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OPERATING INSTRUCTIONS

CT114 TUTOR – AVIONICS UPDATE

AIRCRAFT OPERATING INSTRUCTIONS

(ENGLISH)

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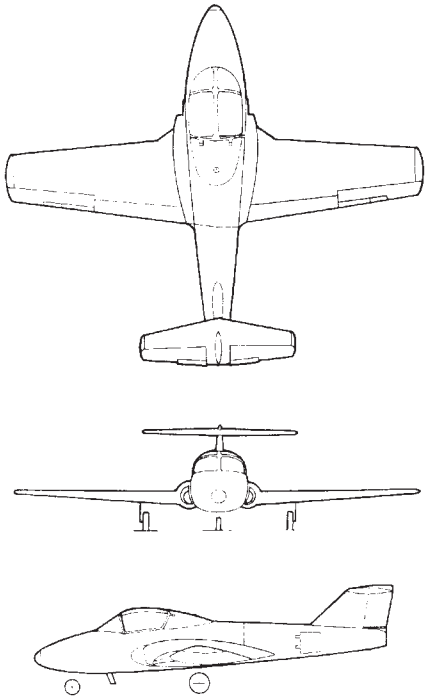

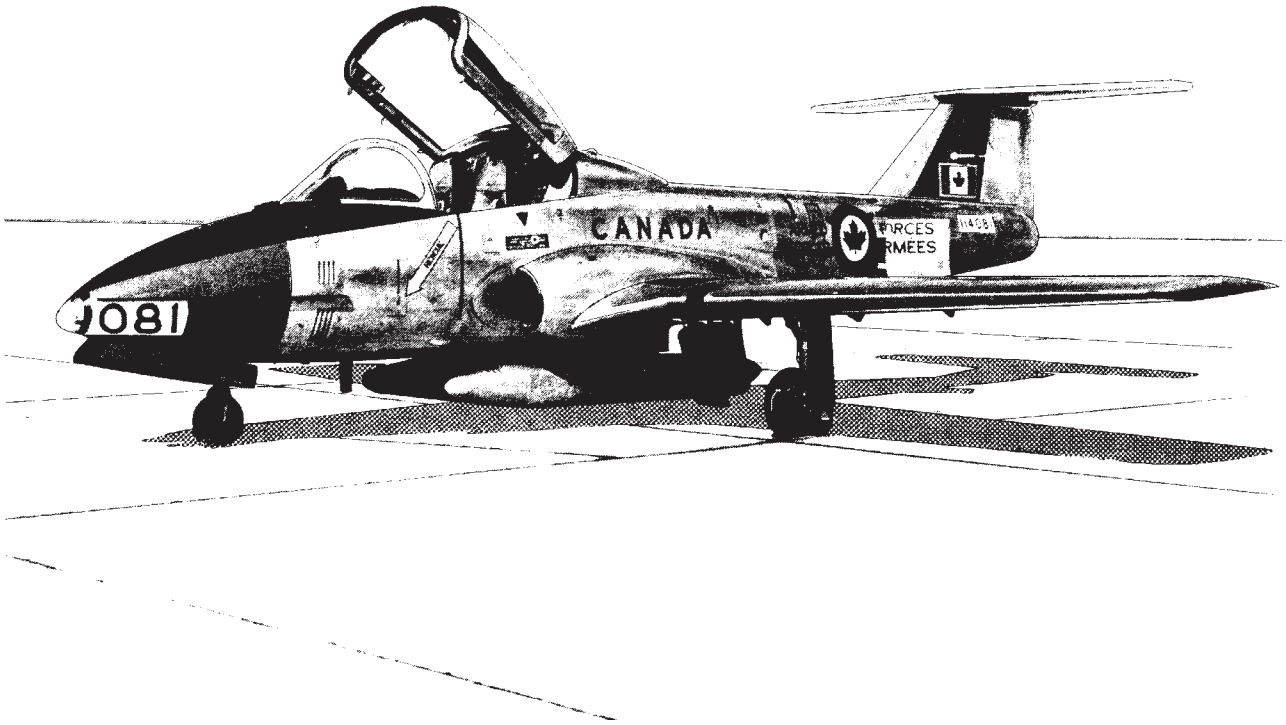

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NOTES TO USERS

GENERAL

1. This Canadian Forces Technical Order (CFTO) is divided into five Parts: General Description, Normal Operating Procedures, Emergency Operating Procedures, Operating Data, and Flight Testing.

NOTE

This publication contains the introduction and operating instructions for the Avionics Update (AUP) CT114 Tutor aircraft. For operating instructions regarding standard trainer (non-AUP) aircraft, refer to C-12-114-000/MB-Z02, for ex-Snowbird aircraft refer to C-12-114-000/MB-Z03, and for Snowbird aircraft refer to C-12-114-000/MB-Z04.

2. PART 1 – GENERAL DESCRIPTION – describes and illustrates the controls, systems and equipment with which the pilot should be acquainted.

3. PART 2 – NORMAL OPERATING PROCEDURES – describes the normal handling of the aircraft by the pilot.

4. PART 3 – EMERGENCY OPERATING PROCEDURES – details the emergency handling of the aircraft by the pilot.

5. PART 4 – OPERATING DATA – gives the flying and engine limitations and includes information on fuel consumption, range, and endurance under various conditions of flight.

6. PART 5 – FLIGHT TESTING – lists the procedures to be followed and the performance standards to be attained during flight testing of the complete aircraft or an individual system after maintenance. This part should be removed by user units prior to distribution to personnel unauthorized to perform the procedures described therein.

7. As a rule, words written in capital letters throughout the text indicate actual markings on the controls concerned.

8. Comments and suggestions should be forwarded through the usual channels to the Commandant, Central Flying School, Attention: Standards Flight Commander (STDS FLT COMD).

9. Danger, Warning, Caution, and Note headings are defined as follows:

DANGER

To draw attention to an extreme, violent and continuous hazard to life.

WARNING

To emphasize operating procedures, practices, etc, which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

To emphasize operating procedures, practices, etc, which, if not correctly followed, could result in damage to or destruction of equipment or legal claims or actions against the crown.

NOTE

To point out a procedure, event or practice which it is desirable or essential to highlight.

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PART 1

GENERAL DESCRIPTION

INTRODUCTION

1. The CT114 Tutor is an all-metal, low-wing, turbo-jet aircraft designed for the training of student pilots. It features side-by-side ejection seats for a crew of two in a pressurized and air-conditioned cockpit. The aircraft is IFR-certified, and instrumentation is provided for navigation, instrument, and night-flying training. The majority of services are electrically operated, but the landing-gear, wing flaps, speed brakes, nose-wheel steering and wheel brakes are hydraulically operated. The engine is a General Electric J85-CAN-40 axial-flow turbo-jet, incorporating an eight-stage compressor and a two-stage turbine. The engine develops approximately 2700 pounds maximum continuous static thrust at sea level under standard atmosphere (ICAO) conditions. For the general arrangement of the aircraft, see Figure 1-1, and for interior arrangement see Figure 1-2.

LEADING PARTICULARS

DIMENSIONS

2. The overall dimensions of the aircraft are:

a. Wing span 36.5 feet

b. Length 32.0 feet

c. Height 9.3 feet

WEIGHTS

3. The weights of the aircraft are as follows:

a. Basic weight (not including usable and residual fuel, crew parachutes or seat packs) is approximately 5500 pounds. Tanks and pylons weigh 178 pounds and are included in a tanked aircraft's basic weight. Trapped oil and fuel are negligible and are not counted.

b. Maximum permissible take-off weight is 9000 pounds (based on the use of JP-8 fuel).

c. Maximum landing weight is 8800 pounds.

FUEL- AND OIL-TANK CAPACITIES

4. The fuel- and oil-tank capacities are as follows:

a. Total usable fuel is approximately:

(1) 1173 litres (258 Imp gal) or 2091 pounds (948.5 kg) of JP-8, without external tanks installed.

(2) 1552 litres (341 Imp gal) or 2767 pounds (1255 kg) of JP-8, with external tanks installed.

b. Residual JP-8 fuel is 11.4 litres (2.5 Imp gal) or 25 pounds (11.3 kg).

c. Total oil capacity is approximately 1 Imp gal (4.5 litres).

FUEL SYSTEM

GENERAL

5. The aircraft fuel system consists of five flexible non-selfsealing fuel cells (arranged and interconnected to form a single tank), a collector tank and booster pump, an electrically operated gate-type shut-off valve, a fuel strainer and a quick disconnect (Figure 1-4). A vent system is incorporated, and low fuel pressure, fuel quantity and low level indication are provided. Gravity refuelling is accomplished through a filler cap on the right side of the fuselage.

6. The fuel-tank system permits gravity flow of fuel from the fuel cells in the fuselage to the centrally located collector tank containing the double-intake fuel booster pump. Fuel is delivered via the shut-off valve, fuel strainer, and quick-disconnect to the engine fuel system. The fuel strainer incorporates a bypass to ensure that a fuel supply to the engine is maintained, should the filter become clogged.

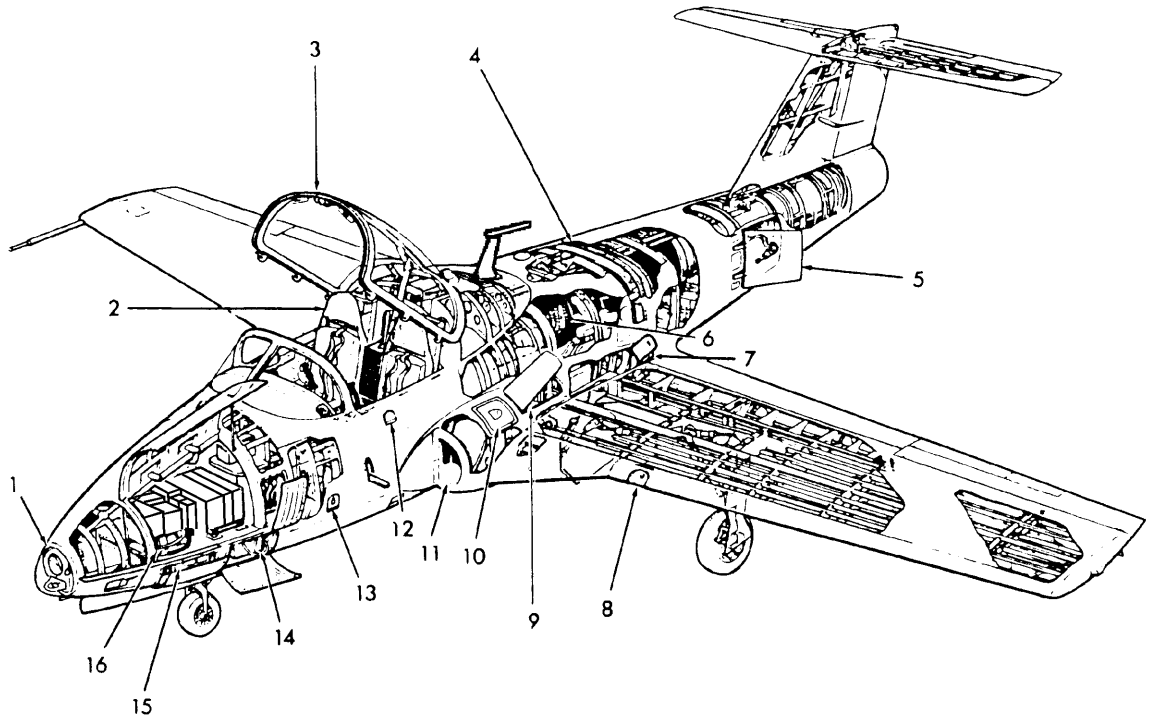
7. Two external fuel tanks can be installed to carry additional fuel for long-range navigational training. See Paragraphs 17 to 21 and Figure 1-4.

FUEL SPECIFICATIONS

8. Fuel specifications are as follows:

a. Standard fuel: NATO F-34 Mil grade JP-8.

b. Alternate fuel: NATO F-40 Mil grade JP-4; NATO F-44 Mil grade JP-5; or Commercial Jet B, Jet A-1, or Jet A, each with FSII added.



1 TAXI AND GROUND OBSERVER LIGHTS
2 UPWARD EJECTION SEAT (TWO)
3 ELECTRICALLY OPERATED JETTISONABLE CANOPY
4 FUSELAGE BREAK
5 SPEED BRAKE (ONE EACH SIDE)
6 ENGINE COMPARTMENT
7 GROUND POWER RECEPTACLE
8 LANDING LIGHT (ONE EACH SIDE)
9 PERSONAL BAGGAGE STOWAGE (ONE EACH SIDE)
10 OXYGEN CYLINDER (ONE EACH SIDE)
OXYGEN FILLER VALVE (LEFT SIDE ONLY)
11 ENGINE AIR INTAKE (ONE EACH SIDE)
12 CANOPY EXTERNAL OPERATING CONTROLS
13 CANOPY EXTERNAL JETTISON CONTROLS
14 BATTERY (ONE EACH SIDE)
15 ELECTRICAL RELAY PANEL (ONE EACH SIDE)
16 ELECTRONIC EQUIPMENT COMPARTMENT

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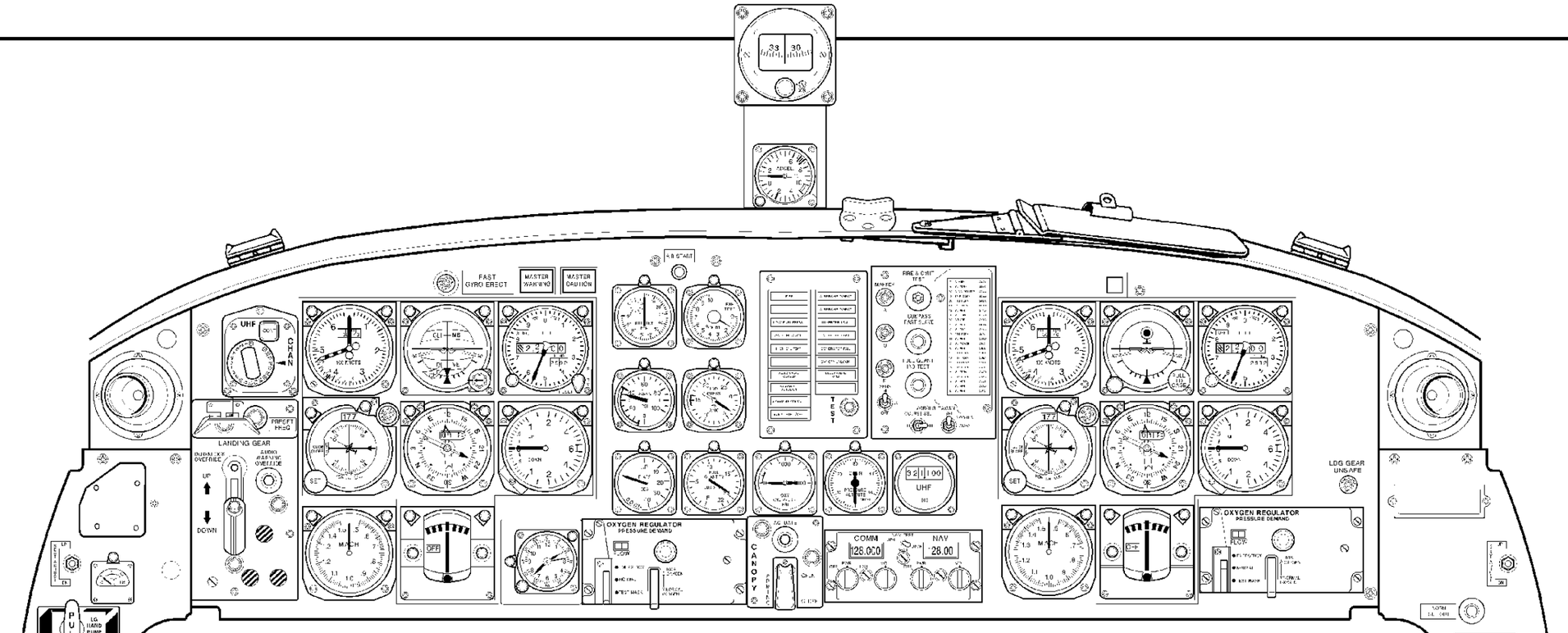
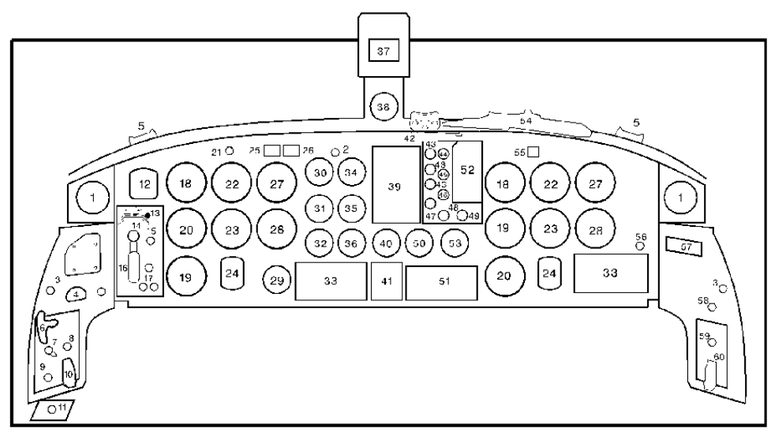
Figure 1-1 General Arrangement



1 Fresh Air Vent
2 Air Start Indicator Light
3 Seat Adjustment Switch
4 Loadmeter
5 Spring Clip
6 Emergency Landing-Gear Selector Handle
7 Pitot & Stall-Warning Anti-Icing Control
8 Landing & Taxi-Light Control Switch
9 Windshield & Canopy-Demist Control Switch
10 Windshield De-Icing Control Switch
11 Pre-stall Warning Test Switch
12 UHF Remote Channel Selector
13 Preset Frequency Read Switch
14 Landing-Gear Downlock Override Switch
15 Audio Warning Override Switch
16 Landing-Gear Control Lever
17 Landing-Gear Position Indicators
18 Airspeed Indicator
19 Track Indicator
20 Machmeter
21 Fast-Erect Switch
22 Attitude Indicator
23 DRMI
24 Turn & Slip Indicator
25 Master Warning Light
26 Master Caution Light
27 Servo Altimeter
28 Vertical-Speed Indicator
29 Clock



INSTRUMENT PANEL

30 Tachometer
31 Oil-Pressure Indicator
32 Wing-Flap-Position Indicator
33 Oxygen Regulator
34 Exhaust-Gas-Temperature Indicator
35 Hydraulic-Pressure Indicator
36 Fuel-Quantity Indicator
37 Standby Magnetic Compass
38 Accelerometer
39 Annunciator Panel
40 Oxygen-Pressure Indicator
41 Canopy Control Panel
42 Diversion Chart Holder
43 Marker-Beacon Indicator Lights
44 Fire & Overheat-Detection Test Switch
45 Gyro Magnetic Compass Fast-Slave Switch
46 Fuel-Quantity Indicator Test Switch
47 Marker Beacon HI/LO/OFF Switch
48 VOR/ILS Track Selector Switch
49 VOR/ILS TACAN Selector Switch
50 Cabin Altimeter
51 NAV/COM Dual Control Unit
52 Frequency-Card Holder
53 UHF Frequency Channel Indicator
54 Let-Down Chart Holder and Guard
55 Take Control Switch
56 Landing-Gear Unsafe Warning Light
57 Datum Oil-Pressure Placard
58 Landing-Gear Horn Cut-Out Button
59 Audio Muting Switch
60 Landing-Gear Up-Selection Override Switch

CF-513, CF-515, CF-520

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Cockpit Layout (Sheet 1 of 5) Figure 1-2

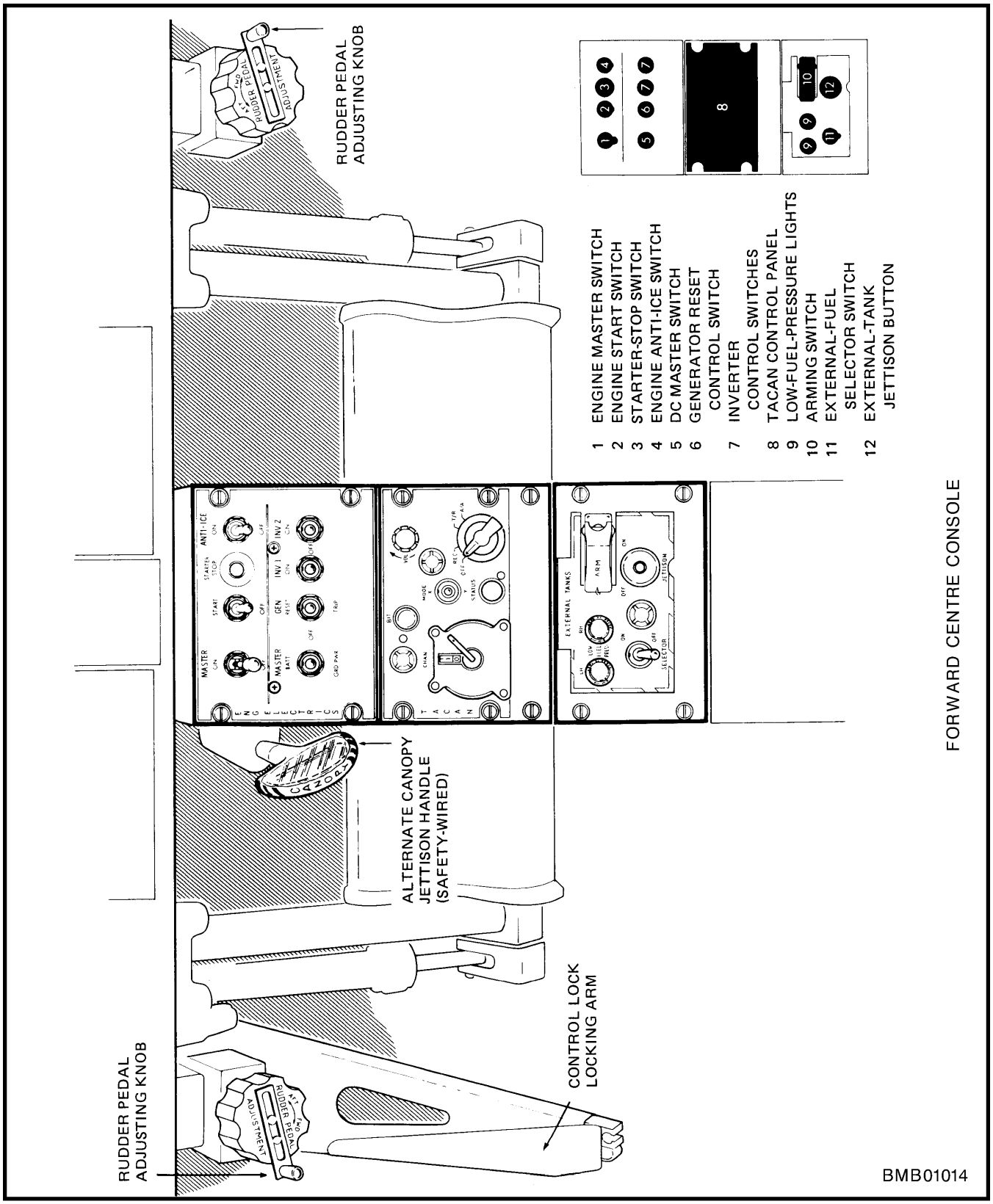


Figure 1-2 (Sheet 2 of 5) Cockpit Layout

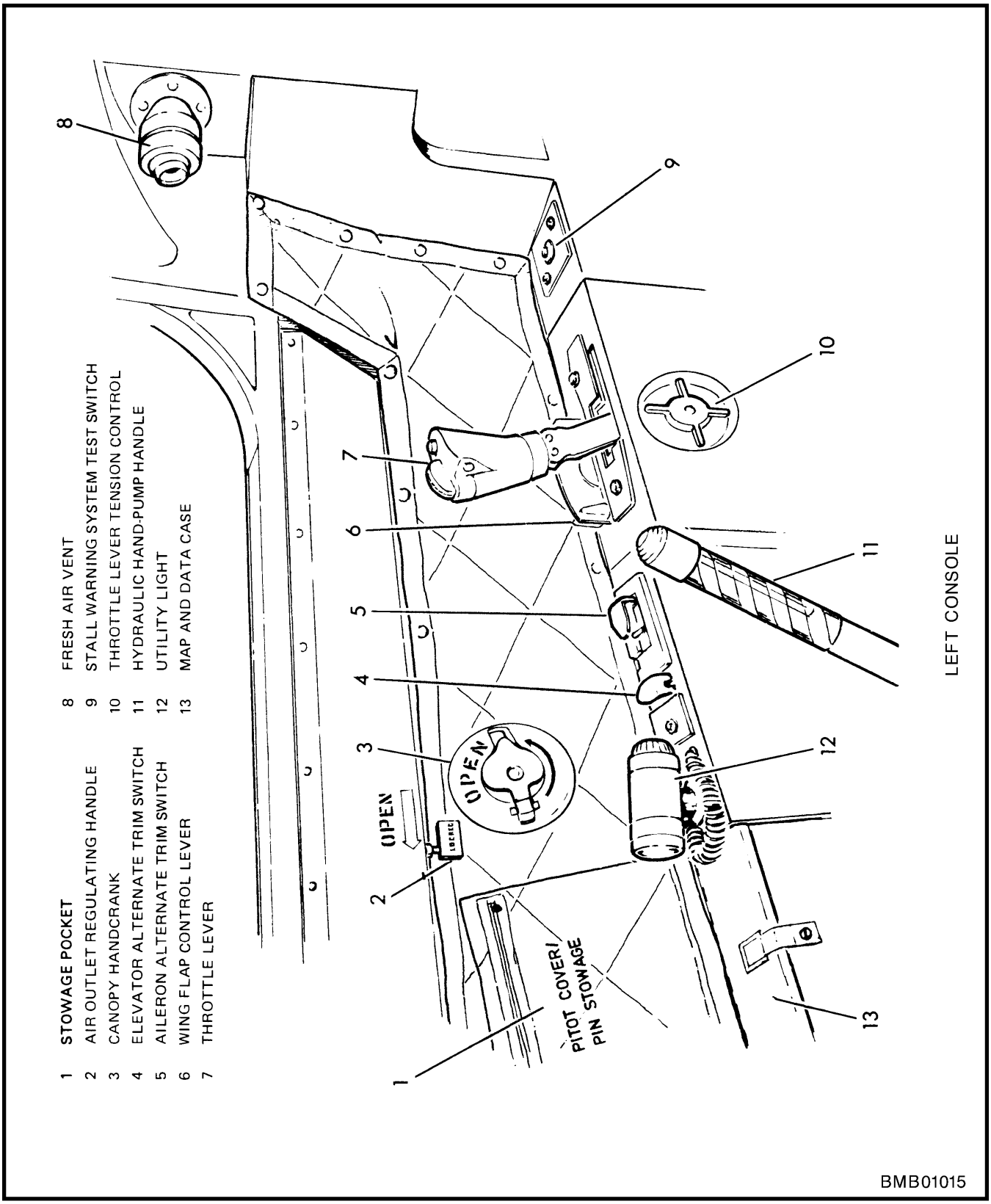


Figure 1-2 (Sheet 3 of 5) Cockpit Layout

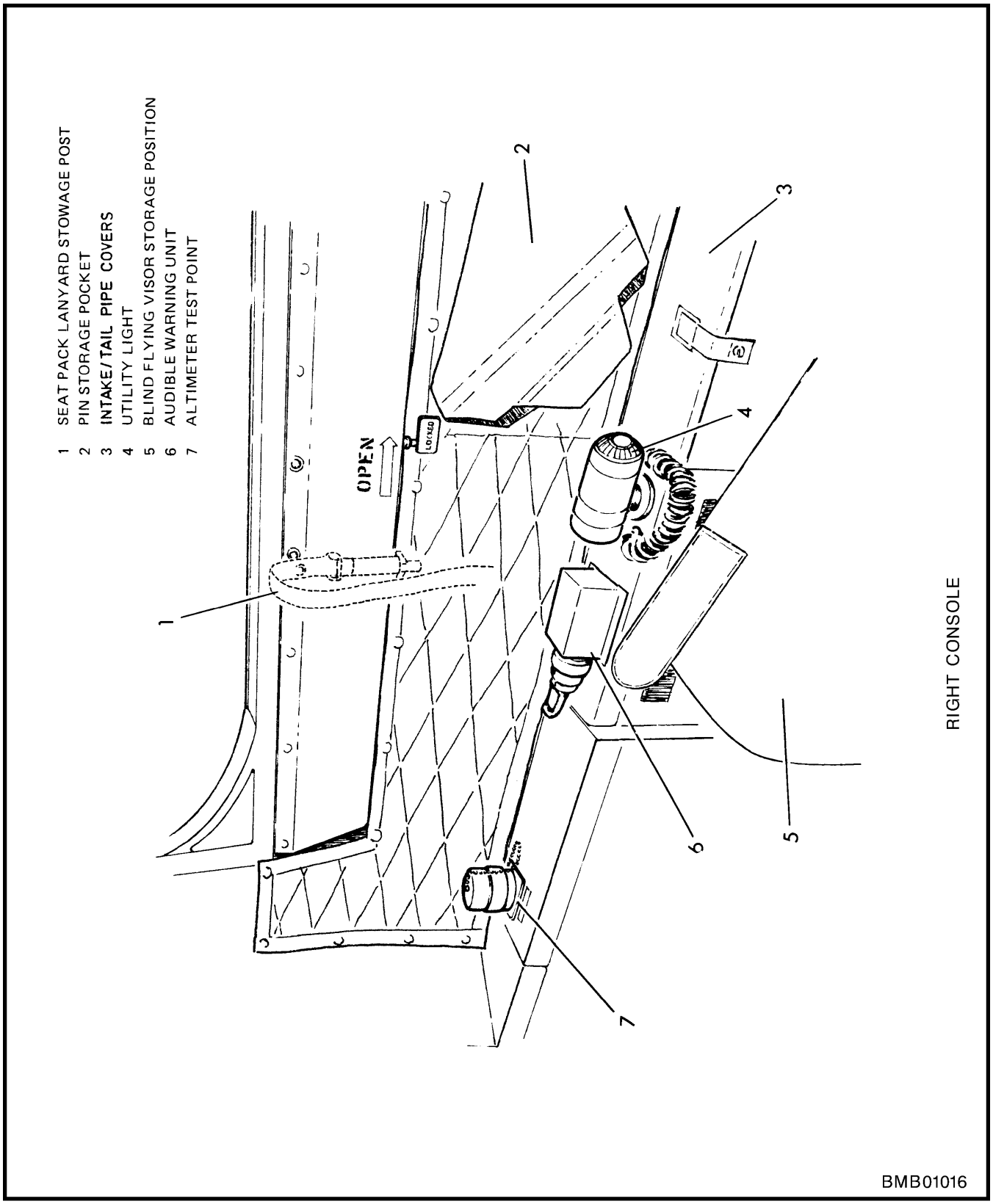


Figure 1-2 (Sheet 4 of 5) Cockpit Layout

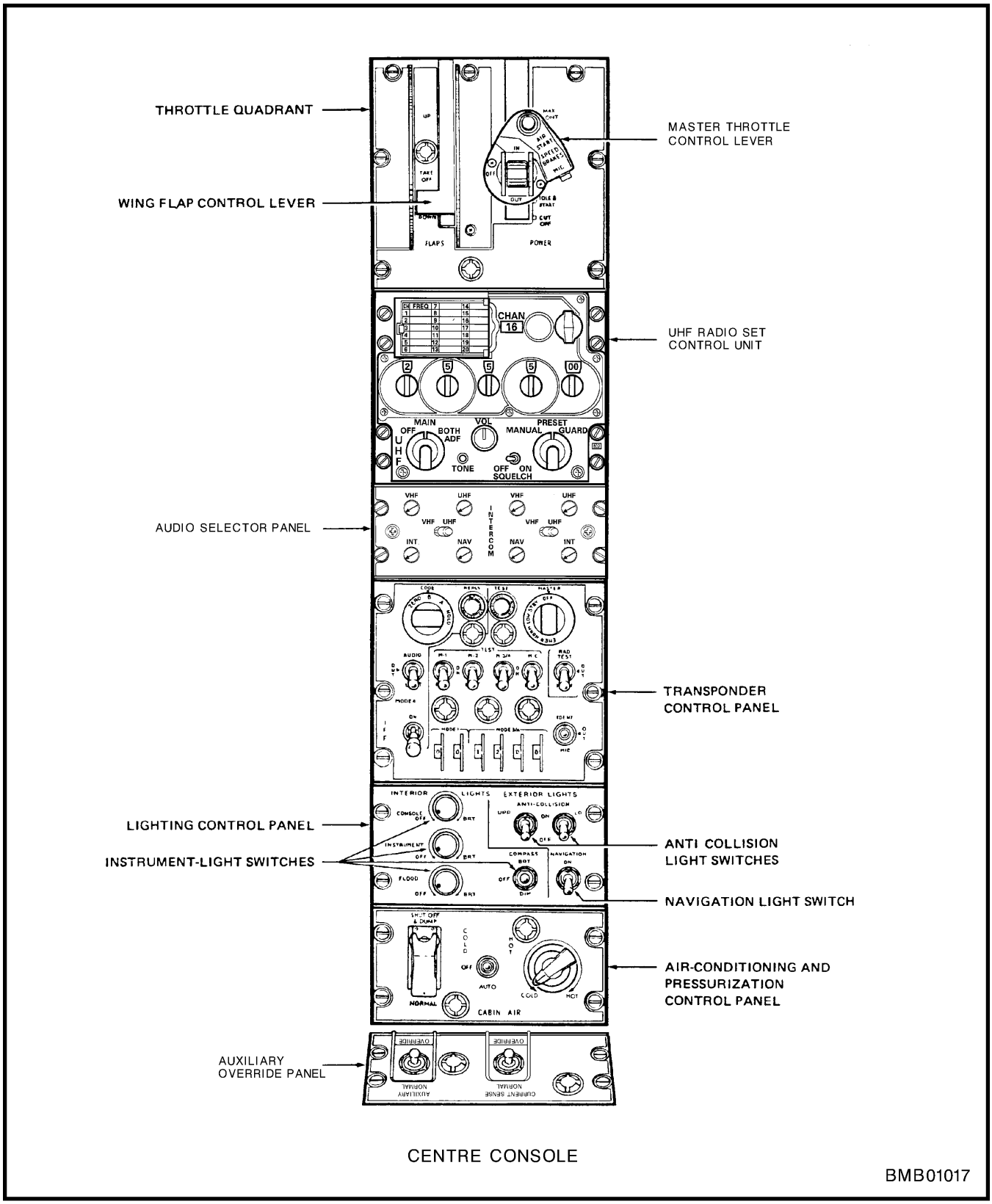


Figure 1-2 (Sheet 5 of 5) Cockpit Layout

NOTE

Aircraft fuel designated by an F number (e.g. F-40) will, by contract, contain FSII. FSII must be added to jet fuel (e.g. Jet A-1) and must be added to the fuel via fuel truck nozzle mixing. Spray bombs and cans are not authorized as they contain material which is toxic and highly corrosive to aluminium and fuel bladder materials.

c. There is no authorized emergency fuel for the Tutor.

CAUTION

F-34 (JP 8) increases the all-up weight for a full fuel load by 75 pounds and F-44 (JP-5) increases the all-up weight by 100 pounds. Higher EGT readings can be expected when using alternate fuels. Freezing point temperatures are higher than the standard fuel.

9. The freezing points of fuel used in the Tutor are listed in Figure 1-3. At the temperatures shown, hydrocarbon crystals (slush) start to form, and, as the temperature is lowered, the liquid fuel will change to a solid state. The crystals can block fuel lines, strainers, and pumps, resulting in engine fuel starvation. The freezing points of all fuels free of water are within the normal temperatures encountered at high altitudes at any time of the year.

WARNING

Do not operate the aircraft for prolonged periods at an altitude where the outside air temperature is equal to or lower than the freezing point of the fuel type in use.

FUEL TANK

10. The main fuel tank is comprised of five fuel cells positioned symmetrically about the centre line of fuselage. They are a forward cell, a right and left centre cell, and a right and left aft cell. The aft cells feed into the centre cells, and the forward and centre cells feed directly into the collector centre tank. A balance line is provided between the forward cell and each of the centre cells. The cells' usable contents are (in Imperial gallons, in litres, and pounds):

CELL	IMP GAL	L	LB
Forward	98	446	764
Centre (2 at 53 gal)	106	482	827
Aft (2 at 24 gal)	48	218	374
Collector Tank	6	27	47
Total Internal	258	1173	2012
External (21 at 41.7 gal)	83.4	379	651
Overall Total	341.4	1552	2663

BOOSTER PUMP

11. The fuel booster pump is mounted in the collector tank and is powered by the aircraft 28-volt DC power supply. The pump is a centrifugal-type and incorporates two screened inlet ports to ensure a limited fuel supply under all flight attitudes. The pump is energized whenever the engine master switch is in the ON position and there is DC power to the aircraft.

SHUT-OFF VALVE

12. The motorized fuel shut-off valve is located downstream of the booster pump, adjacent to the fuel strainer. The valve is operated from the aircraft 28-volt DC power supply. When the engine master switch is ON, the valve is open. When the switch is OFF, the valve is closed. In the event of a power failure, the valve will remain in its current position.

FUEL STRAINER

13. The fuel strainer consists of a 200-mesh element encased in a strainer-housing to prevent the entry of impurities into the engine fuel system. A bypass valve is incorporated to provide an alternate route for the fuel through the strainer, should the strainer become clogged. The fuel low-pressure switch is installed on the outlet side of the housing. A clogged filter is indicated by an indicator button that will protrude from the top of the strainer.

NATO Number	Military Grade	Commercial Grade	FSII	Freezing Point °C
F-34	JP-8	–	Yes	–50
F-40	JP-4	–	Yes	–59
F-44	JP-5	–	Yes	–46
–	Jet B	Jet B	Option	–51
F-35	Jet A-1	Jet A-1	Option	–50
–	Jet A	Jet A	Option	–40

Figure 1-3 Fuel Specifications

14. Whenever the fuel pressure falls below 12 (±0.5) psi, the fuel low-pressure switch on the filter causes the MASTER CAUTION light to flash and the annunciator panel legend marked LOW FUEL PRESS to illuminate. This reduction in fuel pressure could be an indication of a booster pump failure or a blockage in the fuel system.

FUEL-QUANTITY INDICATOR

15. A fuel-quantity indicator, reading in hundreds of pounds (lb ×100), is installed centrally on the instrument panel. Capacitance-type probes are fitted in the forward and right centre fuel cells to give an indication of fuel remaining in the internal fuel system. A fuel quantity test switch is installed centrally on the instrument panel. When the switch is depressed, the electrical circuit to the indicating system is interrupted and the quantity indication will drop toward zero. When the switch is released, the indication should return to the original value.

FUEL LOW-LEVEL WARNING

16. A float-operated switch in the forward fuel cell causes the MASTER CAUTION light to flash and the LOW FUEL QUANT legend on the annunciator panel to illuminate when the fuel tank quantity falls to approximately 380 pounds.

NOTE

During negative-G or linear accelerations the LOW FUEL QUANT light may illuminate, causing the MASTER CAUTION light to flash when fuel is in excess of 380 pounds.

EXTERNAL FUEL TANKS – INSTALLATION

17. All Tutor aircraft are capable of carrying two external fuel tanks with a capacity of 41.7 Imp gal (189.5 litres) or 325.5 pounds each. Two S2 bomb racks are utilized as carrying pylons for these external tanks. The pylons are bolted to front and rear hard points on the left and right sides of the centre fuselage and are not jettisonable. The tanks are attached to the pylons by the use of front and rear hooks and hook retainers. Adjustable sway braces align and steady the tanks. In addition, a crutch assembly is installed. Its main purpose is to prevent the external tanks from moving upward and hitting the underside of the fuselage, or from riding momentarily next to the aircraft subsequent to jettisoning.

NOTE

Maximum airspeed with external tanks installed is 400 KIAS or Mach 0.70, whichever is less. The pylons and crutches have the same limitations as the clean aircraft.

CONTROL PANEL

18. The external fuel control panel is mounted on the forward centre console (Figure 1-2). The following controls are incorporated in the panel:

a. External fuel selector switch (ON/OFF).

b. Arming switch (OFF/ON).

c. JETTISON button.

d. Two LOW FUEL PRESS warning lights LH/LR (one for each tank).

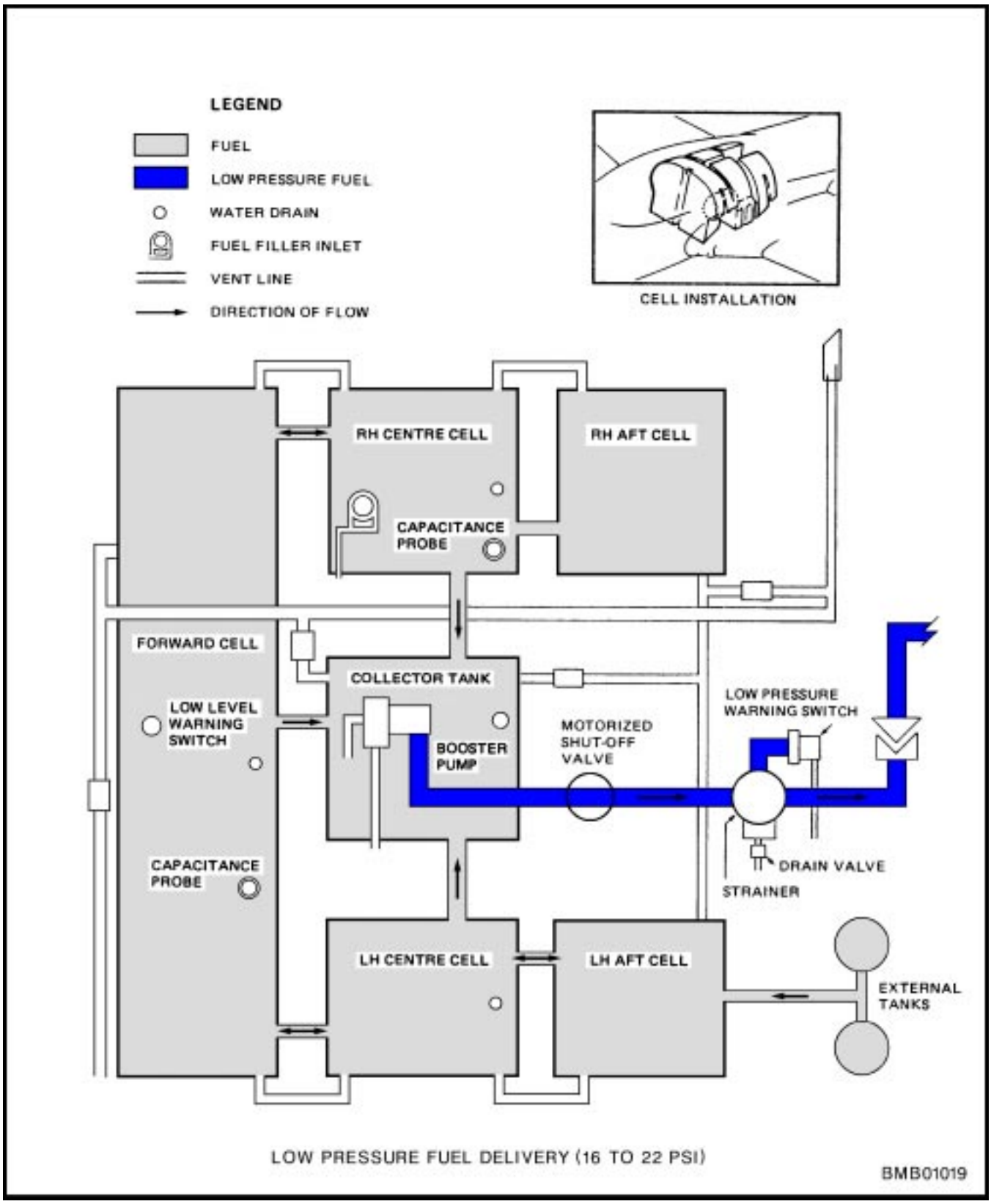


Figure 1-4 (Sheet 1 of 3) Fuel System – Schematic

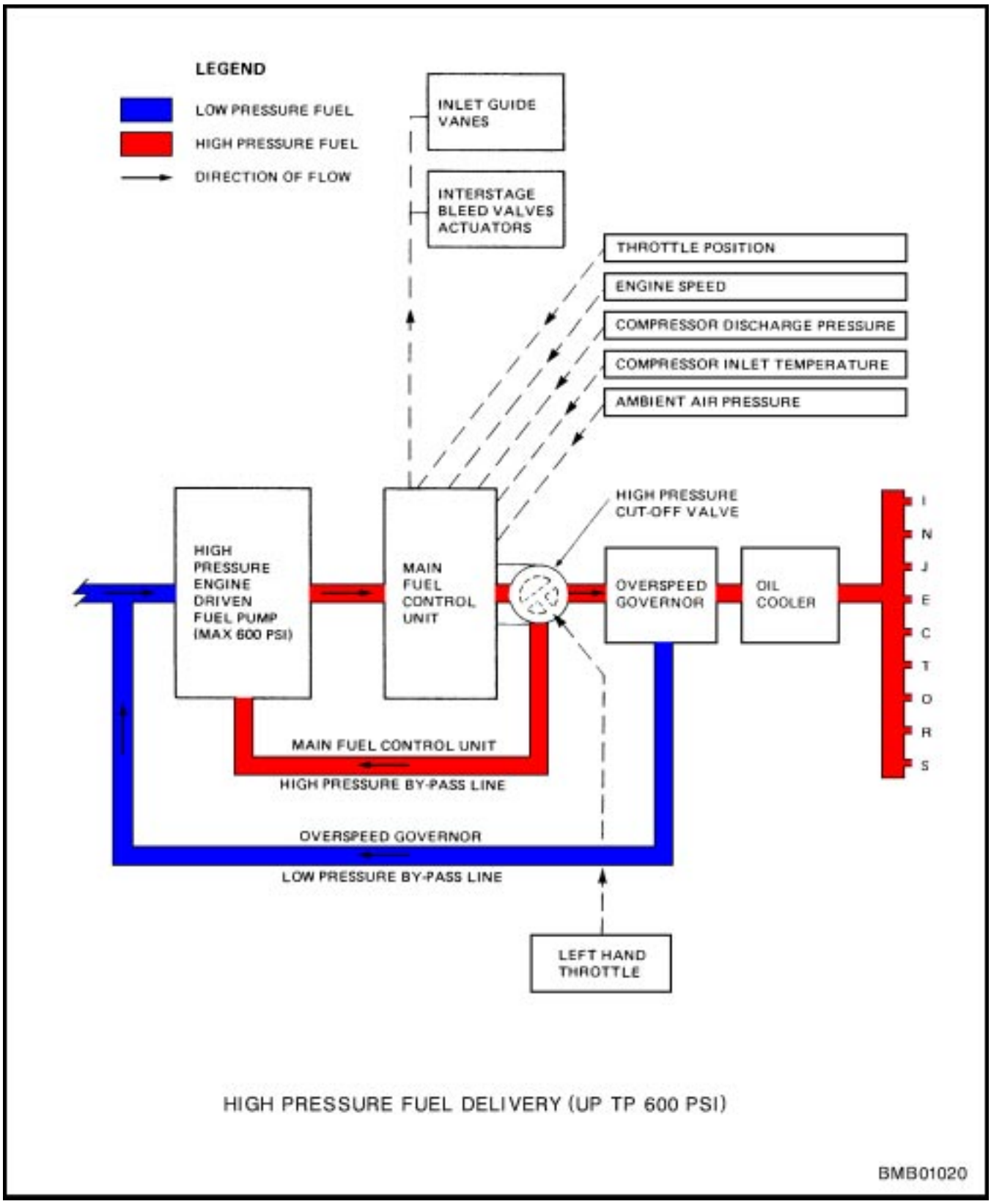


Figure 1-4 (Sheet 2 of 3) Fuel System – Schematic

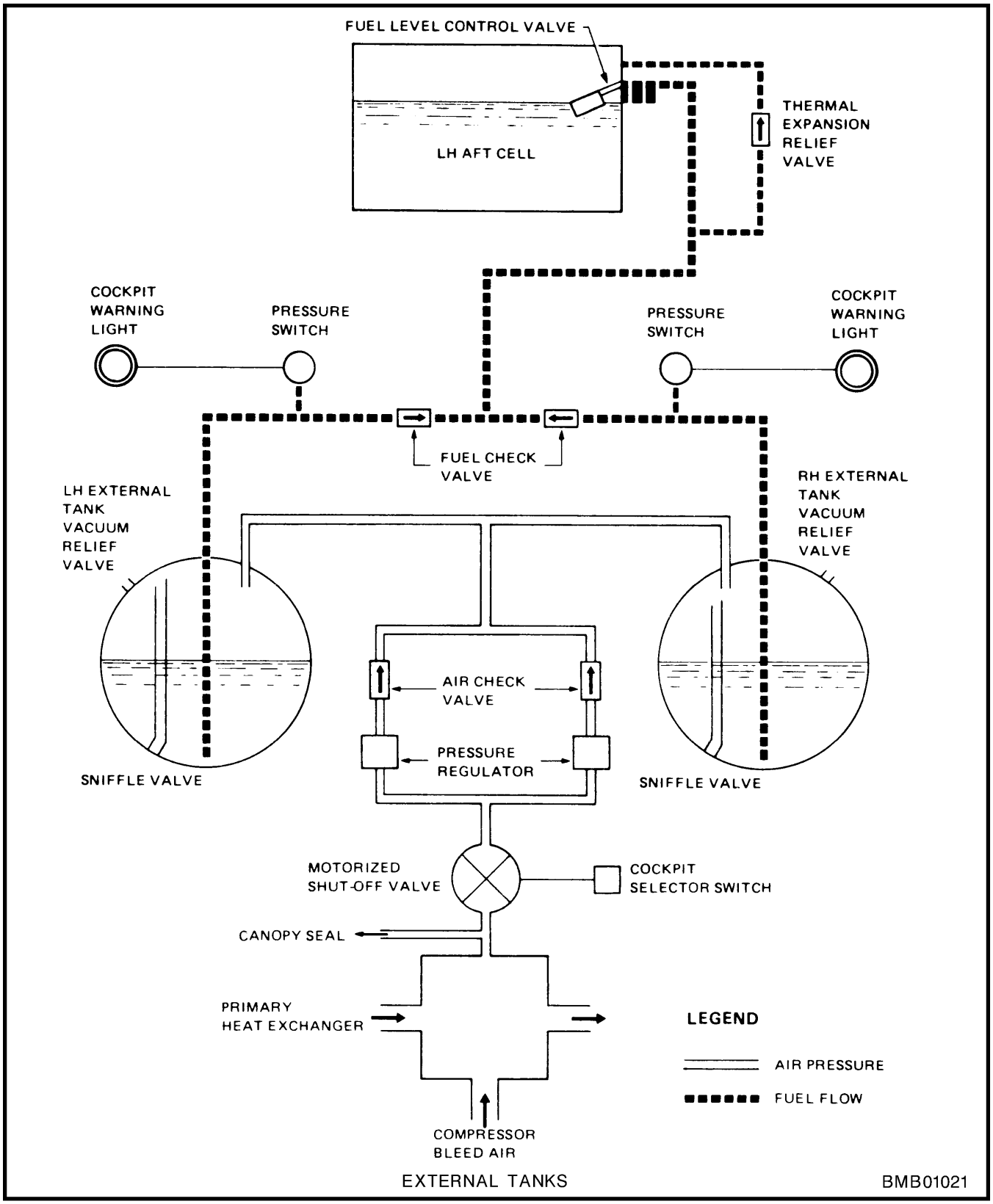


Figure 1-4 (Sheet 3 of 3) Fuel System – Schematic

FUEL TRANSFER

CAUTION

Do not attempt fuel transfer from the external tanks until at least 500 pounds of fuel have been used from the main tanks in order to have room in the internal tank to accept the external fuel. This will prevent the possibility of a tank rupture if the fuel level control valve malfunctions.

19. When external fuel is selected by placing the external fuel selector switch to the ON position, the shut-off valve is electrically opened, and air from the eighth stage is felt at the pressure regulator valve. The outlet pressure of this valve is 6(+0.25) psig; it passes through the air-check valves and pressurizes the external fuel tanks. On tank pressurization, fuel is forced to the left rear fuel cell (Figure 1-4). If the level of the fuel is at or below approximately 1800 pounds, the float valve will allow fuel to enter the tank at a rate of approximately 2500 pounds per hour.

NOTE

Fuel transfer will not take place if the air-conditioning master switch is in the SHUT OFF & DUMP position, or if there is a malfunction in the compressor eighth-stage bleed-air system.

20. The main fuel level will rise approximately 300 pounds, then begin to fall. When all the external fuel is transferred, the fuel pressure felt at the pressure switch decreases, and the switch is de-activated. Simultaneously, the LOW LEVEL PRESS warning lights on the fuel control panel are activated. These lights will remain on until the selector switch is placed OFF. Complete fuel transfer requires 8 to 15 minutes. Two drain valves are provided; one to drain water in the air line, the other to drain water in the fuel line.

NOTE

Place the external fuel selector switch to OFF when all fuel from the external tanks is transferred. This is in order to preclude the fuel from backing up into the air-conditioning system if the switch is left on and the aircraft shut down.

EXTERNAL TANK JETTISON

21. Jettisoning of the external tanks can be accomplished by raising the guard on the ARM switch and placing this switch in the ON position, then pressing the JETTISON button. Placing the arming switch in the ON position provides power to the jettison relays; pressing the JETTISON button allows power from these relays to be transferred to two solenoids, which unlock the pylon hooks, allowing the tanks to drop away.

NOTE

Jettison empty tanks between 125 and 180 KIAS; full tanks between 100 and 300 KIAS.

HYDRAULIC SYSTEM

GENERAL

CAUTION

Due to possible pump cavitation, do not select hydraulic services while experiencing zero or negative-G; hydraulic system failure may result.

22. The hydraulic system (Figure 1-5) provides power to operate the landing-gear and doors, nose-wheel steering, wing flaps, and the speed brakes. (The wheel brakes, although operated hydraulically, are not considered part of the aircraft hydraulic system.) The system, which incorporates a fluid-air heat exchanger, is a closed-circuit, constant-pressure type, operating at a pressure of 1400 to 1625 psi. There is no accumulator in the system; therefore, pressure fluctuations are normal during the operation of services.

NOTE

If the air-conditioning master switch is in the SHUT OFF & DUMP position for any reason during flight, an increase in flap, landing-gear and speed brake cycling times can be anticipated. Extremely cold temperatures will also increase cycling times.

HYDRAULIC FLUID SPECIFICATION

23. The hydraulic fluid specification is 3-GP-26C (NATO H-515).

HYDRAULIC RESERVOIR

24. The hydraulic reservoir is mounted on the left upper section of the engine bay and incorporates a sight gauge and filler cap. The reservoir is pressurized to 8 psi from the engine air-bleed system. A standpipe is incorporated to ensure that sufficient hydraulic fluid is available to lower the landing-gear

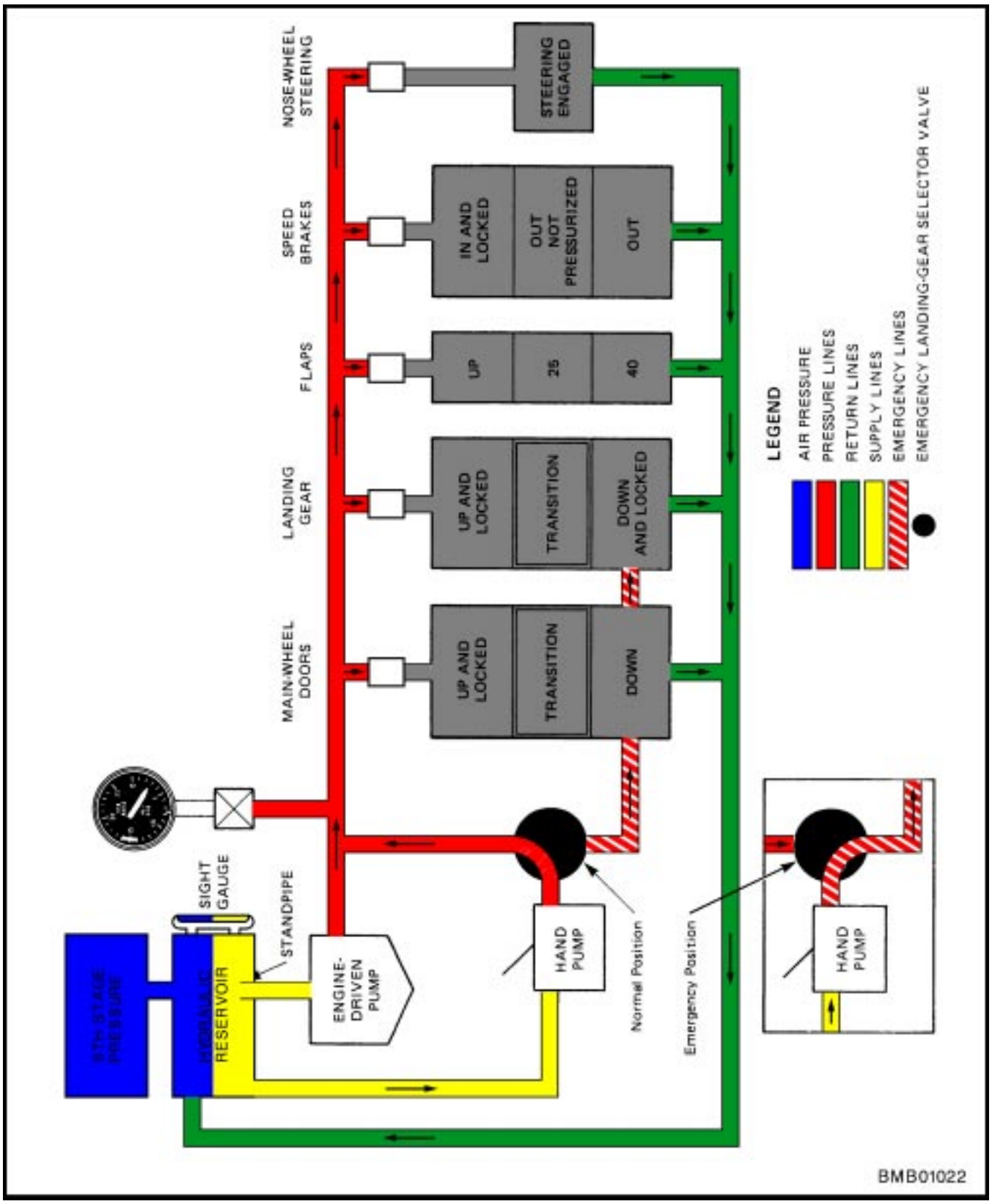


Figure 1-5 Hydraulic System – Schematic

manually with the hand pump in case of a leak in the system. The fluid capacity of the reservoir is approximately 1 Imp gal (4.5 litres).

EMERGENCY LANDING-GEAR SELECTOR HANDLE

25. An emergency landing-gear selector handle marked LG HAND PUMP SELECT is installed on the left side of the cockpit. When the handle is pulled, a valve in the hand pump line is re-positioned to direct hand pump pressure to separate landing-gear-down lines. Pulling the handle also de-activates the landing-gear control lever by disconnecting its electrical power source. Operation of the hand pump opens the doors and lowers the landing-gear. Since, with the selector handle pulled out, the landing-gear cannot be retracted by means of the hydraulic power system, a visual safety feature is incorporated. The first inch of the rod of the selector handle is painted yellow, and the next two inches, red. If the red is visible, the emergency system is engaged.

HYDRAULIC HAND PUMP

26. The hydraulic hand pump is located on the floor of the cockpit, outboard of the left seat. When operated, the hand pump will supply pressure for all hydraulic services except wheel brakes. When the pump is used with the LG HAND PUMP SELECT handle out, only the landing-gear will be lowered regardless of the LANDING GEAR control lever position. The hand pump can be locked in the extended position by rotating the extended portion.

HYDRAULIC PRESSURE GAUGE

27. An AC electrically-operated hydraulic pressure gauge is mounted centrally on the instrument panel; it indicates system pressure in hundreds of pounds per square inch (psi ×100).

ELECTRICAL SYSTEM

GENERAL

28. Electrical power is supplied by a 30-volt, 300-ampere DC starter-generator and two 115/26 Vac, 1000 volt-ampere, 400 Hz, single phase static inverters. Two 25.2-volt nickel-cadmium batteries provide power for emergency operation of systems. Provision is made for the supply of DC ground power. For a schematic of the electrical power distribution, see Figure 1-6. For circuit-breaker locations, see Figure 1-7.

DC ELECTRICAL POWER SYSTEM

29. The DC electrical power generating system consists of a 30-volt, 300-ampere, engine-driven DC starter-generator; a generator control switch; and various circuit breakers. Two 24-ampere-hour, 25.2-volt nickel-cadmium batteries, normally connected in parallel, serve as standby power. The left battery is directly connected to the battery bus. For DC electrical power distribution, see Figure 1-6.

GENERATOR CONTROL SWITCH

30. The generator control switch marked GEN is located on the forward section of the centre console and is spring-loaded to the centre position. The switch positions are marked RESET and TRIP. The RESET position is used to reset the generator. The TRIP position of the switch disconnects the generator from the electrical system by tripping the overvoltage relay in the voltage regulator.

DC MASTER SWITCH

31. The DC master switch, mounted on the forward section of the centre console, is a centre-off, double-throw switch with three positions, marked BATT, OFF, and GRD PWR.

32. When placed to the BATT position, the switch allows the batteries to be connected in parallel to the system feeders (DC buses) for normal operation. In the OFF position, the switch prevents both battery power and ground power from being connected to the system. The GRD PWR position connects ground power supply to the DC buses, prevents the battery start relay from closing, energizes the non-essential DC buses, and energizes the canopy power relay, enabling the canopy actuator to be operated from ground power.

NOTE

The battery bus is energized at all times regardless of the position of the DC master switch.

GENERATOR FAILURE

33. In the event of loss of generator output, the non-essential dc bus is de-energized. The No. 1 and No. 2 inverters can operate from battery power through the essential bus.

34. Illumination of the GENERATOR FAIL legend on the annunciator panel, the MASTER CAUTION warning lights flashing and/or a zero loadmeter reading indicates a loss of power output from the generator.

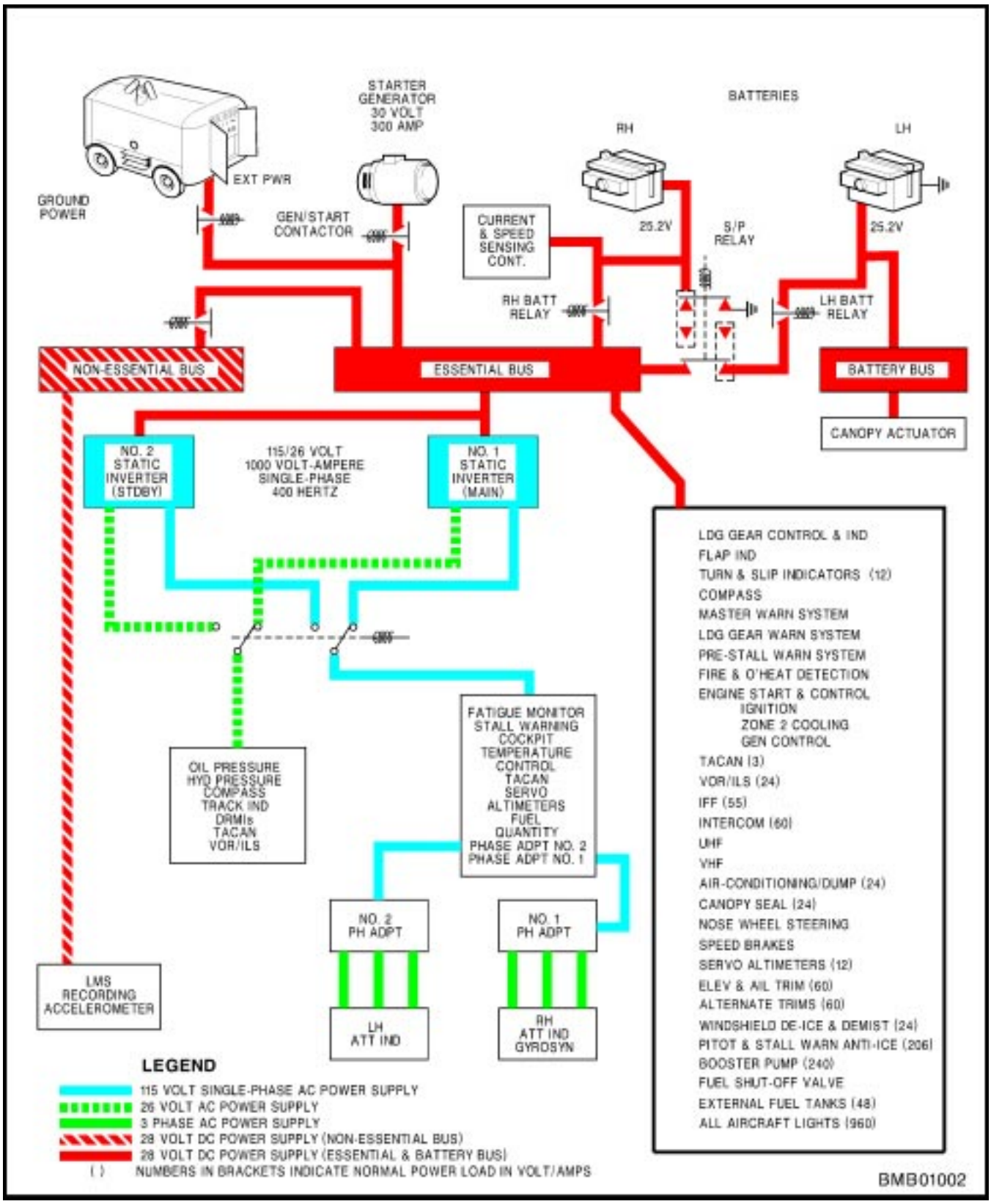


Figure 1-6 Electrical System – Schematic

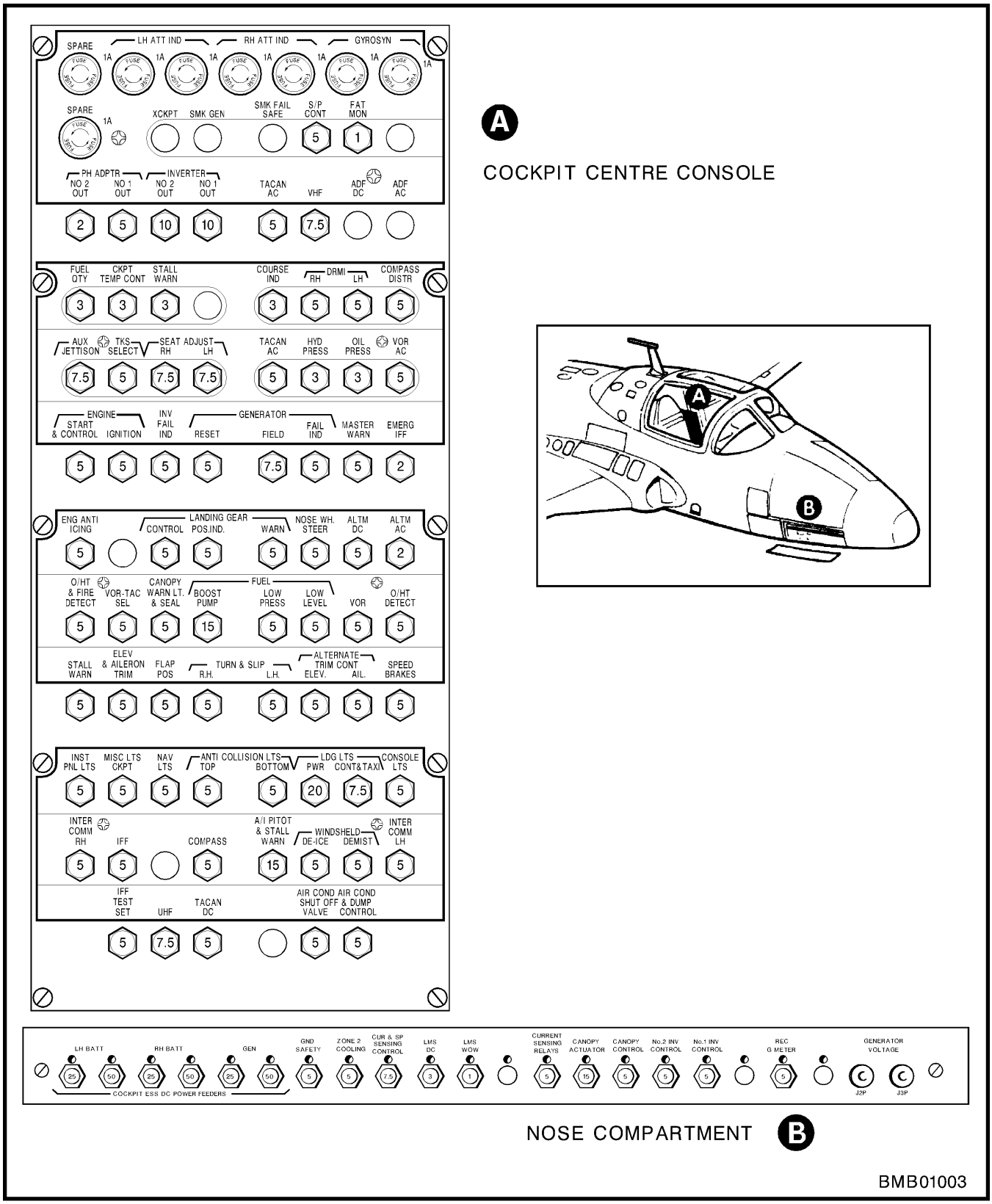


Figure 1-7 Circuit-Breaker Locations

35. An undercurrent sensing network is designed to trip the generator when output falls below 30 amps. Set the SENSE NORMAL/OVERRIDE switch, located on the auxiliary override panel, to OVERRIDE, prior to a generator reset, to verify sensing circuit was not at fault.

AC ELECTRICAL POWER SYSTEM

36. The AC electrical power system consists of two 115-volt, 1000-volt-ampere, 400-cycle, single-phase static inverters, control switches, and various circuit breakers. For AC electrical power distribution, see Figure 1-6.

37. In the event of loss of power from No.1 static inverter, the AC loads are automatically transferred to the No. 2 static inverter. With the No. 1 static inverter on line, a No. 2 static inverter failure will not affect normal system operation.

38. Loss of power output from either inverter is indicated by flashing of the MASTER CAUTION light on the main instrument panel and by illumination of the annunciator panel window marked INVERTER 1 FAIL or INVERTER 2 FAIL.

NOTE

Erratic instrument indications may be caused by a faulty inverter that does not automatically fall off line. By selecting INV 1 switch to the OFF position, power is transferred to the No. 2 inverter and, if No. 1 inverter was originally at fault, instrument indications should return to normal.

INVERTER CONTROL SWITCHES

39. The inverter control switches are located on the forward section of the forward centre console. The switches are single-pole, single-throw ON-OFF switches marked INV 1 and INV 2.

GENERATOR LOADMETER

WARNING

Loadmeter readings of 0.1, or less, under normal conditions indicate an electrical system malfunction.

40. Indication of the electrical load on the generator is provided by a loadmeter located on the left instrument sub-panel. The indication is given as a percentage of the maximum generator output. Under normal operating conditions, the electrical load requirements of the aircraft are indicated by a loadmeter reading of approximately 0.2.

EXTERNAL POWER RECEPTACLE

CAUTION

Starting current for Tutor aircraft is limited to 1000 amperes, because of engine starter-generator torque limitations.

41. The external power supply receptacle is located in the wing fillet on the left side of the aircraft. It provides 28-volt DC power for engine starting and operation of electrical systems.

GROUND SAFETY SWITCHES

42. Two ground safety switches are provided on the main landing-gear. With the weight of the aircraft on both main gear, the switches function as follows:

a. Override the WSHLD DE-ICE switch and shut off the system.

b. Cut out the normal stall-warning circuit, and override the PITOT & STALL WARN A/I control switch, to cut out lift transducer anti-icing circuit.

c. Control LANDING GEAR selector lever, preventing inadvertent up-selection on ground.

d. Control Zone 2 cooling system, selecting it ON.

e. Connect the TAKE-OFF trim advisory light circuit.

43. In addition, a ground safety switch on the nose landing-gear de-energizes the nose-wheel steering circuit when the weight of the aircraft is removed from the nose landing-gear.

POWER PLANT

ENGINE

44. The aircraft is powered by a J85-CAN-40 axial-flow turbo-jet engine, which develops approximately 2700 pounds static thrust at sea level under standard atmospheric conditions. The engine components include an eight-stage axial-flow compressor, driven by a two-stage turbine, an annular combustion section, a fixed area exhaust section, a fuel control system, controlled compressor

interstage air bleed, and variable inlet guide vanes. Mechanical energy to power accessory components is obtained through an engine-mounted gearbox, connected to a transfer gearbox, driven by the compressor shaft.

ENGINE TACHOMETER

45. The engine tachometer, located on the main instrument panel, indicates engine speed as a percentage of a maximum RPM. The instrument is powered by a tachometer-generator, which is driven by the accessory gearbox.

ENGINE FUEL SYSTEM

46. The engine fuel system pressurizes, meters, and injects fuel into the combustion chambers. It is regulated by the engine fuel control unit as a function of throttle position, engine speed, compressor discharge pressure (CDP), compressor inlet temperature (CIT), and ambient pressure. Fuel from the engine-driven pump is supplied to the main fuel control unit, which, in addition to metering fuel, regulates the position of the inlet guide vanes and interstage bleed valves. Fuel, in addition to being used for combustion, is used as a servo fluid within the control unit and as a coolant to maintain engine lubrication oil temperature within operating limits.

47. A fuel cut-off valve shuts off high-pressure fuel supply to the engine burners when the throttle is in the CUT OFF position.

ENGINE FUEL PUMP

48. The engine-driven pump incorporates a centrifugal boost element and a positive-displacement gear-type element to supply the engine high-pressure fuel requirements. The centrifugal boost element supplements the aircraft fuel system booster pump pressure. Fuel is drawn into the fuel-pump inlet by the first-stage centrifugal element. Fuel then passes through a screen into the second-stage gear pump. Incorporated in the gear pump is a spring-loaded relief valve which relieves excessive pressure back to the gear pump inlet. From the pump, fuel is delivered to the main fuel control.

ENGINE OIL SYSTEM

49. Engine lubrication is provided by a self-contained pressure-type oil system (Figure 1-8). Engine oil is pumped via a multi-element, vane-type pump (one element pressure, five elements scavenge) from an oil tank through an oil cooler and filter to lubricate the engine bearings, power take-off (PTO) gearbox, the transfer gearbox, and the accessory drive gearbox. It is returned to the oil tank via a dwell chamber within the tank by scavenge elements of the pump. Oil for the pressure element is picked up by a pendulum, which is prevented from contacting the forward wall of the oil tank by two stops (one on the top and one on the bottom of the oil tank). Provided that the aircraft is not inverted from a nose-down position of 8 degrees or greater, the pendulum will continue to deliver oil to the pump during inverted flight. Air picked up during the movement of the pendulum is vented to the atmosphere through small holes in the compressor drive shaft and the turbine retaining nut. The air passes from the holes into the turbine casing and finally into the exhaust system. During entry and exit to inverted flight, oil pressure fluctuations can be expected to occur, accompanied by the loss of small amounts of engine oil. The oil tank is located on the forward right side of the engine. The filler cap, with an integral dip-stick, is located under an access panel to the right of the fuselage centre line, forward of the fuselage break. An oil-to-fuel heat exchanger cools the oil. The system is fully automatic. The capacity of the oil reservoir is 7 Imperial pints (4 litres). For further information and flight restrictions/limitations, refer to Part 4.

OIL SPECIFICATION

50. Oil specification is 3-GP-904 (NATO O-148).

OIL PRESSURE INDICATOR

51. An AC electrically-operated pressure indicator is mounted centrally on the instrument panel and reads in pounds per square inch (psi). A placard containing the engine serial number and datum oil pressure is installed on the right instrument sub-panel. Fluctuating oil pressure up to a maximum of ±2 psi is allowable within the normal operating limits.

OIL COOLER

52. The oil cooler is a liquid-to-liquid heat exchanger mounted on the oil reservoir mounting flange. The cooler consists of numerous longitudinal passages arranged in a honeycomb pattern. Both fuel and oil simultaneously flow through adjoining passages, and an exchange of heat occurs between hot engine oil and cool fuel. A pressure bypass valve opens in response to excessive pressure. With the valve in the closed position, oil entering the cooler is directed through the longitudinal passages where the heat exchange takes place.

HIGH OIL TEMPERATURE WARNING

53. An oil temperature of 192 °C (±4) or higher will be indicated when the MASTER CAUTION light flashes and the annunciator panel legend marked HIGH OIL TEMP illuminates.

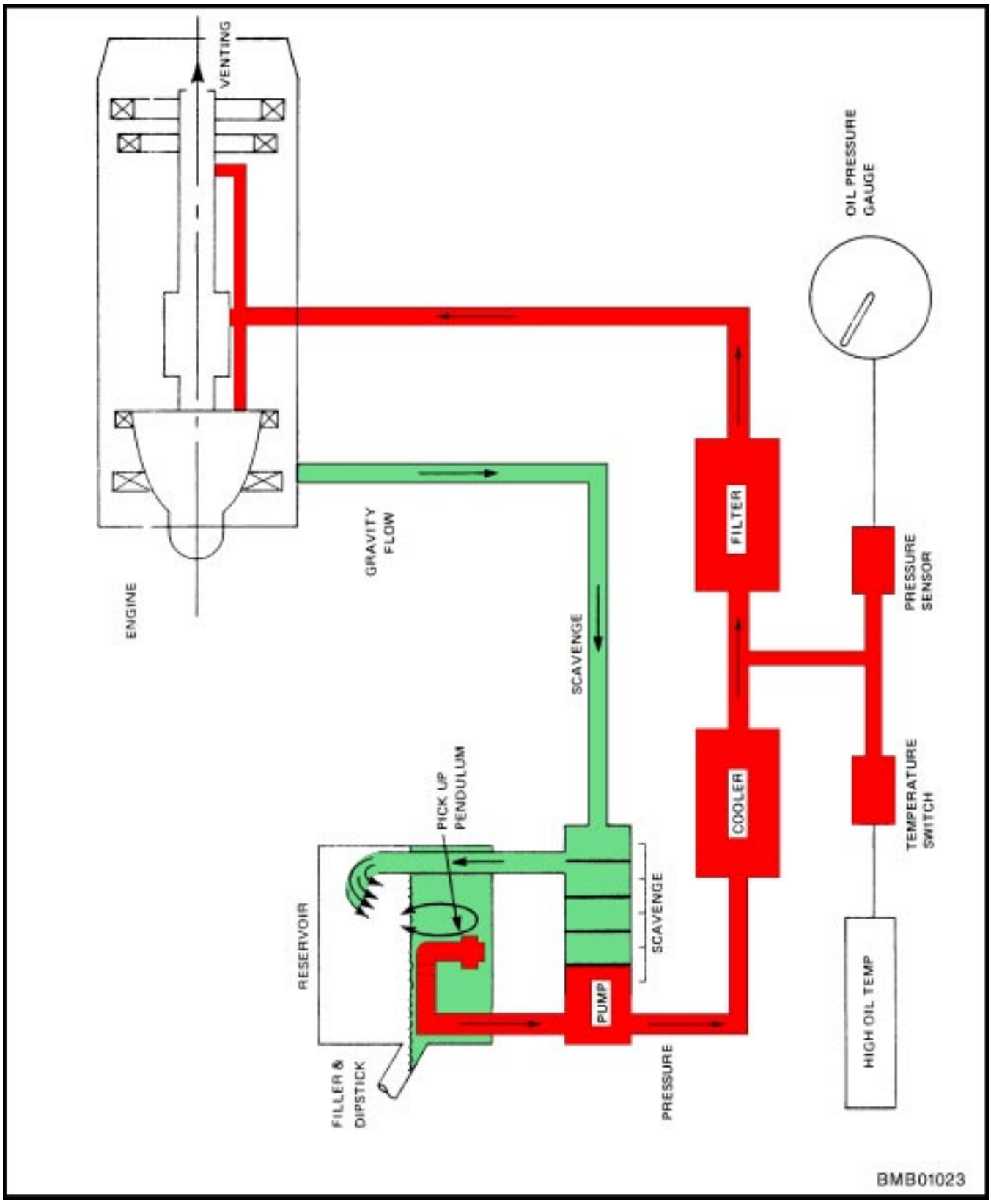


Figure 1-8 Oil System – Schematic

ACCESSORY GEARBOX

54. The accessory gearbox is mounted on brackets below the engine front frame and is connected by a shaft to the compressor-driven transfer gearbox, which is mounted below the engine main frame. The following engine accessories are driven by the accessory gearbox: oil pressure/scavenge pump, tachometer generator, main fuel pump, overspeed governor, hydraulic pump and starter-generator.

STARTER AND IGNITION

55. The combination starter-generator is a single unit that serves during a ground power start as a starter until the engine reaches 35% RPM, then automatically converts to a generator, and may be brought on line at 50% RPM. A battery start takes the engine to 45% RPM and then the starter may be brought on line at 50% to act as a generator. Starter-generator input and output is controlled by a coil-operated relay in the main power line, called a ''starting contactor'' or ''generator cut-out'', depending on the mode of operation, starter or generator. Engine idle RPM is set at 55 ±0.5%.

56. The fuel-air mixture in the combustion section is initially ignited by two igniter plugs. The high-energy output of the plugs is derived from a capacitor discharge-type ignition unit. The ignition circuit is automatically de-energized when the start cycle is completed.

57. The ignition circuit is controlled by three switches for ground starts: the engine master switch, the engine start switch, and the throttle operated microswitch. This micro-switch is mounted in the RH throttle box, and energizes the ignition circuit when the throttle is moved into the IDLE & START position during start-up. Additional switches, one on each throttle, may be used to energize the ignition circuit for relighting in flight.

ENGINE MASTER SWITCH

58. The engine master switch is a two-position lever-locked switch marked ON and OFF. Placing the switch at ON performs the following functions:

a. Energizes the low-pressure fuel system booster-pump relay.

b. Energizes the low-pressure fuel system shut-off valve.

c. Arms the engine start switches.

d. Arms the airstart switches.

e. Arms the ignition circuit to the start control relay.

ENGINE START SWITCH

59. The start sequence is controlled automatically by the start and generator control relays located within the A-1 nose discrete component box. The relays are activated by a speed sensing network receiving its signal from the engine tach generator.

60. The engine start switch is marked START and OFF and is spring-loaded to OFF. Momentarily engaging the switch to START energizes the start and control relay which is then maintained by the speed sensing network, and momentarily energizes the generator reset control relay. The start cycle is now initiated and will proceed uninterrupted through the following sequence until the engine lights up and the speed switches actuate, unless it is terminated manually by the STARTER STOP button. The sequence is as follows:

a. The engine start and control relay energizes the starting contactor, and it closes to energize the starter.

b. The speed sensing network provides a ground through the STARTER STOP button to maintain the start and control relay.

c. Also, simultaneously, the GENERATOR FAIL legend extinguishes and the loadmeter is disconnected.

d. The engine commences turning and accelerates.

e. The ignition circuit to the throttle microswitch is now armed.

f. Zone 2 cooling air and the air-conditioning system are shut off and remain so until 50% RPM is attained.

g. The non-essential bus is removed from the line.

NOTE

If internal batteries are used for the start, they will be connected in series.

THROTTLE MICROSWITCH

61. With the engine accelerating, moving the throttle from CUT OFF to IDLE & START opens the high-pressure fuel shut-off valve and energizes the igniters to ignite the fuel. During a battery start, with the dc MASTER switch placed in BATT position, the series-parallel relay is energized.

NOTE

The throttle must be left in the IDLE & START position to obtain fuel ignition.

ENGINE SPEED SWITCHES

62. During a Ground Power Unit (GPU) start, the speed sensing circuit controls starter cut-out by de-energizing the engine start and control relay at 35% RPM. Ignition then ceases, the starting contactor opens and the GENERATOR FAIL legend flickers. A battery start is terminated at 45% RPM at which time the series-parallel relay is also de-energized to revert batteries back to the parallel configuration.

NOTE

Should the GENERATOR FAIL light not remain illuminated between 0 - 50%, this may indicate a failure of the start control circuits or speed sensing network as well as the possibility that the start contactor has remained energized. Pressing the STARTER STOP button will interrupt the holding circuit for the engine start and control relay, discontinuing the start.

63. As RPM reaches approximately 50%, the 50% relay is energized. This allows the generator to come on line providing output is 0.35 to 0.65 volts higher than battery voltage. When the dc MASTER switch is moved to BATT during a GPU start, the ground power relay opens to remove ground power from the buses. The generator cut-out relay (previously serving as the starter contactor) will close enabling the generator to power all dc buses (providing generator voltage exceeds battery voltage). The generator fail indicator relay will then energize, removing power from the GENERATOR FAIL legend.

AIRSTART SWITCH

64. The normal circuit to the ignition unit is routed through the engine master switch, the start control relay, and the throttle (IDLE & START) micro-switch in that order. Airstart ignition is used to energize the same circuit, except that depression of the airstart switch on either throttle closes the circuit to the ignition unit while by-passing the start control relay and throttle microswitch. The airstart circuit incorporates a 25-second timed airstart function. After the airstart switch is activated, it can be released and ignition will be provided for 25 seconds. If the airstart switch is re-activated while the system is in the 25-second rundown, the system will re-activate for a further 25 seconds. The airstart can be energized in any throttle position.

STARTER STOP SWITCH

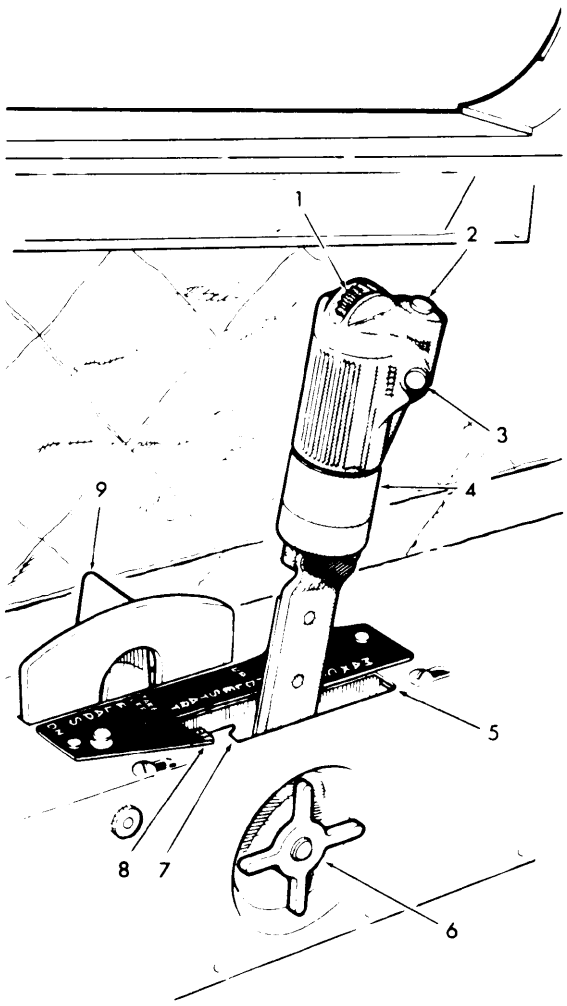
65. The STARTER STOP switch provides the means by which the start may be aborted if, for reason of mechanical malfunction, the engine should fail to commence turning, or if it should fail to light up. It is important to note that it is the only way to stop the starter motor from cranking below 45% for battery start and 35% for GPU start. When operated, the STARTER STOP switch de-energizes the engine start and control relay, which in turn de-energizes the start contactor and, if a battery start is being employed, the series-parallel relay. The ignition circuit is also disarmed.

THROTTLE CONTROL LEVERS

66. Two interconnected throttle control levers are provided for control of engine speed (Figure 1-9). The master control lever is mounted on the left console. The slave control lever is mounted on the centre console. Both levers have three positions, marked MAX CONT, IDLE & START, and CUT OFF, and each throttle quadrant is marked POWER. The master throttle control lever moves in a slot which incorporates a gate at the IDLE & START position, so that the lever must be moved outboard and aft of IDLE & START to the CUT OFF position in order to close the main fuel control cut-off valve. The control switches for airstart, microphone operation, and speed brake operation are mounted on each throttle control lever grip.

ENGINE COMPARTMENT COOLING

67. Compressor discharge air that is not mixed into the fuel-air charge for combustion is used as the basic internal source for cooling the air for engine components in the combustion and turbine sections. In addition, the engine compartment is divided into two zones for cooling purposes. Zone 1 (forward) includes the compressor and accessory sections of the engine. Zone 2 (aft) includes the combustion section and turbine and exhaust sections. Zone 1 is cooled on the ground and in flight by means of ambient air circulated by an ejector eighth-stage bleed air. The starter generator in Zone 1 is also cooled in a similar manner. Similarly, Zone 2 is cooled by ambient air drawn into the rear of the zone and forced overboard by engine-bleed-operated ejector pumps when the aircraft is on the ground. On the ground, the bleed valves are electrically operated. In flight, Zone 2 is cooled by ambient air forced into the zone through a flush ram intake and discharged through the rear. Malfunction of the bleed valve that controls the Zone 2 cooling ejector pumps is indicated on the annunciator panel. Amber legends illuminate to show BLEED VALVE CLOSED or BLEED VALVE OPEN.On the ground, a BLEED VALVE CLOSED



1 SPEED BRAKE SWITCH
2 AIR-START SWITCH
3 MICROPHONE SWITCH
4 THROTTLE CONTROL LEVER
5 MAX CONTINUOUS POWER POSITION
6 THROTTLE TENSION CONTROL
7 IDLE AND START POSITION
8 CUT-OFF POSITION
9 WING FLAP CONTROL LEVER

BMB01024

Figure 1-9 Master Throttle Quadrant

indication is displayed before the engine is started, or if a failure of the Zone 2 cooling system occurs while running. In flight BLEED VALVE OPEN is displayed when the valve opens and the Zone 2 cooling ejector pumps are operating.

ENGINE ANTI-ICING

68. Air to prevent icing is bled from the eighth-stage of the compressor to the variable inlet guide vanes, the inlet guide-vane shroud and the bullet nose. The airflow is controlled by an electrically actuated valve, which is operated by an engine ANTI-ICE ON/OFF switch located on the engine control panel on the forward section of the centre console. In the event of a complete DC power failure, the engine anti-icing system is activated automatically.

NOTE

Turn the engine ANTI-ICE switch ON before icing conditions are expected to occur. Fuel consumption is increased by approximately 6 per cent and a slight increase in EGT is noted with ANTI-ICE switch to the ON position.

FLIGHT CONTROLS

GENERAL

69. The aircraft is equipped with dual control columns and rudder pedals, installed side by side in the cockpit. The control columns are of the normal-control column grip style (Figure 1-10). The aileron and elevator normal trim switch, the elevator trim system isolate switch, the nose-wheel steering switch, and the muting switch are mounted on each control column grip.

70. The flight control system consists of primary and secondary controls. The primary controls are the ailerons, elevators, and rudder. The secondary controls are the trim tabs, wing flaps, and speed brakes.

FLIGHT CONTROL LOCKS

71. When the aircraft is on the ground, the flight controls can be locked to prevent damage from wind buffeting. The controls are locked, in the approximate neutral position, by a single swing-away locking lever suspended from the cross-beam forward of the left control column.

AILERON CONTROL SYSTEM

72. To reduce forces on the control columns under conditions of increased aerodynamic loads on the ailerons, spring servo tabs and geared balance tabs

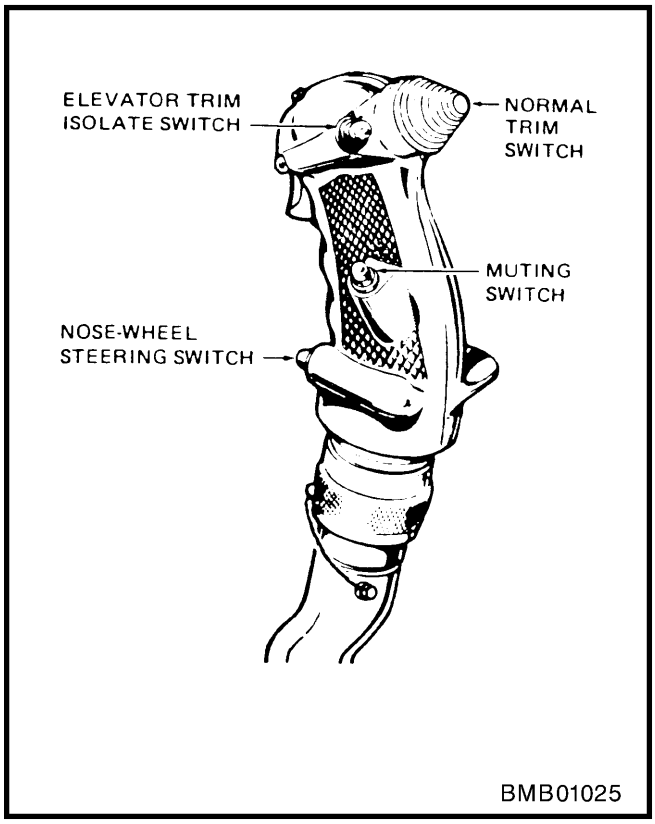


Figure 1-10 Control Column Grip

are installed in the aileron edges. The trailing edge of the left aileron contains a spring servo tab and an electrically-operated trim tab. The right aileron contains a spring servo tab and a geared balance tab. Aileron control movement is transmitted mechanically from either control column. The springs tabs are deflected opposite to the ailerons to induce favourable aerodynamic loads when lateral stick forces exceed approximately 20 pounds. Both ailerons are mechanically interconnected.

ELEVATOR CONTROL SYSTEM

73. Fore and aft movement of either control column is transmitted to a common torque tube, which actuates the mechanically interconnected right and left elevators. A spring bungee provides a down movement to the elevators, thus supplying artificial feel to the pilot at low speeds. The trailing edge of the right elevator incorporates a geared balance tab, while the left elevator contains an electrically operated trim tab.

RUDDER CONTROL SYSTEM

74. Rudder control movement is transmitted mechanically to the rudder. No controllable trim is provided for the rudder control system. However, a fixed trim tab, adjustable on the ground, is located on the rudder. Fore and aft adjustment of the rudder pedals is provided by handles located on the cross-beam above each set of pedals. To prevent jamming, when adjusting the rudder pedals, ensure that the feet are not on the pedals and that the pedals are not adjusted to neither the full forward nor aft position.

TRIM TAB CONTROL SYSTEM

75. The aileron and elevator trim tabs, installed in the left aileron and left elevator trailing edges, are operated by electric actuators directly connected to the tabs by double push-pull rods. The trim tabs are controlled by the following switches:

a. normal trim system switch;

b. elevator trim system isolate switch;

c. elevator alternate trim system switch; and

d. aileron alternate trim system switch.

76. Correct elevator trim setting for take-off is displayed on the annunciator panel by a green legend marked ELEV TRIM T/OFF. The column grip switch is actuated while the trim tab is in the take-off position and the aircraft is on the ground.

NORMAL TRIM SYSTEM SWITCH

77. Normal application of aileron and elevator trim is provided by a five-position knurled switch mounted on top of each control column grip. The switch is spring-loaded to centre-off position so that, when released, the switch returns to the centre position and trim tab actuation stops. Fore and aft and lateral movements of the trim switch produce corresponding elevator and aileron trim respectively.

NOTE

Selection of either aileron or elevator trim on the right control column will override any corresponding trim selection made on the left control column.

ELEVATOR TRIM SYSTEM ISOLATE SWITCH

78. The normal elevator trim system can be isolated by depressing the elevator trim isolate switch located adjacent to the normal trim system switch on each control column grip. When depressed, the isolate switch de-energizes the elevator trim control relay, and the system remains disconnected for as long as the isolate switch is held down.

AILERON ALTERNATE TRIM SYSTEM SWITCH

79. A four-position switch on the left console provides an alternate means of applying aileron trim. The switch positions are OFF, NORMAL, LH WING DN and RH WING DN. The switch is guarded in NORMAL and, when in use, is spring-loaded to OFF. With the switch in NORMAL, the normal trim circuit is energized. When the switch is held to either LH WING DN or RH WING DN, the normal trim circuit is disconnected, and the trim actuator is energized through the alternate trim system. Both the normal and alternate aileron trim circuits are de-energized when the aileron alternate trim system switch is OFF.

ELEVATOR ALTERNATE TRIM SYSTEM SWITCH

80. A four-position switch on the left console provides an alternate trim circuit for the elevator trim tab actuator. The switch positions are OFF, NORMAL, NOSE DN and NOSE UP. The switch is guarded in NORMAL and is spring-loaded to OFF when in use. The normal trim circuit is energized when the switch is in NORMAL. When holding the elevator alternate trim switch in either NOSE DN or NOSE UP position, the normal trim circuit is disconnected and the aircraft is trimmed through the alternate trim system. When the switch is OFF, both the normal and alternate trim circuits are de-energized.

WING FLAPS

CAUTION

The relief valve will not provide the protection if flap limit speeds are exceeded after the flaps are deflected.

81. Mechanically selected and hydraulically operated slotted type flaps are mounted on the inboard trailing edge of each wing. The flaps are controlled by a control lever on each throttle quadrant. The two levers move in unison to three positions corresponding to 0°, 25°, and 40° of flap deflection, and the positions are marked UP, TAKE-OFF, and DOWN, respectively. The flaps are mechanically interconnected to ensure symmetrical and synchronized operation. A flap position indicator, located on the main instrument panel, is calibrated in degrees of flap travel. The flap selector valve features a relief valve to provide a measure of protection to the flaps and wing structure in the event of an inadvertent flap selection at excessive airspeed.

SPEED BRAKES

82. Hydraulically operated speed brakes, located on each side of the rear fuselage, are operable through the full speed range of the aircraft. The speed brakes are controlled by a three-position sliding switch on each throttle lever. The switch positions are marked IN, OFF and OUT.

NOTE

The left speed brake switch is electrically connected to the speed brake actuator through the right switch; any selection made on the left switch can be overridden by the right switch. Whenever the speed brakes have been selected IN or OUT on the right switch, the switch must be returned to the OFF position before the left switch can control the speed brakes.

CAUTION

Reselection of the speed brake switch on either throttle to OFF following an IN selection is essential in order to depressurize the hydraulic speed brake system. If the system is not depressurized, rupture of the hydraulic lines would result in a complete loss of fluid from the normal hydraulic system. In addition to the loss of hydraulic services, the fluid could be ignited in the event of an engine fire.

83. An internal mechanical lock in the actuator retains the speed brakes in the closed position with the hydraulic system depressurized and the electrical control system de-energized. In flight, the switch must be left at the OUT position for the speed brakes to remain out and reselected to the OFF position after an IN selection. Indication of speed brake position is provided by an annunciator panel legend marked SPEED BRAKES OUT. The indication is given whenever the speed brakes are not fully closed.

PRE-STALL WARNING SYSTEM

84. An approaching stall is indicated by an electrically operated pre-stall warning unit which imparts a vibration to both control columns, through a shaker mounted on the left control column, when the aircraft speed is approximately 10 per cent above the stalling speed. The stick shaker is energized by a signal-summing unit which receives signals from a lift transducer mounted within the underside of the right wing leading edge.

85. A press-to-test switch is located on the left console. Operation of the test switch energizes the stick shaker. The system test switch is used to test the serviceability of the system in the air as well as on the ground. Anti-icing heat for the lift transducer is controlled by the PITOT & STALL WARN A/I switch located on the left instrument sub-panel. The lift-transducer heat supply and stick shaker control unit are both de-energized by the ground safety relay when the main landing-gear shock struts are compressed.

LANDING-GEAR

GENERAL

86. The tricycle-type landing-gear incorporates oleo-pneumatic shock struts and is fully retractable through the aircraft hydraulic power system. The main landing-gear retracts inward into the wing, and the nose gear retracts forward into the aircraft nose section. When retracted, the main and nose landing-gears are enclosed by doors. The main-gear doors open to lower the gear and close after the gear has extended. The nose-gear door opens to lower the gear and remains open while the gear is down. Three landing-gear circuit breakers are mounted on the circuit-breaker panel, located in the cockpit (Figure 1-7).

LANDING-GEAR CONTROL PANEL

87. The landing-gear control panel contains the control lever and a DOWNLOCK OVERRIDE switch. The control lever is a two-position switch, acting in the normal sense: up for landing-gear retraction and down for extension. Ground safety switches prevent the lever from being moved to the up position when the weight of the aircraft is on the landing-gear. A guard is installed to prevent the lever from being moved to the down position while in flight. Depressing the DOWNLOCK OVERRIDE switch will bypass the ground safety switches and permit an UP selection of the landing-gear. In the event of complete electrical failure, the landing-gear selector switch becomes inoperative regardless of the position of the DOWNLOCK OVERRIDE switch.

LANDING-GEAR POSITION INDICATORS

88. The landing-gear position indicators are located adjacent to the landing-gear control lever. The three-position indicators, one for each gear, display a wheel when the gear is down and locked, diagonal yellow-and-black or red stripes when the gear is in transit, and the word UP when the gear is up and locked.

LANDING-GEAR WARNING LIGHTS

89. Landing-gear warning lights are provided, two in the landing-gear control lever and one on the right side of the instrument panel. The lights will be illuminated in the following situations:

a. When the landing-gear is not locked in the position selected.

b. When the main-gear doors are not closed and locked after the landing-gear is retracted.

c. When the throttle is retarded to or below 65 (±2)% RPM, (or to idle at high altitudes), if the landing-gear is in any but the fully-down position.

90. The warning lights will also be lit whenever the audible warning signal is heard, but the cut-out switch will not extinguish the lights. The warning lights are dimmed whenever the standby COMPASS BRT/OFF/DIM switch is in the DIM position.

AUDIBLE WARNING SIGNAL AND CUT-OUT CONTROLS

91. Below the altitude of 7000 feet MSL a landing-gear audible warning signal will be heard through the intercommunication system whenever the throttle is retarded below 65% (±2) RPM and the landing-gear is not down and locked. The AUDIO WARNING OVERRIDE switch, located adjacent to the landing-gear lever, will silence the audible warning signal. The HORN CUT OUT button, located below the right-hand SEAT ADJUST switch, will also silence the warning horn but only as long as the button is depressed.

LANDING-GEAR GROUND SAFETY PINS

92. Ground safety pins, one for each gear, are provided to prevent accidental retraction while the aircraft is on the ground. The pins must be removed before flight.

LANDING-GEAR DOOR SWITCH

93. A two-position toggle switch, marked OPEN and CLOSE, is installed in the left main landing-gear wheel well to permit opening of the main-gear doors for maintenance purposes. When the switch is selected to the OPEN (up) position, the doors will open if hydraulic pressure is available and close when selected to the CLOSE (down) position.

NOTE

If the switch is left in the OPEN position, the main gear doors will remain open on a gear-up selection.

LANDING-GEAR UP SELECTION OVERRIDE SWITCH

94. The LDG GEAR UP SELECTION override switch is located on the right instrument sub-panel. The guarded toggle switch is provided to allow the instructor to prevent an UP selection of the landing-gear selector lever. The switch has two positions, OFF and NORM, and is guarded in the NORM position. In the OFF position, the solenoid in the landing-gear control panel is de-energized, and the landing-gear selector lever is prevented from being moved to the up position. When the switch is in the NORM position, the solenoid in the landing-gear control panel is energized, and the landing-gear lever can be moved to the up position in the normal manner. The LDG GEAR UP SELECTION override switch does not prevent landing-gear emergency retraction using the down lock override switch.

LANDING-GEAR DOWN EXTERNAL INDICATOR LIGHT

95. An amber light installed in the aircraft nose section illuminates to indicate to a ground observer that the landing-gear is down and locked. The ground observer light (GOL) and the landing-gear audible warning horn share a common circuit breaker. A malfunction of the GOL may indicate simultaneous loss of the warning horn in flight.

WHEEL BRAKES

GENERAL

96. Hydraulically operated disc-type brakes are installed on each main wheel and are operated by toe pressure on the upper portion of the rudder pedals (Figure 1-11). Each pedal actuates an individual master cylinder fed from a common reservoir, located in the cockpit beside the right-hand seat. Braking action is directly proportional to the pressure applied at the pedals.

PARKING-BRAKE CONTROL

97. The parking-brake handle marked BRAKE is located below the landing-gear position indicators. The brakes are set by pressing on the toe brakes, pulling the parking-brake handle all the way out, releasing toe brake pressure, and then releasing the parking-brake handle. To release the parking brake, depress the toe brakes and ensure that the parking brake goes all the way in.

NOSE-WHEEL STEERING

CAUTION

Use nose-wheel steering for all small radius turns to prevent the nose-wheel scissors from coming in contact with, and damaging, the nose-wheel doors.

98. The nose-wheel steering system is electro-hydraulically engaged and hydraulically powered; it is controlled by the rudder pedals. Steering is accomplished by depressing a switch on the control column, synchronizing the rudder pedals with the nose wheel, and then operating the rudder pedals to control the hydraulically-operated steering unit. This unit turns the nose wheel within approximately 42 degrees each side of centre. With the nose-wheel steering engaged, the minimum turning radius is approximately 20 feet. When the nose-wheel steering is released; hydraulic pressure is removed from the steering unit and the nose wheel will caster within the normal steering range. When the weight of the aircraft is off the nose wheel, a microswitch cuts electrical power to the selector, removing hydraulic pressure. When nose-wheel steering is disengaged, a shimmy-damper dampens oscillations of the nose wheel.

NOTE

The removal of a pip-pin in the nose-gear linkage disconnects the steering unit and permits full castering of the nose wheel for towing purposes.

EIGHTH-STAGE ENGINE-BLEED AIR

99. Air is bled from the eighth stage of the engine compressor and is used to operate the following services (Figure 1-12):

a. air-conditioning and cabin pressurization;

b. windshield and canopy demisting;

c. windshield de-icing;

d. pressurization of the hydraulic system reservoir;

e. canopy seal;

f. engine and zone cooling ejector pumps;

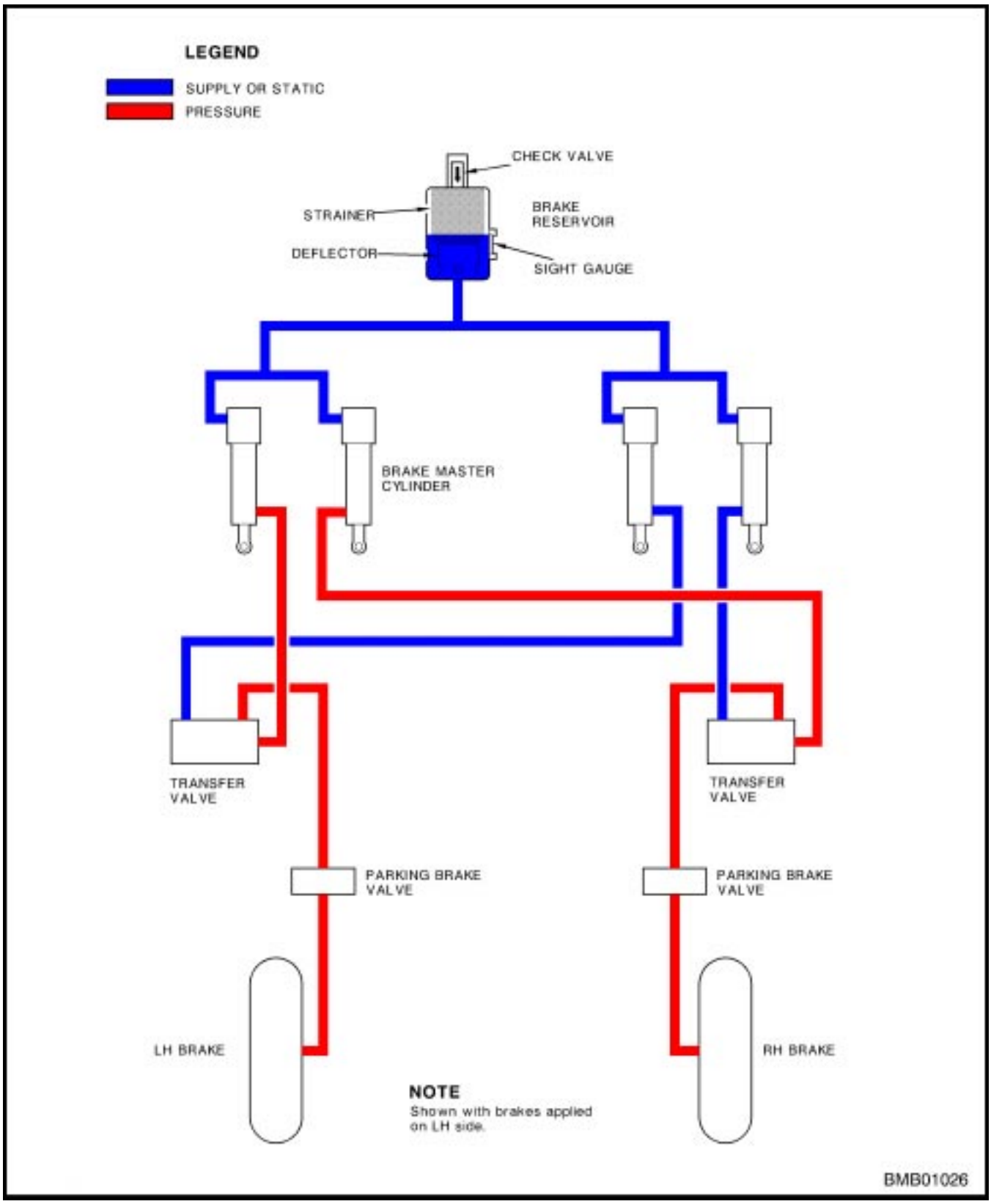


Figure 1-11 Brake Hydraulic System – Schematic

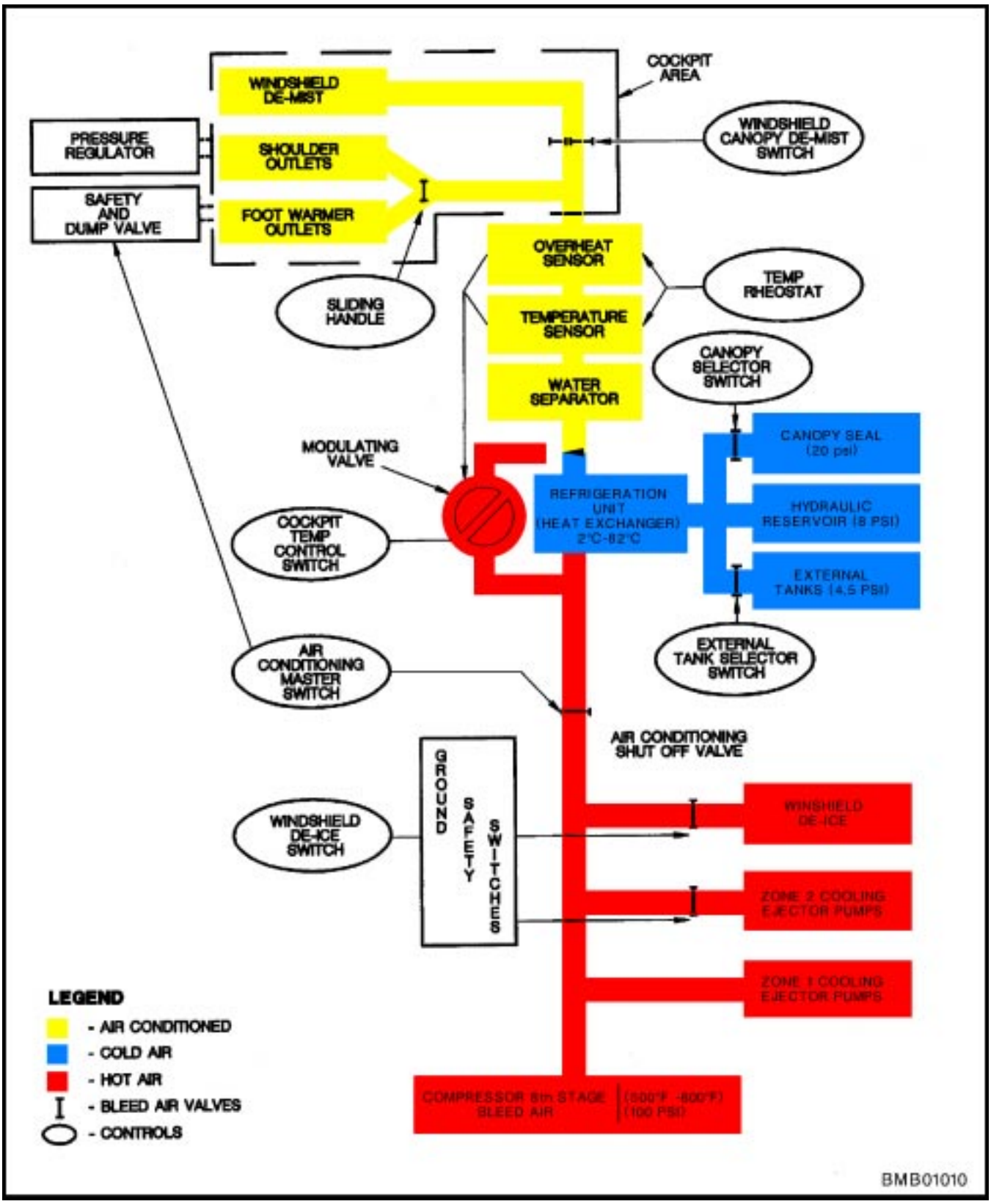


Figure 1-12 Compressor Eighth-Stage Bleed-Air Services – Air Conditioning and Pressurization System – Schematic

g. engine anti-icing; and

h. external fuel tank pressurization.

100. The bleed shut-off valves are open whenever the engine is running at or above 50% RPM or when the aircraft is airborne. With the bleed shut-off valve open, all services listed will be available, with the exception of the windshield de-icing system which is inoperative whenever the aircraft is on the ground. The canopy seal and hydraulic reservoir are automatically pressurized.

AIR-CONDITIONING AND PRESSURIZING

GENERAL

101. Air from the eighth-stage bleed passes through the air-conditioning shut-off valve, then through the air-conditioning unit, and is delivered to the cockpit at a pre-selected temperature and in sufficient quantity to pressurize the occupied area (Figure 1-12). The cockpit is unpressurized below 8000 feet. From 8000 feet to approximately 17 000 feet, until a maximum of 3 psi differential is reached, the cockpit altitude remains at 8000 feet. Above this altitude, the 3 psi differential remains constant. This pressure schedule is controlled by the pressure regulator, which automatically regulates the outflow of air to maintain the pressure differential. A second valve, the safety and dump valve, will automatically open to relieve an increase in pressure over 3.3 psi, or, in an emergency, may be opened through the air-conditioning master switch. The static sources for the pressure regulator and for the safety and dump valve are located on either side of the top half of the fuselage forward of the cockpit. For graph of cockpit altitude versus aircraft altitude, see Figure 1-13.

AIR-CONDITIONING MASTER SWITCH

102. The air-conditioning master switch is located on the centre console and has two positions, NORMAL and SHUT OFF & DUMP. In the guarded NORMAL position, pressurization is automatically controlled through the pressure regulator and temperature selector in conjunction with the cockpit-temperature control switch. In the SHUT OFF & DUMP position, air-conditioning and pressurizing air is shut off, and the cockpit pressure is released through the safety and dump valve. With the switch in the SHUT OFF & DUMP position, the windshield and canopy demisting, hydraulic reservoir pressurizing, external tank pressurization, and canopy seal are also inoperative.

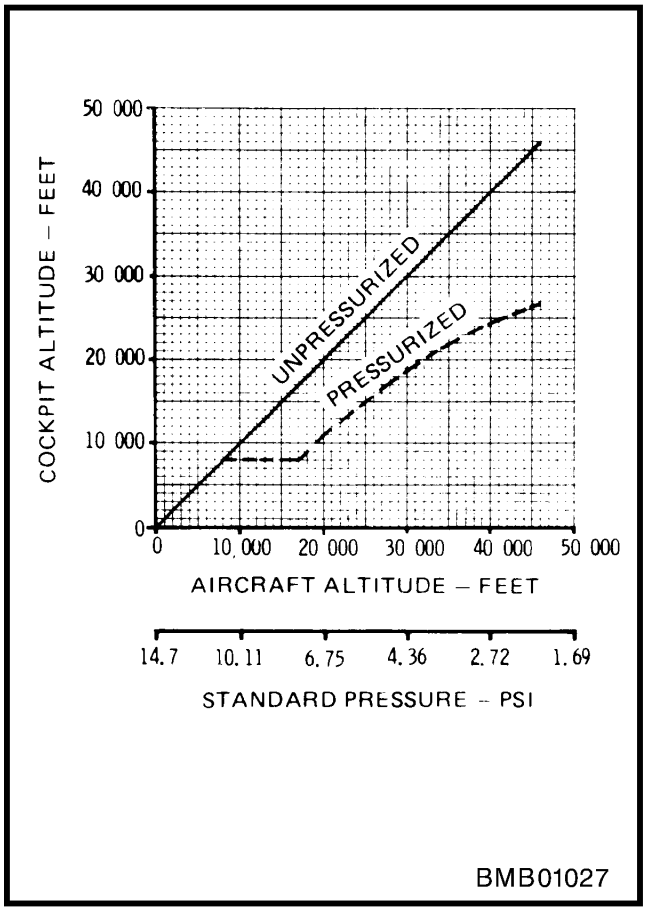


Figure 1-13 Cockpit Altitude vs Aircraft Altitude

NOTE

Failure to ensure that cockpit pressure has been dumped prior to opening the canopy can result in canopy damage if the engine is operating above IDLE RPM.

COCKPIT TEMPERATURE SELECTOR

103. The cockpit temperature selector is located on the centre console and is used to adjust the temperature as desired. The selector is a rheostat which is rotated clockwise for an increase in temperature, and counter-clockwise for a decrease in temperature. The selector controls the temperature of the incoming air through a range of 2° to 82 °C.

COCKPIT TEMPERATURE CONTROL SWITCH

104. The cockpit temperature control switch is a four-position toggle switch, mounted on the centre console and marked OFF, AUTO, HOT, and COLD. In the AUTO position, temperature is maintained at thevalue selected by the cockpit temperature selector. In the event of an automatic system, the switch should be placed in the HOT or COLD position until

the desired temperature is achieved. The switch is spring-loaded to the OFF position. In the OFF position, power to the temperature-modulating valve is disconnected, and the air temperature will remain at the value last selected.

NOTE

At full power it is possible to have smoke enter the cockpit through the air-conditioning system. This smoke is a result of pooled oil and need not cause alarm. To prevent it, ensure that the cockpit temperature control switch is set to AUTO and the temperature selector rheostat is set between the 11 and 12 o'clock positions before take-off. Setting the temperature below the 11 o'clock position may result in rumbling or popping noises of the air-conditioning separator.

COCKPIT AIR OUTLETS

105. Air-conditioning and pressurizing air enters the cockpit through the adjustable shoulder outlets, the foot outlets, and the canopy demisting tubes. The shoulder outlets are mounted below the canopy sill on each side of the cockpit and incorporate a sliding handle, which regulates the distribution of air between the shoulder outlets and the foot outlets. When the handle is moved aft, more air is delivered through the shoulder outlets. Moving the handle forward reverses this distribution ratio.

RAM-AIR INLETS

106. The ram-air system provides ambient air for cockpit ventilation. Ambient air is forced into the cockpit through two ram-air scoops, one on each side of the cockpit adjacent to the windshield. This air supply is controlled through manually adjustable fresh-air vents in the cockpit, installed just below the windshield. A spring-loaded flapper valve is installed in each vent to prevent loss of air when the cockpit is pressurized.

DEMISTING AND DE-ICING

GENERAL

107. The windshield is demisted and de-iced by heated air passed over the interior and exterior of the windshield respectively. Separate controls are provided so that the systems may be used simultaneously or separately (Figure 1-12).

WINDSHIELD DEMIST

108. The windshield and canopy demisting system prevents fogging of the windshield and forward portion of the canopy interior surfaces. This is accomplished by diverting some of the air from the normal air-conditioning outlets at shoulder and foot level to perforated tubes along the bottom of the windshield and the front of the canopy. This nominal flow is present whenever the air-conditioning system is operating. The control switch for the demisting system is located on the left instrument sub-panel and is marked WSHLD& CANOPY DEMIST, ON and OFF. Selection of WSHLD & CANOPY DEMIST switch to ON will operate a valve which diverts a greater portion of air-conditioned air to the demist outlets.

WINDSHIELD DE-ICING

109. A windshield de-icing system clears ice from a section of the windshield in front of each pilot. The system is controlled by a guarded switch located on the left instrument sub-panel and by ground safety switches located on the main landing-gear. The ground safety switches de-activate the windshield de-icing system when the aircraft weight is on the main landing-gear, regardless of the position of the guarded switch. The guarded switch, labelled WSHLD DE-ICE, has two positions, OFF and ON. In the ON position, an electrically operated shut-off valve is opened, allowing hot, undiluted eighth-stage compressor bleed air to be ducted directly onto the windshield.

CAUTION

High RPM settings while using windshield de-ice may cause the windshield to crack. For RPM limitations see Part 2, Section 1, Paragraph 53.

NOTE

A delay of approximately 15 seconds should be anticipated when selecting either WSHLD & CANOPY DEMIST or WSHLD DE-ICE to the ON position.

110. When the WSHLD DE-ICE switch is turned on, an amber legend, WSHLD DE-ICE ON, will illuminate on the annunciator panel. This legend will remain illuminated as long as the switch remains on and until the shut-off valve is actually closed when the switch is turned off. The master caution system is not activated by this annunciator panel legend.

INSTRUMENTS

FLIGHT INSTRUMENTS

111. The flight instruments, which are mounted on each pilot's instrument panel, are either pitot-static or electrically operated. The pitot-static instruments are the airspeed indicator, machmeter, vertical speed indicator, and standby altimeter. The electrically operated instruments are turn-and-slip indicator, attitude indicator, track indicator, distance radio-magnetic indicator (DRMI) (see Paragraphs 194 and 195) and servo altimeter. A fast-erect switch is provided for the left attitude indicator. To fast-erect the attitude indicator, depress the fast-erect switch for one minute and release for 30 seconds. Repeat this action until the attitude indicator is erected. It should erect in approximately three to four minutes.

NOTES

1. The attitude indicator is not reliable after toppling caused by aerobatic manoeuvres. All unserviceabilities not associated with aerobatics must be recorded on Form CF 349.

2. Airspeed, machmeter and altimeter readouts may differ slightly between LH and RH instruments (refer to Part 5).

ENGINE INSTRUMENTS

112. The engine instruments are electrically powered and are mounted centrally on the instrument panel. The group consists of the tachometer, oil pressure indicator, and exhaust-gas-temperature indicator.

MISCELLANEOUS INSTRUMENTS

113. The Tutor has the following miscellaneous instruments. The hydraulic-pressure gauge, flap-position indicator, fuel-quantity indicator, and loadmeter which are electrically operated. The oxygen-pressure indicator is a direct-reading instrument. The cockpit altimeter, the clock, accelerometer, and the standby compass are shared by both pilots and do not require an external source of power.

NOTE

The standby compass will be inaccurate with inoperative inverter(s), since the compass is calibrated with all electrical equipment selected ON.

LOADS MONITORING SYSTEM

114. The loads monitoring system provides a means of acquiring, processing and recording aircraft flight data in order to track the usage trends and the fatigue life of the CT114 aircraft. The system receives its power from two circuit-breakers located in the nose circuit-breaker panel and consists of the following components (Figure 1-14).

a. Data acquisition unit.

b. Nz/roll rate transducer.

c. Pressure transducer.

d. Eight (8) strain gauge sensors.

e. Four (4) rotary switches.

PITOT-STATIC SYSTEM

115. The pitot-static system is a conventional pitot tube on the right wing tip. There is no provision for an alternate static source.

SERVO ALTIMETER

116. Two servo altimeters are installed in the Tutor aircraft: the LH altimeter and the RH altimeter. Both are located in the instrument panel, and both are externally illuminated. They are connected electrically to the altimeter test point shown in Figure 1-2.

ALTIMETER POWER SUPPLIES

117. The servo altimeter system uses AC and DC power. The essential DC bus supplies 28-volt DC through a 5-ampere circuit breaker and the altimeter test point to the LH servo altimeter. The No. 1 inverter supplies 115 volts, single-phase AC through a 2-ampere circuit breaker and the altimeter test point to the RH altimeter. These two circuit breakers are located in the cockpit centre console circuit-breaker panel (Figure 1-7).

RH ALTIMETER

118. The RH altimeter is a self-contained servo-computer altimeter, Bendix Type 3123610C11 (Figure 1-15). This altimeter converts static pressure and total pressure from the aircraft pitot-static system into altitude information, corrected for known error parameters peculiar to the static pressure system of the aircraft. The corrected altitude information is made available to the pilot in the form of a counter-drum and pointer display and also in the form of analog input to the LH servo altimeter. An OFF flag window, located in the face of the instrument, gives an OFF indication to the pilot in the case of a power interruption to the altimeters or a component fault. If

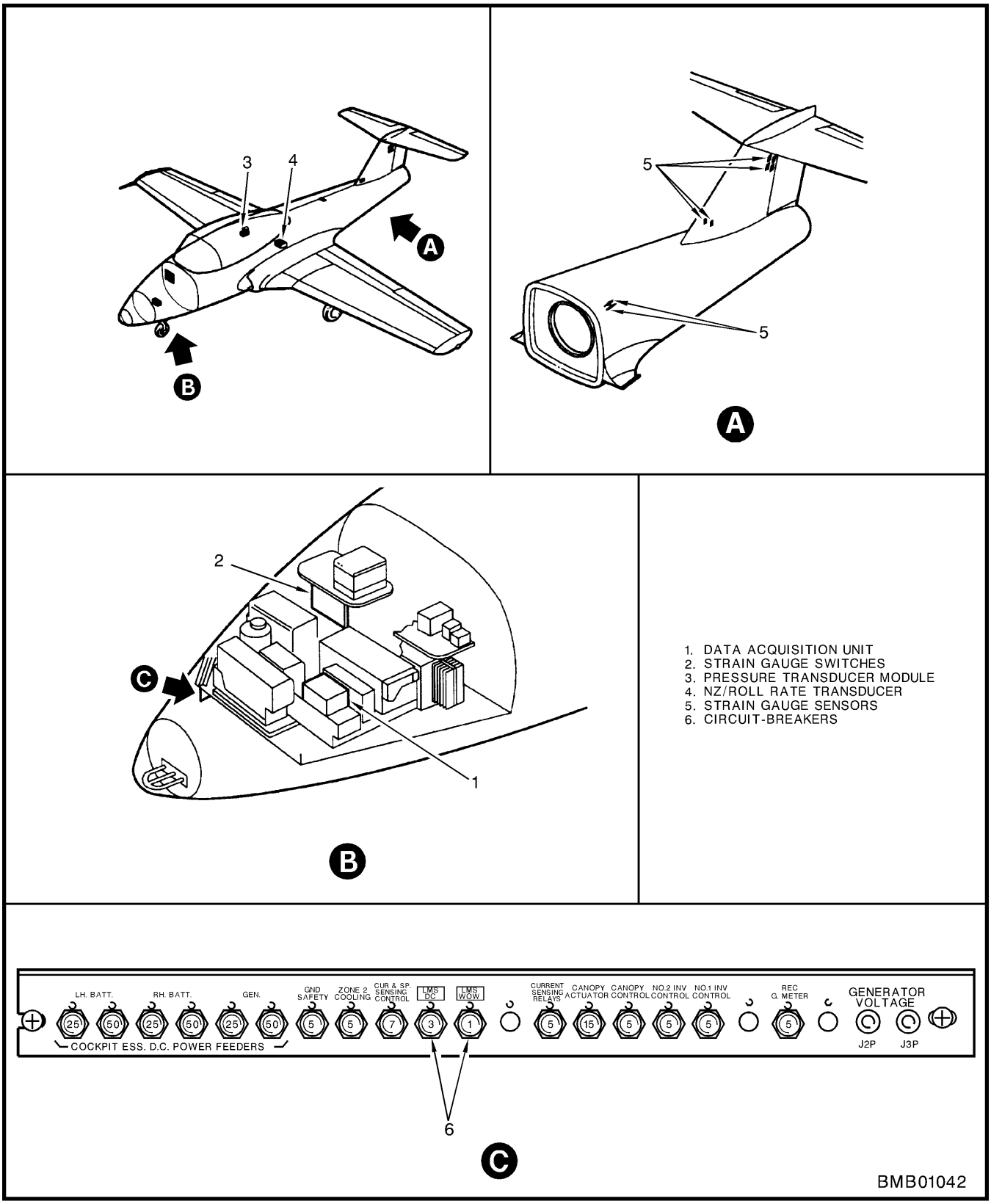


Figure 1-14 Loads Monitoring System – Component Locations

the OFF indication is caused by power failure, the flag will disappear when power is restored. If the OFF indication is the result of a component failure, the flag will remain in view until the failure is corrected. Whatever altitude is indicated at the time of failure will remain unchanged. Corrections for barometric pressure variation are set into the indicator by the baro-setting knob located in the lower left-hand corner of the instrument.

LH ALTIMETER

119. The LH altimeter is a servo altitude indicator, equipped with automatic pressure standby, Type AAU-19A (Figure 1-16). This altimeter is a counter-drum-pointer servo altimeter that receives static pressure from the pitot-static system. When used in the primary mode of operation, it converts the output of the RH servo-computer altimeter into indications of corrected pressure altitude. In the standby mode of operation it performs as a standard altimeter. A standby flag window, located in the face of the LH altimeter, gives a STBY indication to the pilot in case of RH altimeter servo-computer malfunction or power interruption. A RESET/STBY switch is provided in the lower right-hand corner of the front of the instrument to reset the altimeter to resume primary mode of operation. In the event of a fault in the system, the instrument will immediately revert to the standby mode when the RESET/STBY switch is released. Mechanical operation may be selected by the pilot while the altimeter is in the servo mode by momentarily selecting the standby position. Corrections for barometric pressure variations are set into the indicator by the baro-setting knob located in the lower left-hand corner of the instrument. In the standby mode of operation, a DC-operated internal vibrator is automatically energized to remove the friction from the counter-drum-pointer mechanism, decreasing the lag in the altimeter indications.

NOTE

If the LH altimeter internal vibrator is inoperative, owing either to internal failure, or DC power failure, the pointer may momentarily hang up when passing through the 12 o'clock position. This hang-up can be minimized by tapping the case of the instrument.

ALTIMETER CORRECTION CARD

120. Figure 1-17 depicts a sample altitude correction card. Each aircraft has a similar card mounted on the let-down card holder. The correction card accounts for both position and instrument errors in the standby mode. The pilot selects STBY and RESET modes on the altimeter and compares the difference to the value shown on the card corresponding to the airspeed and altitude at the time of the check. The maximum difference between the expected change and the actual change should not exceed ±150 feet at all altitudes. When errors in excess of this tolerance exist, both modes must be considered unreliable.

PITOT TUBE AND LIFT-TRANSDUCER ANTI-ICING

121. The pitot tube and lift transducer of the stall-warning system are electrically anti-iced. A control switch, common to both systems, is mounted on the left instrument sub-panel and is labelled PITOT & STALL WARN A/I. In the ON position, both anti-icing systems are energized while the aircraft is airborne, but a ground safety switch isolates the lift transducer heating element when the weight of the aircraft is on the landing-gear.

INTERIOR AND EXTERIOR LIGHTING

GENERAL

122. The DC-powered aircraft lighting system, which provides general and specific illumination for the aircraft interior and exterior, consists of the following:

a. A panel, located toward the rear of the centre console (Figure 1-2). The following lights are controlled from this panel:

(1) Interior lights:

(a) instrument panel lights,

(b) instrument panel,

(c) console and circuit-breaker panel lights, and

(d) standby compass and annunciator panel lights.

NOTE

In the event of a power interruption during operation, select the interior light switches OFF, then ON to resume operations.

(2) Exterior lights:

(a) anti-collision lights, and

(b) navigation lights.

b. The utility lights, located on the top face of each console. They are controlled by an integral ON/OFF dimmer knob.

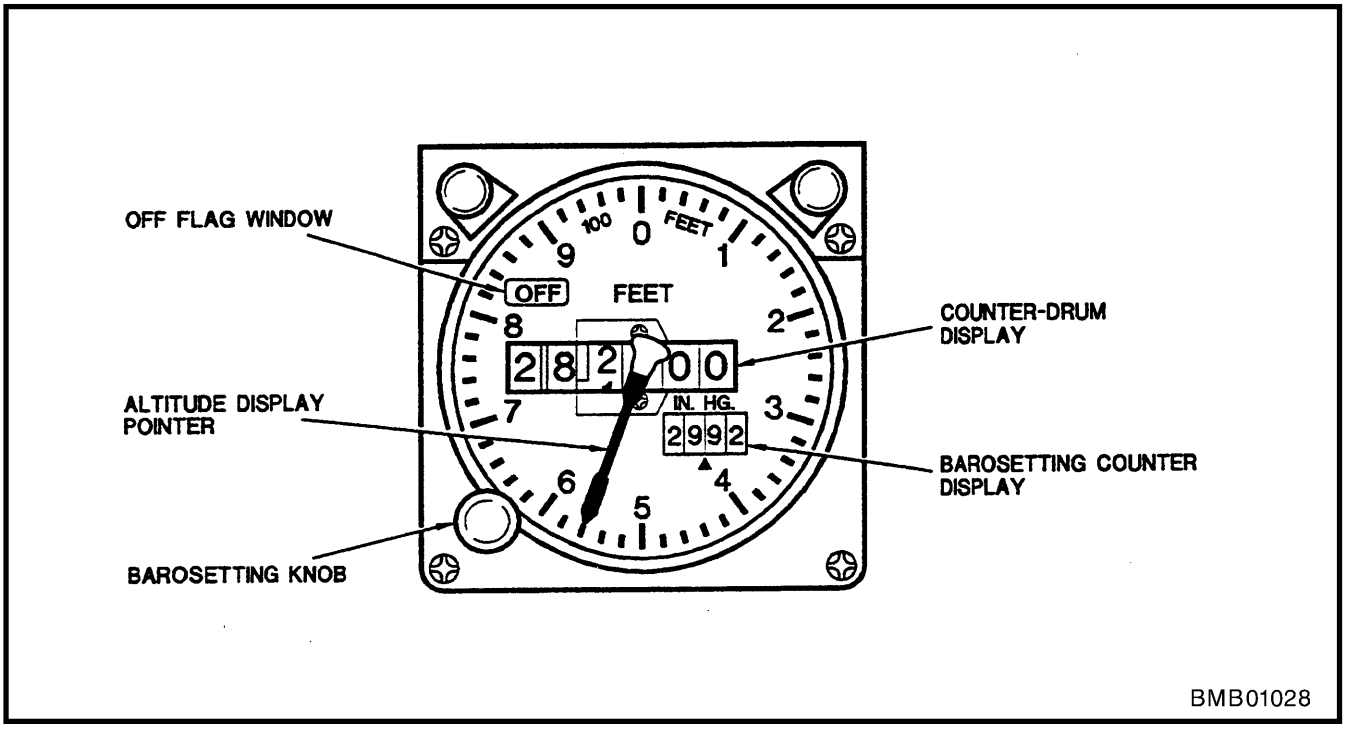


Figure 1-15 RH Servo Altimeter

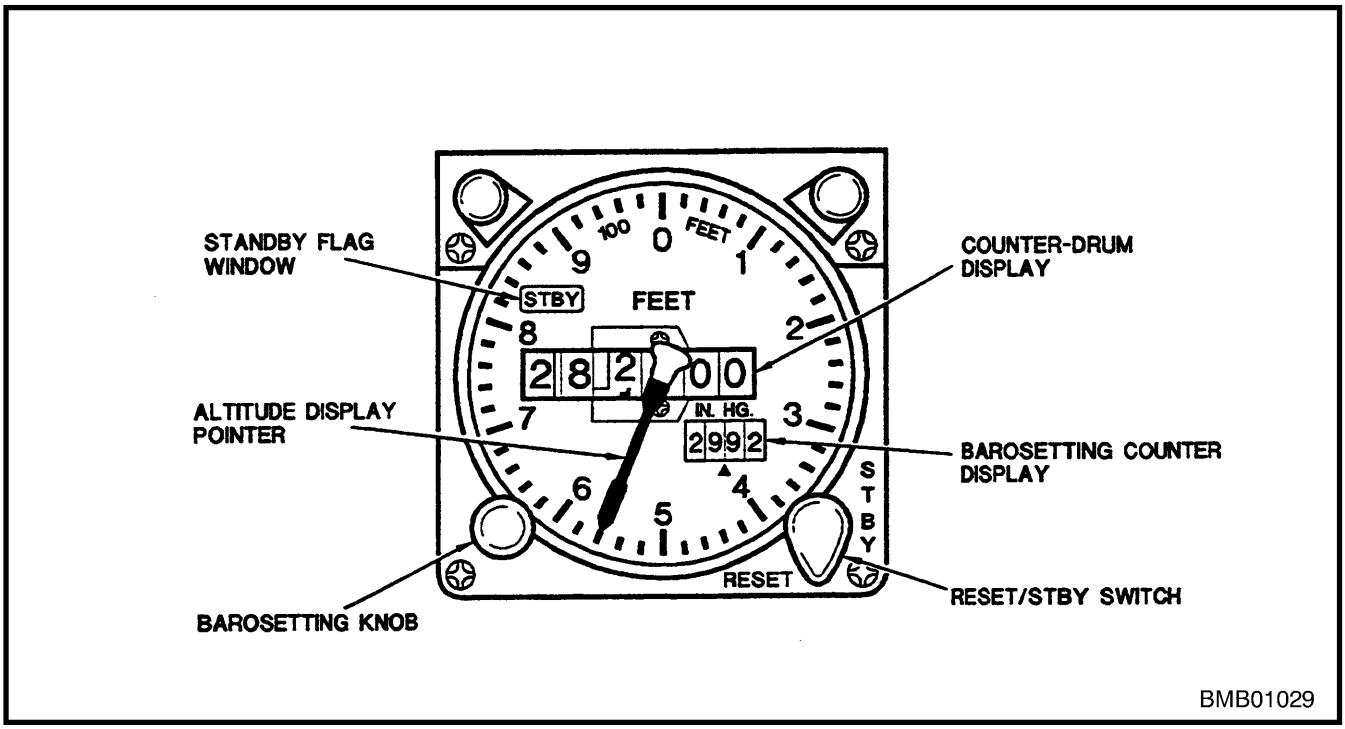


Figure 1-16 LH Servo Altimeter

TUTOR POSITION CORRECTION
STBY ONLY

Speed IAS	Indicated Altitude								
	S.L.	5M	10M	15M	20M	25M	30M	35M	40M
150							-50	-70	
200	-50	-50	-60	-70	-80	-100	-120	-160	
250	-80	-90	-100	-120	-140	-180	-210	-310	
300	-110	-130	-150	-180	-230	-290			
350	-160	-190	-230	-280	-370				
400	-220	-270	-340	-450					

Apply factor to indicated altitude (STBY) to achieve desired altitude.

EXAMPLE: Assigned altitude FL20M
Factor (250 IAS) -140
FLY to indicate 19860

Figure 1-17 Sample Altimeter Correction Card

c. A switch, located on the left instrument sub-panel that controls the landing and taxi lights.

123. Warning lights are not included in the lighting system, but provision is made for dimming the annunciator panel lights and the landing-gear warning lights by moving the standby compass BRT/DIM switch to the DIM position.

NOTE

In the daytime, the warning lights will be difficult to see if the standby compass switch has been left in the DIM position.

INSTRUMENT PANEL LIGHTS

124. Primary illumination of the instrument panels is provided by individual lights and edge-lit panels. Illumination is controlled by a single dimmer knob with an integral off switch.

INSTRUMENT PANEL FLOODLIGHTS

125. Secondary illumination of instrument panels is provided by five white floodlights mounted on the underside of the instrument panel shroud. A single dimmer knob with an integral off switch controls the instrument panel floodlights.

CONSOLE AND CIRCUIT-BREAKER PANEL LIGHTS

126. Illumination of the side and centre consoles, the circuit-breaker panel and part of the left instrument sub-panel is provided by edge-lit panels. The panel lighting is controlled by a single dimmer knob with an integral off switch.

COCKPIT UTILITY LIGHTS

127. A utility light is located on the top face of each side console. It can be selected either red or white and has an integral on-off and dimming control rheostat. A variable swivel-type floodlight assembly is installed on the canopy centre beam to provide a light for the let-down chart.

STANDBY COMPASS LIGHT

128. The brightness of the standby compass integral light is controlled by a separate switch, marked BRT and DIM (refer to Paragraph 123).

LANDING AND TAXI LIGHTS

CAUTION

Without a cooling air flow, the plexiglass covers over the landing lights are susceptible to heat damage. Therefore, the use of the landing lights is restricted to a maximum of five minutes continuous operation on the ground.

129. A landing light is installed in a transparent portion of the leading edge of each wing, and a taxi light is mounted in the nose of the aircraft. The landing and taxi lights are controlled by a single switch, marked LDG/TAXI LTS, OFF and TAXI LT, located on the left instrument sub-panel. When the switch is placed at LDG/TAXI LTS, both landing lights and the taxi light are turned on. With the switch at TAXI LT, only the taxi light comes on.

ANTI-COLLISION LIGHTS

130. Two rotating red anti-collision lights are mounted on the centre line, one above and one below the fuselage. Each light is controlled by an individual ON-OFF switch.

NAVIGATION LIGHTS

131. Conventional navigation lights are controlled by an ON-OFF switch on the centre console.

COCKPIT EQUIPMENT

CANOPY

132. The canopy is hinged at the rear and is raised or lowered by an electro-mechanical actuator mounted immediately forward of the rear pressure bulkhead. The canopy may be electrically or manually operated from either inside or outside the aircraft. Electrical power is obtained from either the battery bus or the external power supply. In an emergency, the canopy may be jettisoned by a ballistic system which fires the canopy off the aircraft. Indication of a canopy-unlocked condition is provided by illumination of an annunciator panel legend marked CANOPY UNLOCKED. Visual indication of a fully closed position is provided by white indicator lines on the canopy and canopy sills. Two break-out knives are located on the fore and aft central member. The knives are removed from the holder by extracting the retaining pin from the handle.

CANOPY CONTROLS

133. The canopy operating controls are as follows:

a. Internal:

(1) selector and actuator switches,

(2) handcrank, and

(3) canopy jettison controls.

b. External:

(1) OPEN/CLOSE and OPERATE switches,

(2) handcrank, and

(3) canopy jettison handle.

CANOPY OPERATING SWITCHES

WARNING

Do not raise the canopy electrically if fuel leakage is suspected.

WARNING

When using the electrical canopy opening, keep fingers clear of rotating gear.

134. Normal electrical operation of the canopy from inside the aircraft is controlled by two switches on the main instrument panel: a selector switch and an actuator switch. The selector switch is a two-position arming switch marked OPEN and CLOSE and is guarded in the CLOSE position. This switch is used to arm the actuator circuit. The actuator switch is a push-button switch marked ACTUATE and is used to operate the canopy actuator. Limit switches automatically de-energize the electrical circuit when the canopy is fully open or closed.

135. Normal operation of the canopy from outside the aircraft is controlled by two switches: one marked OPEN, CLOSE (spring loaded to this position), and one marked OPERATE. These switches are located below the canopy sill on the left side of the fuselage (Figures 1-18 and 1-19). Both switches must be moved simultaneously to open the canopy. To close it, the OPERATE switch alone is required.

NOTE

To restrict access to unauthorized personnel, the electrical connector located in the external canopy control panel can be disconnected and stored so as to simulate a properly installed connector.

CANOPY MANUAL CONTROLS

136. Manual operation of the canopy is possible both from within the cockpit and from the exterior of the aircraft. Manual operation from inside the aircraft is by means of a handcrank located on the left side of the cockpit. The crank must be operated counterclockwise to open the canopy. The procedure is reversed to close the canopy.

137. A similar hand crank is located on the same panel as the external operating switch and is used for manual operation of the canopy from the exterior of the aircraft (Figure 1-18).

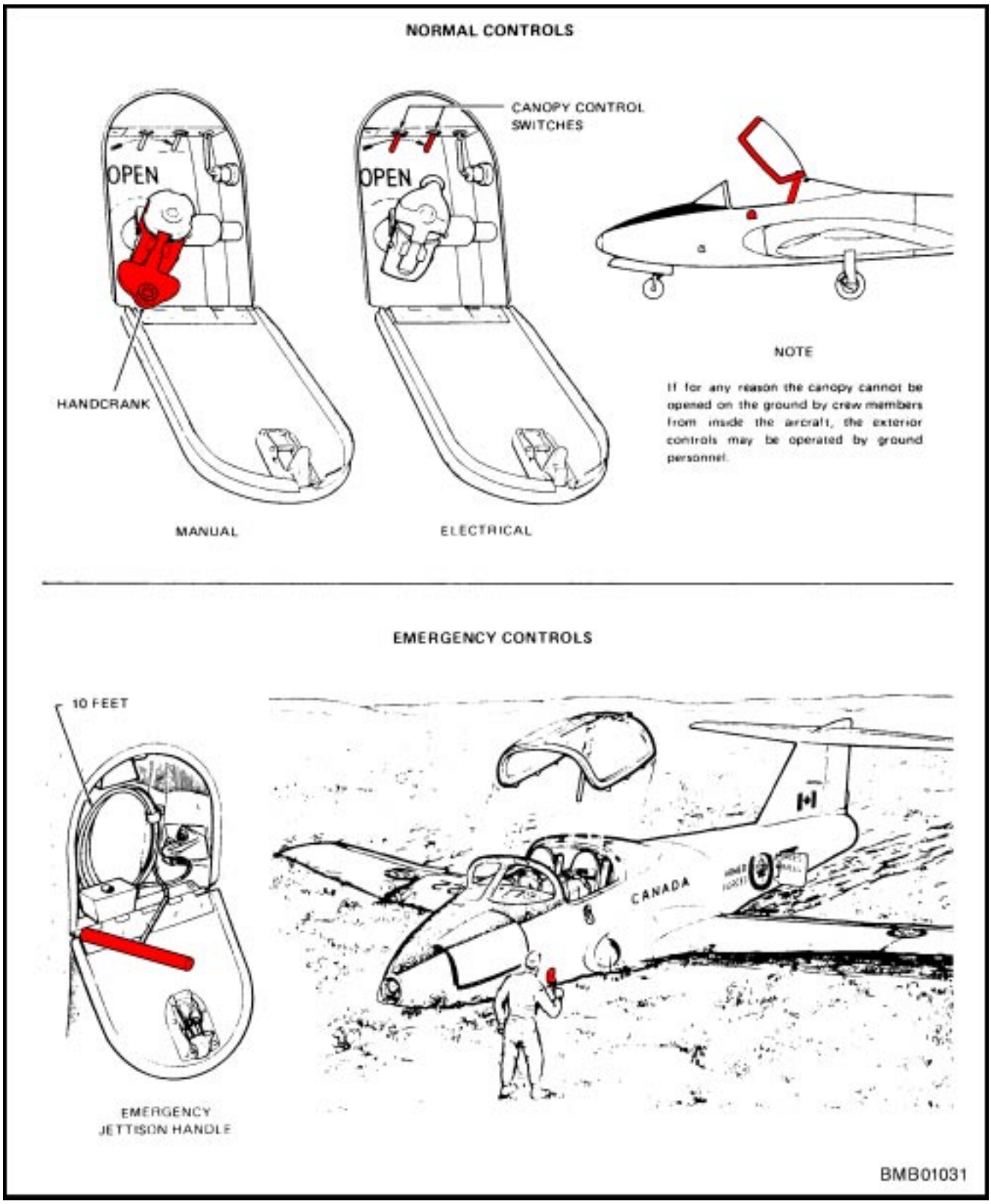


Figure 1-18 External Canopy Controls

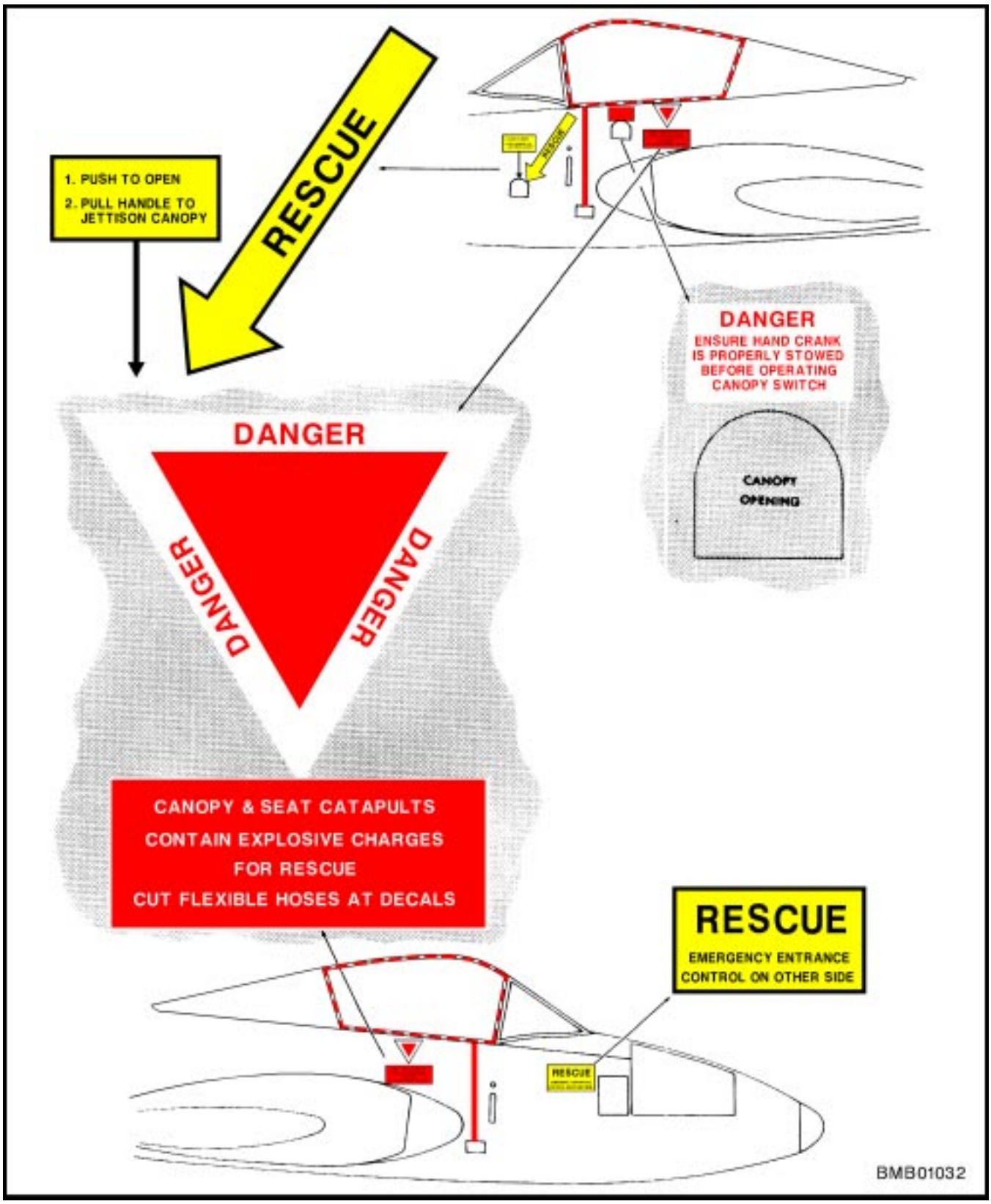


Figure 1-19 External Markings – Rescue and Canopy Warning

CANOPY JETTISON SYSTEM

138. A canopy remover, containing an explosive charge, jettisons the canopy in an emergency. Each seat contains an M27 initiator which is mechanically activated by raising a handgrip on either seat. A mechanically activated canopy emergency jettison initiator (M3A2) can be fired from internal or external emergency canopy jettison handles. The internal handle is located in the centre of the cockpit immediately below the main instrument panel. The external canopy jettison handle is located on the left side of the fuselage and permits ground rescue personnel to jettison the canopy for emergency entrance (Figures 1-18 and 1-19). Both the external and internal jettison handles activate the same initiator to fire the canopy remover.

NOTE

The canopy is automatically jettisoned as part of the ejection sequence.

CAUTION

If the canopy is jettisoned from any position other than fully closed, complete separation from the aircraft will not take place, and the canopy could strike the upper fuselage, resulting in fragmentation and possible rebound.

GROUND SAFETY PINS

139. Ground safety pins equipped with streamers are provided to preclude inadvertent ejection of the canopy and seats. One safety pin, located in the right handgrip of each seat, must be removed by the pilot during the pre-taxi check.

140. One ground safety pin is located at the canopy emergency jettison initiator.

NOTE

The canopy emergency jettison initiator ground safety pin must be removed before the pilot enters the cockpit in preparation for flight.

CANOPY PRESSURE SEAL

141. An inflatable pressure seal is installed in the edges of the canopy frame and seats against the mating surfaces of the canopy sill and windshield to ensure effective cockpit pressurization. The seat pressurization switch, which is operated by the bell-crank assembly located at the top of the canopy actuator, energizes a valve which allows engine bleed air to inflate the seal when the canopy is closed and locked. The seal is deflated as the canopy begins to open.

NOTE

The canopy seal will deflate and the cockpit depressurize on loss of electrical power to the pressurization switch.

PARACHUTES

141A. The primary parachute worn by aircrew and passengers is the 8.5 m diameter (28-ft dia.) canopy flex-back parachute which contains an automatic opening device, see para 155. A 7.3 m diameter (24-ft dia.) parachute may be worn subject to certain conditions, see para 141B, Boarding Weight.

BOARDING WEIGHT

141B. Boarding weight is defined as nude weight plus the weight of clothing, life preserver/survival vest (LPSV), parachute and other aviation life support equipment (ALSE) or equipment worn on the body at the time when the individual enters the cockpit in preparation for flight. The minimum nude weight is 59 kg (130 lbs) while the maximum boarding weight shall not exceed 118.8 kg (262 lbs). The maximum boarding weight is based on a light weight (LW) seat pack weight of 11.6 kg (26 lbs) and is reduced correspondingly in relation to any weight increase in the seat pack weight. There is no set maximum nude weight because of variations of the equipment worn. The maximum boarding weight ensures the maximum weight supported by a parachute canopy does not exceed the maximum descent rate. It also ensures that during an ejection, the maximum all up weight rating of the seat rocket catapult (ROCAT) is not exceeded, see Figure 19A.

NOTE

A 7.3 m dia. chute (24-ft) may be worn in the CT114 Tutor if the individuals boarding weight does not exceed 106 kg (233 lbs) based on a seat pack weight of 11.8 kg (26 lbs).

EJECTION SEATS

WARNING

It is possible to insert the safety pin if the ejection handles have been raised slightly from the stowed position, in which case the handles are not, in fact, secured. A red tape on the handles above the level of the leg guards will be visible if this condition exists.

142. The aircraft is equipped with two upward-ejecting ROCAT seats (Figure 1-20). The rocket catapult ejection seat is a means of emergency escape

SEAT PACK		BOARDING WEIGHT MAXIMUM		NUDE WEIGHT MINIMUM
CONFIGURATION	WEIGHT	With 8.5 m (28 ft) Chute	With 7.3 m (24 Ft) Chute	
Light Weight (LW)	11.8 kg (26 lbs)	119 kg (262 lbs)	106 kg (233 lbs)	59 kg (130 lbs)
Global	15.45 kg (34 lbs)	115.2 kg (254 lbs)	102.05 kg (225 lbs)	59 kg (130 lbs)

Figure 1-19A Boarding Weight Limitations

from the aircraft provided that the aircraft is between 60 and 350 knots (111 and 648 km/h) indicated airspeed and the aircraft altitude is 150 feet (46m) or greater from ground level. The left hand (LH) and right hand (RH) seats are essentially identical, except for the orientation of canopy breakers.

NOTE

Two seat configurations exist within the Tutor fleet, specifically the Basic configuration and the AERO Rigid Arm Drogue (ARAD) equipped ejection seat introduced through modification C-22-166-000/CF-066 in 2000. The ARAD seat is fitted on all operational aircraft while the Basic remain installed on aircraft used for aviation trades training and those aircraft in long term storage. Information listed in this publication will be related to the ARAD seat only. For additional information on the ARAD seat configuration, refer to C-22-166-000/MS-000.

143. Each seat incorporates an electrically operated seat-adjustment mechanism, a lap belt and a harness with automatic release, and a ballistic inertia-reel (BIR) with manual and automatic lock. A ballistic system initiates the canopy jettison, the BIR, the seat rocket and the seat-man separation system. A lanyard system initiates the ARAD system as the seat moves upward on the seat rails. A personal-leads disconnect on the left side of each seat permits automatic disconnection of the oxygen pressure line and both canopy jettison and seat rocket initation propellant gas lines. The intercom quick-disconnects are located on the right side of each seat. In the event of canopy failure, both seats are equipped with a canopy-breaking ram for ejection through the canopy. Emergency transmission on UHF and transponder is provided on ejection of either seat. Should the pilot remain in the aircraft, however, an override switch permits normal operation of UHF (see Paragraph 185).

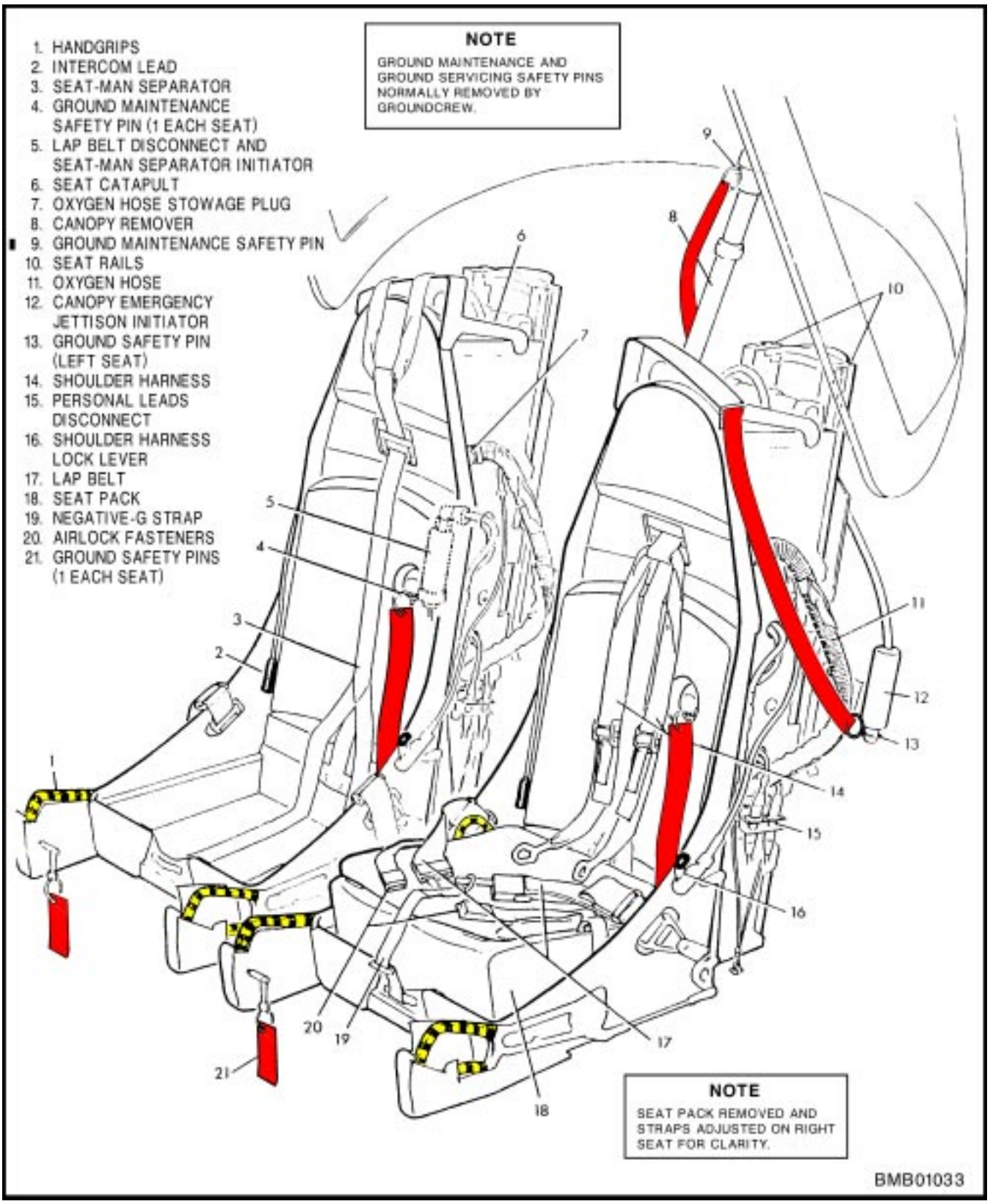


Figure 1-20 (Sheet 1 of 2) Ejection Seats

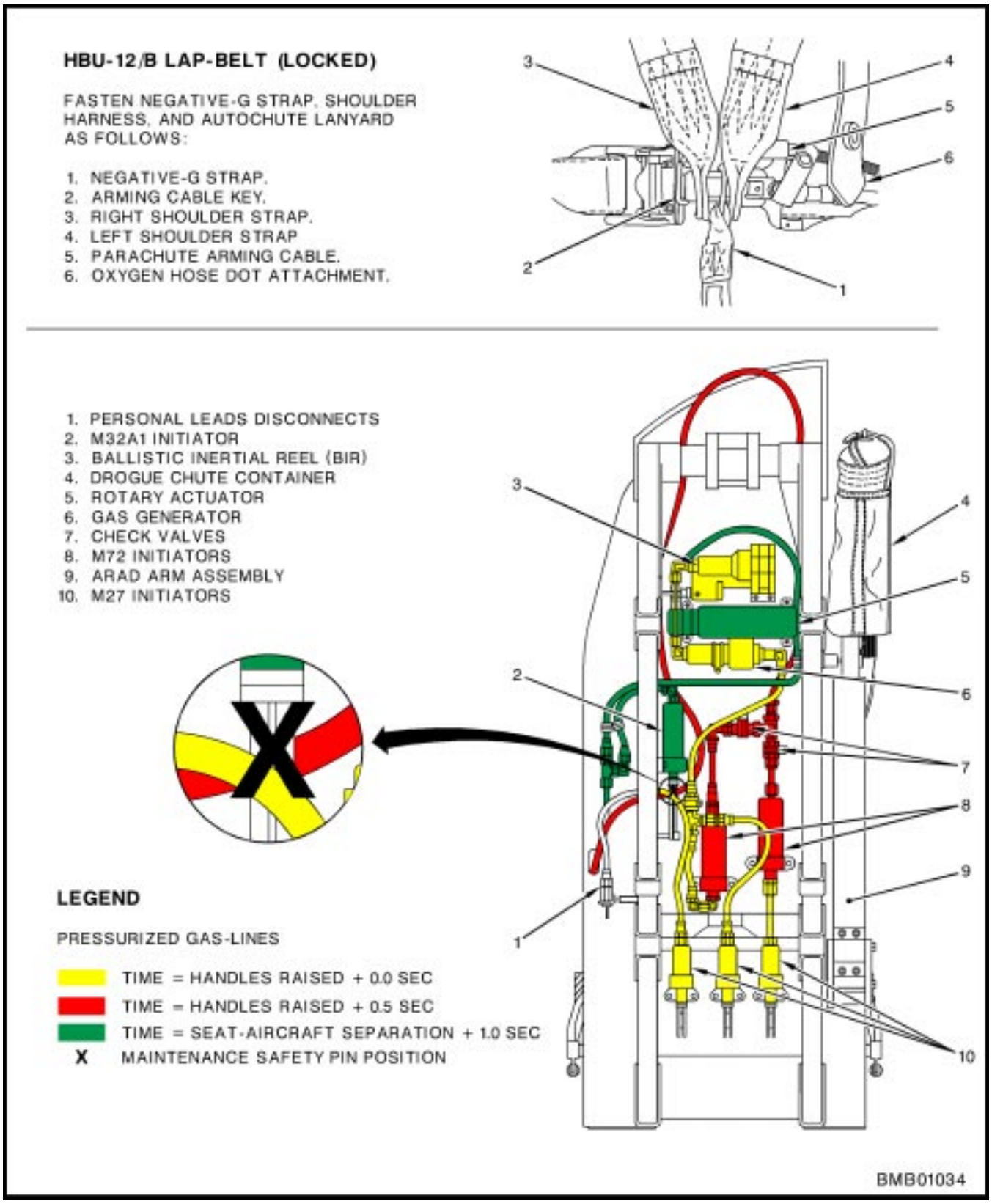


Figure 1-20 (Sheet 2 of 2) Ejection Seats

A ground safety pin, with red streamer attached, is inserted through the handgrip on the right side of each seat to lock the handgrips. A plug on the left side of each seat is provided for stowing the oxygen hose when not in use.

SEAT CONTROLS

144. Each seat incorporates the following operating controls:

a. a vertical seat adjustment switch;

b. handgrips (knee guards) on either side of each seat; and

c. inertia-reel lock lever.

VERTICAL SEAT ADJUSTMENT SWITCHES

WARNING

Do not adjust the seat until strap-in has been completed: lap-belt buckles can become wedged between the cockpit floor or wall and ejection-handle link rods. During downward adjustments, this can cause the cross shaft to rotate and raise the ejection handle.

145. The switches, marked SEAT ADJUST and UP-DN, are spring-loaded to the neutral position and operate the seat through a 5-inch range. They are located one on the left and one on the right instrument sub-panels.

HANDGRIPS (KNEE GUARDS)

146. Each seat is equipped with ejection controls, which consist of loop-type handgrips installed on both sides of the seat. The handgrips, which also act as knee guards, are interconnected so that both grips are simultaneously moved and locked in the fully erect position. Raising either handgrip initiates canopy ejection, activates and locks the ballistic inertia-reel, and fires the seat catapult initiator. The handgrips are protected on the inside by plastic guards to prevent snagging.

INERTIA-REEL LOCK LEVER

WARNING

The automatic locking feature provides an additional safety factor, but the manually locked position should always be used during take-off and landing.

147. The shoulder-harness inertia-reel lock lever, on the left side of each seat, is a manually operated lever for locking and unlocking the shoulder harness. The lever has two positions, locked and unlocked, and is spring-loaded to hold in the selected position.

148. When the lever is in the aft position, the reel is unlocked and the reel strap extends to allow the pilot to lean forward, but locks automatically when a 2 to 3 G body force is exerted on the harness in a forward direction. When the lever is in the forward or locked position, the reel strap is mechanically locked so that the pilot cannot bend forward. When the handgrips are raised during ejection, the locking mechanism is automatically actuated.

BALLISTIC INERTIA-REEL

149. Each seat incorporates a ballistic inertia-reel. The raising of either handgrip fires an initiator, which in turn activates a gas-producing cartridge. This gas powers the inertia-reel which retracts the shoulder harness and pulls the pilot against the back of the seat.

LAP BELT AND HARNESS

150. The seat is equipped with an automatic opening lap belt which facilitates crew member separation from the seat following ejection. Belt opening is automatic as part of the ejection sequence and requires no additional assistance from the crew member. As the seat travels up the rails during ejection, a mechanical tripper located near the top of the rails activates the M32A1 one-second delay gas initiator, which opens the lap belt.

SEAT-MAN SEPARATION SYSTEM

151. A strap-type seat-occupant separator and drogue system (ARAD) ensures separation of the occupant and the survival seat pack from the seat.

152. In order to improve the seat-occupant separation, the CT114 operational aircraft ejection seats have been fitted with an ARAD assembly, drogue chute with assist chute and pencil cutters. The ARAD assembly, which is fitted on the right side of the seat frame, consists of a telescoping ARAD arm assembly

and lock down assembly. The deployment bag, which contains the assist chute and drogue chute, is housed within the drogue chute container above the ARM.

153. The deployment of the drogue chute stabilizes the ejection seat; it also slows the ejection seat in relation to the occupant, thereby allowing for good seat-occupant separation before the occupant's parachute is deployed.

154. During the ejection, as the seat starts to move up the fixed rails, a bracket on the rail contacts the operating lever on the seat which fires the 1.0 second delay M32A1 initiator. Pressurized gas from the M32A1 initiator travels through a ballistic line to the ballistic part of the lap belt to release the lap belt. Pressurized gas also travels to the rotary actuator and fires it. The rotary actuator retracts the webbing strap behind the seat-occupant until it becomes taut and separates the occupant from the seat. The parachute deploys automatically.

AUTOMATIC OPENING OF PARACHUTE AND DELAYED-DROP PROVISION

155. When the lap belt is being released, and as the pilot is separated from the seat, the parachute automatic opening device arming cable is pulled. This actuates the delay mechanism in the parachute pack and, at a pre-set time interval of one second, unlocks the aneroid-type release, which deploys the parachute at the pre-set altitude of 16 000 (±1000) feet. If below the pre-set altitude, the parachute will open at the pre-set time interval.

NOTE

Manual operation of the lap belt release and the parachute D-ring is unaffected by the automatic features.

SEAT PACK

WARNING

If the seat-pack release handle is pulled prior to ejection, the contents will deploy immediately upon pilot-seat separation and may foul with the seat or parachute.

156. The seat pack is contained in the hard-shell that forms the pilot's seat. A yellow handle, located on the right side of the seat pack, is provided to release the contents of the pack after ejection. When the handle is pulled, the seat pack deploys with the contents suspended on the seat-pack lanyard, the hard shell then falls away. A red warning band is incorporated on the base of the release handle. If the red band is visible, the handle has been pulled, and the contents are not secure in the pack.

NOTE

To effect deployment of seat-pack contents, pull up actuating handle sharply; the handle with rip-cord assembly will come free of seat-pack container.

SEAT EJECTION SEQUENCE

157. The ejection seats are operated independently of one another by the seat occupant. The timed sequence of events after one or both leg guard handles are operated is as follows:

a. 0.0 seconds – BIR operates to bring the seat occupant to the correct ejection posture and the canopy is jettisoned.

b. 0.5 seconds – ROCAT fires and the seat begins to move up the rails.

c. 0.5 seconds plus approximately six inches (15 cm) of seat travel – Initiator lanyard/locking pin assembly releases assist chute flaps and drogue chute container flaps, activates drogue chute and the arm restraint pencil cutters.

d. 0.6 seconds – Arm restraint pencil cutters cut the arm restraint (Kevlar cord) to release the ARAD ARM.

e. 1.3 seconds – Drogue chute pencil cutters cut the Kevlar cord on the deployment bag to allow deployment of drogue chute.

f. 1.5 seconds – Lap belt opens, rotary actuator cartridge fires, and parachute arms.

g. 2.5 seconds – Parachute commences deployment.

158. With continued upward movement of the seat in the rails, the personal leads are disconnected and the UHF and transponder emergency transmissions are initiated. As the pilot leaves the seat the parachute is armed. The parachute automatically deploys at an altitude of 16 000 (±1000) feet or after one second below this altitude, whichever is the later. Total ejection time is approximately five seconds.

OXYGEN SYSTEM

GENERAL

159. A high-pressure fixed oxygen system with a reduced-pressure distribution supplies gaseous oxygen from two interconnected storage cylinders to individual automatic pressure-breathing diluter-demand regulators located on the main instrument panel. A pressure gauge on the main instrument panel indicates the oxygen system storage cylinder pressure. A common charging connection is located on the left side of the fuselage aft of the oxygen cylinder. A continuous-flow emergency system is incorporated in each parachute for emergencies and ejection at altitude.

OXYGEN STORAGE CYLINDERS

160. The high-pressure oxygen cylinders are located one in each engine air-intake fairing and, when fully charged to 1800 psi (at 21 °C), each cylinder has a capacity of 623 litres of gaseous oxygen.

DILUTER-DEMAND OXYGEN REGULATORS

161. A pressure-breathing diluter-demand oxygen regulator is provided for each pilot. The regulators operate automatically, but override controls are incorporated. Each regulator incorporates a blinker-type flow indicator, a relief valve, a diluter toggle, and an emergency control toggle. The two-position diluter toggle is marked 100% OXYGEN and NORMAL OXYGEN, and the three-position emergency control toggle is marked EMERGENCY, NORMAL, and TEST MASK. The TEST MASK position is spring-loaded to NORMAL.

162. When the diluter toggle is at NORMAL OXYGEN, the regulator will deliver, on demand, an air/oxygen mixture, the ratio of which varies with cockpit altitude. This ratio is automatically regulated by an integral aneroid. As the cockpit altitude increases, the proportion of air decreases until, at approx 30 000 feet, 100% oxygen is delivered to the mask. With the diluter toggle at 100% OXYGEN, the regulator will deliver, on demand, 100% oxygen at any altitude.

163. The NORMAL position of the emergency control toggle allows the regulator to deliver oxygen or an oxygen-air mixture at cockpit altitudes of up to approximately 30 000 feet. Above this cockpit altitude, the regulator will begin to deliver oxygen at a positive pressure, increasing with altitude. If a positive pressure is required below 30 000 feet, the toggle may be placed in the EMERGENCY position, and 100% oxygen will be supplied under positive pressure. The TEST position of the toggle produces a continuous flow of oxygen for testing purposes. The blinker-type flow indicator shows white when an inhalation is made and oxygen is flowing through the regulator. When the inhalation ceases, the indicator blinker shows black.

EMERGENCY OXYGEN SYSTEM

164. An emergency oxygen bottle is contained in each parachute. The emergency system is used in the event of ejection or malfunction of the main system: it provides oxygen at a pre-set rate for approximately 10 minutes.

165. In the event of ejection, the normal oxygen system is automatically disconnected at the personal-leads disconnect, located on the left side of each seat, and emergency oxygen is supplied to the face mask, via the emergency supply line, by pulling the green ball on the right parachute shoulder harness.

166. In the event of malfunction of the normal oxygen system, emergency oxygen can be supplied to the mask, via the emergency line, by the same method.

NOTE

Following ejection, restricted breathing will be experienced. The emergency oxygen supply is designed to provide supplementary oxygen to the surrounding atmosphere. After an ejection, atmospheric gas will enter the oxygen mask when a breathing suction, sufficient to open the spring-loaded anti-suffocation valve in the MC3M connector, has been reached. The system will maintain an adequate level of oxygen in the blood during ejections from altitudes of as high as 48 000 feet. If emergency bailout oxygen is activated while still connected to the aircraft oxygen system, it is impossible to exhale through the MBU-12/P oxygen mask combination valve.

MASTER WARNING SYSTEM

GENERAL

167. The master warning system presents a centralized visual indication of a malfunction or an abnormal condition in one of the monitored systems. The master warning system consists of a master control box, a MASTER WARNING light, a MASTER CAUTION light, an annunciator panel, and test facility and are all located on the instrument panel. The master control box is located on the back of the annunciator panel and is fed by all associated

warning circuits. When a circuit is energized, the signal is passed through the master control box and so routed to cause flashing of the master lights and illumination of the appropriate legend on the annunciator panel.

MASTER LIGHTS

168. The master lights, on the upper left centre of the main instrument panel, provide the pilots with a flashing indication of a system malfunction or an abnormal condition. Fire is indicated by the flashing red MASTER WARNING light. A flashing amber MASTER CAUTION light indicates malfunctions or abnormal conditions existing in the other monitored systems, except windshield de-icing, speed brakes, and elevator trim tab.

169. Master light indications are cancelled and the lights reset by depressing the appropriate light. When reset, the lights are ready for further warnings pertaining to other monitored systems. However, the illuminated annunciator legend is not affected by the reset mode of the master lights and will continue to identify the system at fault until the malfunction or abnormal condition has been rectified.

ANNUNCIATOR PANEL

170. The annunciator panel, mounted on the centre of the main instrument panel, contains emergency indications given by red legends, cautionary indications given by amber legends, and advisory indications given by green and blue legends (Figure 1-21).

NOTE

Bright sunlight from the rear of the aircraft may create a glare on the annunciator panel, making illuminated legends difficult to detect. Ensure that direct sunlight is shielded from the panel while checking for warning lights.

ANNUNCIATOR TEST SWITCH

171. When the annunciator panel test switch is depressed, the master lights, the annunciator panel legends and the landing-gear visual and audible warning indicators are energized. This switch tests only the lights and tone and does not check the circuits or associated systems.

FIRE AND OVERHEAT DETECTION SYSTEMS

GENERAL

172. The two fire and overheat detection systems operate automatically to give immediate visible warning of a fire and/or an overheat in Zones 1 and 2 of the engine compartment. Each system is electrically operated and consists of a control unit and a continuous-wire temperature-sensing element. A test switch, common to both systems, is installed on the instrument panel.

173. A fire in the engine compartment is detected by two independent systems: a fire/overheat detection system, and a separate overheat detection system. This system also detects overheat conditions in the engine compartment. The fire/overheat system illuminates the annunciator panel FIRE legend, the lower AIRFRAME O/HEAT legend and the MASTER WARNING and MASTER CAUTION lights. The separate overheat detection system illuminates the annunciator panel upper AIR-FRAME O/HEAT legend and the MASTER CAUTION light.

174. Provision is made to test the continuity of the detector cables and the operation of the control units by a FIRE & OVHT TEST switch on the instrument panel.

175. With the separate overheat detector system, when the test switch is pressed, the centre conductor of the detector cables is connected to ground (zero resistance), thus simulating an overheat condition. The control unit will then operate and light the MASTER CAUTION light and an AIRFRAME O/HEAT legend. When the test switch is released, the system will return to normal.

176. The fire/overheat system operation is verified through the test relay contained in the system control unit. When the test switch is pressed, the test relay is energized and actuated. Contacts of this relay connect the centre conductor of the system detector cable to ground (zero resistance), thus simulating both overheat and fire conditions. The control unit will react to this simulated condition by lighting the FIRE and AIRFRAME O/HEAT legends and the MASTER CAUTION and MASTER WARNING lights.

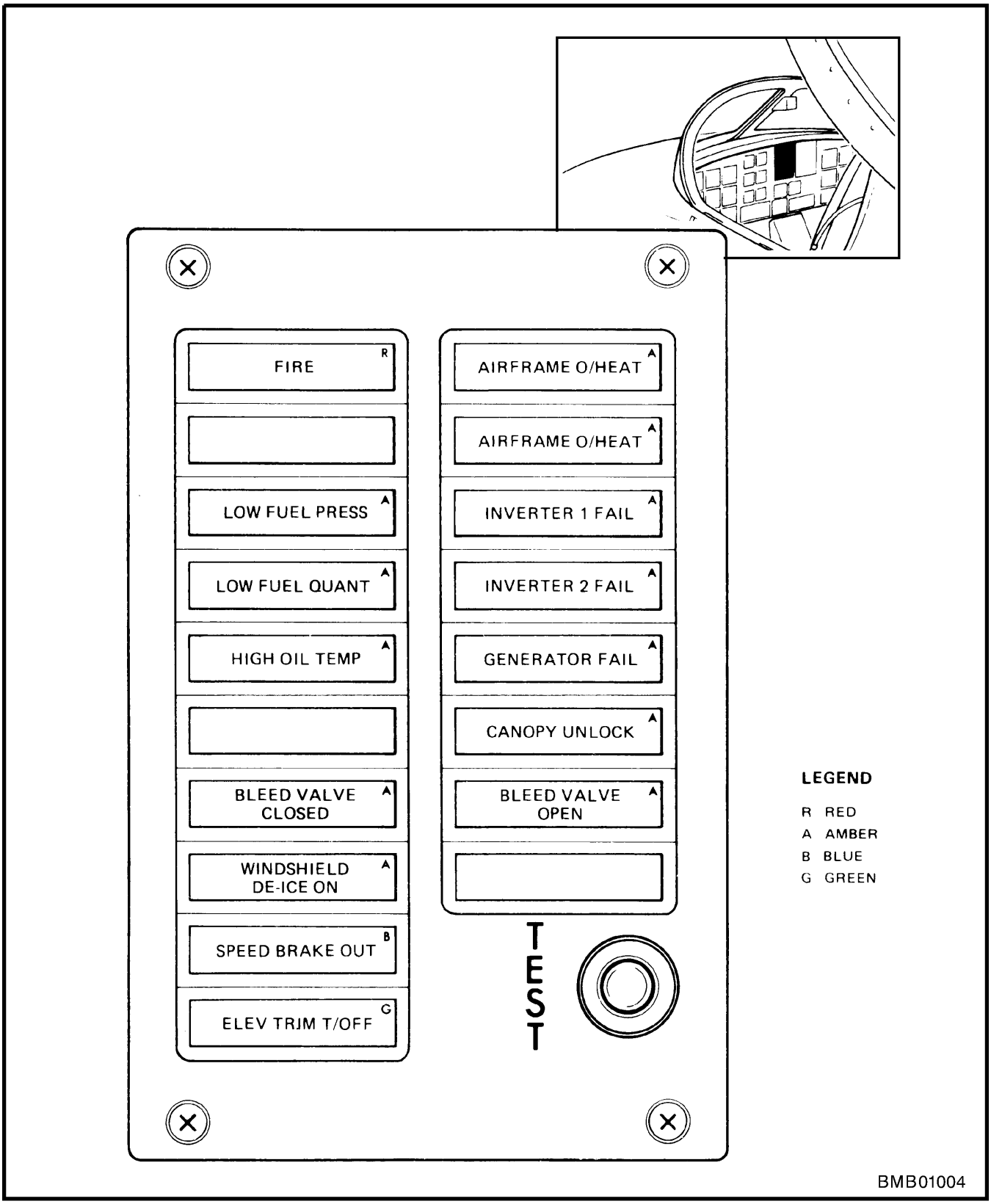


Figure 1-21 Annunciator Panel and Master Control Box

NOTE

The test relay circuit, in the combined system, is interlocked with the fire and overheat warning relays, so that the system test can only be carried out under normal conditions in the absence of an overheat or fire, or a detector cable short circuit. If an overheat or fire exists, the lights are already on. If there is a short, the light cannot illuminate.

COMMUNICATION EQUIPMENT

INTERCOM SYSTEM

177. The AN/AIC-504 intercom system provides hot-mike intercommunication between the two seat positions. The system also provides radio monitoring and microphone control facilities for the UHF and VHF, and reception of TACAN, VOR/ILS/MARKER audio signals.

178. The Audio Selector Panel (ASP) is located on the centre console. All controls are duplicated for the LH and RH seats. There are four rotary volume control knobs (pull on, push off), labelled VHF, UHF, INT and NAV. Also incorporated in the system are two press-to-talk switches, located on each throttle which transfer the microphone amplifier output to the UHF transmitter when either button is depressed. The muting switches, located on each stick grip and on the right instrument sub-panel, can be used to silence the audio inputs of all on board communication receivers simultaneously.

179. For normal operation, the four knobs on the ASP must be pulled and adjusted to a comfortable listening level. As the one NAV knob controls the audio level of the TACAN, VOR/ILS/MARKER jointly, it should be set to a medium/high level, and the individual audio levels set by the volume knob on their respective control panels.

180. An audible warning is transmitted to the pilot's headsets through the intercom system when the landing-gear is in any other position than down and locked, and the throttle is retarded below 65(±2)% RPM, with the aircraft below approximately 7000 feet MSL.

AN/ARC-164 UHF SYSTEM

181. The AN/ARC-164 UHF system which requires DC power, provides voice transmission and reception in the frequency range of 225 to 399.9 MHz in 25 KHz increments through the RT-5078/ARC-164 receiver-transmitter located in the nose compartment. Any one of the 7000 channels can be selected manually on the radio set control unit located on the centre console. Any one of the 20 preset frequencies including the guard channel may be selected remotely by means of the remote channel selector located on the LH side of the instrument panel.

182. A frequency channel indicator located in the centre of the instrument panel indicates either preset or manual frequency. The preset frequency read switch installed on the LH side of the instrument panel must be depressed in order to indicate the chosen preset frequency on the frequency channel indicator.

183. Two take control switches are used with the radio set control panel MANUAL/PRESET/GUARD switch to allow either side to take control of the UHF system. A AT-256A/ARC UHF antenna is installed on the lower fuselage (Figure 1-23).

UHF CONTROLS

184. The radio set control unit, located on the centre console, is used in conjunction with the remote channel selector to provide complete operating control of the UHF radio. The unit incorporates the following controls (Figure 1-22):

a. **Function Switch.** The function switch controls the function of the equipment as selected by the four following positions:

(1) **OFF.** The OFF position de-energizes the equipment.

(2) **MAIN.** In the MAIN position, the set is turned on, and the transmitter and receiver are operated on the same frequency. When the microphone switch is depressed, operation is transferred from the receiver to the transmitter. When the microphone switch is released, the equipment returns to the receiving condition.

(3) **BOTH.** In the BOTH position, the set functions in the same manner as in the MAIN position but, in addition, reception is available on 243.0 Mhz (guard frequency).

NOTE

This function provides monitoring only and does not permit transmission on the guard frequency. Transmission on guard frequency is selected by positioning the preset channel selector to G or by setting up the guard frequency on the manual frequency selector knobs.

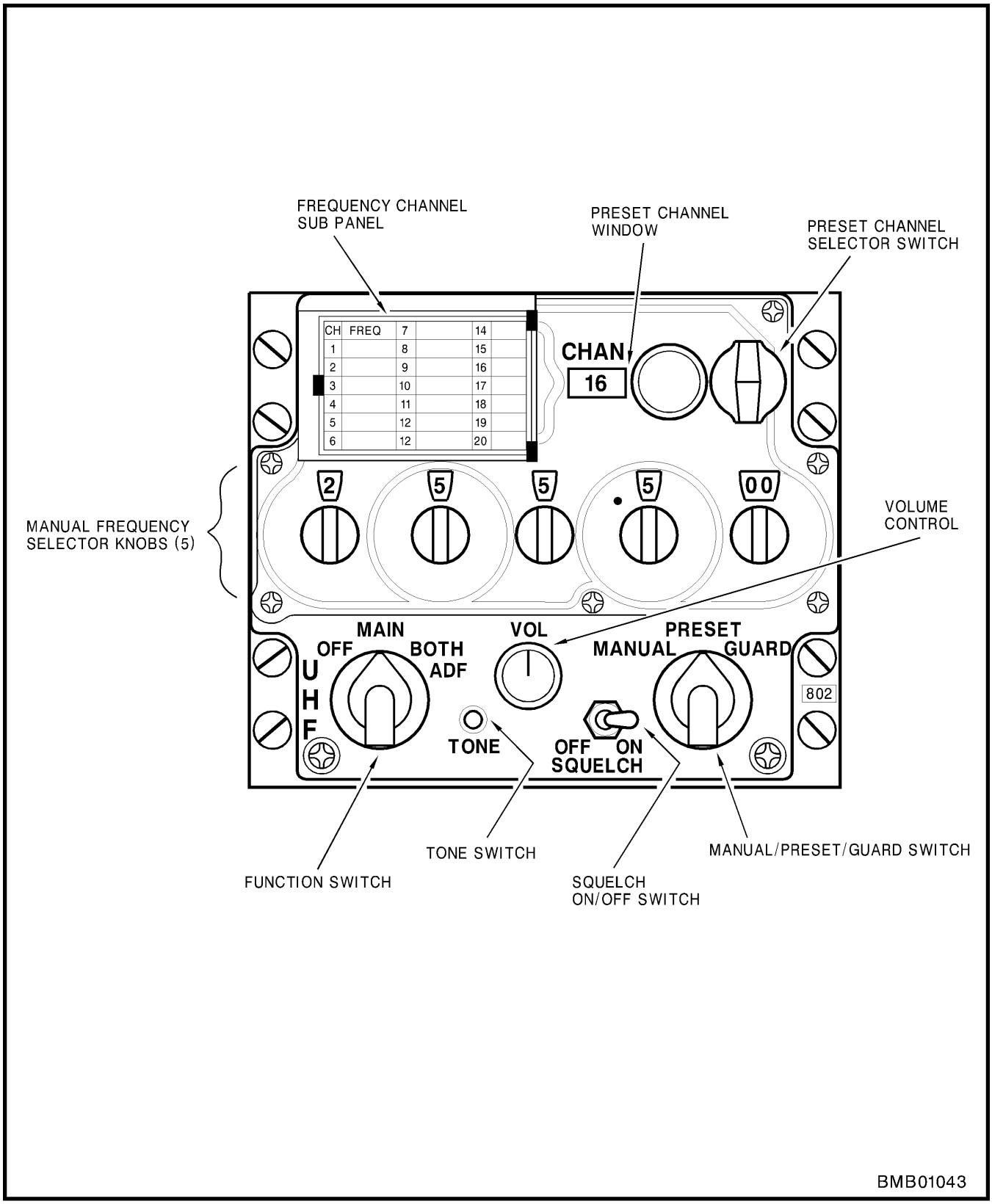


Figure 1-22 UHF Radio Set Control Unit

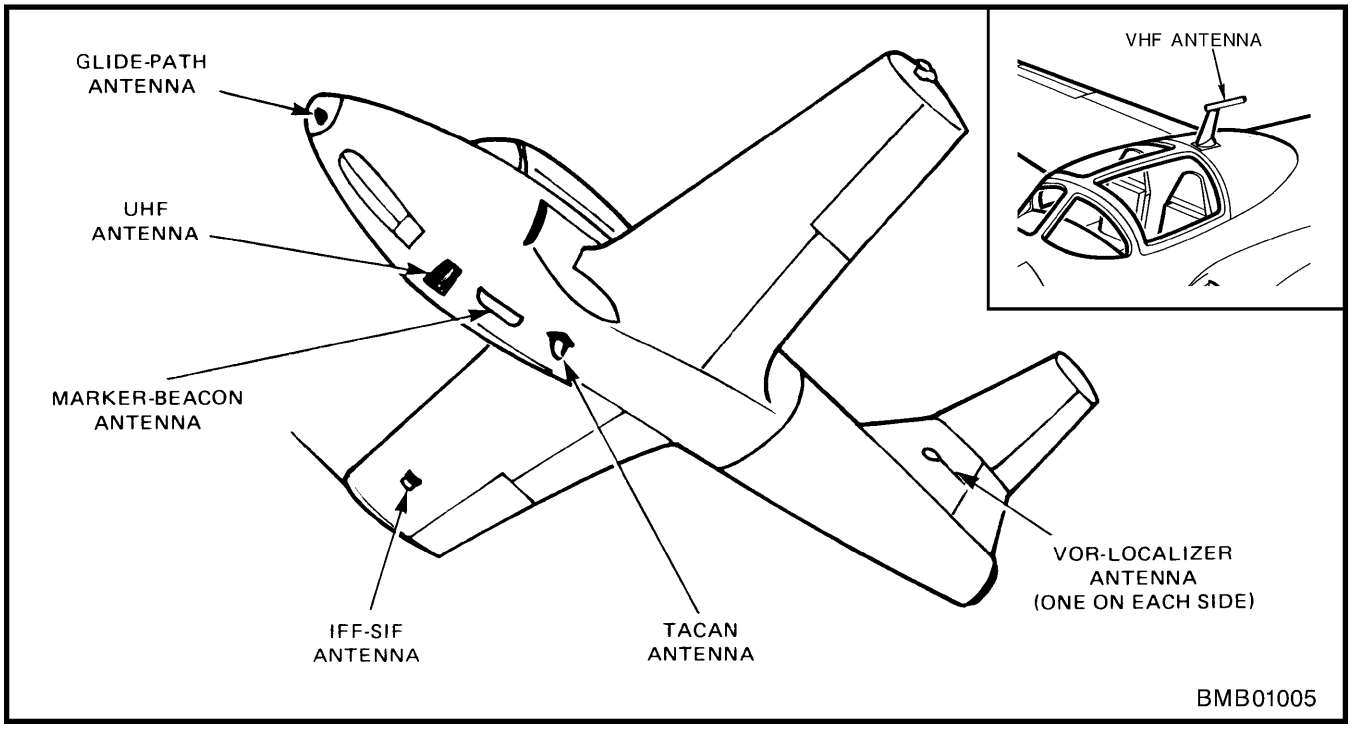


Figure 1-23 External Antennas

(4) **ADF.** The ADF position activates the ADF system and the main receiver.

b. **Manual/Preset/Guard Switch.** This rotary switch provides the method of frequency selection. The MANUAL position permits operation on the frequency selected by the manual frequency selector knobs. The PRESET position permits the use of the preset channel selector for operation on any one of the 20 preset channels including the guard frequency. The GUARD position de-activates the guard receiver.

c. **Manual Frequency Selector Knobs.** Five manual frequency selector knobs are provided on the control panel to set up any desired operating frequency.

d. **Volume Control.** The volume control is a rotary control knob.

e. **Squelch ON/OFF Switch.** The Squelch ON/OFF switch controls the main receiver squelch.

f. **Tone Switch.** The Tone switch controls the transmission of the 1020 Hz tone on the selected frequency.

g. **Frequency Channel Subpanel.** The following controls and adjustments are located behind the frequency channel subpanel:

(1) **BW Switch.** The BW switch selects wide band or narrow band selectivity of the main receiver.

(2) **PRESET Switch.** The PRESET switch stores a selected frequency in a selected preset channel.

(3) **SQUELCH MN Control.** The SQUELCH MN control adjusts the main receiver squelch level.

(4) **SQUELCH GD Control.** The SQUELCH GD control adjusts the guard receiver squelch level.

UHF AND TRANSPONDER EMERGENCY OPERATION AFTER SEAT EJECTION

185. When the pilot ejects, the UHF is automatically switched on and transmits a 1020 Hz tone and the transponder will operate in the emergency mode. However, if the transponder is in the OFF position, approximately 20 seconds will be required for the set to warm up before it is activated. A NORMAL/OVERRIDE switch, located on the auxiliary override panel, is used to regain control of the UHF system by

the remaining occupant should only one pilot eject. The switch does not override the transponder, which will operate in the emergency mode continuously after the first occupant ejects.

VHF RADIO SYSTEM

CAUTION

While transmitting on the VHF, a degree of interference may be noted on the VOR/ILS navigation system. The affected bands change with each different VHF frequency. Pilots should exercise caution when using VHF and the VOR/ILS system in IMC conditions.

186. The VHF radio system operates on DC power and uses a AN/ARC-511 receiver-transmitter to provide air-to-ground and air-to-air voice communication as selected from the NAV/COMM dual control unit. The system operates over a frequency range of 116.000 to 151.975 Mhz on channels spaced at 25KHz intervals. A VHF antenna is installed aft of the canopy dorsal centreline (Figure 1-23).

NAV/COMM DUAL CONTROL UNIT

187. The NAV/COMM dual control unit located in the lower centre instrument panel provides frequency control of airborne VHF communication equipment, VHF navigation receivers and glide slope receivers. The unit incorporates the following controls (Figure 1-24):

a. **VHF Frequency Controls.** Two separate sets of VHF Frequency Controls are placarded as COMM and NAV on the front panel of the NAV/COMM dual control unit. The communication controls adjust the frequency of the VHF communications equipment and the navigation controls adjust the frequency of the VHF navigation receiver and the glideslope receiver.

b. **Frequency Selector Knobs.** Each set of VHF frequency controls contain two frequency selector knobs, for COMM and NAV.

c. **Power and Gain Controls.** Mounted concentrically on the LH COMM and NAV frequency selector knobs are OFF/PWR switches controlling power to their respective equipment. The LH COMM also has a TEST position which disables the squelch circuit in the communication receiver. A Volume (VOL) control, is mounted concentrically on the RH COMM and NAV frequency selector knobs.

d. **NAV TEST Toggle Switch.** The NAV TEST toggle switch is a three-position switch used to test the VOR/LOC system. With the navigation receiver tuned to a localizer frequency, setting the switch to the UP/L position causes the vertical (on course) needle to deflect left and the glideslope pointer to deflect upward on the course indicator. Setting the switch to the DN/R position causes the vertical needle to deflect right and the glideslope pointer to deflect downward. With the navigation receiver tuned to a VOR frequency, setting the NAV TEST toggle switch to the VOR (down) position provides an airborne duplication of a ground VOR test station. The track indicator indicates180 degrees, and with the SET knob set to 180, the vertical needle centres, and the TO-FROM flag indicates TO.

e. **Digital Counter Dials.** The selected frequency is indicated on digital counter dials.

AN/ARN-504 TACAN SYSTEM

188. The airborne AN/ARN-504 micro TACAN equipment operates in conjunction with a surface beacon to form a radio navigation system, which provides bearing and distance information relative to a selected beacon as well as audio beacon identification. It provides for selection of 252 two-way channels. Although line-of-sight limited, the AN/ARN-504 is capable of operation at ranges beyond 300 NM from the ground beacon at 35 000 feet AGL. Beacon identification is available on the intercom system.

189. The airborne system consists of an antenna located on the under side of the fuselage (Figure 1-23), a transmitter/ receiver (T/R) unit installed in the rear portion of the upper left nose compartment, and a control panel mounted on the forward portion of the cockpit centre console (Figure 1-2). The system is normally powered by 28-volt DC power from the essential DC bus and 115-volt and 26-volt AC power from the No. 1 inverter. It also has a built-in test (BIT) capability.

CONTROL PANEL

190. The TACAN control panel (Figure 1-25) contains the following:

a. **Function Selector Switch.** Permits selection of:

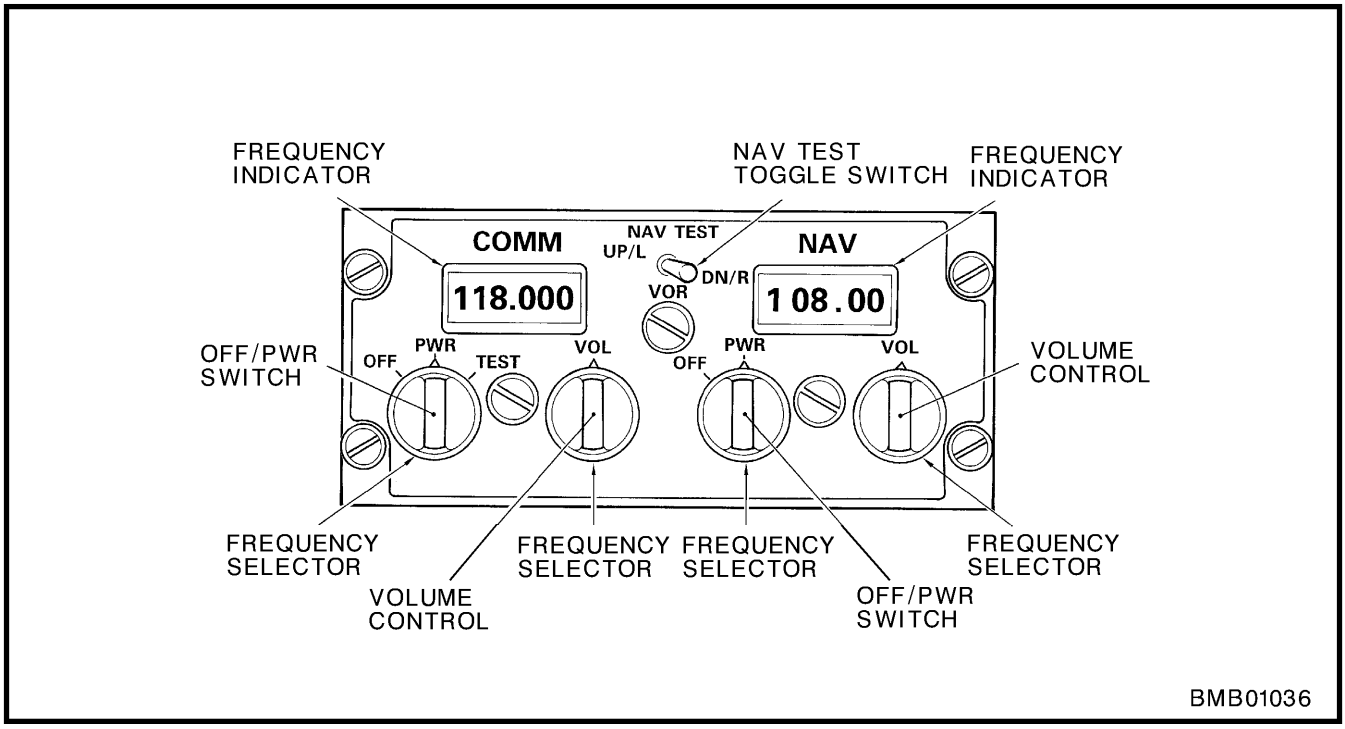


Figure 1-24 NAV/COM Dual Control Unit

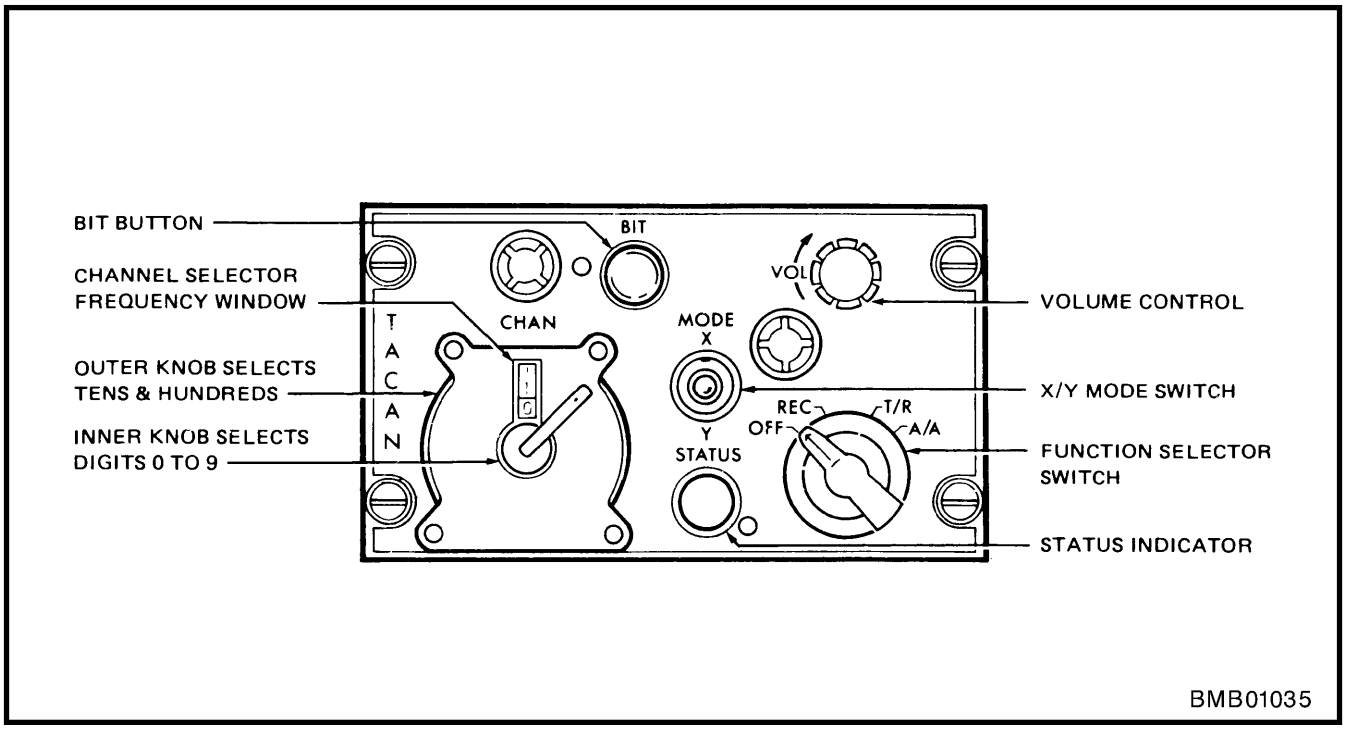


Figure 1-25 TACAN Control Panel

(1) **OFF.** Removes power from the receiver/transmitter.

(2) **REC.** Bearing and track information is displayed on the DRMI and track indicators respectively. Beacon audio identification is available. The DME portion does not function, and an OFF flag will cover the DRMI digital distance display when this mode is selected.

(3) **T/R.** Bearing and distance information is available.

(4) **A/A.** In the A/A mode, the system will compute the slant range to a similarly equipped aircraft (not necessarily ARN-504). One aircraft acts as a reference by operating on a channel that is displaced 63 channels from the others. For example, if the reference aircraft is on Channel 12, then the others would have to be on Channel 75 or vice-versa. Only range information is available in this mode; the bearing pointer goes to 360° and remains there.

b. **Built-In Test (BIT) Button and Status Indicator.** When the BIT button is depressed, a GO will appear in the STATUS indicator, the bearing indicator will slew counter-clock-wise to 360°, and the DME indicator will go to zero. When the BIT button is released, the GO will disappear, and a test of the channel and operational mode selected (but not the antenna system) will be initiated. After 15 to 20 seconds, the GO will reappear for approx 10 seconds, indicating the set is serviceable. If GO does not appear after the bearing and range indications have zeroed, there is a malfunction in the ARN-504 system.

c. **Volume Control.** Controls the volume of the audio beacon identifiers.

d. **X/Y Mode Switch.** The functions are as follows:

(1) **X Mode.** The normal mode of operation permits usage of 126 channels.

(2) **Y Mode.** Gives an additional 126 channels of operation, provided that the other beacon (either ground or airborne) transmits a Y-formatted signal. Recommended for A/A, as it reduces the possibility of ground-station interference.

e. **Rotary Channel Select Switch.** Permits selection of 126 channels in 1-Mhz steps.

NOTES

1. ARN-504 can go from OFF to T/R without damage to the set; however, up to five minutes warm-up in cold weather may be required prior to performing any test functions.

2. The UHF transmitter has demonstrated repeatable radio frequency interference with the ARN-504 when operating at a frequency whose third, fourth, or fifth harmonic is equal to that of the airborne TACAN receiver frequency. When the UHF transmitter is operated at one of these frequencies in excess of three seconds, the bearing pointer will break lock, and, after 10 seconds, the DME will break lock. The TACAN will regain lock after the UHF transmission ceases.

TACAN INDICATORS

191. Bearing and distance information is displayed on ID 5040A/ARN distance radio magnetic indicators (DRMI), located on the main instrument panel at each pilot's station. Two MN97HA-4 track indicators, located adjacent to each DRMI, are utilized as a navigational aid.

FLIGHT-INSTRUMENT INTERFACE CONTROL

192. The two MN97H track indicators interface with the TACAN and VOR/ILS systems via two switches, located on the bottom portion of the multi-function panel mounted above the NAV/COM dual control unit (Figure 1-2). The two-position COURSE SEL switch makes either the left hand or right hand MN97H track indicator the master instrument. The slave instrument duplicates the track and glidepath-bar deviations and TO/FROM indications of the master instrument. However, the course-select knob of the slave instrument is not servoed to the master instruments, and its setting is meaningless. The two-position VOR/ILS-TACAN SEL switch permits the display of either VOR/ILS or TACAN information on the two track indicators. This interface control will not permit the display of TACAN information on one track indicator and VOR or ILS on the other; however, TACAN and VOR information can be simultaneously displayed on the two DMRIs.

GYRO MAGNETIC COMPASS

193. The gyro magnetic compass system supplies magnetic heading reference to the DRMI and the track indicators. The system consists of the flux valve, directional gyro, amplifier, and compass

signal repeater. The flux valve is installed in the left wing, while the other components are located in the nose of the aircraft. A fast-slave switch is located on the main instrument panel adjacent to the annunciator panel.

194. The flux valve senses the aircraft heading with respect to magnetic north. The headings sensed by the flux valve and gyro are compared electrically within the gyro, and an error signal proportional to the difference is produced. This signal is amplified and used to torque the gyro to the flux valve heading. A second heading transmitter in the gyro drives a servo loop in the compass signal transmitter. This servo loop repositions the heading transmitters in the compass signal transmitter which, in turn, supply heading data to the two DRMIs, the two track indicators, and the TACAN transceiver. Pressing the fast-slave switch and releasing it will initiate realignment of the system on the ground or in flight after carrying out manoeuvres that topple the gyro. While slaving, the gyros are unable to respond to a change of heading, and if one is initiated, the gyros will topple even more. For this reason, wings-level flight must be maintained for a minimum of three minutes after pressing the fast-slave switch.

AN/ARN-508 VOR/ILS MARKER BEACON SYSTEM

195. The AN/ARN-508 equipment, manufactured by Collins Radio Company, provides VHF omnidirectional range (VOR) information, instrument landing system (ILS) localizer and glidepath information, and marker-beacon information to the aircrew. This system is powered by both AC and DC. The VOR mode provides magnetic bearing and track indications on the DRMIs and MN97H track indicator respectively. The ILS mode provides instrument approach azimuth and glidepath indications to the aircrew on the track indicators only. The marker beacons indicate both aurally and visually when the aircraft flies over low-power 75-Mhz transmitter ground beacon. For VOR, ILS, and marker beacon antenna positions, see Figure 1-23.

196. The VOR system operates on the even frequencies between 108.2 Mhz and 111.8 Mhz and all frequencies between 112.0 Mhz and 117.9 MHz. The latter are used primarily for en route navigation. It is line-of-sight limited and provides up to 200-NM reception ranges at 35 000 feet AGL.

197. The ILS localizer and glidepath systems operate on the odd frequencies from 108.1 to 111.9 MHz and from 329.3 to 334.9 MHz respectively, and are used for instrument approaches throughout the world. Localizer and glidepath receivers are paired systems, and selecting the localizer frequency on the NAV/COM dual control panel automatically tunes the glidepath receiver to its appropriate frequency. The systems are line-of-sight limited, but low-power transmitters reduce their effective ranges to approximately 25 and 15 NM respectively.

VOR/ILS CONTROLS

198. The AN/ARC-508 VOR/ILS marker beacon system is controlled with the NAV/COM dual control unit located in the lower centre instrument panel (Figure 1-24), and consists of the following:

a. A two-position navigation OFF/PWR switch which operates as follows:

(1) **OFF.** Removes power to the VOR/ILS marker beacon navigation receiver.

(2) **PWR.** This is the position for normal operation. The mode of operation (VOR or ILS) is frequency dependent, and the corresponding outputs are displayed, on the DRMIs and track indicators accordingly. With a VOR beacon tuned in, the bearing will appear on the thin pointer of the DRMI. With the VOR/ILS –TACAN SEL switch in the VOR/ILS position, a track can be selected and the track deviation bar will position itself relative to the aircraft symbol. The glidepath deviation bar will be caged and display an OFF flag. With an ILS beacon tuned in and VOR/ILS selected, the thin pointer of the DRMI will swing to the right wing-tip position, and the track devi-ation bar of the track indicator will position itself according to the aircraft position localizer beam. The glidepath deviation bar performs in an identical fashion and indicates the aircraft relative position in the glidepath beam.

NOTE

To maintain the proper heading-pointer (aircraft symbol) track-indicator relationship, set the published front course in the course-selector window.

b. A three-position NAV TEST (UP/L, DN/R and VOR) toggle switch which operates as follows:

(1) **UP/L.** With a localizer frequency selected, the vertical (on course) needle deflects left and the glide-slope pointer deflects upward on the track indicator.

(2) **DN/R.** With a localizer frequency selected, the vertical (on course) needle deflects right and the glideslope pointer deflects downward on the track indicator.

(3) **VOR.** With a localizer frequency selected, the system provides an airborne duplicate of a ground VOR station. The vertical (on course) needle centres and the MARKER beacon lights, located on the centre instrument panel, illuminate and flicker. A 30 HZ VOR and marker beacon test tone is audible.

c. A navigation megahertz selector knob which adjusts the frequency in 1.0 MHz steps.

d. A navigation kilohertz selector knob which adjusts the frequency in 50 kHz steps.

e. A navigation VOL (volume) control which adjusts the navigation audio level.

f. A navigation indicator window which indicates the selected frequency on a digital display.

MARKER BEACON LIGHTS AND SENSITIVITY CONTROL ASSEMBLY

199. This assembly, which is located on the multi-function panel to the right of the annunciator panel, contains three coloured lights designated A (white), O (blue) and M (amber), and a three-position SENS switch marked OFF, LO, and HI. When the switch is in the LO or HI position, overflight of a ground transmitter site will result in the illumination of the appropriate light and the production of a distinctive aural signal in the headset. The duration of lamp illumination and tone may be reduced by selecting the SENS control to LO. This is especially useful when crossing marker beacons at higher altitudes. With the SENS switch in the OFF position, the lights will illuminate, but there will be no audio indication available.

AN/APX-77 TRANSPONDER

200. The AN/APX 77 is an airborne pulse-type transponder that enables the aircraft to identify itself automatically through the selective identification feature (SIF) when challenged by surface or airborne equipment. The set can also identify the aircraft in which it is installed as a friendly aircraft (identification friend or foe –IFF). Supplementary purposes are to provide momentary identification of position (I/P) and altitude on request. The basic equipment consists of an antenna, mounted under the right wing tip (Figure 1-23), a receiver/transmitter unit installed on the forward portion of the upper nose compartment, and a control panel mounted on the rear of the cockpit centre console (Figure 1-26). The system, powered by the 28-volt essential DC bus, receives a coded pulse train at 1130 Mhz, and transmits a coded reply at 1190 MHz, provided that the received signal correlates with preset conditions. This signal is received by the ground station and displayed on a plan position indicator or letter-symbol indicator permitting specific identification and location of the aircraft. Since the airborne test set TS-1843/APX is installed with the transponder, all modes can be tested without disabling them. The set is not capable of performing interrogation of other stations and is line-of-sight limited.

201. Operation is possible in any one of five modes. All have the capability of I/P and emergency identification.

a. **Mode 1.** Security identity, (tactical operations).

b. **Mode 2.** Personal identity (set on the ground and fixed for any one flight). (VIPs, tail numbers.)

c. **Mode 4.** Inoperative.

d. **Mode 3/A.** Air-traffic identity.

e. **Mode C.** Coded by inputs from the altimeter computer and the transmitted pulse train, it transmits the aircraft altitude to its interrogating radar. The interrogating radar read-out is based on standard pressure, regardless of aircraft altimeter setting.

202. The transponder incorporates the following controls and indicators:

a. **Master Control.** A five-position rotary control permitting selection of the following:

(1) **OFF.** The OFF position removes power from the receiver/ transmitter.

(2) **STBY.** In the STBY position, primary power is applied to the set, but the transponder-receiver is not sensitized, thus no replies can be transmitted.

(3) **LOW.** In the LOW position, the receiver operates at a reduced sensitivity, and replies are transmitted at a reduced power. Only nearby interrogation triggers a response.

(4) **NORM.** In the NORM position, the receiver is fully sensitized, and replies are transmitted at full power.

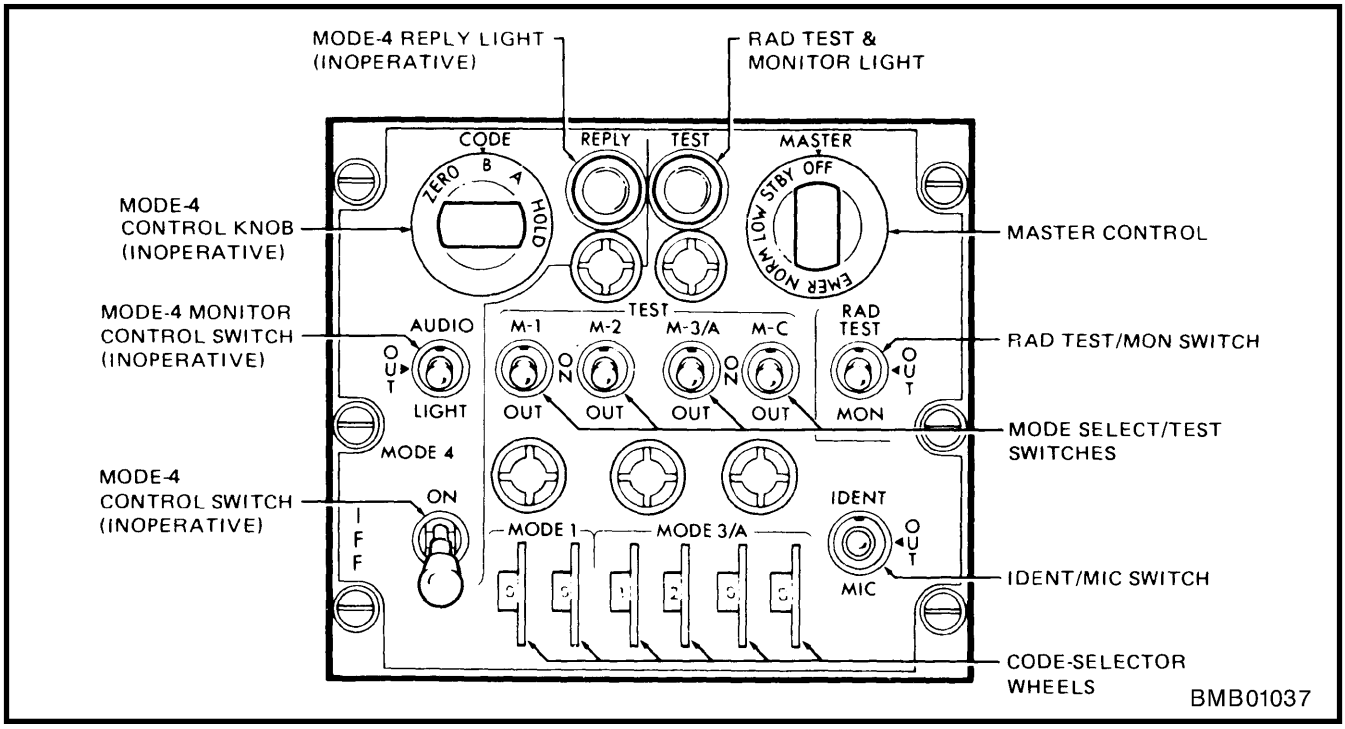


Figure 1-26 IFF Transponder Set Control

(5) **EMER.** In the EMER position, a distinctive emergency reply is transmitted in response to either mode 1 or mode 3A, code 7700 interrogations. Selecting EMER automatically turns all modes on, and the set will reply to any challenge.

NOTE

The master switch must be lifted and rotated in order to select EMER. In the event of an ejection, the set will automatically transmit on mode 3A, code 7700, to all interrogating stations, regardless of the position of the master control, provided that DC power is available to the essential DC bus (DC master on or generator is on the line). A warm-up period of 20 seconds is required prior to transmission if the set is OFF at the time of ejection. The receiver will operate at LOW sensitivity.

b. **M-1, M-2 M-3/A, M-C Switches.** Three-position, spring-loaded, toggle switches with the following selections:

(1) **ON.** Selects appropriate mode.

(2) **TEST.** The TS-1843/APX locally interrogates the transponder and powers the green TEST light when the reply is satisfactory. The transponder continues to operate normally while performing this function. It is spring-loaded to ON from this position.

(3) **OUT.** Turns off applicable mode operations.

c. **IDENT/OUT/MIC Switch.** Holding the switch to the IDENT position causes a double mode 1 or mode 3 code train to be transmitted in response to each interrogation. This response will continue for 30 seconds after the switch is released. The switch is spring-loaded to OUT from this position. When the switch is placed in the MIC position and the UHF transmit button is depressed, the response is the same as if the IDENT position had been used. The microphone button need only be depressed momentarily, since the response lasts 30 seconds. The MIC position is not spring-loaded OUT.

d. **TEST Light.** Illuminates whenever the transponder responds correctly to mode 1, 2, 3A, or C test signals. The TEST light incorporates a press-to-test feature and a manual shutter adjustment which dims when the cap is turned clockwise.

e. **RAD TEST/OUT/MON Switch.** A three-position toggle switch with the following operations:

(1) **RAD TEST.** Enables the transponder to reply to interrogations from external ground-test equipment. The switch is spring-loaded for momentary contact in the RAD TEST position and will return to OUT when released.

(2) **MON.** Energizes the circuits in the TS-1843/APX test set. The TEST light will illuminate whenever a signal response to an interrogation occurs with the switch in the MON position. This is the normal position for flight.

(3) **OUT.** Disables RAD TEST and MON test feature of the system. With the switch in the OUT position, the signal response to an interrogation functions; however, the light will not come on.

f. **Code Selector Wheels.** Two sets of thumb-actuated code selector wheels are provided to set mode 1 and mode 3/A code. The set of wheels marked MODE 1 selects 32 two-digit reply codes. The set of wheels marked MODE 3/A selects 4096 four-digit codes. Each wheel is placarded with the digits 0 to 7, which can be seen in the recessed windows on the face of the control panel.

g. **Mode 4.** The remaining switches and indicator lights on the transponder set control are for mode 4 operation and are inoperative. They comprise the following:

(1) MODE 4 control switch.

(2) AUDIO/OUT/LIGHT switch.

(3) CODE select switch.

(4) REPLY light.

MISCELLANEOUS EQUIPMENT

GENERAL

203. Miscellaneous equipment consists of the rear-view mirrors, map and data cases, blind-flying visor, let-down holder, diversion chart, ground safety pin stowage, personal baggage stowage, and FLIP case holder.

REAR-VIEW MIRRORS

204. Four adjustable rear-view mirrors are secured to the forward frame of the canopy to provide rear vision.

MAP AND DATA CASES

205. Two map and data cases are installed to the rear of the right and left consoles. The cases have a hinged cover and may be used for the stowage of maps and flight handbooks.

BLIND-FLYING VISOR

206. A blind-flying visor, which attaches to the helmet for simulated instrument flight, is stored in a location on the right console just forward of the map and data case.

GROUND SAFETY-PIN STOWAGE

207. The ground safety pins are to be stowed as follows:

a. Stow the canopy pin and the ground safety landing gear pins (3) in the right pocket.

b. Stow the external tank pins (2) and the pitot cover in the left pocket.

c. Stow the left- and right-seat safety pins in the brackets provided on the instrument coaming.

PERSONAL BAGGAGE STOWAGE

CAUTION

It is not recommended to place personal luggage or clothing bags in the cockpit or in the electronics bay in the nose of the aircraft. Items of clothing in the cockpit could interfere with the seat ejection sequence and could be hazardous in the event of a canopy loss. Baggage in the electronics bay may interfere with equipment cooling, and there is also the possibility of dislodging wire harnesses.

208. Personal baggage is carried in a compartment in each wing-root fairing. The access panel of each is secured by quick-release fasteners.

LET-DOWN BOOK HOLDER

209. A let-down book holder is installed on the instrument panel shroud to the right of the cockpit centre line. It may be swung out and hinged down for use by either pilot.

DIVERSION CHART

210. A sliding diversion chart is located underneath the shroud below the let-down book holder. It is constructed of two transparent flexible plastic sheets. Reference material can be placed between these sheets and read in position.

LIFT-TRANSDUCER COVER STOWAGE

211. A lift-transducer cover is stowed on the sloping bulkhead to the left of the left seat.

FORCED-LANDING INSTRUCTIONS

212. The forced-landing instructions are stowed in the left map case in the cockpit.

PART 2

NORMAL OPERATING PROCEDURES

SECTION 1

CLEAN CONFIGURATION

(For Aircraft Equipped With External Tanks Refer to Section 2)

GENERAL

1. The following procedures and checks are an expansion of the check list and may include procedures that are not fully detailed in the check list. While the check list is the in-flight reference document, a complete understanding of this manual is critical for the safe operation of the aircraft.

PRE-FLIGHT CHECKS

2. Check the Aircraft Maintenance Record Set for engineering status and ensure that the aircraft has been properly serviced.

PRE-EXTERNAL CHECK

3. Before completing the EXTERNAL CHECK, complete the following.

WARNING

It is possible to insert the safety pin if the ejection handles have been raised slightly from the stowed position, in which case the handles are not, in fact, secured. A red tape on the handles above the level of the leg guards will be visible if this condition exists.

a. Ground safety seat pin installed in right hand-grip of each seat. Ensure that the ground safety canopy jettison pin, and the single safety pin at the top of the canopy remover have been removed by ground personnel.

b. **Seat-pack Release Handle.** Red warning band not visible.

c. **Alternate Canopy Jettison Handle.** Witness wired.

d. **Accelerometer.** Checked, recording pointers do not exceed maximum G limits, third pointer should be indicating 1 G.

e. **Oxygen Quantity.** Sufficient for flight.

f. **Landing-gear Control Lever.** DOWN.

g. **Electrical Switches.** OFF, to include all nav/radio switches, pitot heat, demister, landing/taxi lights, windshield de-ice, landing-gear UP selector override and all centre console switches.

h. **Starter-stop Switch.** Press.

i. **DC Master Switch.** To BATT.

j. **Night Flying.** All lights checked, then OFF.

k. Landing-gear Indicators. Down and locked, no red lights in the handle.

l. **Engine Master Switch.** ON

m. **Airstart Ignition Switches.** Checked. To check the second switch, the engine master switch must be turned OFF then ON again in order to re-arm the system.

n. **Engine Master Switch.** OFF.

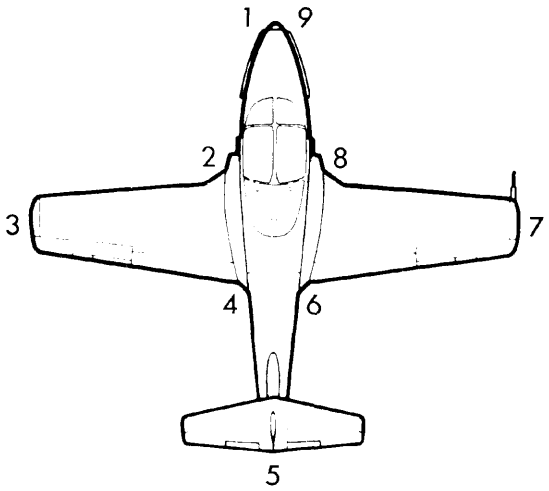
o. **DC Master Switch.** OFF.

p. **Controls.** Unlocked.

4. Carry out pre-flight external checks as in Figure 2-1-1. Ensure that gear safety pins are stowed.

1 NOSE AREA LH

a. Taxi Light, Glide Path Antenna & Ground Observer Light	CONDITION
b. Nose-Wheel Doors	CONDITION & LINKAGE
c. Ground Safety Pin	REMOVED
d. Hydraulic Lines	LEAKS & SECURITY
e. Nose-Wheel Linkage	CONNECTED
f. Tire	INFLATION , SLIPPAGE , & CONDITION
g. Oleo Extension	2¼ INCHES (approximately)
h. Electronics Compartment	PANEL SECURE
i. Static Vents (cockpit Pressure regulator)	CLEAR
j. Cockpit Ram-Air Scoop	PLUG REMOVED, CLEAR
k. Windshield, Canopy and De-Ice Vent	CHECKED
l. Canopy External Jettison Control Panel	SECURE
m. Canopy External Operating Control Panel	SECURE
n. Engine Air Intake	PLUG REMOVED, CLEAR
o. Oxygen Charging Valve Access Panel	SECURE
p. Personal Baggage Stowage	PANEL SECURE
q. Fuselage Access Panel	SECURE
r. Lower Anti-Collision Light	CONDITION
s. TACAN Antenna	CONDITION
t. Marker Beacon Antenna	CONDITION
u. UHF Antenna	CONDITION
w. Fuel-Tank Cavity Vents (6)	CLEAR
x. Fuel Drains (3)	CLEAR
y. Fuel-Tank Drain Panels (2)	SECURE
z. ADF Antenna	CONDITION



2 LH WHEEL WELL

a. Hydraulic Lines	LEAKS & SECURITY
b. Uplock	OPEN
c. Ground Safety Pin	REMOVED
d. Brake Pucks	CONDITION
e. Tire	INFLATION, SLIPPAGE, & CONDITION
f. Oleo Extension	2 INCHES (approximately)
g. Landing Gear Door Switch	CLOSED (DOWN)
h. Doors & Linkage	CONDITION

3 LH WING

a. Landing Light	CONDITION
b. Upper & Lower Wing Surfaces	CONDITION OF SKIN
c. Flux Valve Panel	SECURE
d. Navigation Light	CONDITION
e. Aileron & Tabs	CONDITION & TRAVEL
f. Flap & Hinge	CONDITION

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Figure 2-1-1 (Sheet 1 of 2) Exterior Inspection Diagram

4. LH REAR FUSELAGE

a.	Ground Power Receptacle	GROUND POWER CONNECTED OR PANEL SECURE
b.	Hydraulic Reservoir Panel	SECURE
c.	Bleed Air Exhaust	PLUG REMOVED CLEAR
d.	Generator Cooling Port	PLUG REMOVED CLEAR
e.	Fire Extinguisher Push-In Panel	IN PLACE
f.	Zone-2 Cooling Exhaust	FLAP FREE
g.	Access Panels	SECURE
h.	Speed-Brake Well	BRAKES SECURE LEAKS & SECURITY

5. EMPENNAGE

a.	Horizontal Stabilizer & Elevator	CONDITION OF SKIN
b.	Localizer Antenna	CONDITION
c.	Navigation Light	CONDITION
d.	Rudder	CONDITION OF SKIN, FREEDOM OF MOVE-MENT
e.	Jet Pipe	PLUG REMOVED, CLEAR, CONDITION
f.	Access Panels	SECURE
g.	Elevator Trim	NEUTRAL
h.	Localizer Antenna	CONDITION
i.	VHF Antenna	CONDITION

6. RH REAR FUSELAGE

a.	Speed-Brake Well	BRAKES SECURE, LEAKS & SECURITY, MICROSWITCH FOR CONDITION
b.	Fuel Vent Mast	CLEAR, CONDITION
c.	Zone-2 Cooling Exhaust	FLAP FREE
d.	Access Panels	SECURE
e.	Engine Fuel Drains	CLEAR
f.	Oil Filler Cap Panel	SECURE
g.	Bleed-Air Exhaust	PLUG REMOVED, CLEAR
h.	Cooling-Turbine Exhaust	PLUG REMOVED, CLEAR

7. RH WING

a.	Flap & Hinge	CONDITION
b.	Aileron & Tabs	CONDITION & TRAVEL
c.	Navigation Light	CONDITION
d.	Upper & Lower Wing Surfaces	CONDITION OF SKIN
e.	Pitot-Static Tube	COVER REMOVED, CONDITION
f.	IFF Antenna	CONDITION
g.	Lift Transducer	GUARD REMOVED, CONDITON
h.	Fuel Filler Panel (and cap)	SECURE

8. RH WHEEL WELL

a.	Hydraulic Lines	LEAKS & SECURITY
b.	Uplock	OPEN
c.	Ground Safety Pin	REMOVED
d.	Brake Pucks	CONDITION
e.	Tire	INFLATION, SLIPPAGE, & CONDITION
f.	Oleo Extension	2 INCHES (approximately)
g.	Doors & Linkage	CONDITION

9. RH NOSE AREA

a.	Engine Air Intake	PLUG REMOVED, CLEAR
b.	Personal Baggage Stowage	PANEL SECURE
c.	Fuselage Access Panels	SECURE
d.	Static Vents (cockpit pressure regulator)	CLEAR
e.	Cockpit Ram-Air Scoop	PLUG REMOVED, CLEAR
f.	Electronics Compartment	PANEL SECURE

Figure 2-1-1 (Sheet 2 of 2) Exterior Inspection Diagram

RIGHT SEAT SECURITY FOR SOLO FLIGHT

5. For solo flights, the aircraft is operated from the left seat. Check the right seat as follows:

NOTE

Snowbird aircraft are configured with cross-cockpit modification and can be operated from either seat. The procedures that follow apply to either seat.

a. **Right Handgrip.** Down. Safety Pin. Installed.

b. **Survival Seat-pack.** Removed or secured.

c. **Harness, Oxygen Hose and Radio Cord.** Secure/stowed.

d. **Landing gear Up selector Override Switch.** Normal.

e. Check for general security such as velcro pocket, utility light, etc.

PRE-START

6. After entering the cockpit, proceed as follows:

a. **Kick Step.** Up.

b. Ground safety landing-gear pins (3), external tanks pins (if installed) and pitot head cover shall be stowed.

c. **Parking Brake.** Set as follows:

(1) Apply toe pressure to brake pedals.

WARNING

Do not mistake alternate canopy jettison handle for parking brake handle.

(2) Pull Park Brake handle.

(3) Release brake toe pressure.

(4) Release parking brake handle.

d. **Canopy.** As required. If starting with the canopy OPEN, ensure all objects in the cockpit are secure and cannot be drawn into the engine during start.

CAUTION

Do not place helmet or any other hard objects on the instrument coaming. The windshields are highly susceptible to scratching and marring.

e. Stow helmet, pubs bag, etc. in appropriate locations. A spring clip is provided on each side of the instrument coaming for hanging the helmet while strapping in.

NOTE

When using the spring clip, turn the helmet so that it faces the rear and hang it on the spring clip by the nape strap.

7. Essential steps of the strap-in procedure are illustrated in Figure 2-1-2. Proceed as follows:

a. When the Life Preserver/Survival Vest (LP/SV) is worn, ensure that the inflation mechanism is clear of the lap belt in order to prevent damage to the LP/SV. Route the seat-pack lanyard as follows:

(1) outside right thigh,

(2) over right parachute thigh strap,

(3) to LP/SV lanyard, which is routed under right parachute shoulder strap, see Figure 2-1-2, #5, and

(4) under all seat lap and shoulder straps.

b. When the LP/SV is not worn, route the maritime lanyard as follows:

(1) outside right thigh,

(2) over right parachute thigh strap,

(3) to fastener on right parachute shoulder strap, and

(4) under all seat lap and shoulder straps.

c. Continue as follows:

(1) Tighten parachute leg straps and tuck loose ends under legs,

1. SURVIVAL PACK TO LOWER RIGHT PARACHUTE HARNESS – ATTACH.

2. SURVIVAL PACK TO LOWER LH PARACHUTE HARNESS – ATTACH.

3. SURVIVAL PACK WEB STRAPS – TIGHTEN (RH SHOWN, LH SIMILAR).

4. SURVIVAL PACK WEB STRAP ENDS – TUCK UNDER THIGHS (LH & RH).

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Figure 2-1-2 (Sheet 1 of 7) Strap-in Procedure

5. SURVIVAL PACK LANYARD – ATTACH TO LIFE JACK (WHEN WORN).

6. LEFT SHOULDER HARNESS LOOP – FASTEN ON LAP BELT.

7. LEFT SHOULDER HARNESS AND NEGATIVE G STRAP – ON LAP BELT.

8. LEFT & RIGHT SHOULDER HARNESS & NEGATIVE G STRAP – ON LAP BELT.

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Figure 2-1-2 (Sheet 2 of 7) Strap-in Procedure

9. PARACHUTE ARMING CABLE & KEY – ROUTE UNDER SHOULDER HARNESS.

9A. PARACHUTE ARMING CABLE & KEY – ON LAP BELT.

9B. LAP BELT – PARACHUTE ARMING CABLE & KEY, RIGHT SHOULDER HARNESS & NEGATIVE G STRAP & LEFT SHOULDER HARNESS READY FOR CONNECTION.

10. LAP BELT – PRESS LAP BELT FITTING TOGETHER UNTIL CLICK IS HEARD.

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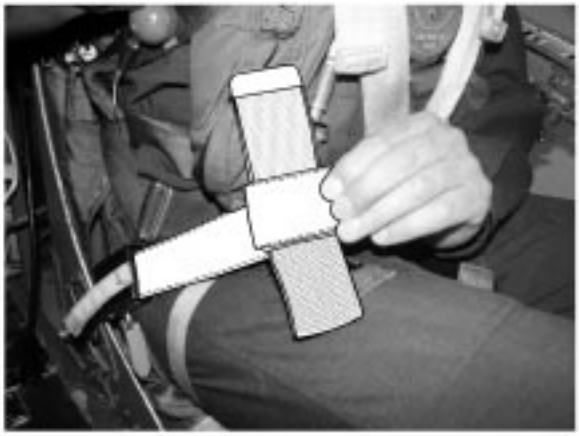
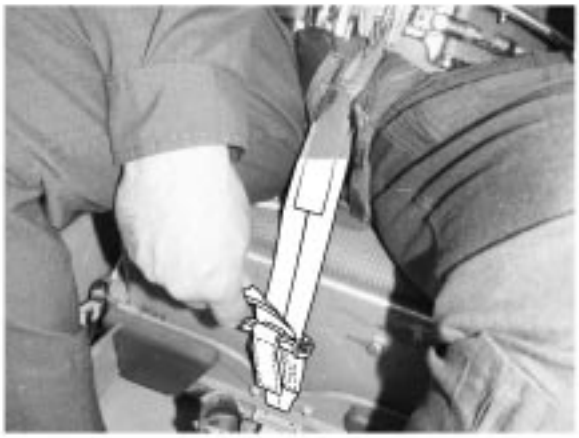
Figure 2-1-2 (Sheet 3 of 7) Strap-in Procedure

11. LAP BELT – POSITION AND TIGHTEN.



11A. LAP BELT – ONCE ADJUSTED, VELCRO IN PLACE (RH SHOWN, LH SIMILAR).

11B. LAP BELT – COMPLETE.



12. NEGATIVE G STRAP – LEAN FORWARD, SNUG UP AND FASTEN VELCRO.

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Figure 2-1-2 (Sheet 4 of 7) Strap-in Procedure

13. SHOULDER HARNESS – ADJUST.

13A. SHOULDER HARNESS – ADJUST UNTIL YOKE TOUCHES THE BACK OF THE NECK.

14. OXYGEN HOSE – ATTACH TO LAP BELT DOT CONNECTOR.

15. OXYGEN-MASK HOSE – CONNECT TO SEAT OXYGEN HOSE.

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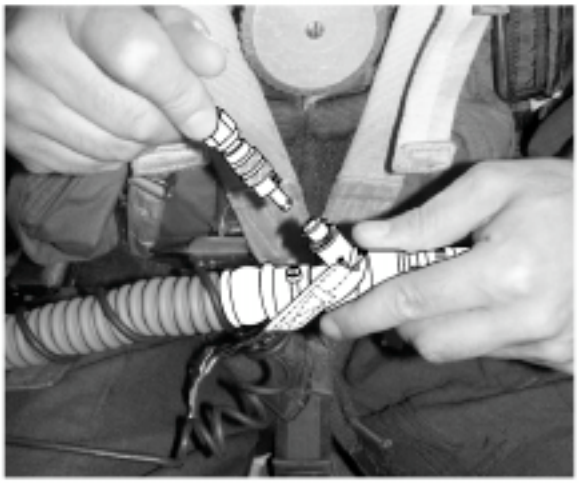
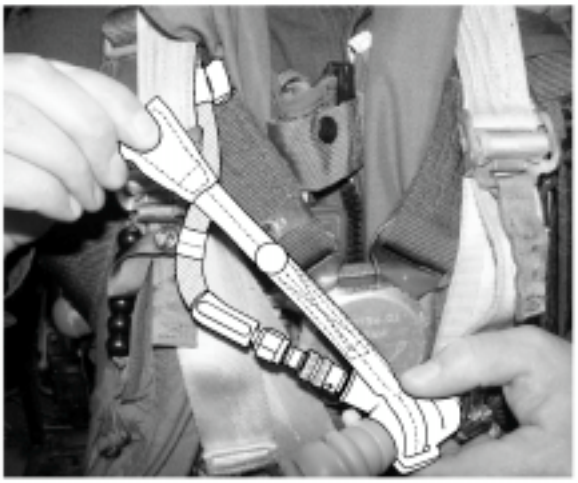
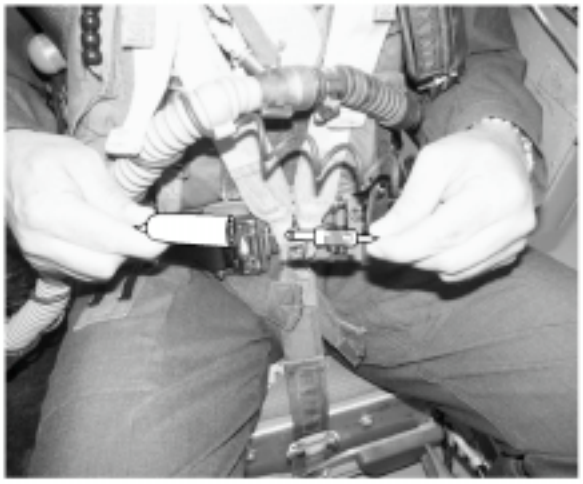
Figure 2-1-2 (Sheet 5 of 7) Strap-in Procedure



16. EMERGENCY OXYGEN BOTTLE HOSE – ROUTE UNDER RIGHT SHOULDER HARNESS STRAP AND CONNECT TO MC3M CONNECTOR.



17. OXYGEN MASK HOSE RETAINING STRAP – CONNECT TO PARACHUTE HARNESS SNAP FASTENER, AND PLACE EMERCENCY OXYGEN HOSE UNDER RIGHT SHOULDER STRAP.



18. MIC-CORD – CONNECT.

19. HELMET CHIN STRAP – FASTEN.

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Figure 2-1-2 (Sheet 6 of 7) Strap-in Procedure

20. OXYGEN MASK – ADJUST TO FIT FACE.

21. STRAP-IN COMPLETE.

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Figure 2-1-2 (Sheet 7 of 7) Strap-in Procedure

(2) Attach the seat-pack airlock fasteners to the parachute harness clips, tighten the straps, and tuck ends under thighs, see Figure 2-1-2, #1 through 4.

WARNING

Do not open the lap belt manually before or during ejection. If the lap belt is opened manually, the automatic opening feature of the parachute is eliminated, and seat-man separation may be rapid at high speeds.

(3) Position the left shoulder harness strap loop onto the left lap belt buckle tongue first followed by the negative ″G″ strap and then the right shoulder strap loop, see Figure 2-1-2 #8,

(4) Route the parachute-arming cable and key under the shoulder harness and place arming cable key with the pins facing away from the buckle onto the lap belt buckle tongue, see Figure 2-1-2 #9A,

(5) Fasten the lap belts together until a click is heard and visually check the Locking Cam Gap, perform a Locking Cam Gap Check, see Figure 2-1-3,

(6) To ensure the lap belt is fully locked, perform the Free Play (Push Past) Check, see Figure 2-1-4,

(7) Centre and tighten the lap belt and stow ends using Velcro, see Figure 2-1-2 #11B,

(8) Lean forward and tighten negative ″G″ strap; fasten the strap to Velcro, see Figure 2-1-2 #12,

(9) With the shoulder harnes unlocked, lean backwards until head touches the headrest and adjust the shoulder straps until the yoke of the harness rests against the nape of the neck, see Figure 2-1-2 #13 and 13A,

(10) Attach the seat oxygen hose to the post on the lap belt with the fastener smooth face up, and the oxygen hose quick-disconnect to the oxygen mask hose quick-disconnect, see Figure 2-1-2 #14 and 15,

(11) Connect the emergency oxygen bottle hose to the oxygen quick-disconnect. Ensure that the emergency oxygen bottle hose comes out between the seat shoulder harness. Connect the oxygen mask hose retaining strap to the parachute harness, see Figure 2-1-2 #16 and 17,

d. Connect the intercom lead, see Figure 2-1-2 #18.

e. Don helmet, adjust mask, fasten chin strap, see Figure 2-1-2 #19 and 20.

f. **Rudder Pedals.** Adjust.

g. **Flight Controls.** Check for free and proper movement and ensure that the spring tabs are deflected opposite the aileron travel.

h. **Speed Brake Switches.** OFF.

i. **LH Throttle.** CUT OFF.

j. **Flap Lever.** DOWN.

k. **External Power.** Connected if APU start is to be used.

l. **DC Master Switch.** GRD PWR or BATT.

m. **No. 1 Inverter.** ON.

n. **Intercom.** As required.

o. **Anti-collision Lights.** ON.

p. **Air-Conditioning & Cockpit Temperature Control.** Set AUTO and temperature rheostat adjusted to between 11 and 12 o'clock position, do not re-adjust until airborne.

q. **Dump Switch.** Normal.

r. **Circuit-breakers.** In.

s. **Fire and Overheat Warning System.** Press to test. MASTER CAUTION, MASTER WARNING, FIRE and both AIRFRAME O/HEAT lights should all illuminate; a system malfunction is indicated if they do not.

t. **Annunciator Panel Test.** All annunciator panel lights, both master lights, both lights in landing-gear handle, RH landing-gear unsafe light and audio horn serviceable.

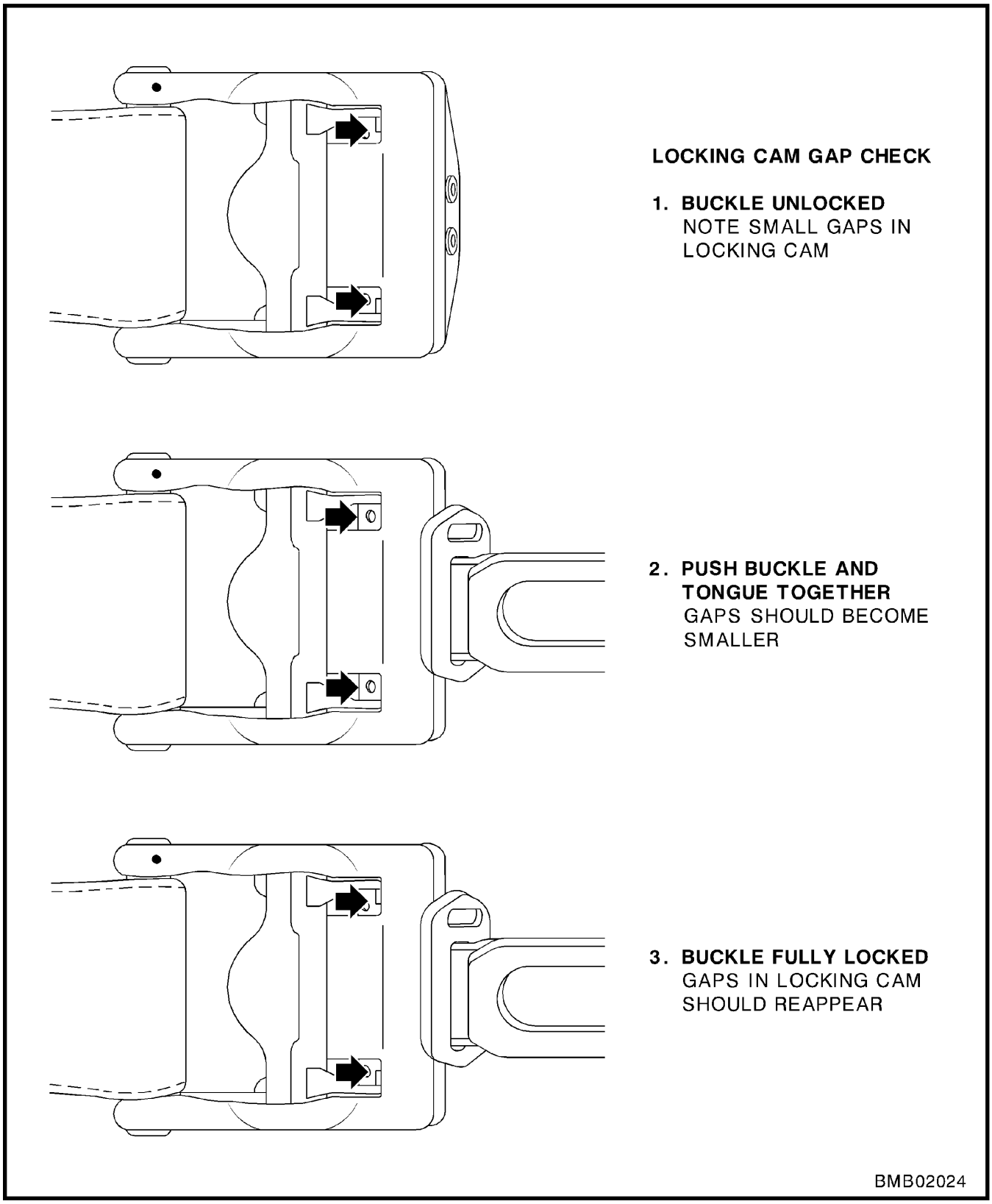
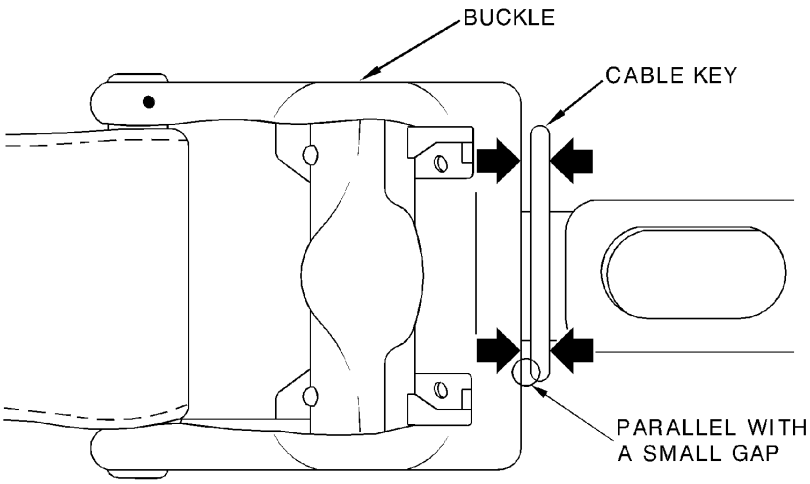


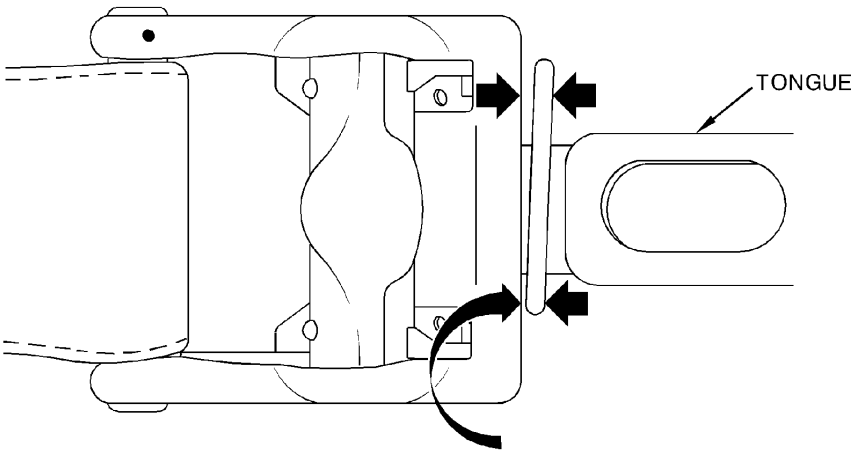
Figure 2-1-3 HBU-12/B Lap Belt Lock Check



PARACHUTE ARMING
CABLE KEY SHOULD
BE NEARLY PARALLEL
WITH BUCKLE

BUCKLE FULLY LOCKED

KEY DOES NOT NEED TO BE PARALLEL



GAP SHOULD
BECOME SMALLER

PUSH BUCKLE AND TONGUE TOGETHER

BMB02025

Figure 2-1-4 HBU-12/B Free Play (Push Past) Check

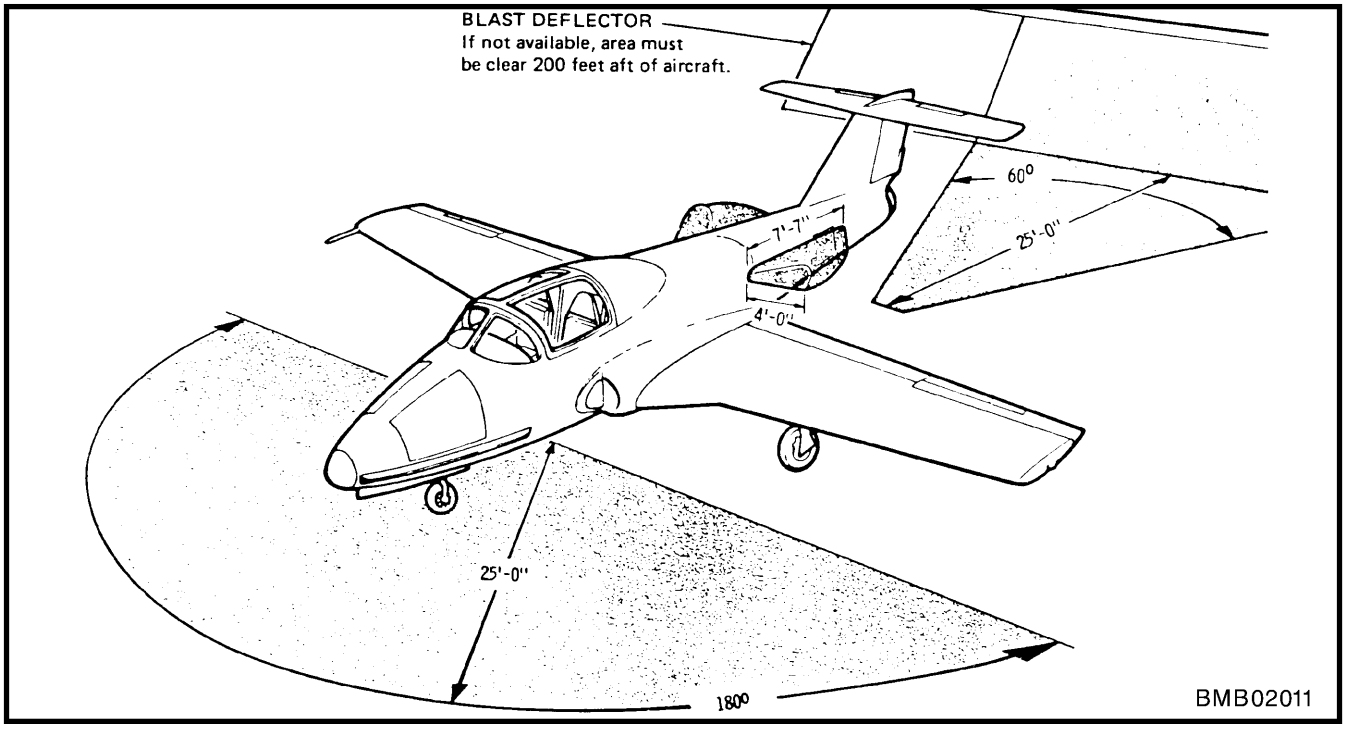


Figure 2-1-5 Danger Areas

MANAGEMENT OF FUEL SYSTEM

8. After the engine master switch has been placed to ON before engine start, management of the fuel system consists of monitoring the fuel contents and LOW FUEL PRESS indication.

NOTE

The engine master switch must never be placed in the OFF position during flight, except when necessary to perform an internal relight (refer to Part 3).

STARTING PROCEDURES

WARNING

Before engine start, ensure that danger areas fore and aft of aircraft (Figure 2-1-5) are clear of personnel and vehicles, etc.

9. Start engines in accordance with Figure 2-1-6.

ENGINE RUN-DOWN (ON GROUND)

WARNING

Do not fly the aircraft until the cause of the run-down is determined and rectified.

10. During ground operations a high OAT, a tail wind, a low battery, or an MFCU malfunction may overload the power output of the engine, causing the RPM to drop below normal ground idle limits. The RPM drop is accompanied by a rise in EGT, which may exceed engine limitations if corrective action is not immediate. For proper corrective action refer to Part 3, Section 1, Paragraph 14.

FAILURE TO LIGHT UP

11. Failure of the engine to light up is normally indicated by no rise in EGT. If engine does not light up within five seconds, proceed as follows:

a. Place throttle lever to CUT OFF immediately.

STARTING PROCEDURES

WARNING

Before engine start, ensure that danger areas fore and aft of aircraft (Figure 2-1-5) are clear of personnel and vehicles, etc.

CAUTION

Whenever possible, start engine with aircraft headed into wind as EGT is increased by tail winds.

CAUTION

The start cycle must be completed with the initial source of power selected (battery or ground power). In the event this is not possible, press STARTER STOP button and carry out proper shutdown procedures.

ACTION	CHECK	NOTES
1. Start engine by use of ground power (28-volt, 1000-amp hard start) or internal aircraft battery.		The use of a GPU with output in excess of 1000 amps may result in a sheared generator shaft.
2. Place engine master switch ON.	Ensure that FUEL LOW PRESS legend goes out.	Do not operate engine without positive indication of fuel boost pressure.
3. Momentarily engage the engine start switch to START.	Ensure audible indication of engine rotation or ensure tachometer readings within five seconds.	Press starter-stop switch immediately if rotation is not indicated by either method, and have the cause investigated.
4. When RPM has reached 7 to 9% for battery start or 10 to 12% (GPU), advance throttle to IDLE & START position.	a. Light off and indication of EGT should occur within five seconds.	If light off is not attained within five seconds, shut down the aircraft and carry out Failure to Light Up procedure. **CAUTION** EGT may rise rapidly on start. If EGT climbs rapidly through 850°C, ABORT start.

Figure 2-1-6 (Sheet 1 of 4) Starting Procedures

ACTION	CHECK	NOTES
	b. Starter motor disengagement occurs at approximately 35% RPM during a GPU start and 45% RPM during a battery start. In AUP aircraft, this will be indicated by the GENERATOR FAIL legend flickering at the applicable percentage (GENERATOR FAIL will be illuminated during the start sequence). In non AUP aircraft, the GENERATOR FAIL legend will not be illuminated until approximately 35% RPM.	If GENERATOR FAIL legend does not flicker at the appropriate RPM percentage, press STARTER STOP switch prior to attaining idle RPM and place aircraft unserviceable. In non AUP aircraft, if GENERATOR FAIL legend does not illuminate at 35% RPM, press STARTER STOP switch prior to attaining idle RPM and place aircraft unserviceable.
	c. Ensure that the BLEED VALVE CLOSED legend is extinguished at approximately 50% RPM.	During ground running, failure of Zone 2 cooling is indicated by illumination of the BLEED VALVE CLOSED legend and flashing of the MASTER CAUTION light.
	d. The maximum time from initiation of start sequence (throttle moved to IDLE and START position) until idle RPM is reached may vary from 48 seconds at –40 °C, 35 seconds at 10 °C, and 44 seconds at 40 °C.	If the engine is slow to reach idle RPM, it may indicate a faulty fuel system and the aircraft should be placed unserviceable.
5. When RPM approaches idle, advance throttle lever to 58% RPM minimum.		Maintain 58% RPM during initial recharging of aircraft batteries.
6. Check EGT reading.	Ensure that the time/temperature limits in CAUTION are not exceeded.	All EGT readings in excess of 800 °C shall be recorded for further maintenance background information.

Figure 2-1-6 (Sheet 2 of 4) Starting Procedures

ACTION	CHECK	NOTES
		CAUTION Exceeding limits listed below, during air or ground operations, renders aircraft unserviceable. Start – 900 °C – Abort – 850 °C for 5 sec – Abort – 780 °C for 10 sec – Abort Running – 700 °C – 5 min after takeoff – 675 °C – Cont See Part 4, Figure 4-25.
7. Check oil pressure.	Ensure that oil pressure indication is normal – 5 psi minimum.	
8. Check hydraulic pressure indication.	Ensure that hydraulic pressure stabilizes at 1400 to 1625 psi.	Do not operate hydraulic services until engine RPM has stabilized at IDLE RPM or higher.
9. Check Zone 2 cooling is operating.	Check Zone 2 cooling legend is not illuminated.	
10. Place DC master switch from GRD PWR to BATT position; press starter-stop switch.		
11. Position No. 2 inverter ON.		
12. Disconnect external power.		
13. Check GENERATOR FAIL legend is out.	If required, re-set generator.	
14. Check loadmeter for normal reading.	Loadmeter may read high initially.	

Figure 2-1-6 (Sheet 3 of 4) Starting Procedures

ACTION	CHECK	NOTES
15. Position generator control switch to TRIP.	a. Check if electrical services are still available and that the loadmeter reads zero. b. Check that the GENERATOR FAIL legend is illuminated.	If they are not available, carry out shutdown procedures and place aircraft unserviceable.
16. Position generator control switch to RESET.	Check that the GENERATOR FAIL legend is out.	
17. Check loadmeter for normal reading.	If RPM is maintained above 58%, or if the loadmeter drops below 0.5, selection of all electrical equipment is allowed.	1. If the loadmeter does not fall to the normal range within five minutes, the aircraft should be shutdown and placed unserviceable. 2. A high loadmeter may cause the engine RPM to fall below normal idle; take corrective action for engine rundown. 3. If a battery start was accomplished, a high loadmeter reading will occur.
18. Select INV1 switch to the OFF position.	Check that all aircraft services are functioning (No. 2 inverter should pick up the load within 3 seconds). MASTER CAUTION light and INVERTER 1 FAIL legend illuminate, INVERTER 2 FAIL legend may illuminate momentarily.	
19. Select INV1 switch to the ON position.	Check that MASTER CAUTION light and INVERTER 1 FAIL legend extinguish.	
20. When loadmeter reading has decreased to 0.5 or less, allow RPM to stabilize with throttle lever at IDLE & START position.		

Figure 2-1-6 (Sheet 4 of 4) Starting Procedures

b. Allow start cycle to continue for 25 seconds, then press the starter-stop switch and investigate.

c. Do not attempt another start, unless the cause of the failure to light up is known.

d. Before the second start attempt, allow a one-minute cooling period.

e. After an additional one-minute cooling period, attempt second start.

f. If second attempt fails, follow procedures outlined in Steps a and b, and make the necessary entries in the Aircraft Maintenance Record Set.

GROUND CRANK

12. In the event that ground cranking is necessary, follow the same procedure as during a normal start, but do not move the throttle from the CUT OFF position.

a. **DC Master Switch.** GRD PWR.

b. **Throttle Lever.** CUT OFF.

c. **Engine Master Switch.** ON.

d. Momentarily engage engine start switch to START.

e. Allow the engine to rotate for the required time, then press the starter-stop switch.

f. Turn off the engine master and DC master switches when RPM reaches zero.

HOT START

13. During a hot start, the EGT increases very rapidly and will exceed the limits if the start is not discontinued in time. A hot start occurs usually at the time of initial combustion or between 30% and 36% RPM. By keeping a close check of EGT, the pilot is able to anticipate a hot-start condition and discontinue it before the temperature limits are exceeded. If, during the normal starting sequence, the temperature limits are, or will be, exceeded, proceed as follows:

a. Place throttle lever to CUT OFF immediately.

b. Allow starter to continue turning to assist in purging excess fuel from the combustion and exhaust sections.

c. Twenty-five seconds after placing throttle lever to CUT OFF, press starter-stop switch to de-energize the starting cycle.

d. Place engine master switch to OFF.

e. Place DC master switch to OFF.

f. If the EGT reached or exceeded 900 °C, do not attempt another start. If the start was aborted in time and EGT did not reach 900 °C, a second start may be attempted, provided that the cause of the near-hot start is determined and rectified.

NOTE

If hot start occurs after 35%, the engine master must be turned OFF, then ON, and the start switch engaged before the engine will commence ground cranking.

HANG-UP ON START

14. If the engine lights up normally, but the RPM hangs up at a value below idle, proceed as follows:

a. Place throttle to CUT OFF.

b. Press starter-stop switch.

c. Do not attempt another start. Place the aircraft unserviceable.

PRE-TAXI

15. Before taxiing, complete the following checks:

CAUTION

Care should be taken to secure any loose article prior to taxi in order to prevent accidental engine FOD.

a. **Speed Brakes.** Select IN (on ground crew signal). Switches are selected OFF.

b. **Flaps.** Check operation and select TAKE-OFF FLAP (25°) (on ground crew signal).

c. **Seat Safety Pins.** Removed and stowed.

d. **Chocks.** Removed.

e. **Marker Beacons.** ON.

f. **VOR/ILS.** PWR.

g. **TACAN.** T/R.

h. **Fuel Control Panel Lights.** Press to test.

i. **Intercom Control Panel and Audio Selectors.** As required.

j. **UHF/VHF and Transponder.** ON.

k. **Standby Compass, Cockpit and Navigation Lights.** As required.

l. **Circuit-breakers.** In.

m. **Utility Light.** Stowed.

n. **Alternate Trim Switches.** Operation checked. Guarded – NORMAL.

o. **Normal Trim.** Checked and set for take off.

p. **Hydraulic Hand Pump Handle.** Stowed.

q. **Stall-warning Test Switch.** Depress.

r. **Canopy & Windshield Demist.** OFF.

s. **Windshield De-ice.** OFF.

t. **Landing and Taxi Lights.** OFF.

u. **Pitot and Stall-warning Heat.** Checked on loadmeter.

v. **Emergency Landing-gear Selection Handle.** IN (red band not visible).

w. **Seat Height.** Adjusted.

x. **Landing-gear Indication.** Down and locked.

y. **UHF Channel Selector.** As required.

z. **LH Flight Instruments.** Checked. Ensure the following:

(1) **ASI.** Less than 50 KIAS – normally 30-40 KIAS.

(2) **Altimeter.** Set to known field elevation.

(3) **DRMI.** Checked against standby compass (±8°).

aa. **Clock.** Checked.

ab. **Standby Compass.** Checked (valid only with canopy closed).

ac. **Accelerometer.** Checked.

ad. **Fuel Quantity Indicator.** Checked; press to test.

ae. **Oxygen Quantity.** Checked.

af. **LH Oxygen Regulator.** Checked; then as required.

ag. **RH Oxygen Regulator.** Checked; then as required.

ah. **Cockpit Altimeter.** Checked.

ai. **RH Flight Instruments.** Checked.

aj. **Landing-gear Unsafe Warning Light.** Out.

ak. **Landing-gear Up-selection Override Switch.** NORMAL.

al. **Utility Light.** Stowed.

am. **VOR/ILS-TACAN Selector Switch.** VOR/ILS.

an. **ILS.** Checked.

ao. **Track Selector Switch.** As required.

ap. **VOR.** Checked.

aq. **VOR/ILS-TACAN Selector Switch.** TACAN.

ar. **TACAN.** Checked.

as. **Taxi Clearance, Altimeter and Clock.** Set.

at. **Altimeter.** Check as follows:

(1) Set station altimeter setting, using baro-setting knob.

(2) The indicated altitude is ±50 feet of field elevation (in STBY mode).

(3) Note the indicated altitude.

(4) Select RESET.

(5) **STBY Flag.** Disappears.

(6) The indicated elevation is ±50 feet of field elevation.

(7) The total altitude difference between servo and STBY modes is 75 feet or less.

NOTE

Maximum allowable altitude discrepancy between LH and RH altimeters in servo mode is 40 feet.

au. **Taxi Light.** As required.

av. **Night Flying.** Landing lights. Checked.

aw. **Canopy.** As required.

NOTES

1. No engine warm-up is required. If oil pressure is within limits, the aircraft is ready for taxiing (refer to Paragraph 78).

2. Prolonged engine operation at idle can cause overheating of the aft compressor section and engine, thus increasing the potential for a ground acceleration stall. A ten-minute interval at idle RPM should be followed by a two-minute cool-down period at 70% RPM.

TAXIING

GENERAL

CAUTION

To release the parking brake, apply light toe pressure to the brake pedals, check visually to see if the parking brake handle is in fully, then release the brake toe pressure. If the parking brake handle is not in fully, and/or the parking brakes do not release, the aircraft is unserviceable.

CAUTION

Use nose-wheel steering for all small radius turns to prevent the nose-wheel scissors from coming in contact with, and damaging, the nose-wheel doors.

CAUTION

Taxiing with the canopy open is permissible over smooth surfaces. Assuming a walking pace taxi speed, the total wind factor affecting the canopy, including wind gusts, must not exceed 30 KIAS.

16. To begin taxiing, engage the nose-wheel steering, then, while holding the brakes on, advance the power to between 60% and 70% RPM. Release the brakes and, as the desired taxi speed is approached, reduce the power to idle and turn onto the taxi route. Nose-wheel steering or differential braking are used for directional control, while wheel brakes and power are used to control taxi speed. Use nose-wheel steering at least once prior to take-off; otherwise, the system may develop a shimmy during the take-off roll.

NOTE

Avoid riding or excessive use of brakes to prevent overheating and unnecessary wear.

17. When taxiing at night, use the taxi light to illuminate the path of the aircraft.

TAXI CHECK

18. Check flight instruments in accordance with the current ‘‘Manual of Instrument Flying’’.

TAKE-OFF PROCEDURE

PRE-TAKE-OFF CHECK

19. Before take-off, complete the following check:

H	Hydraulics	1400 to 1625 PSI
	Harness	Tight and locked
	Pin(s)	Removed
	Autochute	Connected
	QRB	Locked
	Seat-pack lanyard	Connected
	Oxygen assembly	Connections
	Chin strap	Fastened
	Visor	Lowered
T	Trims	Set for take-off
	Tension	As required
F	Fuel	Sufficient for flight
	Flaps	Take-off (25°)
	Flight controls	Free and proper movement
S	Switches:	
	Speed brakes	OFF
	Pitot heat	ON
	Nav aids	As required
	DC master switch	BATT
	Fuel selector	OFF
	UHF/VHF, transponder	As required
O	Oxygen	
	Pressure	
	Contents (sufficient for flight)	
C	Canopy	Closed, line out, white indicator lines aligned

LINE-UP

20. Use nose-wheel steering to line up the aircraft. Before beginning the take-off roll, release the nose-wheel steering.

ENGINE CHECK

21. When lined up on the runway, hold the aircraft with sufficient toe pressure on the brake pedals to prevent aircraft movement. Advance the throttle smoothly to MAX CONT while checking visually for aircraft movement. If movement is detected, increase the brake pressure sufficiently to stop the aircraft and check the following:

a. **Compasses.** Check. (DRMI indication must be within ±3° and the standby compass within ±5° of actual runway heading.)

b. **Localizer.** Checked.

c. **RPM.** 100% (±1%), corrected for temperature (see Figure 2-1-10).

d. **EGT.** Maximum 700 °C. Minimum 640 °C at 15 °C; 560 °C at –40 °C.

e. Oil pressure:

(1) minimum – Datum –10 psi, and

(2) maximum – see NOTE.

NOTE

Take-off is permissible with an oil pressure reading greater than datum oil pressure +10 PSI. However, 5 minutes after take-off the oil pressure must be checked at MAX CONT, and it must read datum oil pressure ±10 psi (refer to Paragraph 78).

f. **Annunciator Panel.** All legends extinguished.

g. **Loadmeter.** Not above 0.5, not at or below 0.1.

h. **Landing Lights.** On.

NOTES

1. Runway conditions may prevent holding the aircraft stationary while full power is applied (refer to Paragraph 22, Step b).

2. **Bodie Stall.** A compressor stall can be induced if, during deceleration from 100% to idle power, the RPM is not allowed to stabilize for 20 seconds at idle RPM prior to attempted re-acceleration to MAX CONT. The stall can be expected to occur between idle and 60% RPM.

TAKE-OFF

22. The two following take-off procedures may be used:

a. **MAX CONT Power, Wheel Brakes On.** Upon releasing the brakes, be careful to correct any tendency of the aircraft to swing because of a brake failing to release or releasing too slowly. Maintain directional control during the initial stage of the take-off run by use of the differential brakes until the rudder control becomes effective at approximately 40 KIAS.

b. **MAX CONT Power Applied During Take-Off Roll.** With this technique, directional control is maintained by use of differential braking as power is applied, and during the initial stage of the take-off run. At approximately 40 KIAS, directional control is transferred from the brakes to the rudder.

23. As the airspeed approaches 70 KIAS, apply a gradual back pressure on the control column until the nose wheel is just off the ground. Maintaining this attitude, the aircraft will become airborne at approximately 95 KIAS. For take-off distance and critical field length, refer to Part 4, Paragraph 31.

POST-TAKE-OFF CHECK

24. When airborne, proceed as follows:

a. **Landing-gear.** UP. Indicate. UP. Warning lights. Out.

b. **Flaps.** UP (110 KIAS). Indicate. UP.

c. **Speed Brakes.** IN switches OFF.

NOTE

For recommended climb speeds, refer to Part 4, Paragraph 35.

CLIMB AND LEVEL OFF CHECK

25. Proceed as follows:

a. **Cabin Pressure.** Check.

b. **Oxygen.** Check.

c. **Altimeter.** Check.

d. **Engine instruments.** Check.

e. **Landing Lights.** Off.

f. **After Level-off.** Check altimeter standby mode and select RESET.

FLYING CHARACTERISTICS

TRIM CHANGES

26. The trim change due to lowering or raising the landing-gear or changing power is slight. Lowering or raising flaps produces a noticeable nose-down or nose-up trim change. There is little directional trim change over the speed range of the aircraft if the fixed rudder tab is adjusted properly on the ground. Elevator trim tab is very effective at high speed and should be used carefully. However, elevator trim tab effectiveness is reduced considerably at low speeds, particularly with land flaps selected down.

27. When the speed brakes are extended, a nose-up trim change occurs; when the speed brakes are retracted, a nose-down trim change occurs. This trim change is barely noticeable at low airspeeds, but is pronounced at higher speeds.

28. The elevator and aileron normal trim switch on the control column is designed to return the neutral position automatically when thumb pressure is released after actuating the switch. However, it is possible for the normal trim switch to remain in the actuated position, which causes an overtrim condition. To preclude such a possibility, return the trim to the neutral position after each actuation.

29. Use electrically operated trim tabs with caution, especially at high speeds. Malfunction of the normal trim switch may be compensated for by use of the alternate trim switches located on the left console.

SPEED BRAKES

30. No speed restrictions are imposed on the operation of speed brakes.

PRE-STALL, SPIN, AEROBATIC CHECK

31. Proceed as follows:

a. **Fuel.** Contents.

b. **Hydraulics.** Pressure.

c. **Harness.** Tight and locked.

d. **Configuration.** Clean.

e. **Altitude.** As required.

f. **Loose Articles.** Stowed.

g. **Locality.** Suitable, clear of cloud, good horizon.

h. **Look-out.** Other aircraft.

STALLS

32. At the stall, there is little noticeable warning by natural buffet due to the horizontal stabilizer's position above the turbulence of the wing airflow. The stall-warning unit provides this indication artificially by imparting a vibration to the control column at speeds ten per cent or less above stalling speed. This warning margin may decrease with altitude and G.

33. Aircraft behaviour at the stall is gentle, and recovery is quickly accomplished with minimum loss of altitude, by easing the control column forward and applying full power. Aileron control remains effective until the aircraft is fully stalled.

34. Accelerated stalls in turns are accompanied by heavy buffeting. Recovery is immediate upon release of the control column backward pressure. For normal stalling speeds, see Figure 2-1-7.

SPINS

35. If the aircraft enters an unrecognized condition of flight, regardless of the position of the controls at the moment of entry, centralize the controls.

36. Hold controls in the central position until a recognized attitude or flight condition is established, from which proper recovery action can be initiated. To effect centralization of the elevator control surfaces, hold the control column approximately in the 2/3 forward position.

NOTE

Once recovery control inputs are established, they must be maintained long enough for control effectiveness to produce results.

SPIN RECOVERY

37. Spin recovery procedure is as follows:

a. Centralize (the controls).

b. Analyze (determine the direction of spin).

c. **Throttle.** Idle.

d. If time permits, attempt to regain clean configuration.

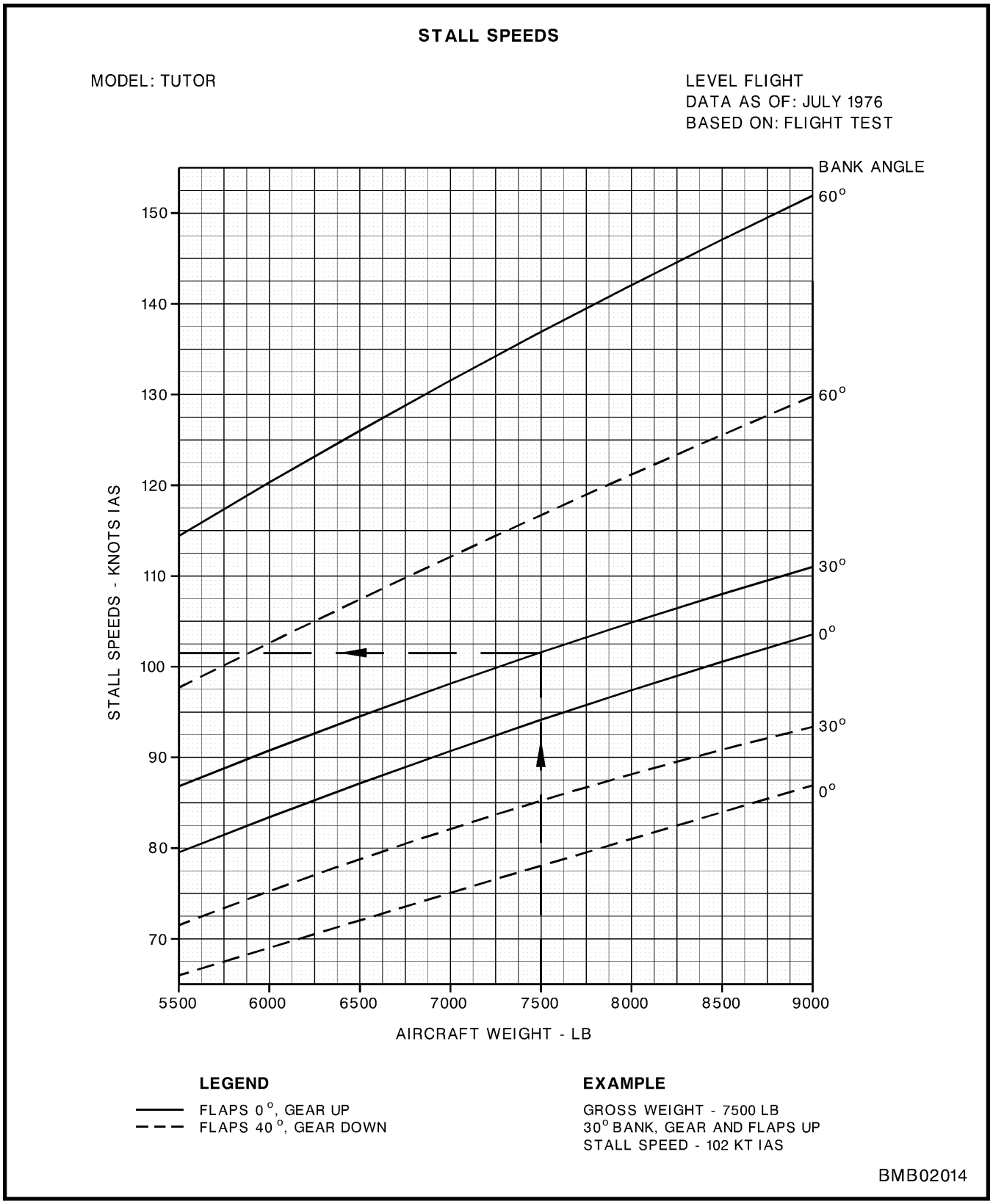


Figure 2-1-7 Stall Speed Chart – Aircraft With or Without Pylons or Tanks

e. Apply progressive rudder opposite to the turn pointer.

f. When spinning stops, centralize the controls.

g. Recover the aircraft to normal flight.

TUMBLING AND INVERTED SPINS

38. A tail slide, or an excessive yaw at low speed in vertical flight, can develop into a tumble or other uncontrolled manoeuvre. The unusual gyrations that accompany these flight attitudes may disorient the pilot to such an extent that the best recommended recovery action is to centralize the controls until the aircraft adopts a recognizable attitude. Almost invariably this will be an upright or inverted spin, and recovery to a normal flight attitude may then be made by using the conventional spin recovery procedure. Inverted spin recovery, if anything, is faster than that for an upright spin. The time interval between tumble and recognizable attitude is usually momentary, but the negative weight factors involved, in the tumble and/or the resultant inverted spin, make structural failure a possibility.

NOTE

The most positive indication of the spin mode is G-force; if POSITIVE, the aircraft is in an upright spin, if NEGATIVE, the aircraft is inverted.

LANDING CONFIGURATION

WARNING

If recovery from an unrecognizable condition of flight or spin is not completed by 7000 feet AGL – eject.

39. Use normal recovery procedure if the aircraft enters a spin inadvertently while in a landing configuration. If gear and flap retraction is not fully completed, clean up the aircraft as soon as possible after recovery to prevent excessive structural loads and possible damage.

DIVES

40. For altitude loss during dive recovery, see Figure 4-26.

SPIRAL DIVES

41. The characteristics of a spiral dive include bank, increasing airspeed, and a low nose attitude in which the nose may drop to a steeper angle below the horizon. With the increasing nose angle, increasing airspeed and G are inherent dangers. As the turn tightens, higher G-forces will be reached, and the pilot will be affected physiologically if he does not take immediate corrective action.

SPIRAL-DIVE RECOVERY

42. The spiral-dive recovery procedure is as follows:

a. **Throttle.** Idle.

b. Roll the wings level (watch rolling G-limit; may have to unload before rolling wings level).

c. **Speed brakes.** Out.

d. Ease out of the dive.

e. Confirm your attitude (you may be disoriented).

f. Check instruments.

UNUSUAL CHARACTERISTICS – RUDDER LOCK

43. Rudder lock can occur if excessive yaw is applied in the flaps down, speed brakes out configuration, particularly at aft CG limits and higher airspeeds. As rudder deflection and side-slip angle increase, a side-slip angle is reached where the rudder-pedal force begins to lighten and the rudder may float unaided to the extreme limit of its travel. The aircraft has entered a self-sustained side-slip (rudder lock) condition, requiring opposite rudder-pedal force (approximately 30 – 50 pounds) to correct. This will occur while speed brakes are out and flaps are fully or partially down. With the speed brakes in, it will not occur.

NOTE

The aircraft has experienced rudder lock in configurations and at airspeeds other than those listed in Paragraph 43.

COMPRESSOR STALL

MECHANICS OF COMPRESSOR STALL

44. A compressor stall results from an interruption of airflow or from an unstable air condition existing within the engine. In normal operation, there is a smooth flow of air through the areas between the rotor blades and stator vanes which are of aerofoil design. The pressure is gradually increased through

each stage of the compressor. As long as the change in compression ratio is not too great between successive stages of the compressor, air will flow smoothly over the aerofoils.

45. If the pressure differential becomes excessive across any stage of the compressor, the velocity of the air over the low-pressure side of the blades is decreased, and the effect is the same as an aircraft wing in a stalled condition. The airflow becomes turbulent, compression is reduced, and abnormal stresses occur. A stall in one stage of the compressor contributes to stalling of other stages. Quite often, the stall will be limited to only a few blades, in which case it will be very mild. If several stages are involved, the air will pile up in the rear stages, and the stall becomes severe.

INDICATIONS OF COMPRESSOR STALL

46. A compressor stall is usually accompanied by a thump or rumble, a rapid rise in exhaust-gas temperature, a loss of thrust, rapid reduction or fluctuation of RPM to the 65 to 80% range, and failure of RPM to increase when the throttle is advanced. Fortunately, if the throttle is closed to IDLE, all of these abnormal conditions usually disappear.

CAUSES OF COMPRESSOR STALL

47. An excessive pressure ratio across the compressor can be caused by a restriction at the compressor discharge or by a sudden drop in pressure at the compressor inlet. The most common causes of compressor stalls are as follows:

a. **Improper Fuel Scheduling.** A malfunctioning main fuel control can cause an excessive fuel flow into the combustion chamber and a resultant rich fuel-air mixture. This results in a build up of combustion pressure and an increase in compressor discharge pressure beyond what it should be for existing compressor speed. This situation may cause a compressor ratio which cannot be provided by the compressor at its speed, and the compressor may therefore stall. Since the throttle is one input to the main fuel control for fuel scheduling, rapid throttle increases can aggravate the situation just described. A compressor stall could also be induced if, during deceleration from 100% to idle power, the RPM is not allowed to stabilize prior to attempted re-acceleration to 100%. The stall can be expected to occur between idle and 60% RPM. This occurrence is commonly called a Bodie Stall.

b. **Restriction of Air Inlet.** The following conditions may cause reductions or distortions of inlet air, which in turn may cause compressor stall:

(1) nose-high attitude at low airspeed,

(2) flying in very turbulent air,

(3) duct stall as a result of rapid throttle handling,

(4) ice formation at the air inlet, and

(5) side-slipping at slow speeds.

c. **Malfunction of the Variable Geometry System (Inlet Guide Vanes and Bleed Valves).** Since this system controls the airflow within an engine, the malfunction or improper rigging of the system or its components can cause compressor stall.

d. **Damaged or Dirty Compressor Blades.** Foreign object damage, including bird ingestion and dirty compressors, causes distortion of aerofoils and decreases the efficiency of the compressor, making it more susceptible to stall.

EFFECTS OF COMPRESSOR STALL

CAUTION

As the causes of a compressor stall during ground running are difficult to analyze, an aircraft experiencing one is to be considered unserviceable. Further throttle movement, except as required for taxiing, should be avoided to preclude further engine damage.

48. The effects of compressor stalls are engine vibration, loss of thrust, and overtemperature of the turbine and exhaust components. The overtemperature condition is the most serious effect, and if allowed to continue or if repeated, can cause immediate and serious damage to the turbine section and, subsequently, engine failure.

PRESSURIZING, AIR-CONDITIONING, DE-MISTING, AND ENGINE ANTI-ICING SYSTEMS

GENERAL

49. Because of the interdependency of the air-conditioning, pressurizing, de-misting, and anti-icing systems, they are treated as a single system.

OPERATION

50. Before starting the engine, the air-conditioning master switch should be in the NORMAL position, the cockpit temperature control switch in AUTO, and the cockpit temperature selector between 11 and 12 o'clock.

51. During flight, the cockpit altitude should be monitored above 8000 feet to ensure that the pressure schedule as shown in Figure 1-13 is maintained. Temperature may be altered by use of the selector, or, if this has failed, the control switch may be moved to either HOT or COLD and, when the desired temperature is reached, moved to the OFF position. For maximum demisting, if required when making a maximum-rate descent, turn the cockpit temperature selector switch to full HOT, close the shoulder outlets, and turn on the WSHLD & CANOPY DEMIST switch.

COCKPIT FOG REMOVAL

52. Under certain atmospheric conditions, water vapour in the air entering the cockpit through the shoulder or floor outlets will condense and resemble smoke. This can be eliminated by temporarily moving the cockpit temperature selector to the full HOT position and then returning the control to a slightly warmer setting than the original selection.

NOTE

In hot weather, condensation may appear on the outside of the foot warmers and drop onto the floor. There is no corrective action for this.

WINDSHIELD DE-ICING

CAUTION

The hot bleed air will crack the windshield if the system is used above 84%. In an emergency, or on final approach during heavy rain, the windshield de-icing may be used for rain removal: but damage will result if the engine is operated in excess of 75% for more than one minute. Anticipate delay between selection and operation of windshield de-ice.

53. The windshield de-icing system should be used only in actual icing conditions and shut off as soon as possible after the ice has cleared sufficiently. Engine RPM should be kept below 84% but may be increased above 84% should the ice not clear.

ENGINE ANTI-ICING

CAUTION

The Tutor engine is very susceptible to FOD damage due to icing. Even with the anti-icing system in operation, ice may form in the intake duct, break off, and be ingested by the engine. Avoid continuous operation in icing conditions. If FOD damage is considered a possibility, minimize throttle movements and land as soon as practical.

54. For continuous operation in icing conditions, select the engine anti-ice switch ON. Do not reduce engine speed below 78% RPM. If it should become necessary to operate at engine speeds lower than 78% RPM, de-ice engine at intervals of one minute by advancing the throttle slowly to full RPM (five seconds from the selected minimum speed to full RPM). Continuous operation of engine anti-icing will also affect aircraft performance (refer to NOTE in Part 1, Paragraph 68).

OXYGEN SYSTEM NORMAL OPERATION

GENERAL

55. Particular care must be taken to avoid wasting oxygen (see Figure 2-1-8). Do not run the tanks dry. If the tanks have been totally depleted, the system must be purged before recharging.

NOTE

When the right seat is unoccupied, connect the unused oxygen hose to the blanking plugs.

56. Before each flight, ensure that there is adequate oxygen for the proposed flight. The maximum leakage rate is 100 psi per 12-hour period during which the system has been undisturbed. The diluter-control lever should always be set at NORMAL OXYGEN, except under emergency conditions or for short periods when taxiing or flying in the wake of another jet aircraft; then the diluter lever should be set at 100% OXYGEN. During flight, periodically check oxygen pressure, oxygen-flow indicator and hose-disconnect coupling.

OXYGEN DURATION CHART
(CREW OF TWO)

TWO CYLINDERS 623 LITRES EACH, TOTAL 1246 LITRES

COCKPIT ALTITUDE (FEET)	DURATION USING NORMAL OXYGEN (HOURS)									DURATION USING 100% OXYGEN (MINUTES)								
25 000	3.07	2.72	2.36	1.01	1.67	1.32	0.96	0.61	0.26	145	129	112	96	79	62.5	46	29	12.5
20 000	3.47	3.07	2.68	2.28	1.88	1.49	1.08	0.69	0.29	111	98	85	73	60	47	35	22	9.5
15 000	4.2	3.71	3.24	2.75	2.27	1.81	1.32	0.84	0.36	89	79	69	59	49	38	28	18	7.7
10 000	4.2	3.71	3.24	2.75	2.27	1.81	1.32	0.84	0.36	72	63	55	47	39	31	22.6	14.4	6.2
SL										48.5	43	37	31.6	26	20	15	9.7	4.1
GAUGE PRESSURE PSI	1800	1600	1400	1200	1000	800	600	400	200	1800	1600	1400	1200	1000	800	600	400	200

Black figures indicate diluter lever at NORMAL.
Red figures indicate diluter lever at 100%.

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Figure 2-1-8 Oxygen Duration Chart

57. To check the oxygen regulator panel, proceed as follows:

a. With the emergency lever at NORMAL OXYGEN, check oxygen flow through the regulator by observing the flow indicator with the diluter lever first in NORMAL OXYGEN, and then at 100% oxygen.

b. Deflect emergency lever to TEST MASK position. Positive pressure should be felt at the mask.

c. Return emergency lever to NORMAL and diluter lever to NORMAL OXYGEN.

LANDING PROCEDURES

PRE-DESCENT PROCEDURES

58. Prior to entering the traffic pattern, complete the following checks:

a. **Fuel Quantity.** Checked.

b. **Hydraulic Pressure.** Normal.

c. **Harness.** Tight and locked.

d. **Demisters and Engine Anti-ice.** As required.

e. **Altimeter.** Proceed as follows:

(1) Set.

(2) Check STBY mode.

(3) Select RESET.

f. **Gyro Compass and A/I.** Check Erected.

g. **Landing Lights.** ON.

IN-FLIGHT ALTIMETER CHECK

CAUTION

Switching rapidly back and forth from servo to standby or performing the check while the aircraft is climbing or descending may result in altimeter damage.

59. When changing from the servo to the standby mode, the altimeter reading should change by the difference between corrected and uncorrected altitude indications. This is depicted on the altimeter correction card as a function of airspeed and altitude. Carry out the following check at an airspeed and altitude for which an altimeter correction is known for the standby mode:

a. Place aircraft in level flight at constant airspeed.

b. Consult altimeter correction card for standby mode correction for that altitude and airspeed.

c. Select STBY.

d. Record actual change in altimeter reading.

e. Compare actual change in altimeter reading with that shown on the altimeter correction card.

WARNING

When errors in excess of these tolerances exist, both modes must be considered unreliable. When an unreliable indication is apparent, carry out a VFR recovery or wing let-down if possible.

f. Maximum allowable discrepancy between the actual change in altimeter reading and the correction card altitude correction must be within ±150 feet at all altitudes.

NOTE

In cases of large altitude discrepancies between modes, the cabin altimeter may assist in establishing which mode is unserviceable.

g. Select RESET.

PRE-LANDING CHECK

60. The Tutor is capable of flying several various approach patterns, such as the jet overhead pattern or the civilian square circuit. The procedures used for each variant are described in the Tutor Manual Of Flying Training. For all types of patterns the Pre-Landing Check includes the following (see Figure 2-1-9):

a. **Speed Brakes.** As required, OUT on touch-down.

b. **Landing Gear.** (Airspeed below 175 KIAS). Lever down; check indicators, tone, and warning lights.

c. **Annunciator Panel.** Checked (should be clear except for the speed brake legend).

d. **Flaps.** As required. Take-off flap is used during the initial portion of the approach with full flap selected on final (below 140 KIAS) as determined by the pilot.

APPROACH

61. Minimum airspeeds are as follows (see Figure 2-1-9):

a. Final turn (take-off flap). 115 KIAS.

b. Instrument/straight-in approach (take-off flap). 115 KIAS.

c. Threshold speed (full flap). 95 KIAS.

d. Add five KIAS to all speeds for fuel quantities in excess of 1500 lbs.

e. For flapless or minimum roll landings refer to Paragraphs 68 to 74.

TOUCH-DOWN

62. The landing technique is normal for tricycle landing-gear aircraft. The aircraft is stable during the touch-down and landing roll. Once the main wheels are firmly on the ground, gently lower the nose wheel to the runway. This is accompanied by a larger change in angle-of-attack, which eliminates any tendency of the aircraft to become airborne again once the nose wheel is on the runway. After the nose wheel has been lowered to the runway, apply very light toe pressure to the brakes to determine that brakes are serviceable, then carry out a normal stop, using recommended braking technique. For touch-down speeds and landing distances, see Figure 4-22.

63. For cross wind techniques, employ the normal corrective measures: wing-down or crab method or a combination of both. The aircraft must be lined up with the runway when the main wheels touch, and drift must be eliminated to avoid unnecessary stress on the landing-gear.

OVERSHOOT PROCEDURE

64. If the landing cannot be completed, the decision to overshoot must be made as early as possible. Take the following actions (see Figure 2-1-9):

a. **Power.** MAX CONT.

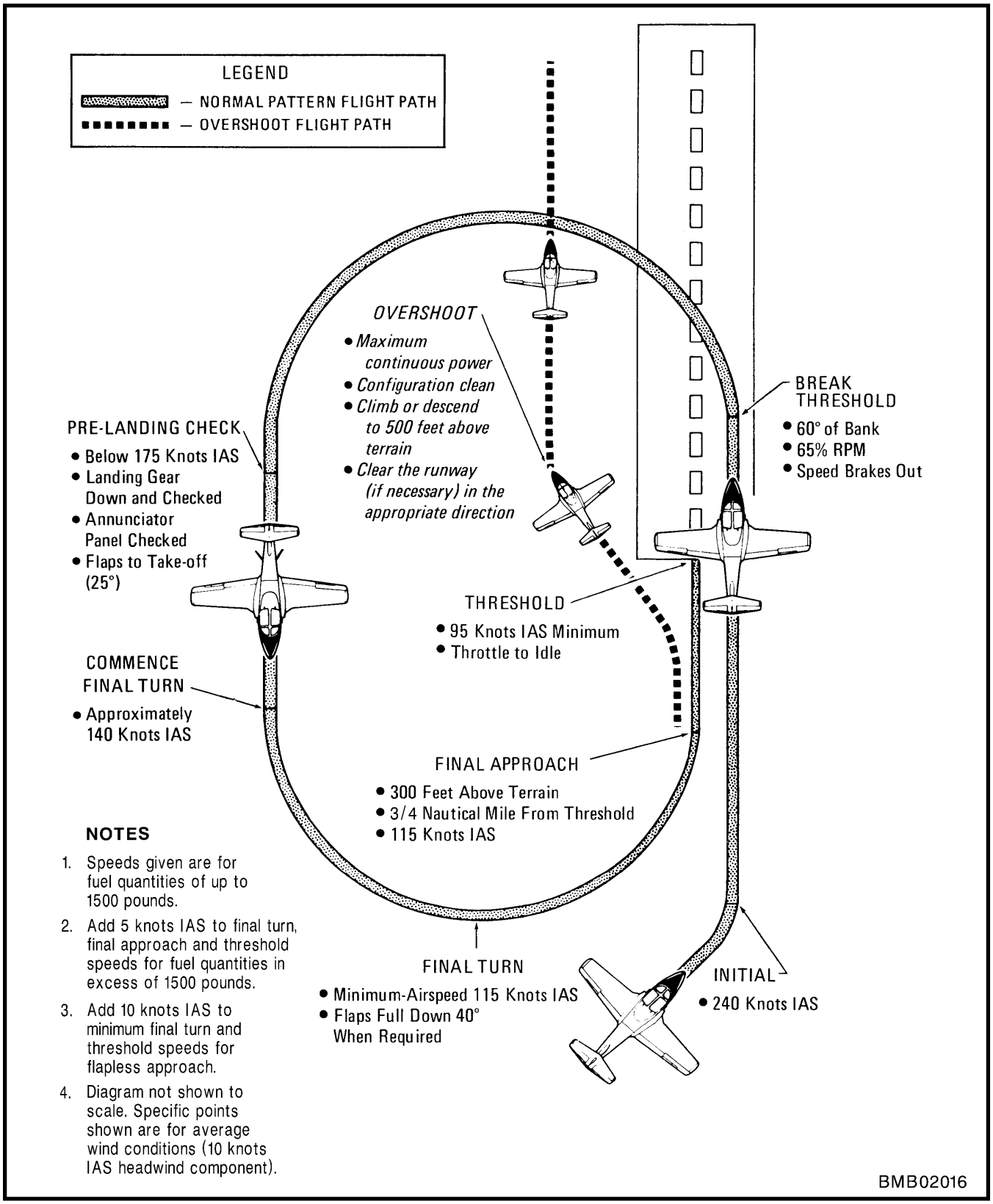

Figure 2-1-9 Normal Circuit

b. **Speed Brakes.** IN.

c. Raise flaps fully above 110 KIAS and the landing-gear prior to 175 KIAS. Clear the area, if necessary, in the appropriate direction.

d. If touch-down has been made or is imminent, wait until safely airborne, then retract the landing-gear.

PORPOISING

65. Porpoising is a series of bounces from the main wheels to the nose wheel and back to the mainwheels; it can result from an improper touch-down, in which the nose wheel contacts the ground before the main landing-gear, or when the pilot over-controls during the correction for a bounce on landing.

RECOVERY FROM PORPOISING

66. The corrective action is to open the throttle to full power, retract the speed brakes, and position the control column neutral or slightly aft of the neutral position. Complete the overshoot after the aircraft is definitely airborne. Certain conditions may preclude the pilot from always completing an overshoot. In this case, keep the control column neutral or slightly aft of the neutral position, until the aircraft starts to sink. Next, in an attempt to touch down on the main wheels, move the control column progressively rearward.

CIRCUIT CHECK

67. Check the following while downwind in the circuit:

a. **Fuel.** Contents.

b. **Hydraulics.** Pressure.

c. **Harness.** Tight and locked.

MINIMUM ROLL LANDING

FULL FLAP LANDING

68. Because of brake failure, short runway length, or poor braking conditions, it may be necessary to stop in the minimum distance after touch-down. To provide a measure of safety in the training environment, the published approach and landing speeds of the Tutor are somewhat higher than the aerodynamically correct speeds. However, during minimum roll landings the aircraft is slowed to the minimum safe approach speed of approximately 1.3 Vs. (For further information see the Manual of Aerodynamics.)

69. A straight-in approach is preferable to allow airspeeds to stabilize; however, if an overhead break is done, the final approach technique is the same. Once established on final approach and with take-off flap selected (speed brakes out), reduce to minimum final approach airspeed as defined below:

(90 KIAS) + (1 KIAS/100 lbs of indicated fuel) + (1/2 gust factor).

-EXAMPLE-

With 600 lbs of fuel remaining and calm winds, the final approach airspeed would be (90+6) 96 KIAS. Add 1/2 gust factor if gust spread is equal to, or greater than, 10 KIAS. (If the winds are gusting 10 KIAS to 20 KIAS, add five KIAS to the approach speed.)

70. On short final with full flap selected, reduce the airspeed a further 10 KIAS. This speed should be achieved just prior to initiating the flare. Co-ordinate closing the throttle in the flare so that the throttle is at idle on completion of the flare. During this time a further five KIAS will be lost. Land without delay and employ minimum after landing procedures as appropriate.

NOTE

It is impossible to determine accurately the total fuel state with external fuel; in this case use (90 KIAS) + (1 KIAS/100 lbs indicated fuel +5 KIAS for any external fuel) + (1/2 gust factor).

71. This procedure does not restrict the use of normal speeds until a point on final where the aircraft can be slowed to minimum final approach airspeed. If circumstances permit, reduce the fuel state to 400 lb prior to landing.

72. Depending on the type of conditions encountered the following procedures are recommended:

CAUTION

Aerodynamic braking is ineffective on the Tutor aircraft and in a critical situation delays the use of wheel brakes. Nose wheel steering will be inoperative if the throttle is at CUT-OFF.

a. **Short Runway.** Lower the nose wheel as soon as possible. Apply strong continual brake pressure once the nose wheel is down. If necessary, flame out the engine and open the canopy.

b. **Poor Braking Conditions or Brake Failure.** Lower the nose immediately and commence judicious braking with whatever braking action is available. If necessary, at 65 KIAS, open the canopy and move the throttle to CUT OFF. Maintain direction with rudder and/or brakes.

c. **Single Brake Failure.** Since the aircraft will ultimately tend to turn in the direction of the serviceable brake, touch-down should be made on the opposite side of the runway. Lower the nose immediately and use the single brake intermittently, maintaining directional control with the nose-wheel steering. If required, open the canopy to reduce the after-landing roll as above.

FLAPLESS LANDING

73. If it is necessary to land with flaps raised, once established on final, reduce airspeed to flapless minimum final approach airspeed, which is defined as follows:

(95 KIAS) + (1 KIAS/100 lbs indicated) + (1/2 gust factor)

Maintain this airspeed through to landing and employ minimum roll techniques after landing as required. During the approach the nose attitude will be higher, the round-out is less pronounced than during a full-flap landing, and a longer after-landing roll should be expected.

NOTE

It is impossible to determine the total fuel state accurately with external fuel; in this case use (95 KIAS) + (1 KIAS/100 lb indicated fuel + 5 KIAS for any external fuel) + (1/2 gust factor).

74. If circumstances permit, reduce fuel state to 400 lb minimum prior to landing.

NOTE

A 15-min cooling period is required between maximum braking landings. Brake fade is possible if this cooling requirement is not observed. (refer to Part 3, Section 2, Paragraph 46 for further information on hot brakes).

POST-LANDING CHECK

75. After landing, or following a ground abort, proceed as follows:

a. **Safety Pins.** Installed.

NOTE

Ensure that the ejection handle is in the detent position before replacing the safety pin.

b. **Speed Brakes.** OFF.

c. **Flaps.** As required. With Tutor servicing available leave flaps DOWN. If not, retract flaps at pilots discretion.

d. **Demisters and De-icers.** OFF.

e. **Pitot Heat.** OFF.

f. **Taxi Light.** As required, OFF prior to shut-down.

g. **UHF/VHF.** As required.

h. **Marker Beacon.** OFF.

i. **VOR/ILS.** OFF.

j. **Engine Anti-ice.** OFF.

k. **TACAN.** OFF.

l. **Fuel Transfer.** OFF.

m. **Transponder.** OFF.

n. **Trims.** Neutral.

o. **Cabin Altitude.** Ensure indicates field elevation, if not, dump cabin pressure.

p. **Canopy.** As required.

END OF FLIGHT PROCEDURE

SHUT-DOWN CHECK

76. On shutting down the engine:

a. **Brakes.** ON (until throttle moved to CUT OFF and aircraft chocked).

b. Ensure that engine has run at idle RPM for 30 seconds since last power application. This ensures an accurate reading when oil level is checked.

c. **Throttle.** CUT OFF.

d. **Inverters.** OFF.

CAUTION

The engine-driven fuel pump and MFCU are fuel lubricated: do not motor the engine unless normal fuel pressure is indicated.

e. **Engine Master Switch.** OFF (below 10% RPM).

f. **All Switches.** OFF.

g. **Controls.** LOCKED.

CAUTION

Do not park aircraft with canopy open if wind velocities above 65 KIAS are expected.

h. **Canopy.** OPEN (may be opened prior to engine shutdown but extreme caution must be exercised in regards to cockpit FOD).

NOTE

Ensure engine master is switched off before the DC master, otherwise the low fuel pressure shut-off valve will remain open.

i. Unstrap, ensuring auto-chute is secured and oxygen hose is stowed on storage plug behind the seat.

COLD WEATHER OPERATION

GENERAL

77. Check entire aircraft to ensure that it is free of frost, snow, and ice. Loss of lift and stalls may result if the aircraft is not adequately cleaned. Brush off snow or frost. Remove ice by a direct airflow from a ground heater. Do not chip or scrape ice; this may damage the aircraft.

78. For a frosted windshield and canopy, proceed as follows:

a. Select cockpit and windshield demist, as required, immediately after engine start.

b. Close canopy.

NOTE

On start-up, an oil pressure in excess of 100 PSI is permissible. Engine must be maintained at IDLE for a maximum of 10 minutes until pressure falls to datum +10 psi or below. If oil over-pressure persists, shut down engine.

TAXIING PROCEDURE

79. Due to increased thrust on cold days and less than ideal taxi surfaces, taxi techniques should be adjusted accordingly. Proceed as follows:

WARNING

Engine icing may occur during ground operations at ambient temperatures between –40 °C and 5 °C whenever the dew point is within 4 °C of ambient temperatures. Pilots should avoid prolonged ground operations in these conditions.

a. Avoid taxiing in deep snow; it is more difficult, and frozen brakes may result.

b. Increase taxiing distance between aircraft at subfreezing temperatures to ensure safe stopping distance and to prevent icing of aircraft surfaces by melted snow and ice from the jet-blast of a preceding aircraft.

c. Use nose-wheel steering in icy surface conditions.

NOTE

Tutor intake ducts and engines are susceptible to icing in certain temperatures/dew point conditions. Exact temperatures versus time ratios required for the formation of ice are unknown. Pilots are therefore to utilize caution and judgement with respect to the following Warning.

TAKE-OFF

80. Proceed as follows:

a. Perform final instrument check during initial stage of take-off run, as the brakes will not hold the aircraft on snow-covered or icy runways at full throttle. Adjust cockpit temperature selector as necessary after becoming airborne.

b. Advance throttle to MAX CONT power. At low ambient temperatures, engine speed may not reach maximum engine RPM,

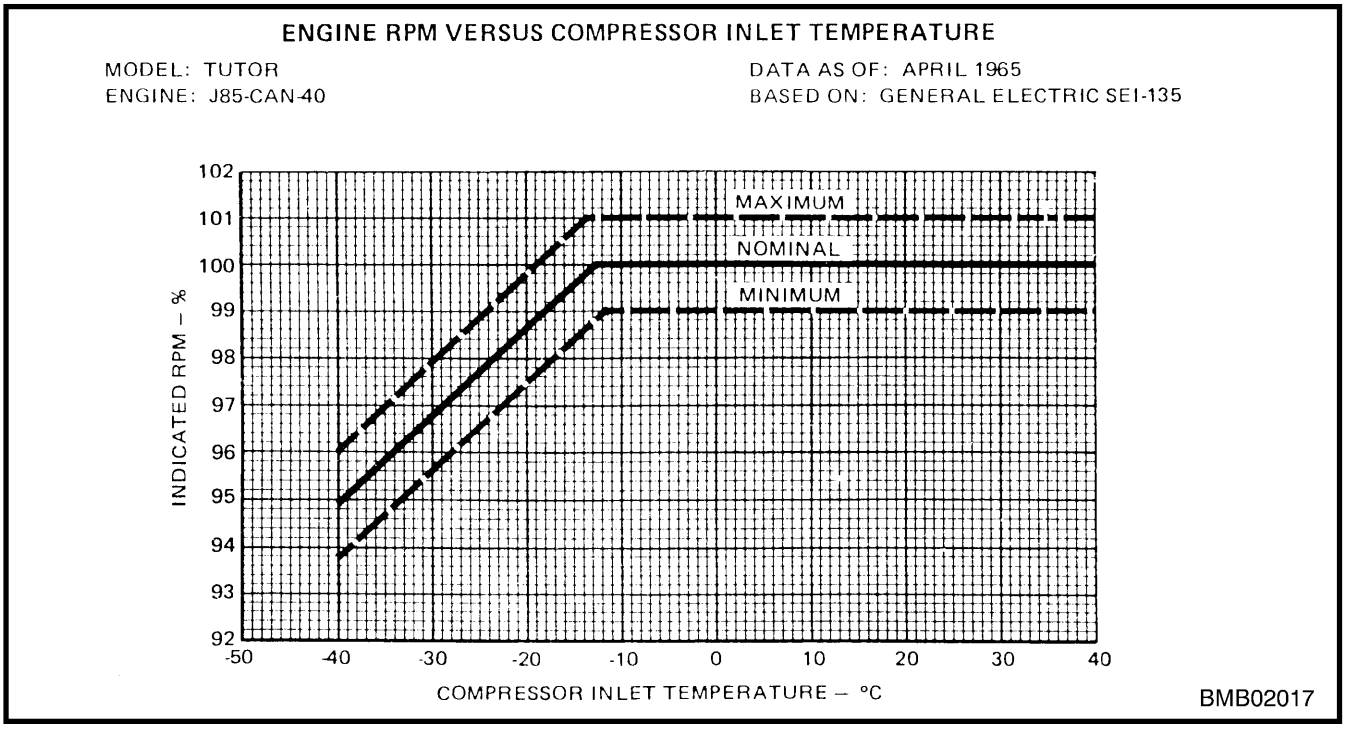

Figure 2-1-10 Engine RPM vs Compressor Inlet Temperature (Throttle at MAX CONT Power)

although take-off thrust can be obtained at less than maximum engine speed. See Figure 2-1-10 for engine RPM versus compressor inlet temperature.

NOTES

1. When runway conditions prevent a full power check before the take-off roll, or extremely cold temperatures cause a high oil pressure reading at maximum continuous power, the check of the oil pressure indication against the datum oil pressure should be made within five minutes after take-off. If oil pressure does not stabilize within 10 PSI of the datum pressure, consider aircraft unserviceable and return to base.
2. Higher than normal oil pressure may also be experienced during cold weather operations after prolonged low RPM settings; they are acceptable, provided that pressures begin to drop after a short period of time at higher RPM.

AFTER TAKE-OFF

81. After take-off from a wet snow, slush, or water-covered runway, operate the landing-gear and flaps through several complete cycles to prevent freezing.

NOTE

If the aircraft has been outside in wet conditions and is subsequently flown in below freezing temperatures, stiff aileron controls can be expected due to ice forming in the aileron plenum seals. Firm aileron cycling should alleviate this condition.

CLIMB

82. Climb performance will be improved during cold weather operation at low altitudes. Follow recommended climb speeds as given in Part 4.

OPERATION IN FLIGHT

83. Engine operation during flight in cold weather is governed by normal procedures.

84. The windshield and canopy demist should be used as required. Adjust cockpit temperatures to a comfortable level.

DESCENT

85. Before commencing a rapid descent, turn the cockpit temperature selector switch to full HOT and close the shoulder outlets. This should clear the windshield and canopy of frost and mist, which may form during a descent from altitude.

APPROACH

86. Make normal patterns and landings.

LANDING

87. Landing speeds and techniques are normal. Take extra care in the use of brakes on snow-covered or slippery runways.

ENGINE SHUT DOWN

88. The engine is shut down in the normal manner.

BEFORE LEAVING COCKPIT

89. Proceed as follows:

a. Release brakes after wheels are chocked.

b. Leave canopy partly open to allow air circulation within the cockpit to prevent canopy cracking from contraction, and to reduce windshield and canopy frosting.

SECTION 2

AIRCRAFT EQUIPPED WITH EXTERNAL TANKS

PRE-FLIGHT CHECKS

WARNING

On entering the cockpit, ensure that the fuel transfer switch is OFF. If the switch has been left on, the possibility that fuel has entered the air-conditioning system exists, especially during high ambient temperatures.

1. In addition to the standard pre-flight procedures, the following steps are required:

   a. Remove the left and right tank safety pins.

   b. Ensure that both filler caps are in the closed position.

   c. Check overall tank condition and crutch and pylon assembly.

GROUND HANDLING

CAUTION

Take care when taxiing across arrestor cables to prevent the cable from bouncing up and over the front of the tanks.

2. Taxi techniques are as for the clean aircraft. However, the tanker may require marginally longer use of power at normal settings to move from the stationary position.

TAKE-OFF

3. Proceed as follows:

   a. As the airspeed approaches 80 KIAS, apply gradual back pressure on the control column until the nose wheel is just off the ground. Maintain this attitude, and the aircraft will become airborne at approximately 105 KIAS.

CAUTION

For aborted take-offs involving maximum braking with a total fuel load in excess of 1900 pounds, where possible, delay braking action until 85 KIAS to avoid possible brake and wheel damage. Maximum braking may be applied below 85 KIAS. If it has been necessary to apply braking above 85 KIAS while carrying external fuel, follow hot brake procedures. A major unserviceability entry on Form CF 349 is mandatory. The aircraft will then be inspected by maintenance personnel before release for further flight.

   b. When safely airborne and above 120 KIAS, raise the flaps.

NOTE

Once total fuel is reduced to 1500 lbs, flaps are raised at 110 KIAS regardless of configuration.

CLIMB

4. The climb speed is the same as for a clean aircraft. Performance varies from a clean aircraft as follows:

	Clean		Tanked	
FL 200	6 min	365 lb	8 min	475 lb
FL 250	9 min	425 lb	12 min	560 lb
FL 290	11 min	470 lb	16 min	630 lb
FL 310	13 min	495 lb	18 min	665 lb

EXTERNAL FUEL TRANSFER

5. Fuel should be transferred internally as soon as possible on all missions. For external transfer, proceed as follows:

   a. **Select External Fuel Selector Switch.** ON at or below 1500 pounds internal fuel. The low fuel pressure lights will illuminate momentarily and then go out to indicate that fuel is transferring.

   b. **Monitor Transfer.** Internal fuel level will rise approximately 300 pounds, if transfer is started at approximately 1500 pounds, and then begin to fall when transfer is complete.

The two LOW FUEL PRESS lights will illuminate steadily when all external fuel has been transferred. Fuel transfer requires eight to 15 minutes, depending on altitude and power setting.

c. **External Fuel Selector Switch.** OFF when transfer complete.

NOTE

When flying a low-powered descent, it is possible to have the transfer lights illuminate although fuel remains in the external tanks.

STALLING

6. Apart from subtle changes in stability, the stalling characteristics with external tanks awaited are the same as in the clean aircraft.

SPINNING

7. Intentional spinning with external tanks is prohibited. If an inadvertent spin is encountered, apply standard spin recovery technique. After the sortie, place the aircraft unserviceable by making an appropriate entry on Form CF 349. An overstress inspection of the pylon fairing attachment must be carried out before further flight.

UNUSUAL CHARACTERISTICS

8. Rudder lock as a result of large side-slip angles is amplified in Paragraph 43 of Part 2, Section 1. With external fuel tanks installed, rudder lock does not occur with an increasing side-slip angle; however, rudder pedal forces will begin to lighten.

TANK JETTISON

CAUTION

Tank hang-ups are a possibility and this should be considered when planning the subsequent approach and landing, after tank jettisoning. If possible, external tank jettisons (full or empty) should be performed in the cruise configuration (landing-gear and flap up).

9. Empty fuel tanks should be jettisoned between 125 – 180 KIAS. Full tanks should be jettisoned within a speed range of 100 – 300 KIAS.

LANDING PROCEDURES

10. The following gliding speed and distance should be used for aircraft equipped with external tanks:

Forced Landings. 130 KIAS. Two NM/1000 feet is the theoretical figure, but pilots are reminded that this could well be optimistic. Flight testing is unavailable.

CAUTION

Maximum landing weight is 8800 pounds. Maximum rate of descent at maximum landing weight is 480 FPM.

11. Normal airspeeds to be flown are not computed on aircraft configuration, but rather on total amount of fuel in the aircraft (external and internal). If total fuel weight is in excess of 1500 pounds, add five KIAS to the basic clean airspeeds for final turn, final, and threshold. If total fuel weight is 1500 pounds or below, use the same airspeed as for a clean aircraft.

GENERAL LIMITATIONS AND RESTRICTIONS

12. The following limitations apply:

a. maximum speed – 0.7 Mach or 400 KIAS, whichever is lowest;

b. maximum take-off weight – 9000 pounds (based on the use of JP-8 fuel) and;

c. acceleration limits:

(1) positive:

(a) symmetric:

+7.33 G at gross weight up to 6900 pounds, decreasing linearly to +5.62 G at gross weight of 9000 pounds, and

(b) unsymmetric:

(2/3 of symmetric): +4.88 G at gross weight up to 6900 pounds, decreasing linearly to +3.75 G at gross weight of 9000 pounds, and

(2) negative:

(a) symmetric:

–2.00 G at airspeeds up to 350 KIAS, decreasing linearly to –0.50 G at 400 KIAS, and

(b) unsymmetric:

–1.00 G at airspeeds up to 350 KIAS, decreasing linearly to 0.0 G at 400 KIAS.

PART 3

EMERGENCY OPERATING PROCEDURES

SECTION 1

NON-CRITICAL EMERGENCIES

NOTE

Emergencies in this section are considered to be of a non-critical nature. Maintain aircraft control. Analyze the situation. Sufficient time is available to consult the checklist for remedial action. Consult appropriate supplement for any differences.

HYDRAULIC SYSTEM MALFUNCTIONS

GENERAL

1. Malfunctions in the hydraulic system range from minor persistent fluctuations to complete failure. Although small fluctuations pose no immediate threat, if prolonged they may lead to more serious problems. These problems are recognized by failure of a hydraulic service or by a zero reading on the hydraulic gauge. The zero reading can be caused by either a gauge failure, in which case services will remain operative; by pump failure; or by loss of hydraulic fluid due to a line or ancillary leak. Depletion of hydraulic fluid will cause the pump to overheat due to lack of lubrication, and fire may result. When a hydraulic system failure is indicated, land the aircraft as soon as possible. Shut down the engine as soon as practical.

LOSS OF HYDRAULIC PRESSURE

2. Loss of hydraulic pressure may be caused by loss of hydraulic fluid as a result of a leak or line breakage, or due to the engine driven pump failing (or the engine seizing). As the actual cause cannot be determined in flight, the only hydraulic service that should be operated is the landing-gear through use of the hydraulic hand pump.

3. If a hydraulic system failure is confirmed, return to base as soon as practical for a straight-in flapless landing and anticipate an emergency landing-gear extension.

NOTE

With zero hydraulic pressure, speed brakes will bleed to the nearly closed position, depending on KIAS. If flaps are down, they will remain in selected position unless selected up by the pilot.

LANDING-GEAR EMERGENCY EXTENSION

4. If it is necessary to lower the landing-gear by use of the hand pump, proceed as follows:

a. Reduce airspeed. Maintain below 175 KIAS.

b. Select landing-gear control lever . . . Down

c. Pull out the emergency landing-gear selector handle.

CAUTION

If the handle is not fully extended, the landing-gear may not extend completely.

d. Operate the hand pump until the landing-gear is down and locked.

WARNING

Failure to follow the above sequence may result in increasing the friction loads on the emergency landing-gear selector handle, making it impossible to pull out, and, in the event of a hydraulic leak, prevent emergency landing-gear extension.

CAUTION

With the emergency landing-gear selector handle pulled out, wing flaps, speed brakes, and nose-wheel steering are inoperative, unless normal hydraulic pressure is available.

NOTE

Variations in pressure may be encountered during use of the hand pump. Disregard

temporary variations and continue using the hand pump until visual confirmation of the landing-gear position is established, or until the hand pump handle can no longer be moved.

e. Do not select the emergency landing-gear selector handle back IN if loss of hydraulic fluid is suspected, or if Steps a to d above have not been followed, as the gear will retract if there is any pressure left in the normal system.

LANDING-GEAR MALFUNCTIONS

5. For all landings with landing-gear malfunctions, ensure the harness is tight and locked.

6. Ensure that the landing-gear circuit breakers and emergency gear selector handle are IN.

7. In the event of a premeditated wheels-up approach in an aircraft equipped with external tanks, pilots are advised to jettison the tanks if the fuel remaining cannot be burned off. If the tanks can be emptied, pilots should consider retaining them. Leave the fuel transfer switch on until just prior to landing in order to purge the tanks of residual fuel and fumes after illumination of the external tanks LOW FUEL PRESS warning lights. As a precaution, all the electrical services should be selected OFF prior to touchdown. When the aircraft comes to rest, install the seat pin (time permitting) and exit the aircraft, using the emergency ground egress procedure.

LANDING WITH NOSE-GEAR RETRACTED

8. If the main gear is locked down, but the nose gear cannot be lowered or cannot be locked down, a landing can be made on the main gear with minimum damage to the aircraft. Carry out the following procedure:

a. Reduce the fuel remaining to 400 pounds.

b. External tanks . . . . . JETTISON at pilot's discretion (Retain if empty)

c. Land in the centre of the runway.

d. Hold the nose off initially, but lower the nose gently to the runway before elevator control is lost.

e. When the nose of the aircraft is on the runway, apply gentle braking.

LANDING WITH ONE MAIN GEAR RETRACTED

9. If nose gear and one main gear only are locked down, but the other main gear cannot be lowered or locked down, a landing can be made on the extended gear as follows:

a. Reduce fuel remaining to 400 pounds.

b. External tanks . . . . . JETTISON at pilot's discretion (Retain if empty)

c. Land on the side of the runway that is away from the faulty gear.

d. Hold the wing up with aileron as long as possible.

e. Attempt to keep straight with brake and nose-wheel steering.

WARNING

If unable to retract gear, eject at pilot's discretion.

10. If only one gear can be extended or locked down, the gear should be retracted and a gear-up landing carried out.

GEAR UP LANDING

11. Proceed as follows:

a. Fuel . . . . . Reduce to 400 pounds

b. External tanks . . . . . JETTISON at pilot's discretion (Retain if empty)

c. Fuel transfer switch . . . . . ON (OFF before landing)

d. Flaps . . . . . DOWN (flaps should be fully down prior to landing)

e. Speed brakes . . . . . OUT

f. Canopy . . . . JETTISON at pilot's discretion (use alternate canopy jettison handle to the left of the centre console)

g. Throttle . . . CUT OFF (just prior to landing)

h. Engine master switch . . . . . OFF

i. DC master switch . . . . . OFF

j. Fly the aircraft onto the runway. Do not stall before touch-down.

LANDING WITH A FLAT TIRE

12. If it is known, while airborne, that a tire is flat, proceed as follows:

a. **Nose-Wheel Tire.** Hold the nose wheel off initially, but allow nose wheel to touch runway gently before elevator control is lost.

b. **Either Main-Wheel Tire Flat.** Land on the side of the runway away from the flat tire. Ease pressure off the wheel with the flat tire by use of the aileron. Attempt to maintain directional control with wheel brakes and nose-wheel steering.

ENGINE

ZONE 2 COOLING SYSTEM

13. If the BLEED VALVE CLOSED legend or the AIRFRAME O/HEAT legends illuminate while on the ground, suspect failure of the Zone 2 ejector pumps and shut down engine. If the BLEED VALVE OPEN legend illuminates in flight, indicating operation of the Zone 2 ejector pumps, engine performance will be compromised slightly, and the flight should be discontinued as soon as practical.

ENGINE RUN-DOWN

ON THE GROUND

14. For engine rundown symptoms, refer to Part 2, Section 1, Paragraph 10. Proceed as follows:

CAUTION

Throttle movement should be slow and restricted; take care not to exceed EGT limitations

Generator . . . . . TRIP

Cabin Pressure . . . . . DUMP

RPM 55–58%

Generator . . . . . RESET

IN FLIGHT

15. When the throttle is retarded during a high-altitude spin or during high-altitude aerobatics, the engine may run down until throttle control of RPM is no longer available. The corrective action is to increase the airspeed until the RPM returns to flight idle before advancing the throttle. For minimum airspeed at altitude, see Figure 4-2.

FUEL SYSTEM EMERGENCY OPERATION

DEFECTIVE FUEL-TANK BOOSTER PUMP

16. A malfunction of the fuel-tank booster pump will be indicated by illumination of the annunciator panel window marked LOW FUEL PRESS and flashing of the MASTER CAUTION light. In the event of a low fuel pressure warning, proceed as follows:

a. Reduce RPM.

b. Avoid zero-or negative-G flight.

c. It is recommended to descend to 20 000 feet or below.

d. At a reduced power setting, land as soon as practical.

NOTE

If the above procedure is employed at the first indication of low fuel pressure, and the aircraft is not subjected to zero-or negative-G, the possibility of engine failure is remote. In situations where engine failure occurs, relight should be successful at 20 000 feet or below, using normal relight procedures.

EXTERNAL TANK JETTISON

17. Proceed as follows:

a. Jettison arming switch . . . . . ON

b. Airspeed:

(1) tanks empty: 125 – 180 KIAS, and

(2) tanks full: 100 – 300 KIAS.

c. Jettison button . . . . . Pressed

OIL SYSTEM MALFUNCTION

WARNING

Simultaneous loss of oil pressure and tachometer reading indicates a sheared oil pump shaft and, subsequently, almost certain engine failure.

18. An engine oil system malfunction may be indicated by a 10 PSI change in the oil pressure reading from a normal reading noted previously at a selected engine speed. Most instances of oil system malfunction are preceded by large fluctuations in oil pressure. These conditions may or may not be accompanied by an illumination of the annunciator panel HIGH OIL TEMP legend and flashing of the MASTER CAUTION light. In this circumstance, reduce power, land as soon as possible, and have the cause investigated.

19. High or zero oil pressure readings usually indicate a failed indicator or circuit. However, since there is no way of verifying this in flight, assume an actual malfunction of the oil system. If the oil pressure actually drops to zero, there will be no lubrication to the engine bearings, and engine seizure will result eventually because of high temperatures and changing loads on the bearings. In the event of either high or zero oil pressure readings, select a power setting sufficient to permit return to base, and avoid unnecessary throttle movements. Do not reduce engine power completely until a landing is assured, as engine seizure is less likely to occur with power on. If conditions (e.g. time, altitude and controllability) permit, the oil pressure circuit breaker may be pulled and reset to confirm the functioning of the oil pressure indicator. This circuit-breaker does not control the functioning of the engine oil system.

ELECTRICAL SYSTEM EMERGENCY OPERATION

GENERAL

CAUTION

Some of the following emergency procedures require turning OFF all electrical switches except the engine master. If Instrument Meterological Conditions (IMC) exist, this will require flight using partial panel techniques. It is therefore recommended, with only MASTER switch to BATT position, that INV1 or INV2 switch be left to the ON position to power the attitude indicators, attempting Visual Meterological Conditions (VMC) as soon as practical.

20. In the event of any system malfunction, pull and reset the appropriate circuit breaker and reselect the service required.

ABNORMAL LOADMETER READING

21. If the loadmeter indicates an abnormally low or high reading in flight, the following action should be taken:

CAUTION

A loadmeter reading of 0.1 or less under normal conditions may indicate a possible electrical system malfunction. The generator failure procedure is to be followed.

a. High loadmeter reading:

(1) DC master switch . . . . . OFF

NOTE

If the loadmeter returns to normal, this indicates a faulty battery. Avoid further use of the battery. Leave DC master switch OFF and land as soon as practical.

If loadmeter continues to read high with DC master switch OFF:

(2) DC master switch . . . . . BATT

(3) Generator control switch . . . . . TRIP

(4) Turn off all electrical switches except engine master switch.

(5) Generator control switch . . . . . RESET

(6) Use only essential services while checking the loadmeter for higher than normal indications.

(7) If the loadmeter continues to read high, TRIP the generator control switch.

NOTE

Only battery power is now available.

(8) If the loadmeter returns to normal, turn on only the essential electrical equipment required for flight while monitoring the loadmeter for higher than normal indications: if it reads high again, turn off the last selected service.

(9) Land as soon as possible.

b. Zero loadmeter reading:

(1) Dc MASTER switch . . . . . OFF

(2) Electrical services operating – loadmeter is unserviceable.

(3) Electrical services not operating – select dc MASTER switch to BATT.

(4) Refer to Paragraph 22.

DC GENERATOR FAILURE

22. A generator failure will be indicated by a zero loadmeter reading, the illumination of the GENERATOR FAIL legend on the annunciator panel and the flashing MASTER CAUTION light. The batteries will automatically take over to supply the dc bus, keeping the inverter on-line. Check the generator circuit-breakers and select the generator RESET/TRIP switch to RESET.

a. Check generator:

(1) GENERATOR circuit-breakers (RESET, FIELD and FAIL IND) . . . . . Checked

(2) GEN control switch . . . . . RESET

(3) If generator comes back on line – essential electrics . . . . . On

(4) Land as soon as possible.

(5) IF generator fails to reset – select current sensing override switch to OVERRIDE.

(6) GEN control switch . . . . . RESET

(7) If generator comes back on line – essential electrics . . . . . On

(8) Land as soon as possible.

(9) If generator fails to reset – non-essential electrics . . . . . Off

(10) BATTERY POWER ONLY AVAILABLE

(11) Refer to Paragraph 24.

(12) Land as soon as possible.

NOTE

Due to the high demand on battery while the generator is off line, navigation with VOR/ILS and/or compass should be considered instead of TACAN.

AC INVERTER FAILURE

23. In the event of a No. 1 inverter failure, all loads will be transferred automatically to the No. 2 inverter after a delay of approximately 3 seconds. Switch off the defective inverter and unnecessary electrical equipment. If required, use the TACAN only for five-minute periods. Land as soon as practical.

ELECTRICAL LOAD SHEDDING/BATTERY POWER ONLY AVAILABLE

24. The batteries will provide sufficient power to operate essential flight, navigation, communication, and miscellaneous equipment for a period of time sufficient in most cases for a normal approach, let-down, and landing. Following the procedure laid out in Paragraphs 25 and 26 will ensure sufficient battery power for a maximum period of 19 minutes, including five minutes for let-down.

NOTE

Expect less than 19 minutes if OAT is less than –34 °C, or if generator failure occurs within 20 minutes of engine start.

25. To obtain maximum battery power available, proceed as follows:

a. TACAN . . . . . OFF

For the first 14 minutes, the available services are as follows:

b. AN/APX-77 transponder is ON for one minute (not at same time as pitot heat), and switched to STBY for the remainder of the 14 minutes.

c. Pitot heat operating for one minute (not at same time as AN/APX-77 transponder).

d. Fuel boost-pump circuit breaker: Pulled below 20 000 feet.

e. Anti-collision, taxi, and landing lights are OFF.

26. For the final five minutes the AN/APX-77 transponder, VOR/ILS, windshield demist, and pitot heat are ON continuously; TACAN only if required. (This will decrease the five-minute time period.)

27. Complete electrical failure is indicated by loss of all electrical services, with the exception of the tachometer and EGT gauges. Avoid flight above 20 000 feet, as a flame-out could possibly occur. Avoid flight through cloud, land as soon as possible, and shut down the engine as soon as practical (refer to NOTE in Paragraph 16).

NOTE

In the event of complete electrical failure, the gear must be manually lowered and the landing-gear indicators will show the landing-gear in transit, regardless of the actual position of the landing-gear. Speed brakes will be inoperative and Zone 2 cooling will be unavailable upon landing.

WINDSHIELD CRACKS

28. In the event of a crack in the windshield, proceed as follows:

a. Windshield de-icing . . . . . OFF

b. Cockpit pressure . . . . . DUMP

c. Altitude . . . . . Reduce to below 8000 feet MSL

d. Airspeed . . . . . Reduce to below 280 KIAS

e. Cockpit pressure . . . . . NORMAL (after altitude has been adjusted)

f. Land as soon as practical.

SECTION 2

CRITICAL EMERGENCIES

WARNING

Emergencies in this section are considered to be of a critical nature. These procedures should be committed to memory in order to react immediately and instinctively. Maintain aircraft control, analyze the situation, and take the appropriate action. If time and conditions permit, consult the checklist. Consult appropriate supplement for any differences.

FIRE

GENERAL

1. There is no fire extinguisher system in the aircraft. Fire or overheat indications are one FIRE legend and two AIRFRAME O/HEAT legends on the annunciator panel. The FIRE (red) and lower AIRFRAME O/HEAT (amber) legends are connected to the combined fire and overheat detection system covering both Zones 1 and 2. The upper AIRFRAME O/HEAT (amber) legend is connected to the overheat system, which also covers Zones 1 and 2. A test switch adjacent to the annunciator panel is used to check the continuity of the detection cables and the operation of the controls units.

2. Illumination of the AIRFRAME O/HEAT (amber) and FIRE (red) legend may be caused by the following:

a. Fire or overheat. (Fuel, oil or hydraulic leak.)

b. Defective system.

c. Structural failure of the engine or tail pipe, causing a hot gas leak and resultant overheat.

3. A fire or overheat condition will normally be indicated as follows:

CAUTION

Due to the design of the combined and separate systems, if any single AIRFRAME O/HEAT legend comes on, suspect circuit or system malfunction, but carry out the procedure as listed in Paragraph 6.

a. A fire is indicated by the illumination of one amber AIRFRAME O/HEAT legend and flashing of the MASTER CAUTION light, followed almost immediately by the second amber AIRFRAME O/HEAT legend, followed by the red FIRE legend and MASTER WARNING light.

b. An overheat condition is indicated by the illumination of one amber AIRFRAME O/HEAT legend and flashing of the MASTER CAUTION light, followed after a short interval by the illumination of the second amber AIRFRAME O/HEAT legend.

FIRE OR OVERHEAT INDICATION

4. If a fire or overheat indication occurs during start, proceed as follows:

a. Throttle . . . . . CUT OFF

b. Engine master switch . . . . . OFF

c. DC master switch . . . . . OFF

d. Carry out Emergency Ground Egress.

5. If a fire or overheat indication occurs while taxiing or on the take-off run carry out the Take-off Abort procedure as outlined in Paragraph 12.

6. If fire or overheat indication occurs during flight, proceed as follows:

a. Throttle . . . . . RETARD to minimum practical power for flight

b. Speed brake switches . . . . . OFF

c. Check for fire:

(1) check for high or zero EGT,

(2) fluctuating RPM and oil pressure,

(3) explosions or loss of control, and

(4) check mirrors for smoke trail.

NOTE

If only one AIRFRAME O/HEAT legend or just the FIRE legend has illuminated, press the annunciator panel test to ensure that the unlit lights and legends are serviceable. Press the FIRE and O/HEAT test to see if the other system is serviceable. (Lights and legends should illuminate.)

d. If fire is confirmed . . . . . EJECT

e. If fire is not confirmed . . . . . LAND AS SOON AS POSSIBLE

7. Do not become unduly alarmed over a warning light, therefore do not abort the take-off with insufficient runway remaining, or eject prematurely. Above all, maintain positive aircraft control while evaluating the situation. There is time to determine, by other indications, whether or not an actual fire does exist. Consideration of the situation will enable you to decide the best course of action. A fire in the engine compartment will produce more heat and cause damage more rapidly than will a fire in the tail section. A prolonged fire in either area may eventually result in loss of control of the aircraft because of the elevator rods burning through.

EMERGENCY GROUND OPERATIONS

CANOPY REMOVAL – EMERGENCY ENTRANCE

8. If the canopy cannot be raised by normal electrical or manual operation, emergency entrance can be gained by:

a. jettisoning the canopy, using the external jettison controls (see Figures 1-18 and 1-19); or

b. cutting through the canopy using cutting tools carried by rescue personnel.

WARNING

Do not raise the canopy electrically if fuel leakage is suspected.

CAUTION

If the canopy is jettisoned from any position other than fully closed, complete separation from the aircraft will not take place, and the canopy could strike the upper fuselage, resulting in fragmentation and possible rebound.

CANOPY REMOVAL – EMERGENCY EXIT

9. If the canopy cannot be raised by normal electrical or manual operation, there are two alternate exit procedures that can be used in an emergency:

CAUTION

If the canopy is jettisoned from any other position than fully closed, complete separation from the aircraft will not take place, and the canopy could strike the upper fuselage, resulting in fragmentation and possible rebound. Do not raise the canopy electrically if fuel leakage is suspected.

a. jettison the canopy using the internal jettison controls (see Figure 1-2); or

b. cut through the canopy using the breakout knife located in the cockpit.

NOTE

When cutting through the canopy, first scratch a square outline of the area to be removed. Grasp the knife in your strongest hand, the curved edge of the blade towards you, and cup the other hand under the handle end to provide additional striking power. Strike the canopy a hard blow in each corner of the square area selected for removal. Continue to aim blows at the four corners or at large impact areas. Do not chop at the edge of a small hole.

GROUND EGRESS

10. If it becomes necessary to evacuate the aircraft on the ground in an emergency, proceed as follows:

a. Personal leads:

(1) Oxygen-mask-hose retaining strap . . . . . DISCONNECT

(2) Emergency oxygen connector . . . . . DISCONNECT

(3) MC3M . . . . . DISCONNECT

b. Lap belt and shoulder harness . . . . . DISCONNECT

c. Maritime lanyard . . . . . DISCONNECT if life jacket is worn

d. Parachute harness . . . . . RELEASE QRB and shed parachute

e. Canopy . . . . . OPEN or JETTISON (at pilot's discretion)

f. ABANDON THE AIRCRAFT.

NOTE

If time permits, install the seat pin(s).

TAKE-OFF ABORT

11. If an abort is required during the take-off, proceed as follows:

a. Throttle . . . . . IDLE

b. Brakes . . . . . APPLY

12. If the abort is the result of an engine failure or fire/overheat indications, proceed as follows:

a. Throttle . . . . . CUT OFF

b. Brakes . . . . . APPLY

c. Engine master switch . . . . . OFF

d. DC master switch . . . . . OFF

e. Carry out the Emergency Ground Egress if there is any indication of fire.

NOTE

If required, the canopy may be opened to aid in reducing the stopping distance; however, if the stopping distance must be shortened immediately, the landing gear may be retracted by depressing the landing-gear down lock OVERRIDE switch while simultaneously raising the landing-gear control lever. The DC master switch must be selected to BATT in order to carry out this procedure.

ENGINE MALFUNCTIONS

13. Engine malfunctions are rather uncommon on the Tutor aircraft. However, due to this fact, it has been observed on several occasions that unrelated problems have been misdiagnosed as engine malfunctions. This is particularly true at low altitude where there is very little time to analyze problems as a result of concern over impacting the ground. Therefore, while at low level, if you suspect an engine malfunction, immediately commence a Zoom keeping the wings level, keep the throttle in its current position, and engage the airstart switch. Take the time to properly analyze the situation concentrating on the engine instruments and your condition of flight. Consider the possibility of ejection as you may well be in a position where recovery of the engine to a usable condition may not be possible. If you decide there is time to continue, proceed with the appropriate emergency response.

LOSS OF THRUST

GENERAL

14. A loss of thrust in flight may be caused by an engine flame out or a compressor stall; however, the immediate reaction to either one is the same. If operating at low altitude, it is imperative that a wings level zoom be carried out to optimize ejection parameters, simultaneously placing the throttle to IDLE and pressing the airstart ignition button. If there is no immediate indication of a relight or if compressor stall symptoms persist (refer to Paragraph 21) then continue with a Procedure 1 Relight. If at a higher altitude, and time permits carry out a Procedure 2 Relight. If time does not permit a Procedure 2 Relight to be completed by 2500 feet AGL, use a Procedure 1 Relight.

ENGINE FAILURE OR COMPRESSOR STALL IMMEDIATELY AFTER TAKE-OFF

15. In the event of a loss of thrust due to an engine failure or a compressor stall, and there is insufficient runway remaining to land or to abort, either eject or force land straight ahead (pilot's discretion).

PROCEDURE 1 RELIGHT

16. The Procedure 1 Relight is as follows:

WARNING

If at any time during this procedure, there is any doubt as to a timely engine recovery, a decision, either to eject or to force land, must be made and carried out.

a. Throttle . . . . . CUT OFF

b. Engine master . . . . . OFF THEN ON

c. Starter switch . . . . . ENGAGE

d. Throttle . . . . . IDLE

e. Airstart ignition . . . . . ON

f. If the relight or compressor stall clearing is successful, then slowly advance the throttle to the required RPM. If a compressor stallwas experienced, the recommended RPM

is 85%. Advancing the throttle after a successful relight will not be effective until flight idle RPM has been reached. Check engine instruments and reset the generator if necessary. Recovery to land should be made as soon as possible. If the relight was unsuccessful and there is sufficient time, press starter stop to conserve battery power.

g. If the engine does not relight eject or force land (pilot's discretion).

17. Wind-up times using either the airstart ignition or a battery start are similar to those for normal ground starts. For example, it takes approximately 10 seconds to recover idle RPM when the engine is relit at 35% RPM, and approximately 25 to 45 seconds to recover idle RPM when the engine is relit at normal gliding RPM (approximately 8%). Since engine RPM winds down rapidly after engine failure, it is essential that relight attempts be initiated as quickly as possible. Nevertheless, expect the relight process to take considerable time, especially since wind-up times could be even greater if the engine is damaged. Low RPM at low altitude may dictate an immediate decision either to eject or to force-land, since even a relit engine may not wind up to useful RPM before it is too late to recover.

18. There is a rapid decrease in aircraft performance following engine failure. At final approach speeds, expect the rate of descent to increase rapidly if airspeed is maintained, and a rapid deceleration if a climbing attitude is attained for ejection. Level flight or a climb can be momentarily attained from normal final-approach speeds; however, safe ejection depends on initiating the ejection sequence immediately upon attaining the desired flight path. At low airspeed and low altitude, trim for level flight and if possible, maintain a positive rate of climb prior to ejection.

CONSIDERATIONS FOR ENGINE RELIGHT

19. An engine relight should be attempted when:

WARNING

Do not attempt a relight if either a fire or a fuel leakage is suspected.

a. The cause of the engine flame-out is corrected.

b. The cause is unknown, but no apparent damage nor fire exists.

FACTORS AFFECTING ENGINE RELIGHT

20. The factors affecting engine relight are as follows:

a. **Engine RPM.** A minimum RPM of 12% up to 15 000 ft and above 15 000 ft an additional 1% RPM for each additional 1 000 ft is needed to obtain a relight using the initial response to Loss of Thrust. Wind up times for wind milling relights may take up to 45 seconds. If the engine RPM has decreased below this value, do not delay in using Procedure 1 Relight, or if time permits, a Procedure 2 Relight.

b. **Altitude.** Successful wind milling relights above 25 000 ft are unlikely; however, at higher altitudes the engine may not always accelerate to flight idle RPM after relight. During internal starts, the generator comes on line at approximately 50%; it may provide enough of a load at higher altitudes to prevent the engine from accelerating to normal flight idle RPM. In this case, flight idle may be attained by increasing the airspeed and/or temporarily tripping the generator. Airspeeds in excess of 200 KIAS may be required in some cases in order to achieve engine acceleration to flight idle. See Part 4, Figure 4-25 for Flight Idle Values.

c. **Indication of a Relight.** A successful relight will be indicated initially by a rise in EGT. Subsequent to an EGT increase, the RPM should accelerate to flight idle RPM, except in some cases at high altitude (refer to Step b).

PROCEDURE 2 RELIGHT

NOTE

Relight attempts are not recommended above 25 000 feet.

21. Procedure 2 Relight is as follows:

CAUTION

If the engine has seized (zero RPM), an attempt to relight using Procedure 2 will probably cause complete electrical failure or possibly a fire. Procedure 2 Relight attempts are not recommended with a seized engine if the aircraft can be force-landed on a prepared surface. However, if the engine has seized, a Procedure 2 Relight might be tried as a last resort in lieu of an ejection.

a. Throttle . . . . . CUT OFF

b. Non-essential electrics . . . . . OFF

c. Ignition, start control and series-parallel circuit-breakers . . . . . IN

d. Dc MASTER switch . . . . . BATT

e. Engine master switch . . . . . OFF THEN ON
This re-arms the start sequence relays.

f. Low fuel-pressure legend . . . . . OUT
If the low fuel pressure legend is still illuminated, this may have beenthe cause of the flame out. In thiscase, delay relight attempts until at,or below, 20 000 feet.

g. Starter switch . . . . . ENGAGE

h. Throttle . . . . . IDLE

i. Airstart ignition . . . . . ON

j. Starter-Stop . . . . . PRESS
Press Starter-Stop when RPM stabilizes or unable to start.

k. Throttle . . . ADVANCE TO REQUIRED RPM
(refer to Procedure 1 Relight, Paragraph 16)

l. Engine instruments . . . . . CHECK

m. Generator control . . . . . RESET
(if necessary)

n. LAND AS SOON AS POSSIBLE

o. If the engine does not relight, eject or force land (pilot's discretion).

COMPRESSOR STALL IN FLIGHT

WARNING

Symptoms of an air conditioning turbine failure: a thump or rumble noise, may be similar to those of a compressor stall. If the initial items in the LOSS OF THRUST check are carried out, the loss of thrust due to moving the throttle to idle may further convince the pilot that there is an engine-related problem. It is therefore critical that, during compressor stall clearing procedures, the engine instruments be checked and the situation analyzed prior to continuing with a relight procedure, forced landing or ejection. An air conditioning turbine failure is often accompanied by white, oily smelling smoke in the cockpit.

22. Normally, a compressor stall is recognized by a thump or rumble which can be felt and heard. A stall can be experienced during rapid throttle movements or during extreme flight attitudes, and is characterized by a loss of thrust, a simultaneous increase in EGT, and a reduction in RPM to the 65-80% range. If a compressor stall occurs in flight, proceed as for LOSS OF THRUST.

EJECTION

EJECTION VS FORCED LANDING

23. In some emergency situations the decision to force-land the aircraft may provide a better survival probability, particularly in high wind. The Tutor is stressed for forced landings. If you are obliged to force-land on rough terrain, pick the best path you can and touch down as slowly as possible with the landing gear and flaps down.

PRE-EJECTION PROCEDURES

24. Before ejection, if time and conditions permit, complete the following checks:

a. Turn aircraft towards uninhabited area.

b. Select GUARD, transmit MAYDAY, transponder to EMERGENCY.

c. Stow all loose equipment.

d. Carry out personal safety check (bottom to top):

(1) Seat pin . . . . . REMOVED

(2) Zippers . . . . . CLOSED

(3) Harnesses . . . . . TIGHT AND LOCKED

(4) QRB . . . . . LOCKED

(5) Chin strap and mask . . . . . TIGHT

(6) Visors . . . . . DOWN

e. Airspeed . . . . . 180 IAS optimum

f. Bail-out bottle . . . . . AS REQUIRED

g. Assume the proper ejection position (see Figure 3-2-1).

LOW-ALTITUDE EJECTION

WARNING

The Tutor aircraft may pitch nose-down abruptly during the ejection sequence. This pitching can be most severe if the speed at ejection initiation is less than when the emergency situation developed and the aircraft has not been trimmed while IAS deteriorated. This stresses the importance of trimming the aircraft neutral as well as assuming a climbing attitude prior to ejection. At very low altitude, maintain control of the aircraft until seat ejection takes place. If necessary, control the aircraft with one hand and raise a handgrip with the other, ensuring that you maintain correct ejection posture.

25. Successful survival from an extremely low-altitude ejection depends on ejection vectors which are governed by such things as aircraft pitch attitude, sink rate, G-forces, and bank angle. If possible, or if time permits during a low-altitude ejection, exchange airspeed for altitude. This has the effect of establishing a nose-up attitude and a positive rate of climb (an up vector). If a rate of climb cannot be attained, level-flight ejection should be accomplished immediately to avoid ejection in a nose-down attitude with a sink rate (a down vector).

HIGH-ALTITUDE EJECTION

26. For a high-altitude ejection, basic ejection procedures apply. The ‘zoom-up’ manoeuvre is used to slow the aircraft to a safer ejection speed, or provide more time and glide distance as long as an immediate ejection is not mandatory. Prior to ejection actuate bail-out bottle.

EJECTION POSTURE AND SEQUENCE

WARNING

Regardless of altitude, do not release the automatic seat belt manually prior to ejection. Doing this would eliminate the automatic opening feature of the parachute. Furthermore, separation from the seat may be too rapid at high speed, thus causing injury to the pilot.

27. Assume ejection position (see Figure 3-2-1). Raise either handgrip (60-lb pull force required), and place hands between thighs. The first action locks the shoulder harness, jettisons the canopy, and actuates the seat. The second ensures that the handgrips are released prior to seat-separation.

NOTE

To allow for automatic canopy jettison, a 1/2 second will elapse from the time the handgrips are pulled until ejection takes place.

28. The total time required for the ejection sequence is approximately five seconds. Ejection sequence is that time beginning with the raising of the handgrips until the parachute is providing a survivable rate of descent. If the aircraft is in a dive, in a sink-rate condition, or in an attitude (inverted, wings level, banking or turning) that would cause ground impact in less than this time, successful ejection cannot be expected. (Part 1 describes the ejection sequence.)

29. If the ejection occurs in a near-stalled or high sink-rate condition at very low altitudes, as well as the ejection up-vector being negated by the aircraft down-vector, there is also the danger of the aircraft wreckage interfering with the escape path of the pilot. Avoid this type of ejection. If, however, the aircraft is irrecoverably in a descent, the only course of action is an attempt to obtain a wings-level, nose-up attitude and eject as soon as possible, since ejection offers the only opportunity for survival.

NOTE

To jettison the canopy only, use the alternate jettison handle.

DUAL EJECTION

30. When the first occupant ejects, the rocket blast will not interfere with the ejection procedure of the remaining occupant.

Figure 3-2-1 Ejection Position

EJECTION-SEAT CAPABILITIES

31. The rocket catapult seat provides for immediate escape from the aircraft. The following are the minimum bail-out altitudes:

a. The rocket catapult ejection seat is a means of emergency escape provided that the aircraft speed is between 60 and 350 knots (111 and 648 km/h) indicated airspeed and the aircraft altitude is 150 feet (46 m) or greater from ground level.

b. Radar final approach (183 MPM (600 FPM) rate of descent) 55 m (180 ft) (46 m (150 ft) plus compensation for rate of descent).

DANGER

These ejection altitudes are absolute minimum system limits. Pilot reaction time is not included, and no safety factor is provided for equipment malfunction.

WARNING

The Tutor ejection seat has only been tested for personnel weighing between 58.96 kg (130 lbs) and 90.17 kg (200 lbs), not including weight of clothing or equipment (optimum weight is 74.84 kg (165 lbs)).

NOTE

Recommended optimum ejection speed is 180 KIAS.

32. The effect of bank on ejection is illustrated in Figure 3-2-2.

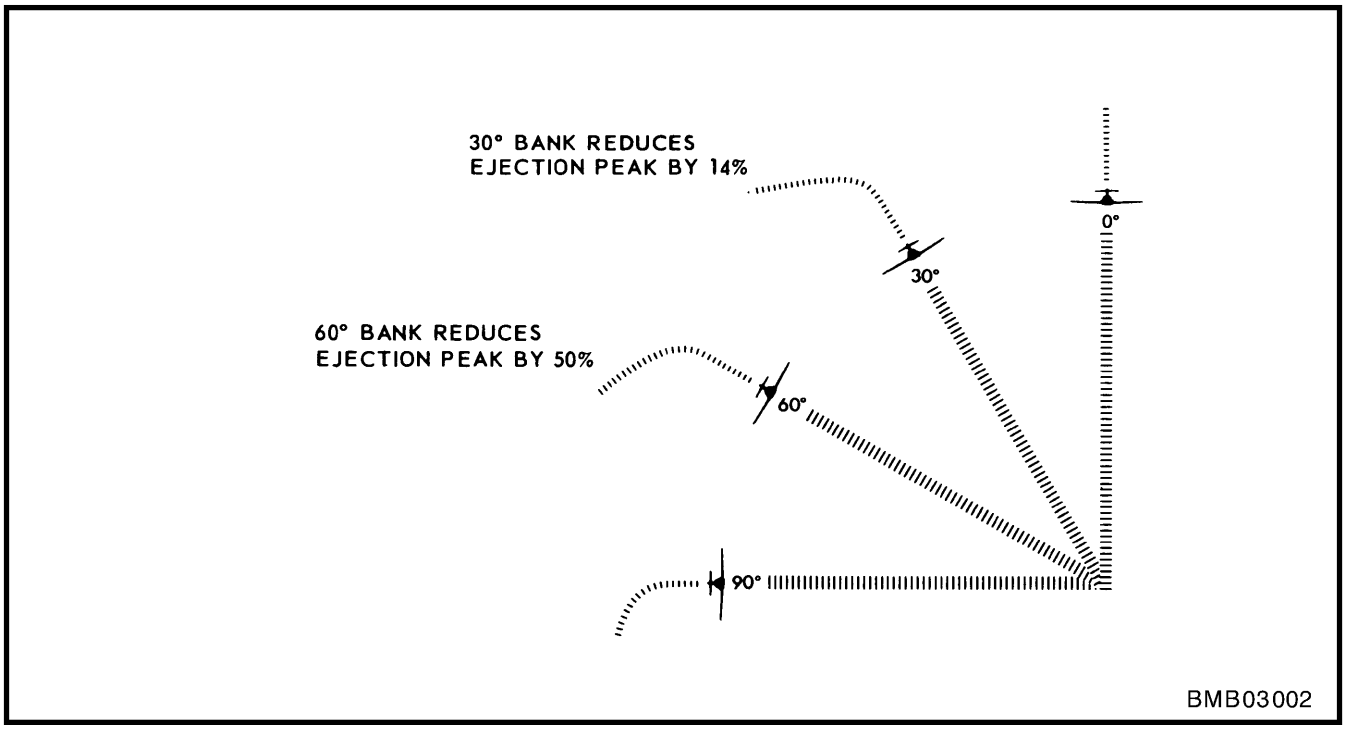

Figure 3-2-2 Effect of Bank on Ejection

EJECTION ALTITUDES

WARNING

Due to excessive altimeter lag, the decision to eject during emergencies involving high rates of descent should not be based on altimeter reading alone because ejection may be delayed until it can no longer be successfully completed. Under these conditions, the decision to eject must be based on the pilot's judgement and ability to control the aircraft, rather than on the altimeter reading.

33. If possible, eject at or above 2000 feet AGL in level flight conditions. The chance of survival in bail-outs below 2000 feet AGL is markedly lower than for those above 2000 feet AGL. In a spin or a dive, eject at 7000 feet AGL or above, whenever possible.

LOCATION SIGNALS

34. Ejection seats in the Tutor aircraft incorporate a feature which enables ground installations to locate the position of an ejection, thereby facilitating rescue of downed aircrew. As the seat leaves the aircraft, the transponder is triggered. It automatically cycles to mode 3 code 7700 and begins transmitting. The UHF will be automatically activated, and it will transmit a continuous direction-finding tone on 243.0 MHz. These signals continue until the aircraft strikes the ground.

POST-EJECTION

35. Immediately after ejection, carry out the following procedures:

WARNING

Excessive G-force accompanying parachute deployment above 16 000 feet could cause serious injury, damage the parachute, or both.

a. Ensure that both handgrips are released.

b. Visually check the lap belt to ensure that it has opened automatically. If the automatic feature has failed, immediately open the lap belt manually. As soon as the belt is released, a determined effort must be made to separate from the seat to obtain full parachute deployment at maximum terrain clearance. This is extremely important for low-altitude ejections.

c. During low-altitude ejection (below 16 000 feet), the system should provide automatic parachute deployment within one second after seat separation. If the lap belt has been opened manually, or if automatic parachute deployment does not occur with in one second after seat separation, immediately pull the parachute ripcord D-ring.

d. During high-level ejection (above 16 000 feet), the system should provide automatic parachute deployment after free fall to approximately 16 000 feet. If the lap belt has been opened manually, or if automatic parachute deployment should fail, pull the parachute ripcord D-ring after free fall to approximately 16 000 feet.

CAUTION

It may be necessary to resort to cutting suspension lines. This action is extremely dangerous: it increases descent rate and decreases stability. Do not attempt cutting lines on a severely damaged canopy.

e. Immediately following parachute deployment, look up and check the canopy. Small rips or splits may be evident. Such minor damage is common and will have little effect on descent and landing. If risers and suspension lines have become twisted, grasp the riser sets and push outward, at the same time kicking the legs in the opposite direction of the twists. If the ejecting pilot (or equipment) becomes entangled in the suspension lines, there must be an attempt to disentangle: serious injuries can result if the body is poorly positioned when landing.

f. Parachute control may be required to stop oscillation beneath the parachute, to change the direction in which the body is facing, and to sideslip away from an undesirable landing area. Manipulation of the risers is the only means of controlling the descent; it is extremely limited for aircrew parachutes. Attempts at parachute control must be discontinued in time to permit the rate of descent to reduce and stabilize before ground contact. As a general rule, manoeuvring should not be initiated nor continued below 500 feet. Note the following detailed points of parachute control.

(1) **Oscillation.** To stop oscillation, reach up and grasp any two adjacent risers and pull down as far as possible. Hold them until the oscillation stops or until reaching 500 feet above ground.

(2) **Change of Direction.** A change in direction can be effected by grasping and pulling down one riser on the side to which a turn is required (i.e., to turn right, pull down on a right riser). Hold the riser down until the body is facing the desired direction or until reaching 500 feet.

(3) **Sideslip.** Pulling down on two risers on one side will result in a sideslip in that direction. Sideslip may be used to carry the parachute from the projected landing area to one which is more desirable. Do not start the sideways movement in this manoeuvre too early: it will be tiring. There may also be changes in wind drift during the descent, which will alter the projected landing points.

g. Below 10 000 feet, if time permits:

(1) loosen the oxygen mask,

(2) disconnect the bail-out bottle from the oxygen hose connector, and

(3) undo the oxygen-hose snap fastener from the parachute shoulder strap.

LANDING IN OPEN TERRAIN

36. Proceed as follows:

a. Discard the oxygen mask. Pull downwards on the bayonet release fittings to release the mask.

WARNING

Do not pull the seat-pack release handle before the parachute is deployed, since this could interfere with the parachute opening. Body oscillations should be controlled prior to deploying the seat pack. Seat-pack deployment while oscillating may increase the oscillations.

b. Pull the handle to deploy the seat pack at approximately 1000 feet AGL. Be advised that while the pilot is suspended in the parachute harness the deployment handle will likely shift up the back from its expected location (i.e., where it is located while sitting on the RSSK). If the seat pack fails to deploy after several attempts, the following should be considered.

(1) The seat pack may be detached by releasing the two airlock fasteners; however, there is a chance that the lanyard may fail and/or some damage may occur to the contents. The possibility of lanyard failure may be reduced by taking up the slack in the lanyard prior to releasing the airlock fasteners and then slowly lowering the seat pack to the lanyard limit.

(2) If the seat pack is retained, there is a high probability of the pilot being injured on ground impact.

(3) The life raft will not inflate while it is in the seat pack whether or not the seat pack is released or still attached.

c. Assume landing position:

(1) Chin in chest.

(2) Back rounded.

(3) Hands on risers, elbows forward.

(4) Feet together and knees slightly bent.

(5) Both feet turned off at right angles to line of travel.

(6) Toes pointed down so that the first contact is made with the balls of the feet.

d. On ground contact:

(1) Allow body to roll with the impact.

(2) Rotate and squeeze the Quick-release box (QRB).

(3) Discard parachute harness.

(4) If the parachute cannot be released by the QRB, collapse the parachute canopy by pulling the suspension lines nearest to the ground or by running towards or around the canopy.

(5) When landing on a field or in water during windy conditions, it is preferable that the QRB be rotated to the release position prior to the landing. At approximately 500 feet

AGL, rotate the QRB to the RELEASE position and place both hands back on the risers until ground/water contact. On ground/water contact, squeeze the QRB hard.

LANDING IN A WOODED AREA

37. When landing in trees, the possibility of the QRB being accidentally struck is considerable. Therefore it is preferable that the QRB be left in the locked state when it appears that landing in a wooded area is inevitable. The following procedures will enhance the chances of a safe landing:

a. Retain seat pack.

b. Ensure oxygen mask is on tightly and visors are down.

c. Cross arms in front of face with chin down and grasp the front risers.

d. Keep knees and feet tightly together.

WATER LANDING

38. Inflate the life preserver by pulling CO^2 bottle toggle. If preserver over-inflates, bleed off excess air by use of the oral inflation valve. Lock the oral inflation valve. If time permits:

a. Discard the oxygen mask.

b. Retain the helmet with visors down.

WARNING

Do not pull the seat-pack release handle before the parachute is deployed, since this could interfere with parachute opening. Body oscillations should be controlled prior to deploying the seat pack. Seat pack deployment while oscillating may increase the oscillations.

c. Pull the seat-pack handle to deploy approximately 1000 feet above water. Ensure that the handle is pulled firmly, then released. Check that the survival kit has been deployed and that the dinghy is inflated.

d. Upon water contact, rotate and squeeze the QRB.

e. Carefully remove any suspension lines that may be wrapped around the body; do not struggle or move rapidly.

f. If trapped under the parachute, move out from under the canopy by slowly pulling the canopy forward from behind the head and following a gore line (panel seam) until clear of the canopy.

g. If dragged on water entry, assume stable drag position, with back to parachute and arms and legs spread, chin in. Release the QRB. Clear leg straps. Place one arm under the shoulder harness, allowing the parachute to pull off that shoulder, and then roll out of the harness.

h. Discard the parachute.

i. Enter dinghy from the small end.

FORCED LANDING

39. If it is decided to carry out a forced landing, turn in the direction of the proposed landing area and glide at 130 KIAS (see Figure 3-2-3 for gliding distances with wind-milling engine).

NOTE

Gliding distances with a tanked or seized-engine aircraft will be less than indicated in Figure 3-2-3.

40. When carrying out a forced landing, proceed as follows:

a. Throttle . . . . . CUT OFF

b. Engine master switch . . . . . OFF

c. Landing gear . . . . . DOWN
As a general rule, the landing gear should be selected down to reduce the landing shock.

d. Flaps/speed brakes . . . . . AS REQUIRED
The wing flaps should be fully deflected prior to touch-down.

e. Canopy . . . JETTISON at pilot's discretion.
Use alternate canopy jettison handle located to the left of the centre console.

f. Harness . . . . . TIGHT AND LOCKED

g. DC master switch . . . . . OFF
Speed brakes will be inoperative when DC master switch is selected OFF.

NOTE

Windmill RPM will provide normal system hydraulic pressure for hydraulic services.

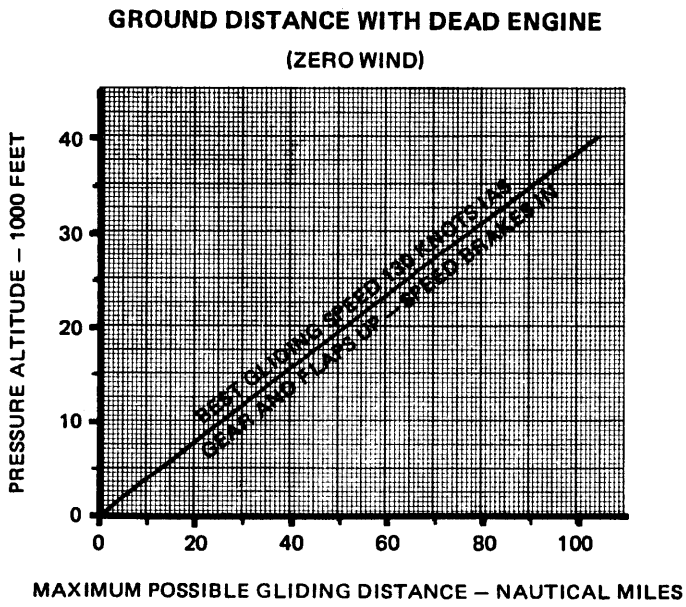

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Figure 3-2-3 Gliding Distance with a Windmilling Engine – Clean Configuration

SMOKE AND FUME ELIMINATION

41. Smoke entering the cockpit is usually caused by a malfunction of an electrical circuit or of the air-conditioning system and can be recognized by the odour. Electrical fire is usually identified by black smoke and an acrid smell. If smoke is present in the cockpit, proceed as follows:

a. Select . . . . . 100% OXYGEN AND EMERGENCY PRESSURE

b. Cabin pressure . . . . . DUMP

c. Fresh-air vents . . . . . Open

CAUTION

If the smoke does not clear sufficiently to permit aircraft control, jettison the canopy, using the alternate canopy jettison handle.

d. Check for source of smoke.

e. If electrical fire is suspected, carry out the following:

(1) VMC (Visual meteorological conditions.)

(a) DC master switch . . . . . OFF

(b) Generator control switch . . . . . TRIP

(2) IMC (Instrument meteorological conditions.)

(a) DC master switch . . . . . OFF

(b) Inverter 2 . . . . . OFF
(An inverter must remain on to power LH A/I and AC instruments.)

(c) Unnecessary electrics . . . . . OFF

(d) ATTEMPT VMC
(Once VMC then continue as above.)

(3) LAND AS SOON AS POSSIBLE OR EJECT

CAUTION

If conditions require an instrument approach, use only minimum electrical equipment; if smoke is still occurring, the consequences of loss of equipment at a critical phase of flight must be considered.

HYPOXIA/HYPERVENTILATION/ OXYGEN SYSTEM EMERGENCY

42. If suspected hypoxia or hyperventilation occurs or if there is no indication of oxygen flow, immediately proceed as follows:

a. Emergency oxygen bottle . . . . . PULL

b. Breathe normally

c. Descend immediately to 10 000 feet cabin altitude

d. LAND AS SOON AS POSSIBLE

NOTE

This procedure provides minimum delay in ensuring breathable air is available. Once at 10 000 feet cabin altitude, removal of the oxygen mask is at the pilot's discretion. However, if there is any doubt as to the purity of the main oxygen supply, the mask should only be used for radio transmissions.

ABNORMAL SYMPTOMS

43. Upon detecting any abnormal physiological symptoms which might be related to respiration, immediately proceed as follows:

a. Avoid pulling G, extreme head movements, high cabin temperatures, and straining manoeuvres.

b. Press to test momentarily.

c. If no pressure is felt in the mask, proceed as follows:

(1) Emergency oxygen bottle . . . . . PULL

(2) Descend cabin altitude to 10 000 feet.

d. If pressure is felt in the mask, proceed as follows:

(1) Select . . . . . 100% OXYGEN and EMERGENCY PRESSURE

(2) Breathe normally.

e. If there is no immediate improvement, proceed as follows:

(1) Emergency oxygen bottle . . . . . PULL

(2) Immediately descend cabin altitude to 10 000 feet.

(3) LAND AS SOON AS POSSIBLE

NOTE

If emergency bailout oxygen is activated while still connected to the aircraft oxygen system, it is impossible to exhale through the MBU-12/P oxygen mask combination valve.

RUNAWAY TRIM

44. A trim isolate switch on either control-column grip removes electrical power from the elevator normal trim circuit. A runaway aileron trim condition is stopped by use of the alternate trim switch on the left console.

NOTE

At airspeeds below 150 KIAS, the aircraft may be flown safely in any configuration with full trim in either direction.

45. If runaway elevator or aileron trim is suspected, proceed as follows:

a. Press the trim isolate switch and hold the control column firmly.

b. Reduce airspeed to 150 KIAS.

c. Operate the elevator or aileron alternate trim switch to regain positive control. The trim isolate switch may be released after the alternate trim switch is moved from the NORMAL position.

d. LAND AS SOON AS POSSIBLE

HOT BRAKES

46. Overheated or hot brakes may be caused by one or more of the following situations:

a. aborted take-off;

b. minimum roll landing using maximum braking;

c. dragging brake caused by mechanical failure or improper use of the brake; and/or

d. use of power against brake for any extended period.

47. High fuel weight (ie tanked aircraft) will increase the likelihood of hot brakes.

48. An overheated brake will cause an increase in the tire temperature that continues for some time after the aircraft is stopped. This continuous build-up of heat could cause catastrophic tire or wheel hub failure. Although this is unlikely on the Tutor aircraft, brake fires and injury to personnel are quite possible. If hot brakes are suspected, it is important to advise emergency crews and carry out the following procedures:

Aircraft . . . . . STOP

If possible:

Face aircraft into wind.

Delay shut-down until fire crew arrives.

This is to prevent vented fuel from contacting the hot brake and possibly causing a fire.

ABANDON THE AIRCRAFT FORWARD

PART 4

OPERATING DATA

ENGINE LIMITATIONS

ENGINE OPERATING LIMITATIONS

1. Engine operating limitations are shown in Figure 4-1. When using RPM at altitudes above 30 000 feet, the minimum airspeeds shown in Figure 4-2 must be observed. Figure 4-6 shows the recommended engine envelope and indicates regions where compressor stall/flameout is more likely to occur at any power setting.

2. For continuous operation in icing conditions, the engine speed must not be reduced below 78% RPM. If it should become necessary to operate at engine speeds lower than 78% RPM, the engine must be de-iced at intervals of one minute by advancing the throttle slowly to full RPM (five seconds from the selected minimum speed to full RPM).

3. The engine Main Fuel Control Unit (MFCU) has a specific gravity setting, which is nomally set for use with JP-8 fuel. Use of JP-4 or Jet B (with FSII) as an alternate fuel is restricted to one flight only, unless maintenance personnel have adjusted the MFCU density setting. Engine limitations may be exceeded when fuel type and MFCU density settings do not match. All other alternate fuels listed at Part 1, Paragraph 8.b. may be used without restriction when the MFCU density setting is adjusted for JP-8 fuel.

STARTER AND IGNITION LIMITATIONS

4. Continued operation of the starter and ignition system is limited to three consecutive stages: 45 seconds ON followed by one minute OFF; 30 seconds ON followed by one minute OFF; 45 seconds ON followed by 25 minutes OFF.

Condition	RPM	Max EGT (°C)	Time Limit
Start		900	Abort
		850 for 5 sec	Abort
		780 for 10 sec	Abort
Running		700	5 minutes after take-off
		675	Continuous
	101%		Refer to Figure 4-26

NOTES

1. All operations above 700 °C, from idle to maximum RPM, shall be entered in the Record of Minor Defects for future maintenance background information.
2. During the start cycle, temperatures between 800 and 900°C shall be recorded on Record of Minor Defects for future maintenance background information. Temperatures in excess of 900 °C are cause for placing the aircraft unserviceable.
3. An increase in EGT and RPM may be experienced as altitude increases with throttle at maximum. This condition is normal and can be overcome with a slight reduction in throttle. The above EGT temperatures do not coincide with C-14-165-000/MF-000 due to accuracy of the EGT gauge.
4. EGT may rise rapidly on start. If EGT climbs rapidly through 850°C, ABORT start.

Figure 4-1 Engine Operating Limitations

5. The nominal operating temperature of the battery for best performance is 0 to 30°C. Battery starts must be minimized during extreme hot or cold temperatures where the aircraft has been exposed to the elements long enough to achieve ambient outside air temperatures. At minus 40°C, battery capacity is halved, and at temperatures in excess of 35°C, an increase in water used will be noted which will contribute to premature failure.

6. If a battery start fails due to suspected weak batteries (slow spool up, low RMP), the batteries shall be replaced prior to the flight. If it is determined that the start failed for reason(s) other than weak batteries, a second start may be attempted. Ideally, this second start should utilize a GPU, however, if a

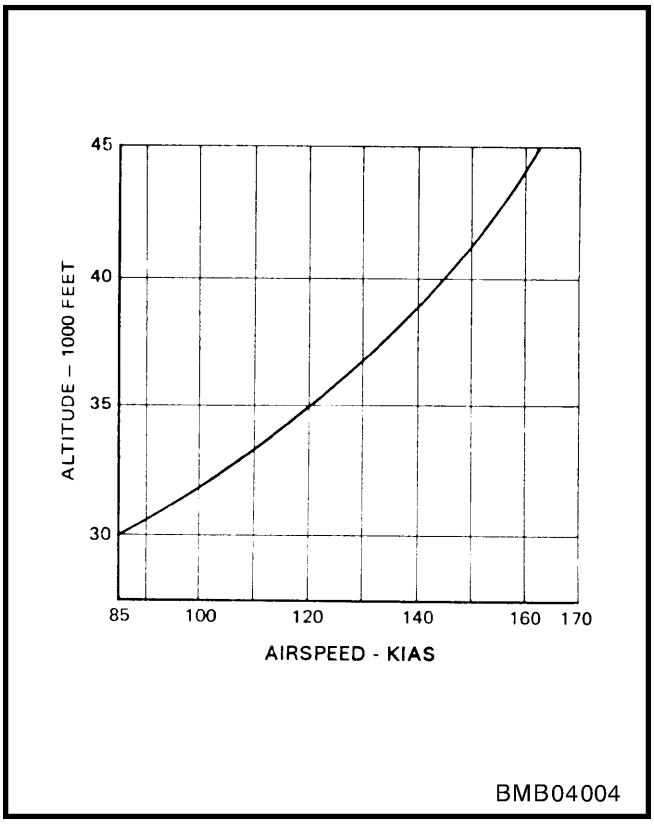


Figure 4-2 Minimum Permissible Airspeed Above 30 000 Feet With Throttle at IDLE

GPU is not available, a battery start may be attempted after it is determined that the batteries have cooled to ambient temperature. If the second battery start fails, the batteries shall be replaced prior to flight.

FLIGHT RESTRICTIONS

GENERAL

7. The following are general restrictions:

   a. For solo flight, operate the aircraft from the left seat, as the right seat station does not have complete operating controls.

   b. Instrument range markings are shown in Figures 4-3 and 4-4.

   c. Because of engine oil supply and pressure requirements, engine operation is restricted to the following:

      Zero Oil Pressure – 30 seconds

CAUTION

One minute must elapse between periods of inverted flight to ensure that the collector tank is completely replenished.

   d. The permissible flight time under zero-or negative-G conditions (including sustained inverted flight) must not exceed 15 seconds.

NOTES

1. Maintain a close check of oil pressure during manoeuvring flight, particularly when negative-G or rolling manoeuvres are performed. During these conditions of flight, oil venting will occur. Excessive loss of oil may be indicated by oil pressure fluctuations or a momentary loss of oil pressure. If oil pressure does not recover within ten seconds, return the aircraft to a normal attitude. Each roll or transition from positive-to negative-G will cause approximately 1/6 to 1/4 pint of oil to be vented. A four-or eight-point roll, or similar manoeuvre in which the aircraft is in other than normal flight attitude, may result in greater oil loss because the resultant G-force on the inverted vent-valve piston is not great enough to cause it to move and seal off the vent lines. Under one pint of oil may be vented each 15 seconds during the manoeuvre. Although continuous, fully inverted and level flight should not cause oil venting if the inverted flight vent is functioning normally; flight under zero-or negative-G conditions is restricted to 15 seconds at any one time. (This is not a cumulative time for a given flight).

2. The oil pressure may drop momentarily, and the LOW FUEL QUANT and LOW FUEL PRESS legend may illuminate momentarily, during entry and recovery. This does not render the aircraft unserviceable.

   e. The aircraft must not be flown under zero-or negative-G conditions following illumination of the LOW FUEL QUANT legend. Under zero-or negative-G conditions, the only fuel available is that remaining in the collector tank. Although the tank holds 6.3 gallons of fuel, only 2.9 gallons can be recovered from

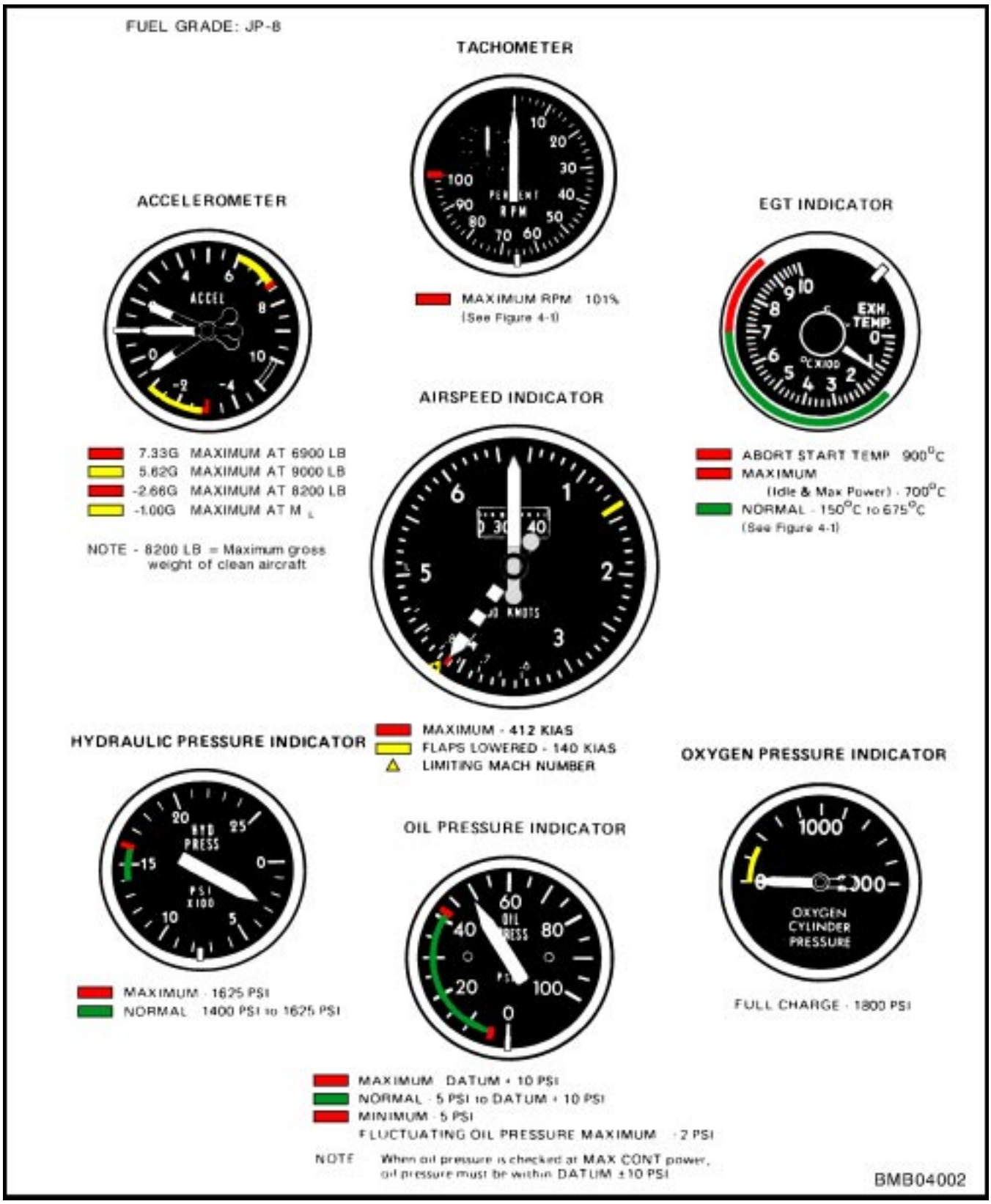


Figure 4-3 Instrument Range Markings

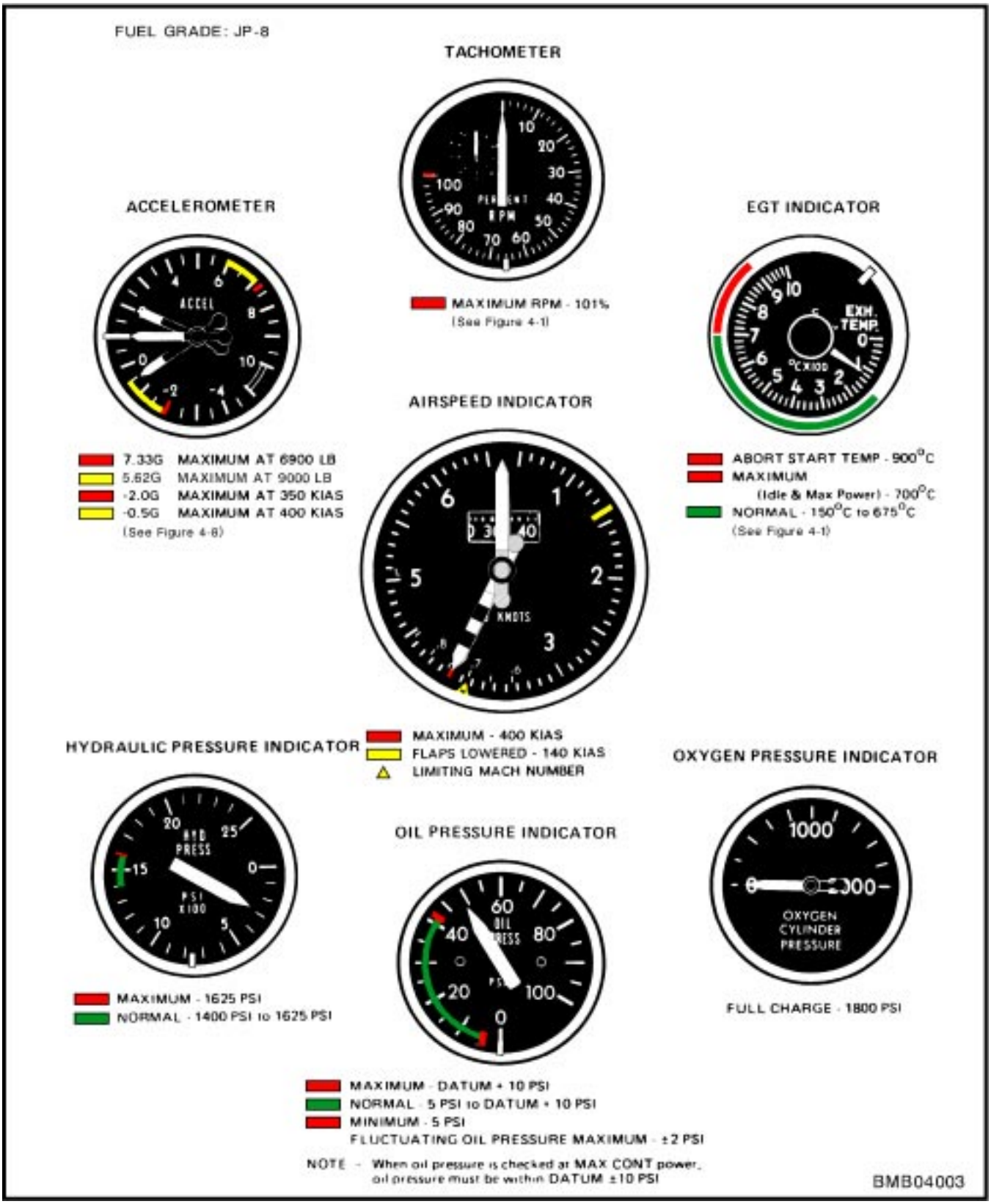


Figure 4-4 Instrument Range Markings – Tanker

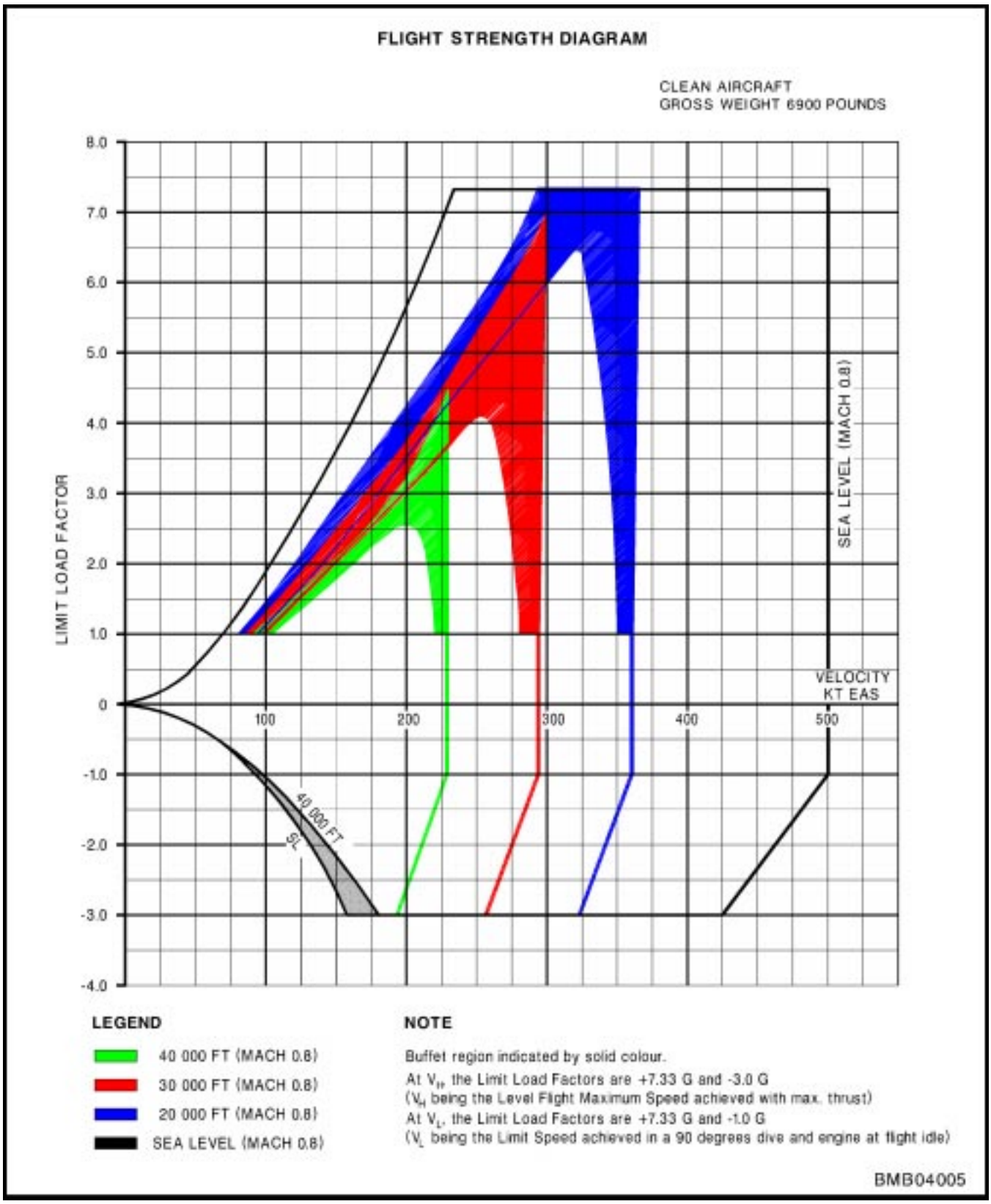


Figure 4-5 Flight Strength Diagram

the tank by the fuel boost pump while the aircraft is inverted. Once this is consumed, the engine will flame out.

f. Heavy rudder sideslips and uncoordinated rolls generate high asymmetrical loads on the horizontal stabilizer. Under certain conditions, these loads may exceed the aircraft structural design limits. Manoeuvres not described in A-12-114-001/PT-D01 – Manual of Flying Training, should be avoided to the maximum extent possible. Specific prohibited manoeuvres are listed in Paragraphs 8 through 12.

g. The aircraft must not be flown in sustained inverted flight above 41 000 feet.

h. Never actuate the canopy in normal flight.

i. Landings with external fuel are restricted to a maximum of 600 FPM rate of descent.

PROHIBITED MANOEUVRES

8. Full rudder side-slips are prohibited in any flaps down/speed brake out (gear up or down) configuration, because the rudder may lock in the deflected position. Positive control application is required to recover (refer to Rudder Lock, Part 2, Section 1, Paragraph 43).

9. The following rolling manoeuvres are prohibited:

a. Rolling manoeuvres at less than -1.0 G;

b. Four point rolls; and

c. Any max deflection aileron manoeuvre.

10. Inverted spins, stall turns, and tumbling manoeuvres are prohibited. Cross controlling during the near vertical phases of looping manoeuvres at low indicated airspeeds will induce extremely large side-slip angles. If the rudder position is maintained, the aircraft may enter a tumble or inverted spin.

WARNING

If this condition of flight is encountered (and allowed to continue), structural failure is possible. Initiate recovery immediately. Complete a simulated landing approach at altitude to check for structural damage before landing. If unable to recover before structural failure occurs, or at 7000 feet above ground level, whichever occurs first, eject!

11. Intentional spins are prohibited when carrying external fuel tanks.

12. Care should be exercised when manoeuvring above 30 000 feet as any yawing, pitching and uncoordinated low airspeed manoeuvres, throttle movements may induce a compressor stall/flame-out. Looping manoeuvres above 30 000 feet are prohibited.

AIRSPEED AND ACCELERATION LIMITATIONS

FLAPS AND LANDING GEAR

13. The maximum permissible speeds with the gear and flaps extended are as follows:

a. landing gear (and gear doors) – 175 KIAS;

b. flaps 25° – 175 KIAS; and

c. flaps 40° – 140 KIAS.

MAXIMUM AIRSPEEDS AND ACCELERATIONS

14. For Flight Strength diagram, see Figure 4-5. Airspeed and acceleration limitations are shown in Figure 4-8.

CAUTION

Maximum operational indicated Mach number (IMN) of 0.73 may be exceeded above 20 000 feet for the purpose of demonstrating compressibility. The effects of compressibility are: a nose-down pitching moment or tuck, airframe buffet, and lateral oscillations. These normally become apparent between 0.73 IMN and 0.78 IMN. Maximum permissible IMN (M_L) of 0.78 must not be exceeded. Dive recovery is accomplished by reducing power, extending the speed brakes, and raising the nose as the airspeed decreases.

FUEL TANK JETTISONING

15. Maximum and minimum release speeds for external fuel tanks are shown in Figure 4-7.

WEIGHT AND BALANCE LIMITATIONS

16. The maximum permissible gross take-off weight is 9000 pounds (4082 kg). The maximum allowable landing gross weight is 8800 pounds (3991.6 kg). For other specific weight and balance data, refer to CFTO C-12-114-000/MW-000.

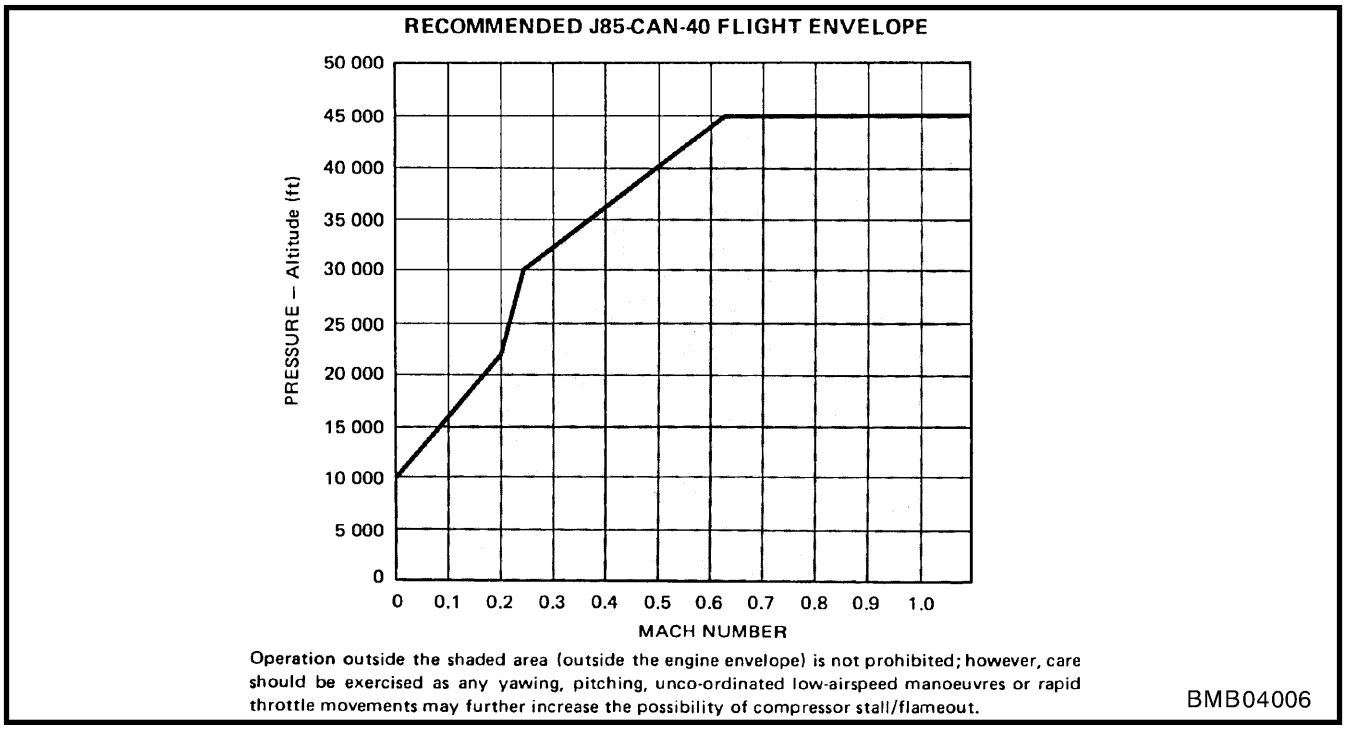


Figure 4-6 Recommended J85-CAN-40 Flight Envelope

Model: Tutor	Cruise Configuration	
Tank Status	Maximum KIAS	Minimum KIAS
Full	300	100
Empty	180	125

Figure 4-7 External Tank Jettison Speeds

PERFORMANCE DATA

GENERAL

17. This part contains the necessary performance data for flight planning. If the material is thoroughly understood and applied correctly, maximum benefit will be derived from its use. As a result, a favourable reduction in fuel consumption will be realized, with consequent gains in range and endurance. Therefore, the optimum performance capabilities of the aircraft will be utilized. A RF-4 training aid, computer wheel calculator, Part No. 9825330-1 (NSN 6910-21-897-4887), is available in circular slide rule format, for basic performance data.

CHART FORM

18. All pertinent information is presented in graphical form, permitting a relatively broad interpolation of values and, generally, dispensing with separate computations. Each chart contains an example of its use and is accompanied by a description in the following Paragraphs. A sample problem, typical of a normal flight, is included with explanations where necessary.

DATA BASIS

19. Unless otherwise stated on the chart, performance parameters are based on flight test data, and Standard Atmospheric (ICAO) is assumed. Where engine performance is concerned, the figures are related to the standard fuel grade specified in Part 1.

AIRSPEED CONVERSION CHART

20. The Airspeed Conversion Chart (see Figure 4-9) is used to relate IAS, TMN, and TAS. See example on chart.

STANDARD ALTITUDE TABLE

21. Significant properties of ICAO Standard Atmosphere are tabulated at 1000-foot increments between –2000 and 65 000 feet altitude (see Figure 4-10). Sea-level values of the properties are listed at the top of the chart for use with the ratios shown in the table.

AIRSPEED POSITION ERROR CORRECTION

22. This chart, consisting of two sheets, shows the position error correction that must be applied to indicated airspeed to determine calibrated airspeed (see Figure 4-11). Correction is provided for two configurations: flaps fully up, gear up or down (Sheet 1); flaps 40°, gear down (Sheet 2).

23. Sheet 1 shows the correction for indicated altitude versus indicated airspeed (up to 40 000 feet and the limiting Mach number respectively). The effect of gross weight is negligible and is therefore excluded. Enter the graph at indicated altitude and indicated airspeed. From the intersection of the two curves, drop a perpendicular to the position error scale and read off the correction.

24. Sheet 2 shows the correction for three representative gross weights versus indicated airspeed up to the maximum permissible airspeed with flaps fully down. This chart is provided for familiarization only, as the error is small enough to be ignored, and would not normally be included. Enter the graph at gross weight and indicated airspeed. From the intersection of the two curves, project a perpendicular to the position error scale and read off the correction.

AIRSPEED COMPRESSIBILITY CORRECTION

25. This chart shows the compressibility correction that must be applied to calibrated airspeed to determine equivalent airspeed (see Figure 4-12). The information is presented as pressure altitude versus calibrated airspeed (up to 50 000 feet and the limiting Mach number respectively). Enter the graph at pressure altitude and calibrated airspeed. From the intersection of the two curves, drop a perpendicular to the scale and read off the correction.

ALTIMETER POSITION ERROR CORRECTION

26. This chart, consisting of two sheets, shows the position error correction that must be applied to indicated pressure altitude to determine actual (calibrated) pressure altitude (see Figure 4-13). Correction is provided for two configurations: flaps fully up, gear up or down (Sheet 1); flaps 40°, gear down (Sheet 2).

27. In Sheet 1, the correction is shown for indicated altitude versus indicated airspeed (up to 40 000 feet and the limiting Mach number respectively). Enter the graph at indicated altitude and airspeed. From the intersection of the two curves, drop a perpendicular to the scale and read off the correction.

28. The graph on Sheet 2 contains two curves: sea level and 10 000 feet. These curves are plotted for airspeeds ranging from the stall to the maximum permissible airspeed with full flap. The largest error is found at opposite ends of this speed range and, being less than one graduation of the instrument calibrations, can be ignored. The chart is included for familiarization only. Enter the graph at indicated airspeed. From the intersection with the sea-level (or 10 000-foot) curve, project a perpendicular to the correction scale and read off the correction.

WIND COMPONENT CHART

29. The closer the wind is to a 90° crosswind, the lesser its influence on take-off or landing rolling distance. At any angle other than 90°, however, an effective headwind or tailwind component exists (in some circumstances it may be negligible). Figure 4-14 is used to determine this component when predicting the take-off and landing distances. The crosswind component can also be found.

30. Enter the chart by plotting the intersection of the angle off the runway and the curve of the velocity. From this point, project a perpendicular to each scale and read off the components.

TAKE-OFF DISTANCE, CRITICAL FIELD LENGTH, AND LINE SPEED

31. The take-off distance chart (see Figure 4-15) shows the ground-roll distance (Sheet 1), and the total ground and airborne distance to clear a 50-foot obstacle (Sheet 2). These distances apply for all configurations and establish the minimum requirements in field length for the given conditions of weight, temperature, altitude, wind, and runway gradient. Should the available field length be less, a take-off must not be attempted. In both cases, the calculations assume a hard and dry surface and are based upon the maximum performance technique, where the aircraft is lined up at the threshold with the brakes held on, while maximum continuous power is applied.

CAUTION

For aborted take-offs involving maximum braking with a total fuel load in excess of 1900 pounds, where possible, delay braking action until 85 KIAS to avoid possible brake and wheel damage. Maximum braking may be applied below 85 KIAS. If it has been necessary to apply braking above 85 KIAS while carrying external fuel, follow hot brake procedures. A major unserviceability entry on Form CF 349 is mandatory. The aircraft will then be inspected by maintenance personnel before release for further flight.

NOTE

The aborted take-off field length requirements have not been established (loss of engine during take-off roll requiring maximum braking to stop). It is recommended that take-offs not be attempted unless total field length is twice the value presented in Figure 4-15.

32. The inset graph on Sheet 1 determines the lift-off IAS at which the predicted ground-roll value will be met; that on Sheet 2 shows the IAS in the climb-out, which must be maintained if the obstacle is to be cleared.

33. Enter the chart at the surface air temperature. Proceed upward to the appropriate pressure altitude curve (interpolating as necessary), then horizontally to the take-off weight curve, and then drop vertically to the wind base line. Proceed down (or parallel to) the grid diagonally for headwind or tailwind, as applicable, to the windspeed line; then drop vertically to the runway slope base line. Proceed diagonally ‘‘uphill’’ or ‘‘downhill’’ to the slope per cent line, drop vertically to the take-off ground-run distance line, and read off the solution. If the wind component and runway slope are zero, proceed vertically from the wind base line to the take-off ground-run distance line for the solution.

34. To determine the indicated airspeed at a specified distance during the take-off run, follow the chart through to the ‘‘wind knots’’ portion and continue vertically down to the runway slope chart (disregard the wind at this point). Follow the appropriate line through the runway slope chart. Enter the ‘‘line speed chart’’ at this position and continue vertically downward to the lift-off speed. At this position an acceleration curve is reached. Follow this curve to read off the speed corresponding to a particular distance. Now apply the surface wind to this speed. Add 80% of the headwind component (see Figure 4-14) or subtract 120% of the tailwind component. This value gives an indicated airspeed at any known distance during the take-off run.

CLIMB SCHEDULE

35. This chart (see Figure 4-16) presents time taken, fuel consumed, and distance travelled during the climb to altitude using maximum continuous power for clean aircraft (Sheet 1) and aircraft with external fuel tanks installed (Sheet 2). A recommended climb CAS for every 5000 feet of altitude and the expected rate of climb are also presented.

36. The climb begins when an airspeed of 220 KIAS is attained after take-off. The table shows that 220 knots CAS is maintained to 20 000 feet pressure altitude, and that CAS must be decreased by 4 KIAS for every 1000 feet gained above 20 000 feet. The fuel values do not include the allowance for start, taxi, and take-off.

37. The graphs are plots of initial climb weight versus desired altitude. Enter the charts at the desired altitude, go horizontally to the initial climb weight, then vertically to read time and fuel required as well as distance travelled in the climb to the desired altitude. Additionally, values can be pre-determined when a climb between intermediate altitudes is planned. In this instance, determine values for old and new altitudes at the planned weights, then subtract the lower reading from the higher.

RANGE SUMMARY

38. This chart (see Figure 4-17) provides a compact picture of the still-air zero fuel range capabilities of the aircraft when cruising at constant altitude between sea level and 35 000 feet. Sheet 1 is for the clean aircraft and Sheet 2 is for the aircraft with external fuel tanks installed. The relationship between time, distance, and fuel consumed can be read off directly, without separate reference to the climb and cruise (specific range) charts. However, these latter charts must be consulted for the accurate CAS (which varies with reducing fuel weight) if the ranges shown on the range summary charts are to be achieved. It should be noted that range summary charts are exact only when start-up weights match (if start-up weights are heavier, less range will be possible and vice versa).

39. Fuel used is measured from start-up with full tanks at gross weight of 7437 pounds (8250 pounds with external tanks installed). The origin of the chart (sea level, zero distance, and zero time) corresponds

to the point where an airspeed of 220 KIAS is attained following the take-off. At chart origin, the fuel consumed is 175 pounds and gross weight is 7262 (8075 pounds with external fuel tanks).

40. The range summary chart is entered at origin. The flight path follows the climb to desired altitude, then moves horizontally across the grid. At any point along the flight path (including the climb), the fuel consumed, the total flight time to that point, and the air distance already covered can be read off. Thus, if one of the factors is known, the other two can be readily established.

41. Similarly, the values of an intermediate stage can be determined by plotting the points of any two known factors, and by subtracting the results of one from the results of the other.

42. For flights where the known distance is less than 180 nautical miles (NM), there is a cruise altitude that will show the most economical fuel requirement between take-off and arrival over destination. This altitude is determined by the intersection of the distance line and the optimum cruise-altitude curve.

43. The following examples demonstrate the use of the chart:

-EXAMPLES-

1. What is the flight time and fuel required to cruise 400 NM at 30 000 feet?

   On the 30 000-foot flight level, plot the 400-mile point.

   Sheet 1:

   Interpolate between the 1:20 and 1:40 time curves: flight time = 1 hr 23 min.

   Interpolate between the 1200 and 1400 fuel-used curves: fuel consumed = 1325 pounds.

   Sheet 2:

   Interpolate between the 1:20 and 1:40 time curves: flight time = 1 hr 25 min.

   Interpolate between the 1400 and 1600 fuel-used curves: fuel consumed = 1550 pounds.

2. What is the maximum range at 25 000 feet, with 500 pounds of fuel remaining over destination: What is the flight time?

   Sheet 1:

   Fuel consumed: 2012 – 500 = 1512 pounds. Plot the intersection of this curve with the 25 000-foot flight level.

   Read off the distance = 442 NM.

   Interpolate between the 1:20 and 1:40 time curves: flight time = 1 hr 34 min.

   Sheet 2:

   Fuel consumed: 2662 – 500 = 2162 pounds. Plot the intersection of this curve with the 25 000-foot flight level. Read off the distance = 592 NM.

   Interpolate between the 2:00 an d 2:20 time curves: flight time = 2 hrs 12 min.

3. It is necessary to position an aircraft over a point 100 NM from base for the longest possible period. What is the most economical transit altitude? How much fuel has already been consumed on arrival? Plot the intersection of the 100-NM line and the optimum cruise altitude curve.

   Sheet 1:

   Read off the pressure altitude: cruise altitude = 21 500 feet.

   Interpolate between the 600 and 800 fuel-used curves: fuel consumed = 615 pounds.

   Sheet 2:

   Read off the pressure altitude: cruise altitude = 17 800 feet.

   Interpolate between the 600 and 800 fuel-used curves: fuel consumed = 700 pounds.

4. From arrival over a 200-mile destination at 30 000 feet, the flight time at the same altitude is to be increased by 41 minutes. How much extra fuel will be consumed? What will be the total air nautical miles flown? Plot the intersection of the 200-mile line and the 30 000-foot level.

Sheet 1:

By interpolating, read off the fuel consumed and the flight time: fuel consumed = 860 pounds; flight time = 42 min. The total flight time will be 41 + 42 = 1 hr 23 min.

Plot this point along the 30 000-foot level. Read off the fuel consumed (1325 pounds) and the distance: extra fuel consumed = 1325 – 860 = 465 pounds; total air distance flown = 400 NM.

Sheet 2:

By interpolating read off the fuel consumed and the flight time: fuel consumed = 1015 pounds: flight time = 43 min.The total flight time will be 41 + 43 = 1 hr 24 min.

Plot this point along the 30 000-foot level. Read off the fuel consumed (1550 pounds) and the distance: extra fuel consumed = 1550 – 1015 = 535 pounds; total air distance flown = 395 NM.

CRUISE SCHEDULE

44. This chart (see Figure 4-18), consisting of Sheets 1 and 2, presents nautical miles per pound data for the clean and external fuel tank configured aircraft throughout the speed range, from maximum endurance to maximum continuous thrust, in a parametric form applicable to any altitude or gross weight. The chart shows basic plots of the fuel economy parameter (nautical miles per pound x Δ) versus Mach number for various gross weights divided by Δ. Conversion curves are supplied on the charts to find W/Δ for any flight weight and altitude condition, calibrated and true airspeed for the applicable altitude, actual miles per pound of fuel, and fuel flow from the fuel economy parameter.

NOTE

Δ (delta) is the ratio of the pressure at the specified altitude divided by the standard-day pressure at sea level (see Figure 4-10).

45. At the peak of each W/Δ curve, there is an optimum Mach number for maximum still-air range. On Sheet 1, for example, at 30 000 pounds this Mach number is 0.471. A line is drawn through the peak of all W/Δ curves. This line determines the maximum range Mach number for all W/Δ values.

46. Two additional lines are drawn on the cruise charts: the recommended range line gives 99 per cent of maximum possible range; the fast cruise line gives 95 per cent of maximum possible range. The recommended range line can be considered to give the maximum range for all practical purposes. The advantage of using this line, rather than the maximum range line, is that the Mach number (and therefore CAS) is increased substantially, while range is reduced only one per cent. Where maximum range is not required, a further increase in CAS can be obtained by using the fast cruise line. This gives a reduction of five per cent in the maximum range. In addition, the fast cruise line should be flown when maximum range is required where adverse headwinds are anticipated.

47. The cruise charts can be used in combination with climb charts whenever range calculations in more detail than range summary charts are required, or whenever speeds other than for recommended range are desired. Note the following points:

a. Remember, the foregoing is applicable in standard atmosphere (ICAO) conditions only. In non-standard temperatures, the chart is used merely to determine the CAS and the specific range. Regardless of conditions, the CAS must always be maintained by adjusting power as necessary or even by sacrificing altitude if insufficient power is available. However, the resultant change in fuel flow will be compensated for by a change in TAS leaving the air nautical miles/pounds of fuel substantially unchanged. Correction for wind can be found using the following formula:

$$\frac{AIRNM}{lb} \times \frac{G/S}{TAS} = \frac{groundNM}{lb}$$

b. Approximately six per cent range penalty can be expected when flying with engine anti-icing continuously operating.

-EXAMPLE-

Clean Aircraft. What is the expected distance to be travelled at 30 000 feet under the following conditions:

ICAO standard day.
Fast cruise schedule.
Initial cruise gross weight = 7070 pounds.
Fuel remaining, start cruise = 1570 pounds.
Fuel reserve, end cruise = 300 pounds. 60 KIAS headwind.

Gross weight at end of cruise = 7070 – (1570 – 300) = 5800 pounds.

Average gross weight during mission = (7070 + 5870)/2 = 6470 pounds.

Enter the W/Δ conversion chart, the average gross weight, and the cruise pressure altitude, and read cruise W/Δ = 21 500 pounds.

Enter the parametric fuel economy curve at the cruise W/Δ and fast cruise intersection, and read fuel economy parameter = 0.127 and Mach number = 0.543.From the same cruise Mach number proceed vertically downward to a point opposite the cruise pressure altitude. Read 200 knots CAS directly. Follow the true airspeed guidelines down to the TAS scale and read 318 KIAS.

Groundspeed is 318 – 60 = 258 KIAS. To determine average-air nautical miles per pound, enter chart on right at previously determined fuel economy parameter, proceed to the cruise pressure altitude and read 0.467 air nautical miles per pound of fuel.

Determine the average ground NM per pound of fuel by using the following formula:

$$\frac{groundNM}{lb} = \frac{airNM}{lb} \times \frac{G/S}{TAS}$$
$$= 0.420 \times \frac{258}{318}$$
$$= 0.340$$

Fuel to be used in cruise is 1570 – 300 = 1270 pounds.

Cruise range available is 0.340 x 1270 = 433 NM.

Time required for 433/267 = 1 hr 41 min.

From the air nautical miles per pound of fuel obtained above, continue vertically downward opposite TAS and read average fuel flow = 785 lb/hr.

ENDURANCE AT CONSTANT ALTITUDE

48. This chart (see Figure 4-19) is a plot of altitude versus fuel flow and RPM for an endurance speed of 125 knots CAS at three representative weights for the clean configuration (Sheet 1) and four representative weights for external fuel tank configuration (Sheet 2).

49. Enter the chart at pressure altitude and intersect with the appropriate weight curve under both fuel flow and RPM. In each case, drop to the respective scale and read off the solution.

NORMAL DESCENT

50. This chart (see Figure 4-20) presents the descent performance as altitude versus fuel used, time and distance covered. Sheet 1 is for the clean aircraft in two configurations, and Sheet 2 is for the external tank configuration in one configuration.

51. Enter the required graph at altitude. Intersect with the appropriate configuration curve (note that in Rate of Descent the positions are reversed) and read off the solution at the bottom scale.

CRUISE DESCENT

52. This chart (see Figure 4-21) presents the power-on descent performance as altitude versus fuel used, time, and distance covered (in still air). Sheet 1 shows the descent from cruise altitude to sea level; Sheet 2 is the top segment enlarged to show the descent to 20 000 feet.

53. The data are based on the 75% RPM at a constant let-down speed. Depending on altitude, the initial let-down speed is Mach 0.55 to 0.65. As the descent progresses and the IAS has increased to 250 KIAS or in the case of commencing from lower altitudes, where 250 KIAS is equivalent to less than Mach 0.55, the let-down is continued at this indicated airspeed.

54. Enter the chart and read off the solution in the same manner as that employed with the normal descent chart. An average ground-speed for the descent can be found by applying time and distance covered to the Appleyard scale of the E6B computer.

LANDING DISTANCE

55. The landing-distance chart (see Figure 4-22) shows the minimum ground-roll and the minimum total of ground-roll plus airborne distance from a 50-foot obstacle, for various combinations of weight, temperature, altitude, wind, and runway gradient. The calculations assume a hard and dry surface and maximum braking technique. These distances establish the minimum requirements in field length for the given conditions. Should the available field length be less, a landing must not be attempted under normal circumstances.

56. The separate speed graph in Figure 4-22 shows the maximum IAS at 50 feet and at touch-down, neither of which must be exceeded if the predicted distances are to be matched. The chart is read in a similar manner to that for take-off (refer to Paragraph 32).

TURNING PERFORMANCE

57. This chart (see Figure 4-23) presents a compact picture of the sustained turning capability of the clean aircraft at a representative gross weight of 6500 pounds. The chart shows basic plots of altitude versus Mach number for four different load factors. For example, at 15 000 feet and 0.535 Mach, a 3 G turn can be sustained without losing airspeed or altitude.

SAMPLE PROBLEM

BRIEFING

58. A two-man crew is authorized for a flight at 28 000 feet from Airfield A to Airfield B, a distance of 480 NM. Airfield condition reports are available and are expected to remain unchanged. Other than expected fair conditions and negligible winds en route, no weather forecast for cruising is available; however, surface temperatures indicate that for all practical purposes, standard atmosphere (ICAO) conditions prevail. The climb, cruise, and descent calculations will be based accordingly.

FLIGHT PLAN

59. The following flight plan demonstrates the use of the charts. Climb and cruise charts will be used in this example; however, it should be borne in mind that consultation of the range summary chart gives the same results, provided that start-up gross weights are correct and recommended range speeds are used.

-EXAMPLE-

Airfield A

Altitude	800 feet ASL
Runway Length	4000 feet
Slope	1-1/2% uphill
50-ft Obstruction	700 feet off runway end
Surface Wind	35° off, 12 KIAS
Take-Off	Downwind
Tailwind Component	10 KIAS
Crosswind Component	7.5 KIAS
Surface Temperature	14°C
Fuel	2012 pounds
Take-Off Gross Weight	7437 pounds
External Fuel Tanks	Not installed

Take-off. Enter the take-off ground-run and take-off obstacle charts at surface temperature. Read off: ground-run = 1800 feet, distance to clear obstacle = 2550 feet.

These are both within available field lengths. Since available runway length is greater than twice the required runway length, an abort can be successfully achieved during the ground roll (refer to NOTE in Paragraph 31). Lift-off speed is 91 KIAS, and maximum speed for climb-out is 97 KIAS.

Climb at 220 knots CAS after take-off; 175 pounds of fuel will have been used, and initial climb weight will then be 7262 pounds. For this weight and planned altitude of 28 000 feet, the climb chart will show: time = 10.7 min, fuel consumed = 305 pounds, distance travelled in still air = 48 NM.

Cruise. At the top of the climb, a total of 480 pounds of fuel will have been used. Initial cruise weight will be 6957 pounds; distance to go will be 432 NM. In the approach to Airfield B, the ''clean'' Mach 0.65 descent at idle RPM will be carried out, and the values (see Normal Descent Chart, Figure 4-20) must be backtracked to establish the let-down point. They are time = 8.8 min, distance = 44 NM, fuel used = 55 pounds.

Cruise distance at altitude becomes, thereby, 435 – 44 = 391 NM.

The average W/Δ for the mission must be estimated. Enter the cruise chart with 6957 pounds and 28 000 feet and read a W/Δ of 21 400 pounds. The fuel economy parameter at recommended cruise speed is 0.129, which corresponds to a specific range of 0.396 NM per pound of fuel. Approximate amount of fuel required will be 391/0.396 = 987 pounds, and approximate weight of the aircraft at let-down will be 6957 – 987 = 5970 pounds.

The average weight, therefore, will be (6957 + 5970)/2 = 6464 pounds. Enter the cruise chart with 6464 pounds and 28 000 feet and read a W/Δ of 19 900 pounds. The following information can now be determined:Fuel economy parameter = 0.1345, Mach number = 0.493, true airspeed = 293 knots, calibrated airspeed = 190 knots. Specific range = 0.414 NM/pound of fuel, fuel flow = 710 pound/hour.

At the let-down point, the values are, therefore: fuel used = 480 + 391/0.414 = 1424 pounds, gross weight = 7437 – 1424 = 6013 pounds, flight time = 10.7 + (391/293) x 60 = 1 hr 31 min.

Compare these values with those of the Range Summary Chart (see Figure 4-17) by plotting on this chart 436 NM (the let-down point) on the 28 000-foot level.

The values are approximately: fuel used = 1435 pounds, flight time = 1 hr 31 min.

Endurance. In anticipation of holding instructions, the endurance at the let-down point will be:

Fuel remaining = 588 pounds. Subtract the total of 55 pounds of descent plus the minimum reserve for landing, which is 300 pounds.

588 – (55 + 300) = 233 pounds

The aircraft can hold until this balance of fuel-to-spare has been consumed.

In the Endurance Chart (see Figure 4-19), the fuel flow for 6000 pounds gross weight at 28 000 feet is seen to be 505 lb/hr. Holding time at 125 KIAS is therefore:

$$\frac{\textit{Fuel-to-Spare}}{\textit{Fuel Flow}} \times 60 = \frac{233}{505} \times 60 = 28\text{min}$$

Landing. Including the descent, but excluding the holding time, the values on the landing approach to airfield B are: Flight time = 1 hr 40 min, Fuel used = 1479 pounds, Gross weight = 5958 pounds.

If aircraft held at 28 000 feet to maximum endurance, they would be: flight time = 2 hrs 8 min, fuel used = 1712 pounds, gross weight = 5725 pounds.

Airfield B

Altitude . . . . . 1500 feet ASL

Runway Length . . . . . 1500 feet

Slope . . . . . 1% uphill

50-foot Obstacle . . . . . 400 feet back from threshold

Surface Wind . . . . . 30° off, 11 KIAS

Landing . . . . . Into wind

Headwind Component . . . . . 9 KIAS

Crosswind Component . . . . . 5 KIAS

Surface Temperature . . . . . 24°C

Landing Gross Weight . . . . 6100 pounds

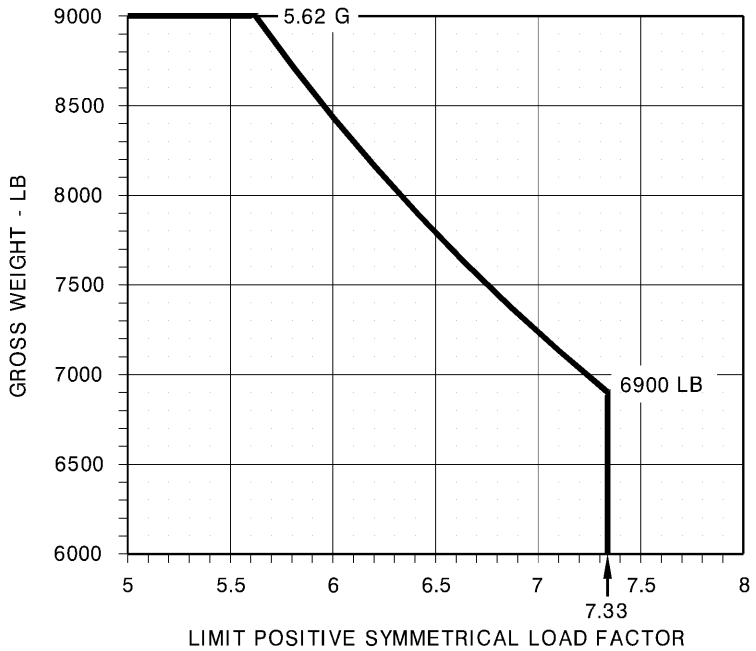
External Fuel Tanks . . . . . Not installed

Enter the Landing Distance Chart (see Figure 4-22) at surface temperature. Read off: ground-run = 1015 feet, distance after clearing obstacle = 1725 feet.

These are both within the available field lengths. Maximum speed at 50-foot obstacle is 83 KIAS, maximum touch-down speed is 77 KIAS.It should be noted that difficulty may be experienced on departure from Airfield B due to its short runway length. For the same conditions, a downhill take-off with a 12-knot headwind, although possible, would leave no margin for stopping should engine failure occur during the take-off roll. Take-off would be impossible in either direction if the winds were reversed.

LOAD FACTOR LIMITATIONS

Model: TUTOR ALL CONFIGURATIONS



AIRSPEED LIMITATIONS

CONFIGURATION	ACCELERATION LIMITS				SPEED LIMITS
	SYMMETRICAL		UNSYMMETRICAL		
	POSITIVE	NEGATIVE	POSITIVE	NEGATIVE	
FLAPS UP - Clean - With Pylons installed - With Smoke Tanks Installed	+7.33 G up to 6900 lb AUW decreasing linearly* to +5.62 G at 9000 lb AUW	-3.0 G at V_H (7300 lb), -2.6 G at V_H (8200 lb) decreasing linearly* to -1.0 G at V_L (See Figure 4-5)	4/5 of symmetrical value	-1.0 G at 8500 lb at up to 350 KEAS decreasing linearly to 0.0 G at 400 KEAS	412 KEAS or 0.73 IMN whichever occurs first (max permissible IMN above FL 200 is 0.78)
- With External Fuel Tanks Installed	As above	-1.88 G (between 8500 - 9000 lb) at up to 350 KEAS decreasing linearly to -0.47 G at 400 KEAS	2/3 of symmetrical value	-0.92 G (between 8500 - 9000 lb) at up to 350 KEAS decreasing linearly to 0.0 G at 400 KEAS	400 KEAS or 0.70 IMN, whichever occurs first
FULL FLAPS DOWN - Clean - With Pylons installed - With External Fuel or Smoke Tanks Installed	+2.36 G (between 8500 - 9000 lb) and +2.5 G at 8500 lb	0.0 G	+1.58 G (between 8500 - 9000 lb)	+0.35 G (between 8500 - 9000 lb)	140 KEAS

*Approximation

Note: All speeds are given in KEAS. For conversion in KIAS, see Figures 4-12 and 4-13.

BMB04009

Figure 4-8 Airspeed and Acceleration Limitation Chart

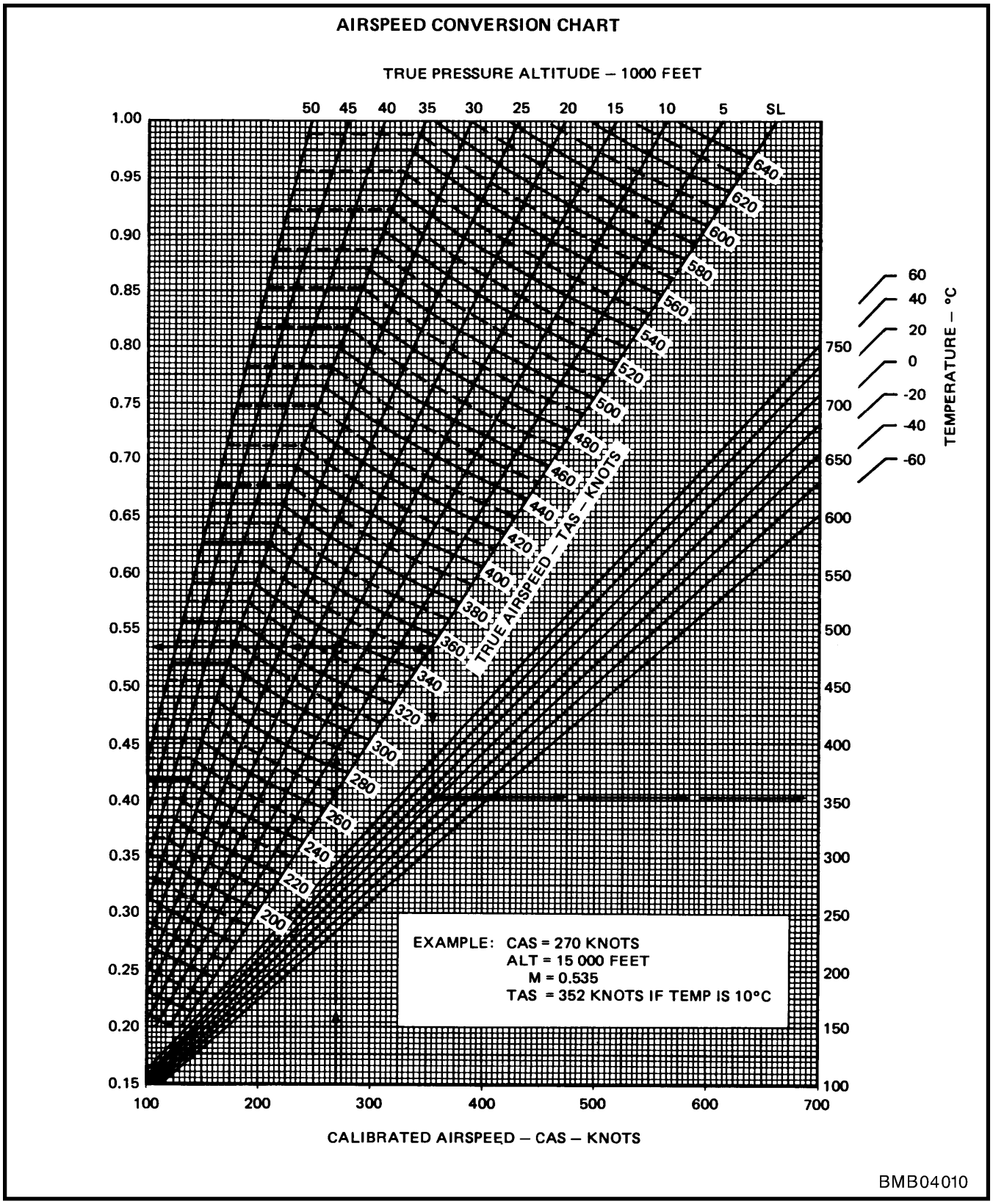


Figure 4-9 Airspeed Conversion Chart

STANDARD ALTITUDE

STANDARD SEA LEVEL AIR: W = 0.076475 lb/cu ft = 0.0023769 slugs/cu ft
T = 15 °C 1 in. of Hg = 70.732 lb/sq ft = 0.4912 lb/sq in.
P = 29.921 in. of Hg $\alpha_\circ$ = 1116.89 ft/sec = 661.47 kt

STANDARD ATMOSPHERE (NACA TECHNICAL REPORT NO. 1235)

Altitude Feet	Density Ratio $\rho/\rho_\circ=\sigma$	$1/\sqrt{\sigma}$	Temperature °C	Speed of Sound Ratio $\alpha/\alpha_\circ$	Pressure	
					In. of Hg	Ratio $\rho/\rho_\circ=\delta$
–2 000	1.0598	0.9714	18.962	1.0064	32.15	1.0294
–1 000	1.0296	0.9855	16.981	1.0030	31.02	1.0147
0	1.0000	1.0000	15.000	1.0000	29.92	1.0000
1 000	0.9711	1.0148	13.019	0.9966	28.86	0.9644
2 000	0.9428	1.0299	11.038	0.9931	27.82	0.9298
3 000	0.9151	1.0454	9.057	0.9896	26.82	0.8962
4 000	0.8881	1.0611	7.075	0.9862	25.84	0.8637
5 000	0.8617	1.0773	5.094	0.9827	24.90	0.8320
6 000	0.8359	1.0938	3.113	0.9792	23.98	0.8014
7 000	0.8106	1.1107	1.132	0.9756	23.09	0.7716
8 000	0.7860	1.1279	–0.849	0.9721	22.22	0.7428
9 000	0.7620	1.1456	–2.831	0.9686	21.39	0.7148
10 000	0.7385	1.1637	–4.812	0.9650	20.58	0.6877
11 000	0.7156	1.1822	–6.793	0.9614	19.79	0.6614
12 000	0.6932	1.2011	–8.774	0.9579	19.03	0.6360
13 000	0.6713	1.2205	–10.756	0.9543	18.29	0.6113
14 000	0.6500	1.2403	–12.737	0.9507	17.58	0.5875
15 000	0.6292	1.2606	–14.718	0.9470	16.89	0.5643
16 000	0.6090	1.2815	–16.699	0.9434	16.22	0.5420
17 000	0.5892	1.3028	–18.681	0.9397	15.57	0.5203
18 000	0.5699	1.3246	–20.662	0.9361	14.94	0.4994
19 000	0.5511	1.3470	–22.643	0.9324	14.34	0.4791
20 000	0.5328	1.3700	–24.624	0.9287	13.75	0.4595
21 000	0.5150	1.3935	–26.605	0.9250	13.18	0.4406
22 000	0.4976	1.4176	–28.587	0.9213	12.64	0.4223
23 000	0.4807	1.4424	–30.568	0.9175	12.11	0.4046
24 000	0.4642	1.4678	–32.549	0.9138	11.60	0.3876
25 000	0.4481	1.4938	–34.530	0.9100	11.10	0.3711
26 000	0.4325	1.5206	–36.511	0.9062	10.63	0.3552
27 000	0.4173	1.5480	–38.492	0.9024	10.17	0.3398
28 000	0.4025	1.5762	–40.473	0.8986	9.725	0.3250
29 000	0.3881	1.6052	–42.455	0.8948	9.297	0.3107
30 000	0.3741	1.6349	–44.436	0.8909	8.885	0.2970
31 000	0.3605	1.6654	–46.417	0.8871	8.488	0.2837
32 000	0.3473	1.6968	–48.398	0.8832	8.106	0.2709
33 000	0.3345	1.7291	–50.379	0.8793	7.737	0.2586
34 000	0.3220	1.7623	–52.361	0.8754	7.382	0.2467
35 000	0.3099	1.7964	–54.342	0.8714	7.041	0.2353
36 000	0.2981	1.8315	–56.323	0.8675	6.712	0.2243
37 000	0.2844	1.8753	–56.500	0.8671	6.397	0.2138
38 000	0.2710	1.9209	–56.500	0.8671	6.097	0.2038
39 000	0.2583	1.9677	–56.500	0.8671	5.811	0.1942
40 000	0.2462	2.0155	–56.500	0.8671	5.538	0.1851
41 000	0.2346	2.0645	–56.500	0.8671	5.278	0.1764
42 000	0.2236	2.1148	–56.500	0.8671	5.030	0.1681
43 000	0.2131	2.1662	–56.500	0.8671	4.794	0.1602
44 000	0.2031	2.2189	–56.500	0.8671	4.569	0.1527
45 000	0.1936	2.2728	–56.500	0.8671	4.355	0.1455
46 000	0.1845	2.3281	–56.500	0.8671	4.151	0.1387
47 000	0.1758	2.3848	–56.500	0.8671	3.956	0.1322
48 000	0.1676	2.4428	–56.500	0.8671	3.770	0.1260
49 000	0.1597	2.5022	–56.500	0.8671	3.593	0.1201
50 000	0.1522	2.5630	–56.500	0.8671	3.425	0.1145
51 000	0.1451	2.6254	–56.500	0.8671	3.264	0.1091
52 000	0.1383	2.6892	–56.500	0.8671	3.111	0.1040
53 000	0.1318	2.7546	–56.500	0.8671	2.965	0.09909
54 000	0.1256	2.8216	–56.500	0.8671	2.826	0.09444
55 000	0.1197	2.8903	–56.500	0.8671	2.693	0.09001
56 000	0.1141	2.9606	–56.500	0.8671	2.567	0.08578
57 000	0.1087	3.0326	–56.500	0.8671	2.446	0.08176
58 000	0.1036	3.1063	–56.500	0.8671	2.331	0.07792
59 000	0.09877	3.1819	–56.500	0.8671	2.222	0.07426
60 000	0.09414	3.2593	–56.500	0.8671	2.118	0.07078
61 000	0.08972	3.3386	–56.500	0.8671	2.018	0.06746
62 000	0.08551	3.4198	–56.500	0.8671	1.924	0.06429
63 000	0.08150	3.5029	–56.500	0.8671	1.833	0.06127
64 000	0.07767	3.5881	–56.500	0.8671	1.747	0.05840
65 000	0.07403	3.6754	–56.500	0.8671	1.665	0.05566

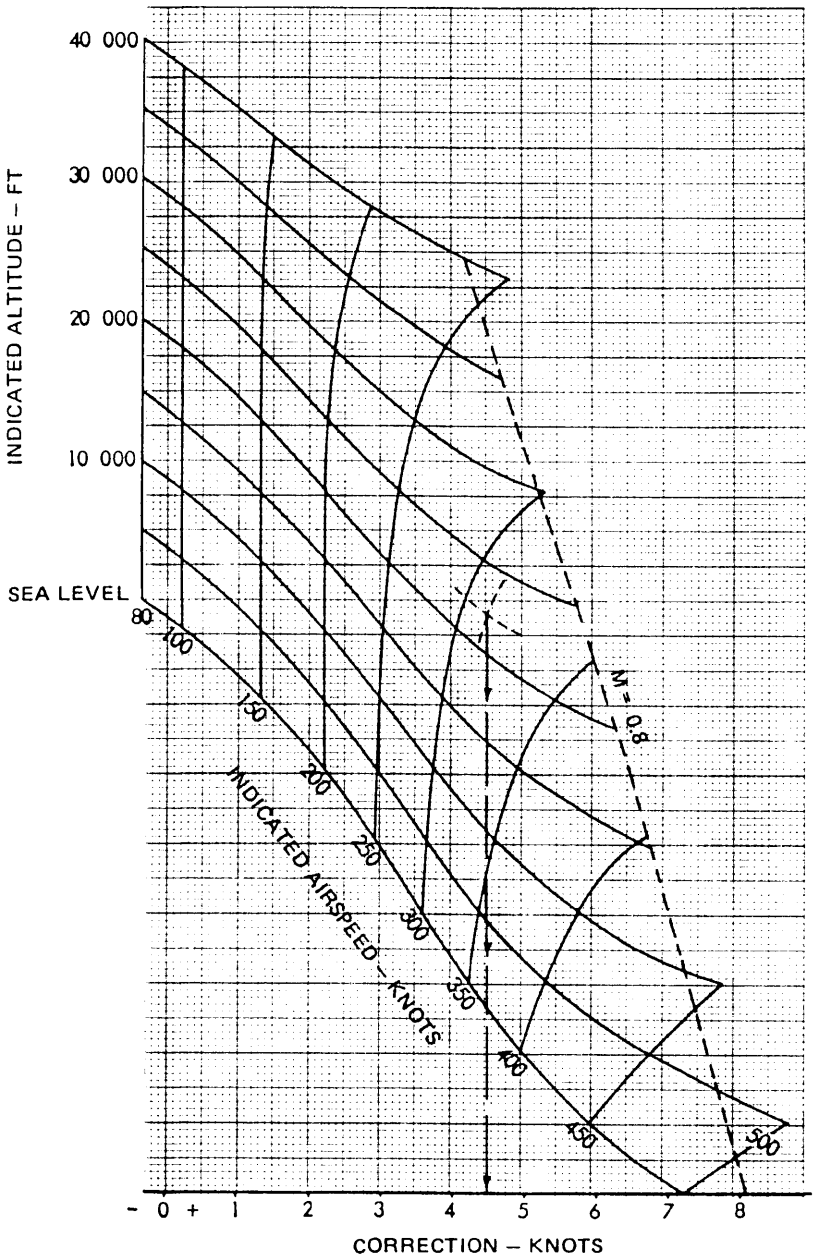
Figure 4-10 Standard Altitude Table

AIRSPEED POSITION-ERROR CORRECTION

MODEL: TUTOR

FLAPS: 0°
GEAR: UP OR DOWN

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST



NOTE

Apply correction to instrument reading (IAS) to obtain calibrated airspeed (CAS).

EXAMPLE

INDICATED ALTITUDE	22 000 FT	POSITION-ERROR CORRECTION	+5 KT
INDICATED AIRSPEED	310 KT	CALIBRATED AIRSPEED	315 KT

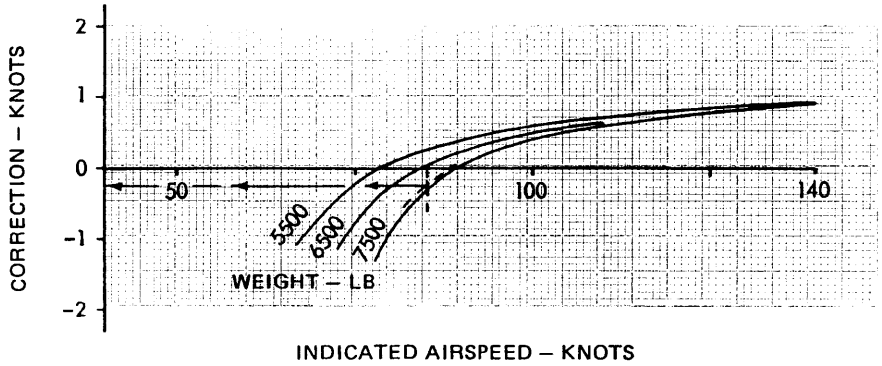
BMB04012

Figure 4-11 (Sheet 1 of 2) Airspeed Position-Error Correction Chart

AIRSPEED POSITION-ERROR CORRECTION

MODEL: TUTOR

FLAPS: 40°
GEAR: DOWN
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST



EXAMPLE

GROSS WEIGHT	7437	LB
INDICATED AIRSPEED	85	KT
POSITION-ERROR CORRECTION	0	KT
CALIBRATED AIRSPEED	85	KT

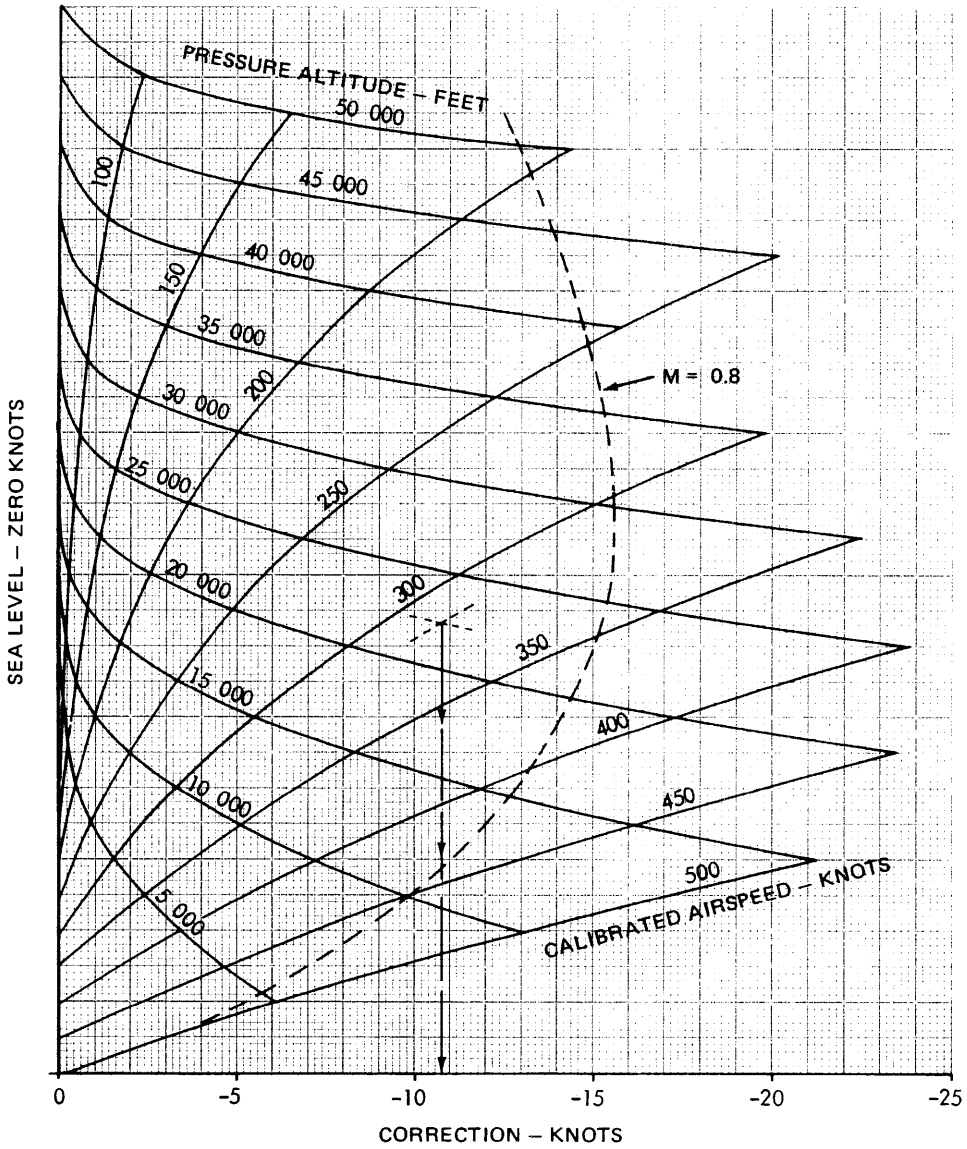
BMB04013

Figure 4-11 (Sheet 2 of 2) Airspeed Position-Error Correction Chart

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

MODEL: TUTOR

DATA AS OF: JAN 1966
BASED ON: ESTIMATE



NOTE

Subtract correction from calibrated airspeed (CAS) to obtain equivalent airspeed (EAS).

EXAMPLE

PRESSURE ALTITUDE	22 275 FT
CALIBRATED AIRSPEED	315 KT
CORRECTION FOR COMPRESSIBILITY	-11 KT
EQUIVALENT AIRSPEED	304 KT

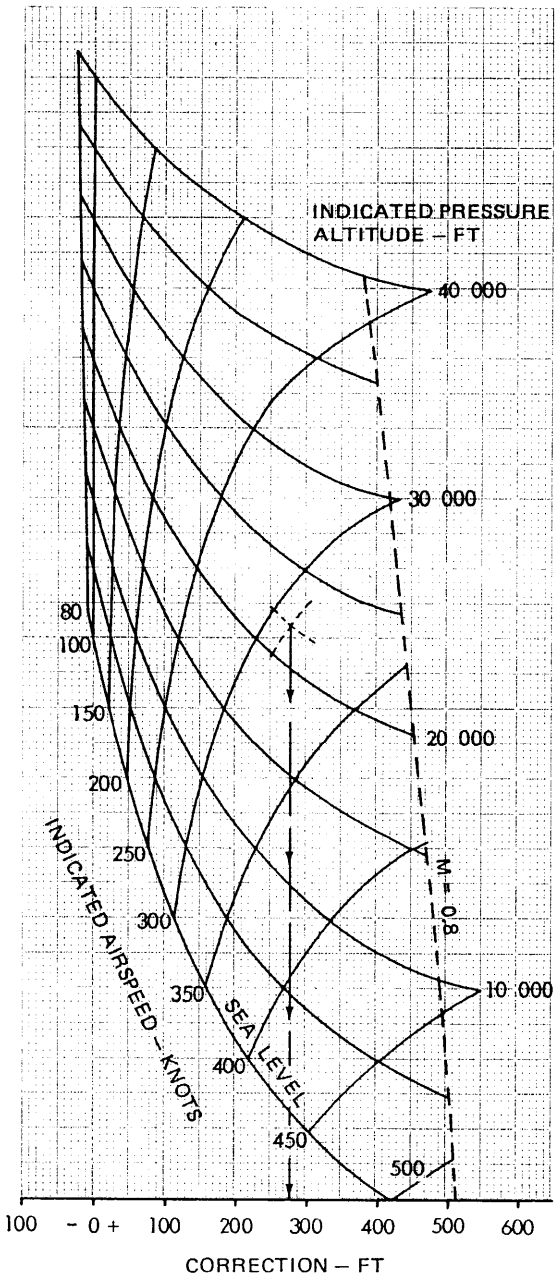
BMB04014

Figure 4-12 Airspeed Compressibility Correction Chart

ALTIMETER POSITION-ERROR CORRECTION

MODEL: TUTOR

FLAPS: 0°
GEAR: UP OR DOWN
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST



NOTE

Apply correction to indicated pressure altitude to determine actual pressure altitude.

EXAMPLE

INDICATED AIRSPEED	310 KT
INDICATED PRESSURE ALTITUDE	22 000 FT
POSITION-ERROR CORRECTION	+275 FT
ACTUAL PRESSURE ALTITUDE	22 275 FT

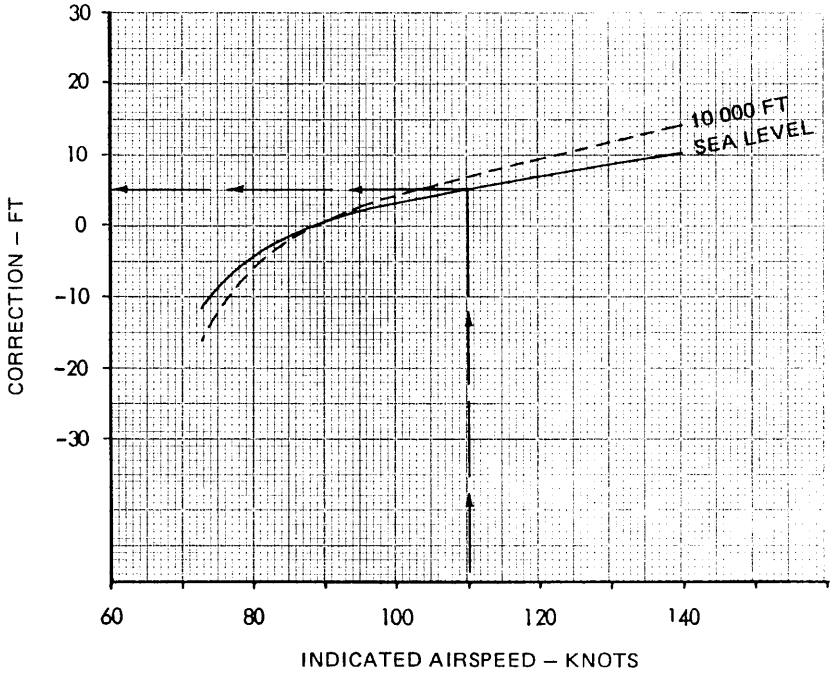
BMB04015

Figure 4-13 (Sheet 1 of 2) Altimeter Position-Error Correction Chart

ALTIMETER POSITION-ERROR CORRECTION

MODEL: TUTOR

FLAPS: 40°
GEAR: DOWN
DATA AS OF: JAN 1966
BASED ON: TEST FLIGHT



NOTE

Apply correction to indicated pressure altitude to determine actual pressure altitude.

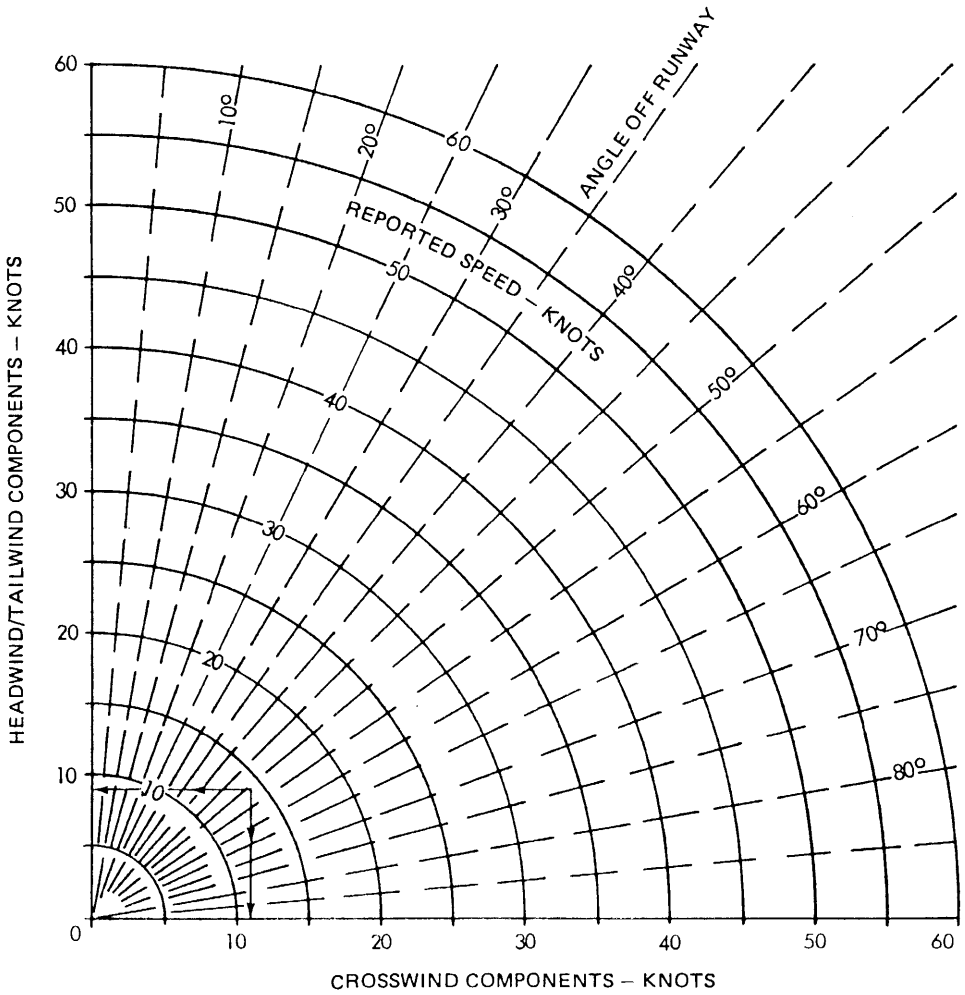
EXAMPLE

INDICATED AIRSPEED	100 KT
ALTITUDE	SEA LEVEL
CORRECTION	+5 FT

BMB04016

Figure 4-13 (Sheet 2 of 2) Altimeter Position-Error Correction Chart

WIND COMPONENT – TAKE-OFF AND LANDING



NOTE

Double-check the solution: headwind or tailwind.

EXAMPLE

ANGLE OFF RUNWAY	51°
REPORTED SPEED	14 KT
HEADWIND COMPONENT	9 KT
CROSSWIND COMPONENT	11 KT

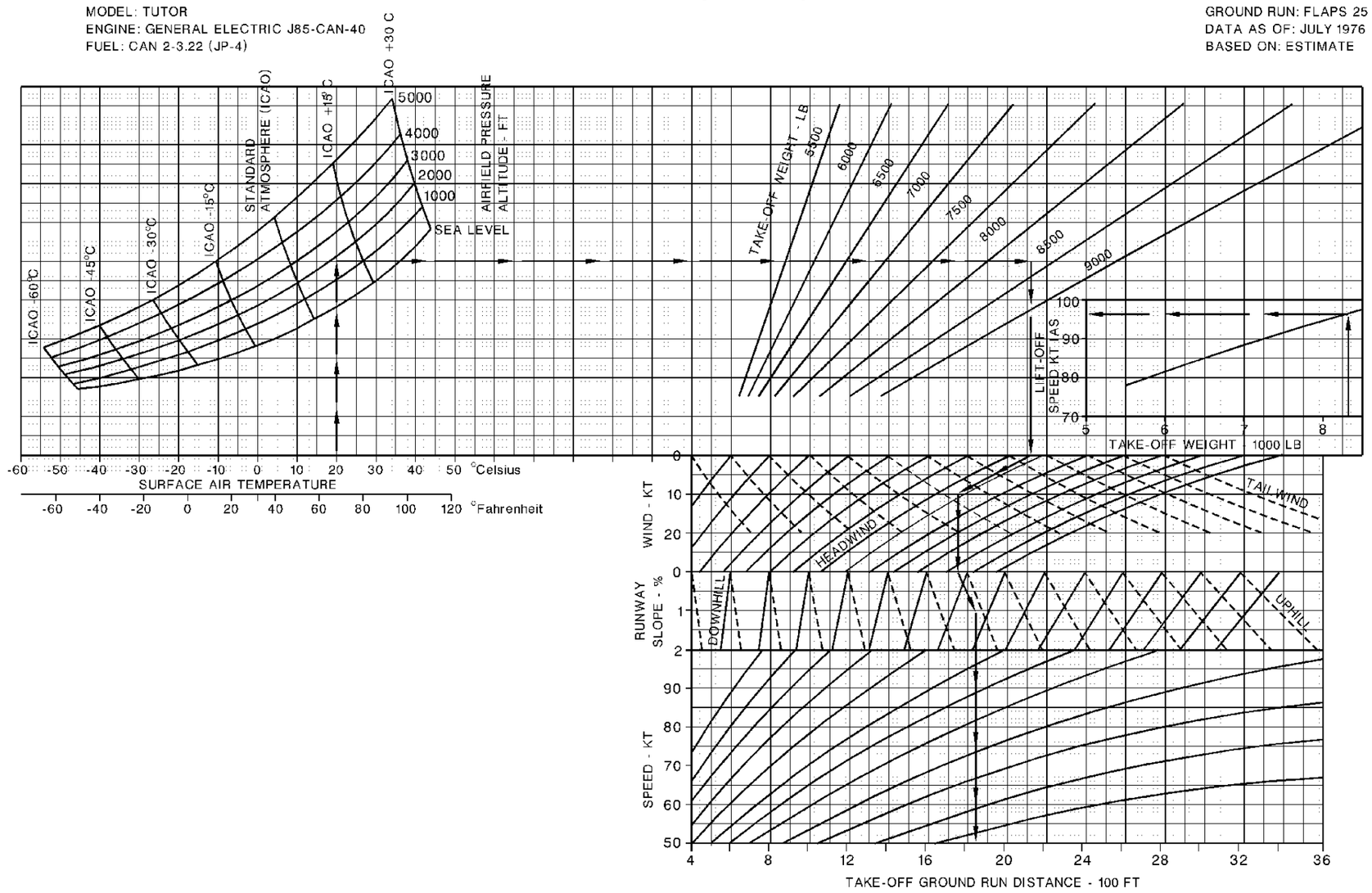
BMB04017

Figure 4-14 Wind Component Chart

TAKE-OFF DISTANCE

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL: CAN 2-3.22 (JP-4)

GROUND RUN: FLAPS 25 °
DATA AS OF: JULY 1976
BASED ON: ESTIMATE



NOTE

For flapless take-off, increase distance by 30%.

EXAMPLE

SURFACE AIR TEMPERATURE	20°C	HEADWIND	10 KT	TAKE-OFF GROUND RUN DISTANCE	1850 FT
AIRFIELD PRESSURE ALTITUDE	2000 FT	RUNWAY SLOPE	1% UPHILL	LIFT-OFF SPEED	96 KT
TAKE-OFF WEIGHT	8300 LB				

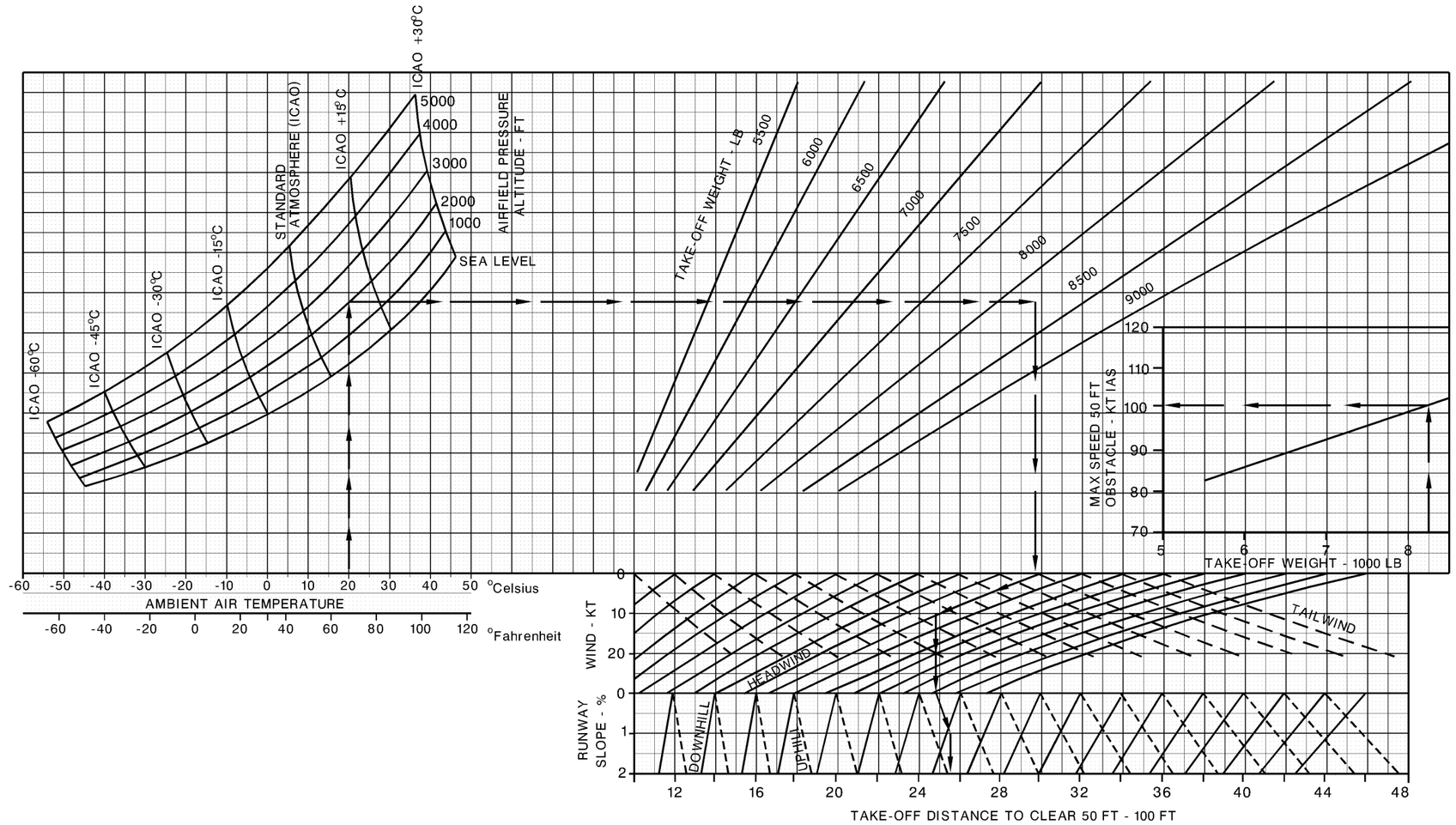
BMB04018

Take-Off Distance Chart (Sheet 1 of 2) Figure 4-15

TAKE-OFF DISTANCE

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL: CAN 2-3.22 (JP-4)

TO CLEAR 50-FT OBSTACLE: FLAPS 25 °
DATA AS OF: JULY 1976
BASED ON: ESTIMATE



NOTE

For flapless take-off, increase distance by 20%.

EXAMPLE

SURFACE AIR TEMPERATURE	20°C	HEADWIND	10 KT
AIRFIELD PRESSURE ALTITUDE	2000 FT	RUNWAY SLOPE	1% UPHILL
TAKE-OFF WEIGHT	8300 LB	TAKE-OFF DISTANCE TO CLEAR 50 FT	2560 FT
		MAXIMUM SPEED AT 50-FT OBSTACLE	101 KT

BMB04019

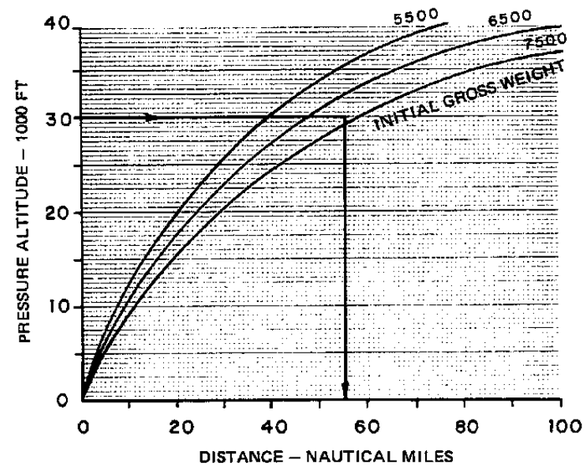
Take-Off Distance Chart (Sheet 2 of 2) Figure 4-15

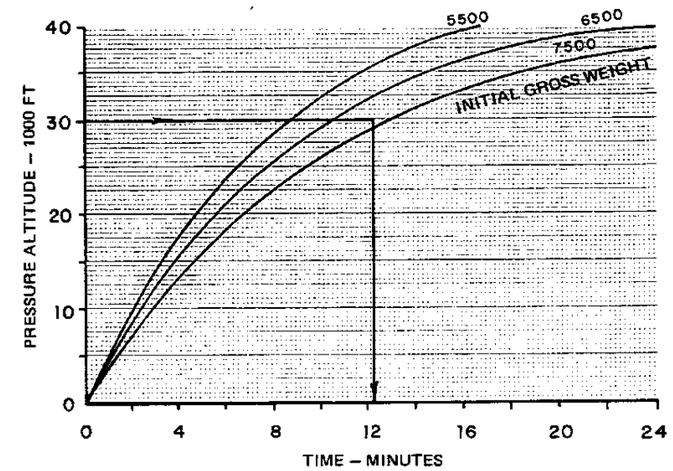
MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL: CAN 2-3.22 (JP-4)

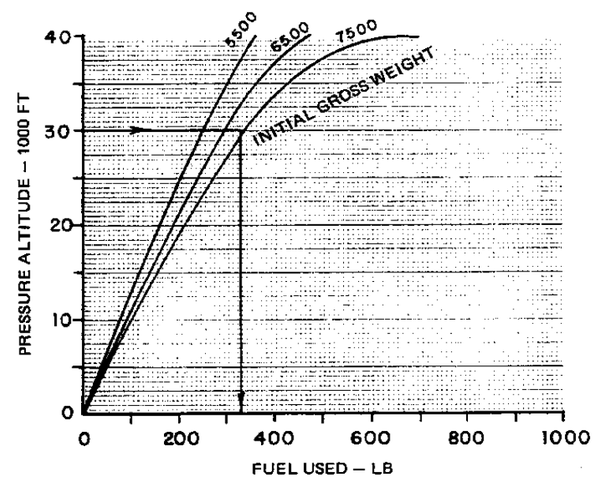
CLIMB PERFORMANCE
CLEAN CONFIGURATION

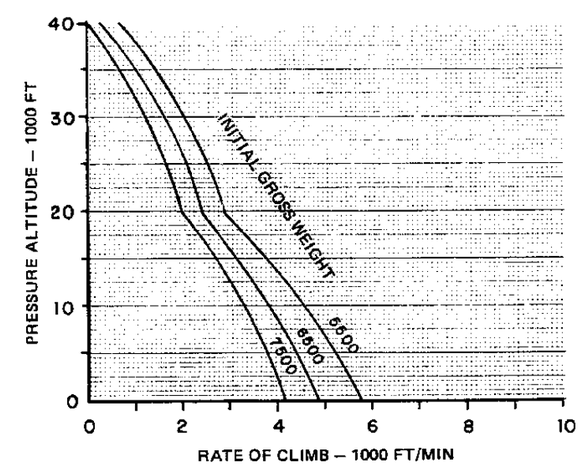
MAXIMUM CONTINUOUS POWER
DATA AS OF: JULY 1976
BASED ON: FLIGHT TEST

CLIMB SCHEDULE	
ALTITUDE	CAS
SEA LEVEL	220
5 000	220
10 000	220
15 000	220
20 000	220
25 000	200
30 000	180
35 000	160
40 000	140









NOTE

Fuel used includes 5% operational tolerance.

EXAMPLE

INITIAL CLIMB WEIGHT	7 400 LB	TIME REQUIRED	12.2 MIN
TO PRESSURE ALTITUDE	30 000 FT	FUEL USED	330 LB
		DISTANCE TRAVELLED	55 NM

BMB04020

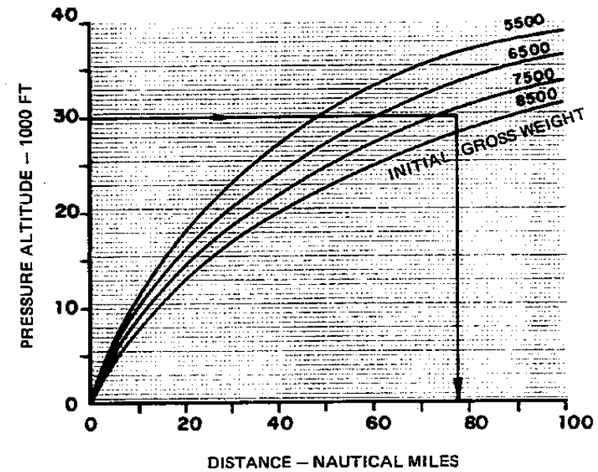
Climb Chart (Sheet 1 of 2) Figure 4-16

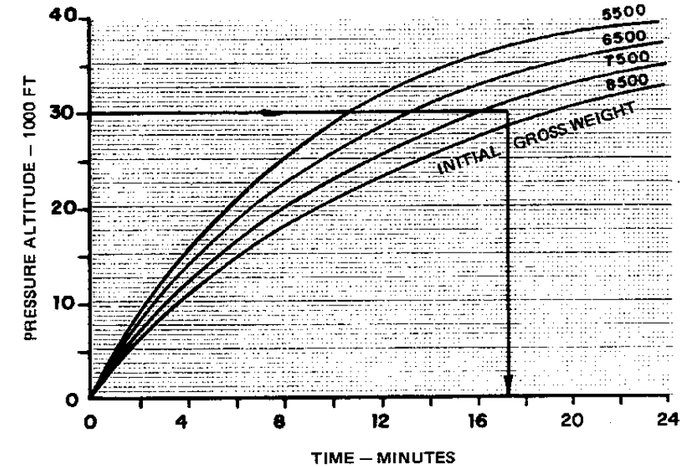
MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL: CAN 2-3.22 (JP-4)

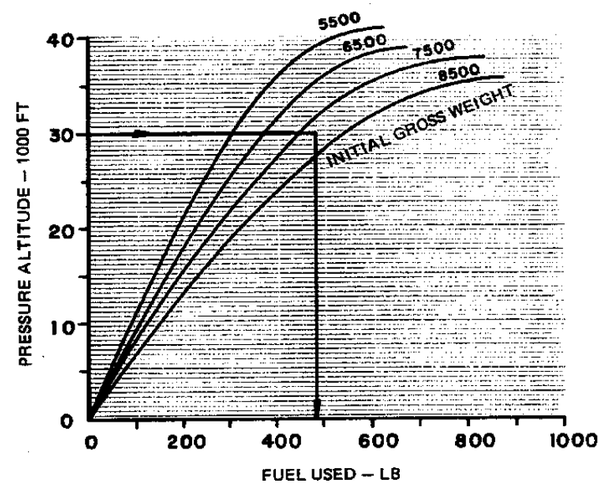
CLIMB PERFORMANCE
EXTERNAL TANKS INSTALLED

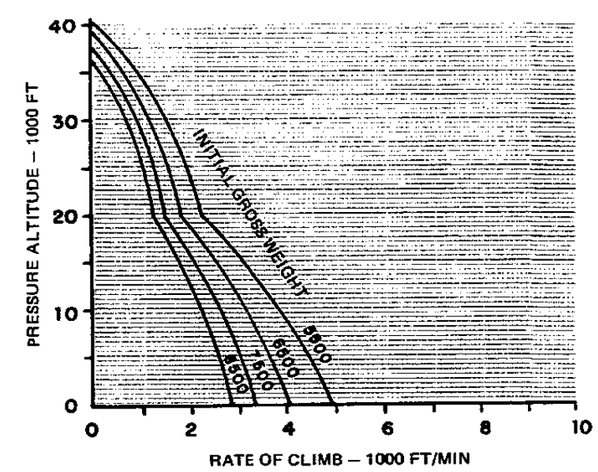
MAXIMUM CONTINUOUS POWER
DATA AS OF: JULY 1976
BASED ON: FLIGHT TEST

CLIMB SCHEDULE	
ALTITUDE	CAS
SEA LEVEL	220
5 000	220
10 000	220
15 000	220
20 000	220
25 000	200
30 000	180
35 000	160
40 000	140









NOTE
Fuel used includes 5% operational tolerance.

EXAMPLE

INITIAL CLIMB WEIGHT	7 700 LB	TIME REQUIRED	17.4 MIN
TO PRESSURE ALTITUDE	30 000 FT	FUEL USED	490 LB
		DISTANCE TRAVELLED	78 NM

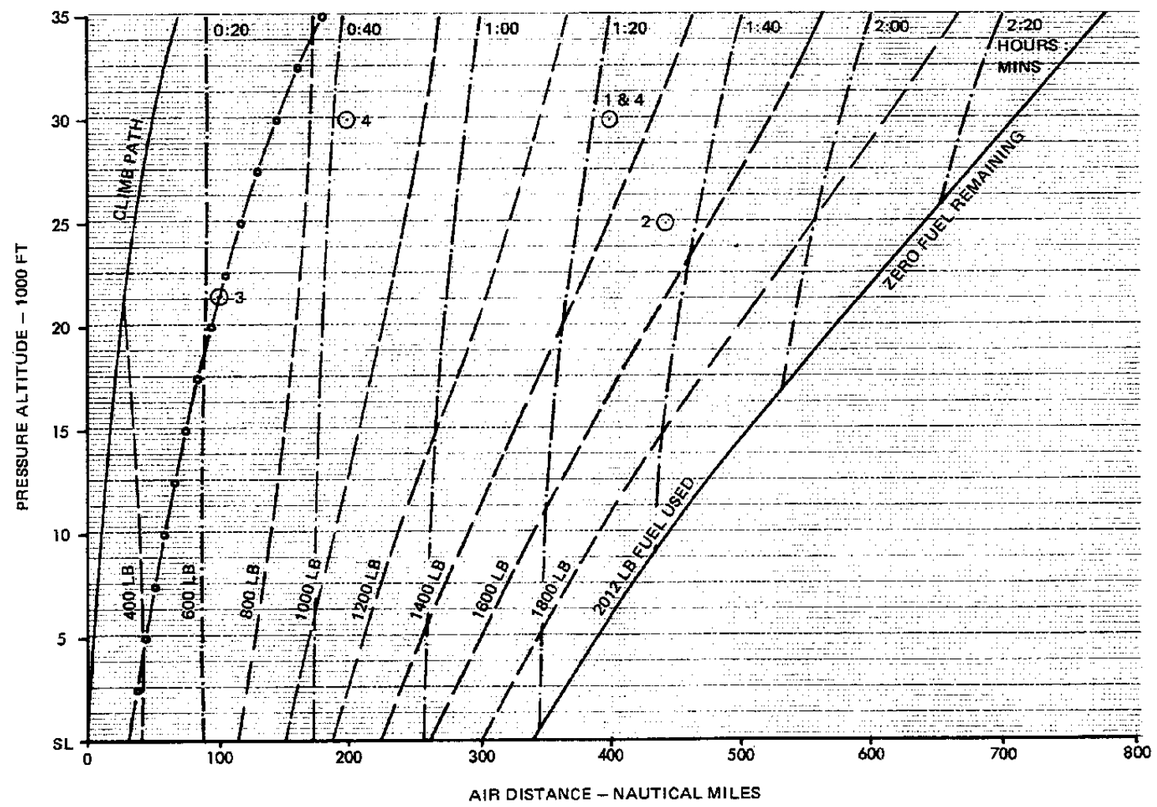
BMB04021

Climb Chart (Sheet 2 of 2) Figure 4-16

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL GRADE: CAN 2-3.22 (JP-4)
FUEL DENSITY: 7.8 LB/GAL

RANGE SUMMARY
CLEAN CONFIGURATION

START-UP GROSS WEIGHT: 7437 LB
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST



LEGEND

- ——— FUEL USED
- —·—· FLIGHT TIME
- —o— OPTIMUM CRUISE ALTITUDE
- ⊙ EXAMPLE (Reference Text)

NOTES

1. 175 fuel allowance included for taxi, take-off and acceleration to initial climb speed. Fuel flow includes 5% operational tolerance.
2. Climb at maximum continuous power.
3. Constant-altitude cruise at recommended long-range cruise speed.
4. No allowance for holding, approach, descent, or landing.

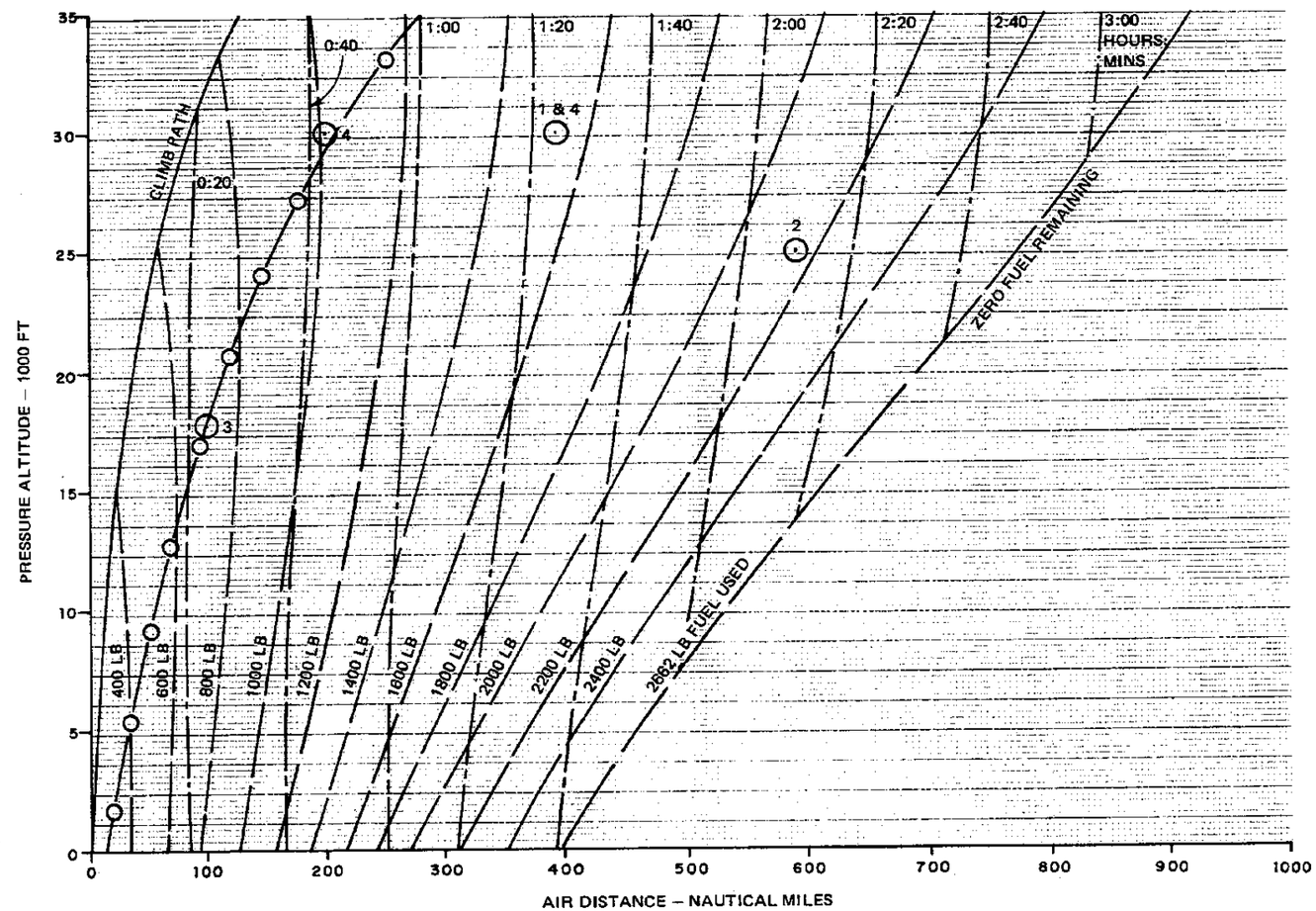
BMB04022

Range Summary Chart (Sheet 1 of 2) Figure 4-17

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL GRADE: CAN 2-3.22 (JP-4)

RANGE SUMMARY
EXTERNAL TANKS INSTALLED

START-UP GROSS WEIGHT: 8250 LB
DATA AS OF: JULY 1976
BASED ON: FLIGHT TEST



LEGEND

- FUEL USED
- FLIGHT TIME
- OPTIMUM CRUISE ALTITUDE
- EXAMPLE (Reference Text)

NOTES

1. 175 fuel allowance included for taxi, take-off, and acceleration to initial climb speed. Fuel flow includes 5% operational allowance.
2. Climb at maximum continuous power.
3. Constant-altitude cruise at recommended long-range cruise speed.
4. No allowance for holding, approach, descent, or landing.

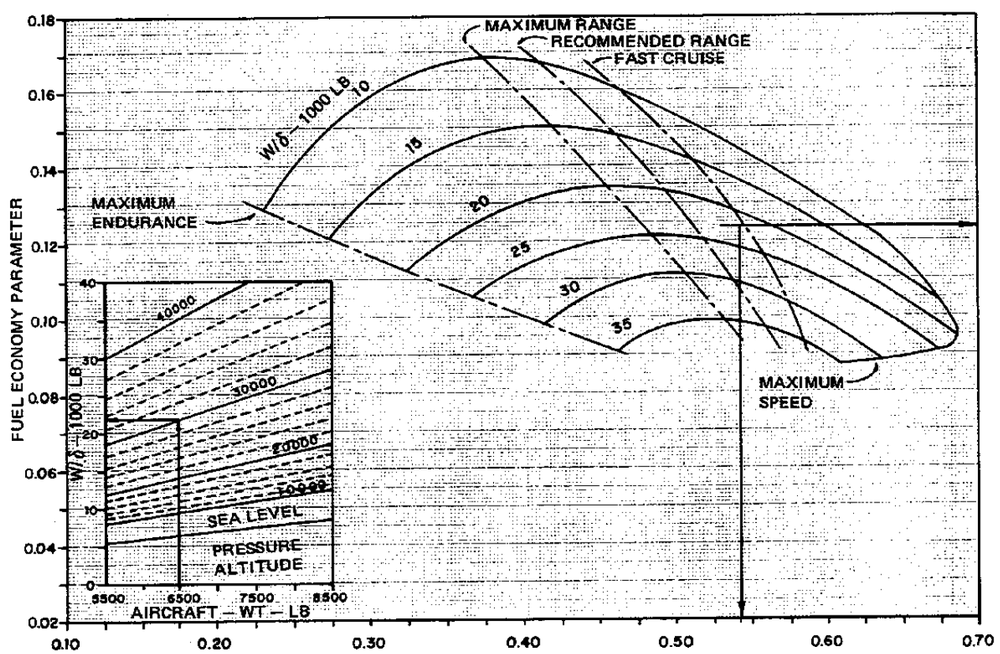
BMB04023

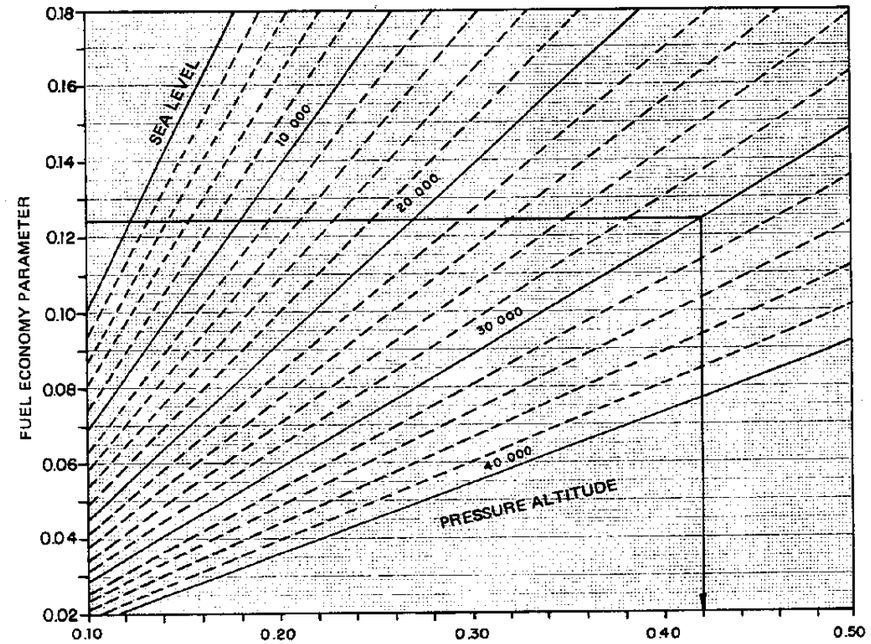
Range Summary Chart (Sheet 2 of 2) Figure 4-17

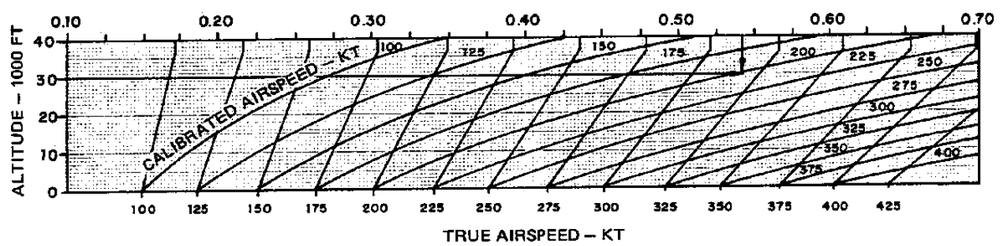
MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL: CAN 2-3.22 (JP-4)

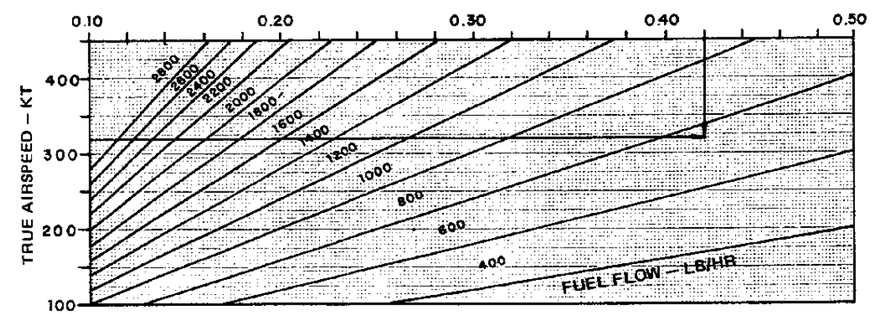
CRUISE PERFORMANCE
CLEAN CONFIGURATION

DATA BASED ON ICAO STANDARD DAY
DATA AS OF: JULY 1976
BASED ON: FLIGHT TEST









NOTES

1 Fuel flow increased 5% for operational tolerance.
2 Reduce nautical miles per pound 5% for flights with pylons only installed.

EXAMPLE

FAST CRUISE ALTITUDE	30 000 FT	MACH	0.54			SPECIFIC RANGE	0.418 NMPP
AVERAGE WEIGHT	6 500 LB	INDICATED AIRSPEED	200	KT		FUEL FLOW	760 LB/HR
W/δ	21 500 LB	TRUE AIRSPEED	318	KT			

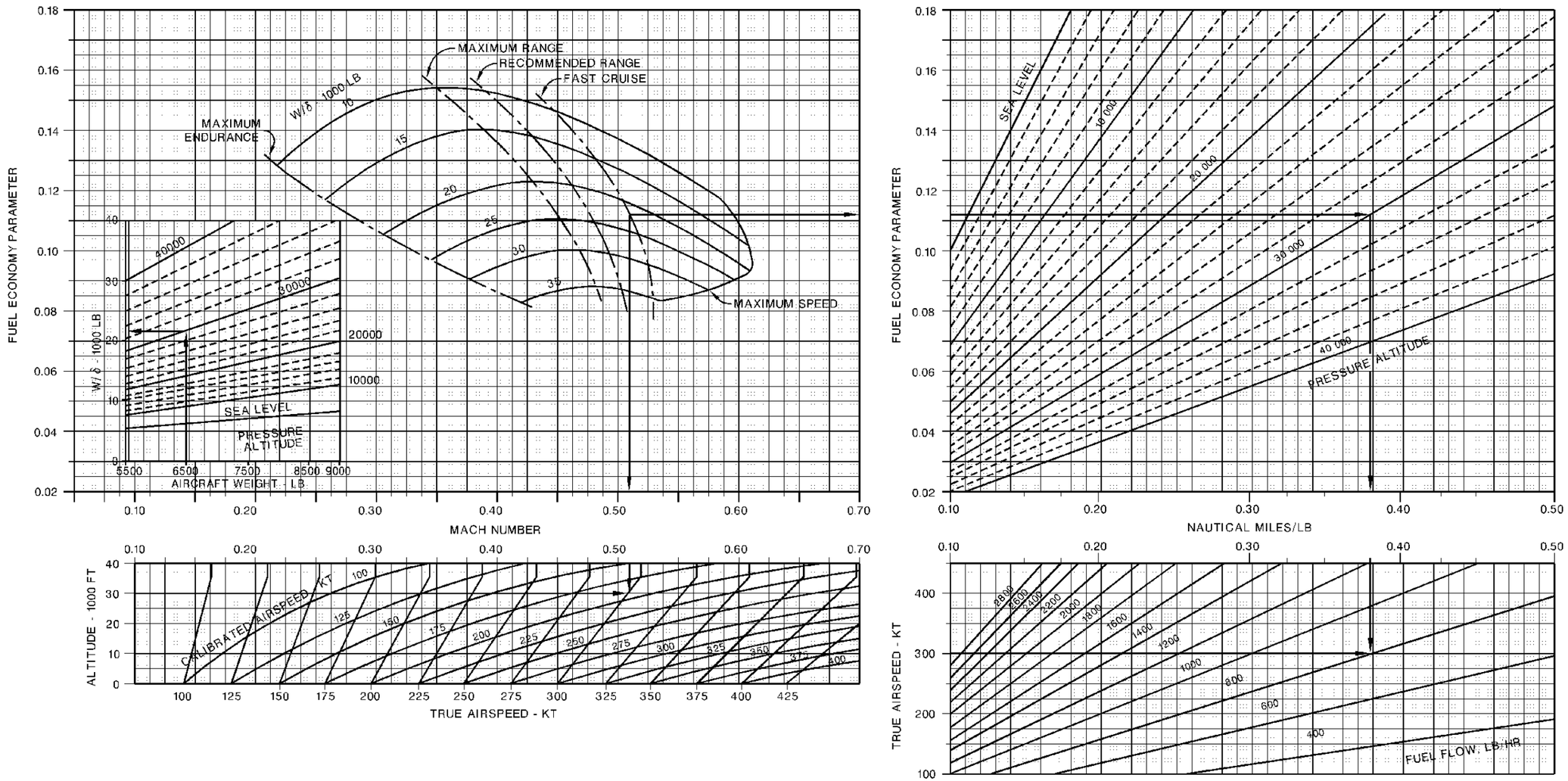
BMB04024

Cruise Performance Chart (Sheet 1 of 2) Figure 4-18

CRUISE PERFORMANCE
EXTERNAL TANKS INSTALLED

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL GRADE: CAN 2-3.22 (JP-4)

DATA BASED ON ICAO STANDARD DAY
DATA AS OF: JULY 1976
BASED ON: FLIGHT TEST



NOTE

Fuel flow increased 5% for operational tolerance.

EXAMPLE

FAST CRUISE		W/δ	21 500 LB	TRUE AIRSPEED	300 KT
ALTITUDE	30 000 FT	MACH	0.51	SPECIFIC RANGE	0.375 NMPP
AVERAGE WEIGHT	6 500 LB	INDICATED AIRSPEED	187 KT	FUEL FLOW	800 LB/HR

BMB04025

Cruise Performance Chart (Sheet 2 of 2) Figure 4-18

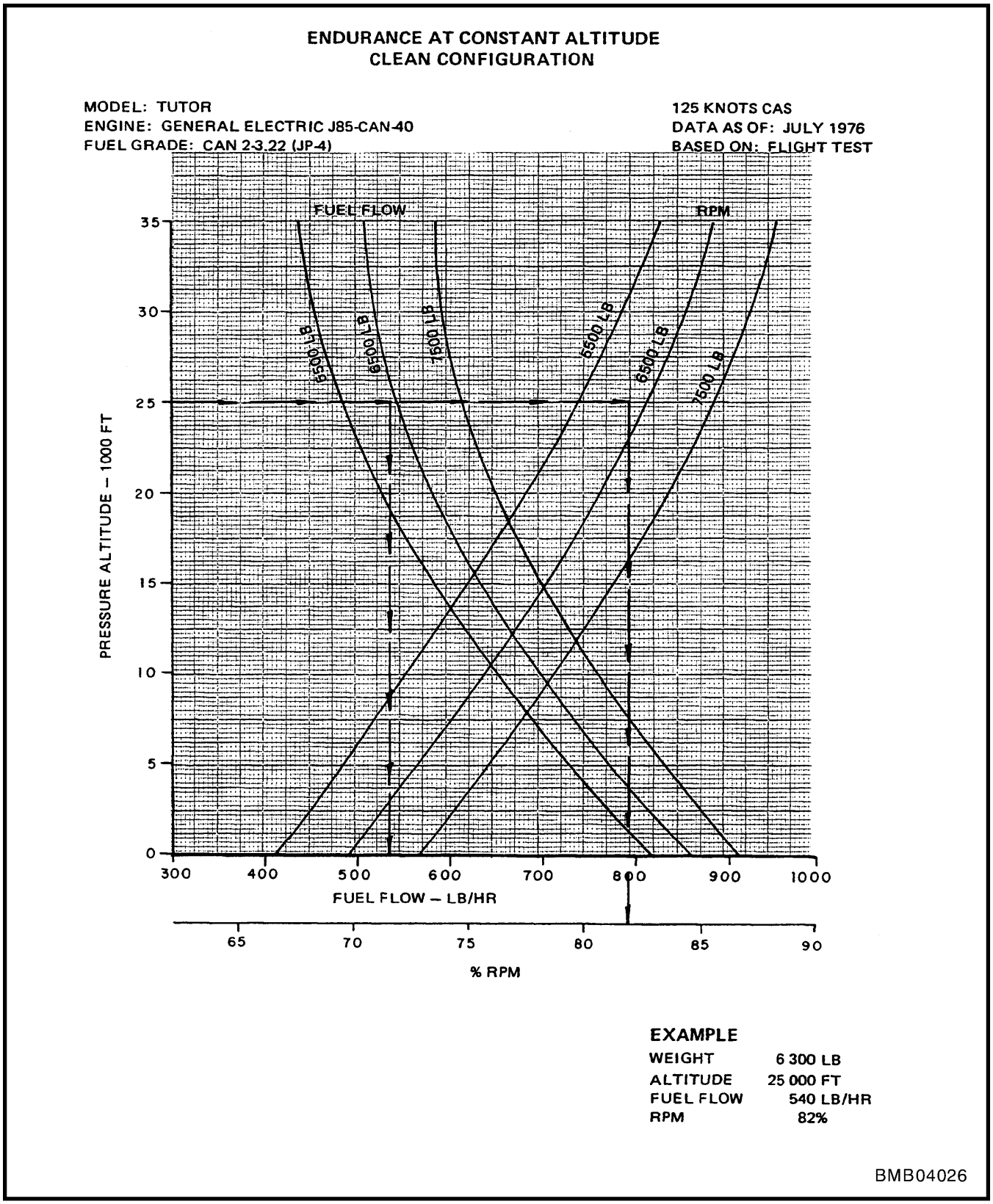
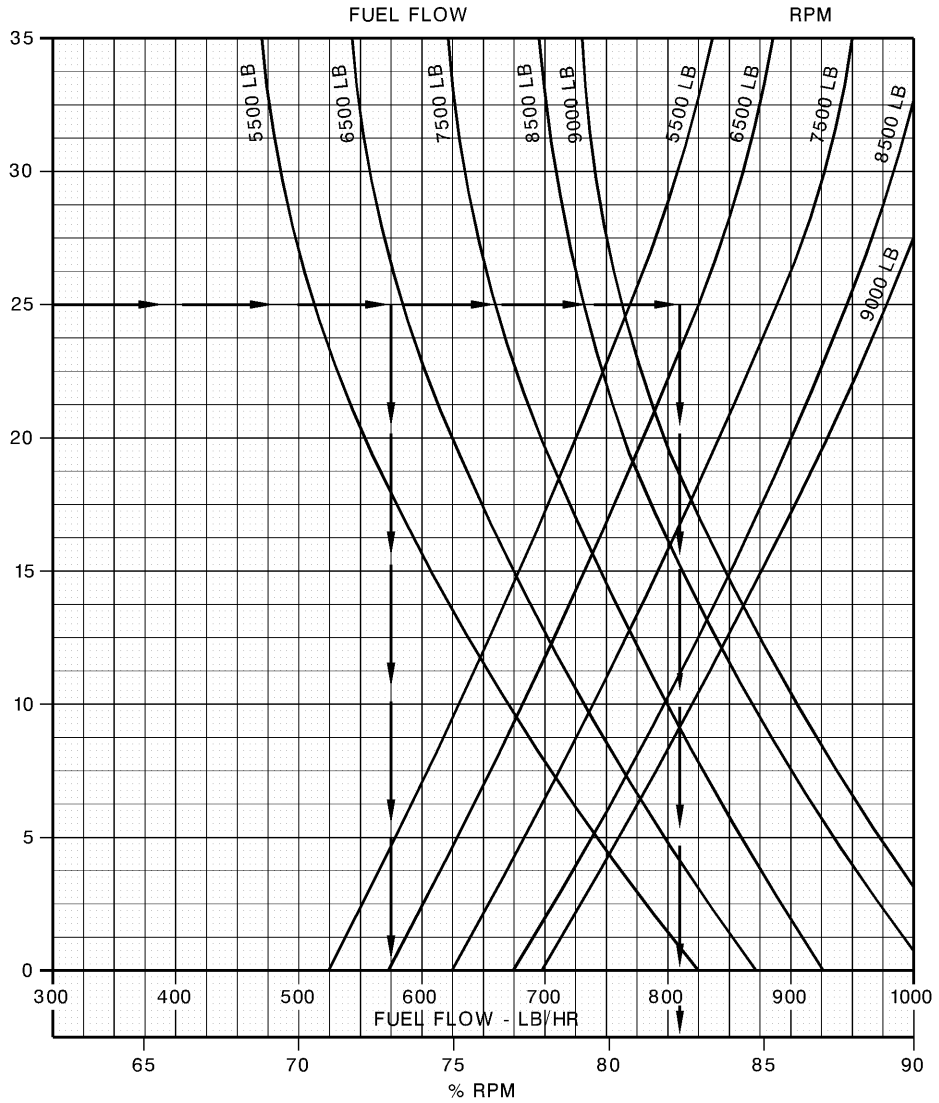


Figure 4-19 (Sheet 1 of 2) Endurance Chart

ENDURANCE AT CONSTANT ALTITUDE
EXTERNAL TANKS INSTALLED

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC (J85-CAN-40)
FUEL GRADE: CAN 2-3.22 (JP-4)

125 KNOTS CAS
DATA AS OF: JULY 1976
BASED ON: FLIGHT TEST



EXAMPLE

WEIGHT	6 300 LB
ALTITUDE	25 000 FT
FUEL FLOW	575 LB/HR
RPM	82.5%

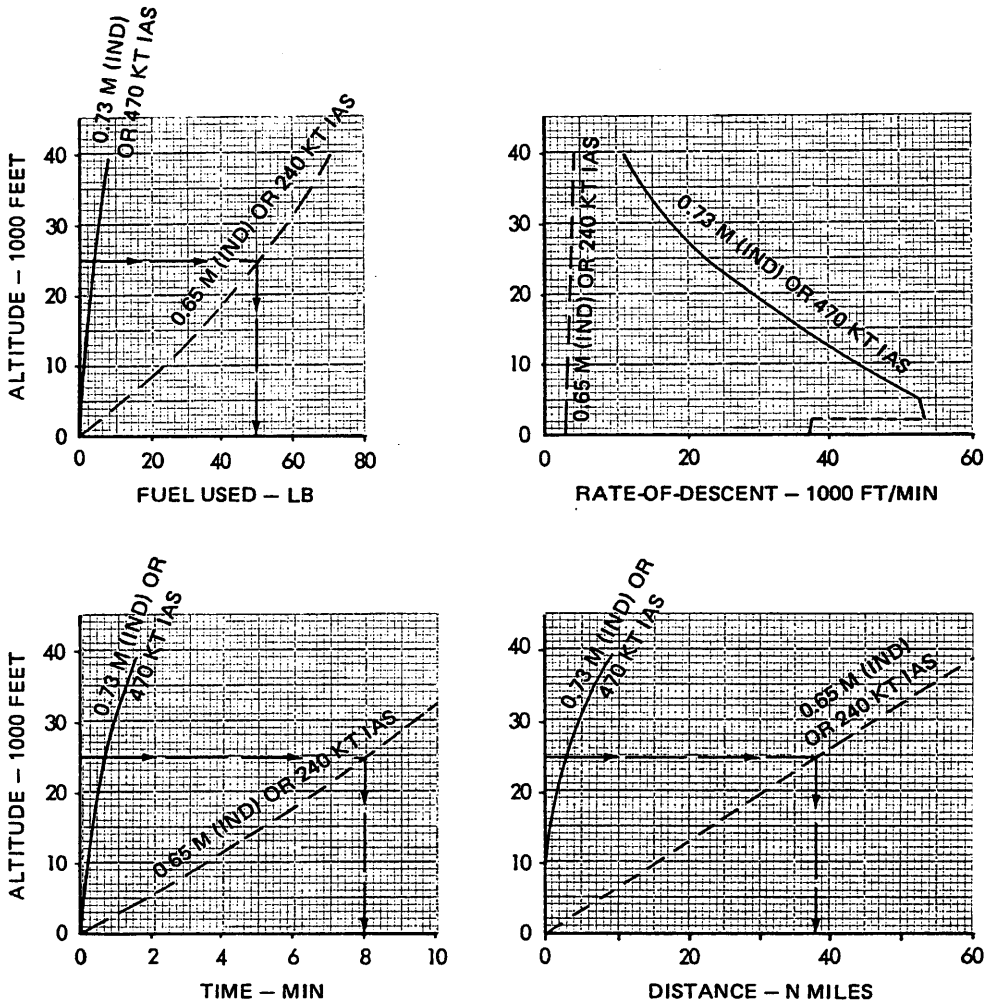
BMB04027

Figure 4-19 (Sheet 2 of 2) Endurance Chart

NORMAL DESCENT
CLEAN CONFIGURATION

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40

ISA DAY
POWER: IDLE RPM
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST



LEGEND

— — CLEAN CONFIGURATION
—— AIR BRAKES EXTENDED

NOTE

Descend at specified Mach until specified IAS registers, then hold this IAS.

EXAMPLE

ALTITUDE	25 000 FEET
FUEL USED	50 LB
RATE-OF-DESCENT	3500 FT/MIN
TIME	8 MIN
DISTANCE	38 NAUTICAL MILES

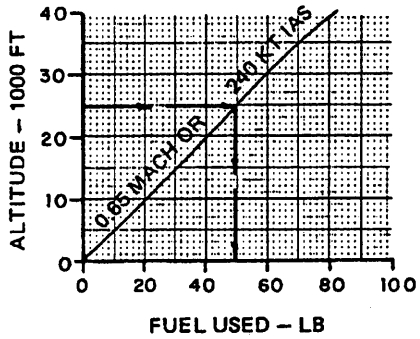
BMB04028

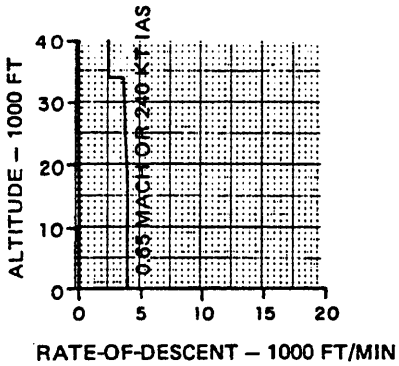
Figure 4-20 (Sheet 1 of 2) Normal Descent Chart

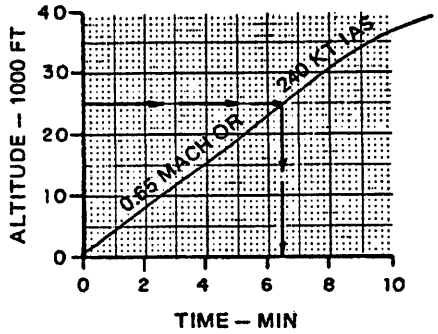
NORMAL DESCENT
EXTERNAL TANKS INSTALLED

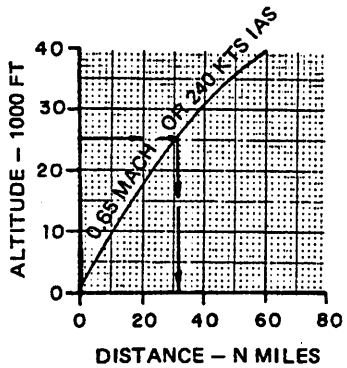
MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL: CAN 2-3.22 (JP-4)

POWER: IDLE RPM
DATA AS OF: JULY 1976
BASED ON: FLIGHT TEST









NOTE

Descend at specified Mach until specified IAS registers, then hold this IAS.

EXAMPLE

ALTITUDE	25 000	FT
FUEL USED	50	LB
RATE-OF-DESCENT	3 750	FT/MIN
TIME	6.4	MIN
DISTANCE	32	NAUTICAL MILES

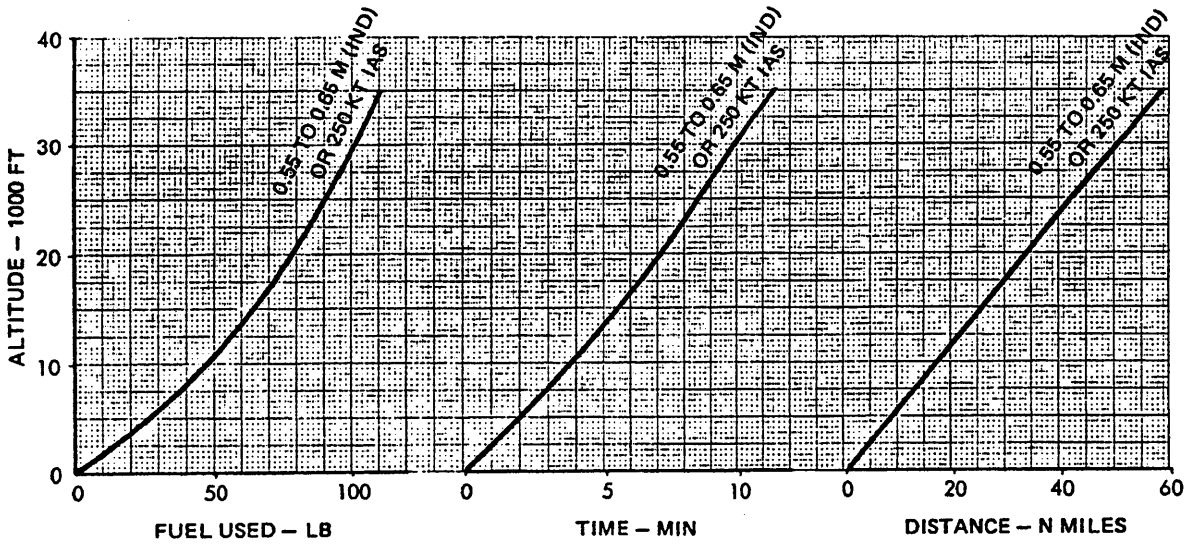
BMB04029

Figure 4-20 (Sheet 2 of 2) Normal Descent Chart

POWER-ON DESCENT
CRUISE ALTITUDE TO SEA LEVEL

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL GRADE: CAN 2-3.22 (JP 4)
FUEL DENSITY: 7.8 LB/GAL

POWER: 75% RPM
CLEAN CONFIGURATION
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST



NOTE

Descend at Mach 0.55 to 0.65 until ASI registers 250 kt. Then hold 250 kt IAS.

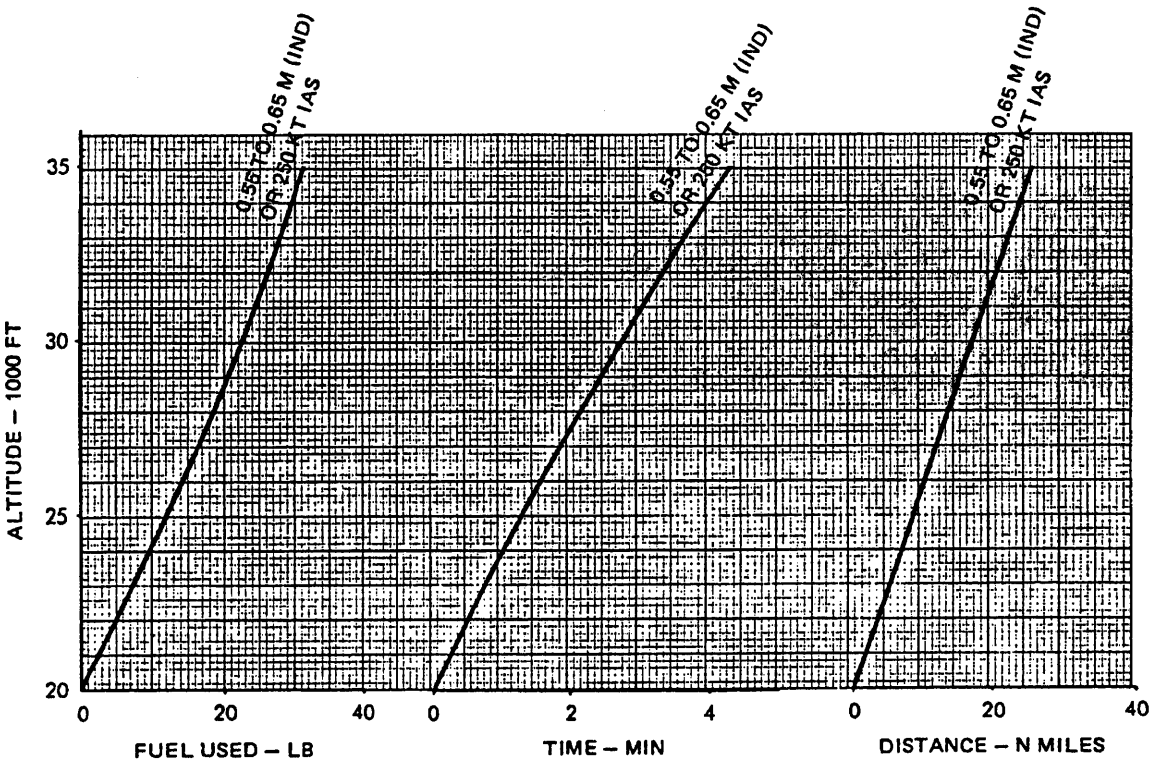
BMB04030

Figure 4-21 (Sheet 1 of 2) Cruise Descent Chart

POWER-ON DESCENT
CRUISE ALTITUDE TO 20 000 FT

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC J85-CAN-40
FUEL GRADE: CAN 2-3.22 (JP-4)
FUEL DENSITY: 7.8 LB/GAL

ISA DAY
POWER: 75% RPM
CLEAN CONFIGURATION
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST



NOTE

Descend at Mach 0.55 to 0.65 until ASI registers 250 kt. Then hold 250 kt IAS.

BMB04031

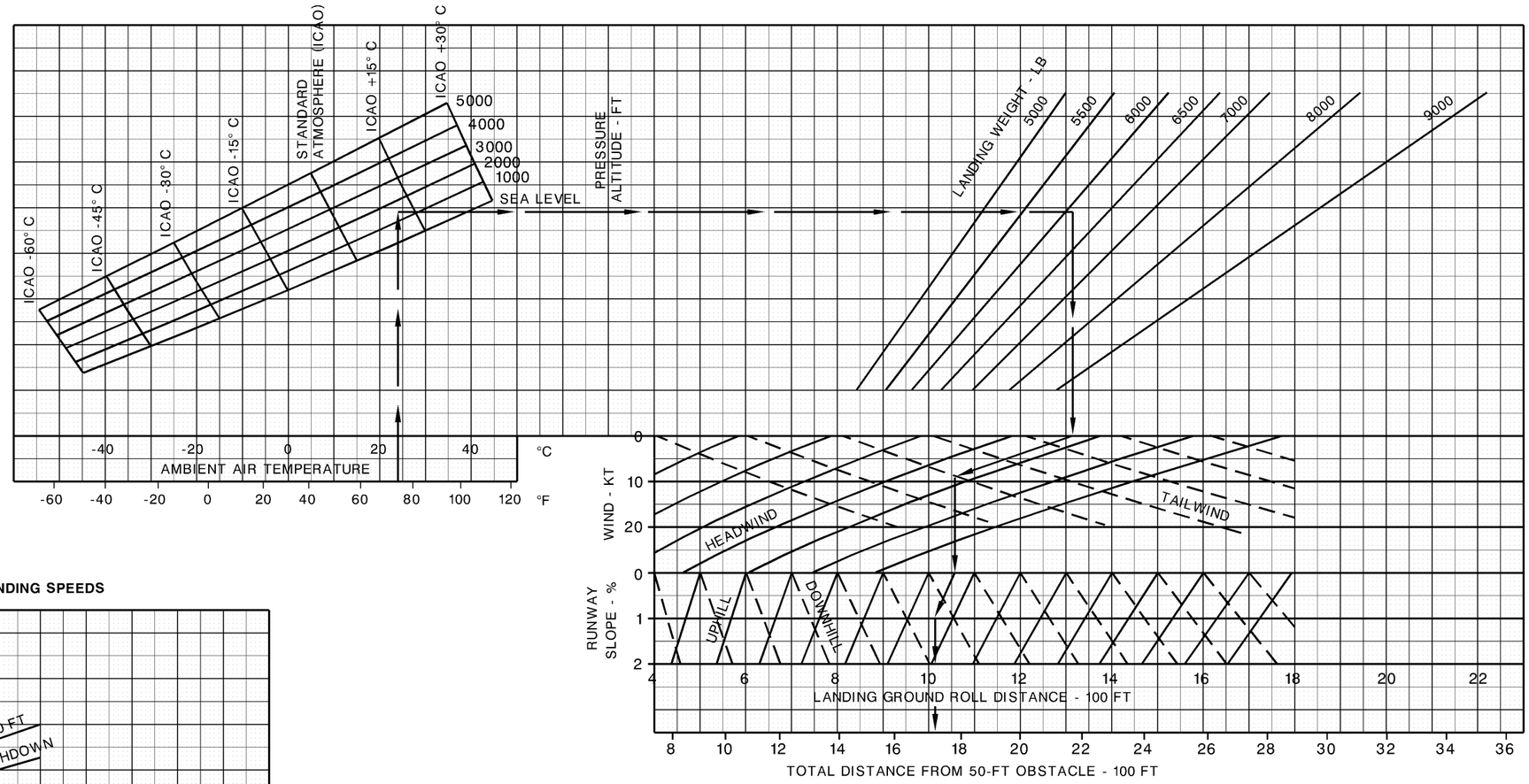
Figure 4-21 (Sheet 2 of 2) Cruise Descent Chart

MINIMUM LANDING DISTANCE

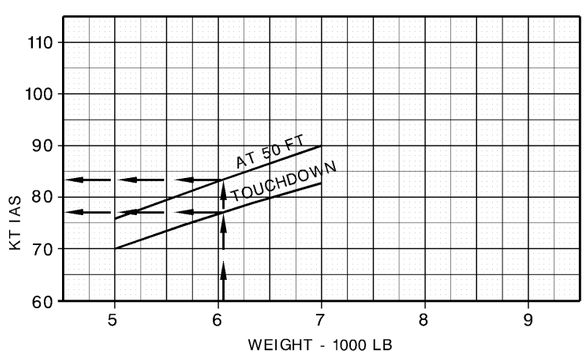
MODEL: TUTOR

FLAPS: 40°
NORMAL APPROACH
SPEED BRAKES OUT

MAXIMUM BRAKING
DATA AS OF: JAN 1960
BASED ON: FLIGHT TEST



LANDING SPEEDS



NOTE

THE DATA DOES NOT REPRESENT AIRCRAFT EQUIPPED WITH PN5006306 WHEEL BRAKE SYSTEM. LANDING DISTANCES REPRESENTED SHOULD BE CONSIDERED CONSERVATIVE FOR AIRCRAFT EQUIPPED WITH THIS NEWER BRAKE SYSTEM.

EXAMPLE

SURFACE AIR TEMPERATURE	24° C	LANDING GROUND ROLL	1015 FT
AIRFIELD PRESSURE ALTITUDE	1500 FT	TOTAL DISTANCE FROM 50-FT OBSTACLE	1725 FT
LANDING WEIGHT	6100 LB	SPEED AT 50 FT	83 KT
HEADWIND	9 KT	TOUCHDOWN SPEED	77 KT
RUNWAY SLOPE	1% UPHILL		

BMB04032

Landing Distance Chart Figure 4-22

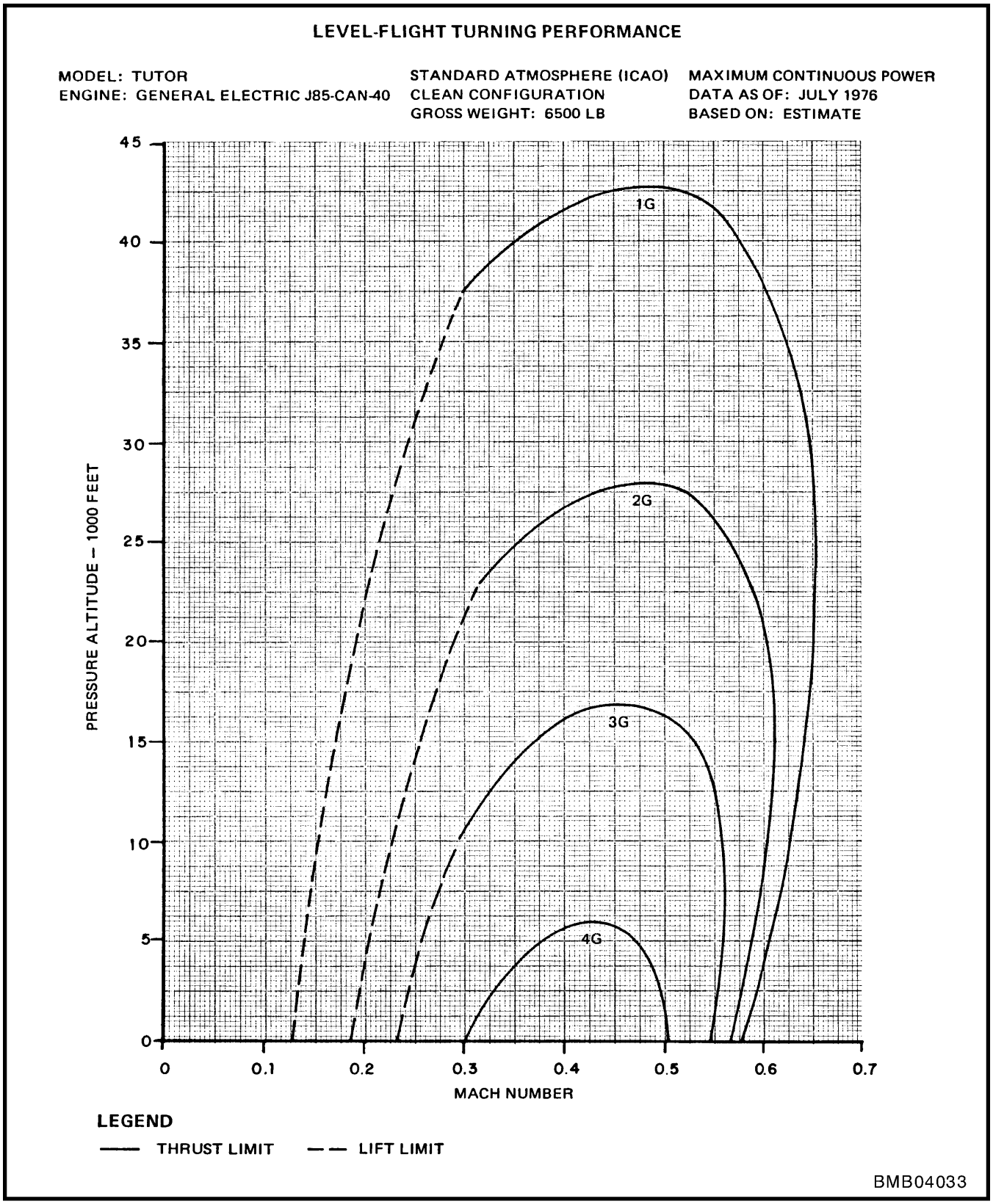


Figure 4-23 Level-Flight Turning Performance Chart

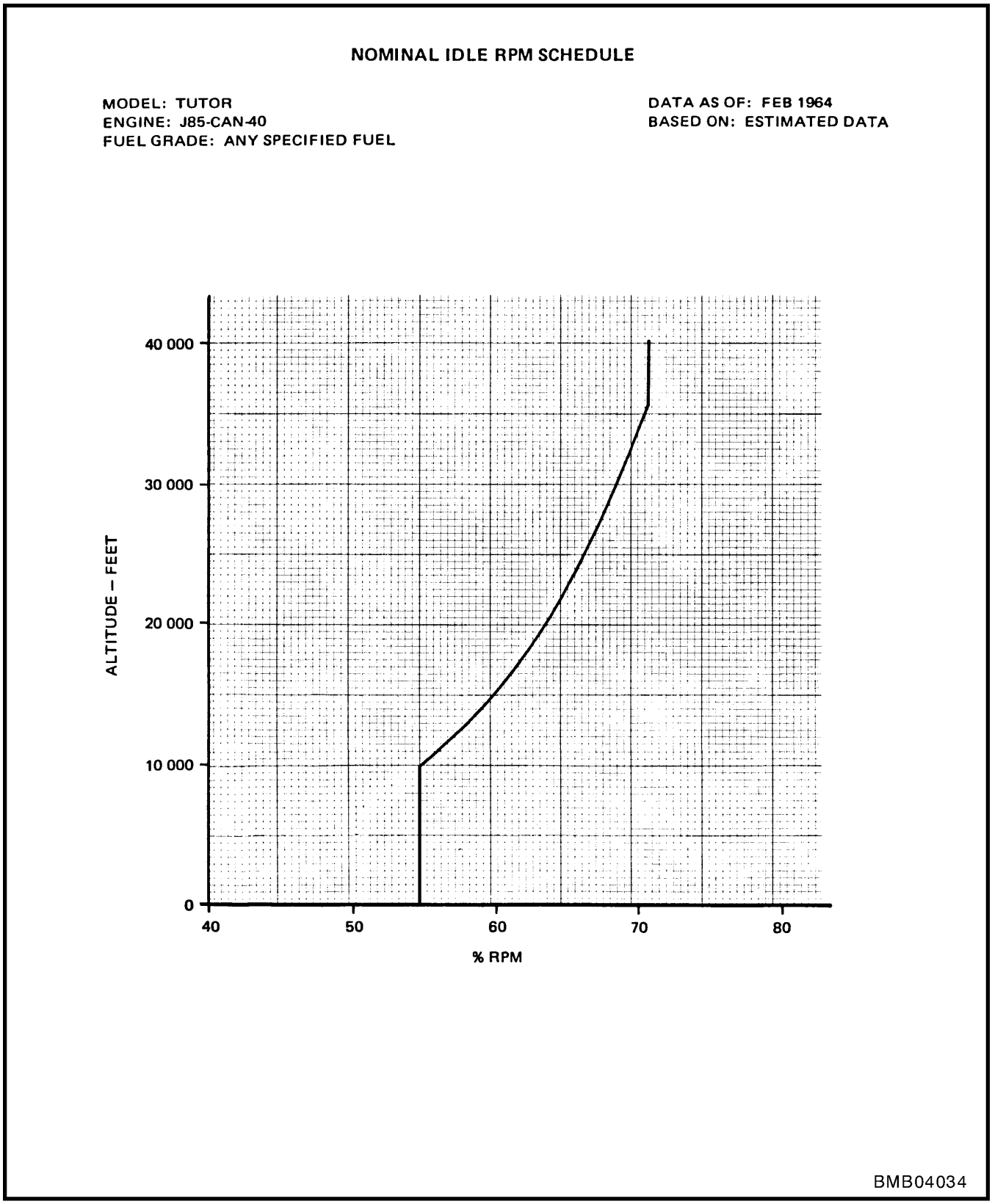
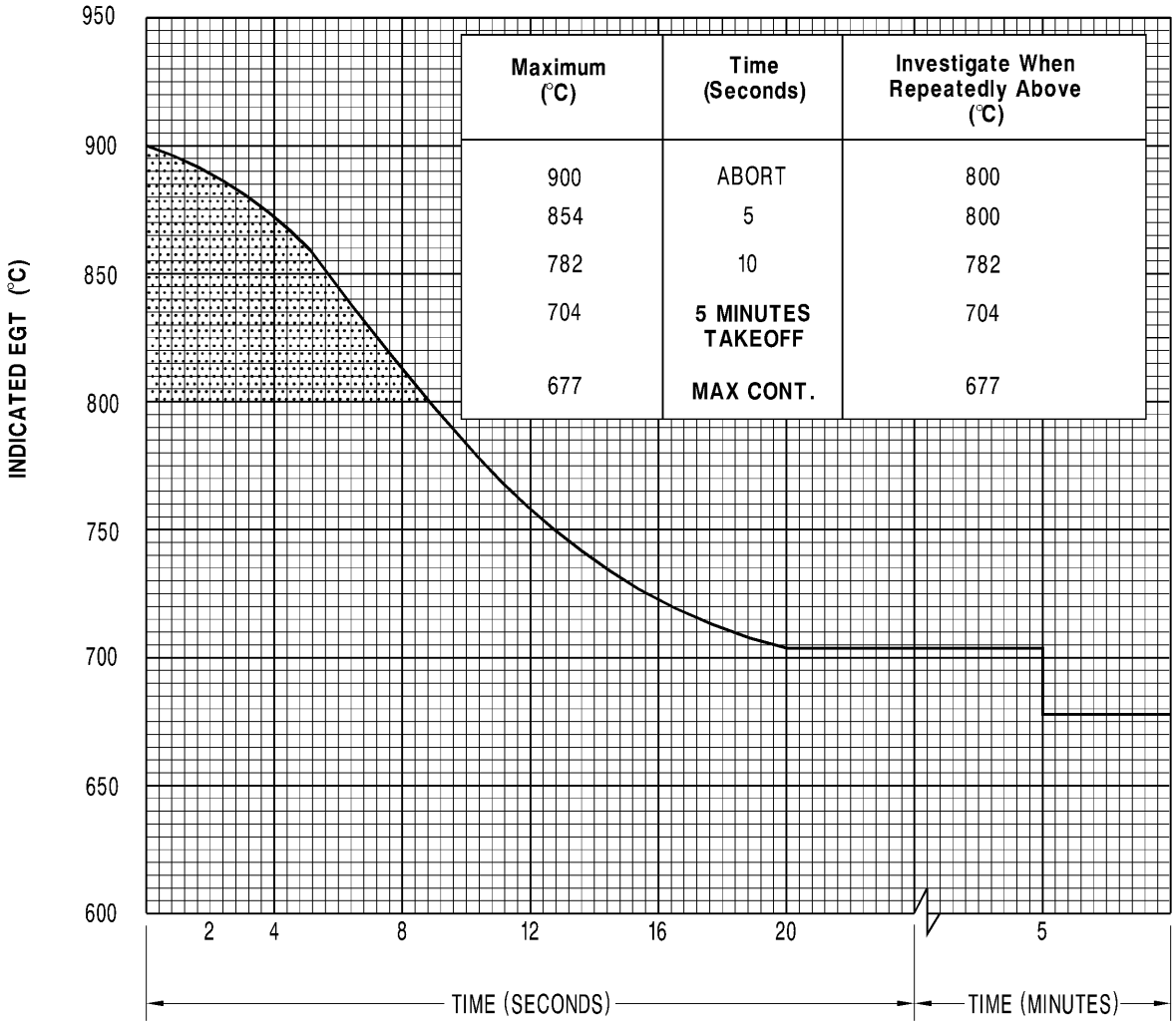


Figure 4-24 Nominal Idle RPM Schedule



Maximum (°C)	Time (Seconds)	Investigate When Repeatedly Above (°C)
900	ABORT	800
854	5	800
782	10	782
704	**5 MINUTES TAKEOFF**	704
677	**MAX CONT.**	677

NOTES

1 Engine operation below the curve is within allowable limits but engine operation above the curve is not permitted.

2 Occasional starting temperatures in shaded area are permissible, but starts which are repeatedly in this area shall be investigated and corrective action shall be taken. See text for jetpipe nozzle area adjustments.

3 Engine operation above the curve will require a hot end inspection and precautionary replacement of turbine blades.

4 EGT may rise rapidly on start. If EGT climbs rapidly through 850 °C, ABORT start.

BMB04035

Figure 4-25 EGT – Starting and Time at Temperature Limits

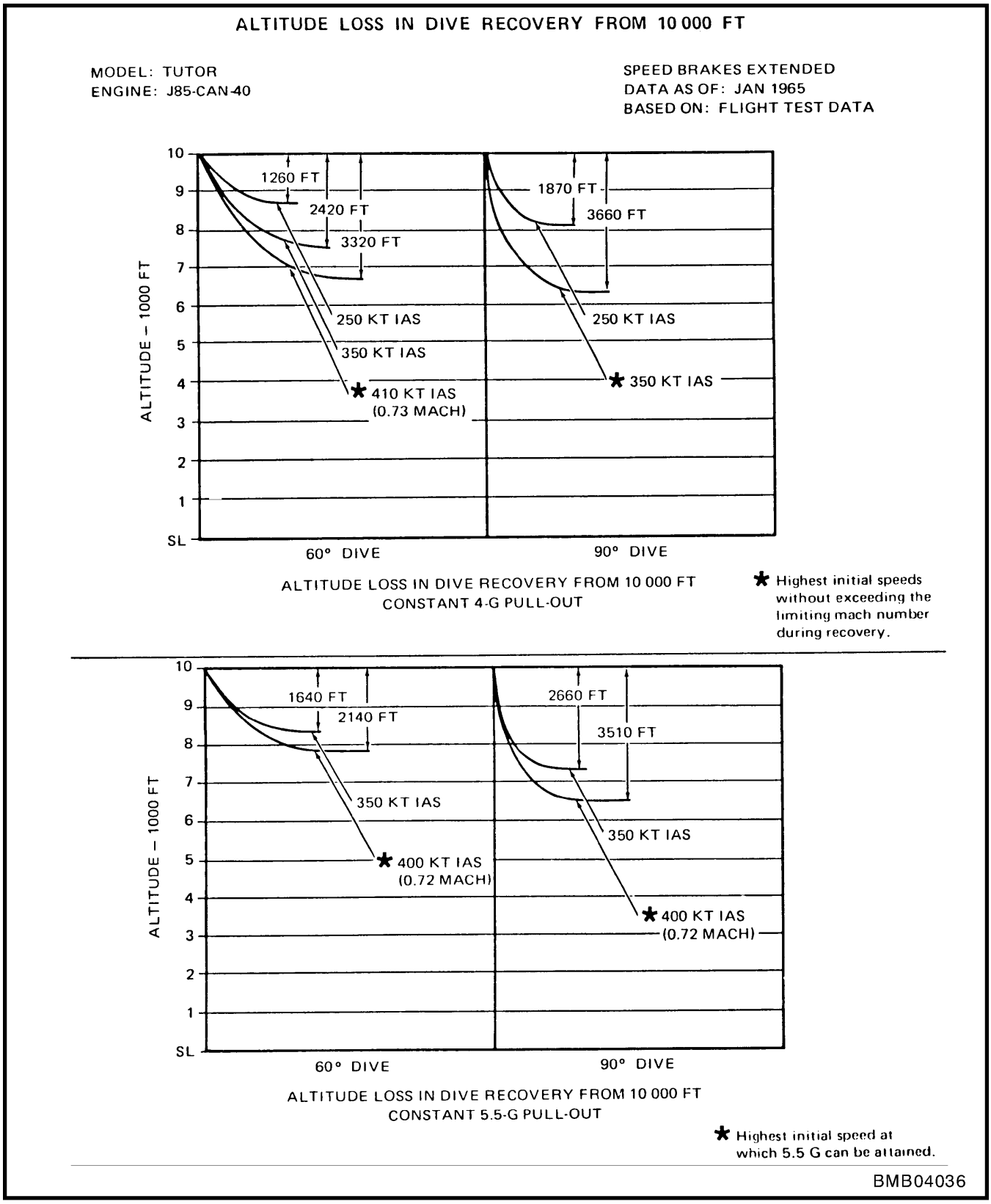


Figure 4-26 Altitude Loss During Dive Recovery for Aircraft Without Pylons or Tanks

PART 5

FLIGHT TESTING

SECTION 1

CLEAN CONFIGURATION

PROCEDURES

1. The procedures detailed in this part are to be observed during all flight testing of the aircraft and its systems. The flight profile is shown in Figure 5-1-1. Test cards are shown in Figure 5-1-2. The following rules also apply:

a. All maintenance flight testing must be carried out in accordance with Flying Orders, B-GA-100-003/AA-001 (CFP 100); Flight Test Orders for the Canadian Forces, C-05-020-007/AM-000, Part 8, and Parts 2, 3, and 4 of this CFTO.

b. All flight-data readings must be taken from the left hand side instruments.

c. Ensure that the weight and balance as shown in C-12-114-000/MW-000 are within specified limits.

NOTES

1. The test procedures in this part do not relieve the test pilot from complying with the procedures and checks laid out in Parts 1 to 4 inclusive, the Tutor Check List, C-12-114-000/MC-000 and Operational Restrictions listed in Section III of the CF 339, Aircraft Information Record.

2. Items that are checked in normal operations are not detailed in this part, unless amplification is required.

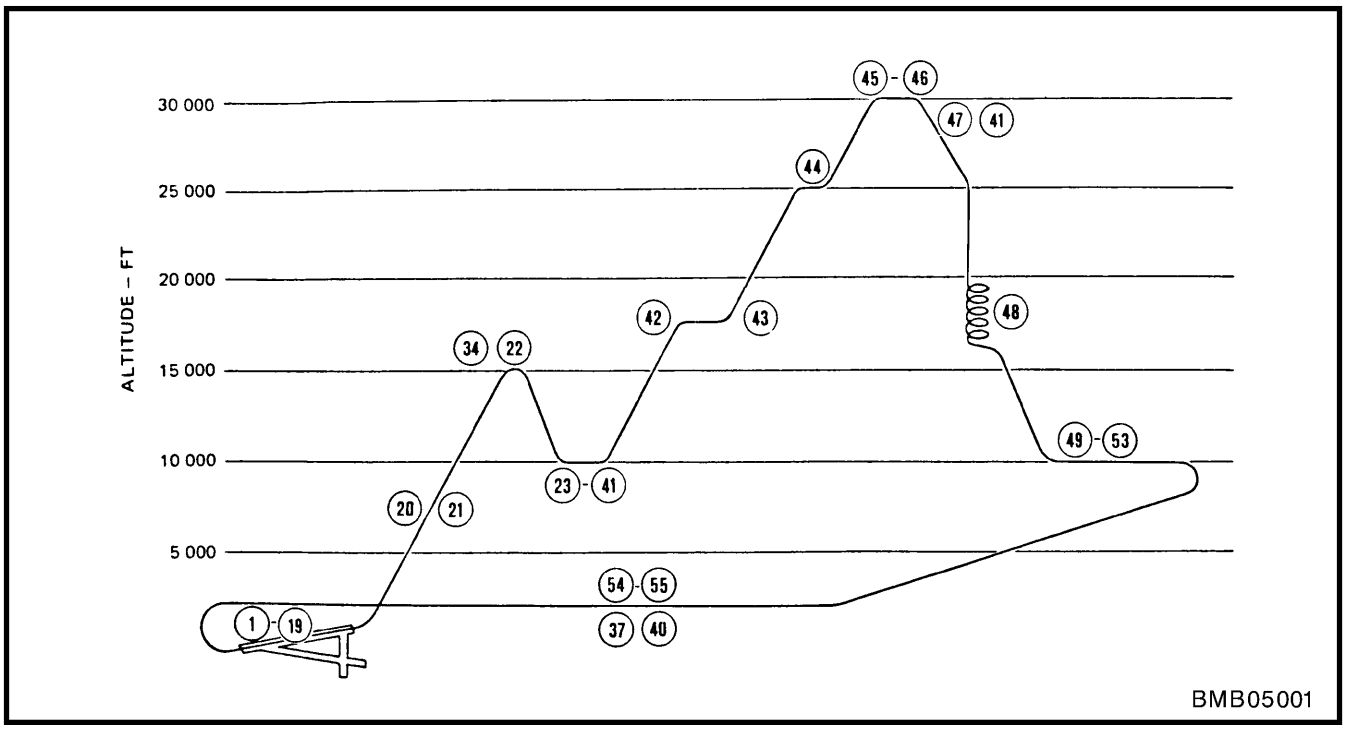


Figure 5-1-1 Flight Test Profile

BEFORE FLIGHT

EXTERNAL

2. Carry out all the external checks listed in Part 2 before entering the cockpit.

PRE-START

3. Carry out the pre-start check, and include the following specific items in normal sequence:

a. cockpit cleanliness, panels secure, no loose articles;

b. internal paint, decals and instrument markings correct and in good condition, and not obscuring the instrument pointers;

c. seat harness in good condition; release and locking mechanisms functioning correctly;

d. seat and rudder adjustments functioning correctly;

e. rudder pedals, control columns and hand grips correctly positioned;

f. airspeed indicators indicating less than 50 KIAS - normally 30-40 KIAS, and barber pole set at 412 KIAS; and

g. vertical speed indicators reading zero (0) feet per minute.

4. Check aileron, rudder, and elevator controls for smooth and correct operation. When the ailerons reach full lateral deflection in either direction, a further application of lateral force on the control column will deflect the spring tabs in both ailerons in a direction opposite to aileron deflection.

5. Check operation of INVERTER FAIL lights.

6. Complete a functional check of inter-communications, UHF, VHF, TACAN, VOR, ILS, and APX-77 transponder.

7. Elevator and aileron trim:

a. With the elevator (aileron) alternate trim system switch at OFF, visually ensure that both left and right elevator (aileron) stick-grip trim switches are inoperative.

b. With the elevator (aileron) alternate trim system switch selected to NOSE UP and NOSE DOWN (LH WIND DN and RH WING DN), visually check the following:

(1) elevator (aileron) trim tab operating in the correct direction, and

(2) elevator (aileron) trim tab movement unaffected by any selection made by either the left or right elevator (aileron) stick-grip trim switch.

c. With elevator (aileron) alternate trim switch at NORMAL, visually check the following:

(1) elevator (aileron) trim tab operating in the correct direction, using each stick-grip switch in turn,

(2) right stick-grip elevator (aileron) trim selection overrides left stick-grip trim selection, and

(3) trim override switch on each stick-grip renders both stick-grip elevator trim circuits inoperative.

d. When ELEV TRIM T/OFF legend is illuminated, ensure that elevator trim tab is approximately neutral.

NOTE

The ELEV TRIM T/OFF legend will illuminate only when the elevator trim tab is at neutral and while the stick-grip switch is actuated.

8. With DC master switch to BATT, engine master switch ON and throttle in CUT OFF, ensure that each airstart switch energizes the igniter plugs (recognized by an audible, irregular sparking), and illumination of the timed airstart light (25 ±2.5 seconds).

9. Oxygen system:

a. With the selector set at NORMAL, EMERGENCY, or TEST MASK, and the diluter lever at 100% OXYGEN or NORMAL OXYGEN, the blinker should indicate oxygen flow. Check both regulators.

b. With the selector in TEST or EMERGENCY, positive pressure must be felt.

10. When ground power is applied, ensure that the LOW FUEL PRESS, GENERATOR FAIL, INVERTER 2 FAIL, BLEED VALVE OPEN, and SPEED BRAKE OUT legends are illuminated and all others off.

START

11. Carry out a normal start. Record time to light up, time to idle, maximum EGT, oil pressure, and hydraulic pressure. When loadmeter has stabilized at approximately 0.3 to 0.4, indicating a fully charged battery, record idle RPM, idle EGT, and loadmeter reading.

NOTE

The maximum time from initiation of the start sequence until idle RPM is reached may vary from 48 seconds at –40 °C to 35 seconds at 10 °C. If the engine is slow to reach idle RPM, or light-up indication is not observed within five seconds of completion of throttle movement to idle position, it may indicate a faulty fuel system or EGT indicating system, and the aircraft should be placed unserviceable.

12. During the operation of the speed brakes, ensure that the right-hand switch overrides the selection made by the left.

BEFORE TAXIING

13. Before taxiing, check the generator and both inverters as follows:

a. Move generator control switch to TRIP, ensuring that the MASTER CAUTION light and GENERATOR FAIL legend illuminate. Cancel MASTER CAUTION light and confirm GENERATOR FAIL legend remains illuminated.

b. Ensure that the AC essential loads are maintained.

c. Reset generator, ensuring that the GENERATOR FAIL legend extinguishes, and that failed electrical services are regained.

d. Ensure both INV1 and INV2 switches are ON. Select INV1 switch to OFF. No. 1 and No. 2 INVERTER FAIL legends and the MASTER CAUTION lights shall illuminate. After approximately 3 seconds, the INVERTER 2 FAIL legend will extinguish. Ensure essential AC loads are maintained.

e. Select INV1 switch to ON. Ensure MASTER CAUTION lights and INVERTER 1 FAIL legend extinguish.

f. Complete a navigational-aid check.

14. Adjust altimeters to field altimeter setting. Ensure that each instrument reads within ±50 feet of field elevation in STBY mode. Select RESET and ensure that indicated altitude is ±50 feet at field elevation. Check that the total altitude difference between servo and STBY modes is 75 feet or less. Maximum allowable altitude difference between LH and RH altimeters in servo mode is 40 feet.

15. The nose-wheel steering should be checked from both seats (where possible). Depress nose-wheel steering button and, by moving the rudder pedals, confirm that steering engages. Upon engagement, with rudder pedals neutral, the aircraft should track straight ahead. The aircraft should steer positively, accurately, and without undue sensitivity. The nose-wheel turning radius should be approximately 20 feet. Release steering button and ensure that nose-wheel steering disengages.

16. Check the wheel brakes while taxiing out for take-off and during the engine check (new brake pucks must be broken in to ensure maximum braking potential). Ensure that it is possible to maintain a straight course with light differential braking. Ensure that braking action is smooth and positive, and that no pumping of the brake pedals is required. After releasing the brakes, check for dragging brakes. Ensure that they will hold the aircraft stationary at maximum continuous power during the engine check.

ENGINE CHECK

17. Complete the engine check before lining up on the runway:

CAUTION

Prolonged engine operation at idle can cause overheating of the aft section of the compressor and engine, thus increasing the potential for a ground acceleration stall. A ten-minute interval at idle RPM should be followed by a two-minute cool-down period at 70% RPM.

a. With engine idling and air-conditioning ON, move throttle from idle to full power within one second. Record time taken for RPM to ascend to, and stabilize at, maximum. Record maximum RPM, EGT, oil pressure, and hydraulic pressure.

NOTE

The engine instrument readings must stabilize, and acceleration time must be within 15 seconds.

b. Move throttle from full power to idle within one second.

c. Record time taken for RPM to descend to, and stabilize at, idle. The RPM, EGT, and hydraulic pressure should be essentially the same as was recorded at Start Check (refer to Paragraph 11).

18. During the engine check, place anti-ice ON at maximum continuous power, and note a rise of 10° to 15 °C in EGT. Switch OFF, and EGT should decrease to the original figure.

NOTE

If no rise in EGT is evident, re-select anti-ice in the climb and check for decrease in thrust and a rise in EGT.

WHEEL SHIMMY

19. During the take-off run, ensure that there is no wheel shimmy.

MEDIUM ALTITUDE – 10 000 to 15 000 FEET

20. Below 8000 feet, open both fresh air vents, note flow of air, and begin a climb. At an altitude between 8000 and 11 500 feet, the air vents should cut off air flow.

21. Contact a ground radar station and request a transponder check. The ground station should report satisfactory operation of IFF on Modes 1 and 3, Emergency, and Ident. If ground station can check altitude mode, set 29.92 on altimeter and cross-check reported altitude.

ENGINE RELIGHT

NOTE

Prior to flaming out the engine, ensure the airstart ignition system is serviceable by pressing the AIRSTART button. The airstart light should illuminate and a buzzing sound should be heard on the intercom. The timed airstart cycle must be completed prior to engine shutdown.

22. The procedure for engine relight is as follows:

a. Flame out the engine at 15 000 feet pressure altitude (29.92 set) or above, and establish a stabilized glide at the appropriate airspeed for the altitude (180 KIAS at 15 000 feet MSL, minus 2.5 KIAS for each additional 1000 feet).

b. Ensure that this airspeed schedule sustains a minimum windmill RPM of 12%.

c. Relight the engine via airstart only, and record any undesirable characteristics, windmill RPM, and time required for the start (30 seconds).

d. If the engine fails to relight within 30 seconds, and if altitude permits, continue to hold airstart ignition ON and increase airspeed to give a higher windmill RPM. Record altitude, KIAS, and windmill RPM at which relight occurs. If the engine does not relight within an additional 30 seconds, revert immediately to Procedure 2.

NOTE

Reject an engine that does not satisfy Step b, or that will not start within 30 seconds while at the appropriate airspeed/altitude combination and with a minimum windmill RPM of 12%.

TRIM SYSTEM AND PRIMARY FLIGHT CONTROLS – 10 000 FEET AGL (MIN)

23. The procedure for trim setting is as follows:

a. Trim the aircraft for straight-and-level flight at 250 KIAS.

b. Check aileron trim-tab position and turn-and-slip indicator.

NOTE

The maximum acceptable deflection of the aileron trim tab is 1/4 inch. The maximum acceptable deflection of the ball is 1/32 inch. If the trim tab is out of tolerance, retrim before landing and leave set to permit ground adjustment.

24. The procedure for lateral and longitudinal trim is as follows:

a. Trim the aircraft for straight-and-level flight at 250 KIAS.

b. Operate aileron trim to left, right, and back to neutral. The aircraft must roll in response to trim selection.

c. Using the primary controls, bank the aircraft to left and right, then return to level flight. No trim change should be required to maintain level flight.

d. Trim nose down, nose up, and back to neutral. The aircraft must pitch in response to trim selection.

e. Reduce airspeed to 150 KIAS and trim laterally. Move control column approximately two inches to left, then release. The aircraft should roll in response to aileron deflection, and the control column should re-centre within 1/2 inch.

f. Move control column approximately one inch forward or back, then release. The aircraft must pitch in response to elevator deflection, and the control column must re-centre within 1/8 inch.

g. Deflect rudder smoothly throughout the full travel and release. The rudder must exhibit positive centring.

NOTE

Failure to meet the requirements of Steps e, f, and g may indicate improperly rigged control systems or excessive control circuit friction.

DIRECTIONAL TRIM

25. Directional trim procedure is as follows:

a. Increase speed to 350 KIAS. The lateral stick force required to maintain level flight throughout the speed range should not exceed two pounds.

b. Note that the turn-and-slip indicator, during the speed change from 250 KIAS, decreased to 150 KIAS and then increased to 350 KIAS. With no application of rudder, both the needle and ball must remain within 1/32 inch of the original position over the entire speed range.

SPEED BRAKES

26. The procedure for speed brakes is as follows:

a. Trim aircraft for straight-and-level flight at maximum speed. Extend and retract the speed brakes. The speed brakes must extend in a maximum of three seconds (as noted by the recovery of the hydraulic pressure), and must retract in a maximum of five seconds.

b. Ensure that the SPEED BRAKE OUT legend illuminates as the speed brakes extend.

c. Ensure that speed brakes extend symmetrically: that is, extension does not cause yaw, objectionable buffet, or other undesirable flight characteristics.

FLAPS

27. The procedure for flaps is as follows:

a. Trim aircraft in straight-and-level flight at 138 KIAS. Fully deflect and raise the flaps.

b. Extension time should be 8 to 12 seconds.

c. Retraction time should be 8 to 12 seconds.

NOTE

In temperatures below –7 °C these times may be exceeded. Operate the flaps at least three times to circulate all cold fluid through the reservoir, then record times on the fourth operation.

d. The flap position indicator must give an approximate indication of flap position.

e. With flaps fully down, let airspeed decrease from 140 KIAS to the stick shaker and check for any roll tendency.

f. There must be no change in lateral trim during flap movement or during deceleration to the stick shaker.

STALL

28. This stall series is conducted to determine any undesirable flight characteristics involving severe wing drop or flick rolls. Carry out all sequences at 10 000 feet AGL minimum. Stall speed shall be as per Figure 5-1-2 (±3 KIAS).

a. **Clean.** Enter with nose slightly above the horizon, keeping the wings level with aileron. Retract speed brakes at 100 KIAS and maintain altitude until aircraft stalls. As speed decreases from 100 KIAS, record IAS at which stick-shaker is activated. Continue to allow IAS to decrease until aircraft stalls. Record stall speed. Stickshaker should have activated approximately 9 KIAS above the stall speed.

b. **Landing Attitude.** Simulate the final approach with speed brakes out, landing-gear and flaps fully down, RPM at 65% and 115 KIAS. Allow IAS to decrease to 95 knots, then round out until the stall occurs. The aircraft is serviceable if there is no wing drop throughout the approach to the stall. Controllable wing drop may occur after the stall. Record the stick-shaker and stall speeds.

c. **High Speed.** Enter a co-ordinated 60-degree bank turn at 160 KIAS. Reduce power to idle, maintain altitude, and allow airspeed to decrease to 140 KIAS. At 140 KIAS, progressively add back pressure on control column until the aircraft stalls. Repeat procedure in the opposite direction. If the stall can be sustained for about two seconds and the recovery can be made without ''flicking'', the aircraft is serviceable. The roll tendency is more pronounced with an aft CG, e.g., when right seat is unoccupied.

ACCELEROMETER

29. Test the accelerometer as follows:

a. AT 10 000 feet MSL and 250 KIAS, roll into a 60-degree level turn and check that the accelerometer reads 2.0 G ±0.1 G. Advance the throttle to max continuous and tighten the turn smoothly in order to attain, gradually, approximately 6 G, noting that the accelerometer operates normally with no indication of sticking or over-sensitivity.

b. With a minimum of 1000 pounds of fuel, at 250 KIAS, with max continuous power, nose 10 to 15 degrees above the horizon, roll inverted and smoothly push the stick forward to attain approximately –1.5 G, noting that the accelerometer operates normally with no sticking or over-sensitivity. Roll upright.

BOOST PUMP NEGATIVE-G VALVE

30. Using the same entry procedure as in Paragraph 29, Step b, maintain –1 G and maximum RPM for 15 seconds. Reject the engine if one of the following occurs:

a. the LOW FUEL PRESS legend illuminates;

b. the engine flames out; or

CAUTION

If the oil pressure drops to zero and does not recover when the aircraft is stabilized in inverted flight, return to a normal attitude immediately. With the loss of oil pressure, the engine operating limitation is 30 seconds.

c. the oil pressure does not recover to specified limits.

NOTE

The oil pressure may drop momentarily, and the LOW FUEL QUANT and LOW FUEL PRESS legends may illuminate momentarily during entry and recovery. This does not render the aircraft unserviceable.

COCKPIT TEMPERATURE CONTROL

31. The procedure for cockpit temperature control is as follows:

a. Establish level flight at 10 000 feet at cruise power, with altitude, speed, and power setting stabilized.

b. Move cockpit temperature selector from one extreme to the other, both automatically and manually. The air flowing into the cockpit should change temperature in accordance with the selected position of the control, on both automatic and manual, with no cockpit pressure fluctuation.

CANOPY DEMISTING

32. The procedure for canopy demisting is as follows:

a. Test demisting at both cruise and idle power. Move canopy demist switch from OFF to ON. Ensure that flow of air from windshield and canopy demist outlets increases when demist is turned ON.

b. Check the alignment of the canopy demisting horns at the top front of the canopy.

COCKPIT PRESSURE DUMP

33. Actuate cockpit pressure dump switch. The cockpit altitude should immediately climb and approximate aircraft altitude.

ARC-164 UHF

34. The UHF must be checked at an altitude of approximately 10 000 feet and a minimum distance of 100 NM from the ground station selected. Two-way communication should be satisfactory on the frequency selected using both pre-set and manual. Two-way communication should be satisfactory on 243.0 MHz, using both preset and manual.

AN/ARN-504 TACAN AND AN/ARN-508 VOR

35. Above 10 000 feet, at a range of approximately 75 NM from the ground facility, fly over a selected geographical location and home to the TACAN station with the track selector set to the TACAN radial in order to centre the track bar. Where possible, terminal control radar should be used to assist in this check. Both left and right indicators should be used to check the following:

a. the indicated bearing should be within three degrees of the actual radial bearing from the TACAN station;

b. the indicated range should be within 2 NM of the actual range to the TACAN station;

c. the track bar must centre and give correct left-right indications with deviations from the selected radial;

d. the TACAN identifiers shall be clearly audible;

e. the TO/FROM flag shall read FROM and switch to TO when the inbound reciprocal radial is selected; and

f. complete Steps a to e, deleting Step b for the VOR procedure. Note that station passage will occur as the TO/FROM indicator changes from TO to FROM.

TURN-AND-SLIP INDICATOR

36. To check the turn-and-slip indicators:

a. Trim aircraft in straight-and-level flight at 200 KIAS.

b. Establish and hold a rate-1 turn through 360 degrees, first to the right, then to the left.

c. Ensure that the time lapse for the complete turn is two minutes, that during turning manoeuvres the needle and ball of each instrument move freely, and that the indications on both instruments are the same.

NOTE

A momentary indication of turn in the opposite direction may occur as the turn is initiated.

ATTITUDE INDICATOR

37. In turns checking turn-and-slip indicators, check also the attitude indicators; the angle of bank should be 25 to 30 degrees. On straightening out from each turn, the bank angle error should not exceed five degrees (to right or left as appropriate); the difference in reading between the two instruments should not exceed 1-1/2 degrees within the same five degrees.

ALTIMETERS

38. The altimeter pointers should move positively and without hesitation under normal flying conditions. The difference obtained in altimeter readings when changing from the RESET position to the STBY mode should approximate that indicated on the altimeter correction card. Differences between the expected change and the actual change should not exceed ±150 feet at all altitudes.

PRESSURIZATION

39. At aircraft altitudes between 8500 and 16 150 feet, the cockpit altitude must be 8000 ±1000 feet, with maximum fluctuations of 100 feet. This tolerance must be maintained at all altitudes between 8500 and 16 150 feet (see Part 1, Figure 1-13).

VERTICAL SPEED INDICATOR

40. The difference in reading between the two instrument pointers must not exceed 200 feet/minute. Check instrument accuracy against a timed climb or descent.

AIRSPEED INDICATOR AND MACHMETER

41. The airspeed indicators and machmeters should be checked at two or three airspeeds, as follows:

a. the maximum allowable difference between the two airspeed indicators is 4 KIAS at 100 KIAS and 8 KIAS at 340 KIAS; and

b. the maximum allowable difference between the two machmeters is 0.04 Mach.

ENGINE CLIMB CHECK

42. During a maximum continuous power climb between 15 000 and 18 000 feet, record maximum RPM, EGT, oil pressure, and hydraulic pressure. The maximum RPM at all altitudes must be in accordance with Part 2, Section 1, Figure 2-1-10.

PRESSURIZATION LEAK

43. With aircraft in level flight at 18 000 feet and 98% RPM, adjust the cockpit temperatures for pilot comfort:

a. Record cockpit altitude and note when it is 9400 ±1000 feet.

b. Retard power to flight idle for one minute. Cockpit altitude should remain approximately constant.

HIGH ALTITUDE

ENGINE ACCELERATION AND DECELERATION

44. Proceed as follows:

a. At 25 000 feet, 100 KIAS, and flight Idle, move throttle from idle to maximum continuous power in one second. Engine should accelerate and stabilize maximum RPM within 15 seconds.

b. Record RPM, EGT, oil pressure, and hydraulic pressure.

c. Move throttle from stabilized maximum continuous power to idle in one second. Engine should decelerate and stabilize at flight idle.

PRESSURIZATION

45. At 30 000 feet and using maximum continuous power, cockpit altitude should be 18 000 ±2000 feet.

IDLE RESET

46. The idle reset procedures are as follows:

a. At 30 000 feet and 90 KIAS, with the throttle at idle and RPM stabilized, continue for 30 seconds with the following services selected:

Panel and Instrument Lights . . . . . ON

Anti-Collision and Nav Lights . . . . . ON

Landing Lights . . . . . ON

UHF, VOR/ILS, VHF, TACAN,
IFF, Intercom . . . . . ON

Cockpit Air-Conditioning . . . . . AUTO

Windshield De-ice . . . . . ON

b. Ensure that engine RPM does not run down, and note idle RPM reading.

NOTES

1. Idle RPM must correspond approximately to that of the schedule shown in Part 4, Figure 4-25.

2. Take-off flap may be required to maintain 90 KIAS.

DESCENT

MACH RUN

47. Carry out the Mach run as follows:

a. Trim aircraft for straight-and-level flight at 30 000 feet, using maximum continuous power. Dive to increase airspeed to the limiting Mach number 0.78 or ‘‘nose tuck’’, whichever occurs first.

b. The aircraft should be stable, and no excessive vibration or buffet should be encountered prior to attaining the limiting Mach number.

c. Nose tuck may be encountered prior to attaining the limiting Mach number. It can be compared to a nose-down overtrim and should not be violent. If this occurs, note the IMN and recover. Enter this information on the aircraft data sheet in the front of the Aircraft Maintenance Record.

NOTE

During Mach run the ball of the turn-and-slip indicator may suddenly become displaced from the centre. This may be caused by incorrect adjustment of the tailpipe and must be rectified before the aircraft is considered serviceable.

SPIN

CAUTION

Spins are to be attempted only if stall characteristics are normal.

48. Proceed as follows:

a. Spin aircraft to both the left and the right in the clean configuration. The aircraft must make at least three full turns.

b. Record any abnormal characteristics. The recovery must be satisfactory, and the engine must not flame out; otherwise the aircraft is unserviceable.

LOW ALTITUDE

LANDING-GEAR WARNING

49. During descent to low altitude with the throttle below 65% RPM, ensure that the landing-gear warning horn sounds at approximately 7000 feet MSL.

50. Proceed as follows:

a. Establish level flight at 1000 feet AGL, 240 KIAS, with landing-gear up.

b. Slowly retard throttle, and note RPM at which audible warning commences and red warning lights illuminate (should be 65 (±2)%).

c. Depress AUDIO WARNING OVERRIDE button and note that tone ceases; warning lights will remain on. Advance throttle and ensure that warning lights go out.

LANDING-GEAR OPERATION

51. Carry out following procedure:

a. Establish level flight at 160 to 170 KIAS.

b. Extend and retract the landing-gear. (Aircraft yaw during extension or retraction may indicate an undesirable asymmetrical gear operation.)

c. Ensure that the landing-gear indicators and red warning light correspond to gear and selector lever position. Extension and retraction times should be eight seconds maximum.

LANDING-GEAR UP SELECTION OVERRIDE SWITCH

52. Proceed as follows:

a. Set up aircraft as in Paragraph 51.

b. Lower gear in the normal manner, then move LDG GEAR UP SELECTION override switch to OFF, and attempt to select landing-gear UP.

NOTE

The normal selector lever and hence the landing-gear should remain locked down as long as the LDG GEAR UP SELECTION override switch is in the OFF position.

EMERGENCY LANDING-GEAR LOWERING

53. At 175 KIAS or less, pull the LG HAND PUMP SELECT handle and pump landing-gear down. The landing-gear should lock down, and the gear position indicators should show three wheels. Lower landing-gear selector lever and re-establish the normal hydraulic system by selecting the LG HAND PUMP SELECT handle in fully.

ARC 511 VHF RADIO

54. The ARC 511 must be checked at an altitude of approximately 10 000 feet and a minimum distance of 100 NM from the selected ground station.

ILS

55. Complete a full ILS approach to check accuracy of the on-course and glidepath indications. Check marker beacon operation on both HI and LO settings.

FUEL LOW-LEVEL WARNING

56. When in level flight at 128 KIAS and below 5000 feet altitude, ensure that the low-level warning light illuminates when the fuel quantity falls between 330 to 430 pounds remaining (as indicated on the gauge).

NOTE

Do not perform this check immediately after any unusual aircraft attitudes. Moderate turbulence may also give erroneous fuel low-level warnings.

FTC (1) MAY 93

TUTOR TEST FLIGHT CARD

CLEAN CONFIGURATION

AIRCRAFT DATE PILOT

TIME FUEL OAT TEST

1 *This card is to be used in conjunction with C-12-114-000/MB-001, Part 5, Flight Testing, Section 1, Clean Configuration. The number beside each sequence corresponds to the equivalent para number in Part 5, Section 1.*

2.	EXTERNAL			15.	N/W STEER		
	SEAT	VSI (0)		16.	BRAKES		
	ASI (30-40/412)			17.	ENGINE	INC	DEC
4.	CONTROLS				Time (15 Sec)		
5.	INVERTER FAIL				RPM		
6.	INTERCOM				EGT		
7.	TRIMS				Oil Press		
8.	AIRSTART (25 ± 3)				Hyd Press		
9.	OXYGEN			18.	ANTI-ICE (10-15°)		
10.	ANNUNCIATOR PANEL			19.	WHEEL SHIMMY		
11.	START - Time to Light			20.	FRESH-AIR VENTS		
	Time to Idle			21.	IFF		
	Max EGT			22.	RELIGHT TIME (30 Sec)		
	RPM				10 000' AGL (Min)		
	EGT			23.	TRIM CONTROL (250 KIAS)		
	Oil Press				Trim Set-All ¼ Ball 1/32		
	Hyd Press			24.	TRIM LATERAL & LONGITUDINAL (250-150 KIAS)		
	Loadmeter (.3 -.4)						
12.	S/B OVERRIDE			41.	ASI - 340 KIAS (± 8)		
13.	PRE-TAXI-ELECT			25.	DIR TRIM (350-150 KIAS)		
14.	ALT (± 50')			26.	S/B (3/5 Sec)		
	Diff LH & RH (40')			27.	FLAPS (8-12 Sec)		
	Servo/Stby (75')						

41.	ASI (100 ± 4 KIAS)			38.	ALT - 25 000 (± 150')		
28.	STALLS - Min 10 000' AGL			44.	ENGINE ACCEL	INC	DEC
	Stick Shaker Clean				Time (15 Sec)		
	Stall Clean				RPM		
	Stick Shaker Dirty				EGT		
	Stall Dirty				Oil Press		
	High-Speed (140 KIAS)				Hyd Press		
29.	ACCELEROMETER			45.	PRESS (18 000' ± 2)		
30.	NEG-G VALVE			46.	IDLE RESET (80 KIAS)		
31.	COCKPIT TEMP	RH		47.	MACH RUN - 30 000'		
32.	DEMIST/HORNS			41.	Machmeter (.04)		
33.	DUMP VALVE				IAS		
34.	UHF				T/S - Ball		
35.	TACAN/VOR (3° 2NM)				Effects		
36.	T/S INDICATORS				S/B		
37.	ATT IND (1½°)			48.	SPINS L	R	
38.	ALT 15 000 (± 75')				DESCEND - LOW LEVEL		
39.	PRESS (8000' ± 1)			49.	L/G WARN (7000')		
40.	VSI (200' DIFF)			50.	L/G WARN (65 ± 2)		
42.	CLIMB - 15 to 18 000')			51.	L/G OPER (8 Sec)		
	RPM			52.	L/G OVERRIDE		
	EGT			53.	EMERG L/G LOWER		
	Oil Press			54.	VHF		
	Hyd Press			55.	ILS		
43.	PRESS LEAK			37.	ATT IND (1½°)		
	CLIMB - 25 000'			40.	VSI (200' DIFF)		
				56.	FUEL LOW LEVEL WARN		

REMARKS:

SERVICEABLE ☐

UNSERVICEABLE ☐

TEST PILOT

FTC (1) MAY 93

TUTOR TEST FLIGHT CARD

AIRCRAFT DATE PILOT

TIME FUEL OAT TEST

EXTERNAL TANKS INSTALLED

2.	EXTERNAL			6.	MACH RUN (0.7/400)		
3.	INTERNAL			7.	STALLS - CLEAN		
4.	TRANSFER (1500 + 300)				DIRTY		
5.	LIGHTS			9.	VOR	ILS	

SNOWBIRD AIRCRAFT

2.	EXTERNAL			5.	ALT		
3.	PRE-START			6.	"G" METER		
	ADF			7.	START - GPU		
	UHF FREQ IND.				BATT		
				8.	S/B (L/R CONT)		
4.	TRIMS				AIRBORNE		
	L/R CONT -	L	R	10.	MACH RUN (0.7/400)		
	ELEV			13.	SMOKE L	R	
	AIL			14.	L/G EMERG LOWER		
	OVERRIDE						

REMARKS:

SERVICEABLE ☐

UNSERVICEABLE ☐

TEST PILOT

BMB05002

Flight Test Card – Clean Configuration Figure 5-1-2

SECTION 2

AIRCRAFT EQUIPPED WITH EXTERNAL TANKS

PROCEDURES

1. The procedures detailed in this section are to be observed during flight testing of a tanked aircraft in order to check the operation of the aircraft with external tanks installed. Aircraft will not normally be flight tested in this configuration. The test card is shown in Figure 5-1-2.

NOTE

The test pilot must comply with the restrictions placed on the aircraft equipped with external tanks. Items that are detailed in Part 5, Section 1, are not detailed in this section.

EXTERNAL

2. Carry out all the external checks as detailed in Part 2, with particular attention to the external tanks.

INTERNAL

3. External tanks selector switch must be OFF, and the guarded jettison arm switch must be lock-wired to the OFF position.

EXTERNAL TANKS ON

4. Select external tanks ON during flight when fuel gauge is reading 1500 pounds or less. Turning external tank switches ON before the internal fuel is reduced to 1500 pounds or less may cause tank rupture if the fuel level control valve is not operating properly.

MONITOR FUEL FEEDING

5. Lights should remain OFF, and fuselage tank reading should increase by approximately 300 pounds if the external tanks are feeding properly.

MACH RUN

6. With tanks installed, speed limitation is Mach 0.70 or 400 KIAS, whichever is less.

NOTE

With pylons and crutches, speed limitations are the same as for a clean aircraft.

STALLS – 10 000 FEET

7. Use same procedure as in Section 1, Paragraph 28.

NOTE

Stalls should be the same as for a clean aircraft when external tanks are empty.

ACCELERATION CHECK

8. Maximum load factor at 8300 pounds is 6.0 G, increasing to 7.33 G at 6900 pounds. The limited negative load factor with tanks is –2.0 G at all weights and speeds up to 350 KIAS, decreasing linearly to –0.5 G at 400 KIAS.

VOR/ILS

9. Check the VOR at 100 NM distance from facility. Check ILS and marker beacons.

SECTION 3

SNOWBIRD AIRCRAFT

PROCEDURES

1. The procedures detailed in this section are to be observed during the flight test of a Snowbird aircraft in order to check the operation of the aircraft with and without smoke tanks installed. Normally two flights will be required: the first flight flown from the left seat without smoke tanks installed; the second flight from the right seat with smoke tanks installed. The test card is shown in Figure 5-1-2.

NOTE

The test pilot must comply with the restrictions placed on the aircraft when equipped with external tanks (refer to Section 2).

EXTERNAL

2. Carry out all external checks as detailed in C-12-114-000/MB-Z04, Part 2 with particular attention to the pylons, crutches and smoke tanks.

PRE-START

3. Intercommunications and navigation equipment:

   a. Functional check of the UHF frequency channel indicator to be carried out on both preset and manual frequencies.

   b. Functional check of the ADF to be carried out on all bands and modes (where installed).

4. Elevator and aileron trim:

CAUTION

The LEFT/RIGHT CONTROL SWITCH (L/R CONT) must remain in the correct position for flight and is not to be selected in the air. Landing-gear levers and other control switches must be checked for position prior to switching control to the other side.

   a. Visually check the operation of both the left and right side elevator and aileron alternate trim switches with the L/R CONTROL switch selected as appropriate (refer to Section 1).

   b. Right side trim selections should override left stick trim selections regardless of the L/R CONT position.

5. Check ‘‘G’’ meter mounting. A special mounting plate, which elevates the ‘‘G’’ meter approximately 4 inches for improved vision over the UHF frequency channel indicator, should be installed.

START

6. To ensure system integrity it is recommended that one GPU start and one internal battery start be carried out.

7. Ensure speed brake operation is controlled solely by the left side or right side speed brake switch as selected by the L/R CONT switch.

TAXIING

8. Operation of the taxi light is restricted on the ground when a LANDING LIGHT has been installed in the taxi light position.

MACH RUN

9. Speed limitations with smoke tanks installed or when only pylons and crutches are installed are the same as a clean aircraft (refer to Section 1).

SPINS AND STALLS

10. Spins and stalls are prohibited with smoke tanks installed.

11. Spins and stall characteristics should be the same as clean aircraft (refer to Section 1).

SMOKE GENERATION

12. Operation of the smoke generating equipment can be monitored using the rear view mirrors. Smoke should be tested from both the left and right tanks under both positive and negative ‘‘G’’ loadings. Trigger operation should be checked from both seats.

LANDING-GEAR OPERATION

13. A complete check of landing-gear operations including emergency landing-gear lowering is to be carried out. A second complete check of the landing-gear lowering is to be completed from the right seat during the second test flight.

SECTION 4

TAXI TEST – BRAKE WEAR-IN PROCEDURE (FOLLOWING BRAKE CHANGE)

REQUIREMENTS

1. Taxi tests will be carried out following all brake unit changes to ensure new brake pucks are broken in to provide maximum braking potential.

2. The aircraft will be prepared IAW Part 5 of this CFTO. Log Set will be prepared IAW C-02-005-P05/AM-001, Part 3.

3. Unit Test Pilot will accept the aircraft as per normal flight operations.

PROCEDURES

4. Determine which brake was changed from Aircraft Log Set.

CAUTION

Braking action is very limited after both brakes have been replaced. Exercise caution until normal braking is achieved.

5. Perform Pre-Start, Start and Before Taxiing Checks as per normal flight operations and proceed as follows:

a. Once on taxi way:

(1) Nose wheel steering is to be used for directional control; the opposing brake used for speed control.

(2) Maintain normal taxi speed with higher than normal RPM.

(3) Apply brake pressure to ″new″ brake until brake fade is felt. Release pressure to allow the pucks to cool for a moment, and then re-apply pressure. Repeat this procedure two to three times.

b. On runway:

(1) Select Flaps Up on initial wear-in run and then lower for additional drag on subsequent runs.

(2) Apply full power and roll aircraft to approximately 60 knots, then brake hard until brake fade, them allow brakes to cool. Re-apply brake as required exiting runway.

CAUTION

Excessive brake pressure may cause hot brakes and/or warp the discs.

6. After leaving runway use minimum required braking to return to ramp. Brakes are very hot at this point and will not provide much in stopping efficiency.

7. If spongy brakes are encountered at any time during the taxi test, the aircraft will be returned and placed unserviceable.

8. After the brake wear-in, the aircraft is required to track straight ahead and respond evenly to both brakes. The brakes must hold the aircraft firmly in position at maximum power using normal braking pressure.

CAUTION

When conducting a Taxi Test on a short runway, decrease speed to ensure control of the aircraft as it approaches the end of the runway.