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CANADIAN FORCES

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AIRCRAFT OPERATING INSTRUCTIONS

TUTOR

REVISION NOTICE

LATEST REVISED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert revised pages into basic publication. Destroy superseded pages. Interim Revision 1-72 is incorporated in the revised pages and is to be removed from the basic publication.

ISSUED ON AUTHORITY OF THE CHIEF OF THE DEFENCE STAFF

18 JAN 68
Revised 11 Apr 73

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NOTES TO USERS

1 This publication is divided into five Parts: Description, Handling, Emergency Handling, Operating Data, and Flight Testing.

2 PART 1 - DESCRIPTION of the controls and equipment with which the pilot should be acquainted.

3 PART 2 - HANDLING describes the normal handling of the aircraft by the pilot.

4 PART 3 - EMERGENCY HANDLING describes 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 In the text, words written in capital letters indicate actual markings on the controls concerned.

8 Comments and suggestions should be forwarded through the usual channels to the Commander, Training Command, attention: Deputy Chief of Staff Flying Training (DCOS FlyTrg).

9 Warning, Caution, and Note headings in this Engineering Order are defined as follows:

WARNING

To cover operating procedures, practices, etc., which, if not followed, will result in loss of life or destruction of equipment.

CAUTION

To cover operating procedures, practices, etc., which, if not observed, will result in damage to equipment.

NOTE

Any operating procedure, event, etc., which it is desirable to highlight.

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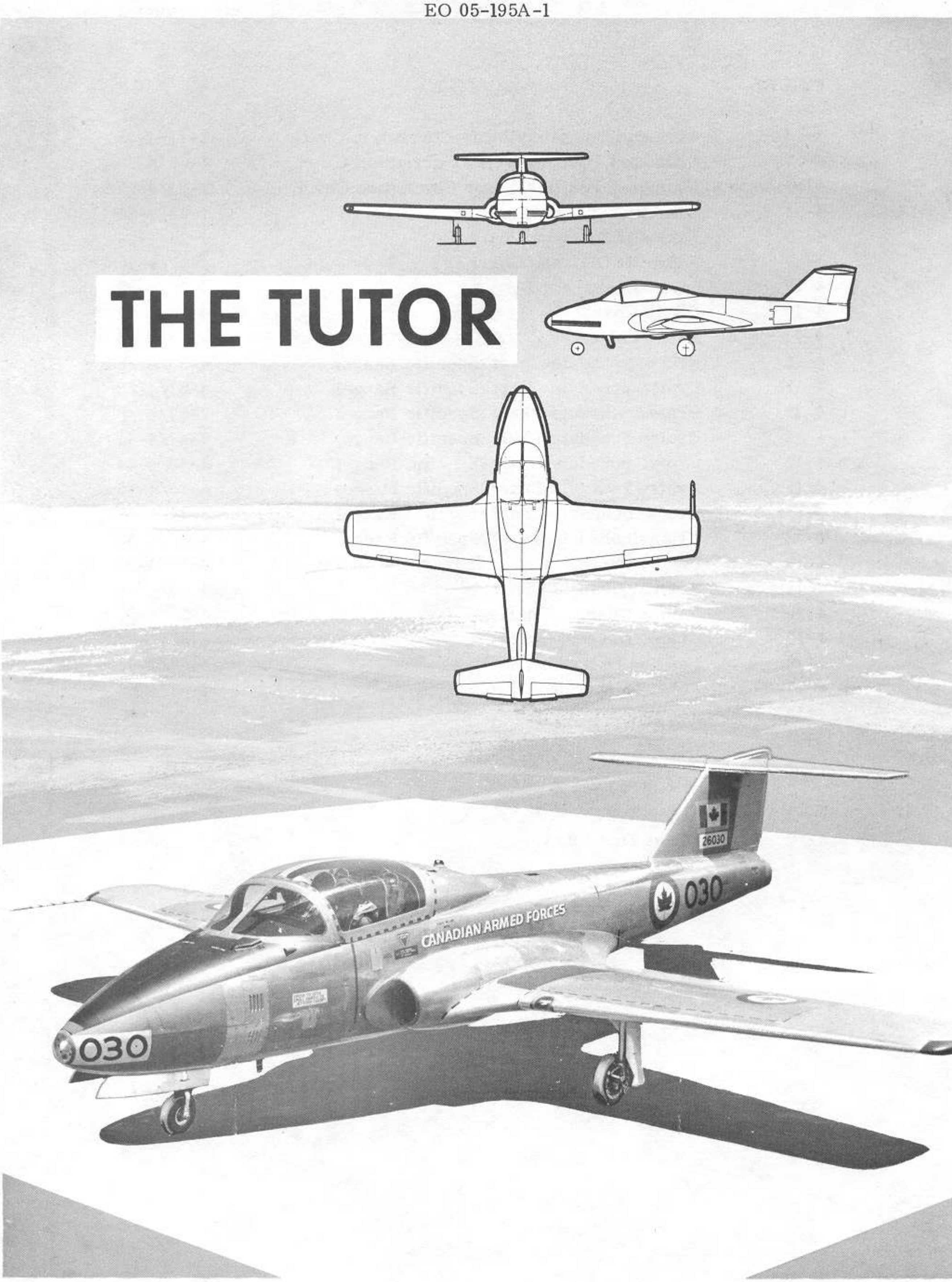
THE TUTOR
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PART 1

DESCRIPTION

INTRODUCTION

1 The Tutor is an all-metal, low-wing, turbojet aircraft designed for the basic training of student pilots. It features side-by-side ejection seats for a crew of two in a pressurized and air-conditioned cockpit. 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 turbojet, incorporating an eight-stage compressor and a two-stage turbine. The engine develops approximately 2,700 pounds maximum continuous static thrust at sea level under standard atmosphere (ICAO) conditions. For the general arrangement of the aircraft, see Figure 1-1. For interior cockpit arrangement, see Figure 1-2.

LEADING PARTICULARS

DIMENSIONS

2 The overall dimensions of the aircraft are as follows:

(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 (including removable equipment, but not crew, oil, or fuel) is approximately 4,860 pounds.

(b) Maximum permissible take-off weight is 7,437 pounds.

(c) Maximum landing weight is 7,000 pounds.

FUEL AND OIL TANK CAPACITIES

4 The fuel and oil tank capacities are as follows:

(a) Total usable fuel capacity is approximately 258 Imperial gallons (2,012 pounds) (JP-4).

(b) Total oil capacity is approximately 1 Imperial gallon.

FUEL SYSTEM

GENERAL
(See Figure 1-3)

5 The aircraft fuel system consists of five flexible non-self-sealing 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. A vent system is incorporated, and fuel pressure, contents and low level indication is 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 a fuel supply to the engine, should the filter become clogged.

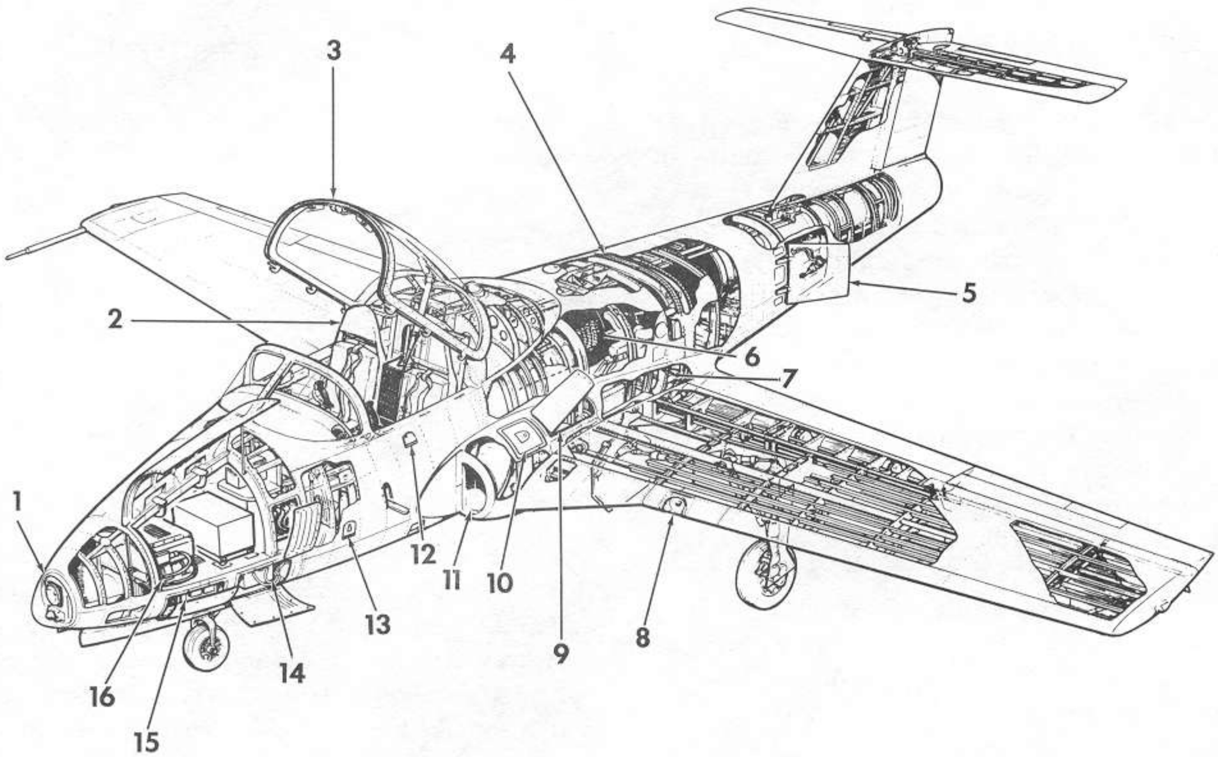
FUEL SPECIFICATIONS

7 The fuel specifications are as follows:

(a) Standardized fuel: 3-GP-22 (NATO F-40) grade JP-4.

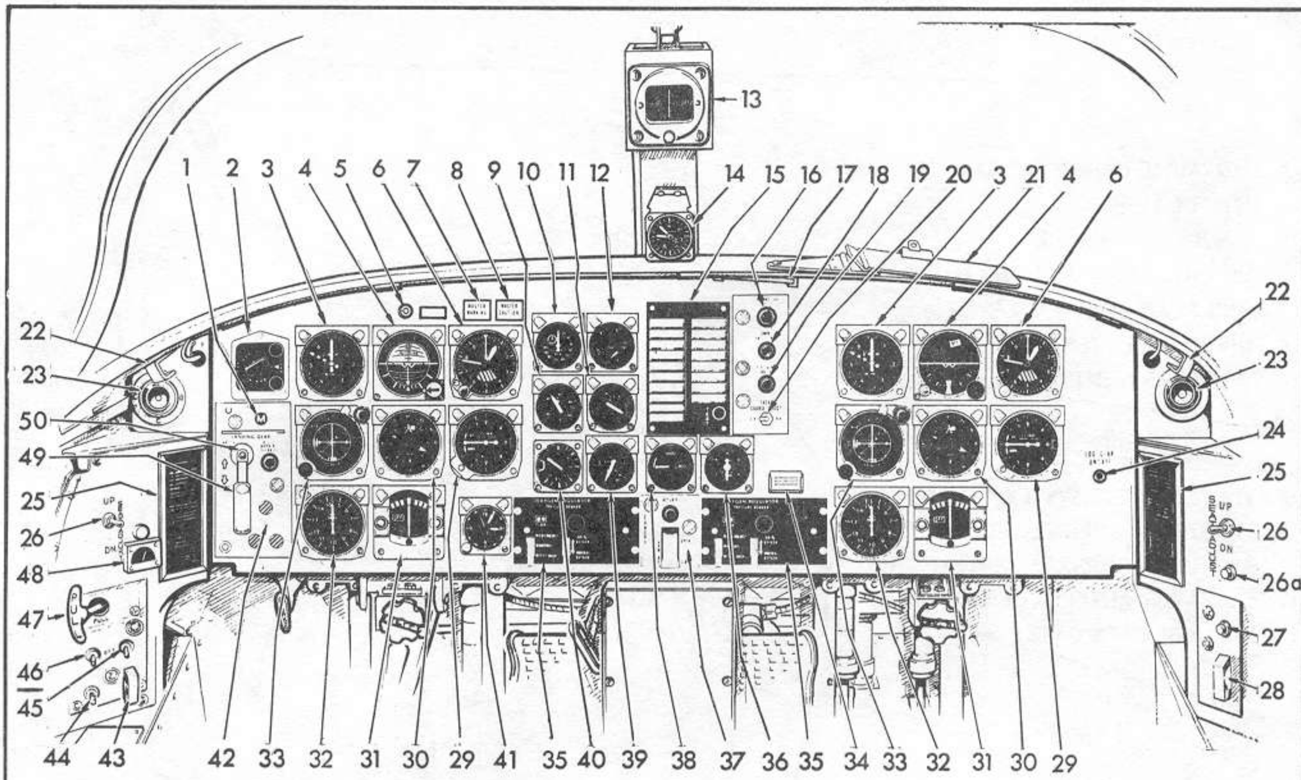
(b) Acceptable alternate fuel: 3-GP-23 (NATO F-34) grade JP-1.

(c) There is no authorized emergency fuel for the Tutor aircraft.



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

Figure 1-1 General Arrangement



1 UHF COMMAND INDICATOR
2 UHF CHANNEL SELECTOR
3 AIRSPEED INDICATOR
4 ATTITUDE INDICATOR
5 FAST-ERECT SWITCH
6 ALTIMETER
7 MASTER WARNING LIGHT
8 MASTER CAUTION LIGHT
9 OIL PRESSURE INDICATOR
10 TACHOMETER
11 HYDRAULIC PRESSURE INDICATOR
12 EGT INDICATOR
13 STANDBY MAGNETIC COMPASS
14 ACCELEROMETER
15 ANNUNCIATOR PANEL
16 FIRE & OVERHEAT TEST SWITCH
17 CHECK LIST HOLDER
18 GYRO MAGNETIC COMPASS FAST-SLAVE SWITCH
19 FUEL QUANTITY INDICATOR TEST SWITCH
20 TACAN TRACK SELECTOR SWITCH
21 LET-DOWN BOOK HOLDER
22 SEAT PIN STOWAGE
23 FRESH AIR VENT
24 LANDING-GEAR-UNSAFE WARNING LIGHT
25 FREQUENCY CARD HOLDER
26 SEAT ADJUSTMENT SWITCH
26a LANDING-GEAR WARNING HORN CUT-OUT BUTTON
27 AUDIO MUTING SWITCH
28 LANDING-GEAR UP-SELECTION OVERRIDE SWITCH
29 VERTICAL SPEED INDICATOR
30 DISTANCE RADIO MAGNETIC INDICATOR (DRMI)
31 TURN-AND-SLIP INDICATOR
32 MACHMETER
33 TRACK INDICATOR
34 DATUM OIL PRESSURE PLACARD
35 OXYGEN REGULATOR
36 COCKPIT ALTIMETER
37 CANOPY CONTROL PANEL
38 OXYGEN PRESSURE INDICATOR
39 FUEL QUANTITY INDICATOR
40 WING FLAP POSITION INDICATOR
41 CLOCK
42 LANDING GEAR POSITION INDICATORS
43 WINDSHIELD DE-ICING CONTROL SWITCH
44 WINDSHIELD & CANOPY DEMIST CONTROL SWITCH
45 LANDING & TAXI LIGHT CONTROL SWITCH
46 PITOT & STALL-WARNING ANTI-ICING CONTROL SWITCH
47 EMERGENCY LANDING-GEAR SELECTOR HANDLE
48 LOADMETER
49 LANDING-GEAR CONTROL LEVER
50 LANDING-GEAR DOWNLOCK OVERRIDE SWITCH

Figure 1-2 (Sheet 1 of 3) Cockpit - Forward View

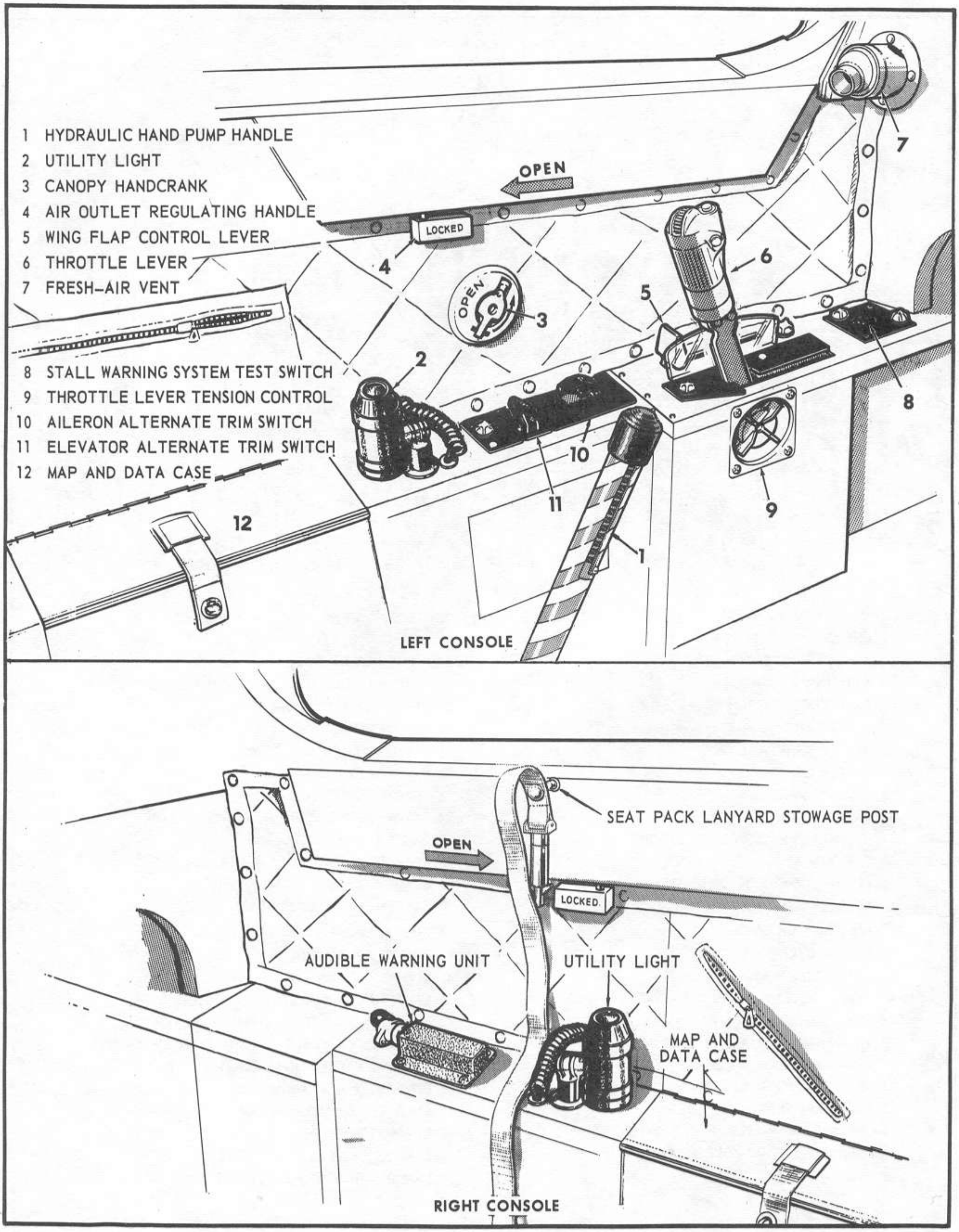
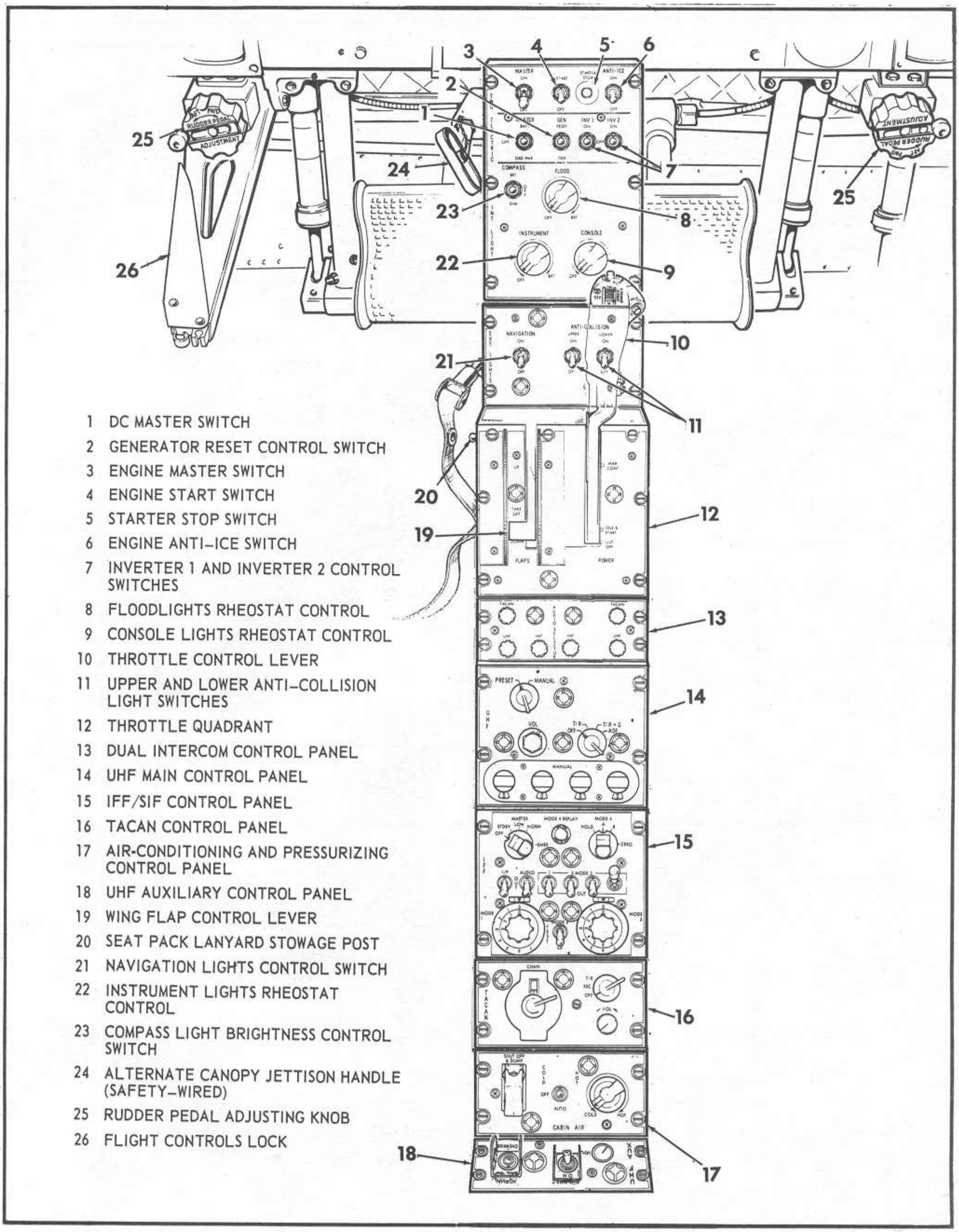


Figure 1-2 (Sheet 2 of 3) Cockpit - Left and Right Consoles



1 DC MASTER SWITCH
2 GENERATOR RESET CONTROL SWITCH
3 ENGINE MASTER SWITCH
4 ENGINE START SWITCH
5 STARTER STOP SWITCH
6 ENGINE ANTI-ICE SWITCH
7 INVERTER 1 AND INVERTER 2 CONTROL SWITCHES
8 FLOODLIGHTS RHEOSTAT CONTROL
9 CONSOLE LIGHTS RHEOSTAT CONTROL
10 THROTTLE CONTROL LEVER
11 UPPER AND LOWER ANTI-COLLISION LIGHT SWITCHES
12 THROTTLE QUADRANT
13 DUAL INTERCOM CONTROL PANEL
14 UHF MAIN CONTROL PANEL
15 IFF/SIF CONTROL PANEL
16 TACAN CONTROL PANEL
17 AIR-CONDITIONING AND PRESSURIZING CONTROL PANEL
18 UHF AUXILIARY CONTROL PANEL
19 WING FLAP CONTROL LEVER
20 SEAT PACK LANYARD STOWAGE POST
21 NAVIGATION LIGHTS CONTROL SWITCH
22 INSTRUMENT LIGHTS RHEOSTAT CONTROL
23 COMPASS LIGHT BRIGHTNESS CONTROL SWITCH
24 ALTERNATE CANOPY JETTISON HANDLE (SAFETY-WIRED)
25 RUDDER PEDAL ADJUSTING KNOB
26 FLIGHT CONTROLS LOCK

Figure 1-2 (Sheet 3 of 3) **Cockpit - Centre Console**

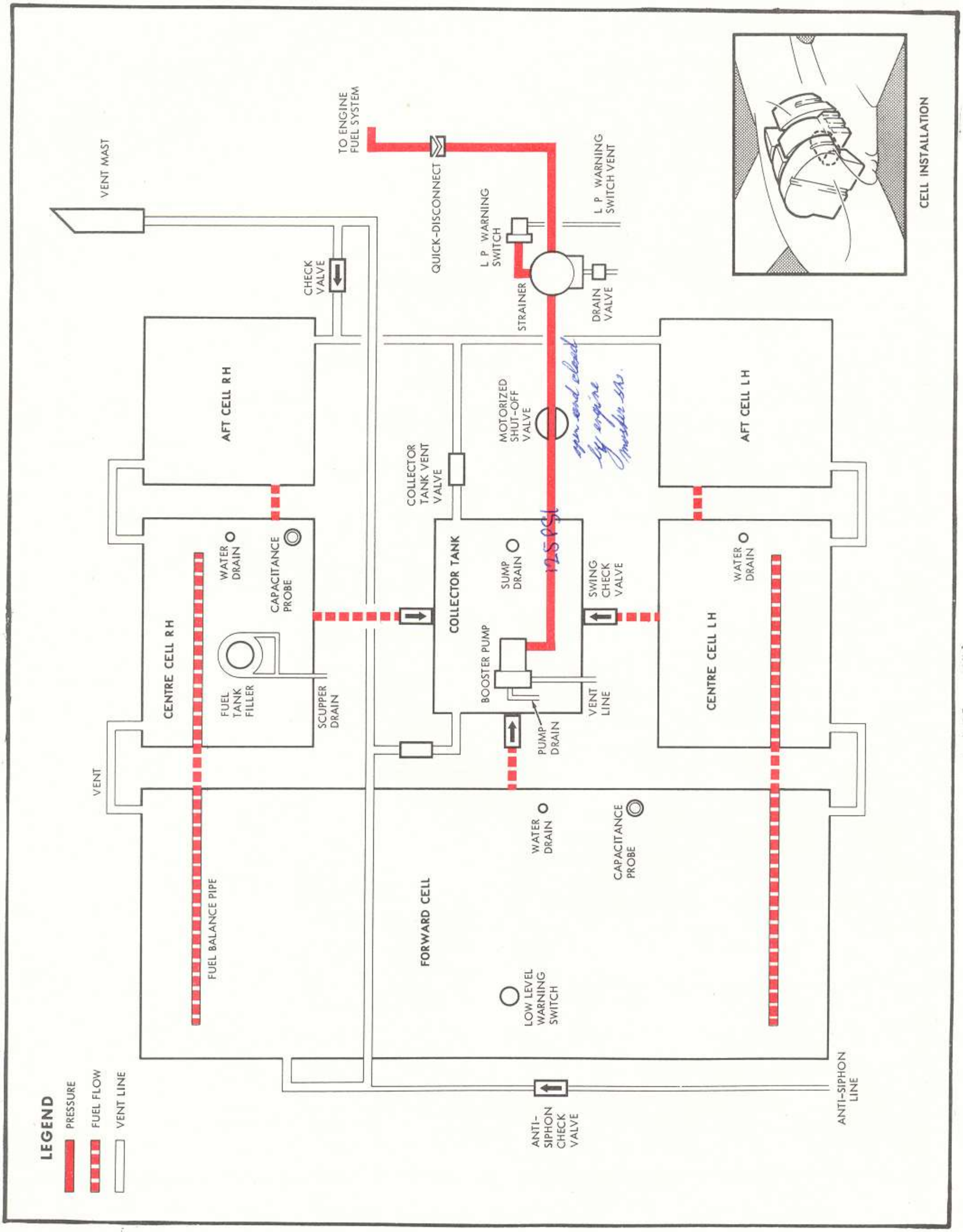


Figure 1-3 Aircraft Fuel System - Schematic

FUEL TANK

8 The five fuel cells constituting the tank are positioned symmetrically about the centre line of the fuselage and consist of 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 tank. A balance line is provided between the forward cell and each of the centre cells. The cells' usable contents are as follows:

Cell	Imp Gal	Pounds
Forward	98	764.4
Centre (2 at 53)	106	826.8
Aft (2 at 24)	48	374.4
Collector Tank	6	46.8
Total	258	2,012.4

BOOSTER PUMP

9 The fuel booster pump is mounted in the collector tank and is powered by the aircraft 28-volt DC power supply. The pump incorporates two screened inlet ports to ensure a 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

10. 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 open.

FUEL STRAINER

11 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, should the strainer become clogged. The fuel low-pressure switch is installed on the outlet side of the housing.

LOW-FUEL-PRESSURE WARNING

12 Whenever the fuel pressure falls below 12(±0.5) PSI, the fuel pressure switch on the filter causes the MASTER CAUTION light to flash and the annunciator panel window marked LOW FUEL PRESS to illuminate.

FUEL QUANTITY INDICATOR

13 A fuel quantity indicator, reading in pounds (LBS x 100), is installed centrally on the instrument panel. Capacitance-type probes are fitted in the forward and right centre fuel cells to give indication of fuel remaining in the fuel tank 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.

NOTE

Do not take fuel gauge readings while transmitting on UHF: transmitter interference could cause erroneous readings.

LOW-FUEL-LEVEL WARNING

14 A float-operated switch in the forward fuel cell causes the master caution light to flash and the annunciator panel window marked LOW FUEL QUANT to illuminate when the fuel tank quantity falls to approximately 380 pounds.

NOTE

During negative G or linear accelerations the low-fuel-quantity light may illuminate, causing the master caution light to flash when fuel is in excess of 380 pounds.

OIL SYSTEM

GENERAL

15 Engine lubrication is provided by a self-contained pressure-type oil system. The tank is located on the forward right side of the engine.

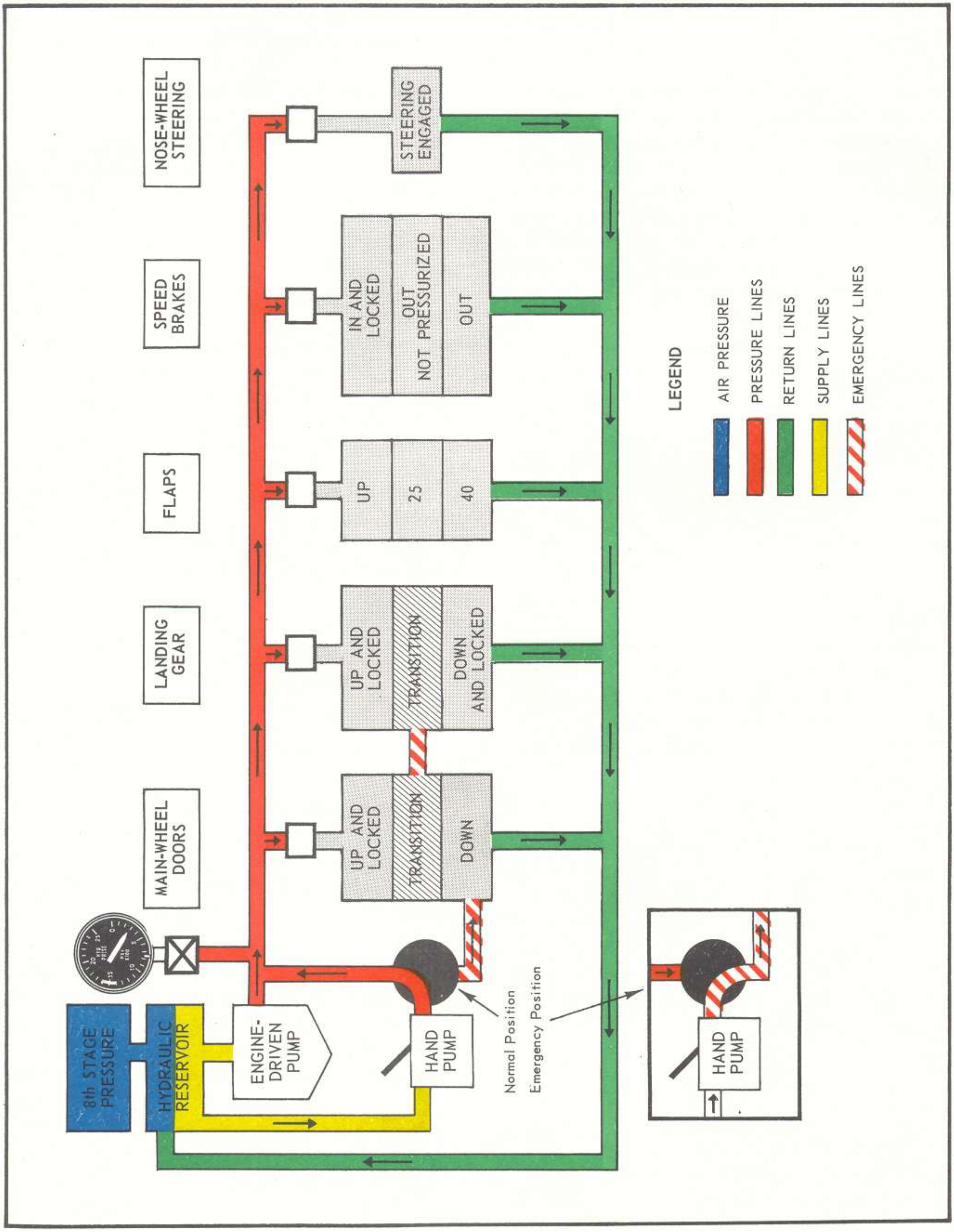


Figure 1-4 Hydraulic System

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 exchanger is utilized to cool the oil. The system is fully automatic. The capacity of the oil reservoir is 7 Imperial pints.

OIL SPECIFICATION

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

OIL PRESSURE INDICATOR

17 An electrically operated pressure indicator is mounted centrally on the instrument panel and reads in pounds per square inch. A placard containing the engine serial number and datum oil pressure is installed to the right of the instrument panel directly above the oxygen regulator. Fluctuating oil pressure up to a maximum of ±2 PSI is allowable within the normal operating limits.

HIGH OIL TEMPERATURE WARNING

18 An oil temperature of 192° (±4°) C or higher will be indicated by the master caution light flashing, and the annunciator panel window marked HIGH OIL TEMP illuminating.

HYDRAULIC SYSTEM

GENERAL
(See Figure 1-4)

19 The hydraulic system 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 is provided with a fluid-air heat exchanger, is a closed-circuit, constant-pressure type, operating at a pressure of 1,400 to 1,625 PSI. There is no accumulator in the system; therefore small pressure drops are normal during operation of services.

CAUTION

Do not select hydraulic services while under zero-G conditions; hydraulic system failure would probably result.

NOTE

If the air-conditioning master switch is in the DUMP position for any reason during flight, an increase in flap, landing-gear and speed-brake cycling times may be anticipated.

HYDRAULIC FLUID SPECIFICATION

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

HYDRAULIC RESERVOIR

21 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. The fluid capacity of the reservoir is approximately 1 Imperial gallon.

HYDRAULIC HAND PUMP

22 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 emergency landing-gear selector 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.

EMERGENCY LANDING-GEAR
SELECTOR HANDLE

23 An emergency landing-gear selector handle is installed on the left side of the cockpit. When the handle is pulled, a valve on 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

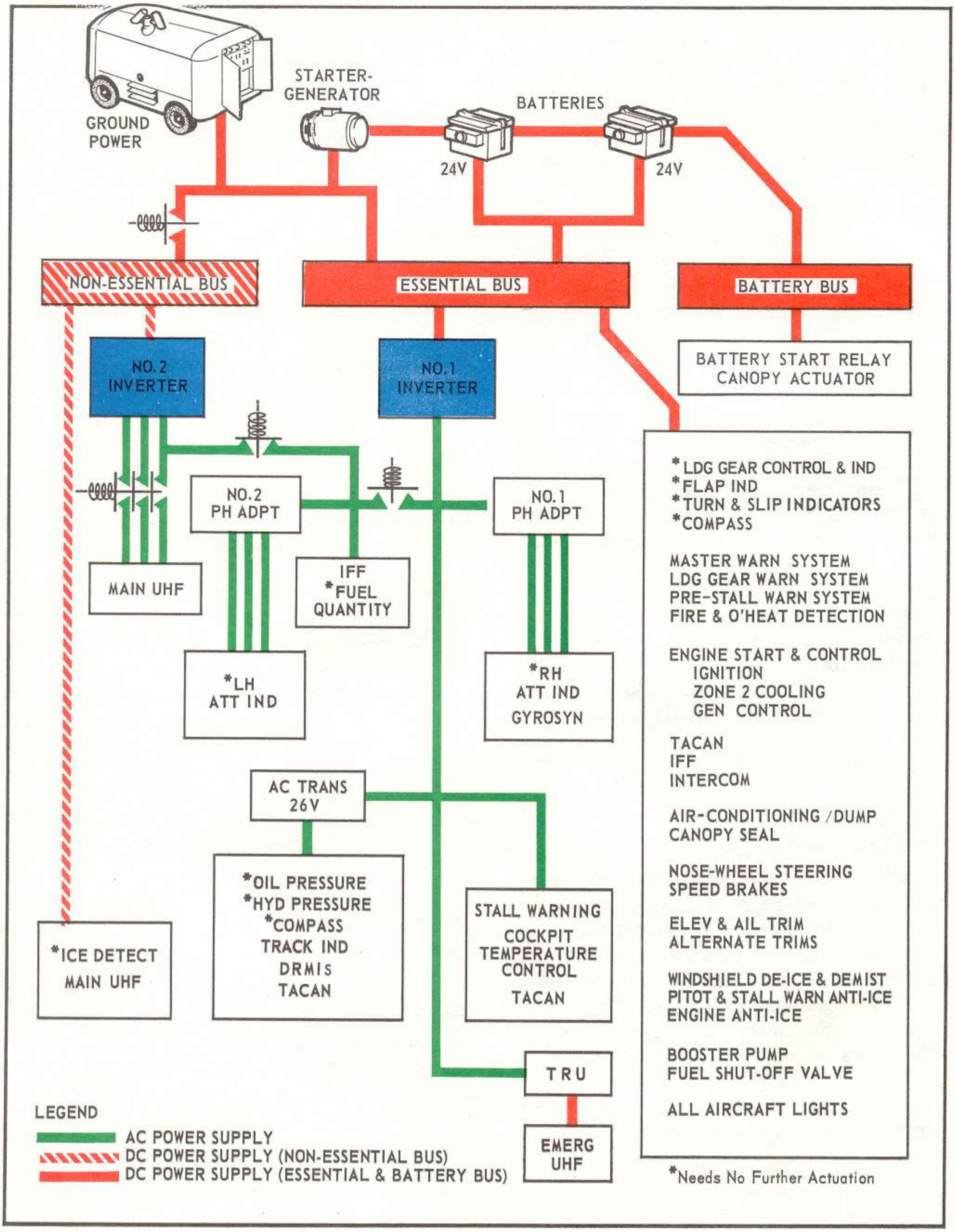


Figure 1-5 Electrical System - Schematic

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 PRESSURE GAUGE

24 An electrically operated hydraulic pressure gauge is mounted centrally on the instrument panel and indicates system pressure in pounds per square inch.

ELECTRICAL SYSTEM

GENERAL

25 Electrical power is supplied by a 30-volt, 300-ampere DC starter-generator; a 115-volt, 750-voltampere, 400-cycle, single-phase rotary inverter; and a 115-volt, 750-voltampere, 400-cycle, three-phase rotary inverter. Two 24-volt nickel-cadmium batteries provide power for emergency operation of systems. Provision is made for the supply of DC ground power. For a schematic illustration of the electrical power distribution, see Figure 1-5. For circuit breaker locations, see Figure 1-6.

DC ELECTRICAL POWER SYSTEM

26 The DC electrical power generating system consists of a 30-volt, 300-ampere, engine-driven DC starter-generator; a generator control switch; a DC master switch; and various circuit breakers. Two 22-ampere-hour, 24-volt nickel-cadmium batteries, normally connected in parallel, serve as standby power. The left battery energizes the canopy circuit. For DC electrical power distribution, see Figure 1-5.

GENERATOR CONTROL SWITCH

27 The generator control switch 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 DC regulator control panel.

DC MASTER SWITCH

28 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.

29 When placed to the BATT position, the switch allows the batteries to be connected in parallel to the bus 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 system feeders, prevents the battery start relay from closing, and energizes the non-essential DC bus.

NOTE

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

GENERATOR FAILURE

30 In the event of loss of generator output, the DC non-essential bus is de-energized, causing the loss of No. 2 inverter (and main UHF), engine intake, ice detector, and recording accelerometers.

31 Loss of power output from the generator is indicated by flashing of the master caution light on the main instrument panel and illumination of the GENERATOR FAIL and INVERTER 2 FAIL windows on the annunciator panel.

AC ELECTRICAL POWER SYSTEM

32 The AC electrical power system consists of a 115-volt, 750-voltampere, 400-cycle single-phase inverter (No. 1 inverter); a 115-volt, 750-voltampere, 400-cycle, three-phase inverter (No. 2 inverter); control switches; and various circuit breakers. For AC electrical power distribution, see Figure 1-5.

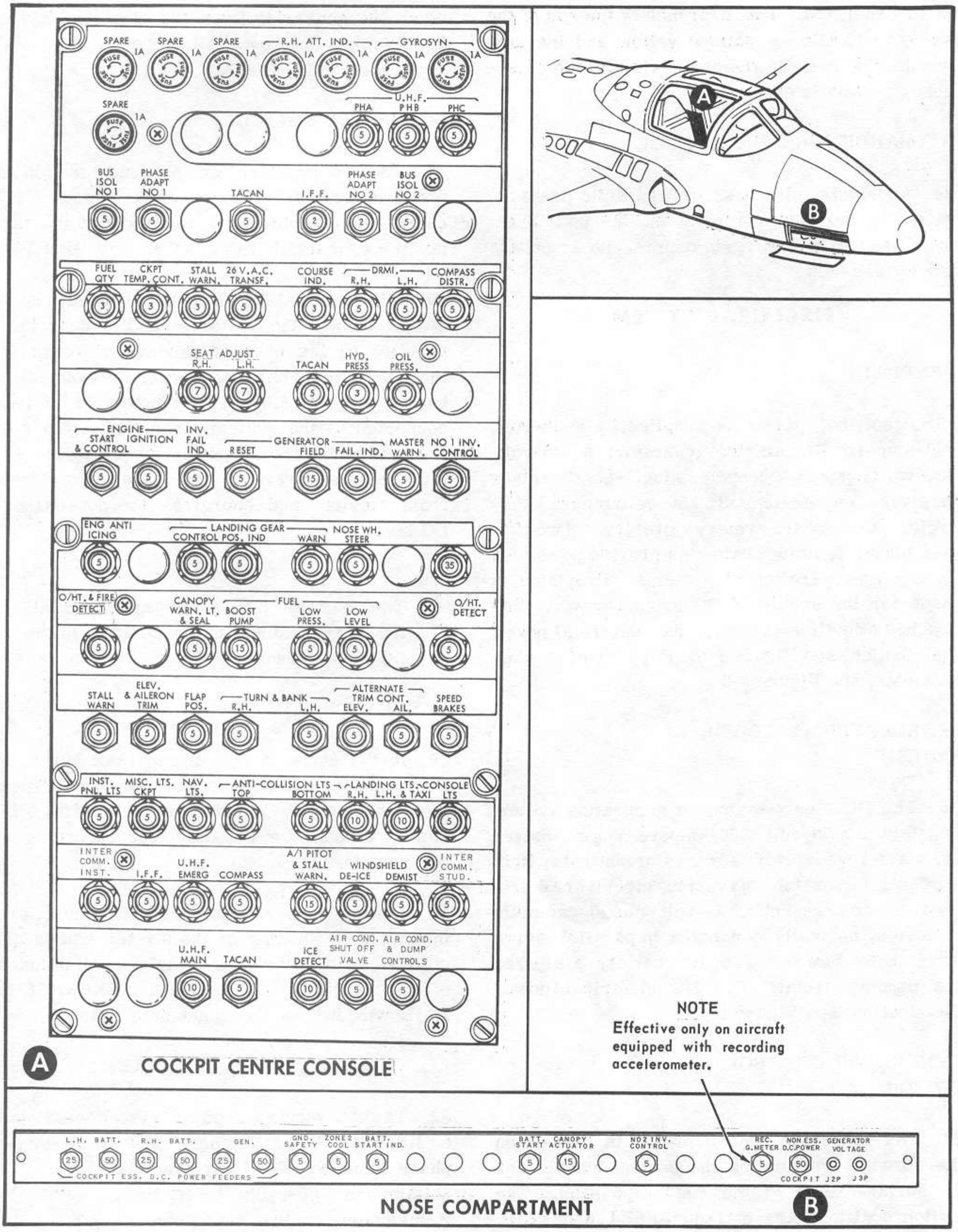


Figure 1-6 Circuit Breaker Locations

√ 33 In the event of loss of power from either inverter, the main UHF is disconnected, the EUHF is activated, and the remaining AC loads are automatically connected to the serviceable inverter.

√ 34 In the event of loss of generator output, the No. 2 inverter is disconnected from the system, causing the loss of the main UHF and automatic activation of the EUHF. The No. 1 inverter will then supply the remaining AC loads.

√ 35 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.

INVERTER CONTROL SWITCHES

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

GENERATOR LOADMETER

37 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 an approximate 0.4 loadmeter reading.

EXTERNAL POWER RECEPTACLE

38 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.

CAUTION

Starting current for Tutor aircraft is limited to 1,000 ampere, because of engine starter-generator torque limitations.

GROUND SAFETY SWITCHES

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

(a) Override the windshield de-icing switch and shut off the system.

(b) Cut out the normal stall-warning circuit and override the pitot and stall-warning anti-icing control switch to cut out the lift transducer anti-icing circuit.

(c) Control the landing-gear selector lever, preventing an inadvertent up selection on the ground.

(d) Control the zone 2 cooling system, selecting it on.

(e) Control the air-conditioning, causing it to be automatically cut off during start.

(f) Connect external canopy switch circuit.

(g) Connect the TAKE-OFF trim advisory light circuit.

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

POWER PLANT

ENGINE

41 The aircraft is powered by a J85-CAN-40 axial-flow turbo-jet engine, which develops approximately 2,700 pounds static thrust at sea level under standard atmosphere (ICAO) 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 gear-box, connected to a transfer gear-box, which is driven by the compressor shaft.

ENGINE TACHOMETER

42 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.

ENGINE FUEL SYSTEM

43 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. Besides being used for combustion, fuel is used as a servo fluid within the control and as a coolant for maintaining engine lubrication oil temperature within operating limits.

44 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

45 The engine-driven fuel 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 boost 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.

OIL COOLER

46 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. Excessive high oil temperature is indicated by flashing of the master caution light and illumination of an annunciator panel window marked HIGH OIL TEMP.

ACCESSORY GEAR-BOX

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

ENGINE STARTER AND IGNITION SYSTEMS

48 A combination starter-generator unit is provided for cranking the engine. Engine ground starts are made by using power from a 28-volt DC ground power unit. The engine control panel, located on the forward section of the centre console, contains the engine master switch, engine start switch, starter stop switch and engine anti-icing switch. Airstarts are made possible by an airstart switch on each throttle control lever.

49 Engine ignition is provided by a dual-output capacitor-discharge ignition unit, which supplies sparking power to two igniter plugs. Ignition stops upon completion of the engine starting cycle, combustion being self-sustaining. The ignition circuit is controlled by an engine master switch, an engine start control relay, and a throttle microswitch. The throttle microswitch, which is mounted in a box at the right-hand throttle quadrant, energizes the ignition unit as the throttle control lever is moved from CUT OFF to IDLE & START. During airstarts,

ignition is available through the airstart switch on either throttle control lever. The airstart ignition circuit bypasses the microswitch on the throttle quadrant, thus allowing ignition in any throttle position. The airstart switch provides ignition without energizing the start control relay.

ENGINE MASTER SWITCH

50 The engine master switch, located on the engine control panel, is a two-position lever-locked switch marked ON and OFF. Placing the switch to ON performs the following functions:

(a) Energizes the fuel system boost pump relay.

(b) Energizes the low-pressure fuel shut-off valve.

(c) Arms the engine start switch.

(d) Arms the airstart switches.

(e) Arms the ignition circuit at the start control relay.

ENGINE START SWITCH

51 The engine start switch, located on the engine control panel, is marked START and OFF, it is spring-loaded to OFF. When the switch is placed to START, it initiates the following functions, which are uninterrupted, regardless of the subsequent position of the start switch, until terminated automatically by the engine speed switches or manually by the starter stop switch:

(a) Closes the generator cut-off relay and connects power to the starter.

(b) Connects the batteries in series during a Procedure-2 (internal) start.

(c) Arms the throttle lever ignition microswitch.

(d) Disconnects the DC non-essential buses (internal start only) and the loadmeter.

(e) Shuts off the zone-2 cooling air and air-conditioning. These remain shut until 46% RPM is reached.

STARTER STOP SWITCH

52 A push-button switch, marked STARTER STOP, is located adjacent to the engine start switch on the engine control panel. The starter stop switch is used to de-energize the start control relay in the event the engine fails to start and also to prevent damage to the starter, should the starter cut-out fail to operate.

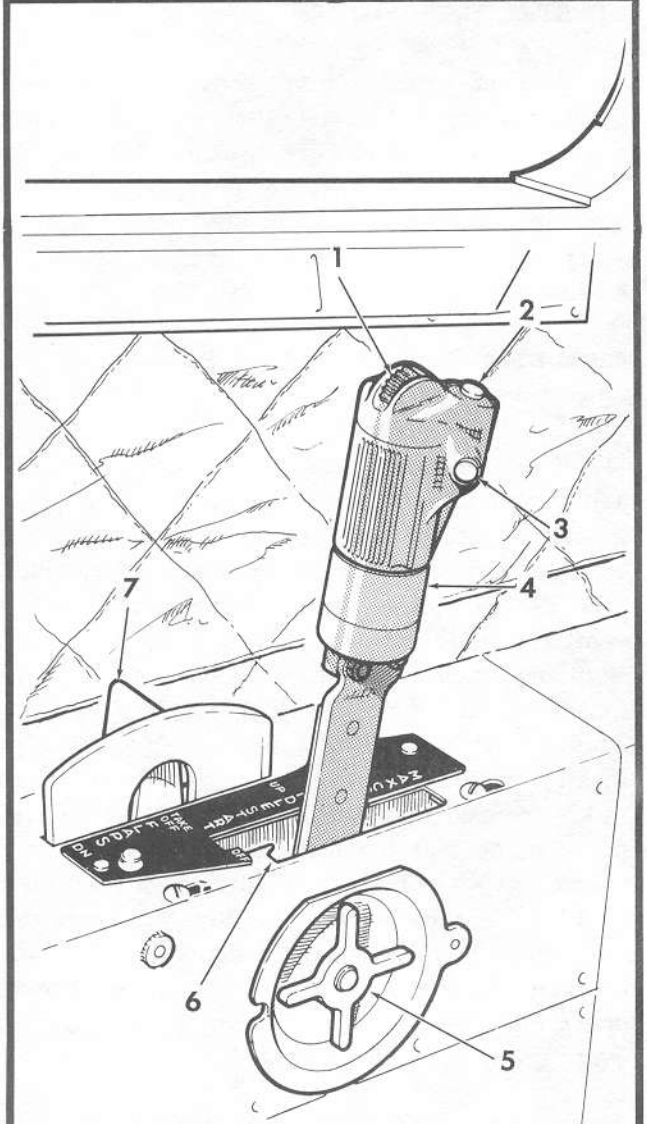
THROTTLE CONTROL LEVERS
(See Figure 1-7)

53 Two interconnected throttle control levers are provided for control of engine speed. The master control lever is mounted on the left console and is operated by the student pilot. The slave control lever is mounted on the centre console and is operated by the instructor. 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 high-pressure fuel cut-off valve. The control switches for airstart microphone operation and speed brake operation are mounted on each throttle control lever grip.

54 A microswitch, incorporated in a box in the right-hand throttle quadrant, provides power to the ignition unit when the throttle levers are moved to IDLE & START. The microswitch circuit is armed by the engine master switch and start control relay.

ENGINE COMPARTMENT COOLING

55 Compressor discharge air that is not mixed into the fuel-air charge for combustion is used as the basic internal source of cooling 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)



1 SPEED BRAKE SWITCH
2 AIR-START SWITCH
3 MICROPHONE SWITCH
4 THROTTLE CONTROL LEVER
5 THROTTLE TENSION CONTROL
6 IDLE AND START POSITION
7 WING FLAP CONTROL LEVER

Figure 1-7 Master Throttle Quadrant

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 pump, which is operated by compressor 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. Operation 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 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

56 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 of the forward section of the centre console. In the event of a complete DC power failure, the engine anti-icing system is activated automatically.

ENGINE ICE DETECTION INSTALLATION

57 When icing conditions are encountered in flight, the engine ice detector probe installed in the engine air intake duct provides a visual warning through the flashing master caution light and illumination of an annunciator panel window marked ENGINE ICING. Simultaneously, power is applied to a probe heater which melts the ice in the probe. This operates a switch to

de-energize the ice detector relay and extinguish the lights. If icing conditions still exist, the cycle will be repeated until the engine anti-icing switch is placed to ON.

NOTE

When the engine anti-icing switch is selected to ON, the visual warning of the ice detection circuit is inoperative and the fuel consumption is increased.

FLIGHT CONTROLS

GENERAL

58 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 type (see Figure 1-8). 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.

59 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

60 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

61 To reduce forces on the control columns under conditions of increased aerodynamic loads on the ailerons, spring tabs and geared tabs are installed in the aileron trailing edges. The trailing edge of the left aileron contains a spring tab and an electrically operated trim tab. The right aileron contains a spring tab and a geared tab. Aileron control movement is transmitted mechanically from either control column. Both ailerons are mechanically interconnected.

ELEVATOR CONTROL SYSTEM

62 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 tab, while the left elevator contains an electrically operated trim tab.

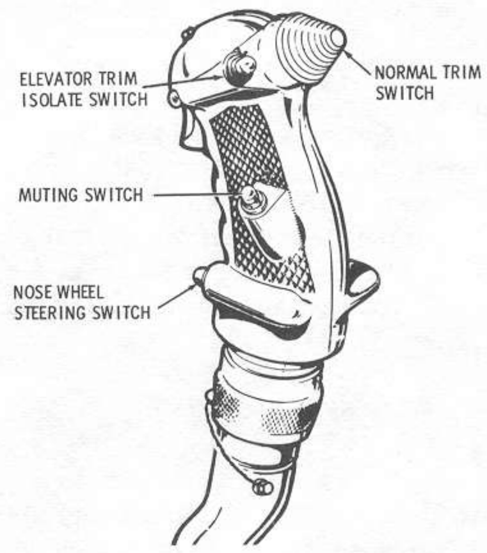


Figure 1-8 Control Column Grip

RUDDER CONTROL SYSTEM

63 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.

CAUTION

When making rudder pedal adjustments, ensure the rudder pedals are neutral, no foot pressure is being applied to the pedals and the adjustment handle is not forced past its full limit of travel.

TRIM TAB CONTROL SYSTEM

64 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.

(d) Aileron alternate trim system switch.

65 Correct elevator trim setting for take-off is displayed on the annunciator panel by a green legend marked ELEV TRIM T/OFF. The indicator illuminates only when the control 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

66 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 movement of the trim switch produces corresponding elevator and aileron trim respectively.

NOTE

Selection of either aileron or elevator trim by the instructor will override any corresponding trim selection made by the student.

ELEVATOR TRIM SYSTEM ISOLATE SWITCH

67 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

68 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

69 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

70 Mechanically selected and hydraulically op-

erated 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.

CAUTION

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

SPEED BRAKES

71 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, and 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.

72 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. Indication of speed brake position is provided by an annunciator panel window marked SPEED BRAKES OUT. The indication is given whenever the speed brakes are not closed.

PRE-STALL WARNING SYSTEM

73 Onset of the stall is heralded 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.

74 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

75 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 gear 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.

LANDING-GEAR CONTROL PANEL

76 The landing-gear control panel contains the control lever and an 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. Depressing the 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 override switch becomes inoperative.

LANDING-GEAR POSITION INDICATORS

77 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

78 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, if the landing gear is in any but the fully-down position.

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 instrument lights are selected on.

AUDIBLE WARNING SIGNAL AND CUT-OUT CONTROLS

79 Below the altitude of 7,000 ft ASL a landing-gear audible signal will be heard through the intercommunication system whenever the throttle is retarded below the minimum cruising power position and the gear is not down and locked. The cut-out switch, located adjacent to the landing-gear lever will silence the audible warning signal. The landing-gear warning horn cut-out button, located below the right-hand SEAT ADJUST switch, will also silence the warning horn as long as the button is depressed.

LANDING-GEAR GROUND SAFETY LOCKS

80 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

81 A two-position toggle switch, marked OPEN and CLOSE, is installed in the left main landing-gear wheel well to permit the opening of the main-gear doors for maintenance purposes. When the switch is selected to the OPEN position, the doors may be opened by hydraulic pressure, and closed when selected to the CLOSE position.

LANDING-GEAR-UP SELECTION OVERRIDE SWITCH

82 The landing-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 NORMAL, and is guarded in the NORMAL 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 NORMAL 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 landing-gear-up selection override switch does not prevent landing-gear emergency retraction.

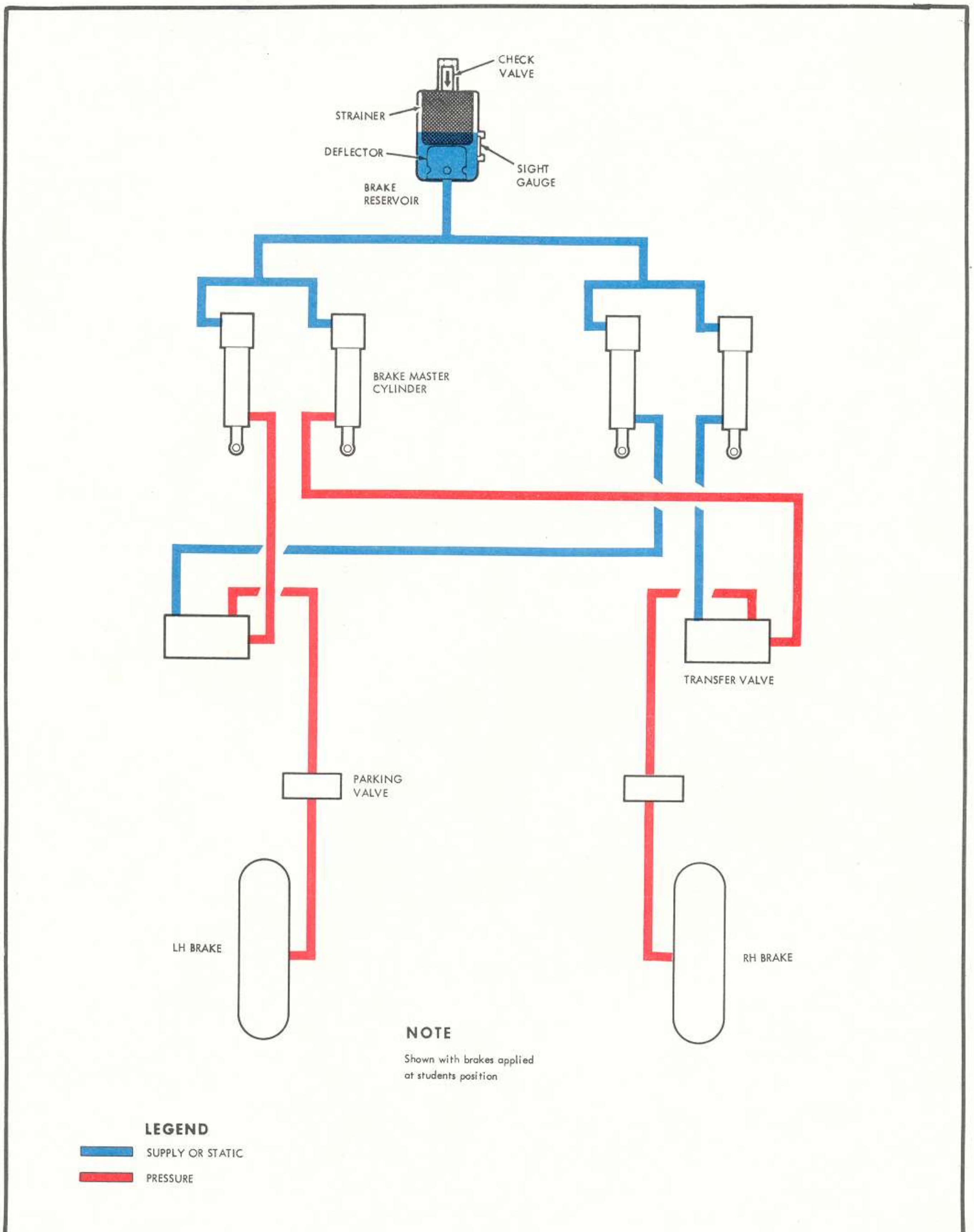


Figure 1-9 Brake Hydraulic System - Schematic

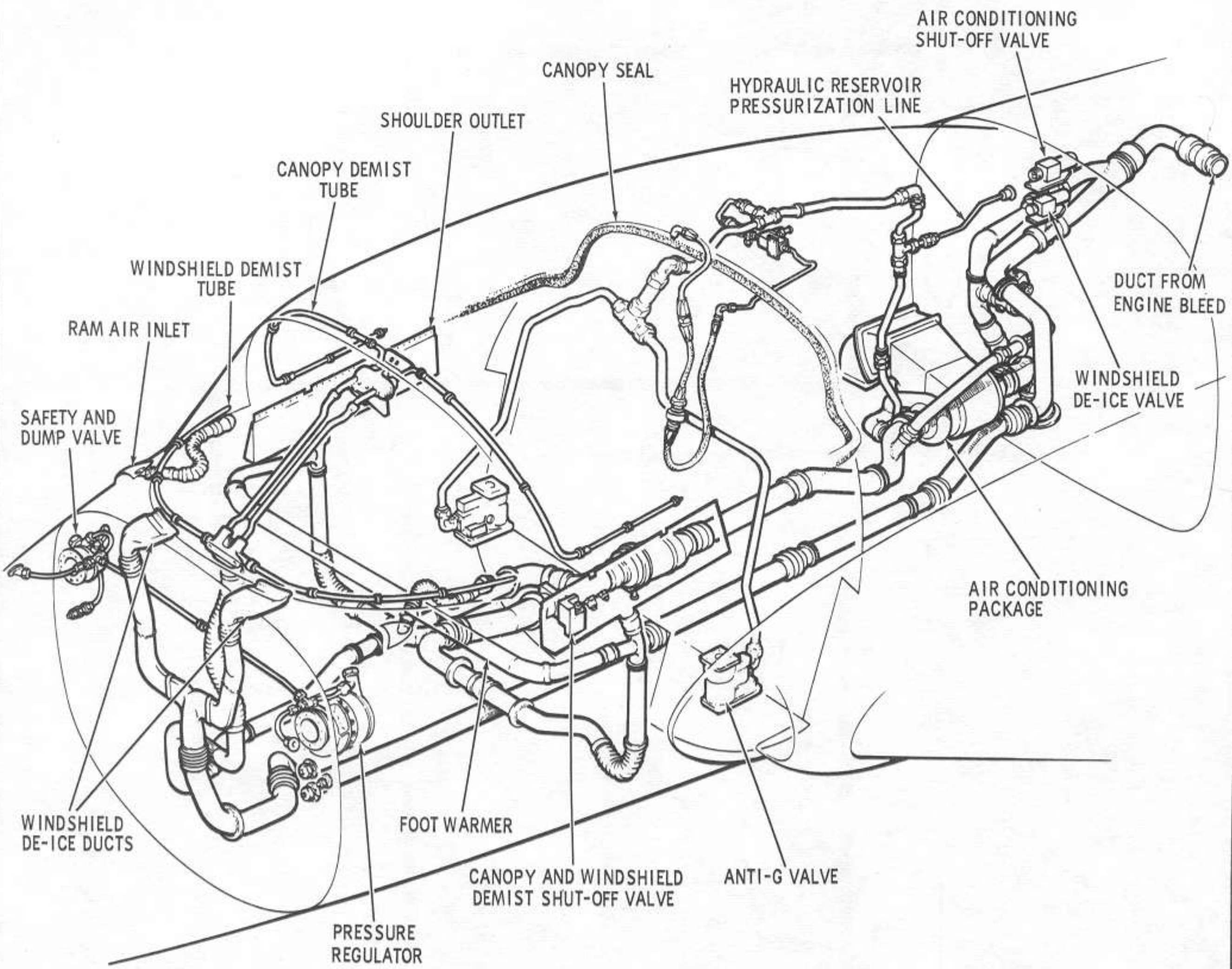


Figure 1-10 Air-Conditioning and Pressurizing System - Schematic

LANDING-GEAR-DOWN EXTERNAL INDICATOR LIGHT

83 An amber light installed in the aircraft nose section illuminates to indicate to a ground observer that the landing gear is down and locked.

WHEEL BRAKES

GENERAL
(See Figure 1-9)

84 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. Each pedal energizes an individual master cylinder fed from a common reservoir. Braking action is directly proportional to the pressure applied at the pedals.

PARKING BRAKE CONTROL

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

NOSE-WHEEL STEERING

86 The nose-wheel steering system is electro-hydraulically engaged and hydraulically powered, and 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 wheel within approximately 42 degrees each side of centre. When the switch is released, hydraulic power is cut off and the nose wheel will castor within the normal steering range. When the weight of the aircraft is off the nose wheel, hydraulic power to the steering unit is disconnected and the nose wheel is automatically centred. The removal of a pip-pin in the nose-gear linkage disconnects the steering unit and permits full castoring of the nose wheel for towing purposes.

EIGHTH-STAGE ENGINE BLEED AIR

87 Air is bled from the eighth stage of the engine compressor and is used to operate the following services:

(a) Air-conditioning and pressurizing.

(b) Windshield and canopy demisting.

(c) Windshield de-icing.

(d) Pressurization of the hydraulic system reservoir.

(e) Canopy seal.

(f) Anti-G suit valve.

(g) Engine and zone-cooling ejector pumps.

(h) Engine anti-icing.

88 The bleed shut-off valves are open whenever the engine is running at and above idle RPM. All the services listed will be available with the exception of the windshield de-icing system, which is inoperative while the aircraft is on the ground. The canopy seal, anti-G suit valve, and hydraulic reservoir pressurization are automatically pressurized.

AIR-CONDITIONING AND PRESSURIZING

GENERAL
(See Figure 1-10)

89 Air from the eighth-stage bleed passes 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. The cockpit is unpressurized below 8,000 feet. From 8,000 feet to approximately 17,000 feet, until a maximum of 3(± 0.1) PSI differential is reached, the cockpit altitude remains at 8,000 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(± 0.15) PSI, or, in an emergency, may be opened through the air-conditioning master switch. The static source for the pressure regulator and 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 1-11.

AIR-CONDITIONING MASTER SWITCH

90 The air-conditioning master switch is located on the centre console and has two positions, NORMAL and 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 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 DUMP position, the windshield and canopy demisting, hydraulic reservoir pressurizing, anti-G suit valve and canopy seal are also inoperative.

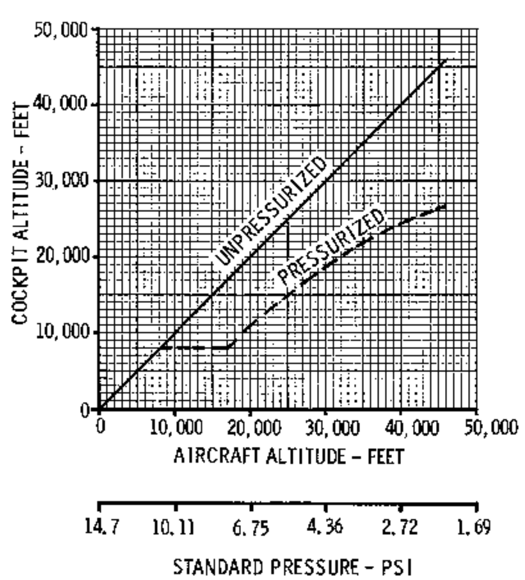


Figure 1-11 Cockpit Altitude vs Aircraft Altitude

COCKPIT TEMPERATURE SELECTOR

91 The cockpit air 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 increased temperature and counter-clockwise for a decrease in temperature. The selector controls the temperature of the incoming air through a range of 1.7° to 82.2° C.

COCKPIT TEMPERATURE CONTROL SWITCH

92 The cockpit temperature control switch is a four-position toggle switch, marked OFF, AUTO, HOT and COLD, mounted on the centre console. With the switch in the AUTO position, temperature is maintained at the value selected by the cockpit temperature selector. In the event of a failure in the 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 below the 12 o'clock position before take-off.

COCKPIT AIR OUTLETS

93 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 and less through the foot outlets. Moving the handle forward reverses this distribution ratio.

RAM AIR INLETS

94 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 demist tubes on each side of 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

95 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 in conjunction or separately (see Figure 1-10).

WINDSHIELD DEMIST

96 The windshield and canopy demisting system is provided to prevent 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 DEMIST and OFF. Selection of DEMIST on the switch will operate a valve which diverts a greater portion of air-conditioned air to the demist outlets.

WINDSHIELD DE-ICING

97 A windshield de-icing system is provided to clear 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

The hot bleed air will crack the windshield if the system is used above 84% RPM and in excess of 1 minute.

98 When the WSHLD DE-ICE switch is turned on, a blue legend, WINDSHIELD 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 legend.

INSTRUMENTS

FLIGHT INSTRUMENTS

99 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 altimeter. The electrically operated instruments are the turn-and-slip indicator, attitude indicator, track indicator and the distance radio magnetic indicator (DRMI). A fast-erect switch is provided for the left attitude indicator. To fast-erect the attitude indicator, depress the fast-erect switch for 1 minute and release for 30 seconds. Repeat this action until the attitude indicator is erected. It should erect in approximately 3 to 4 minutes.

NOTE

The attitude indicator is not reliable after toppling caused by aerobatic manoeuvres. All unserviceabilities not associated with aerobatics must be recorded in form CF 339.

ENGINE INSTRUMENTS

100 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

101 The miscellaneous instruments are the electrically operated hydraulic pressure gauge, flap position indicator, fuel quantity indicator and loadmeter. The oxygen pressure indicator is a direct-reading instrument. The cockpit altimeter is self-contained. 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 swung with all electrical equipment selected ON.

PITOT-STATIC SYSTEM

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

PITOT AND LIFT TRANSDUCER ANTI-ICING

103 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 OFF position, both anti-icing systems are inoperative. 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

104 The aircraft lighting system, which provides general and specific illumination for the aircraft interior and exterior, is composed of the following lights:

(a) Interior lights:

(1) Instrument panel lights.

(2) Instrument panel flood-lights.

(3) Console and circuit-breaker panel lights.

(4) Cockpit utility lights.

(5) Standby compass light.

(b) Exterior lights:

(1) Landing and taxi lights.

(2) Anti-collision lights.

(3) Navigation lights.

105 Warning lights are not included in the lighting system, but provision is made for the dimming of the annunciator panel lights by moving the instrument panel light rheostat, on the centre console, from the OFF position.

NOTE

With the rheostat in any but the OFF position, the annunciator panel and landing-gear warning lights are dim.

INSTRUMENT PANEL LIGHTS

106 Primary illumination of the instrument panels is provided by individual lights and edge-lit panels. Illumination is controlled by a single rheostat with an integral off switch, located on the forward section of the centre console.

INSTRUMENT PANEL FLOOD-LIGHTS

107 Secondary illumination of the instrument panels is provided by five white flood-lights mounted on the underside of the instrument panel shroud. A single rheostat with an integral off switch, located on the forward section of the centre console, controls the instrument panel flood-lights.

CONSOLE AND CIRCUIT-BREAKER PANEL LIGHTS

108 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 rheostat located on the forward section of the centre console.

COCKPIT UTILITY LIGHTS

109 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 flood-light assembly is installed on the canopy centre beam to provide a light for the let-down chart.

STANDBY COMPASS LIGHT

110 The brightness of the standby compass integral light is controlled by a separate switch, marked BRT, OFF and DIM, located on the forward section of the centre console.

LANDING AND TAXI LIGHTS

111 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 LT, OFF and TAXI LT, located on the left instrument sub-panel. When the switch is placed at LDG LT, both landing lights are turned on. With the switch at TAXI LT, only the taxi light comes on.

CAUTION

Without a cooling air flow, the plexiglas cover over the landing lights is susceptible to heat damage. Therefore the use of the landing lights is restricted to a maximum of 5 minutes continuous operation on the ground.

ANTI-COLLISION LIGHTS

112 Two flashing 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 located on the centre console.

NAVIGATION LIGHTS

113 Conventional navigation lights are controlled by an ON-OFF switch on the centre console and flash intermittently when selected ON. When either or both anti-collision lights are switched on, the navigation lights are switched to steady illumination.

COCKPIT EQUIPMENT

CANOPY

114 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 derived from either the internal batteries or the external power supply. In an emergency, the canopy is 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 window marked CANOPY UNLOCKED. Visual indication of a fully-closed position is provided by white alignment stripes 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.

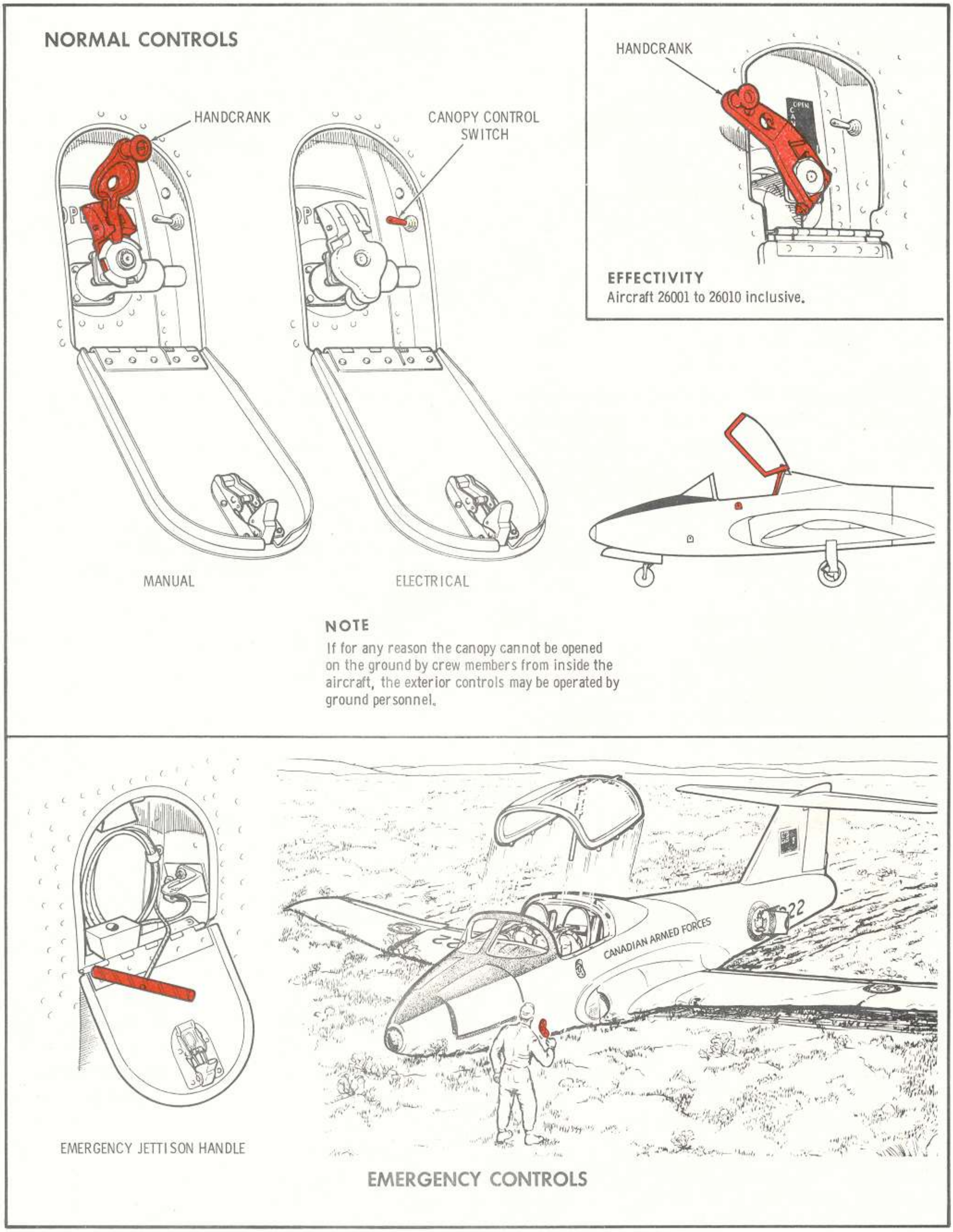


Figure 1-12 External Canopy Controls

CANOPY CONTROLS

115 The canopy operating controls are as follows:

(a) Internal:

(1) Selector and actuator switches.

(2) Handcrank.

(3) Canopy jettison controls.

(b) External:

(1) OPEN and CLOSE switch.

(2) Handcrank.

(3) Canopy jettison handle.

CANOPY OPERATING SWITCHES

116 Normal electrical operation of the canopy from inside the aircraft is controlled by two switches located 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-type 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.

117 Normal electrical operation of the canopy from outside the aircraft is controlled by a switch, marked OPEN and CLOSE, which is located below the canopy sill on the left side of the aircraft fuselage (see Figures 1-12 and 1-13). The external canopy control switch is de-activated when the aircraft weight is off the main landing gear.

NOTE

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

CANOPY MANUAL CONTROLS

118 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 counter-clockwise to open the canopy. The procedure is reversed to close the canopy.

119 A similar handcrank 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 (see Figure 1-12).

CANOPY JETTISON SYSTEM

120 A canopy catapult, containing an explosive charge, jettisons the canopy in an emergency. The catapult-firing mechanism includes three initiators, which can be independently fired from inside the aircraft by raising the handgrips on either seat, or by pulling the jettison handle, which is located in the centre of the cockpit immediately below the main instrument panel. A canopy external jettison handle, located on the left side of the fuselage, permits ground rescue personnel to jettison the canopy for emergency entrance (see Figures 1-12 and 1-13). Both the external and internal jettison handles use the same linkage system to fire the canopy catapult.

GROUND SAFETY PINS

121 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 pre-flight checks.

122 Ten additional safety pins, provided for maintenance purposes only, are located as follows:

(a) One safety pin at the canopy emergency jettison initiator.

(b) One safety pin at the canopy catapult.

(c) One safety pin at each of the four initiators located at the back of each seat.

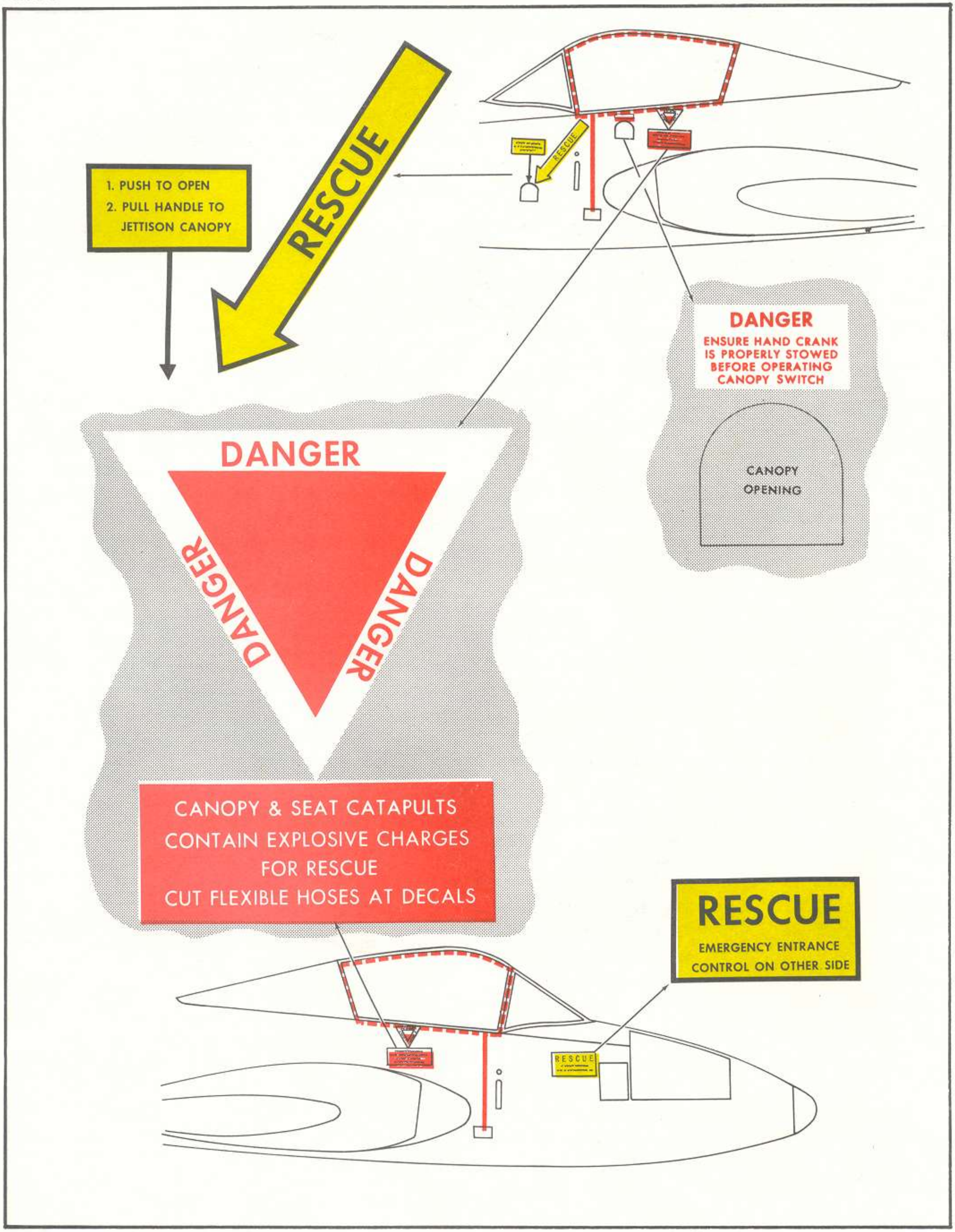


Figure 1-13 External Markings - Rescue and Canopy Warning

CAUTION

The ten safety pins provided for use during maintenance operations must be removed before the pilot enters the cockpit.

CANOPY PRESSURE SEAL

123 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 seal 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 upon placing the canopy selector switch to OPEN.

EJECTION SEATS
(See Figure 1-14)

124 The seats eject upward. The safety rating of the rocket catapult seat has been test-established at 0-60; that is, ground-level ejection can be accomplished at minimum speeds of 60 knots IAS. Each seat incorporates an electrically operated seat adjustment mechanism, a lap belt and harness with automatic release, an inertia-reel lock and a chaff-dispenser-type bail-out marker. A ballistic system initiates the canopy jettison and the seat rocket, and separates seat from man. A personal-leads disconnect on the left side of each seat permits automatic disconnection of the oxygen and anti-G suit pressure lines and the canopy jettison propellant gas line. The intercom quick-disconnects are located on the right side of each seat. Both seats are equipped with a canopy-breaking ram for ejection through the canopy. Emergency transmission of UHF and IFF is provided upon ejection of either seat. An override switch permits normal operation of UHF, however, should one pilot remain in the aircraft (refer to para 155). 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 the stowing of the oxygen hose when not in use.

SEAT CONTROLS

125 Each seat incorporates the following operating controls:

(a) A vertical seat adjustment switch.

(b) Handgrips (knee guards) on either side of each seat.

(c) Independent ejection triggers located in both left and right handgrip of each seat.

(d) Inertia-reel lock lever.

VERTICAL SEAT ADJUSTMENT SWITCHES

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

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 jettison handle.

HANDGRIPS (KNEE GUARDS)

127 Each seat is equipped with ejection controls which consist of loop-type handgrips incorporating ejection triggers, 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 erected position. Raising either handgrip initiates canopy ejection, locks the inertia reel, and arms the seat ejection triggers. The seat-ejection trigger mechanism is so arranged that, with the triggers in the firing position, either trigger may be squeezed without moving the other. Squeezing either trigger fires its respective seat catapult initiator.

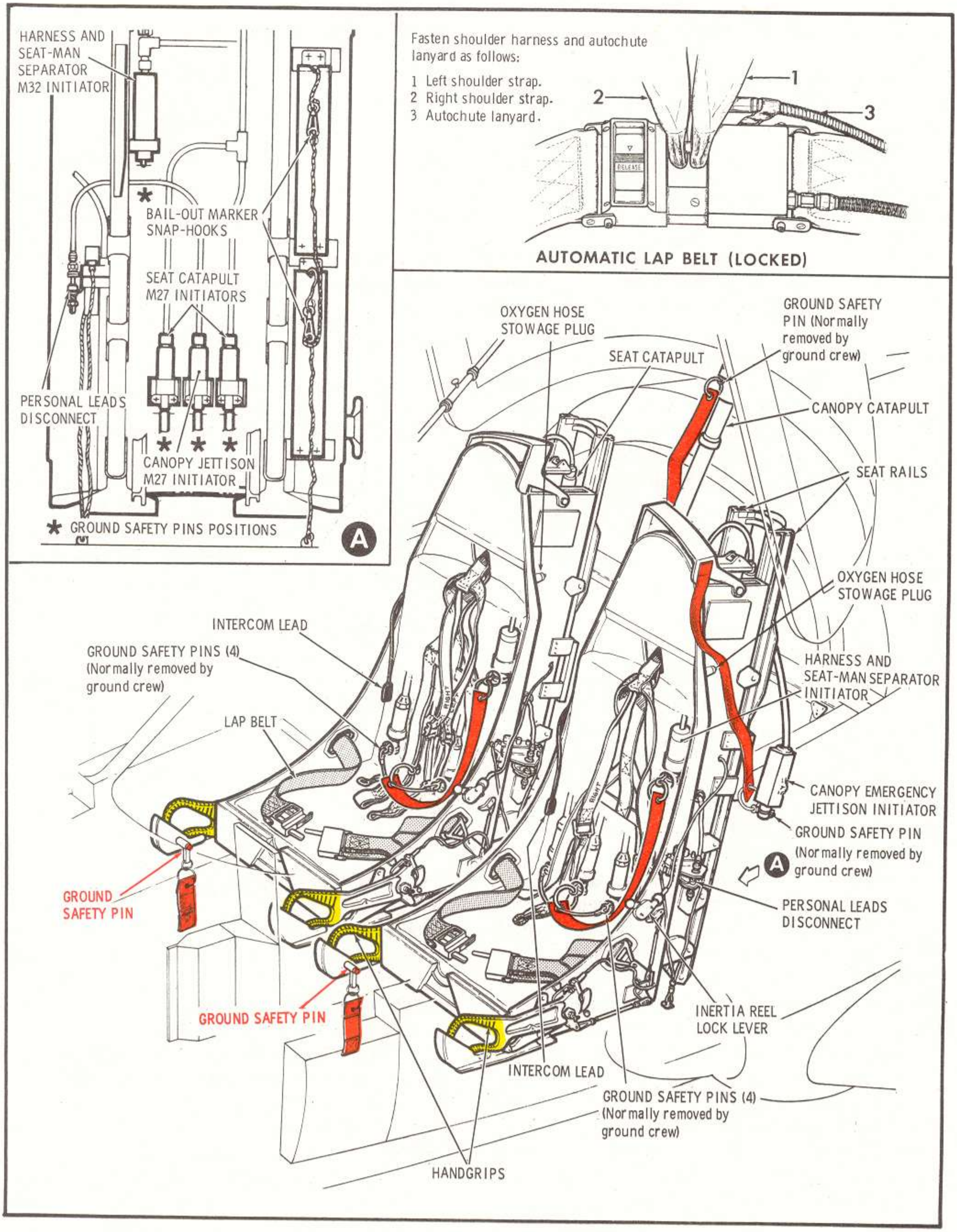


Figure 1-14 Ejection Seats

INERTIA-REEL LOCK LEVER

128 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.

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

CAUTION

The automatic locking feature provides an additional safety factor, but the manually locked position should always be used when a crash landing is anticipated.

LAP BELT AND HARNESS

130 The seat is equipped with an automatically 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 flexible cable attached to the airframe pulls a pin to fire a one-second-delay gas initiator, which opens the lap belt.

SEAT-MAN SEPARATION SYSTEM

131 A strap-type seat-man separator is provided with each seat and operates in conjunction with the lap-belt and harness release system. As the lap belt and harness are released, a rotary actuator cartridge is energized to actuate a wind-up reel, which pulls the straps to separate the pilot and seat pack from the seat. This, in turn, actuates the parachute release.

AUTOMATIC OPENING OF PARACHUTE AND DELAYED DROP PROVISION

132 When the seat harness is being released, and as the pilot is separated from the seat, the parachute release is pulled. This actuates the delay mechanism in the parachute pack and, at a pre-set time interval of 1 second, unlocks the aneroid-type release, which deploys the parachute at the pre-set altitude of 16,000(±500) feet. If below the pre-set altitude, the parachute will open at the pre-set time interval.

NOTE

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

SEAT PACK

133 The seat pack is contained in the hardshell that forms the pilot's seat. A yellow-and-black striped 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, and the hardshell 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.

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.

NOTE TO EFFECT DEPLOYMENT OF SEAT PACK CONTENTS, PULL UP ACTUATING HANDLE SHARPLY – THEN RELEASE.

BAIL-OUT MARKER

134 A chaff-dispenser-type bail-out marker is installed on the right rear of each seat for radar identification of pilots during bail-out. Automatically actuated by a lanyard attached to the aircraft structure, the chaff is diffused into the air surrounding the pilot, facilitating radar tracking.

SEAT EJECTION SEQUENCE

135 Seat ejection consists of raising either or both handgrips, causing the following sequence of events to take place:

(a) The canopy initiator is fired.

(b) The shoulder harness is locked.

(c) The seat catapult initiator is fired 0.5 seconds later.

(d) As the seat is moving up the ejection rails, the personal leads are disconnected, the bail-out marker is actuated, and the UHF/IFF emergency transmission is initiated.

136 With continued upward movement of the seat, a one-second delay initiator is fired to release the lap belt and harness. This actuates the seat-man separation system, and, as the pilot leaves the seat, the parachute release is armed. The parachute automatically deploys at an altitude of 16,000(±500) feet or after 1 second, whichever is the later.

OXYGEN SYSTEM

GENERAL

137 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 high 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

138 The high-pressure oxygen cylinders are located one in each engine air intake fairing and, when fully charged to 1,800 PSI (at 21°C), each cylinder has a capacity of 623 litres of gaseous oxygen.

DILUTER-DEMAND OXYGEN REGULATORS

139 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 and 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.

140 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 approximately 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.

141 The NORMAL position of the emergency control toggle allows the regulator to deliver oxygen or oxygen/air mixture at cockpit altitudes 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 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.

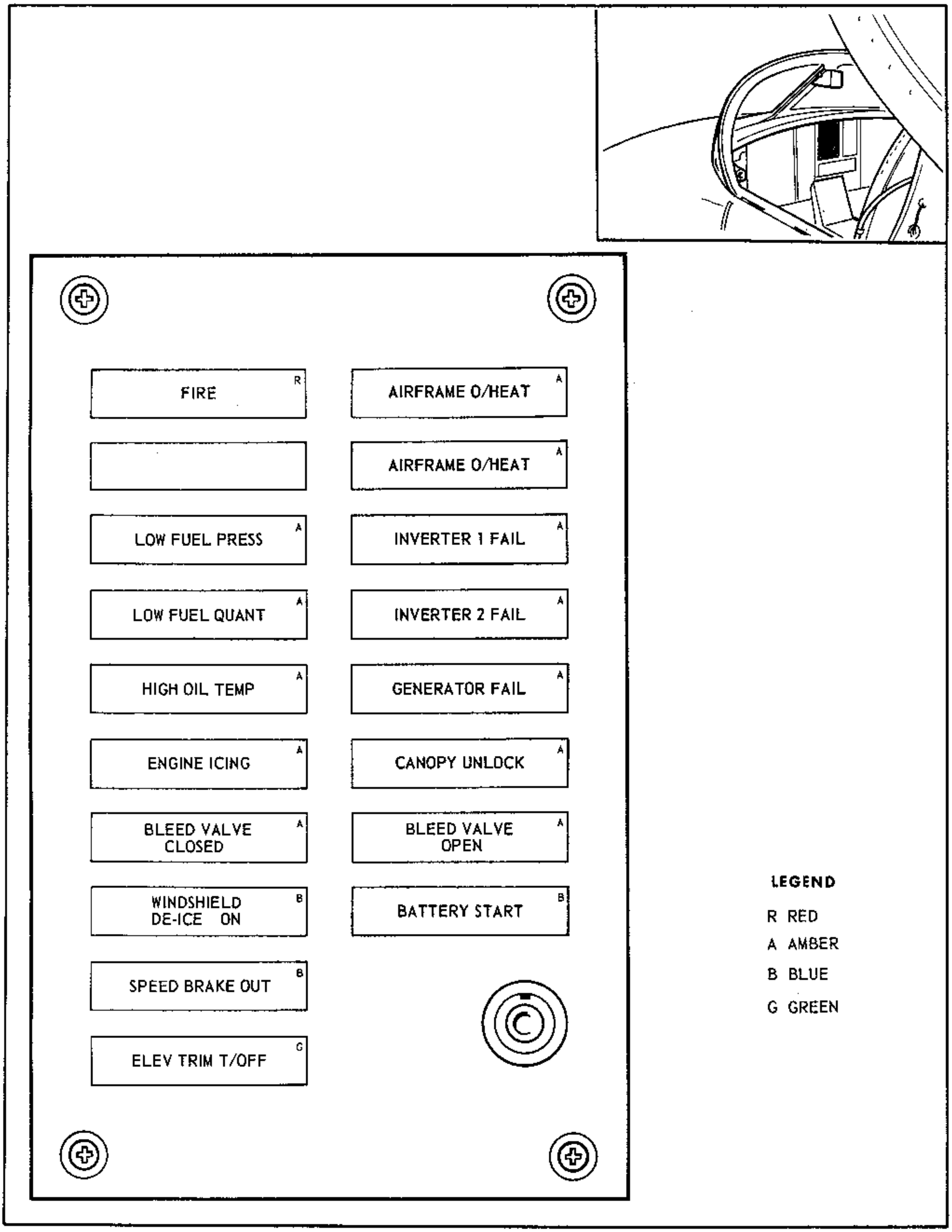


Figure 1-15 Annunciator Panel

EMERGENCY OXYGEN SYSTEM

142 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.

143 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. 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.

MASTER WARNING SYSTEM

GENERAL

144 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 essentially of a master control box, a master warning light, a master caution light, an annunciator panel, and test facility. The master control box 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 window on the annunciator panel.

MASTER LIGHTS

145 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. Malfunctions or abnormal conditions existing in the other monitored systems, except windshield de-icing, speed brakes and elevator trim tab, are indicated by the flashing amber master caution light.

146 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 window 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
(See Figure 1-15)

147 The annunciator panel, mounted on the centre of the main instrument panel, contains emergency indication windows illuminated by red legends, cautionary indication windows illuminated by amber legends, and advisory indication windows illuminated by green and blue legends.

ANNUNCIATOR TEST SWITCH

148 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 SYSTEM

GENERAL

149 The fire and overheat detection system consists of two continuous elements, each element completely covering both zones 1 and 2. One element is used for overheat detection only, while the other element is used for both fire and overheat detection. An overheat condition is indicated by flashing of the master caution light and illumination of one airframe overheat light on the annunciator panel, followed closely by illumination of the second airframe overheat light on the annunciator panel. A fire condition is indicated by flashing of the master warning light, illumination of a red annunciator panel window marked FIRE, flashing of the master caution light, and illumination of both airframe overheat lights on the annunciator panel, marked AIRFRAME O/HEAT.

PRESS-TO-TEST SWITCH

150 A press-to-test switch, marked FIRE & OVHT TEST, is provided on the main instrument panel to permit testing of the fire and overheat detection-system electrical circuits.

COMMUNICATION EQUIPMENT

AN/ARC-552 AND AN/ARC-504 UHF SYSTEMS

151 The UHF system is a radio communication system providing voice transmission and reception in the frequency range of 225 to 399.9 MHZ. The installation consists of two transceivers, one for AN/ARC-552 main UHF and one for AN/ARC-504 emergency UHF. Transmission and reception are on the same frequency, and a single antenna is shared by both transceivers. A test panel is provided in the nose compartment.

MAIN UHF SYSTEM

152 In the main UHF system, 1,750 channels are available in steps of 0.1 MHZ. Any one of the 1,750 channels can be selected manually on the control panel located on the centre console, and any 23 of the 1,750 channels or the guard channel may be selected remotely by means of the rotary channel selector on the upper left side of the main instrument panel. A UHF command indicator is also provided that indicates either pre-set or manual frequency control.

MAIN UHF CONTROLS

153 The main control panel, located on the centre console, is used in conjunction with the rotary channel selector to provide complete operating control of the main UHF radio. The panel incorporates the following controls:

(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) T/R - In the T/R 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) T/R+G - In the T/R+G position, the set functions in the same manner as in the T/R position but, in addition, the guard receiver is energized.

NOTE

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

(4) ADF - The ADF position is inoperative.

(b) PRESET/MANUAL switch - This rotary-type switch provides the method of frequency selection. The PRESET position permits the use of the pre-set channel selector for operation on any one of the 23 pre-set frequencies or the guard frequency. The MANUAL position permits operation on the frequency selected by the manual frequency selector knobs.

(c) Manual frequency selector knobs - Four manual frequency selector knobs are provided on the control panel to set up any desired operating frequency.

(d) Volume control - The volume control consists of a rotary control knob.

EMERGENCY UHF SYSTEM

154 The emergency UHF system is controlled from the auxiliary control panel located on the aft section of the centre console and operates on 243.0 MHZ only. The emergency UHF system, which is on standby under normal conditions, must be put into operation manually if only the main UHF fails. When there is a loss

of power from the generator or either inverter, the emergency UHF system comes on automatically. The emergency UHF performs the same functions as the main UHF in the emergency mode. When emergency UHF is selected to ON, the main UHF system is de-energized.

UHF AND IFF EMERGENCY OPERATION AFTER SEAT EJECTION

155 If the UHF is selected ON and the IFF is selected to any but the OFF position when the pilot ejects, the emergency UHF will transmit a continuous DF tone on 243.0 MHZ, and the IFF will operate in the emergency code. A UHF bail-out override switch, located on the auxiliary control panel, is used to regain control of the UHF system by the remaining occupant, should only one pilot eject. If this occupant subsequently ejects, the EUHF will again transmit a continuous DF tone on 243.0 MHZ, regardless of the position of the override switch. The switch does not override the IFF, which will operate in the emergency code continuously after the first occupant ejects.

INTERCOM SYSTEM

156 The AN/AIC-502 intercom system provides hot mike intercommunication between instructor and student. The system also provides radio monitoring and microphone control facilities for the UHF and reception of TACAN audio signals.

157 The intercom dual control panel is located on the centre console. The volume control knobs (push off, pull on) adjust the audio level of the intercom system, the UHF and the TACAN. Incorporated in the intercom system are two press-to-talk switches and three muting switches. When either of the two press-to-talk switches, located one on each throttle lever, is pressed, the output of the associated microphone amplifier is transferred from the intercom system to the UHF channel (main or emergency). The muting switches, located on each stick grip and on the right instrument sub-panel, can be used to silence the audio and side-tone signals from UHF-system and TACAN-beacon identification signals.

158 An audible warning is transmitted to the pilots' headsets through the intercom system when the landing gear is in any other position than down and locked, and the throttle is retarded below cruise power, with the aircraft at or below 7,000 feet MSL.

TACAN SYSTEM

159 The AN/ARN-501 TACAN equipment operates in conjunction with a surface beacon to form a radio navigation system which provides beacon identification, and bearing and distance information relative to a selected beacon. The system provides 126 two-way channels at 1-MHZ spacing to enable the operator to select a desired ground station. The TACAN antenna is located on the lower fuselage section. Beacon identification is available on the intercom system.

TACAN CONTROL PANEL

160 The TACAN control panel, mounted on the centre console, contains a rotary function selector switch marked OFF, REC and T/R, a channel selector switch marked CHAN, and a volume level control marked VOL. The REC position of the function selector switch energizes the receiver portion only to provide bearing information, and the T/R position energizes the complete TACAN system for bearing and distance display. The OFF position de-energizes the complete system.

TACAN TRACK SELECTOR SWITCH

161 The TACAN track selector switch is used to energize the TACAN track selector relay. When the switch is in the RH position, the relay is energized, and track selection is controlled by the right-hand track indicator. In the LH position, the relay is de-energized and track selection is controlled by the left-hand indicator. Display is the same on both indicators.

TACAN INDICATORS

162 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 navigation aid.

GYRO MAGNETIC COMPASS

163 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.

164 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 re-positions 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. The fast-slave switch is used to align the system quickly prior to flight or to realign the system in flight after carrying out manoeuvres which topple the gyro.

AN/APX-46 IFF SYSTEM

165 The AN/APX-46 IFF is an airborne pulse-type transponder which enables the aircraft to identify itself whenever it is challenged by interrogating systems. IFF interrogation signals automatically actuate the transmission of a coded reply which 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. A test panel is provided in the nose compartment.

IFF CONTROLS

166 A control panel is provided on the centre console to energize, set, and select the conditions and modes of operation. It also permits selection of replies coded by SIF (selective identification feature) in mode 1 and mode 3. The panel incorporates the following controls:

(a) Master switch - The master switch is a five-position rotary switch permitting selection of the following operating conditions as positioned:

(1) OFF - The OFF position de-energizes the set.

(2) STDBY - In the STDBY position, all primary power is turned on, and tubes are heated and ready for immediate operation. However, the transponder receiver is not sensitized, thus no replies can be transmitted.

(3) LOW - In the LOW position, the transponder receiver operates the same as in the NORM position, but at reduced sensitivity, and replies will be transmitted upon receipt of strong interrogation signals, ordinarily from nearby interrogator responders.

(4) NORM - In the NORM position, the transponder is fully sensitized and operates with maximum performance. Transmitted power from the transponder is the same for both the LOW and NORM positions.

(5) EMER - In the EMER position, a distinctive emergency reply is transmitted in response to either mode 1 or mode 3 interrogations. Mode 1 and mode 3 permit quick positive identification of the aircraft in distress. The reply consists of four successive groups of the selected pulse train.

NOTE

The master switch must be lifted to select EMER.

(b) Mode 1 switch - The mode 1 switch has two positions, OUT and MODE 1. In the MODE 1 position, there are 32 possible reply codes available as selected by the MODE 1 dial on the IFF panel. The IFF transceiver is internally wired so that MODE 1 is permanently IN; therefore the MODE 1 OUT position is not applicable.

(c) Mode 2 switch - The mode 2 switch has two positions, OUT and MODE 2. In the MODE 2 position, there are 4,096 possible reply codes available. The number and interval of these codes are pre-set on the code selector prior to flight.

(d) Mode 3 switch - The mode 3 switch has two positions, OUT and MODE 3. In the MODE 3 position, there are 64 possible reply codes available to the pilot as selected by the MODE 3 dial on the panel.

(e) Mode 4 switch - The mode 4 switch is inoperative.

(f) IP-OUT-MIC switch - Holding the switch in the IP (spring-loaded) position causes a double mode 1 or mode 3 code train to be transmitted in response to each mode 1 or mode 3 interrogation. This response will continue for 30 seconds after the switch is released to OUT from the IP position. When the switch is placed to the MIC position and the microphone button is depressed, the response is the same as if the IP switch 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.

(g) SIF control - The SIF control provides selection of the various reply codes in both mode 1 and mode 3 transponder operation. The panel contains two coaxial dials, labelled MODE 1 and MODE 3. Dial operation is as follows:

(1) Mode 1 dial - The mode 1 dial consists of two coaxial knobs; the outer knob bears the numbers 0 to 7 and the inner knob from 0 to 3, thus making possible 32 different selected responses from the mode 1 operation. The set responds to mode 1 interrogations according to the code selected on the mode 1 dial, whenever the master switch is in the LOW, NORM or EMER position. Mode 1 operates independently, or concurrently with mode 2 and mode 3.

NOTE

The pilot has no control over selection of mode 2 code replies. The number and interval of these replies must be pre-set on the transponder prior to flight.

(2) Mode 3 dial - The mode 3 dial also consists of two coaxial knobs. Both the outer and inner dials are numbered from 0 to 7, making possible 64 different selected responses for mode 3 operation. The set will respond to mode 3 interrogations according to the code selected on the mode dial, provided the master switch is in the LOW, NORM or EMER position, and the mode 3 switch is in mode 3 position. Mode 3 operates independently of, or concurrently with, mode 1 and mode 2.

(h) Test switch - The test switch is inoperative.

MISCELLANEOUS EQUIPMENT

GENERAL

167 Miscellaneous equipment consists of the rear-view mirrors, map and data cases, blind-flying hood, anti-G suit valves, let-down holder, diversion chart, ground safety pin stowage, personal baggage stowage and FLIP case holder.

REAR-VIEW MIRRORS

168 An adjustable rear-view mirror is secured to the forward frame of the canopy in front of each pilot's seat to provide rear vision.

MAP AND DATA CASES

169 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 HOOD

170 A blind-flying hood can be installed at either seat to provide for instrument flying simulations. The hood is stowed in the left zippered pocket.

ANTI-G SUIT SYSTEM

171 The anti-G suit utilizes compressor bleed air from the engine compressor. The air for each suit is routed through an anti-G valve and from there to the personal-leads disconnect on the ejection seat. The anti-G valves are located outboard of each seat. The valves are set to begin suit inflation at approximately +1.75G. A button on the top of the valve can be manually depressed to inflate the suit when desired.

GROUND SAFETY PIN STOWAGE

172 The ground safety pins are to be stowed as follows:

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

(b) Stow the left and right seat safety pins in the brackets provided.

(c) Secure the ground safety pins (9) in the container provided and stow in the left wing root fairing.

PERSONAL BAGGAGE STOWAGE

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

CAUTION

Do not place personal luggage and clothing bags in the cockpit. These items could interfere with the seat ejection sequence and could be hazardous in the event of canopy loss.

LET-DOWN BOOK HOLDER

174 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 the use of either pilot.

DIVERSION CHART

175 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

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

FORCED-LANDING INSTRUCTIONS

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

PART 2
HANDLING

PRE-FLIGHT CHECKS

BEFORE ENTERING COCKPIT

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

2 Before entering the cockpit, complete the following pre-flight checks:

(a) Windshield de-icing vents - Clear.

(b) Canopy - Checked for cracks and cleanliness.

(c) Engine compartment ram-air scoop plug - Remove, clear.

(d) Inspection panels on top of fuselage - Secure.

(e) Ground safety seat pin installed in right handgrip of each seat. Ensure that the ground safety canopy jettison pin, the four ground safety pins at the back of each seat, and the single safety pin at the top of the canopy catapult have been removed by ground personnel.

(f) Seat-pack release handle - Red warning band not visible.

(g) Accelerometer - Checked.

(h) Landing-gear control lever - DOWN.

(j) STARTER STOP switch - Press.

(k) DC master switch - To BATT. (Ensure BATTERY START legend is out.)

NOTE

The illumination of the BATTERY START legend at this time would indicate that a battery start has taken place some time before and that groundcrew corrective action has not been taken: Place the aircraft unserviceable.

(m) Night flying - All lights checked, then OFF.

(n) Landing gear indicators - Down.

(p) Engine master switch - ON (BATTERY START legend should illuminate, indicating a functional system); air-start ignition - Checked.

(q) Engine master switch - OFF.

(r) DC master switch - OFF.

(s) Controls - Unlocked.

3 Carry out pre-flight external checks as in Figure 2-1.

RIGHT SEAT FOR SOLO FLYING

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

(a) Right handgrip - Down; safety pin - Inserted.

(b) Harness and oxygen hose - Secure.

(c) Survival seat pack - Removed or secure.

(d) Landing-gear-up selection override switch - NORMAL.

PRE-START

5 After entering the cockpit, proceed as follows:

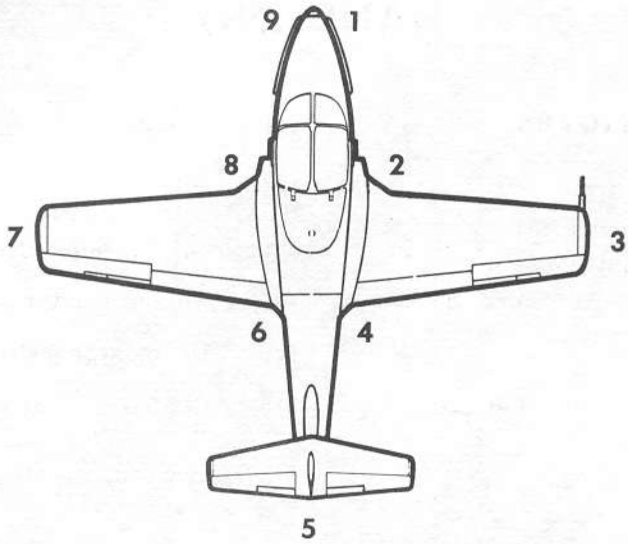
(a) Ground safety landing gear pins (3) and lift-transducer cover - Stowed.

(b) Alternate canopy jettison handle - In.

(c) Place helmet on instrument coaming - visor forward. Allow oxygen mask and hose to hang down.

CAUTION

Ensure that the helmet does not scratch the windshield, and do not allow the pate or the oxygen quick-disconnect to strike the instrument panel.



1 NOSE AREA RH

(a) TAXI LIGHT AND GROUND OBSERVER LIGHT	CONDITION
(b) NOSE WHEEL DOORS	CONDITION AND LINKAGE
(c) GROUND SAFETY PIN	REMOVED
(d) HYDRAULIC LINES	LEAKS AND SECURITY
(e) NOSE WHEEL LINKAGE	CONNECTED
(f) TIRE	INFLATION, SLIPPAGE AND CONDITION
(g) OLEO EXTENSION	2-1/4 INCHES (APPROX)
(h) ELECTRONICS COMPARTMENT	PANEL SECURE
(j) STATIC VENTS (COCKPIT PRESS REG)	CLEAR
(k) COCKPIT RAM AIR SCOOP	PLUG REMOVED, CLEAR
(m) ENGINE AIR INTAKE	PLUG REMOVED, CLEAR
(n) PERSONAL BAGGAGE STOWAGE	PANEL SECURE
(p) BOTTOM FUSELAGE ACCESS PANELS	SECURE
(q) LOWER ANTI-COLLISION LIGHT	CONDITION
(r) TACAN ANTENNA	CONDITION
(s) UHF ANTENNA	CONDITION
(t) FUEL TANK CAVITY VENTS (6)	CLEAR
(u) FUEL DRAINS (3)	CLEAR
(v) FUEL TANK DRAIN PANELS (2)	SECURE

2 RH WHEEL WELL

(a) HYDRAULIC LINES	LEAKS AND SECURITY
(b) UPLOCK	OPEN
(c) GROUND SAFETY PIN	REMOVED
(d) BRAKE PUCKS	CONDITION
(e) TIRE	INFLATION, SLIPPAGE AND CONDITION
(f) OLEO EXTENSION	2 INCHES (APPROX)
(g) DOORS AND LINKAGE	CONDITION

3 RH WING

(a) LANDING LIGHT	CONDITION
(b) LIFT TRANSDUCER	GUARD REMOVED, CONDITION
(c) PITOT-STATIC TUBE	COVER REMOVED, CONDITION
(d) IFF ANTENNA	CONDITION
(e) UPPER AND LOWER WING SURFACES	CONDITION OF SKIN
(f) NAVIGATION LIGHT	CONDITION
(g) AILERON AND TABS	CONDITION AND TRAVEL
(h) FLAP AND HINGE	CONDITION
(j) FUEL FILLER PANEL	SECURE
(k) UPPER ANTI-COLLISION LIGHT	CONDITION

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

4 REAR FUSELAGE RH

(a) BLEED AIR EXHAUST	PLUG REMOVED, CLEAR
(b) OIL FILLER CAP PANEL	SECURE
(c) ACCESS PANELS	SECURE
(d) COOLING TURBINE EXHAUST	PLUG REMOVED, CLEAR
(e) ENGINE FUEL DRAINS	CLEAR
(f) FUEL VENT MAST	CLEAR, CONDITION
(g) ZONE 2 COOLING EXHAUST	FLAP FREE
(h) SPEED BRAKE WELL	BRAKE SECURE, LEAKS AND SECURITY, MICROSWITCH FOR CONDITION

5 EMPENNAGE

(a) HORIZONTAL STABILIZER AND ELEVATORS	CONDITION OF SKIN
(b) NAVIGATION LIGHT	CONDITION
(c) RUDDER	CONDITION OF SKIN, FREEDOM OF MOVEMENT
(d) JET PIPE	PLUG REMOVED, CLEAR, CONDITION
(e) ACCESS PANELS	SECURE
(f) ELEVATOR TRIM	NEUTRAL

6 REAR FUSELAGE LH

(a) SPEED BRAKE WELL	BRAKE SECURE, LEAKS AND SECURITY
(b) ACCESS PANELS	SECURE
(c) ZONE 2 COOLING EXHAUST	FLAP FREE
(d) GROUND POWER RECEPTACLE	GROUND POWER CONNECTED OR PANEL SECURE
(e) FIRE EXTINGUISHER PUSH-IN PANEL	IN PLACE
(f) BLEED AIR EXHAUST	PLUG REMOVED CLEAR
(g) HYDRAULIC RESERVOIR PANEL	SECURE
(h) GENERATOR COOLING PORT	PLUG REMOVED, CLEAR

7 LH WING

(a) FLAP AND HINGE	CONDITION
(b) AILERON AND TABS	CONDITION AND TRAVEL
(c) NAVIGATION LIGHT	CONDITION
(d) UPPER AND LOWER WING SURFACES	CONDITION OF SKIN
(e) LANDING LIGHT	CONDITION

8 LH WHEEL WELL

(a) HYDRAULIC LINES	LEAKS AND SECURITY
(b) UPLOCK	OPEN
(c) GROUND SAFETY PIN	REMOVED
(d) BRAKE PUCKS	CONDITION
(e) TIRE	INFLATION, SLIPPAGE AND CONDITION
(f) OLEO EXTENSION	2 INCHES(APPROX)
(g) LANDING GEAR DOOR SWITCH	DOWN
(h) DOORS AND LINKAGE	CONDITION

9 NOSE AREA LH

(a) OXYGEN CHARGING VALVE ACCESS PANEL	SECURE
(b) PERSONAL BAGGAGE STOWAGE	PANEL SECURE
(c) ENGINE AIR INTAKE	PLUG REMOVED, CLEAR
(d) CANOPY EXTERNAL OPERATING CONTROL PANEL	SECURE
(e) STATIC VENTS (COCKPIT PRESSURE REGULATOR)	CLEAR
(f) CANOPY EXTERNAL JETTISON CONTROL PANEL	SECURE
(g) COCKPIT RAM AIR SCOOP	PLUG REMOVED, CLEAR
(h) ELECTRONICS COMPARTMENT	PANEL SECURE

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

(d) Tighten parachute leg straps and tuck hose ends under legs; attach the seat pack Airlock fasteners to the parachute harness clips and tighten the straps.

(e) When life jacket is worn, route the maritime lanyard as follows:

(1) Outside right thigh.

(2) Over right parachute thigh strap.

(3) To life jacket lanyard which is routed under right parachute shoulder strap.

(4) Under all seat straps.

(f) When life jacket 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.

(4) Under all seat straps.

(g) Position the left and right shoulder harness strap loops on the left connecting bar of the lap belt. Route the parachute arming cable and key under the shoulder harness and insert into key slot of the right lap belt. The key must be inserted before the two portions of the lap belt can be mated. Fasten the lap belts together, centre and tighten the lap belt, and tuck in its ends. With the shoulder harness unlocked, lean backwards until the head touches the headrest, and adjust the shoulder straps until the yoke of the harness rests against the nape of the neck.

WARNING

Do not open lap belt manually prior to 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.

(h) Connect the oxygen hose and bail-out bottle to the oxygen quick-disconnect. Ensure that the bail-out bottle hose comes out between the seat shoulder harness.

(j) Attach the oxygen hose to the post on the left lap belt, and the oxygen quick-disconnect harness. Ensure the dome fastener is attached between the seat shoulder harness.

(k) Connect the intercom lead.

(m) Don helmet, adjust mask, fasten chin strap.

(n) Rudder pedals - Adjust.

(p) Canopy - Closed.

(q) Parking brake - On and set as follows:

(1) Apply light toe pressure to brake pedals.

(2) Pull parking brake handle.

(3) Release brake toe pressure.

(4) Release parking brake handle.

(r) Flight controls - Check for free and proper movement.

(s) Engine master switch - OFF.

(t) Engine start switch - OFF.

(u) Engine anti-icing switch - OFF.

(v) DC master switch - OFF.

(w) Generator switch - NORMAL.

(x) Inverters - OFF.

(y) Speed-brake switch - OFF.

(z) LH throttle - CUT OFF.

(aa) Flap lever - As required.

(ab) External power - Connected; APU - On.

(ac) DC master switch - GRD PWR.

(ad) Inverters - ON (No. 1; then No. 2).

(ae) Anti-collision lights - ON.

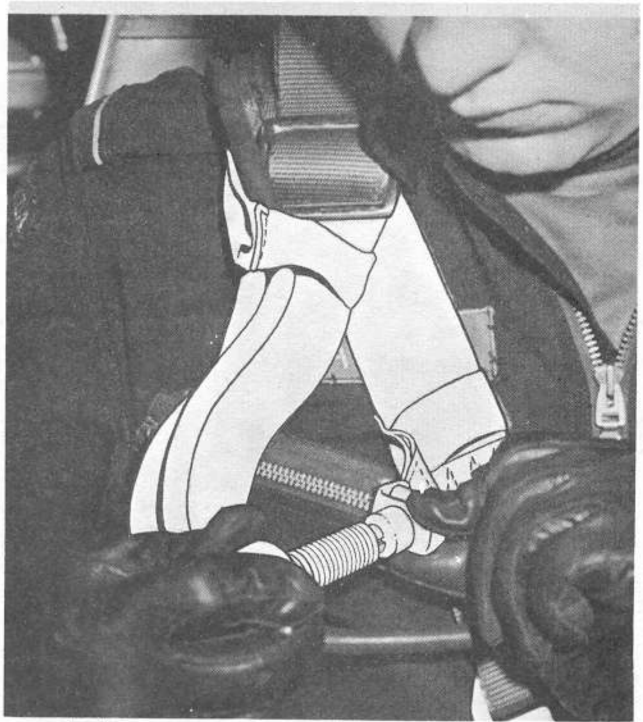
(af) Intercom - As required.

(ag) Dump valve - Winter operation: NORMAL; summer operation: DUMP.

(ah) All circuit breakers - In.

(aj) Fire and overheat warning system — Press to test.

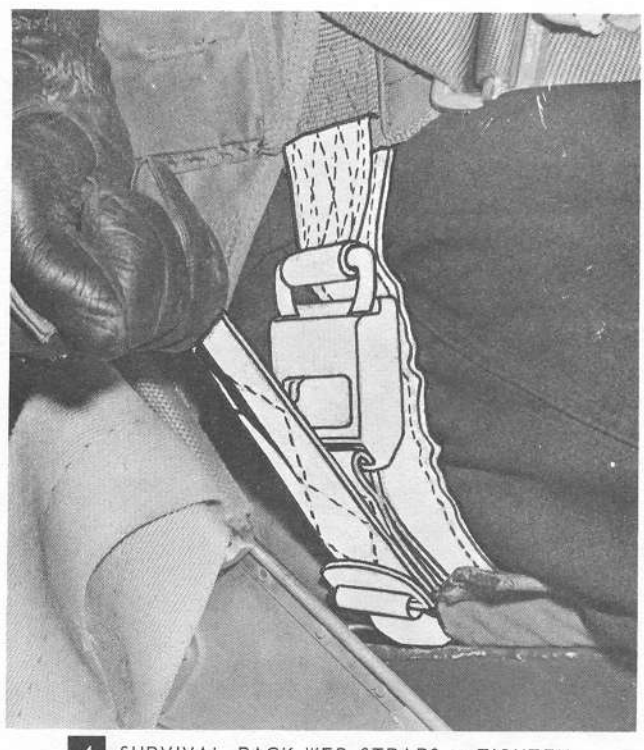
(ak) Ensure BATTERY START legend on annunciator panel is out.



1 SURVIVAL PACK LANYARD - ATTACH TO PARACHUTE HARNESS OR LIFE JACKET (IF WORN).

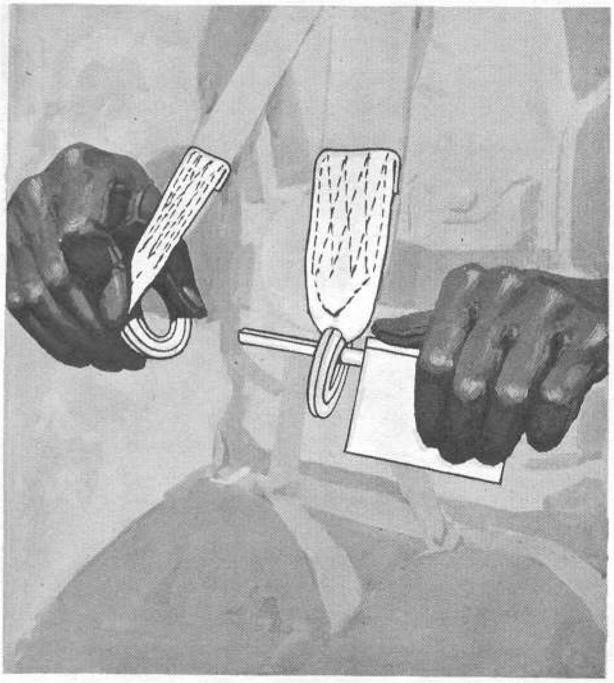
2 SURVIVAL PACK TO LOWER RIGHT PARACHUTE HARNESS - ATTACH.

3 SURVIVAL PACK TO LOWER LEFT PARACHUTE HARNESS - ATTACH.

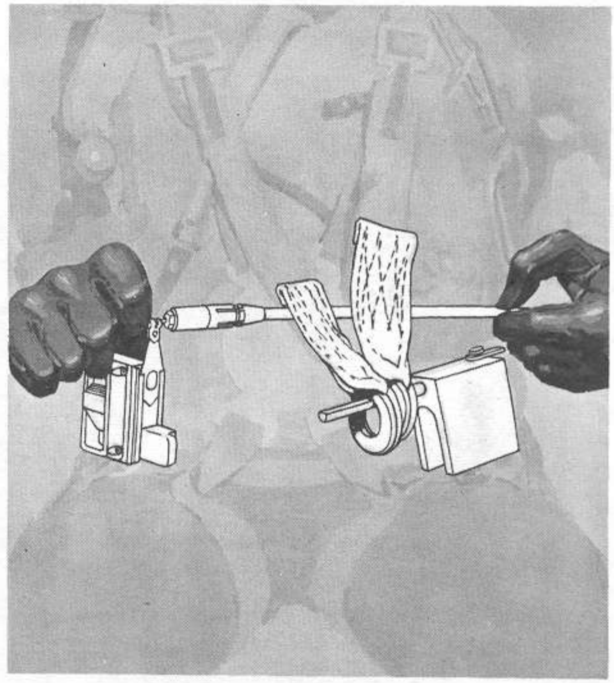


4 SURVIVAL PACK WEB STRAPS - TIGHTEN.

Figure 2-2 (Sheet 1 of 4) Strap-In Procedure



5 LEFT AND RIGHT SHOULDER HARNESS STRAP LOOPS - FASTEN ON LAP BELT.

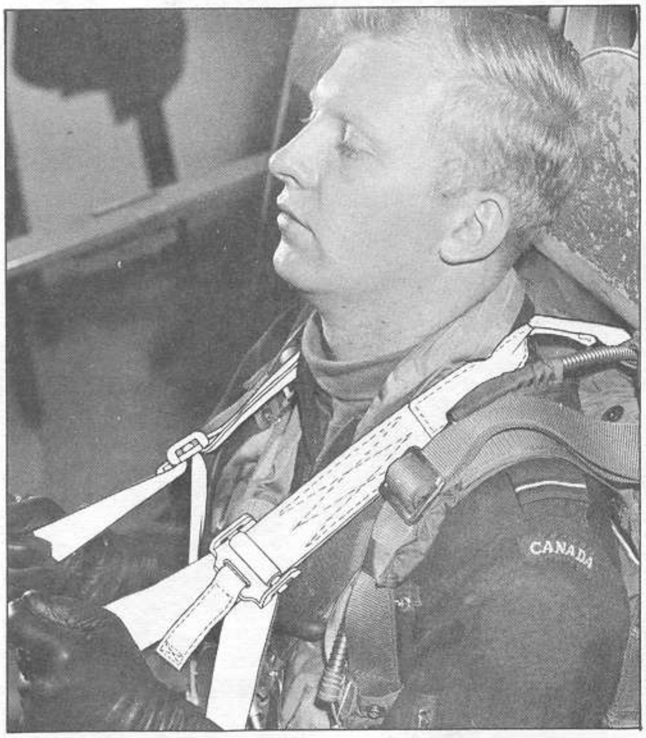


6 PARACHUTE ARMING CABLE KEY - ROUTE UNDER SHOULDER HARNESS STRAPS AND INSERT INTO KEY SLOT OF RIGHT LAP BELT.

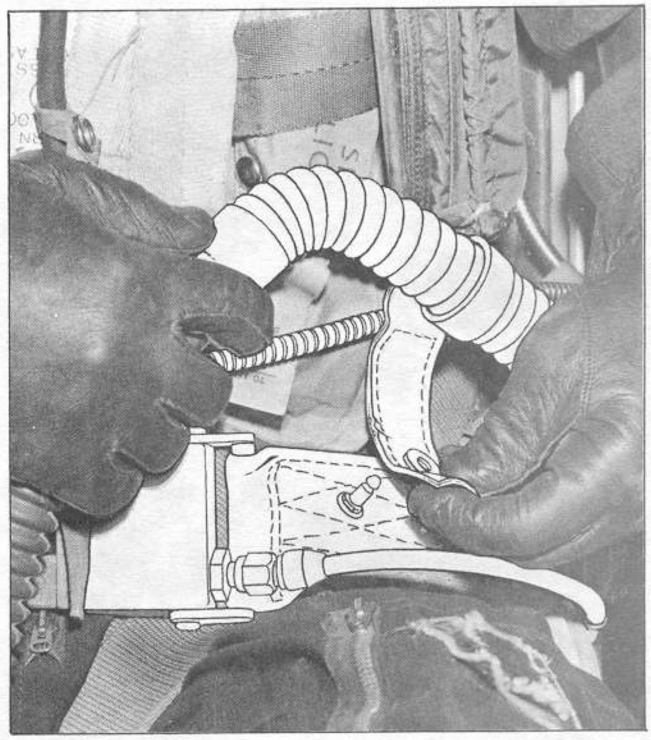
7 LAP BELT - FASTEN.

8 RIGHT AND LEFT BELTS - TIGHTEN.

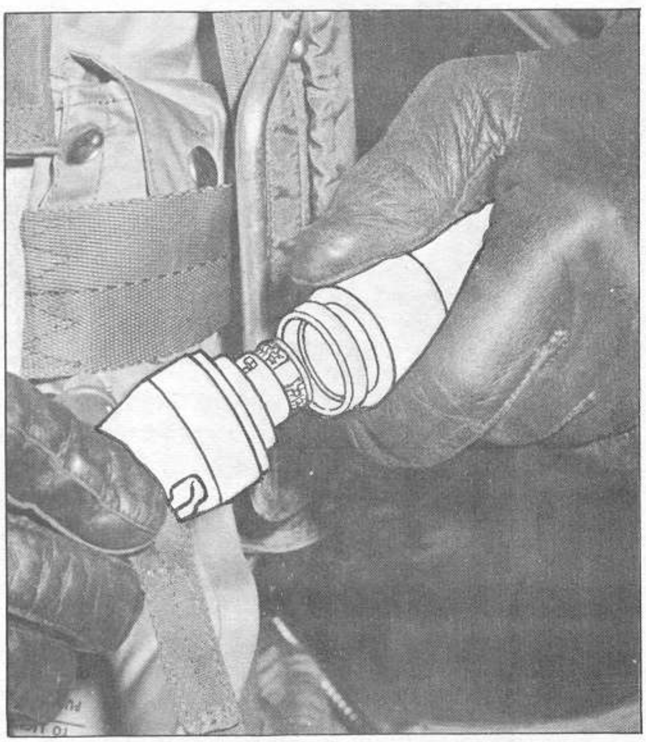
Figure 2-2 (Sheet 2 of 4) Strap-In Procedure



9 SHOULDER HARNESS – ADJUST UNTIL YOKE TOUCHES BACK OF NECK.



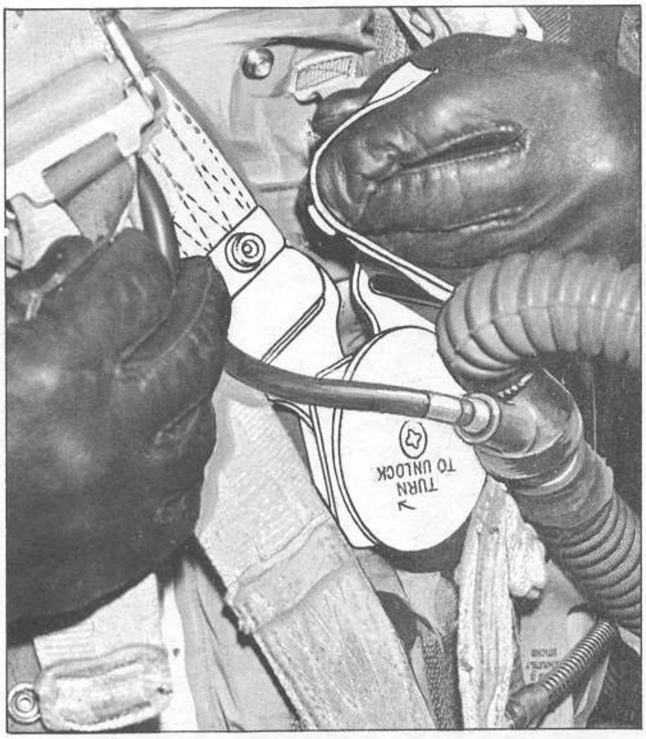
10 OXYGEN HOSE – ATTACH TO LAP BELT DOT FASTENER.



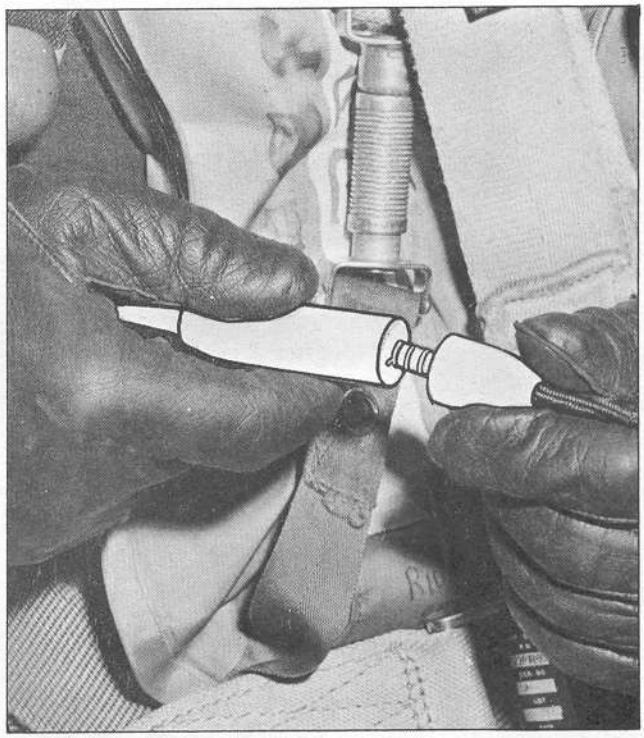
11 OXYGEN MASK HOSE – CONNECT TO SEAT OXYGEN HOSE.

12 BAIL–OUT BOTTLE OXYGEN HOSE–ROUTE UNDER RIGHT SHOULDER HARNESS STRAP AND CONNECT TO MC-3A CONNECTOR.

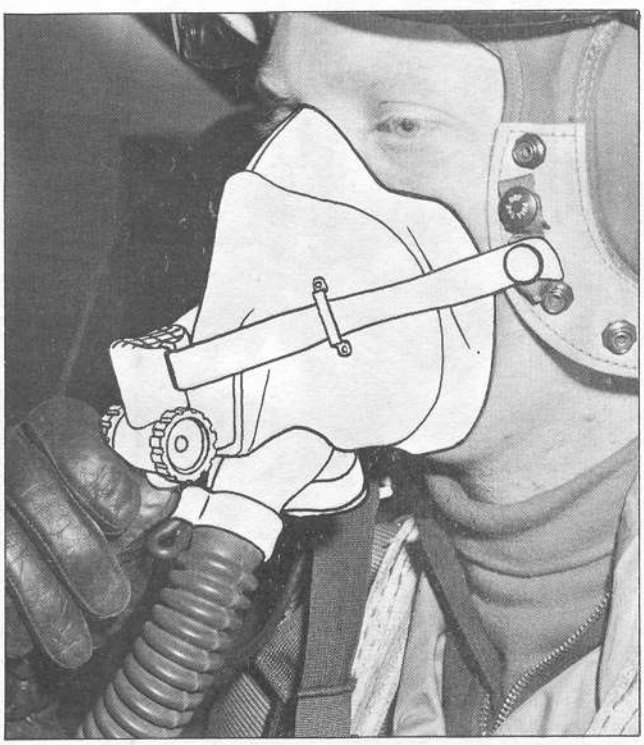
Figure 2-2 (Sheet 3 of 4) Strap-In Procedure



13 OXYGEN MASK RETAINING HOSE STRAP - CONNECT TO PARACHUTE HARNESS SNAP FASTENER.



14 MIKE CORD - CONNECT.



15 OXYGEN MASK - ADJUST TO FIT FACE.

16 HELMET CHIN STRAP - FASTEN.

Figure 2-2 (Sheet 4 of 4) Strap-In Procedure

MANAGEMENT OF FUEL SYSTEM

6 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-pressure warning.

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).

NOTE

In case of failure of either inverter, it will be necessary to switch the TACAN OFF to obtain a reliable indication of fuel quantity.

STARTING PROCEDURE

STARTING THE ENGINE

7 The engine is to be started by use of ground power. Battery starts are not permitted.

WARNING

Before starting the engine, ensure that the danger areas fore and aft of the aircraft are clear of personnel, aircraft, and vehicles (see Figure 2-3). Ensure that the area is clear of debris, etc. Whenever possible, start engine with aircraft headed into the wind, as exhaust-gas temperature may be increased by tailwind.

8 To start the engine, proceed as follows:

(a) Place engine master switch ON and ensure that fuel-low-pressure warning light goes out and that BATTERY START light on annunciator panel is out.

CAUTION

A BATTERY START legend at this time indicates that a battery start will be carried out if the start cycle is continued.

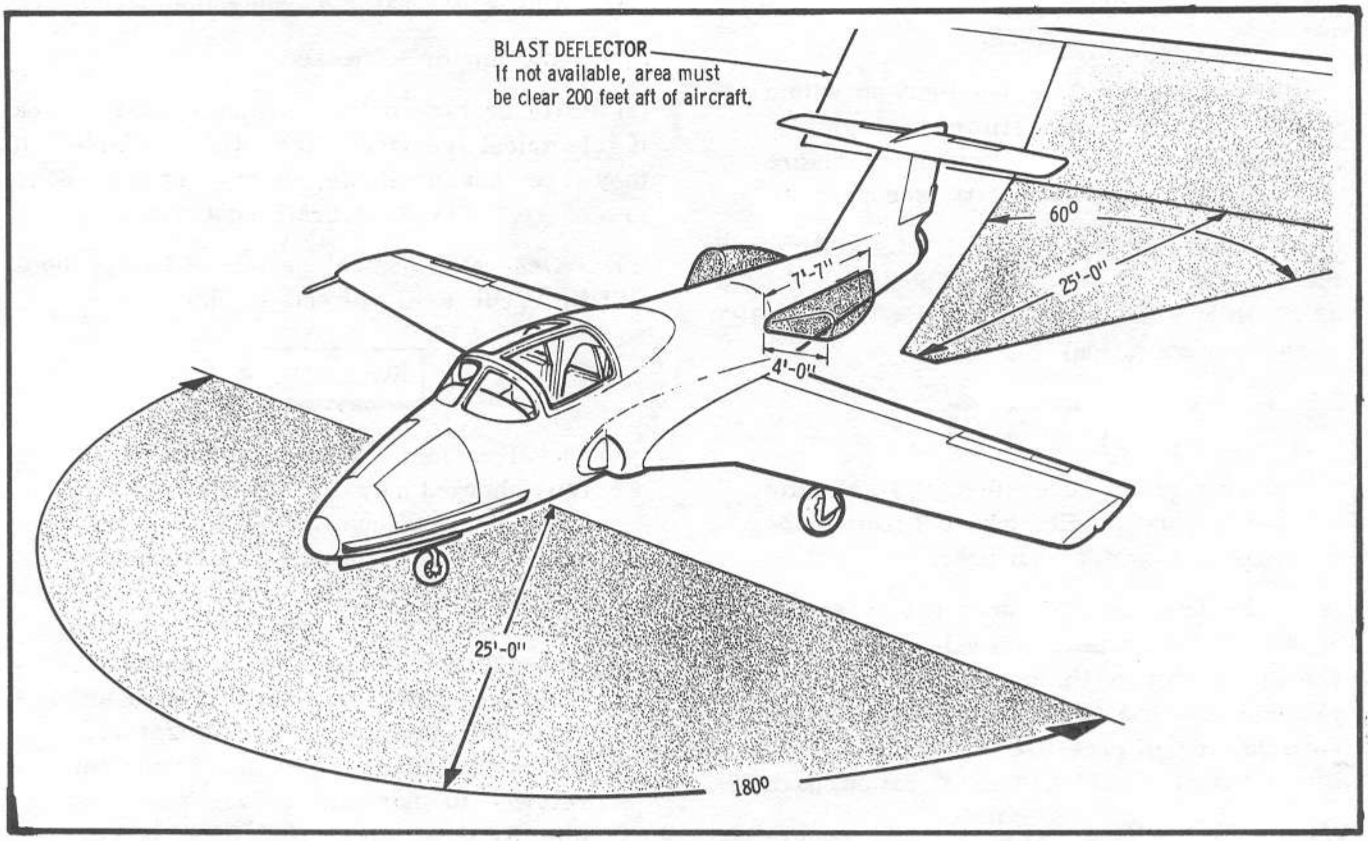


Figure 2-3 Danger Areas

NOTE

Whenever a battery start has been performed, shut down the aircraft and make an entry in form CF 337.

(b) Hold engine start switch to START for 3 seconds, then release.

CAUTION

To preclude damage to the starter-generator, press the starter stop switch immediately and investigate, if there is no audible indication of engine rotation or if the tachometer fails to register within 5 seconds.

(c) When RPM indication is noticeable, advance throttle lever to IDLE.

CAUTION

On starting, EGT may rise very rapidly. The start must be aborted if the EGT reaches 900°C.

NOTE

If the engine does not light up within 20 seconds, the Failure to Light Up procedure must be completed before attempting another start (see para 9).

(d) Allow the engine RPM to stabilize with the throttle lever at the IDLE position (46.5% to 49.5% RPM — winter operation; 50% to 51% RPM — summer operation).

CAUTION

During ground operation, if RPM falls below normal idle, take corrective action for engine run-down.

(e) Ensure that EGT does not exceed 675°C. Should the EGT exceed this value, ensure that the time/temperature limits in Figure 4-1 are not exceeded (for example, 705°C for 5 minutes). Ensure that the oil pressure indicator reads 5 to 20 PSI. (Refer to Cold Weather Operation, para 57).

(f) When RPM stabilizes at idle, ensure that hydraulic pressure stabilizes at 1,400 to 1,625 PSI.

NOTE

During engine starting, hydraulic services should not be operated until engine speed has stabilized at idle RPM.

(g) Ensure that BLEED VALVE CLOSED legend is extinguished.

NOTE

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.

(h) Ensure that EGT reading is normal and oil pressure is between 5 and 20 PSI. (Refer to Cold Weather Operation, para 57).

(j) Inverters - OFF.

(k) Place DC master switch from GRD PWR to BATT position, and press starter stop switch.

(m) Inverters - ON (No. 1; then No. 2).

(n) External power - Disconnected.

(p) Check generator warning light - Out.

(q) Loadmeter - Checked.

(r) Generator control switch - TRIP; check if electrical services are still available. If they are not available, carry out shut-down procedure. Place aircraft unserviceable.

(s) Generator control switch - RESET; check GENERATOR FAIL legend - OUT.

WARNING

Nickel-cadmium batteries that are not fully charged may cause temporary high loadmeter readings, which in turn may cause a decrease in idle RPM (rundown). The corrective action is to trip the generator, dump cabin pressure, and increase RPM to between 50% and 51%, reset generator and dump switch, and wait until the loadmeter returns to a normal reading. When the loadmeter returns to normal, reduce power to idle RPM. However, if RPM is still below the idle range, the aircraft is unserviceable and must be shut down. Should the increase in RPM fail to reduce a high loadmeter reading, the aircraft is to be shut down and placed unserviceable. Prior to take-off, the loadmeter must read approximately 0.4 and the RPM should stabilize at normal idle RPM with the throttle in the IDLE position.

NOTE

If the starter motor fails to disengage at approximately 36% RPM during the start cycle, the GENERATOR FAIL light on the annunciator panel does not illuminate. If this occurs, press the starter stop switch before the engine reaches idle RPM.

FAILURE TO LIGHT UP

9 Failure of the engine to light up is normally indicated by no EGT rise. If engine does not light up within 20 seconds, proceed as follows:

(a) Place throttle lever to CUT OFF immediately.

(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) For the second start attempt allow a one-minute cooling period, then ground-crank the engine for 25 seconds to ensure adequate purging.

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

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

GROUND CRANK

10 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) Hold engine start switch to START for 3 seconds.

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

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

HOT START

11 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 most often 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 the starting cycle 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 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 the EGT did not reach 900°C, a second start may be attempted, provided the cause of the near-hot start is determined and rectified.

HANG-UP ON START

12 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

13 Before taxiing, complete the following checks:

(a) Speed brakes - Select IN (on crewman's signal).

(b) Flaps - Check operation and select TAKE OFF (25°) (on groundcrew signal).

(c) Safety pins - Removed and stowed.

(d) Chocks - Removed.

(e) Intercom control panel, audio selectors - As required.

(f) UHF, IFF/SIF, TACAN - ON.

(g) Air-conditioning and cockpit temperature - Cockpit temperature AUTO, temperature rheostat adjusted below 12 o'clock position.

(h) Air-conditioning/dump switch - Winter operation: NORMAL; summer operation: DUMP.

(j) Emergency UHF - OFF (volume maximum, override normal).

(k) All circuit breakers - In.

(m) Utility light - Stowed.

(n) Alternate trim switches - Operation checked. Guarded - NORMAL.

(p) Normal trim - Checked and set for take-off.

(q) Hydraulic hand pump handle - Stowed.

(r) Stall-warning test switch - Depress.

(s) Canopy and windshield demist - OFF.

(t) Windshield de-ice - OFF.

(u) Landing and taxi lights - OFF.

(v) Pitot and stall-warning heat - Checked on loadmeter.

(w) Emergency landing-gear selection handle - In (red band not visible).

(x) Seat height - Adjusted.

(y) Landing-gear indication - DOWN and LOCKED.

(z) Landing-gear control lever light - Out.

(aa) UHF channel selector - As required.

(ab) LH flight instruments - Checked.

(ac) Clock - Checked.

(ad) Standby compass - Checked.

(ae) Accelerometer - Checked.

(af) Annunciator panel test - All lights serviceable.

(ag) Fuel quantity indicator - Checked; press to test.

(ah) Oxygen quantity - Checked.

(aj) LH oxygen regulator - Checked; then as required.

(ak) RH oxygen regulator - Checked; then as required.

(am) Cockpit altimeter - Checked.

(an) RH flight instruments - Checked.

(ap) Landing-gear-unsafe warning light - Out.

(aq) Landing-gear-up selection override switch - NORMAL.

(ar) Utility light - Stowed.

(as) TACAN selector switch - As required.

(at) TACAN - Checked.

(au) Taxi clearance: altimeter and clock - Set.

(av) Canopy - As required.

(aw) Taxi light - On.

(ax) Night flying: landing lights - Checked.

NOTE

No engine warm-up is required. If oil pressure is normal, the aircraft is ready for taxiing.

TAXIING

GENERAL

CAUTION

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

14 To begin taxiing, advance the power to 60% to 70% RPM while holding the brakes. Engage the nose-wheel steering and release the brakes. As the desired taxi speed is approached, reduce the power to idle and turn onto the taxi route. Nose-wheel steering is used primarily for directional control, and wheel brakes and power are used to control taxi speed. The nose-wheel steering should be used regularly when taxiing, otherwise the system will develop a shimmy at high speeds.

SEE INTERIM REVISION 1-74

NOTE

During summer operation, in order to reduce the risk of engine rundown, all ground-handling outside of dispersal areas should be done with a minimum power setting of 52%.

CAUTION

Taxiing with canopy open is permissible over smooth runways, provided the canopy opening does not exceed 5 inches above the windshield frame and the windspeed does not exceed 20 knots. When the aircraft is taxied over rough surfaces, the canopy should rest on the canopy sill.

15 When taxiing at night, the taxi light should be used to illuminate the path of the aircraft.

TAXI CHECK

16 Check flight instruments.

TAKE-OFF PROCEDURE

PRE-TAKE-OFF CHECK

17 Before take-off, complete the following checks:

H	Hydraulics	Pressure 1,400 to 1,625 PSI.
	Harness	Secured.
	Chin strap	Fastened.
	Safety pins (2)	Checked and stowed.
	Auto-chute	Connected.
	Quick-release box	Locked.
C	Canopy	Closed, light out.
T	Trim	Aileron neutral, visual check.
		Elevator green light on.
	Throttle tension	Adjusted.
F	Fuel	Sufficient for flight, check gauge.
	Flaps	TAKE OFF (25°).
S	Speed Brakes	IN.
	Switches	DC master switch - BATT.
		Pitot heat - ON.
		IFF/SIF - As required.
		Dump valve - NORMAL, (pressure checked).
O	Oxygen	NORMAL.
		Bail-out bottle - Connected.

LINE-UP

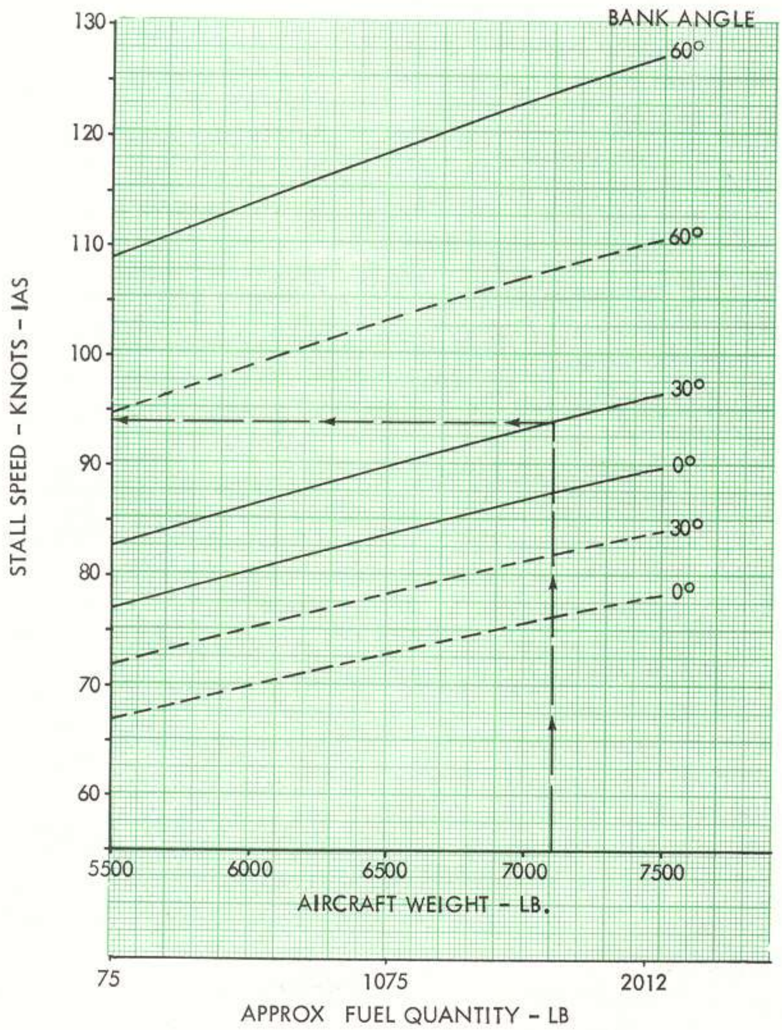
18 Nose-wheel steering should be used to line up the aircraft. However, it must be released before beginning the take-off roll.

ENGINE CHECK

19 When lined up on the runway, hold the aircraft with slightly more than light toe pressure on the brake pedals. Smoothly advance the throttle to MAX CONT while visually checking for aircraft movement. If movement is detected, increase the brake pressure sufficiently to stop the aircraft and check the following:

STALL SPEEDS (LEVEL FLIGHT)

MODEL: TUTOR



LEGEND

——— FLAPS 0° GEAR UP

------- FLAPS 40° GEAR DOWN

EXAMPLE

GROSS WEIGHT - 7100 LB
30° BANK, GEAR & FLAPS UP
STALL SPEED - 94 KNOTS IAS

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 2-4 Stall Speed Chart

(a) RPM - 100%(±1%), corrected for temperature.

(b) EGT - Maximum - 705°C. Minimum - 640°C at 15°C (59°F); 560°C at -40°C (-40°F).

(c) Oil pressure - Datum pressure (±10 PSI).

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 Cold Weather Operation, para 57.)

(d) Loadmeter - Not above 0.5.

(e) Annunciator panel - All legends extinguished.

TAKE-OFF

20 Two take-off techniques may be used, as follows:

(a) MAX CONT Power, Wheel Brakes On - Upon releasing brakes, care must be exercised to correct any tendency of the aircraft to swing due to a brake failing to release, or releasing too slowly. Maintain directional control during the initial stage of the take-off run by use of differential brakes until rudder control becomes effective at approximately 40 knots IAS.

(b) MAX CONT Power Applied During Take-Off Run - 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 knots IAS, directional control is transferred from brakes to the rudder.

21 As the airspeed approaches 70 knots IAS, 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 90 knots IAS. For maximum take-off performance, refer to Part 4.

POST-TAKE-OFF CHECK

22 When airborne, proceed as follows:

(a) Landing gear - UP; indicate - UP; warning lights - Out.

(b) Flaps - UP at 110 knots IAS; indicate - UP.

NOTE

For recommended climb speeds, refer to Part 4.

FLYING CHARACTERISTICS

TRIM CHANGES

23 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 properly adjusted on the ground. The elevator trim tab is very effective at high speed and should be used carefully.

24 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. It is pronounced at higher speeds.

25 The elevator and aileron normal trim switch on the control column is designed to return to 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, the trim switch should be returned to the neutral position after each actuation. Trim should be applied in a series of short movements rather than in one continuous movement.

26 Electrically operated trim tabs should be used 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

27 There are no restrictions imposed on the operation of speed brakes.

STALLS

28 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 10 per cent or less above stalling speed. This warning margin may decrease with altitude and G.

29 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.

30 Accelerated stalls in turns are accompanied by heavy buffeting. Recovery is immediate upon release of control column backward pressure. For normal stalling speeds, see Figure 2-4.

SPINS SEE INTERIM REVISION 2-73

31 Spin characteristics generally follow the normal pattern, and recovery is as follows:

(a) Close the throttle.

(b) Clean up the aircraft.

(c) Apply full rudder opposite to the direction of yaw as indicated by the turn needle.

(d) Move the control column progressively forward until the spin stops.

(e) Centralize the controls.

(f) Level the wings.

(g) Ease out of the dive.

NOTE

In cleaning up the aircraft, retract flaps, landing gear, and speed brakes, in that order. Maintain ailerons in the neutral position throughout recovery.
SEE INTERIM REVISION 2-74

DIVES

32 For altitude loss during dive recovery, see Figure 2-7.

COMPRESSOR STALLS

MECHANICS OF COMPRESSOR STALLS

33 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.

34 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 STALLS

35 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, 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 STALLS

36 An excessive pressure ratio across the compressor can be caused either 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 the 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.

(b) Restriction of air inlet - The following conditions may cause reduction or distortion of inlet air, which, in turn, will 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.

(c) Malfunction of 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 STALLS

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

PRESSURIZING, AIR-CONDITIONING AND DEMISTING SYSTEMS

GENERAL

38 Due to the interdependency of the air-conditioning, pressurizing and demisting systems, all three systems are treated as a single system.

OPERATION

39 Before starting the engine, the air-conditioning master switch should be in the NORMAL position (winter operation) or DUMP position (summer operation), the cockpit temperature control switch in AUTO and the cockpit temperature selector below the 12 o'clock position.

40 During flight, the cockpit altitude should be monitored above 8,000 feet to ensure that the pressure schedule as shown in Figure 1-11 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 windshield and canopy demist switch.

COCKPIT FOG REMOVAL

41 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 on the floor. There is no corrective action for this occurrence.

OPERATION OF WINDSHIELD DE-ICING SYSTEM

42 Use the windshield de-icing system only in actual icing conditions. Keep the engine RPM below 84%. Should this not clear the ice, RPM may be increased above 84% for a one-minute period.

CAUTION

In an emergency, or on final approach during heavy rain conditions when vision is obscured, 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 1 minute.

OXYGEN SYSTEM NORMAL OPERATION

GENERAL

43 Particular care must be taken to avoid wasting oxygen. See Figure 2-5 for the oxygen duration chart.

NOTE

With the right seat unoccupied, the unused oxygen hose must be connected to the blanking plug.

44 Before each flight, ensure that there is adequate oxygen for the proposed flight. The diluter-control lever should always be set at NORMAL, 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-diconnect coupling.

OXYGEN REGULATOR PANEL CHECK

45 To check the oxygen regulator panel, proceed as follows:

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

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	2.02	1.67	1.32	.96	.61	.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	.69	.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	.84	.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	.84	.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%.

Figure 2-5 Oxygen Duration Chart

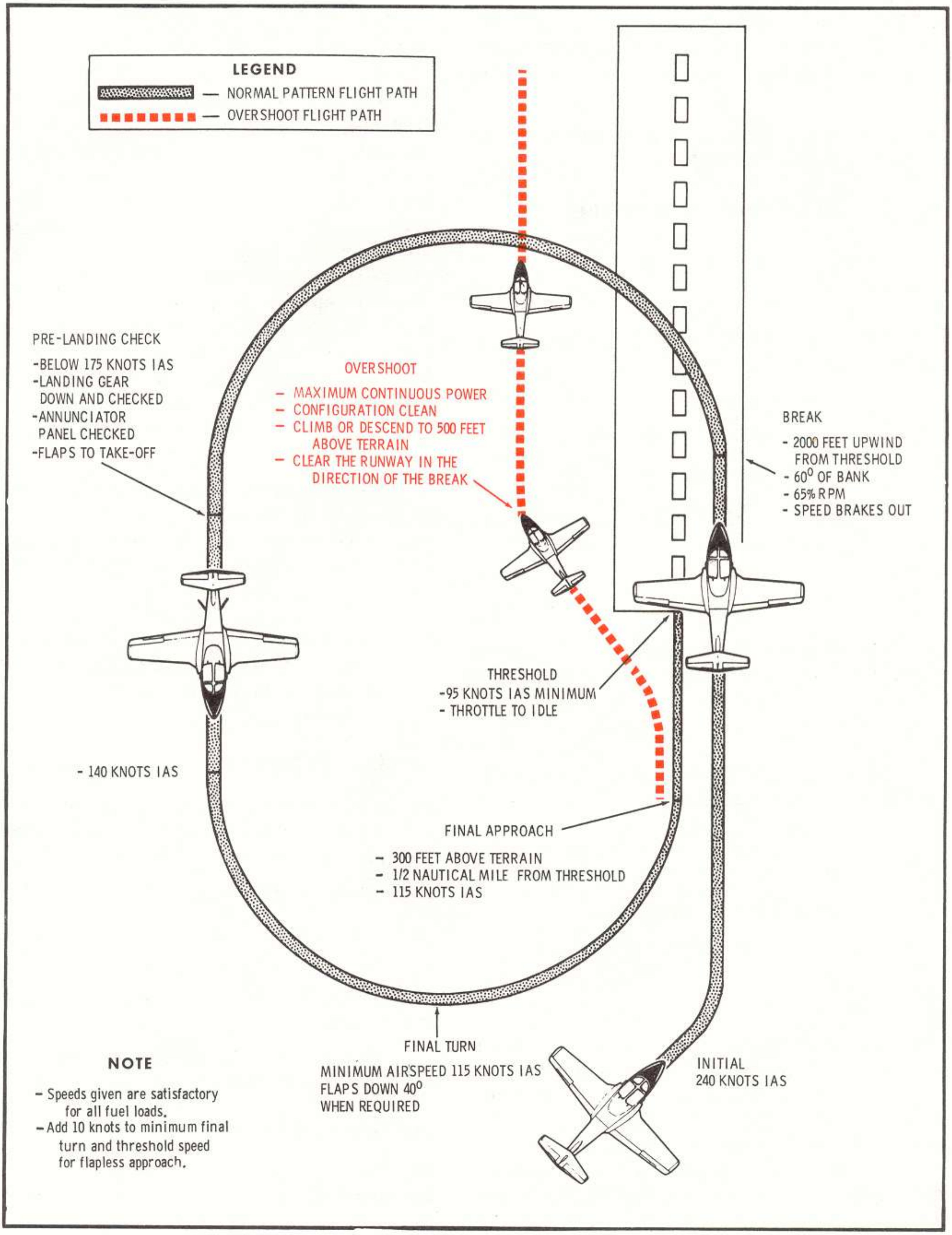


Figure 2-6 Normal Circuit

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

(c) Return emergency lever to NORMAL and diluter lever to NORMAL.

LANDING PROCEDURE

PRE-DESCENT AND CIRCUIT ENTRY CHECK

46 Prior to entering the traffic pattern, complete the following checks:

(a) Fuel quantity - Checked.

(b) Hydraulic pressure - Normal.

(c) Harness - Tight.

(d) Demisters - As required.

(e) Altimeter - Set.

PRE-LANDING CHECK

47 The normal circuit is illustrated in Figure 2-6. The Pre-Landing Check includes the following:

(a) Airspeed - Below 175 knots IAS.

(b) Landing gear - Lever down; check indicators, tone and warning lights.

(c) Annunciator panel - Checked.

(d) Flaps - TAKE OFF (25°).

(e) Airspeed - Below 140 knots IAS.

(f) Flaps - DOWN (40°).

APPROACH

48 With the landing gear down and speed brakes out, begin the final turn at approximately 140 knots IAS. Lower full flap as required.

49 Complete the final turn at a minimum of 300 feet above ground level and at a speed of 115 knots IAS. During the final approach, the airspeed may be reduced. Aim to cross the runway threshold at 95 knots IAS, reducing the power to idle during round-out.

TOUCH-DOWN

50 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 large 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, refer to Part 4.

51 The crosswind landing technique consists of the normal corrective procedure. The aircraft must be lined up with the runway with all drift eliminated prior to touch-down.

CAUTION

A 15-minute cooling period is required between maximum-braking landings. Brake fade is possible if this cooling requirement is not observed.

OVERSHOOT PROCEDURE

52 If the landing cannot be completed, the decision to overshoot must be made as early as possible. Actions to be taken are as follows:

(a) Power - MAX CONT.

(b) Speed brakes - IN.

(c) If touch-down has been made or is iminent, wait until safely airborne: then retract landing gear.

(d) Raise flaps fully at 110 knots IAS. Clear the area in the direction of the circuit.

FLAPLESS LANDING

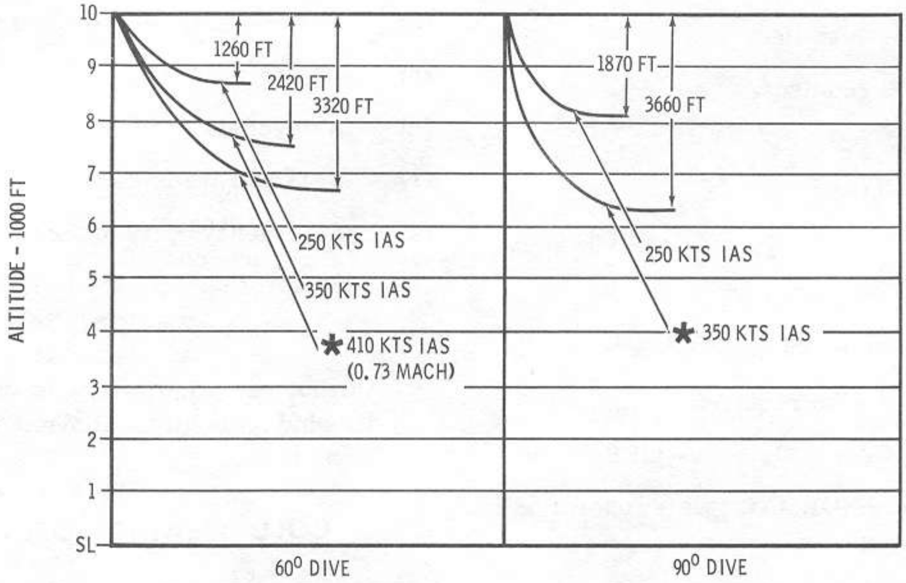
53 If it is necessary to land with flaps raised, the approach and touch-down speeds must be increased by 10 knots above normal. Allow for a flat approach, in a nose-high attitude, and a longer landing roll.

ALTITUDE LOSS IN DIVE RECOVERY FROM 10,000 FT

MODEL: TUTOR
ENGINE: J85-CAN-40

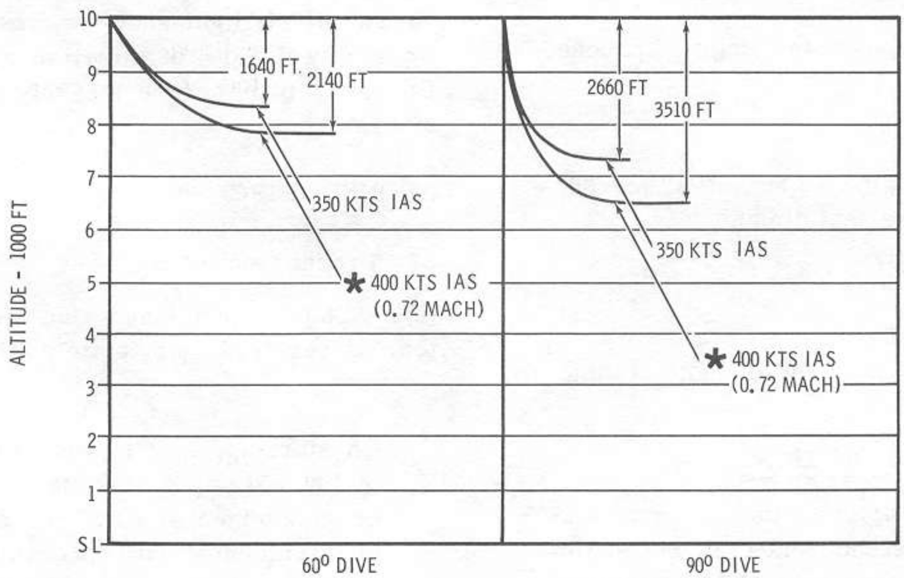
SPEED BRAKES EXTENDED

Data as of: Jan 1965
Based on: Flight Test Data



★ Highest initial speeds without exceeding the limiting mach number during recovery.

ALTITUDE LOSS IN DIVE RECOVERY FROM 10,000 FT
CONSTANT 4G PULL-OUT



★ Highest initial speed at which 5.5G can be attained.

ALTITUDE LOSS IN DIVE RECOVERY FROM 10,000 FT
CONSTANT 5.5G PULL-OUT

Figure 2-7 Altitude Loss During Dive Recovery

POST-LANDING CHECK

54 After landing proceed as follows:

(a) Safety pins - Installed.

(b) Oxygen - As required.

(c) Flaps - UP.

(d) Taxi light - OFF.

(e) Pitot heat - OFF.

(f) Demist and de-ice - OFF.

(g) Engine anti-icing switch - OFF.

(h) UHF channel - As required.

(j) IFF and TACAN equipment - OFF.

(k) Dump valve - NORMAL (winter operation); DUMP (summer operation).

(m) Trims set for take-off - Neutral.

END-OF-FLIGHT PROCEDURE

SHUT-DOWN CHECK

55 On shutting down the engine, proceed as follows:

(a) Parking brake - On.

(b) Run the engine at 50% RPM for 30 seconds (this includes taxi time).

(c) Throttle - CUT OFF.

(d) UHF - OFF.

(e) Engine master switch - OFF (below 10% RPM).

CAUTION

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

(f) Lights - OFF.

(g) No. 1 and No. 2 inverters - OFF.

(h) DC master switch - OFF.

(j) Ensure that ground safety pins are inserted in the right handgrip of each seat.

(k) Controls - Locked.

(m) Chocks - In place.

(n) Parking brake - Released.

(p) Lap belt - Disconnected.

(q) Auto-chute - Secured.

(r) Personal leads - Disconnected.

(s) Emergency oxygen hose - Disconnected.

(t) Survival seat pack - Unfastened.

CAUTION

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

COLD WEATHER OPERATION

BEFORE ENTERING COCKPIT

56 Check the entire aircraft for freedom from frost, snow and ice. Loss of lift and stalls may result if the aircraft is not adequately cleaned. Brush off all light snow or frost. Remove ice by a direct flow of air from a ground heater. Do not chip or scrape ice: this may damage the aircraft.

GROUND CHECK

57 Proceed as follows:

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

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.

(b) Check surface controls, speed brakes and trim tabs for proper operation.

WARNING

Wheel chocks must be firmly anchored for all engine run-ups.

TAXIING PROCEDURE

58 Proceed as follows:

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

(b) Increase taxiing distance between aircraft at sub-freezing 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 when ice conditions exist.

TAKE-OFF

59 Proceed as follows:

(a) Make 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 indicated RPM, although take-off thrust can be obtained at less than maximum engine speed. See Figure 2-8 for engine RPM versus compressor inlet temperature.

NOTE

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 5 minutes after take-off. If the oil pressure does not stabilize within ±10 PSI of the datum pressure, the aircraft is to be considered unserviceable and returned to base.

AFTER TAKE-OFF

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

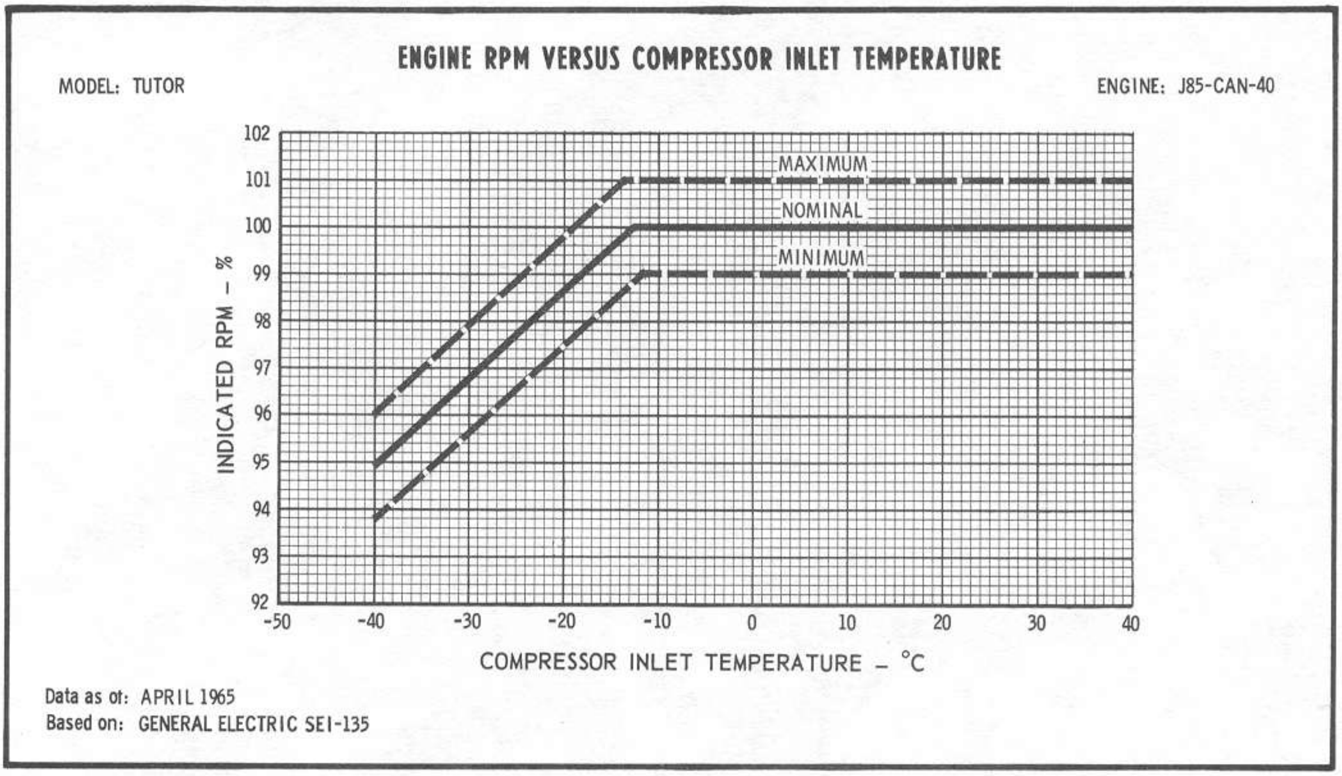


Figure 2-8 Engine RPM vs Compressor Inlet Temperature

CLIMB

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

OPERATION IN FLIGHT

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

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

DESCENT

64 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

65 Make normal patterns and landings, but allow for a flatter glide because of increased thrust.

LANDING

66 Landing speeds and technique are normal, with extra care to be exercised in the use of brakes on snow-covered or slippery runways.

STOPPING THE ENGINE

67 The engine is stopped in the normal manner.

BEFORE LEAVING COCKPIT

68 Proceed as follows:

(a) Release brakes after wheels are chocked.

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

PART 3

EMERGENCY HANDLING

SECTION 1

NON-CRITICAL EMERGENCIES

EMERGENCIES IN THIS SECTION ARE CONSIDERED TO BE OF A NON-CRITICAL NATURE. SUFFICIENT TIME IS AVAILABLE TO CONSULT THE CHECK LIST FOR REMEDIAL ACTION.

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 — prolonged, they may lead to more serious problems. These problems are recognized by failure of a hydraulic service or by a zero hydraulic gauge reading. 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.

HYDRAULIC PUMP FAILURE

2 If the engine-driven hydraulic pump fails (or the engine seizes), the hydraulic system may still be pressurized and all normal services operated by use of the hand pump.

LOSS OF HYDRAULIC FLUID

3 If a failure of the hydraulic system is due to loss of hydraulic fluid as a result of a leak or line breakage, the only hydraulic service that should be operated with the hand pump is the landing gear.

CAUTION

Except in case of engine seizure, in which the cause of hydraulic failure is evident, do not use the hand pump to pressurize the entire hydraulic system. Use the emergency landing-gear selector handle to isolate the landing gear system and insure an adequate supply of hydraulic fluid for landing gear extension.

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 to 175 knots IAS or below.

(b) Select landing-gear lever down.

(c) Pull out the emergency landing-gear selector handle.

(d) Operate the hand pump until the landing gear is down and locked.

WARNING

Failure to follow the above sequencing 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 hand pump. Disregard temporary variations and continue use of hand pump until visual confirmation of landing gear position is established or until the hand pump can no longer be moved.

LANDING GEAR MALFUNCTION

LANDING WITH NOSE GEAR RETRACTED

5 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) Land in the centre of the runway.

(c) Hold the nose off initially, but lower the nose gently to the runway before elevator control is lost.

(d) When the nose of the aircraft is on the runway, apply gentle braking.

LANDING WITH ONE MAIN GEAR RETRACTED

6 If the nose gear and one main gear only are locked down, but the other main gear cannot be lowered or cannot be locked down, a landing can be made on the extended gear as follows:

(a) Reduce the fuel remaining to 400 pounds.

(b) Land on the side of the runway that is away from the faulty gear.

(c) Hold the wing up with aileron as long as possible.

(d) Attempt to keep straight with brake and nose-wheel steering.

GEAR-UP LANDING

7 If only one gear can be extended or locked down, the gear should be retracted and a gear-up landing carried out. Proceed as follows:

(a) Fuel - Reduce to 400 pounds.

(b) Flaps - DOWN (flaps should be fully down prior to landing).

(c) Speed brakes - OUT.

(d) Canopy - Jettison at pilot's discretion (use alternate canopy jettison handle to the left of the centre console).

(e) Throttle - OFF (just prior to landing).

(f) Engine master switch - OFF.

(g) DC master switch - OFF.

(h) Fly the aircraft onto the runway. Do not stall before touch-down.

LANDING WITH A FLAT TIRE

8 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 wheel with flat tire by use of the aileron. Attempt to maintain directional control with wheel brakes and nose-wheel steering.

ELECTRICAL SYSTEM EMERGENCY OPERATION

GENERAL

9 In the event of any system malfunction, pull and reset appropriate circuit breaker and re-select service required.

AC INVERTER FAILURE

10 Loss of either inverter will de-energize the main UHF system. All other loads will be automatically transferred to the remaining inverter after a delay of approximately 10 seconds. The emergency UHF comes on automatically. Switch off the defective inverter.

CAUTION

In case of inverter failure, it will be necessary to switch the TACAN system OFF to obtain a reliable indication of fuel quantity.

NOTE

If either inverter fails, there may be up to a one-minute delay before all electrical services (except main UHF) are restored.

DC GENERATOR FAILURE

11 A generator failure will be indicated by the illumination of the GENERATOR FAIL light and the INVERTER 2 FAIL light on the annunciator panel, and the flashing MASTER CAUTION light. In this case select both inverters OFF, check the generator circuit breakers and select the generator RESET/TRIP switch to RESET. If the generator fails to come back on line, turn No. 1 inverter ON and use minimum electrical equipment for safe flight.

12 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 paras 13 and 14 will ensure sufficient battery power for a maximum period of 19 minutes (including 5 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.

13 For the first 14 minutes the available services are as follows:

(a) AN/ARC-504 emergency UHF system (transmit 50 per cent of the time - receive 50 per cent of the time).

(b) AN/APX-46 IFF/SIF - ON for 1 minute (not at same time as pitot heat), and switched to STDBY for the remainder of the 14 minutes.

(c) Pitot heat operating for 1 minute (not at same time as AN/APX-46 IFF/SIF).

(d) TACAN - OFF.

(e) Fuel boost-pump circuit breaker - Pulled below 20,000 feet.

(f) Anti-collision lights - OFF.

14 For the final 5 minutes the AN/APX-46 IFF/SIF, TACAN, windshield demist and pitot heat - On continuously.

COMPLETE ELECTRICAL FAILURE

15 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 flame-out could possibly occur. Avoid flight through extensive cloud, land as soon as possible, and shut down the engine as soon as practical.

NOTE

In the event of complete electrical failure, the landing-gear indicators will show the landing gear in transit, regardless of the position of the landing gear.

ABNORMAL LOADMETER READING

16 If the loadmeter indicates an abnormally low or high reading in flight, the following action should be taken:

(a) Zero loadmeter reading:

(1) Annunciator panel - Ensure GENERATOR FAIL light out.

(2) DC master switch - BATT.

(3) Generator control switch - RESET (if GENERATOR FAIL light is on).

(4) DC master switch - OFF, if loadmeter still reads zero.

(5) If electrical services continue to operate, the loadmeter is unserviceable.

(6) If electrical services fail and/or the generator failure light remains on, battery power only is available.

(7) Land as soon as practicable.

(b) High loadmeter reading:

(1) DC master switch - OFF.

CAUTION

If the loadmeter returns to normal, this indicates a faulty battery, and further use of the battery should be avoided. Leave DC master switch OFF. Land as soon as practicable.

(2) Generator control switch - TRIP (if loadmeter continues to read high with DC master switch OFF).

(3) Turn off all electrical switches except engine master switch.

(4) DC master switch - BATT.

(5) Generator control switch - RESET.

(6) Turn on only the essential electrical equipment required for flight while monitoring the loadmeter for higher than normal indications.

(7) Land as soon as practicable.

FUEL SYSTEM EMERGENCY OPERATION

DEFECTIVE FUEL TANK BOOSTER PUMP

17 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) Descend to 20,000 feet or below.

(c) Return to base at reduced power and land as soon as possible.

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.

ENGINE RUN-DOWN

18 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 unavailable. The corrective action is to increase the airspeed until the RPM returns to flight idle before advancing the throttle. For minimum airspeed at altitude refer to Figure 4-4.

ENGINE OIL SYSTEM MALFUNCTION

19 An engine oil-system malfunction may be indicated by a 10-PSI change in the oil pressure reading from a previously noted normal 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 illumination of the annunciator panel window marked HIGH OIL TEMP and flashing of the master caution light. In this circumstance, reduce power, land as soon as possible, and have the cause investigated.

20 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 eventually result because of high temperatures and changing loads on the bearings. In the event of either high or zero oil pressure readings, select reduced 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.

WARNING

Simultaneous loss of oil pressure and tachometer reading indicates a sheared oil pump and, subsequently, almost certain engine failure.

ZONE-2 COOLING SYSTEM

21 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 the 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.

WINDSHIELD CRACKS

22 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 8,000 feet.

(d) Airspeed - Reduce to below 280 knots IAS.

(e) Cockpit pressure - NORMAL after altitude has been adjusted.

(f) Land as soon as practicable.

SECTION 2

CRITICAL EMERGENCIES

EMERGENCIES IN THIS SECTION ARE CONSIDERED TO BE OF A CRITICAL NATURE. THESE PROCEDURES SHOULD BE PERFORMED IMMEDIATELY AND INSTINCTIVELY, WITHOUT REFERENCE TO WRITTEN CHECK LISTS, AND SHOULD BE COMMITTED TO MEMORY.

ENGINE FAILURE PROCEDURE

INDICATIONS OF FLAME-OUT

23 A flame-out is indicated by the following:

(a) Loss of thrust.

(b) Drop in RPM.

(c) Drop in EGT.

ENGINE FAILURE BEFORE LEAVING THE GROUND (ABORT)

24 In the event of engine failure before leaving the ground, proceed as follows:

(a) Place the throttle lever to CUT OFF immediately.

(b) Apply wheel brakes.

(c) Engine master switch - OFF.

(d) DC master switch - OFF.

(e) Open canopy.

(f) Abandon aircraft.

NOTE

If it is imperative that the stopping distance be shortened immediately, the landing gear may be retracted by depressing the landing-gear override switch while simultaneously raising the landing-gear control lever. DC master switch must be selected to BATT to retract the landing gear. The canopy should be jettisoned prior to retracting the landing gear on the ground.

ENGINE FAILURE AFTER TAKE-OFF

25 In the event of engine failure immediately after take-off, when there is insufficient runway remaining to land and abort, proceed as follows:

(a) Attempt relight.

(b) If relight is unsuccessful - eject or force land (pilot's decision).

ENGINE FAILURE IN FLIGHT

26 Engine flame-out in flight is usually caused by one of the following:

(a) Fuel starvation.

(b) Mechanical malfunction.

(c) Mishandling.

CONSIDERATIONS FOR ENGINE RELIGHT

27 An engine relight should be attempted when:

(a) The cause of engine flame-out is corrected.

(b) The cause is unknown but no apparent damage or fire exists.

WARNING

Do not attempt a relight if fire or fuel leakage are suspected.

ENGINE RELIGHT

Procedure 1

28 When a loss of RPM and EGT is evident, carry out the following as rapidly as possible:

(a) Throttle - Idle; Airstart ignition - ON (simultaneously).

(b) Throttle - Advance to desired RPM (when relight complete).

(c) Engine instruments - Checked.

(d) Generator control switch - Reset (if necessary).

(e) Land as soon as possible.

NOTE

If altitude permits, increase engine windmill by increasing airspeed until relight occurs. If, however, the altitude is critical, or no relight has been effected in 30 seconds, perform relight Procedure 2 immediately.

Procedure 2

29 If Procedure 1 is unsuccessful, perform an internal start. Note the effects of altitude on normal idle RPM, as outlined in para 30(c).

(a) Throttle - CUT OFF.

(b) Establish glide at 130 knots IAS and turn towards nearest airfield.

(c) Non-essential electrical equipment - OFF.

NOTE

Do not turn off the No. 1 inverter; otherwise, the emergency UHF will be inoperative.

(d) Ignition circuit breaker - In.

(e) DC master switch - BATT.

(f) Engine master switch - Select OFF, then ON.

(g) Low fuel-pressure warning light - Out.

(h) Starter switch - START for 3 seconds.

(j) Throttle - IDLE.

(k) Airstart ignition - On.

(m) Starter stop switch - Pressed (when RPM stabilizes at flight idle or if unable to start).

(n) Throttle - Advance to desired RPM.

(p) Engine Instruments - Check.

(q) Generator control switch - RESET if necessary.

(r) Land as soon as possible.

FACTORS AFFECTING ENGINE RELIGHT

30 The factors affecting engine relight are as follows:

(a) Airspeed - 180 knots IAS at 15,000 feet MSL normally produces minimum relight RPM (12%). This minimum (Procedure 1) relight airspeed increases with a decrease in altitude at a rate of 2.5 knots IAS per 1,000 feet.

NOTE

The airspeed of 180 knots IAS at 15,000 feet MSL is provided as an approximate planning figure. The important consideration is to adjust the aircraft attitude in order to attain a windmill RPM of 12%.

(b) Windmill RPM - The greater the RPM, up to a maximum of 34%, the quicker the relight. The engine will not normally relight below 12%, using Procedure 1.

CAUTION

If the engine has seized (zero RPM), an attempt to start using Procedure 2 will probably cause complete electrical failure or possibly fire. Procedure-2 start 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 start might be tried as a last resort in lieu of an ejection or a forced landing on an unprepared surface.

(c) Altitude - Relights have been successful at altitudes up to 30,000 feet. However, at altitudes above 20,000 feet the engine may not accelerate to normal idle RPM after relight.

In this case, normal idle RPM may be attained by increasing the airspeed. Approximately 200 knots IAS may be required in some cases to achieve engine acceleration to idle RPM.

(d) Indications 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 idle RPM, except in some cases at high altitude. Refer to subpara (c).

FAILURE TO RELIGHT

31 If all attempts at relighting are unsuccessful, a decision must be made to either eject or force-land. Should it be decided to abandon the aircraft, follow Ejection Procedures. If an airfield is within gliding distance and a forced landing is contemplated, follow the Forced Landing Procedures.

FORCED LANDING

32 If it is decided to carry out a forced landing, turn in the direction of the proposed landing area and glide at 130 knots IAS. See Figure 3-2-1 for gliding distances with dead engine. Proceed as follows:

(a) Throttle - CUT OFF.

(b) Landing gear - DOWN (as a general rule the landing gear should be selected down to reduce the landing shock).

(c) Flaps - As required (the wing flaps should be fully deflected prior to touch-down).

(d) Canopy - Jettison at pilot's discretion (use alternate canopy jettison handle located to the left of the centre console).

(e) Engine master switch - OFF.

(f) DC master switch - OFF.

EMERGENCY CANOPY REMOVAL ON GROUND

33 If the canopy cannot be raised by normal electrical or manual operation, there are two alternate procedures that can be used in an emergency:

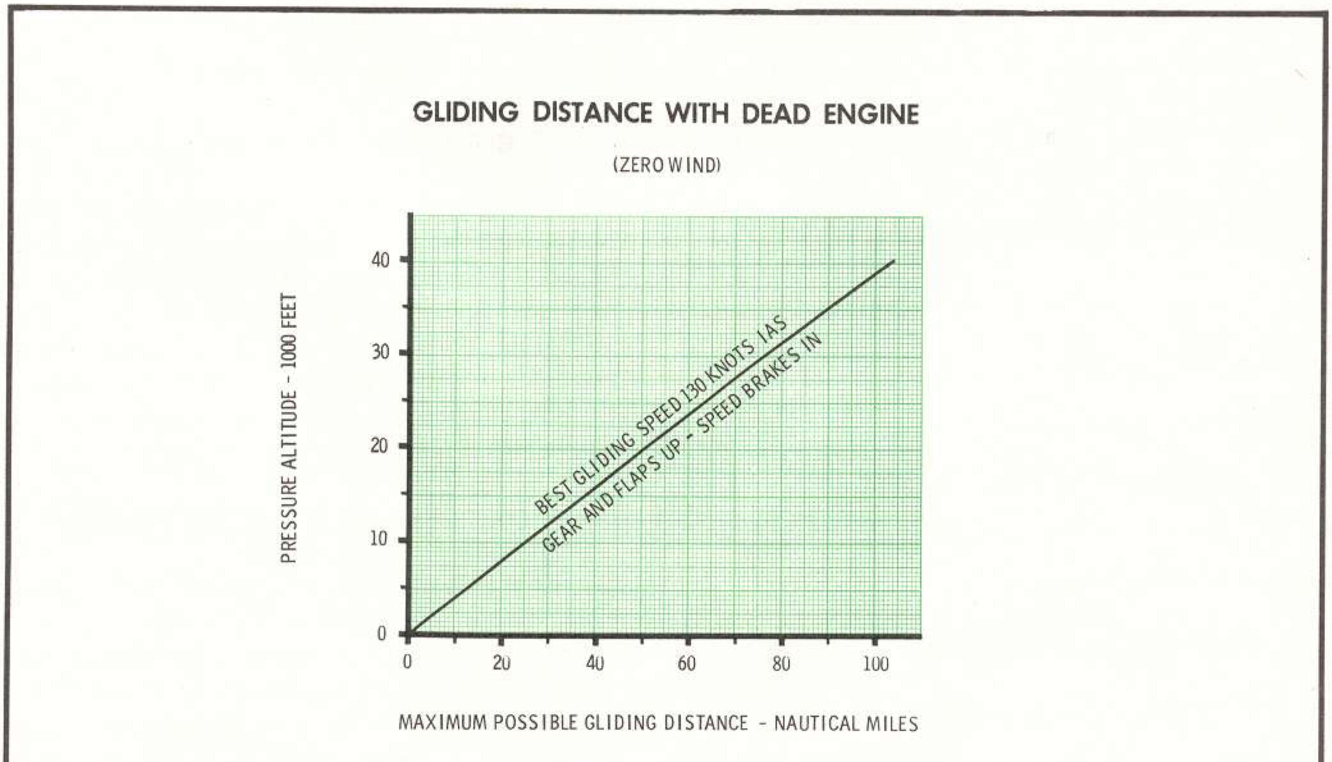


Figure 3-2-1 Gliding Distance with Dead Engine

(a) Cutting through the canopy, using the break-out knife located in the cockpit or any other cutting tool carried by rescue personnel.

NOTE

When cutting through the canopy, grasp the knife in your stronger hand — curved edge of the blade toward you — and cup other hand under the handle end to provide additional striking power. Strike the canopy a hard blow in each corner of a square area selected for removal. Continue to aim blows at the four corners or at large intact areas. Do not chop at the edge of a small hole.

(b) Jettisoning the canopy using the internal or external jettison controls (see Figures 1-12 and 1-13).

WARNING

If the canopy is jettisoned from a partially open position, complete separation from the aircraft may 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.

EMERGENCY GROUND EGRESS

34 Should it be necessary to abandon the aircraft while on the ground, the following procedure is recommended:

(a) Undo lap strap.

(b) Undo maritime lanyard.

(c) Undo seat pack.

(d) Abandon aircraft.

EMERGENCY OXYGEN SYSTEM

MAIN OXYGEN SYSTEM FAILURE

35 If the main oxygen system fails, utilize the emergency bail-out bottle and descend to a cockpit altitude of less than 10,000 feet immediately. Failure of the main oxygen system will be evident if there is no indication of flow, and no pressure is delivered to the mask when the emergency control lever is placed to TEST MASK.

SUSPECTED HYPOXIA

36 In case of suspected hypoxia, proceed as follows:

(a) Press to test.

(b) If there is no pressure in mask:

(1) Bail-out bottle - On.

(2) Descend immediately to 10,000 feet cockpit altitude.

(c) If there is pressure in mask:

(1) Emergency pressure switch - On.

(2) If no improvement - Pull bail-out bottle.

(3) Descend immediately to 10,000 feet cockpit altitude.

(4) Breathe normally.

(d) Land as soon as possible.

BIRD INGESTION IN FLIGHT

37 Bird ingestion is recognized by an audible stall with a rapid loss of power, which can usually be recovered, depending upon the size and quantity of birds encountered. If power is sufficient to sustain flight, maintain throttle setting and land as soon as possible. If power is not sufficient to sustain flight, carry out compressor stall clearing procedures.

COMPRESSOR STALL IN FLIGHT

38 Normally, a compressor stall is recognized by a thump or rumble which can be felt and heard. The stall is normally experienced during rapid throttle movements and is characterized by a loss of thrust, a simultaneous increase in EGT, and a reducing RPM to the 65 to 80% range. If compressor stall occurs, proceed as follows:

(a) Immediately retard the throttle to idle and press the airstart switch.

(b) Slowly (3 to 5 seconds) advance the throttle to 85% RPM.

(c) Operate the engine at 85% and land as soon as possible.

(d) If the stall persists, or the RPM is already at idle or below, move the throttle to CUT OFF and immediately carry out a Procedure -1 relight. Slowly accelerate to 85% RPM and land as soon as possible.

RUNAWAY TRIM

39 A trim isolate switch on either control-column grip removes electrical power from the elevator normal trim circuit and is used to arrest runaway elevator trim. A runaway aileron trim condition is stopped by use of the alternate trim switch on the left console.

NOTE

At airspeeds below 150 knots, the aircraft may be safely flown in any configuration with full trim in either direction.

40 If a runaway elevator or aileron trim condition is suspected, proceed as follows:

(a) Press the trim isolate switch and hold control column firmly.

(b) Reduce airspeed - 150 knots IAS.

(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.

ACTION IN EVENT OF FIRE

GENERAL

41 There is no fire extinguisher system on the aircraft. Fire or overheat indication is given by one fire warning light and two overheat warning lights on the annunciator panel. The fire (red) and lower overheat (amber) warning lights are connected to a continuous-element detection system covering both zones 1 and 2. The upper overheat (amber) warning light is connected to a second continuous element, which also covers both zones 1 and 2. A test switch adjacent to the annunciator panel is used to check the continuity of the detection system electrical circuits.

42 Illumination of the fire (red) and/or overheat (amber) warning lights may be caused by the following:

(a) Fire or overheat.

(b) Defective system.

(c) Structural failure of the engine or tail pipe, causing a hot gas leak and resultant overheat.

43 A fire or overheat condition will normally be indicated as follows:

(a) A fire is indicated by the illumination of one amber overheat warning light and flashing of the master caution light, followed almost immediately by the second amber overheat light, followed by the red fire warning light and master warning light.

(b) An overheat condition is indicated by the illumination of one amber warning light and flashing of the master caution light, followed after a short interval by the illumination of the second amber overheat warning light.

CAUTION

If any single overheat light comes on, suspect circuit or system malfunction, but carry out the procedures as listed.

FIRE OR OVERHEAT WARNING LIGHT ILLUMINATING

44 If a fire or overheat warning light illuminates during start, proceed as follows:

(a) Throttle - CUT OFF.

(b) Engine master switch - OFF.

(c) DC master switch - OFF.

(d) Abandon aircraft.

45 If a fire or overheat warning light illuminates during take-off run, follow the ground abort procedures as outlined in para 24.

46 If a fire or overheat warning light illuminates during flight, proceed as follows:

(a) Throttle - Retard to minimum practical power for flight.

(b) Check for fire - If only one circuit detection light has illuminated, press to test the other circuit, check for high or zero EGT, smoke, fluctuating RPM, explosions, and loss of control.

(c) If fire is confirmed and altitude permits, eject.

(d) If fire is not confirmed, land as soon as possible.

47 Do not become unduly alarmed over a warning light: don't abort 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 actual fire does exist. Consideration of the situation will enable the pilot to decide the best course of action. A fire in the engine compartment will produce more heat and cause damage more rapidly than 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.

SMOKE AND FUME ELIMINATION

48 Smoke entering the cockpit is usually caused by a malfunction of an electrical circuit or 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.

(b) Check for fire.

(c) Cockpit pressure - DUMP.

(d) Fresh-air vents - Open.

WARNING

If the smoke does not clear sufficiently to permit aircraft control, jettison the canopy, using the alternate canopy jettison handle.

(e) If an electrical fire is suspected, carry out the following:

(1) DC master switch - OFF.

(2) Generator control switch - TRIP.

(3) Electrical equipment - Off.

(4) DC master switch - BATT.

(5) Generator control switch - RESET.

(6) Turn on only essential electrical equipment required for flight. Land as soon as possible. Continue to monitor the loadmeter for higher than normal indications.

EJECTION

GENERAL

49 The rocket catapult seat provides for immediate escape from the aircraft. The ejection system provides the following minimum bail-out altitudes:

(a) Ground level (60 to 420 knots IAS) - zero feet.

(b) Radar final approach (600 fpm rate of descent) - 30 feet.

(c) Circuit or forced landing (3,100 fpm rate of descent) - 155 feet.

WARNING

These ejection altitudes are absolute minimum system limits. Pilot reaction time is not included and no safety factor is provided for equipment malfunction. Successful survival from an extremely low altitude ejection depends on

aircraft pitch attitude,
sink rate,
G forces, and
bank attitude.

If possible, or 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. If a rate of climb cannot be attained, level-flight ejection should be accomplished immediately to avoid ejection in a nose-down configuration with a sink rate.

In some low-altitude emergency situations the decision to force-land the aircraft may provide a better survival probability. The Tutor is stressed for forced landings. If 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.

WARNING

The Tutor aircraft may pitch down abruptly following canopy jettison. This further stresses the importance of placing the aircraft in a nose-up, climbing attitude prior to ejection.

NOTE

When the first occupant ejects, the rocket blast will not interfere with the ejection procedure of the remaining occupant.

PREPARATION FOR EJECTION

50 If time permits, carry out as much of the following as possible prior to all ejections:

(a) Transmit Mayday, give position report, and select IFF/SIF to EMERGENCY.

(b) Stow all loose equipment.

(c) Airspeed - 180 knots.

(d) Lower visor.

(e) Actuate bail-out bottle.

(f) If at low altitude, raise the nose of the aircraft above the horizon prior to ejection.

(g) Assume the proper position.

(h) Check lap belt and shoulder harness tight.

EFFECT OF BANK ON EJECTION

51 The effect of bank on ejection is illustrated in Figure 3-2-2.

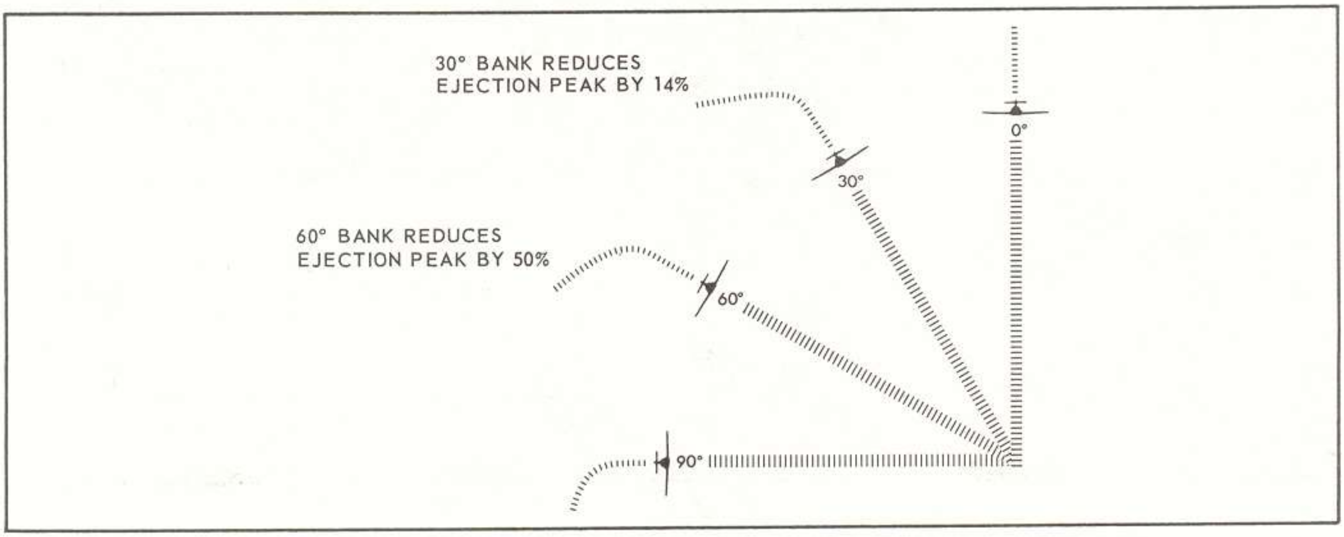


Figure 3-2-2 Effect of Bank on Ejection

Figure 3-2-3 Ejection Position

EJECTION PROCEDURE
(See Figure 3-2-3)

52 For all ejections, proceed as follows:

(a) Raise handgrips. This action locks the shoulder harness, jettisons the canopy and actuates the seat.

WARNING

Regardless of altitude, do not manually release the automatic seat belt 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.

NOTE

To jettison canopy only, use alternate jettison handle.

AFTER EJECTION

53 In the unlikely event that some component in the automatic equipment fails, manually release the lap belt, kick free of the seat, and pull the parachute D-ring. Regardless of automatic functioning, perform these actions during any low-altitude ejection, to ensure minimum loss of altitude prior to parachute opening.

54 If ejecting from high altitude, the parachute D-ring should not be pulled until the vicinity of 16,000(±500) feet is reached in free fall.

NOTE

Below 10,000 feet, if time permits, disconnect the bail-out bottle hose from the quick-disconnect and undo the oxygen hose snap fastener from the left shoulder parachute harness. To prevent injury and decrease the rate of descent on touch-down, the seat pack contents should be deployed at 1,000 to 2,000 feet above ground. After landing discard the parachute harness as quickly as possible.

PARACHUTE LANDING TECHNIQUES

55 When nearing the ground, assume the proper landing position. By this time drift should have been checked, oscillation dampened, and any necessary planning carried out. The following are the correct positions for various types of terrain:

(a) Open Terrain:

(1) Chin on chest.

(2) Back rounded.

(3) Hands on risers, elbows forward.

(4) Knees slightly bent.

(5) Turn feet off at a 45-degree angle.

(6) Present the balls of feet to the ground.

(7) Go into roll.

(8) Spill chute by running around it or by pulling in two or three of the lines which are closest to the ground.

(b) Bush: When landing in wooded areas, carry out the same procedure, with the exception that the face must be protected with arms, and knees should have a slight bend. Above all, keep feet together.

(c) Water — Do not attempt to judge height when approaching open water:

(1) Turn the quick-release box so that the red mark is in the up position.

(2) Place hands over the quick-release box, ready to depress it.

(3) Keep legs together and head erect.

(4) When feet come in contact with the water (and not before) press the quick-release box and clear leg straps. Carefully remove any shroud lines that may be wrapped around body. Do not struggle or move rapidly. Slowly pull dinghy close, using the lanyard. Enter dinghy from the small end. If dragged on entry

to the water, assume stable drag position — on back, arms and legs spread, chin in. When stabilized, squeeze quick-release box. Place one arm under shoulder harness, allowing parachute to be pulled off that shoulder, and roll out of harness.

PART 4

OPERATING DATA

ENGINE LIMITATIONS

ENGINE OPERATING LIMITATIONS

1 Engine operating limitations are shown in Figure 4-1. When using idle RPM at altitudes above 30,000 feet, the minimum airspeeds shown in Figure 4-4 must be observed.

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 1 minute by advancing the throttle slowly to full RPM (5 seconds from the selected minimum speed to full RPM).

STARTER AND IGNITION LIMITATIONS

3 Continued operation of the starter and ignition systems is limited to three consecutive stages:

45 seconds on - 1 minute off
followed by
30 seconds on - 1 minute off
followed by
50 seconds on - 25 minutes off

FLIGHT RESTRICTIONS

GENERAL

4 The following are general restrictions:

(a) For solo flight, the aircraft must be operated from the left seat, as the right seat station does not have complete operating controls.

(b) Instrument range markings are shown in Figure 4-2.

(c) The permissible flight time under zero- or negative-G conditions (including sustained inverted flight) must not exceed 15 seconds.

NOTE

- Application of zero or negative G should be kept to a minimum, because it is possible to vent approximately one pint of oil during each 15 seconds of flight under zero- or negative-G conditions.
- Oil to the lube pump 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. If the aircraft is inverted from a nose-down position of 8 degrees or more, the pendulum will remain against the bottom

CONDITIONS	RPM	MAX EGT (°C)	TIME LIMIT
Start		900	Abort
Ground Idle		735	2 minutes
Running		705 685 675	5 minutes 30 minutes Continuous
	101%		Continuous

NOTE: SEE INTERIM REVISION 1-73 REVISION 2

Figure 4-1 Engine Operating Limitations

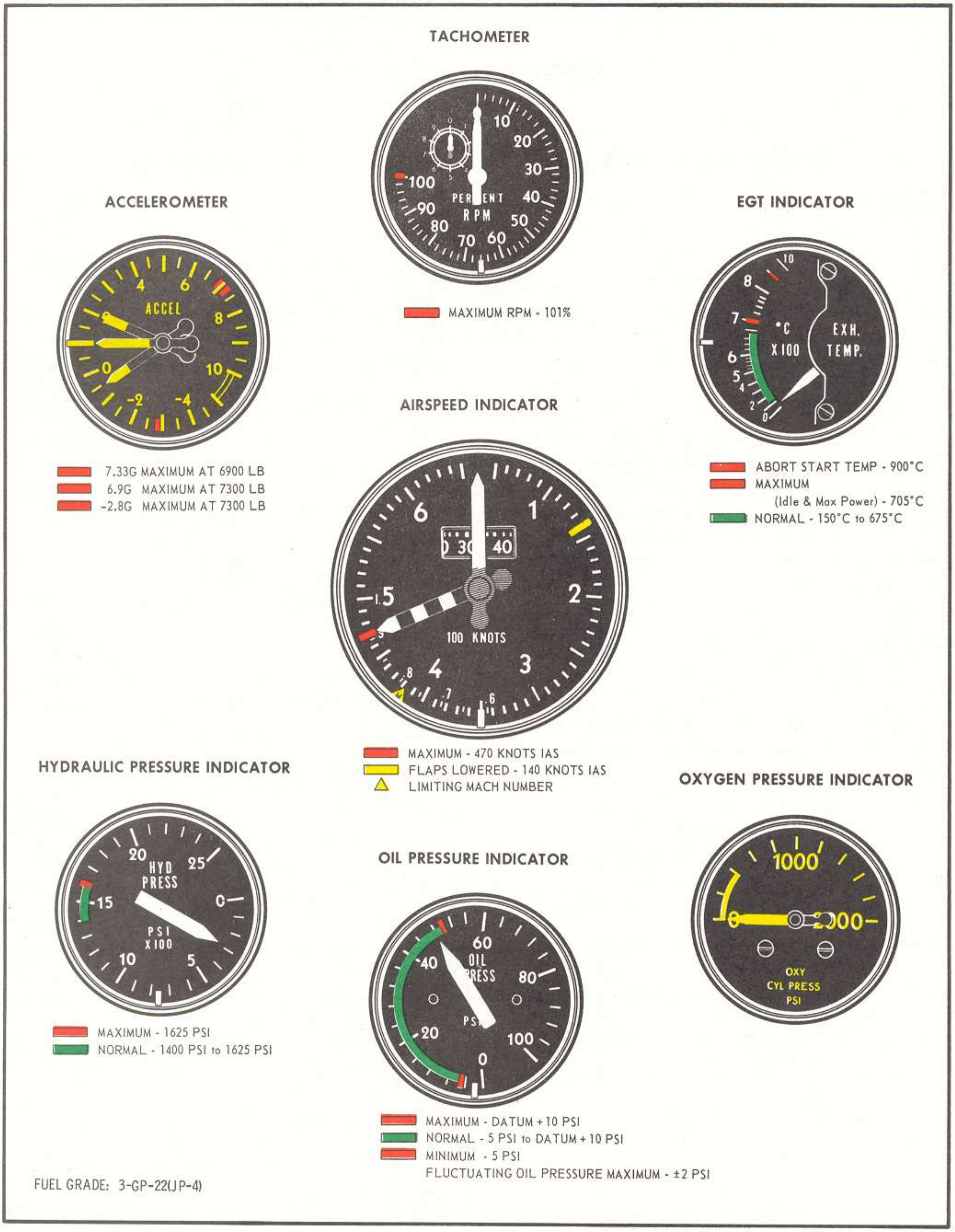


Figure 4-2 Instrument Range Markings

stop. Returning the aircraft to normal flight attitude will immerse the pendulum in the oil and restore engine oil pressure.

(d) The aircraft must not be flown under zero- or negative-G conditions following illumination of the fuel low-level warning light. Under zero- or negative-G conditions, the only fuel available is that remaining in the collector tank. Once this is consumed, the engine will flame out.

(e) The aircraft must not be flown in sustained inverted flight above 41,000 feet.

WARNING

Never actuate the canopy in normal flight.

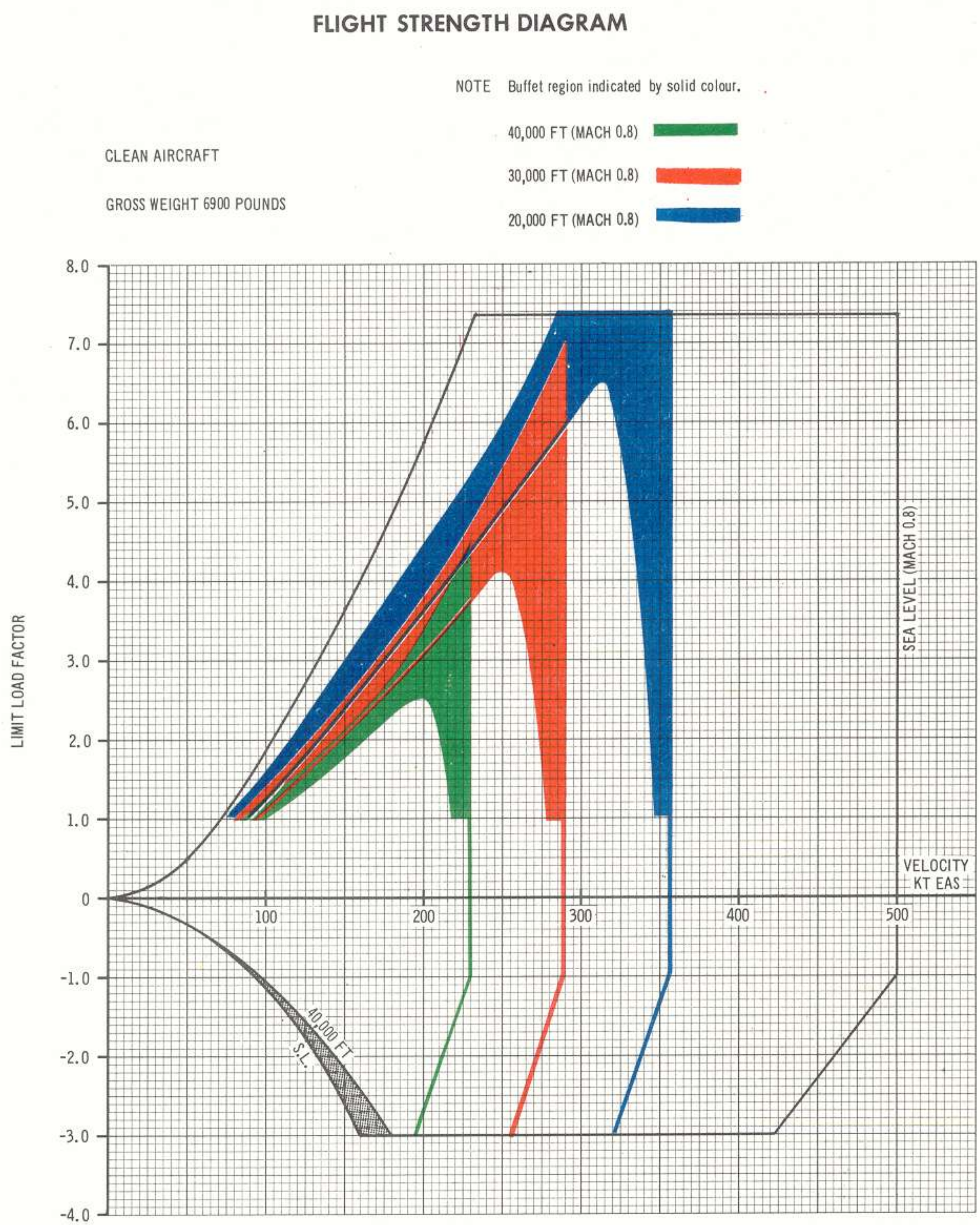


Figure 4-2A Flight Strength Diagram

PROHIBITED MANOEUVRES

5 Full rudder side slips in the take-off and landing configurations are prohibited, because the rudder may tend to remain in the deflected position. Positive control application and power are required to recover.

6 Inverted spins 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 7,000 feet above ground level, whichever occurs first, eject.

AIRSPEED AND ACCELERATION LIMITATIONS

FLAPS AND LANDING GEAR

7 The maximum permissible speeds with the gear and flaps extended are as follows:

(a) Landing gear - 175 knots IAS.

(b) Flaps 25° - 175 knots IAS.

(c) Flaps 40° - 140 knots IAS.

MAXIMUM AIRSPEEDS AND ACCELERATIONS

8 For Flight Strength diagram, see Figure 4-2A. Airspeed and acceleration limitations are shown in Figure 4-3.

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

CONFIGURATION	SYMMETRICAL		ROLLING PULL-OUT		SPEED LIMITS
	Max	Min	Max	Min	
Clean (below 6,900 pounds gross weight)	+7.33G	-3.00G -1.00G at M_L	+5.86G	-1.00G	Max speed at all altitudes 412 knots IAS or IMN (M_M) of 0.73, whichever occurs first. Max permissible IMN (M_L) above 20,000 feet = 0.78 (refer to AIRSPEED AND ACCELERATION LIMITATIONS)

Figure 4-3 Load Factor Limitations

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.

WEIGHT AND BALANCE LIMITATIONS

9 The maximum permissible gross take-off weight is 7,437 pounds. The maximum allowable landing gross weight is 7,000 pounds. For other specific weight and balance data, refer to EO 05-195A-8.

PERFORMANCE DATA

GENERAL

10 This section 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; namely, a favourable reduction in fuel consumption will be realized, with consequent gains in range and endurance. Thus, the optimum performance capabilities of the aircraft will be utilized.

CHART FORM

11 The information is presented in graphical form, thus 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

12 Unless otherwise stated on the chart, performance parameters are based on flight test data, and Standard Atmosphere (ICAO) is assumed. Where engine performance is concerned, the figures are related to the fuel grade specified in Part 1.

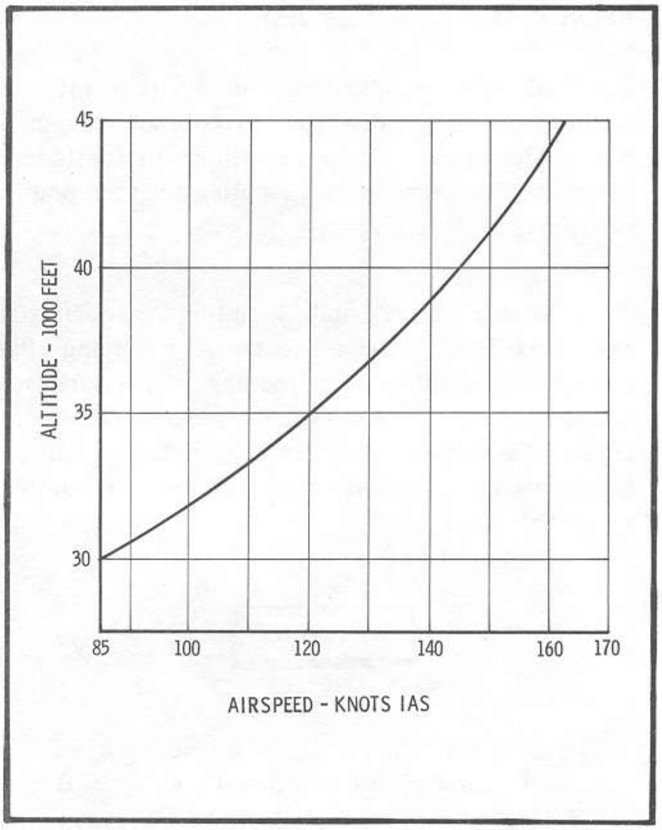


Figure 4-4 Minimum Permissible Airspeed Above 30,000 Feet with Throttle at IDLE

AIRSPEED POSITION ERROR CORRECTION (See Figure 4-5)

13 This chart, consisting of two sheets, shows the position error correction that must be applied to indicated airspeed to determine calibrated airspeed. Correction is provided for two configurations: flaps fully up, gear up or down (Sheet 1); flaps 40°, gear down (Sheet 2).

14 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.

15 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
(See Figure 4-6)

16 This chart shows the compressibility correction that must be applied to calibrated airspeed to determine equivalent airspeed. 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
(See Figure 4-7)

17 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. Correction is provided for two configurations: flaps fully up, gear up or down (Sheet 1); flaps 40°, gear down (Sheet 2).

18 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.

19 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
(See Figure 4-8)

20 The greater the angle off the runway, the lesser the influence of wind on the rolling distance. Despite large angles, however, an effective headwind or tailwind component exists (its effect may be negligible) at anything less than 90°, and this chart is used to determine this component when predicting the take-off and landing distances. The crosswind component can also be found.

21 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 AND LINE SPEED
(See Figure 4-9)

22 The take-off distance chart shows the ground roll distance (Sheet 1), and the total of roll and airborne distance to clear a 50-foot obstacle (Sheet 2). These distances are calculated from various combinations of weight, temperature, altitude, wind, and runway gradient, and establish the minimum requirements in field length for the given conditions. 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 maximum performance technique being employed, where the aircraft is lined up at the threshold with the brakes held on, while maximum continuous power is applied.

23 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.

24 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 baseline. 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 baseline. Proceed diagonally "uphill" or "downhill" to the slope percent line, drop vertically to the take-off ground-run distance line, and read off the solution. If the wind component and runway slope is zero, proceed vertically from the wind baseline to the take-off ground-run distance line for the solution.

25 To determine the indicated airspeed at a specified distance during the take-off run, follow the chart through to the "wind-kts" 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. To this speed now apply the surface wind. Add 80% of the headwind component (see Figure 4-8) or subtract 120% of the tailwind component. This value gives an indicated airspeed at any known distance during the take-off run.

CLIMB SCHEDULE
(See Figure 4-10)

26 The two sheets of this chart present time taken and fuel consumed during the climb to altitude at maximum continuous power. Sheet 1 contains a table of best climb CAS (and the respective TAS) for every successive 5,000 feet of altitude.

27 The climb begins when an airspeed of 250 knots is attained after take-off. The table shows that the CAS must be decreased by 3 knots for every 1,000 feet gained if the optimum rate of climb is to be achieved. The fuel values do not include the allowance for start, taxi, and take-off.

28 The curves in each chart are plots of initial climb weight and desired altitude. Enter the chart at the intersection of the two, project a horizontal, and note the solution. Additionally, values can be pre-determined when a climb between intermediate altitudes is planned. In this instance, project a horizontal from the weight curve at both the old and the new altitudes, then subtract the lower reading from the higher. The descent charts may be used in a similar manner, thus enabling the pilot to compute accurately beforehand many en route changes in altitude.

RANGE SUMMARY
(See Figure 4-11)

29 This chart provides a compact picture of the still-air zero-fuel range capabilities of the aircraft when cruising at constant altitudes between sea level and 35,000 feet. The relationship between time, distance, and fuel consumed can be read off directly, without separate reference to the climb and cruise (specific range) charts. These latter charts, nevertheless, must be consulted for the accurate CAS (which varies with reducing fuel weight), if the ranges shown on the range summary chart are to be achieved.

30 Fuel used is measured from start-up with full tanks at a gross weight of 7,437 pounds. The origin of the chart (sea level, zero distance, and zero time) corresponds to the point where an airspeed of 250 knots is attained following the take-off. At chart origin, then, fuel consumed is 175 pounds and gross weight is 7,262 pounds.

NOTE

Chart construction assumes the recommended long-range speed for a given altitude and constantly reducing weight in still-air conditions.

The 175-pound take-off allowance is an assumed maximum. In practice, 150 pounds is a more likely figure.

31 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.

32 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.

33 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.

34 The following examples demonstrate the use of the chart:

- EXAMPLE 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.

Interpolate between the 1:20 and 1:40 time curves: Flight time = 1 hr 23 min.

Interpolate between the 1,200 and 1,400 fuel-used curves: Fuel consumed =1,325 pounds.

- EXAMPLE 2 -

What is the maximum range at 25,000 feet, with 500 pounds of fuel remaining when over destination? What is the flight time?

Fuel consumed: 2,012 - 500 = 1,512 pounds. Plot the intersection of this curve with the 25,000-foot flight level.

Read off the distance: Range = 442 nm.

Interpolate between the 1:20 and 1:40 time curves: Flight time = 1 hr 34 min.

- EXAMPLE 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-mile line and the optimum cruise altitude curve.

Read off the pressure altitude: Cruise altitude = 21,500 feet.

Interpolate between the 600 and 800 fuel-used curves: Fuel consumed = 615 pounds.

- EXAMPLE 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. 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 (1,325 pounds) and the distance: Extra fuel consumed = 1,325 - 860 = 465 pounds; total air distance flown = 400 nm.

CRUISE SCHEDULE
(See Figure 4-12)

35 This chart, consisting of Sheets 1 to 8, presents a cruise schedule for flight at constant altitude, and covers each 5,000-foot increment from sea level to 35,000 feet inclusive. In all cases, the chart is constructed around the specific range curves for three representative gross

weights, and shows the relationship between weight, power setting, fuel flow, calibrated airspeed, true airspeed, and the air nautical miles flown per pound of fuel consumed (the specific range). Sheet 1 includes an inset showing specific range versus altitude and CAS at 6,500 pounds, for purposes of fuel economy comparison.

36 At the peak of each weight curve, there is an optimum CAS for maximum still-air range. On Sheet 1, for example, at 6,500 pounds this is 229 knots. A line is drawn through the peak of all three weight curves. This line determines the maximum-range CAS for all weights at the applicable altitude. However, in practice, the only time that the maximum-range CAS would be used is when the absolute maximum range is required in a tailwind.

37 Two further lines are drawn on the cruise charts: one, the recommended long-range CAS, gives 99% of maximum possible range, while the other, the headwind long-range CAS, gives 95% of the maximum possible range. The recommended long-range CAS can be considered to give the maximum range, for all practical purposes. The advantage of using this line, rather than the maximum-range CAS, is that the CAS is increased substantially, while the range is reduced by only 1%. Where maximum range is not required, a further increase in the CAS can be obtained by using the headwind long-range CAS. This gives a reduction of 5% in the maximum range. In addition, the headwind long-range CAS must be flown when maximum range is required where adverse headwinds are anticipated.

38 To use the chart, enter the appropriate altitude graph (see Sheet 6) at gross weight and intersect the long-range (or headwind) CAS line. From this plot, read off:

(a) The required CAS and related power setting.

(b) The fuel flow.

(c) The resultant air nautical miles/pounds of fuel.

(d) The true airspeed.

NOTE

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:

$$\text{air nm/lb} \times \frac{G/S}{TAS} = \text{ground nm/lb}$$

ENDURANCE AT CONSTANT ALTITUDE
(See Figure 4-13)

39 This chart is a plot of altitude versus fuel flow and rpm for an endurance speed of 125 knots CAS at three representative weights.

40 Enter the chart at pressure altitude. 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
(See Figure 4-14)

41 This chart presents the descent performance as altitude versus fuel used, time, and distance covered at two configurations and associated speeds.

42 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
(See Figure 4-15)

43 This chart 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.

44 The data are based on 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 knots or, in the case of commencing from lower altitudes, where 250 knots is equivalent to less than Mach 0.55, the let-down is continued at this indicated airspeed.

45 Enter the chart and read off the solution in the same manner as that employed with the normal descent chart. An average groundspeed for the descent can be found by applying time and distance covered to the Appleyard scale of the E6B computer.

LANDING DISTANCE
(See Figure 4-16)

46 The landing distance chart 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.

47 The separate speed graph in Figure 4-16 shows the maximum IAS at 50 feet and at touchdown, 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 (see para 24).

SAMPLE PROBLEM

BRIEFING

48 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

49 The following flight plan demonstrates the use of the charts. If the range summary chart is consulted, it should be borne in mind that altitude can be accurately plotted on this chart, whereas the cruise chart will reflect the results of the nearest 5,000-foot increment. Also, a final comparison of results will depend entirely upon the number of stages chosen by the user when applying the cruise chart to the distance involved; they should not, however, differ extensively.

- EXAMPLE -

Airfield A:

Altitude	800 feet ASL
Runway Length	2,000 feet
Slope	1-1/2% uphill
50-ft Obstruction	700 feet off runway end
Surface Wind	35° off, 12 knots
Take-Off	Downwind
Tailwind Component	10 knots
Crosswind Component	7.5 knots
Surface Temperature	14°C
Fuel	2,012 pounds
Take-Off Gross Weight	7,437 pounds

Take-Off - Enter the Take-Off Ground Run and Take-Off Obstacle charts at surface temperature. Read off: Ground Run = 1,800 feet, Distance to Clear Obstacle = 2,550 feet.

These are both within the available field lengths. Lift-off speed is 91 knots IAS, and maximum speed for climb-out is 97 knots IAS.

Climb - At 250 knots CAS after take-off, 175 pounds of fuel will have been used, and initial climb weight will then be 7,262 pounds. For this weight and planned altitude of 28,000 feet, the climb chart will show: time = 10.6 min, average TAS = 255 knots, fuel consumed = 308 lbs.

The distance covered in still air will, therefore, be 45 nm.

Cruise - At the top of the climb, a total of 483 pounds of fuel will have been used. Initial cruise weight will be 6,954 pounds; distance to go will be 436 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 4-14) must be backtracked to establish the let-down point. They are: time = 8.8 min, distance = 44 nm, fuel used = 55 lbs.

Cruise distance at altitude becomes, thereby, 435 - 44 = 391 nm.

The long-range cruise CAS must now be determined. With reducing weight the value changes and, therefore, two constant speeds are to be chosen for the first and second halves of the flight, based respectively upon the initial weight at the start of each stage. The initial weight for the first stage is known; the initial weight for the second stage (at half cruise distance = 195 nm) must now be determined, and will be top-of-climb weight minus weight of fuel used at half-way point.

Enter the 30,000-foot chart and plot 6,954 pounds on the recommended long-range CAS l ne. Read off: CAS = 188 knots, TAS = 302 knots, air nm/lb = 0.415, fuel flow = 730 lbs/hr, power setting = 89%.

Weight of fuel used:

$$\frac{\text{Cruise Distance}}{\text{TAS}} \times \text{Fuel Flow} =$$

$$\frac{195}{302} \times 730 = 471 \text{ lbs}$$

Gross weight at half-way point:
6,954 - 471 = 6,483 lbs.

The values at the let-down point must now be determined.

Plot 6,483 pounds gross weight on recommended long-range CAS line. Read off: CAS = 185 knots, TAS = 296 knots, air nm/lb = 0.429, fuel flow = 690 lbs/hr, power setting = 88%.

Weight of fuel used in second stage:

$$\frac{\text{Cruise Distance}}{\text{TAS}} \times \text{Fuel Flow} =$$

$$\frac{196}{296} \times 690 = 457 \text{ lbs}$$

At the let-down point, the values are therefore:

Gross weight = 6,483 - 457 = 6,026 lbs.

Fuel Used = 483 + 471 + 457 = 1,411 lbs.

Flight Time =

$$10.6 + \left(\frac{195}{302} \times 60\right) + \left(\frac{196}{296} \times 60\right) = 1 \text{ hr } 29 \text{ min}$$

Compare these values with those of the Range Summary Chart (see Figure 4-11) by plotting on this chart 436 nm (the let-down point) on the 28,000-foot level.

The values are approximately: fuel used = 1,435 lbs, flight time = 1 hr 31 min.

Endurance - In anticipation of holding instructions, the endurance at the let-down point will be: fuel remaining =

601 lbs, Subtract the total of 55 pounds for descent plus the minimum reserve for landing, which is 300 pounds.

$$601 - (55 + 300) = 246 \text{ lbs}$$

The aircraft can hold until this balance of fuel-to-spare has been consumed.

In the Endurance Chart (see Figure 4-13) the fuel flow for 6,000 pounds gross weight at 28,000 feet is seen to be 505 lb/hr. Holding time at 125 knots is therefore:

$$\frac{\text{Fuel-to-Spare}}{\text{Fuel Flow}} \times 60 = \frac{246}{505} \times 60 = 30 \text{ min}$$

Landing - Including the descent, but excluding the holding time, the values on the landing approach to airfield B are: flight time = 1 hr 38 min, fuel used = 1,466 lbs, gross weight = 5,971 lbs. If the aircraft held at 28,000 feet to maximum endurance, they would be: flight time = 2 hrs 08 min, fuel used = 1,712 lbs, gross weight = 5,725 lbs.

Airfield B:

Altitude	1,500 feet ASL
Runway Length	1,500 feet
Slope	1% downhill
50-ft Obstruction	400 feet back from threshold
Surface Wind	30° off, 14 knots
Landing	Into wind
Headwind Component	12 knots
Crosswind Component	7 knots
Surface Temperature	11°C
Landing Gross Weight	5,971 pounds

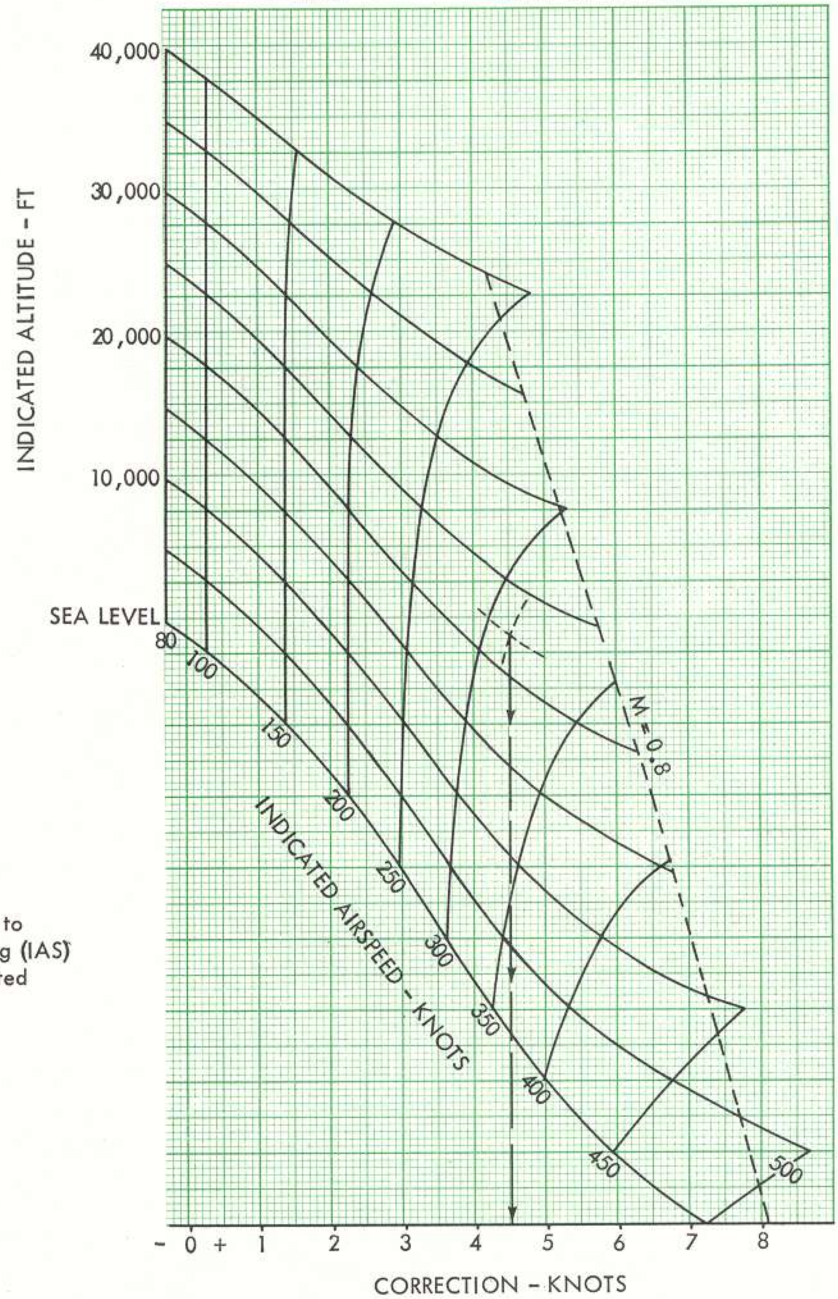
Enter the Landing Distance Chart (see Figure 4-16) at surface temperature. Read off: Ground Run = 1,000 feet, Distance After Clearing Obstacle = 1,700 feet.

These are both within the available field lengths. Maximum speed at 50-foot obstacle is 83 knots, maximum touch-down speed is 76 knots.

AIRSPEED POSITION ERROR CORRECTION

FLAPS: 0° GEAR: UP OR DOWN

MODEL: TUTOR



NOTE

Apply correction to instrument reading (IAS) to obtain calibrated airspeed (CAS).

EXAMPLE

INDICATED ALTITUDE	22,000 FEET
INDICATED AIRSPEED	310 KNOTS
POSITION ERROR CORRECTION	+ 5 KNOTS
CALIBRATED AIRSPEED	315 KNOTS

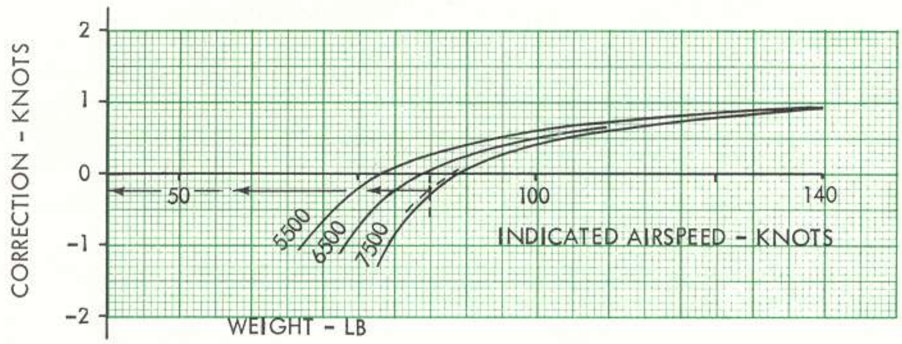
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-5 (Sheet 1 of 2) Airspeed Position Error Correction Chart

AIRSPEED POSITION ERROR CORRECTION

FLAPS: 40° GEAR: DOWN

MODEL: TUTOR



EXAMPLE

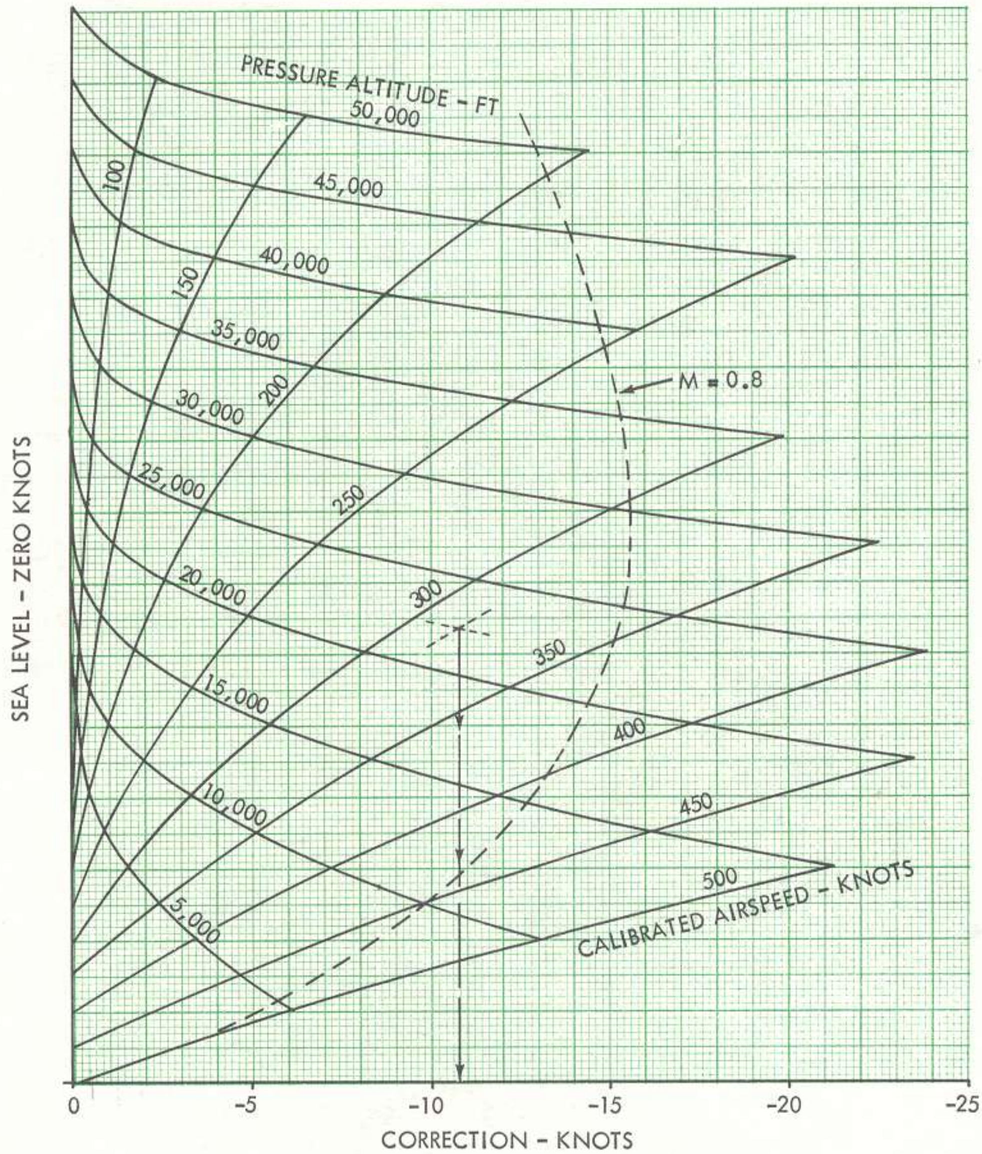
INDICATED AIRSPEED	85 KNOTS
GROSS WEIGHT	7437 LB
POSITION ERROR CORRECTION	ZERO
CALIBRATED AIRSPEED	85 KNOTS

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-5 (Sheet 2 of 2) Airspeed Position Error Correction Chart

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

MODEL: TUTOR



NOTE

Subtract correction from calibrated airspeed (CAS) to obtain equivalent airspeed (EAS).

EXAMPLE

PRESSURE ALTITUDE	22,275 FEET
CALIBRATED AIRSPEED	315 KNOTS
CORRECTION FOR COMPRESSIBILITY	-11 KNOTS
EQUIVALENT AIRSPEED	304 KNOTS

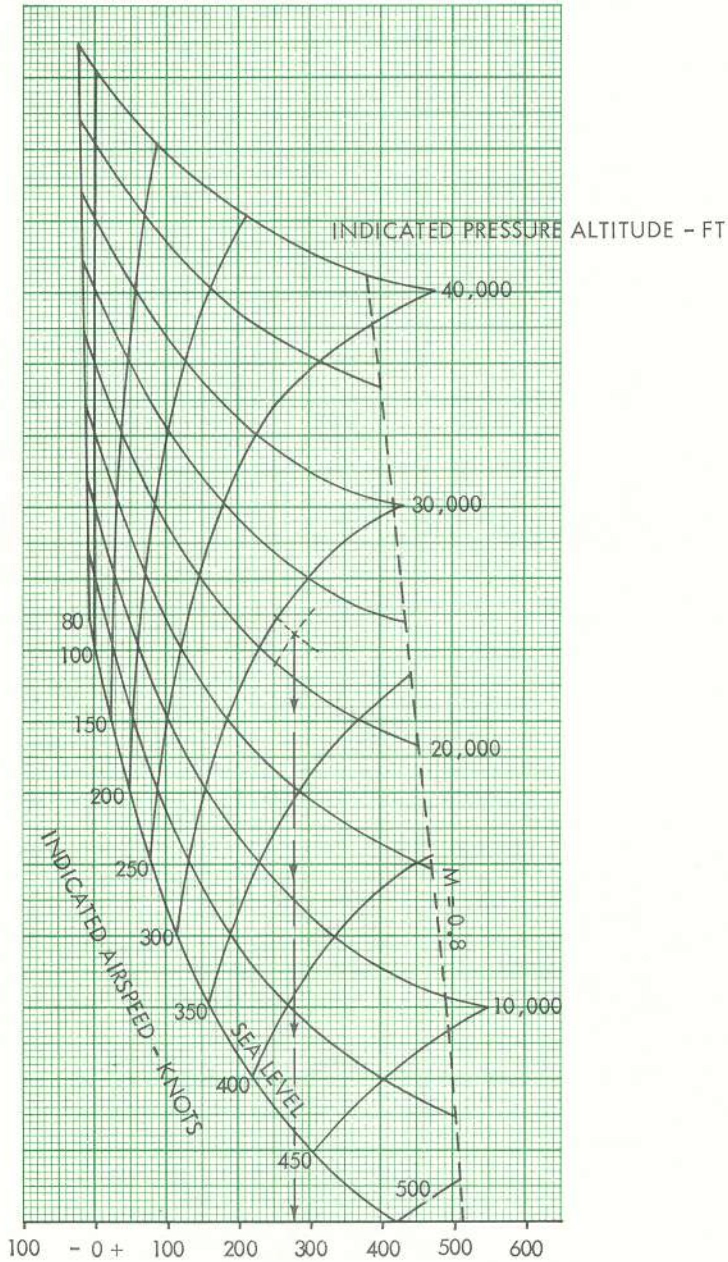
DATA AS OF: JAN 1966
BASED ON: ESTIMATED

Figure 4-6 Airspeed Compressibility Correction Chart

ALTIMETER POSITION ERROR CORRECTION

FLAPS: 0° GEAR: UP OR DOWN

MODEL: TUTOR



NOTE

Apply correction to indicated pressure altitude to determine actual pressure altitude.

EXAMPLE

INDICATED PRESSURE ALTITUDE	22,000 FEET
INDICATED AIRSPEED	310 KNOTS
POSITION ERROR CORRECTION	+275 FEET
ACTUAL PRESSURE ALTITUDE	22,275 FEET

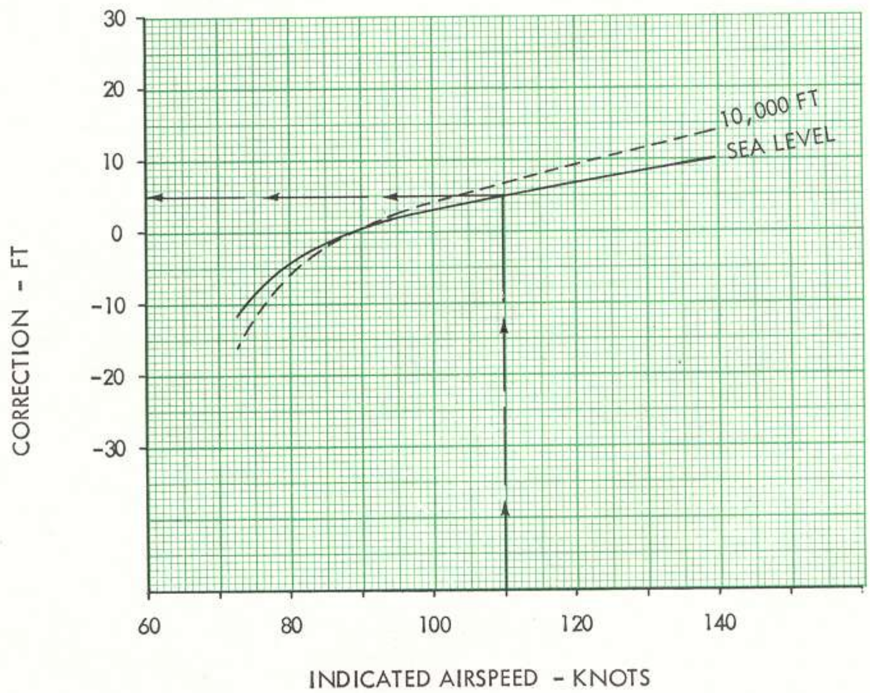
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-7 (Sheet 1 of 2) Altimeter Position Error Correction Chart

ALTIMETER POSITION ERROR CORRECTION

FLAPS: 40° GEAR: DOWN

MODEL: TUTOR



NOTE

Apply correction to indicated pressure altitude to determine actual pressure altitude.

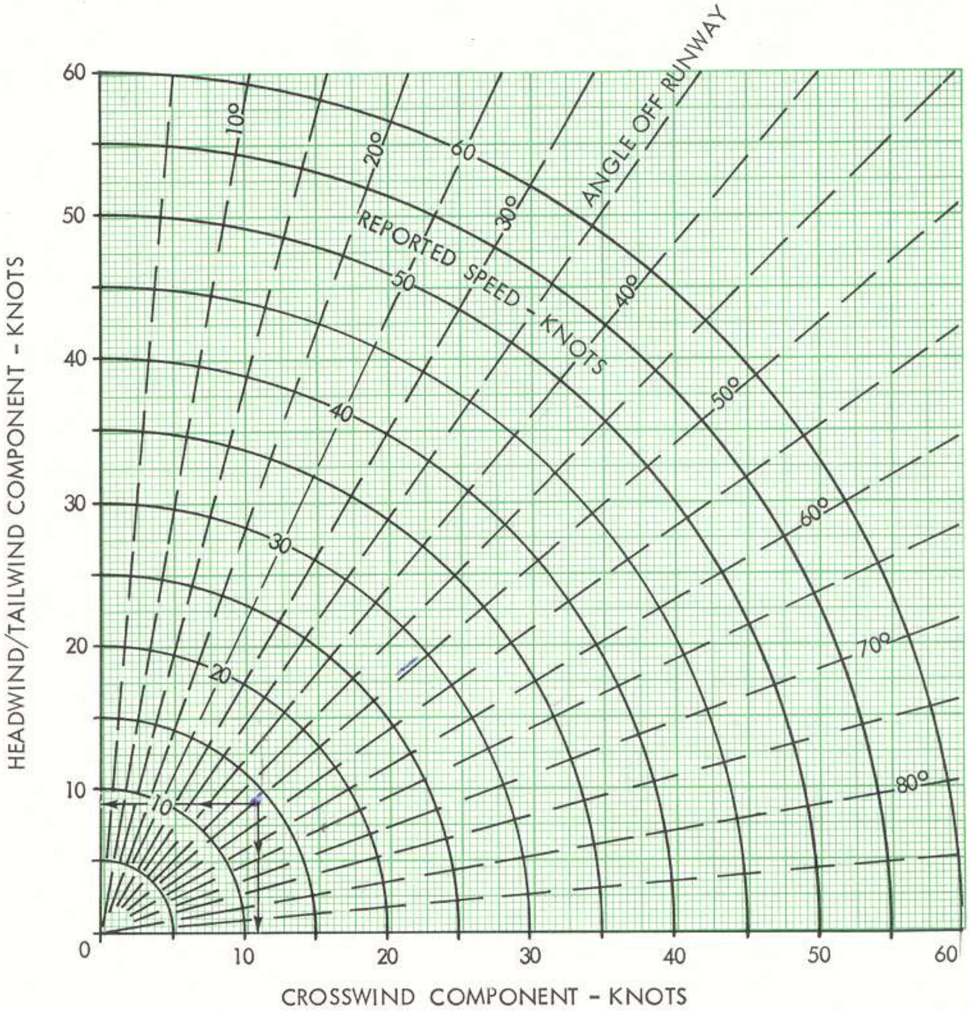
EXAMPLE

INDICATED AIRSPEED	110 KNOTS
ALTITUDE	SEA LEVEL
CORRECTION	+ 5 FEET

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-7 (Sheet 2 of 2) Altimeter Position Error Correction Chart

WIND COMPONENT - TAKE-OFF AND LANDING



EXAMPLE

ANGLE OFF RUNWAY	51 DEGREES
REPORTED SPEED	14 KNOTS
HEADWIND COMPONENT	9 KNOTS
CROSSWIND COMPONENT	11 KNOTS

NOTE

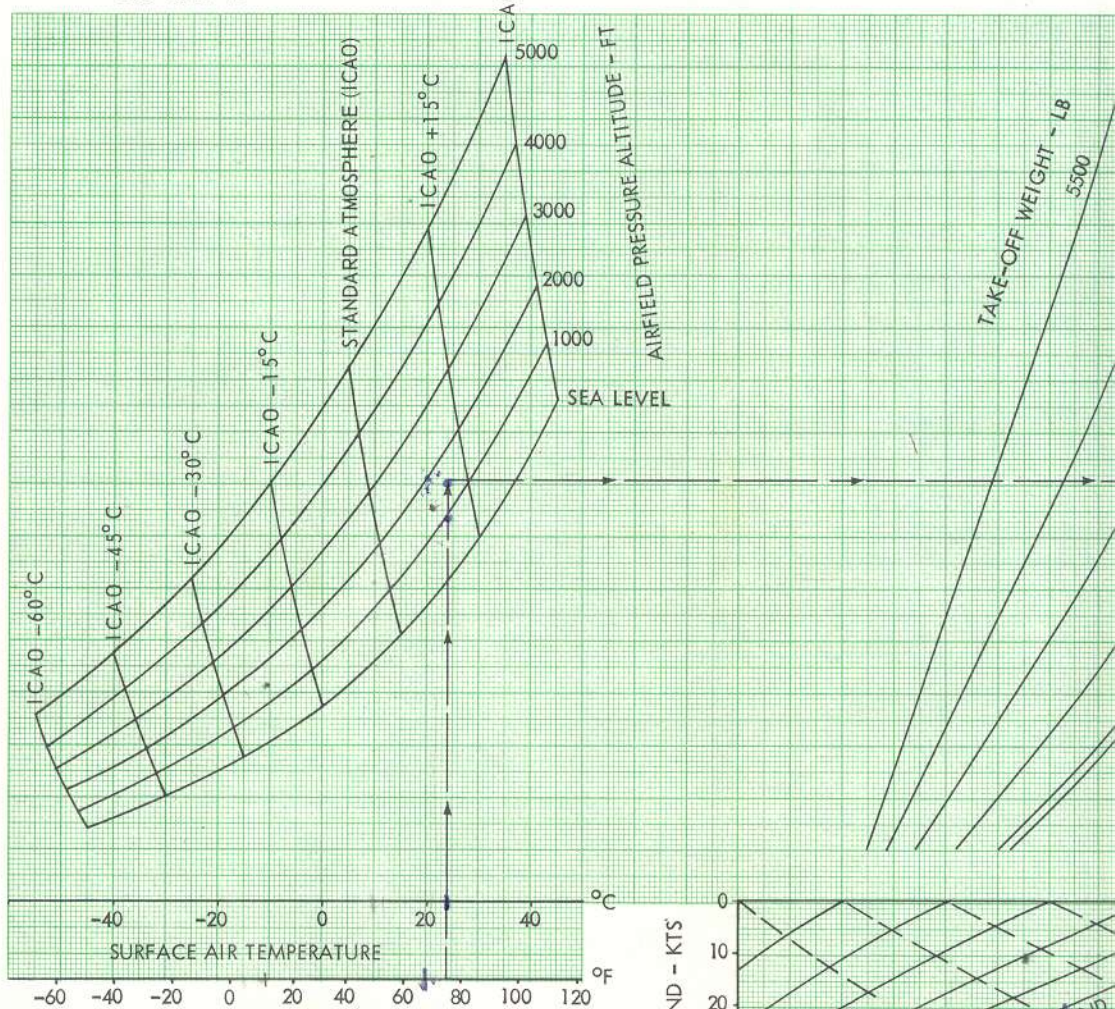
Double-check the solution: headwind or tailwind.

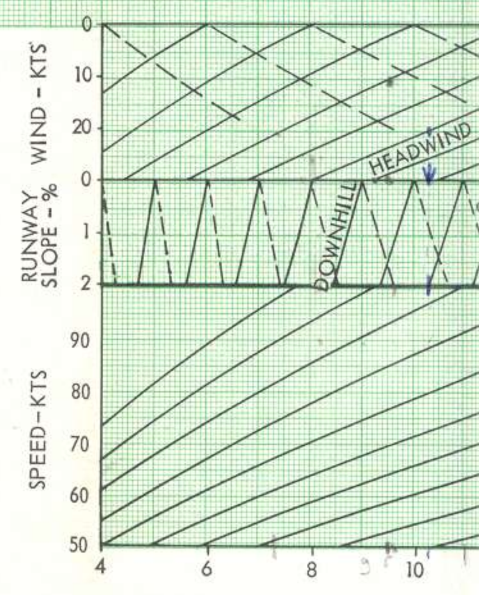
Figure 4-8 Wind Component Chart

TAKE-OFF DISTANCE - GRO

FLAPS: 25°

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40





EXAMPLE

SURFACE AIR TEMPERATURE	24° C
AIRFIELD PRESSURE ALTITUDE	1500 FEET
TAKE-OFF WEIGHT	7437 LB
HEADWIND	9 KNOTS
RUNWAY SLOPE	1% UPHILL
TAKE-OFF GROUND RUN DISTANCE	1370 FEET
LIFT-OFF SPEED	90 KNOTS

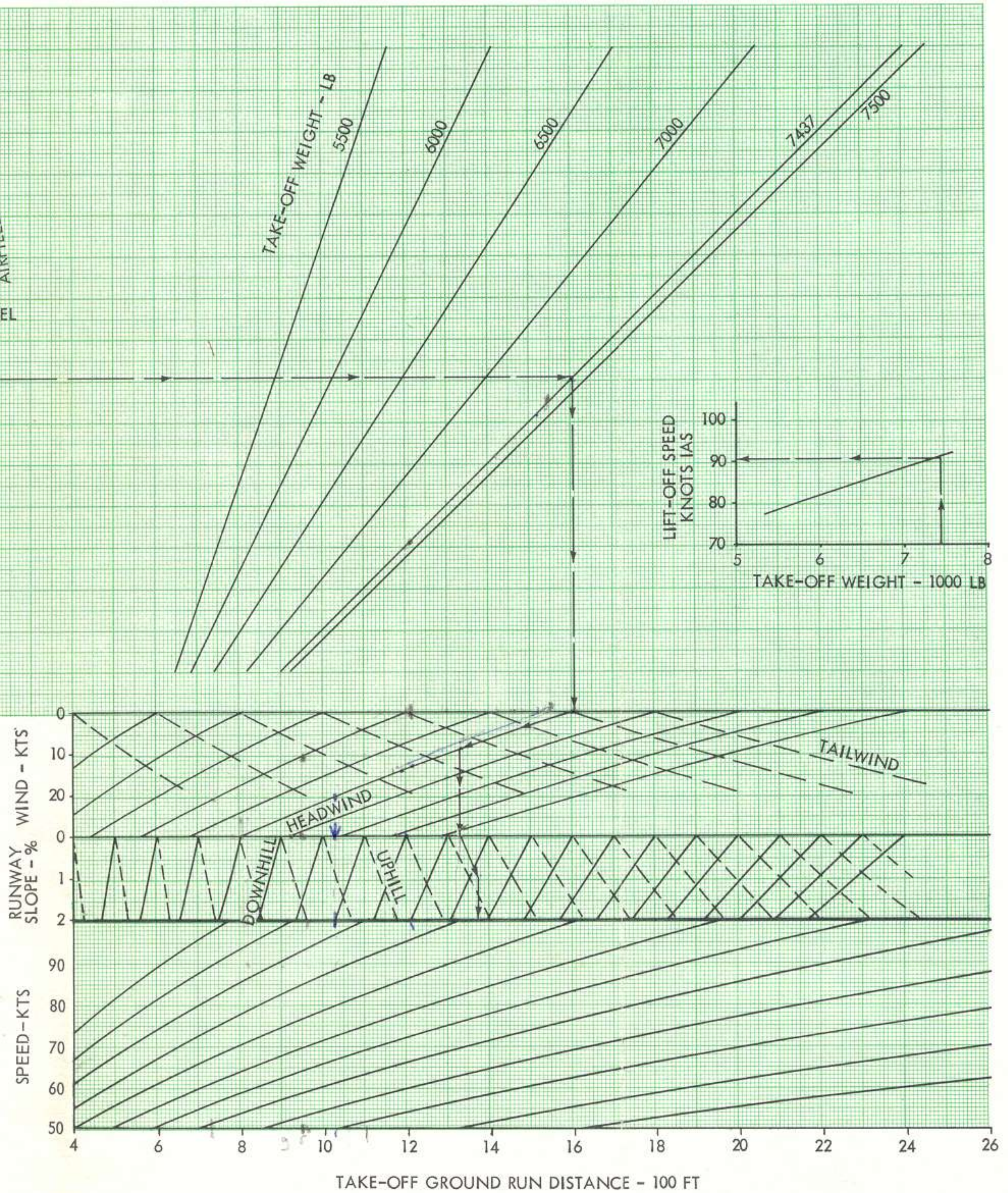
NOTE

For flapless take-off, increase distance by 30%.

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

KE-OFF DISTANCE - GROUND RUN

FLAPS: 25°



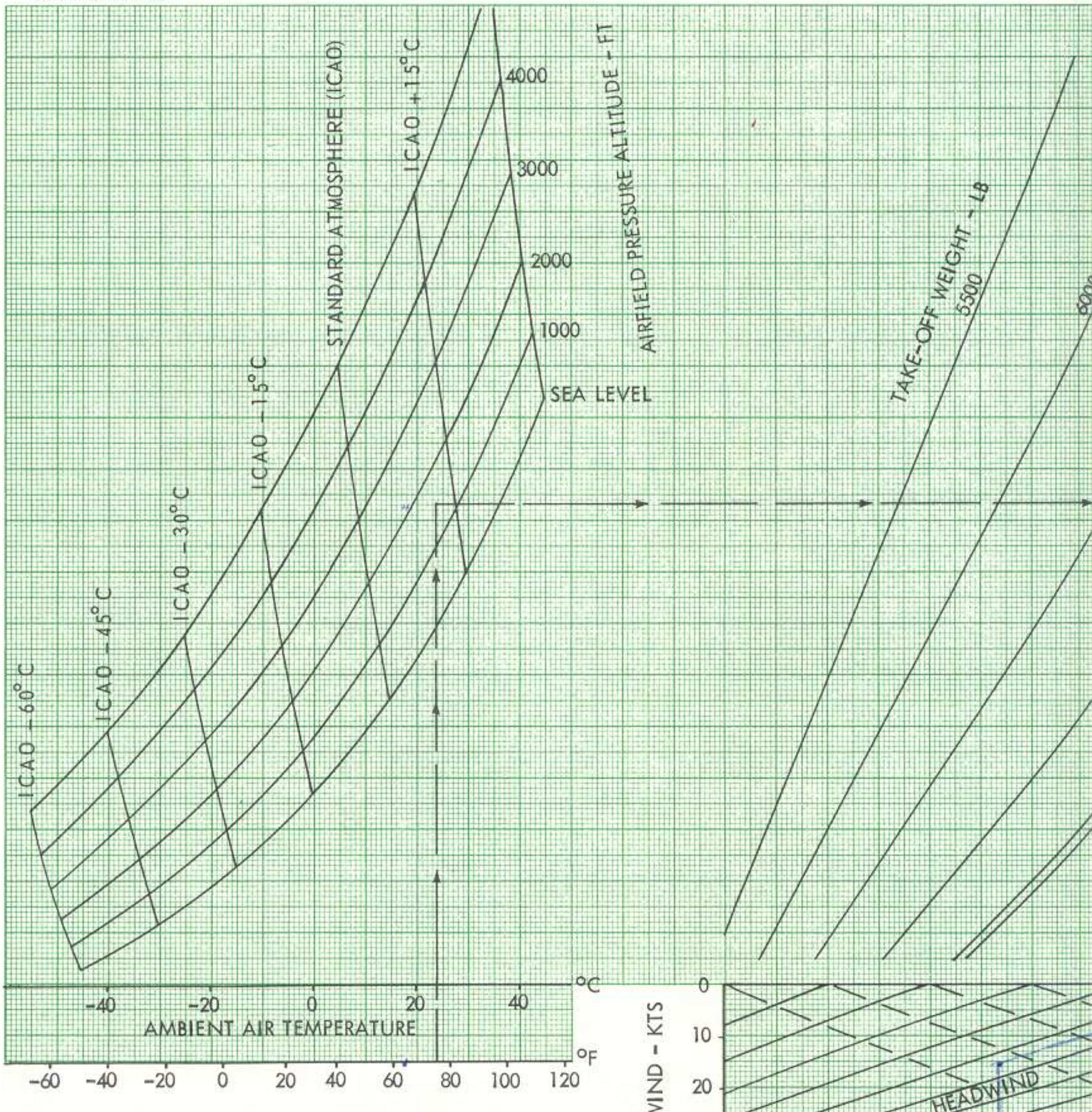
FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

Figure 4-9 (Sheet 1 of 2) Take-Off Distance Chart

TAKE-OFF DISTANCE - TO CLEAR 5

FLAPS: 25°

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40



EXAMPLE

SURFACE AIR TEMPERATURE	24°C
AIRFIELD PRESSURE ALTITUDE	1500 FEET
TAKE-OFF WEIGHT	7437 LB
HEADWIND	9 KNOTS
RUNWAY SLOPE	+ 1% UPHILL
TAKE-OFF DISTANCE TO CLEAR 50 FEET	2020 FEET
MAXIMUM SPEED AT 50-FOOT OBSTACLE	97 KNOTS

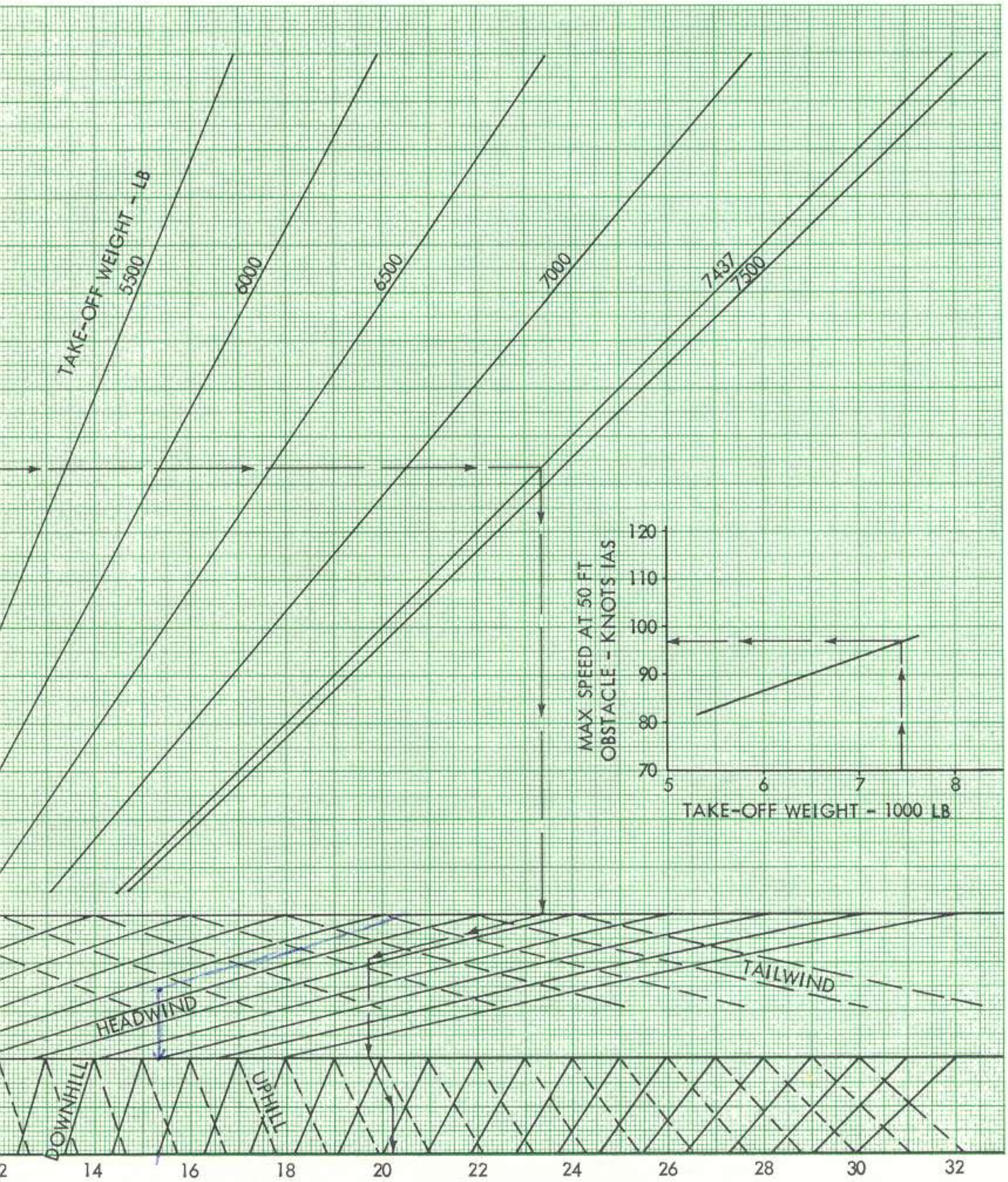
NOTE

For flapless take-off,

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

- TO CLEAR 50-FOOT OBSTACLE

FLAPS: 25°



NOTE

For flapless take-off, increase distance by 20%.

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

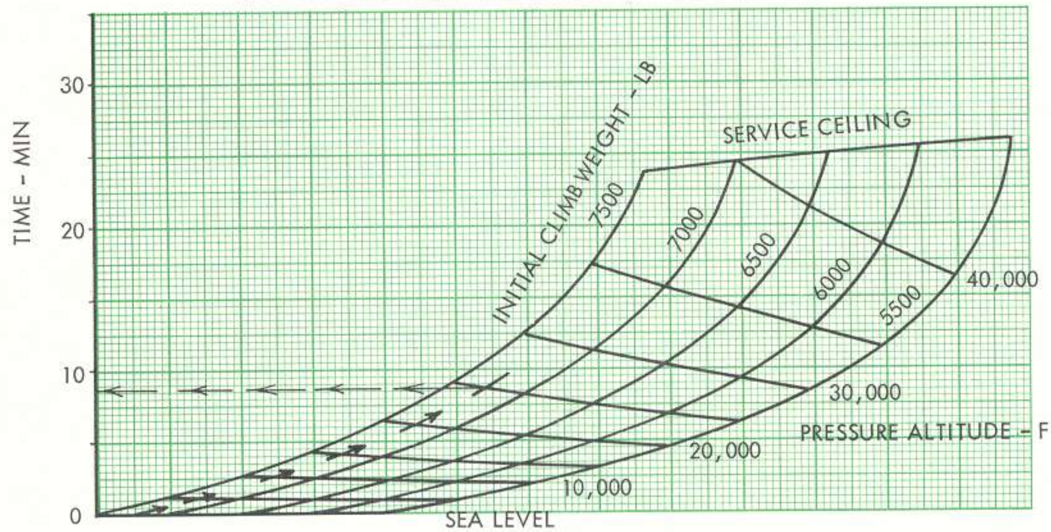
Figure 4-9 (Sheet 2 of 2) Take-Off Distance Chart

CLIMB SCHEDULE - TIME TO ALTITUDE

MAXIMUM CONTINUOUS POWER
CLEAN CONFIGURATION

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40

RATE-OF-CLIMB AT 7262 LB GROSS WEIGHT			
ALTITUDE FT	CAS KNOTS	TAS KNOTS	FT/MIN
SEA LEVEL	250	250	4250
5000	235	252	3720
10000	220	254	3220
15000	205	256	2700
20000	190	257	2200
25000	175	258	1675
30000	160	257	1100
35000	145	256	555
39370	132	257	100



EXAMPLE

INITIAL CLIMB WEIGHT 7262 LB
TO PRESSURE ALTITUDE 25,000 FEET
TIME 8.8 MIN

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

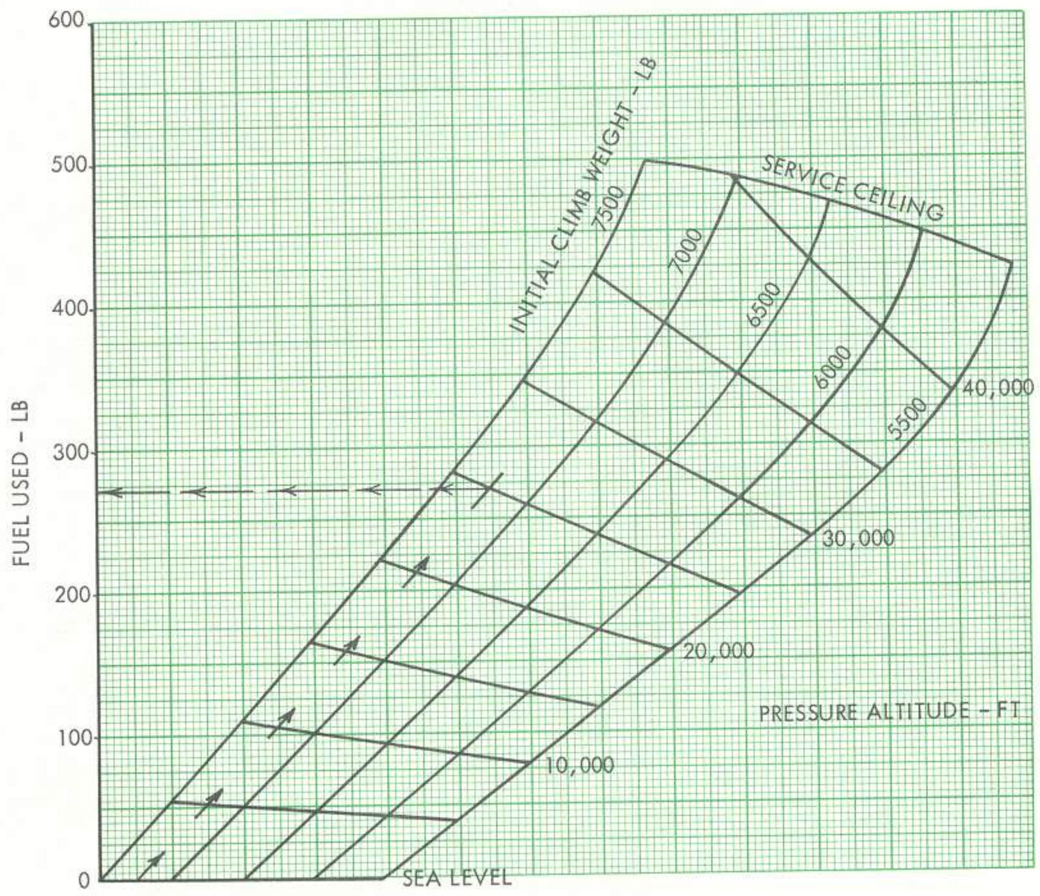
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-10 (Sheet 1 of 2) Climb Chart

CLIMB SCHEDULE - FUEL CONSUMED

MAXIMUM CONTINUOUS POWER
CLEAN CONFIGURATION

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40



NOTE

5% operational allowance included.

EXAMPLE

INITIAL CLIMB WEIGHT	7262 LB
TO PRESSURE ALTITUDE	25,000 FEET
FUEL USED	273 LB

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

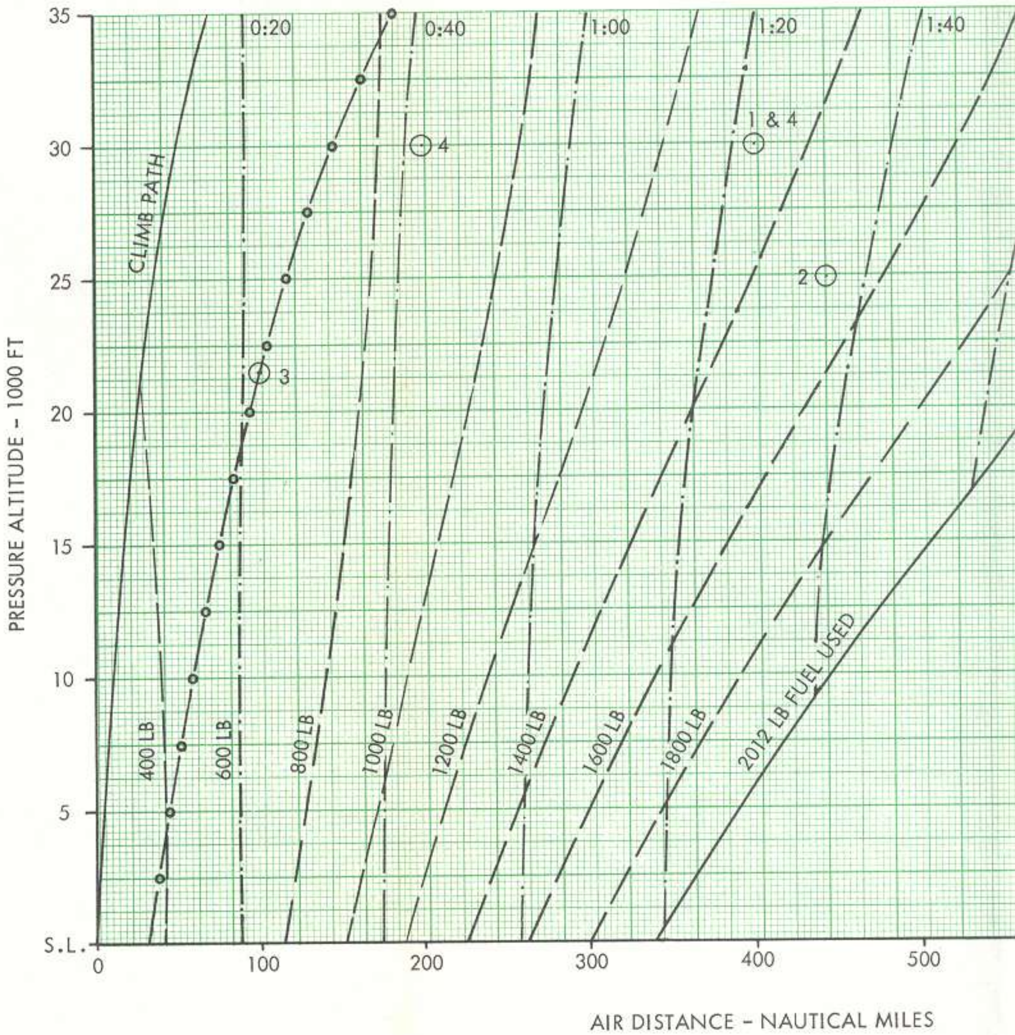
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-10 (Sheet 2 of 2) Climb Chart

RANGE SUMMARY

START-UP GROSS WEIGHT: 7437 LB

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40



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.

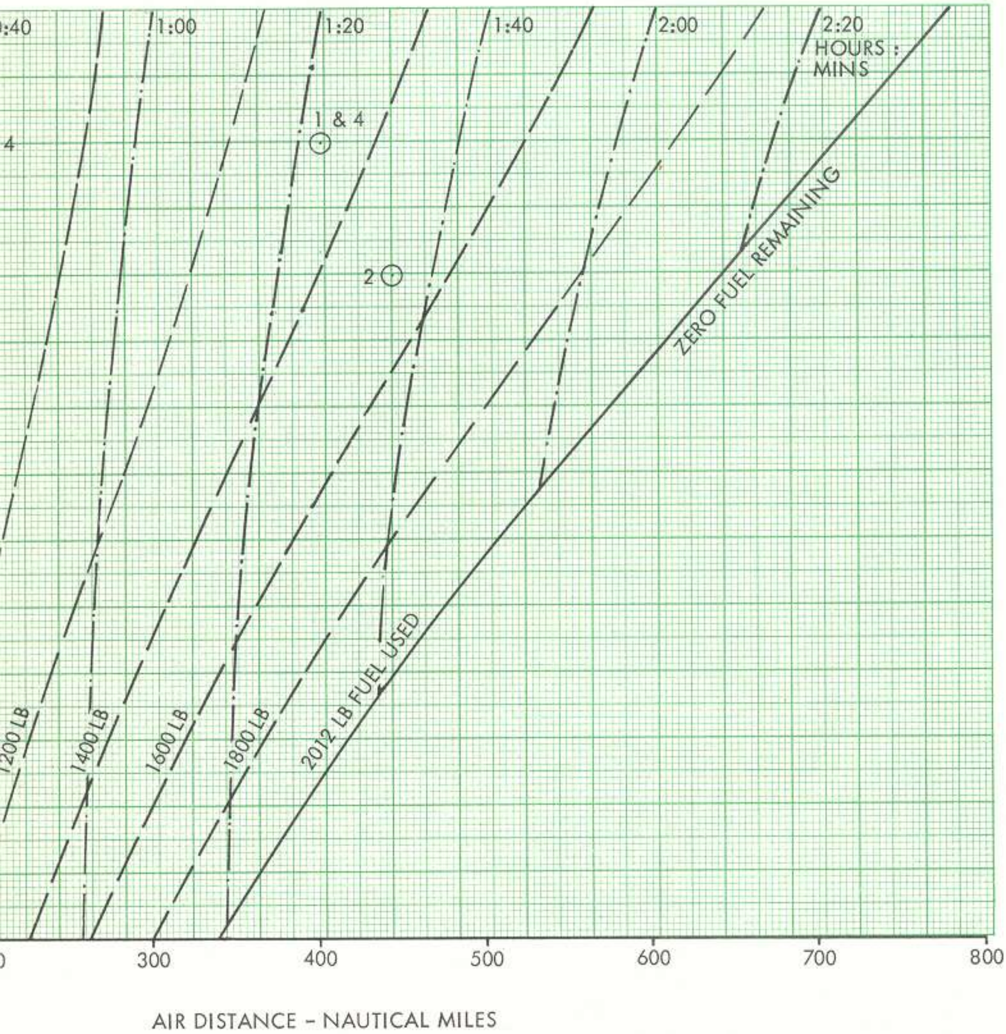
3 Constant-altitude cruise at recommended long-range cruise speed.

4 No allowance for holding, approach descent, or la

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

RANGE SUMMARY

START-UP GROSS WEIGHT: 7437 LB



NOTES

1 175 fuel allowance included for taxi, take-off, and acceleration to initial climb speed. Fuel flow includes 5% operational allowance.

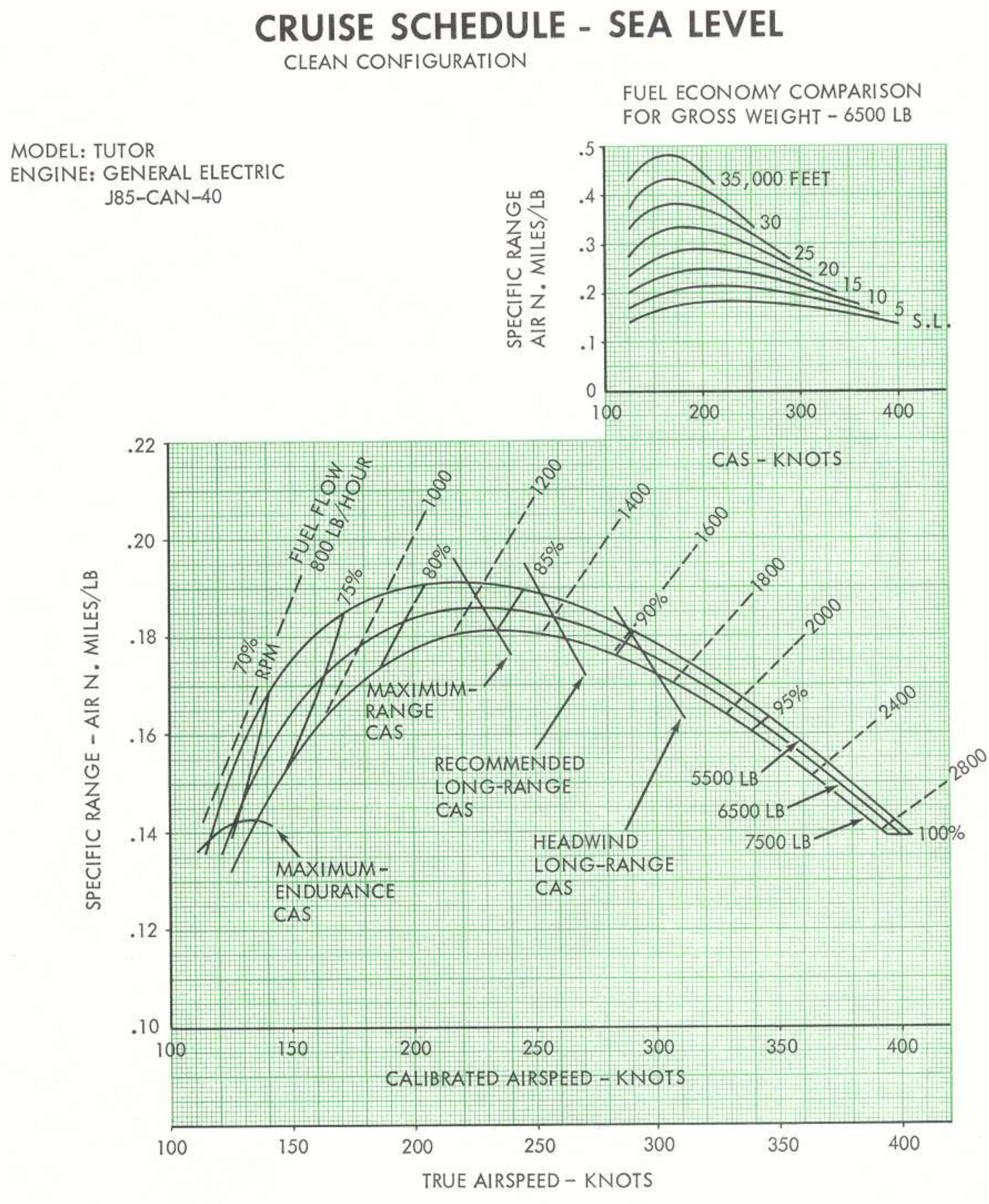
2 Climb at maximum continuous power.

3 Constant-altitude cruise at recommended long-range cruise speed.

4 No allowance for holding, approach descent, or landing.

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

Figure 4-11 Range Summary Chart



NOTE

Fuel flows include 5% operational allowance.

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

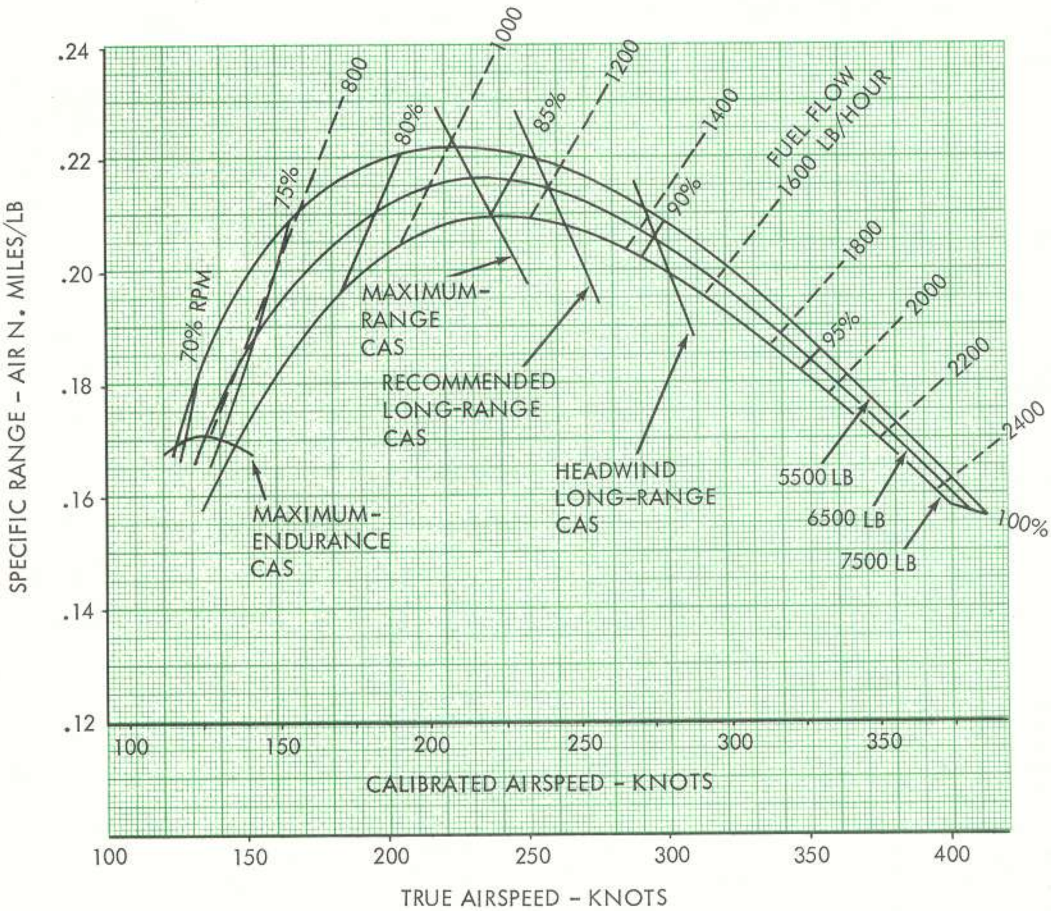
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-12 (Sheet 1 of 8) Cruise Schedule Chart (Specific Range)

CRUISE SCHEDULE - 5000 FT

CLEAN CONFIGURATION

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40



NOTE

Fuel flows include
5% operational allowance.

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

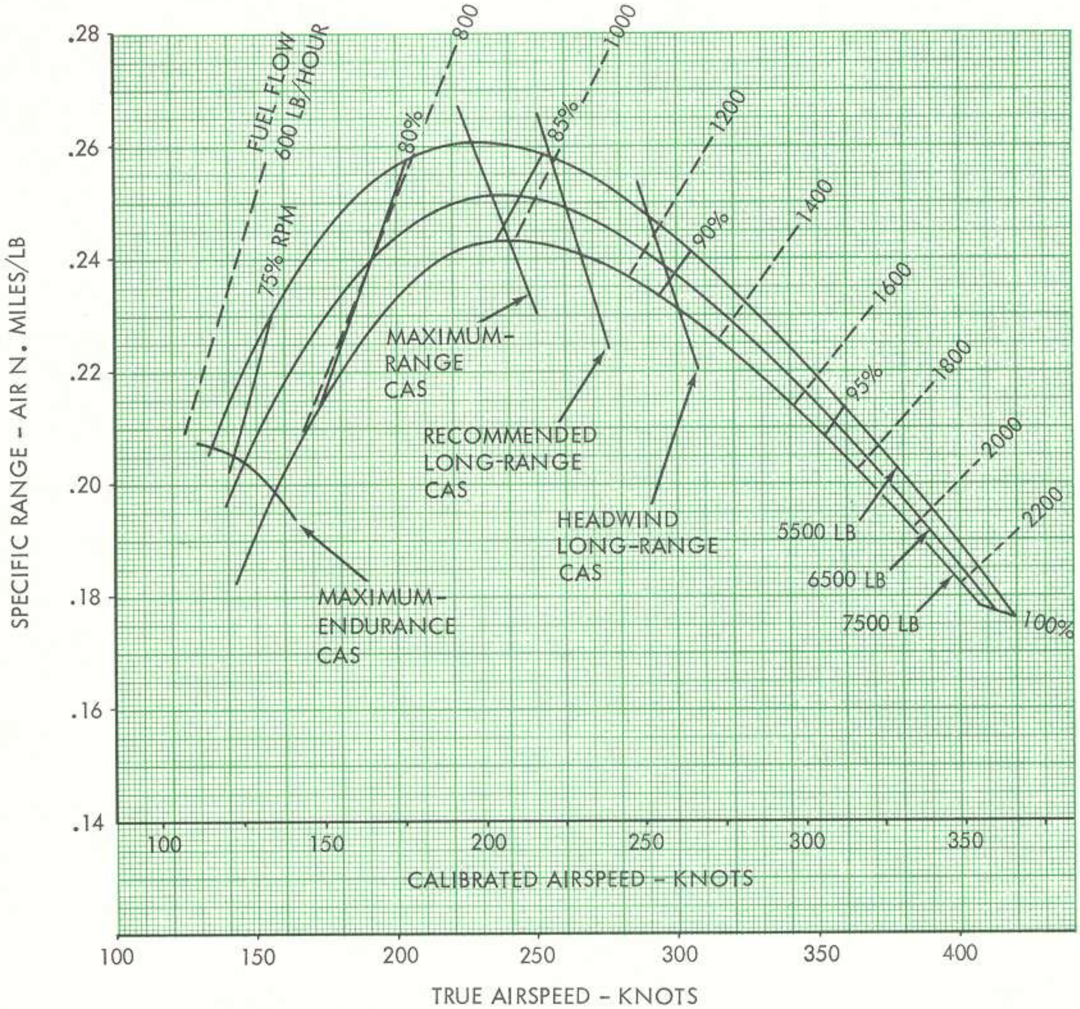
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-12 (Sheet 2 of 8) Cruise Schedule Chart (Specific Range)

CRUISE SCHEDULE - 10,000 FT

CLEAN CONFIGURATION

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40



NOTE

Fuel flows include
5% operational allowance.

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

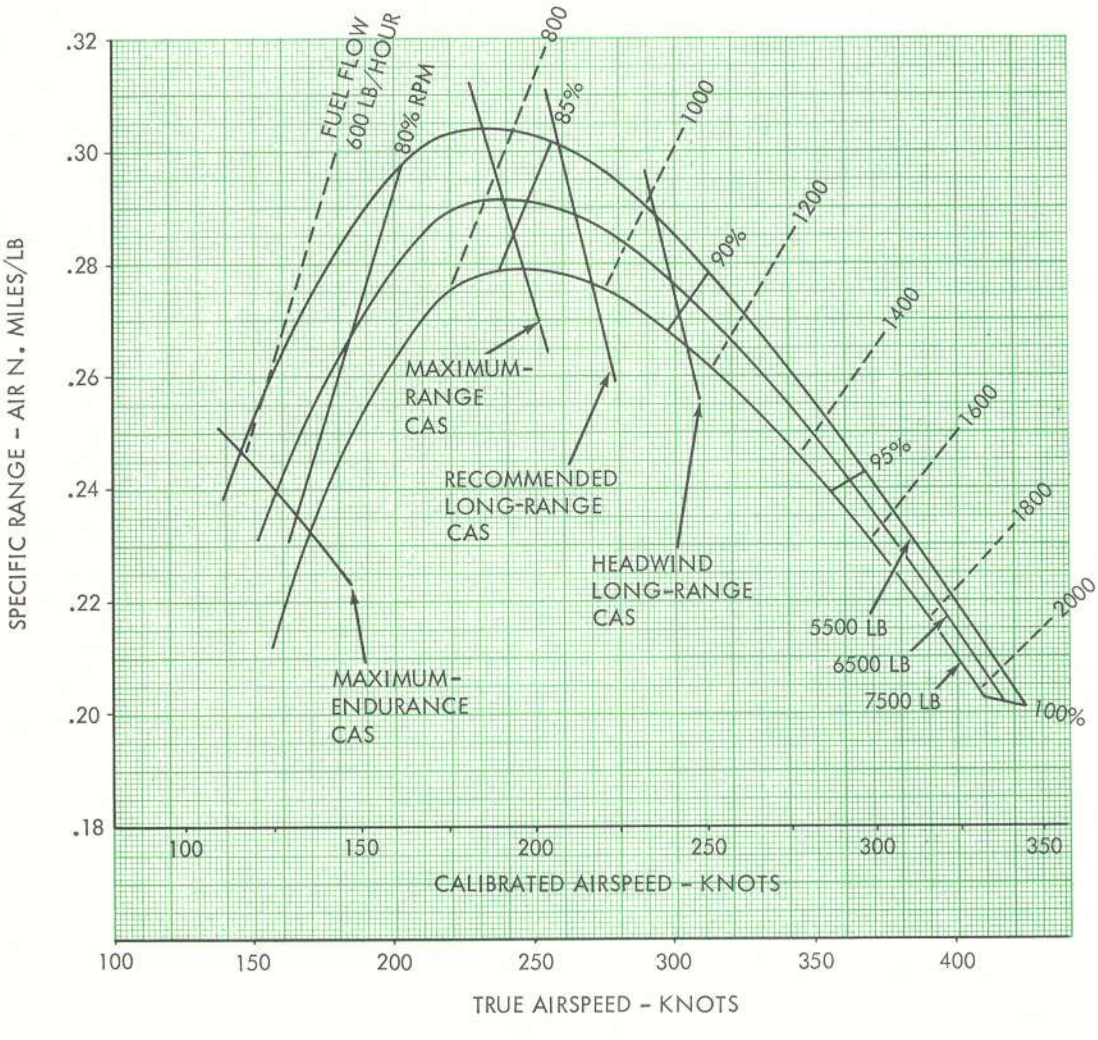
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-12 (Sheet 3 of 8) Cruise Schedule Chart (Specific Range)

CRUISE SCHEDULE - 15,000 FT

CLEAN CONFIGURATION

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40



NOTE

Fuel flows include
5% operational allowance.

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

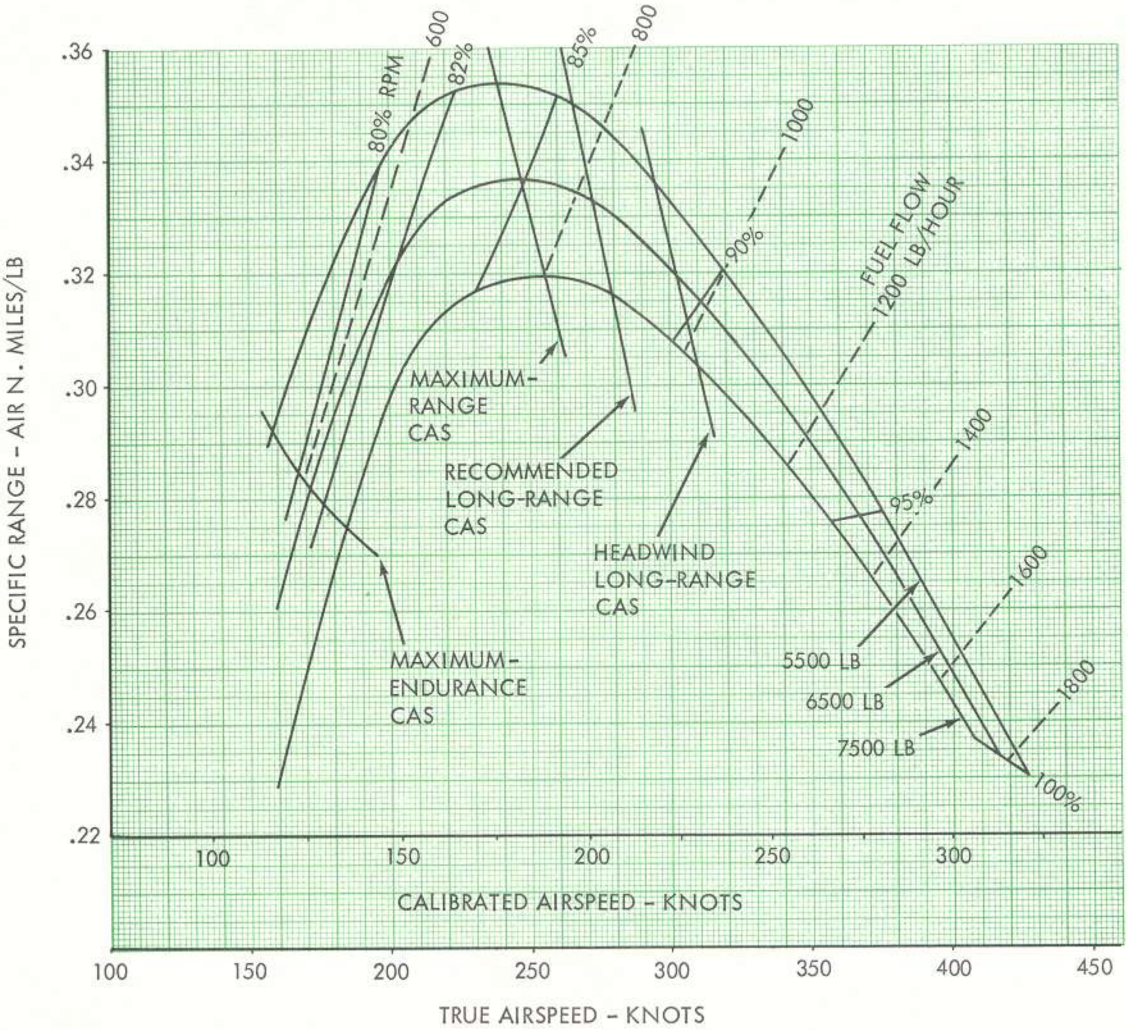
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-12 (Sheet 4 of 8) Cruise Schedule Chart (Specific Range)

CRUISE SCHEDULE - 20,000 FT

CLEAN CONFIGURATION

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40



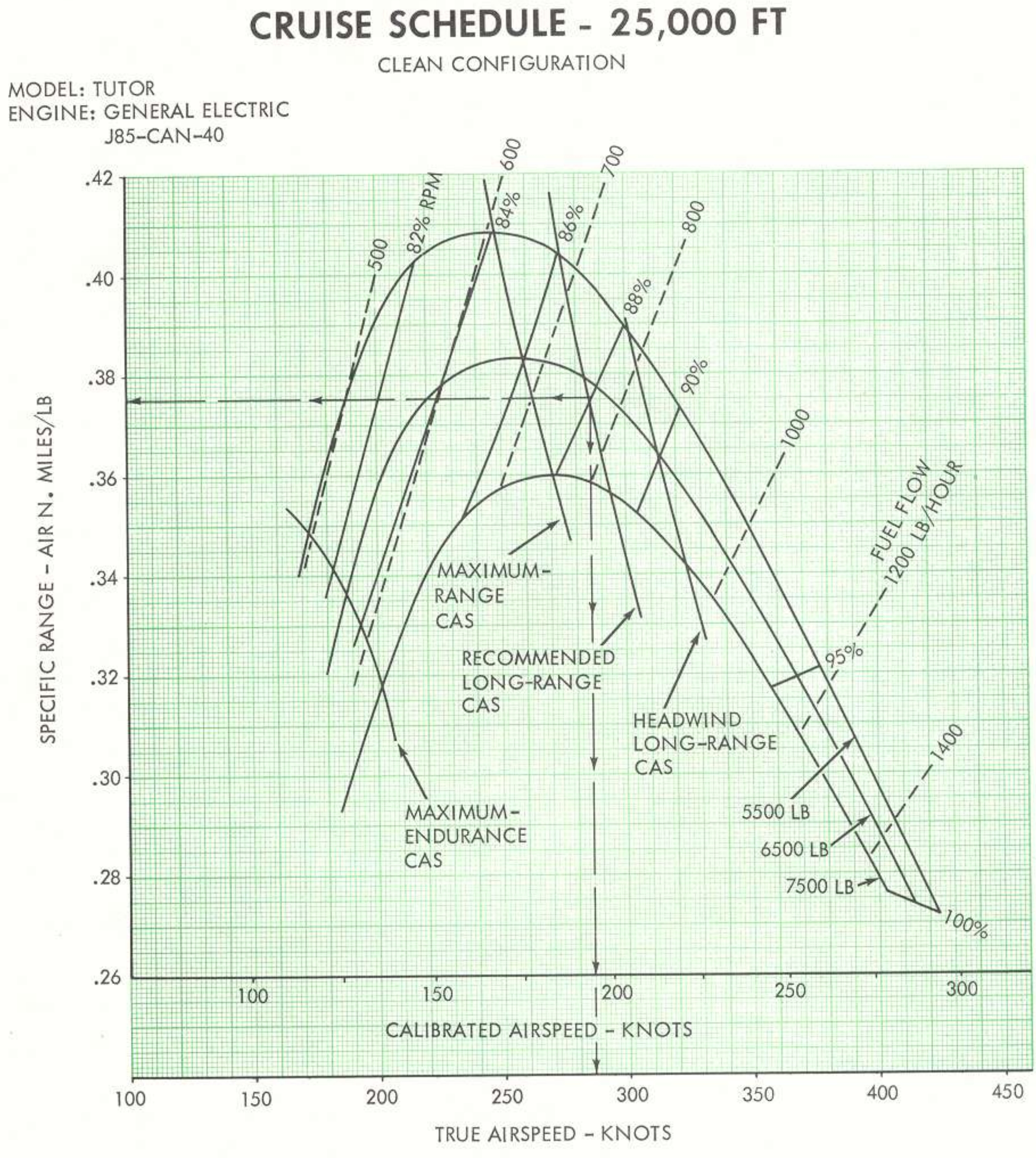
NOTE

Fuel flows include
5% operational allowance.

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-12 (Sheet 5 of 8) Cruise Schedule Chart (Specific Range)



NOTE

Fuel flows include
5% operational allowance.

EXAMPLE

WEIGHT	6700 LB
RPM	88 %
FUEL FLOW	762 LB/HR
CALIBRATED AIRSPEED	195 KNOTS
TRUE AIRSPEED	286 KNOTS
SPECIFIC RANGE	.3752 N. MILES/LB

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

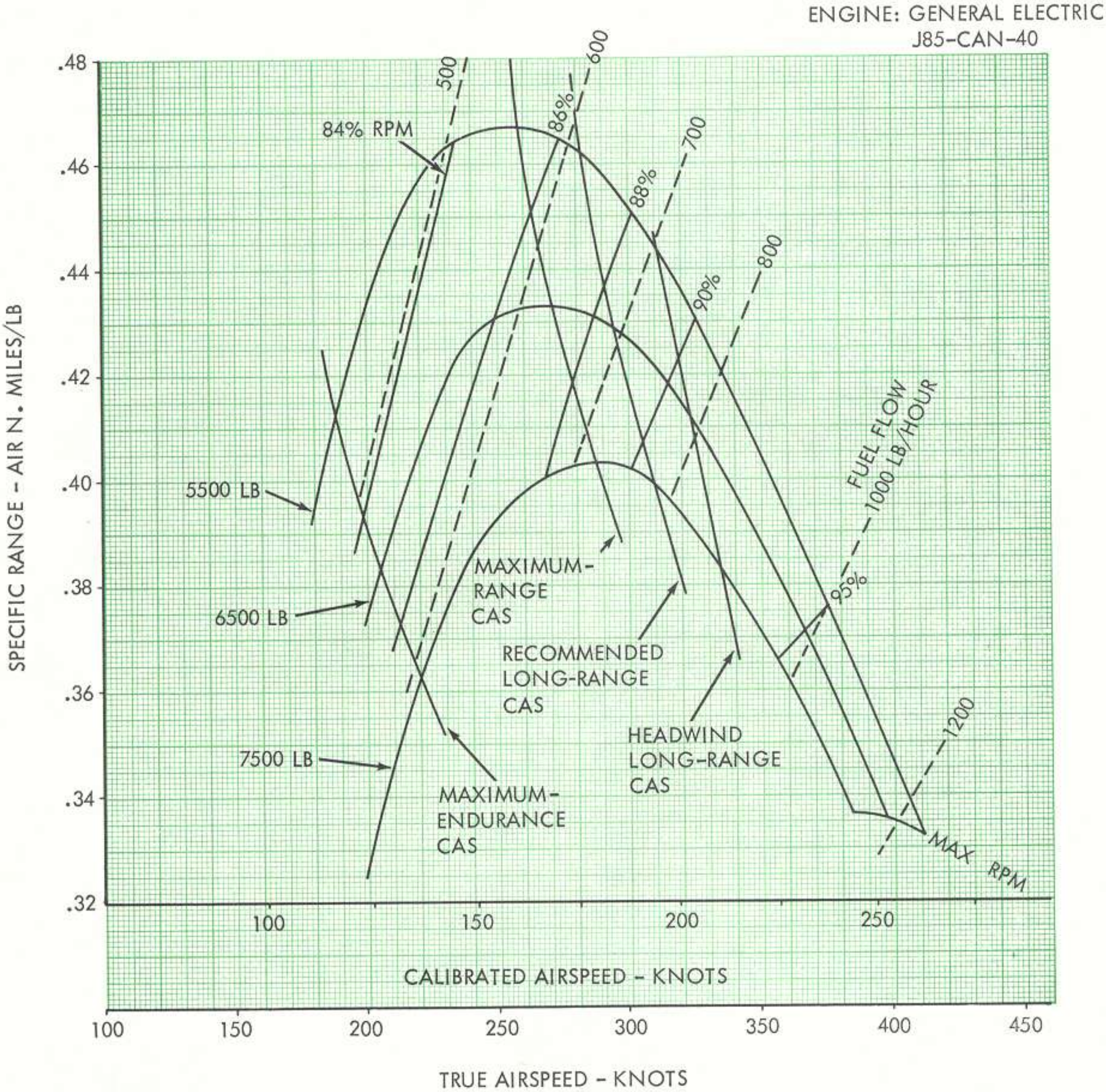
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-12 (Sheet 6 of 8) Cruise Schedule Chart (Specific Range)

CRUISE SCHEDULE - 30,000 FT

CLEAN CONFIGURATION

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40



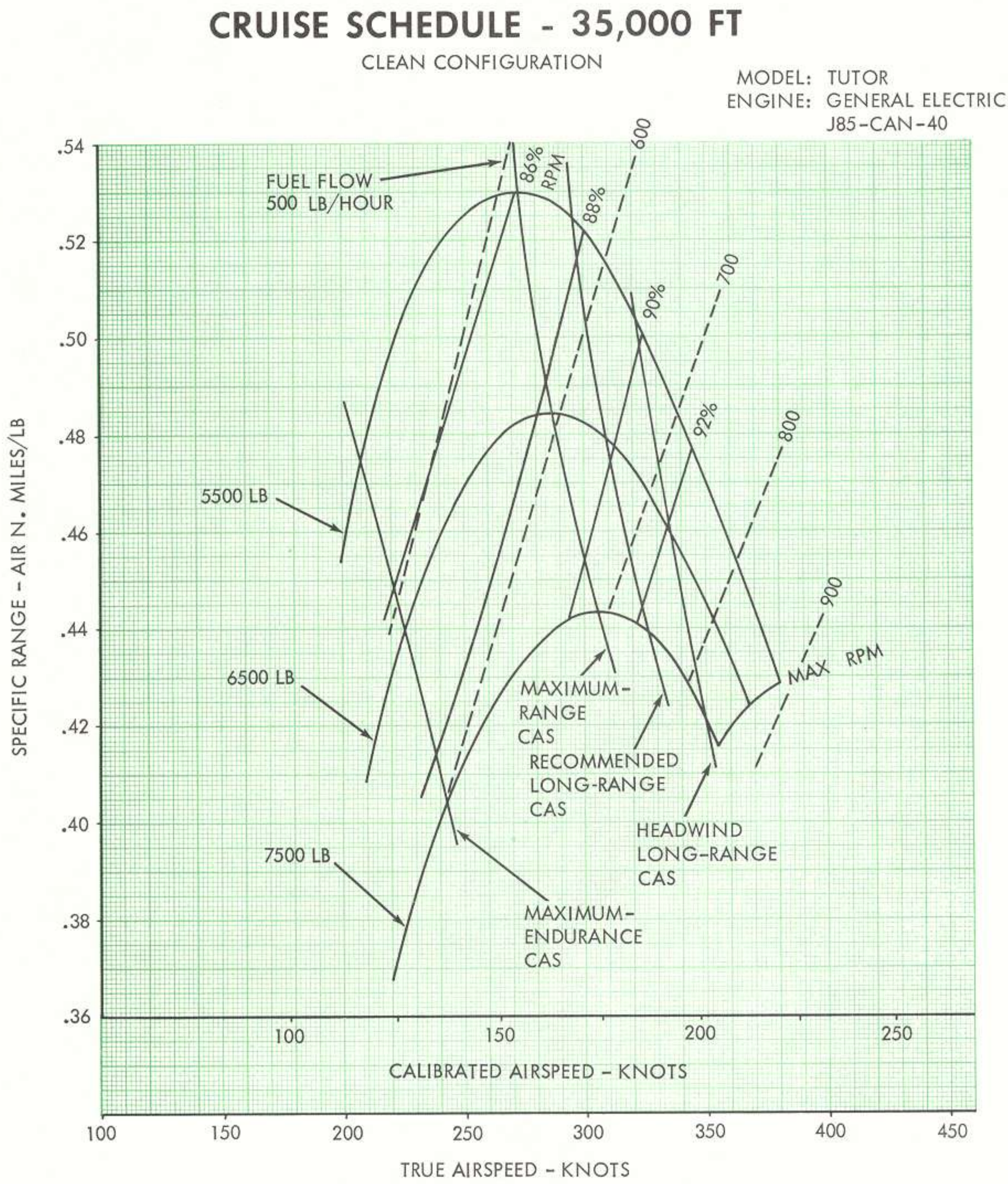
NOTE

Fuel flows include
5% operational allowance.

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-12 (Sheet 7 of 8) Cruise Schedule Chart (Specific Range)



NOTE

Fuel flows include
5% operational allowance.

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

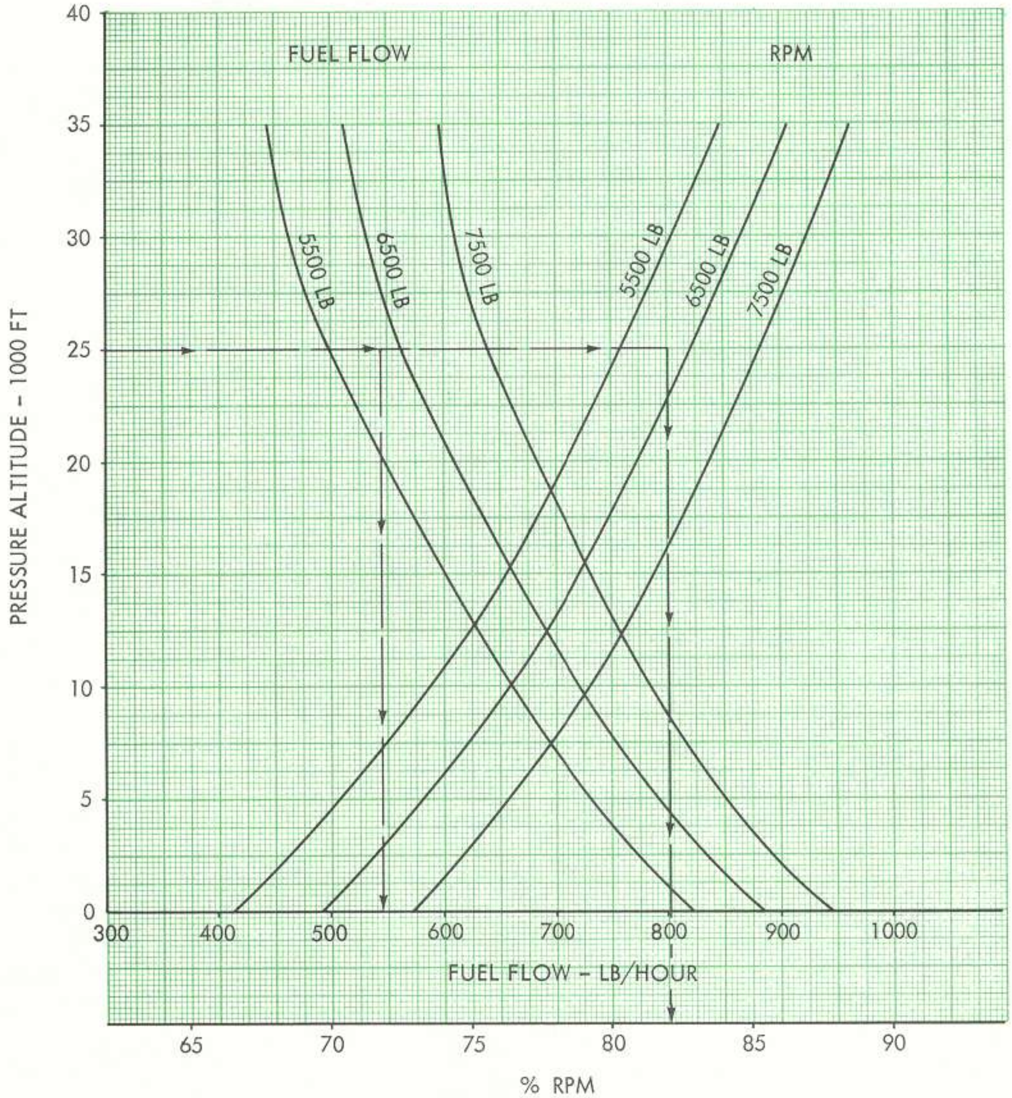
Figure 4-12 (Sheet 8 of 8) Cruise Schedule Chart (Specific Range)

ENDURANCE AT CONSTANT ALTITUDE

125 KNOTS CAS

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40

CLEAN CONFIGURATION



EXAMPLE

WEIGHT	6300 LB
ALTITUDE	25,000 FEET
FUEL FLOW	545 LB/HR
RPM	82%

FUEL GRADE: 3-GP-22(JP-4)
FUEL DENSITY: 7.8 LB/GAL

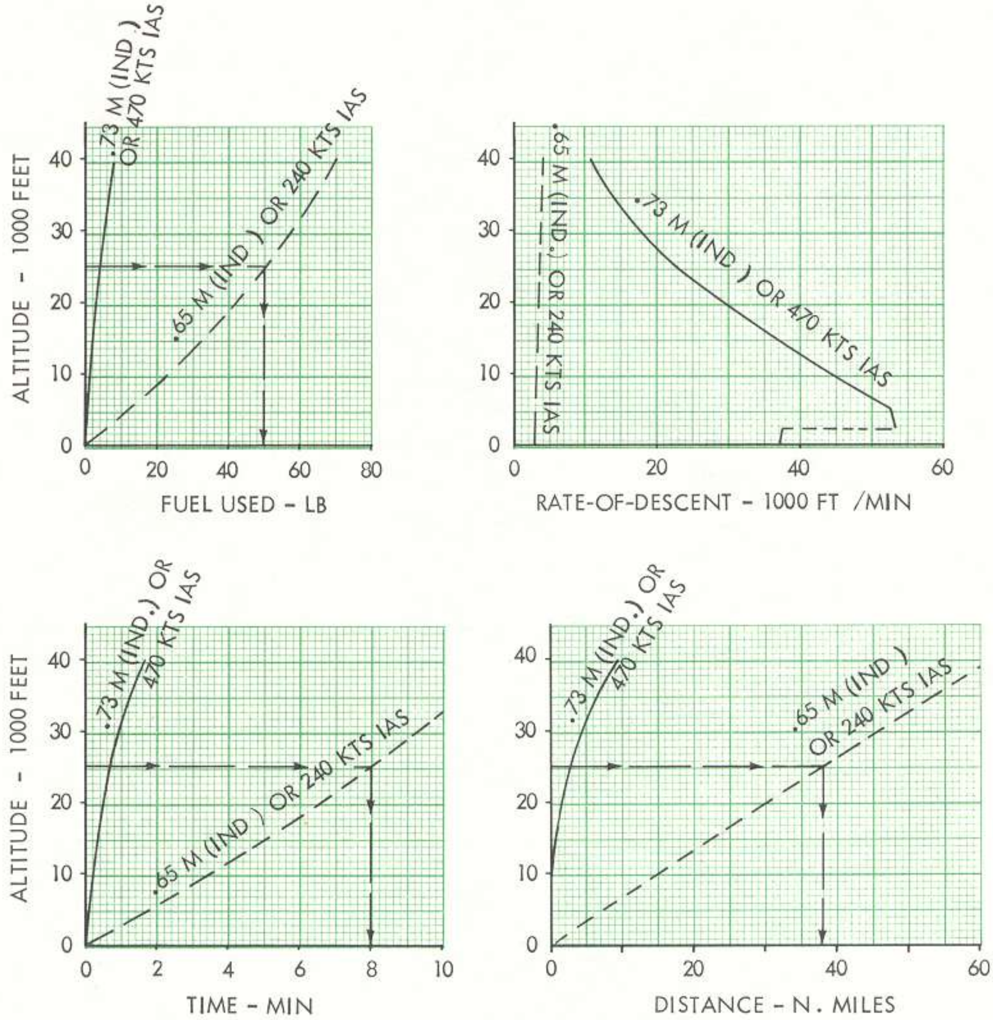
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-13 Endurance Chart

NORMAL DESCENT

POWER: IDLE RPM

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40



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 N. MILES

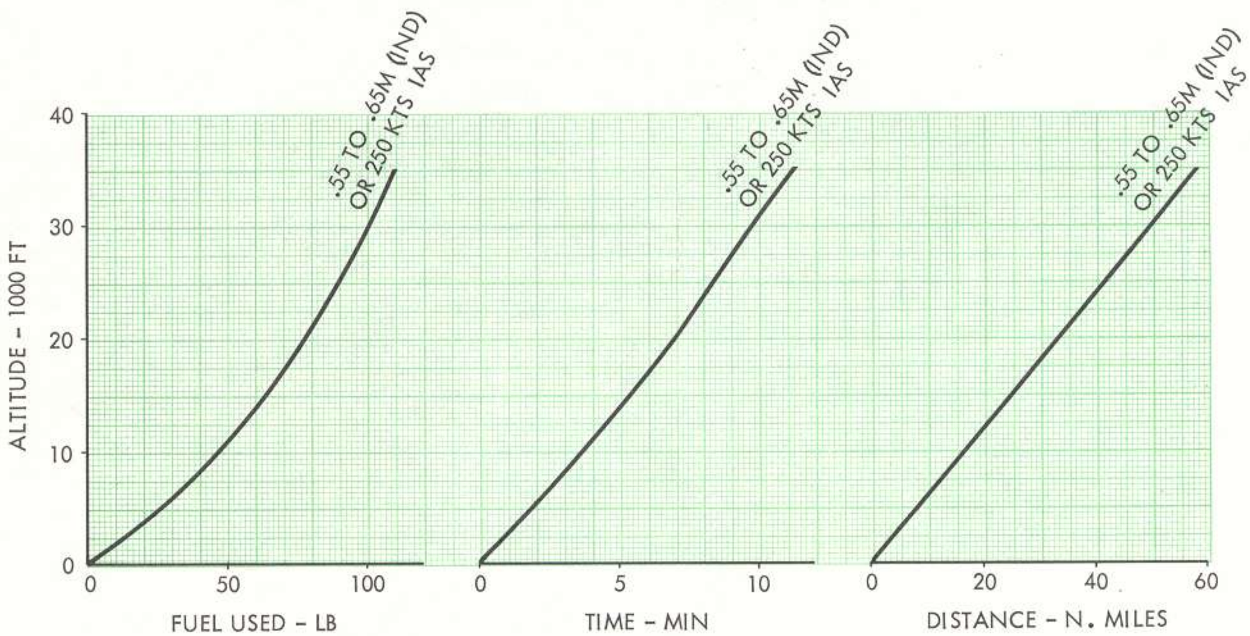
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-14 Normal Descent Chart

POWER-ON DESCENT
CRUISE ALTITUDE TO SEA LEVEL

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40

75% RPM
CLEAN CONFIGURATION



NOTE

Descend at Mach .55 to .65 until ASI registers 250 kts. Then hold 250 kts IAS.

FUEL GRADE: 3-GP-22 (JP-4)
FUEL DENSITY: 7.8 LB/GAL

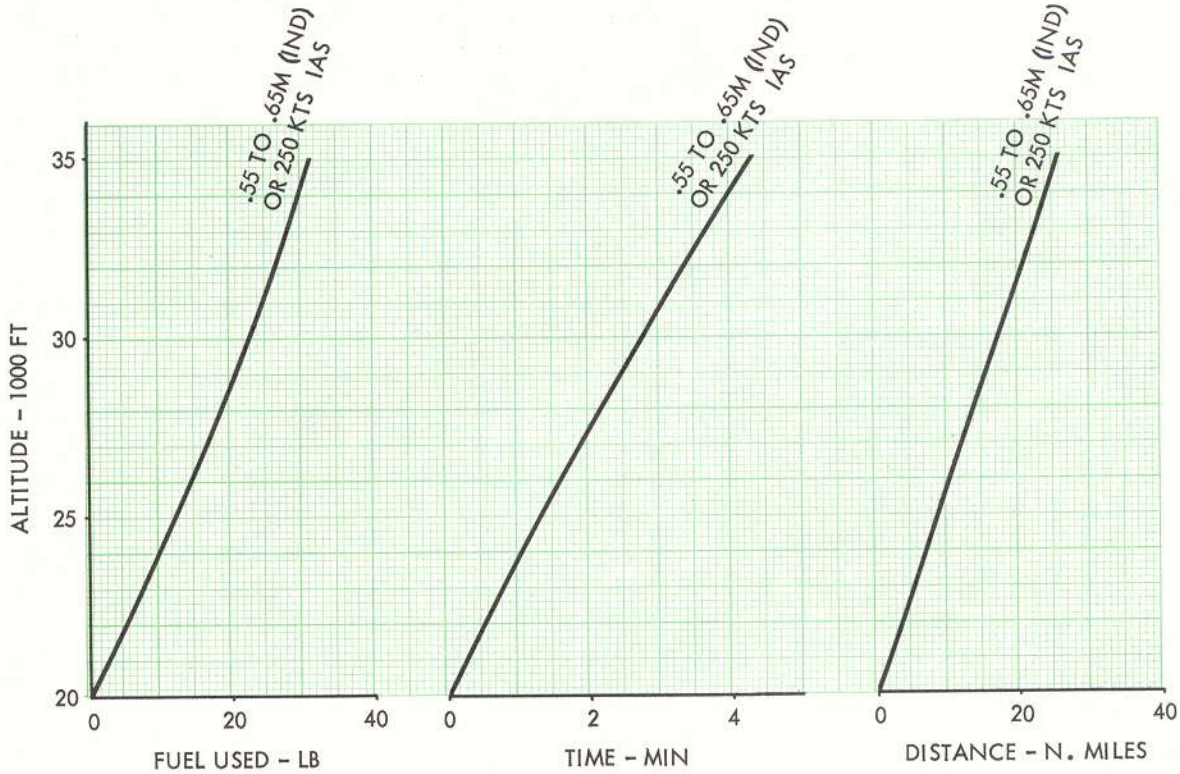
DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

Figure 4-15 (Sheet 1 of 2) Cruise Descent Chart

POWER-ON DESCENT
CRUISE ALTITUDE TO 20,000 FT

MODEL: TUTOR
ENGINE: GENERAL ELECTRIC
J85-CAN-40

75% RPM
CLEAN CONFIGURATION



NOTE

Descend at Mach .55 to .65 until ASI registers 250 kts. Then hold 250 kts IAS.

FUEL GRADE: 3-GP-22 (JP-4)
FUEL DENSITY: 7.8 LB/GAL

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

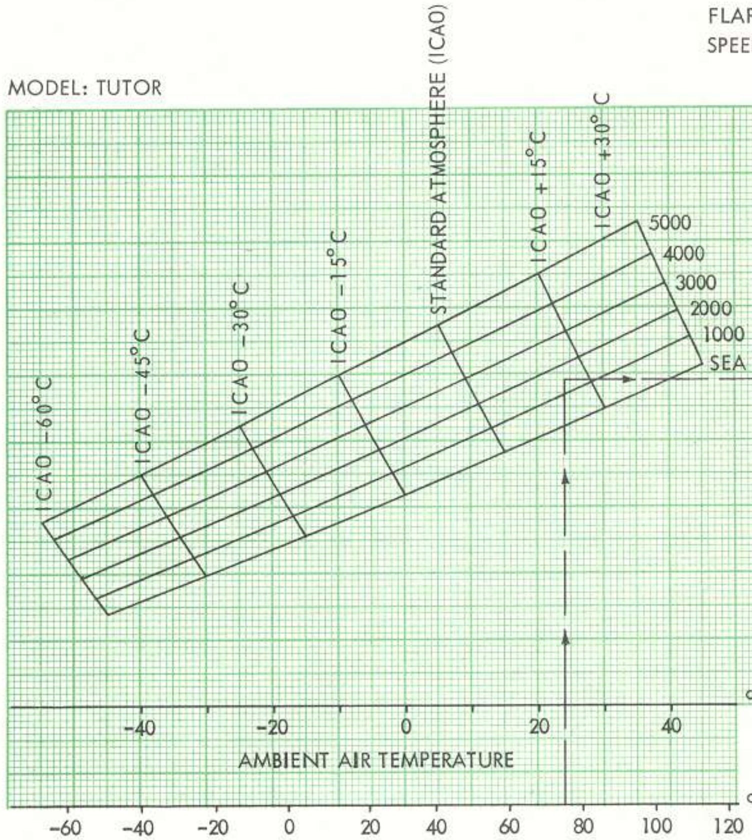
Figure 4-15 (Sheet 2 of 2) Cruise Descent Chart

MINIMUM LANDING DIST

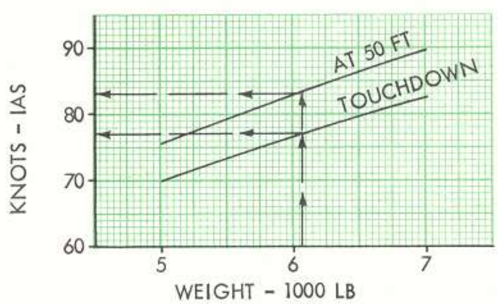
FLAPS: 40° NORMAL APPRO

SPEEDBRAKES OUT MAXIMUM BRAK

MODEL: TUTOR



LANDING SPEEDS



EXAMPLE

SURFACE AIR TEMPERATURE
AIRFIELD PRESSURE ALTITUDE 1
LANDING WEIGHT 6
HEADWIND
RUNWAY SLOPE

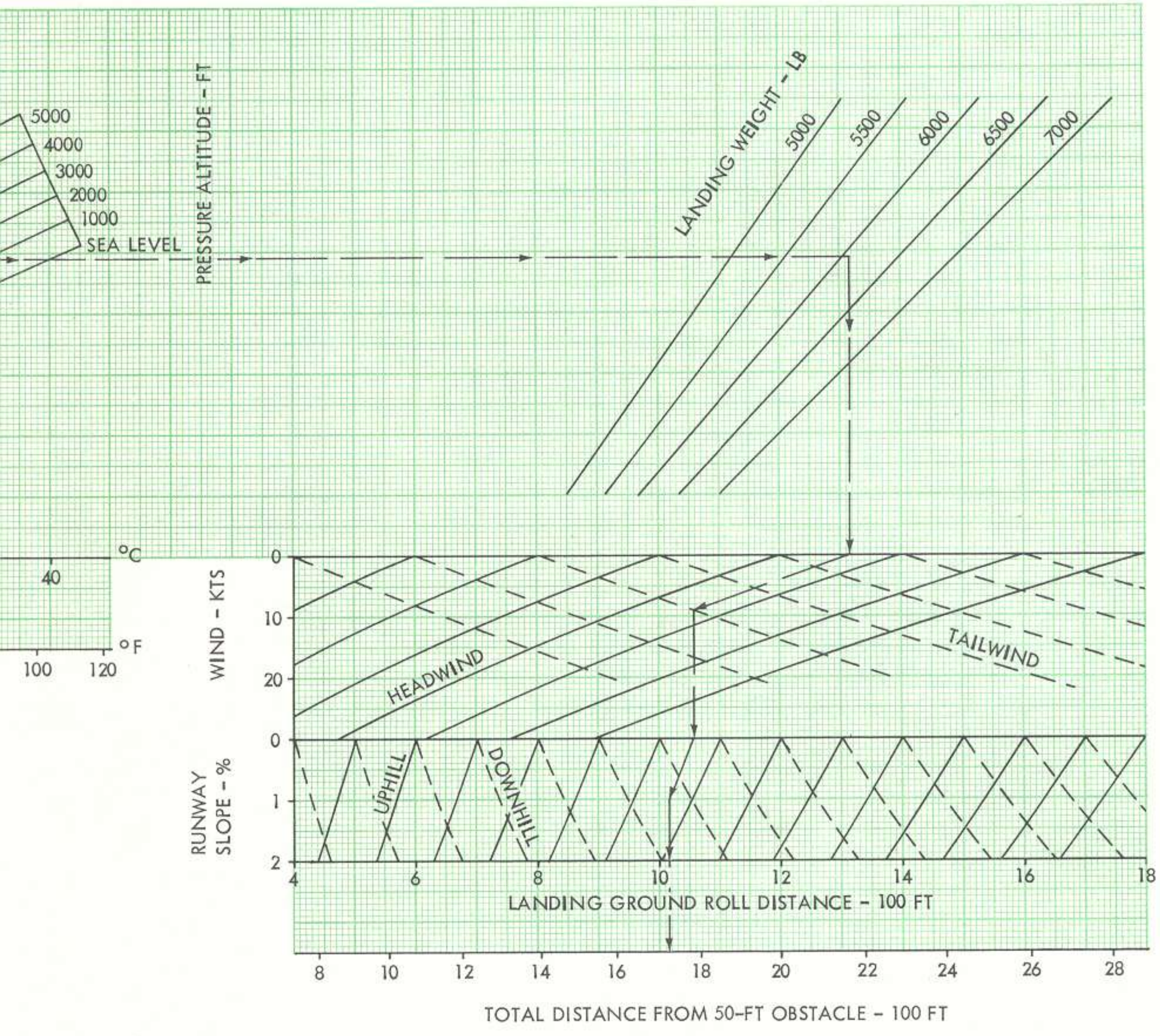
LANDING GROUND ROLL 1
TOTAL DISTANCE FROM 50-FT OBSTACLE 1

SPEED AT 50 FT
TOUCHDOWN SPEED

DATA AS OF: JAN 1966
BASED ON: FLIGHT TEST

MINIMUM LANDING DISTANCE

FLAPS: 40° NORMAL APPROACH
SPEEDBRAKES OUT MAXIMUM BRAKING



EXAMPLE

SURFACE AIR TEMPERATURE	24°C
AIRFIELD PRESSURE ALTITUDE	1500 FEET
LANDING WEIGHT	6100 LB
HEADWIND	9 KNOTS
RUNWAY SLOPE	1% UPHILL
LANDING GROUND ROLL	1015 FT
TOTAL DISTANCE FROM 50-FT OBSTACLE	1725 FT
SPEED AT 50 FT	83 KNOTS
TOUCHDOWN SPEED	77 KNOTS

Figure 4-16 Landing Distance Chart

LEVEL FLIGHT SPEED TABLE

STANDARD ATMOSPHERE (ICAO)

MODEL: TUTOR

ENGINE: J85-CAN-40

CONFIGURATION: CLEAN AIRCRAFT
GROSS WEIGHT: 7300 POUNDS

NORMAL RATED RPM					95% RPM			
APPROXIMATE				PRESSURE ALTITUDE (FEET)	APPROXIMATE			
LB/HR	TAS (KNOTS)	CAS (KNOTS)	% RPM		% RPM	CAS (KNOTS)	TAS (KNOTS)	LB/HR
2870	408	408	100	S.L.	95	349	349	2100
2560	418	391	100	5,000	95	340	364	1930
2260	425	371	100	10,000	95	326	375	1745
1975	427	347	100	15,000	95	312	385	1560
1670	422	318	100	20,000	95	295	393	1380
1375	412	286	100	25,000	95	273	395	1180
1085	390	247	97	30,000	95	242	382	975
825	369	214	95	35,000	95	214	369	825
630	351	181	94	40,000	94	181	351	630

NOTES

1 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (NATO F-40) fuel.

2 Divide pounds by 8.15 to obtain gallons of 3-GP-23 (NATO F-34) alternate fuel.

3 Fuel data include 5% operational allowance.

LEGEND

LB/HR Fuel consumption
TAS True airspeed
CAS Calibrated airspeed

Data as of: March 1964
Based on:

Fuel grade: Any specified fuel
Fuel density: As noted

Figure 4-17 Level Flight Speed Table

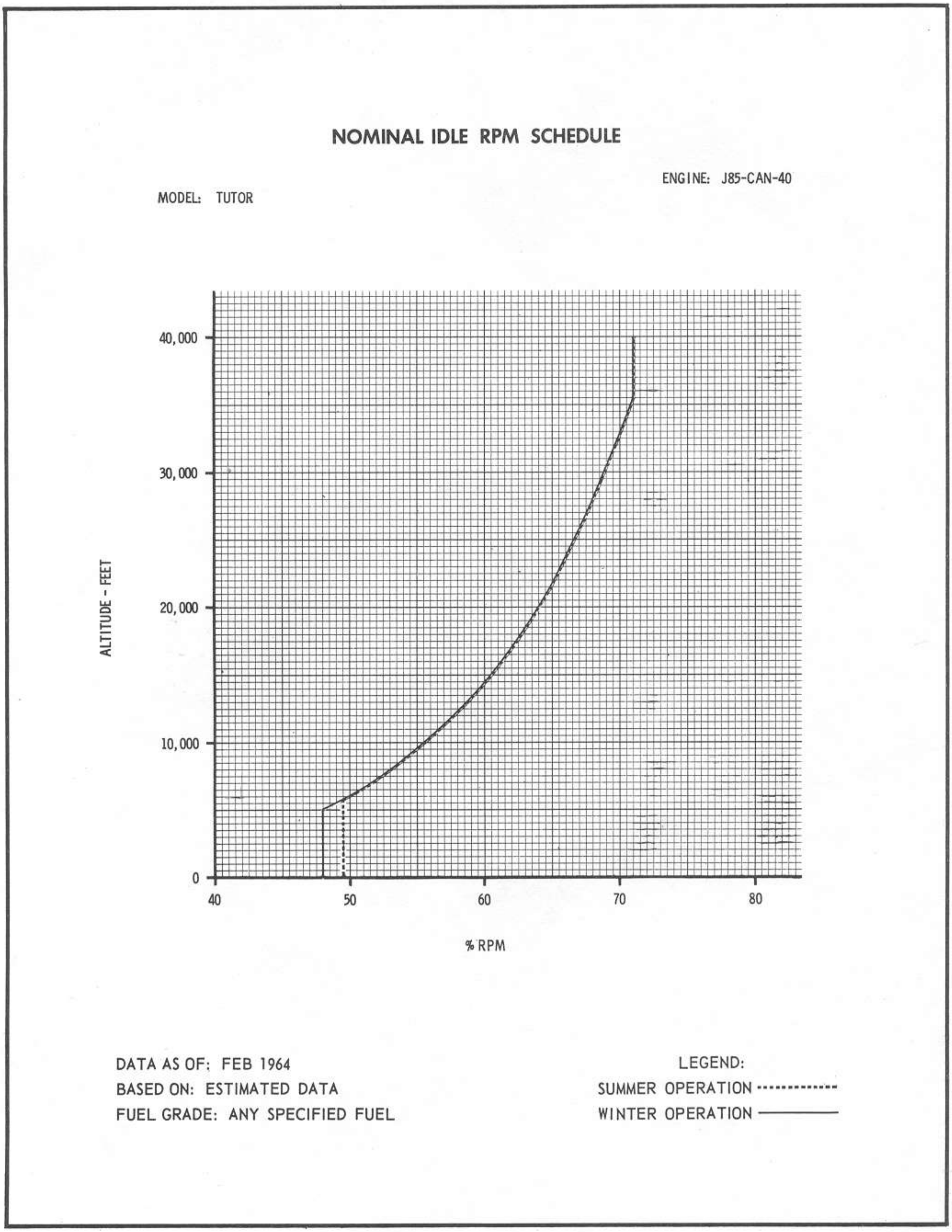


Figure 4-18 Nominal Idle RPM Schedule

PART 5

FLIGHT TESTING

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. The test card is shown in Figure 5-2. The following rules also apply:

(a) All maintenance flight testing must be carried out in accordance with CFP 100(A), art 232; EO-00-50-20, Part 4; and Parts 2, 3, and 4 of this EO.

(b) All flight data readings must be taken from the left-hand side instruments.

(c) Ensure that the weight and balance as shown in EO 05-195A-8 are within specified limits.

NOTE

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, and CFP 167(3). Items that are checked in normal operations are not detailed in this part unless amplification is required.

BEFORE FLIGHT

EXTERNAL

2 Carry out all the external checks listed before entering the cockpit.

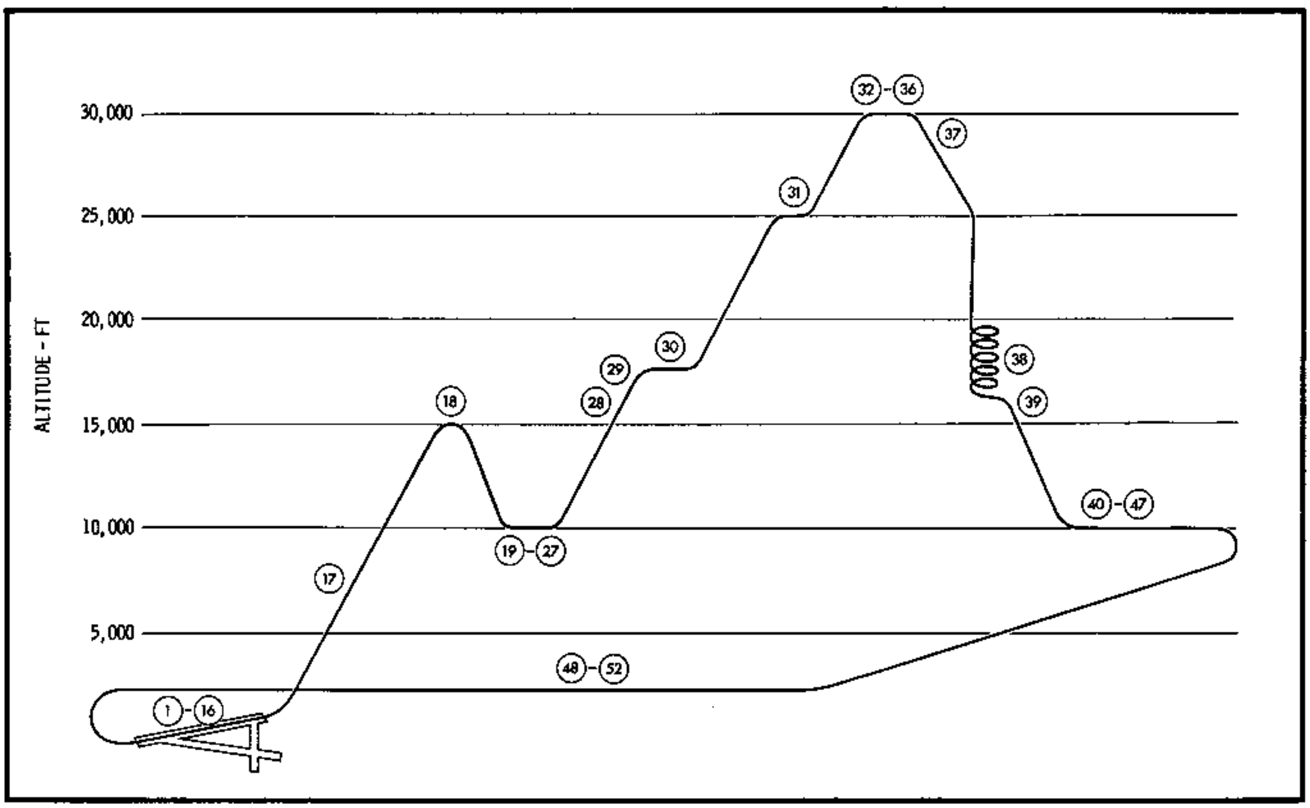


Figure 5-1 Flight Test Profile

PRE-START

NOTE

Carry out the pre-start check, and include the following specific items in normal sequence.

3 Check aileron, rudder, and elevator controls for smooth and correct operation. Check operation of INVERTER FAIL lights.

4 Complete a functional check of inter-communications, main UHF, emergency UHF, and TACAN.

5 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 WING DN and RH WING DN), visually check the following:

(1) Elevator (aileron) trim tab operating in correct sense.

(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 sense, using each stick-grip switch in turn.

(2) Right stick-grip elevator (aileron) trim selection overrides left stick-grip trim selection.

(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 trim switch is actuated.

6 With DC master switch to BATT, engine master switch ON, and throttle in CUT OFF, ensure that each air-start switch energizes the igniter plugs (recognized by audible and irregular sparking).

7 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.

8 When ground power is applied, ensure that the LOW FUEL PRESS, GENERATOR FAIL, BLEED VALVE OPEN, and SPEED BRAKE OUT legends are illuminated and all others off.

START

9 Carry out a normal start. Record light-up rpm, maximum start EGT, oil pressure, and hydraulic pressure. When loadmeter has stabilized at approximately 0.3 to 0.4 for a fully charged battery, record loadmeter and idling rpm readings.

NOTE

Light-up rpm in excess of 13% may indicate a faulty fuel system. Place aircraft unserviceable.

10 During operation of the speed brakes, ensure that right-hand switch overrides the selections made by the left.

BEFORE TAXIING

11 Before taxiing, check the generator and both inverters as follows:

TUTOR AIR TEST CARD

AIRCRAFT	DATE	PILOT	
TIME	FUEL	OAT	TEST

1 THIS CARD IS TO BE USED IN CONJUNCTION WITH EO 05-195A-1, PART 5 – FLIGHT TESTING. THE NUMBER BESIDE EACH SEQUENCE CORRESPONDS TO THE EQUIVALENT PARA NUMBER IN PART 5.

2 EXTERNAL		
3 PRE-START		
4 INTERCOMMUNICATIONS		
5 TRIMS		
6 AIRSTART IGNITION		
7 OXYGEN		
8 ANNUNCIATOR PANEL		
9 START		
LIGHT-UP RPM		
MAXIMUM EGT		
OIL PRESSURE		
HYDRAULIC PRESSURE		
IDLE RPM		
IDLE EGT		
LOADMETER		
10 SPEED BRAKE OVERRIDE SWITCH		
11 PRE-TAXI – ELECTRICAL		
12 NOSE-WHEEL STEERING		
13 WHEEL BRAKES		
14 ENGINE	INCREASE	DECREASE
TIME		
RPM		
EGT		
OIL PRESSURE		
HYDRAULIC PRESSURE		

15 ANTI-ICE	
16 WHEEL SHIMMY	
17 FRESH-AIR VENTS	
18 RELIGHT	
19 TRIM CONTROLS – 10,000 FT	
TRIM SETTING	
20 LATERAL TRIM AND	
LONGITUDINAL TRIM	
21 FLAPS	
22 DIRECTIONAL TRIM	
23 SPEED BRAKES	
24 COCKPIT TEMP CONTROL	
25 CANOPY DEMIST	
26 ANTI-G VALVE	
27 DUMP VALVE	
28 PRESSURIZATION	
29 CLIMB – 15,000 TO 18,000 FT	
RPM	
EGT	
OIL PRESSURE	
HYDRAULIC PRESSURE	
30 PRESSURIZATION LEAK	

FTC-2 REVISED JAN 68

31 ENGINE ACCELERATION – 25,000 FT	INCREASE	DECREASE
TIME		
RPM		
EGT		
OIL PRESSURE		
HYDRAULIC PRESSURE		
32 UHF		
33 TACAN		
34 IFF		
35 PRESSURIZATION		
36 IDLE RESET		
37 MACH RUN – 30,000 FT		
IAS		
EFFECTS		
SPEED BRAKES		
38 SPINS		
39 STALLS – 17,000 FT		
40 STALLS – 10,000 FT		
STICK SHAKER CLEAN		
STALL CLEAN		
STICK SHAKER DIRTY		
STALL DIRTY		

	LH	RH
41 NEGATIVE-G VALVE		
42 TURN-AND-SLIP INDICATORS		
43 ATTITUDE INDICATORS (1½°)		
44 VSI		
45 ACCELEROMETER		
46 ALTIMETERS	LH	RH
FIELD (±50)		
10,000 (±200)		
15,000 (±400)		
47 AIRSPEED INDICATORS AND MACHMETERS	LH	RH
100K (±4K)		
340K (±8K)		
MACHMETER– MAX DIFF 0.04		
48 LANDING GEAR WARNING		
49 OPERATION		
50 OVERRIDE		
51 EMERGENCY LOWERING		
52 FUEL LOW-LEVEL WARNING		

REMARKS:

SERVICEABLE ☐

UNSERVICEABLE ☐

TEST PILOT

Figure 5-2 Flight Test Card

(a) Move generator control switch to TRIP, ensuring that, in addition to MASTER CAUTION light, the GENERATOR FAIL and INVERTER 2 FAIL legends illuminate. Cancel MASTER CAUTION, and confirm that GENERATOR FAIL and INVERTER 2 FAIL legends remain illuminated.

(b) Ensure that the AC essential loads are maintained, and that main UHF has failed.

(c) Reset generator, ensuring that the GENERATOR FAIL and INVERTER 2 FAIL legends extinguish, and that failed electrical services are regained.

TAXIING

NOTE

At this stage, adjust altimeters to field altimeter setting. Ensure that each instrument reads within ±50 feet of airfield altitude (see item 46 on test card, Figure 5-2).

12 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.

13 Check the wheel brakes while taxiing out for take-off and during the engine check (new brake pucks must be broken in, to realize 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 they will hold the aircraft stationary at maximum continuous power during the engine check.

ENGINE CHECK

14 Complete the engine check before lining up on the runway:

(a) With engine idling and air-conditioning ON, move throttle from idle to full power within 1 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 1 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 recorded at Start Check (see para 9).

CAUTION

On the ground, the engine must not be run for a prolonged period at maximum continuous power without a two-minute cool-down period at 70% rpm after every five-minute interval.

15 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.

WHEEL SHIMMY

16 During the take-off run, ensure there is no wheel shimmy.

MEDIUM ALTITUDE

RAM AIR SYSTEM

17 Below 8,000 feet, open both fresh-air vents, note flow of air, and begin a climb. At an altitude between 8,000 feet and 11,500 feet the air vents should cut off air flow.

ENGINE RELIGHT

18 Procedure:

(a) Flame out the engine at 15,000 feet or above, and establish a stabilized glide at the appropriate airspeed for the altitude (180 knots at 15,000 feet MSL, minus 2.5 knots for each additional 1,000 feet).

(b) Ensure that this airspeed schedule sustains a minimum windmill RPM of 12%.

(c) Relight the engine (Procedure 1) and record undesirable characteristics, windmill RPM, and time required for the start.

(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, IAS, 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 subpara (b) above, or 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

19 The procedure for trim setting is as follows:

(a) Trim aircraft for straight and level flight at 250 knots IAS.

(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.

20 The procedure for lateral and longitudinal trim is as follows:

(a) Trim aircraft for straight and level flight at 250 knots IAS.

(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 knots IAS and trim laterally. Move control column approximately two inches to left, then release. Move control column approximately two inches to right, 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 sub-paras (e), (f), and (g) may indicate improperly rigged control systems or excessive control circuit friction.

FLAPS

21 Procedure:

(a) Trim aircraft in straight and level flight at 138 knots IAS. 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) There must be no change in lateral trim during flap movement.

22 Directional trim procedure is as follows:

(a) Increase speed to 350 knots IAS. The lateral stick force required to maintain level flight throughout the speed range should not exceed 2 pounds.

(b) Note the turn-and-slip indicator during the speed change from 250 knots decreased to 150 knots and increased to 350 knots. With no application of rudder, both the needle and ball must remain within ±1/32 inch of the original trim position over the entire speed range.

SPEED BRAKES

23 Procedure:

(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 3 seconds (as noted by the recovery of the hydraulic pressure), and must retract in a maximum of 5 seconds.

(b) Ensure that SPEED BRAKE OUT annunciator 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.

COCKPIT TEMPERATURE CONTROL

24 Procedure:

(a) Establish level flight at 10,000 feet at cruise power, with altitude, speed, and power settings 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

25 Test demisting at 10,000 feet 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.

ANTI-G VALVE

26 Apply positive acceleration. The G valve will open between 1.5 and 2G, increasing pressure with increasing G and decreasing pressure with decreasing G.

NOTE

If a G suit is not worn, the system may be checked by noting that the flow of air at the G-suit connection increases with an increase in G, and decreases with a decrease in G.

COCKPIT PRESSURE DUMP

27 Actuate cockpit pressure dump switch. The cockpit altitude should immediately climb and approximate aircraft altitude.

CLIMB

PRESSURIZATION

28 At altitudes of 8,500 and 16,150 feet, the cockpit altitudes must be 8,000 (±1,000) feet, with maximum fluctuations of ±100 feet. This

tolerance of 8,000 (±1,000) feet must be maintained at all altitudes between 8,500 and 16,150 feet (see Figure 1-11).

ENGINE CLIMB CHECK

29 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 Figure 2-8.

PRESSURIZATION LEAK

30 With aircraft in level flight at 18,000 feet and 98% rpm, adjust cockpit temperatures for pilot comfort:

(a) Record cockpit altitude and note when it is 9,400 (±1,000) feet.

(b) Retard power to flight idle for 1 minute. Cockpit altitude should remain approximately constant.

HIGH ALTITUDE

ENGINE ACCELERATION AND DECELERATION

31 Proceed as follows:

(a) At 25,000 feet, 100 knots IAS, and flight idle, move throttle from idle to maximum continuous power in 1 second. Engine should accelerate to stabilized 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 1 second. Engine should decelerate and stabilize at flight idle.

ARC-552 MAIN UHF AND ARC-504 EMERGENCY UHF RADIO

32 The ARC-552 must be checked at an altitude of 30,000 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 mcs, using both pre-set and manual. The ARC-504 must be checked for satisfactory two-way communications within 50 nm of the selected ground station.

AN/ARN-501 TACAN

33 Between 10,000 feet and 30,000 feet, and at a range of approximately 75 nm from the ground facility, fly over a selected geographical location, and home on 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 ±3 degrees of the actual radial bearing from the TACAN station.

(b) Indicated range should be within ± 2 nm of the actual range to the TACAN station.

(c) The track bar must zero and give correct left/right indications with deviations from the selected radial.

(d) 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.

AN/APX-46 IFF TRANSPONDER

34 At 30,000 feet and approximately 60 nm from a ground Radar station, contact the station and request a "parrot" check. The ground station should report satisfactory operation of IFF/SIF in modes 1 and 3, emergency, and I/P.

PRESSURIZATION

35 At 30,000 feet and using maximum continuous power, cockpit altitude should be 18,000 (±2,000) feet.

IDLE RESET

36 Procedure:

(a) At 30,000 feet and 90 knots IAS, 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, TACAN, IFF, Intercom	- On
Cockpit Air-conditioning	- Auto
Windshield Anti-icing	- On
Drag	- As required

(b) Ensure that engine rpm does not run down, and note idle rpm reading.

NOTE

Idle rpm must correspond approximately to that of the schedule shown in Figure 4-18.

DESCENT — FLIGHT CHARACTERISTICS

MACH RUN

37 Carry out the mach run as follows:

(a) Trim aircraft for straight and level flight at 30,000 feet, using maximum continuous power, and with the speed brakes retracted. Dive to increase airspeed to the limiting mach number 0.78.

(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 situation 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

38 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.

STALL

39 This stall series is conducted to determine any undesirable flight characteristics involving severe wing drop or flick rolls. Carry out all sequences at 17,000 feet.

(a) Clean - Enter with nose slightly above horizon, keeping the wings level with aileron. Retract speed brakes at 100 knots, and hold attitude until aircraft stalls.

(b) Landing Attitude - Simulate the final approach; that is, speed brakes out, landing gear and flaps down, rpm at 65%, and airspeed 115 knots. Allow airspeed to decrease to 95 knots, then round out until the stall occurs.

NOTE

The aircraft is serviceable if there is no wing drop throughout the approach to the stall. Wing drop may occur after the stall.

(c) High Speed - Enter a co-ordinated 60-degree bank turn at 160 knots. Reduce power to flight idle, maintain altitude, and permit airspeed to decrease. At 140 knots, progressively increase back pressure on control column until aircraft stalls. Repeat in the opposite direction.

NOTE

If the stall can be sustained for about 2 seconds, and the recovery then made, without 'flicking', the aircraft is serviceable. The roll tendency is more pronounced with an aft CG, eg, when the right seat is unoccupied.

MEDIUM ALTITUDE-10,000 FEET

STALL SPEED

40 Carry out the following procedure:

(a) With approximately 1,000 pounds of fuel remaining, perform a power-off clean-configuration stall. Approach stall maintaining aircraft directionally straight and laterally level, decreasing speed gradually over the last 15 knots.

(b) Record speed at which stick shaker is activated. Continue to decrease speed until aircraft stalls. Record stall speed and fuel remaining. The stall speed should be 83(±3) knots. The stick shaker should be activated approximately 9 knots above the speed at which the stall occurs.

(c) Repeat stall test with flaps and gear down, and with speed brakes out. The stall speed should be 72(±3) knots.

NOTE

For any other fuel weight, see Figure 2-3 for stall speeds.

BOOST PUMP NEGATIVE-G VALVE

41 At 10,000 feet with a minimum of 1,000 pounds of fuel, enter inverted flight maintaining -1G and maximum RPM for 15 seconds. Reject the engine if one of the following occurs:

(a) The low fuel-pressure warning light illuminates.

(b) The engine flames out.

(c) The oil pressure does not recover to specified limits.

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. If the oil pressure recovers on return to normal attitude, the engine is serviceable. With loss of oil pressure, the engine operating limitation is 30 seconds.

NOTE

The oil pressure may drop momentarily, and the low-fuel-quantity and low-fuel-pressure warning lights may illuminate momentarily during entry and recovery. This does not render the aircraft unserviceable.

TURN-AND-SLIP INDICATOR

42 To check the turn-and-slip indicators:

(a) Trim aircraft in straight and level flight at 200 knots IAS.

(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 2 minutes, that during turning manoeuvres the needle and ball of each instrument move freely, and that both instruments indicate alike.

NOTE

A momentary indication of turn in the opposite direction may occur as the turn is initiated.

ATTITUDE INDICATOR

43 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 5 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 5 degrees.

VERTICAL SPEED INDICATOR

44 The difference in reading between the two instrument pointers must not exceed 200 feet/minute. Check instrument accuracy against a timed climb or descent.

ACCELEROMETER

45 Apply up to maximum allowable positive and negative G, and note that needles move in harmony with G applied. The accelerometer should operate normally, and should show no indication of sticking or over-sensitivity.

ALTIMETER

46 The altimeter pointers should move positively and without hesitation under normal flying conditions. The reading between the two instruments should not differ by more than 200 feet at an altitude of 10,000 feet. Above 15,000 feet the readings may differ by as much as 300 to 400 feet.

AIRSPEED INDICATOR AND MACHMETER

47 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 knots at 100 knots.

8 knots at 340 knots.

(b) The maximum allowable difference between the two machmeters is 0.04 mach.

LOW ALTITUDE

LANDING GEAR WARNING

48 Proceed as follows:

(a) Establish level flight at 1,000 feet AGL, 240 knots IAS, with landing gear UP.

(b) Slowly retard throttle, and note rpm at which audible warning commences and red warning light illuminates (should be 65(±2)%).

(c) Depress horn cut-out button and note that tone ceases; warning light will remain on. Advance throttle and ensure that light goes out.

LANDING GEAR OPERATION

49 Carry out the following procedure:

(a) Establish level flight at 160 and 170 knots IAS.

(b) Extend and retract landing gear. (Aircraft yaw during extension or retraction may indicate an undesirable asymmetric 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 8 seconds maximum.

LANDING GEAR UP-SELECTION OVERRIDE SWITCH

50 Proceed as follows:

(a) Set up aircraft as in para 49.

(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 gear-up-selection override switch is in OFF position.

EMERGENCY LANDING GEAR LOWERING

51 At 175 knots IAS or less, select emergency system 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.

FUEL LOW-LEVEL WARNING

52 When in level flight at 128 knots IAS and below 5,000 feet altitude, ensure that the low-level warning light illuminates when the fuel quantity falls to 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 low-level fuel warnings.