EO 05-5C-1

ROYAL CANADIAN AIR FORCE

PILOTS OPERATING INSTRUCTIONS

SABRE MKS 2 & 4

This EO includes advance revision dated 1 Mar 54

"REVISION" NOTICE

LATEST REVISED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert revised pages into basic publication. Destroy superseded pages.

ISSUED ON AUTHORITY OF THE CHIEF OF THE AIR STAFF

31 DEC 53

Revised 19 Mar 54

LIST OF RCAF REVISIONS

Date	Page No	Date	Page No
19 Mar 54	27		
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SABRE 2 & 4

"This is an Advance Revision to EO 05-5C-1 dated 31 Dec 53 revised 19 Mar 54, carrying the full authority of AFEOs. This format is adopted to provide holders of the subject E.O. with advance notice of important amendments that will be included in a regular revision at a later date."

1 Page 85, Part 3, Para 35

35 Sudden loss of fuel pressure and a decrease in engine rpm indicates failure of some portion of the main fuel control system and necessitates switching to the emergency fuel control system for continued operation. In order to switch safely from the main to the emergency fuel system, either the emergency system must be turned on before engine rpm drops below 80% rpm, or the throttle control must be retarded to IDLE, the emergency system switched ON, and the throttle control re-advanced slowly. In an emergency where time does not permit this procedure, the emergency system may be switched ON if the power lever position is retarded to a point where the power called for by its position is less than that being obtained from the engine. A slow acceleration must be made at all times when the emergency system is ON.

WARNING

Do not turn on emergency fuel switch if rpm is below 80% without first following the procedure outlined above. To do so may cause dangerous engine overheating or compressor stall.

CAUTION

No automatic engine overspeed protection is provided when the emergency fuel control system is being used and throttle movement must be smooth and gradual to avoid flameout or engine overspeeding, particularly at high altitudes.

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NOTES TO USERS

1 This publication is divided into four parts: Description, Handling, Emergency Handling and Operating Data.

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 airplane by the pilot.

4 PART 3 - EMERGENCY HANDLING describes the emergency handling of the airplane 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 These notes are complementary to EO 05-1-1 - Pilot's Operating Instructions General and assume a thorough knowledge of its contents.

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 Air Force Headquarters.

Figure 1-1 Sabre Aircraft

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PART 1

DESCRIPTION

INTRODUCTION

General

1 The Sabre MK 2 and MK 4 aircraft is a single place, jet-propelled monoplane, characterized by a swept-back wing and empennage. Designed primarily as a high-speed, high-altitude fighter, the aircraft may also be used to attack ground or naval objectives with gunfire, bombs, chemicals and rockets. The pilot is protected fore and aft by armour-plate bulkheads. The horizontal stabilizer controls are also protected by armour-plate between the normal and alternate hydraulic systems at the horizontal stabilizer. (See figures 1-1 and 1-2.)

2 The power plant is an axial-flow, turbo-jet engine, model J-47-GE-13, providing approximately 5200 pounds of static thrust. An electric starter is provided which operates on an external source of power only.

LEADING PARTICULARS

Dimensions

3 The overall dimensions of the aircraft are as follows:

(a)	Wing span	37. 1 feet
(b)	Length	37. 5 feet
(c)	Height	14. 7 feet

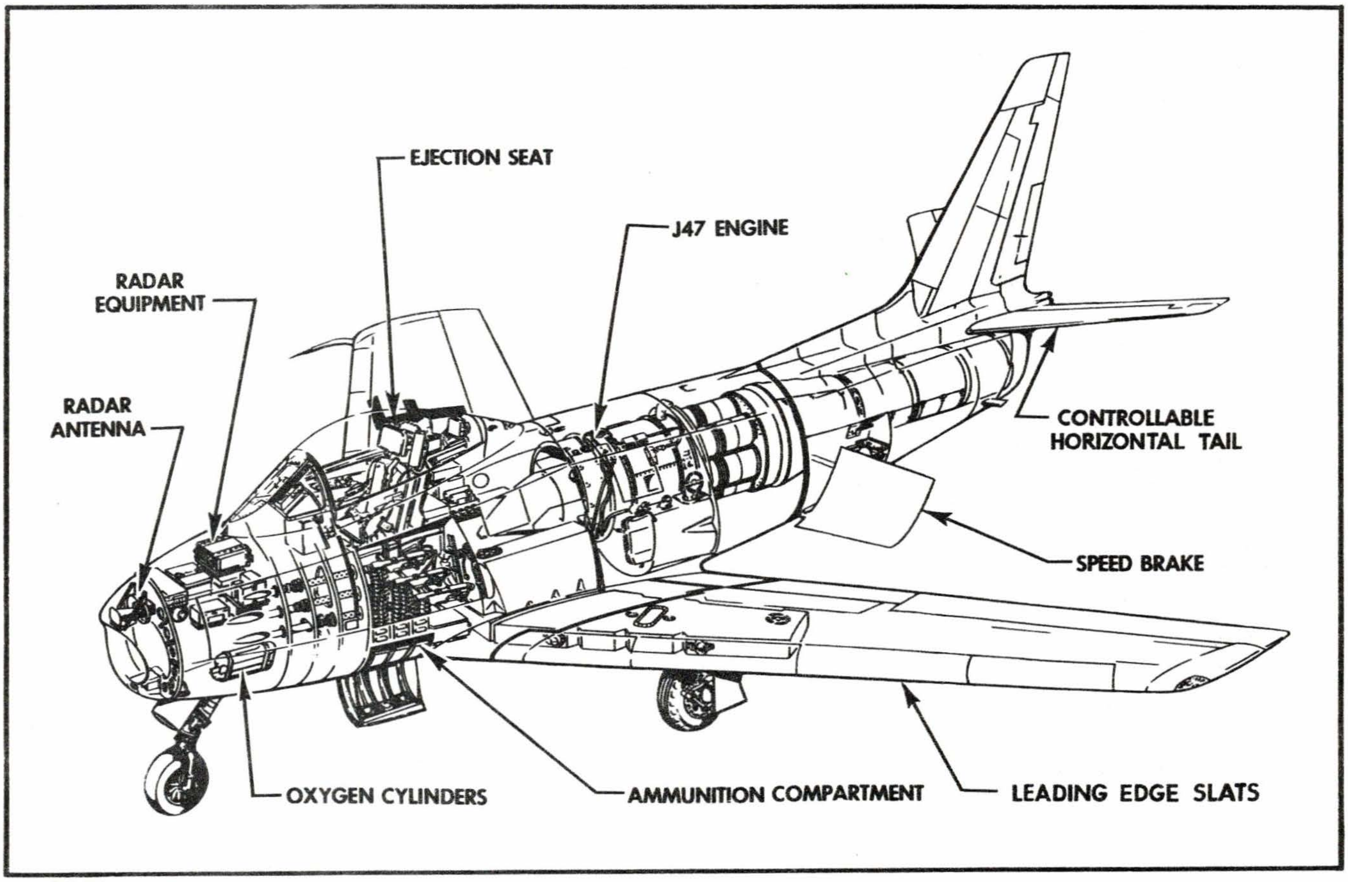


Figure 1-2 General Arrangement

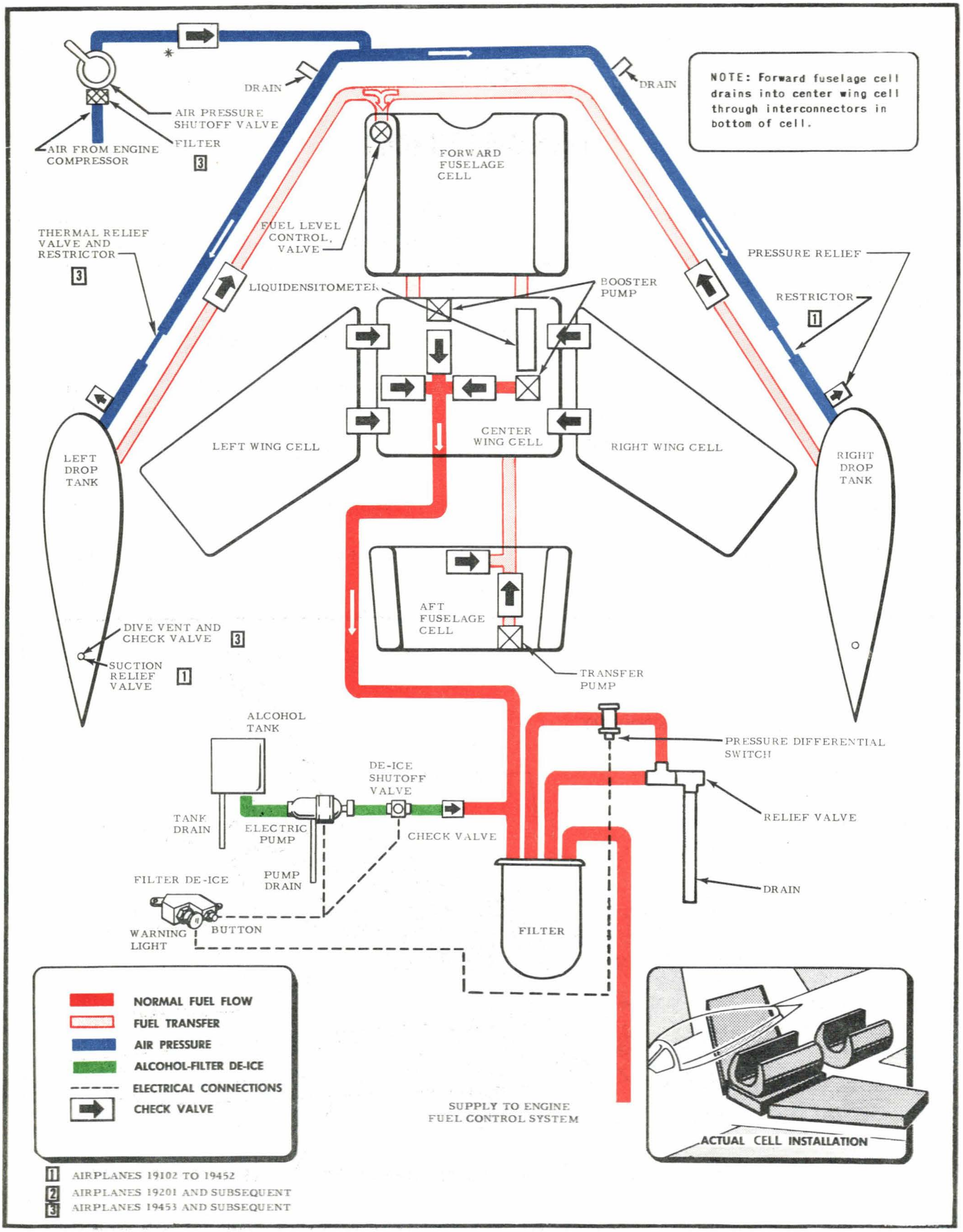


Figure 1-3 (Sheet 1 of 2) Fuel System

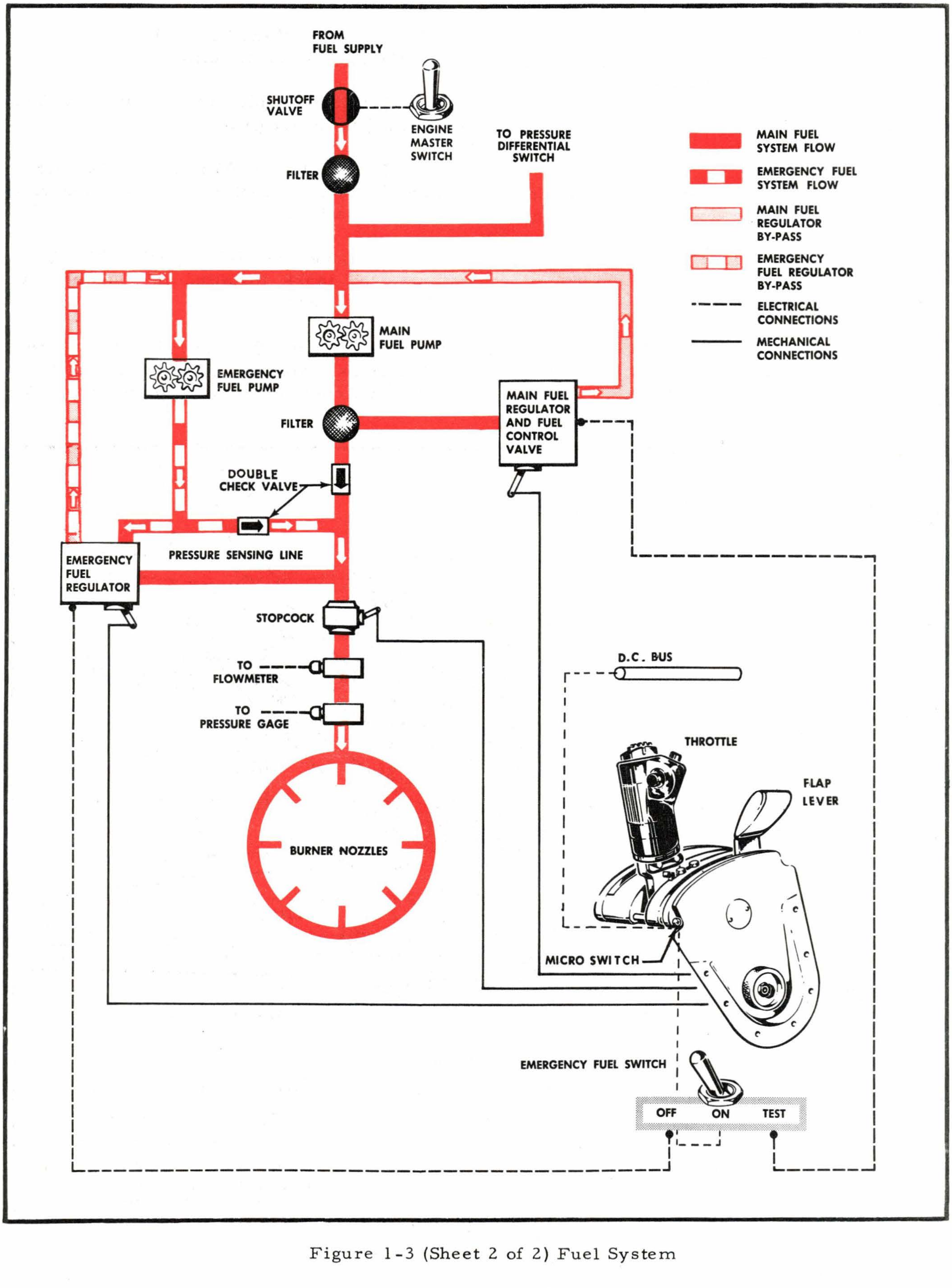


Figure 1-3 (Sheet 2 of 2) Fuel System

Weight

4 Approximate weights are as follows (see EO 05-5C-8 for actual weights):

(a) Basic weight (no fuel, oil, ammunition or pilot) 11,100 pounds.

(b) Clean aircraft loaded (including internal fuel, oil, ammunition and pilot) 14,640 pounds.

(c) With two 100 Imperial (120 U.S.) gallon drop tanks (including full fuel, oil, ammunition and pilot) 16,480 pounds.

(d) With two 167 Imperial (200 U.S.) gallon drop tanks (including full fuel, oil, ammunition and pilot) 17,750 pounds.

Fuel Cell and Oil Tank Capacities

5 Capacities are as follows:

(a) Total available internal fuel is 362 Imperial (435 U.S.) gallons.

(b) Total fuel with 100 Imperial (120 U.S.) gallon drop tanks installed is 562 Imperial (675 U.S.) gallons.

(c) Total fuel with 167 Imperial (200 U.S.) gallon drop tanks installed is 696 Imperial (835 U.S.) gallons.

(d) On aircraft 19102 to 19452 the approximate oil tank capacity is 4.7 Imperial(5.7 U.S.) gallons, and expansion space approximately .95

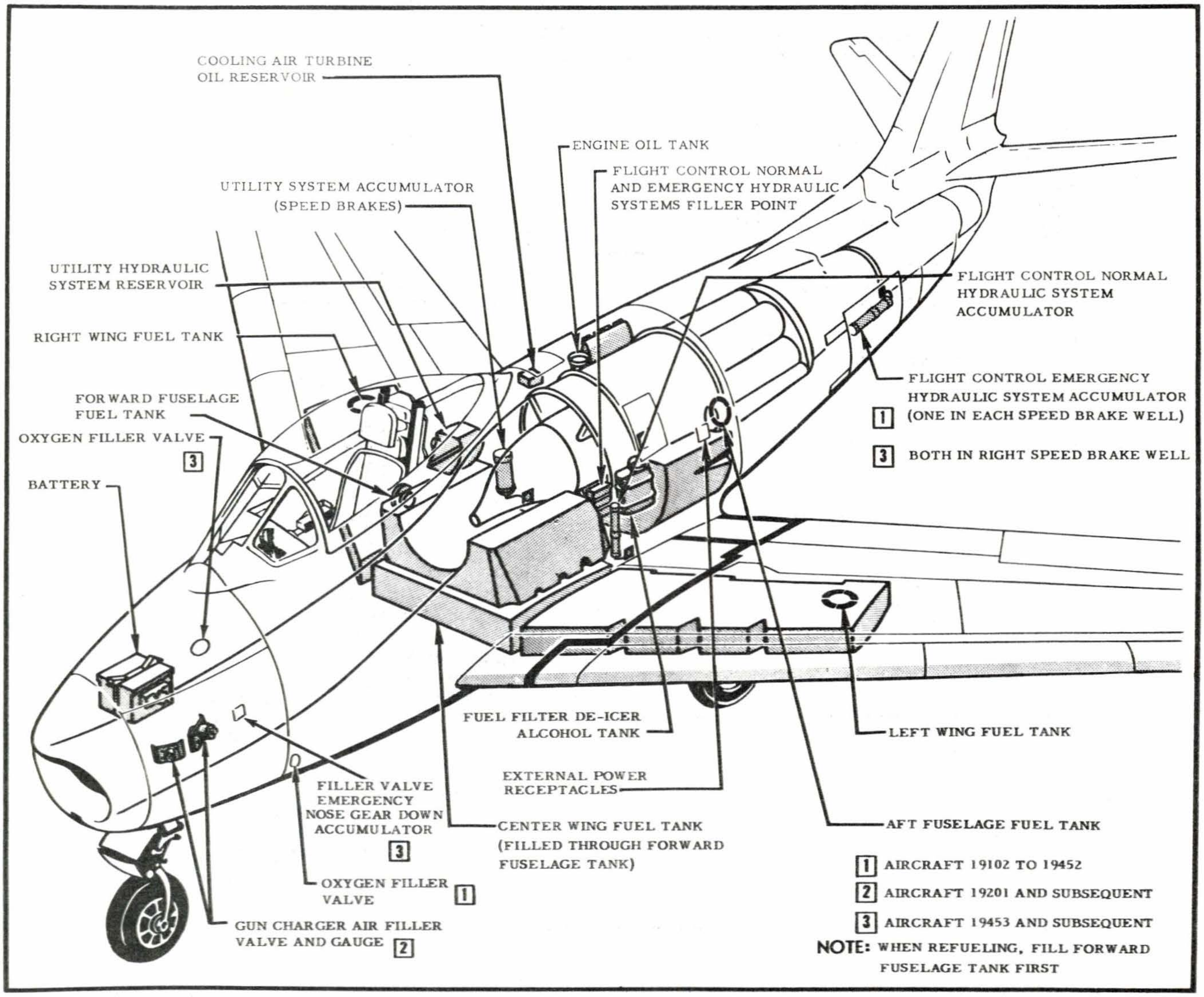


Figure 1-4 Servicing Diagram

Imperial (1. 15 U.S.) gallon. On aircraft 19453 and subsequent the maximum oil tank capacity is approximately 2.9 Imperial (3. 5 U.S.) gallons with an expansion space of approximately . 8 Imperial (1. 0 U.S.) gallon.

NOTE

> All tanks, irrespective of their capacity, will be filled to 2. 9 Imperial (3. 5 U.S.) gallons only.

FUEL SYSTEM

General

6 Five self-sealing fuel cells are installed; two in the fuselage, one in the centre wing section, and one in each outer wing panel (see figure 1-3). Fuel is supplied to the engine from the centre wing cell which receives fuel from other cells by gravity feed. Flow from the rear fuselage cell is aided by a transfer pump which is actuated when the level in the centre wing cell drops below approximately 46 Imperial (56 U.S.) gallons. A 100 Imperial (120 U.S.) gallon or a 167 Imperial (200 U.S.) gallon drop tank may be installed under each outer wing. Compressed air from the engine compressor section forces fuel from the drop tanks to the forward fuselage cell, through a fuel level control valve, when the fuel level in the fuselage cell decreases by 4 Imperial (5 U.S.) gallons.

7 There are individual filler points for each tank except the centre wing tank, which is filled through the forward fuselage tank. The fuel filler access doors cannot be closed unless the fuel tank filler caps are screwed in the locked position. When refuelling, the forward fuselage cell must be filled first in order to utilize the full capacity of the fuel system. If the wing tanks or the aft fuselage tank are filled first fuel from these tanks will slowly drain into the centre wing tank while the forward fuselage tank is being serviced.

Fuel Grade and Specifications

8 Recommended fuels are 3-GP-23a (Grade JP-1, MIL-F-5616) 8. 15 pounds per Imperial gallon; 3-GP-22a (Grade JP-4, MIL-F-5624A); 7. 8 pounds per Imperial gallon, and 3-GP-25b (MIL-F-5572A, Grade 100/130) 7. 2 pounds per Imperial gallon. For servicing diagram, see figure 1-4.

Fuel Quantity Gauge

9 A fuel quantity gauge, (see figures 1-5, 1-6, and 1-7) indicating total internal fuel in gallons, is located on the instrument panel. No gauge is provided for the drop tanks. During take off, with drop tanks full, the fuel quantity gauge normally will indicate a decrease until drop tanks begin to transfer fuel. At full power, fuel may be used at a greater rate than fuel is being transferred from the drop tanks.

10 On aircraft 19171 and subsequent the liquidometer type fuel quantity system is replaced by the liquidensitometer type system. The densitometer system incorporates a guarded selector switch on the right aft console. When the guard is down, the switch is at IN (normal position) and the fuel quantity gauge will show the total fuel supply in pounds, corrected for any variation in fuel density. When the guard is raised and the switch moved to OUT, the system is adjusted to permit uncompensated gauge readings. This latter condition is used when a standard indication of quantity, such as a full condition after refuelling, is desired.

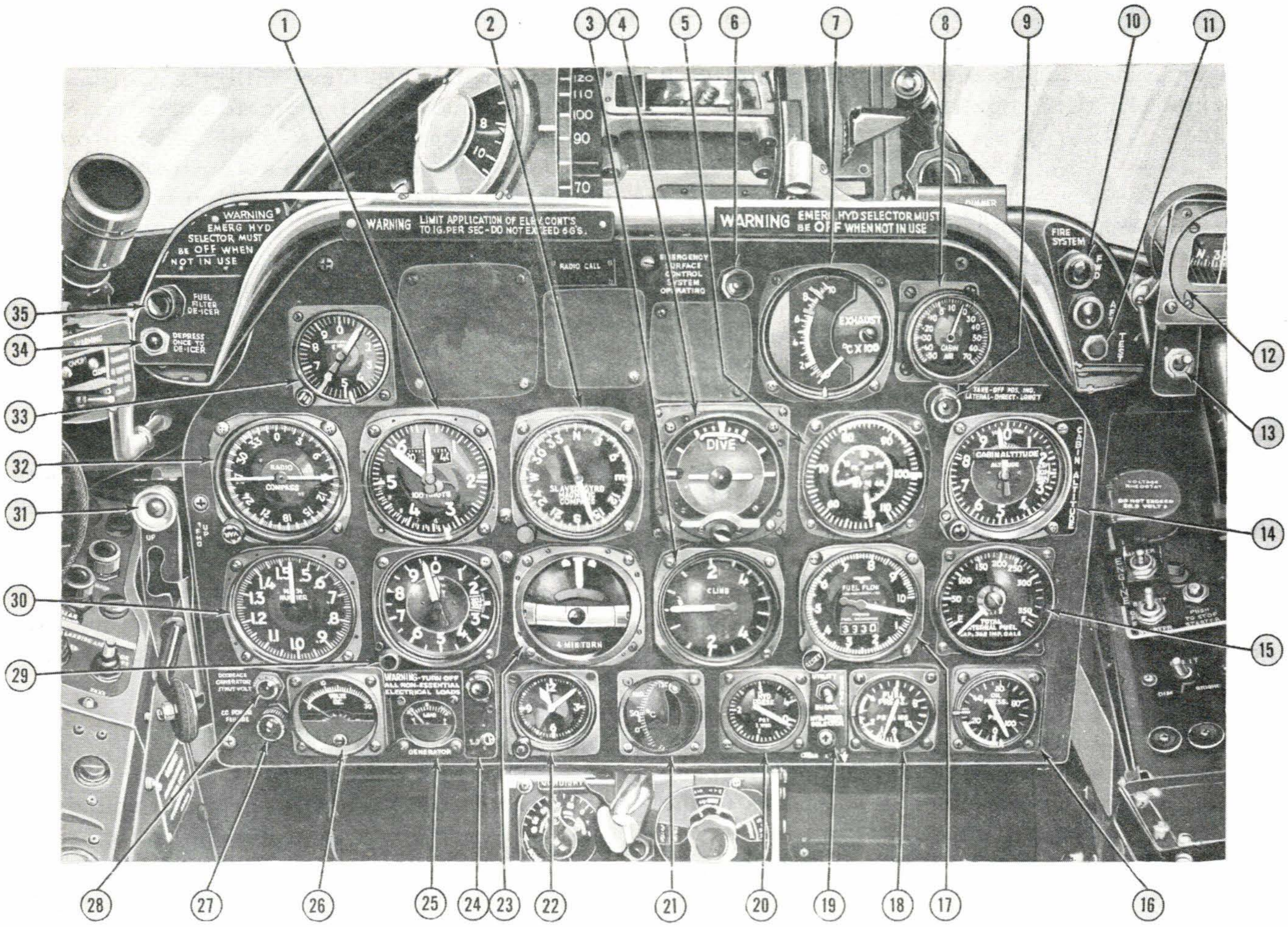
Fuel Flowmeter and Totalizer

11 The fuel flowmeter on the instrument panel shows the rate of fuel flow in pounds per hour and includes a totalizer dial which indicates the number of pounds of fuel remaining. A knob on the flowmeter is used to preset the totalizer to correspond to the total pounds of fuel in the tanks before take-off. On aircraft 19102 to 19170 inclusive, which have the fuel quantity gauge calibrated in gallons, the fuel total, including that in the drop tanks, must be converted to pounds before the totalizer is set. On aircraft 19171 and subsequent, the totalizer must be preset to agree with the quantity gauge, including also whatever poundage is in the drop tanks.

12 The totalizer dial of the fuel flowmeter should not be relied upon for accurate indications of fuel remaining because of errors inherent in the instrument. Instrument errors are due to temperature variations and chemical make-up of the fuel. Accurate indications of internal fuel remaining can be obtained only from the fuel quantity gauge.

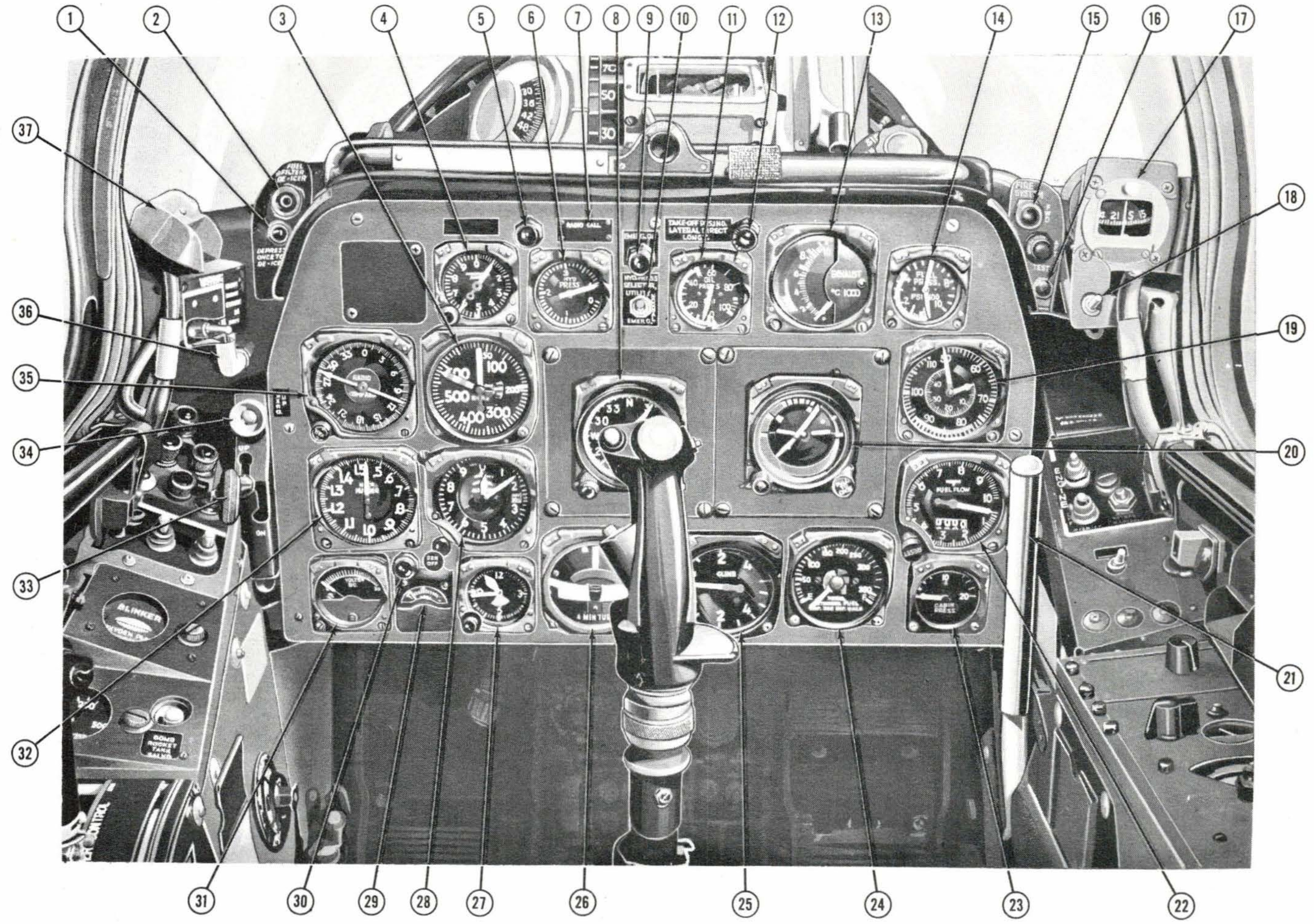
Booster Pumps

13 Two booster pumps in the centre wing cell are energized during starting when external power is connected, or when the engine master switch is ON and the throttle control lever



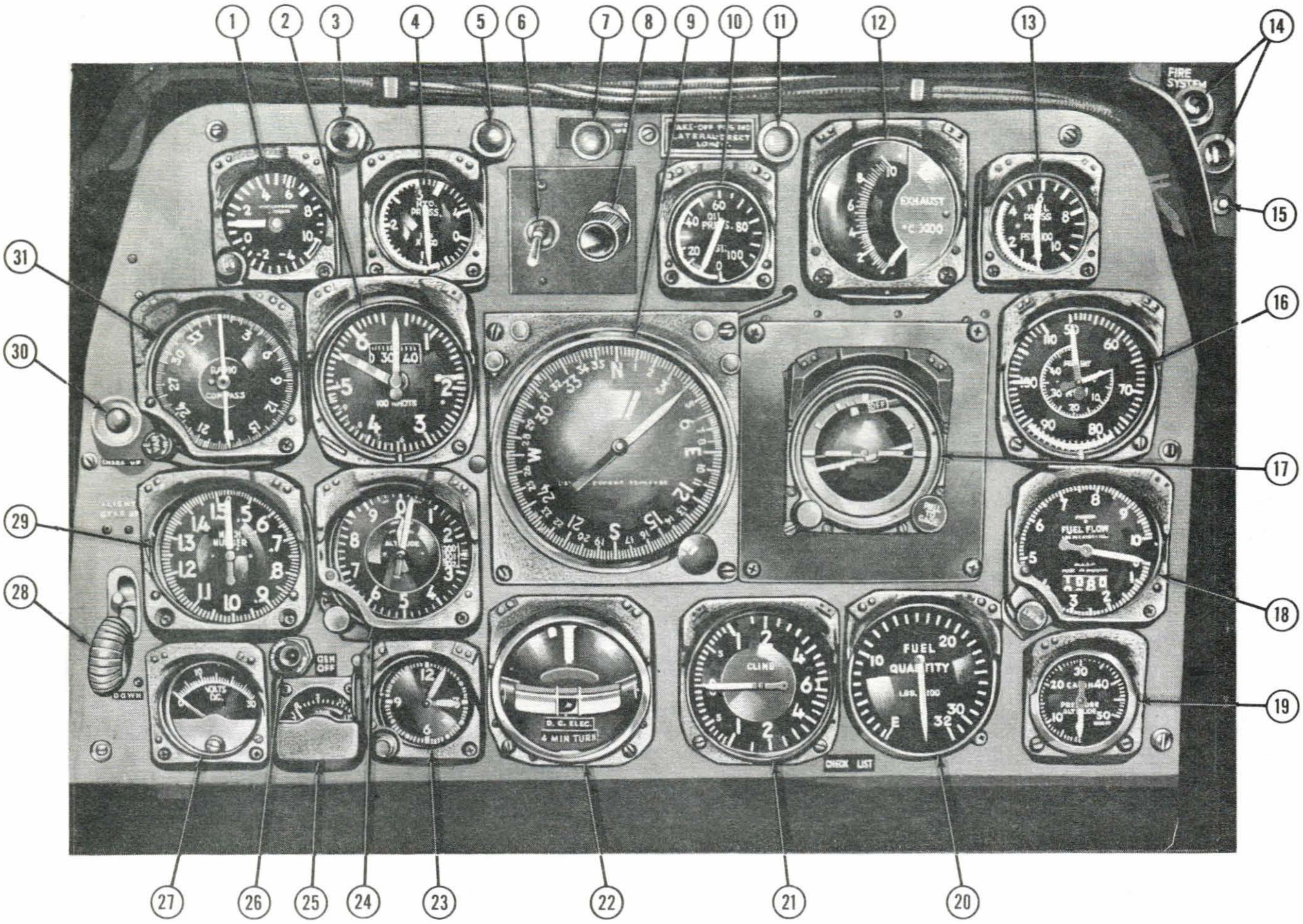
1 Airspeed indicator.
2 Gyro compass.
3 Rate of climb indicator.
4 Artificial horizon.
5 Tachometer.
6 Emergency flight control indicator.
7 Tailpipe thermometer.
8 Cabin thermometer.
9 Take-off position indicator light.
10 Fire warning lights.
11 Fire warning lights test button.
12 Magnetic compass.
13 Magnetic compass light switch.
14 Cabin altimeter.
15 Fuel contents gauge.
16 Oil pressure gauge.
17 Fuel flowmeter.
18 Fuel pressure gauge.
19 Hydraulic pressure selector.
20 Hydraulic pressure gauge.
21 Oil temperaure indicator.
22 Clock.
23 Turn and bank indicator.
24 Generator off warning light.
25 Loadmeter.
26 Voltmeter.
27 A.C. power failure warning light.
28 Generator overvoltage warning light.
29 Altimeter
30 Machmeter.
31 Landing gear emergency up button.
32 Radio compass.
33 Accelerometer.
34 Fuel filter de-ice button.
35 Fuel filter ice warning light.

Figure 1-5 Cockpit-Forward View (Aircraft 19102 to 19121, 19123 to 19140)



1 Fuel filter de-ice button.
2 Fuel filter ice warning light.
3 Airspeed indicator.
4 Accelerometer.
5 Instrument power selector.
6 Hydraulic pressure gauge.
7 Radio call.
8 Gyrosyn compass.
9 Emergency hydraulic light.
10 Hydraulic pressure gauge selector switch.
11 Oil pressure gauge.
12 Take-off position indicator light.
13 Tailpipe thermometer.
14 Fuel pressure gauge.
15 Fire warning lights.
16 Fire warning lights test button.
17 Magnetic compass.
18 Magnetic compass light switch.
19 Tachometer.
20 Artificial horizon.
21 Hydraulic hand pump.
22 Fuel flow meter.
23 Cabin pressure gauge.
24 Fuel contents gauge.
25 Rate of climb indicator.
26 Turn and bank indicator.
27 Clock.
28 Altimeter.
29 Loadmeter (ammeter)
30 Generator off warning light.
31 Voltmeter.
32 Machmeter.
33 Landing gear control handle.
34 Landing gear emergency up button.
35 Radio compass.
36 Parking brake handle.
37 Auxiliary instrument panel light.

Figure 1-6 Cockpit-Forward View (Aircraft 19122, 19141 to 19452)



1 Accelerometer.
2 Airspeed indicator.
3 Main instrument inverter off warning light.
4 Hydraulic pressure gauge.
5 Both instrument inverter off warning light.
6 Hydraulic pressure indicator selector switch.
7 Radar inverter off warning light.
8 Emergency hydraulic light.
9 Gyro compass.
10 Oil pressure gauge.
11 Take-off position indicator light.
12 Tailpipe thermometer.
13 Fuel pressure gauge.
14 Fire warning lights (fwd and aft).
15 Fire warning lights test button.
16 Tachometer.
17 Artificial horizon.
18 Fuel flowmeter.
19 Cabin pressure gauge.
20 Fuel contents gauge.
21 Rate of climb indicator.
22 Turn and bank indicator.
23 Clock.
24 Altimeter.
25 Loadmeter.
26 Generator off warning light.
27 Voltmeter.
28 Landing gear control handle.
29 Machmeter.
30 Landing gear emergency up button.
31 Radio compass.

Figure 1-7 Cockpit-Forward View (Aircraft 19453 and Subsequent) is moved outboard from the **OFF** position to pass the idle stop. The pumps are turned off when the throttle is moved inboard to the **OFF** position.

14 The booster pumps and transfer pumps in the aft fuselage cell may be tested on the ground by means of three switches, two in the left wheel well and one in the right wheel well.

Shut-off Valve

15 The fuel shut-off valve, located upstream of the filter, is controlled through the engine master switch.

Engine Fuel Stopcock

16 The engine fuel stopcock is controlled by the throttle control. Movement of the throttle control lever from OFF to IDLE opens the stopcock.

Drop Tank Pressure Shut-off Valve

17 A drop tank pressure shut-off valve is located on the left aft console. (See figures 1-8, 1-9 and 1-10.) When the valve is turned ON, both drop tanks are pressurized by air from the engine compressor section. Since there is no quantity gauge to show when the drop tanks are empty, the pressure shut-off valve should be ON at all times in flight, when the drop tanks are installed, to ensure that all fuel in the drop tanks is used.

Drop Tank Release

18 The drop tanks may be released simultaneously by means of the normal bomb release system or both tanks can be jettisoned simultaneously by operation of the bomb-rocket-tank salvo switch. On aircraft 19301 and subsequent the emergency jettison handle may be used to release both tanks simultaneously.

Fuel Filter De-ice Button

19 The fuel filter de-ice button, located adjacent to the filter de-icer warning light, is depressed to start the electric pump and open a shut-off valve to allow alcohol to be pumped to the low pressure fuel filter. The de-ice button must be held in to operate the pump and hold the shut-off valve open until the filter is de-iced, which is indicated by warning light going out. Do not operate for more than 15 seconds at a time.

OIL SYSTEM

General

20 Lubrication is provided by a pressure-type oil system with scavenge pump return to the oil tank located at the forward right side of the engine.

21 Oil Specification: MIL-O-6081A, Grade 1005 for all weather conditions.

Oil Pressure and Oil Temperature Indicators

22 An electric oil pressure indicator and an oil temperature indicator, the latter installed on aircraft 19102 to 19121, 19123 to 19140 only, are located on the instrument panel. For desired readings, refer to Part 4.

HYDRAULIC SYSTEMS

General

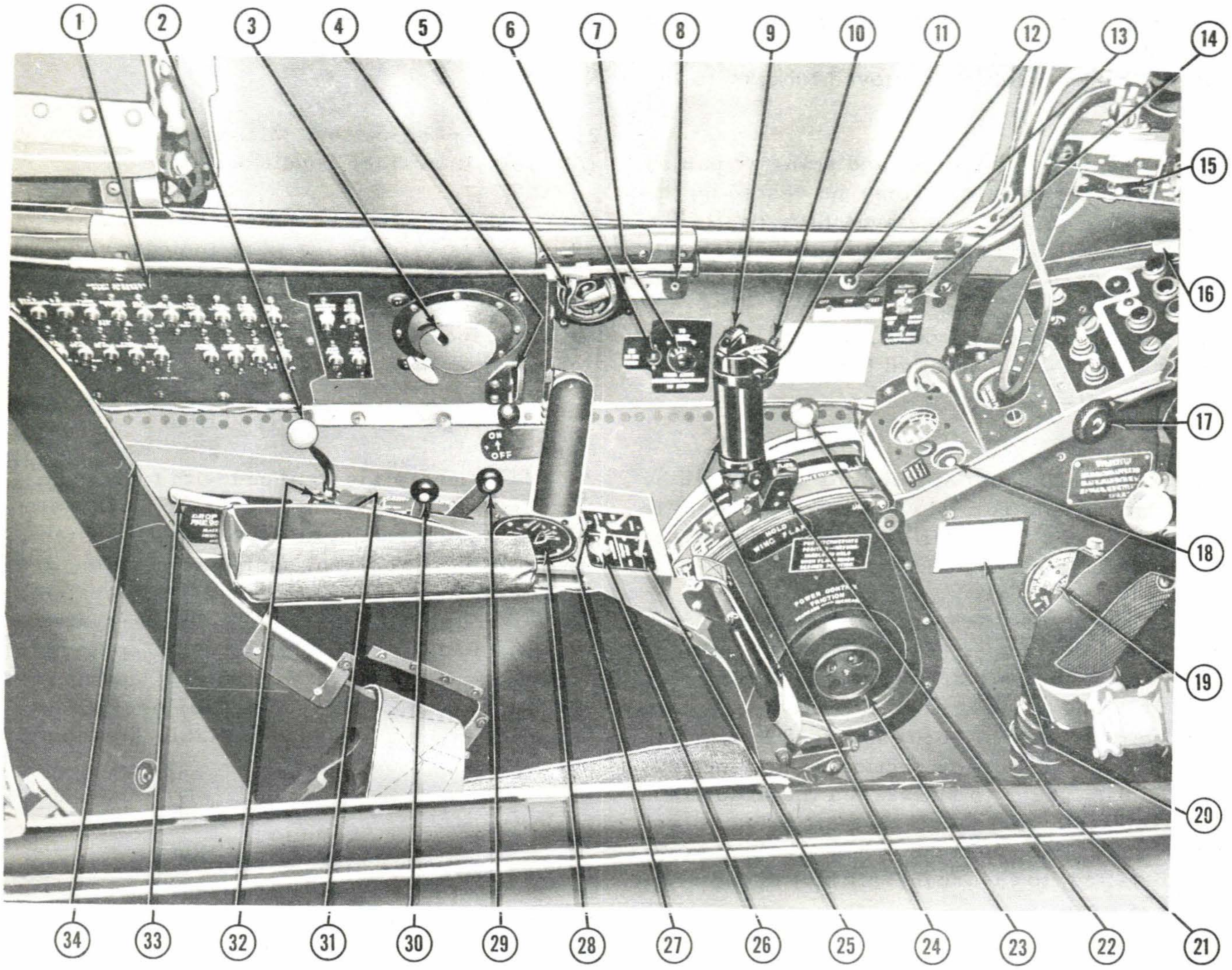
23 The aircraft is equipped with four separate hydraulic systems, a utility hydraulic system, an emergency utility hydraulic system, a normal flight control hydraulic system, and an alternate flight control hydraulic system, (see figures 1-15 and 1-16). These systems are of the closed-centre, constant-pressure type. The normal flight control hydraulic system supplies hydraulic power for operation of the ailerons and the controllable horizontal tail.

Utility Hydraulic System

24 The utility hydraulic system is a constant-pressure system incorporating a variable-output pump. An accumulator for pressure storage is provided for the operation of the speed brakes only. The system supplies power for operation of landing gear, speed brakes, nose wheel steering, and wheel brake control boost. Operating speed brakes and landing gear on a constant-pressure-type system makes it unnecessary to return controls to neutral after each operation. The neutral position provided for each control should be used, however, as this will isolate the individual systems from the pressure supply and prevent loss of fluid in case of a damaged line.

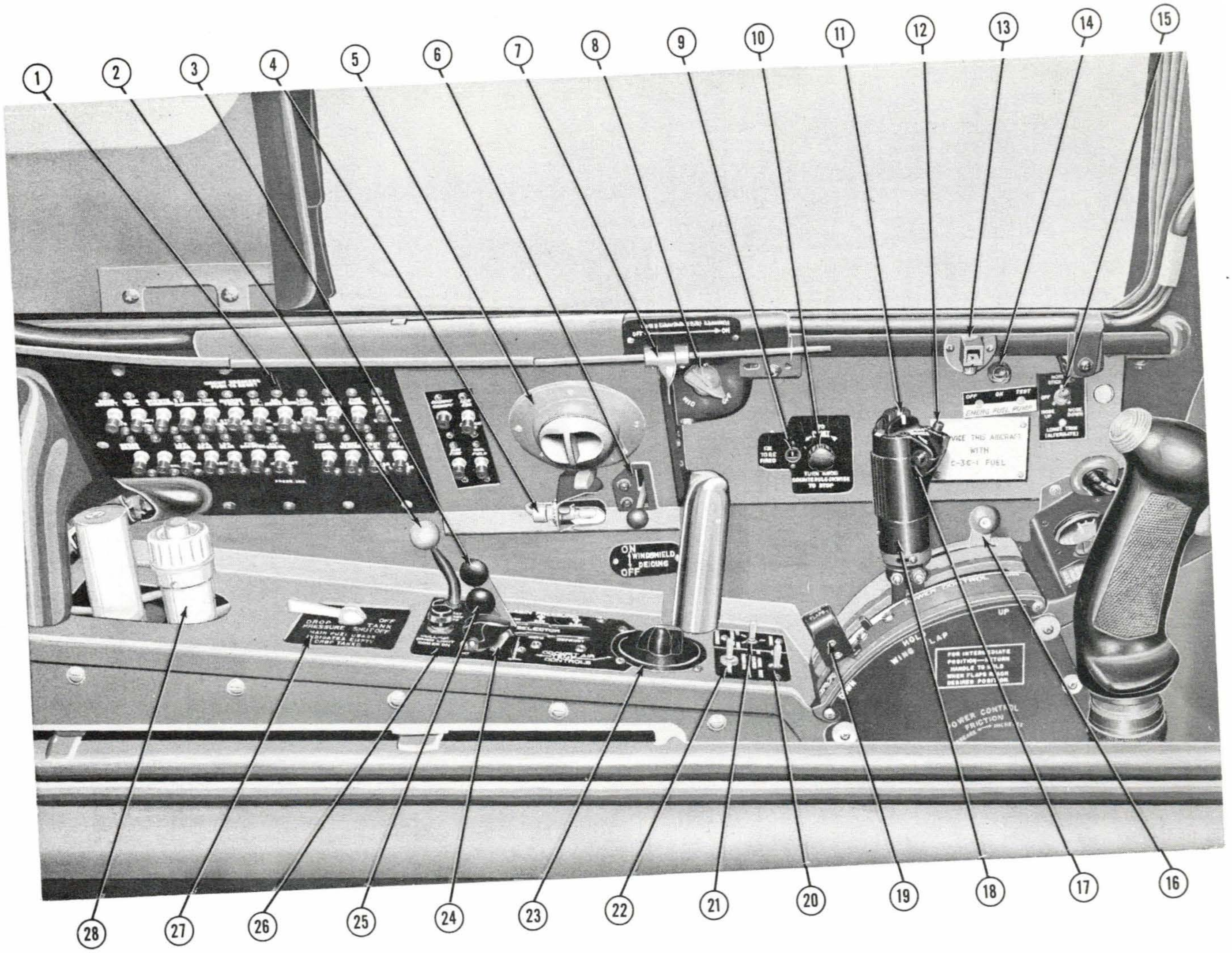
Emergency Utility Hydraulic System

25 On aircraft 19102 to 19452 inclusive, the emergency utility hydraulic system consists of a reservoir, selector valve and hand pump. The system provides a means of supplying pressure to the utility system with a hand-pump located on the right side of the cockpit. On aircraft 19453 and subsequent, the hand-pump and reservoir are replaced by a hydraulic accumulator.



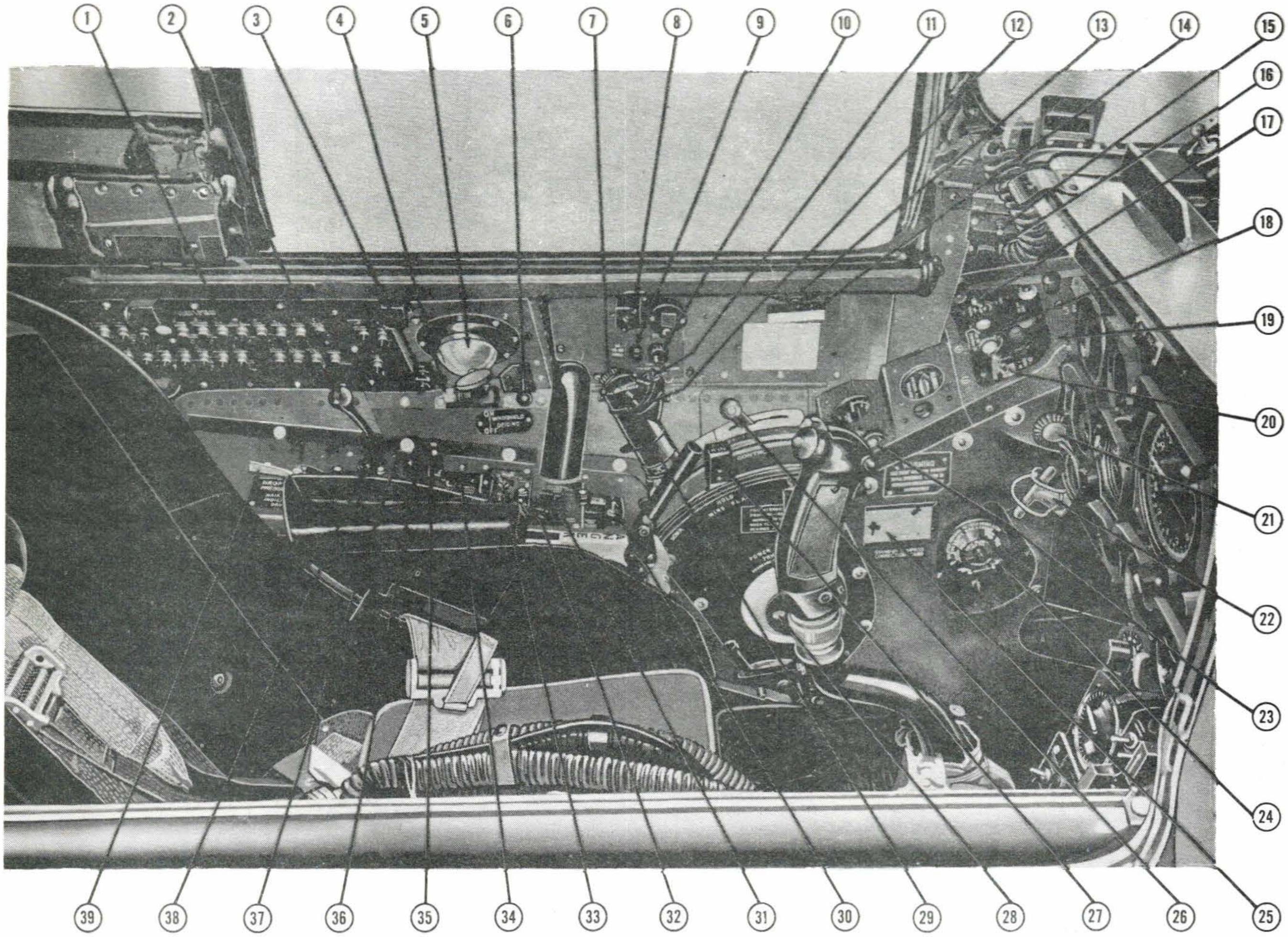
1 L.H. circuit breaker panel.
2 Ammunition heat emergency shut-off.
3 Cockpit air outlet.
4 Windshield de-ice control.
5 Canopy de-frost control and floodlight control rheostat.
6 Rocket release indicator.
7 Rocket re-set knob.
8 Alternate bracket for instrument floodlight.
9 Speed brake control switch.
10 A-1CM sight gyro caging button.
11 Microphone button.
12 Emergency fuel switch.
13 Emergency fuel switch decal.
14 Longitudinal trim switch (alternate) .
15 Canopy switch.
16 Parking brake handle.
17 Landing gear control handle.
18 L.H. Forward console.
19 Oxygen regulator.
20 Magnetic compass correction card.
21 Speed brake emergency control.
22 Flap control lever.
23 Throttle friction wheel.
24 Throttle.
25 Power control switch (flight control hydraulic systems).
26 Rudder trim switch.
27 Lateral trim switch (alternate).
28 Cockpit air temperature control rheostat.
29 Cockpit pressure control lever.
30 Air outlet selector control.
31 Cockpit air temperature control switch.
32 Ammunition compartment overheat warning light.
33 Drop tank pressure shut-off valve.
34 Anti-G suit valve.

Figure 1-8 Cockpit-Left Side (Aircraft 19102 to 19121, 19123 to 19140)



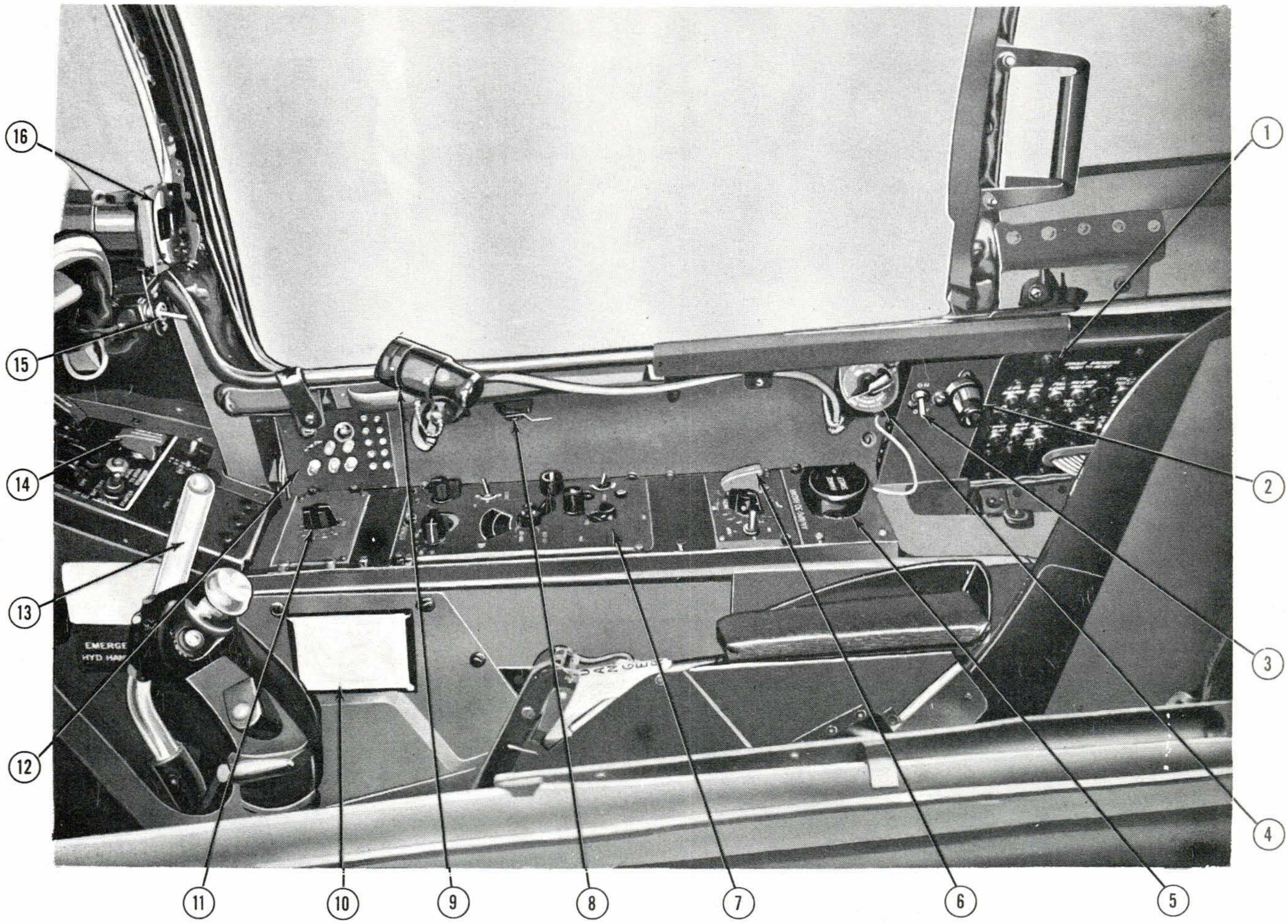
1 L.H. circuit breaker panel.
2 Ammunition heat emergency shut-off.
3 Cabin pressure control lever.
4 Auxiliary console light.
5 Cabin conditioned air outlet.
6 Windshield de-ice control.
7 Auxiliary canopy de-frost control.
8 Floodlight control rheostat.
9 Rocket setting indicator.
10 Rocket projector release control.
11 Speed rate control switch.
12 A-1CM sight gyro caging button.
13 Alternate instrument floodlight position.
14 Emergency fuel switch.
15 Longitudinal trim switch (alternate).
16 Emergency speed brake control.
17 Microphone button.
18 Throttle.
19 Flap control lever.
20 Power controls switch (flight control hydraulic systems).
21 Laternal trim switch (alternate).
22 Rudder trim switch.
23 Cockpit temperature control.
24 Cockpit temperature switch.
25 Air outlet selector control.
26 Ammunition compartment heat warning light.
27 Drop tank pressure shut-off valve.
28 Anti-G suit valve.

Figure 1-9 Cockpit-Left Side (Aircraft 19122, 19141 to 19452)



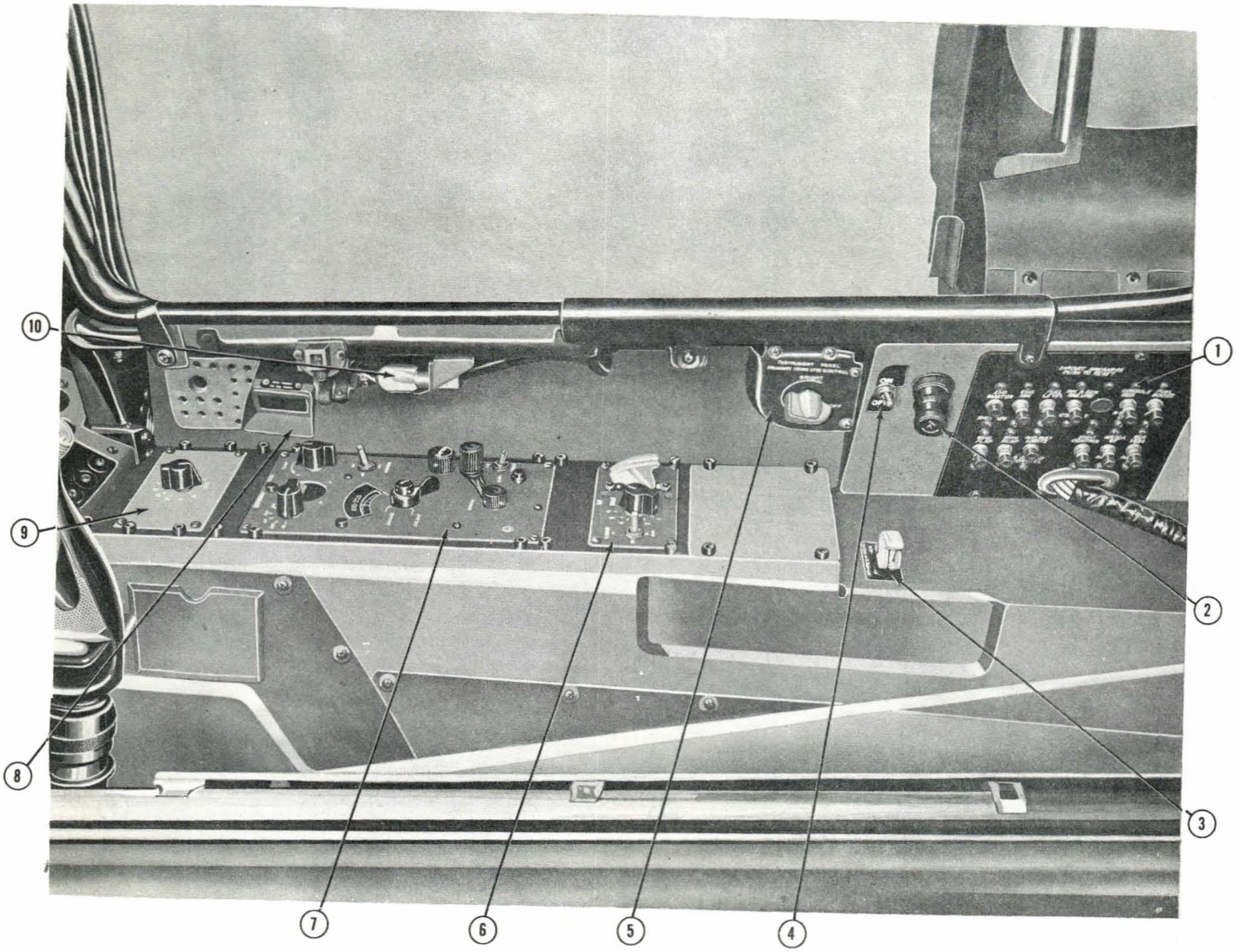
1 L.H. circuit breaker panel.
2 Ammunition heat emergency shut-off.
3 Windshield de-ice overheat warning light.
4 Auxiliary console light.
5 Cockpit air outlet.
6 Windshield de-ice control.
7 Speed brake control switch.
8 Instrument floodlight socket.
9 Rocket projector release control indicator.
10 Rocket projector release control.
11 A-1CM sight gyro caging button.
12 Microphone button.
13 Emergency fuel switch.
14 Emergency fuel switch decal.
15 Canopy switch.
16 Tow target jettison switch.
17 Pitot heater switch.
18 Landing gear position indicator.
19 L.H. forward console.
20 Landing and taxi lights control switch.
21 Landing gear control handle.
22 Emergency manual jettison handle.
23 Bomb, rockets, tank salvo switch.
24 Oxygen regulator.
25 Magnetic compass correction card.
26 Emergency speed brake control.
27 Flap control lever.
28 Throttle friction wheel.
29 Throttle.
30 Hydraulic change-over reset switch.
31 Longitudinal trim switch.
32 Rudder trim switch.
33 Lateral trim switch.
34 Pressure differential switch.
35 Air selector and temperature control.
36 Cockpit air temperature control rheostat.
37 Cockpit air temperature control switch.
38 Ammunition compartment overheat warning light.
39 Drop tank pressure shut-off valve.

Figure 1-10 Cockpit-Left Side (Aircraft 19453 and Subsequent)



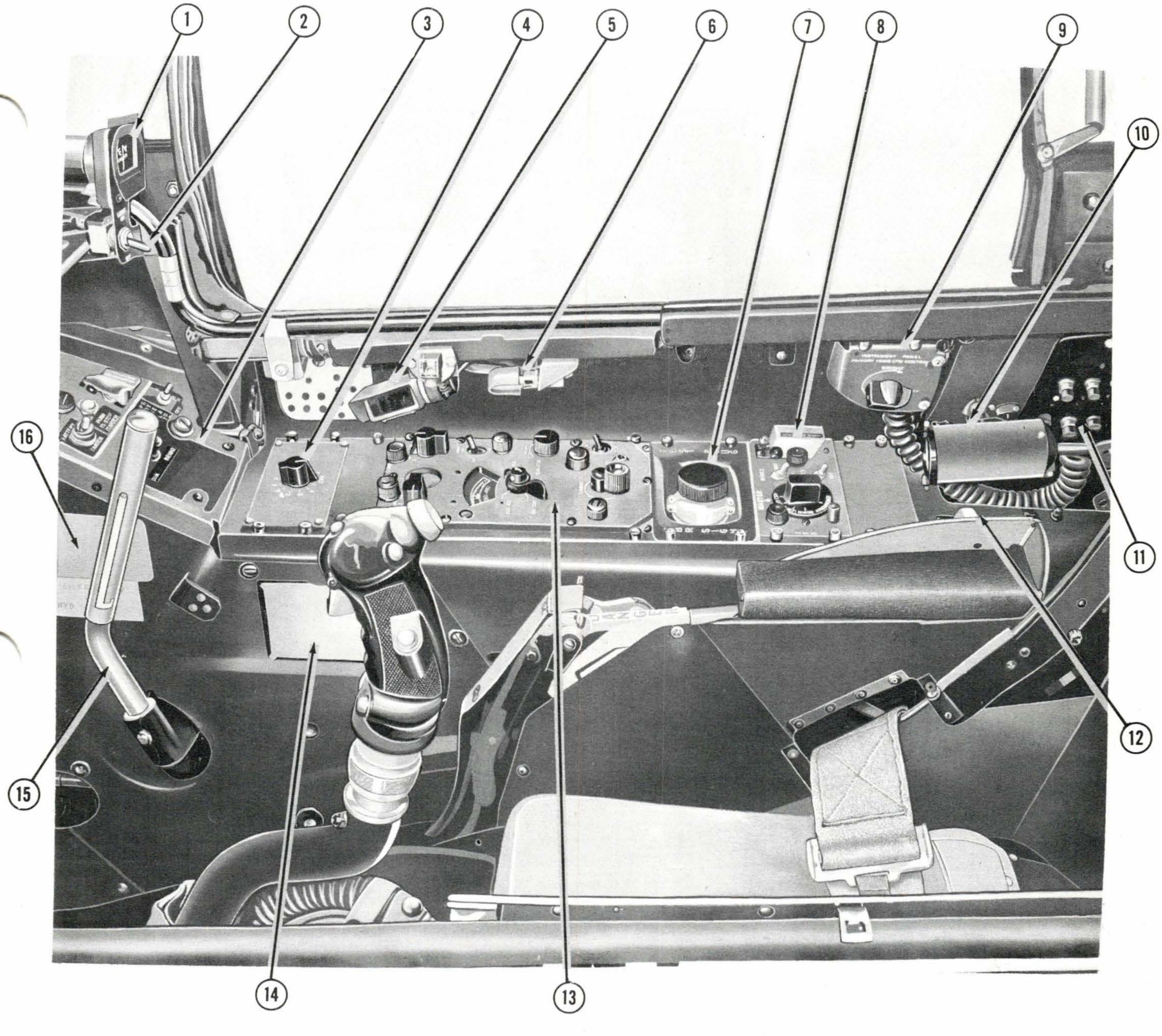
1	Circuit breaker panel.
2	Extension light.
3	Extension light switch.
4	Instrument panel light control.
5	Range sweep control.
6	IFF radar control panel.
7	Radio compass control panel.
8	Air outlet valve.
9	Instrument panel flood light.
10	Radio frequency control.
11	VHF radio control panel.
12	Right forward circuit breaker panel.
13	Emergency hydraulic hand pump.
14	Right forward console.
15	Magnetic compass light switch.
16	Magnetic compass.

Figure 1-11 Cockpit-Right Side (Aircraft 19102 to 19121, 19123 to 19140)



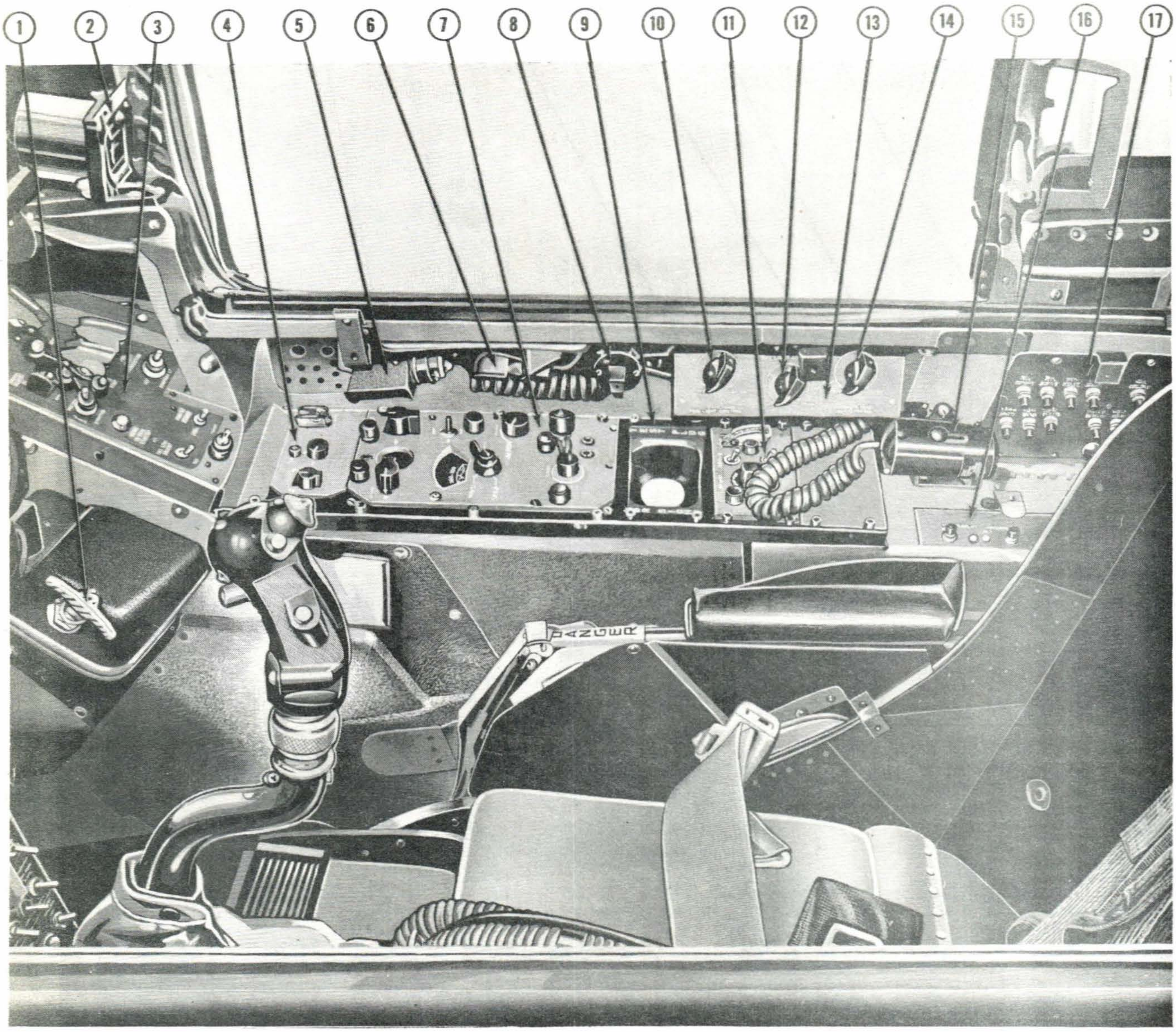
1	R.H. circuit breaker panel.
2	Extension light.
3	Liquidensitometer switch.
4	Extension light switch.
5	Instrument ring lights rheostat.
6	IFF radar control panel.
7	Radio compass control panel.
8	Auxiliary floodlight.
9	VHF radio control panel.
10	Auxiliary console light.

Figure 1-12 Cockpit-Right Side (Aircraft 19122, 19141 to 19200)



1 Magnetic compass.
2 Magnetic compass light switch.
3 Right forward console.
4 VHF radio control panel.
5 Auxiliary panel light.
6 Auxiliary console light.
7 GBR sight test plug.
8 IFF radar control panel.
9 Instrument panel lights dimmer control.
10 Extension light.
11 Right circuit breaker panel.
12 Liquidensitometer switch.
13 Radio compass control panel.
14 Radio frequency card.
15 Hydraulic emergency hand pump.
16 Landing gear emergency instructions.

Figure 1-13 Cockpit-Right Side (Aircraft 19201 to 19452)



1 Manual hydraulic change-over handle.
2 Magnetic compass.
3 Right forward console.
4 VHF radio panel.
5 Auxiliary instrument floodlight.
6 Radio panel light.
7 Radio compass control panel.
8 Light support socket.
9 GBR sight test plug.
10 Instrument primary light control rheostat.
11 IFF radar control panel.
12 Instrument auxiliary light control rheostat.
13 Cockpit lights rheostat panel.
14 Console and panel light control panel.
15 Extension light.
16 Three phase inverters circuit breaker panel.
17 Right circuit breaker panel.

Figure 1-14 Cockpit-Right Side (Aircraft 19453 and Subsequent)

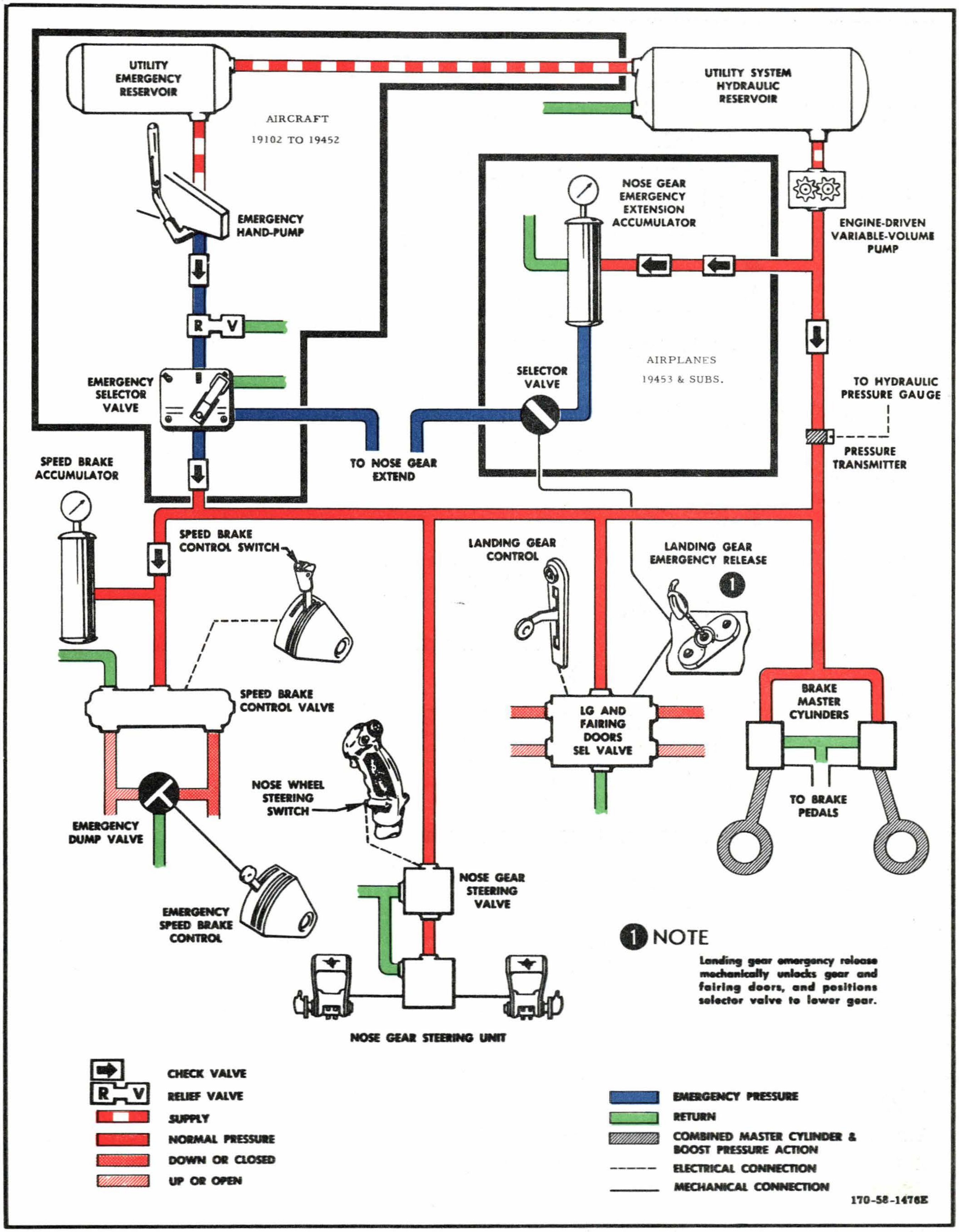


Figure 1-15 Utility Hydraulic System

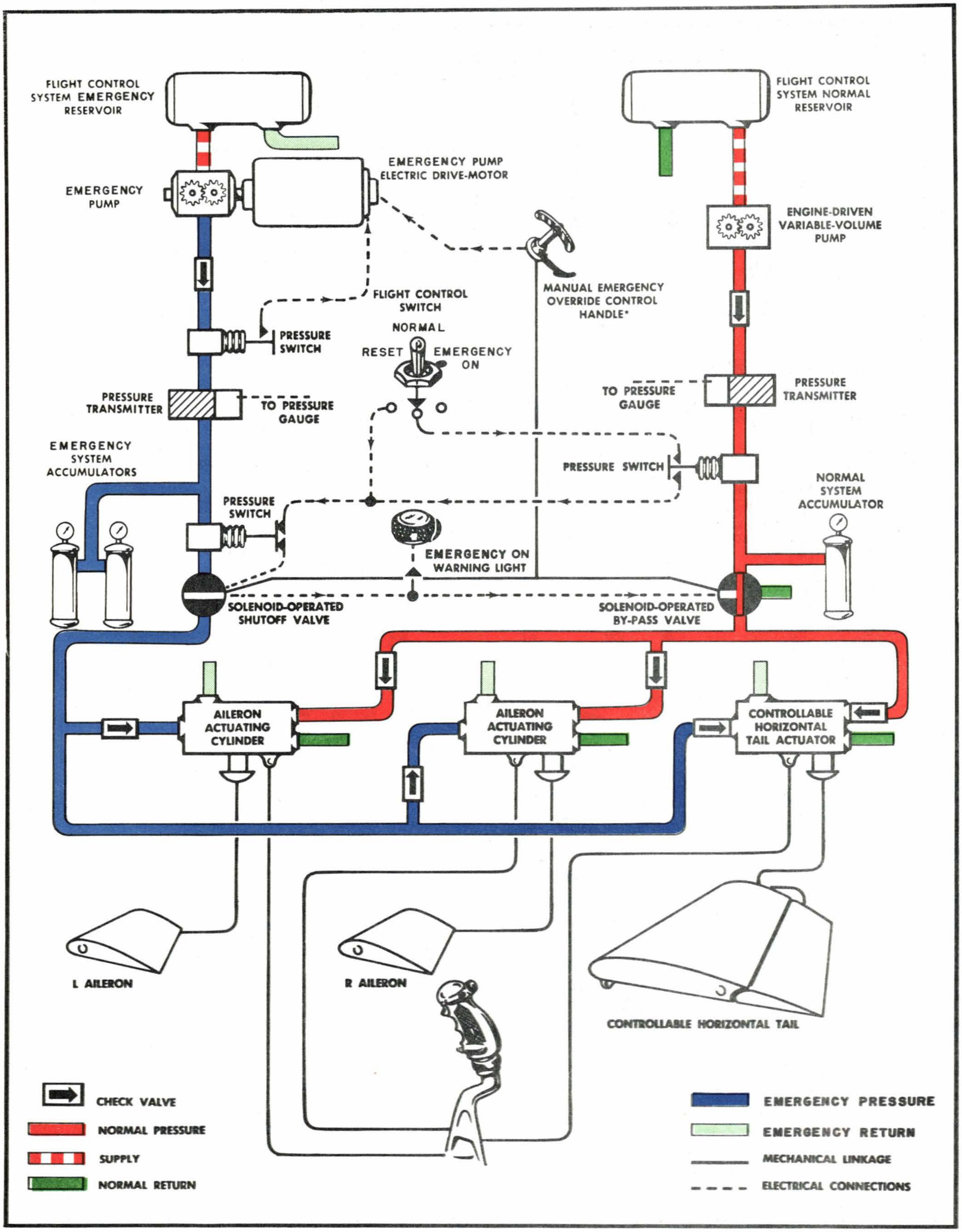


Figure 1-16 Flight Control Hydraulic System

Hydraulic Emergency Selector Valve

26 The hydraulic emergency selector valve is installed on aircraft 19102 to 19452 inclusive, and is located at the bottom of the centre pedestal, (see figure 1-17). With the valve at NOSE GEAR position, the hand-pump can be used to supply pressure to extend and latch the nose gear. At GND TEST position, the hand-pump can be used to supply pressure to the entire utility system, and must be used on the ground only. The third position is OFF, which is the normal flight position. On aircraft 19453 and subsequent, the hand-pump has been removed and pressure is supplied from an accumulator.

Hydraulic Pressure Gauge and Pressure Gauge Selector Switch

27 A three-position toggle switch marked UTILITY, NORMAL (flight control) and EMERG (flight control), selects pressure gauge readings for the corresponding systems. For ordinary flight conditions the switch should be kept at NORMAL. Both switch and gauge are located on the main instrument panel.

Normal Flight Control Hydraulic System

28 The flight control normal hydraulic system (see figure 1-16), supplied by an engine-driven pump, operates the ailerons and the controllable horizontal tail.

Alternate Flight Control Hydraulic System

29 The alternate flight control hydraulic system is supplied by an electrically-driven hydraulic pump connected to the aircraft battery bus and is automatically engaged when external power is applied for starting. The alternate hydraulic system is incorporated into the aileron and controllable horizontal tail control system in such a way that in the event of a loss of pressure in the normal system, the independent alternate systems, operating from a separate reservoir, will automatically be engaged. No single hydraulic failure can cause failure of both systems, as the normal and alternate systems are independent. The alternate system may be manually selected by the flight control switch and, by the emergency override handle.

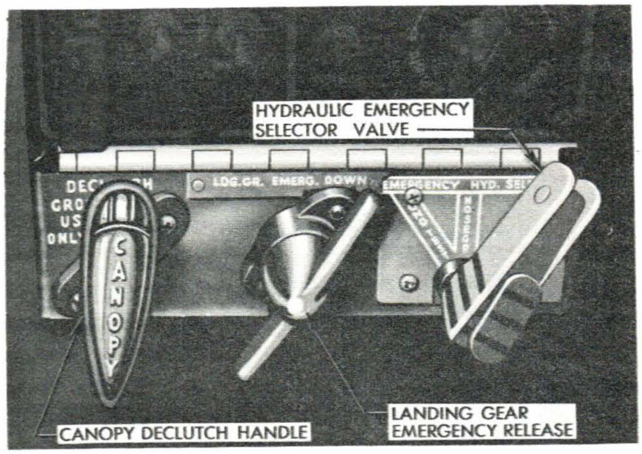


Figure 1-17 Lower Centre Pedestal

NOTE

> Because of the lower output of the alternate pump, control movements should be held to a minimum to avoid the possibility of exhausting hydraulic accumulator pressure supply while operating on alternate system.

Flight Control Switch (Flight Control Hydraulic Systems)

30 A three-position flight control switch on the left console provides a means of manually changing from the normal to the alternate flight control hydraulic system. With the switch in the NORMAL position (engine running), the normal system supplies pressure to the flight controls, and the alternate system will cut in automatically should the normal system fail. With switch in the EMERGENCY ON position on aircraft 19102 to 19452, and on aircraft 19453 and subsequent in the ALTERNATE ON position, the normal system pressure is by-passed through the hydraulic by-pass valve, and the alternate system supplies pressure to the flight controls. The RESET position de-energizes the normal system by-pass valve and the alternate system shut-off valve, allowing them to return to the normal position (normal system operating). This position of the flight control switch must be used whenever a switch-over from alternate to normal system is desired. On aircraft 19102 to 19200, pressure in the normal system is zero when the emergency or alternate system is on. It is therefore necessary to hold the flight control switch at RESET until the pressure in the normal system has built up to 1000 psi to ensure a switch over to the normal system. When the engine is not operating, the alternate system can be checked with an external source of power. To check transfer of the normal system to the alternate system and operation of the by-pass

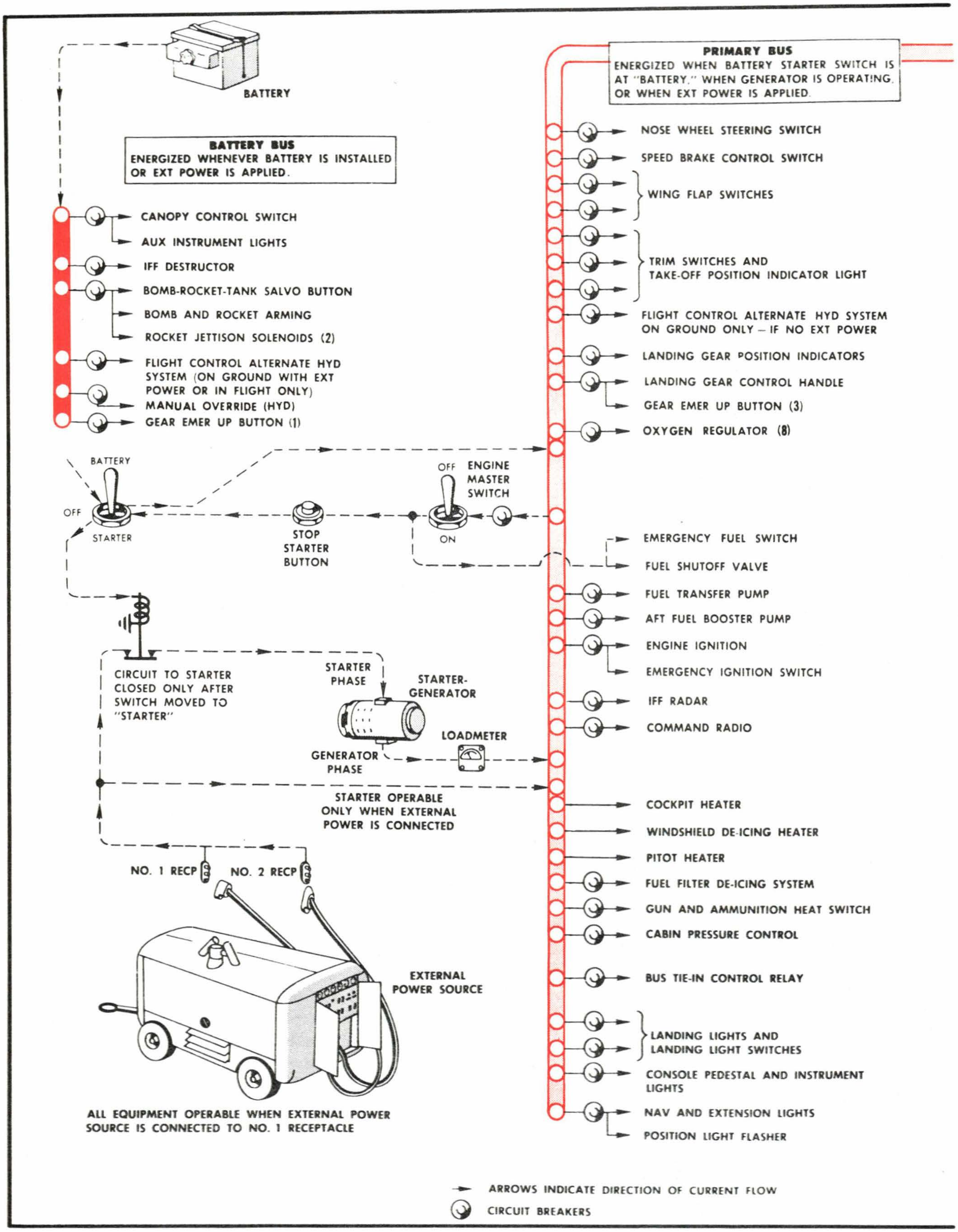
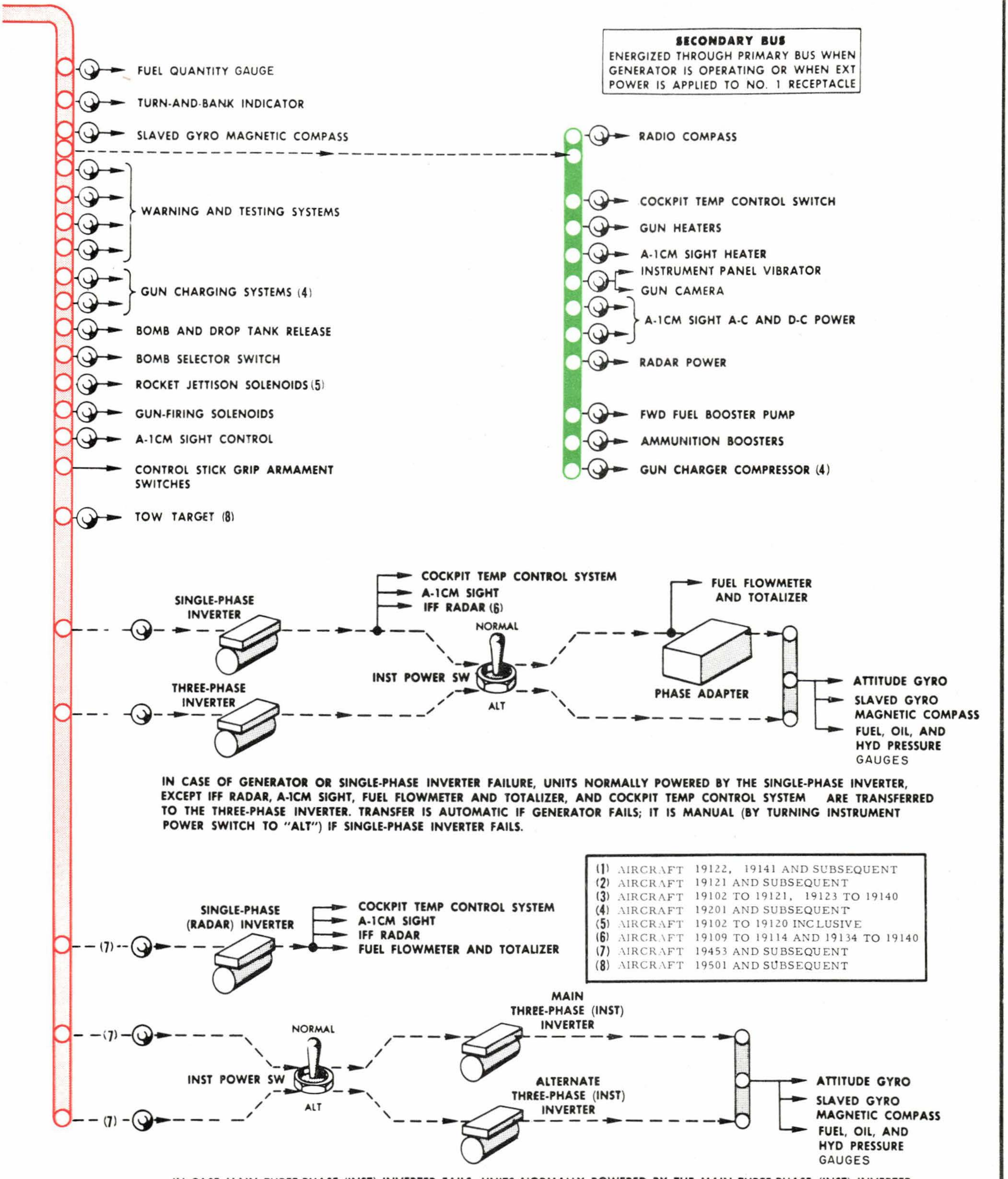


Figure 1-18 (Sheet 1 of 2) Electrical Power Distribution



IN CASE OF GENERATOR OR SINGLE-PHASE INVERTER FAILURE, UNITS NORMALLY POWERED BY THE SINGLE-PHASE INVERTER, EXCEPT IFF RADAR, A-1CM SIGHT, FUEL FLOWMETER AND TOTALIZER, AND COCKPIT TEMP CONTROL SYSTEM ARE TRANSFERRED TO THE THREE-PHASE INVERTER. TRANSFER IS AUTOMATIC IF GENERATOR FAILS; IT IS MANUAL (BY TURNING INSTRUMENT POWER SWITCH TO "ALT") IF SINGLE-PHASE INVERTER FAILS.

(1) AIRCRAFT	19122, 19141 AND SUBSEQUENT
(2) AIRCRAFT	19121 AND SUBSEQUENT
(3) AIRCRAFT	19102 TO 19121, 19123 TO 19140
(4) AIRCRAFT	19201 AND SUBSEQUENT
(5) AIRCRAFT	19102 TO 19120 INCLUSIVE
(6) AIRCRAFT	19109 TO 19114 AND 19134 TO 19140
(7) AIRCRAFT	19453 AND SUBSEQUENT
(8) AIRCRAFT	19501 AND SUBSEQUENT

IN CASE MAIN THREE-PHASE (INST) INVERTER FAILS, UNITS NORMALLY POWERED BY THE MAIN THREE-PHASE (INST) INVERTER ARE TRANSFERRED TO THE ALTERNATE THREE-PHASE (INST) INVERTER BY TURNING INSTRUMENT POWER SWITCH TO "ALT."

Figure 1-18 (Sheet 2 of 2) Electrical Power Distribution valve, the engine must be running.

NOTE

> This switch is marked POWER CONTROLS on aircraft 19102 to 19452, and FLIGHT CONTROLS on aircraft 19453 and subsequent.

Emergency Override Handle

31 The emergency override handle, recessed in the inboard face of the right forward console, permits the alternate flight control hydraulic system to be engaged should the electric transfer system fail. The altnerate system will be in operation as long as the handle is in the extended position. If the handle is returned to the normal position, the alternate system will remain in operation until the flight control switch is momentarily held at RESET and then released to NORMAL.

Alternate-On Warning Light

32 The amber alternate-on warning light on the instrument panel is illuminated whenever the alternate flight control hydraulic system is operating.

ELECTRICAL SYSTEM

D.C. Electrical Power System

33 The d.c. power system (see figure 1-18) is supplied by a 28-volt, 400-ampere engine-driven generator. A 24-volt, 36-ampere-hour storage battery serves as a standby. D.C. power is distributed from three electrical busses; battery, primary and secondary. The battery bus is hot at all times so that the essential equipment, powered by the battery, is operable regardless of the position of the battery-starter switch. The primary bus is energized by the battery bus when the battery-switch is at BATTERY position, or is energized directly when the generator is functioning or an external power supply is used. The secondary bus, which receives power through the primary bus, is energized only when the generator is operating or an external power source is connected to the number 1 receptacle.

A.C. Electrical Power System

34 On aircraft 19102 to 19452 inclusive, a.c. power is supplied by a single-phase inverter, combined with a phase adapter, and a standby three-phase inverter, (see figure 1-18). The single-phase inverter, which serves as the normal source of a.c. power is energized by the primary bus. This inverter furnishes single-phase a.c. power to the sight, IFF radar, fuel flowmeter and totalizer. The phase adapter transforms a portion of the single-phase inverter output to three-phase for powering the artificial horizon, the gryo magnetic compass, and the fuel, oil and hydraulic pressure indicating systems. If the generator fails, the single-phase inverter becomes inoperative and the three-phase instruments normally powered by the single-phase and phase adapter system are automatically transferred to the alternate three-phase inverter. Other units requiring single-phase power will be inoperative. The alternate three-phase inverter, energized by the primary bus, operates only in case of single-phase inverter failure and the transfer to the three-phase inverter must be accomplished by switching the instrument power switch from NORMAL to ALTERNATE. This switch is also used if the automatic transfer does not function when the generator fails. Warning lights indicate generator or inverter failure.

35 On aircraft 19453 and subsequent, a three-phase inverter powered from the primary bus replaces the phase adapter and operates the same equipment. The single-phase inverter supplies power to the sight, radar, flowmeter and air conditioning control system. Should the main three-phase inverter fail, the alternate three-phase inverter is engaged by switching the instrument power switch from NORMAL to ALTERNATE. Instruments normally powered by the main three-phase inverter are then transferred to the alternate three-phase inverter. No transfer system is provided for the single-phase inverter. Lights indicate when the generator or individual inverters fail.

Battery-Starter Switch

36 The battery-starter switch is located on the right forward console. This three-position switch may be selected to maintained positions of BATTERY and OFF and may be selected against spring-loading to the STARTER position.

Electrical System Indicators

37 A voltmeter and a generator load indicator (loadmeter) are installed on the instrument panel. The voltmeter provides a direct indication of the system voltage. The load indicator is marked LOAD and indicates the percentage of the total generator capacity being used.

Inverter Warning Light

38 Failure of any inverter is indicated by illumination of an amber inverter warning light, located on the instrument panel. On aircraft 19453 and subsequent, three inverter failure warning lights are set horizontally along the upper left edge of the instrument panel. An amber light illuminates when the main radar (single-phase) inverter fails. Another amber light indicates loss of the main instrument (three-phase) inverter, at which time the alternate three-phase inverter should be selected. When both instrument inverters (main and alternate three-phase) fail, the red warning light is illuminated. All lights are of the push-to-test type.

Generator Switch

39 A generator control switch, located on the engine control panel on the right console, is held by a guard in its normal ON position. This switch has three positions, ON, OFF, and RESET.

Generator - Off Warning Light

40 In case of generator failure, or when generator output falls below that required to close the reverse-current relay, a generator warning light, located on the instrument panel, illuminates. This indicates that all equipment powered by the secondary bus is inoperative, and that all non-essential electrical equipment should be turned off, as the electrical system is operating solely on the battery.

Overvoltage Warning Light

41 Overvoltage protection is provided by means of an overvoltage relay, a generator field control relay, and on aircraft 19102 to 19121, 19123 to 19140 an overvoltage warning light. If generator voltage exceeds 31 volts, the overvoltage relay will electrically trip the generator field control relay, disconnecting the generator from the system and illuminating the overvoltage warning light on those aircraft so equipped. The generator field control relay may be reset, placing the generator back into the electrical system, by holding the generator control switch at RESET until the overvoltage warning light goes out. The switch is then placed in the ON position.

Voltage Regulator

42 The voltage regulator is preset on the ground, but in an emergency may be adjusted in flight by means of a guarded rheostat mounted on the engine control panel, on the right console. With engine rpm above 45%, voltmeter readings should be 28 ± 0.5 volts. On aircraft 19201 and subsequent, the voltage regulator rheostat on the engine control panel is deleted.

Circuit Breakers

43 Most of the d.c. electrical circuits are protected by push-to-reset circuit breakers, or circuit breaker switches. Panels mounting the circuit breakers are located on each side of the cockpit with an additional one located in the nose. All a.c. circuits are protected by fuses which are not replaceable in flight.

External Power Receptacles

44 Two external power receptacles are located on the left side of the fuselage, above and aft of the trailing edge of the wing. The external power source must be connected to the number 1 receptacle to make power available to both busses. If the number 2 receptacle is connected alone, power is supplied only to the primary bus. Both external power receptacles must be connected for engine starting.

WHEEL BRAKES

General

45 The power boost wheel brakes are operated by toe action on the rudder pedals. Brake pressure is supplied from brake master cylinders supplemented by power boost from the utility hydraulic system. However, in the event that no pressure is available from the utility hydraulic system, the brakes function through action of the brake master cylinders when toe pressure is applied to the rudder pedals.

Parking Brake Control

46 The parking brake handle is located on the left side of the cockpit, above and outboard of the landing gear control. Parking brakes are set by pressing hard on the toe brakes, pulling the parking brake handle all the way out, releasing toe brake pressure and then releasing the parking brake handle. Parking brakes are released by exerting pressure on the toe brakes. If brakes do not release easily, the toe brakes should be pressed hard and the parking brake handle pushed all the way in.

SURFACE CONTROLS

Surface Control Operation

47 To reduce control stick forces in flight, the ailerons and horizontal tailplanes are oper-

ated by the surface control hydraulic power system. Control cables run from the stick to hydraulic control valves at the ailerons. Operation of the stick for aileron control causes the control cables to actuate the hydraulic valves, which allow hydraulic fluid under pressure to enter the operating struts for either up or down aileron motion. Control cables also run from the stick to a control valve in the hydraulic actuating strut at the tailplane. Operation of the stick for tailplane movement allows hydraulic fluid to enter the strut for either up or down movement of the tailplane. Should the surface control power system fail or lose pressure, an emergency circuit will automatically come into action and power the surface controls. Since the operating struts are irreversible, control surface attitude cannot change except in response to stick movement. In the event of a failure in the linkage between the control stick and the artificial feel bungee, the horizontal stabilizer can be controlled through approximately half its maximum range by the use of trim. The rudder is cable operated and is provided with an electrically operated tab.

Artificial Feel System

48 Because no feel of air loads can be transmitted through the irreversible hydraulic control system, no conventional stick feel is present. To supply usual stick feel under all flight conditions, an artificial feel system is installed. Normal stick forces resulting from G loads are provided through a bobweight. Control surface air loads are simulated by bungees connected into the control system. The bungees apply loads to the stick in proportion to the degree of stick deflection from the neutral position. To trim the aircraft, the neutral position of the stick is changed by means of the normal or alternate trim switch, and the bungees are repositioned correspondingly to maintain stick feel.

NOTE

> **In the rare possibility of failure of the artificial feel system, while the stick forces would be reduced to practically nil, the aircraft is still completely controllable. Great care must be exercised not to over-control.**

Control Stick

49 The control stick grip mounts the following controls; radar target selector button (radar out button), lateral and longitudinal normal trim switch, bomb and rocket release switch, nose wheel steering engaging switch and gun trigger switch. (See figure 1-19.)

Rudder Pedals

50 Pedal adjustment is conventional and exact alignment is facilitated by position indicating wheels on the outboard side of each pedal. When the visible dial numbers correspond, the pedals are adjusted evenly.

Controllable Horizontal Tail

51 The elevators and the horizontal stabilizer are controlled and operated as one unit, known as the controllable horizontal tail. The portion of this unit usually known as the horizontal stabilizer is pivoted at the aft edge so that the leading edge can be moved up or down

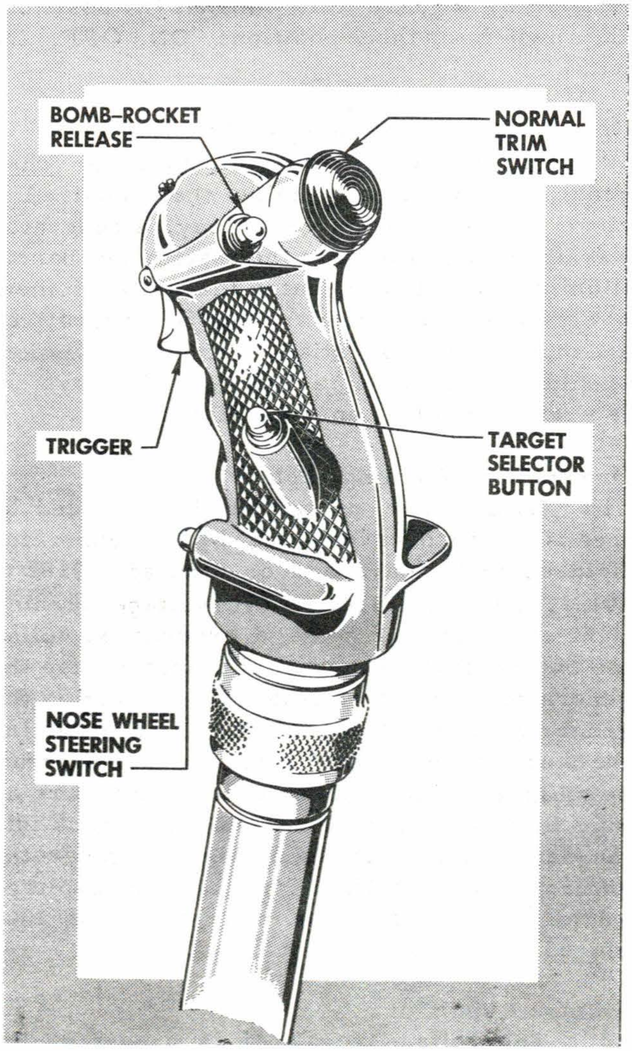


Figure 1-19 Stick Grip

through normal control stick action. The elevator portion of the unit is operated at the same time through mechanical linkage to the stabilizer section, and moves in definite proportion to movement of the stabilizer. Elevator travel is somewhat greater than that of the stabilizer. The controllable horizontal tail can be trimmed through use of either a normal or an alternate trim switch.

Normal Trim Switch

52 Normal trim of the horizontal tail or of the ailerons is provided through a five-position knurled switch on top of the control stick grip (figure 1-19). This switch is spring-loaded to centre off position. When the lateral alternate trim switch is at NORMAL and the longitudinal alternate trim switch is at NORMAL GRIP CONT, holding the normal trim switch to either side causes the corresponding wing to be trimmed down. When the longitudinal alternate trim switch is at NORMAL GRIP CONT, holding the normal trim switch forward trims the nose down, while holding it aft trims the nose up. When the switch is released, it automatically returns to the centre off position and trim action stops.

NOTE

> The elevator and aileron trim switch installed in type B-8 control stick grips is designed to return to the neutral position automatically when thumb pressure is released after actuating the switch. Experience shows that this switch has a tendency to remain in the actuated position, which causes an overtrim condition. To preclude such a possibility, and pending the acceptance and availability of the type B-9 stick grip, the trim switch should be returned to the neutral position by applying thumb pressure in the opposite direction after each actuation of the trim switch.

Longitudinal Alternate Trim Switch

53 A four-position switch on the left side of the cockpit provides an alternate trim circuit for the horizontal tail. Operation of this switch accomplishes longitudinal trim at the same speed obtained through use of the normal trim control. The longitudinal alternate trim switch is usually kept at NORMAL GRIP CONT which allows the normal trim switch to be used for trimming. Holding the longitudinal alternate trim switch at NOSE UP or NOSE DOWN disconnects the normal trim circuits for the ailerons and stabilizer, and trims the aircraft accordingly through the alternate trim system. The switch is spring-loaded from NOSE UP or NOSE DOWN to OFF and is guarded in the NORMAL GRIP CONT position. When the switch is at OFF, both of the normal trim circuits, as well as the alternate longitudinal trim are inoperative.

Lateral Alternate Trim Switch

54 A four-position switch on the left aft console provides an alternate means of lateral trim. Ordinarily this switch is kept at NORMAL. Holding the switch at either LEFT or RIGHT will trim the corresponding wing down and will disconnect the normal aileron trim circuit. The switch is spring-loaded from LEFT or RIGHT to OFF. Both the normal and alternate lateral trim circuits are inoperative when the alternate lateral trim switch is off.

Rudder Trim Switch

55 A switch on the aft left console controls the electrically-actuated rudder trim tab. The switch is held to LEFT or RIGHT for corresponding rudder trim.

Take-off Trim Position Indicator Light

56 An amber light on the instrument panel is provided to indicate take-off trim position for ailerons, horizontal tail, and rudder. The light will illuminate whenever any one of these controls is trimmed to take-off position, and will go out when the trim switch is released. It will illuminate again when the next control is trimmed for take-off, etc.

57 On aircraft 19102 to 19654 inclusive, the take-off position indicator light is illuminated for a small range of longitudinal trim so that at the forward or nose heavy end of the range, the stick forces necessary for take-off are approximately one-third greater than at the aft end of the range. To ensure minimum stick forces on take-off, set the longitudinal trim by running it fully forward, then fully aft, then forward until the take-off position indicator light illuminates.

58 On aircraft 19655 and subsequent the horizontal tail trim should be in the fully aft position for take-off. The indicator light will come on indicating this is the correct take-off trim position. Less pull force on the control

stick will be required in these aircraft to become airborne. Soon after becoming airborne, continuous forward trim will be desirable while accelerating to the best climbing speed, because the rate of horizontal tail trim is considerably slower than on previous aircraft. The forward travel of the horizontal tail trim has been increased so that less stick force is required to hold the aircraft in a sustained dive. Regardless of the trim position only average strength will be required to overcome any stick forces encountered.

Wing Slats

59 Wing slats are fitted along the full length of the leading edge of each wing on aircraft prior to and including 19800. These slats open and close automatically with variations in airspeed. At speeds below approximately 180 knots they open and smooth the airflow over the wing, thereby increasing stability and lift. Higher speeds will close them. Up to approximately .65 Mach number, an increase in G may open the slats. At higher Mach numbers, they will not open at any value of G.

Wing Flaps

60 Electrically-operated, slotted-type flaps extend from the aileron to the fuselage on each wing panel. Each flap is actuated through an individual electric motor and electric circuit. The flaps are mechanically interconnected so that if one actuating motor or one circuit fails, the corresponding flap will still be actuated through mechanical linkage with the opposite flap. This mechanical interlinkage also prevents individual or uneven flap operation. A clutch, or brake arrangement, on each actuating motor prevents air loads from moving the flaps. No emergency system is provided, as there is enough protection present in the normal system through the mechanical linkage, the individual electric motors and the individual circuits.

Wing Flap Control Lever

61 The wing flap control lever, inboard of the throttle on the left console, moves on a quadrant marked UP, HOLD, and DOWN. To move the flaps to the full up or the full down position, the flap lever is placed at UP or DOWN, and then returned to HOLD. For intermediate flap positions in flight, the lever is held at UP or DOWN, and then moved to HOLD when the desired flap effect is obtained. There is no flap position indicator. A red line is painted on the leading edge of the flap, which, when it becomes visible, indicates flap take-off position.

Rudder Control Lock

62 A rudder control lock is permanently installed beneath the centre of the instrument panel. When the handle is pulled aft, a rudder cable lock is set to engage when the rudder pedals are neutralized. The nose wheel steering cable is locked at the same time. The other surfaces, being hydraulically operated, are irreversible and do not require a lock.

Speed Brakes

63 Hydraulically operated speed brakes are located on each side of the rear fuselage. An hydraulic accumulator is provided to supply hydraulic pressure for one complete cycle of speed brakes in event of utility hydraulic system failure. Emergency control to close the speed brakes is also provided.

Speed Brake Switch

64 A serrated rotary switch on top of the throttle controls the speed brake hydraulic control valve. The switch has three fixed positions; IN, OUT and a neutral position which is indicated by a white mark on the switch guide. After the brakes have been opened or closed, the switch should be returned to neutral. An accumulator stores energy for emergency opening of the brakes.

WARNING

> Since the hydraulic lines to the speed brake actuating cylinders are routed near the engine it is extremely important that the speed brake switch be kept in the neutral position to minimize the fire hazard should a line be damaged.

Emergency Speed Brake Control

65 To provide a means of closing the speed brakes when normal operation fails, an emergency speed brake control is installed just outboard of the throttle lever. Normally, the control is safety-wired at its aft NORMAL position. When pushed forward to the EMERG. CLOSED position, the control mechanically opens a dump valve, relieving hydraulic pressure from the speed brake actuating cylinders. Air loads will then close the brakes. No emergency means of opening the brakes is provided once the accumulator is exhausted.

LANDING GEAR

General

66 The landing gear and wheel fairing doors are hydraulically actuated and electrically controlled and sequenced. A removable ground safety lock may be inserted in the nose gear assembly to prevent inadvertent retraction on the ground. No ground safety locks are provided for the main gear, as the weight of the aircraft on the main gear prevents accidental retraction.

Normal Landing Gear Control

67 A landing gear control handle at the left side of the instrument panel electrically controls the landing gear and door hydraulic selector valves. The control handle has three positions: UP, COMBAT, (neutral) and DOWN. On aircraft 19453 and subsequent the COMBAT position has been eliminated. When the gear is down and locked and the weight of the aircraft is on the gear, a ground safety switch prevents retraction if the gear handle is inadvertently moved to UP. The fairing doors are not controlled by this switch and will follow their normal sequence, opening when the gear control is moved to UP, thereby providing warning to the ground crew that the gear control is in the wrong position for ground operation.

Landing Gear Handle Up Indicator Light

68 On aircraft 19102 to 19452 inclusive, an amber light, located on the left forward console (see figures 1-20 and 1-21) illuminates whenever the gear handle is in the UP position, as a reminder that the handle should be returned

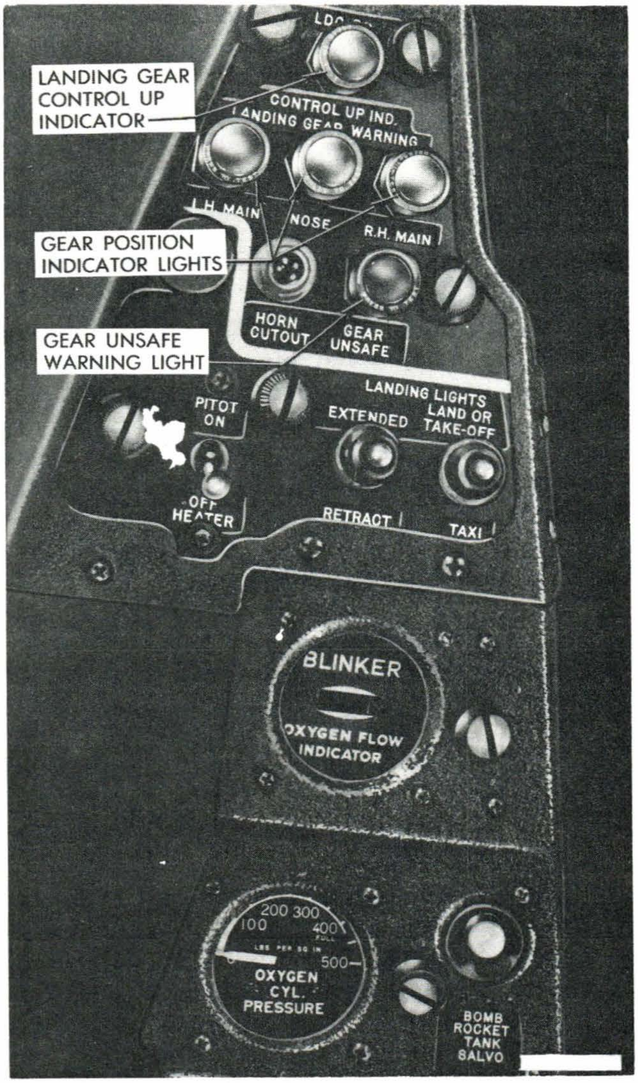


Figure 1-20 Left Forward Console
(Aircraft 19102 to 19452)

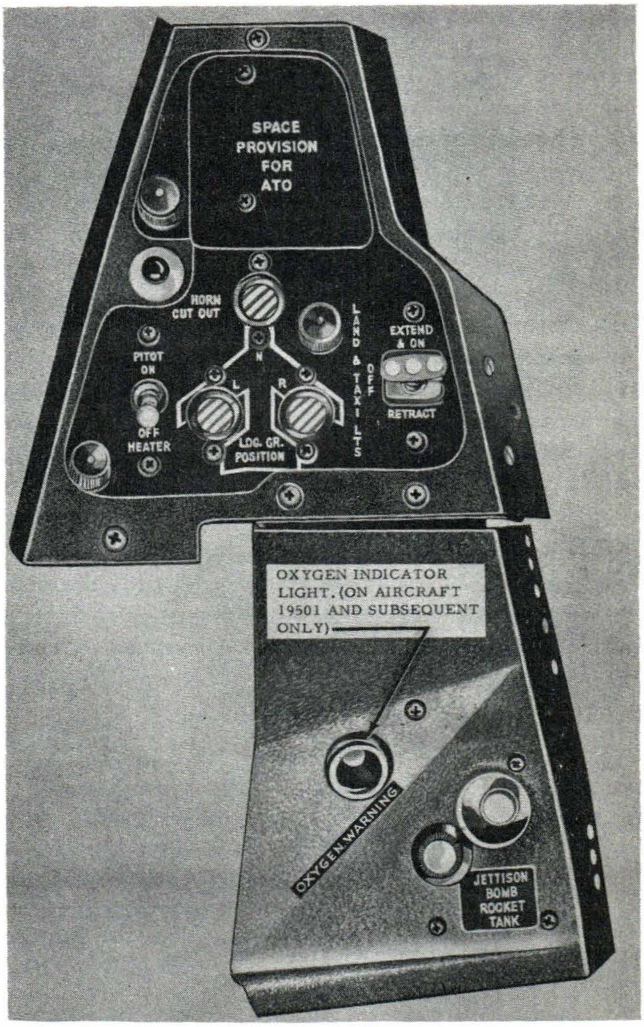


Figure 1-21 Left Forward Console
(Aircraft 19453 and subsequent)

to COMBAT. The gear-up indicator lamp can be turned to dim the light when desired.

Landing Gear Emergency Up Control

69 If it is necessary to collapse the gear in an emergency, the landing gear ground safety switch can be overridden by use of a guarded EMERG. UP push button switch located above the gear control handle. When the gear control is at UP and the emergency-up button is depressed, the ground safety switch is by-passed and the gear is retracted hydraulically in the normal manner, except that the fairing doors may not have sufficient time to fully open. On aircraft 19102 to 19121, and 19123 to 19140, the battery-starter switch must be at BATTERY to make the emergency-up button effective when the generator is not operating. On aircraft 19122, 19141 and subsequent, the emergency-up button is effective regardless of battery-starter switch position.

Landing Gear Emergency Release

70 When the landing gear emergency release at the bottom of the centre pedestal is pulled all the way out and held for at least 11 seconds, the main gear and all the fairing doors are mechanically unlocked and the gear and door hydraulic selector valves are positioned to lower the gear. If the electrical control system has failed, the gear will lower under pressure from the main hydraulic system. If the hydraulic system has failed, the main gear will fall free when the emergency release is pulled, but the nose gear up-lock must be released and the nose gear forced into the down latched position by placing the emergency hydraulic selector at NOSE GEAR and supplying pressure with the hand pump. On aircraft 19453 and subsequent, the hand pump is eliminated and power to lower the nose gear is provided by a hydraulic accumulator.

NOTE

On aircraft 19453 and subsequent, the nose gear cannot be retracted in flight when the emergency nose gear lowering system has been used, since the emergency lowering valve must be re set on the ground.

Landing Gear Position Indicators

71 On aircraft 19102 to 19452, landing gear position indicator lights are located on the left forward console. Three green lights, one for each gear, and one red light, connected to all three gears, provide a visual indication of gear position. Each green light illuminates when its respective gear is down and locked and is extinguished, together with the red light, when its respective gear is up and locked and the throttle control is forward beyond minimum cruising power. The red light illuminates when in any position other than down and locked, or up and locked, or if the gear is up and locked and the throttle control is retarded below minimum cruising rpm; or if the gear is up and locked and any gear door is not completely closed.

72 On aircraft 19453 and subsequent, the position of the landing gear is shown by three indicators on the left forward console. One indicator is provided for each gear and will display parallel red and yellow diagonal lines if its respective gear is in an unlocked condition. Diagonal lines also appear when battery-starter switch is not at BATTERY or when primary bus is not energized.

73 The word UP appears if the gear is up-and-locked, and a miniature wheel shows when the gear is down-and-locked. A red light within the wheel portion of the landing gear control handle illuminates when any gear is in any unlocked position. It is also illuminated if the gear is up-and-locked when the throttle is retarded below minimum cruising rpm, or if the gear is up-and-locked and any gear door is not completely closed. The handle light can be checked by pressing the warning horn cut-out button with the throttle retracted.

Landing Gear Warning Horn

74 A warning horn in the cockpit sounds, if the gear is not down-and-locked, when the throttle is retarded below cruising power. A horn cut-out button is located on the forward left console.

Nose Wheel Steering

75 Nose wheel steering is electrically engaged, hydraulically powered, and controlled by the rudder pedals. Steering is accomplished by depressing a switch on the control stick grip and then operating the rudder pedals to control a hydraulically operated nose wheel steering unit. This unit permits the wheel to be turned approximately 21 degrees each side of centre by pressure on the respective rudder pedal.

When not engaged for steering, the unit serves as a hydraulic shimmy damper. A safety switch, mounted on the nose wheel strut torque link, prevents engagement of the steering unit whenever the weight of the aircraft is off the nose gear.

Nose Wheel Towing Release Pin

76 The nose wheel towing release pin is located on the left side of the nose gear strut, just above the wheel fork. For towing the aircraft, the pin is disengaged. This allows the wheel to swivel by disconnecting the steering damper unit. Before flight, make sure the safety cap is on. This will ensure that the pin is engaged.

Nose Wheel Steering Switch

77 The push-button type nose wheel steering switch on the control stick grip actuates a shut-off valve to supply hydraulic pressure to the nose gear steering unit. To engage the steering unit, the switch must be depressed and the rudder pedals synchronized with the nose wheel. The steering unit will not engage if the nose wheel is more than 21 degrees either side of centre.

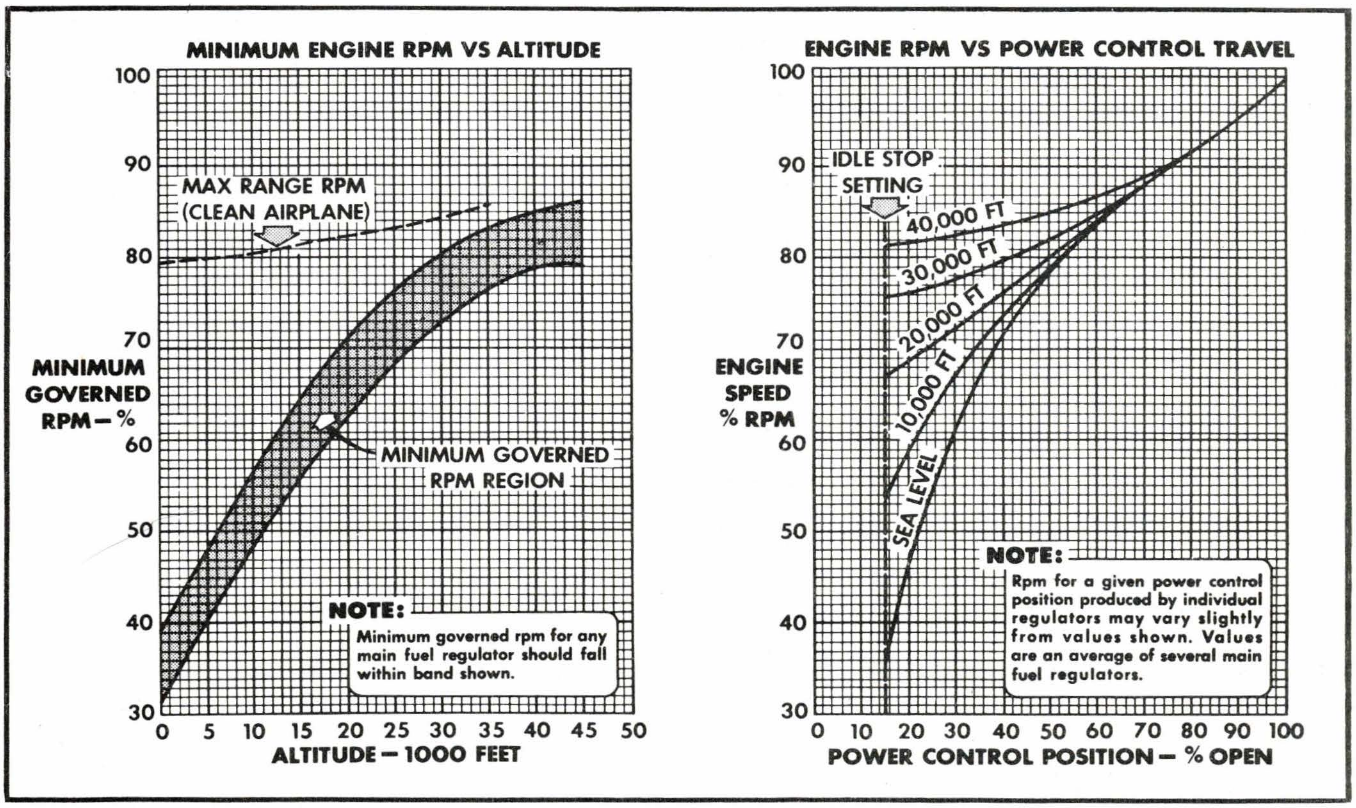
POWER PLANT CONTROL SYSTEM

Main Fuel Control System

78 The main fuel control system incorporates an engine-driven constant-output fuel pump, a fuel control valve and a fuel flow regulator. Engine rpm selected by throttle setting is maintained by action of the main fuel flow regulator and the fuel control valve, regardless of altitude or airspeed changes. The fuel flow regulator controls the amount of fuel delivered to the combustion chambers by operating the fuel control valve, which by-passes any fuel not required by the engine. Overspeed protection is provided through a wide-range governor in the fuel flow regulator. Although the governor section of the fuel flow regulator is designed to produce constant engine rpm for a given throttle setting, minimum idle rpm increases with altitude. (See figure 1-22.) This causes the first portion of throttle travel to be less effective at higher altitudes.

Emergency Fuel Control System

79 A continuously operating emergency fuel pump and an emergency fuel regulator act as a standby for the main fuel control system. This emergency system can be turned on or



NOTE: Minimum governed rpm for any main fuel regulator should fall within band shown.

NOTE: Rpm for a given power control position produced by individual regulators may vary slightly from values shown. Values are an average of several main fuel regulators.

Figure 1-22 Main Fuel Regulator Characteristics off, or placed in a test position, by use of an emergency fuel switch. The emergency fuel system is controlled in the same manner as the main fuel system through the mechanical linkage to the throttle. Altitude changes are compensated for in order to maintain rpm selected by throttle setting, but there is no overspeed protection. The emergency regulator is set to give 99% rpm on a 38°C (100°F) day, and will provide less than 99% rpm at lower temperatures.

Exhaust Temperature Variation

80 Exhaust temperature of jet engine with fixed area exhaust nozzle is affected by outside air temperature, altitude and airspeed. Generally, with constant rpm, exhaust temperature will increase with an increase in altitude or outside air temperature, and will decrease with an increase in airspeed. These three factors can change singly or simultaneously, thus causing inconsistent exhaust temperatures for any given rpm. Ordinarily, an increase in exhaust temperature may be expected during take-off. As the aircraft becomes airborne and picks up speed, the temperature will drop to below that obtained at 100% rpm on the ground, until medium or high altitudes are reached. Above 35,000 feet, exhaust temperature will increase with altitude until a reduction in rpm may be necessary to hold exhaust temperatures within the limit. Any reduction in rpm for this purpose will not result in thrust loss, but may cause a slight thrust increase because of engine characteristics.

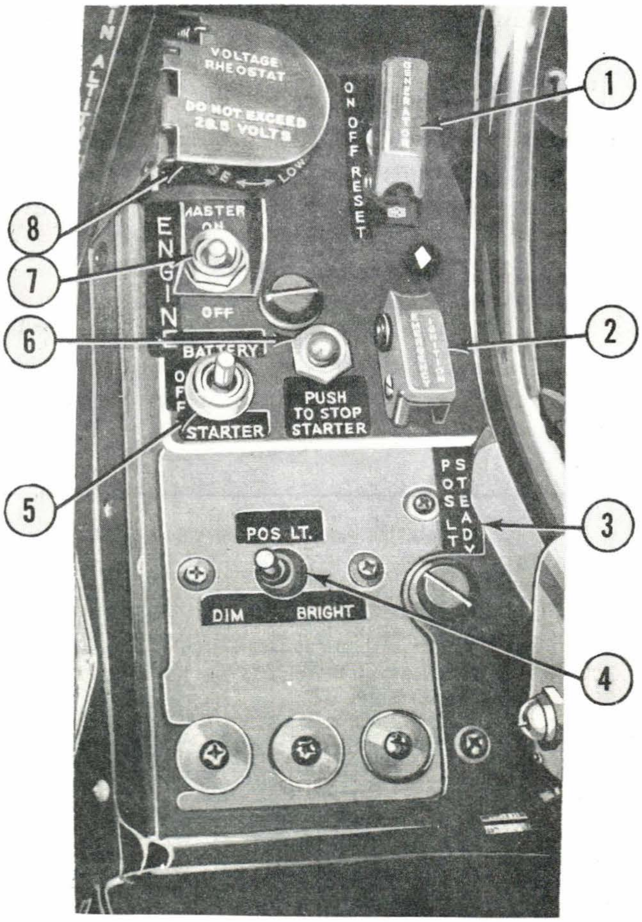
NOTE

> With engine rpm above approximately 98%, thrust is primarily determined by exhaust temperature and not by engine rpm.

81 No action can be taken in flight if exhaust temperature is below the limit, although it should be remembered that thrust decreases with decrease in exhaust temperature during operation at a constant engine rpm. To ensure proper exhaust temperatures, the exhaust nozzle area is adjustable on the ground by installation of metal segments on the inside of the nozzle.

Throttle Control Lever

82 The throttle control lever is located at the left side of the cockpit. A stop is provided on the quadrant between the IDLE and OFF positions to prevent shutting off the fuel supply inadvertently when retarding the throttle control lever. Outboard movement of the lever (which is spring-loaded inboard) allows the stop to be by-passed when starting or stopping the engine. When the engine master switch is ON, initial outboard movement of the lever from OFF closes a microswitch which energizes the circuits to the booster pumps and the ignition system. Subsequent movement of the lever to IDLE opens the engine fuel stopcock. Further advan-



1	Generator control switch.
2	Emergency ignition switch.
3	Exterior lights control switch.
4	Exterior lights dimmer switch.
5	Battery-start switch.
6	Stop starter button.
7	Master engine switch.
8	Voltage rheostat. (Aircraft 19102 to 19200 inclusive)

Figure 1-23 Right Forward Console

cement of the throttle lever increases engine rpm by changing the setting of the fuel flow regulator. The grip on the throttle lever contains the speed brake switch, the gun sight gyro caging button, and the microphone button. Also incorporated in the throttle lever grip is a manual ranging control for the gun sight. Rotation of the throttle lever handle about its vertical axis will manually range the radar gun sight.

Engine Master Switch

83 The guarded engine master switch, on the right console (see figure 1-23) controls the fuel shut-off valve and completes the electrical circuits to the fuel booster pumps and to the throttle lever actuated microswitch controlling ignition (during starting only).

Ignition

84 Ignition is required only during the starting procedure, since the mixture in the combustion chambers will burn continuously after once being ignited. Current for ignition is supplied to the spark plugs when the engine master and starter switches are on, and the throttle lever is moved from the OFF position. When the starter is subsequently disconnected from the circuit (at approximately 23% rpm) the ignition relay is de-energized.

Emergency Ignition Switch

85 An emergency ignition switch on the engine control panel is used to supply ignition for restarting the engine in flight. When the emergency ignition switch is on, it connects the battery to the ignition system when the throttle lever is advanced from OFF and the battery switch is ON. The switch should be left on only until ignition occurs, as it creates a heavy drain on the battery. If the switch is left on for longer than 3 minutes or used too frequently, the ignition transformer will probably be damaged.

Starter

86 A combination starter-generator unit is provided for cranking the engine up to approximately 23% rpm. An external 28.5 volt power source capable of supplying 1500 amperes must be used for starting, as the starter cannot be powered by the aircraft battery. The battery-starter switch on the engine control panel operates the starter when held momentarily at the STARTER position. A starter relay continues to energize the starter until engine speed reaches approximately 23% rpm at which point the starter circuit is automatically disconnected.

Push to Stop Starter Button

87 A push to stop starter button, located outboard of the battery starter switch on the right forward console, can be used to de-energize the starter if ignition fails or malfunction occurs.

Emergency Fuel Switch

88 A three-position emergency fuel switch is located above the throttle quadrant. When this switch is ON, the emergency fuel system is acting as a standby for the main system and will supply fuel to the engine in case of main system failure. When the switch is OFF the emergency system is ineffective. When the switch is held in the momentary TEST position the main system is made inoperative and the emergency system should automatically take over with very little drop in rpm.

FLIGHT AND ENGINE INSTRUMENTS

General

89 The following flight instruments are provided: altimeter; turn and bank indicator; rate of climb indicator; artificial horizon; directional gyro magnetic compass; airspeed indicator; clock; accelerometer; machmeter; cabin altimeter; radio compass indicator and a magnetic compass.

CAUTION

> Care must be exercised when caging the artificial horizon to prevent damaging the mechanism.

90 The following engine instruments are provided; oil temperature indicator on aircraft 19102 to 19121, 19123 to 19140 only; oil pressure indicator; tachometer indicator; fuel quantity indicator; fuel flow indicator; exhaust temperature indicator; ammeter (loadmeter); fuel pressure indicator; voltmeter and a hydraulic pressure indicator.

LIGHTING EQUIPMENT

Navigation and Fuselage Lights

91 The aircraft is equipped with two fuselage lights, one in the aft portion of the canopy and the other on the bottom of the fuselage, and navigation lights including one white and one yellow tail light. These lights are controlled

by a flasher switch and a dimmer switch, both on the right forward console. The fuselage lights are on steady regardless of whether the flasher switch is in FLASH or STEADY. When the flasher switch is in FLASH, the red and green lights go on and off and the tail lights alternate from white to yellow.

Landing Lights

92 Two retractable lights are located in the fuselage nose just forward of the nose wheel door. The lights are controlled by two switches on the left forward console. The light extension switch has EXTEND, RETRACT and OFF positions. Both lights are automatically turned off when retracted, regardless of the position of the landing and taxi light switch. The taxi light alone is turned on when the landing and taxi light switch is positioned at TAXI. Moving the switch to LAND & TAKE-OFF turns on the landing light and, when the nose wheel is on the ground, also turns on the taxi light. On aircraft 19453 and subsequent, the landing and taxi lights are controlled by one switch, located on the left forward console. When switch is at EXTEND, both lights illuminate and extend to landing position. When the aircraft touches the ground, the landing light goes out and retracts, and the taxi light extends still further to taxiing position.

Interior Lights

93 On aircraft 19102 to 19121, 19123 to 19140, instrument panel lighting is provided by two fluorescent lamps, one on each side of the cockpit. The intensity of each light is controlled by a rheostat located just forward of the ventilating air outlet on the related side of the cockpit. On aircraft 19122, 19141 and subsequent the fluorescent lamps are replaced by two auxiliary instrument lights. Two red console lights one on each side of the cockpit and 20 ring-type instrument light assemblies are added and controlled by a rheostat on the right side wall. On aircraft 19453 and subsequent, the lighting control rheostats are located on a panel on the right side wall of the cockpit.

Interior Extension Light

94 An extension light for general cockpit illumination is provided. The controlling switch is just forward of the light. On aircraft 19201 and subsequent, the switch is on the extension light assembly.

Indirect Console Lighting

95 The right and left forward consoles and the centre pedestal are illuminated indirectly. Lighting is controlled by a panel light rheostat located on the centre pedestal. On aircraft 19453 and subsequent, the control is located on the right side wall in the cockpit.

COCKPIT EQUIPMENT

Canopy

96 The electrically-operated canopy may be controlled from either inside or outside the aircraft. The canopy actuator is directly powered by the battery or by an external power source. The battery-starter switch need not be at BATTERY for canopy operation. Air loads prevent the canopy from being opened at speeds above 215 knots IAS. Emergency release of the canopy in flight is accomplished by means

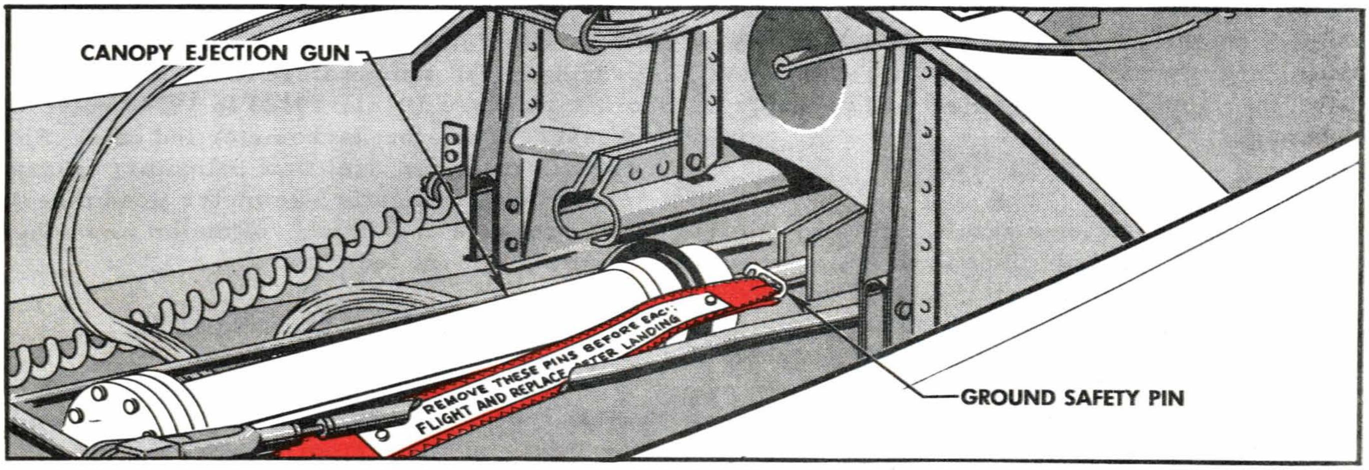


Figure 1-24 Canopy Ejection Gun

of a remover gun which fires the canopy off the aircraft. The canopy is fired by raising the right handgrip on the seat in preparation for seat ejection. When the canopy is ejected in flight, it pulls a safety pin from the seat catapult firing mechanism. This safety pin prevents seat ejection until after the canopy leaves the aircraft. A ground safety pin on the canopy ejection gun prevents the gun being fired accidentally while the aircraft is on the ground. (See figure 1-24.) This safety pin must be removed before flight and replaced after flight. Safety pins with their red streamers are stowed in the map case during flight and are reinstalled immediately upon landing.

Canopy Seal

97 An inflatable canopy seal is provided which seals the canopy in the closed position. Pressure for inflation of the seal is provided by engine compressor air and is automatically controlled by a pressure regulator. The seal becomes inflated whenever the canopy is fully closed. When the canopy switch is actuated, the seal is automatically deflated to allow the canopy to move. The seal is also automatically deflated before canopy ejection. Should the canopy switch be moved to CLOSED during flight, it will cause the seal to deflate, and, at altitude, will result in loss of cockpit pressurization. When the switch is released, the canopy seal will be inflated and the cockpit will become pressurized again.

Canopy Buttons (External)

98 The canopy is operated externally by

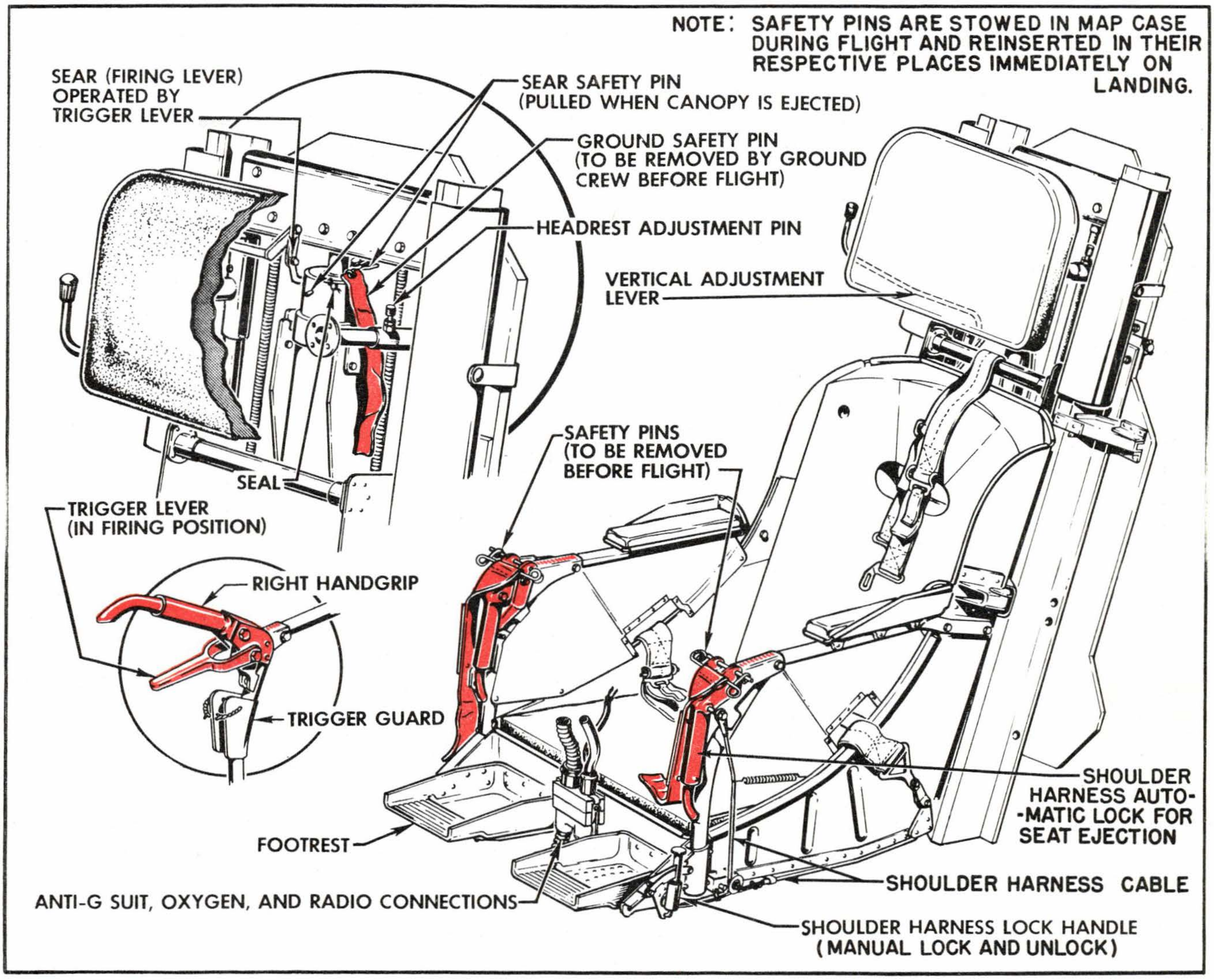


Figure 1-25 Ejection Seat

means of two spring-loaded push buttons located on each side of the fuselage approximately two feet below and in line with the windshield. One button is marked OPEN, the other CLOSED. Operation of any external button overrides the selection of the cockpit switch, but if the cockpit switch is left at OPEN and an external button used for closing, the canopy will open again as soon as the external button is released.

Canopy Switch

99 From within the cockpit the canopy is controlled by a three-position toggle switch above the left forward console. To close the canopy, the switch must be held at the spring-loaded CLOSE position. To open the canopy, select the OPEN position. When the canopy has fully opened, power to the canopy actuator is automatically cut off. When the switch is at the middle OFF position the canopy is locked, whether partially open, fully open or closed.

Canopy Declutch and Manual Control Handles

100 A canopy declutch handle, at the bottom of the centre pedestal, is for ground use only and, when pulled, disengages the canopy from the drive shaft so it can be moved manually by means of the manual control handle on the right side of the canopy bow. The canopy can be manually opened during flight (after the internal canopy declutch handle is operated) approximately two inches when air loads will prevent further opening. However, the canopy can be electrically opened during flight at speeds below 215 knots IAS. The canopy can then be declutched and airloads should remove it from the aircraft.

External Canopy Emergency Release

101 An external canopy emergency release handle can be reached through an access door on the left side of fuselage below the canopy frame. The external release does not fire the canopy remover gun but merely releases the canopy so it may be moved manually.

WARNING

> Whenever the canopy is opened by operating the declutch or external release, the ejection gun safety pin must be installed immediately and the aircraft declared unserviceable while the canopy is being re-installed and adjusted.

Ejection Seat

102 An ejection seat is provided (see figure 1-25). Arm and footrests on the seat are fixed. The handgrips are hinged to pull up into a vertical position for ejection. Ground safety pins, installed through the handgrips to prevent their being raised inadvertently, must be removed prior to flight and stowed in the map case. When the seat is ejected, anti-G suit, oxygen hose, microphone and headset connections automatically disconnect at a single fitting attached to the seat between the footrests.

Right Handgrip

103 The catapult trigger lever, located beneath the folding handgrip at the forward end of the right armrest, is protected by a guard and safety wire. As the right handgrip is pulled up in preparation for ejection, the safety wire is broken and the trigger is raised out of the guard. At its full up position the canopy gun is fired, jettisoning the canopy, the handgrip locks and the trigger lever is within reach of the fingers. Squeezing the trigger fires the seat catapult. A safety pin in the seat catapult firing mechanism renders the trigger lever ineffective until after the canopy is jettisoned.

Left Handgrip

104 Raising the folding left handgrip to its full up position will automatically lock the shoulder harness for ejection.

Headrest Adjustment Pins

105 The seat headrest can be adjusted horizontally on the ground. Pulling up the spring-loaded pin in each of the two tubes aft of the headrest releases it for adjustment.

Seat Vertical Adjustment Lever

106 A control for mechanical seat adjustment is provided by a handle to the right of the headrest. Pulling the handle down releases the seat for adjustment.

Shoulder Harness Lock Handle

107 The shoulder harness inertia reel lock handle, located on the left side of the seat, is operated for manually locking and unlocking the shoulder harness. The shoulder harness inertia reel will automatically lock under a 2 to 3 G forward deceleration, as in a crash landing. It is necessary to manually lock the shoulder harness only during manoeuvers and flight in rough air, or as an added safety precaution in event of a forced landing.

NOTE

Before a forced landing, battery, generator and engine master switches not readily accessible with the shoulder harness locked should be cut before moving harness lock handle to the locked position.

108 If the harness is manually locked while the pilot is leaning forward, as he straightens up, the harness will retract with him moving into successive locked positions as he moves back against the seat. To unlock the harness, the pilot must be able to lean back enough to relieve the tension on the lock. If the harness is locked while the pilot is leaning back hard against the seat, it may not be unlocked without first releasing it momentarily at the safety belt or by releasing the harness buckles. After automatic locking of the harness, it will remain locked until the lock handle is moved to the locked position and then back to unlocked.

PNEUMATIC SYSTEM

Anti-G Suit Provisions

109 An air pressure outlet connection on the front of the seat provides for attachment of the air pressure intake tube of the anti-G suit. Air pressure for inflation of the suit bladders is conducted from the engine compressor through a pressure regulating valve, located on the left console, which starts functioning at a predetermined number of G's depending on the setting of the valve. Acceleration above approximately 1.75 G. causes the valve to open, inflating the anti-G suit. For each additional 1G acceleration force, a corresponding 1 psi (LO setting) or 1.5 psi (HI setting) air pressure is exerted in the suit. A button on top of the valve can be manually depressed to inflate the suit momentarily when desired.

AIR CONDITIONING AND PRESSURIZING SYSTEM

General

110 Air is extracted from the final stage of the engine compressor and is delivered to the cockpit under pressure, at a preselected temperature, for either heating or ventilating. (See figure 1-26.) The cockpit is not pressurized from sea level to 12,500 feet. Above this altitude, either of two (2.75 psi or 5.00 psi) cockpit pressure schedules are available through a selectively controlled automatic pressure regulator. The hot air from the engine compressor is cooled by passage through a cooling unit. If additional heat is required, an electric cockpit heater is automatically energized and cycled on and off to maintain selected cockpit temperature. Air outlets are located on both sides of the cockpit, above the consoles and forward of the pilot's feet.

Cockpit Pressure Control

111 A cockpit pressure control lever is located on the left aft console. With the lever in either of the ON positions, the system shut-off valve in the air supply line from the engine compressor section is open and sufficient air flows into the cockpit to maintain the selected pressure schedule. During operation on the lower pressure schedule, the regulator maintains a cockpit altitude of 12,500 feet until a flight altitude of 21,200 feet is reached. Above 21,200 feet, the regulator maintains a constant cockpit pressure 2.75 psi greater than the corresponding outside air pressure. The higher pressure schedule maintains a cockpit altitude of 12,500 feet up to a flight altitude of 31,000 feet, with a 5.00 psi pressure differential maintained. above that altitude. At altitudes above either 21,200 or 31,000 feet, depending on the pressure schedule selected, the cabin altimeter will rise above 12,500 feet on a scale proportional to the flight altitude. See figure 1-27 for comparison of flight altitude to cockpit altitude and for cockpit altitude tolerances.

112 On aircraft 19122 and 19141 to 19272 inclusive, the cabin altimeter is replaced by a pressure gauge. A conversion chart for this gauge is installed on the right side of the canopy. When the lever is moved to OFF (RAM AIR ON-DUMP OPEN), the system shut-off valve is closed and an emergency dump valve is opened, releasing cockpit pressure and allowing ram air to enter the cockpit. The ram air may be automatically heated, by the cockpit heater in the normal system, before being delivered to the cockpit, by positioning the temperature control switch to HOT.

Cockpit Pressure Control Switch

113 On aircraft 19453 and subsequent, a two-position cockpit pressure control switch is on the left aft console. When the switch is placed at RAM, the system shut-off valve is closed and the cockpit dump valve and a ram-air shut-off valve are opened. This shuts off all incoming pressurized hot air from the engine compressor, releases the cockpit pressure, and permits cold ram-air to enter the

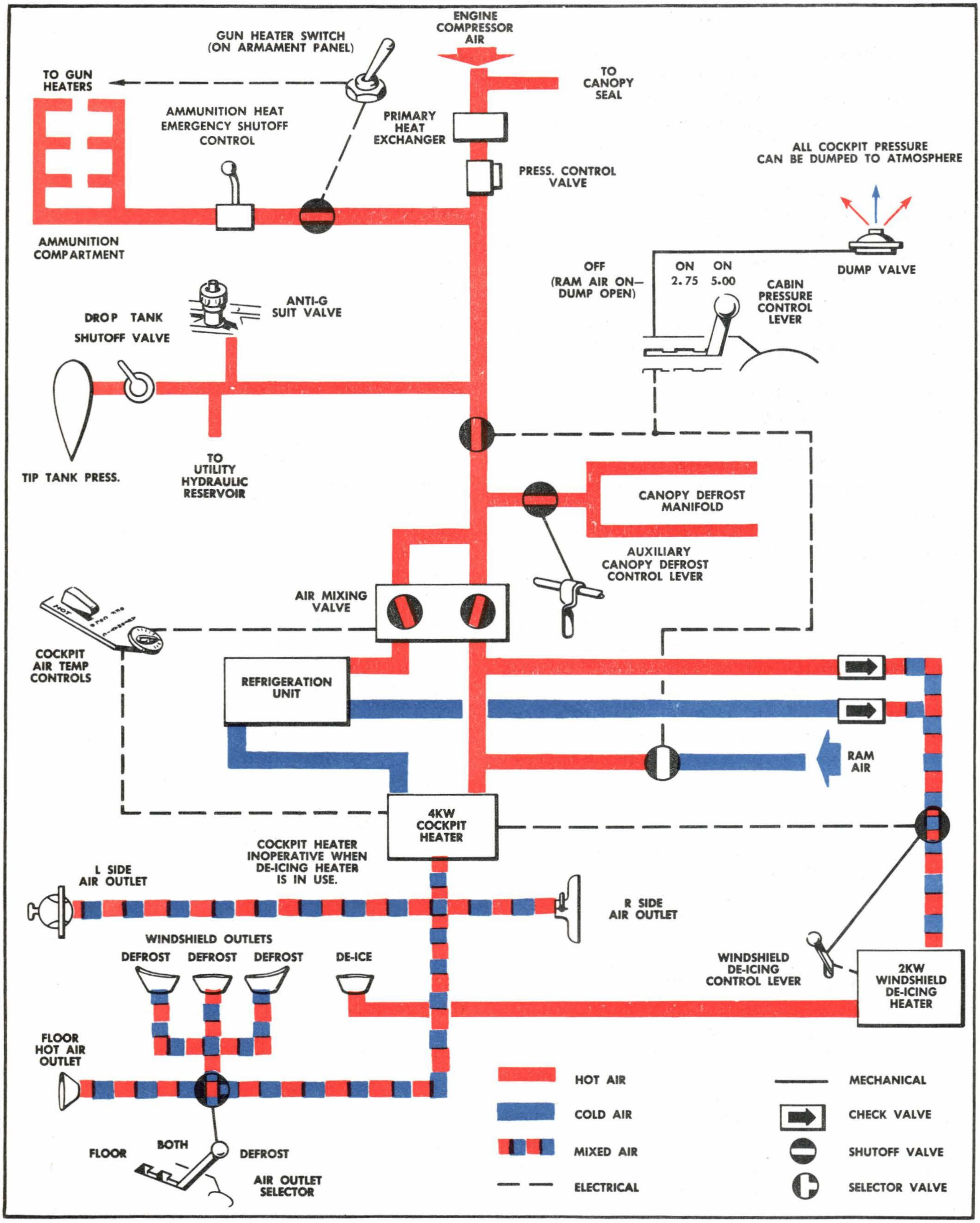
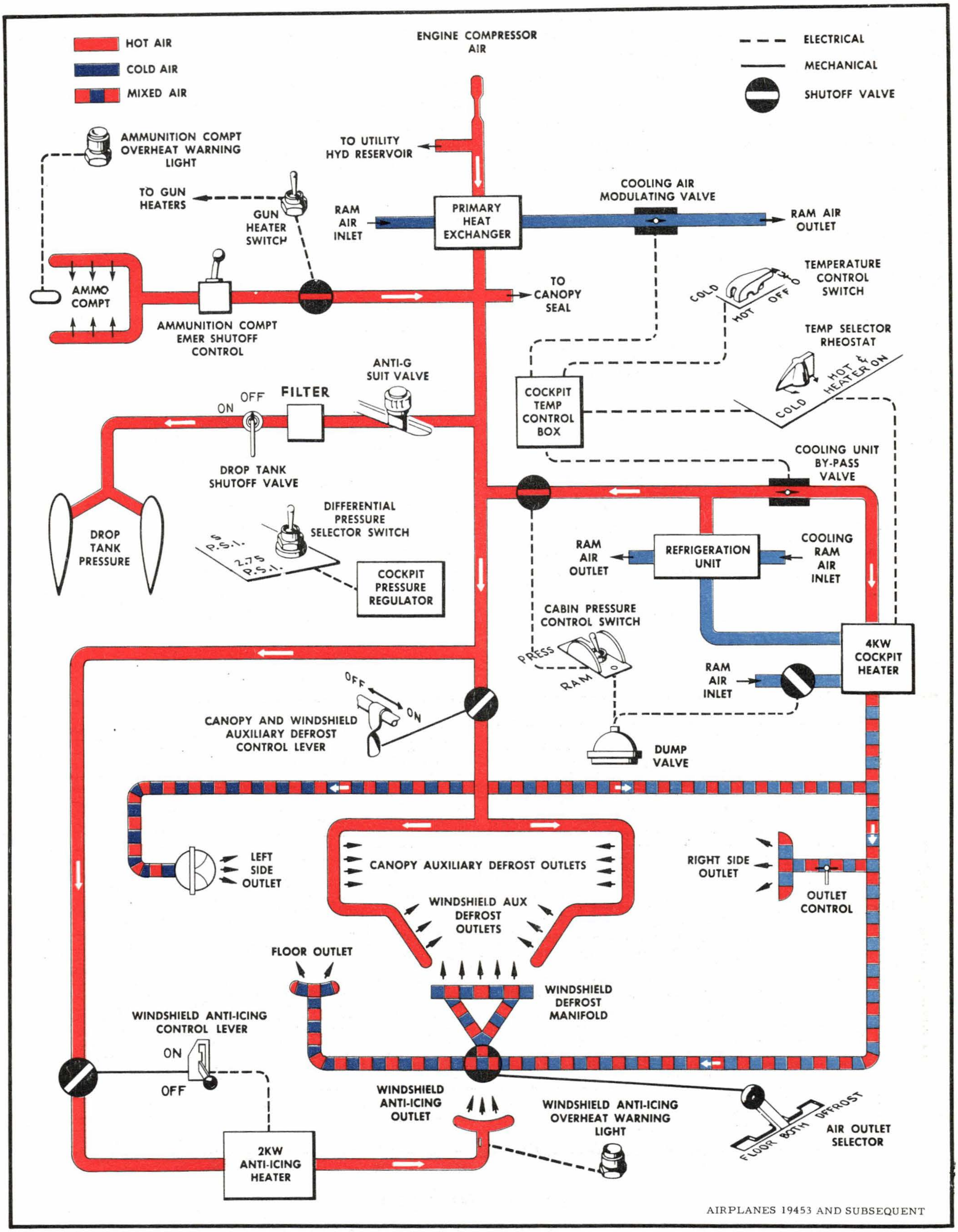


Figure 1-26 (Sheet 1 of 2) Air Conditioning and Pressurizing System (Aircraft 19102 to 19452)



AIRPLANES 19453 AND SUBSEQUENT

Figure 1-26 (Sheet 2 of 2) Air Conditioning and Pressurizing System (Aircraft 19453 and Subsequent) cockpit. The ram-air may be heated by turning the air temperature control rheostat to HOT & HEATER ON. To provide controlled cockpit pressures, the pressure control switch is set at PRESS. This opens the system shut-off valve and closes the ram-air shut-off valve so that air flows into the cockpit to maintain the selected cockpit pressure schedule, as determined by the pressure selector switch. A dive rate control unit is installed on the pressure regulator to regulate the rate of pressure differential increase at one psi per minute.

Cockpit Pressure Selector Switch

114 On aircraft 19453 and subsequent, a pressure selector switch, located on the left aft console, is positioned at either 2. 75 psi or 5 psi to select the desired cockpit pressure schedule.

NOTE

> Moving the cockpit pressure control lever to OFF on aircraft 19102 to 19452, or moving the pressure control switch to RAM on aircraft 19453 and subsequent, also shuts off all air supply for windshield de-icing and canopy defrosting.

Air Outlet Selector

115 An air outlet selector, inboard of the pressure control lever on the left console, can be positioned to FLOOR, DEFROST (windshield), or BOTH and air will be delivered to the corresponding areas. Direction of airflow from the outlet on the left side of the cockpit can be manually controlled by rotation of the outlet, and airflow on the right side of the cockpit can be manually controlled by use of an air outlet control valve under the right longeron. Both outlets can be shut completely.

Cockpit Air Temperature Control Switch

116 Temperature of the air admitted to the cockpit is controlled by a four-position temperature control switch on the left aft console. With the switch in the AUTOMATIC position, air temperature is automatically maintained at the temperature selected by the cockpit air temperature control rheostat. In case of failure of the automatic control system, the switch may be moved to HOT or COLD until the desired cockpit temperature is reached. On aircraft prior to 19453, the switch is spring-loaded to the HOT or COLD position and will automatically return to OFF when released. On air-

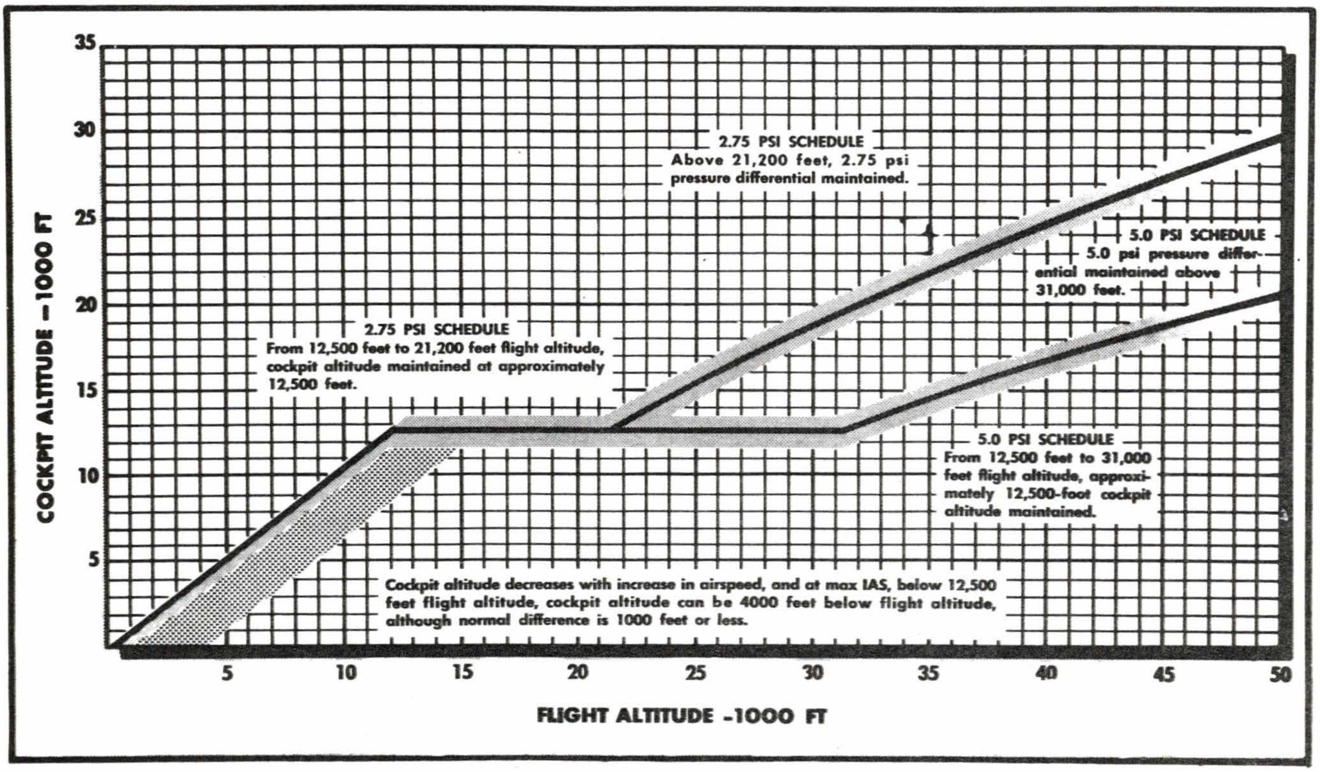


Figure 1-27 Cockpit Pressure Schedule

craft 19453 and subsequent, the switch guard holds the switch in AUTO position when not in use.

Cockpit Air Temperature Control Rheostat
117 Cockpit air temperature is selected by the temperature control rheostat on the left aft console. With the temperature control switch at AUTOMATIC, the rheostat may be positioned in the range between 4°C and 27°C to maintain the desired cockpit temperature. When high outside air temperatures are encountered, the refrigeration unit may be operating at full capacity to provide cockpit cooling, and turning the control rheostat to a lower setting may not result in additional cockpit temperature reduction.

DEFROSTING AND DE-ICING SYSTEMS

General
118 Windshield defrosting is accomplished by directing heated cockpit air through three windshield defrost outlets. Perforated tubes along the windshield and canopy tracks direct engine compressor air for auxiliary canopy defrosting. Windshield de-icing is provided from an outlet that circulates engine compressor air between the outer windshield and the armour glass. A windshield de-icing air heater automatically provides additional heat if necessary. For information on the windshield de-frosting air outlet selector, refer to Paragraph 113, preceding. On aircraft 19453 and subsequent a layer of heater air is passed over the outside surface of the windshield.

Windshield De-icing Control Lever
119 Windshield de-icing is turned ON or OFF by means of a windshield de-icing control lever, located forward of the air outlet, above the left aft console. The windshield de-icing air heater will operate only when the de-icing control lever and the pressurization system are turned on, and the engine is operating. On aircraft 19453 and subsequent, this system should only be used during icing conditions and in all other cases the lever must be OFF.

NOTE

> When the windshield de-icing system is turned on, the electric cockpit heater is inoperable.

Auxiliary Canopy Defrost Control Lever
120 Air to both sides of the canopy is controlled by a defrost control lever on the left longeron in the cockpit. Pulling the lever aft turns the system off; pushing it forward turns the system on. Since no temperature protection is provided, do not operate the system on the ground if outside temperature above is 32°C.

NOTE

> To prevent formation of frost on the canopy due to rapid changes in temperature and humidity during a descent from altitude, it is recommended that the auxiliary canopy defrosting system be maintained on or partially on in flight at all times unless the cooling system is unable to maintain tolerable cockpit temperatures.

Windshield Anti-icing Overheat Warning Light
121 On aircraft 19453 and subsequent, indication of anti-icing air temperatures in excess of 135°C is provided by an amber warning light on the left side of the cockpit, aft of the side air outlet. The light is controlled by an overheat thermostat in the anti-icing air outlet. The windshield anti-icing lever should be moved to OFF when light comes on.

Fuel Filter De-icing System
122 Fuel filter de-icing is accomplished by injecting alcohol into the fuel entering the filter. Alcohol from a one gallon reservoir is pumped by an electric pump to the fuel filter inlet. The alcohol supply will last for approximately one minute of de-icing operation. A fuel filter de-icer button, on the left side of the instrument panel shroud, controls the alcohol pump. Warning of the presence of ice in the fuel filter is indicated by illumination of the amber light located next to the de-icer button. The light will go out when ice has been removed.

Pitot Heater
123 The pitot tube is heated by an electric heater in the pitot head which is controlled by a circuit breaker on the left forward console. The pitot heater should not be used on the ground as serious overheating will occur.

OXYGEN SYSTEM

General
124 A low pressure oxygen system is used, including a pressure-demand regulator, a flow indicator, and a pressure gauge. Normal minimum pressure for the system is 400 psi.

On aircraft 19102 to 19500, the A-14 pressure-demand regulator is installed. On aircraft 19501 and subsequent, the D-1 regulator is installed. (See EO 05-1-1, Pilots Operating Instructions General, Part 3, Chapter 9, for details of the regulators.)

Oxygen Pressure Gauge
125 On aircraft 19102 to 19500 an oxygen pressure gauge is located on the left forward console. On aircraft 19501 and subsequent a combination oxygen pressure gauge and flow indicator is located on the face of the D-1 regulator.

Oxygen Flow Indicator
126 On aircraft 19102 to 19500 a blinker-type oxygen flow indicator, located on the left forward console, provides a visual indication that oxygen is being supplied. On 19501 and subsequent, a combination oxygen pressure gauge and flow indicator is located on the face of the D-1 regulator.

ARMAMENT EQUIPMENT

General
127 The aircraft is equipped with a sight for use with the machine guns, bombs, chemical tanks and rockets. Three .50 machine guns are located on each side of the engine air intake. Bomb racks for bombs or chemical tank and rocket launchers may be carried under each wing.

A-1CM and A-4 Gun-Bomb-Rocket Sights
128 The A-1CM sight is used on aircraft 19102 to 19464 inclusive, and the A-4 sight is installed in aircraft 19465 and subsequent (see figures 1-28, 1-29 and 1-30). Both sights operate on the same principles and are basically similar, the A-4 sight being a redesign of the A-1CM. The sight is located above and forward of the instrument panel shroud and automatically shows the computed lead on a target. It may be also used for rocket firing and for bomb release. The sight reticle image varies with the two sights. On the A-1CM, the image is a centre dot and a circle; the A-4 sight has the same centre dot, but the outer circle is composed of a number of diamond-shaped dots. The image is projected on the windshield armour glass or on the reflector glass aft of the windshield and indicates the required lead for gun and rocket

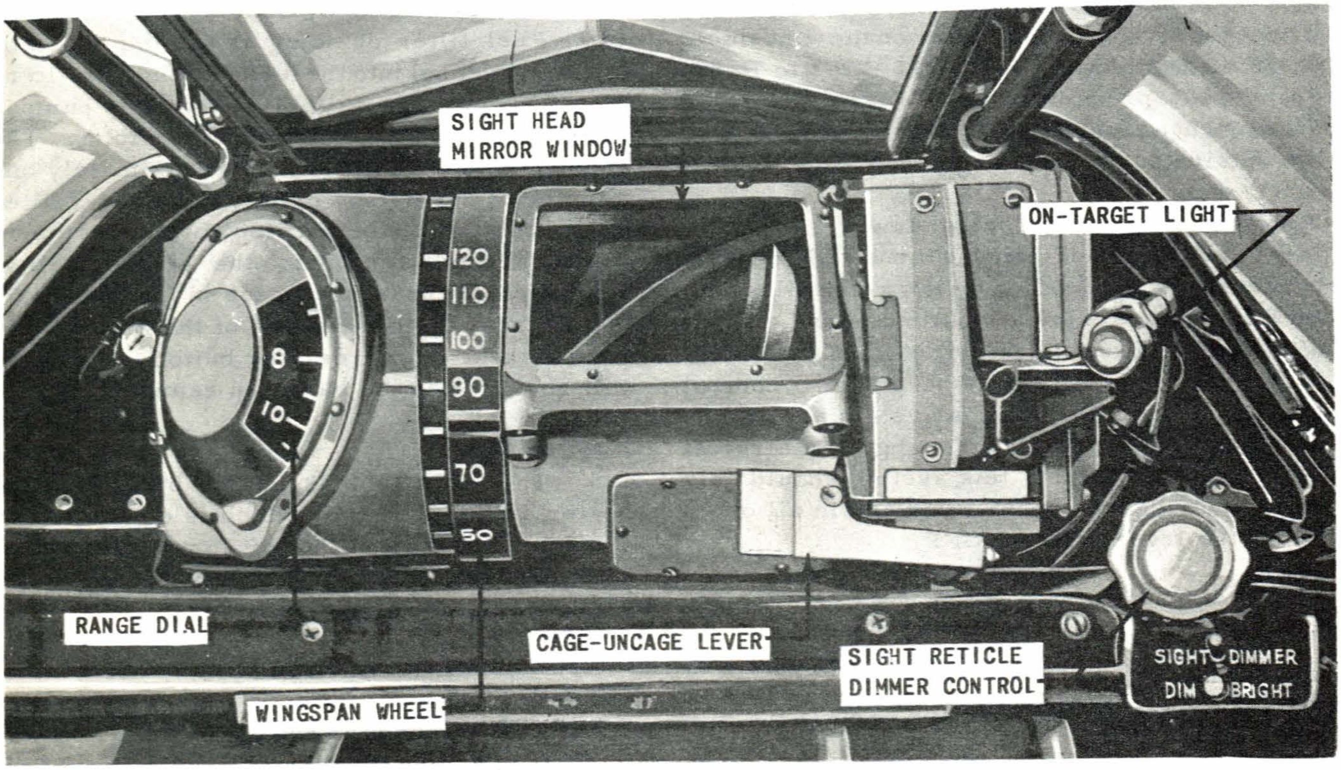


Figure 1-28 A-1CM Sight (Aircraft 19102 to 19121, 19123 to 19140)

firing. Range data for gunnery operation is supplied to the sight by the AN/APG-30 radar ranging equipment or by a manual range control. The radar system provides automatic search within its range. It automatically locks onto and tracks a target in range and indicates when the equipment is tracking a target. Bombs can be released automatically at the proper release point by a mechanism within the sight. Electrical power (a. c.) is supplied to the sight through the single-phase inverter, and manual sight ranging may be used if the power supply or radar fails. The sight can be operated as a fixed-reticle sight as long as d. c. power is available.

Gun Safety Switch

129 Electric power for operating the sight, gun camera, radar and guns is controlled by the guarded gun safety switch on the centre pedestal. Power is supplied to the sight, camera, and radar when switch is in either GUNS or SIGHT CAMERA RADAR position. The gunfiring circuit receives power only when switch is at GUNS. When guard is down, the switch is OFF.

Reticle Dimmer Control

130 Brilliance of reticle illumination may be adjusted by means of a reticle dimmer control to the right of the sight. When the sight is not in use, the dimmer control should be turned to DIM.

Filament Selector Switches

131 On aircraft 19102 to 19464, two filament selector switches allow selection of either primary or secondary filaments in the lamps that illuminate the reticle dot and circle, should one of the filaments burn out. The filament selector switches are located on the centre pedestal. (See figure 1-31.)

132 On aircraft 19465 and subsequent selection of alternate filaments (primary or secondary) within the lamp that illuminates the sight reticle image is controlled by the filament selector switch on the centre pedestal. (See figure 1-32.)

Sight Electrical Caging Button

133 An electrical caging button is provided on the throttle grip to stabilize the reticle image while manoeuvring for an attack.

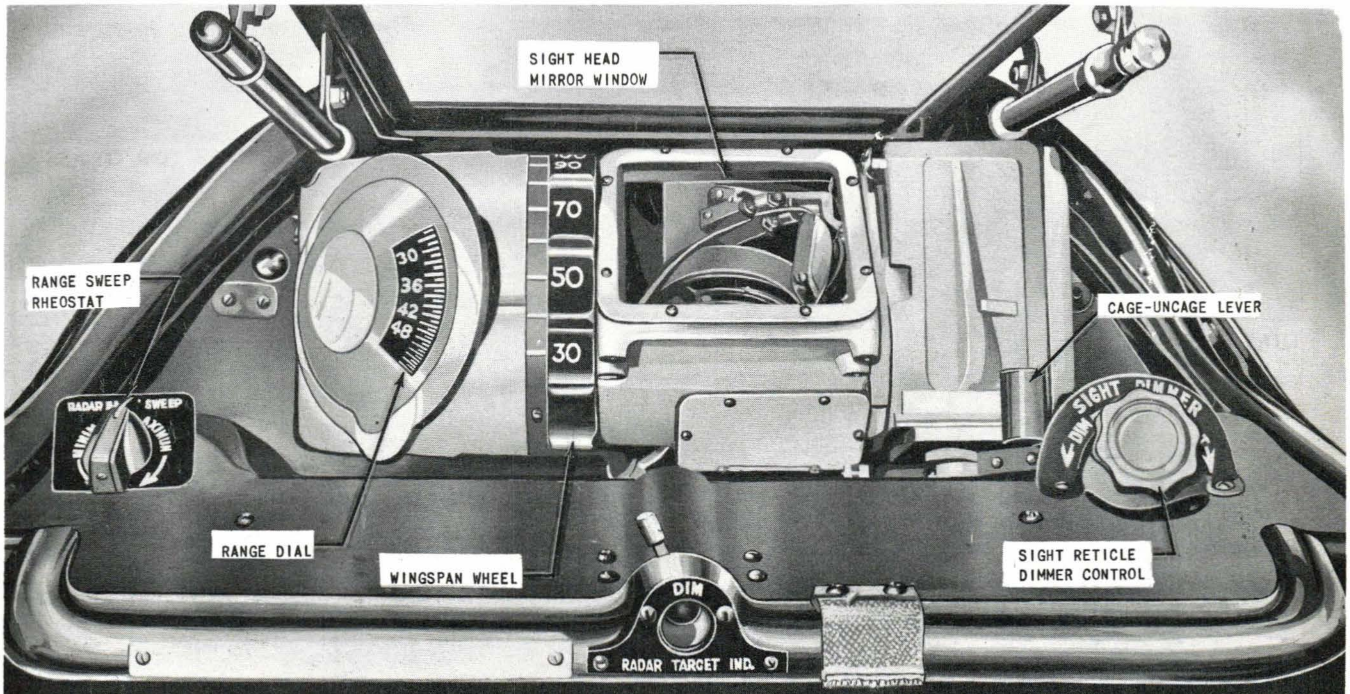


Figure 1-29 A-1CM Sight (Aircraft 19122, 19141 to 19464)

Sight Mechanical Caging Lever

134 A mechanical caging lever, on the right side of the sight is moved left to CAGE and right to UNCAGE. For firing at ground targets, or in the event of sight failure, the caging lever may be placed at CAGE and the reticle used as a fixed sight.

Wing Span Adjustment

135 Used in connection with the manual ranging system during gunnery operation, the wing span dial or knob is set to correspond to the span of the target aircraft.

NOTE

> It is not necessary to put in span adjustment when radar ranging is used.

Manual Ranging Control

136 A twist grip incorporated in the throttle lever provides for manual ranging during gunnery operation when radar ranging is erratic (below 6000 feet on overland targets). The range control covers a span of 1500 feet, from approximately 1200 feet to approximately 2700 feet. Clockwise rotation of the twist grip reduces the range (increases reticle size). The manual ranging control is spring-loaded to the full counterclockwise position for operation of the radar ranging system.

Radar Target Selector

137 When the radar detects a target, it locks on it and measures its range. The radar may be shifted to another target by means of a target selector button on the control stick grip. Holding the selector button depressed for several seconds causes the radar to reject the target upon which it had locked. The radar can then lock on the targets at ranges greater than the one it was caused to reject, until the maximum radar sweep range is reached. It then automatically recycles, commencing to sweep from minimum sweep range. On aircraft equipped with A-4 sights, depressing the radar target selector button automatically moves the sight function selector lever to GUN.

Radar Range Sweep Control

138 The range sweep control rheostat on the left side of the instrument panel shroud can be used to lower radar ranging distance to prevent radar from locking on the earth when aircraft is at low altitude. Turning the rheostat toward MINIMUM decreases the range. Range is increased when rheostat is turned toward

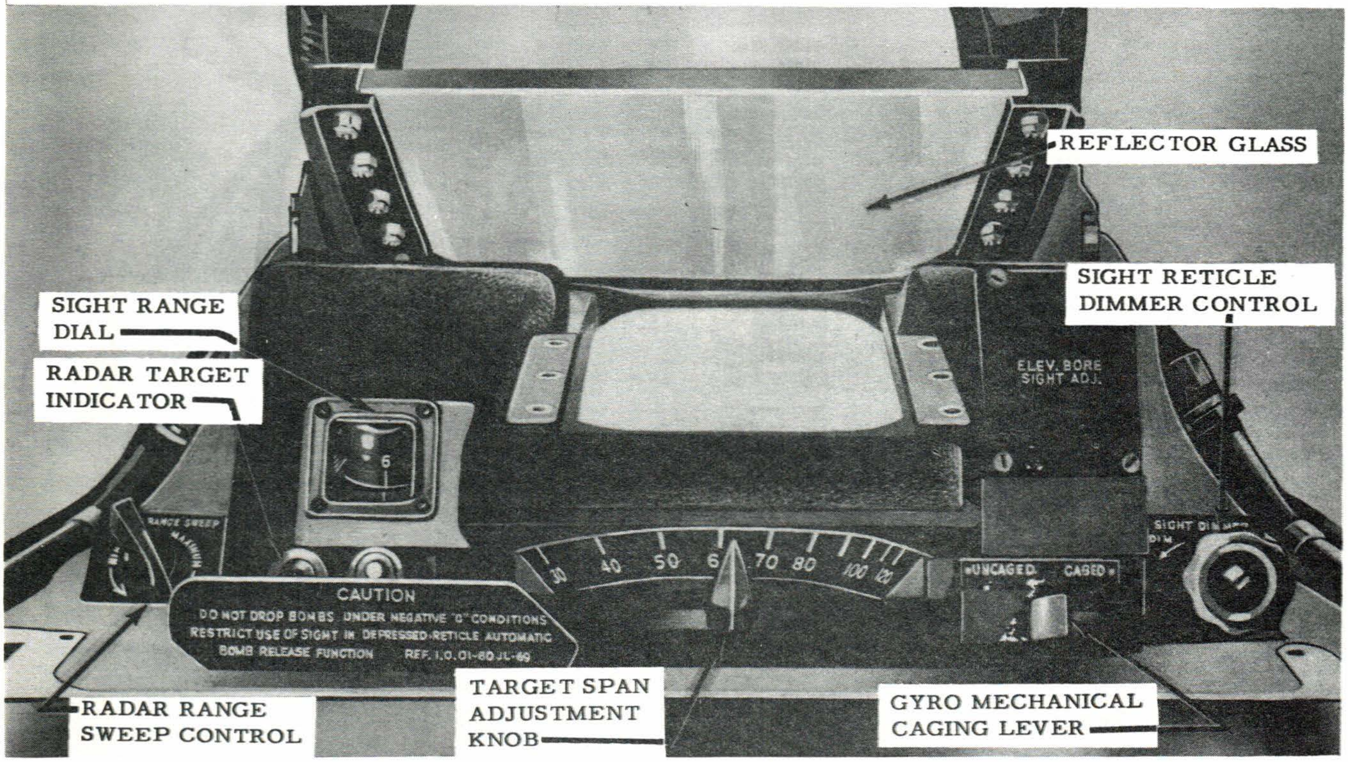
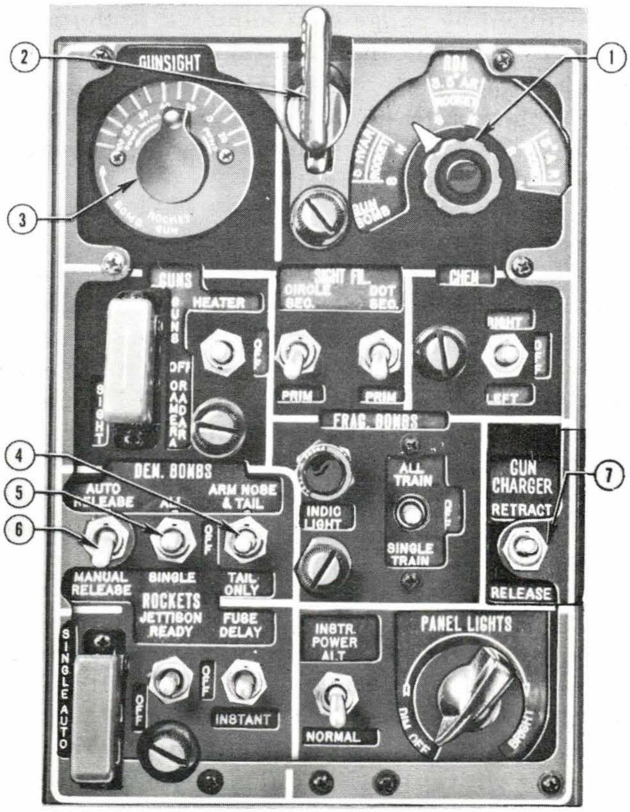


Figure 1-30 A-4 Sight (Aircraft 19465 and Subsequent)

MAXIMUM. During normal operations, control should be at MAXIMUM.

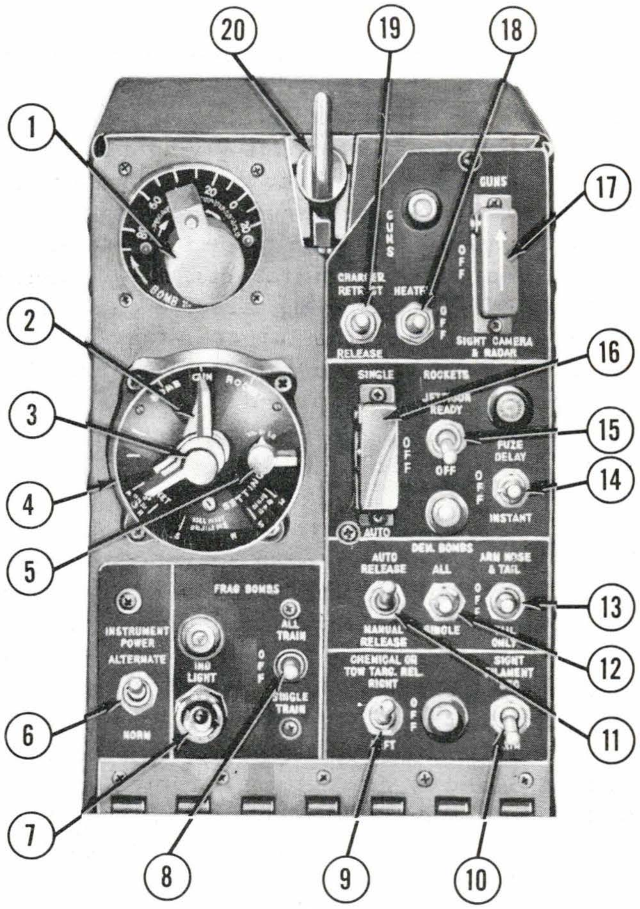
Bomb-Target Wind Control

139 The bomb-target wind control on the centre pedestal is used for bombing operations only. Setting the B-TW control adjusts the sight to compensate for the components of wind velocity and target motion parallel to the direction of the attacking aircraft. For stationary targets, corrections are made on the dial UPWIND (for bombing run into a head



1 Rocket dive angle control.
2 Rudder lock.
3 Bomb-target wind control.
4 Demolition bomb arming switch.
5 Demolition bomb all-single selector switch.
6 Demolition bomb release selector switch.
7 Gun charger switch (Aircraft 19201 and subsequent)

Figure 1-31 Centre Pedestal
(Aircraft 19102 to 19464)



1 Bomb target wind control.
2 Sight function selector lever.
3 Rocket setting lever.
4 Sight selector unit.
5 Target speed switch.
6 Instrument power selector switch.
7 Fragmentation bombs indicator light.
8 Fragmentation bombs release switch.
9 Chemical or tow target release switch.
10 Sight filament selector switch.
11 Demolition bomb release selector switch.
12 Demolition bomb all-single selector switch.
13 Demolition bomb arming switch.
14 Rocket arming switch.
15 Rocket jettison switch.
16 Rocket single-auto selector switch.
17 Gun (sight, camera, radar) safety switch.
18 Gun heater switch.
19 Gun charger switch.
20 Rudder lock.

Figure 1-32 Centre Pedestal
(Aircraft 19465 and Subsequent)

wind) or DOWNWIND (when bombing run is made with a tail wind,) according to the estimated wind velocity. If wind direction is not in line with the course of the aircraft during a bombing run, the amount of correction must be estimated. When the target is moving, additional correction must be made for velocity of target. For approaching targets, correction is DOWNWIND; for receding targets, correction is UPWIND. When the target is travelling at right angles to the line of attack, no correction is necessary. When the sight is used for firing either rockets or guns, the pointer should be positioned on ROCKET GUN.

Rocket Dive Angle Control (A-1CM Sight)

140 For rocket firing, the rocket dive angle control on the centre pedestal is used to provide a depression angle correction for the type of rocket to be fired and the intended dive angle of the attack. Settings are provided for three types of rockets: 5 HVAR, 3.5 AR and 5 AR. At each of the three positions are two detents, marked S and N, for setting the intended dive angle. For attacks between 0 and 40 degrees, set the control at N (Normal), and for attacks between 40 and 60 degrees, set the control at S (Steep). When the sight is used for firing guns or dropping bombs, the R-DA control should be placed at the GUN BOMB position.

Sight Selector Unit (A-4 Sight)

141 Three sight controls, the rocket setting lever, the sight function selection lever, and the target speed switch, are incorporated in the sight selector unit. The rocket setting lever has the same functions as it has on the A-ICM. The sight function selection lever is set at either BOMB, GUN or ROCKET to adjust the sight system for the desired operation. When the selector lever is moved to BOMB, the sight reticle image dot is depressed to approximate the bomb trajectory. Moving the function selector lever to ROCKET permits subsequent operation of the rocket setting lever to adjust the sight reticle image for rocket firing. The selector lever will automatically return to GUN position, if set at BOMB or ROCKET, when the radar target selector button on the stick grip is depressed. The target speed switch is used during gunnery missions to control lead angle data in accordance with the speed ratio between the attacking aircraft and its target. When an attack is to be made on a slow target, the target speed switch is set at LO. The switch is moved to HI when the target speeds are high. The TR position is used when firing on a drogue or other training target.

Radar Target Indicator

142 On aircraft equipped with the A-1CM sight, the radar target indicator is on the centre of the instrument panel shroud. On aircraft with A-4 sights, the indicator light is located on the sight head just below the range dial. In either installation, the light is illuminated when the radar ranging equipment locks on a target.

Sight Range Dial

143 The target range, in hundreds of feet as determined by range data supplied to the sight by the radar or the manual ranging, is indicated by the range dial. The dial, which is located on the left side of the sight head, indicates graduations in 100 feet intervals and covers a span of 600 to 6,000 feet.

Gunnery Equipment

144 A bank of three .50-calibre machine guns is mounted on each side of the engine air intake duct in the nose of the aircraft. Three hundred rounds of ammunition may be carried for each gun, although the normal load is 267 rounds. Guns cannot be charged in flight on aircraft 19102 to 19200 inclusive, but are charged before take-off by means of a manual charger stowed in each gun compartment. Aircraft 19201 and subsequent are equipped with a pneumatically operated automatic gun charging system. Charging of individual guns occurs automatically to correct any failure to fire condition caused by faulty ammunition. Simultaneous charging of all guns, or retraction of the gun bolts, may be selectively controlled by means of the gun charger switch. The system includes an air storage tank and a pressure-controlled compressor to maintain adequate continuous air pressure for charger operation. A camera mounted in the nose below the intake duct is operated automatically when guns or rockets are being fired, or may be operated separately.

Trigger

145 The control stick contains a trigger for firing the guns and for operating the gun and sight camera. The trigger has two definite positions when depressed; the first position operating the camera and the ammunition booster, the second position firing the guns.

Gun Charger Switch

146 Selective control of the gun-charging sys-

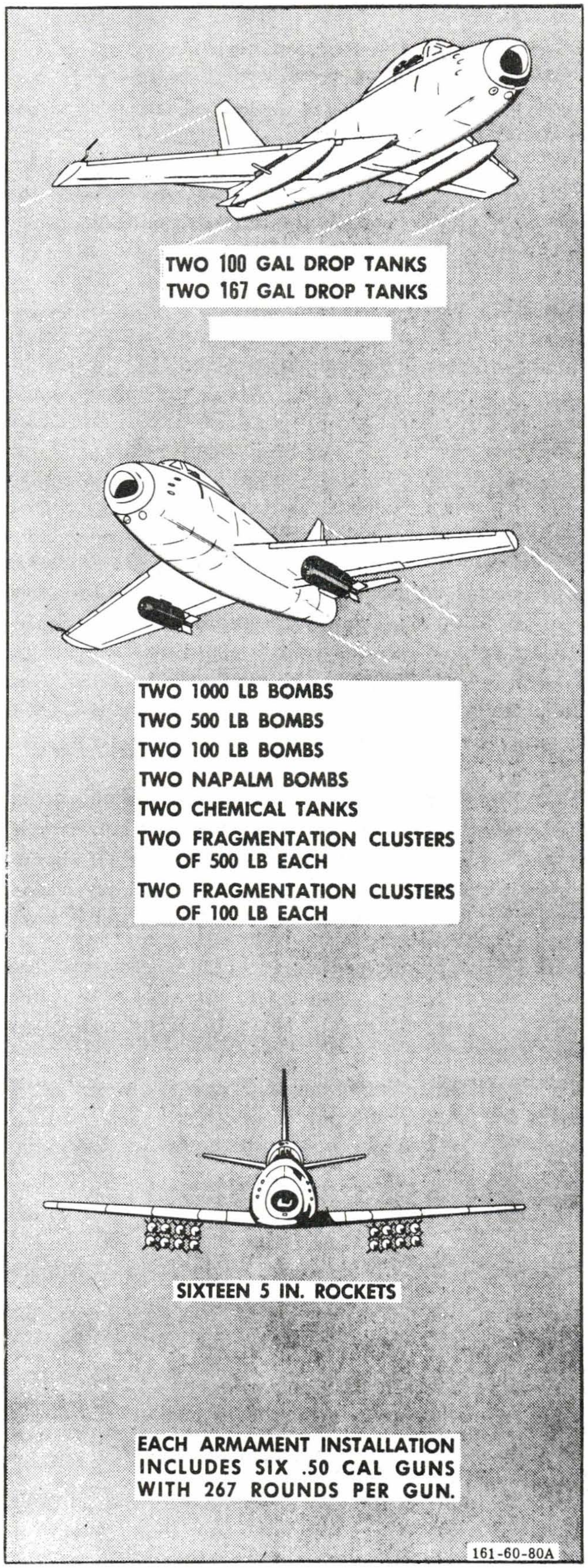


Figure 1-33 Possible Armament and Drop Tank Installations

tem is provided on aircraft 19201 and subsequent by the charger switch on the centre pedestal. The three-position switch, which actuates all gun chargers simultaneously, is spring-loaded from RETRACT and RELEASE positions to the centre (off) position. Momentarily holding the switch at RETRACT causes the gun bolts to be brought to the rear and held in this position. Release of the bolts and subsequent charging occurs when the charger switch is momentarily held at RELEASE or the trigger is depressed to fire the guns. Since the charging system automatically charges the guns whenever stoppages take place during gun firing, the charger switch is normally used only for initial charging of the guns before firing or for moving gun bolts to desired positions. The RETRACT position is utilized when it is necessary to have the bolts at the rear for safety (preventing cock-offs) or gun cooling purposes; RELEASE allows the bolts to go forward to aid gun heating.

Gun Heater Switch

147 Electric gun heaters, one mounted on each gun, are controlled by the gun heater switch on the centre pedestal. Turning on the gun heater switch also turns on ammunition compartment heat by permitting heated air, which is extracted from the cockpit air conditioning system, to enter the compartments.

Ammuntion Heat Emergency Shut-off Control

148 An ammunition compartment overheat warning light and emergency shut-off control are provided on the left aft console. The warning light illuminates when the temperature in the armament compartments becomes excessive, and the ammunition heat emergency shut-off control should be pulled. The emergency shut-off cannot be reset in flight and should not be used until it is certain that the warning light will remain on. A momentary illumination of the warning light does not necessarily indicate system malfunction.

Bombing Equipment

149 A removable bomb rack can be installed on the lower surface of each outer wing panel. Each rack will carry single bombs from 100 to 1000 pounds, bomb clusters up to 500 pound size, a chemical tank, or one fragmentation bomb rack assembly, (see figure 1-33). The sight is used for bomb sighting and automatic bomb release. Controls are provided for normal or emergency release of either demolition or fragmentation bombs. Normal release may be

accomplished automatically or manually, with bombs released singly or simultaneously. The arming condition of bomb nose and tail fuses, upon release, is also selectively controlled. A mechanical emergency release system is incorporated on aircraft 19301 and subsequent.

CAUTION

> To prevent bombs from striking the aircraft, do not release 500 or 1000 pound bombs by means of the sight or during any negative G-load condition.

Demolition Bomb Single-All Selector Switch

150 The demolition bomb single-all selector switch on the bomb section of the centre pedestal, provides for releasing bombs (except fragmentation bombs) or chemical tanks singly or simultaneously when bomb-rocket release button on the control stick grip is depressed. With the selector switch set at SINGLE, the left bomb rack is tripped as the release button is actuated. The right rack releases when the release button is depressed again. Bomb racks release simultaneously when the demolition bomb selector switch is at ALL and the bomb-rocket release button is depressed.

Bomb-Arming Switch

151 All bombs, with the exception of fragmentation bombs, are armed by means of an arming switch in the bomb section of the centre pedestal. With the switch at NOSE & TAIL, bombs are armed to explode instantly on impact. With the switch at TAIL ONLY, bombs are armed for delayed detonation; with the switch in the OFF position, bombs will be released unarmed.

Demolition Bomb Release Selector Switch

152 A two-position bomb release selector switch on the centre pedestal provides for selecting either MANUAL RELEASE or AUTO RELEASE. With the switch at MANUAL RELEASE, bomb release occurs when the bomb-rocket release button is depressed, provided that the demolition bomb single-all selector switch is at SINGLE or ALL. When the selector switch is in the AUTO RELEASE position and the release button is held closed, the bomb is released automatically, by mechanism within the sight, when the path of the aircraft on the bombing spiral is tangent to a bomb trajectory. During both release conditions, the correct bomb release point is indicated by automatic extinction of sight reticle image circle. A red flashing bombs-away light is reflected on the windshield armour glass from the sight when bomb is released. (The A-4 sight does not incorporate the flashing bombs-away light.) If the bomb single-all selector switch is in the SINGLE position, only one bomb (lefthand bomb released first) will be dropped during each bombing run.

Fragmentation Bomb Selector Switch

153 The fragmentation bomb selector switch is located on the right side of the centre pedestal and should be used during release of fragmentation bombs only. Placing the switch at SINGLE TRAIN results in release of fragmentation bombs in a train, from the left rack and then from right, as long as bomb-rocket release button is depressed. When the fragmentation bomb selector switch is at ALL TRAIN, the bombs are released in a train, from left and right racks simultaneously. Bombs are auto-

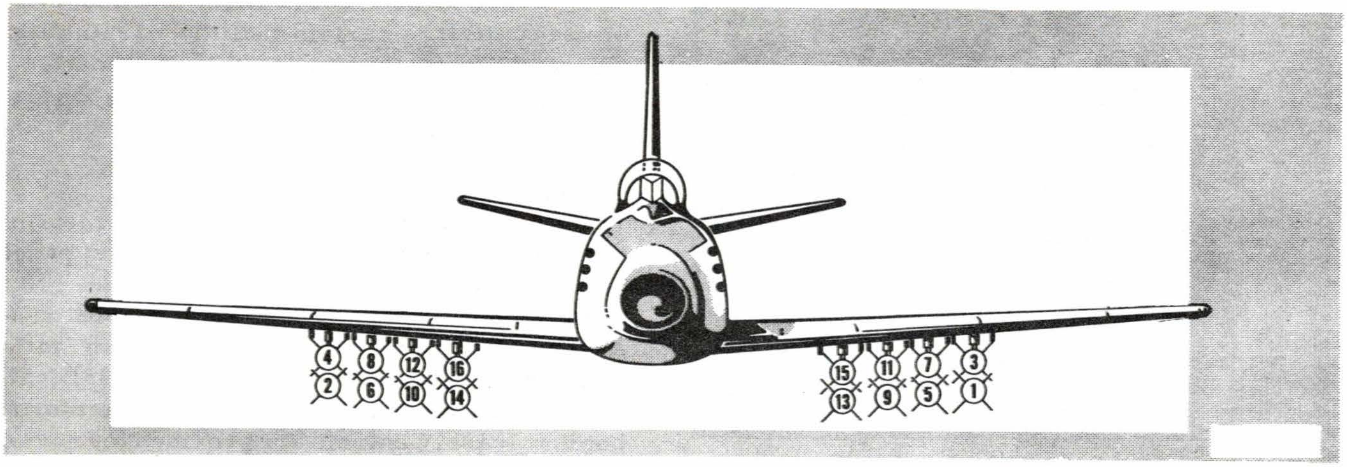


Figure 1-34 Rocket Firing Order

matically armed upon release. Whenever fragmentation bombs are to be released the demolition bomb release selector switch must be at MANUAL RELEASE position.

Fragmentation Bomb Indicator

154 The fragmentation bomb indicator, adjacent to the fragmentation bomb switch on the centre pedestal, is illuminated when the switch is moved to either SINGLE TRAIN or ALL TRAIN position. The light is automatically extinguished when the last fragmentation bomb is released.

Bomb-Rocket-Tank Salvo Button

155 All external loads (bombs, fragmentation bombs, rockets, droppable fuel tanks, and chemical tanks) may be salvoed unarmed by depressing the bomb-rocket-tank salvo button recessed in the left forward console. Bombs and rockets are salvoed unarmed, regardless of position of arming switch.

Emergency Jettison Handle

156 On aircraft 19301 and subsequent, all external loads may be released unarmed by pulling the guarded emergency jettison handle recessed in the inboard face of the left forward console. Actuation of the handle jettisons the load mechanically, independently of the electrical release systems, and automatically interrupts the bomb-and-rocket-arming circuits. Therefore, when the emergency jettison handle is used, bombs and rockets are released unarmed regardless of arming switch position.

Rocket Equipment

157 Eight rockets may be carried under each wing on four removable rocket launchers, each holding two rockets, one above the other. The sight is used for aiming rockets and the rockets are fired by depressing bomb-rocket release button on the control stick grip. The camera in the nose of the aircraft operates automatically when rockets are fired.

Rocket Release Selector

158 A rocket release selector on the centre pedestal has OFF, SINGLE and AUTO positions. With selector at SINGLE, one rocket is fired with each depression of bomb-rocket release button. With selector at AUTO, all rockets are released in train with one maintained depression of the stick grip release button. Sequence of rocket release is shown in figure 1-34. Automatic firing will stop whenever button is released. The release selector will not function unless the rocket jettison switch is at OFF.

Rocket Fuse Arming Switch

159 Rocket arming is controlled by the rocket fuse switch on the centre pedestal. When switch is at INSTANT, the rocket nose fuse is armed to provide instantaneous detonation upon contact. The nose fuse is unarmed when switch is at DELAY or OFF, but an internal fuse will cause delayed detonation after impact upon a normal release condition. Nose fuse arming is selective during jettison release. During salvo release, the nose fuse is automatically unarmed. The internal fuse is inoperative during jettison and salvo release conditions.

Rocket Projector Release Control Indicator

160 The projector release control, mounted on left side of cockpit, is an intervalometer for releasing rockets in sequence during automatic and manual release. When the rocket selector switch is at AUTO and the bomb-rocket release button on the control stick grip is depressed, the projector release control will release rockets in sequence at approximately 1/10-second intervals as long as the release button is held down. With the selector switch at SINGLE, one rocket is released each time the release button is actuated and the projector release control automatically maintains the correct firing sequence. An indicator visible through window in projector release control housing, indicates the rocket to be fired. The reset knob is used to return the dial to position 1 when all rockets have been released, or is set for release of any one particular rocket in case of misfire or other malfunction. If the lower rocket fails to fire during a normal release, the upper rocket on the same mount cannot be fired. The unfired rockets should be jettisoned in a safe area. Jettisoning is not selective, all rocket stations jettisoning simultaneously.

Rocket Jettison and Salvo Controls

161 Controls are provided for releasing rockets simultaneously by either jettison or salvo release. The rockets are automatically dropped safe by the bomb-rocket-tank salvo button. A mechanical emergency release system, incorporated on aircraft 19301 and subsequent, is operated by the emergency jettison handle. Rockets cannot be jettisoned or salvoed electrically when aircraft is on the ground, as these circuits are inoperative when weight of the aircraft is on the landing gear.

Rocket Jettison Switch

162 The rocket jettison switch on the centre pedestal permits the rockets to be released simultaneously, in nose fuse armed or unarmed condition, by means of the bomb-rocket release button on the stick grip. On aircraft 19301 and subsequent, rockets are jettisoned unarmed only. Rocket jettison release is accomplished by setting rocket fuse switch at desired position, moving jettison switch to READY, and depressing bomb-rocket-release button. The jettison switch must be OFF for the rocket release selector to be operative.

WARNING

Rocket fuse switch must be preset at OFF or DELAY to jettison rockets unarmed in event of engine failure on take-off.

Emergency Jettison Handle

163 Refer to Paragraph 154, preceding.

Chemical Tank Equipment

164 A type AN-M10 chemical tank may be carried on each bomb rack. Tank selection is provided by a switch on the centre pedestal and after discharge of chemicals by means of bomb-rocket release button, the tanks may be dropped by operation of the bomb-rocket-tank salvo switch, the normal bomb release system, or the emergency jettison handle on aircraft 19301 and subsequent.

COMMUNICATIONS EQUIPMENT

General

165 The following communications equipment is installed in the aircraft:

(a) On aircraft 19461 and subsequent, an AN/ARC-3 transmitter-receiver is installed. On aircraft prior to 19461, the ICA-67 was installed but is to be replaced by the AN/ARC-3 as available.

(b) AN/ARN-6 Radio compass.

(c) On aircraft 19102 to 19205 inclusive, an SCR 695A IFF installation is provided.

(d) On aircraft 19206 and subsequent, an APX-6 IFF installation has been provided.

VHF Equipment

166 The VHF transmitter-receiver, remotely controlled from the right console, operates on ten frequencies for the ICA-67 and 8 frequencies for the AN/ARC-3. OFF position for the equipment is against the fully clockwise stop.

Radio Compass

167 The AN/ARN-6 radio compass indicator is installed on the instrument panel. Controls are on the right console.

Identification Equipment

168 An SCR-695A radar IFF set is incorporated in aircraft 19102 to 19205 inclusive, to provide for identification of friendly aircraft. An additional function permits transmissions of an emergency or distress signal. The controls are mounted on the right console and consist of an ON-OFF switch, a destructor switch (inoperative), a code selector switch marked from 1 to 6, an emergency position and a band switch. The circuit breaker for the system is installed on the left circuit breaker panel. The inertia switch is not installed in the aircraft.

169 An APX-6 radar is installed on aircraft 19206 and subsequent. The necessary switches for operation of the equipment are installed on the right console. Operation of the APX-6 radar is as follows:

CAUTION

Before take-off check that the APX-6 frequency counters have been set to the proper frequency channels and that the three destructors have been inserted in the face of the IFF transponder. (IFF units are accessible through the radio access door on the left side of the fuselage). Remove all three destructors immediately after landing and insert dummy plug.

(a) Rotate master control to NORM position (full sensitivity and maximum performance) or to STBY or LOW as required.

(b) Set the mode 2 switch to required position. Normally, this will be I/P.

(c) Set the mode 3 switch to required position. Normally this will be OUT.

(d) For emergency operation, press the dial stop and rotate the master control to EMERGENCY position. In this position, the equipment will automatically transmit a signal indicating that the aircraft is in distress and requires immediate assistance.

(e) An impact switch to fire the destructors and destroy the IFF system is incorporated in the system as a security measure. However, the destructors may be fired manually by a destructor switch on the IFF control panel. To manually fire destructors, lift destructor switch guard by breaking the safety wire, and place toggle switch in the ON position. The destructor switch should be operated only when the APX-6 equipment is in danger of falling into enemy hands.

(f) To turn off equipment, rotate the master switch to OFF position. If the APX-6 transponder was destroyed during flight, report this information immediately upon landing.

ENGINE FIRE DETECTOR SYSTEM

General

170 Warning of engine fire is given by two indicator lights mounted on the shroud above the right side of the instrument panel. Two lights, marked FWD and AFT are provided to show which section of the fuselage contains the fire. A stainless steel fire-wall divides the engine compartment at a point immediately aft of the compressor. FWD includes the compressor and accessory section; AFT, the combustion chambers and tail pipe. Operation of warning system and lights can be checked by means of the system test button below the lights. The lights are push-to-test type, permitting check of bulb illumination independent of system operation.

PART 2

HANDLING

PRELIMINARIES

Before Entering Aircraft

1 Perform the following checks:

(a) Check Form L14A for engineering status and make sure aircraft has been serviced with required amounts of fuel, oil, hydraulic fluid, and oxygen. Check that cooling turbine has been serviced and that fuel filter de-icer alcohol tank is full. Make preflight check as shown in figure 2-1.

(b) The cockpit is accessible from either side of the aircraft. The lower ammunition access door on either side of the fuselage hinges down to serve as a step up to the wing. A kick-in step and handle are provided above the access door. The canopy is operated by means of two electrical push buttons located on either side of the fuselage below the edge of the windshield. (See figure 2-2.)

CAUTION

> Do not use handle on fuselage side for a step. Do not step on canopy seal or track.

2 Before entering cockpit, check the canopy ejection gun and ejection seat as follows:

(a) Open canopy fully in order to check canopy ejection gun.

(b) Visually check connection of firing cable from seat right hand-grip to canopy remover gun firing lever.

(c) Be sure canopy gun ground safety pin has been removed from hole above the firing lever.

(d) On the seat, make sure that safety pin is connected to canopy emergency release cable and that safety wire is installed in end of safety pin.

(e) Check connection of firing linkage from trigger to seat catapult firing lever.

(f) Be sure safety seals are not broken.

(g) Check that the ground safety pin has been removed from hole above firing lever.

(h) Check cable and linkage from left hand-grip to safety harness inertia reel.

After Entering Aircraft

NOTE

> A Pilot's Check List is located under the right side of the instrument panel.

3 Check as follows:

(a) Armament switches OFF.

CAUTION

> Armament switches must be in the OFF position before starting and during ground operation, as low voltages will cause damage to the sight electronic inverter with the switches ON.

(b) Speed brake switch at neutral.

(c) Check engine master and emergency ignition switches OFF.

(d) Anti-G suit regulator valve HI or LO, as desired.

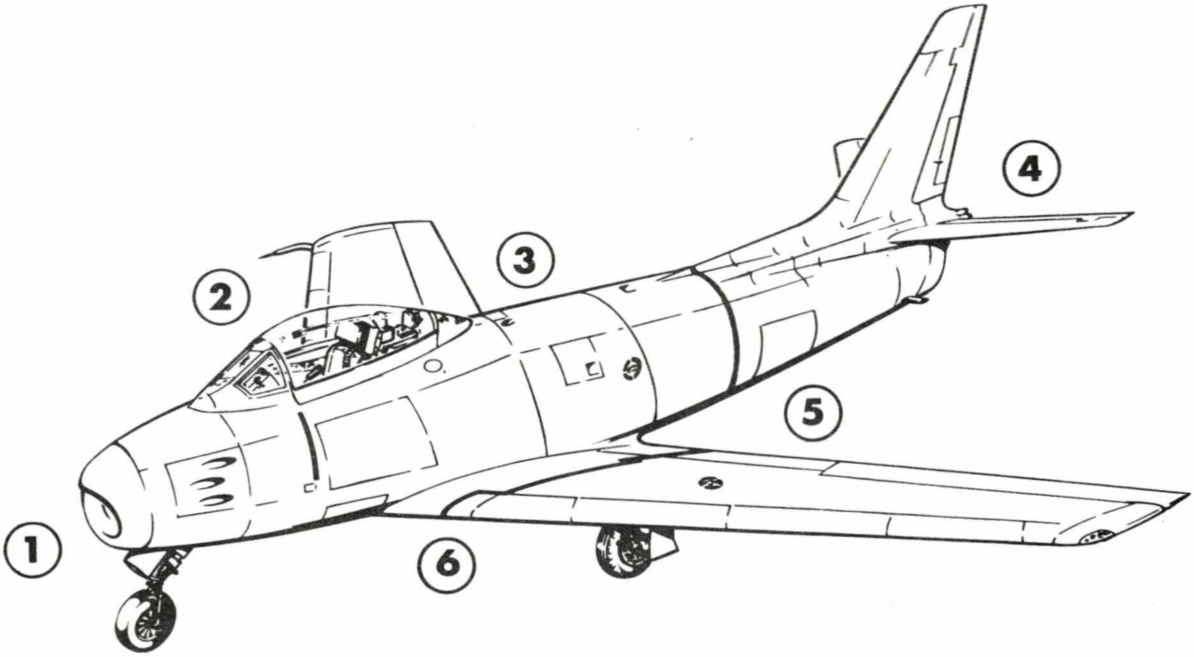
(e) Drop tank pressure shut-off ON if drop tanks installed, OFF if tanks not installed.

(f) Cockpit temperature control switch AUTOMATIC, desired temperature selected on rheostat.

(g) Cabin pressure control at desired pressure schedule.

(h) Windshield de-ice control OFF.

(j) Alternate lateral trimming switch at NORMAL.



STARTING AT NOSE OF AIRCRAFT, MAKE FOLLOWING CHECKS:

① **NOSE.**

NOSE GEAR GROUND SAFETY LOCK REMOVED. TOW PIN SAFETY CAP TIGHT.
[1] – NOSE GEAR EMERGENCY EXTENSION ACCUMULATOR AIR PRESSURE 1200 PSI (IN NOSE WHEEL WELL).
NOSE GEAR OLEO STRUT EXTENSION; TIRE FOR SLIPPAGE AND PROPER INFLATION. CHECK FOR HYDRAULIC FLUID LEAKS.
INTAKE DUCT CLEAR.
GUNS CHARGED; ARMAMENT DOORS SECURED; GUN PORT PLUGS INSTALLED.

[2] – GUN CHARGER SYSTEM AIR PRESSURE 1500 PSI MINIMUM.

[3] GSAP CAMERA ACCESS PANEL SECURE.

[4] RED MARKS IN LINE ON PANEL RETAINERS IN NOSE WHEEL WELL

② **FORWARD FUSELAGE AND RIGHT WING LEADING EDGE.**

[1] SLATS FOR FREEDOM OF MOVEMENT.
FUEL CAPS (WING AND FUSELAGE), OIL AND HYDRAULIC TANK ACCESS DOORS SECURED.
DROP TANK SWAY BRACES FOR LOOSENESS.
PITOT TUBE UNCOVERED; POSITION LIGHT.

[2] ALL ACCESS DOORS UNDER FUSELAGE SECURE.

③ **RIGHT WING TRAILING EDGE AND AFT FUSELAGE.**

AILERON AND FLAP FOR LOOSE RIVETS, ETC.
GEAR DOOR POSITION, GEAR STRUT EXTENSION, HYDRAULIC LEAKS; TIRE FOR SLIPPAGE AND PROPER INFLATION; WHEEL CHOCKED.
UTILITY SYSTEM SPEED BRAKE ACCUMULATOR AIR PRESSURE 1200 PSI (IN WHEEL WELL).
ALL ACCESS DOORS SECURED.
DUCT IN OIL ACCESS DOOR FOR DUST STREAK INDICATING A FAULTY GENERATOR.
COOLING TURBINE SERVICED WITH OIL.
FLIGHT CONTROL ALTERNATE HYDRAULIC ACCUMULATOR AIR PRESSURE 700 PSI (IN R. H. SPEED BRAKE WELL).

④ **EMPENNAGE.**

TAIL SURFACES FOR CONDITION.
POSITION LIGHTS.
TAIL-PIPE COVER REMOVED; TAIL PIPE FOR CRACKS OR EXCESSIVE DISTORTION.

⑤ **AFT FUSELAGE AND LEFT WING TRAILING EDGE.**

FLIGHT CONTROL ALTERNATE HYDRAULIC ACCUMULATOR AIR PRESSURE 700 PSI (IN SPEED BRAKE WELL).
FUEL CAP AND ALL ACCESS DOORS SECURED.
NORMAL FLIGHT CONTROL SYSTEM ACCUMULATOR AIR PRESSURE 700 PSI (IN WHEEL WELL).
EMERGENCY FLIGHT CONTROL CIRCUIT BREAKER IN. (INSPECT PANEL FORWARD OF SPEED BRAKE)

⑥ **LEFT WING LEADING EDGE AND FORWARD FUSELAGE.**

MAKE SAME CHECKS AS ON RIGHT WING IN REVERSE ORDER.

[1] AIRCRAFT 19453 AND SUBSEQUENT

[2] AIRCRAFT 19201 AND SUBSEQUENT

Figure 2-1 Exterior Inspection

(k) Throttle control OFF.

(l) Emergency fuel switch OFF.

(m) Alternate longitudinal trimming switch at NORMAL STICK GRIP.

(n) Oxygen regulator air valve at NORMAL OXYGEN. Check oxygen pressure and oxygen system for operation.

(p) Pitot heat and landing light switches OFF.

(q) Landing gear handle DOWN.

(r) Parking brake OFF.

(s) Instrument power switch at NORMAL.

(t) Utility hydraulic system emergency selector valve OFF.

(u) Set clock and altimeter.

(v) Sight dimmer at DIM.

(w) Generator switch ON.

(x) Battery-starter switch at OFF.

(y) External power source connected to both receptacles; all circuit breakers in.

(z) Wing flap lever UP.

(aa) Check all warning lights and indicators for operation.

(ab) All light switches OFF.

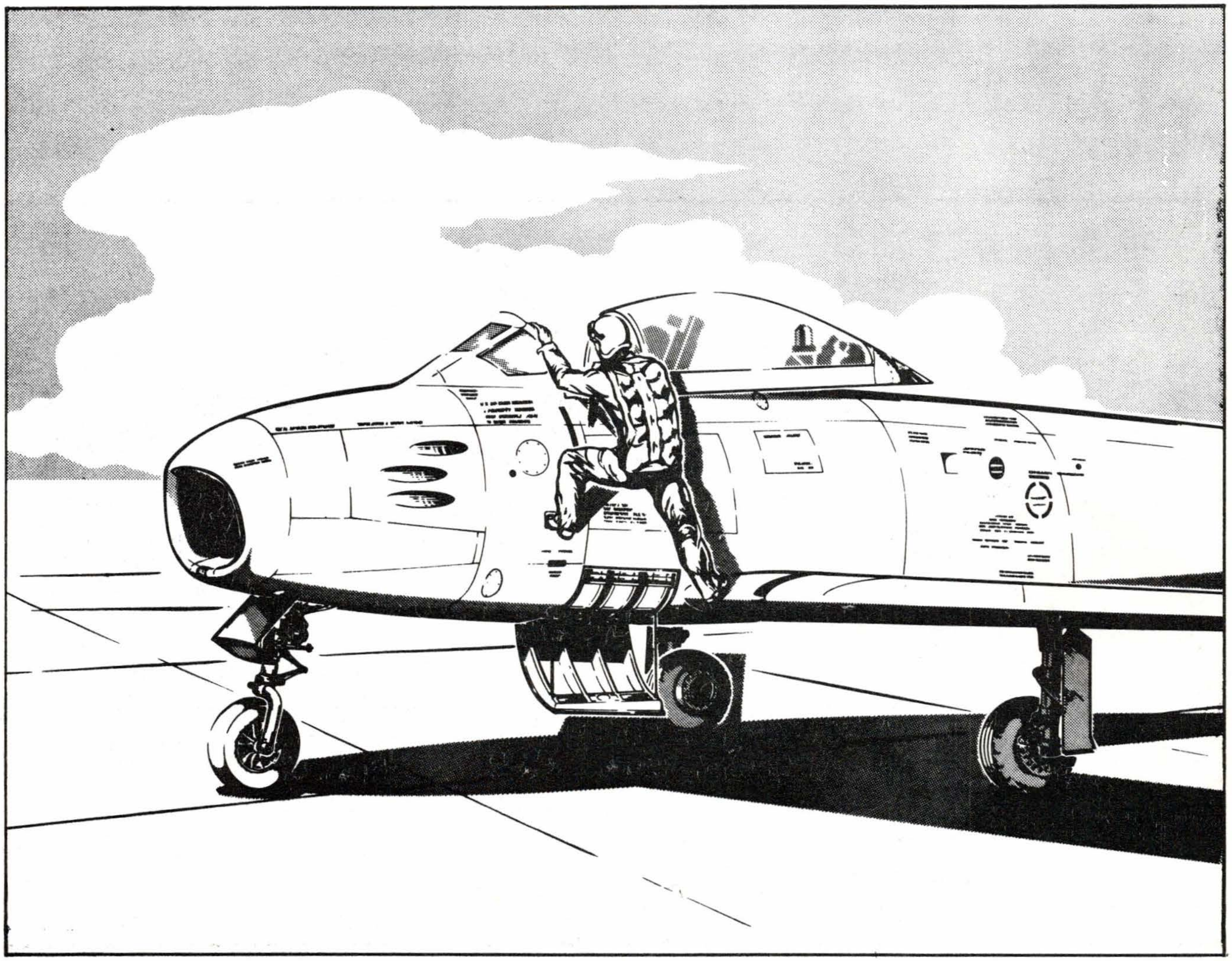


Figure 2-2 Entering Cockpit

(ac) Release rudder lock, and check rudder, ailerons, trim, and horizontal tail for the proper response to control action.

NOTE

> Only the alternate surface control hydraulic system will operate until the engine is started. After the engine has started, the alternate hydraulic system may be by-passed and the normal hydraulic system brought into action by moving the hydraulic power controls switch to RESET and then back to NORMAL.

(ad) Gun sight on. Check operation of sight (allow approximately 10 minutes for sight to warm up) after airborne.

(ae) Switch ON and check operation of the communication equipment. Set to the desired frequency, adjust volume control and contact ground station for tuning and reception.

(af) Check fuel quantity and set totalizer dial.

NOTE

> On aircraft 19171 and subsequent, move densitometer switch to OUT to check that the fuel tanks are full. Return switch to IN to provide a continuous gauge indication of actual fuel quantity based on fuel density.

(ag) Synchronize gyrosyn compass by depressing the knob on the lower left corner of the instrument and turn either left or right to clear the annunciator window.

CAUTION

> The knob must not be depressed for longer than 2 minutes as heavy current drain will damage the clutch mechanism.

(ah) Adjust ejection seat and headrest, ensuring that the headrest is securely locked in the desired position.

(aj) Remove safety pins from seat handgrips.

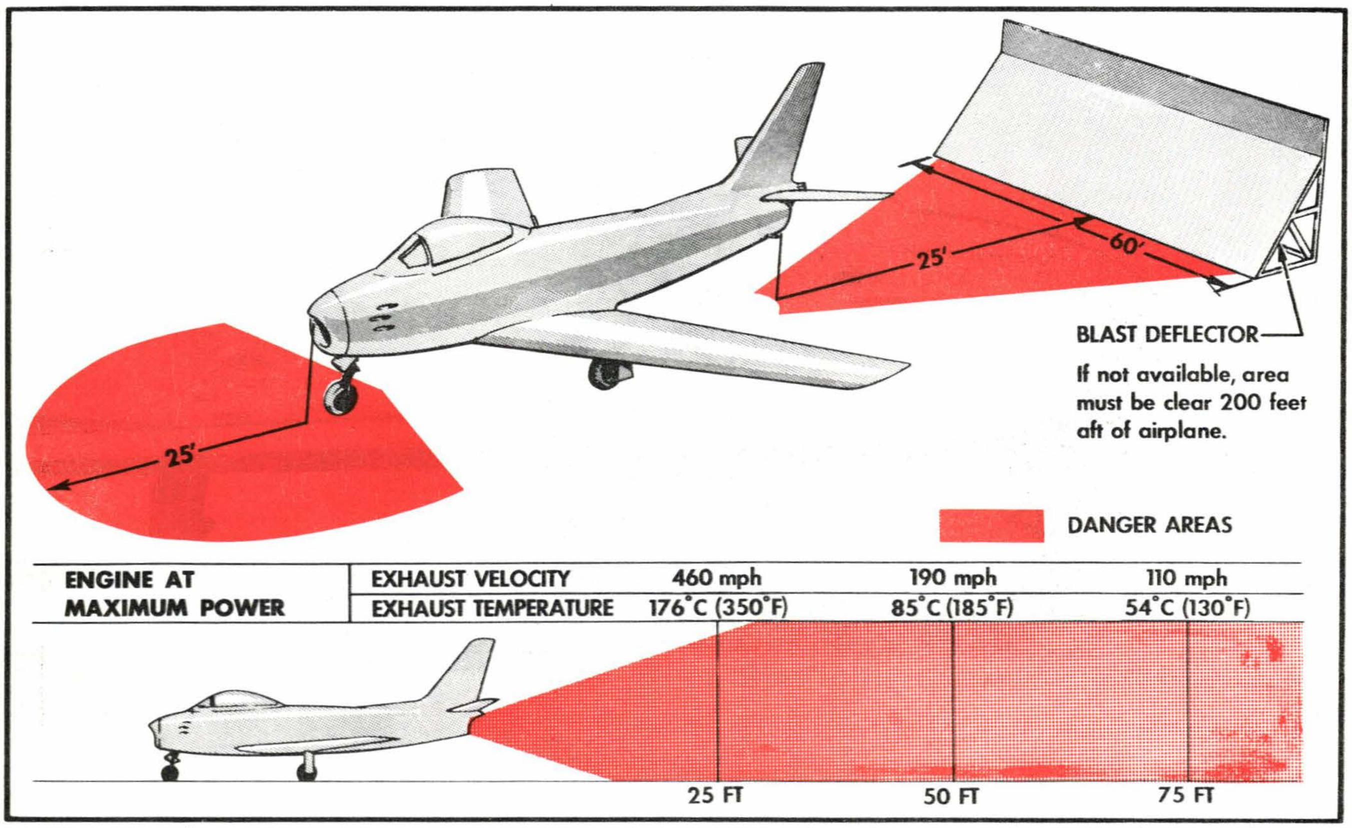


Figure 2-3 Danger Areas

(ak) Prior to night or instrument take-off, check all lights and electrical flight instruments. Allow instruments to warm up.

OPERATION OF THE FUEL SYSTEM

General

4 Although operation of the fuel system is essentially automatic, requiring no tank selection, the following supplemental procedures are necessary:

(a) For normal operation, leave emergency fuel switch OFF.

(b) Leave drop tanks pressure shut-off ON at all times during flight with drop tanks installed to make sure that all fuel is used. OFF if tanks are not installed.

(c) Remember that the flowmeter is calibrated for 3-GP-22a (JP-4, MIL-F-5624A) fuel. When operating on gasoline 3-GP-25b (MIL-F-5572A grade 100/130), add 10% to flowmeter reading. When operating on 3-GP-23a (JP-1, MIL-F-5616) subtract 5% from flowmeter reading.

(d) Since the de-icing alcohol supply lasts for only one minute of de-icing operation, make sure the light burns steadily before depressing the de-ice button. De-ice for no longer than 15 seconds at a time.

STARTING PROCEDURE

WARNING

Before starting engine, make sure danger areas fore and aft of aircraft are clear of personnel, aircraft, and vehicles. (See figure 2-3.) Suction at the intake duct is of sufficient magnitude to kill or seriously injure personnel if they are drawn into or pulled suddenly against the duct. Danger aft of the aircraft is created by the high exhaust temperature and blast from the tail pipe. Whenever practicable, start and run up engine on a concrete surface to minimize the possibility of dirt and foreign objects being drawn into the engine. If possible, start engine with aircraft headed into or at right angles to the wind, as exhaust temperature may be increased or an engine fire during starting aggravated by a tail wind.

Starting Engine

5 External power supplied through both receptacles must be used for starting, as the battery does not supply power to the starter. Start engine as follows:

(a) Ensure that the energizer is functioning correctly, is properly connected to the aircraft, and the voltage is set at 28.5 volts. Energizer selected to Ground Power.

(b) Throttle fully back - OFF.

(c) Turn engine master switch ON.

(d) Hold battery-starter switch momentarily at the STARTER position, then move switch to BATTERY position.

NOTE

It is not necessary to position battery-starter switch at OFF during engine start as battery is automatically cut out when starter is in operation.

CAUTION

The high current required for starting will burn out the starter within a few seconds if the turbine does not begin to turn as soon as the starter is engaged. If there is no audible indication of engine rotation or if tachometer fails to register within a few seconds, depress the PUSH TO STOP STARTER button immediately.

(e) At 3% rpm move throttle outboard to energize booster pumps and start ignition.

(f) At 6% rpm, advance throttle firmly with both hands to obtain a fuel flow of from 500 to 700 pounds per hour.

CAUTION

Extreme care must be exercised in the throttle movements since small adjustments result in large changes in fuel flow and excessive temperature may result.

(g) After ignition, allow the temperature to stabilize, then advance the throttle as rapidly as possible to idle stop, maintaining the temperature between 600°C and 690°C.

(h) Check oil pressure. If there is no indication of oil pressure within 30 seconds, shut down engine and investigate.

(j) Check engine instruments for desired readings.

(k) Have external power source disconnected after engine has reached 23% rpm.

NOTE

Refer to Part 3 following, for instructions in case of fire during starting.

Failure to Start

6 The start is to be abandoned by depressing the PUSH TO STOP STARTER button when either of the following conditions arise:

(a) If ignition has not occurred by the time engine speed has reached 9%.

(b) If the rate of acceleration between 6% and 9% is unduly slow coupled with failure to ignite. 9% rpm and ignition should be attained within 10 seconds of advancing the throttle. If 9% rpm is not obtained, the external power source should be checked to see that it is delivering 28 volts to the starter. Failure to stop the starter when the above conditions arise will result in excessive temperatures if engine should fire after fuel has accumulated in the combustion chambers. Wait 3 minutes before attempting another start to allow drainage of fuel accumulation and to permit starter to cool. If fuel to Specification 3-GP-23a (type JP-1) is used at ambient temperature below -15°C, any excess fuel which may remain in the tail pipe is to be removed before attempting a further start.

CAUTION

The starter is limited to three starts of one minute duration per start during any 30 minute period. If more than three starts are required, allow starter to cool 30 minutes before using again. Do not use PUSH TO STOP STARTER button to disengage the starter after normal starts, as it will cause rapid deterioration of the switch and may also cut out the starter too soon, slowing the rate of acceleration.

Hot Start

7 Any one start or acceleration, during which exhaust temperature exceeds 1000°C, or any 10 starts or accelerations during which exhaust temperature exceeds 870°C but does not exceed 1000°C, shall constitude overtemperature operation and will require that the engine be removed from the aircraft and returned to overhaul. This is required in case of 10 hot starts, regardless of time lapse between starts. The temperature and duration of all overtemperature operation (870°C) shall be entered in Form L14A.

8 Five starts or accelerations during which exhaust temperature exceeds 870°C requires that the engine be carefully inspected for possible damage prior to flight.

9 When a hot start occurs, shut down engine immediately. If smoking or fire persists engage the starter with throttle OFF for approximately 20 to 30 seconds to rid engine of excess fuel.

GROUND TESTS

General

10 .No engine warm-up is necessary. As soon as the engine stabilizes at idling speed with normal gauge reading, the throttle control may be slowly opened to full power. After engine is started, check the following:

NOTE

Rapid acceleration to 100% rpm on a cold engine usually results in the exhaust temperature exceeding the limits.

CAUTION

If a full power engine run-up is made during ground tests, be sure wheels are chocked and, in addition, hold toe brakes on.

(a) Idle rpm should be between 34% and 38% rpm.

(b) Check the hydraulic pressure gauge selector switch at NORMAL. Then engage the flight control normal hydraulic system by holding flight control switch at RESET until gauge indicates 1000 psi. Allow switch to return to NORMAL. Check that alternate system indicator light is out.

(c) Check flight control normal hydraulic system as follows: With the flight control switch at NORMAL, move the control stick and visually check resultant control surface movement. Wait 15 seconds and then check the pressure indicated on the gauge.

(d) Check alternate flight control hydraulic system as follows: With the flight control switch at ON EMERG (ALTERNATE ON for aircraft 19453 and subsequent), check that alternate system indicator light is on. Move the control stick and visually check resultant movement of the control surfaces. Wait 30 seconds and, with the pressure gauge selector switch at EMERGENCY (ALTERNATE for aircraft 19453 and subsequent), check pressure indicated on the gauge, set pressure gauge selector switch at NORMAL and hold flight control switch at RESET until gauge indicates 1000 psi, then release. Alternate system indicator should be out.

(e) Check flight control manual emergency override system on aircraft 19453 and subsequent as follows: With flight control switch at NORMAL, pull emergency override handle to extreme aft position. Alternate system indicator should illuminate. Move control stick and visually check control surfaces for proper movement. Wait 30 seconds, set pressure gauge selector switch at EMERGENCY and check gauge indication. Return handle to its normal position. Move pressure gauge selector switch to NORMAL and hold flight control switch at RESET until gauge registers 1000 psi, then release. Check alternate system indicator light out.

CAUTION

If emergency override handle is not pulled fully out there is a possibility of jamming the flight controls.

(f) Check the utility hydraulic system as follows: Run speed brakes through one complete cycle. With the pressure gauge selector switch at UTILITY, check pressure indicated on the gauge.

CAUTION

Before operating speed brakes, be sure aft fuselage area around speed brakes is clear, as brakes operate rapidly and could injure personnel.

(g) At 45% engine rpm, check electrical loadmeter reading. Check voltmeter for reading of approximately 28.5 volts. Generator will not operate below approximately 23% rpm.

11 Signal for removal of wheel chocks.

12 Parking brakes off.

Taxiing Instructions

13 Observe the following instructions during taxiing.

(a) Once the aircraft is moving, taxi at lowest practical rpm.

(b) Maintain directional control through the steerable nose wheel by use of rudder pedals. Hold steering switch depressed at all times while taxiing. Nose wheel and rudder pedal positions must be coordinated before steering mechanism will engage.

(c) Avoid excessive or rapid jockeying of throttle control during taxiing.

(d) Minimize taxi time, as aircraft range is considerably decreased by high fuel consumption during taxiing. Fuel consumption with engine operating at 35 to 40% rpm is approximately 3 gallons (20 pounds) per minute.

Procedures Prior to Take-off

14 Just prior to take-off, complete the following checks.

H Hydraulic - Pressure 3000 (+160, -60) psi.

Harness and safety belt - Tightened; lockhandle unlocked.

T Trim - Set for take-off.

F Fuel - Sufficient for flight.

Flaps - One-half DOWN; Speed brakes - CLOSED.

G Gyros - Uncaged and set.

S Switches - Generator - ON.

- Engine master - ON.
- Battery start - BATT.
- Instrument power - NORMAL
- Auto-manual release selector switch - AUTO
- All other armament switches OFF

NOTE

To jettison drop tanks or other external stores during take-off, use bomb-rocket-tank-salvo button.

O Oxygen - Checked and NORMAL

C Canopy - Closed

P Pitot heat - As required

15 Taxi to take-off position, heading aircraft straight down runway with nose wheel centered.

Take-off Procedure

16 **For normal take-off, with or without drop tanks, proceed as follows:**

(a) Check engine instruments for desired readings. Do not attempt take-off if exhaust temperature is below 675°C.

(b) With throttle control at take-off rpm, release brakes and begin take-off run.

(c) Maintain directional control by using brakes until rudder control becomes effective at approximately 50 knots IAS.

NOTE

Nose wheel steering is not to be used during take-off runs except in the case of a main tire failure.

(d) On aircraft fitted with leading edge slats, lift nose wheel slightly at approximately 90 knots IAS. As speed reaches 95 to 105 knots IAS, pull back stick to lift aircraft off.

(e) On aircraft fitted with the extended leading edge, a clean aircraft weighing 15,000 pounds has a nose wheel lift-off speed of 105 knots and a take-off speed of 120 knots. An aircraft, fitted with two 167 gallon drop tanks, weighing 18,000 pounds will have a nose wheel lift-off speed of 115 knots and a take-off speed of 130 knots.

(f) A nose-high attitude must be maintained for take-off. After take-off, the aircraft will assume a more normal attitude as airspeed increases and flaps are raised.

(g) Refer to Take-off Chart in Part 4 for required take-off distances.

(h) Refer to Part 3 for procedure in case of engine failure during take-off.

17 When aircraft is definitely airborne:

(a) Landing gear handle UP. On aircraft 19102 to 19452, when gear unsafe light goes out, return handle to COMBAT. On aircraft 19453 and subsequent, leave handle UP. Approximately 8 seconds is required for gear retraction.

(b) Wing flaps UP immediately after landing gear handle UP. No sink will occur because of the rapid acceleration of the aircraft. When flaps are full up, move the wing flap lever to HOLD.

CAUTION

Aircraft speed must be kept below 185 knots IAS until the flaps are fully raised and the gear is locked up. Otherwise, excessive air loads may damage gear operating mechanism and prevent subsequent extension of gear. If flaps do not fully retract, avoid high-speed, high-G pull-ups. Failure of the flap actuating mechanism may occur if the flaps are not supported against the up-stop (fully retracted) during any accelerated manoeuvres at high speed. If flaps have been left down or inadvertently lowered at speeds over 185 knots, leave extended, avoid high speeds and land as soon as possible.

(c) Trim horizontal tail as required.

(d) Level off and accelerate immediately to best climbing speed. Refer to Part 4 for climb data.

NOTE

> Slats if fitted, will close at approximately 180 knots IAS either with or without external stores.

CLIMB

General

18 Climb at take-off rpm (time limit - 30 minutes). Refer to Climb Charts in Part 4 for recommended indicated airspeeds to be used during climb, and for rates of climb and fuel consumption.

DURING FLIGHT

General

19 The aircraft must be frequently and carefully trimmed to fly hands-off to ensure against any out-of-trim condition.

NOTE

> The elevator and aileron trim switch installed in the type B-8 control stick grip is designed to return to the neutral position automatically when thumb pressure is released. Experience shows that this switch has a tendency to remain in the actuated position, which causes an overtrim condition, resulting in a hazardous condition. To preclude such a possibility and pending the acceptance and availability of the type B-9 stick grip, the trim switch should be returned to the neutral position by applying thumb pressure in the opposite direction after each actuation of the trim switch.

Engine Operation

20 Observe the following engine operating instructions:

(a) Retard throttle control to desired setting. (Refer to Flight Operation Instruction Charts in Part 4 for cruise data.)

(b) Periodically check instrument readings. During high-power operation above approximately 40,000 feet, it may be necessary to retard throttle control to keep exhaust temperature from exceeding the limit.

Engine Acceleration

21 When increasing power, move throttle control slowly at first and then advance it more rapidly as rpm increases. Rapid increases in thrust are possible only above approximately 63% rpm, since the acceleration control may be ineffective up to that engine speed. When operating on the main fuel regulator, very rapid acceleration above 63% rpm is possible at all altitudes up to 40,000 feet. However, above 40,000 feet slower throttle control movement must be used in accelerating in order to avoid flame-out or engine stall. Do not have the emergency fuel switch ON while operating on the main fuel system during flight, because the emergency system will probably take over during rapid advancement of the throttle control and cause a compressor stall or flame-out.

Compressor Surge and Stall

22 Compressor surge (or pulsation) may result from too rapid acceleration of the engine, especially at altitudes above 40,000 feet. If the acceleration is made at very high exhaust temperature, surge will be much more severe. If the rate of acceleration was a marginal case, surge may be absent and compressor stall will occur. Surge or stall may be recognized in flight by one or more of the following characteristics:

(a) Loss of thrust.

(b) Pulsating, roaring noise accompanied by heavy engine vibration.

(c) Rapid rise of exhaust temperature.

(d) Loss of acceleration, and even possible deceleration.

(e) Long flame from tail pipe.

(f) Possible flame-out at high altitude.

23 Whenever such conditions are encountered, immediately retard throttle control until exhaust temperature returns to normal, then accelerate more slowly to the desired rpm.

Acceleration Flame-out

24 Acceleration flame-out may result from compressor surge and is most likely to be encountered at 25,000 feet or above. If surge is not the cause, acceleration flame-out is most likely to occur between 75% and 90% rpm, and can be avoided by accelerating at a slower

rate. It is indicated by loss of thrust, drop in exhaust temperature and deceleration. If the exhaust temperature does not drop too low (below 260°C), it may mean that some of the combustion chambers are still ignited. An attempt may be made to relight the other chambers by retarding the throttle control to IDLE and advancing it slowly.

Engine Noise and Roughness

25 Engine roughness in flight may occur on some aircraft, especially when operating at high rpm above 15,000 feet. Usually this roughness can be eliminated by changing the rpm. However, if engine roughness occurs at all altitudes and engine speeds, it indicates a mechanical failure and a landing should be made as soon as possible.

Hydraulic System Flight Check

26 Check hydraulic systems periodically as follows:

(a) Place pressure gauge selector switch at UTILITY and read gauge for proper utility system pressure.

(b) Fly straight and level for 30 seconds

AIRCRAFT FITTED WITH LEADING EDGE SLATS

Power-on Stall Speeds. Knots, I.A.S.

ANGLE OF BANK	LOAD FACTOR	GEAR AND FLAPS UP SLATS OPEN GROSS WEIGHT (LBS.)				GEAR AND FLAPS DOWN SLATS OPEN GROSS WEIGHT (LBS.)			
		11,000	14,000	17,000	20,000	11,000	14,000	17,000	20,000
0	1.0 G	90	103	115	125	85	96	107	116
30	1.2 G	97	111	124	133	91	104	116	125
45	1.4 G	109	124	137	148	102	117	129	140
60	2.0 G	131	149	164	176	124	140	155	166

Power-off Stall Speeds. Knots, I.A.S.

ANGLE OF BANK	LOAD FACTOR	11,000	14,000	17,000	20,000	11,000	14,000	17,000	20,000
0	1.0 G	95	107	118	127	90	101	111	119
30	1.2 G	102	115	127	136	96	108	119	128
45	1.4 G	113	127	140	150	106	120	132	143
60	2.0 G	134	151	166	178	127	143	157	168

G Limits shown are maximum for listed stall speeds. Any attempt to increase G without increasing airspeed will result in a stall.

FOR AIRCRAFT FITTED WITH EXTENDED LEADING EDGE (NO SLATS), THE ABOVE STALL SPEEDS ARE INCREASED BY 10 KNOTS.

Figure 2-4 Stall Speeds

and, with the gauge selector switch at NORMAL, read pressure gauge for surface control normal system pressure.

(c) Without moving control stick and with gauge selector switch at EMERGENCY, (ALTERNATE for aircraft 19453 and subsequent), read gauge for surface control emergency system pressure.

(d) Check surface control emergency system operation in this manner; place the power control switch at ON EMERG. (ALTERNATE ON for aircraft 19453 and subsequent), and check operation of the horizontal tail and the ailerons. Hold the switch at RESET momentarily, and then release. Switch will automatically return to NORMAL. On aircraft 19102 to 19200 it is necessary to hold the switch at RESET until pressure in the normal system has built up to 1000 psi to ensure a change over from the emergency to the normal system.

Landing Gear Operation in Flight (Aircraft 19102 to 19452)

27 If the gear-unsafe light comes on during flight, indicating a gear unsafe condition, reduce speed to below 185 knots IAS and place gear handle at UP. When the light goes out, return the gear handle to COMBAT. If light comes on again, keep speed low and return to base.

CAUTION

> Moving gear handle from COMBAT during flight may cause cycling of the gear fairing doors, and if airspeed is above 185 knots IAS, fairing doors can be torn off.

FLYING CHARACTERISTICS

General

28 The hydraulic flight control system is considerably more sensitive than conventional control systems. Until experience is gained in handling the flight control system, large or abrupt control stick movements should be avoided. Two completely independent hydraulic flight control systems are provided as a safety feature in the event one of the systems is damaged in combat.

29 Inverted flying or any manoeuvre resulting in negative acceleration must be limited to 10 seconds duration, as there is no means of ensuring a continuous flow of fuel or oil in this attitude.

Stalls

30 The swept-back wing has no unusual effect on the stall other than the higher angle of attack at the stalling point. There is no severe rolling or yawing tendency at the stall. In general, all starts are preceded by rudder and general aircraft buffet which begins approximately 8 knots in advance of the actual stall and which increases in severity with increasing speed and acceleration. Due to the artificial feel, and the non-reversible controls, the stick control feels solid throughout low and high-speed stalls. The slats become fully open 20 to 25 knots above the stall. Stalling speeds are shown in figure 2-4.

31 Aircraft fitted with the extended leading edge (no slats) suffer a deterioration of stall characteristics as compared with a slatted wing aircraft and caution must be exercised in the slow speed operation. The aircraft exhibits the following general characteristics at the low speed stall attitude:

(a) There is much reduced stall warning shake or buffet.

(b) A yaw, accompanied by a roll, occurs at the stall.

(c) The actual stalling speed is increased by about 10 knots depending upon the weight and configuration.

High-Speed Accelerated Stalls

32 An accelerated or high-speed stall can damage the aircraft or cause pilot black-out and consequent loss of control. As the aircraft approaches a high-speed stall considerable airframe buffet is encountered. The buffet, which is aerodynamically excited, causes severe cyclic stresses and strains on the airframe structure which can cause eventual damage. Avoid severe airframe buffet conditions as much as possible. Depending on the rapidity of the manouvre, the actual stall may be accompanied by either a sharp but small wing drop or a snap roll. When approaching a high-speed stall, the buffet onset gives warning to avoid the stall. To avoid high-speed stalls do not pull the stick back abruptly and do not pull stick back when the speed brakes are opening.

Spins

33 The aircraft shows normal spin characteristics during spin entry, sustained spin and recovery. Spins are initiated in the normal manner but may vary. In some cases it may be impossible to properly spin the aircraft at all. In a fully developed spin, the nose rises and falls slowly during each turn, which takes about four seconds and 2000 feet of height. Buffeting occurs and usually decreases as the spin progresses.

Spin Recovery

34 To recover from a spin proceed as follows:

(a) Reduce throttle to idle rpm, close speed brakes, if open, and retract flaps and landing gear if extended.

(b) Apply full opposite rudder.

(c) Move the control stick slowly forward until the spin stops. Do not push the control stick fully forward as this is not necessary and will only result in an excessively steep recovery attitude, possibly beyond the vertical.

(d) Keep ailerons neutral.

(e) Centralize rudder as soon as spin stops.

(f) Gently ease out of the resulting dive and be sure to retain flying speed before opening speed brakes or pulling up, or the aircraft will stall and snap into another spin.

35 Actual tests have shown that the above procedure applies to the following configurations:

(a) Clean aircraft, speed brakes in or out, right or left hand spins.

(b) With 100 Imperial (120 U.S.) gallon drop tanks full or empty, speed brakes in or out, right or left hand spins.

(c) Although spins with external armament or 167 Imperial gallon drop tanks are prohibited, recovery from inadvertent spins can be made as outlined above, but may require 2-1/2 turns. If at this time recovery is not successful, and altitude permits, jettison stores and/or 167 gallons tanks and repeat normal recovery action, which should be effective in 1/4 to 1 turn.

Minimum Altitude for Spin Recovery

36 Flight tests indicate that 7000 feet is the minimum altitude required to complete recovery from a one-turn spin (plus a one-turn recovery and a 4G pull-out). The altitude loss during this manoeuvre will be about 6500 feet. Therefore, in a spin below 7000 feet, bail out since the margin of safety is too small to try a recovery. Practice spins should be entered at about 25,000 to 30,000 feet.

Inverted Spins

37 Inverted spins in this aircraft are characterized by a roll upright into a 45° dive attitude approximately every three-fourths turn followed by a roll again into the inverted spin position, repeating the initial spin. Each turn takes approximately six seconds. Recovery can be initiated at any time by neutralizing the controls and dropping the nose as the aircraft rolls upright.

NOTE

Although inverted spin recovery is described, it is improbable that such a condition will be encountered.

Aileron Control

38 Until familiar with aileron effectiveness at high speeds, care should be taken not to overcontrol in making abrupt or consecutive rolls. Refer to Part 4, following, for restrictions with certain external stores. Should failure of the normal flight control system occur, automatic change-over to the alternate system is provided instantaneously with no reduction in aileron control power or increase in pilot effort.

Use of Speed Brakes

39 To reduce speed, especially in aerobatics or formation flight, speed brakes may be used without objectionable buffeting or uncontrollable changes in trim. In a pull-out, recovery may be effected with minimum altitude loss by first opening the speed brakes and then pulling out at maximum permissible G. Opening the speed brakes without pulling on the stick at all, results in automatic pull-out of about 3 G.

WARNING

Except in extreme emergencies, do not pull the stick back during the time the speed brakes are opening. To do so may result in exceeding the limit load factor. The speed brakes open fully in approximately 2 seconds.

Low Speed

40 The handling characteristics and stalling qualities at low speed are very good. Except for a higher required angle of attack during take-off and landing, which is a characteristic of a swept-wing aircraft, no outstanding differences between a Sabre and a conventional straight-wing fighter will be noticed. Rate of roll is high and the response to stick movement, in the slower speed ranges, is positive down to the stall. Abrupt stick movements should be avoided, especially during landing. See Paragraph 31 for changes in stalling characteristics for aircraft with extended leading edge.

Cruise Speed

41 In the medium-to-high speed range, level-flight handling characteristics are considered good about all three axes - roll, pitch, and yaw. For those accustomed to conventional elevator control, the more effective stabilizer on the Sabre may appear considerably more sensitive because of the faster aircraft reaction to small stick motions. It is advisable not to attempt close formation flight until accustomed to the control. Maximum available rate of roll is quite high at all altitudes. The aircraft is most sensitive to small fore-and-aft stick motions between .8 and .9 Mach number at low altitudes.

High Speed

42 Stability and control are unaffected by compressibility up to approximately Mach number .95 with the exception of a slight flattening tendency in the stick force gradient for 1 G flight between .85 and .90 Mach number. The aircraft nose-up tendency which appears in this high-speed region requires steadily increasing push forces and forward stick movement to increase the speed of the aircraft. As in other speed ranges, use of the stabilizer results in positive and immediate aircraft reaction. The power of the controllable horizontal tail will become particularly noticeable above 500 knots, especially in turbulent air. A limit airspeed of 600 knots or the airspeed where wing roll becomes excessive has been established, based on structural design limits. This limit has been imposed because wing heaviness, although easily controllable at high altitude, may become a limiting condition at lower altitude.

Turning Radius Control

43 Since turn radius increases with airspeed, a very effective method of tightening the turn is to decrease speed abruptly by opening the speed brakes. The nose-up effect of opening the speed brakes and the nose-down effect of closing them should be anticipated with corrective stick movements in order to hold a constant G. Use speed brakes only as necessary to tighten the turn, and close again before too much speed is lost. Manoeuvrability at high altitudes is increased with the extended leading edge because more G can be pulled before the initiation of buffet. Although the maximum G obtainable, as limited by buffet magnitude, remains unchanged with the extended leading edge, less speed is lost during manoeuvres since the drag rise from buffet is delayed. With the extended leading edge it is possible to turn in a smaller radius without losing speed rapidly at higher altitudes, because the turn can be tightened considerably before buffet is encountered.

Recommended Speed for Minimum Radius Turns

44 The level-flight turning radius (constant Mach numbers and altitude) of the aircraft becomes a minimum at about .55 Mach number and increases with increasing speed. This increase is gradual up to about .8 Mach number and begins rising rapidly beyond that point. The following tabulation lists the approximate Mach numbers at which this rapid increase takes place at various altitudes. Although minimum-radius turns can be achieved at low Mach numbers, it is better not to let the speed drop below that for best climb, also tabulated, as this would place the aircraft in a speed range where acceleration to higher speeds is more difficult without sacrifice of altitude. The same information applies to diving turns made at maximum G at constant Mach number. Note also that the high-speed manoeuvring essential in combat may lead to proportionately higher turning radii.

Letdown

45 Normally the most economical letdown with the clean aircraft is at .8 Mach number, with the throttle setting which allows minimum operating tailpipe temperature. Emergency

RECOMMENDED SPEED FOR MINIMUM RADIUS TURNS
Military Power - 14,000 lb. Gross Weight

Altitude - FT	Level Turn Speed		Best Climb Speed Mach No.
	Knots IAS	Mach No.	
40,000	230	.76	.80
35,000	275	.81	.79
30,000	315	.83	.76
25,000	360	.85	.73
20,000	400	.85	.71
15,000	435	.85	.68
10,000	475	.85	.66
5,000	520	.85	.64
Sea Level	550	.83	.61

letdown rates of descent as high as 27,000 feet per minute can be obtained by closing the throttle, opening speed brakes and diving to maintain .95 Mach number.

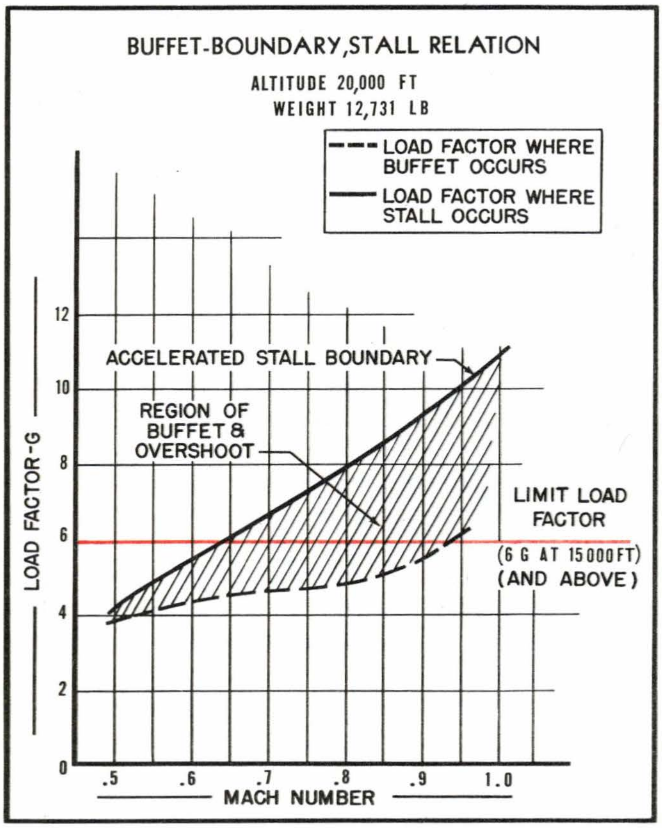


Figure 2-5 Buffet-Boundary, Stall Relation

G-Limit Overshoot

46 The tendency of the aircraft to dig in and automatically increase G during a turn or pull-up is caused mainly by a basic instability characteristic at high G's. When G is increased beyond the point at which buffet begins, the aircraft will feel less stable in pitch and may develop a tendency to increase G automatically. Termed overshoot, this condition can cause trouble, as the limit load factor limitations (refer to Part 4,following) may be inadvertently exceeded. This overshoot condition is one reason the maximum allowable load factor has been set at 6 G above 15,000 feet. With this limit, the pilot is less apt to inadvertently overshoot to a higher G, which could damage the aircraft. Overshoot is likely to begin at the buffet boundary i.e., the G at which a distinct increase in aircraft buffeting is noticed. This general airframe buffet increase should be regarded as a warning of overshoot. Use of the stabilizer as a primary control surface makes possible immediate and effective recovery action before the aircraft exceeds any limit G loads. The onset of buffet serves as a warning that a critical flight condition is being approached whatever the conditions of altitude, Mach number, gross weight and configuration may be. While the buffet warning is a convenient reminder at all conditions of flight, the following items should be remembered.

(a) When encountering the buffet boundary, slow the rate of pull-up and be prepared to apply immediate recovery control to prevent overshoot and possible damage to the aircraft (see figure 2-5).

(b) The aircraft is limited to stated load factors (refer to Load Factor Limits Table, in Part 4, following). Never deliberately exceed these limits.

Dive Recovery

47 Because of aircraft trim changes which occur during pull-ups at high Mach numbers, the following procedure is recommended for recovering from high Mach number dives or manoeuvres.

(a) Open the speed brakes. Do not pull back on the stick until after speed brakes are open and the nose-up pitch due to brake extension has developed.

(b) Pull stick back as necessary to effect the desired pull-out. (See figure 2-6.)

48 At a speed of approximately Mach .9 the aircraft becomes wing heavy. Either wing may drop, but aileron control is sufficient to counteract.

Strength Diagram

49 The strength diagram (see figure 2-7), describes the strength limitations of the clean aircraft, i. e. without external load, for symmetrical manoeuvres. The left hand boundary lines, marked for various altitudes, define the number of G's that can be attained in this aircraft at stall. For other conditions, such as unsymmetrical or rolling pull-out and with external load, refer to Load Factor Limits Table, in Part 4, following.

NOTE

If the accelerometer records G's in excess of those specified for any particular flight condition in the load factor limits table, have the aircraft inspected after landing for signs of structural damage.

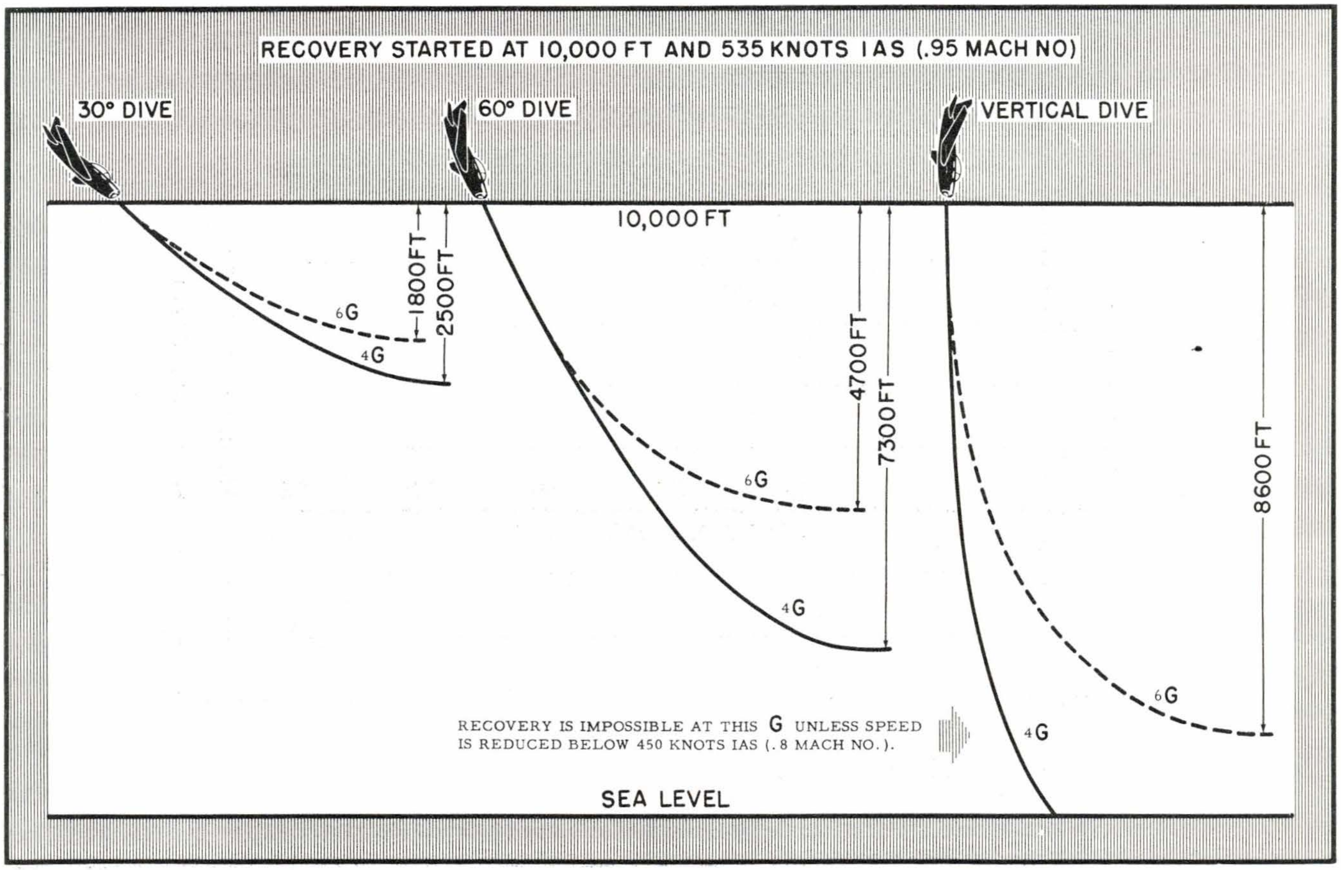


Figure 2-6 Typical Dive Recovery

Flight with External Loads

50 For flights with any external loads, refer to the Load Factor Limits Table in Part 4, following, to obtain G, speed limits and special manoeuvre restrictions. The following comments refer to general aircraft handling with each specific external load. With all external loads, take-off distances will be greater and the rate of climb and acceleration reduced due to increased aircraft drag and weight. Refer to Part 4, following, to determine performance effects.

Drop Tanks - 100 Imperial (120 U.S.) and 167 Imperial (200 U.S.) Gallons

51 Flying qualities of the aircraft are essentially unaffected by these drop tanks. The tanks may be dropped full or empty up to allowable maximum level flight speeds for the particular flight altitude.

Rockets

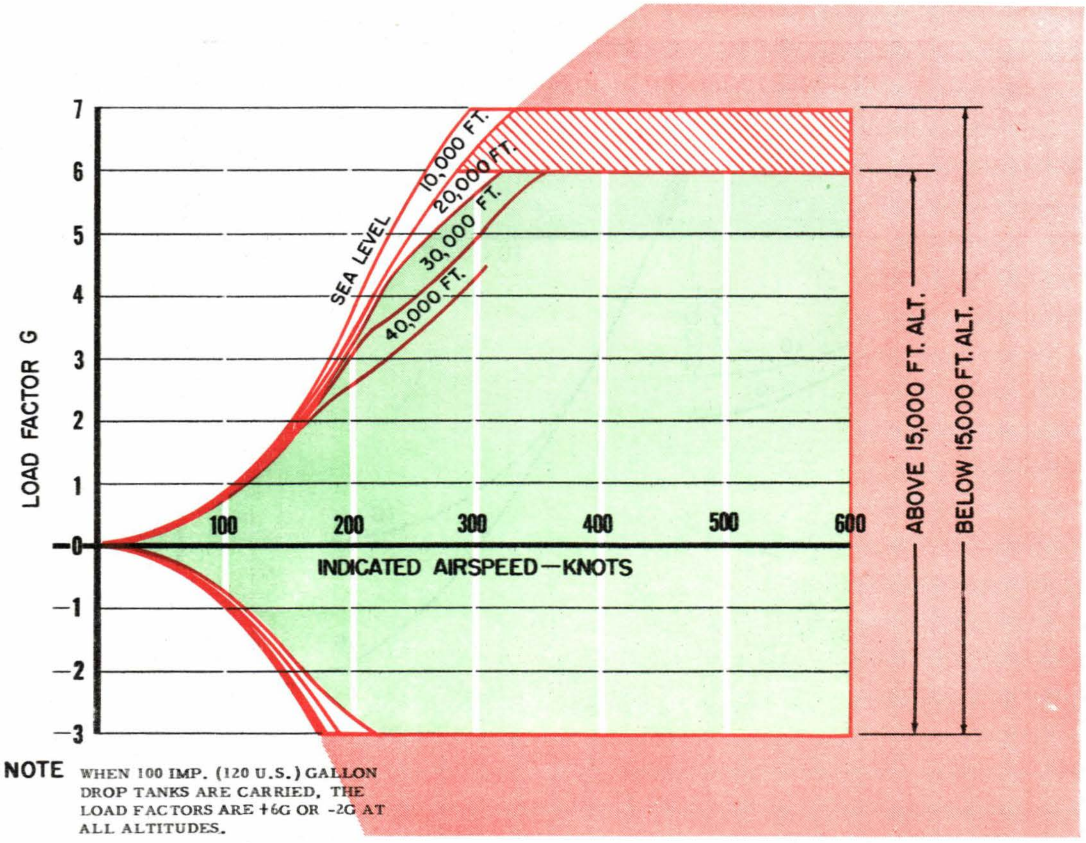
52 The stability and control of the aircraft are unaffected by the presence of the rockets. Avoid buffet regions.

100 and 1000 Pound Bombs

53 Bombs may be released at all speeds up to the limit Mach number of .85 or the airspeed at which buffet is encountered, whichever is lower. The bomb dropping will be evidenced by a longitudinal lurch of the aircraft. The aircraft immediately returns to trim and the lurch is not objectionable.

500 Pound Bombs

54 The lower limit for this bomb, without the T-127 fins installed, is due to the bomb itself, which, at high speeds causes turbulence severe enough to damage the wing flaps.



NOTE WHEN 100 IMP. (120 U.S.) GALLON DROP TANKS ARE CARRIED, THE LOAD FACTORS ARE +6G OR -2G AT ALL ALTITUDES.

Figure 2-7 Strength Diagram

OPERATION OF AIR CONDITIONING AND PRESSURIZING SYSTEM

General

55 Operate as follows:

(a) Cabin pressure control lever, on aircraft 19102 to 19452 inclusive, at either ON 2.75 or ON 5.00. On aircraft 19453 and subsequent, cockpit pressure control switch at PRESS and pressure selector at either 2.75 or 5 psi.

NOTE

On aircraft 19102 to 19452 inclusive, cockpit pressure must not exceed 2.75 psi during gun firing, as higher pressures will cause movement of windshield armour glass and sight line deflection.

(b) Cockpit air temperature control switch - AUTOMATIC.

(c) Air temperature control rheostat set at desired cockpit temperature.

(d) Air outlet selector at FLOOR, DEFROST or BOTH.

(e) Side outlet adjusted as desired.

(f) Turn on canopy defrost lever, if necessary.

Operation of Windshield Defrosting and De-icing

56 Proceed as follows:

(a) If the inner surface of the windshield and/or the outer surface of the armour glass becomes fogged or frosted, move windshield de-icing lever to ON.

NOTE

If windshield icing is frequently encountered during let-downs, turn windshield de-icing system on before starting let-down. Windshield de-icing is not possible with the pressurizing system off.

(b) If the inner or cockpit surface of the armour glass becomes fogged, move the air-outlet selector on the left console to DEFROST position. Close both side outlets until fog is removed.

(c) If atmospheric or flight conditions cause fog to be emitted from windshield and side outlets, turn cockpit temperature rheostat to full hot position (27°C). This may cause an uncomfortably warm cockpit temperature but will help to maintain clear vision for flight and landing.

(d) If fogging continues in spite of this procedure, move air temperature control switch on left aft console to the HOT position.

ARMAMENT OPERATION

Firing Guns

NOTE

On aircraft 19102 to 19200 inclusive, check that all guns are charged before take-off. On aircraft 19102 to 19452 inclusive, set cockpit pressure schedule at 2.75 psi.

57 Operate as follows: (see figure 2-9).

(a) Gun safety switch at GUNS. Before attempting gunnery, the sight and radar should be in operation for 10 to 15 minutes to allow proper warm-up.

(b) Gun heater switch ON if outside air temperature is 2°C or below.

(c) Gun charger switch at RETRACT for approximately 2 seconds, then move to RELEASE. (Aircraft 19201 and subsequent.)

(d) On aircraft 19102 to 19464 inclusive, set B-TW control at ROCKET-GUN; R-DA control at GUN-BOMB. On aircraft 19465 and subsequent, set sight function selector lever at GUNS and target speed switch at TR, HI, or LO, depending upon rate of closure.

(e) Instrument power switch at NORMAL. Check inverter warning light off.

(f) Reticle dimmer control adjusted to desired brilliancy.

(g) Set wing span adjustment dial, on sight head, to wing span of aircraft expected to be encountered in combat so that, in case of radar failure, manual ranging can be used.

(h) If more than one target is within range

GUN-BOMB-ROCKET SIGHT CHART OF SWITCHING AND OPERATION

	BOMB COMPUTER B.T.W. DIAL	R.D.A. ROCKET SETTING	CAGING BUTTON (POWER CONTROL HANDLE) . THROTTLE	COMPUTER GUN-BOMB SWITCH	MANUAL BOMB RELEASE SWITCH	SIGHT HEAD CAGING LEVER	MANUAL RANGE MANUAL -RADAR SWITCH	BOMB SELECTOR SWITCH	SIGHT HEAD ELEVATION MIRROR	SIGHT HEAD DEFLECTION MIRROR
GUNFIRE ELECT. CAGED (ON APPROACH)	GUN - ROCKET	GUN - BOMB	CLOSED	OPEN	OPEN	UNCAGED	MANUAL OR RADAR AT PILOT'S OPTION	MANUAL OR AUTO	FOLLOWS COMPUTER	FOLLOWS COMPUTER
GUNFIRE UNCAGED (TRACKING TARGET)	GUN - ROCKET	GUN - BOMB	OPEN	OPEN	OPEN	UNCAGED	MANUAL OR RADAR AT PILOT'S OPTION	MANUAL OR AUTO	FOLLOWS COMPUTER	FOLLOWS COMPUTER
BOMBING (ON APPROACH)	BOMB	GUN - BOMB	CLOSED	CLOSED	OPEN	UNCAGED	RADAR (NORMAL RELEASED HAND CONTROL)	AUTO	PULLED DOWN AGAINST 10° STOP	FOLLOWS COMPUTER
BOMBING (TRACKING TARGET)	BOMB	GUN - BOMB	OPEN	CLOSED	CLOSED	UNCAGED	RADAR (NORMAL RELEASED HAND CONTROL)	AUTO	PULLED DOWN AGAINST 10° STOP	FOLLOWS COMPUTER
ROCKET FIRE (ON APPROACH)	GUN - ROCKET	ROCKET AND DIVE ANGLE SELECTED	CLOSED	OPEN	OPEN	UNCAGED	RADAR (NORMAL RELEASED HAND CONTROL)	MANUAL OR AUTO	FOLLOWS COMPUTER ANGLE PLUS FIXED R.D.A.	FOLLOWS COMPUTER
ROCKET FIRE (TRACKING TARGET)	GUN - ROCKET	ROCKET AND DIVE ANGLE SELECTED	OPEN	OPEN	OPEN	UNCAGED	RADAR (NORMAL RELEASED HAND CONTROL)	MANUAL OR AUTO	FOLLOWS COMPUTER ANGLE PLUS FIXED R.D.A.	FOLLOWS COMPUTER
FIXED SIGHT	GUN - ROCKET OR BOMB	GUN - BOMB OR ROCKET	OPEN	DEPENDS ON B.T.W. DIAL	OPEN	CAGED	RADAR (NORMAL RELEASED HAND CONTROL)	MANUAL OR AUTO	CAGED AT ZERO	CAGED AT ZERO

Figure 2-8 (Sheet 1 of 2) Gun-Bomb-Rocket Sight Switching and Operating Chart-
(Aircraft 19102 to 19464)

GUN-BOMB-ROCKET SIGHT CHART OF SWITCHING AND OPERATION

	B.T.W. CONTROL	GUN, BOMB, ROCKET SELECTOR	ROCKET SETTING SELECTOR	TR. HI. LO SELECTOR	ELECTRIC CAGING	MECH CAGING LEVER	MANUAL RANGE	BOMB SELECTOR	MANUAL BOMB RELEASE	SIGHTHEAD ELEVATION MIRROR	SIGHTHEAD DEFLECTION MIRROR
GUNFIRE (ON APPROACH)	GUN-ROCKET	GUN	GUN	TR. HI or LO	CLOSED	UNCAGED	MANUAL or NORMAL	MANUAL or AUTO	OPEN	FOLLOWS COMPUTER	FOLLOWS COMPUTER
GUNFIRE (TRACKING)	GUN - ROCKET	GUN	GUN	TR. HI or LO	OPEN	UNCAGED	MANUAL or NORMAL	MANUAL or AUTO	OPEN	FOLLOWS COMPUTER	FOLLOWS COMPUTER
BOMBING (ON APPROACH)	BOMB	BOMB	BOMB	HI	CLOSED	UNCAGED	NORMAL	AUTO	OPEN	PULLED DOWN AGAINST 10° STOP	FOLLOWS COMPUTER
BOMBING (TRACKING)	BOMB	BOMB	BOMB	HI	OPEN	UNCAGED	NORMAL	AUTO	CLOSED	PULLED DOWN AGAINST 10° STOP	FOLLOWS COMPUTER
ROCKET FIRE (ON APPROACH)	GUN - BOMB	ROCKET	TYPE and DIVE ANGLE SELECTED	HI	CLOSED	UNCAGED	MANUAL or NORMAL	MANUAL or AUTO	OPEN	FOLLOWS COMPUTER PLUS FIXED ROCKET SETTING	FOLLOWS COMPUTER
ROCKET FIRE (TRACKING)	GUN - BOMB	ROCKET	TYPE and DIVE ANGLE SELECTED	HI	OPEN	UNCAGED	MANUAL or NORMAL	MANUAL or AUTO	OPEN	FOLLOWS COMPUTER PLUS FIXED ROCKET SETTING	FOLLOWS COMPUTER
FIXED SIGHT	GUN - ROCKET	GUN	GUN	TR. HI or LO	OPEN	CAGED (wing span at 60 for 100 mil)	NORMAL	MANUAL or AUTO	OPEN	CAGED at ZERO	CAGED at ZERO

NOTE: PRESSING THE RADAR OUT BUTTON (ON STICK GRIP) RETURNS GUN, BOMB, ROCKET SELECTOR TO GUNS.

IN MECHANICAL CAGE CONDITION, SIGHT GOES BACK TO 600 FEET

Figure 2-8 (Sheet 2 of 2) Gun-Bomb-Rocket Sight Switching and Operating Chart- (Aircraft 19465 and Subsequent) along the aircraft flight path, make sure radar is tracking the desired target. As range is decreased, the reticle should grow larger to span the target continually. Check range dial against estimated range of target. If necessary, depress radar out button to shift radar to desired target.

(j) Depress caging button momentarily to stabilize reticle image and begin tracking by placing reticle on target and holding in that position.

(k) After releasing caging button, continue to track the target smoothly, without slipping or skidding, for about one second, then fire.

(l) Should the radar fail, as indicated by the on-target light going out or by improper range indication, use manual range control incorporated in the throttle control lever. Keep target closely encompassed by reticle image circle.

(m) In the event of sight failure or for firing at ground targets, move mechanical caging lever on the sight to CAGE and use it as a fixed reticle sight.

Releasing Demolition Bombs

58 Operate as follows: (See figure 2-8.)

(a) Gun safety switch at SIGHT, CAMERA, RADAR to supply power to the sight.

(b) Instrument power switch at NORMAL. Check inverter warning light off.

(c) Sight reticle dimmer control adjusted for desired brilliancy.

(d) Bomb release selector at AUTO for automatic release through the sight, or at MANUAL for selective manual release.

(e) Demolition bomb selector switch at ALL or SINGLE. Check fragmentation bomb selector is OFF. If this switch is not OFF, demolition bomb switch is inoperative.

(f) After sighting target and before starting approach, position bomb arming switch at NOSE & TAIL or TAIL ONLY.

(g) Set B-TW control for proper target and wind conditions. Check R-DA control at GUN-BOMB position on aircraft 19102 to 19464. On aircraft 19465 and subsequent, set sight function lever at BOMBS.

(h) Depress electrical caging button during the push-over into the dive.

(j) Begin tracking run and release caging button. For automatic release, depress bomb-rocket release button on stick grip.

(k) Track smoothly and keep centre dot on the target.

(l) On AUTO release, the bombs will automatically drop as the reticle circle image disappears. For MANUAL release, depress bomb-rocket release button as the circle image disappears. On aircraft 19102 to 19464 only, the red bombs-away light is reflected on windshield armour glass as bomb is released.

Releasing Fragmentation Bombs

NOTE

Fragmentation bombs should not be released automatically through operation of the sight, as the sight is used for dive bombing only.

59 Operate as follows: (See figure 2-8.)

(a) Check demolition bomb release selector at MANUAL.

(b) Fragmentation bomb selector switch at ALL TRAIN or SINGLE TRAIN. Check indicator light on.

(c) To release bombs depress bomb-rocket release button on control stick grip.

(d) Check that indicator light goes out when the last bomb is released.

Firing Rockets

CAUTION

Before initial firing of rockets, make sure rocket projector release control is on position 1. Rockets must be fired in proper sequence to ensure that upper rocket will not be fired while rocket below it is still in place.

60 Operate as follows: (See figure 2-8.)

(a) Gun safety switch at SIGHT, CAMERA, RADAR to supply power to the sight.

(b) Instrument power switch at NORMAL. Check inverter warning light off.

(c) Sight reticle dimmer control adjusted to desired brilliancy.

(d) On aircraft 19102 to 19464 inclusive, set B-TW control at ROCKET, GUNS.

(e) On aircraft 19102 to 19464 inclusive, R-DA control set to type of rocket to be used and intended dive angle. On aircraft 19465 and subsequent, set sight function lever at ROCKET.

(f) Rocket selector switch at SINGLE or AUTO.

(g) Rocket arming switch on DELAY or INSTANT.

(h) Rocket jettison switch OFF.

(j) During push-over into the dive depress electrical caging button.

(k) Begin tracking run and release caging button.

(l) Track target smoothly for 5 seconds. Fire rockets by depressing bomb-rocket release button.

Chemical Tank Equipment

61 Tank selection is provided by switch on the centre pedestal, and after discharge of chemicals by means of bomb-rocket release button, the tanks may be dropped by operation of the bomb-rocket-tank salvo switch, the normal bomb release system, or, on aircraft 19301 and subsequent, the emergency jettison handle.

CAUTION

When chemicals are released, the demolition bomb single-all selector switch must be OFF to prevent dropping the tanks.

OXYGEN SYSTEM NORMAL OPERATION
(Aircraft 19102 to 19500)

General

62 Care must be exercised to prevent wasting oxygen when using the pressure-demand oxygen regulator installed in this aircraft. For consumption table, see figure 2-9.

WARNING

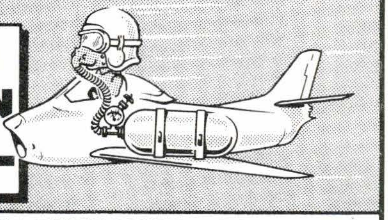
Use only an A-13 or A-13A pressure-demand oxygen mask with a pressure-demand oxygen regulator.

(a) Before each flight, check that the oxygen pressure gauge reads 450 to 500 psi, or have oxygen system charged to capacity before take-off.

(b) Always position oxygen diluter lever at NORMAL OXYGEN except under emergency conditions.

(c) At cockpit altitude below 30,000 feet, set pressure dial at NORMAL.

OXYGEN DURATION —HOURS—



CABIN ALT - FEET -	GAUGE PRESSURE PSI							
	400	350	300	250	200	150	100	BELOW 100
40,000	5.7 5.7	4.9 4.9	4.1 4.1	3.2 3.2	2.4 2.4	1.6 1.6	0.8 0.8	EMERGENCY — DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
35,000	5.7 5.7	4.9 4.9	4.1 4.1	3.2 3.2	2.4 2.4	1.6 1.6	0.8 0.8	
30,000	4.2 4.2	3.6 3.6	3.0 3.0	2.4 2.4	1.8 1.8	1.2 1.2	0.6 0.6	
25,000	3.4 4.0	2.9 3.4	2.4 2.8	1.9 2.3	1.4 1.7	1.0 1.1	0.5 0.6	
20,000	2.7 4.5	2.3 3.9	1.9 3.2	1.5 2.6	1.2 1.9	0.8 1.3	0.4 0.6	
15,000	2.1 5.4	1.8 4.6	1.5 3.9	1.2 3.1	0.9 2.3	0.6 1.5	0.3 0.8	
10,000	1.8 7.2	1.5 6.2	1.3 5.2	1.0 4.1	0.7 3.1	0.5 2.1	0.3 1.0	

Black figures indicate diluter lever "NORMAL"
Red figures indicate diluter lever "100%."
Cylinders: Four Type D-2

Figure 2-9 Oxygen Consumption Table

(d) Between 30,000 and 40,000 feet cockpit altitude, set the pressure dial at the SAFETY position.

(e) Above 40,000 feet cockpit altitude, set pressure dial according to cockpit altitude.

NOTE

Above 30,000 feet a vibration or wheezing sound may be noticed in the pressure-demand mask. This condition does not indicate malfunction of the mask and can be overlooked.

OXYGEN SYSTEM NORMAL OPERATION
(Aircraft 19501 and Subsequent)

General

63 Proceed as follows:

(a) Turn oxygen supply knob ON. Pressure gauge should read between 450 and 500 psi.

(b) Switch warning system switch ON. After two minutes of normal breathing through the mask, the warning lights will reduce from bright to a dim glow, indicating normal operation. A bright glow indicates zero oxygen flow or a steady flow, either of which indicate an interruption of normal operation.

(c) Set lever at NORMAL OXYGEN.

(d) Put on mask and check mask fit.

LANDING PROCEDURE

General

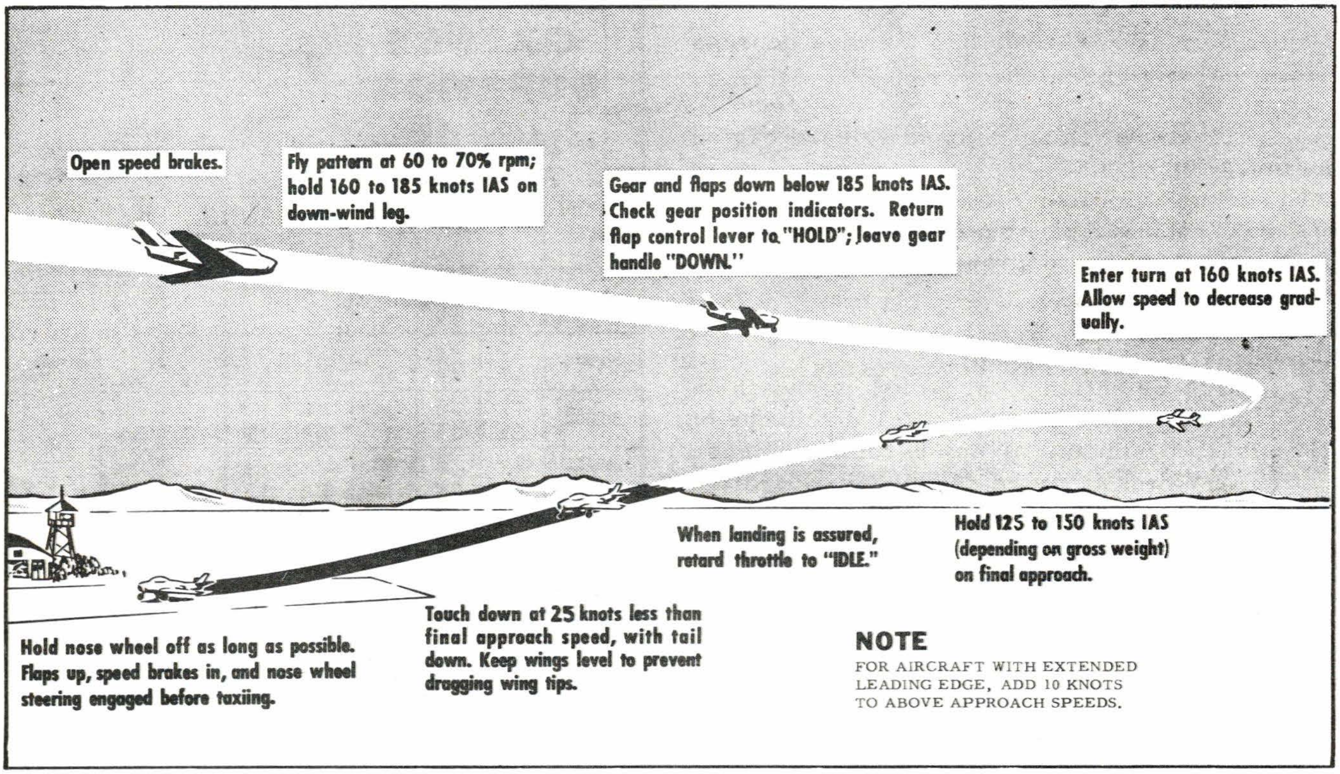
64 Circumstances may arise which require a descent from high altitude in the shortest possible time. Rates of descent as high as 27,000 feet per minute can be obtained by opening the speed brakes, and increasing the dive angle until the limit airspeed is reached.

CAUTION

Prior to rapid descent from altitude, turn on windshield de-ice and canopy defrosting. Turn off as soon as possible to avoid cracking of armour glass.

Vital Actions Before Landing

65 During approach to field make the following checks:



Open speed brakes.

Fly pattern at 60 to 70% rpm; hold 160 to 185 knots IAS on down-wind leg.

Gear and flaps down below 185 knots IAS. Check gear position indicators. Return flap control lever to "HOLD"; leave gear handle "DOWN."

Enter turn at 160 knots IAS. Allow speed to decrease gradually.

Hold 125 to 150 knots IAS (depending on gross weight) on final approach.

When landing is assured, retard throttle to "IDLE."

Touch down at 25 knots less than final approach speed, with tail down. Keep wings level to prevent dragging wing tips.

Hold nose wheel off as long as possible. Flaps up, speed brakes in, and nose wheel steering engaged before taxiing.

NOTE

FOR AIRCRAFT WITH EXTENDED LEADING EDGE, ADD 10 KNOTS TO ABOVE APPROACH SPEEDS.

Figure 2-10 Normal Approach and Landing

(a) Safety belt and shoulder harness tightened. Shoulder harness lock handle unlocked.

(b) Armament switches OFF.

(c) Check hydraulic pressures normal.

66 See figure 2-10 for complete approach and landing procedures. Observe the following precautions:

(a) Rapid increases in thrust are possible only above approximately 63% rpm. To ensure adequate acceleration in an emergency it is desirable to use full flaps and speed brakes and to hold 60% to 70% rpm on final approach.

(b) Do not lower gear in turns, pull-ups, while side slipping, or above 185 knots IAS.

(c) During night landings, do not lower landing lights until final approach.

Normal Landing

67 See figure 2-10 for landing pattern and Part 4 for estimated landing distances. Observe the following precautions:

(a) Do not attempt a full-stall landing because the angle of attack at the stall is so high the tail will drag.

(b) Rapid increases in thrust are possible only above approximately 63% rpm. To ensure adequate acceleration in an emergency, it is desirable to use full flaps and speed brakes and to hold approximately 60% to 70% rpm on final approach.

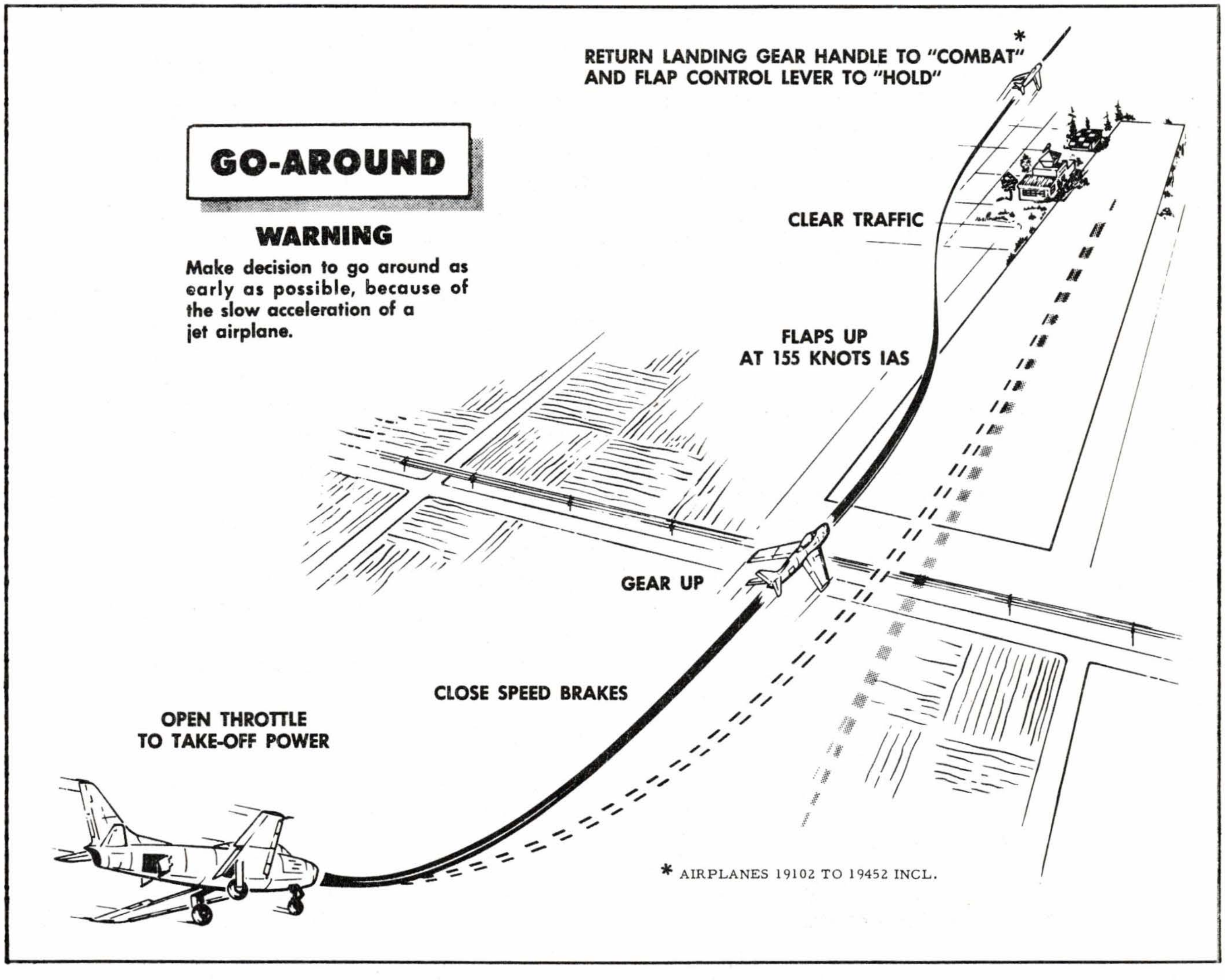


Figure 2-11 Go Around

CAUTION

Do not apply brakes before nose wheel is on runway. Do not use nose wheel steering during landing run except in the case of a main tire failure.

Cross-Wind Landing

68 A cross-wind landing may be accomplished as follows:

(a) Maintain 160 knots IAS in turn onto final approach.

CAUTION

Approach speed should be increased with an increase in the cross-wind velocity.

(b) Slow to 110 knots IAS for touchdown. On aircraft with extended leading edge, slow to 120 knots IAS.

(c) At touchdown, get nose wheel down as soon as possible.

Minimum-Run Landing

69 Proceed as follows:

(a) Maintain 150 to 160 knots IAS in turn onto final approach.

(b) On final approach, maintain 100 to 110 knots IAS, (110 to 120 knots IAS on aircraft with extended leading edge) using 70% to 80% rpm.

(c) Get nose wheel down quickly, after touch-down, to permit braking. Use brakes evenly, smoothly and apply as hard as runway conditions will permit without locking the wheels.

Mislanding

70 See figure 2-11 for complete go-around procedure.

END OF FLIGHT PROCEDURE

Stopping Engine

71 To stop engine, proceed as follows:

WARNING

To minimize danger of explosion due to accumulation of fuel vapor, always park aircraft headed into the wind, and wait at least 15 minutes after any engine operation (flight or ground) before moving aircraft into hangar.

(a) Set parking brakes.

(b) Operate the engine at between 60% and 70% rpm for three minutes to stabilize engine temperatures.

(c) Pull throttle control sharply to OFF.

(d) When engine stops rotating, turn engine master switch and battery switch OFF.

(e) Dump utility system hydraulic pressure by operating speed brakes.

(f) Turn off all switches with the exception of the generator switches.

Turbine Noise During Shutdown

72 The light scraping or squealing noise which may be heard during engine shutdown results from interference between the turbine buckets and turbine shroud. Contact of the two parts is due to the tendency of the shroud to shift and distort under varying temperature conditions such as are induced by engine shutdown. The scraping, while undesirable, does not damage either part. To minimize it, idle the engine for approximately 5 minutes before shutdown after any high-power operation, either flight or ground. If heavy scraping occurs on shutdown, do not attempt to restart engine until turbine temperature has dropped sufficiently to provide adequate clearance between the buckets and shroud, since a starting attempt might result in destruction of the starter. If a start must be made when interference is suspected, station an observer at leading edge of wing at fuselage to check audibly that engine begins to turn as soon as starter is engaged and note tachometer indication.

73 If engine does not begin turning at starter engagement, depress PUSH TO STOP STARTER button immediately.

Smoke From Turbine During Shutdown

74 When the engine is shutdown, fuel may accumulate in the turbine housing, where heat of the turbine section of the engine causes the fuel to boil. Although a turbine housing drain

is provided, the drain may not prevent accumulation of some fuel. Presence of this residual fuel in the engine will be indicated by emission of fuel vapor or smoke from the tail pipe or inlet duct. Boiling fuel, indicated by appearance of white fuel vapor, is not injurious to the engine, but does create a hazard to personnel because of the possibility of explosion if the vapor is allowed to accumulate in the engine and fuselage. The appearance of black smoke out of the tail pipe subsequent to shutdown indicates burning fuel, which will damage the engine and should be cleared immediately as follows:

(a) External power source connected.

(b) Station an observer at leading edge of wing at fuselage to audibly check that engine starts to turn as soon as starter is engaged. Note tachometer indication.

(c) Throttle control OFF.

(d) Engine master switch ON.

(e) Hold the battery-starter switch momentarily at STARTER.

(f) Allow engine to crank to approximately 6% rpm (20 seconds maximum), then depress PUSH TO STOP STARTER button. Turn engine master switch OFF.

Before Leaving Aircraft
75 Make following checks before leaving the aircraft:

NOTE

Leave landing gear handle DOWN when aircraft is on the ground.

(a) Check all electrical controls are OFF, except generator switch.

(b) Drop tank pressure shut-off valve OFF.

(c) Hydraulic power switch at NORMAL.

(d) Rudder lock engaged.

(e) Install safety pins in ejection seat handgrips.

(f) Wheels chocked and nose gear ground safety lock installed.

(g) Release parking brakes.

(h) Install ground safety pins in seat and canopy catapults.

(j) Close canopy.

(k) Install intake duct plug and tail-pipe cover.

(l) Remove destructors, if installed, from IFF equipment.

HOT-WEATHER OPERATION

NOTE

Do not attempt to take off in a sandstorm or dust storm. Park aircraft crosswind and shut down engine.

Take-off
76 The increase in required take-off distances commonly associated with hot-weather operation of any aircraft is even greater when the aircraft is powered by a jet engine.

After Take-off
77 Follow normal flight procedures, being particularly careful to maintain a power setting that will keep the tail-pipe exhaust temperature within its prescribed limits.

Before Leaving Aircraft
78 Make sure that protective covers are installed on pitot head, canopy and intake and exhaust ducts. Leave canopy slightly open to permit air circulation within the cockpit.

ARCTIC OPERATION

General
79 The normal operating procedures should be adhered to, with the following additions and exceptions.

Before Entering Cockpit
80 Proceed as follows:

(a) Remove all protective covers and dust plugs.

(b) At temperatures below -26°C use preheat in the cockpit and on the canopy seal.

(c) Check the entire aircraft for freedom from frost, snow and ice. Brush off all light snow or frost. Remove all ice by a direct flow of air from a portable ground heater. Do not chip or scrape away ice as this may damage the aircraft.

(d) Check bottom section of front stator blades for evidence of ice. Moisture, collected on previous flights and from condensation after landing, can accumulate and freeze on this part of the engine. If ice is present or suspected, check freedom of engine by hand. If engine does not rotate, apply external heat to forward engine section and, after thawing, start engine immediately before further freezing occurs.

WARNING

> The collection of snow, frost and ice on the aircraft surfaces constitutes one of the major flight hazards in low-temperature operation and will result in the loss of lift and treacherous stalling characteristics.

(e) Be sure wing slats move freely and that they can be moved manually into the closed position.

(f) Make sure shock struts and actuating cylinders are clear of ice and dirt. Clean with a cloth moistened with hydraulic fluid. Check shock struts for proper inflation.

(g) Check oil cooler drain, fuel filter and fuel tank drain cocks for ice. Drain condensate.

(h) Inspect pitot tube, fuel tank vent and oil tank vent. Remove any ice.

(j) Check oil system for correct lubricant.

(k) Check fuel system for correct fuel.

NOTE

> 3-GP-22a (JP-4, MIL-F-5624A) fuel, or gasoline, 3-GP-25b (MIL-F-5572A), if fuel 22a is not available, should be used at all temperatures below -18°C to provide satisfactory low temperature engine starts. In an emergency, when 3-GP-22a fuel or gasoline (3-GP-25b) is not available, 3-GP-23a (JP-1, MIL-F-5616) fuel may be used for starting at temperatures between -18°C and -29°C.

(l) Check that the fuel filter de-icing alcohol tank has been filled.

(m) Be sure that an external power source of 28.5 volts at 1500 amperes is available for starting. Use preheat on engine accessory section, if necessary, to reduce starter loads. Ground heating equipment can be connected to the air intake duct of the engine compartment if preheating is necessary.

On Entering Aircraft

81 Proceed as follows:

(a) External power source connected.

(b) Check flight controls for proper operation.

(c) Check that the canopy can be fully closed.

(d) Check electrical and radio equipment.

Starting Engine

82 Carry out the normal starting procedure with the following exceptions:

(a) Wait until 9% rpm is reached before advancing the throttle with both hands to obtain a fuel flow of 700 pounds per hour. Retard the throttle slightly on ignition to control exhaust temperature.

(b) If there is no indication of oil pressure after 30 seconds of engine operation at idle, or if oil pressure drops to zero after a few minutes of ground operation, stop engine and investigate.

Warm-up and Ground Check

WARNING

> Use firmly anchored wheel chocks for engine run-ups. The aircraft should be tied down securely before attempting a full power run-up. Because of low outside air temperatures, the thrust developed at all engine speeds is noticeably greater than normal.

83 Proceed as follows:

(a) Turn on cabin heat and windshield defrosting system as required immediately after engine start.

(b) Check surface controls, speed brakes, rudder trim tab, aileron and horizontal tail trim for proper operation.

NOTE

> Cycle the normal and alternate flight controls approximately six times on each system.

(c) Check wing flap operation.

Taxiing

84 Proceed as follows:

(a) Avoid taxiing in deep snow, as taxiing and steering are extremely difficult and frozen brakes are likely to result.

(b) Increase taxi interval at subfreezing temperatures to ensure safe stopping distance and to prevent icing of aircraft surfaces by melted snow and ice in the jet blast of a preceding aircraft.

(c) Minimize taxi time to conserve fuel and reduce amount of ice fog generated by jet engines.

Before Take-off

85 Proceed as follows:

(a) Check that the canopy is properly closed.

(b) Make normal full-power check. If field conditions make this impossible, final instrument check must be made during the first part of the take-off roll.

(c) Turn pitot heater switch ON just before moving into take-off position.

Take-off Procedure

86 At low temperatures, excessive tail-pipe temperatures may result at high engine speeds and zero or low ram air pressures. Therefore, exhaust temperatures may be a limiting factor for take-off rpm during the first part of the take-off roll. Any reduction in engine speed necessary to reduce exhaust temperature to flaps through several complete cycles to preclude their freezing in retracted position. Expect considerably slower operation of the landing gear in cold weather due to stiffening of all lubricants.

After Take-off

87 Proceed as follows:

(a) After take-off from a wet snow or slush-covered field, operate the landing gear and permissible limit will be more than compensated for by the thrust augmentation resulting from increased air density; e.g., 100% rated thrust is reached at 94% rpm at -18°C and at 88% rpm at -54°C.

(b) Turn on gun heaters immediately after take-off.

(c) Check instruments. Many flight instruments may be unreliable at extremely low temperatures.

During Flight

88 Proceed as follows:

(a) Use cockpit heat and defroster as required.

(b) Operate fuel filter de-icing system as required.

NOTE

> Since the de-icing alcohol supply will last for only one minute of de-icing operation, make sure the light burns steadily before depressing the de-icer button. Use the de-icer system for 15 seconds at a time.

Icing

89 Ice will adhere to the windshield, leading edge of the wings, empennage, and nose of the external fuel tanks. It is recommended that the altitude be changed immediately so that reduction in airspeed, due to ice accumulation, will not reduce the range of the aircraft.

WARNING

> Heavy ice accumulations can cause the stalling speed to be greatly increased, and extreme caution must be exercised when landing under such conditions. Icing of the engine air intake area is an ever-present possibility when operating in weather with temperatures near the freezing point. A reduction in fuel pressure and rpm with a loss of thrust (no

mechanical difficulties present) can indicate engine icing. A major rise in tail-pipe temperature is one of the normal indications of engine icing on this type of engine. Low airspeed and high engine rpm conditions are the most conductive to engine icing.

90 During take-offs into fog or low clouds, when temperature is at or near freezing, the engine could be subject to icing. Climbs should be made at higher than normal indicated airspeeds under such conditions.

WARNING

When engine icing is detected, reduce power to minimum cruising rpm and change altitude immediately to leave icing layer. If throttle is not retarded immediately to maintain normal tail-pipe temperatures, engine failure may occur rapidly because of overheating of turbine and exhaust system. Engine icing does not necessarily occur with wing icing.

Descent

91 Proceed as follows:

(a) Operate defroster to clear armour glass panel of frost usually formed during rapid descent from altitude.

Approach

92 Proceed as follows:

(a) Make normal pattern and landing but allow for flatter glide due to thrust augmentation caused by extremely low ambient temperatures.

(b) Turn off all electrical equipment not necessary at least one minute before final approach to reduce battery load when rpm is lowered and generator cuts out.

(c) Pump brake pedals several times.

(d) Energize the fuel filter de-icer system for 15 seconds prior to initial approach to preclude the possibility of an engine failure at low altitude.

After Landing

93 Proceed as follows:

(a) If snow and ice tires are installed on aircraft, apply brakes intermittently and carefully to keep treads from filling and glazing over.

(b) If conditions permit, taxi with sufficient rpm to cut in generator, as low temperatures decrease battery output.

(c) Turn pitot heater switch OFF.

Stopping Engine

94 The engine is stopped in the normal manner. If 3-GP-22a (JP-4, MIL-F-5624A) fuel is used, it is unnecessary to drain the fuel lines and tanks. If 3-GP-23a (JP-1, MIL-F-5616) fuel is used, operate engine until fuel is exhausted, or drain fuel and lines, and service with 3-GP-22a or gasoline (3-GP-25b) if a cold engine start is anticipated.

Before Leaving Aircraft

95 Perform the following:

(a) Release brakes after the wheels are chocked.

(b) If weather conditions permit, leave canopy partly open to allow circulation within the cockpit, to prevent canopy cracking from differential contraction and to decrease windshield and canopy frosting.

PART 3

EMERGENCY HANDLING

EMERGENCY TAKE-OFF

General

1 The aircraft is ready for take-off as soon as the engine is started. No warm-up period is necessary except to ensure correct oil temperature during cold weather starts.

EMERGENCY RELIGHTING IN FLIGHT

General

2 Typical flame-outs at altitudes above 25,000 feet are caused by too rapid movement of the throttle control or by a faulty regulator. Flame-outs can be identified by a loud explosion in the aft section of the aircraft and may be accompanied by a slight vibration. This type of explosion has not yet damaged an aircraft, and is not to be considered dangerous. Flame-outs that are not accompanied by an audible explosion are usually caused by failure of the main engine fuel control system and any attempt at an air restart will have to be made on the emergency system.

Engine Air Restart

3 Engine air restarts are most successful at 15,000 feet or below. Attempts to start at higher altitudes should not be made unless absolutely necessary, as high altitude engine restarts are unpredictable and an unsuccessful attempt at a high altitude restart might prevent a successful start when a lower altitude is reached. Never attempt a restart above 25,000 feet. Restarts should be made with the airspeed stabilized to obtain 12 - 15% engine rpm through windmilling. Restarts at higher engine rpm are very difficult and can result in excessive exhaust temperatures.

Engine Restarts at 15,000 Feet and Below

4 At altitudes of 15,000 feet or below, restart engine as follows:

(a) Throttle control OFF immediately after engine failure.

(b) Check engine master, generator and battery starter switches ON.

(c) If altitude is available, hold aircraft as level as possible for at least 5 seconds to drain any fuel that may have accumulated in the combustion chambers or turbine section.

(d) Slow aircraft to minimum safe airspeed in order to obtain an engine windmilling speed of 12 - 15%.

CAUTION

Restarts in flight with the engine windmilling in excess of 15% rpm are difficult and may result in excessive and damaging exhaust temperature.

(e) Turn off all non-essential electrical equipment as the generator is not operating.

(f) If main engine fuel control system failure is suspected, turn emergency fuel switch ON.

NOTE

If flame-out was caused by too rapid throttle control movement, do not turn on the emergency fuel system. Unless the main system has actually failed, the emergency system should not be used. Starts made with the main fuel system in operation have greater chance of success.

(g) Emergency ignition switch ON.

(h) Move throttle control to slightly below the IDLE detent and wait until rising exhaust temperature shows that engine has started.

(j) If combustion does not take place within 20 seconds, slowly retard the throttle control to reduce fuel pressure and then re-advance to just below IDLE. Repeat this procedure until ignition occurs or until one minute has elapsed.

(k) If initial restart is unsuccessful, and altitude is still sufficient, turn emergency ignition switch OFF and retard throttle control to OFF. Hold aircraft level as long as is practical to drain combustion chambers and turbine section, then repeat starting procedure.

(l) When combustion takes place and exhaust temperature stabilizes, turn emergency ignition OFF and adjust throttle control to keep exhaust temperature at not over 500°C until idle rpm is reached.

CAUTION

Ignition units may be damaged if emergency ignition is left on more than 3 minutes. If start is evidenced by low exhaust temperature (approximately 200°C) and temperature does not increase when throttle control is advanced, shut off engine and restart, as this condition indicates that not all burners are lighted. The engine may be damaged if this condition is allowed to continue.

(m) If ignition does not occur before aircraft descent to an altitude of 5,000 feet, make a forced landing, or abandon the aircraft.

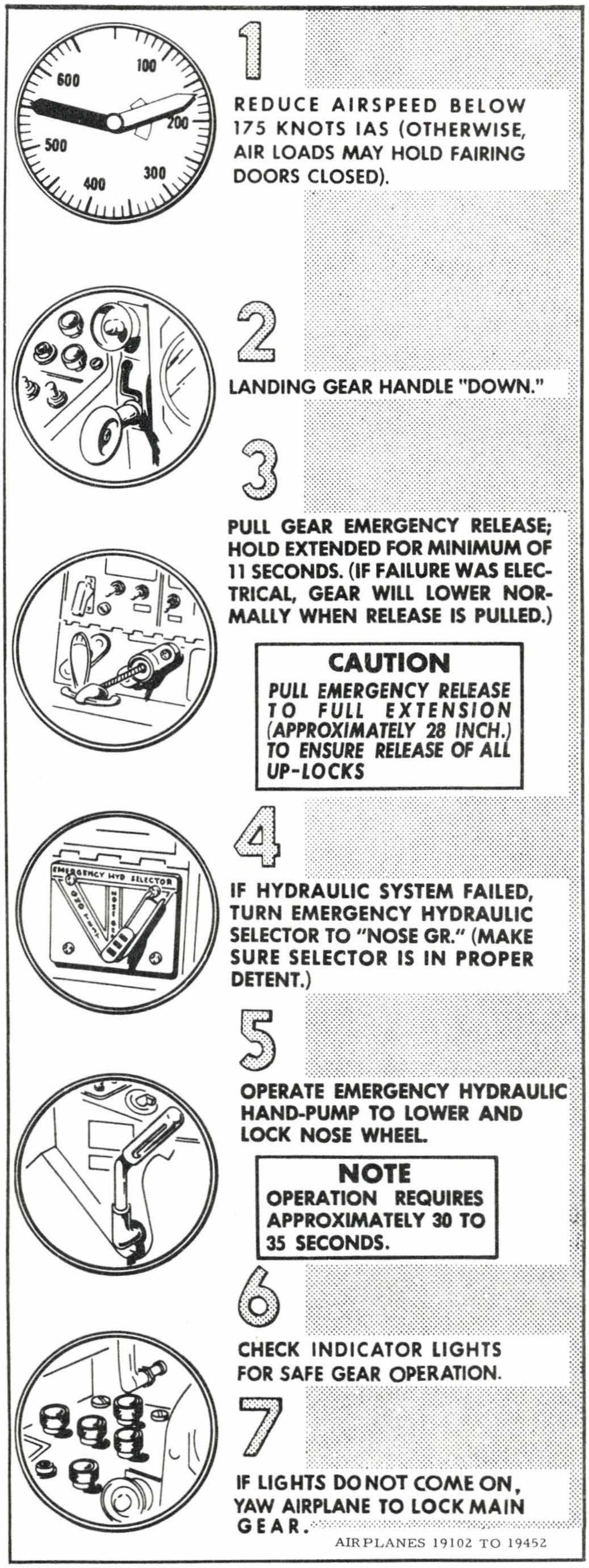
Engine Restarts Above 15,000 Feet

5 Air restarts above 15,000 feet should not be attempted unless absolutely necessary, as the procedure is critical and results are unpredictable. Restarts above 20,000 feet should not be attempted when 3-GP-23a (JP-1) fuel is used. Restarts above 25,000 feet should not be attempted when gasoline, 3-GP-25b is used. High altitude restarts are possible and best results will be obtained by following the same procedure outlined for starts at 15,000 feet and below, but making definite allowances for the following facts:

(a) At very high altitudes, the engine can be on the verge of a compressor stall with the throttle control at IDLE. Any advancement of the throttle control could cause a complete stall. Should stall occur, throttle control must be moved to OFF, and restart procedure attempted again at a suitable height using a slightly lower initial throttle control setting.

NOTE

It may be necessary to use a setting considerably below IDLE, because of the



1

REDUCE AIRSPEED BELOW 175 KNOTS IAS (OTHERWISE, AIR LOADS MAY HOLD FAIRING DOORS CLOSED).

2

LANDING GEAR HANDLE "DOWN."

3

PULL GEAR EMERGENCY RELEASE; HOLD EXTENDED FOR MINIMUM OF 11 SECONDS. (IF FAILURE WAS ELECTRICAL, GEAR WILL LOWER NORMALLY WHEN RELEASE IS PULLED.)

CAUTION

PULL EMERGENCY RELEASE TO FULL EXTENSION (APPROXIMATELY 28 INCH.) TO ENSURE RELEASE OF ALL UP-LOCKS

4

IF HYDRAULIC SYSTEM FAILED, TURN EMERGENCY HYDRAULIC SELECTOR TO "NOSE GR." (MAKE SURE SELECTOR IS IN PROPER DETENT.)

5

OPERATE EMERGENCY HYDRAULIC HAND-PUMP TO LOWER AND LOCK NOSE WHEEL.

NOTE

OPERATION REQUIRES APPROXIMATELY 30 TO 35 SECONDS.

6

CHECK INDICATOR LIGHTS FOR SAFE GEAR OPERATION.

7

IF LIGHTS DO NOT COME ON, YAW AIRPLANE TO LOCK MAIN GEAR.

AIRPLANES 19102 TO 19452

Figure 3-1 Landing Gear Emergency Extension (Aircraft 19102 to 19452) reduced fuel pressures necessary for combustion at high altitudes.

(b) Slow, careful movement of the throttle control is important in restart procedures, as very small changes in fuel pressure make a great deal of difference at higher altitudes.

(c) Exhaust temperatures during high altitude restarts will be critical and care must be used to keep them within safe limits.

TRIM FAILURE

Horizontal Tail Normal Trim Failure

6 If a failure of the normal trim control for the controllable horizontal tail occurs, the tail can be trimmed through use of the alternate longitudinal trim switch.

REDUCE AIRSPEED BELOW 175 KNOTS IAS (OTHERWISE, AIR LOADS MAY HOLD FAIRING DOORS CLOSED).

LANDING GEAR HANDLE "DOWN"

PULL GEAR EMERGENCY RELEASE; HOLD EXTENDED FOR MINIMUM OF 11 SECONDS TO LOWER GEAR.

CAUTION
PULL EMERGENCY RELEASE TO FULL EXTENSION (APPROXIMATELY 28 INCHES) TO ENSURE RELEASE OF ALL UP-LOCKS.

CHECK INDICATOR FOR SAFE GEAR INDICATION.

IF NECESSARY, YAW AIRPLANE TO LOCK MAIN GEAR.

(AIRCRAFT 19453 AND SUBS.)

Figure 3-2 Landing Gear Emergency Extension (Aircraft 19453 and Subsequent)

Aileron Normal Trim Failure

7 In event of a failure of the normal aileron trim control, the ailerons can be trimmed through use of the alternate lateral trim switch on the left console, aft of the throttle control.

Wing Flap Failure

8 No emergency flap control system is provided. If unequal retraction or extension of the flap occurs during normal flap operation, hold aircraft level and return flap control to original position. Land as soon as possible without further attempts to operate the flaps. Aileron control is sufficient to overcome the rolling effect of unequal flap extension.

SPEED BRAKE SYSTEM FAILURE

General

9 To close speed brakes in case of electrical or hydraulic failure, move the emergency speed brake control to EMERG. CLOSED. To open speed brakes in case of a hydraulic failure, use the normal speed brake control. A hydraulic accumulator will provide pressure for one complete cycle of the speed brakes.

Sticking of Slats

10 Under certain conditions of flight, such as a high speed stall in a steep climbing turn, it may be possible to have one slat jam at the outboard edge while the other slat opens normally. This causes the aircraft to flick out of control in a very erratic spiral dive. The method of recovery is to increase speed by closing the dive brakes if open, keeping the nose down and opening the throttle.

LANDING GEAR EMERGENCY OPERATION

Landing Gear Emergency Retraction

11 If it is necessary to retract gear while aircraft is on the ground, move normal gear control handle to UP and hold emergency-up button depressed until gear retracts. The gear will retract only if hydraulic pressure is available.

Landing Gear Emergency Extension

12 See figures 3-1 and 3-2. Before using emergency gear lowering procedure, check gear indicator light bulbs for operation. When the landing gear indicators or the horn indicate that one or more of the wheels are not locked

down, a visual check, if feasible, should be made by the control tower. In the wheel down cycle, the downlock microswitches, wired in series, will not close the landing gear doors until all three wheels are down and locked. If the tower confirms that the wheels are down and the doors closed, the landing gear must be locked down and continued evidence by the indicators or horn of an unsafe gear can be attributed to an electrical fault in the system.

NOTE

On aircraft 19102 to 19452 inclusive, 15 to 20 strokes of the emergency hand pump are required to lower and lock the nose gear. This procedure takes approximately 30 to 35 seconds, therefore attempt to have the operation completed before final approach.

Main Gear Down, Nose Gear Up or Unlocked

13 If the nose gear will not extend or lock down, jettison all external load and, if time and conditions permit, fire all ammunition and expend any excess fuel to establish an aft centre of gravity condition and to minimize possible fire hazard. A landing should be made, in the following manner:

(a) Canopy switch OPEN (below 215 knots IAS).

(b) Plan approach to touch down as near end of runway as possible.

(c) Make a normal approach with flaps down and speed brakes open.

(d) Throttle control OFF.

(e) Just before touchdown, engine master, generator, and battery-starter switches OFF. (Battery-starter switch last so that power will be available to close fuel shut-off valve when engine master switch is turned OFF.)

(f) Lock shoulder harness, and unbuckle parachute harness.

(g) At touch down, pull stick full back. Hold the nose wheel off as long as possible. Ease nose down before horizontal stabilizer control is ineffective, to prevent nose or nose wheel from dropping abruptly to the ground.

(h) Do not use brakes unless necessary.

NOTE

If nose gear is down and every other method of locking has failed, attempt to snap it into the locked position by making a touch-and-go landing. Make a power approach and touch the main gear to the runway with a slight bounce, and then go around.

One Main Gear Up or Unlocked

14 If one or both main gears will not extend or lock down, jettison all external load, and if conditions permit, fire all ammunition and expend any excess fuel to minimize fire hazard. If possible, retract gear and make a belly landing. If gear cannot be retracted, land on the runway with as many wheels down as possible. Use the following procedure:

(a) Canopy switch OPEN (below 215 knots IAS).

(b) Just before touch down, throttle control OFF, and engine master, generator, and battery-starter switches OFF. (Battery-starter switch last so that power will be available to close fuel shut-off valve when engine master switch is turned OFF.)

CABIN PRESSURIZATION EMERGENCY OPERATION

WARNING

Always have oxygen available for immediate use when flying above 10,000 feet with cockpit pressurized.

Emergency Depressurization

15 Should sudden depressurization of cockpit be necessary, proceed as follows:

(a) On aircraft 19102 to 19500 inclusive, turn oxygen regulator dial control to ABOVE 45M, and tighten mask to hold pressure.

(b) On aircraft 19102 to 19452 inclusive, move cabin pressure control lever to OFF. On aircraft 19453 and subsequent, move cockpit pressure switch to RAM.

(c) If at high altitude, descend below 25,000 feet immediately.

Cooling Unit Failure

16 Failure of the cooling unit of the cockpit air conditioning and pressurizing system will allow air at high temperatures to enter the cockpit. If very high temperature air enters the cockpit, proceed as follows:

(a) If at high altitude, immediately descend to 20,000 feet or less.

(b) On aircraft 19102 to 19452 inclusive move cabin pressure lever to OFF. (RAM AIR ON-DUMP OPEN). On aircraft 19453 and subsequent, move cabin pressure switch to RAM.

OXYGEN SYSTEM EMERGENCY OPERATION (Aircraft 19102 to 19500 Inclusive)

General

17 With symptoms of the onset of anoxia, or if smoke or fuel fumes should enter the cockpit, set the diluter lever to 100% OXYGEN.

18 If the oxygen regulator should become inoperative, descend to a cockpit altitude not requiring oxygen.

NOTE

After emergency is over, set diluter lever of regulator to NORMAL OXYGEN and the pressure dial as required by altitude.

OXYGEN SYSTEM EMERGENCY OPERATION (Aircraft 19501 and Subsequent)

General

19 Should symptoms suggestive of the onset of anoxia occur, or should the regulator become inoperative, immediately deflect the EMERGENCY toggle switch to the right or left and descend below 10,000 feet.

20 Whenever excessive carbon monoxide or other noxious or irritating gas is present or suspected, the diluter lever should be set at 100% OXYGEN regardless of aircraft altitude until the danger has passed or the flight completed.

ARMAMENT EMERGENCY OPERATION

Bomb, Rocket and Chemical Tank Emergency Release

NOTE

For emergency jettison procedure during take-off refer to Paragraphs 32 and 33 following.

21 To jettison demolition bombs unarmed, press the bomb-rocket-tank salvo button. These bombs can also be dropped safe by having the bomb arming switch OFF and the demolition bomb single-all selector switch at ALL, and then depressing the bomb release button on the control stick grip.

22 Fragmentation bombs are automatically armed as they are released from the rack, so that unarmed release of individual fragmentation bombs is impossible. If the complete fragmentation bomb rack is released with bombs installed, the bombs will be dropped safe. This unarmed release of fragmentation bombs is accomplished by depressing the bomb-rocket release button on the control stick grip after positioning the fragmentation bomb selector switch at OFF and the demolition bomb single-all selector switch at ALL. On aircraft 19301 and subsequent, demolition and fragmentation bombs may be jettisoned mechanically by pulling the emergency jettison handle. Demolition bombs are released unarmed, as the bomb arming circuit is broken when the handle is actuated. Fragmentation bombs are dropped safe, as the complete fragmentation bomb racks are released.

23 Rockets may be jettisoned by positioning the rocket fuse arming switch at DELAY or OFF and the rocket jettison switch at JETTISON READY, and then depressing the bomb-rocket release button on the control stick.

24 To salvo rockets, hold bomb-rocket-tank salvo button on momentarily, or, on aircraft 19301 and subsequent, pull the emergency jettison handle.

WARNING

To prevent accidental rocket ignition during jettison release on aircraft 19102 to 19300 inclusive, the rocket release selector must be at OFF.

25 The chemical tanks may be dropped by operation of the bomb rocket-tank salvo switch, the normal bomb release system, or, on aircraft 19301 and subsequent, the emergency jettison handle.

Ammunition Heat Emergency Shut-off

26 Should ammunition compartment overheat indicator light come on, indicating excessive ammunition compartment temperature, pull the ammunition heat emergency shut-off to its full extension to shut off the supply of heated air to the ammunition compartment.

NOTE

The emergency shut-off cannot be reset in flight, consequently preventing the use of ammunition compartment heat for the remainder of the flight.

FIRE

NOTE

There is no fire extinguishing system on this aircraft.

Engine Fire During Starting

27 If a fire detector light comes on or there are other indication of fires, proceed as follows:

(a) Throttle control OFF.

(b) Depress PUSH TO STOP STARTER button, if necessary.

(c) Engine master switch OFF.

(d) Battery switch OFF.

(e) Leave aircraft as quickly as possible.

Engine Fire During Flight

28 Proceed as follows:

(a) If forward fire detector light comes on, shut down engine immediately.

(b) If aft fire detector light comes on, reduce power to see if light will go out. If light goes out, continue flight at reduced power, landing as soon as possible. If light does not go out, shut down engine immediately.

(c) Generator and battery switches OFF, if fire does not go out when engine is dead.

CAUTION

When it is necessary to turn off the electrical power source, most of the electrical equipment including fire warning lights will be inoperative.

(d) If indication of fire persists after engine is shut down, or if fire goes out and an emergency landing is impossible, abandon aircraft immediately.

Smoke or Fumes in Cockpit

29 If smoke or fumes should enter the cockpit, proceed as follows:

(a) Move cabin pressure control lever to OFF, ram air ON, dump OPEN, or cockpit pressure control switch to RAM.

(b) Oxygen regulator diluter lever 100% OXYGEN.

(c) On aircraft 19102 to 19500 inclusive, set oxygen regulator pressure dial as required by cockpit altitude.

Electrical Fire

30 Circuit breakers and fuses protect most of the electrical circuits and will tend to isolate an electrical fire. If electrical fire occurs, turn battery and generator switches OFF and land as soon as possible, since battery power for surface control emergency hydraulic pump operation will last only from eight to twenty-five minutes.

ENGINE FAILURE

Engine Failure Before Leaving Ground

31 Proceed as follows:

(a) Throttle control OFF.

(b) Apply brakes.

(c) Canopy switch OPEN.

32 If gear must be retracted because of insufficient remaining runway:

(a) Press bomb-rocket-tank salvo button when bombs, rockets, or drop tanks are installed.

NOTE

Rockets cannot be jettisoned electrically when weight of aircraft is on gear.

(b) Landing gear handle UP. Hold gear

emergency up button depressed until gear retracts.

(c) Engine master switch and battery-starter switches OFF.

CAUTION

> Turn engine master switch OFF, while battery-starter switch is still at BATTERY, so that power will be available to close the fuel shut-off valve.

Engine Failure During Take-Off

33 If the engine fails on take-off after the aircraft is airborne, prepare for an emergency landing, accomplishing as much of the following as possible.

(a) Throttle control OFF.

(b) Press bomb-rocket-tank salvo button if external stores are carried.

(c) Landing gear handle UP.

(d) Canopy switch OPEN.

(e) Check flaps control lever DOWN.

(f) Engine master, generator, and battery-starter switches OFF before ground contact.

CAUTION

> Turn engine master switch OFF while battery-starter switch is still at BATTERY, so power will be available to close the fuel shut-off valve.

(g) Shoulder harness locked.

(h) Land straight ahead, changing course only enough to miss obstacles.

Engine Failure During Flight

34 If engine failure occurs during flight, follow this procedure:

(a) Throttle control OFF.

(b) Establish glide at 185 knots IAS with gear and flaps up and speed brakes closed for maximum glide distance.

(c) Turn off non-essential electrical equipment.

(d) Attempt an air restart (refer to Paragraph 2, preceding).

(e) If an air restart is impossible, jettison all external load and make a forced landing.

(f) If no suitable landing area is available, bail out. If a forced landing is contemplated, maintaining the glide at 185 knots IAS (gear and flaps up, speed brakes in), will provide the maximum gliding distance. Unless the engine is damaged, it will windmill at sufficient speed to provide power for the hydraulic system, although landing gear operation may be slower than usual. The surface control hydraulic system will operate normally, but excessive use of the controls should be avoided in order to conserve accumulator pressure. At normal gliding speeds, engine windmilling does not provide adequate generator output and the battery is then the only source of electric power. With engine master switch, IFF radar, radio, armament equipment, pitot heater, and lights turned off, the battery can supply power for only approximately 7 to 28 minutes.

WARNING

> If engine damage prevents windmilling (causing normal hydraulic system pressure failure), the automatic operation of the surface control emergency hydraulic pump imposes the maximum drain on battery power and results in minimum time of battery output.

FUEL SYSTEM EMERGENCY OPERATION

General

35 Sudden loss of fuel pressure and a decrease in engine rpm indicates failure of some portion of the main fuel control system and necessitates switching to the emergency fuel control system for continued operation. In order to switch safely from the main to the emergency fuel system, either the emergency system must be turned on before engine rpm drops below 80% rpm, or the throttle control must be retarded to IDLE, the emergency system switched ON, and the throttle control re-advanced slowly.

WARNING

> Do not turn on emergency fuel switch if rpm is below 80% without first retarding throttle control to IDLE. To do so may

cause dangerous engine overheating or compressor stall.

CAUTION

No automatic engine overspeed protection is provided when the emergency fuel control system is being used and throttle movement must be smooth and gradual to avoid flameout or engine overspeeding, particularly at high altitudes.

36 If the flame is not extinguished and only a partial loss in power exists, proceed as follows:

(a) Retard throttle to IDLE.

(b) Switch emergency fuel system ON.

(c) Open throttle slowly and check that rpm increases.

CAUTION

Avoid rapid throttle movement when operating on the emergency fuel system, particularly at altitude.

37 If complete failure of main fuel system is experienced, proceed with an air restart as outlined in Paragraphs 2 to 5, preceding, using the emergency fuel system.

38 If engine stops before emergency system is turned on, attempt an air restart.

EXTERNAL LOAD EMERGENCY RELEASE

General

39 To drop any external load during an in flight emergency, follow this procedure:

(a) Push bomb-rocket-tank salvo button.

(b) Check to make sure load is released.

(c) If load failed to release, pull emergency release handle on aircraft 19301 and subsequent.

(d) If check reveals that load did not release and if time permits, check circuit breakers in, and demolition bomb release selector switch at MANUAL RELEASE. Place demolition bomb single-all selector switch at ALL and rocket jettison switch at READY, then press bomb-rocket release button on stick grip.

ELECTRICAL SYSTEM EMERGENCY OPERATION

General

40 If a complete electrical failure should occur or if for any reason it becomes necessary to turn off both battery and generator, proceed as follows:

(a) If possible, before turning off electrical power, reduce airspeed and adjust trim, as trim or flaps are not adjustable without electrical power.

(b) The fuel booster pumps will be inoperative when electrical power is shut-off and it may be necessary to reduce altitude and rpm in order to maintain satisfactory engine operation.

(c) Reduction of rpm for satisfactory engine operation without booster pumps may require that the aircraft be held in a slightly nose-high attitude to maintain altitude. If prolonged flight in this condition is necessary, approximately 21 Imperial (25 U.S.) gallons of fuel may be trapped in the aft fuselage tank since the transfer pump will also be inoperative. The actual quantity of fuel trapped will depend upon the total fuel in all tanks at the time of electrical failure. When sufficient altitude is available, some trapped fuel can be drained into the centre wing tank by levelling off or nosing down slightly for a short period.

(d) Land as soon as possible.

Generator Failure

41 If the generator-off warning light illuminates indicating generator failure or drop in generator output all non-essential equipment should be turned off to reduce the load on the battery. If generator output is off because of engine failure, the engine master switch should be moved to OFF to lessen battery loads. The length of time that useable battery power is available for continued operation is approximately 7 to 28 minutes. Battery output duration may be decreased, however, by a number of variable factors including low state of battery charge, excessive electrical loads, and low battery temperature.

CAUTION

On aircraft 19102 to 19300 inclusive, when generator fails, drop any external load immediately, because the normal and emergency release controls will be operative only as long as battery power is available.

WARNING

In case normal surface control hydraulic system fails while generator is out, battery power for emergency hydraulic pump operation will last only from 6 to 7 minutes with the dead engine windmilling.

Generator Overvoltage

42 If generator overvoltage is indicated by warning light or voltmeter, attempt to bring the generator back into the circuit as follows:

(a) Hold the generator switch as RESET momentarily, then turn switch OFF. If the voltmeter shows normal system voltage, it indicates the overvoltage was temporary. Turn generator switch ON.

(b) On aircraft 19102 to 19200 inclusive, if overvoltage is still indicated by voltmeter, attempt to bring voltage below allowable limit (28 volts) by adjusting voltage rheostat, with generator switch OFF. A maximum of 31 volts is allowable in an emergency if voltage cannot be decreased to 28. Hold generator switch momentarily at RESET again and then turn switch ON. If overvoltage warning light remains out, check voltage and readjust rheostat as necessary to obtain normal system voltage. On aircraft 19201 and subsequent, the rheostat is not installed, and pilots cannot adjust for overvoltage.

(c) If voltage cannot be brought within allowable limit, leave generator switch OFF, reduce load on battery as much as possible, and land as soon as practicable.

43 If the ammeter at any time reads zero and the generator-off warning light is not illuminated, move the generator switch to the RESET position, as it is quite possible the warning light has burned out and therefore will not indicate an overvoltage condition.

Inverter Failure

44 On aircraft 19102 to 19452, if failure of the single-phase inverter is indicated by illumination of the instrument power off warning light, move instrument power switch to ALT. On aircraft 19453 and subsequent, move the instrument power switch to ALT when the main instrument (three-phase) inverter off warning light is illuminated.

CAUTION

Loss of a.c. power results in failure of the fuel flowmeter and totalizer, and the hydraulic, fuel, and oil pressure gauges. These instruments, while inoperative, will provide erroneous indications as pointers continue to register conditions which existed when power failed.

FLIGHT CONTROL HYDRAULIC SYSTEM FAILURE

General

45 In case of failure in the normal flight control hydraulic system, the alternate system will automatically take over, as indicated by the emergency-on warning light. If the alternate system fails to take over automatically, move the power controls switch to ON EMERG. (Aircraft 19102 to 19452) or ALTERNATE ON (Aircraft 19453 and Subsequent). If this fails to engage the alternate system, pull the manual override handle (Aircraft 19453 and Subsequent).

WARNING

Because of the lower output of the emergency pump, control movement should be held to a minimum to avoid the possibility of exhausting hydraulic accumulator pressure supply.

ABANDONING IN FLIGHT

Emergency Exit

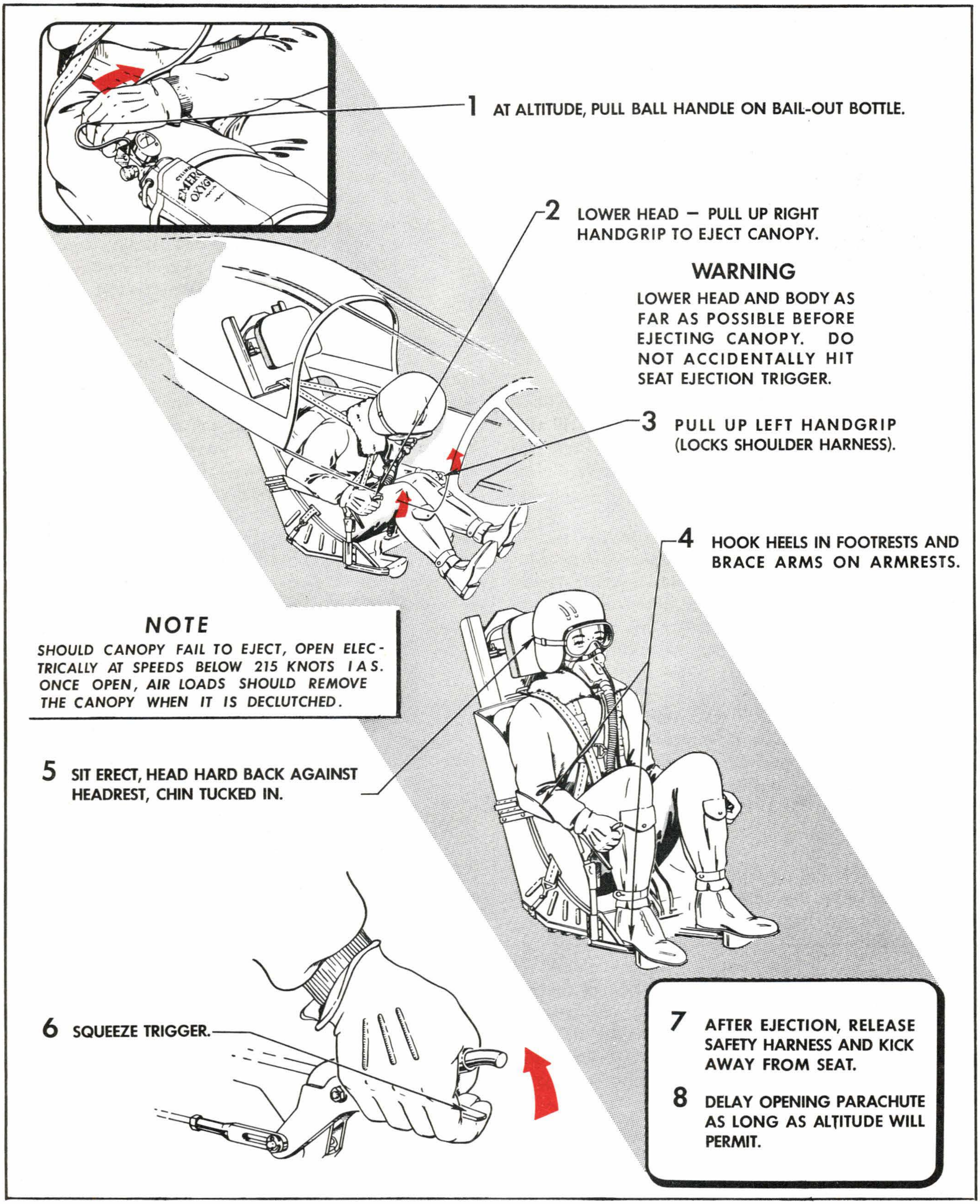
46 In all cases of emergency exit in flight, escape must be accomplished by means of seat ejection.

47 For seat ejection procedure, see figure 3-3.

NOTE

Stow all loose equipment before ejection.

48 Following ejection and after kicking away from seat, delay opening parachute as long as possible to reduce parachute opening shock, and to allow seat to fall clear so it will not foul parachute when opened. For ejection below



1 AT ALTITUDE, PULL BALL HANDLE ON BAIL-OUT BOTTLE.

2 LOWER HEAD — PULL UP RIGHT HANDGRIP TO EJECT CANOPY.

WARNING

LOWER HEAD AND BODY AS FAR AS POSSIBLE BEFORE EJECTING CANOPY. DO NOT ACCIDENTALLY HIT SEAT EJECTION TRIGGER.

3 PULL UP LEFT HANDGRIP (LOCKS SHOULDER HARNESS).

4 HOOK HEELS IN FOOTRESTS AND BRACE ARMS ON ARMRESTS.

NOTE

SHOULD CANOPY FAIL TO EJECT, OPEN ELECTRICALLY AT SPEEDS BELOW 215 KNOTS IAS. ONCE OPEN, AIR LOADS SHOULD REMOVE THE CANOPY WHEN IT IS DECLUTCHED.

5 SIT ERECT, HEAD HARD BACK AGAINST HEADREST, CHIN TUCKED IN.

6 SQUEEZE TRIGGER.

7 AFTER EJECTION, RELEASE SAFETY HARNESS AND KICK AWAY FROM SEAT.

8 DELAY OPENING PARACHUTE AS LONG AS ALTITUDE WILL PERMIT.

Figure 3-3 Ejection Seat Operation

2000feet, if proper position on the seat can be maintained, unfasten the seat belt before proceeding with the ejection sequence.

EMERGENCY ENTRANCE

General

49 For emergency access to cockpit on ground if canopy cannot be opened by external electrical push button, pull emergency canopy release on left side of fuselage just below canopy frame and slide canopy to rear of fuselage deck.

CRASH LANDING

General

50 See figure 3-4 for maximum glide distance obtainable from different altitudes, and see figure 3-5 for procedure to follow in case of a forced landing.

CAUTION

> If utility hydraulic system is out, do not cycle the speed brakes at any time during the glide, as remaining hydraulic accumulator pressure will be exhausted and will not be available when needed for landing.

Practice Forced Landing

51 When practicing forced landings, it should be realised that a jet engine at idling rpm continues to give several hundreds pounds thrust, whereas a powerless, windmilling engine creates drag. If the speed brakes are opened and the throttle set at 72%, the gliding angle will approximate that given by a windmilling engine with the undercarriage raised. With the undercarriage lowered, set the throttle at 69% rpm.

DITCHING

NOTE

> Inspect emergency equipment, parachute, life vest and raft pack before each over water flight.

General

52 Ditch only as a last resort. All emergency survival equipment is carried by the pilot and there is no advantage in riding the aircraft down. If altitude is not sufficient for emergency exit and ditching is unavoidable, proceed as follows:

(a) Follow radio distress procedure.

(b) Jettison drop tanks, bombs, or rockets.

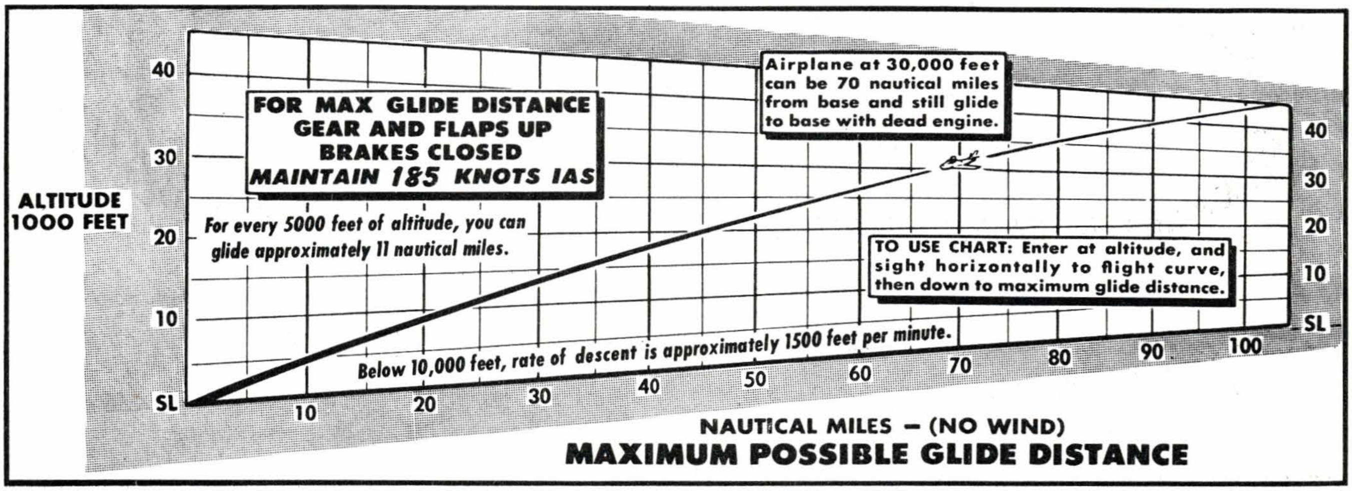
(c) See that no personal equipment will foul when leaving the cockpit. Disconnect anti-G suit and oxygen hose.

(d) Make sure safety belt is tight.

(e) Check gear up and speed brakes in.

(f) Throttle control OFF.

(g) Canopy switch OPEN (below 215 knots IAS).



FOR MAX GLIDE DISTANCE GEAR AND FLAPS UP BRAKES CLOSED *MAINTAIN 185 KNOTS IAS*

For every 5000 feet of altitude, you can glide approximately 11 nautical miles.

Airplane at 30,000 feet can be 70 nautical miles from base and still glide to base with dead engine.

TO USE CHART: Enter at altitude, and sight horizontally to flight curve, then down to maximum glide distance.

Below 10,000 feet, rate of descent is approximately 1500 feet per minute.

MAXIMUM POSSIBLE GLIDE DISTANCE

Figure 3-4 Glide Distance with Dead Engine

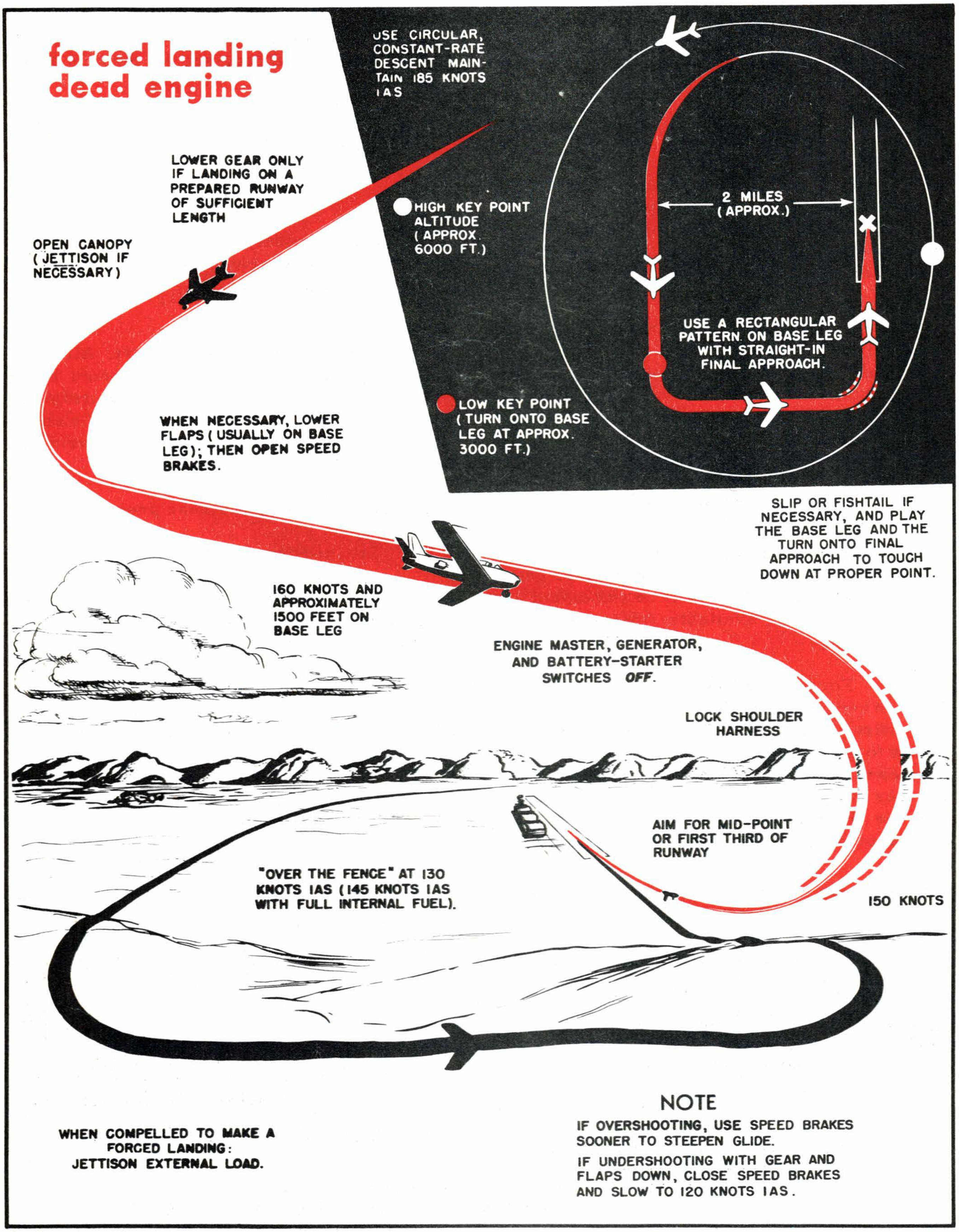


Figure 3-5 Forced Landing

(h) Lower wing flaps. Flaps collapse on impact and do not tend to make aircraft dive.

(j) Engine master, generator, and battery-starter switches OFF. (Battery-starter switch last so that power will be available to close fuel shut-off valve when engine master switch is turned OFF).

(k) Shoulder harness locked.

(i) Unless wind is high or sea is rough, plan approach heading parallel to any uniform swell pattern and try to touch down along wave crest or just after crest passes. If wind is as high as 25 knots or surface is irregular, the best procedure is to approach into the wind and touch down on the falling side of a wave.

(m) Make normal approach and flare out to normal landing attitude, being careful to keep the nose high.

WARNING

If aircraft is ditched in a near-level attitude, it will dive violently shortly after contact.

PART 4

OPERATING DATA

FLIGHT RESTRICTIONS

General

1 The following tabulation summarizes the aircraft load factor limits and restrictions for various configurations and manoeuvres. The aircraft has been demonstrated within these boundaries, but not beyond. Do not exceed.

		LOAD FACTOR LIMITS				
		Symmetrical		Rolling Pull out		
Configuration	Speed Limits	Max.	Min.	Max.	Min.	Miscellaneous
Clean	600 KTS IAS or airspeed where wing roll is excessive	7.0 G at 15000' or below. 6.0 G over 15000'	-3.0 G	4.5 G at 15000' or below. 4.0 G over 15000'	-1.0 G	
Rockets	Max. obtainable, except avoid buffet regions	6.0 G	-2.0 G	4.0 G	-1.0 G	No continuous rolls (A continous roll is defined as one exceeding 360 degrees)
100 Imperial (120 U.S.) gallon drop tanks (Aircraft 19102 to 19452 inclusive)	Above 15000' Max. obtainable, unless excessive wing heaviness is encountered. At 15000' and below. Mach .90 or 555 KTS whichever is less. Do not exceed buffet initiation speed.	6.0 G	-2.0 G	4.0 G	-1.0 G	

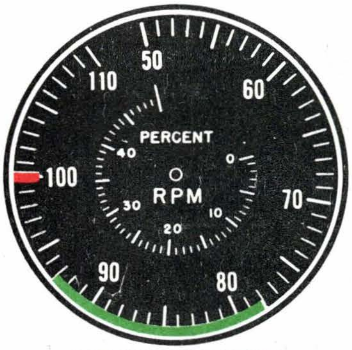
Figure 4-1 (Sheet 1 of 5) Load Factor Limits Chart

		LOAD FACTOR LIMITS				
		Symmetrical		Rolling Pull out		
Configuration	Speed Limits	Max.	Min.	Max.	Min.	Miscellaneous
167 Imperial (200 U.S.) gallon drop tanks (Aircraft 19453 and subsequent)	Above 15000' Max. obtainable, unless excessive wing heaviness is encountered. 15000' and below. Mach .95 or 555 KTS. whichever is less. Do not exceed buffet initiation speed.	5.0 G	-2.0 G	3.33 G	-1.0 G	No continuous rolls
Bomb 100 or 1000 lb.	Any Alt. Mach .85 Do not exceed buffet initiation speed.	6.0 G	-2.0 G	4.0 G	-1.0 G	No continuous rolls
Bomb 500 lb.	Any Alt. Mach .70 Do not exceed buffet initiation speed.	6.0 G	-2.0 G	4.0 G	-1.0 G	No continuous rolls
Bomb 500 lb. with T-127 fins installed	Above 25000' Mach .90 Below 25000' .85 Mach or 500 KTS. IAS whichever is less.	6.0 G	-2.0 G	4.0 G	-1.0 G	No continuous rolls
Bomb 250 lb GP	Above 15000' Max. obtainable, unless excessive wing heaviness is encountered. 15000' and below. Mach .90 or 555 KTS whichever is less. Do not exceed buffet initiation speed.	6.0 G	-2.0 G	4.0 G	-1.0 G	

CAUTION

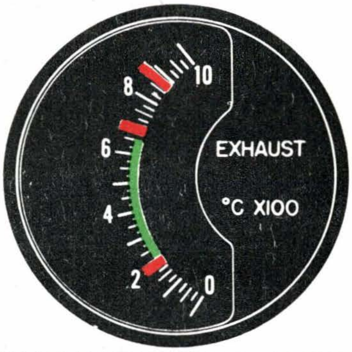
In turbulent air, manoeuvres over 2 G applied are not recommended.

Figure 4-1 (Sheet 2 of 5) Load Factor Limits Chart



TACHOMETER

🟩	78% rpm	Minimum Cruise
🟩	78% - 93% rpm	Continuous
🟩	93% rpm	Max Continuous (Operation Above This Point Limited)
🟥	100% rpm	Take-off and Military Power (30 Minutes Max)



EXHAUST TEMPERATURE

🟥	200°C	Minimum
🟩	200°C to 655°C	Continuous
🟥	690°C	Maximum (Take-off and Military Power–30 Min Max)
🟥	870°C*	Max During Starting and Acceleration Only

*Refer to warning on hot starts in starting procedure, part II.

OIL PRESSURE

🟥	2 psi	Minimum
🟩	2 - 50 psi	Continuous
🟥	50 psi	Maximum

Above 70% rpm, minimum oil pressure limit is 5 psi.

BASED ON ANY FUEL NOTED IN FLIGHT OPERATIONAL INSTRUCTION CHARTS

FUEL PRESSURE

🟥	40 psi	Minimum
🟩	40-400 psi	Continuous
🟥	600 psi	Maximum

HYDRAULIC PRESSURE

		UTILITY HYDRAULIC SYSTEM	FLIGHT CONTROL NORMAL HYDRAULIC SYSTEM	FLIGHT CONTROL ALTERNATE HYDRAULIC SYSTEM
🟨	650-2700 psi	Malfunction within system–unit operation sluggish.		Normal only if system is engaged and controls are operating.
🟩	2700-3000 psi	Normal		Normal when controls are not in use.
🟥	3400 psi	Maximum		

Figure 4-1 (Sheet 3 of 5) Load Factor Limits Chart

MANOEUVRES PROHIBITED

(a) Opening canopy above 215 knots.

(b) Lowering landing lights above final approach speed.

(c) Raising or lowering landing gear or flaps above 185 knots.

(d) Spins with bombs, rockets or 167 Imperial (200 U.S.) gallon drop tanks installed.

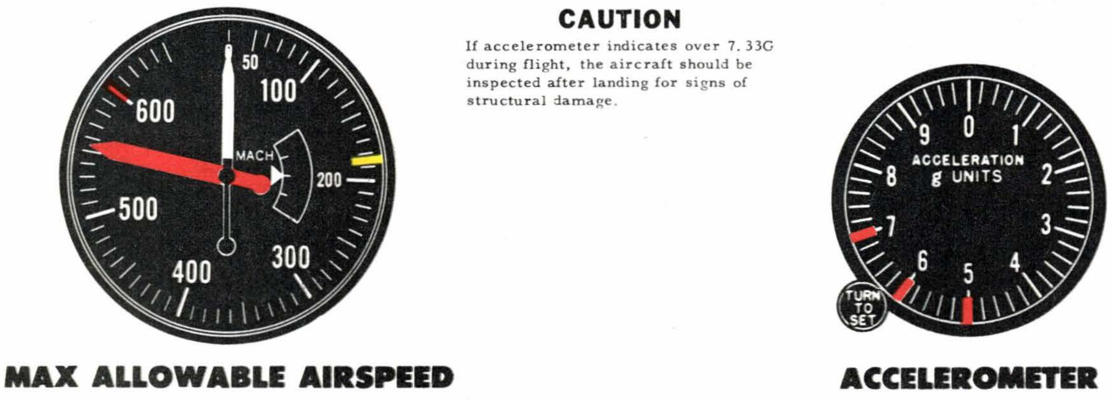
(e) All aerobatics when bombs or rockets are installed.

(f) Inverted flying or any manoeuvre resulting in negative acceleration must be limited to 10 seconds duration.

(g) Continuous rolls when rockets, 500 pound or 1,000 pound general purpose bombs, or 167 Imperial (200 U.S.) gallon drop tanks are carried.

(h) Refer to EO 05-1-1, Pilots Operating Instructions - General, Part 1, Chapter 1, for standard prohibited manoeuvres.

Figure 4-1 (Sheet 4 of 5) Load Factor Limits Chart



CAUTION

If accelerometer indicates over 7.33G during flight, the aircraft should be inspected after landing for signs of structural damage.

Figure 4-1 (Sheet 5 of 5) Load Factor Limits Chart

WEIGHT AND BALANCE DATA

General

NOTE

Refer to Weight and Balance Data, EO 05-5C-8, for loading information.

2 Proceed as follows:

(a) Check take-off and anticipated landing gross weight and balance.

(b) Make sure weight and balance clearance is satisfactory. If no guns or ammunition are installed be sure proper ballast is installed.

(c) Make sure total weight of fuel, oil, armament, oxygen and special equipment carried is suited to the mission to be performed.

AIRSPEED CORRECTION TABLES

General

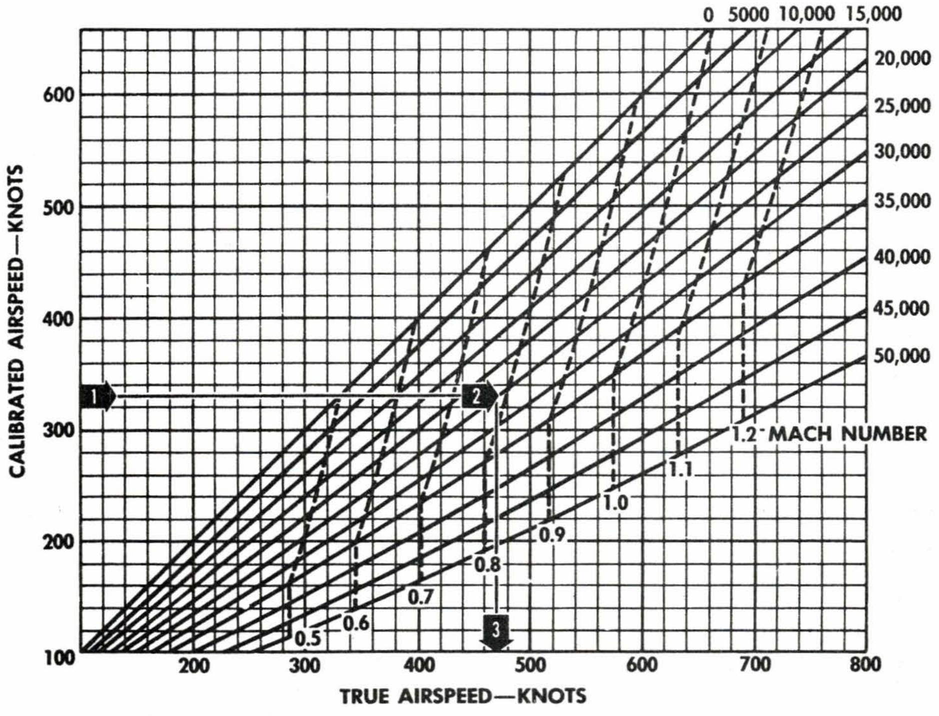
3 Airspeed installation error is very minor and may be considered negligible with aircraft in any configuration, therefore calibrated airspeed (CAS) is considered equal to indicated airspeed (IAS). A Compressibility Correction Table (see figure 4-2) is provided for computing equivalent airspeed (EAS) from calibrated airspeed (CAS). An Airspeed Conversion Graph (see figure 4-3) is also included to assist the pilot in obtaining the approximate true airspeed (TAS).

COMPRESSIBILITY CORRECTION TABLE

SUBTRACT CORRECTION FROM CALIBRATED AIRSPEED TO OBTAIN TRUE INDICATED AIRSPEED

PRESSURE ALTITUDE	CAS — KNOTS									
	150	200	250	300	350	400	450	500	550	600
5,000	0	0	1	2	2	3	5	6	8	10
10,000	0	1	2	3	5	7	10	13	17	21
15,000	1	2	3	5	8	12	16	21	27	
20,000	1	3	5	8	12	17	23	31		
25,000	2	4	7	11	17	24	32			
30,000	2	5	9	15	23	32				
35,000	3	7	12	20	29					
40,000	4	9	16	25						

Figure 4-2 Compressibility Correction Table



TO USE CHART:

Enter with CAS **1**, move horizontally to altitude **2** to find Mach No.

To find TAS, drop to vertical index scale of graph **3**.

TAS values from the graph are correct only on an NACA standard day. Otherwise TAS values will tend to be conservative when true free air temperature is higher than standard, and optimistic when true free air temperature is lower than standard.

EXAMPLE:

On an NACA standard day, 330 knots CAS at 25,000 feet is .82 Mach No. and 470 knots TAS.

Figure 4-3 Airspeed Conversion Graph for NACA Standard Day

WADC
Form 241G
(11 Jun 51)

TAKE-OFF DISTANCES

(FEET)

HARD-SURFACE RUNWAY

MODEL: F-86E

ENGINE (S): (1) J47-GE-13

CONFIGURATION AND GROSS WEIGHT	PRESSURE ALTITUDE	-5 DEGREES CENTIGRADE				+15 DEGREES CENTIGRADE				+35 DEGREES CENTIGRADE				+55 DEGREES CENTIGRADE			
		ZERO WIND		30-KNOT WIND		ZERO WIND		30-KNOT WIND		ZERO WIND		30-KNOT WIND		ZERO WIND		30-KNOT WIND	
		GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.	GROUND RUN	TO CLEAR 50 FT OBST.
TWO 167 IMP. (200 U.S.) GAL. TANKS 17,700 POUNDS	SL	2500	3900	1450	2400	3200	4700	1850	2950	4200	5900	2550	3800	6600	7700	3500	5100
	1000	2750	4200	1600	2600	3500	5100	2050	3200	4600	6400	2850	4200	6100	8400	3900	5700
	2000	3000	4500	1750	2800	3800	5500	2300	3600	5000	7000	3200	4600	6700	9300	4300	6300
	3000	3300	4800	1950	3000	4200	5900	2550	3900	5500	7600	3500	5100	7300	10,200	4700	7100
	4000	3600	5100	2150	3300	4600	6400	2850	4200	6000	8300	3800	5600	8000	11,400	5200	8000
	5000	3900	5600	2400	3700	5000	7000	3200	4600	6600	9100	4200	6200	8800	12,700	5800	8900
16 ROCKETS 16,900 POUNDS	SL	2300	3600	1300	2200	2850	4300	1650	2650	3800	5400	2250	3500	5000	6900	3100	4500
	1000	2500	3800	1450	2400	3200	4600	1850	2900	4200	5900	2500	3800	5400	7500	3400	5000
	2000	2700	4100	1550	2550	3500	5000	2100	3200	4600	6400	2800	4200	5900	8200	3800	5500
	3000	2900	4400	1700	2750	3800	5400	2300	3500	5000	6900	3100	4500	6500	9000	4200	6000
	4000	3200	4700	1900	3000	4200	5900	2550	3800	5500	7500	3500	5000	7100	9900	4600	6700
	5000	3500	5100	2150	3300	4500	6300	2800	4100	6000	8200	3900	5500	7900	11,200	5200	7700
TWO 100 IMP. (120 U.S.) GAL. TANKS 16,400 POUNDS	SL	2150	3400	1200	2100	2750	4100	1600	2550	3600	5100	2100	3300	4700	6500	2800	4200
	1000	2350	3700	1350	2250	2950	4400	1700	2700	3900	5600	2450	3600	5100	7100	3300	4700
	2000	2550	3900	1450	2400	3200	4700	1900	2950	4300	6000	2600	3900	5600	7700	3500	5200
	3000	2750	4200	1600	2600	3500	5100	2100	3200	4700	6500	2900	4200	6100	8500	3900	5600
	4000	3000	4500	1750	2800	3900	5500	2450	3600	5100	7100	3200	4600	6800	9300	4400	6300
	5000	3300	4800	1900	3000	4300	6000	2650	3900	5700	7700	3400	5000	7500	10,300	4800	7000
CLEAN 14,600 POUNDS	SL	1650	2750	900	1650	2100	3300	1150	2000	2650	4000	1500	2450	3500	5000	2100	3200
	1000	1800	2950	1000	1800	2250	3500	1300	2150	2900	4300	1700	2650	3800	5400	2250	3400
	2000	1950	3100	1100	1950	2450	3800	1400	2300	3300	4700	1900	3000	4200	5900	2450	3700
	3000	2100	3400	1200	2050	2650	4000	1500	2450	3500	5000	2050	3200	4600	6400	2700	4100
	4000	2300	3600	1300	2200	2850	4300	1700	2700	3800	5400	2300	3500	5000	6900	3000	4500
	5000	2600	4000	1400	2350	3200	4700	2000	2950	4200	5900	2550	3800	5500	7600	3400	5000

REMARKS: Take-off distances are aircraft requirements under normal service conditions.

1. Take-off with full flaps and 100%rpm.
2. Chart values based on normal take-off technique.
3. Red data is estimated only.

DATA AS OF 3-25-52
BASED ON FLIGHT TEST AND ESTIMATED DATA

172-93-1207 B

FUEL GRADE:
FUEL DENSITY: BASED ON ANY FUEL

Figure 4-4 Take-off Distances

NOTE

Indicated airspeed (IAS) is the airspeed indicator reading. Calibrated airspeed (CAS) is indicated airspeed (IAS) corrected for installation error. Equivalent airspeed (EAS) is calibrated airspeed (CAS) corrected for compressibility error. True airspeed (TAS) is equivalent airspeed corrected for atmospheric density.

Sample Problem

4 For purposes of explaining the use of the Compressibility Correction Table, consider an aircraft flying at 20,000 feet with a true free air temperature of -29°C, and an airspeed indicator reading of 393 knots. The value of 393 knots is also the calibrated airspeed (CAS) as installation error is negligible in any configuration. Use CAS and true free air temperature with a type D-4 or Type G-1 airspeed computer to determine true airspeed (TAS) of 512 knots. When using the dead-reckoning computer (Type AN5835-1), the CAS (393 knots) must be corrected for compressibility. The Compressibility Correction Table shows that 17 knots must be subtracted from CAS (393 knots) to obtain equivalent airspeed (376 knots). Use the dead-reckoning computer and the value of 376 knots and -29°C to determine the true airspeed of 512 knots.

FLIGHT PLANNING

General

5 A series of charts on the following pages presents performance of the aircraft. Fuel quantities are given in pounds so that the charts can be used with 3-GP-22a, 3-GP-23a or 3-GP-25b fuel (MIL-F-5624A; MIL-F-5616; MIL-F-5572A, grade 100/130). Conversion factors for the three fuels are given at the bottom of each chart. All charts except the Take-off and Landing Distance Charts are based on operation in NACA standard atmosphere; however, Flight Operation Instruction Charts are applicable in non-standard atmosphere if the recommended CAS values are maintained. Range marking is shown in figure 4-1.

Take-off Chart

6 Ground run distances, for obstruction-free take-off and to clear a 50 ft. obstacle, are tabulated in figure 4-4. Distances are given for zero wind, a 30 knot wind, various ground temperatures and a dry, hard surface runway. The charted distances contain estimated and flight-tested data.

Climb Chart

7 From the Climb Chart (see figure 4-5) and the Military Power Climb Chart (see figure 4-6) can be determined the best climb speed, fuel consumed, time to climb, distance covered, and rate of climb for either maximum continuous thrust or military thrust. A fuel allowance for warm-up and take-off is listed at sea level. Fuel requirements at other altitudes include this allowance plus the fuel needed to climb from sea level. Fuel required for an inflight climb from one altitude to another is the difference of the tabulated fuel required to climb to each altitude from sea level. Time and distance covered during an inflight climb may be obtained in the same manner. The Formation Climb Chart (see figure 4-7) should be used for formation climbs only.

Descent Chart

8 The descent chart (see figure 4-8) is based on airspeed corresponding to approximately Mach .5 for descents with speed brakes in and approximately Mach .6 to .8 with speed brakes out.

Landing Chart

9 Figure 4-9 shows landing distances, both ground run and total to clear 50-foot obstacle, for landings with speed brakes open. A percentage increase noted on the chart may be applied to estimate the additional distance required for landings with speed brakes closed. A dry hard-surface runway and no wind are the only landing conditions considered. The tabulated distances are 125 percent of the distance obtainable in high-performance landings.

Combat Allowance Chart.

10 The Combat Allowance Chart (see figure 4-10) presents fuel flow at military thrust and at maximum continuous thrust.

Maximum Endurance Chart

11 The Maximum Endurance Chart, (figure 4-11), gives the best rpm and airspeed to use in obtaining the lowest possible fuel consumption.

Maximum Range Summary Chart

12 The maximum range summary chart, figure 4-12, summarises the cruising operating procedures for zero wind condition entered on the Flight Operation Instruction Chart.

WADC
Form 241J
(11 Jun 51)

NORMAL POWER CLIMB CHART

STANDARD DAY

93% RPM

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 17,700 POUNDS

CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 14,700 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
2300	0	0	200 (5)	340	SEA LEVEL	335	200 (5)	0	0	2900
1900	15	2.5	420	325	5,000	320	370	2	10	2500
1500	30	5.5	660	305	10,000	305	550	4	20	2100
1100	50	9.0	940	285	15,000	285	750	6.5	40	1600
800	85	14.0	1280	265	20,000	270	980	10.0	60	1200
400	135	23.0	1790	245	25,000	250	1260	15.0	90	800
					30,000	230	1690	24.0	140	400
					35,000					
					40,000					
					45,000					

CONFIGURATION: 16 ROCKETS

GROSS WEIGHT: 16,900 POUNDS

CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 16,400 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
2200	0	0	200 (5)	280	SEA LEVEL	330	200 (5)	0	0	3000
1800	10	2.5	420	265	5,000	310	360	2.0	10	2600
1400	25	5.5	660	250	10,000	295	530	4.0	20	2100
1100	45	9.5	940	240	15,000	280	720	6.5	35	1600
700	75	15.0	1300	225	20,000	260	940	10.0	60	1200
300	130	26.0	1850	215	25,000	245	1220	15.0	85	800
					30,000	225	1630	24.0	140	400
					35,000					
					40,000					
					45,000					

REMARKS:

1 Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
2 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
3 Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
4 Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) 100/130 grade.
5 Warm-up and take-off allowance.
6 Multiply nautical units by 1.15 to obtain statute units.
7 Red data is estimated only (Airplanes 19453 and subsequent).

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED IN KNOTS

DATA AS OF 8-23-51
BASED ON FLIGHT TEST AND ESTIMATED DATA

172-93-1208 C

FUEL GRADE:
FUEL DENSITY: ANY FUEL LISTED IN REMARKS

Figure 4-5 (Sheet 1 of 2) Climb Chart

WADC
Form 241J
(11 Jun 51)

NORMAL POWER CLIMB CHART

STANDARD DAY

93% RPM

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: CLEAN

GROSS WEIGHT: 14,600 POUNDS

CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 14,600 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
4200	0	0	200 (5)	355	SEA LEVEL	325	200 (5)	0	0	3500
3600	5	1.5	320	340	5,000	305	340	1.5	10	3000
3100	15	3.5	440	325	10,000	295	480	3.5	20	2500
2500	30	4.5	570	310	15,000	275	630	5.5	30	2000
2000	40	7.0	700	295	20,000	260	810	8.5	50	1500
1600	60	10.0	870	280	25,000	245	1020	12.0	70	1100
1100	90	14.0	1050	265	30,000	225	1290	18.0	105	600
600	130	20.0	1290	245	35,000	210	1750	30.0	175	200
100	235	35.0	1770	225	40,000					
					45,000					

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
					SEA LEVEL					
					5,000					
					10,000					
					15,000					
					20,000					
					25,000					
					30,000					
					35,000					
					40,000					
					45,000					

REMARKS:

1 Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
2 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
3 Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
4 Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) 100/130 grade.
5 Warm-up and take-off allowance.
6 Multiply nautical units by 1.15 to obtain statute units.

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED IN KNOTS

DATA AS OF 8-23-51
BASED ON FLIGHT TEST

172-93-1567 B

FUEL GRADE:
FUEL DENSITY: ANY FUEL LISTED IN REMARKS

Figure 4-5 (Sheet 2 of 2) Climb Chart

WADC
Form 241J
(11 Jun 51)

MILITARY POWER CLIMB CHART

STANDARD DAY

100% RPM

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 17,700 POUNDS

CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 14,700 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
4200	0	0	200 (5)	400	SEA LEVEL	400	200 (5)	0	0	5200
3700	10	1.0	370	375	5,000	375	330	1.0	5	4700
3200	20	2.5	540	350	10,000	350	470	2.0	15	4100
2700	30	4.5	710	325	15,000	325	610	3.5	25	3500
2200	45	6.5	890	300	20,000	300	750	5.0	35	2900
1700	60	9.0	1080	275	25,000	280	890	7.0	45	2300
1100	85	12.5	1300	255	30,000	255	1050	9.5	65	1700
600	125	18.5	1600	235	35,000	230	1240	13.0	85	1100
					40,000	205	1670	23.5	155	200
					45,000					

CONFIGURATION: 16 ROCKETS

GROSS WEIGHT: 16,900 POUNDS

CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 16,400 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
			(5)		SEA LEVEL		(5)			
					5,000					
					10,000					
					15,000					
					20,000					
					25,000					
					30,000					
					35,000					
					40,000					
					45,000					

REMARKS:

1 Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
2 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
3 Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
4 Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) 100/130 grade.
5 Warm-up and take-off allowance.
6 Multiply nautical units by 1.15 to obtain statute units.
7 Red data is estimated only (Airplanes 19453 and subsequent).

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED IN KNOTS

DATA AS OF 12-17-51
BASED ON FLIGHT TEST **AND ESTIMATED DATA**

172-93-1209D

FUEL GRADE:
FUEL DENSITY: ANY FUEL LISTED IN REMARKS

Figure 4-6 (Sheet 1 of 2) Military Power Climb Chart

WADC
Form 241J
(11 Jun 51)

MILITARY POWER CLIMB CHART

STANDARD DAY

100% RPM

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: CLEAN

GROSS WEIGHT: 14,600 POUNDS

CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 14,600 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
7100	0	0	200 (5)	430	SEA LEVEL	400	200 (5)	0	0	5900
6200	5	1.0	300	410	5,000	375	320	1.0	5	5200
5400	10	1.5	390	390	10,000	350	430	2.0	15	4600
4700	20	2.5	490	365	15,000	330	550	3.0	20	3900
3900	30	3.5	590	340	20,000	310	670	4.5	30	3300
3200	40	5.0	690	320	25,000	290	790	6.0	40	2600
2500	50	7.0	790	295	30,000	270	920	8.5	55	1900
1800	70	9.0	910	270	35,000	250	1080	12.0	80	1200
900	100	13.0	1070	240	40,000	230	1320	18.0	120	500
					45,000					

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
					SEA LEVEL					
					5,000					
					10,000					
					15,000					
					20,000					
					25,000					
					30,000					
					35,000					
					40,000					
					45,000					

REMARKS:

1 Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
2 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
3 Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
4 Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) 100/130 grade.
5 Warm-up and take-off allowance.
6 Multiply nautical units by 1.15 to obtain statute units.

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED IN KNOTS

DATA AS OF 8-23-51
BASED ON FLIGHT TEST

172-93-1277 C

FUEL GRADE:
FUEL DENSITY: ANY FUEL LISTED IN REMARKS

Figure 4-6 (Sheet 2 of 2) Military Power Climb Chart

WADC
Form 241J
(11 Jun 51)

FORMATION POWER CLIMB CHART

STANDARD DAY

97% RPM

MODEL: F-86E

ENGINE(S): J47-GE-13

CONFIGURATION: NO EXTERNAL LOAD

GROSS WEIGHT: 14, 600 LB

CONFIGURATION: TWO 100 IMPERIAL (120 US) GAL DROP TANKS

GROSS WEIGHT: 16, 400 LB

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
5500	0	0	200 (5)	430	SEA LEVEL	375	200 (5)	0	0	4200
5000	5	1	310	405	5,000	350	340	1.5	5	3700
4400	15	2	410	380	10,000	330	480	3	15	3300
3800	25	3.5	520	360	15,000	310	620	4.5	25	2800
3300	35	4.5	620	335	20,000	290	760	6	40	2400
2800	45	6.5	720	315	25,000	270	910	9	55	1900
2200	60	8.5	830	295	30,000	250	1070	12	75	1300
1600	80	11	960	270	35,000	230	1290	17	110	700
550	115	16	1130	240	40,000					
					45,000					

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
					SEA LEVEL					
					5,000					
					10,000					
					15,000					
					20,000					
					25,000					
					30,000					
					35,000					
					40,000					
					45,000					

REMARKS

1 Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
2 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
3 Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
4 Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) fuel.
5 Warm-up and take-off allowance.
6 Multiply nautical units by 1.15 to obtain statute units.

LEGEND

RATE OF CLIMB - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED

DATA AS OF 8-23-51
BASED ON FLIGHT TEST

170-93-1170A

FUEL GRADE:
FUEL DENSITY: Based on any fuel listed in remarks.

Figure 4-7 Formation Climb Chart

WADC
Form 2410
(11 Jun 51)

DESCENT CHART

STANDARD DAY

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: WITH OR WITHOUT DROP TANKS
SPEED BRAKES CLOSED

GROSS WEIGHT: 12,000 POUNDS

CONFIGURATION: WITH OR WITHOUT DROP TANKS
SPEED BRAKES OPEN

GROSS WEIGHT: 13,000 POUNDS

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF DESCENT	TO SEA LEVEL						TO SEA LEVEL			RATE OF DESCENT
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
2,500	45	9.0	160	140	45,000	160	40	3.5	18	13,000
3,000	35	7.0	130	155	40,000	180	35	3.0	16	14,000
3,500	25	5.5	105	175	35,000	210	30	2.5	14	15,000
4,000	20	4.0	80	190	30,000	270	25	2.0	12	16,000
5,000	15	3.0	60	210	25,000	320	25	1.5	10	17,000
6,500	10	2.0	45	225	20,000	370	20	1.0	8	18,000
7,500	10	1.5	35	245	15,000	390	15	1.0	6	19,000
9,000	5	1.0	20	260	10,000	400	10	0.5	4	17,500
10,000	5	0.5	10	280	5,000	410	5	0.5	2	15,000
0	0	0	0	295	SEA LEVEL	420	0	0	0	0

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE				CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE			
RATE OF DESCENT	TO SEA LEVEL						TO SEA LEVEL			RATE OF DESCENT
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
					45,000					
					40,000					
					35,000					
					30,000					
					25,000					
					20,000					
					15,000					
					10,000					
					5,000					
					SEA LEVEL					

REMARKS:

1. Speed brakes open - maintain 40 psi fuel pressure.
2. For maximum range without power, descend at 185 knots CAS with speed brakes closed.

LEGEND

RATE OF DESCENT - FEET PER MINUTE
DISTANCE - NAUTICAL MILES
TIME - MINUTES
FUEL - POUNDS
CAS - CALIBRATED AIRSPEED

DATA AS OF
BASED ON FLIGHT TEST

172-93-1213B

Figure 4-8 Descent Chart

Maximum Continuous Power Chart

13 Airspeeds and fuel flow rates in level flight at maximum continuous power (normal rated power) are shown for different gross weights and altitudes in the Maximum Continuous Power Chart, figure 4-13.

FLIGHT OPERATION INSTRUCTION CHARTS

General

14 The Flight Operation Instruction Charts (figures 4-12 to 4-19) are provided to facilitate flight planning. They show the range of the aircraft at maximum range airspeeds, and the procedure required to obtain this range. The charts contain columns for each 5000 - foot increase in altitude up to the maximum altitude at which 93% rpm operation is possible. On line opposite available fuel in the upper half of the chart, ranges are shown for each initial altitude. In general, two range values are quoted for each altitude and fuel quantity. One is for continued flight at the initial altitude and one is for the maximum range obtainable by climbing to a higher altitude. The charted ranges do not include fuel consumed and distance covered during warm-up, take-off, and initial climb at the start of a flight. However, fuel used and distance covered during letdown or during in-flight climb to an optimum altitude are taken into account. No allowances are made for navigational errors, combat, formation flight, landing or other contingencies. Such allowances must be made as required.

15 The lower half of each chart presents operating procedure to obtain the ranges quoted in the upper half. When altitude is changed, operating instructions in the column according to the new altitude must be used if the ranges listed are to be obtained.

16 Under different wind conditions, ranges (in ground miles) are varied by the effect of wind on ground speed. Let down distances are affected for the same reason. Recommended CAS also may change in order to maintain the most favorable ground miles per pound. To facilitate range computation under wind conditions, the operating procedure in the lower half of each chart contains instructions for various winds at each altitude listed. Ground miles in a wind are obtained by multiplying chart air miles by the range factor found opposite the effective wind at the cruising

WADC
Form 241Q
(11 Jun 51)

LANDING DISTANCES
(FEET)
STANDARD DAY
ZERO WIND

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

GROSS WEIGHT (LB)	BEST CAS FOR FINAL APPROACH		HARD-SURFACE—NO WIND							
	POWER ON	POWER OFF	AT SEA LEVEL		AT 2000 FT		AT 4000 FT		AT 6000 FT	
	(KNOTS)	(KNOTS)	GROUND ROLL	TO CLEAR 50 FT OBST.	GROUND ROLL	TO CLEAR 50 FT OBST.	GROUND ROLL	TO CLEAR 50 FT OBST.	GROUND ROLL	TO CLEAR 50 FT OBST.
18000	150	150	2900	4600	3000	4900	3200	5100	3400	5300
16000	145	145	2600	4300	2700	4500	2900	4700	3100	4900
14000	135	135	2200	3900	2400	4000	2500	4200	2700	4400
12000	125	125	1900	3500	2000	3600	2200	3800	2300	4000

LEGEND
CAS – CALIBRATED AIRSPEED
OBST – OBSTACLE

1. Landing distances are aircraft requirements under normal service condition.
2. If speed brakes are closed, increase distance 20 per cent.
3. Decrease speeds 15 knots at 50 ft. obstacle.

NOTE
FOR AIRCRAFT WITH EXTENDED LEADING EDGE, ADD 10 KNOTS TO ABOVE APPROACH SPEEDS.

DATA AS OF 8-23-51
BASED ON FLIGHT TEST

172-93-1214 B

Figure 4-9 Landing Distance Chart

altitude. Thus, range factors may be used to determine the best altitude for cruising when there is a known wind difference at different altitudes.

17 Although a wind may be from any direction with respect to the aircraft course, it may be expressed as an effective wind. An effective wind has the same effect on the aircraft ground speed as if it were a straight head wind or tail wind, in other words the wind component in the direction of the aircraft heading is the effective wind. For example, a 100-knot wind at 30 degrees to the course is an effective head wind of approximately 85 knots. If the aircraft true airspeed is 485 knots the true ground speed is approximately 400 knots.

18 The approximate rpm values quoted on any one chart are based on the gross weight equal to the high limit of the chart weight band. If the recommended CAS values are maintained, the rpm values will decrease slightly as the gross weight decreases.

Pre-flight Range Planning

19 Select the applicable Flight Operation Instruction Chart. Determine the amount of fuel available for flight planning. Available fuel is equal to the total amount in the aircraft before starting the engine, minus the amount needed for warm-up, taxi, take-off, initial climb, and necessary reserves. Select a figure in the fuel column equal to, or less than, the amount available for flight planning. Interpolate if necessary.

COMBAT ALLOWANCE CHART

STANDARD DAY

MODEL: F-86E ENGINE(S): J47-GE-13

PRESSURE ALTITUDE (FEET)	FUEL REQUIRED (LB PER MINUTE)	
	MILITARY POWER 100% RPM (30 MIN LIMIT)	MAXIMUM CONTINUOUS POWER 93% RPM
SEA LEVEL	140	95
5,000	125	85
10,000	105	80
15,000	90	70
20,000	80	60
25,000	65	50
30,000	55	45
35,000	45	40
40,000	35	30
45,000	30	25
50,000		

REMARKS:
1 DIVIDE PM BY 8.15 TO OBTAIN GPM OF 3GP23 (JP-1) FUEL.
2 DIVIDE PM BY 7.8 TO OBTAIN GPM OF 3GP22 (JP-3) FUEL.
3 DIVIDE PM BY 7.2 TO OBTAIN GPM OF 3GP25 GASOLINE.
4 MILITARY POWER EXHAUST TEMP. LIMIT 690° C.
5 MAX. CONTINUOUS POWER EXHAUST TEMP. LIMIT 655° C.

DATA AS OF 8-21-51 BASED ON FLIGHT TEST.

Figure 4-10 Combat Allowance Chart

20 To determine maximum range at a given altitude, move horizontally right or left to the desired altitude column. Multiply the range value thus obtained by the correct range factor and add the distance covered in initial climb to obtain total range with a given wind at altitude. Fly according to the instructions in the lower half of the chart.

21 To fly a given distance, determine range factors for the effective winds and altitudes to be considered. From the desired distance subtract the miles covered in climb. Divide the resultant figure by the range factor to obtain miles to be covered in cruise and descent. Enter the chart as described in Paragraph 19, preceding. Move horizontally right or left to a range figure which exceeds the calculated air distance to be covered in cruise and descent. Fly according to the instructions for the altitude so obtained.

22 If altitude, wind or external load does not remain reasonably constant, break the flight up into several sections and plan each section separately.

In-flight Range Planning

23 To use the charts in flight, determine altitude, available fuel and effective wind. Available fuel is equal to total fuel less necessary reserves.

24 Enter the appropriate Flight Operation Instruction Chart at a fuel quantity equal to or less than the available fuel. Move horizontally right or left to the applicable altitude column.

25 From the ranges and wind factors listed, determine the altitude at which the flight will be continued. For continued cruising at the present altitude, refer to the instructions directly below. When changing charts, refer to cruising instructions on the new chart at the altitude of flight.

26 To obtain the range shown at optimum altitude when flying at a given altitude, climb immediately according to the recommended climb procedure. For cruising instructions at the new altitude, refer to the lower half of the

WADC
Form 241R
(11 Jun 51)

MAXIMUM ENDURANCE CHART

STANDARD DAY

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS GROSS WEIGHT: 17,700 POUNDS				CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS GROSS WEIGHT: 14,700 POUNDS		
APPROXIMATE		CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE	
LB/HR	% RPM	(KNOTS)	(FEET)	(KNOTS)	% RPM	LB/HR
2050	74	220	SEA LEVEL	200	70	1800
1950	76	220	5,000	200	72	1650
1900	79	220	10,000	200	75	1600
1900	81	220	15,000	200	78	1550
1950	83	225	20,000	200	80	1550
1950	86	225	25,000	205	83	1550
2000	89	235	30,000	205	85	1600
			35,000	210	88	1650
			40,000			
			45,000			
			50,000			

CONFIGURATION: 16 ROCKETS GROSS WEIGHT: 16,900 POUNDS				CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS GROSS WEIGHT: 16,400 POUNDS		
APPROXIMATE		CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE	
LB/HR	% RPM	(KNOTS)	(FEET)	(KNOTS)	% RPM	LB/HR
1950	73	185	SEA LEVEL	195	70	1850
1950	75	185	5,000	195	73	1750
1950	77	185	10,000	195	75	1700
1950	81	185	15,000	195	78	1650
2000	83	185	20,000	195	80	1650
2050	86	185	25,000	195	83	1650
2200	90	185	30,000	195	85	1700
			35,000	195	89	1800
			40,000			
			45,000			
			50,000			

REMARKS:

1 Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
2 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
3 Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
4 Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) fuel.
5 Red data is estimated only (Airplanes 19453 and subsequent).

LEGEND

CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION

DATA AS OF 8-23-51
BASED ON FLIGHT TEST AND ESTIMATED DATA

172-93-1211 C

FUEL GRADE:
FUEL DENSITY: ANY FUEL LISTED IN REMARKS

Figure 4-11 (Sheet 1 of 2) Maximum Endurance Chart

WADC
Form 241R
(11 Jun 51)

MAXIMUM ENDURANCE CHART

STANDARD DAY

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: CLEAN	CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS
GROSS WEIGHT: 14,600 POUNDS	GROSS WEIGHT: 14,600 POUNDS

APPROXIMATE		CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE	
LB/HR	% RPM				% RPM	LB/HR
1750	67	195	SEA LEVEL	195	67	1750
1600	69	195	5,000	195	69	1600
1450	71	195	10,000	195	71	1450
1400	74	195	15,000	195	74	1400
1350	76	195	20,000	195	76	1350
1300	78	195	25,000	195	78	1300
1300	81	195	30,000	195	81	1300
1300	83	195	35,000	195	83	1300
1400	88	195	40,000	195	88	1400
1350	91	190	45,000			
			50,000			

CONFIGURATION:	CONFIGURATION:
GROSS WEIGHT:	GROSS WEIGHT:

APPROXIMATE		CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	APPROXIMATE	
LB/HR	% RPM				% RPM	LB/HR
			SEA LEVEL			
			5,000			
			10,000			
			15,000			
			20,000			
			25,000			
			30,000			
			35,000			
			40,000			
			45,000			
			50,000			

REMARKS:

1 Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
2 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
3 Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
4 Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) fuel.

LEGEND

CAS – CALIBRATED AIRSPEED IN KNOTS
LB HR – FUEL CONSUMPTION

DATA AS OF 8-23-51
BASED ON FLIGHT TEST

172-93-1569 B

FUEL GRADE:
FUEL DENSITY: ANY FUEL LISTED IN REMARKS

Figure 4-11 (Sheet 2 of 2) Maximum Endurance Chart

WADC
Form 241S
(11 Jun 51)

MAXIMUM RANGE SUMMARY CHART

STANDARD DAY

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 17,700 POUNDS

CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 14,700 POUNDS

APPROXIMATE		MACH NO.	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MACH NO.	APPROXIMATE	
% RPM	MI/LB						MI/LB	% RPM
78	.105	.42	280	SEA LEVEL	275	.41	.111	77
81	.116	.47	285	5,000	265	.44	.125	78
83	.129	.51	285	10,000	260	.48	.141	80
85	.141	.57	285	15,000	260	.52	.156	82
87	.154	.62	280	20,000	260	.56	.172	83
88	.167	.66	275	25,000	250	.61	.188	85
91	.176	.72	270	30,000	250	.67	.202	87
				35,000	240	.72	.214	90
				40,000				
				45,000				
				50,000				

CONFIGURATION: 16 ROCKETS

GROSS WEIGHT: 16,900 POUNDS

CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 16,400 POUNDS

APPROXIMATE		MACH NO.	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MACH NO.	APPROXIMATE	
% RPM	MI/LB						MI/LB	% RPM
78	.099	.39	255	SEA LEVEL	290	.44	.114	77
80	.109	.41	250	5,000	280	.46	.129	78
82	.119	.45	250	10,000	275	.50	.145	80
84	.128	.50	250	15,000	270	.54	.160	82
86	.136	.54	245	20,000	265	.58	.175	83
90	.143	.59	245	25,000	265	.64	.191	86
92	.148	.63	235	30,000	260	.69	.203	88
				35,000	255	.76	.213	91
				40,000				
				45,000				
				50,000				

REMARKS:

1. Red data is estimated (Airplanes 19453 and subsequent) only.

LEGEND

CAS – CALIBRATED AIRSPEED

MI/LB – NAUTICAL MILES PER POUND OF FUEL CONSUMED

DATA AS OF 8-23-51

BASED ON FLIGHT TEST AND ESTIMATED DATA

172-93-1210 B

Figure 4-12 (Sheet 1 of 2) Maximum Range Summary Chart

WADC
Form 241S
(11 Jun 51)

MAXIMUM RANGE SUMMARY CHART

STANDARD DAY

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: CLEAN

GROSS WEIGHT: 14,600 POUNDS

CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 14,600 POUNDS

APPROXIMATE		MACH NO.	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MACH NO.	APPROXIMATE	
% RPM	MI/LB						MI/LB	% RPM
77	.125	.49	325	SEA LEVEL	280	.42	.117	76
77	.145	.50	305	5,000	275	.45	.133	77
78	.166	.53	295	10,000	265	.48	.151	79
80	.190	.57	290	15,000	265	.52	.168	80
81	.215	.62	285	20,000	255	.56	.186	83
82	.242	.66	275	25,000	255	.61	.205	84
84	.266	.72	270	30,000	250	.67	.220	86
86	.287	.78	265	35,000	245	.73	.233	88
91	.302	.82	250	40,000	220	.74	.248	93
93	.329	.84	225	45,000				
				50,000				

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE		MACH NO.	CAS (KNOTS)	PRESSURE ALTITUDE (FEET)	CAS (KNOTS)	MACH NO.	APPROXIMATE	
% RPM	MI/LB						MI/LB	% RPM
				SEA LEVEL				
				5,000				
				10,000				
				15,000				
				20,000				
				25,000				
				30,000				
				35,000				
				40,000				
				45,000				
				50,000				

REMARKS:

LEGEND
CAS – CALIBRATED AIRSPEED
MI LB – NAUTICAL MILES PER POUND OF FUEL CONSUMED

DATA AS OF 8-23-51
BASED ON FLIGHT TEST

172-93-1568

Figure 4-12 (Sheet 2 of 2) Maximum Range Summary Chart

WADC
Form 241T
(11 Jun 51)

MAXIMUM CONTINUOUS POWER CHART

STANDARD DAY

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 17,700 POUNDS

CONFIGURATION: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 14,700 POUNDS

APPROXIMATE			% RPM	PRESSURE ALTITUDE (FEET)	% RPM	APPROXIMATE		
LB/HR	TAS (KNOTS)	CAS (KNOTS)				CAS (KNOTS)	TAS (KNOTS)	LB/HR
5400	445	445	93	SEA LEVEL	93	445	445	5450
4850	450	425	93	5,000	93	425	455	4900
4350	460	400	93	10,000	93	405	460	4350
3850	460	375	93	15,000	93	380	465	3850
3350	460	350	93	20,000	93	355	465	3350
2900	455	320	93	25,000	93	325	465	2900
2450	445	285	93	30,000	93	295	460	2450
				35,000	93	260	445	2050
				40,000				
				45,000				
				50,000				

CONFIGURATION: 16 ROCKETS

GROSS WEIGHT: 16,900 POUNDS

CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 16,400 POUNDS

APPROXIMATE			% RPM	PRESSURE ALTITUDE (FEET)	% RPM	APPROXIMATE		
LB/HR	TAS (KNOTS)	CAS (KNOTS)				CAS (KNOTS)	TAS (KNOTS)	LB/HR
				SEA LEVEL				
				5,000				
				10,000				
				15,000				
				20,000				
				25,000				
				30,000				
				35,000				
				40,000				
				45,000				
				50,000				

REMARKS:

1 Maximum exhaust temperature 655° C.
2 Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
3 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
4 Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
5 Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) fuel.
6 Red data is estimated only (Airplanes 19453 and subsequent).

LEGEND

LB/HR - FUEL CONSUMPTION
TAS - TRUE AIRSPEED IN KNOTS
CAS - CALIBRATED AIRSPEED IN KNOTS

DATA AS OF 8-23-51
BASED ON FLIGHT TEST AND ESTIMATED DATA

172-93-1212A

FUEL GRADE:
FUEL DENSITY: ANY FUEL LISTED IN REMARKS

Figure 4-13 (Sheet 1 of 2) Maximum Continuous Power Chart

WADC
Form 241T
(11 Jun 51)

MAXIMUM CONTINUOUS POWER CHART

STANDARD DAY

MODEL: F-86E

ENGINE(S): (1) J47-GE-13

CONFIGURATION: CLEAN

GROSS WEIGHT: 14,600 POUNDS

CONFIGURATION: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS

GROSS WEIGHT: 14,600 POUNDS

APPROXIMATE			% RPM	PRESSURE ALTITUDE (FEET)	% RPM	APPROXIMATE		
LB/HR	TAS (KNOTS)	CAS (KNOTS)				CAS (KNOTS)	TAS (KNOTS)	LB/HR
5750	520	520	93	SEA LEVEL	93	465	465	5700
5150	530	500	93	5,000	93	445	475	5100
4650	535	470	93	10,000	93	420	480	4550
4100	535	440	93	15,000	93	395	485	4050
3500	525	400	93	20,000	93	370	490	3600
3050	520	370	93	25,000	93	340	485	3200
2550	510	335	93	30,000	93	305	470	2600
2300	500	300	93	35,000	93	270	460	2200
1700	490	260	93	40,000	93	220	425	1700
1450	480	225	93	45,000				
				50,000				

CONFIGURATION:

GROSS WEIGHT:

CONFIGURATION:

GROSS WEIGHT:

APPROXIMATE			% RPM	PRESSURE ALTITUDE (FEET)	% RPM	APPROXIMATE		
LB/HR	TAS (KNOTS)	CAS (KNOTS)				CAS (KNOTS)	TAS (KNOTS)	LB/HR
				SEA LEVEL				
				5,000				
				10,000				
				15,000				
				20,000				
				25,000				
				30,000				
				35,000				
				40,000				
				45,000				
				50,000				

REMARKS:

1 Maximum exhaust temperature 655° C.
2 Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
3 Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
4 Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
5 Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) fuel.

LEGEND

LB/HR - FUEL CONSUMPTION
TAS - TRUE AIRSPEED IN KNOTS
CAS - CALIBRATED AIRSPEED IN KNOTS

DATA AS OF 8-23-51
BASED ON FLIGHT TEST

172-93-1570

FUEL GRADE:
FUEL DENSITY: ANY FUEL LISTED IN REMARKS

Figure 4-13 (Sheet 2 of 2) Maximum Continuous Power Chart

WADC Form 241M (11 Jun 51)	MODEL F-86E	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEM NONE
ENGINE(S):	J47-GE-13	CHART WEIGHT LIMITS: 14,600 OR LESS POUNDS	NUMBER OF ENGINES OPERATING: ONE

LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(C)	OIL PRESS. (PSI)		FUEL PRESS (PSI)
MILITARY	30	100	690	50		600
NORMAL	NONE	93	655	50		400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF 8-23-51

BASED ON FLIGHT TEST

LOW-ALTITUDE CHART

172-93-1222

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
				(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)												
(370)	45	(770)	3000	(440)	45	(810)	(500)	45	(810)	(570)	45	(840)	3000	(650)	45	(860)
310	45	600	2500	360	45	640	420	45	640	480	45	670	2500	540	45	700
250	40	440	2000	290	45	480	330	40	480	380	40	500	2000	430	45	530
190	30	290	1500	220	35	310	250	35	330	290	35	350	1500	320	40	380
120	25	160	1000	150	25	180	170	30	200	190	30	220	1000	220	30	230
60	5	70	500	80			80	15	90	100			500	110		

CRUISING AT SEA LEVEL						EFFEC-TIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
						120 H.W.												
						80 H.W.							335	81	2400	305	.75	5
350	79	2850	310	.85	0	40 H.W.	325	79	2450	310	.85	0	315	80	2200	320	.85	5
325	77	2600	325	1.00	0	0	305	77	2250	325	1.00	0	295	78	2050	340	1.00	5
300	75	2400	340	1.15	0	40 T.W.	290	76	2150	350	1.15	0	280	77	1950	365	1.15	5
						80 T.W.							265	76	1800	385	1.25	5
						120 T.W.												

CRUISING AT 15,000 FT						EFFEC-TIVE WIND	CRUISING AT 20,000 FT					
	APPROXIMATE							APPROXIMATE				
CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST
						120 H.W.	325	84	2100	310	.70	5
315	82	2100	310	.75	10	80 H.W.	315	83	2000	340	.80	10
300	81	2000	330	.90	10	40 H.W.	300	82	1900	360	.90	10
290	80	1900	360	1.00	10	0	285	81	1750	380	1.00	10
275	79	1800	380	1.10	10	40 T.W.	275	80	1700	410	1.10	10
265	78	1700	410	1.25	10	80 T.W.	265	80	1650	435	1.25	10
						120 T.W.	260	79	1600	470	1.35	15

Figure 4-14 (Sheet 1 of 2) Flight Operation Instruction Chart - 14,600 Pounds or Less

HIGH-ALTITUDE CHART

MODEL: F-86E **ENG:** J47-GE-13 **CHART WT LIMITS:** 14,600 OR LESS LB **EXT LOAD:** NONE **NO. OF ENGINES OPERATING:** ONE

IF YOU ARE AT 25,000 FT			FUEL (POUNDS)	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL (POUNDS)	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
				(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)												
(730)	45	(880)	3000	(800)	45	(900)	(860)	45	(920)	(900)	45	(950)	3000	(980)		
610	45	720	2500	(660)	45	(740)	(710)	45	(760)	(750)	45	(780)	2500	(820)		
480	45	550	2000	530	45	570	570	45	600	600	45	620	2000	(650)		
360	40	400	1500	400	40	410	420	40	430	450			1500	480		
240	30	250	1000	270			280			300			1000	320		
120			500	130			140			150			500	150		

CRUISING AT 25,000 FT						EFFECTIVE WIND (KNOTS)	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFECTIVE WIND (KNOTS)	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE																	
CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
310	85	1950	325	.70	10	120 H.W.	295	86	1800	340	.70	15	275	87	1650	345	.70	20	255	91	1600	360	.75	25	120 H.W.	225	93	1450	360	.75	35
295	84	1800	345	.80	10	80 H.W.	285	85	1700	365	.80	15	270	86	1600	380	.80	20	255	91	1600	400	.80	30	80 H.W.	225	93	1450	400	.85	40
285	83	1700	370	.90	15	40 H.W.	275	84	1650	390	.90	20	270	86	1600	420	.90	20	250	91	1550	435	.90	30	40 H.W.	225	93	1450	440	.90	40
275	82	1650	400	1.00	15	0	270	84	1600	425	1.00	20	265	85	1600	450	1.00	25	250	91	1550	475	1.00	35	0	225	93	1450	480	1.00	45
270	82	1600	430	1.10	15	40 T.W.	260	83	1500	450	1.10	20	260	85	1550	485	1.10	30	250	91	1550	515	1.10	40	40 T. W.	225	93	1450	520	1.10	50
265	82	1600	465	1.20	20	80 T.W.	255	83	1500	480	1.20	25	260	85	1550	525	1.20	30	250	91	1550	555	1.15	40	80 T. W.	225	93	1450	560	1.15	50
260	81	1550	495	1.30	20	120 T.W.	250	82	1450	515	1.30	25	255	85	1500	555	1.30	30	245	90	1500	585	1.25	45	120 T. W.	225	93	1450	600	1.25	55

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are nautical units.
3 Multiply all nautical units by 1.15 to obtain statute units.

(4) Divide lb/hr by 8.15 to obtain gals/hr of 3GP23 (JP-1) fuel.
Divide lb/hr by 7.8 to obtain gals/hr of 3GP22 (JP-3) fuel.
Divide lb/hr by 7.2 to obtain gals/hr of 3GP25 gasoline.

5. Multiply gallons by factor in Note 4 to obtain pounds.
6. Multiply 362 Imp. Gallons by factor in Note 4 to obtain maximum available fuel in pounds
7. Maximum weight at 45,000 feet is 13,600 pounds.

EXAMPLE

If you are flying at 10,000 feet with 2500 pounds of available fuel, you can fly 420 nautical air miles by holding 295 knots CAS. However, you can fly 640 nautical air miles by immediately climbing to 45,000 feet using 100% rpm. At 45,000 feet, cruise at 225 knots CAS and start letdown 45 nautical miles from home. With an 80-knot head wind, the range at 45,000 feet would be .85 x 640, or 545 nautical miles. Cruise at 225 knots CAS with this wind and start letdown 40 nautical miles from destination.

LEGEND

EFFECTIVE WIND – H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR – RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. – GROUND SPEED IN KNOTS
CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION – POUNDS PER HOUR
RANGE – NAUTICAL MILES
KN – KNOTS
OPT. ALT – OPTIMUM ALTITUDE
DISTANCE – NAUTICAL MILES

WADC
Form 241N

4-14 (Sheet 2 of 2) Flight Operation Instruction Chart
14,600 Pounds or Less

WADC Form 241M (11 Jun 51)	**MODEL** F-86E	**FLIGHT OPERATION INSTRUCTION CHART**	**EXTERNAL LOAD ITEM** TWO 100 (120 U.S.) GALLON DROP TANKS

ENGINE(S): J47-GE-13

CHART WEIGHT LIMITS: 16,400 TO 14,600 POUNDS

NUMBER OF ENGINES OPERATING: ONE

LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(C)	OIL PRESS. (PSI)		FUEL PRESS. (PSI)
MILITARY	30	100	690	50		600
NORMAL	NONE	93	655	50		400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF 8-23-51

BASED ON FLIGHT TEST

LOW-ALTITUDE CHART

172-93-1220

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(520)	30	(910)	4500	(590)	30	(930)	(670)	30	(950)	(750)	30	(980)	4500	(820)	30	(1000)
460	30	780	4000	530	30	800	590	30	820	660	30	860	4000	730	30	880
400	30	660	3500	460	30	680	520	30	700	580	30	730	3500	640	30	750
350	30	530	3000	390	30	550	440	30	570	490	30	610	3000	540	30	630
290	30	420	2500	330	30	440	370	30	460	410	30	500	2500	450	30	520

EFFECTIVE WIND (KNOTS)	CRUISING AT SEA LEVEL						CRUISING AT 5000 FT					
	CAS	APPROXIMATE					CAS	APPROXIMATE				
		% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
120 H.W.												
80 H.W.												
40 H.W.	310	79	28	270	.85	0	300	80	2550	280	.85	2
0	290	77	2550	290	1.00	0	280	78	2300	300	1.00	2
40 T.W.	265	75	2300	305	1.15	0	265	77	2200	325	1.15	2
80 T.W.												
120 T.W.												

EFFECTIVE WIND (KNOTS)	CRUISING AT 10,000 FT						CRUISING AT 15,000 FT					
	CAS	APPROXIMATE					CAS	APPROXIMATE				
		% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
120 H.W.												
80 H.W.	305	83	2500	270	.75	3	300	84	2400	290	.75	5
40 H.W.	290	81	2350.	295	.85	4	285	83	2250	315	.85	5
0	275	80	2200	315	1.00	4	270	82	2100	335	1.00	6
40 T.W.	265	79	2100	345	1.15	4	265	82	2050	370	1.15	7
80 T.W.	255	78	2000	375	1.25	5	255	81	1950	395	1.25	7
120 T.W.												

EFFECTIVE WIND (KNOTS)	CRUISING AT 20,000 FT					
	CAS	APPROXIMATE				
		% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
120 H.W.	305	86	2450	285	.65	5
80 H.W.	290	85	2300	305	.75	6
40 H.W.	275	84	2100	330	.90	7
0	265	83	2050	355	1.00	8 .
40 T.W.	260 .	83	2000	390	1.10	9
80 T.W.	255	83	1950	420	1.25	10
120 T.W.	250	82	1900	455	1.35	11

Figure 4-15 (Sheet 1 of 2) Flight Operation Instruction Chart - Two 100 Imp. (120 U.S.) Gal. Tanks. - 16,400 to 14,600 Pounds.

HIGH-ALTITUDE CHART

MODEL: F-86E ENG: J47-GE-13 CHART WT LIMITS: 16,400 TO 14,600 LBI EXT LOAD: TWO 100 (120 U.S.) GALLON DROP TANKS NO. OF ENGINES OPERATING: ONE

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)

IF YOU ARE AT 25,000 FT			FUEL (POUNDS)	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL (POUNDS)	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(900)	30	(1030)	4500	(970)	35	(1040)	(1020)	35	(1050)				4500			
800	30	890	4000	(860)	35	(910)	(900)	35	(930)				4000			
700	30	770	3500	750	35	790	790	35	800				3500			
600	30	640	3000	640	35	670	670	35	680				3000			
490	30	530	2500	530	35	550	550						2500			

CRUISING AT 25,000 FT						EFFEC-TIVE WIND (KNOTS)	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFEC-TIVE WIND (KNOTS)	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE																
CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
290	88	2300	295	.70	7	120 H.W.	280	90	2250	315	.70	8	265	93	2150	330	.70	10							120 H.W.						
280	87	2200	325	.80	8	80 H.W.	275	89	2200	350	.80	10	265	93	2150	370	.80	11							80 H.W.						
270	86	2050	350	.90	9	40 H.W.	265	88	2050	375	.90	11	260	92	2100	405	.90	13							40 H.W.						
265	86	2000	385	1.00	10	0	260	88	2000	410	1.00	12	255	91	2050	435	1.00	14							0						
260	85	1950	415	1.10	11	40 T.W.	255	87	1950	440	1.10	13	255	91	2050	475	1.10	15							40 T.W.						
255	85	1900	450	1.20	12	80 T.W.	255	87	1950	480	1.20	14	250	91	2000	505	1.20	17							80 T.W.						
250	84	1900	485	1.35	13	120 T.W.	250	87	1950	515	1.30	16	245	90	1950	540	1.30	18							120 T.W.						

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are nautical units.
3. Multiplv all nautical units by 1.15 to obtain statute units.

(4) Divide lb/hr by 8.15 to obtain gals/hr of 3GP23 (JP-1) fuel.
Divide lb/hr by 7.8 to obtain gals/hr of 3GP22 (JP-3) fuel.
Divide lb/hr by 7.2 to obtain gals/hr of 3GP25 gasoline.

5. Multiply gallons by factor in Note 4 to obtain pounds.
6. Multiply 562 Imp. gallons by factor in note 4 to obtain maximum fuel available in pounds.

EXAMPLE

If you are at 10,000 feet with 4000 pounds of available fuel, you can fly 590 nautical air miles by holding 275 knots CAS. However, you can fly 820 nautical air miles by immediately climbing to 30,000 feet using 100% rpm. At 30,000 feet, cruise at 260 knots CAS and start letdown 12 nautical miles from home. With an 80-knot head wind, the range at 30,000 feet would be .80 x 820, or 660 nautical miles. Cruise at 275 knots CAS with this wind and start letdown 10 nautical miles from destination.

LEGEND

EFFECTIVE WIND – H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR – RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. – GROUND SPEED IN KNOTS
CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION – POUNDS PER HOUR
RANGE – NAUTICAL MILES
KN – KNOTS
OPT. ALT – OPTIMUM ALTITUDE
DISTANCE – NAUTICAL MILES

WADC
Form 241N

Figure 4-15 (Sheet 2 of 2) Flight Operation Instruction Chart - Two 100 Imp. (120 U.S.) Gal. Tanks. - 16,400 to 14,600 Pounds.

W ADC
Form 241M
(11 Jun 51)

MODEL
F-86E

FLIGHT OPERATION INSTRUCTION CHART

EXTERNAL LOAD ITEM
TWO 100 (120 U.S.) GALLON DROP TANKS

ENGINE(S): J47-GE-13

CHART WEIGHT LIMITS: 14,600 OR LESS POUNDS

NUMBER OF ENGINES OPERATING: ONE

LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(C)	OIL PRESS. (PSI)		FUEL PRESS (PSI)
MILITARY	30	100	690	50		600
NORMAL	NONE	93	655	50		400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF 8-23-51

BASED ON FLIGHT TEST

LOW-ALTITUDE CHART

172-93-1218

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
				(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)												
350	40	600	3000	400	40	620	460	40	640	510	40	660	3000	560	40	680
290	40	470	2500	330	40	490	380	40	520	430	40	540	2500	470	40	560
230	35	350	2000	270	40	370	300	40	390	340	40	410	2000	380	40	430
180	30	240	1500	200	30	260	230	30	270	260	35	290	1500	280	35	310
120	15	130	1000	130	20	150	150	25	170	170	25	180	1000	190	25	200
60			500	70			80			90			500	100		

CRUISING AT SEA LEVEL						EFFECTIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT						EFFECTIVE WIND	CRUISING AT 20,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE							APPROXIMATE				
CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
						120 H.W.																			120 H.W.	300	85	2300	280	.65	5
						80 H.W.							300	82	2400	265	.75	3	290	83	2200	280	.75	5	80 H.W.	285	84	2100	300	.80	6
305	78	2650	265	.85	0	40 H.W.	290	79	2350	270	.85	2	280	80	2250	285	.85	4	275	81	2050	300	.85	5	40 H.W.	270	83	1950	320	.90	7
280	76	2400	280	1.00	0	0	275	77	2200	295	1.00	2	265	79	2050	305	1.00	4	265	80	1950	330	1.00	6	0	255	83	1850	340	1.00	8
260	74	2200	300	1.15	0	40 T.W.	260	76	2050	320	1.15	2	255	78	1950	335	1.15	4	250	79	1850	350	1.15	7	40 T.W.	245	81	1750	370	1.10	9
						80 T.W.							245	77	1850	365	1.30	5	145	79	1800	385	1.25	8	80 T.W.	235	80	1700	400	1.25	10
						120 T.W.																			120 T.W.	230	80	1650	430	1.35	11

Figure 4-16 (Sheet 1 of 2) Flight Operation Instruction Chart - Two 100 Imp. (120 U.S.) Gal. Tanks. - 14,600 Pounds or Less

HIGH-ALTITUDE CHART

MODEL: F-86E ENG: J47-GE-13 CHART WT LIMITS: 14,600 OR LESS LB EXT. LOAD TWO 100 (120 U.S.) GALLON DROP TANKS NO. OF ENGINES OPERATING: ONE

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)

IF YOU ARE AT 25,000 FT			FUEL (POUNDS)	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL (POUNDS)	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
620	40	700	3000	670	40	720	710	40	740	760			3000			
520	40	570	2500	560	40	600	590	40	620	630			2500			
410	40	450	2000	450	40	470	470	40	490	500			2000			
310	40	330	1500	340	40	350	360	40	370	380			1500			
210			1000	230			240			260			1000			
110			500	120			120			130			500			

CRUISING AT 25,000 FT						EFFECTIVE WIND (KNOTS)	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFECTIVE WIND (KNOTS)	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE																	
CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST		CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
285	86	2100	290	.65	7	120 H.W.	270	87	2000	300	.70	8	260	90	1950	325	.70	10	220	93	1700	305	.70	11	120 H.W.						
270	85	1950	310	.80	8	80 H.W.	260	87	1900	330	.80	10	255	90	1900	355	.80	11	220	93	1700	345	.80	13	80 H.W.						
260	84	1850	335	.90	9	40 H.W.	255	86	1800	360	.90	11	255	90	1900	395	.90	13	220	93	1700	385	.90	14	40 H.W.						
255	84	1800	370	1.00	10	0	250	86	1800	400	1.00	12	245	88	1800	420	1.00	14	220	93	1700	425	1.00	16	0						
245	83	1700	400	1.10	11	40 T.W.	245	85	1750	435	1.10	13	240	88	1750	450	1.10	15	220	93	1700	465	1.10	18	40 T.W.						
240	83	1700	430	1.25	13	80 T.W.	240	85	1700	460	1.20	14	240	88	1750	490	1.20	17	220	93	1700	505	1.20	19	80 T.W.						
235	82	1650	460	1.35	14	120 T.W.	240	85	1700	500	1.30	16	235	88	1700	525	1.30	19	220	93	1700	545	1.30	21	120 T.W.						

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units.
4) Divide lb/hr by 8.15 to obtain gals/hr of 3GP23 (JP-1) fuel.
   Divide lb/hr by 7.8 to obtain gals/hr of 3GP22 (JP-3) fuel
   Divide lb/hr by 7.2 to obtain gals/hr of 3GP25 gasoline.
5. Multiply gallons by factor in Note 4 to obtain pounds.

EXAMPLE

If you are at 10,000 feet with 2500 pounds of available fuel, you can fly 380 nautical air miles by holding 265 knots CAS. However, you can fly 520 nautical air miles by immediately climbing to 40,000 feet using 100% rpm. At 40,000 feet, cruise at 220 knots CAS and start letdown 16 nautical miles from home. With an 80-knot head wind, the range at 40,000 feet would be .80 x 520, or 420 nautical miles. Cruise at 220 knots CAS with this wind, and start letdown 13 nautical miles from destination.

LEGEND

EFFECTIVE WIND – H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR – RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. – GROUND SPEED IN KNOTS
CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION – POUNDS PER HOUR
RANGE – NAUTICAL MILES
KN – KNOTS
OPT. ALT – OPTIMUM ALTITUDE
DISTANCE – NAUTICAL MILES

WADC

Figure 4-16 (Sheet 2 of 2) Flight Operation Instruction Chart - Two 100 Imp. (120 U.S.) Gal. Tanks. - 14,600 Pounds or Less

WADC Form 241M (11 Jun 51)	MODEL F-86E	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEM 16 ROCKETS
ENGINE(S): J47-GE-13		CHART WEIGHT LIMITS: 16,900 OR LESS POUNDS	NUMBER OF ENGINES OPERATING: ONE

LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(C)	OIL PRESS. (PSI)		FUEL PRESS. (PSI)
MILITARY	30	100	690	50		600
NORMAL	NONE	93	655	50		400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated

DATA AS OF 8-23-51
BASED ON FLIGHT TEST

LOW-ALTITUDE CHART

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(300)	30	(410)	3000	(330)	30	(420)	(360)	30	(430)	(390)	30	(440)	3000	(410)	30	(450)
250	30	330	2500	280	30	350	300	30	360	330	30	360	2500	340	30	370
200	30	260	2000	220	30	270	240	30	280	260	30	290	2000	270	30	300
150	30	180	1500	170	30	200	180	30	210	200	30	220	1500	210	30	220
100	30	110	1000	110	30	120	120	30	130	130	30	140	1000	140	30	150
50			500	60			60			70			500	70	30	80

CRUISING AT SEA LEVEL						EFFECTIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT					
	APPROXIMATE					(KNOTS)		APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB, HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
						120 H.W.																		
						80 H.W.							280	85	2850	240	.70	5	270	86	2700	255	.75	5
275	80	2850	235	.85	0	40 H.W.	265	81	2650	245	.85	5	260	83	2550	260	.85	5	255	85	2500	275	.85	10
255	78	2600	255	1.00	0	0	250	80	2450	270	1.00	5	250	82	2400	290	1.00	5	250	84	2450	310	1.00	10
240	77	2400	280	1.15	0	40 T.W.	240	79	2350	300	1.15	5	245	82	2350	320	1.15	5	240	84	2300	340	1.15	10
						80 T.W.							235	81	2250	350	1.30	5	235	83	2250	375	1.25	15
						120 T.W.																		

EFFECTIVE WIND	CRUISING AT 20,000 FT					
(KNOTS)		APPROXIMATE				
	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
120 H.W.	270	89	2800	240	.65	5
80 H.W.	260	88	2650	270	.75	5
40 H.W.	250	87	2500	300	.85	10
0	245	86	2400	330	1.00	10
40 T.W.	240	86	2350	360	1.15	10
80 T.W.	235	86	2300	400	1.25	15
120 T.W.	230	85	2250	430	1.40	15

Figure 4-17 (Sheet 1 of 2) Flight Operation Instruction Chart - Sixteen Rockets - 16,900 Pounds or Less.

HIGH-ALTITUDE CHART

MODEL: F-86E ENG: J47-GE-13 CHART WT LIMITS: 16,900 OR LESS LB EXT LOAD: 16 ROCKETS NO. OF ENGINES OPERATING: ONE

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)

IF YOU ARE AT 25,000 FT			FUEL	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
(430)	30	(450)	3000	(450)									3000			
360	30	380	2500	380									2500			
290	30	310	2000	300									2000			
220	30	230	1500	230									1500			
150	30	160	1000	160									1000			
70	30	80	500	80									500			

CRUISING AT 25,000 FT						EFFECTIVE WIND (KNOTS)	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFECTIVE WIND (KNOTS)	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE																
CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.	CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.		CAS	% RPM	LB/HR	G.S. (KN)	RANGE FACTOR	LET-DOWN DIST.
260	91	2750	255	.65	10	120 H.W.	245	93	2650	265	.65	15													120 H.W.						
255	91	2650	290	.75	10	80 H.W.	245	93	2650	305	.80	15													80 H.W.						
245	90	2500	315	.90	15	40 H.W.	240	93	2600	340	.90	20													40 H.W.						
245	90	2500	355	1.00	15	0	235	92	2500	370	1.00	20													0						
240	89	2450	390	1.10	15	40 T.W.	235	92	2500	410	1.10	20													40 T.W.						
235	89	2350	420	1.25	20	80 T.W.	230	92	2450	445	1.20	25													80 T.W.						
235	89	2350	460	1.35	20	120 T.W.	230	92	2450	485	1.35	25													120 T.W.						

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units

(4) Divide lb/hr by 8.15 to obtain gals/hr of 3GP23 (JP-1) fuel.
Divide lb/hr by 7.8 to obtain gals/hr of 3GP22 (JP-3) fuel.
Divide lb/hr by 7.2 to obtain gals/hr of 3GP25 gasoline.

5. Multiply gallons by factor in Note 4 to obtain pounds.
6. Multiply 362 Imp. gallons by factor in Note 4 to obtain maximum available fuel in pounds.

EXAMPLE

If you are at 10,000 feet with 2500 pounds of available fuel, you can fly 300 nautical air miles by holding 250 knots CAS. However, you can fly 360 nautical air miles by immediately climbing to 30,000 feet using 100% rpm. At 30,000 feet, cruise at 235 knots CAS and start letdown 20 nautical miles from home. With an 80-knot head wind, the range at 30,000 feet would be .80 x 360, or 290 nautical miles. Cruise at 245 knots CAS with this wind and start letdown 15 nautical miles from destination.

LEGEND

EFFECTIVE WIND – H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR – RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. – GROUND SPEED IN KNOTS
CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION - POUNDS PER HOUR
RANGE – NAUTICAL MILES
KN – KNOTS
OPT. ALT – OPTIMUM ALTITUDE
DISTANCE – NAUTICAL MILES

WADC
Form 241N

Figure 4-17 (Sheet 2 of 2) Flight Operation Instruction Chart - Sixteen Rockets - 16,900 Pounds or Less.

WADC Form 241M (11 Jun 51)	MODEL F-86E-15	FLIGHT OPERATION INSTRUCTION CHART STANDARD DAY	EXTERNAL LOAD ITEM TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS
ENGINE(S): (1) J47-GE-13		CHART WEIGHT LIMITS: 17,700 TO 14,700 POUNDS	NUMBER OF ENGINES OPERATING: ONE

POWER LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(°C)	OIL PRESS. (PSI)		FUEL PRESS (PSI)
MILITARY	30	100	690	50		600
NORMAL	NONE	93	655	50		400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF: 6-25-52

BASED ON: ESTIMATED

LOW-ALTITUDE CHART

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)

IF YOU ARE AT SEA LEVEL			FUEL	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT		
RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT ALT
580	30	920	5400	650	30	940	730	30	960	800	30	980
540	30	850	5000	600	30	870	670	30	890	750	30	910
480	30	760	4500	550	30	780	610	30	800	680	30	820
430	30	670	4000	490	30	690	550	30	710	600	30	730
380	30	580	3500	430	30	600	480	30	620	530	30	640
330	30	490	3000	370	30	510	420	30	530	460	30	550
280	30	390	2500	310	30	420	350	30	440	390	30	460

FUEL	IF YOU ARE AT 20,000 FT		
(POUNDS)	RANGE IN AIR MILES		
	BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
5400	880	30	1000
5000	820	30	930
4500	740	30	840
4000	660	30	750
3500	580	30	660
3000	510	30	570
2500	430	30	480

CRUISING AT SEA LEVEL						EFFECTIVE WIND	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
						120 H.W.																		
						80 H.W.							320	86	2950	285	.75	3	305	87	2750	300	.75	5
305	81	2950	265	.85	0	40 H.W.	305	83	2800	285	.90	2	305	85	2700	310	.85	4	300	86	2650	330	.90	5
280	78	2650	280	1.00	0	0	285	81	2650	305	1.00	2	285	83	2550	325	1.00	4	285	85	2500	355	1.00	6
265	77	2500	305	1.15	0	40 T.W.	270	80	2450	330	1.15	2	270	82	2400	350	1.15	4	275	84	2400	385	1.10	7
						80 T.W.							260	81	2300	385	1.30	5	270	84	2300	415	1.25	7
						120 T.W.																		

EFFECTIVE WIND	CRUISING AT 20,000 FT					
		APPROXIMATE				
(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET DN DIST
120 H.W.	310	89	2850	295	.7	5
80 H.W.	300	88	2700	320	.8	6
40 H.W.	290	87	2550	345	.9	7
0-	280	87	2450	375	1.00	8
40 T.W.	275	86	2350	405	1.1	9
80 T.W.	270	86	2300	440	1.25	10
120 T.W.	265	85	2250	475	1.35	11

Figure 4-18 (Sheet 1 of 2) Flight Operation Instruction Chart - Two 167 Imp. (200 U.S.) Gal. Tanks. - 17,700 to 14,700 Pounds

HIGH-ALTITUDE CHART

MODEL: F-86E-15 ENG: (1) J47-GE-13 CHART WT LIMITS: 17,700 TO 14,700 LB EXT LOAD: TWO 167 IMPERIAL (200 U.S.) GALLON DROP TANKS NO. OF ENGINES OPERATING: ONE

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)

IF YOU ARE AT 25,000 FT			FUEL	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES			(POUNDS)	RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
960	30	1010	5400	1020	30	1030							5400			
890	30	940	5000	950	30	960							5000			
800	30	850	4500	860	30	870							4500			
720	30	770	4000	770	30	780							4000			
640	30	680	3500	690									3500			
550	30	590	3000	600									3000			
470	30	510	2500	510									2500			

CRUISING AT 25,000 FT						EFFEC-TIVE WIND	CRUISING AT 30,000 FT					
	APPROXIMATE							APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
295	91	2650	305	.70	7	120 H.W.	285	93	2600	325	.70	8
285	90	2550	335	.80	8	80 H.W.	280	92	2500	355	.80	10
280	89	2400	360	.90	9	40 H.W.	275	92	2450	390	.90	11
275	88	2350	395	1.00	10	0	270	91	2400	425	1.00	12
270	88	2300	425	1.10	11	40 T.W.	265	91	2350	460	1.10	13
265	87	2300	460	1.20	12	80 T.W.	260	91	2300	490	1.20	14
260	87	2250	500	1.35	13	120 T.W.	255	90	2250	520	1.30	16

EFFEC-TIVE WIND	CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						CRUISING AT 45,000 FT					
		APPROXIMATE						APPROXIMATE						APPROXIMATE				
(KNOTS)	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
120 H.W.																		
80 H.W.																		
40 H.W.																		
0																		
40 T.W.																		
80 T.W.																		
120 T.W.																		

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are in nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units.
4. Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
   Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
   Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel.
   Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) fuel.
5. Multiply gallons by factor in note 4 to obtain pounds.
6. Multiply 696 Imp. gallons by factor in note 4 to obtain maximum available fuel in pounds.

EXAMPLE

If you are at 10,000 feet with 4000 pounds of available fuel, you can fly 550 nautical air miles by holding 285 knots CAS. However, you can fly 710 nautical air miles by immediately climbing to 30,000 feet using 100% rpm. At 30,000 feet, cruise at 270 knots CAS and start letdown 12 nautical miles from home. With an 80-knot headwind, the range at 30,000 feet would be 8 x 710 or 570 nautical miles. Cruise at 280 knots CAS with this wind and start letdown 10 nautical miles from destination.

LEGEND

EFFECTIVE WIND – H.W., HEAD WIND; T.W., TAIL WIND
RANGE FACTOR – RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S. – GROUND SPEED IN KNOTS
CAS – CALIBRATED AIRSPEED IN KNOTS
LB/HR – FUEL CONSUMPTION – POUNDS PER HOUR
RANGE – NAUTICAL MILES
OPT. ALT – OPTIMUM ALTITUDE
DISTANCE – NAUTICAL MILES

DATA AS OF: 6-25-52

WADC
Form 241N

Figure 4-18 (Sheet 2 of 2) Flight Operation Instruction Chart - Two 167 Imp. (200 U.S.) Gal. Tanks. - 17,700 to 14,700 Pounds

WADC
Form 241M
(11 Jun 51)

MODEL
F-86E-15

FLIGHT OPERATION INSTRUCTION CHART

STANDARD DAY

EXTERNAL LOAD ITEM
TWO 167 IMPERIAL
(200 U.S.) GALLON DROP TANKS

ENGINE(S): (1) J47-GE-13

CHART WEIGHT LIMITS: 14,700 OR LESS POUNDS

NUMBER OF ENGINES OPERATING: ONE

POWER LIMITS	TIME LIMIT	% RPM	TAIL PIPE TEMP(°C)	OIL PRESS. (PSI)	FUEL PRESS (PSI)	FUEL PRESS. (PSI)
MILITARY	30	100	690	50		600
NORMAL	NONE	93	655	50		400

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT—Select figure in fuel column equal to, or less than, fuel available for cruise (fuel on board minus allowance for reserve, combat, navigational errors, formation flights, etc). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instruction in appropriate cruising altitude section. (B) FLIGHT PLANNING—From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distance to range values. DATA BELOW CONTAINS NO FUEL RESERVE FOR LANDING.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (because of external configuration or gross weight changes), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts, a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA AS OF: 6-25-52

BASED ON: ESTIMATED

172-93-1573

LOW-ALTITUDE CHART

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)

IF YOU ARE AT SEA LEVEL			FUEL (POUNDS)	IF YOU ARE AT 5000 FT			IF YOU ARE AT 10,000 FT			IF YOU ARE AT 15,000 FT			FUEL (POUNDS)	IF YOU ARE AT 20,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT SL	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 5000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 10,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 15,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 20,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
330	35	510	3000	380	35	540	420	35	560	470	35	570	3000	520	35	590
280	30	400	2500	310	35	430	350	35	450	390	35	470	2500	430	35	490
220	30	300	2000	250	30	320	280	30	340	320	30	360	2000	350	30	380
170	30	200	1500	190	30	220	210	30	240	240	30	260	1500	260	30	280
110	10	120	1000	130	15	140	140	15	150	160	20	160	1000	180	30	180
60			500	60			70			80			500	90		

CRUISING AT SEA LEVEL						EFFECTIVE WIND (KNOTS)	CRUISING AT 5000 FT						CRUISING AT 10,000 FT						CRUISING AT 15,000 FT						EFFECTIVE WIND (KNOTS)	CRUISING AT 20,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE							APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.		CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.		CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
						120 H.W.																			120 H.W.	295	86	2450	270	.65	5
						80 H.W.							300	83	2600	265	.75	3	290	84	2400	280	.75	5	80 H.W.	280	85	2200	295	.75	6
295	79	2700	255	.85	0	40 H.W.	285	80	2500	270	.85	2	280	81	2300	280	.85	4	275	83	2200	300	.85	5	40 H.W.	270	84	2100	320	.85	7
275	77	2450	275	1.00	0	0	265	78	2250	285	1.00	2	260	80	2100	300	1.00	4	260	82	2050	325	1.00	6	0	260	83	2000	345	1.00	8
260	75	2300	300	1.15	0	40 T.W.	250	76	2100	305	1.15	2	245	79	2000	325	1.15	4	250	81	1950	350	1.15	7	40 T.W.	250	83	1950	375	1.15	9
						80 T.W.							235	78	1950	355	1.30	5	240	80	1900	380	1.30	8	80 T.W.	240	82	1900	405	1.25	10
						120 T.W.																			120 T.W.	235	82	1850	440	1.40	11

Figure 4-19 (Sheet 1 of 2) Flight Operation Instruction Chart - Two 167 Imp. (200 U.S.) Gal. Tanks. - 14,700 Pounds or Less

HIGH-ALTITUDE CHART

MODEL: **F-86E-15** FNG: **(1) J47-GE-13** CHART WT LIMITS: 14,700 OR LESS LB EXT LOAD: TWO 100 IMPERIAL (120 U.S.) GALLON DROP TANKS NO. OF ENGINES OPERATING: ONE

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL.)

IF YOU ARE AT 25,000 FT			FUEL (POUNDS)	IF YOU ARE AT 30,000 FT			IF YOU ARE AT 35,000 FT			IF YOU ARE AT 40,000 FT			FUEL (POUNDS)	IF YOU ARE AT 45,000 FT		
RANGE IN AIR MILES				RANGE IN AIR MILES			RANGE IN AIR MILES			RANGE IN AIR MILES				RANGE IN AIR MILES		
BY CRUISING AT 25,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 30,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 35,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT	BY CRUISING AT 40,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT		BY CRUISING AT 45,000 FT	OPT. ALT (1000 FT)	BY CRUISING AT OPT. ALT
570	35	620	3000	610	35	630	650						3000			
470	35	510	2500	510	35	520	540						2500			
380	35	400	2000	410	35	410	440						2000			
290	30	300	1500	310	30	310	330						1500			
190	30	200	1000	210	30	210	220						1000			
100			500	110			110						500			

CRUISING AT 25,000 FT						EFFECTIVE WIND (KNOTS)	CRUISING AT 30,000 FT						CRUISING AT 35,000 FT						CRUISING AT 40,000 FT						EFFECTIVE WIND (KNOTS)	CRUISING AT 45,000 FT					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE							APPROXIMATE				
CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.		CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.	CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.		CAS	% RPM	LB/HR	G.S.	RANGE FACTOR	LET-DN DIST.
280	88	2300	285	.65	7	120 H.W.	270	89	2150	300	.70	8	260	93	2150	320	.70	10							120 H.W.						
270	86	2100	310	.75	8	80 H.W.	260	88	2050	330	.80	10	250	92	2050	350	.80	11							80 H.W.						
260	86	2000	335	.90	9	40 H.W.	255	88	2000	360	.90	11	245	91	2000	380	.90	13							40 H.W.						
250	85	1950	370	1.00	10	0	250	87	1950	390	1.00	12	240	90	1950	415	1.00	14							0						
245	85	1900	400	1.10	11	40 T.W.	245	87	1900	425	1.10	13	240	90	1950	450	1.10	15							40 T.W.						
240	84	1850	430	1.20	13	80 T.W.	240	87	1850	460	1.20	14	235	90	1900	485	1.20	17							80 T.W.						
235	84	1800	465	1.35	14	120 T.W.	235	86	1800	495	1.35	16	235	90	1900	525	1.30	19							120 T.W.						

REMARKS:

1. Climb at 100% rpm.
2. All distances and speeds are in nautical units.
3. Multiply all nautical units by 1.15 to obtain statute units.
4. Maximum exhaust temperature 655° C.
   Divide pounds by 8.15 to obtain gallons of 3-GP-23A (MIL-F-5616) fuel.
   Divide pounds by 7.8 to obtain gallons of 3-GP-22 (MIL-F-5624) fuel.
   Divide pounds by 7.8 to obtain gallons of 3-GP-22A (MIL-F-5624A) fuel
   Divide pounds by 7.2 to obtain gallons of 3-GP-25A (MIL-F-5572) fuel.
5. Multiply gallons by factor in note 4 to obtain pounds.
6. Multiply 362 Imp. gallons by factor in note 4 to obtain maximum available fuel in pounds.

EXAMPLE

If you are at 10,000 feet with 2000 pounds of available fuel, you can fly 280 nautical air miles by holding 260 knots CAS. However, you can fly 340 nautical air miles by immediately climbing to 30,000 feet using 100% rpm. At 30,000 feet, cruise at 250 knots CAS and start letdown 12 nautical miles from home. With an 80-knot headwind, the range at 30,000 feet would be .8 x 340 or 270 nautical miles. Cruise at 260 knots CAS with this wind and start letdown 10 nautical miles from destination.

LEGEND

EFFECTIVE WIND	– H.W. HEAD WIND; T.W., TAIL WIND
RANGE FACTOR	– RATIO OF GROUND DISTANCE TO AIR MILES FOR CORRESPONDING WINDS
G.S.	– GROUND SPEED IN KNOTS
CAS	– CALIBRATED AIRSPEED IN KNOTS
LB/HR	– FUEL CONSUMPTION – POUNDS PER HOUR
RANGE	– NAUTICAL MILES
OPT. ALT	– OPTIMUM ALTITUDE
DISTANCE	– NAUTICAL MILES

DATA AS OF: **6-25-52**

BASED ON: **ESTIMATED DATA**

FUEL GRADE:

FUEL DENSITY:

WADC
Form 241N
(11 Jun 51)

Figure 4-19 (Sheet 2 of 2) Flight Operation Instruction Chart - Two 167 Imp. (200 U.S.) Gal. Tanks. - 14,700 Pounds or Less.

chart in the column under the new altitude. When changing charts, refer to cruising instructions on the new chart at the new altitude of flight. For absolute maximum range, climb (using military power) to the altitude at which maximum rate of climb is 500 feet per minute. Hold .75 Mach number and 93% rpm constant, allowing aircraft to seek its own altitude.

Sample Problems Based on 3-GP-22a (JP-4) Fuel

Problem 1

27 To illustrate use of the charts for planning a flight, suppose an aircraft must be ferried 500 nautical miles. For unexpected difficulties, a general reserve of 900 pounds (115 Imperial gallons) is considered necessary.

28 From the Flight Operation Instruction Charts, it is apparent that drop tanks must be carried. It is desired to keep the tanks. Use of 100 Imperial (120 U.S.) gallon drop tanks will give a maximum fuel capacity of 562 Imperial gallons x 7.8 (pounds per gallon 3-GP-22a (JP-4) fuel) or 4383 pounds. The initial, known conditions are as follows:

(a)	Required range	500 nautical miles
(b)	Effective winds	40 knot head wind at 30,000 feet and below 80 knot head wind at 35,000 feet

29 From the Climb Chart and the Flight Operation Instruction Chart for 100 Imperial (120 U.S.) gallon drop tanks the following data is obtained.

(a)	Cruising Altitude	20,000	25,000	35,000
(b)	Fuel Capacity, pounds (determined in Paragraph 28)	4,383	4,383	4,383
(c)	Reserve Fuel pounds (determined in Paragraph 27)	900	900	900
(d)	Fuel used to altitude, pounds (climb at 100% rpm)	740	890	1,260
(e)	Available cruise fuel, pounds (b-c-d) ...	2,743	2,593	2,223
(f)	Cruise and descent air distance (interpolate as necessary)	495	510	520
(g)	Range factor	.9	9	.8
(h)	Cruise and descent ground distance (f x g).	445	460	415
(j)	Nautical miles covered in initial climb...	35	50	100
(k)	Nautical miles ground range (h + j)	480	510	515

30 Therefore, the flight can be made at 25,000 feet or higher. The cruise airspeed at 25,000 feet for a 40 knot head wind, while within the weight limits of 16,400 and 14,600 pounds, is 270 knots CAS. However when the weight has decreased to 14,600 pounds or less, the cruise airspeed is 260 knots CAS. The letdown would begin 9 nautical miles from destination.

Problem 2

31 Suppose that during the descent at the end of this theoretical flight, the pilot has reached 5000 feet when he learns that the field is closed, and he must use an alternate airport some 100 nautical miles further on. Fuel remaining is only the 900 pounds originally planned for general reserve. Reference to the Flight Operation Instruction Chart for 100 Imperial (120 U.S.)

gallon drop tanks shows that with the existing head wind and the empty tanks still on, available range with 1000 pounds of fuel is approximately 110 nautical miles at 5000 feet (135 at optimum altitude, 20,000 feet) with no reserve for landing. It is evident, therefore, that the empty drop tanks should be jettisoned immediately.

32 Reference to the Flight Operation Instruction Chart for No External Load shows that even without the drop tanks only 125 (.85 x 150) miles can be covered at 5000 feet with 1000 pounds of fuel and a 40 knot head wind. However, by climbing immediately to 25,000 feet (optimum altitude) at 100% rpm, a range of 180 miles with zero wind or 160 (180 x .90) miles with existing 40 knot head wind can be attained. At 25,000 feet, the cruise conditions will be 285 knots CAS, 1700 pounds per hour fuel flow, 370 knots ground speed and letdown begun 15 miles from destination.

33 Since the required range is only 100 nautical miles, the difference between 160 and 100 miles is the reserve which, expressed in time is (60 miles - 370 knots ground speed = .16 hour or 9.5 minutes). The corresponding fuel reserve is 270 pounds (.16 hour x 1700 pounds per hour). However, this was figured for 1000 pounds of fuel at 5000 feet and only 900 pounds was available, so the landing reserve will be 100 pounds less, or 170 pounds.

34 Judging from this sample problem, when it is necessary to obtain maximum range on the fuel available, climb immediately to optimum altitude and, if necessary, jettison empty drop tanks. It is further pointed out that when operating on a limited fuel reserve, it is best to determine the condition of the intended destination before descending from altitude. In this problem, with 1000 pounds of fuel available at the cruising altitude of 25,000 feet, by reference to the Flight Operation Instruction Chart, it is seen that the range with 100 Imperial (120 U.S.) gallon drop tanks at existing 40 knot head wind is 190 (210 x .90) nautical miles, and without the drop tanks 215 (240 x .90) nautical miles. By staying at altitude, a landing reserve of approximately 400 pounds remains at the alternate airport.

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