
3. Mixture – as required.

Section VI — ELECTRICAL SYSTEM

4-42. ELECTRICAL SYSTEM FAILURE.

NOTE

If a complete electrical failure occurs, or if it becomes necessary to turn the alternator and master switches OFF, a landing should be made as soon as practicable.

4-43. Malfunctions in the electrical power supply system can be detected by periodic monitoring of the ammeter and over-voltage warning light; however, the cause of these malfunctions is usually difficult to determine. Broken or loose alternator wiring is most likely the cause of alternator failures, although other factors could cause the problem. A damaged or improperly adjusted voltage regulator can also cause malfunctions. Problems of this nature constitute an electrical emergency and should be dealt with immediately. Electrical power malfunctions usually fall into two categories: excessive rate of charge and insufficient rate of charge. The paragraphs below describe the recommended remedy for each situation.

4-44. EXCESSIVE RATE OF CHARGE.

4-45. After engine starting and heavy electrical usage at low engine speeds (such as extended taxiing) the battery condition will be low enough to accept above normal charging during the initial part of a flight. However, after thirty minutes of cruising flight, the ammeter should be indicating less than two needle widths of charging current. If the charging rate were to remain above this value on a long flight, the battery would overheat and evaporate the electrolyte at an excessive rate. Electronic components in the electrical system could be adversely affected by higher than normal voltage if a faulty voltage regulator setting is causing the overcharging. To preclude these possibilities, an over-voltage sensor will automatically shut down the alternator and the over-voltage warning light will illuminate if the charge voltage reaches approximately 32 volts. Assuming that the malfunction was only momentary, an attempt should be made to reactivate the alternator system. To do this, turn the master switch OFF and then ON again. If the problem no longer exists, normal alternator charging will resume and the warning light will go off. If the light comes on again, a malfunction is confirmed. In this event, the flight should be terminated and/or the current drain on the battery minimized because the battery can supply the electrical system for only a limited period of time. If the emergency occurs at night, power must be conserved for later use of the landing light and flaps during landing.

4-46. INSUFFICIENT RATE OF CHARGE.

4-47. If the ammeter indicates a continuous discharge rate in flight, the alternator is not supplying power to the system and should be shut down since the alternator field circuit may be placing an unnecessary load on the system. All non-essential equipment should be turned off and the flight terminated as soon as practicable.

Section VII — HYDRAULIC SYSTEM (Not applicable)

Section VIII — LANDING AND DITCHING

4-48. EMERGENCY DESCENT.

4-49. Emergency descent is a maximum effort in which damage to the aircraft or engine must be considered secondary to getting the aircraft down. For emergency descent, proceed as follows:

1. Mixture – RICH.
2. Propeller – INCREASE rpm.
3. Throttle – CLOSED.
4. Flaps – UP.
5. Airspeed – 182 MPH. (158 KTS)

4-50. LANDING EMERGENCIES (EXCEPT DITCHING).

4-51. LANDING ON ROUGH TERRAIN.

4-52. If engine power is available, a landing on rough terrain should not be attempted until a pass has been made over the landing area at a safe but low altitude to inspect the terrain for obstructions and surface conditions. In the descent from altitude, a Before Landing check should be made to set up the aircraft for landing, then drag over the selected field with flaps 20° at 75 MPH, noting the preferred area for touchdown on the next landing approach. After the pass, retract the flaps when well clear of all obstacles. When a landing pattern has been established, turn off all switches except the ignition and master switches to minimize the chances of fire, and proceed as follows:

1. Parachutes – unbuckled.
2. Seat belt and shoulder harness – tightened.
3. Doors – OPEN.
4. Flaps – as required.
5. Shoulder harness – LOCKED.
6. Make a normal, tail-low, full-stall landing.

NOTE

In the event the aircraft is damaged during landing, the rear seat occupant should exit through the cabin door (either side) first since it is easier to exit out the door from the rear seat with the front seats forward. If necessary, exit could be made from the rear seat by kicking out the side windows. The parachute should be removed prior to emergency egress through a window. After the rear occupant exits, the front seat occupant can slide his seat aft to exit. If the doors are jammed shut, pull the emergency door release handle (one for each door) and push the door outward. Exit could also be made by opening the cabin door windows.

4-53. LANDING WITH FLAT TIRE.

4-54. When a landing is made with a flat tire on a main gear, the aircraft can be expected to turn toward the flat tire side. If aware that the main gear tire is flat, a landing close to the edge of the runway opposite the flat tire will help avoid veering off the runway. With flaps extended, land the aircraft with the nose up and the wing tilted to hold the flat tire off the ground as long as possible. At touchdown, directional control can be maintained with rudder and the brake on the good wheel. If the nose wheel tire is flat, nose wheel stability will be reduced and application of brakes should be used only as required to maintain positive control. Use the following procedure:

1. Land – on side of runway favoring good tire.
2. Brake – on good wheel only.

4-55. EMERGENCY ENTRANCE.

4-56. To gain emergency entrance into the cabin, pull the hinge pins which secure the cabin door hinges on either cabin door and pull the door(s) from the aircraft. If unsuccessful, entrance can also be gained by kicking in any of the cabin windows. See figure 4-2.

4-57. DITCHING.

4-58. Prepare for ditching by securing or jettisoning heavy objects located in the baggage area, and collect folded coats (if available) for protection of occupant's face at touchdown. Plan the approach into the wind if wind is high and seas are heavy. With heavy swells and light wind, land parallel to the swells, being careful not to allow a wing tip to hit first. Approach with flaps 40° and sufficient power for a 300 foot/minute rate of descent at approximately 75 MPH. Maintain a continuous descent until touchdown in a level attitude. Avoid a landing flare because of the difficulty in judging the aircraft height over a water surface. For additional protection on impact, place folded coats in front of face. Evacuate the aircraft through the cabin doors. The aircraft cannot be depended upon for flotation for more than a few minutes. During the preparation for ditching, proceed as follows:

1. Radio – distress procedure.
2. Passengers – briefed.
3. Parachute – unbuckled, remove shoulder straps.
4. Belts and harnesses – tight and locked.
5. Doors – OPEN.
6. Flaps – DOWN.
7. Master switch – OFF. Turn off just before impact.

AUXILIARY EQUIPMENT

Section I — INTRODUCTION

6-1. GENERAL.

6-2. This chapter includes the description and normal and emergency operation of all equipment not directly contributing to flight, but which enables the aircraft to perform certain specialized functions.

Section II — HEATING, VENTILATING AND DEFROSTING SYSTEMS

6-3. HEATING SYSTEM (figure 6-1).

6-4. Ram air, routed through a duct connected to the forward right-hand engine baffle, is delivered to the exhaust muffler heat exchanger, where it is heated and then ducted to the firewall shutoff valve. The firewall shutoff valve is mechanically operated by a push-pull control (15, figure 2-4) labeled CABIN HT, PULL ON, located on the lower switch and control panel. As the control is pulled, the firewall shutoff valve is opened, and heated air is allowed to flow through. The heated air then enters the air distribution plenum where it feeds the defrosters and the forward and aft cabin outlets. The defroster ducts deliver the heated air to outlets at the lower edge of the windshield. The forward cabin receives heated air from a series of holes in the air distribution plenum. Heated air for the aft cabin is provided by two outlets, one on each side of the cabin, that terminate at the forward doorposts. When the CABIN HT control is pushed full in, the firewall shutoff valve is closed and the heated air is dumped overboard.

6-5. CABIN HEAT CONTROL KNOB.

6-6. The push-pull control (15, figure 2-4) labeled CABIN HT, PULL ON, is located on the lower switch and control panel. The control provides a mechanical means of opening and closing the firewall shutoff valve. The position of this valve determines the quantity of heated air which enters the air distribution plenum. Heated air flow is at its maximum when the control is pulled full aft.

6-7. VENTILATING SYSTEM (figure 6-1).

6-8. An adjustable ventilation air intake valve is provided on the forward right-hand side of the fuselage The valve is mechanically operated by a push-pull control, (14, figure 2-4) labeled CABIN AIR, PULL ON, located on the lower switch and control panel. As the control is pulled, ram air enters the valve and is ducted to the air distribution plenum where it feeds the defroster, forward and aft cabin outlets.

6-9. CABIN AIR CONTROL KNOB.

6-10. The push-pull control (14, figure 2-4) labeled CABIN AIR, PULL ON, is located on the lower switch and control panel. The control provides a mechanical means of opening and closing the ventilating air intake valve. The position of this valve determines the quantity of ventilating air which enters the air distribution plenum. Ventilation air flow is at its maximum when the control is pulled full aft. The cabin air control may be used in conjunction with the cabin heat control to provide a higher flow rate and more precise temperature control of the heated air.

6-11. NORMAL OPERATION (HEATING AND VENTILATING SYSTEMS).

a. Heating.

1. Cabin heat control - as required.
2. Cabin air control - as required.

b. Ventilation.

1. Cabin air control - as required.

c. Shutdown.

1. Cabin heat control - push in.
2. Cabin air control - push in.

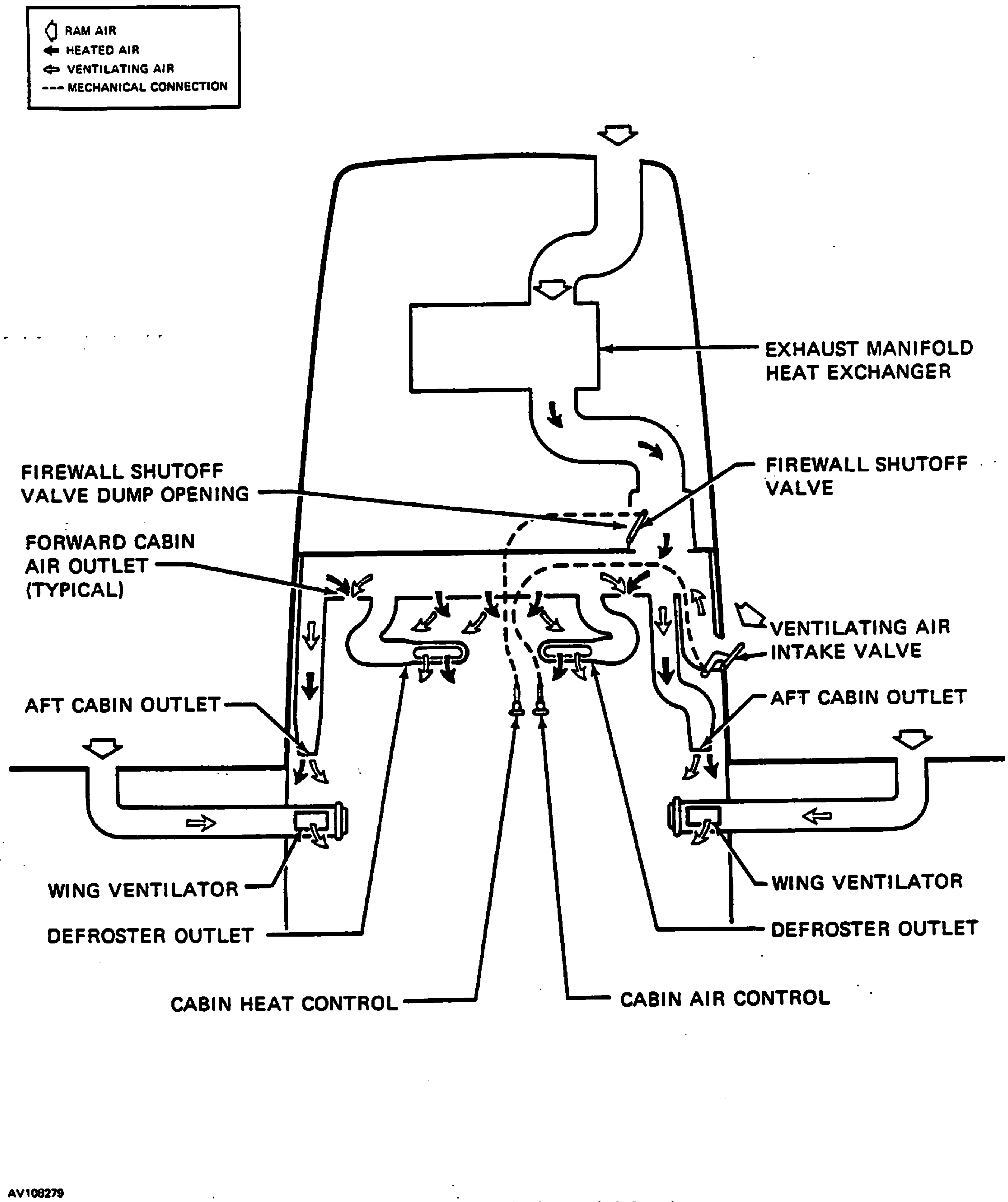


Figure 6-1. Heating, ventilating and defrosting system.

6-12. EMERGENCY OPERATION (HEATING AND VENTILATING SYSTEMS).

6-13. Should fumes or smoke enter the cabin through the heating and ventilating system, perform the following:

a. Heating system.

1. Cabin heat control - push in.

b. Ventilating system.

1. Cabin air control - push in.

6-14. DEFROSTING SYSTEM (figure 6-1).

6-15. The defrosting system air is supplied by two ducts routed from the air distribution plenum to outlets at the lower edge of the windshield. Air is supplied to the system whenever the CABIN HT or CABIN AIR control knobs are pulled. The CABIN HT control regulates the quantity of heated air and the CABIN AIR control regulates the quantity of ventilating air which is supplied to the defroster outlets.

6-16. WING-MOUNTED VENTILATORS.

6-17. One wing-mounted ventilator (9, figure 2-8, and 5, figure 2-9) is provided near each upper corner of the windshield. These ventilators pick up ram air from intakes on the leading edge of each wing. The ventilators are pulled out to allow airflow, and pushed in to stop the airflow. The ventilators may be rotated fore and aft and therefore provide some directional control for the airflow.

Section III — ANTI-ICING AND DEICING SYSTEM

6-18. PITOT HEAT SYSTEM.

CAUTION

Always place the pitot heat switch in the off position while on the ground to prevent overheating of the heating elements.

6-19. The electrically heated pitot tube is heated by a 24 volt, 80 watt heater which is controlled by a PITOT HEAT, PULL-ON switch (5, figure 2-4) located on the lower switch and control panel. The circuit is protected by an 8 amp push-to-reset circuit breaker (22, figure 2-4) located on the lower switch and control panel.

Section IV — LIGHTING EQUIPMENT

6-20. EXTERIOR LIGHTING.

WARNING

The rotating or flashing beacon should not be used when flying through clouds or overcast; the rotating or flashing light reflected from the water droplets or particles in the atmosphere, particularly at night, can produce vertigo and loss of orientation.

6-21. NAVIGATION LIGHTS.

6-22. Conventional red and green navigation lights are mounted in the wing tips. A white navigation light is mounted in the upper aft rudder tip. The navigation lights switch (6, figure 2-4) is labeled NAV. LIGHTS, PULL ON and located on the lower switch and control panel. The navigation lights circuit is protected by a 5 amp push-to-reset circuit breaker (21, figure 2-4) located on the lower switch and control panel.

6-23. ROTATING BEACON (AIRCRAFT NOT MODIFIED BY CONTRACT DAAJ01-72-C-0477).

6-24. The rotating beacon is attached to the upper forward area of the vertical fin. The beacon contains a small motor, which rotates a shutter containing three lens openings, around a single bulb; this assembly is covered by a red lens. The rotating beacon switch (7, figure 2-4) is labeled BEACON, PULL-ON and located on the lower switch and control panel. The rotating beacon circuit is protected by an 8 amp push-to-reset circuit breaker (24, figure 2-4) located on the lower switch and control panel.

6-25. FLASHING BEACON (AIRCRAFT MODIFIED BY CONTRACT DAAJ01-72-C-0477).

6-26. The falshing beacon is attached to the upper forward area of the vertical fin. The flashing beacon is an iodine-vapor lamp electrically switched by a solid-state flasher assembly. The flashing beacon switch (7, figure 2-4) is labeled BEACON, PULL-ON and located on the lower switch and control panel. The flashing beacon circuit is protected by a 5 amp push-to-reset circuit breaker (24, figure 2-4) located on the lower switch and control panel.

6-27. LANDING AND TAXI LIGHTS.

6-28. The landing and taxi lights are mounted in the leading edge of the left wing. A clear plastic cover provides weather protection for the lamps and is shaped to maintain the leading edge curvature of the wing. The landing light mounted on the inboard side is adjusted to project its beam forward, while the taxi light mounted on the outboard side projects its beam down. Both lights may be used for take-off and landing. The landing and taxi lights switch (8, figure 2-4) is labeled LAND LIGHTS, PULL-ON and located on the lower switch and control panel. The switch incorporates two stops as it is pulled out. The first stop applies power to the taxi light only; the second stop applies power to both lights. The landing and taxi lights circuit is protected by a 10 amp push-to-reset circuit breaker (19, figure 2-4) located on the lower switch and control panel.

6-29. INTERIOR LIGHTING.

6-30. INSTRUMENT PANEL LIGHTS.

6-31. Individual post lights are provided for non-glare instrument lighting. The intensity of the instrument post lights is controlled by the PANEL-LIGHTS control (9, figure 2-4) located on the lower switch and control panel.

6-32. INSTRUMENT PANEL FLOOD LIGHT.

6-33. The instrument panel flood light (4, figure 2-8) consists of a red lens and a single bulb mounted in the forward portion of the overhead console. Flood lighting is controlled by a dimming rheostat on the right side of the overhead console.

6-34. COCKPIT LIGHT.

6-35. The cockpit light (4, figure 2-8) consists of a frosted lens and a single bulb mounted in the center of the overhead console. The light is controlled by a slide switch located adjacent to the light.

6-36. MAP LIGHT.

6-37. The map light (8, figure 2-8) mounted on the forward left door post provides both white map lighting and red non glare instrument lighting. The map light is controlled by a three-position switch labeled RED, and red non-glare instrument lighting. The map light is controlled by a three-position switch labeled RED, OFF, WHITE located directly below the map light. The intensith of the red light is controlled by the rheostat located on the overhead console.

Section V — OXYGEN

(Not applicable)

Section VI — AUXILIARY POWER UNIT

(Not applicable)

Section VII — ARMAMENT

(Not applicable)

OPERATING LIMITATIONS

Section I — INTRODUCTION

7-1. GENERAL.

7-2. This chapter covers all important limitations that must be observed during normal flight operations.

7-3. EXTENT OF COVERAGE.

7-4. Limitations that are characteristic of specialized phases of operation are not covered in this chapter, but may be found either in Chapter 4, Emergency Procedures, or Chapter 10, Weather Operation.

Section II — LIMITATIONS

7-5. GENERAL.

7-6. This section includes the aircraft and engine limitations to be observed during normal operation. The limits are presented to insure your safety and to help obtain maximum utility from the equipment. The instrument markings are shown in figure 7-1.

7-7. MINIMUM CREW REQUIREMENT.

7-8. The minimum crew consists of one pilot in the left front seat.

7-9. INSTRUMENT MARKINGS.

7-10. Instruments which display operating limitations are illustrated in figure 7-1. The operating limitations are color coded on the instrument faces. Color coding of each instrument is explained in the illustrations.

7-11. ENGINE LIMITATIONS.

7-12. All normal engine limitations are shown in figure 7-1. An engine overspeed up to 3200 RPM, for a maximum of 10 seconds, requires no teardown or inspection. A log book entry is the only requirement. Overspeeds from 3200 to 3400 RPM, for a maximum of 10 seconds, require inspection. Overspeeds above 3400 RPM require engine removal for complete major overhaul.

7-13. PROPELLER LIMITATIONS.

7-14. The maximum allowable propeller speed is 2800 RPM. A propeller overspeed in excess of 2800 RPM but not to exceed 3220 RPM requires only a visual inspection of the propeller. An overspeed from 3220 RPM not to exceed 3640 RPM requires propeller teardown and inspection. Any overspeed in excess of 3640 RPM requires the propeller be replaced.

7-15. AIRSPEED LIMITATIONS.

7-16. The following is a list of the calibrated airspeed limitations.

(158 KTS)	Maximum Allowable (red line) . . .	182 MPH
(126–158 KTS)	Caution Range (yellow arc) . .	145 - 182 MPH
(56–126 KTS)	Normal Range (green arc) . . .	64 - 145 MPH
(49–87 KTS)	Flap Operating Range (white arc)	56 - 100 MPH

CAUTION

The maneuvering speed is the maximum speed at which abrupt control travel can be used.

Maneuvering Speed (110 KTS) 127 MPH

7-17. MANEUVERS.

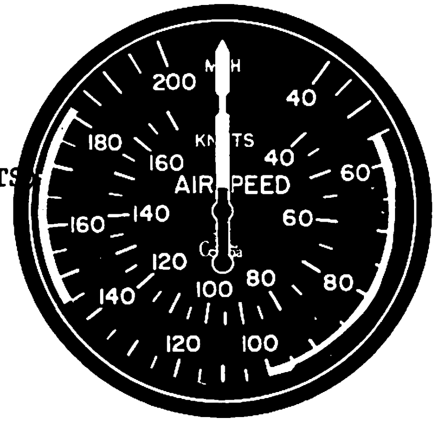
7-18. NORMAL CATEGORY.

7-19. The normal category is applicable to aircraft intended for non-aerobatic operations. These include any maneuvers incidental to normal flying, stalls (except whip stalls) and turns in which the angle of bank is not more than 60°. In connection with the foregoing, the following gross weight and acceleration limits apply:

BASED ON AVIATION GRADE 115/145 FUEL

AIRSPEED

- 182 MPH, Maximum Allowable (158 KTS)
- 145-182 MPH, Caution Range (126-158 KTS)
- 64-145 MPH, Normal Operating Range (56-126 KTS)
- 56-100 MPH, Flap Operating Range (49-87 KTS)



FUEL FLOW AND MANIFOLD PRESSURE

FUEL FLOW

- 3.0 psi, Minimum
- 4.5-11.5 GPH, Normal Operating Range
- 18.5 psi (18 GPH), Maximum

MANIFOLD PRESSURE

- 15-25 Inches Hg, Normal Operating Range

TACHOMETER

- 2800 RPM, Maximum
- 2200-2600 RPM, Normal Operating Range

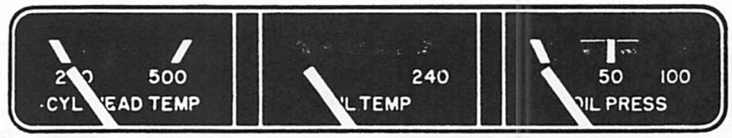
AV108280.1

Figure 7-1. Instrument markings (sheet 1 of 2) (typical).

CYLINDER HEAD TEMPERATURE

460°F, Maximum

200° - 460°F, Normal Operating Range



OIL TEMPERATURE

240°F, Maximum Allowable

100° - 240°F, Normal Operating Range

OIL PRESSURE

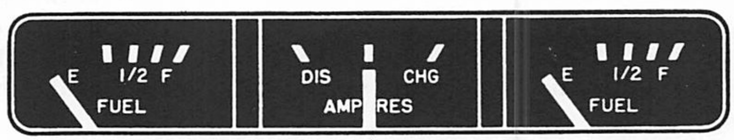
10 psi, Minimum Idling

30-60 psi, Normal Operating Range

100 psi, Maximum

FUEL QUANTITY

Empty



SUCTION

4.6 - 5.4 Inches Hg., Normal Operating Range

AV108280.2

Figure 7-1. Instrument markings (sheet 2 of 2) (typical).

Gross weight	2500 lbs.
Flaps Up	+3.8 g -1.52 g
Flaps Down	+3.5 g

7-20. UTILITY CATEGORY.

CAUTION

The baggage compartment and rear seat must not be occupied while performing maneuvers.

CAUTION

No aerobatic maneuvers are approved except those listed.

7-21. In connection with the utility category, the following gross weight, acceleration limits, maneuvers and entry speeds apply:

Gross weight	2200 lbs.
Flaps Up	+4.4 g -1.76 g
Flaps Down	+3.5 g

MANEUVER	MAXIMUM ENTRY SPEED
Chandelles	127 MPH (110 knots)
Lazy Eights	127 MPH (110 knots)
Steep Turns	127 MPH (110 knots)
Spins	Slow Deceleration
Stalls (Except whip stalls)	Slow Deceleration

7-22. ACCELERATION LIMITATIONS.

7-23. For acceleration limitations, refer to the paragraphs covering the normal and utility categories in this section.

7-24. CENTER OF GRAVITY LIMITATIONS.

WARNING

Improper loading can result in exceeding approved aircraft weight and cg limits.

7-25. Refer to Chapter 12, WEIGHT AND BALANCE COMPUTATION, for weight control data.

7-26. WEIGHT LIMITATIONS.

7-27. NORMAL CATEGORY.

7-28. The maximum designed gross weight for all normal category operations, including take-off and landing is 2500 pounds. Space provisions are available for loading in excess of this amount. Limitations of fuel, and extra mission equipment are necessarily dependent on each other if the flight is to be within the designed gross weight of the aircraft.

7-29. UTILITY CATEGORY.

7-30. The maximum designed gross weight for all utility category operations, including take-off and landing is 2200 pounds. Space provisions are available for loading in excess of this amount. Limitations of fuel, and extra mission equipment are necessarily dependent on each other if the flight is to be within the designed gross weight of the aircraft.

FLIGHT CHARACTERISTICS

Section I — INTRODUCTION

8-1. GENERAL.

8-2. This chapter describes the flight characteristics of the aircraft.

8-3. EXTENT OF COVERAGE.

8-4. Thorough coverage is provided on stalls, spins, diving and maneuvering flight.

Section II — GENERAL FLIGHT CHARACTERISTICS

8-5. STALLS.

8-6. NORMAL STALL CHARACTERISTICS.

8-7. The stall characteristics of the aircraft are conventional. Stall warning is provided by the stall warning horn between 5 and 10 mph above stall in all configurations. The power-on stall occurs at a high angle of attack with or without flaps and it is difficult to inadvertently stall the aircraft during normal maneuvering flight. The stalls in all configurations are characterized by a gentle drop of the nose in a wing level attitude. Recovery is effected very quickly with a minimum loss of altitude providing the nose is not lowered excessively and power is applied promptly.

NOTE

The term power-on means that the engine and propeller are operating normally at power settings appropriate for cruise or climb. The term power-off shall mean the engine is operating at idle power.

8-8. ACCELERATED STALLS.

8-9. Accelerated stalls are caused by increasing the aircraft's weight due to centrifugal force in a turn or an abrupt pull-out from a dive. Stalls in accelerated flight are preceded by both the stall warning horn and a mild aerodynamic buffet. Recovery can most easily be accomplished by releasing back pressure on the control wheel and, if necessary, increasing power and diving to accelerate out of stall speed range.

8-10. STALL RECOVERY.

CAUTION

Observe the maximum flap operating speed if the flaps are extended, as excessive air loads may cause structural damage.

8-11. Conventional stall recovery techniques are used, and ailerons may be used to counteract any wing dropping tendencies.

8-12. PRACTICE STALLS.

8-13. Practice stalls should include power-on and power-off stalls in straight and turning flight with recovery initiated before and after the stall is entered. Retard the throttle smoothly for power-off stalls and use a power setting of about 23 in. Hg. and 2400 RPM for power-on stalls. In power-off stalls, the aircraft may be stalled by rotating the aircraft to the approximate normal landing attitude. Recoveries should include dropping the nose to regain flying speed and applying full power. The nose should not be lowered excessively and the return to level flight should be initiated promptly to prevent excessive loss of altitude. Recovery from power-on stalls can be accomplished by lowering the nose towards a level attitude. The aircraft should fly out of the stall with minimal altitude loss.

GROSS WT (LBS)	0° FLAPS						20° FLAPS						40° FLAPS					
	2500		2200		1900		2500		2200		1900		2500		2200		1900	
	MPH	KN	MPH	KN	MPH	KN	MPH	KN	MPH	KN	MPH	KN	MPH	KN	MPH	KN	MPH	KN
LEVEL FLIGHT	64	56	60	52	56	49	58	50	54	47	51	44	53	46	50	43	46	40
30° BANK	69	60	64	56	60	52	62	54	58	50	55	48	57	50	54	47	49	43
45° BANK	76	66	71	62	67	58	69	60	64	56	61	53	63	55	59	51	55	48
60° BANK	91	78	85	74	79	69	82	72	76	66	72	63	75	65	71	62	65	56
POWER OFF — CAS																		
Power-off stall speeds are presented as calibrated airspeeds since indicated airspeeds are unreliable near the stall.																		

AV108281

Figure 8-1. Stall speed.

8-14. SPINS.

8-15. Intentional spins are permitted only while operating in the utility category where occupants are restricted to the front seats.

8-16. SPIN CHARACTERISTICS.

8-17. Although the aircraft is inherently resistant to spins, the following procedure may be used to perform intentional spins. To obtain a clean entry, decelerate the aircraft at a slightly faster rate than is used for stalls. Then, just as the stall occurs, apply full up elevator, full rudder in the desired spin direction, and momentarily apply a burst of engine power. As the aircraft begins to spin, reduce the power to idle and maintain full elevator and rudder deflections.

8-18. SPIN RECOVERY.

8-19. To recover from a spin, use the following standard recovery procedure:

1. Throttle – retard to idle.

2. Rudder – apply full rudder opposite the direction of rotation.

3. Control wheel – move briskly forward of neutral position.

NOTE

During spin recovery, the wheel should be moved straight forward to prevent binding of the control shaft.

4. As the rotation stops, neutralize the rudder, and make a smooth recovery from the resulting dive.

8-20. DIVING.

CAUTION

To avoid structural damage, do not exceed the engine or airspeed limitations.

8-21. Dives in smooth air shall be limited to the maximum diving airspeed as shown on the airspeed indicator. In rough air the dive speed should be reduced toward the top of the green arc range. The trim changes and other characteristics are conventional in dives. Recovery from any dive should be made gradually, since the structural load on the aircraft increases in direct relation to the abruptness of the pullout and turbulence in the atmosphere.

8-22. MANEUVERS.

8-23. NORMAL CATEGORY.

8-24. The normal category is applicable to aircraft intended for non-aerobatic operations. These include any maneuvers incidental to normal flying, stalls (except whip stalls) and turns in which the angle of bank is not more than 60°.

8-25. UTILITY CATEGORY.

8-26. The utility category is applicable to the aircraft when the limitations of the category are observed. The aircraft then may be flown into the approved aerobatic maneuvers, which are: chandelles, lazy eights, steep turns, spins and stalls (except whip stalls). While performing these maneuvers the baggage compartment and rear seat must not be occupied. Refer to Chapter 7 for the maneuver entry speeds and permissible load factors.

Section III — CONTROL CHARACTERISTICS

8-27. FLIGHT CONTROLS.

8-28. The aircraft is stable under all normal flight conditions. Aileron, elevator, rudder and trim tab controls function effectively throughout slow, cruising, and high speed flight. In cross control maneuvers such as steep sideslips, a nose-down pitching motion may be encountered under certain combinations of airspeed, sideslip angle, and center of gravity loadings. To avoid this condition, limit the flap setting to 30° when performing slips.

8-29. LEVEL FLIGHT CHARACTERISTICS.

8-30. All flight characteristics are conventional throughout the level flight speed range. No special technique is required.

WEIGHT AND BALANCE COMPUTATION

SECTION I — INTRODUCTION

12-1. GENERAL.

12-2. This chapter provides appropriate information required for the computation of weight and balance for loading the T-41B aircraft.

12-3. EXTENT OF COVERAGE.

12-4. Sufficient data has been provided so that, knowing the basic weight and moment of the aircraft, any combination of weight and balance can be computed.

12-4A. CLASS.

12-4B. Army Model T41-B is in Class 2. Additional directives governing weight and balance of Class 2 aircraft forms and records are contained in AR 95-16, TM 55-1500-342-23 and DA PAM 738-751.

SECTION II — GENERAL

12-5. PURPOSE.

12-6. The data to be inserted on weight and balance charts and forms are applicable only to the individual aircraft, the serial number of which appears on the title page of the booklet entitled WEIGHT AND BALANCE DATA supplied by the aircraft manufacturer and on the various forms and charts which remain with the aircraft in accordance with existing directives. The charts and forms referred to in this chapter may differ in nomenclature and arrangement from time to time, but the principle on which they are based will not change.

12-7. CHARTS AND FORMS.

12-8. The standard system of weight and balance control requires the use of several different charts and forms. They are identified as follows:

1. Chart C – Basic Weight and Balance Record, DD Form 365C.

2. Chart E – Loading Data, Charts and Graphs.

12-9. RESPONSIBILITY.

12-10. The aircraft manufacturer inserts all aircraft identifying data on the title page of the booklet entitled WEIGHT AND BALANCE DATA and on the various charts and forms. All charts, including one sample Weight and Balance Clearance Form F, if applicable, are completed at time of delivery. This record is the basic weight and balance data of the aircraft at delivery. All subsequent changes in weight and balance are compiled by the weight and balance technician.

12-11. AIRCRAFT WEIGHING.

12-12. The aircraft must be weighed periodically as required by pertinent directives or when:

1. The pilot reports unsatisfactory flight characteristics (nose or tail heaviness).

2. Major modifications or repairs are made.

3. The basic weight data contained in the records are suspected to be in error. The basic weight and cg location can only be as accurate as the scale equipment employed. The pilot has available the current basic weight, moment/100, and index in the WEIGHT AND BALANCE DATA booklet.

12-13. DEFINITIONS.

12-14. Throughout this chapter, certain terminology is used to fully explain the procedures contained herein. The definitions of such terminology are outlined in the following paragraphs.

12-15. WEIGHT DEFINITIONS.

12-16. **BASIC WEIGHT.** The basic weight of an aircraft is that weight which includes all fixed operating equipment, trapped fuel and oil, and unusable fuel, to which it is only necessary to add variable or expendable load items for various missions.

NOTE

The basic weight of an aircraft varies with structural modifications and changes in fixed operating equipment. The term basic weight, when qualified with a word indicating the type mission, such as Basic Weight for Ferry, etc. may be used in conjunction with directives stating what the equipment shall be for these missions. For example, extra fuel tanks and various items of equipment installed for long range ferry flights will be included in Basic Weight for Ferry.

12-17. OPERATING WEIGHT. The operating weight is the weight of the aircraft, including the crew and all equipment required for the mission, but not including fuel or payload.

12-18. GROSS WEIGHT.

NOTE

The gross weight is the total weight of an aircraft and its contents.

1. The take-off gross weight is the operating weight plus the variable and expendable load items which vary with the mission. These items include fuel, etc.

2. The landing gross weight is the take-off gross weight minus the expended load items.

12-19. BALANCE DEFINITIONS.

12-20. REFERENCE DATUM. The reference datum is an imaginary vertical plane from which all horizontal distances are measured for balance purposes. Diagrams of the aircraft show this reference datum as balance station zero.

12-21. ARM. ARM, for balance purposes, is the horizontal distance in inches from the reference datum to the cg of the item. Arms may be determined from the aircraft diagram in Chart E.

12-22. MOMENT. Moment is the weight of an item multiplied by its arm. Moment divided by a constant is generally used to simplify balance calculations by reducing the number of digits. For this aircraft, inches and moment/100 have been used.

12-23. AVERAGE ARM. Average arm is the arm obtained by adding the weights and adding the moments of a number of items and dividing the total moment by the total weight.

12-24. BASIC MOMENT. Basic moment is the sum of the moments of all items making up the basic weight. When using data from an actual weighing of an aircraft, the basic moment is the total moment of the basic aircraft with respect to the reference datum.

12-25. CENTER OF GRAVITY (CG). Center of gravity is the point about which an aircraft would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the gross weight of the aircraft.

12-26. CG LIMITS. CG limits are the extremes of movement which the cg can have without making the aircraft unsafe to fly. The cg of the loaded aircraft must be within these limits at take-off, in the air, and on landing. In some cases, separate take-off and landing limits may be specified.

SECTION III — CHART EXPLANATIONS

12-27. CHART C — BASIC WEIGHT AND BALANCE RECORD.

12-28. Chart C (figure 12-1) is a continuous history of the basic weight and moment, resulting from structural and equipment changes in service. At all times, the last weight and moment/100 entry is considered the current weight and balance status of the basic aircraft.

12-29. CHART E — LOADING DATA.

12-30. The loading data in Chart E (figure 12-2) is

*U.S.Government Printing Office:1986-754-043/40491

intended to provide information necessary to work a loading problem for the aircraft. From the loading graphs or tables, weight and moment/100 are obtained for all variable load items and are added arithmetically to the current basic weight and moment/100 (from Chart C) to obtain the gross weight and moment. The cg of the loaded aircraft is represented by a moment figure in the center of gravity table. If the aircraft is loaded within the forward and aft cg limits, the moment figure will fall numerically between the limiting moments. The effect on the cg of the expenditure in flight of such items as fuel may be checked by subtracting the weights and moments of such items from the take-off gross weight and moment and checking the new moment with the center of gravity table. This check should be made to determine whether the cg will remain within limits during the entire flight.

CHART C—BASIC WEIGHT AND BALANCE RECORD

(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T. O. 1-1B-40, AN 01-1B-40 & TM 55-405-9

AIRCRAFT MODEL: T-41B (SAMPLE ONLY)

SERIAL NO.: 00-00000

PAGE NO: 1

DATE	ITEM NO. IN	ITEM NO. OUT	DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE ADDED (+) WEIGHT	ADDED (+) ARM	ADDED (+) MOMENT[1] / 100	REMOVED (−) WEIGHT	REMOVED (−) ARM	REMOVED (−) MOMENT[1] / 100	RUNNING TOTAL BASIC AIRCRAFT WEIGHT	RUNNING TOTAL MOMENT[1] / 100	INDEX[2]
21 Sept 66			Basic Weight Delivery (Actual)							1515.0	586.1	
	C2		RT348/ARC-54 Transceiver	22.5	116.0	26.1						
	C3		MT-1535/ARC-54 Mount	1.5	116.0	1.7						
	D8		AT-1703/ARC-54 and C942 Antenna and Coupler	3.0	58.0	1.7						
			Basic Weight (Modified)							1542.0	615.6	

[1] Enter constant used below line

[2] Balance computer index.

DD FORM 1 SEP 54 365 C

PREVIOUS EDITIONS OF THIS FORM MAY BE USED UNTIL STOCKS ARE EXHAUSTED

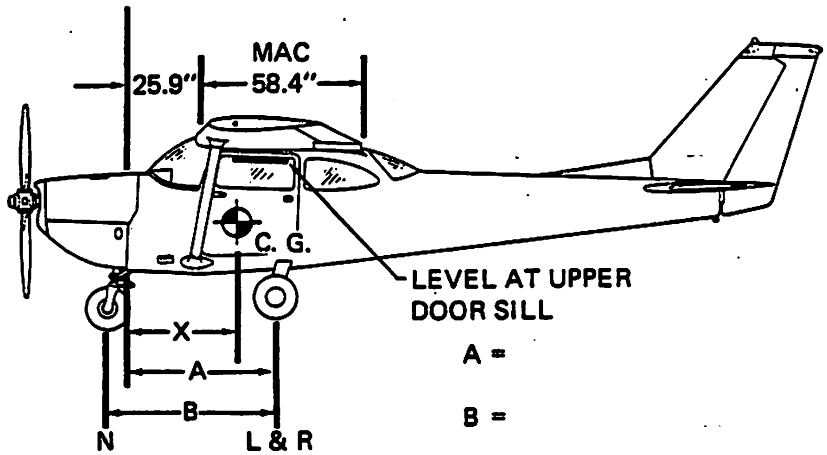
U.S. GOVERNMENT PRINTING OFFICE 1959—O-526970

AV108282

Figure 12-1. Chart C - basic weight and balance record.

WEIGHING PROCEDURE

REFERENCE DATUM (FIREWALL, FRONT FACE, LOWER PORTION)
STA. 0.00



SCALE POSITION	SCALE READING	TARE	SYMBOL	NET WEIGHT
LEFT WHEEL			L	
RIGHT WHEEL			R	
NOSE WHEEL			N	
AIRCRAFT WEIGHT (AS WEIGHED)			W	

$$X = \text{ARM} = (A) - \frac{(N) \times (B)}{W};\quad X = (\quad) - \frac{(\quad) \times (\quad)}{(\quad)} = (\quad)\ \text{IN.}$$

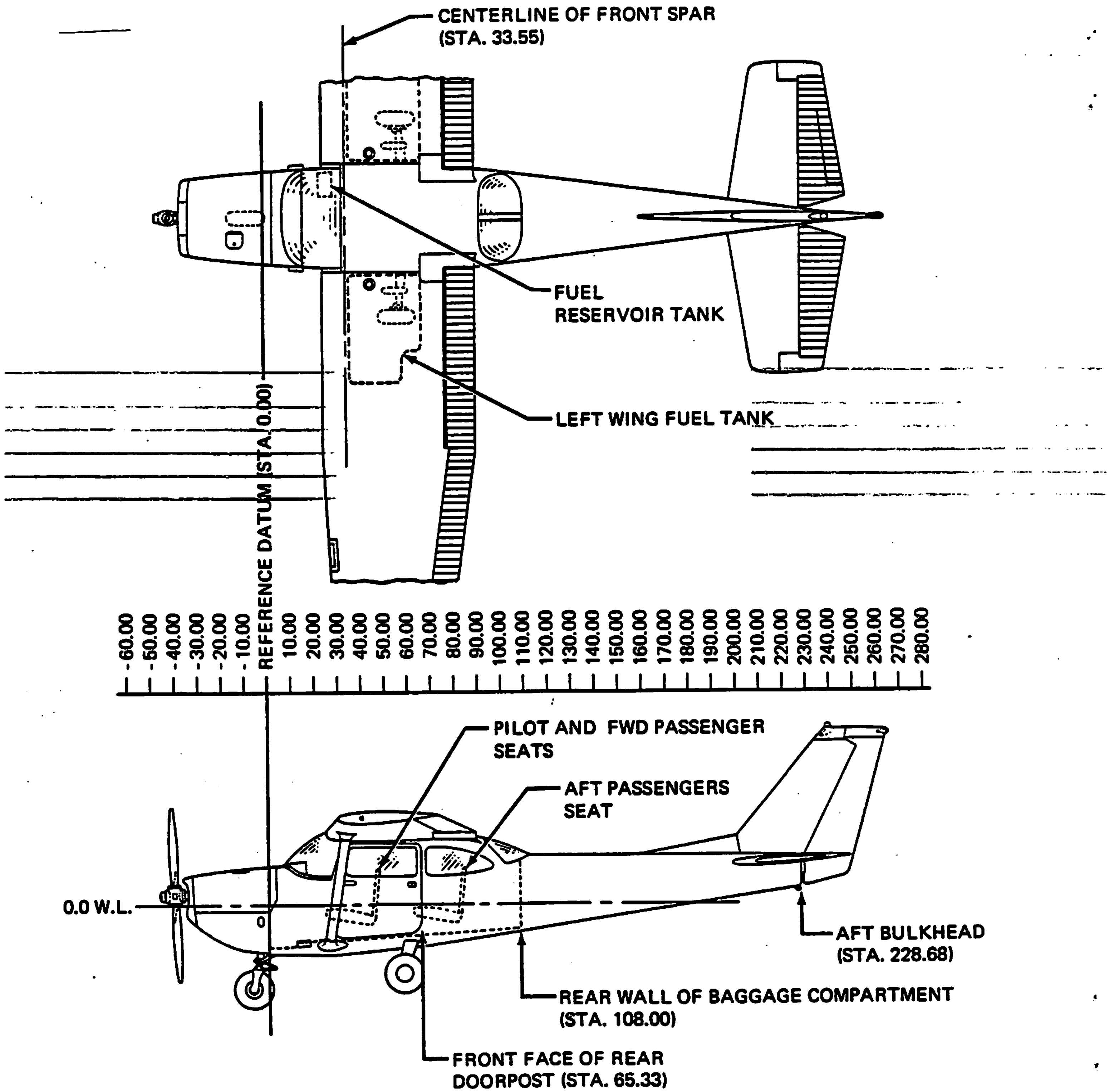
$$\%\text{MAC} = \frac{\text{ARM} - 25.9}{58.4} \times 100 = \frac{(\quad) - 25.9}{58.4} \times 100 = (\quad)\ \%\text{MAC}$$

1. Preparation:
   a. Inflate tires to recommended operating pressures.
   b. Drain wing tank sumps and reservoir tank to remove all fuel.
   c. Remove oil sump drain plug to drain all oil.
   d. Move all sliding seats to the most forward position. All seat backs should be in the most nearly vertical position.
   e. Put flaps in the fully retracted position.
   f. Place all control surfaces in neutral position.
2. Leveling:
   a. Place scales under each wheel (600# nose, 1000# each main, minimum capacity for scales).
   b. Deflate nose tire to center bubble on level (see diagram).
3. Weighing:
   a. With the aircraft level and brakes released, record the weight shown on each scale. Deduct the tare, if any, from each reading.
4. Measuring:
   a. Obtain measurement "A" by measuring horizontally (along the aircraft center line) from a line stretched between the main wheel centers to a plumb bob dropped from the firewall.
   b. Obtain measurement "B" by measuring horizontally and parallel to the aircraft center line, from center of nose wheel axle, left side, to a plumb bob dropped from the line between the main wheel centers. Repeat on right side and average the measurement.
5. Completing the Form:
   a. Using weights from (3) and measurements from (4), the aircraft weight and C. G. can be determined.
   b. Obtain basic weight by adding weight and moment of 6 gallons of unusable fuel (weight = 36#; moment = 1656 lb. in.) to aircraft weight and moment, as weighed.

AV108283.1

Figure 12-2. Chart E - loading data (sheet 1 of 6).

AIRCRAFT DIAGRAM



AV108283.2

Figure 12-2. Chart E - loading data (sheet 2 of 6).

FUEL LOADING TABLE		
GALLONS	WEIGHT (LBS)	MOMENT/100 (MAIN TANK ARM, 48)
2	12	5.8
4	24	11.5
6	36	17.3
8	48	23.0
10	60	28.8
12	72	34.6
14	84	40.3
16	96	46.1
18	108	51.8
20	120	57.6
22	132	63.4
24	144	69.1
26	156	74.9
28	168	80.6
30	180	86.4
32	192	92.2
34	204	97.9
36	216	103.7
38	228	109.4
40	240	115.2
42	252	121.0
44	264	126.7
46	276	132.5

CAPACITIES	
TANK	GALLONS
MAIN (LEFT WING)	23
MAIN (RIGHT WING)	23

OIL LOADING TABLE		
GALLONS	WEIGHT (LBS)	MOMENT/100 (ARM, - 21.5)
0.5	4	- .9
1.0	8	-1.7
1.5	11	-2.4
2.0	15	-3.2

CAPACITY 2.0 GALLONS

BAGGAGE LOADING TABLE			
WEIGHT (LBS)	MOMENT/100 (ARM, 95)	WEIGHT (LBS)	MOMENT/100 (ARM, 95)
5	4.8	105	99.8
10	9.5	110	104.5
15	14.3	115	109.3
20	19.0	120	114.0
25	23.8	125	118.8
30	28.5	130	123.5
35	33.3	135	128.3
40	38.0	140	133.0
45	42.8	145	137.8
50	47.5	150	142.5
55	52.3	155	147.3
60	57.0	160	152.0
65	61.8	165	156.8
70	66.5	170	161.5
75	71.3	175	166.3
80	76.0	180	171.0
85	80.8	185	175.8
90	85.5	190	180.5
95	90.3	195	185.3
100	95.0	200	190.0

CREW AND PASSENGER LOADING TABLE			
MEMBER	WEIGHT (LBS)	ARM	MOMENT /100
PILOT	200	36	72
INSTRUCTOR PILOT OR FWD PASSENGER	200	36	72
1 AFT PASSENGER	200	70	140
2 AFT PASSENGERS	400	70	280

NOTE

MOMENT/100 IS USED IN LIEU OF MOMENT/1000.

AV108283.3

Figure 12-2. Chart E - loading data (sheet 3 of 6).

UTILITY CATEGORY CENTER OF GRAVITY TABLE — MOMENT/100

GROSS WEIGHT (LBS)	% MAC											
	15.6	16.4	17.3	18.2	19.0	19.9	20.7	21.6	22.4	23.3	24.1	25.0
	ARM											
	35.0	35.5	36.0	36.5	37.0	37.5	38.0	38.5	39.0	39.5	40.0	40.5
1500	525	532	540	547	555	562	570	577	585	592	600	607
1550	542	550	558	566	573	581	589	597	604	612	620	628
1600	560	568	576	584	592	600	608	616	624	632	640	648
1650	577	586	594	602	610	619	627	635	643	652	660	668
1700	595	603	612	620	629	637	646	654	663	671	680	688
1750	612	621	630	639	647	656	665	674	682	691	700	709
1800	630	639	648	657	666	675	684	693	702	711	720	729
1850	647	657	666	675	684	694	703	712	721	731	740	749
1900	665	674	684	693	703	712	722	731	741	750	760	769
1950	682	692	702	712	721	731	741	751	760	770	780	790
2000		710	720	730	740	750	760	770	780	790	800	810
2050			738	748	758	769	779	789	799	810	820	830
2100				766	777	787	798	808	819	829	840	850
2150					795	806	817	828	838	849	860	871
2200						825	836	847	858	869	880	891

NOTES

1. MOMENT/100 IS USED IN LIEU OF MOMENT/1000.
2. BLANK SPACES ARE BEYOND APPROVED CG LIMITS.

AV108283.4

Figure 12-2. Chart E - loading data (sheet 4 of 6).

NORMAL CATEGORY CENTER OF GRAVITY TABLE – MOMENT/100													
GROSS WEIGHT (LBS)	% MAC												
	15.6	16.4	17.3	18.2	19.0	19.9	20.7	21.6	22.4	23.3	24.1	25.0	36.6
	ARM												
	35.0	35.5	36.0	36.5	37.0	37.5	38.0	38.5	39.0	39.5	40.0	40.5	47.3
1500	525	532	540	547	555	562	570	577	585	592	600	607	709
1550	542	550	558	566	573	581	589	597	604	612	620	628	733
1600	560	568	576	584	592	600	608	616	624	632	640	648	757
1650	577	586	594	602	610	619	627	635	643	652	660	668	780
1700	595	603	612	620	629	637	646	654	663	671	680	688	804
1750	612	621	630	639	647	656	665	674	682	691	700	709	828
1800	630	639	648	657	666	675	684	693	702	711	720	729	851
1850	647	657	666	675	684	694	703	712	721	731	740	749	875
1900	665	674	684	693	703	712	722	731	741	750	760	769	899
1950	682	692	702	712	721	731	741	751	760	770	780	790	922
2000		710	720	730	740	750	760	770	780	790	800	810	946
2050			738	748	758	769	779	789	799	810	820	830	970
2100				766	777	787	798	808	819	829	840	850	993
2150					795	806	817	828	838	849	860	871	1017
2200						825	836	847	858	869	880	891	1041
2250							855	866	877	889	900	911	1064
2300								885	897	908	920	931	1088
2350									916	928	940	952	1112
2400										948	960	972	1135
2450											980	992	1159
2500												1012	1182

NOTES

1. MOMENT/100 IS USED IN LIEU OF MOMENT/1000.
2. BLANK SPACES ARE BEYOND APPROVED CG LIMITS.

AV108283.5

Figure 12-2. Chart E - loading data (sheet 5 of 6).

TYPICAL SERVICE LOAD CONDITIONS					
ITEM	ARM	UTILITY CATEGORY		NORMAL CATEGORY	
		WEIGHT (LBS)	MOMENT /100	WEIGHT (LBS)	MOMENT /100
BASIC WEIGHT	38.6	1550	599.9	1550	599.9
PILOT	36.0	200	72.0	200	72.0
INSTRUCTOR PILOT OR FWD PASS.	36.0	200	72.0	200	72.0
AFT PASSENGERS	70.0	—	—	200	140.0
FUEL (TO GROSS WEIGHT OR MAXIMUM OF 46 GAL.)	48.0	235	112.8	276	132.5
OIL (ENGINE)	-21.5	15	-3.2	15	-3.2
BAGGAGE	95.0			59	56.1
TOTALS		2200	853.5	2500	1069.3
		ARM = 38.8		ARM = 42.8	

MISCELLANEOUS DATA

CENTROIDS OF LOAD ITEMS (INCHES AFT (+) OR FORWARD (-) OF DATUM)

- Pilot . . . . . + 36
- Instructor Pilot or Forward Passenger . . . . . + 36
- Aft Passengers . . . . . + 70
- Fuel . . . . . + 48
- Oil . . . . . -21.5
- Baggage . . . . . + 95

DISTANCE FROM DATUM LINE (INCHES AFT (+) OR FORWARD (-) OF DATUM)

- Center of Gravity at Basic Weight . . . . . +38.6
- Centerline of Main Wheels at Basic Weight . . . . . +58.0
- Centerline of Nose Wheel at Basic Weight . . . . . - 7.6

BASIC WEIGHT (POUNDS) 1550

GENERAL DIMENSIONS:

- Wing Span . . . . . 434 in. (36 ft. 2 in.)
- Length . . . . . 316½ in. (26 ft. 4½ in.)
- Height (Maximum) . . . . . 107 in. (8 ft. 11 in.)
- Wheel Base (At Basic Weight) . . . . . 65 in. (5 ft. 5 in.)
- Tread (At Basic Weight) . . . . . 86 in. (7 ft. 2 in.)

(Weights and Dimensions are Approximate)

NOTE: Moment/100 is used throughout in lieu of Moment/1000

AV108263.6

Figure 12-2. Chart E - loading data (sheet 6 of 6).

CESSNA AIRCRAFT COMPANY
WICHITA, KANSAS

MODEL R172E

Weight & Balance Data

Aircraft Serial No. F.A.A. Registration No. Date:

ITEM		Weight (lbs.)	C.G. Arm (inches)	Moment (lb. ins.)
Standard Airplane (Empty, Dry & Unpainted)	Actual Computed			
Optional Equipment				
Special Installations (DOM Approved)				
Paint		23.0	103.5	2380
Unusable Fuel (6.0 Gal)		36.0	46.0	1656
Licensed Empty Weight = Total of Items Above		1561.25	37.5"	58611.125

(GROSS WT.) - (LICENSED EMPTY WT.) = USEFUL LOAD

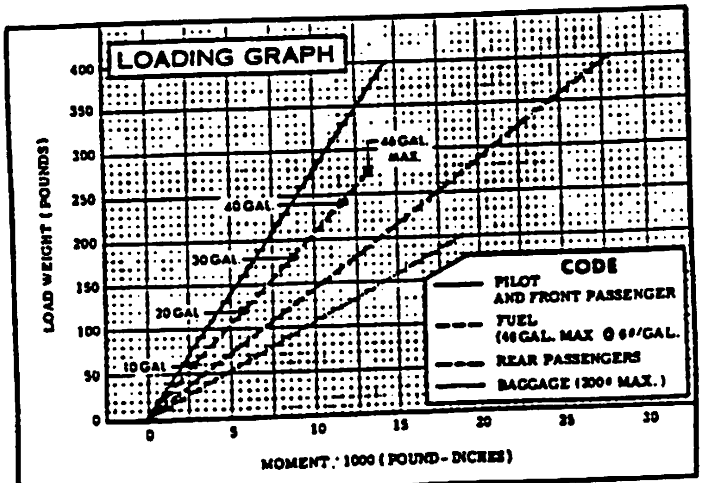
(2500 LBS) - (LBS) = LBS

SAMPLE LOADING PROBLEM

	Weight (lbs.)	C.G.Arm (inches)	Moment (lb-ins/1000)
Licensed Empty Wt.			
Oil (10 Qts.)	19	-21.5	-0.4
Pilot & Front Passenger	400	36.0	14.4
Fuel		48.0	
Rear Seat Passengers		70.0	
Baggage		95.0	

Total Loaded Airplane - 2500

Locate this point (2500:) on the C.G. Moment Envelope. Since the point falls within the envelope the loading meets all balance requirements.



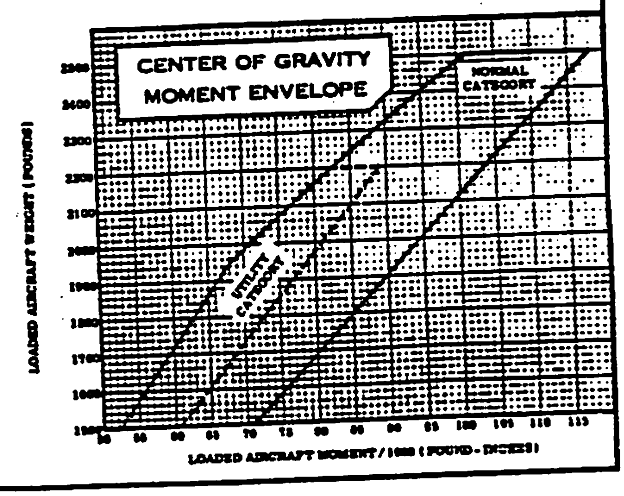
IT IS THE RESPONSIBILITY OF THE PILOT AND AIRPLANE OWNER TO INSURE THAT THE AIRPLANE IS LOADED PROPERLY. THE EMPTY WEIGHT C.G. & USEFUL LOAD ARE FOR THE AIRPLANE AS DELIVERED FROM THE FACTORY. REFER TO FORM FAA-337 WHEN ALTERATIONS HAVE BEEN MADE.

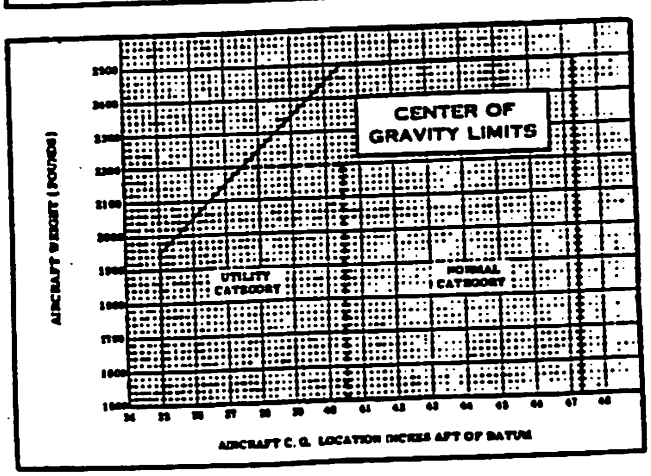
C.G. MOMENT ENVELOPE INSTRUCTIONS

I To the licensed empty weight add weight of all items to be carried.

II To licensed empty weight moment add moment of all items to be carried.

III Locate point determined by I & II and if it falls within the C.G. moment envelope the loading is satisfactory.





Form issue date: September 5, 1966

.KE Cessna MODEL R-172E SERIAL No. R172-0216 REGISTRATION No. N88763

DATUM IS Firewall, Front Face, Lower Portion Sta. 0.00

COMPUTE AS FOLLOWS IF AIRCRAFT WEIGHED

1. Leveling means: Upper Door Sill
2. Main wheel weighing point is located (– ____ "FORWARD) (+ 58.6 "AFT) of datum.
3. Tail (or nose point centerline is located (– 65 "FORWARD) (+ ____ "AFT) of main weight point centerline.
4. Oil over and above "ZERO" tank reading – (a. 2.5 Gals.) (b. 18.75 Lbs.) (c. ____ In.)

4a. Fuel over and above "ZERO" tank reading (46 Gals.) (276 Lbs.) (+48 In.)

ACTUAL EMPTY WEIGHT

	WEIGHT POINT	SCALE READING	SCALE CORRECTION –	TARE =	NET WEIGHT
5.	Right	625		5	620
6.	Left	665		4	661
7.	Tail				
8.	Nose	575		0	575
9.	Total Net Weight				1856

CENTER OF GRAVITY AS WEIGHED

C.G. relative to main wheel weighing point:

(a) Tail wheel airc. (item 3) x (item 7) / (item 9) = ____ = C. G.

(b) Nose wheel airc. -56" (item 3) x 575 lb. (item 8) / 1856 lb. (item 9) = -20.1" = C. G.

11. C.G. relative to datum:

(a) Tail wheel airc. ____ (item 10a) added to ____ (item 2) = ____ = C. G.

(b) Nose wheel airc. -20.1" (item 10b) added to 58.6" (item 2) = 38.5" = C. G.

* COMPUTE IF AIRCRAFT WEIGHED WITH OIL (Item 4) OR FUEL (Item 4a)

	Weight X	Arm =	Moment
Aircraft	1856	38.5"	71456
Less Fuel	- 276	48.0"	-13248
Oil	-18.75	-21.5"	403.125
Empty Totals	(a) 1561.25		(b) 58611.125

(b) 58611.125 / (a) 1561.25 = (c) 37.5" = Empty Weight C. G.

REPAIR AGENCY J. Mongino A&P 262-46-1236 DATE 7/21/88
Name Number

* Check applicable regulation under which the aircraft is certified to determine if the oil is a part of the empty weight

12-1?

EQUIPMENT CHANGE

COMPUTING, NEW C.G.

Item, Make, and Model*	Weight	X	Arm	=	Moment
Airc. Empty					
NET TOTALS	= NW				= NM

(Item 13) $\frac{NM}{NW}$ = __________ = __________ = New C. G. (Item 14)

*ITEM NUMBERS WHEN LISTED IN PERTINENT AIRCRAFT SPECIFICATION MAY BE USED IN LIEU OF "ITEM, MAKE, AND MODEL".

WEIGHT AND BALANCE EXTREME CONDITIONS

Approved fwd limit +40.5" Approved max. weight 2500 1b. Approved aft limit +47.3"

Item	Forward Check Weight	X Arm	— Moment	Rearward Check Weight	X Arm	— Moment
Airc. Empty	1561.25	37.5	58611.125	1561.25	37.5	58611.125
Oil	18.75	-21.5	-403	18.75	-21.5	-403
Pilot	170	36	6120	170	36	6120
Fuel	105	48	5040	276	48	13248
Passenger (s)	170	36	6120	340	70	23800
Baggage				200	95	19000
TOTAL	2025		75488.125	2566		120376.125

$\frac{TM}{TW} = \frac{75488.125}{2025} = 37.3"$ Most Forward C. G. location

$\frac{TM}{TW} = \frac{120376.125}{2566} = 46.9"$ = Most rearward C. G. location

J Mangino ATP 262-46-17

MAXIMUM LOAD	
Empty Wt.	
Oil	
Fuel	
Occupants	
Baggage	
TOTAL	

LOADING SCHEDULE

Condition	Gallons of Fuel	Number of Passengers	Pounds of Baggage

The above includes pilot and capacity oil.

EQUIPMENT LIST

* Required or Optional Item Numbers as Shown in A/C Specification

Special Equipment

Item	Make	Model	Weight	Arm

Enter above those items included in the empty weight

Cessna®

CESSNA AIRCRAFT CO

EQUIPMENT LIST

MODEL R172E

WICHITA, KANSAS

AIRCRAFT SERIAL NO. R172-0216 REGISTRATION NO. N88763 DATE

NOTES

1. Suffix letters to item numbers:
   - -R = required items of equipment for FAA certification
   - -S = standard equipment items

2. Status of equipment:
   - ✓ = installed in the aircraft at the factory

3. Unless otherwise indicated, true values (not net change values) for weight and arm are shown. Positive arms are distances aft of datum; negative arms are distances forward of datum (see weight and balance data sheet for datum location).

4. A separate FAA approval must be obtained if the following items are not installed per applicable Cessna drawings or accessory kit instructions.

ITEM NO 1	2	DESCRIPTION	REF DRAWING	WT LBS	ARM INS
001-R	✓	Engine, Continental (includes starter) IO-360D	0550316	316.0	-20.0
002-R	✓	Propeller, Constant Speed (McCauley D2A34C67/76C)	C161004-0104	47.0	-41.0
003-R	✓	Governor, Propeller (McCauley C90-D2/T6)	C161030-0106	4.0	-33.5
004-R	✓	Alternator 38-Amp, 28 Volt	C611502-0201	11.0	- 5.5
005-R	✓	Regulator, Alternator 38-Amp, 28 Volt	C611002-0102	0.5	3.0
006-R	✓	Battery, 24 Volt, 17-Amp Hr.	0870060	28.0	117.0
007-R	✓	Oil Cooler, Engine (Harrison)	AP10AU10	4.5	-34.5
008-R	✓	Filter, Induction Air	C294510-0401	1.0	-20.5
009-R	✓	Heating System, Cabin & Engine Air (includes exhaust system)	1455012 1455009	16.5	-15.0
010-R	✓	Wheel, Brake, & Tire Assembly (two) 6.00 x 6 4-ply (main)	1241156	30.0	58.0
011-R	✓	Wheel & Tire Assy. (one) 6.00 x 6 4-ply (nose)	1241156	12.0	- 7.0
012-R	✓	Tachometer, Recording	S-1305-13	1.5	14.0
013-R	✓	Altimeter, Sensitive	C661011-0105	1.0	14.5
014-R	✓	Compass	0713068	0.5	14.0
015-R	✓	Indicator, Airspeed	S-1538-2	0.5	16.0
016-R	✓	Indicator, Stall Warning - Audible	0523112	0.5	28.5
017-S	✓	Indicator, Turn & Bank	CM2651-L-1	2.0	13.0
018-S	✓	Indicator, Rate of Climb	S-1392N2	1.0	14.0
019-S	✓	Clock, Electric	S-1317N1	0.5	16.5
020-R	✓	Gage, Fuel Pressure & Manifold Pressure	C662001-0105	1.0	15.0
021-S	✓	Gyro, Directional (Garwin)	23-401-02	2.5	14.5
022-S	✓	Gyro, Horizon (Garwin)	23-501-03	2.0	14.0
023-S	✓	Gage, Suction	S-1414N1	0.5	16.5
024-S	✓	Light, Map	0700149	0.5	32.0
025-S	✓	Lights, Instrument Post	0513242	0.5	17.0
026-S	✓	Light, Rotating Beacon	0531007	1.5	245.0

APPROVED Cessna Aircraft Co. Commercial Div. [illegible] Executive Engineer

ISSUED: 10-24-66

REVISED: 7-12-88

APPROVED: 10-24-66

SHT 1 OF 2

[illegible] R.F. DIVER [illegible] 7-20-88

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Cessna

CESSNA AIRCRAFT CO

EQUIPMENT LIST (CONT'D)

MODEL R172E

WICHITA, KANSAS

ITEM NO 1	2	DESCRIPTION	REF DRAWING	WT LBS	ARM INS
027-S	✓	Light, Landing (dual beam)	0522100	2.5	31.0
028-R	✓	Seat, Vertically Adjusting, Pilot	1514000	13.5	38.0
029-S	✓	Seat, Vertically Adjusting, Co-pilot	1514000	13.5	38.0
030-S	✓	Seat, Rear	0514003	16.0	76.0
031-R	✓	Belt, Safety, Pilot	54H19650	3.0	36.0
032-S		~~Harness, Shoulder, Pilot~~	50D3770	1.0	45.0
033-S		~~Inertia Reel & Control - Pilot~~	MA-2	3.0	65.0
034-S	✓	Belt, Safety, Co-pilot	54H19650	3.0	36.0
035-S		~~Harness, Shoulder, Co-pilot~~	50D3770	1.0	45.0
036-S		~~Inertia Reel & Control - Co-pilot~~	MA-2	3.0	65.0
037-S	✓	Belts, Safety, Rear Seat (2)	S-1622-3	2.0	70.0
038-S		~~Baggage Net~~	0500411	0.5	95.0
039-S	✓	Rings, Airplane Hoisting	0541115	2.0	49.0
040-S	✓	Steps, Airplane Refueling	0513395	1.0	17.0
041-S		~~Fire Extinguisher~~	0500275	8.0	45.5
042-S		~~First Aid Kit~~	0500412	2.0	47.0
043-S	✓	External Power Receptacle	0570401	2.5	-1.5
044-S	✓	Paint, Exterior	0500319	18.0	103.5
		KMA 24 Audio Panel		1.7	
		KX 155 w/GS Nav/Com		5.3	
		KI 209 Ind.		1.2	
		KX 155 Nav/Com		4.74	
		KI 208 Ind.		1.0	
		KN 64 DME		2.6	
		KR 87 ADF		3.2	
		KI 227 ADF IND		.7	
		KA 44B ADF ANT.		3.2	
		KT 76A TRANSPONDER		3.1	
		TCI encoder		1.3	
		SPA 400 Intercom			

ISSUED REVISED: 7-12-88 [signature] R F DICK ACP226925IA

SHT 2 of 2

PERFORMANCE DATA

Section I — INTRODUCTION

14-1. GENERAL.

14-2. This chapter contains various performance charts and information to enable the estimation of the performance of the aircraft for actual atmospheric conditions for a particular mission. The information in this chapter is consistent with the operating procedures as specified in other chapters of this manual. All performance data is based on flight tests.

14-3. EXTENT OF COVERAGE.

14-4. The information contained on the charts is consistent with the recommended operating procedures and techniques set forth in other chapters of this manual.

Section II — CHARTS

14-5. TAKE-OFF AND LANDING DATA CARD.

14-6. The take-off and landing data card, when completed, provides a quick reference for performance data for the existing conditions. This data card should be completed prior to take-off using performance information from this chapter. A sample completed card is shown in figure 14-1.

14-7. DENSITY ALTITUDE CHART.

14-8. The density altitude chart (figure 14-2) enables the determination of the density altitude and a density factor that can be used for calculating true airspeed (from calibrated airspeed). The chart is based on pressure altitude (altimeter set to 29.92 inches of mercury) and outside air temperature. This chart has a subscale in degrees Fahrenheit and, therefore, a conversion from degrees Celsius to degrees Fahrenheit can be made.

14-9. STANDARD ATMOSPHERE CHART.

14-10. The standard atmosphere chart (figure 14-3) shows the standard conditions of density, temperature, and pressure. Some performance charts in this chapter are based on a standard day and the corresponding atmospheric conditions can be determined from this chart.

14-11. AIRSPEED CORRECTION CHART.

14-12. The airspeed correction chart (figure 14-4) shows the accuracy of the airspeed indicating system assuming no error in the airspeed indicator itself. Information from this chart can be used to convert airspeed indicator readings to calibrated airspeed.

14-13. TAKE-OFF AND LANDING CROSSWIND CHART.

14-14. The take-off and landing crosswind chart (figure 14-5) shows the maximum wind conditions for which a take-off or landing is recommended. This chart can be used to resolve the reported wind into headwind and crosswind components. The headwind component should be used for the determination of take-off or landing distances.

14-15. TAKE-OFF DISTANCE CHART.

14-16. The take-off distance chart (figure 14-6) shows the minimum ground run and total distance to clear a 50 foot obstacle based on a maximum performance technique using 20° wing flaps. Distances shown are based on a sod surface runway. These distances require the use of the obstacle clearance speeds as specified on the chart.

14-17. CLIMB CHART.

14-18. The climb chart (figure 14-7) shows the maximum rate of climb and the time, distance, and fuel used during a climb at maximum power. The fuel used information on this chart includes an allowance of 1.3 gallons for taxi and take-off. A note is included on this chart to permit correction of this data for a variation in temperature.

14-19. CRUISE PERFORMANCE CHARTS.

14-20. Five cruise performance charts (figures 14-8, 14-9, 14-10, 14-11, and 14-12 are provided for altitudes of 2500 feet to 12,500 feet. These charts show the true airspeed, fuel consumption, and nautical miles per gallon of fuel that can be expected at various power settings. These power settings extend as low as those that result in maximum miles per gallon of fuel. These charts also include endurance and range figures based on a total usable fuel of 46 gallons for cruise. Allowances for take-off, climb and reserve fuel should be determined for a specific mission and the expected endurance and range should be calculated to account for these variables for a specific mission. A power computer is available for this aircraft and provides a quick means of determining fuel consumption and endurance for any selected power setting. This computer also includes a scale adjustment for non-standard temperatures if precise power data is desired.

14-21. LANDING DISTANCE CHART.

14-22. The landing distance chart (figure 14-13) shows the minimum distances that can be achieved using a maximum performance technique on a sod surface runway. This assumes maximum braking and flaps retracted during the ground roll. This chart is based on a speed of 60 MPH IAS at the 50 foot height. Distance shown on this chart may be used for any landing gross weight.

14-23. SAMPLE PROBLEM.

14-24. The following sample problem utilizes information from the various charts to determine performance data for a sample mission as follows:

1. Take-off and climb on course to 5000 feet.
2. Cruise at 5000 feet.
3. Land at a remote base 357 nautical miles away.

The following information is known:

1.	Take-off gross weight	2500 pounds
2.	Pressure altitude at take-off	1000 feet
3.	Outside air temperature	$35^{o}C$
4.	Surface wind	14 knots, gusts to 20 knots, 40^{o} off runway heading.
5.	Wind at cruise altitude	10 knots headwind.

STEP 1. TAKE-OFF DISTANCE.

The crosswind chart (figure 14-5), can be used to determine the following wind components:

Headwind	11 knots
Crosswind	13 knots

The headwind component of 11 knots should be used to determine the take-off distance.

The following distances are obtained from the take-off distance chart (figure 14-6) for a pressure altitude of 1000 feet and a gross weight of 2500 pounds.

	$20^{o}C$	$40^{o}C$
Ground run, 0 wind	715 FT.	815 FT.
Ground run, 20 knots	270 FT.	320 FT.

	$20^{o}C$	$40^{o}C$
Total distance, 0 wind	1165 FT.	1310 FT.
Total distance, 20 knots	530 FT.	615 FT.

The above conditions bracket the existing atmospheric conditions and, in many cases, inspection of the data for these conditions and a comparison with the available runway length is sufficient. However, more precise information can be determined, if desired, using an interpolation procedure similar to the following:

$$\text{Distance at } 35^{o}C = \text{Distance at } 20^{o}C + \frac{15}{20}(\Delta\,\text{Distance})$$

Where Δ Distance = Difference in distance for $20^{o}C$ and $40^{o}C$

This results in the following distances at $35^{o}C$:

Ground run, 0 wind	790 FT.
Ground run, 20 knots	308 FT.
Total distance, 0 wind, to clear a 50 ft. obstacle	1274 FT.
Total distance, 20 knots wind, to clear a 50 ft. obstacle.	594 FT.

An interpolation of the above figures can be made for the actual headwind component of 11 knots.

Distance at 11 knots = Distance for no wind - $\frac{11}{20}$ (ΔDistance)

Where ΔDistance = Difference in distance for 0 wind and 20 knots headwind.

This results in the following distances:

Ground run	525 FT.
Total distance over 50 ft. obstacle	900 FT.

STEP 2. CLIMB PERFORMANCE.

The time, distance, and fuel used during a climb from sea level to 5000 feet can be determined from the climb chart (figure 14-7) as follows:

Time	6 minutes
Distance	9 miles
Fuel (total)	2.9 gallons
Fuel during climb	1.6 gallons

This data is for a climb from sea level on a standard day; corrections may be made for actual conditions. Since take-off altitude is 1000 feet, a correction for altitude can be made by using the increments between S.L. and 2500 feet and reducing the climb figures using a factor equal to $\frac{1000}{2500}$ = 0.4.

This results in the following increments:

Time	3 x 0.4 = 1.2 minutes
Distance	4 x 0.4 = 1.6 miles
Fuel used	0.8 x 0.4 = 0.3 gallons

Decreasing the time, distance and fuel used by these increments results in the following:

Time	6 - 1.2 = 4.8 minutes
Distance	9 - 1.6 = 7.4 miles
Fuel used	2.9 - 0.3 = 2.6 gallons

The standard atmosphere chart (figure 14-3) shows that the standard temperature at 1000 feet is 13°C. Therefore, the 35°C outside air temperature assumed for this problem is 22°C hotter than standard.

The next step is a correction for a hot day. The note on the climb chart specifies that the figures should be increased by 15% for each 10°C above standard. This would be $\frac{22}{10}$ x 15 = 33% increase for the assumed conditions. Therefore the final figures are:

Time	4.8 + (0.33 x 4.8)	= 6.4 minutes
Distance	7.4 + (0.33 x 7.4)	= 9.8 miles
Fuel used	2.6 + 0.33 x (2.6-1.3)	= 3.0 gallons

STEP 3. FUEL USED FOR CRUISE.

The cruise chart for 5000 feet (figure 14-9) shows that the following performance can be expected at a selected power setting of 2400 RPM and 23 inches of manifold pressure:

True airspeed	122 knots
Fuel consumption	11.2 gallons per hour

This true airspeed should be corrected to a ground speed with the expected 10 knot headwind. This will be 122-10 = 112 knots.

The distance remaining for cruise after climb to 5000 feet is 357-10 = 347 miles.

Therefore, the time during cruise is:

$$\frac{347}{112} = 3.1 \text{ hours}$$

Fuel used during cruise = 3.1 x 11.2 = 34.7 gallons.

The total fuel required is:

Cruise	34.7
Climb	3.0
Total fuel used	37.7 gallons

Assuming 46 gallons of usable fuel at take-off, this results in 8.3 gallons reserve fuel, or $\frac{8.3}{11.2}$ x 60 = 44 minutes.

STEP 4. LANDING DISTANCE.

Assuming the same atmospheric conditions at landing, the landing distances can be determined similar to the procedure used for take-off.

This results in landing distances as follows, for no wind.

Ground run	430 FT.
Total distance over 50 FT.	927 FT.

The correction for headwind is to reduce the distance by 10% for each 4 knots of headwind. Therefore the reduction is $\frac{11}{4}$ x 10 = 27.5%.

This results in the following:

Ground run = 430-.275 x 430 = 312 feet.
Total distance = 927-.275 x 927 = 672 feet.

TM 55-1510-212-CL

TAKE-OFF AND LANDING DATA CARD

TAKE-OFF DATA

MINIMUM GROUND RUN ____________ FT

TAKE-OFF OVER 50 FT OBST __________ FT

OBSTACLE CLEARANCE SPEED __________ KN

LANDING IMMEDIATELY AFTER TAKE-OFF

MINIMUM APPROACH SPEED __________ KN

MINIMUM GROUND ROLL ____________ FT

P-1

TM 55-1510-212-CL

LANDING DATA

OBSTACLE CLEARANCE SPEED __________ KN

MINIMUM GROUND ROLL ____________ FT

TOTAL DISTANCE ______________ FT

CONDITIONS

PRESSURE ALTITUDE ____________ FT

TEMPERATURE ______________ °C

WIND DIRECTION _____ VELOCITY _____ KN

RUNWAY LENGTH ______________ FT

RUNWAY HEADING ______________

GROSS WT (TAKE-OFF) ____________ LB

REMARKS:

Wind limitations:
- 90° crosswind . . . . 15 knots
- 60° crosswind . . . . 17 knots
- 30° crosswind . . . . 30 knots
- Maximum wind . . . . 30 knots
- Maximum gust spread . . . . 10 knots

P-2

AV108284

Figure 14-1. Take-off and landing data card.

DENSITY ALTITUDE

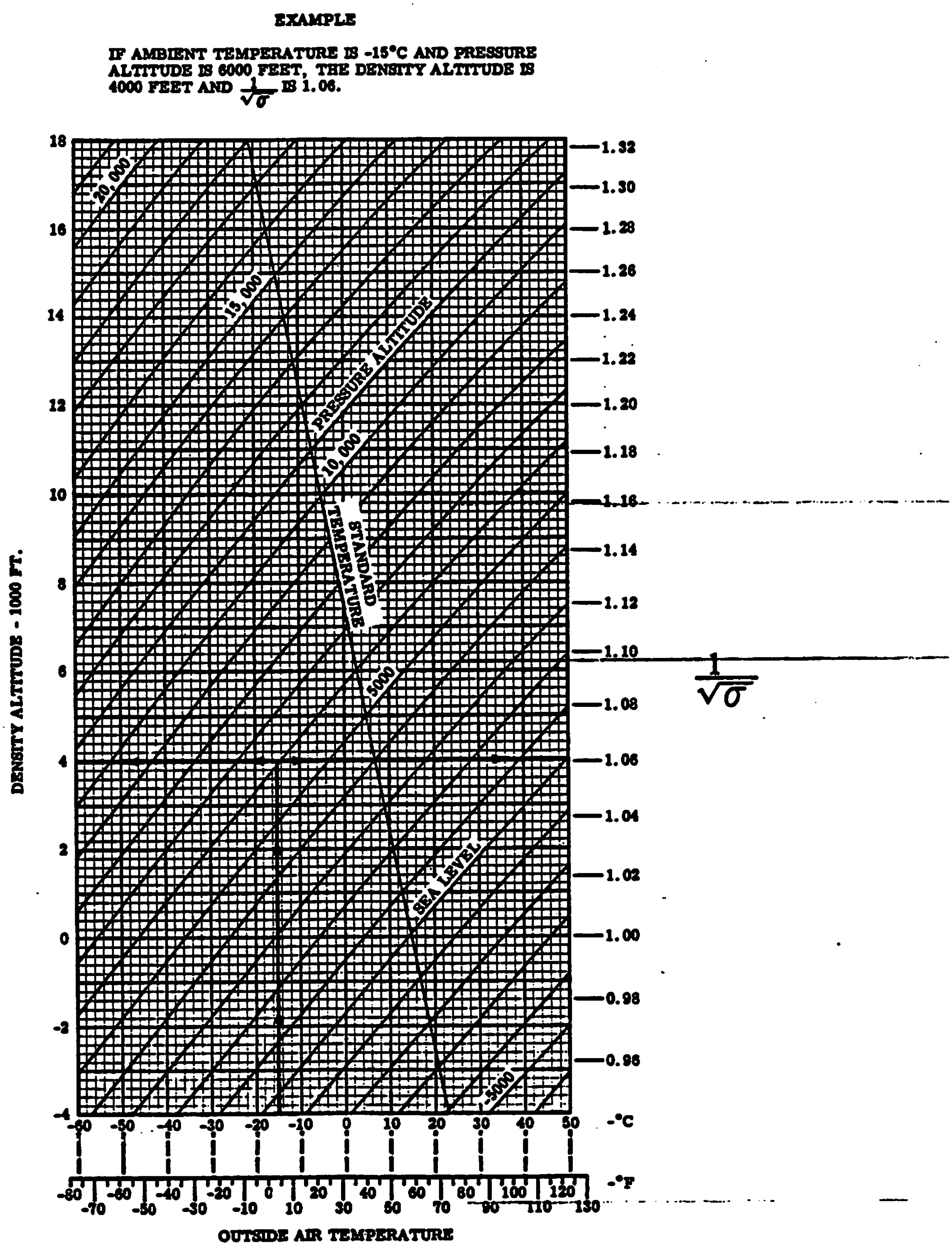


Figure 14-2. Density altitude.

STANDARD ATMOSPHERE

ALTITUDE FEET	DENSITY RATIO $\sigma = \rho/\rho_0$	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE DEG. F	TEMPERATURE DEG. C	PRESSURE IN. OF HG.
0	1.0000	1.0000	59.0	15.0	29.92
500	0.9854	1.0074	57.2	14.0	29.38
1000	0.9711	1.0148	55.4	13.0	28.86
1500	0.9568	1.0223	53.7	12.0	28.33
2000	0.9428	1.0299	51.9	11.0	27.82
2500	0.9289	1.0376	50.1	10.0	27.32
3000	0.9151	1.0454	48.3	9.1	26.82
3500	0.9015	1.0532	46.5	8.1	26.33
4000	0.8881	1.0611	44.7	7.1	25.84
4500	0.8748	1.0692	43.0	6.1	25.37
5000	0.8617	1.0855	41.2	5.1	24.90
5500	0.8487	1.0838	39.4	4.1	24.43
6000	0.8359	1.0938	37.6	3.1	23.98
6500	0.8232	1.1022	35.8	2.1	23.53
7000	0.8106	1.1107	34.0	1.1	23.09
7500	0.7983	1.1193	32.3	0.1	22.65
8000	0.7860	1.1279	30.5	-0.8	22.22
8500	0.7739	1.1367	28.7	-1.8	21.80
9000	0.7620	1.1456	26.9	-2.8	21.39
9500	0.7502	1.1546	25.1	-3.8	20.98
10,000	0.7385	1.1637	23.3	-4.8	20.58
10,500	0.7269	1.1729	21.6	-5.8	20.18
11,000	0.7156	1.1822	19.8	-6.8	19.79
11,500	0.7043	1.1916	18.0	-7.8	19.41
12,000	0.6932	1.2011	16.2	-8.8	19.03
12,500	0.6822	1.2107	14.4	-9.8	18.66
13,000	0.6713	1.2205	12.6	-10.8	18.29
13,500	0.6606	1.2303	10.9	-11.7	17.93
14,000	0.6500	1.2403	9.1	-12.7	17.58
14,500	0.6396	1.2504	7.3	-13.7	17.23
15,000	0.6292	1.2606	5.5	-14.7	16.89
15,500	0.6190	1.2710	3.7	-15.7	16.55
16,000	0.6090	1.2815	1.9	-16.7	16.22
16,500	0.5990	1.2921	0.2	-17.7	15.89
17,000	0.5892	1.3028	-1.6	-18.7	15.57
17,500	0.5795	1.3136	-3.4	-19.7	15.25
18,000	0.5699	1.3246	-5.2	-20.7	14.94
18,500	0.5605	1.3358	-7.0	-21.7	14.64
19,000	0.5511	1.3470	-8.8	-22.6	14.34
19,500	0.5419	1.3584	-10.5	-23.6	14.04
20,000	0.5328	1.3700	-12.3	-24.6	13.75

AV108286

Figure 14-3. Standard atmosphere.

AIRSPEED CORRECTION

Data Basis: Flight Test								Model: T-41B
Date: July 1966								Engine: IO-360-D
WING FLAPS UP					WING FLAPS DOWN 20° TO 40°			
IAS		CORRECTION			IAS		CORRECTION	
MPH	KN	MPH	KN		MPH	KN	MPH	KN
50	43	+10	+9		50	43	+9	+8
60	52	+ 4	+3		60	52	+3	+3
70	61	-1	-1		70	61	+1	+1
80	70	-3	-3		80	70	0	0
90	78	-4	-3		90	78	-2	-2
100	87	-4	-3		100	87	-2	-2
110	96	-4	-3					
120	104	-4	-3					
130	113	-4	-3					
140	122	-3	-3					
150	130	-3	-3					

REMARKS: Add correction to instrument reading (IAS) to obtain calibrated airspeed (CAS).

AV108287

Figure 14-4. Airspeed correction.

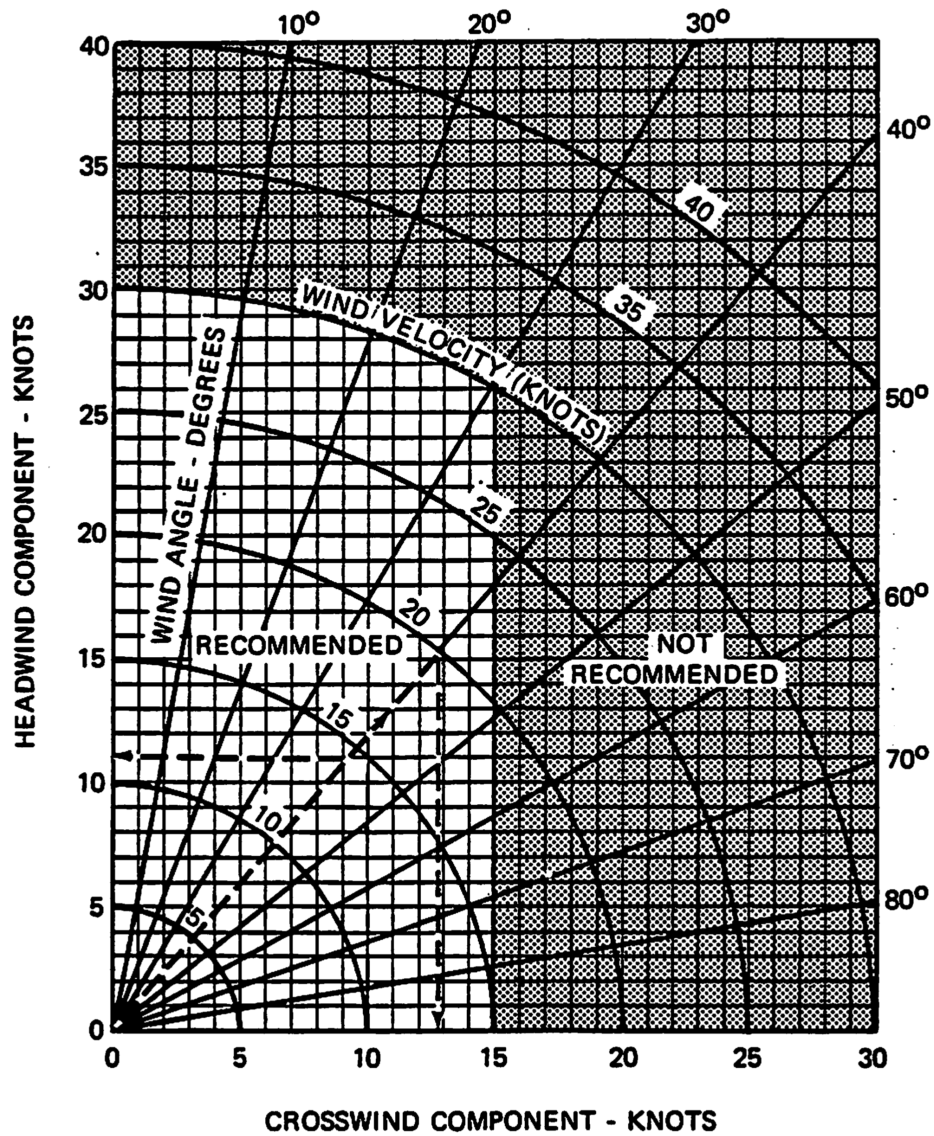
TAKE-OFF AND LANDING CROSSWIND

Data Basis: Flight Test

Date: June 1963

Model: T-41B

Engine: IO-360-D



REMARKS: Use maximum gust velocity for determining crosswind component and steady wind velocity for determining headwind component.

AV108288

Figure 14-5. Take-off and landing crosswind.

TAKE-OFF DISTANCE

Minimum Run/Obstacle Clearance

Data Basis: Flight Test

Date: August 1966

Conditions:
1. Flaps 20°
2. Sod surface runway
3. 2800 RPM, Full Throttle

Model: T-41B

Engine: IO-360-D

GROSS WEIGHT POUNDS	IAS AT 50 FT.		PRESSURE ALTITUDE	-20°C				0°C				20°C				40°C			
				ZERO WIND		20 KNOT HEADWIND		ZERO WIND		20 KNOT HEADWIND		ZERO WIND		20 KNOT HEADWIND		ZERO WIND		20 KNOT HEADWIND	
	MPH	KN		Ground Run	Clear 50 Ft.	Ground Run	Clear 50 Ft.	Ground Run	Clear 50 Ft.	Ground Run	Clear 50 Ft.	Ground Run	Clear 50 Ft.	Ground Run	Clear 50 Ft.	Ground Run	Clear 50 Ft.	Ground Run	Clear 50 Ft.
2500	60	52	SL	495	845	165	355	570	955	200	415	655	1075	245	485	750	1210	290	560
			1000	540	910	185	390	625	1035	225	460	715	1165	270	530	815	1310	320	615
			2000	590	990	205	430	685	1125	250	505	785	1275	305	590	890	1430	360	685
			3000	640	1070	230	475	745	1225	280	560	855	1390	340	655	975	1570	400	765
			4000	705	1170	260	525	820	1345	315	625	935	1515	380	730	1070	1730	450	855
			5000	770	1275	290	585	895	1465	355	695	1030	1680	425	825	1175	1900	505	960
			6000	845	1395	325	655	980	1610	400	780	1130	1850	475	920	1290	2105	565	1080
			7000	925	1540	370	735	1085	1790	450	880	1245	2050	535	1040	1430	2375	635	1240
2200	56	49	SL	370	655	110	255	425	735	135	300	485	820	165	345	555	915	195	400
			1000	400	700	125	280	465	790	150	330	530	885	185	380	600	985	220	435
			2000	435	755	140	310	505	855	170	360	580	960	205	420	655	1065	245	480
			3000	475	815	155	340	550	920	190	395	630	1035	230	460	715	1160	275	530
			4000	520	880	175	375	605	1005	215	440	685	1120	255	510	785	1265	305	590
			5000	565	955	195	410	655	1085	240	485	755	1230	290	570	855	1380	340	655
			6000	620	1035	220	455	720	1185	270	540	825	1340	325	630	940	1510	385	730
			7000	680	1130	250	505	790	1300	305	600	905	1465	365	700	1035	1670	430	820
1900	52	45	SL	265	500	70	180	305	555	85	210	350	615	105	240	395	680	125	275
			1000	285	530	80	195	330	595	95	230	375	660	115	265	430	730	140	300
			2000	310	570	90	215	360	635	110	250	410	710	130	290	465	785	155	330
			3000	340	610	100	235	390	685	120	275	450	765	145	315	510	845	175	360
			4000	370	655	110	255	430	740	135	300	485	820	165	345	555	915	195	400
			5000	405	705	125	280	465	795	155	330	535	890	185	385	605	990	220	440
			6000	440	760	140	310	510	860	170	365	580	965	205	420	660	1075	245	485
			7000	480	825	160	345	555	935	195	405	635	1045	235	465	725	1175	275	540

REMARKS: 1. Maximum power applied and mixture adjusted to placarded fuel flow prior to brake release.

AV108289

Figure 14-6. Take-off distance.

CLIMB PERFORMANCE

Data Basis: Flight Test

Date: August 1966

Conditions:
1. 2800 RPM, Full Throttle
2. Flaps Up
3. Standard Day
4. No Wind

Model: T-41B

Engine: IO-360-D

GROSS WEIGHT POUNDS	PRESSURE ALTITUDE FT.	BEST IAS		RATE OF CLIMB FPM	FROM SEA LEVEL		
		MPH	KN		TIME MIN.	DIST. N. MI.	FUEL GAL.
2500	SL	95	83	915	0	0	1.3
	2500	93	81	800	3	4	2.1
	5000	91	79	680	6	9	2.9
	7500	89	77	565	11	15	3.8
	10,000	87	76	450	16	22	4.9
	12,500	85	74	330	23	31	6.2
2200	SL	92	80	1120	0	0	1.3
	2500	90	78	985	2	3	2.0
	5000	88	76	860	5	6	2.7
	7500	87	75	730	8	11	3.4
	10,000	85	74	595	12	16	4.3
	12,500	83	72	470	17	23	5.2
1900	SL	88	76	1390	0	0	1.3
	2500	86	75	1240	2	2	1.8
	5000	85	74	1095	4	5	2.3
	2500	83	72	945	7	8	2.9
	10,000	82	71	800	10	12	3.5
	12,500	80	70	650	13	17	4.2

REMARKS:

1. Mixture adjusted during climb to placarded fuel flow.

Alt.	GPH
Sea level	17
4000 Ft.	15
8000 Ft.	13
12,000 Ft.	11

2. Fuel used information includes 1.3 gallons for warm-up, taxi and take-off allowance.
3. Increase time, distance and fuel used by 15% for each 10°C above standard temperature.

AV108290

Figure 14-7. Climb performance.

CRUISE PERFORMANCE - 2500 FEET

Data Basis: Flight Test

Date: August 1966

Conditions:
1. Standard Day
2. Normal Lean Mixture
3. Zero Wind
4. 2500 Pounds Gross Weight

Model: T-41B

Engine: IO-360-D

RPM	MP	% BHP	TAS KNOTS	GAL/ HOUR	N.MI/ GAL.	46 GAL (NO RESERVE) ENDR HOURS	46 GAL (NO RESERVE) RANGE N. MI
2600	24	76	125	12.6	9.9	3.7	455
	23	71	122	11.9	10.3	3.9	475
	22	67	119	11.2	10.6	4.1	490
	21	62	115	10.5	11.0	4.4	505
2500	25	77	126	12.7	9.9	3.6	455
	24	73	123	12.1	10.2	3.8	470
	23	68	120	11.4	10.5	4.0	485
	22	64	117	10.8	10.8	4.3	500
2400	25	72	123	12.0	10.3	3.8	475
	24	68	120	11.4	10.5	4.0	485
	23	64	117	10.8	10.8	4.3	500
	22	60	113	10.2	11.1	4.5	510
2300	25	68	120	11.4	10.5	4.0	485
	24	64	117	10.8	10.8	4.3	500
	23	60	113	10.2	11.1	4.5	510
	22	56	109	9.6	11.4	4.8	525
2200	25	63	116	10.7	10.8	4.3	500
	24	59	113	10.1	11.2	4.6	515
	23	55	109	9.4	11.6	4.9	535
	22	52	106	9.0	11.8	5.1	545
	21	48	102	8.3	12.3	5.5	565
	20	44	98	7.7	12.7	6.0	585
	19	40	93	7.1	13.1	6.5	600
	18	37	87	6.6	13.2	7.0	605

REMARKS:
1. Do not operate engine at mixture settings leaner than indicated.
2. Range and endurance figures shown in this chart do not allow for fuel used during taxi, takeoff or climb.

AV108291

Figure 14-8. Cruise performance - 2500 feet.

CRUISE PERFORMANCE - 5000 FEET

Data Basis: Flight Test

Date: August 1966

Conditions:
1. Standard Day
2. Normal Lean Mixture
3. Zero Wind
4. 2500 Pounds Gross Weight

Model: T-41B

Engine: IO-360-D

RPM	MP	% BHP	TAS KNOTS	GAL/ HOUR	N.MI/ GAL.	46 GAL (NO RESERVE) ENDR HOURS	46 GAL (NO RESERVE) RANGE N. MI
2600	23	75	127	12.4	10.2	3.7	470
	22	70	124	11.7	10.6	3.9	490
	21	65	121	11.0	11.0	4.2	505
	20	61	116	10.4	11.2	4.4	515
2500	23	72	125	12.0	10.4	3.8	480
	22	67	122	11.2	10.9	4.1	500
	21	62	118	10.5	11.2	4.4	515
	20	58	114	9.9	11.5	4.6	530
2400	23	67	122	11.2	10.9	4.1	500
	22	63	118	10.7	11.1	4.3	510
	21	59	114	10.1	11.3	4.6	520
	20	54	111	9.3	11.9	4.9	545
2300	23	63	118	10.7	11.1	4.3	510
	22	59	115	10.1	11.3	4.6	520
	21	55	111	9.4	11.8	4.9	540
	20	51	107	8.8	12.1	5.1	560
2200	23	58	114	9.9	11.5	4.6	530
	22	55	111	9.4	11.8	4.9	540
	21	51	107	8.8	12.2	5.1	560
	20	47	103	8.2	12.6	5.6	580
	19	43	98	7.6	12.9	6.1	595
	18	39	92	6.9	13.4	6.7	615
	17	35	86	6.3	13.7	7.3	630

REMARKS:
1. Do not operate engine at mixture settings leaner than indicated.
2. Range and endurance figures shown in this chart do not allow for fuel used during taxi, takeoff or climb.

AV108292

Figure 14-9. Cruise performance - 5000 feet.

CRUISE PERFORMANCE - 7500 FEET

Data Basis: Flight Test

Date: August 1966

Conditions:
1. Standard Day
2. Normal Lean Mixture
3. Zero Wind
4. 2500 Pounds Gross Weight

Model: T-41B

Engine: IO-360-D

RPM	MP	% BHP	TAS KNOTS	GAL/ HOUR	N.MI/ GAL	46 GAL (NO RESERVE) ENDR HOURS	46 GAL (NO RESERVE) RANGE N. MI
2600	21	69	126	11.5	10.9	4.0	505
	20	64	122	10.8	11.3	4.3	520
	19	59	117	10.1	11.6	4.6	535
	18	54	113	9.3	12.1	4.9	560
2500	21	66	123	11.1	11.1	4.1	510
	20	61	119	10.4	11.4	4.4	525
	19	56	115	9.6	11.9	4.8	550
	18	52	110	9.0	12.2	5.1	565
2400	21	62	120	10.5	11.4	4.4	525
	20	57	116	9.7	11.9	4.7	550
	19	53	112	9.1	12.3	5.0	565
	18	49	107	8.5	12.6	5.4	580
2300	21	58	116	9.9	11.7	4.6	540
	20	53	112	9.1	12.3	5.0	565
	19	49	107	8.5	12.6	5.4	580
	18	45	102	7.9	13.0	5.8	595
2200	21	54	112	9.3	12.1	4.9	555
	20	50	108	8.7	12.4	5.3	570
	19	46	103	8.0	12.9	5.8	595
	18	42	98	7.4	13.3	6.2	610
	17	38	92	6.8	13.5	6.8	620

REMARKS:
1. Do not operate engine at mixture settings leaner than indicated.
2. Range and endurance figures shown in this chart do not allow for fuel used during taxi, takeoff or climb.

AV108293

Figure 14-10. Cruise performance - 7500 feet.

CRUISE PERFORMANCE - 10,000 FEET

Data Basis: Flight Test

Date: August 1966

Conditions:
1. Standard Day
2. Normal Lean Mixture
3. Zero Wind
4. 2500 Pounds Gross Weight

Model: T-41B

Engine: IO-360-D

RPM	MP	% BHP	TAS KNOTS	GAL/ HOUR	N.MI/ GAL.	46 GAL (NO RESERVE) ENDR. HOURS	46 GAL (NO RESERVE) RANGE N. MI.
2600	19	62	123	10.5	11.7	4.4	540
	18	58	118	9.9	11.9	4.6	550
	17	53	113	9.1	12.4	5.1	570
	16	47	107	8.2	13.1	5.6	600
2500	19	60	120	10.2	11.8	4.5	540
	18	55	116	9.4	12.3	4.9	565
	17	50	110	8.7	12.7	5.3	585
	16	45	104	7.9	13.2	5.8	605
2400	19	56	117	9.6	12.2	4.8	560
	18	51	112	8.8	12.7	5.1	585
	17	47	107	8.2	13.0	5.6	600
	16	42	100	7.4	13.5	6.2	620
2300	19	52	113	9.0	12.5	5.1	575
	18	48	108	8.3	13.0	5.5	595
	17	44	102	7.7	13.2	6.0	610
	16	39	95	6.9	13.7	6.7	630
2200	19	49	109	8.5	12.8	5.4	590
	18	45	104	7.9	13.1	5.8	605
	17	41	97	7.3	13.3	6.3	610
	16	37	90	6.6	13.7	7.0	630

REMARKS:
1. Do not operate engine at mixture settings leaner than indicated.
2. Range and endurance figures shown in this chart do not allow for fuel used during taxi, takeoff or climb.

AV108294

Figure 14-11. Cruise performance - 10,000 feet.

CRUISE PERFORMANCE - 12,500 FEET

Data Basis: Flight Test

Date: August 1966

Conditions:
1. Standard Day
2. Normal Lean Mixture
3. Zero Wind
4. 2500 Pounds Gross Weight

Model: T-41B

Engine: IO-360-D

RPM	MP	% BHP	TAS KNOTS	GAL/ HOUR	N.MI/ GAL.	46 GAL (NO RESERVE) ENDR HOURS	46 GAL (NO RESERVE) RANGE N.MI
2600	17	56	119	9.6	12.4	4.8	570
	16	51	114	8.8	13.0	5.2	595
	15	46	107	8.0	13.4	5.8	615
	14	40	98	7.1	13.7	6.5	630
2500	17	54	117	9.2	12.7	5.0	585
	16	49	111	8.4	13.2	5.5	605
	15	44	104	7.6	13.6	6.0	625
	14	39	94	6.8	13.7	6.7	630
2400	17	50	113	8.6	13.0	5.3	600
	16	46	107	7.9	13.4	5.8	620
	15	41	98	7.2	13.7	6.4	630
2300	17	47	108	8.1	13.4	5.7	615
	16	42	101	7.4	13.7	6.2	630
2200	17	44	104	7.6	13.6	6.0	625
	16	39	96	7.0	13.7	6.6	630

REMARKS:
1. Do not operate engine at mixture settings leaner than indicated.
2. Range and endurance figures shown in this chart do not allow for fuel used during taxi, takeoff or climb.

AV108295

Figure 14-12. Cruise performacne - 12,500 feet.

LANDING DISTANCE
Obstacle Clearance/Minimum Run

Data Basis: Flight Test

Date: August 1966

Conditions:
1. Flaps 40°
2. Power Off
3. Sod Surface Runway
4. Zero Wind

Model: T-41B

Engine: IO-360-D

GROSS WEIGHT POUNDS	IAS AT 50 FT.		PRESSURE ALT. FT.	-20°C		0°C		20°C		40°C	
	MPH	KN		Ground Roll	Clear 50 Ft.	Ground Roll	Clear 50 Ft.	Ground Roll	Clear 50 Ft.	Ground Roll	Clear 50 Ft.
2500	60	52	SL	365	785	385	830	405	870	425	915
			2000	385	825	405	875	425	920	445	960
			4000	405	870	425	920	450	965	470	1010
			6000	425	920	450	970	470	1015	495	1060
			8000	450	970	475	1020	495	1070	520	1115

REMARKS:
1. Maximum braking and flaps up immediately after touchdown.
2. Decrease distances by 10% for each 4 knots headwind.

AV108296

Figure 14-13. Landing distance.