Forcing the selector switch to positions other than the three indicated positions may result in loss of control of the aircraft.

Automatic Approach Equipment Operation.

1. Instrument Approach Equipment—ON.
2. Autopilot—ON and ENGAGED.

   Turn autopilot on and place autopilot control surface engaging switches to ENGAGE.
3. When Localizer Beam Is Intercepted: Automatic Approach Selector Switch—LOCALIZER.

   Place automatic approach selector switch to LOCALIZER when vertical needle on course indicator begins to deflect.
4. Altitude Control Switch (If ON)—OFF.

   When steady on localizer, place altitude control switch (if ON) to OFF prior to intercepting glide slope.
5. Aircraft—Trim as required.

   Retrim aircraft with autopilot pitch control knob.
6. When Glide Slope Is Intercepted: Automatic Approach Selector Switch—APPROACH.
7. When Prescribed Automatic Approach Minimums Are Reached: Disengage Autopilot.

AUTOPILOT — F-1 SYSTEM (EC-54 AIRCRAFT).

The airplane is equipped with an electrically operated F-1 autopilot which automatically controls the ailerons, elevator, and rudder. The primary purpose of the autopilot is to relieve pilot fatigue and allow the pilot to perform his other duties. It must be realized that the autopilot does not replace the pilot and that, although it will keep the airplane on the desired heading, it will not correct for drift or unexpected crosswind. The autopilot, when engaged, provides a system of automatic control which holds the airplane in straight and level flight on any selected heading. The autopilot will return the airplane to the selected heading when momentary displacement occurs, and simultaneously keep the airplane stable in pitch and bank. While under autopilot control, the airplane may be made to dive, climb, and execute coordinated turns. A barometric altitude control may be used in conjunction with the autopilot to maintain any desired altitude. The autopilot receives power from the 28-volt dc system and the 115-volt, 3-phase ac system. The autopilot system incorporates the following equipment: one servo in the center wing section and three in the tail section for operating the ailerons, elevators, elevator trim tabs, and rudder; autopilot controller, power switch, clutch engaging button, and pitch trim indicator on the pilots' control pedestal; a master direction indicator, autopilot turn and bank control and indicator, and autopilot vertical gyro indicator on the main instrument panel; two autopilot release buttons on the pilot's and copilot's control columns; and an autopilot emergency disconnect lever, located on the stanchion behind the pilot's seat.

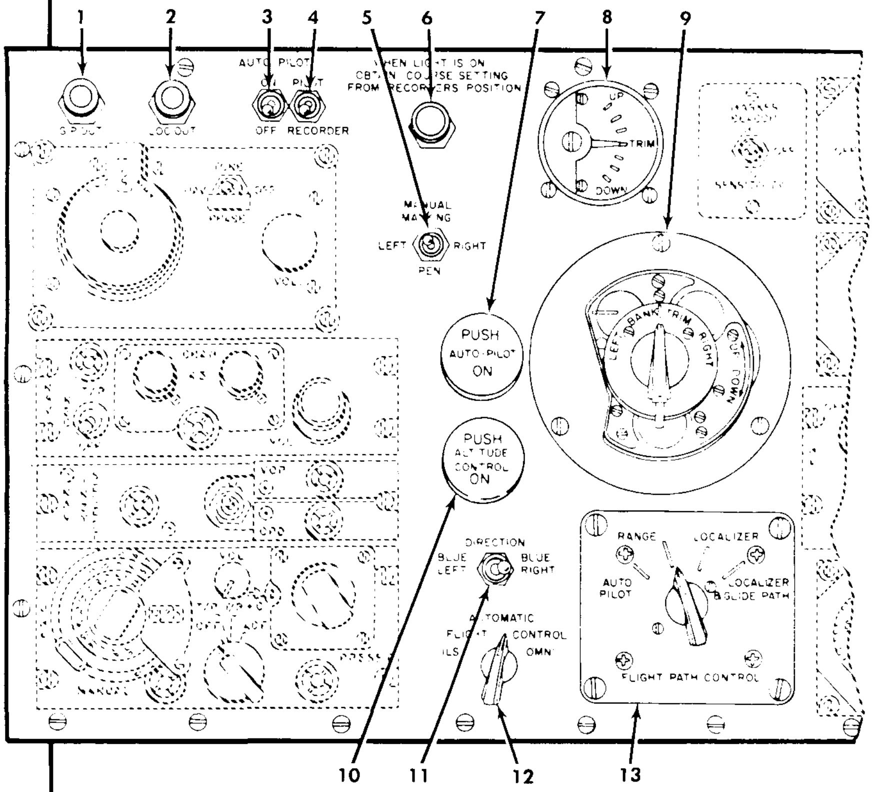
AUTOPILOT CONTROLLER.

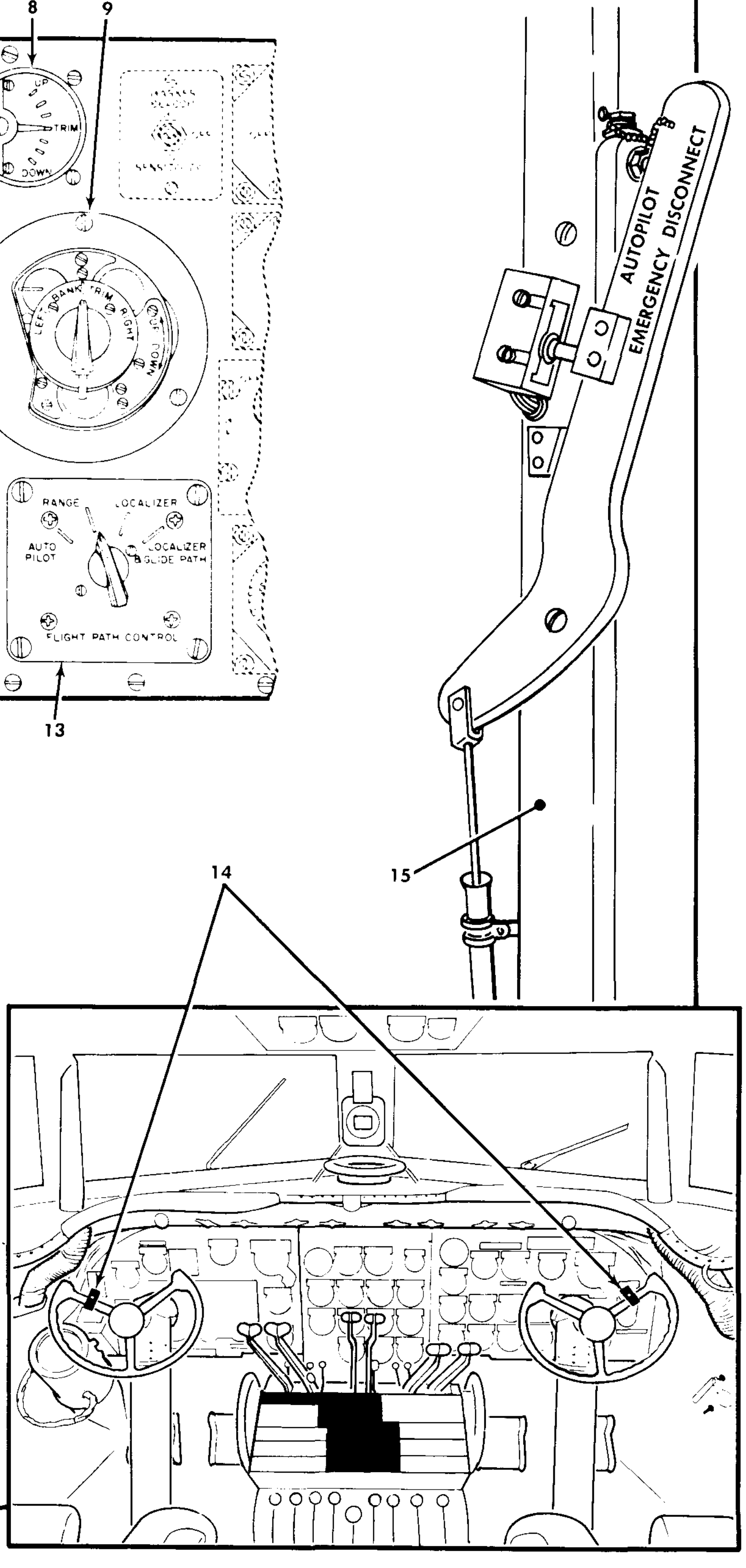
The autopilot controller (9, figure 4-23) incorporates an UP-DOWN pitch trim wheel, LEFT-RIGHT bank trim wheel, and a turn control knob. The pitch trim wheel and bank trim wheel provide a means of trimming the airplane while the autopilot is engaged. Using the pitch trim wheel, a climb or dive attitude up to 40 degrees is possible. By using the bank trim wheel, banks up to 10 degrees are possible. The turn control knob may be turned to the left or right of the detent (center) position to execute a coordinated left or right turn. When the turn control knob is returned to the detent position, the airplane will resume straight and level flight.

POWER SWITCH.

An ON-OFF power switch (3, figure 4-23) is used to control the servomotors. When the switch is placed in the ON position, the servomotors are energized but not engaged.

F-I AUTOPILOT CONTROLS





1. GLIDE PATH OUT LIGHT
2. LOCALIZER OUT LIGHT
3. AUTOPILOT POWER SWITCH
4. OMNI BEARING SELECTOR SWITCH
5. PILOT'S MANUAL SIDE PEN SWITCH
6. OMNI BEARING SELECTOR LIGHT
7. CLUTCH ENGAGING BUTTON
8. PITCH TRIM INDICATOR
9. AUTOPILOT CONTROLLER
10. ALTITUDE CONTROL ENGAGING BUTTON
11. FIELD DIRECTION SWITCH
12. ILS-OMNI SELECTOR SWITCH
13. FLIGHT PATH CONTROL SWITCH
14. AUTOPILOT RELEASE BUTTONS
15. AUTOPILOT EMERGENCY DISCONNECT LEVER

Figure 4-23

X1-294

CLUTCH ENGAGING BUTTON.

The clutch engaging button (7, figure 4-23) is used to engage or disengage the autopilot. When the button is pushed in, the master direction indicator is connected to the autopilot system and four electrically operated clutches, one in each of the servos, are engaged. The autopilot may be disengaged by pulling the clutch engaging button out.

AUTOPILOT RELEASE BUTTONS.

The autopilot release buttons (14, figure 4-23), located on each pilot's control wheel, are used to disengage the autopilot. When either button is depressed, the clutch engaging button pops out, releasing the clutches and fully disengaging all autopilot control.

AUTOPILOT EMERGENCY DISCONNECT LEVER.

The autopilot emergency disconnect lever (15, figure 4-23) is employed to manually disengage the servos from the control system of the airplane in event of electrical failure or other emergencies. When the lever is pulled, the servo pulleys are released and will turn freely when the control surfaces are operated manually. The servo pulleys cannot be reconnected in flight.

ALTITUDE CONTROL ENGAGING BUTTON.

The altitude control engaging button (13, figure 4-23), located on the autopilot control panel, is used to engage the barometric altitude control. When the button is depressed at the desired altitude, the control will automatically maintain that altitude. If a variation in altitude is due to a temporary aerodynamic condition, such as turbulence or similar cause, the barometric altitude control will correct back to the original altitude. If a variation in altitude is due to a shift in loading or a similar cause, the barometric altitude control is not able to bring the airplane back to the original altitude, although it does prevent the airplane from losing or gaining altitude after the elevator servos have corrected for the load shift. If the barometric altitude control is engaged and the flight path control switch (refer to FLIGHT PATH CONTROL SYSTEM, this section) is turned to LOCALIZER-GLIDE PATH, the barometric altitude control is automatically disengaged. To disengage the barometric altitude control normally, pull the altitude control engaging button out.

AUTOPILOT MASTER HEADING INDICATOR.

The autopilot master heading indicator (29, sheet 4, figure 1-10) moves in response to impulses set up by the gyro flux gate compass transmitter and automatically transmits signals to the servos to keep the airplane on the desired heading. When the autopilot is energized but not engaged, the indicator serves as a heading indicator.

AUTOPILOT TURN AND SLIP CONTROL AND INDICATOR.

The autopilot turn and slip control and indicator (3, figure 1-10), located on the copilot's side of the main instrument panel, which functions as a rate control gyro unit, automatically transmits a rate of turn signal to the rudder servo to stabilize the airplane in yaw. When the autopilot is energized, but not engaged, the rate control gyro unit serves as a conventional turn and slip indicator.

AUTOPILOT ATTITUDE INDICATOR.

The autopilot attitude indicator (28, figure 1-10), which functions as a vertical gyro control unit, automatically transmits signals to the aileron and elevator servos. These signals cause the aileron and elevator servos to return the airplane to the proper attitude in pitch and roll whenever displacement occurs with reference to the vertical seeking gyro. A caging knob, located on the face of the indicator, is used to erect the gyros in the attitude indicator and flux gate compass. If the attitude indicator is caged when the autopilot is engaged, the autopilot clutch engaging button pops out and disengages the autopilot.

PITCH TRIM INDICATOR.

The pitch trim indicator (8, figure 4-23) shows the direction in which trimming is required to eliminate the load on the elevator servo. It is very important to note that the pitch trim indicator does not indicate the actual trim of the airplane.

AUTOPILOT NORMAL OPERATION.

To Start:

1. Autopilot Three-phase Inverter Switch—MAIN ON. Allow gyros 2 minutes to gain speed.
2. Autopilot Attitude Indicator—Cage and uncage.
3. Power Switch—ON.
4. Bank, Pitch, and Turn Trim Controls On Autopilot Controller—Center.
5. Aileron, Rudder, and Elevator Trim Tab Controls—Manually trim airplane.

To engage:

1. Clutch Engaging Button—Push in.
2. Altitude Control Engaging Button—Push in.

To make adjustmenst during flight:

1. Pitch Trim Wheel—Turn UP or DOWN until desired pitch is attained.

CAUTION

Do not adjust pitch trim wheel when barometric altitude control is engaged to prevent undue elevator servo load.

2. Bank Trim Wheel—Turn to left or right, as required to level wings.
3. Turn Control Knob—Turn to left or right until desired heading is reached.

CAUTION

- After any appreciable load change (rpm, flaps, landing gear, etc.), disengage autopilot, retrim airplane manually, and reengage autopilot.
- Do not adjust manual trim tab controls while the autopilot is engaged to prevent undue servo loads.

To disengage, accomplish any of the following:

1. Autopilot Release Button—Depress.
2. Autopilot Attitude Indicator—Cage.
3. Power Switch—OFF.
4. Clutch Engaging Button—Pull out.

AUTOPILOT EMERGENCY DISCONNECT PROCEDURE.

1. Emergency Disconnect Lever—Pull down.

Note

When the autopilot is disconnected by this method, it cannot be reset during flight.

2. Autopilot Three-phase Inverters—OFF.

FLIGHT PATH CONTROL SYSTEM.

The flight path control system is employed to maneuver the airplane automatically along a desired omnirange course or localizer beam, and to make an automatic all-weather landing approach. In addition to bringing the aircraft in on the localizer and glide path beams, the system will apply the correct amount of throttle control as the airplane descends toward the runway. However, when the airplane reaches the minimum field altitude, the pilot must take over visually and perform the actual landing operation. When tracking a course by the flight path control system, the pilot must set the correct crab angle to compensate for crosswind conditions. Once this is done, the airplane will automatically fly the desired course despite wind gusts or possible errors in the beam. However, since a change in the original wind conditions may cause the airplane to drift off course, the pilot must keep the flight under close surveillance and make the necessary wind correction. The flight path control system incorporates a flight path computer, two throttle servos, throttle servoamplifier, flight path control switch, ILS-OMNI selector switch, field direction switch, throttle interlock switch, and two indicator lights. This system also utilizes all controls of the autopilot system, instrument landing system, barometric altitude control, and omnidirectional range system. Power for operating the flight path control system is received from the 28-volt dc system and the 115-volt, 3-phase, ac system.

FLIGHT PATH CONTROL SWITCH.

The flight path control switch (10, figure 4-23) is located on the autopilot control panel. The positions of this switch are AUTOPILOT, RANGE, LOCALIZER, and LOCALIZER-GLIDE PATH. The AUTOPILOT position is used to keep the flight path control system in a standby condition while using the autopilot. When the switch is turned to the RANGE position, the VOR receiver controls the flight path control system for flying VOR courses. The course selected by the courses at knob will cause the autopilot to make the corrections needed to keep the airplane centered on the beam. The LOCALIZER position is used for tracking to a localizer station and is effective only when the heading pointer of the flight path or course indicator is operating. The LOCALIZER-GLIDE PATH position is used to make an automatic landing approach and is not effective until reaching the glide slope beam.

ILS-OMNI SELECTOR SWITCH.

An ILS-OMNI selector switch (11, figure 4-23), located on the autopilot control panel, is used to transfer control of the flight path control system to the ILS or OMNI receivers. With the flight path control switch in the LOCALIZER-GLIDE PATH position, the flight path control system can use either the ILS or VOR receivers for localizer and glide slope beam signals.

FIELD DIRECTION SWITCH.

The field direction switch (12, figure 4-23), located on the control panel, has BLUE LEFT and BLUE RIGHT positions. This switch reverses the polarity of receiver output signals to the flight path computer, but does not reverse the indication on the flight path indicator or the course indicator. When making an automatic landing approach, the field direction switch must be positioned to BLUE LEFT or BLUE RIGHT, depending on the direction of the blue field.

THROTTLE INTERLOCK SWITCH.

The throttle interlock switch is connected to the throttle friction lock within the pilots' control pedestal. When the throttle friction lock lever is locked, the throttle interlock switch automatically disengages the throttle servos. The throttle friction lock lever must be unlocked prior to automatic glide slope operation.

LOCALIZER OUT LIGHT.

The localizer out light (2, figure 4-23), located on the autopilot control panel, comes on to indicate the localizer channel of the flight path computer is not operating.

GLIDE SLOPE OUT LIGHT.

The glide slope out light (1, figure 4-22), placarded G. P. OUT, is located on the autopilot control panel. When the light comes on, the glide slope channel of the flight path computer is not operating.

Note

The flight path control system also utilizes indicators of the ILS, omnidirectional range, and autopilot system when operating in conjunction with these systems. For further information concerning these indicators, refer to the appropriate paragraphs in this section.

FLIGHT PATH CONTROL SYSTEM OPERATION.

Vor Operation.

1. ILS-OMNI Selector Switch—OMNI.
2. Field Direction Switch—BLUE RIGHT inbound or BLUE LEFT outbound.
3. ILS-OMNI Selector Switch—PILOT.
4. Course Indicator—Set in desired course heading.
5. Autopilot Controller—Maneuver airplane until heading pointer is centered.
6. Flight Path Control Switch—RANGE.

Note

The maximum heading change is ±15 degrees. For greater crab angle, resequence the flight path control switch from RANGE to AUTOPILOT and back to RANGE.

To disengage:

Flight Path Control Switch—Turn to AUTOPILOT.

Localizer Operation.

1. ILS-OMNI Selector Switch—Select ILS or OMNI as desired.
2. Field Direction Switch—BLUE RIGHT inbound or BLUE LEFT outbound.
3. Flight Data (range, heading, and altitude)—Conform to published data.
4. Localizer Beam Interception—Intercept at approximately 45-degree angle.
5. Flight Path Control Switch—Turn to LOCALIZER position when heading pointer starts toward center.

To disengage:

Flight Path Control Switch—Turn to AUTOPILOT.

GLIDE SLOPE OPERATION.

Before entering the glide slope beam:

1. Flaps, Gear, and RPM—As per standard operating procedures.
2. Altitude Control Engaging Button—Pull out.
3. Pitch Trim Wheel—Trim elevator for level flight.
4. Altitude Control Engaging Button—Push in.
5. Flight Path Control Switch—LOCALIZER.

To engage automatic glide slope control:

1. Flight Path Control Switch—Turn to LOCALIZER—GLIDE PATH when glide slope indicator shows one dot deflection.
2. Throttle Friction Lock Lever—Unlock when glide slope indicator shows approximately one-half dot deflection.

Note

Control surfaces, trim tabs, and throttles are now under control of the flight path control system.

To disengage:

Flight Path Control Switch—Turn to AUTO-PILOT.

NAVIGATION EQUIPMENT.

For instrument approach equipment, see communication and associated electronic equipment, this section. For instrument approach procedures, see Section IX. Provisions are made for the installation of the following navigational equipment; driftmeter, sextant astrocompass, and a flux gate or N-1 remote-indicating compass.

NAVIGATOR'S STOOL.

The navigator's stool incorporates an upholstered seat cushion, a safety belt, a foot support ring, and a height adjustment. The stool is also used as a stand for taking navigation sights through the astrodome.

DRIFTMETER.

A driftmeter (figure 4-24) is used by the navigator to measure drift and azimuth. The instrument obtains direct indications of drift, relative bearing angle of a fixed object on the earth, and data for calculating groundspeed. The driftmeter is installed so that it may be rotated through 360 degrees in azimuth without mechanical interference. A gyro incorporated in the driftmeter should be caged at all times when not in use.

ASTROCOMPASS.

Provisions for mounting a MK II astrocompass are located under the astrodome. On some aircraft, the astrocompass is stowed in the navigator's map compartment.

FLUX GATE REMOTE INDICATING COMPASS.

The flux gate remote-indicating compass is an electrically actuated magnetic direction indicator. The system uses a master direction indicator (10, figure 4-14), installed at the navigator's station, and a compass repeater indicator (28, sheets 1 and 3, figure 1-10), located on the main instrument panel. Power source is the 115-volt ac bus. Power for the remote-indicating compass caging motor and switch box is derived from the 28-volt dc bus.

N-1 COMPASS SYSTEM.

On some aircraft the N-1 compass system is installed to replace the flux gate remote-indicating compass system. The N-1 compass is designed to alleviate the problems of polar navigation and to provide a source of directional reference with the degree of accuracy required by a dependent navigational system. It provides two methods of operation. When flying through the high latitudes where a magnetic compass becomes unreliable, the N-1 compass operates as a directional gyro that is constantly being corrected for the effects of the rotation of the earth by a latitude correction device. On flights in the lower latitudes, the compass serves as a gyro stabilized magnetic compass. The high latitude N-1 compass system consists essentially of a master indicator (10, figure 4-14 and 7, figure 4-19) at the navigator's station; repeater indicators (28, sheets 1 and 3, figure 1-10), located on the pilots' instrument panel; and a flux valve, located in the left wingtip. In addition, the system actuates the rotating compass cards on the radio magnetic indicators (7, figure 1-10 and 11, figure 4-15) at the pilots' and navigator's stations. (Refer to AN/ARN-14, NAVIGATIONAL RECEIVER (VOR), this section.)

DRIFTMETER

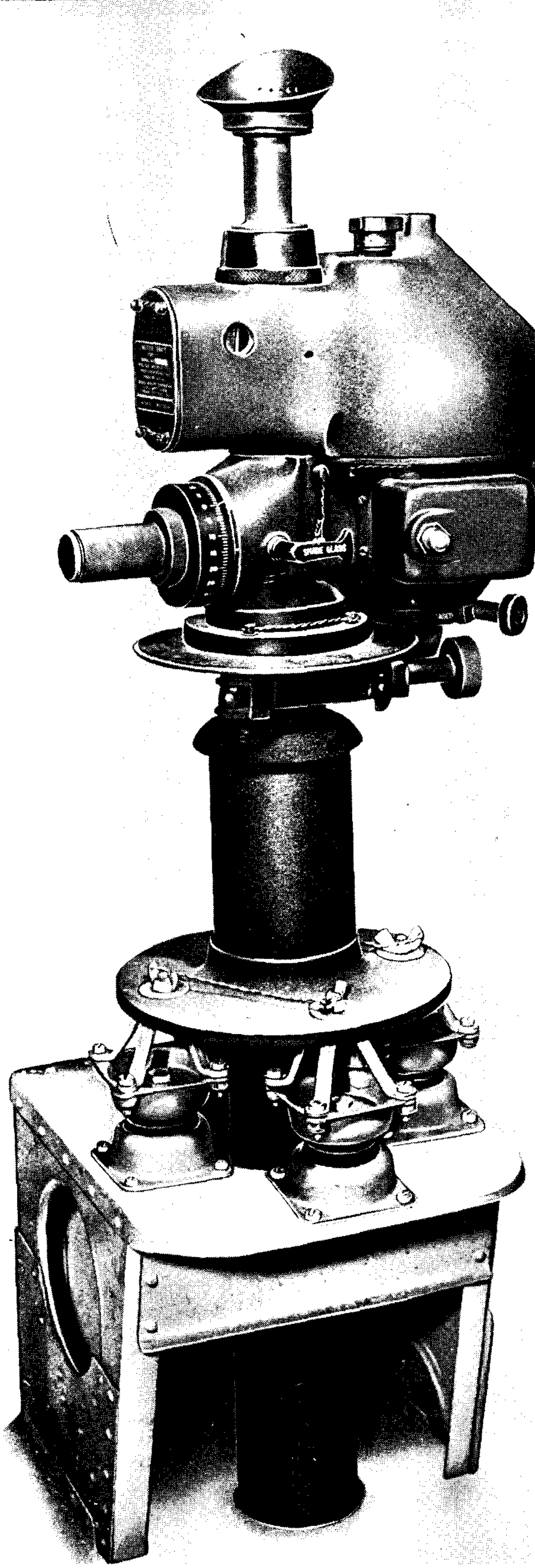


Figure 4-24 X1-27

When operating as a magnetic compass, the system is slaved (electrically connected) to the flux valve. The flux valve senses its position with respect to the earth's magnetic meridian and transmits a heading signal to the master indicator. A synchronizer knob on the master indicator is used to quickly synchronize the indicator with the flux valve when the system is initially put into operation. An annunciator pointer on the master indicator shows the direction the synchronizer knob must be turned to align the indicator with the flux valve. When the annunciator is centered, the indicator and flux valve are synchronized. Power to the N-1 compass is supplied by a power switch (9, figure 4-15) at the navigator's station. The N-1 compass system receives power from the 28-volt dc, 115-volt single-phase ac and the 115-volt 3-phase ac power systems.

Note

The standby compass should be used to crosscheck headings against the N-1 compass reading. The N-1 compass system is a complex system utilizing several electronic components and as such is subject to failure. Especially on long flights where the aircraft heading is not altered very often, failure of the system can occur, and the pilot's repeaters remain on the same heading, yet the aircraft may slowly drift off course. A frequent check of the standby compass will prevent this.

Operation as a Slaved Magnetic Compass.

1. N-1 Compass Power Switch—ON.

Note

From 10 to 15 minutes are required for the gyro to reach a synchronous speed and erect.

2. Latitude Correction Knob On Master Indicator—Full counterclockwise.

Note

The small latitude pointer will move to the off position, rendering the latitude correction device inoperative and slaving the compass to the flux valve. During flight, the compass will be temporarily deslaved by a slaving control gyro when the aircraft is turning at a rate in excess of approximately 23 degrees per minute.

3. Annunciator Pointer—Center.

   Center annunciator pointer, using synchronizer knob. When annunciator is centered, flux valve and indicator are synchronized.

CAUTION

Be sure to turn the synchronizer knob to the left or right as indicated by the annunciator pointer, since it is possible to center the pointer with the compass 180 degrees off the magnetic heading. A check with the pilots' standby compass will verify the accuracy of the adjustment.

Note

In magnetic operation, if the heading pointer on the master indicator is not synchronized to the flux valve, the system will drive itself into synchronization at the rate of 1 to 3 degrees per minute. When in magnetic operation, if the autopilot is used and the master indicator is not synchronized, the autopilot will drift in azimuth at the rate of 1 to 3 degrees per minute as long as the master indicator is not synchronized.

Before flying into regions where magnetic references become unreliable, turn latitude correction knob until latitude pointer indicates actual latitude. This deslaves flux valve and starts operation of latitude correction device. Continual movement of white dot indicates that latitude correction is being made. Except for random wander of 1 degree or less per hour, indicator will continue to indicate correct magnetic heading.

CAUTION

The basic magnetic reference will be lost if the synchronizer knob is moved.

Operation as a Directional Gyro.

1. N-1 Compass Power Switch—ON.
2. Latitude Correction Knob—CLOCKWISE until pointer indicates latitude of aircraft position.
3. As Aircraft Changes Latitude In Flight—Reset latitude pointer to new latitude.

Note

Setting of the midlatitude every 2 degrees is sufficient for proper operation.

4. Synchronizer Knob—Engage and rotate to gyro heading reference desired.

Note

Check rotation of the small white dot. The indicator rotates clockwise in northern latitudes and counterclockwise in southern latitudes.

AUXILIARY POWER PLANT (APP).

An auxiliary power plant (APP) (15, figure 1-3) is installed in the forward lower cargo compartment to provide a source of electrical power independent of a ground power supply and for emergencies in flight. On some aircraft the APP is mounted in the main cabin near the tail cone access door. When so mounted, starting, engaging, and stopping of the unit must be accomplished at its physical location. The auxiliary power plant is a two-cylinder, four-cycle, V-type gasoline engine with a muffler and a self-contained oil supply system that will operate from sea level up to 10,000 feet. The fuel is supplied from the No. 3 main wing tank. The auxiliary power plant generator will supply, at constant speed, an electrical output of 0 to 175 amperes at 27.5 ± 0.5 volts. The generator is also used as a starter for starting the auxiliary power plant.

WARNING

No fire detector system is incorporated in a cabin-mounted APP.

CAUTION

The auxiliary power plant has a normal continuous output rating of from 0 to 175 amperes and an emergency output rating of from 175 to 263 amperes at sea level. The emergency rating should not be used for periods longer than 5 minutes as damage to the auxiliary power plant can result. As altitude is attained, the amperage output decreases until at 10,000 feet the maximum continuous output is from 0 to 158 amperes.

Note

Should fire develop in the auxiliary power plant, the fire detectors in the forward lower cargo compartment will be actuated and the appropriate fire warning lights will come on.

APP THROTTLE LEVER.

An APP throttle lever (7, figure 4-25), with CHOKE, IDLE, and RUN positions, is located below the APP control panel. The CHOKE position uses the richest fuel mixture and is used as the initial starting position with temperatures below 10°C (50°F). The IDLE position is used after the engine has started, and provides a slow speed for engine warmup. The RUN position is used after the engine has warmed up thoroughly (approximately 5 minutes) and provides high engine speed for maximum power output. An additional APP throttle lever is located on the APP.

APP FUEL AND IGNITION SWITCH.

An APP fuel ignition switch (6, figure 4-25), with ON and OFF positions, is located on the APP control panel. In the ON position, a circuit is closed to a fuel solenoid valve on the No. 3 main wing tank to supply fuel to the APP, and the grounding circuit of the magneto is opened, permitting the magneto to generate current for the APP ignition. Placing the switch in the OFF position closes the fuel solenoid valve and grounds the magneto. Another APP fuel and ignition switch is located on the APP.

APP GENERATOR FIELD AND ARMATURE SWITCHES.

Two ganged spring-loaded switches, the APP generator field and armature switches (9, figure 4-25), are located on the APP control panel and have START and OFF positions. When the switches are held in the START positions, a circuit from the main bus is completed, energizing the generator field and armature through various relays, causing the generator to act as a starting motor for the APP engine. When the switches are released to the OFF positions after the APP engine has started, the relays are deenergized, allowing the generator to furnish power to the main bus when the APP load switch is in the LOAD position.

APP LOAD SWITCH.

An APP load switch (8, figure 4-25), with LOAD and OFF positions, is located on the APP control panel. When the switch is placed in the LOAD position, a relay is closed to connect the APP generator output to the main bus. Placing the switch in the OFF position isolates the APP generator.

APP FIRE WARNING LIGHTS TEST SWITCH.

An APP fire warning lights test switch (4, figure 4-25), with unmarked TEST and OFF positions, is located on the APP control panel. The switch is spring loaded to the OFF position; and, when held in the TEST position, the test circuit is closed and the APP fire warning lights will come on. In the OFF position, the test circuit is deenergized.

APP VOLTAMMETER.

An APP voltammeter (3, figure 4-25), calibrated in volts and amperes, is located on the APP control panel. The voltage output of the APP generator is normally indicated when the APP is in operation. Pressing a push-button, located on the face of the instrument, will provide an indication of the amperage output of the APP generator.

APP CYLINDER HEAD TEMPERATURE INDICATOR.

An APP cylinder head temperature indicator (1, figure 4-25), calibrated in degrees centigrade, is located on the APP control panel and provides an indication of the APP cylinder head temperature.

APP FUEL AND IGNITION ON INDICATOR LIGHT.

The APP fuel and ignition on indicator light (5, figure 4-25) is located on the APP control panel and will come on when the fuel and ignition switch is in the ON position.

APP FIRE WARNING LIGHTS.

Two APP fire warning lights (2, figure 4-25) are located on the APP control panel. When any of the thermocouple fire detectors for the APP are actuated, the two APP fire warning lights and the baggage compartment fire warning light (APP) on the pilots' instrument panel will come on.

STARTING AUXILIARY POWER PLANT ELECTRICALLY.

1. Battery Switch—ON.
2. APP Throttle Lever—Between IDLE and RUN positions.

Note

Operation of the choke can best be determined by experience. Little or no choke will be necessary above 10°C (50°F).

3. APP Fuel and Ignition Switch—ON.

   Check that fuel and ignition on indicator light comes on.

4. APP Generator Field and Armature Switches—START.

   Hold generator field and armature switches in START position until engine starts, then release to OFF.

5. APP Throttle Lever—RUN.

   After engine has warmed up (approximately 5 minutes in IDLE position), move throttle lever to RUN position.

CAUTION

To prevent damage to the auxiliary power plant, the throttle lever must not be moved to the RUN position until after the engine has warmed up.

6. Load Switch—LOAD.

AUXILIARY POWER PLANT MANUAL STARTING (SOME AIRCRAFT).

The auxiliary power plant may be manually started by means of a pull cord located on the power plant.

STOPPING AUXILIARY POWER PLANT.

1. APP Load Switch—OFF.
2. APP Throttle Lever—IDLE for 5 minutes.
3. APP Fuel and Ignition Switch—OFF.

CARGO LOADING EQUIPMENT.

BOOM HOIST.

Provisions are made for a boom hoist in the cargo compartment aft of the aft cargo door.

MAIN CABIN DOOR AND CARGO DOORS.

Double doors (12, and 13, figure 1-3) are mounted on hinges that permit the doors to open outward. Each door is provided with a trigger latch mechanism that secures the door against the fuselage in the open position, to allow unobstructed passenger or cargo loading operations. The forward door is a cabin door used as a passenger entrance and exit door when the aircraft is on the ground. It can also be jettisoned by an emergency release mechanism during flight to serve as an emergency exit (figure 3-5). The forward door can be opened or closed from either side by a handle. The aft portion is a cargo door and can be opened or closed from the main cargo compartment only; it is secured in the closed position by four latch pins. With both doors fully open, dimensions of the main cargo entrance are 95 3/4 inches wide by 67 inches high. Each corner of the entrance is rounded by a 8 1/8 inch radius, which slightly restricts the clear opening. Two lower cargo compartment doors are mounted on hinges that permit the doors to swing inward to the open position. A handle installed on the exterior of each door serves to either lock or unlock the door latch assembly.

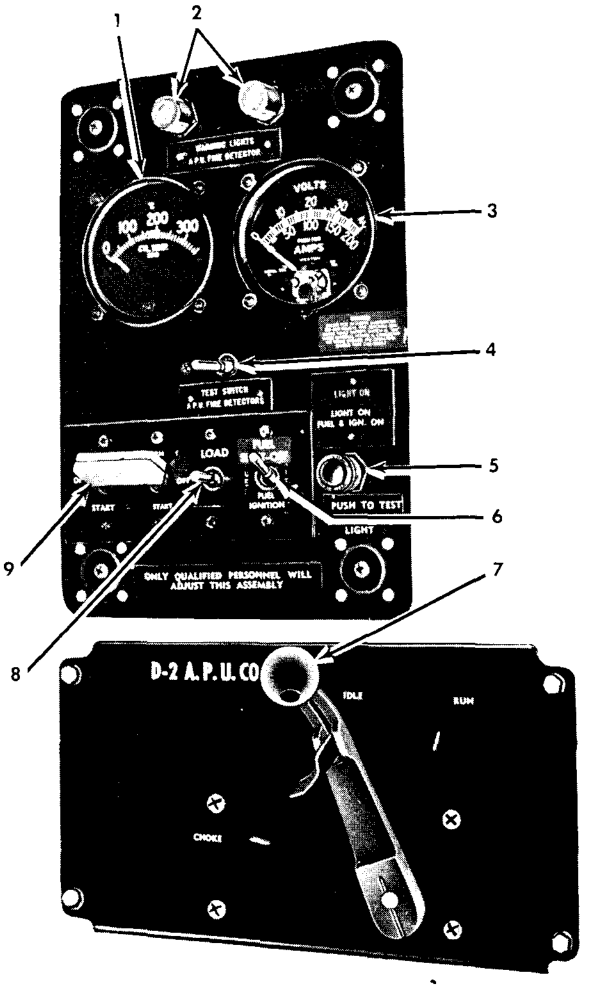
AUXILIARY CARGO DOOR (HC-54 AIRCRAFT).

The aft cargo door has been modified to incorporate an auxiliary cargo door (29, sheet 2, figure 1-3). The auxiliary door provides a means of inflight cargo drops. The auxiliary cargo door is hinged at the top of the aft cargo door and opens inward. The auxiliary cargo door is held in the open position by a ring and strap from the top of the fuselage. Two latches lock the auxiliary cargo door to the aft cargo door. A rod-type lock assembly locks the auxiliary cargo door to the aft cargo door and the aft cargo door to the fuselage. Two lower cargo compartment doors are mounted on hinges that permit the doors to swing up to the open position. A locking receptacle on the exterior of each lower compartment door is provided to receive a T-handle which serves to either lock or unlock the door latch assembly.

TROOP AND CASUALTY CARRYING PROVISIONS.

Troop carrying equipment consists of folding canvas benches and safety belts installed along the sides of the main cabin, to accommodate 35 to 49 persons. As an ambulance transport, 28 to 36 litters can be installed in horizontal tiers. On some aircraft, 40 to 44 removable

AUXILIARY POWER PLANT (APP) CONTROL PANEL—Typical



1. CYLINDER HEAD TEMPERATURE INDICATOR
2. FIRE WARNING LIGHTS
3. VOLTAMMETER
4. FIRE WARNING LIGHTS TEST SWITCH
5. FUEL AND IGNITION INDICATOR LIGHT
6. FUEL AND IGNITION SWITCH
7. THROTTLE LEVER
8. LOAD SWITCH
9. GENERATOR FIELD AND ARMATURE SWITCHES

Figure 4-25

X1-26

commercial-type passenger seats are installed in the main cabin (see figure 4-29).

CREW ACCOMMODATIONS.

Accommodations for a relief crew are provided aft of the rear bulkhead at the radio operator's and the navigator's stations. Facilities available to the relief crew include two crew bunks, a crew lavatory, and a washbasin. On EC-54 aircraft, the bunks are mounted one above the other over the fuselage oil tank in the main cabin. The bunk enclosure is provided with curtains. On HC-54 the crew bunks are located aft of the navigators station in the fuselage fuel tank compartment. Each bunk is equipped with a safety belt. (See figure 1-3 for locations of crew accommodations.)

MISCELLANEOUS EQUIPMENT.

WINDSHIELD WIPERS AND CONTROL KNOBS.

A hydraulically actuated windshield wiper unit is installed on each windshield panel. The wiper units are controlled by knobs (13, figure 1-7 and 9 figure 1-8) located on the outboard side of each pilots' seat. Some aircraft are equipped with a dual wiper unit with a single control located outboard of the copilot's station. Type of wiper installed can be determined by checking the hydraulic unit above the glareshield, at the base of the windshield center post. Turning the knob counterclockwise mechanically opens a needle valve which increases the speed of windshield wiper action.

CAUTION

To avoid scratching the windshield, do not operate the windshield wiper blades when the windshield is dry.

RADIO OPERATOR'S SEAT.

A radio operator's seat (see figure 4-9) is equipped with a safety belt. No provisions are made for adjustment of the seat.

DATA RECORDER OPERATOR'S SEAT (EC-54 AIRCRAFT).

The data recorder operator is provided with a metal, swivel-type seat (12, figure 4-17) equipped with a safety belt.

NAVIGATOR'S SEAT (HC-54 AIRCRAFT).

On HC-54 aircraft, the navigator is provided with an adjustable swivel seat (17, figure 4-15). The seat is equipped with an upholstered seat cushion, backrest cushions, safety belt, and shoulder harness.

SCANNER'S SEATS (HC-54 AIRCRAFT).

Each scanner is equipped with an adjustable seat (4, figure 4-28). Each seat is provided with an upholstered seat cushion, backrest cushions, safety belt, and shoulder harness.

Shoulder Harness Inertia Reel Lock Handles (HC-54 Aircraft).

The shoulder harness inertia reel lock handles have LOCKED and RELEASED positions and are located on both scanner's seats. A latch is provided for positively retaining the handle at either position of the quadrant. Pressing down on the top of the handle releases the latch; the handle may then be moved freely from one position to the other. When the handle is in the RELEASED position, the reel harness cable will extend to allow the seat occupant to lean forward; however, the reel harness cable will automatically lock when an impact force of 2 to 3 G's is encountered. When the reel is locked in this manner, it will remain locked until the handle is moved to the

LOCKED position then returned to the RELEASED position. When the handle is in the LOCKED position, the reel harness cable is manually locked so that the crewmember is prevented from bending forward. The LOCKED position is used only when a crash landing is anticipated.

Note

> It is recommended that the shoulder harness be manually locked during maneuvers, flight in rough air, and as an added precaution in the event of forced landing.

PASSENGERS' SEATS (HC-54 AIRCRAFT).

Eight airline reclining-type seats (31, sheet 2, figure 1-3) are provided to accommodate eight passengers. Each seat has an upholstered seat cushion, backrest cushions, and a safety belt.

ENTRANCE LADDER.

An entrance ladder is provided for leaving and gaining entrance to aircraft.

SUIT HEATER RHEOSTATS.

An electric suit heater rheostat (1, figure 1-7 and 6, figure 1-8) is installed at each pilot's station and two are mounted on the bulkhead aft of the navigator's station, to be used by the radio operator and the navigator. Power source is the 28-volt dc bus.

BUFFET.

On some aircraft, a buffet (22, sheets 1 and 2, figure 1-3), operating off the 28-volt dc bus, is installed in the main cabin. It contains a hot and cold food storage box, beverage containers, two electrically operated hot cups, three 1-gallon thermos jugs, and a food storage cabinet.

CREW WATER TANK.

A 10.5-gallon crew water tank (8, figure 1-3) is installed in the ceiling over the navigator's station.

MAIN CABIN WATER TANK.

A 10.5-gallon water tank (24, sheets 1 and 2, figure 1-3) is installed aft of the lavatory bulkhead. On the C-54M, a 23-gallon water tank is installed.

MAP CASES.

Two map cases are installed in the pilots' compartment, one outboard of each pilot's seat.

TAIL SUPPORT STAND.

A tail support stand is stowed in the right side of the aft cabin. The support stand is secured to the tail skid to prevent inadvertent lowering of the tail to the ground during loading or unloading operations. The support stand is adjustable to compensate for various ground-to-tail heights.

FUEL TANK DIPSTICK.

A fuel tank dipstick is installed for measuring the fuel in the auxiliary fuel tanks.

SAFETY HARNESSES (HC-54 AIRCRAFT).

Two sets of safety harnesses are stowed in the aft MA-1 sea rescue kit rack. The safety harnesses are used by personnel in the area of the cargo doors when the auxiliary cargo door is opened. The safety harnesses are fastened to D-rings in the floor near the cargo doors.

RESCUE EQUIPMENT (HC-54 AIRCRAFT).

The rescue equipment is stowed in the forward and aft equipment stowage bins (27, figure 1-3). The bins are located forward and aft of the right scanner's station. Three MA-1 rescue kits are stowed in the forward bins and one MA-1 kit is stowed in the aft bin.

CARGO DROP GUIDE (HC-54 AIRCRAFT).

The cargo drop guide is stowed in the tail compartment. The cargo drop guide aids in ejecting the rescue kits through the auxiliary cargo door.

PARACHUTE STATIC LINE (HC-54 AIRCRAFT).

A parachute static line is installed in the left side of the main cabin.

FLARE LAUNCHER (HC-54 AIRCRAFT).

An electropneumatic flare launcher is provided for use in land or sea rescue operations. The flare launcher can be actuated either electrically or manually and provides a means of ejecting Mark 6 and Mods aircraft float lights. An adapter (5, figure 4-26) may be installed on the launcher for ejection of Mark 1 Mod 2 and Mod 3 depth charge marker day-sea dye flare. When not in use, the flare launcher is stowed aft of the forward equipment bins (see figure 4-27): when in use, the flare launcher is installed in a flare launcher receptacle (5, figure 4-28) in the floor forward of the left scanner's station. The flare launcher receives power from the 28-volt dc bus.

Air Storage Cylinder Shutoff Valve Knob.

An air storage cylinder shutoff valve knob (2, figure 4-26), located on the flare launcher, is used to regulate air pressure to the ejector mechanism.

Manual Release Lever.

A manual release lever (4, figure 4-26), located on the flare launcher, is used for manual or emergency operation.

Flare Launcher Release Switches.

One flare launcher release switch (39, sheet 5, figure 1-11) is located on the pilots' overhead panel, and one switch is at each scanner's station. The switches are used to electrically release flares remotely from the pilots' compartment or from either scanner's station.

Air Storage Cylinder Pressure Indicator.

A direct reading air storage cylinder pressure indicator (6, figure 4-26), located on the flare launcher, indicates usable pressure in psi in the air storage cylinder.

Ejector Pressure Indicator.

A direct reading ejector pressure indicator (7, figure 4-26), located on the flare launcher, indicates pressure in psi in the ejector chamber.

Flare Launcher Release Indicator Light.

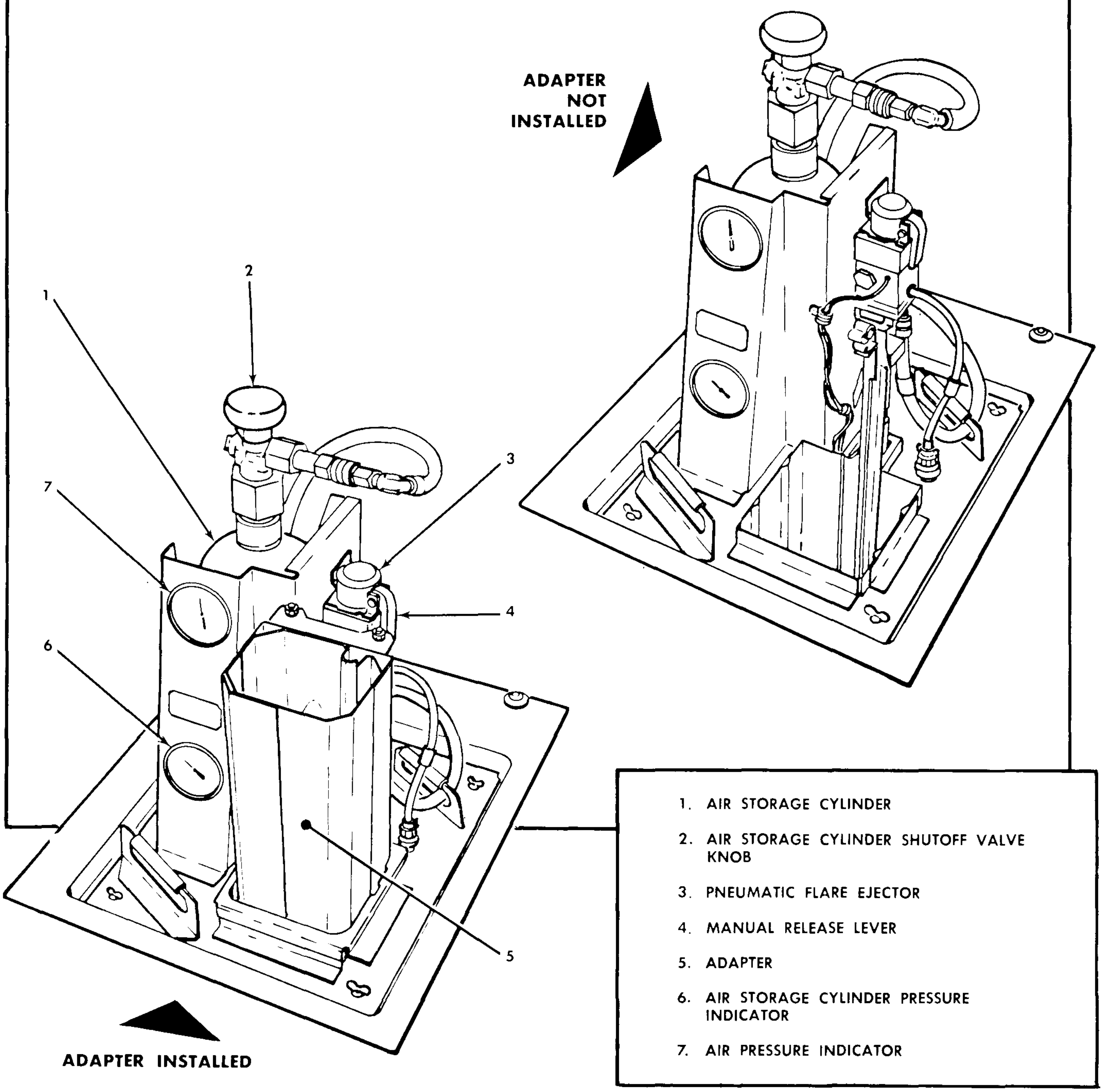
A green flare launcher release indicator light (39, sheet 5, figure 1-11), located on the pilots' overhead panel, comes on to indicate that the flare launcher is loaded and ready for operation.

Flare Launcher Operation

Before Loading.

1. Flare Launcher—Check condition and security.

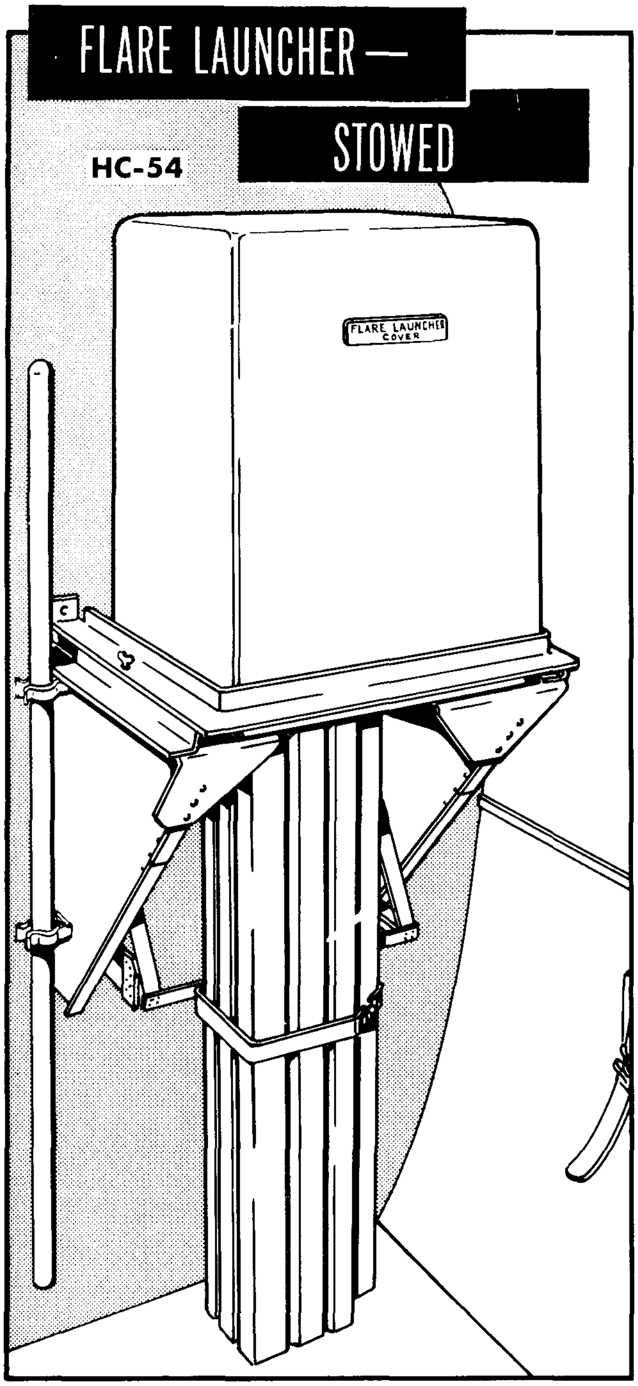
FLARE LAUNCHER — INSTALLED



1. AIR STORAGE CYLINDER
2. AIR STORAGE CYLINDER SHUTOFF VALVE KNOB
3. PNEUMATIC FLARE EJECTOR
4. MANUAL RELEASE LEVER
5. ADAPTER
6. AIR STORAGE CYLINDER PRESSURE INDICATOR
7. AIR PRESSURE INDICATOR

X1-295

Figure 4-26



X1-296

Figure 4-27

2. Flare Launcher Door Mechanism Cable—Check condition and adjustment.

3. Electrical Connectors—Check.

4. Circuit Breaker—Check IN.

5. Snap Action Switch in Flare Chute Tube—Manually actuate.

When switch is actuated, green flare launcher release indicator light on pilots' overhead panel should come on.

6. Air Storage Cylinder Shutoff Valve Knob—OPEN.

CAUTION

Open air storage bottle air valve very slowly to prevent equipment damage.

7. Air Storage Cylinder Pressure Indicator—Check.

Check air storage cylinder pressure indicator for reading of 1800 psi (fully charged).

8. Ejector Pressure Indicator—Check.

Check ejector pressure indicator for reading of 750 ± 50 psi.

9. Manual Release Lever—Check operation.

10. Emergency Flare Ejector Handle Assembly—Position.

Position emergency flare ejector handle assembly in MA-1 kit bin across from launcher.

11. Lanyard Assemblies—Check.

Check for availability of short (18-inch) and long (44-inch) lanyard assemblies.

Loading.

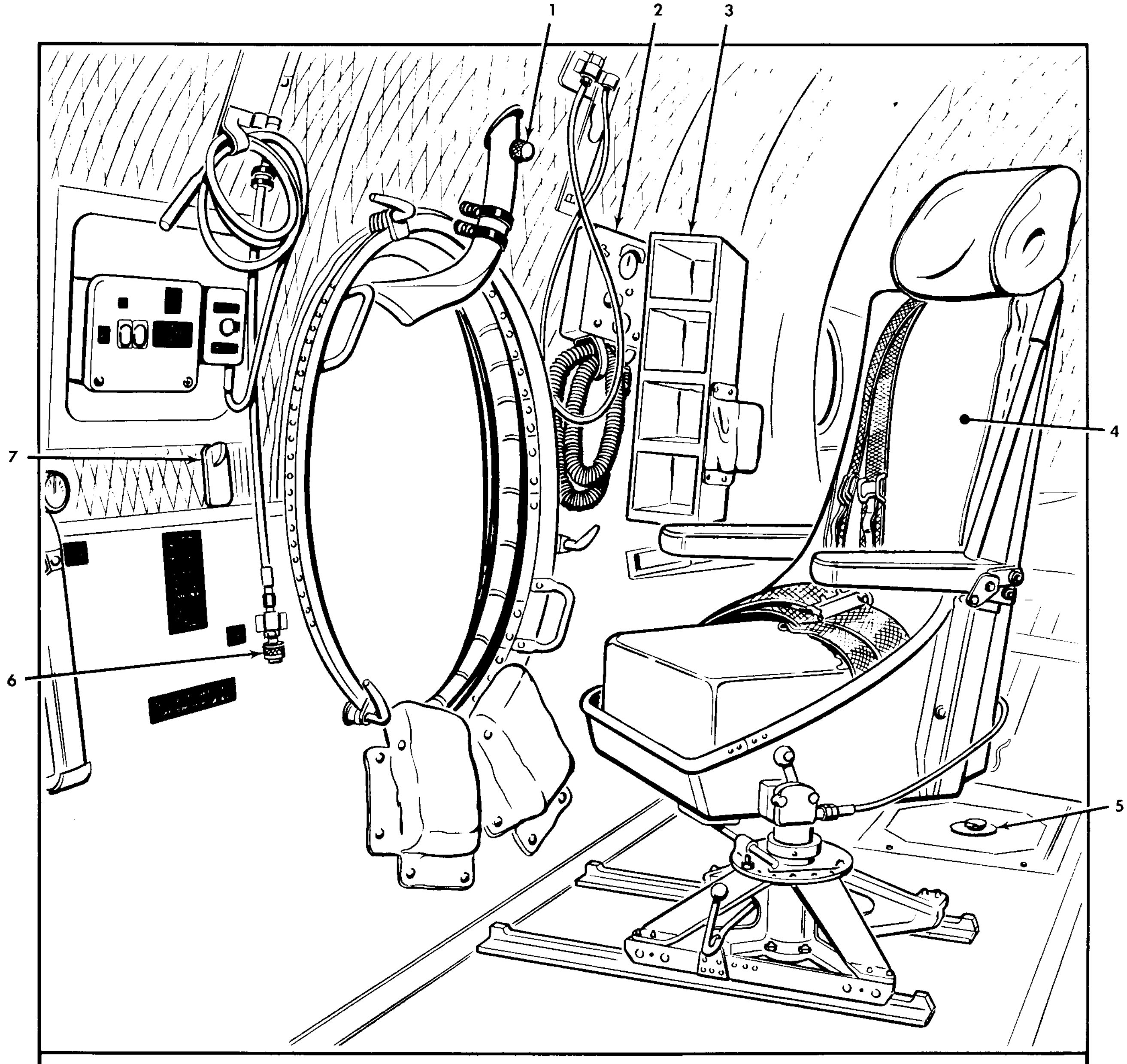
1. Aircraft Float Light (Mark 6 And Mods):

   a. Place float in flare chute with metal nose plate down.

   b. Push round down until round rests on reaction latch in flare chute. Round is in position when approximately 8 inches below top of launching tube. Green flare launcher release indicator light on pilots' overhead panel should come on to show that flare is in chute.

SCANNER'S STATION — Typical

HC-54



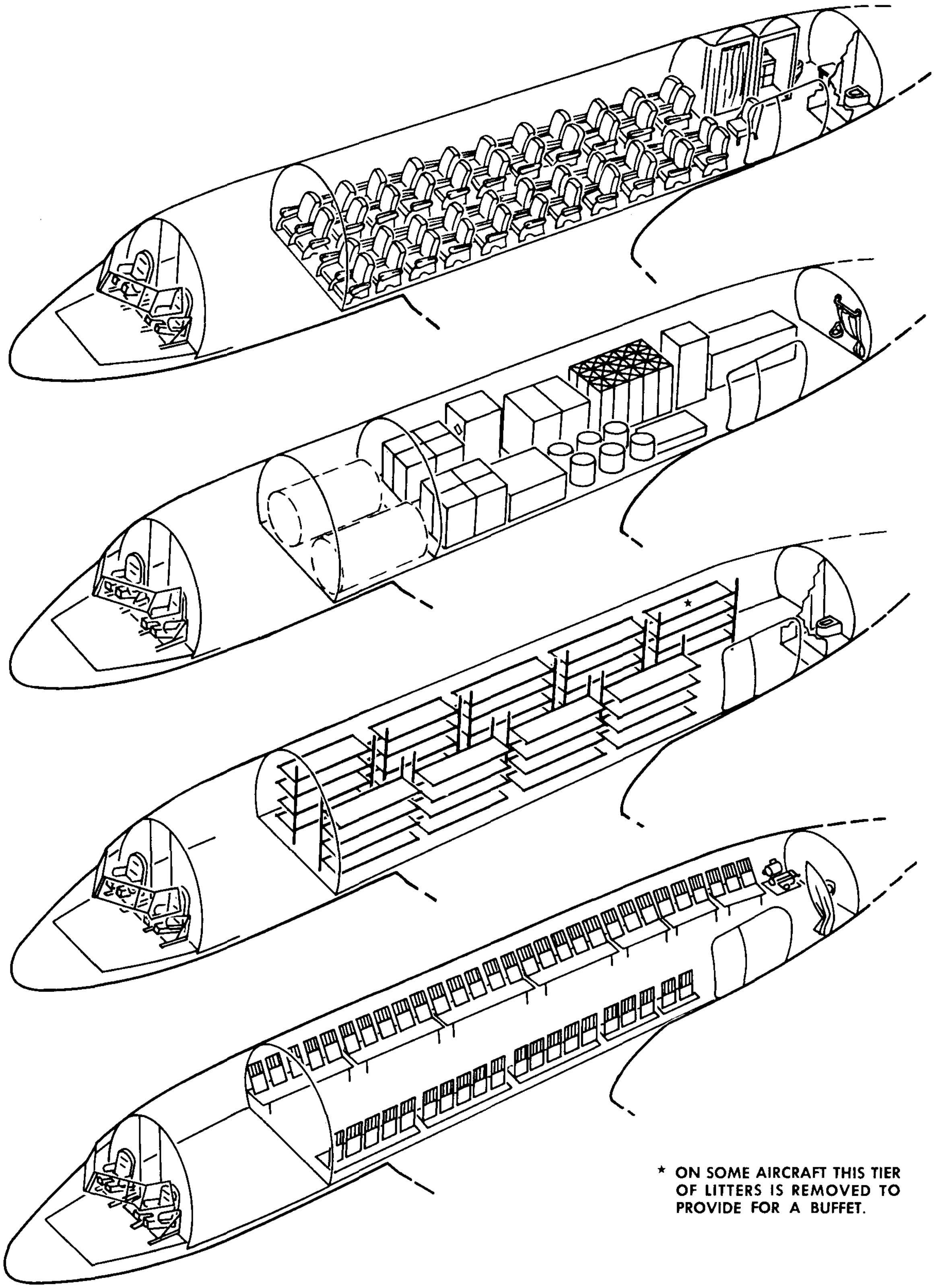
1. BLISTER DEFROSTING KNOB
2. OXYGEN REGULATOR PANEL
3. FLARE STOWAGE BIN
4. SCANNER'S SEAT
5. FLARE LAUNCHER RECEPTACLE
6. PORTABLE OXYGEN CYLINDER RECHARGER ASSEMBLY
7. ASH TRAY

X1-297

Figure 4-28

INTERIOR

USAF AND NAVY C-54



*** ON SOME AIRCRAFT THIS TIER OF LITTERS IS REMOVED TO PROVIDE FOR A BUFFET.**

Figure 4-29 (Sheet 1 of 2)

X1-28

ARRANGEMENT — Typical

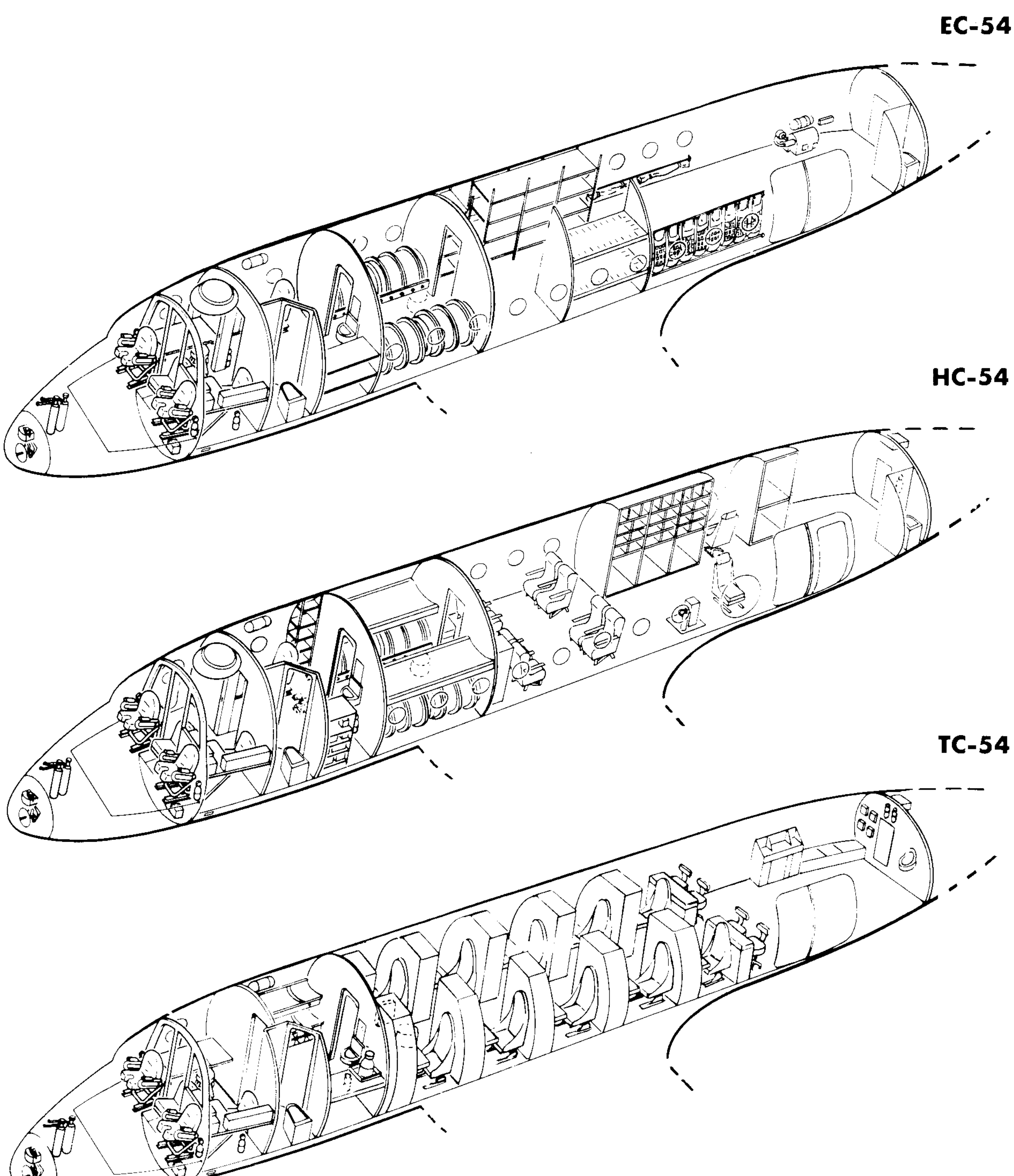


Figure 4-29 (Sheet 2 of 2)

X1-298

c. Remove only center adhesive tape covering pull ring on round.

d. Attach short lanyard (18-inch) to pull ring on round and attach other end of lanyard to latch assembly on top of ejection sliding piston.

e. Notify aircraft commander that round is ready for firing.

2. Aircraft Parachute Flare (Mark 6 and Mods):

a. Before loading, remove metal cover from fuse end of flare.

b. Carefully pull lanyard loose from side of flare; fold and secure lanyard on top of flare with piece of 1-inch masking tape.

CAUTION

Do not set time delay fuse before placing the flare in the flare chute.

c. Place flare in flare chute with parachute end down and fuse end up.

d. Lower flare until flare rests on reaction latch in flare chute.

e. Green flare launcher indicator light on pilots' overhead panel should come on to show that flare chute is loaded.

f. Loosen pointer on time delay fuse and turn from SAFE to desired dropping distance; then tighten thumbscrew on pointer so that pointer penetrates chipboard flare case.

Note

The fuse setting is the distance the flare will drop from the aircraft before the flare ignites.

g. Attach installed lanyard to latch assembly on top of ejection (sliding) piston.

h. Fold remaining part of lanyard neatly on top of flare and secure lanyard to top of round with piece of 1-inch masking tape.

i. Notify aircraft commander that round is ready for firing.

3. Depth Charge Marker (Mark 1 Mod 3):

a. Remove flare launcher adapter from stowed position.

b. Slide adapter in flare chute until adapter touches reaction latch, then apply downward pressure by hand on adapter and pull up on ejector assembly (pogo stick). This will release the reaction latch and allow adapter to seat.

Note

When the adapter is installed, the green flare launcher release indicator light on the pilots' overhead panel will come on and stay on as long as the adapter is installed.

c. Attach long lanyard (44-inch) to pull ring on round.

d. Insert round into flare chute carefully by hand so that firing pin will not be actuated. Push round to bottom of adapter flare chute so round rests on launcher door.

e. Attach other end of long lanyard to snap stud on top of adapter.

f. Notify aircraft commander that round is ready for firing.

Operation.

1. Electrical Operation:

a. Actuate flare launcher using flare launcher release switch at either scanner's station or on pilots' overhead panel.

WARNING

To launch the round, it is necessary to actuate one of the release switches for at least 3 seconds to ensure positive operation of the launcher.

b. Wait until launching cycle is completed before attempting to reload launcher.

c. Remove lanyard from latch assembly or snap stud before reloading launcher.

2. Manual Operation:

a. Move safety on manual release lever to unlock position.

b. Actuate manual release lever on top of ejector assembly (pogo stick).

WARNING

To launch the round, it is necessary to actuate the manual release lever for at least 3 seconds to ensure positive operation of the launcher.

c. Wait until launching cycle is completed before attempting to reload launcher.

d. Remove lanyard from latch assembly or snap stud before reloading launcher.

3. Emergency Operation:

a. If round is not ejected by electrical or manual actuation, immediately proceed to eject round by placing pad end of emergency flare ejector handle on top of round and pushing downward while simultaneously pulling up on ejector assembly. This will release reaction latch. Continue pushing downward on round until round is out of aircraft.

SECTION V

OPERATING LIMITATIONS

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

INTRODUCTION.

This section includes the engine and aircraft limitations that must be observed during normal operation. Particular notice must be taken of the instrument limit markings (figure 5-1), which form a part of these limitations, and must be referred to because these limitations are not necessarily repeated in the text.

Note

When any limitation is exceeded, record limitation, magnitude, and conditions in the appropriate section of Form 781 (appropriate Naval Maintenance Form for Navy C-54 aircraft).

MINIMUM CREW REQUIREMENT.

USAF C-54, EC-54, HC-54, AND TC-54 AIRCRAFT.

The minimum crew consists of a pilot, a copilot and flight engineer. Additional crew members, as required, will be added at the discretion of the commander.

NAVY C-54 AIRCRAFT.

The minimum crew consists of a pilot and copilot. Additional crew members, as required to accomplish special missions, will be added at the discretion of the commander.

INSTRUMENT MARKINGS.

Refer to figure 5-1 for instrument limit markings.

ENGINE LIMITATIONS.

ENGINE OVERSPEED.

Refer to figure 5-1 for normal engine operating limits. Overspeed limits for the engines are: 3100 to 3300 rpm—engine must have complete inspection; over 3300 rpm—engine must be replaced. Note all conditions of overspeed on AFTO Form 781.

CAUTION

Under no conditions should 2550 rpm be exceeded during engine operation in HIGH blower.

ENGINE OVERBOOST.

Refer to figure 5-1 for normal engine operating limits and 1C-54D-1 Appendix, Section A-2 for power schedules and authorized corrective factors.

a. Excessive Manifold Pressure (MAP) overboost limits: when operating engine (S) at Take-off RPM any MAP above Take-Off MAP limit is considered an overboost. When operating at METO RPM or below, any MAP above METO power MAP limit is considered an overboost. The time limit for METO and Take-Off are the same and are as follows:

(1) An overboost of 1 to 5 inches Hq for periods up to 5 seconds requires no action.

CAUTION

If the following engine overboost conditions occur, do not take-off, or if airborne, land as soon as practicable. Should mission requirements and/or flight safety dictate continued operation of an overboosted engine, consideration should be given to reduce power and maintain close surveillance of the affected engine's performance.

(2) Overboost of 1 to 10 inches for 5 to 15 seconds.

(3) Overboost of 5.1 to 10 inches Hq for any period of time up to 15 seconds.

(4) Overboost of any magnitude for periods in excess of 15 seconds.

(5) Overboost of 10 inches Hq or more for any period of time.

b. Overboost conditions listed in (2), (3), (4) and (5) above require maintenance actions and must be carefully recorded on Form 781 noting (if possible) the MAP, RPM, CAT, Mixture Setting, Altitude and duration of overboost.

Note

The above overboost limits are not intended in any way to allow or condone operation of the engine at any combination of horsepower, RPM and MAP in excess of those authorized in the Tables and the Power Performance Charts of Appendix (T.O. 1C-54D-1).

NORMAL FUEL GRADE OPERATING LIMITS.

The normal operating limits on grade 115/145 and 100/130 fuel are the same and are as follows:

Power	HP	RPM	MP (Inches Hg)	ALT	Blower	Mixture
Maximum (5 minutes)	1450	2700	49.5 *50.0	1000 S. L.	LOW	AUTO-RICH
METO	1200	2550	40.5 42.0	5300 S. L.	LOW	AUTO-RICH
METO	1100	2550	43.0 44.0	15,000 7000	HIGH	AUTO-RICH
Maximum Cruise	800	2230 2112	29.0 33.0	12,000 S. L.	LOW	AUTO-LEAN
Maximum Cruise	750	2150	31.1	19,000	HIGH	AUTO-LEAN

*An increase of up to 1.5 inches is authorized to compensate for horsepower loss due to humidity. (See Appendix I).

MAXIMUM POWER LIMITATIONS.

Flight safety dictates the use of maximum power for every takeoff. Maximum rpm is used so that the engine is putting its full capacity into operation. Maximum rpm also helps the propeller by compensating for the lack of forward speed with high rotational velocity. This crankshaft speed will be maintained until the aircraft has accelerated to a speed at which directional control can easily be maintained if one engine should fail suddenly, thus creating excessive drag. Normally, maximum power is seldom used for more than 1 minute. However, when conditions require, maximum power may be used for a period not to exceed 5 minutes, subject to limiting cylinder head and oil temperatures.

Note

The cylinder head temperature must not exceed 170°C before start takeoff or exceed 260°C during takeoff.

METO (MAXIMUM EXCEPT TAKEOFF) POWER.

METO power (maximum continuous) is the limit of engine reliability. This is the maximum power (bhp) and engine speed (rpm) that may be used for continuous operation.

Note

During high blower operation the maximum (METO) power is 1100 bhp with a more restrictive carburetor air temperature limit (+15°C).

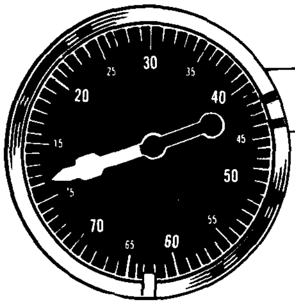
OIL PRESSURE LIMITS.

The following oil pressure limits are based on oil inlet temperature of 60°C. Desired oil pressure at 2200 rpm, at this temperature, is 85 to 90 psi.

RPM	Oil Pressure (psi) Minimum	Maximum
2700 (Maximum Power)	80	110
2550 (METO Power)	80	100
2000 to 2200	65	100
1600	55	90
1400	45	---
Idle	15	---

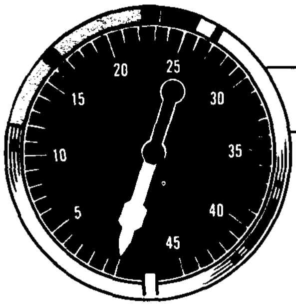
INSTRUMENT LIMIT

FUEL GRADE 100/130



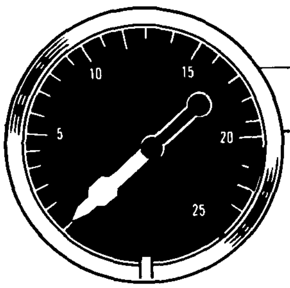
MANIFOLD PRESSURE

- 42 IN. Hg METO POWER LOW BLOWER
- 44 IN. Hg METO POWER HIGH BLOWER (OPERATION ABOVE THIS PRESSURE LIMITED TO FIVE MINUTES)
- 50 IN. Hg MAXIMUM



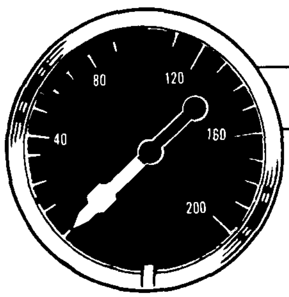
TACHOMETER

- 1200 TO 1600 RPM AUTO LEAN PERMITTED
- 1601 TO 1699 RPM DANGEROUS EMPENNAGE VIBRATION
- 1700 TO 2230 RPM AUTO LEAN PERMITTED
- 2231 TO 2309 RPM RICH REQUIRED
- 2310 TO 2510 RPM POSSIBLE CRANKSHAFT FAILURE
- 2550 RPM MAXIMUM CONTINUOUS (OPERATION ABOVE THIS RPM LIMITED TO 5 MINUTES)
- 2700 RPM MAXIMUM



FUEL PRESSURE

- 21 PSI MINIMUM FOR FLIGHT
- 21 TO 23 PSI NORMAL OPERATION
- 25 PSI MAXIMUM



OIL PRESSURE

- 15 PSI MINIMUM IDLE
- 55 PSI MINIMUM FOR FLIGHT
- 55 TO 100 PSI NORMAL OPERATION
- 100 PSI MAXIMUM (110 PSI MAX POWER)

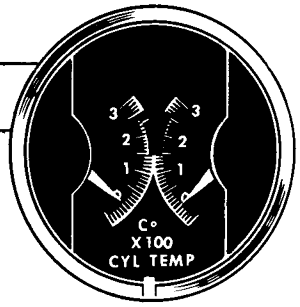
Figure 5-1 (Sheet 1 of 4)

X1-299

MARKINGS

FUEL GRADE 100/130

CYLINDER HEAD TEMPERATURE

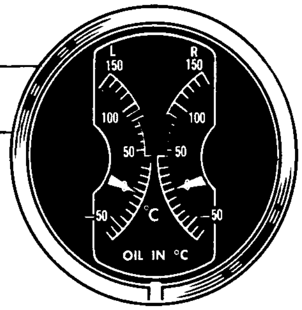


150° C TO 232° C NORMAL (150° C TO 200° C DESIRED) AUTO LEAN PERMITTED

232° C TO 260° C AUTO RICH REQUIRED

260° C MAXIMUM

OIL TEMPERATURE

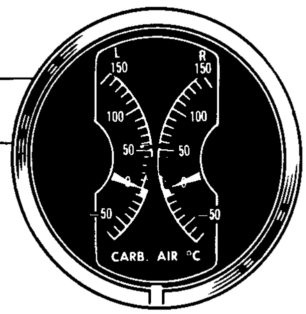


40° C MINIMUM FOR FLIGHT

40° C TO 85° C CONTINUOUS OPERATION (60° C TO 75° C DESIRED)

93° C MAXIMUM

CARBURETOR AIR TEMPERATURE

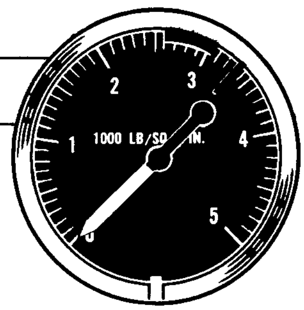


—10° C TO 15° C DANGER OF ICING

15° C TO 38° C NORMAL OPERATION

55° C MAXIMUM DANGER OF DETONATION

HYDRAULIC PRESSURE



2600 TO 3050 PSI NORMAL OPERATION

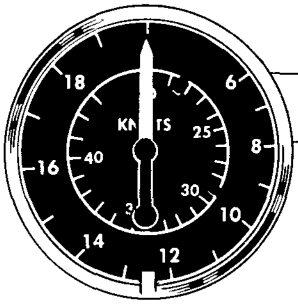
3300 PSI MAXIMUM

Figure 5-1 (Sheet 2 of 4)

X1-300

INSTRUMENT LIMIT

FUEL GRADE 100/130

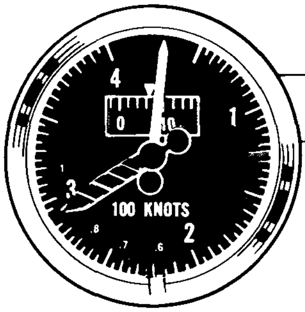


AIRSPEED

125 KNOTS LANDING GEAR AND MAXIMUM FLAPS (NAVY C-54 AIRCRAFT — LANDING GEAR 156 KNOTS)

217 KNOTS MAXIMUM LEVEL FLIGHT

290 KNOTS MAXIMUM DIVE



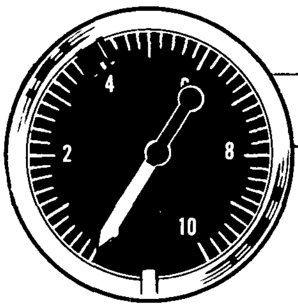
AIRSPEED

125 KNOTS LANDING GEAR AND MAXIMUM FLAPS (NAVY C-54 AIRCRAFT — LANDING GEAR 156 KNOTS)

217 KNOTS MAXIMUM LEVEL FLIGHT

290 KNOTS MAXIMUM DIVE

▲ MACH INDEX SET AT MINIMUM MACH SETTING

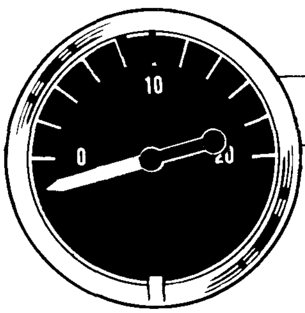


VACUUM PRESSURE

3.75 IN. Hg MINIMUM

3.75 TO 4.25 IN Hg NORMAL OPERATION

4.25 IN Hg MAXIMUM



DEICING SYSTEM PRESSURE

8 TO 8.5 PSI NORMAL OPERATION

10 PSI MAXIMUM

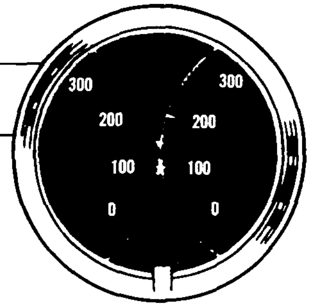
Figure 5-1 (Sheet 3 of 4)

X1-112

MARKINGS

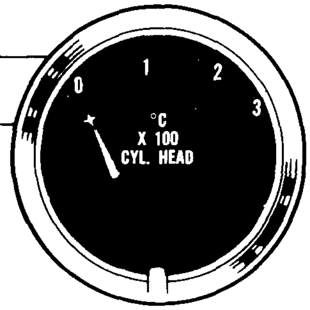
FUEL GRADE 100/130

CABIN HEATER AIR TEMPERATURE



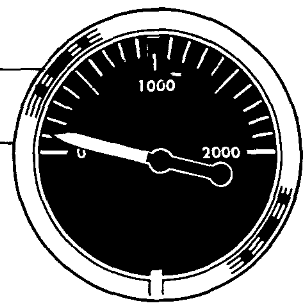
185° C MAXIMUM

PILOTS' COMPARTMENT (COCKPIT) HEATER AIR TEMPERATURE



185° C MAXIMUM

EMERGENCY AIRBRAKE PRESSURE

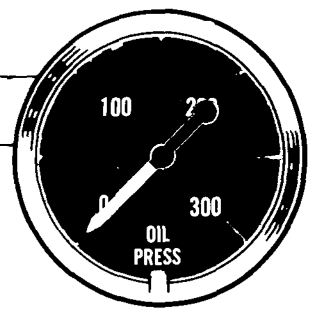


950 PSI MINIMUM

950 TO 1050 PSI NORMAL OPERATION

1050 PSI MAXIMUM

AUTOPILOT (A3-A) OIL PRESSURE



120 PSI MINIMUM

120 TO 130 PSI NORMAL OPERATION

130 PSI MAXIMUM

Figure 5-1 (Sheet 4 of 4)

X1-301

CARBURETOR AIR TEMPERATURE LIMITATIONS.

Low Blower: Maximum CAT without carburetor heat . . . . +55° C

Low Blower: Maximum CAT with carburetor heat . . . . +38° C

High Blower: Maximum CAT . . . . . +15° C

AIRSPEED LIMITATIONS.

1. The maximum level flight airspeed is 217 knots IAS.

2. The maximum dive speed is 290 knots IAS.

These limiting airspeeds are applicable at all altitudes. For effect of gross weight on speed limitation, refer to cruise speeds paragraph, this section.

3. Wing flaps:

Wing Flap Angle (degrees)	Speed (Approximate IAS) (knots)
10	186
20	176
30	138
40	125

4. Landing light operation: Maximum speed with the landing lights extended is 125 knots IAS.

5. Landing gear extension: Maximum speed with the landing gear extended is 125 knots IAS (156 knots IAS for Navy C-54 aircraft).

CROSSWIND COMPONENT.

The maximum crosswind component for take-off or landing is 26 knots.

PROHIBITED MANEUVERS.

All aerobatics, including angles of bank in excess of 60 degrees, are prohibited in this aircraft.

Slipping or skidding as required for asymmetric power conditions, or for landing approaches, are permitted at airspeeds not in excess of 152 knots IAS.

WARNING

If flight conditions have required that an abrupt control surface movement be made and possible or actual structural damage has taken place, it is imperative that the surface deflected be allowed to return at a slower or dampened rate, otherwise structural failure may result.

CENTER OF GRAVITY LIMITATIONS.

The location of the center of gravity for any gross weight configuration must be as determined from T. O. 1-1B-40, "Handbook of Weight and Balance Data," and must fall within the linits shown in the Center-of-Gravity Limitations chart (See Figure 5-1A.) These limitations are a combination of structural, aerodynamic, and control limitations which must be observed to obtain safe and effective performance of the airplane.

The airplane should be loaded in accordance with T. O. 1-1B-40 and never during the mission should the center of gravity be allowed to move outside these limits as a result of fuel usage or cargo removal.

CENTER OF GRAVITY LIMITS

MODEL: C-54
DATE: 29 DEC 66
DATA BASIS: CALCULATED

——— LANDING GEAR DOWN

– – – LANDING GEAR UP

NOTE:
LOADS WHICH FALL WITHIN THE LANDING GEAR DOWN ENVELOPE WILL FALL WITHIN THE LANDING GEAR UP ENVELOPE WHEN THE GEAR IS RETRACTED.

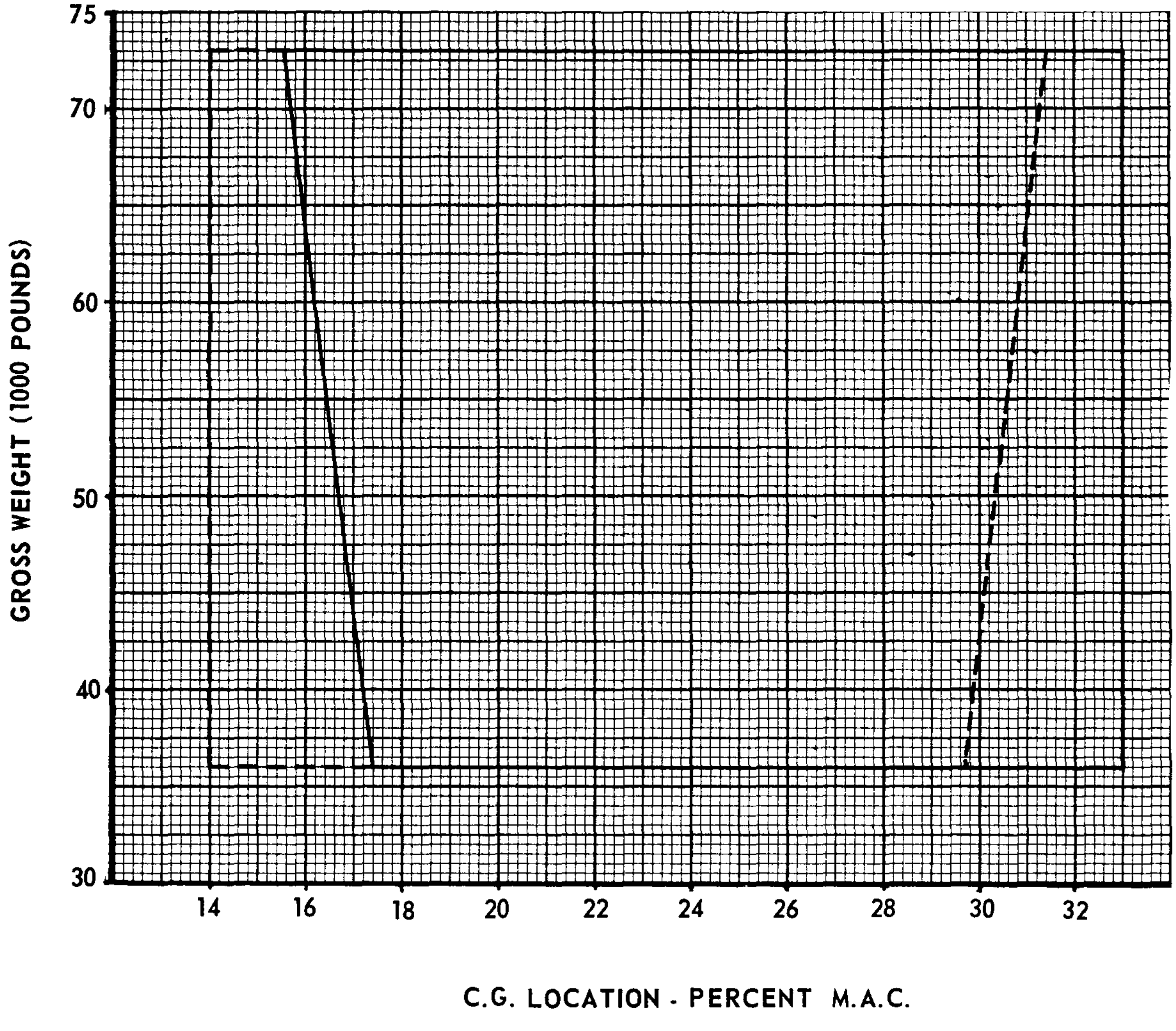


Figure 5-1A.

TRIM TAB LIMITS.

The trim tab limits for the aircraft in straight and level flight with a normal (23 percent MAC) center of gravity location are as follows:

Aileron	±2 degrees
Elevator	±2 degrees
Rudder	±3 degrees

If trim tab settings in excess of these limits are required to trim the aircraft for straight and level flight, the aircraft is either incorrectly rigged or is loaded in such a manner that the center of gravity location is abnormal.

OPERATIONAL WEIGHT LIMITATIONS.

Weight, more than any other single factor, will determine the capability and performance of your aircraft. If this limitation is exceeded, a loss in the performance of the aircraft is inevitable and structural failure is quite probable. When the aircraft is loaded beyond the established limits, ceiling and range are decreased, control forces and stalling speeds become higher, and the rate of climb falls off rapidly as the maximum gross weight is exceeded. The takeoff and landing rolls increase appreciably with an increase in gross weight. Likewise, the brakes may become insufficient to brake the forward momentum of the aircraft, and the wings will become more vulnerable to airloads during maneuvers or flight through turbulent air.

In order that cargo of various sizes may be accommodated, the cargo hold is of such proportions that space is not a restrictive factor; consequently, overloading is entirely possible.

The maximum recommended structural gross weight limitations for normal operation are as follows:

Takeoff	73,000 pounds
Landing	63,500 pounds
C-54 Aircraft prior to AF44-9101 Zero Wing Fuel (six and eight tank fuel system)	58,000 pounds
C-54 Aircraft AF44-9101 and Subsequent Zero Wing Fuel (eight tank fuel system)	60,700 pounds

CAUTION

It is recommended that landings not be made with more than 1580 gallons integral wing fuel, distributed as follows: 395 gallons in each inboard (No. 2 and 3) main tanks, and 395 gallons in each outboard (No. 1 and 4) main or outboard main and outboard (1 or 4, or left or right) auxiliary fuel tanks combined. This limitation is necessary in order that the wing may safely withstand the designed basic normal landing requirements.

WEIGHT AND LOADS.

As fuel, cargo, crew members, and additional equipment are added in order that the aircraft may accomplish a specific mission, the weight of the aircraft correspondingly increases and the additional weight constitutes a force acting on the aircraft structure. On the ground, this load must be sustained by the landing gear; in flight, by the wings. There is a limit to the load which the landing gear is capable of supporting during taxi, takeoff, and landing operations; there is likewise a limit to the load which the wings can sustain in flight.

During maneuvering and flight through turbulent air, additional loads are imposed on the aircraft. These loads, caused by the acceleration of the aircraft are the result of forces which, in addition to that of gravity, act upon the total mass of the loaded aircraft. Both these forces tend to produce undesirable and potentially dangerous loads on the aircraft structure and its members. The maximum weight which the aircraft can safely carry is dependent upon distribution of the weight throughout the aircraft and its capacity to sustain airloads in accelerated flight.

LOAD FACTORS.

A load factor is the ratio of the load imposed on the aircraft when accelerated in any direction as compared with the load imposed on the aircraft by gravity in any condition of static equilibrium. The load factor denotes the strength of the forces acting on the aircraft because of sudden changes in air currents and manipulation of the controls, and is expressed by the term, g, which is the gravitational force. An aircraft at rest on the ground or in straight and level flight is subject to a load factor of 1.0 g since the only force acting on the aircraft under either of these conditions is gravity. In turbulent air, or during maneuvers, additional forces are imposed on the structure. The additional load on the wings resulting from these forces is expressed in relation to the gravitational force and referred to as 0.5 g, 2.0 g, 3.0 g, etc., which means that the forces exerted on the wing structure are 1/2, 2, or 3 times the force of gravity.

MARGIN OF SAFETY.

The margin of safety is the range between the load factor at any given moment and the maximum load factor the aircraft can sustain without danger of structural damage. For example, if an aircraft loaded to the 2.0 g limit shown on the Weight Limitations Chart (figure 5-2), is subjected to a gust or maneuver load of 2.0 g, the margin of safety is zero. Any load factor in excess of 2.0 g can result in possible structural damage. With an aircraft loaded to the 2.5 g limit, the margin of safety, under these same conditions, would be 0.5 g. Any increase in weight actually becomes a component of the forces acting on the aircraft, and lessens the capacity of the aircraft to sustain loads resulting from maneuvering or turbulence. For this reason, it is advisable in loading the aircraft, to maintain a margin of safety which will not be exceeded during any period of flight.

WARNING

If the loading of the aircraft is such that the combined weight of cargo and fuel is above the 2.5 g limit line, turns and pullouts should be made with caution in order to keep the resulting load factors within the margin of safety. To avoid reducing the margin of safety beyond safe operating limits, do not load the aircraft above the weight indicated by the 2.0 g load factor line.

EXPLANATION OF CHARTS.

The gross weight limitations charts (figure 5-2) are intended to present graphically the weight-carrying capabilities of the aircraft as defined by the various criteria which provide limits for safe and efficient operation. Through the use of these charts, the flight planner is aided in recognizing the weight limitations which will restrict operation in a specific mission, and in determining what margin of safety may be established. Separate charts are provided for use with Navy C-54 aircraft and USAF C-54 aircraft prior to AF44-9101, and for aircraft AF44-9101 and subsequent.

Note

Although the charts indicate the limitations involved in the loading of the aircraft, the authority for operating the aircraft at a given gross weight remains the responsibility of the local authority.

GROSS WEIGHTS.

The data in the selected chart (figure 5-2) is based on an initial operating weight of the aircraft exclusive of fuel and cargo. The zero point of the chart at the junction of the fuel and cargo load axes represents an operating weight of 40,000 pounds. Because individual

WEIGHT LIMITATIONS CHART

C-54 AIRCRAFT AF44-9101 AND SUBSEQUENT

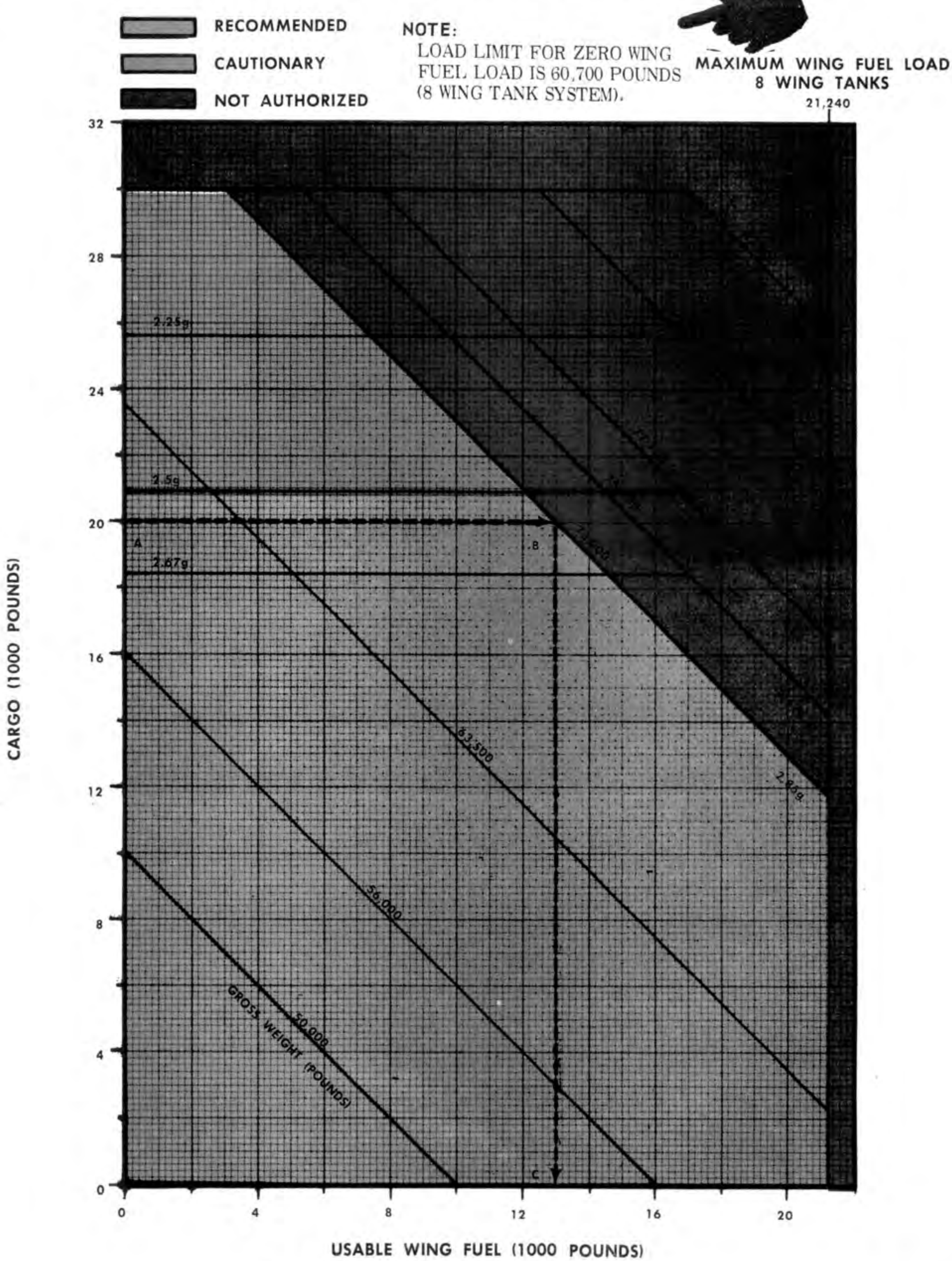


Figure 5-2 (Sheet 1 of 2)

X1-322

WEIGHT LIMITATIONS CHART

C-54 AIRCRAFT PRIOR TO AF44-9101

LIMITATIONS BASED UPON A BASIC OPERATING WEIGHT OF 40,000 POUNDS

Note:

1. The information on this chart is to be used as a general guide. For other than standard conditions, refer to the performance data for weight limitations.
2. A structural limitation of 73,000 lb. is imposed on the aircraft, since this is the critical weight on the landing gear for ground turning.
3. This chart is based on the sequence of fuel loading and usage outlined in Section VII.
4. Load limit for zero wing fuel load is as follows:
   6 wing tank system = 58,000 pounds
   8 wing tank system = 58,000 pounds

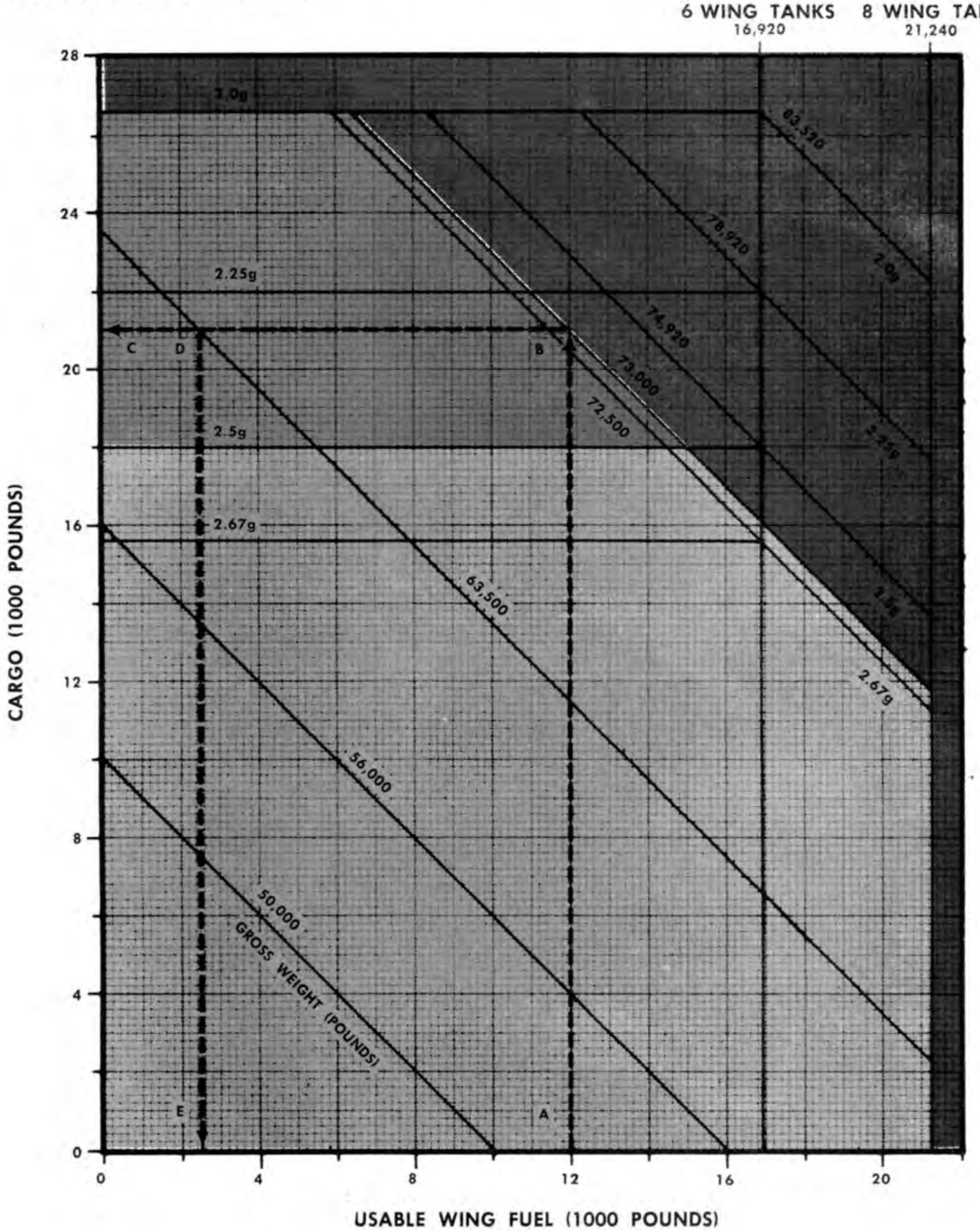


Figure 5-2 (Sheet 2 of 2)

X1-323

operating weights may vary, it will be necessary to adjust the chart for the specific aircraft involved. The operating weight plus the fuel and cargo as required in a mission can be shown by gross weight lines which slope at a 45 degree angle to the axis of the chart. These diagonal lines also indicate various structural and performance limitations. However, any gross weight line may be plotted to obtain a graphic representation of the limitations involved in the fuel-weight combination which a mission may require.

Note

The gross weight of the aircraft should never exceed that required for the mission, since unnecessary risk and wear of the equipment will otherwise result. Takeoff gross weights must also be considered in the light of available runways, surrounding terrain, altitude, atmospheric conditions, mission requirements, and the urgency of the mission.

DISTRIBUTION OF LOAD.

The maximum load that the aircraft can carry is dependent on the way that load is distributed throughout the aircraft. The weight of an aircraft in flight is supported by the wings, and therefore, the more load that is carried in the fuselage, the greater will be the bending moment on the wings. This means that an aircraft might safely carry 25,000 pounds, if 12,000 pounds were carried in the fuselage and 13,000 pounds were in the wings. But the same 25,000 pounds might become an unsafe load if the weight distribution were 23,000 pounds in the fuselage and 2000 pounds in the wings, the unsafe condition resulting from the excessive bending moment imposed on the wings by the 23,000 pounds in the fuselage. When carrying cargo, load factors capabilities below 2.5 G's are not considered desirable because the cargo-distribution may be critical enough to overload the floor and/or the fuselage shell.

LONG-RANGE OR FUSELAGE FUEL LOAD.

When long-range or fuselage fuel tanks are installed in the cargo compartment to increase the range of the aircraft or to transport fuel, the total weight of this fuel and the tanks is computed as cargo load. In computing the fuselage fuel as cargo load, detailed chart work is eliminated, as are the individual calculations involved in adding the weight of the fuselage fuel to the fuel load and the weight of the fuselage tanks to the cargo load. Whenever fuselage fuel is carried, a reduction in the cargo load is necessary to compensate for the weight of the fuselage fuel and tanks.

CARGO LOAD.

In any mission, range and fuel consumption directly determine the fuel which must be carried, and indirectly the cargo which can be transported. With the necessary fuel for the mission established, cargo loading is variable within the limits established by the strength and performance of the aircraft. The payload, as carried in the cargo compartment, appears in thousands of pounds along the vertical axis of the chart. When fuselage fuel is utilized to increase the range of the aircraft, the combined weight of the fuel and tanks is computed as cargo load.

WING FLIGHT LOAD FACTORS.

The Weight Limitations Charts (figure 5-2) show wing flight load factors of 2.0, 2.25, 2.5, and 2.67 g's. The load factor lines indicate the maximum gross weights at which the given load factor can be experienced without danger of damage to the structure. The 2.0 g line indicates the maximum gross weight which should never be exceeded, due to the dangerously small margin of safety. The effect of weight distribution on wing flight load factors is illustrated by the shape of the load factor lines. For example, from sheet 2 of figure 5-2 (for Navy C-54 and C-54 aircraft prior to AF44-9101), it can be seen that the wing flight load factor of 2.0 g can be exceeded at a gross weight of only 66,600 pounds (assuming and empty operating weight of 40,000 pounds), which could occur if all fuel is used from the wing tanks prior to using fuel from the fuselage tanks. However, at this same gross weight, the wing flight load factor is 2.5 g, if 8,600 pounds of this load is carried in the wing fuel tanks, and the remaining 18,000 pounds as cargo. At a gross weight of 71,000 pounds, the wing flight load factor would be exceeded with wing fuel weight of 5,000 pounds or less, but would be within the 2.5 g limit, providing 13,600 or more of this weight is carried in the wing fuel tanks. At any gross weight above 83,250 pounds, the wing flight load factor limit is exceeded regardless of the distribution of the load. On aircraft with the eight wing tank fuel system, and fully loaded wing fuel tanks (21,240 pounds), the maximum load that can be carried without exceeding the 2.0 g limit is 22,280 pounds. On aircraft with the six wing tank fuel system, the cargo weight limit for a 2.0 g load factor with full wing tanks, is 26,600 pounds. Sheet 1 of figure 5-2 shows a correspondingly higher weight limit for the 2.0 g load factor due to the increased wing structure limitations of aircraft AF44-9101 and subsequent.

CRUISE SPEEDS.

Caution must also be exercised in selecting the cruise speeds for operation. Load factors result not only from maneuvers instituted by the pilot, but also by encountering atmospheric gusts. At any given speed and gross weight, the larger the gust the higher the load factor. Similarly, at any given gross weight and stated gust intensity, the higher the speed the larger the load factor. The aircraft is basically designed to be able to safely withstand the load factors resulting from a 30 FPS gust at 217 knots with 18,000 pounds of cargo, on Navy C-54 aircraft and aircraft prior to AF44-9101, or 20,700 pounds of cargo on aircraft AF44-9101 and subsequent. From the Weight Limitations Charts it can be seen that, as the cargo weight is increased, the load factor made good is decreased. If a 30 FPS gust is to be made good, then the speed must be decreased. With 26,600 pounds of cargo (30,000 pounds for aircraft AF44-9101 and subsequent) and low fuel weights, the cruise speed should be reduced to 138 knots to make good a 30 FPS gust; conversely at 217 knots, only a 19 FPS gust can be made good with this latter gross weight and distribution.

LANDING GEAR LIMITATIONS.

The landing gear structure is designed for landing during routine operation at a gross weight of 63,500 pounds, at a maximum contact sinking speed of 540 feet per minute (see figure 5-3). This is the maximum recommended landing weight for normal operation. The landing gear strength for ground turning becomes critical at a gross weight of 73,000 pounds, which is the maximum recommended takeoff gross weight. However, in case of emergency, takeoffs and landings may be made at gross weights above 73,000 pounds.

PERFORMANCE LIMITATIONS.

See Appendix for effect of gross weight on performance and effect of power loss on performance at various gross weights.

RECOMMENDED LOADING AREA.

The green area on the charts represents the loading conditions that present no particular problem in regard to strength or performance of the aircraft. Operation of the aircraft at weights outside this recommended loading area should be avoided unless the dictates of the mission require it. The green area is bounded by the 2.5 G wingload factor line and the landing gear ground turning structural limitation of 73,000 pounds.

CAUTIONARY LOADING AREA.

The yellow area on the charts represents loading of progressively increasing risk as the red area is approached.

LOADING NOT AUTHORIZED.

The red area represents loadings which are not authorized because of loss of the margin

MAXIMUM LANDING SINK RATE CHART

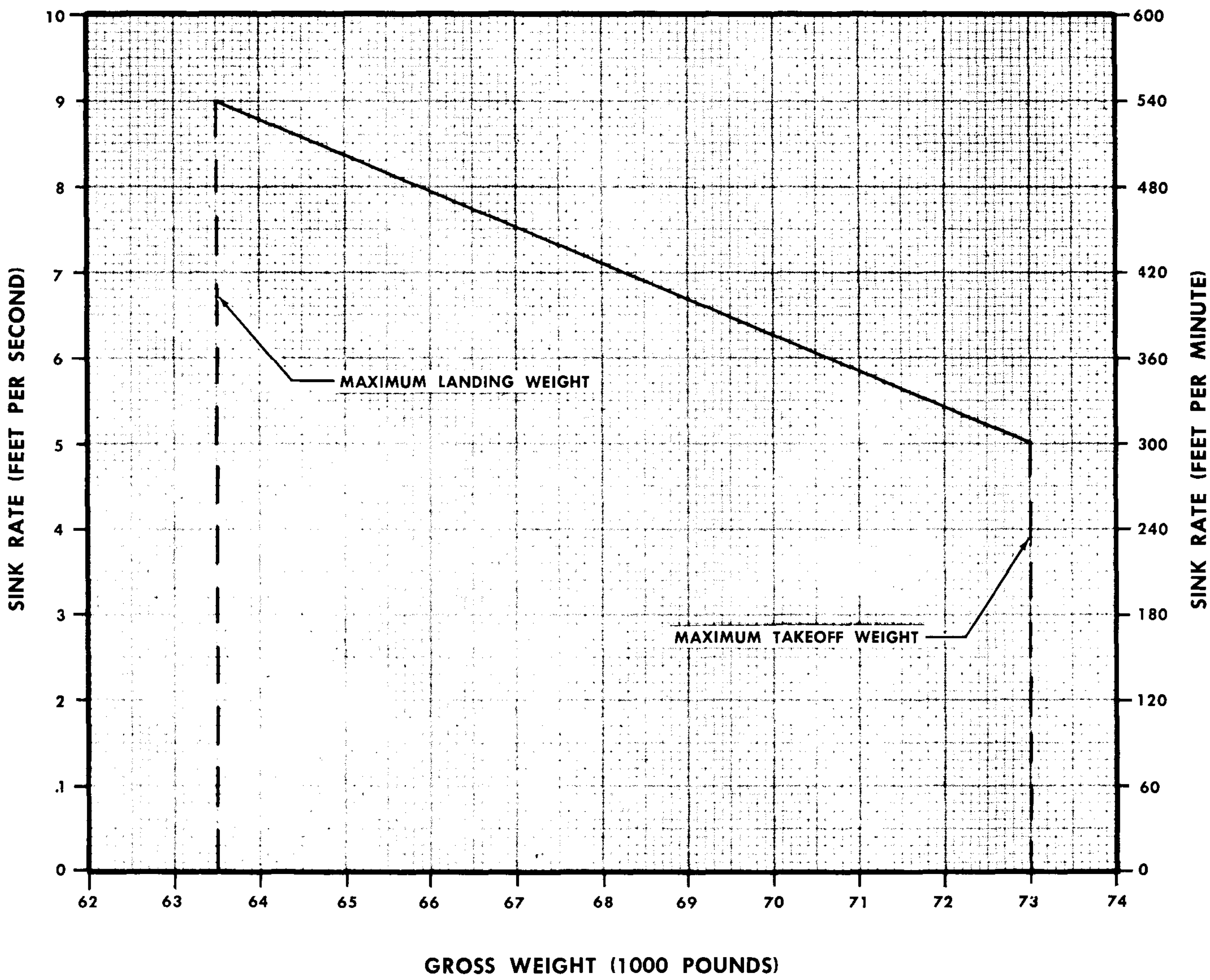


Figure 5-3

X1-30

of safety from the standpoint of both performance and structural limitations. Under conditions of extreme emergency when safety of flight is of secondary importance, the commanding officer will determine if the degree of risk warrants operation of the aircraft at gross weights appearing in the red zone.

USE OF WEIGHT LIMITATIONS CHARTS.

The following examples illustrate the method of determining the aircraft loading requirements from the Weight Limitations Charts (figure 5-2) both for allowable cargo load for a given fuel, weight and for allowable fuel load for a given cargo weight.

Example 1.

GIVEN: Aircraft Series = C-54 with serial number AF44-9101 or later.

Aircraft Operating Weight Empty = 40,000 pounds.

Required Cargo Load = 20,000 pounds.

FIND: Maximum amount of fuel that can be carried.

1. Select appropriate chart, Sheet 1 for aircraft AF44-9101 and subsequent.
2. No correction is necessary for basic operating weight since the weight of 40,000 pounds is the same as the weight on which the chart is based. Enter the chart at a cargo weight of 20,000 pounds (A), and read across to the takeoff gross weight limit of 73,000 pounds (B).
3. Read down to find usable wing fuel load of 13,000 pounds (C).
4. Convert fuel weight to gallons. Assuming a fuel density for this problem, of 6 pounds per gallon, the maximum fuel load that can be carried with this cargo weight is 2166 gallons.
5. Since the cargo and fuel loading falls within the green area of the chart, no special precautions are necessary in regard to gust loads or maneuver loads.

Example 2.

GIVEN: Aircraft Series = C-54 with serial number prior to AF44-9101.

Aircraft Operating Weight Empty = 45,000 pounds.

Fuel Require To Reach Destination = 2000 gallons.

FIND: Maximum cargo load that can be carried.

1. Convert fuel from gallons to pounds. For this problem, assume a fuel density of 6 pounds per gallon; 2000 x 6 = 12,000 pounds of fuel.
2. Select the appropriate chart for aircraft model, use sheet 2 for serial number prior to AF44-9101. Enter the chart at a usable wing fuel load of 12,000 pounds (A), and read up to the takeoff gross weight limit of 73,000 pounds (B).
3. Read across to find a cargo weight of 21,000 pounds (C).
4. The operating weight of 45,000 pounds exceeds the normal basic operating weight, on which the chart is based, of 40,000 pounds. This additional weight must be considered as added alternate cargo which reduces the usable cargo load. Reduce total cargo load by this amount to determine usable cargo; 45,000-40,000 = 5000 pounds, 21,000-5000 = 16,000 pounds of usable cargo.
5. In this case, the loading falls within the yellow cautionary area of the chart, exceeding the 2.5 wing flight load factor limit by 3000 pounds. Since this results in a reduced margin of safety, caution must be exercised to insure that gust and maneuver loads are kept as low as possible, or, the cargo load reduced by this amount to keep the loading within the green area of the chart.

Example 3.

The maximum allowable fuel load for landing without exceeding the recommended maximum landing weight can be computed or determined from the chart. To compute the final weight, add the aircraft operating weight and usable cargo weight, and subtract this total from the landing gross weight. For the same conditions stated in Example 2, above; 45,000 + 16,000 = 61,000 pounds, 63,500 - 61,000 = 2,500 pounds usable fuel weight at landing. Converted to gallons, this is 416 gallons.

To determine this figure from the chart proceed as follows:

1. Enter chart at total cargo weight of 21,000 pounds (C), and read across to recommended maximum landing weight of 63,500 pounds (D).
2. Read down to find usable wing fuel load of 2,500 pounds (E).
3. Convert fuel to gallons. Assuming 6 pounds per gallon, fuel load at a landing weight of 63,500 pounds will be 416 gallons.

Zero wing fuel loading is determined by adding cargo load and aircraft operating weight. Using the same conditions given for Example 2, the zero wing fuel load of 61,000 pounds exceeds the limit for the six wing tank configuration by 3000 pounds, and the eight wing tank limit of 60,700 pounds, by 300 pounds.

In the preceding examples, the difference in actual operating weight and the basic aircraft operating weight resulted in a loss of usable cargo load. Conversely, on an aircraft with an empty operating weight less than the basic weight, an increase in cargo load would be realized. In this case, the difference in the two weights would be added to the usable cargo load, rather than subtracted as in Example 2. To illustrate, an empty operating weight of 38,000 pounds, applied to Example 2, would result in a total usable cargo load of 23,000 pounds at the same maximum gross weight, or the capability of operating within the green area of the chart with a cargo weight of 20,000 pounds, a total gross weight of only 70,000 pounds for takeoff, and still retaining the same initial fuel load of 12,000 pounds.

SECTION VI

FLIGHT CHARACTERISTICS

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

GENERAL FLIGHT CHARACTERISTICS.

The flight characteristics of the aircraft are entirely satisfactory. Extensive flight and service testing have proved the aircraft to be stable about all axes. Maneuvering and control of the aircraft does not require undue force by the pilot throughout the entire airspeed range of the aircraft. Little change in trim is required to maintain the desired aircraft attitude.

AERODYNAMIC CHARACTERISTICS.

The aircraft is dynamically stable about all axes; that is, if an oscillation is induced about the roll, pitch, or yaw axis of the aircraft, it will dampen out. Static stability can be defined as the tendency of the aircraft to return to its original trimmed condition, following a displacement from that condition. From the point of view of control forces, an aircraft is statistically stable in pitch (longitudinally) if a push force is required to maintain an airspeed above trim airspeed, and a pull force is required to maintain an airspeed below trim airspeed. Spiral stability is approximately neutral. As an example, when the aircraft is properly trimmed for a standard rate turn in the instrument approach configuration (landing gear up, wing flaps 10 degrees, airspeed 120 KIAS), it will tend to remain in that attitude. Dihedral effect will cause the aircraft to bank automatically into the turn as rudder is applied. This effect is helpful in obtaining maximum maneuverability.

CONTROL FORCE AND EFFECTIVENESS.

At high airspeeds, a given rate of roll can be developed with a small force applied to the controls and with a small control movement. To develop the same rate of roll at low airspeeds, both a greater force and movement must be applied to the controls.

The ratio of rudder to aileron displacement required to accomplish a coordinated turn varies with airspeed. At high airspeeds, turns may be made primarily with the ailerons, very little rudder being required. As airspeed decreases, and/or landing gear and wing flaps are extended, a greater proportion of rudder to aileron displacement is required. This should be taken into consideration when making approaches in gusty air conditions, or with one or more engines inoperative.

At high airspeeds, the elevator is extremely effective and, therefore, requires a very small amount of force and movement to maneuver the aircraft. Control force increases with elevator displacement; therefore, both a greater movement and a greater force are required at low airspeed as compared to cruising flight.

During landing, the center-of-gravity position greatly affects the amount of elevator required. The further aft the CG, the less elevator required; the further forward the CG, the more elevator required. If the aircraft is loaded aft of the aft CG limit, it will be unstable; if loaded forward of the forward limit, the amount of elevator control available will probably be insufficient to properly flare the aircraft.

EQUIVALENT PARASITE DRAG AREA.

The following table of drag items is given in square feet.

Item	Drag of Item (Square Feet)
Basic Aircraft	27.1
Landing Gear	32.0
10 Degrees Wing Flaps	9.5
20 Degrees Wing Flaps	19.0
30 Degrees Wing Flaps	31.0
40 Degrees Wing Flaps	64.0
30 Degrees (Open) Cowl Flaps	25.0
10 Degrees (Trail) Cowl Flaps	5.1
0-3 Degrees (Closed) Cowl Flaps	.0
Windmilling Propeller	13.5

From the above table it can be seen that the total equivalent parasite area of the basic aircraft with the landing gear up, wing flaps up, cowl flaps closed, and no propeller feathered is 27.1 square feet. However, compare this against a basic aircraft with the wing flaps down, landing gear down, and the cowl flaps open with a 148.1 square feet area. It can be easily seen from these figures that considerably more power would have to be used to obtain the same airspeed with the wing flaps and landing gear down and the cowl flaps open.

WING FLAP CHARACTERISTICS.

The wing flaps provide the additional **lift** required for take-off and both extra lift and drag for approach and landing. At small angles (10 degrees to 20 degrees) the wing flaps act primarily as an added lift device, and at large angles (30 degrees to 40 degrees), as both an added lift and drag device. High drag obtained at maximum wing flap extension is obtained primarily from the amount of extra surface exposed to the airstream.

In effect, as the wing flaps are extended, the camber of the wing is increased, giving it a higher lift at any given angle of attack. This explains the ballooning of the aircraft as the wing flaps are extended. Conversely, the opposite occurs as the wing flaps are retracted and the aircraft settles. Extension of the wing flaps also reduces the stalling airspeed of the aircraft.

STALLS.

The stall warning is definite, appearing as a control buffet and structural shake, well in advance of the stall. Because of the severe amplitude of the buffet during the actual stall, it is recommended that complete stalls be avoided. It is well to remember that the stalling airspeed increases with the angle of bank and the buffeting airspeed decreases. Figure 6-1 is based on the effect of acceleration and gives the change in stalling airspeed for gross weight, landing gear and wing flap positions, and for all bank angles up to 60 degrees. The use of this chart is illustrated by the dashed lines drawn on its face. Buffeting occurs at approximately 7 to 13 knots above stalling airspeed with the wing flaps up. With the wing flaps full down, buffeting occurs at approximately 4 knots above the airspeed for a complete stall. The extended landing gear has no appreciable effect on the stalling characteristics. Due to slipstream effect over the wing, power on stalling airspeeds is lower than zero thrust stalling airspeeds by approximately 4 to 7 knots at approach power, and 7 to 13 knots at takeoff power. This difference is not taken into consideration in calculating performance airspeeds, so is available as an extra margin of safety.

RECOVERY FROM STALL.

In case the aircraft is inadvertently stalled, recovery should be made by allowing the nose to pitch down gently and applying power. When sufficient airspeed is regained, make a smooth recovery from a slightly nose-down attitude. Avoid abrupt pullout to prevent entering an accelerated stall.

SPINS.

Spins are a prohibited maneuver and must never be done intentionally. However, in case a spin is entered accidentally, use normal recovery procedure to regain level flight.

LEVEL FLIGHT AND DESCENT.

The maximum level flight and descent airspeed is outlined in Section V. This airspeed is the maximum airspeed at which the aircraft can fly continuously without damage to the structure, and should not be exceeded unless the urgency of the situation demands acceleration to maximum dive airspeeds.

DIVING.

The maximum dive airspeed is outlined in Section V. The airspeed pointer should not be allowed to exceed the limit marking on the rim of the airspeed indicator (figure 5-1), but if this should happen, avoid an abrupt pullout during recovery to prevent structural damage.

POWER OFF STALLING AIRSPEEDS

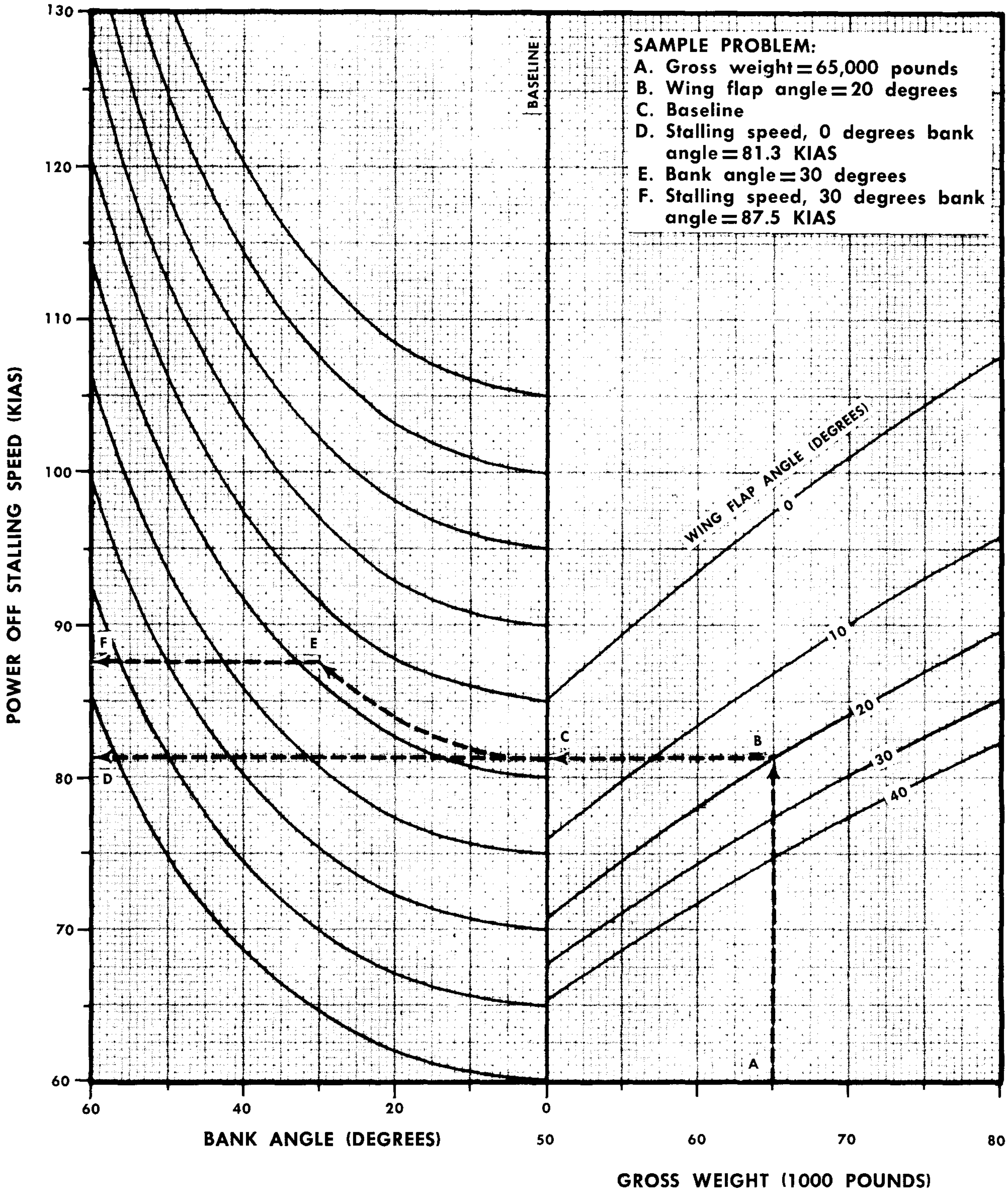


Figure 6-1

X1-321

*U.S. GOVERNMENT PRINTING OFFICE: 1969-346-591/1480

BUFFETING.

Buffeting may result from various abnormal conditions affecting the wing surfaces (especially the leading edges), nacelle cowling, fuselage, or empennage. Some general conditions that can cause moderate to severe buffeting during normal operation are:

1. Damage to wing leading edge.
2. Loose, damaged, or missing cowling.
3. Excessive cowl flap openings.
4. Windmilling propeller.
5. Fuselage or empennage damage.

In the cruise configuration, buffeting from these causes is not usually confined to the wing alone. The empennage may be affected in proportion to the severity of the turbulence, due to the airflow into the region of the horizontal tail surfaces. Tail buffeting can occur from disturbances as far outboard as the outboard nacelles. Severe tail buffeting is usually accompanied by loss of elevator effectiveness and severe aircraft vibration. However, the vibration is not of a frequency or magnitude that will cause immediate failure of any primary structure essential to continued flight of the aircraft. The following procedures are recommended to improve the flying characteristics sufficiently to allow a safe landing to be made.

1. Try all airspeeds within the speed range in combination with wing flaps, as in step 2, until buffeting is sufficiently reduced.

High power settings may be used to maintain the required airspeed as even emergency power has not been known to increase the severity of tail buffeting. Furthermore, any yawing tendency of the aircraft should be held to a minimum by utilization of evenly applied rudder.

2. Lowering the wing flaps increases the downwash and raises the tail. In many cases this will result in a very efficient reduction in buffeting. Usually 5 to 10 degrees or 10 to 20 percent of wing flaps is sufficient to eliminate all except extremely severe buffeting, but more flap extension may be required. In some cases, this may even reduce the turbulent drag and improve performance. With sufficient wing flap extension to eliminate buffeting, elevator control effectiveness will usually return to normal. If buffeting is not reduced with wing flap extension, the wing flaps should be retracted to minimize performance losses. In very severe cases where the extent of damage is not known, it is advisable before landing is attempted to check the controls in landing configuration to be sure that both elevator and aileron controls are adequate.

WARNING

If buffeting continues to increase and control of the aircraft becomes more difficult, an immediate decision should be made regarding the advisability of abandoning the aircraft.

SECTION VII

SYSTEMS OPERATION

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

ENGINE RATINGS.

Engine ratings may be defined as operating limits within which the accepted degree of reliability and efficiency can be obtained. When operating outside of these limits, the pilot is relying on safety margins which have not been proven. Maximum power for takeoff for the R2000 engine is 1450 bhp under standard day, sea level conditions. METO power is determined as 1200 bhp. METO rpm (2550 rpm) is the maximum engine speed that may be used for continuous operation. Climb power is established at 950 bhp when fuel economy and engine durability are of more concern than tactical necessity to use METO power.

The difference between atmospheric pressure at the altitude being flown and the total pressure delivered to the carburetor through the air scoop is known as ram pressure. Ram pressure varies with airspeed and, to a lesser degree, with the aircraft angle of attack. Ram pressure increases as airspeed increases and as the angle of attack decreases. Also, ram pressure may be varied by restricting the ram air passage. This type of variation occurs during the application of carburetor air heat.

For a given power setting, power available will vary with ram pressure; therefore, the highest ram pressure and, consequently, the highest power available, determine the highest critical altitude for that power setting.

Note

The minimum cruising engine rpm is 1600. This rpm is determined by propeller design efficiency. Operation below this value will cause the airspeed to decrease, even with the bhp remaining at the same value. This is due to the propeller's ability to displace air being sharply reduced below 1600 rpm.

CAUTION

When maneuvering or during descents with low power, it is important to cushion the high inertia loads on the master rod bearings which occur with high rpm and low manifold pressure. As a rule of thumb, each 100 rpm requires at least 1 inch Hg manifold pressure. Operation at high rpm and low manifold pressure should be kept to a minimum.

BLOWERS (SUPERCHARGERS).

The rear crankcase section of each engine accommodates drive gears and clutches for the single-stage, two-speed, integral, engine-driven blower. The blower ratio clutch incorporates creeper gears that aid in preventing sludge accumulation. The creeper gears cause intermittent bleeding of pressure oil from the clutches to dissipate sludge formations which tend to cause clutches to stick. The formation and accumulation of sludge will vary with the operating conditions and the types of oil. Consequently, it is advisable to shift the clutches prior to each takeoff to insure proper clutch operation. All engine ground operation will be in low blower except the items required on Engine Runup checklist. All takeoffs should be made in low blower except under high altitude takeoff conditions when the power output is insufficient in low blower. The decision to use high blower for takeoff must be made as a result of a study of the engine power calibrations, not on the basis of the availability of manifold pressure. Approximately 6 inches Hg additional manifold pressure is needed in high blower at sea level to develop the same brake horsepower power obtained in normal low blower. The increase of brake horsepower required to drive the high blower creates an increased fuel consumption of about 10 gallons per hour per engine. The manifold pressure differential and fuel consumption decrease with altitude until critical blower altitude is reached.

BLOWER SHIFTING.

During a climb, the use of the low blower ratio should be maintained as long as possible. Shifting to the high blower ratio should be accomplished when the critical blower altitude is reached. The critical altitude at METO power will occur at approximately 5300 feet and at climb power at approximately 9100 feet. The shock which usually accompanies the blower shift is not harmful to the engines. When low blower critical altitude (full throttle) is reached, retard throttles (symmetrically two at a time, ie; No. 1 and 4, and No. 2 and 3) to reduce manifold pressure about 4 inches Hg, to prevent manifold pressure surge when shifting into high blower ratio. No change in rpm is necessary.

Note

Periodic shifting of the blowers is no longer necessary provided the approved oil additive or detergent oil is used.

CARBURETORS.

CARBURETOR ICING.

The carburetor air control must be maintained in COLD position at all times except when weather conditions are conducive to carburetor icing, and when CAT is below -10° C and poor fuel vaporization and distribution are indicated by engine roughness or loss of power (see operating limitations, Section V). Carburetor heat reduces the ram pressure of the inlet air reducing engine critical altitude and requiring premature shift to high blower operation.

If manifold pressure and fuel flow drop unaccountable, carburetor icing may be the cause. Apply carburetor heat for a short period. This will result in a further manifold pressure reduction, but if a subsequent slow rise is noted in manifold pressure, ice is present and is melting. In this event, continue applying carburetor heat until icing conditions no longer prevail. Manifold pressure and cylinder head temperatures should be watched closely during this period. When the ice has been cleared, return the carburetor temperature to the desired limits.

Use carburetor heat before carburetor icing becomes critical because, if the ice accretion is allowed to progress, the loss of engine power may make it impossible to generate sufficient heat to clear the engine. If the heat is sufficient and if remedial action is not delayed, screen or impact tube icing can be controlled.

If carburetor heat fails to remove the ice formation, use the carburetor alcohol anti-icing system until the malfunctioning engine is operating properly.

CARBURETOR SETTINGS.

Automatic-type carburetor settings are incorporated which provide an acceptable degree of metering with a minimum of crew attention. These settings will insure satisfactory acceleration, provide detonation protection and adequate cooling in climb and at METO power and takeoff power, and satisfactory fuel economy in cruise. Necessary manufacturing and maintenance tolerances prevent attaining the optimum adjustments. Metering variations from plus 6 to minus 9 percent in fuel air ratio from the mean of any carburetor setting may result from an adverse accumulation of known tolerances within the carburetor. Fuel flow values should be carefully monitored at all stages of flight and irregular indications noted in Form 781.

CAUTION

Manually leaning the carburetor below the AUTO LEAN setting is not recommended. Operating in this range may cause detonation. Normally the AUTO LEAN position will automatically supply the proper mixture.

CARBURETOR AIR TEMPERATURE.

Because of the higher temperature rise through the supercharger when operating in high blower ratio, the temperature of the air entering the carburetor must be held to a lower limit than when operating in lower ratio in order to keep the supercharged temperatures below the detonation range. Temperature corrections for manifold pressure should be made on the basis of the deviation of the carburetor air temperature rather than the deviation of the outside air temperature from standard, because the density of the air charge is determined by the temperature in the induction system rather than that of the ambient air.

SPARK PLUG FOULING.

Spark plug fouling is a major cause of ignition trouble, which in turn is one of the most common engine maintenance and operating problems with military aircraft using 100/130 grade fuel having a relatively high lead content of up to 4.6 cc. Fouling is the result of an accumulation of deposits which cause misfiring or prevent firing across the spark plug electrodes. The most common types of fouling are lead fouling and carbon fouling, with lead fouling causing the majority of trouble. Cause, prevention, and elimination of spark plug fouling are all related to the chemistry and physics of the combustion cycle, which alternately is subject to wide variation under different ground and flight operating conditions. Prevention would seem to be the most economical method of solution.

LEAD FOULING AND CONTRIBUTING FACTORS.

Tetraethyl lead is the basic cause of lead fouling. Scavenger agents are provided to combine with the lead during combustion and remove it with the exhaust gases. However, under certain conditions of temperature and pressure, lead oxide or lead bromide compounds will condense on the spark plug insulator. In the presence of excess carbon as a reducing agent, these compounds may form metallic lead particles which can prevent ignition or firing. Additional factors which influence spark plug misfiring include the type of ignition system, spark plug characteristics and time element, general engine condition, operating requirements, and specific engine operating conditions. Spark plug fouling involves an accumulation of deposits through prolonged operation under a fixed set of conditions. Prevention and elimination of fouling depend upon taking action to vary these conditions, upset the chemistry of the fouling cycle, and restore normal ignition.

FOULING DURING GROUND OPERATION.

During ground operation, spark plug fouling may be caused by either carbon or lead. Lead fouling may be residual from a previous flight. Prolonged engine operation at idle speed will result in carbon fouling, particularly when the idle mixture is richer than best power; excess carbon from the rich mixture and burned engine oil form fouling deposits on the spark plugs. Such fouling will usually be indicated by excessive magneto drop during the power check at field barometric manifold pressure; however, engine malfunction during takeoff may be experienced in frequent cases where plug fouling has occurred but has not been apparent during engine checkout procedure.

Prevention of Fouling.

If possible, avoid prolonged or unnecessary ground operation. If engine shutdown is impractical, the engines should be run up to field barometric manifold pressure in AUTO LEAN for 1 minute after each 10 minutes of ground running. The idle mixture should be adjusted to best power mixture at the idle speed commonly used for ground running, rather than at the minimum idle speed, since there is a tendency for the mixture to enrich with any increase in rpm, and excessively rich idling mixtures are the most common cause of carbon fouling. Frequent checks and proper adjustments of the idle mixture should be made to insure the setting is correct.

Cure of Fouling.

Preventive action is the best cure. The only practical cure of fouling may be spark plug change. The 1-minute runup to field barometric pressure in AUTO LEAN may have a curative effect. Additional running for short periods of time with manifold pressure changes of 2 inches Hg is occasionally effective. Prolonged operation at or above field barometric manifold pressure must be avoided because of insufficient engine cooling.

FOULING DURING TAKEOFF.

The rapid change in combustion temperatures and pressures and the high levels achieved under takeoff conditions are favorable to spark plug misfiring if there is any fouling from previous flight or ground running. The electrical resistance of residual deposits decreases rapidly as limiting temperatures are approached, so that the spark may short circuit along the insulator rather than firing the gap. If excess carbon is present, metallic lead may be formed by the reducing action of free carbon on lead oxides and lead bromides. The most common symptoms are backfiring and rough running.

Prevention of Fouling.

The best prevention of fouling during takeoff is proper ground running procedures. In addition, it is important to reduce cylinder head temperature to the recommended pretakeoff cylinder head temperature level to take advantage of the increased brake horsepower, and decreased tendency for misfiring with relatively cool cylinder head temperature during takeoff. Smooth and steady application of power is preferable to rapid or jam acceleration. If backfiring or rough running occurs, reduce manifold pressure 2 to 5 inches or as required to restore smooth operation.

FOULING DURING CRUISE.

During cruise, lead fouling is usually generated rather than carbon fouling. Long-continued application of a given set of engine conditions typical of cruise flight contribute to lead fouling. An additional factor is operation with abnormally low CHT. Common symptoms are backfiring or afterfiring.

Prevention of Fouling.

Prevention of fouling is preferable to cure, and results may be accomplished by use of AUTO RICH for 5 minutes at hourly intervals; a change of from 3 to 5 inches Hg, with a simultaneous increase on the inboard engines and decrease on the outboard engines to maintain airspeed; or a change of 100 to 300 rpm.

Cure of Fouling.

Cure of fouling may be effected by a complete change of power settings, including use of AUTO RICH, a reduction of from 8 to 10 inches manifold pressure with a period of engine cooling, followed by gradual increase to cruise power settings in increments of 2 to 3 inches manifold pressure with several minutes of operation at each power level. Another method is to gradually increase power to METO power for several minutes. Spark plugs which are misfiring or completely fouled, may resume firing at lower power settings, so it is advisable to reduce power and then restore it, rather than attempt to attain METO power and thereby introduce the possibility of destructive backfiring during application of increased power.

IGNITION ANALYZER OPERATION (C-54, EC-54, HC-54, AND TC-54 AIRCRAFT).

IGNITION ANALYSIS.

1. System power switch on analyzer switch panel—ON.

2. Analyzer power switch on ignition analyzer—ON. The system power indicator light on switch panel should illuminate.

3. Allow approximately 1 minute for analyzer tubes to warm up. A bright dot should appear on analyzer screen. Allow this dot to stabilize at one position on screen, then adjust position switches until dot is in center of the screen.

4. If dot does not appear, adjust horizontal and vertical position switches on analyzer until dot appears.

Note

To avoid burning a spot on the analyzer screen, the bright dot should not be held in one position on the screen for more than 2 minutes. When power is to be left on the analyzer for a longer period, select a pattern or shift the dot to the extreme side of the screen.

5. Analyzer magneto selector knob—TURN to LEFT 1 position.

Note

The analyzer magneto selector knob remains in the LEFT 1 position throughout the operating procedure; this is the only position of the selector knob used in the circuit.

6. Engine and magneto selector knob on switch panel—Rotate to engine and magneto position desired.

7. Check for abnormalities in patterns with knob in R and L positions. Cylinders which show abnormal patterns are determined by counting off from first pattern and referring to placard on front of analyzer switch panel. (See figure 7-2 for representative patterns.)

8. Use horizontal position, vertical position, and horizontal gain control knobs to isolate and enlarge any abnormal pattern for more detailed study. Try to keep at least three patterns on screen for comparison.

9. To check magneto synchronization of both sides of cylinder ignition, place magneto selector knob at each of R and L positions. The patterns for any one cylinder viewed on screen should be superimposed.

Voltage Control Operation (On Ground Only)

Use the voltage control knob on a ground check to determine the condition of spark plugs before noticeable failure occurs.

Operation of the voltage control switch is as follows:

1. Relay-resistor switch on switch panel—ON for engine to be tested.

CAUTION

Guards for these switches should be down during flight to prevent inadvertent use of the voltage control, which could result in misfiring of cylinders, backfiring within the manifold section, or damage to the engine by fire.

2. Voltage control knob—Pull out and rotate from OFF in the increase direction,

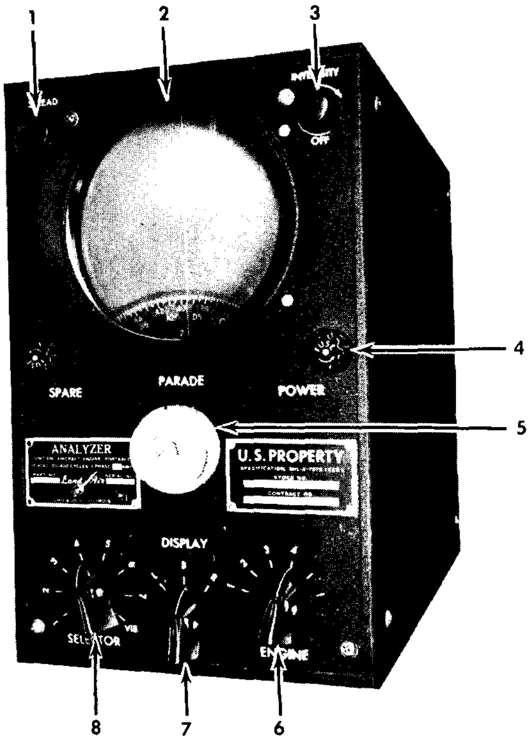
while viewing the pattern on analyzer screen. Misfiring, and finally complete stoppage of plug firing, should occur. (See figure 7-2 for representative patterns.)

Note

The voltage control knob will return to the inoperative position when released.

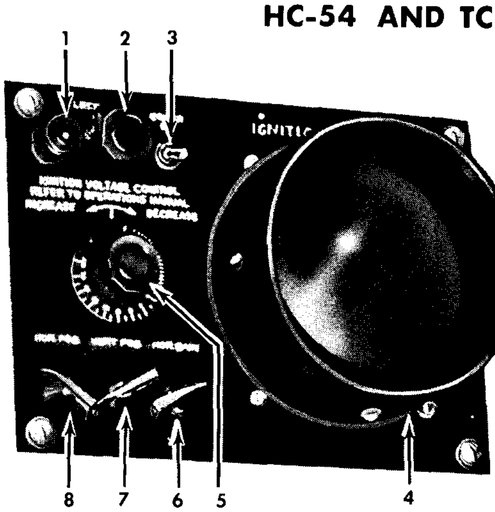
IGNITION ANALYZER

NAVY C-54



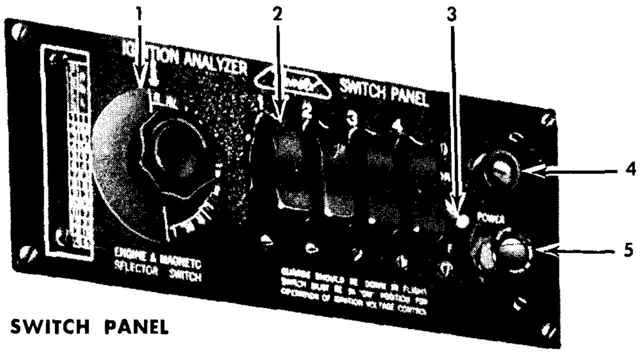
1. SPREAD KNOB
2. SCREEN
3. INTENSITY KNOB
4. FUSE
5. PARADE DIAL KNOB
6. ENGINE SELECTOR SWITCH
7. DISPLAY SELECTOR SWITCH
8. CONDITION SELECTOR SWITCH

USAF C-54, EC-54, HC-54 AND TC-54



IGNITION ANALYZER

1. POWER INDICATOR LIGHT
2. MAGNETO SELECTOR SWITCH
3. POWER SWITCH
4. SCREEN
5. VOLTAGE CONTROL SWITCH
6. HORIZONTAL GAIN SWITCH
7. VERTICAL POSITION SWITCH
8. HORIZONTAL POSITION SWITCH



SWITCH PANEL

1. ENGINE AND MAGNETO SELECTOR SWITCH
2. RELAY-RESISTOR SWITCHES
3. SYSTEM POWER SWITCH
4. FUSE
5. SYSTEM POWER INDICATOR LIGHT

X1-246

Figure 7-1

3. Note value of dial readings when misfiring and complete stoppage of firing occur. A low dial reading indicates that ignition system is in good condition.

IGNITION ANALYZER OPERATION (NAVY C-54 AIRCRAFT).

IGNITION ANALYSIS.

For ignition analysis, the ignition analyzer is operated as follows:

1. Intensity control knob—Rotate one-quarter turn in clockwise direction.

Note

Allow at least 1 minute for the equipment to warm up and a pattern to appear on the face of the cathode ray tube. For protection of the tube face, the circuits are arranged so that no portion of the trace can appear unless the engines are in operation.

2. Rotate intensity control knob until pattern appears at a comfortable level of brightness (the arrow points in the direction of greater intensity). (See figure 7-2 for representative patterns.)

Note

If the intensity control knob is rotated too far in a clockwise direction, the pattern may bloom, that is, the pattern may become very large and then disappear. Rotating the knob in a counter-clockwise direction will restore the pattern. This feature protects the tube from excessive intensity which might otherwise burn the phosphor.

3. Spread control knob—Adjust to display three ignition patterns on the tube face.
4. Engine selector switch—Rotate to desired position.
5. Magneto selector switch—Rotate to desired magneto primary. This selects left and right primaries in pairs and connects them to the display switch.
6. Display switch—Rotate to desired magneto primary lead.
7. Parade dial—Turn until pattern appears on the face of screen. The dial is calibrated to the index line on tube face.
8. Analyze each cylinder pulse now being displayed, rotating parade dial to observe individual pulses.
9. Repeat above procedure until all cylinders on all engines are checked.

VIBRATION ANALYSIS.

1. Engine selector switch—Rotate to desired position.
2. Magneto selector switch—Rotate to VIB position.
3. Parade dial—Rotate through one full turn. Vibration patterns will appear on face of cathode ray tube in order of pattern sequence: (a) exhaust valve closing;(b) intake valve closing;(c) combustion;(d) exhaust valve opening; (e) intake valve opening; (f) scavenge or exhaust stroke.
4. Repeat above procedure until all cylinders on all engines are checked.

FUEL SYSTEM MANAGEMENT.

Fuel flow is governed by the positioning of the fuel tank selector levers. Since vapor vent return lines connected to each carburetor return fuel to the four main wing tanks, fuel levels should be checked periodically to avoid overfilling when operating all engines on the auxiliary wing tanks or the fuselage tanks (if installed). When selecting a new fuel supply, the new supply should be selected before the old supply is depleted, in order to prevent fuel surge to the carburetor. If a fuel supply is completely depleted before selecting a new supply, retard the throttle or throttles of the affected engines before selecting the new supply to prevent fuel surge to the carburetor. This also prevents the possibility of an uncontrolled overspeed propeller, which can result from the sudden resumption of power following a momentary power loss. Figures 7-5 (six-tank system) and 7-6 (eight-tank system) show the fuel flow and the selector valve settings for various combinations of fuel system management.

WARNING

Fuel transfer in flight is prohibited except in an emergency.

The following sequence is recommended when changing to a new fuel supply.

1. Booster Pump Switch—LOW.

   Position appropriate booster pump switch to LOW for tank being selected.

2. Fuel Tank Selector Lever—ON.

   Select new fuel source.

3. Crossfeed Selector Lever—As required.

   Select fuel route.

4. Fuel Tank Selector Lever—OFF.

   Turn off old fuel source.

5. Booster Pump Switch—As required.

CAUTION

The fuel system must be monitored closely when changing tanks. The fuel selector valve must be centered in the detent or fuel syphoning may occur. After changing tanks, monitor the fuel quantity gages closely to determine if fuel is transferring between tanks.

FUEL LOADING.

The Fuel Loading Charts (figures 7-3 and 7-4) are used to determine the quantity of fuel to be serviced in the different fuel tanks for a given fuel load.

Note

Under conditions where it is necessary to service the aircraft for possible long flights and the possibility of a short flight exists, limit the wing fuel to that recommended for landing and service the remainder of the fuel in the fuselage tanks.

FUEL USAGE (SIX-TANK SYSTEM, EXCEPT HC-54).

The sequence for using the fuel supply during engine starts, takeoffs, and landing operations will be a straight line system of each main tank to its respective engine, i.e., MAIN TANK No. 1 to engine No. 1, MAIN TANK No. 2 to engine No. 2, MAIN TANK No. 3 to engine No. 3, and MAIN TANK No. 4 to engine No. 4. After takeoff and climb, the following fuel sequence will be used in accordance with the amount of fuel in the aircraft:

1. If fuselage fuel tanks are installed for longrange operation, follow steps a through c.

   a. LH fuselage tank through crossfeed to ALL ENGINES until 50 gallons

IGNITION ANALYZER PATTERNS—Typical

NAVY C-54

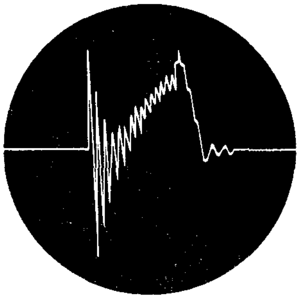
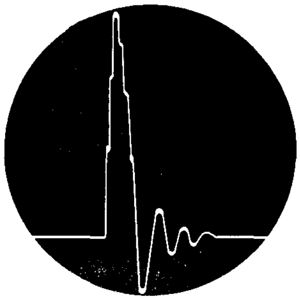
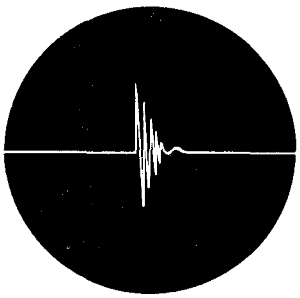
	POSSIBLE SOURCES OF MALFUNCTION
NORMAL 	
OPEN SECONDARY 	1. Spark plug lead missing or not connected; extremely wide spark plug gap. 2. Open coil secondary or open high tension lead. 3. Damaged cigarette or missing cigarette spring.
SHORTED SECONDARY 	1. Badly fouled spark plug. 2. Short in high tension lead or coil secondary.

Figure 7-2 (Sheet 1 of 5)

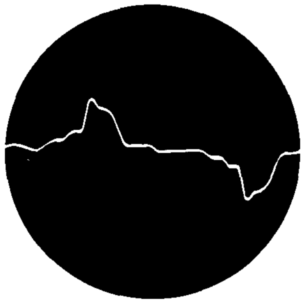
X1-31

IGNITION ANALYZER PATTERNS—Typical

NAVY C-54

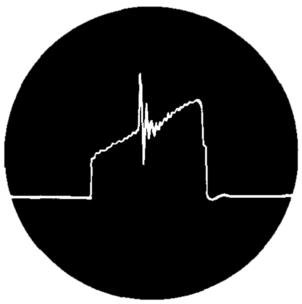
POSSIBLE SOURCES OF MALFUNCTION

OPEN PRIMARY



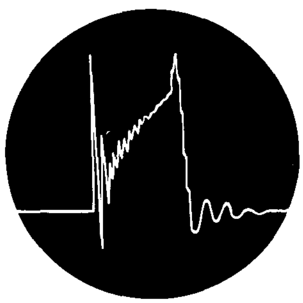
1. Open lead from magneto winding to breaker points.
2. Breaker points not closing.

ARCING BREAKER POINTS



1. Defective primary condenser.
2. Lead from breaker point to condenser disconnected.
3. Severely burned or oily breaker points.

HIGH VOLTAGE FIRING



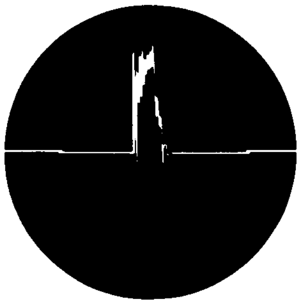
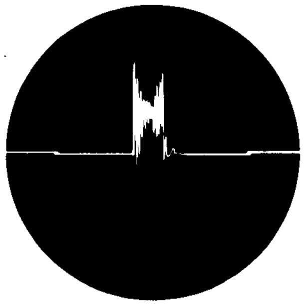
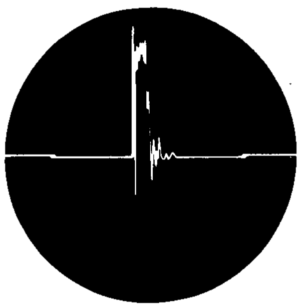
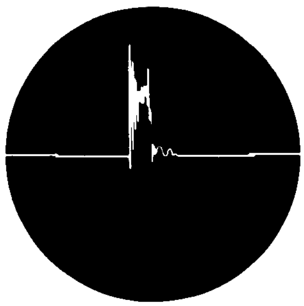
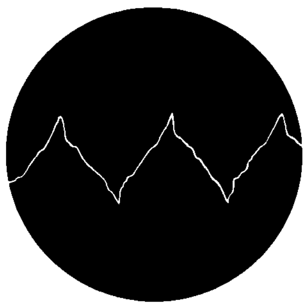
1. Wide spark plug gap.
2. Cigarette spring missing or not making contact.
3. Poor contact at distributor finger.
4. Contact spring in coil missing or not making contact.

Figure 7-2 (Sheet 2 of 5)

X1-247

IGNITION ANALYZER PATTERNS—Typical

USAF C-54, EC-54, HC-54 AND TC-54

	POSSIBLE SOURCES OF MALFUNCTION
NORMAL  WITH SECONDARY CONDENSER  WITHOUT SECONDARY CONDENSER	
HIGH VOLTAGE FIRING  WITH SECONDARY CONDENSER  WITHOUT SECONDARY CONDENSER	1. Wide spark plug gap. 2. Cigarette spring missing or not making contact. 3. Poor contact at distributor finger. 4. Contact spring in coil missing or not making contact.
OPEN PRIMARY  WITH OR WITHOUT SECONDARY CONDENSER	1. Open lead from magneto winding to breaker points. 2. Breaker points not closing.

X1-248

Figure 7-2 (Sheet 3 of 5)

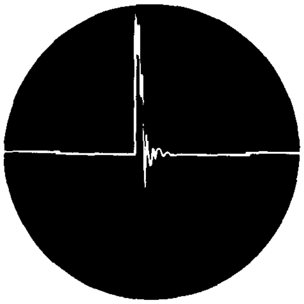
IGNITION ANALYZER PATTERNS—Typical

USAF C-54, EC-54, HC-54 AND TC-54

POSSIBLE SOURCES OF MALFUNCTION

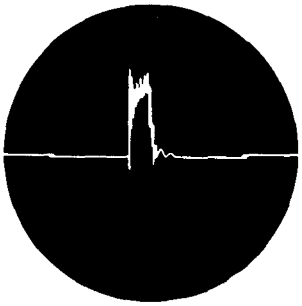
OPEN SECONDARY

WITH OR WITHOUT SECONDARY CONDENSER

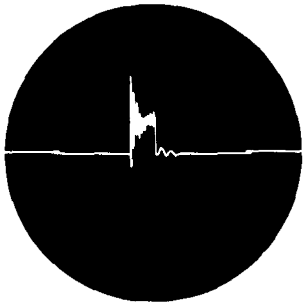


1. Spark plug lead missing or not connected; extremely wide spark plug gap.
2. Open coil secondary or open high tension lead.
3. Damaged cigarette or missing cigarette spring.

SHORTED SECONDARY (BETWEEN DISTRIBUTOR AND SPARK PLUG)



WITH SECONDARY CONDENSER



WITHOUT SECONDARY CONDENSER

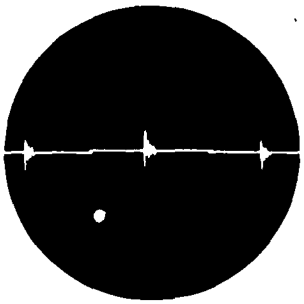
1. Badly fouled spark plug.
2. Short in high tension lead.

SHORTED SECONDARY (BETWEEN MAGNETO COIL AND DISTRIBUTOR)

WITH SECONDARY CONDENSER

1. Grounded high tension magneto lead.
2. Distributor finger center electrode shorted to ground.

WITH OR WITHOUT SECONDARY CONDENSER



WITHOUT CONDENSER

1. Grounded high tension magneto lead.
2. Shorted secondary of magneto coil.
3. Distributor finger center electrode shorted to ground.

WITH CONDENSER

1. Shorted secondary of magneto coil.
2. Grounded high tension magneto lead.

X1-249

Figure 7-2 (Sheet 4 of 5)

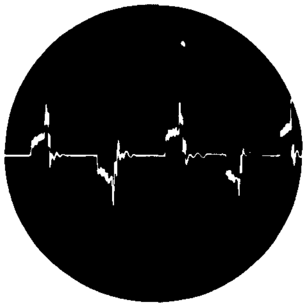
IGNITION ANALYZER PATTERNS—Typical

USAF C-54, EC-54, HC-54 AND TC-54

POSSIBLE SOURCES OF MALFUNCTION

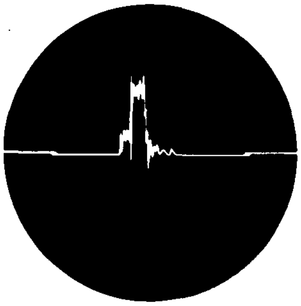
ARCING BREAKER POINTS (SEVERE)

WITH OR WITHOUT SECONDARY CONDENSER

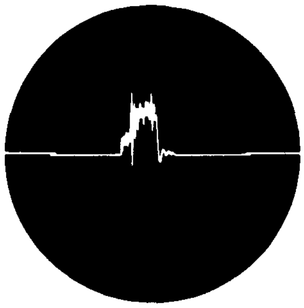


1. Defective (open) primary condenser.
2. Open lead from breaker points to condenser.
3. Severely burned or oil on breaker points.

ARCING BREAKER POINTS (PARTIAL)



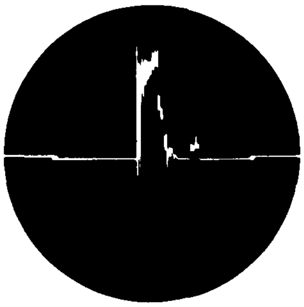
WITH SECONDARY CONDENSER



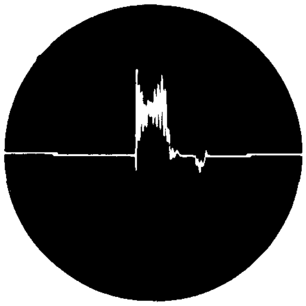
WITHOUT SECONDARY CONDENSER

1. Defective (open) primary condenser.
2. Open lead from breaker points to condenser.
3. Oil on breaker points.

BREAKER POINT BOUNCE



WITH SECONDARY CONDENSER

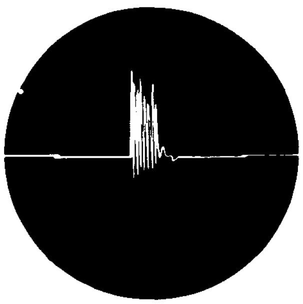


WITHOUT SECONDARY CONDENSER

1. Weak breaker point spring.
2. Damaged (rough) cam.

NO COMBUSTION

WITH OR WITHOUT SECONDARY CONDENSER



1. Poor carburetion.
2. Piston failure.
3. Induction system leaks.
4. Sticking valves.

Figure 7-2 (Sheet 5 of 5)

X1-250

FUEL LOADING CHART – SIX WING TANK SYSTEM

TOTAL USABLE FUEL LOAD (GALLONS)	FUEL TANKS				*USAGE
	NO. 1 AND NO. 4 MAIN (EACH TANK)	NO. 2 AND NO. 3 MAIN (EACH TANK)	AUXILIARY (EACH TANK)	FUSELAGE (EACH TANK)	
1200	300	300			1
1300	325	325			1
1400	350	350			1
1500	375	375			1
1600	400	400			1
1700	425	425			1
1800	450	450			1
1900	475	475			1
2000	490	500	10		1-3
2100	490	500	60		1-3
2200	490	500	110		1-3
2300	490	500	160		1-3
2400	490	500	210		1-3
2500	490	500	260		1-3
2600	490	500	310		1-3
2700	490	500	360		1-3
2800	490	500	410		1-3
2900	490	500	420	40	1-2
3000	490	500	420	90	1-2
3100	490	500	420	140	1-2
3200	490	500	420	190	1-2
3300	490	500	420	240	1-2
3400	490	500	420	290	1-2
3500	490	500	420	340	1-2
3600	490	500	420	390	1-2
3720	490	500	420	450	1-2

See paragraph FUEL USAGE (6 TANK SYSTEM)

X1-253

Figure 7-3

remain. Make final runout of the LH fuselage tank through one engine only, operating other engines on their respective wing tanks.

b. When only 10 gallons remain in LH fuselage tank, select the RH fuselage tank through crossfeed to ALL ENGINES until 50 gallons remain.

FUEL LOADING CHART — EIGHT WING TANK SYSTEM

TOTAL USABLE FUEL LOAD (GALLONS)	FUEL TANKS					*USAGE
	NO. 1 AND NO. 4 MAIN (EACH TANK)	NO. 2 AND NO. 3 MAIN (EACH TANK)	NO. 1 AND NO. 4 AUX. (EACH TANK)	NO. 2 AND NO. 3 AUX. (EACH TANK)	FUSELAGE TANKS (EACH TANK)	
1200	300	300				1
1300	325	325				1
1400	350	350				1
1500	375	375				1
1600	400	400				1
1700	425	425				1
1800	450	450				1
1900	475	475				1
2000	490	500	10			1-3
2100	490	500	60			1-3
2200	490	500	110			1-3
2300	490	500	160			1-3
2400	490	500	210			1-3
2500	490	500	260			1-3
2600	490	500	310			1-3
2700	490	500	360			1-3
2800	490	500	410			1-3
2900	490	500	420	40		1-3
3000	490	500	420	90		1-3
3100	490	500	420	140		1-3
3200	490	500	420	190		1-3
3300	490	500	420	240		1-3
3400	490	500	420	290		1-3
3500	490	500	420	340		1-3
3600	490	500	420	360	30	1-2
3700	490	500	420	360	80	1-2
3800	490	500	420	360	130	1-2
3900	490	500	420	360	180	1-2
4000	490	500	420	360	230	1-2
4100	490	500	420	360	280	1-2
4200	490	500	420	360	330	1-2
4300	490	500	420	360	380	1-2
4400	490	500	420	360	430	1-2
4440	490	500	420	360	450	1-2

See paragraph FUEL USAGE (8 TANK SYSTEM)

Figure 7-4

X1-254

Make final runout on RH fuselage tank through one engine only, operating the other engines on their respective wing tanks.

c. When only 10 gallons remain in RH fuselage tank, return engine operating from the fuselage tank to its respective wing tank.

Note

If operating below 1000 feet altitude, do not operate more than two engines from any one fuselage fuel tank unless absolutely necessary.

2. LH AUX TANK to engines No. 1 and 2. RH AUX TANK to engines No. 3 and 4.

Note

Should fuel weight distribution become unbalanced due to excessive engine fuel consumption or the auxiliary tanks feeding unevenly, run all engines from the fullest auxiliary tank until fuel weight distribution is in balance.

CAUTION

Never use both auxiliary tanks to supply fuel to all engines at the same time. This condition will result in fuel draining to the tank lowest in position or quantity.

3. A straight line system of each main tank to its respective engine, i.e., MAIN TANK No. 1 to engine No. 1, MAIN TANK No. 2 to engine No. 2, MAIN TANK No. 3 to engine No. 3, MAIN TANK No. 4 to engine No. 4 (it must be remembered that the landing is made using these tanks).

CAUTION

It is recommended that landings not be made with more than 1580 gallons integral wing fuel, distributed as follows: 395 gallons in each inboard (No. 2 and 3) main tanks and 395 gallons in each outboard (No. 1 and 4) main, or outboard main and outboard auxiliary fuel tanks combined. This limitation is necessary in order that the wing may safely withstand the designed basic normal landing requirements.

FUEL USAGE (HC-54 ONLY).

The sequence for using the fuel supply during engine starts, takeoffs, and landing operations will be a straight line system of each main tank to its respective engine, i.e., MAIN TANK No. 1 to engine No. 1, MAIN TANK No. 2 to engine No. 2, MAIN TANK No. 3 to engine No. 3, and MAIN TANK No. 4 to engine No. 4. After takeoff and climb, the following fuel sequence will be used in accordance with the amount of fuel in the aircraft:

1. If fuselage fuel tanks are serviced for long-range operation, use fuel in following order:

   a. Left fuselage to No. 2 and No. 3 engines (down to 50 gallons); No. 1 and No. 4 engines on main tanks.

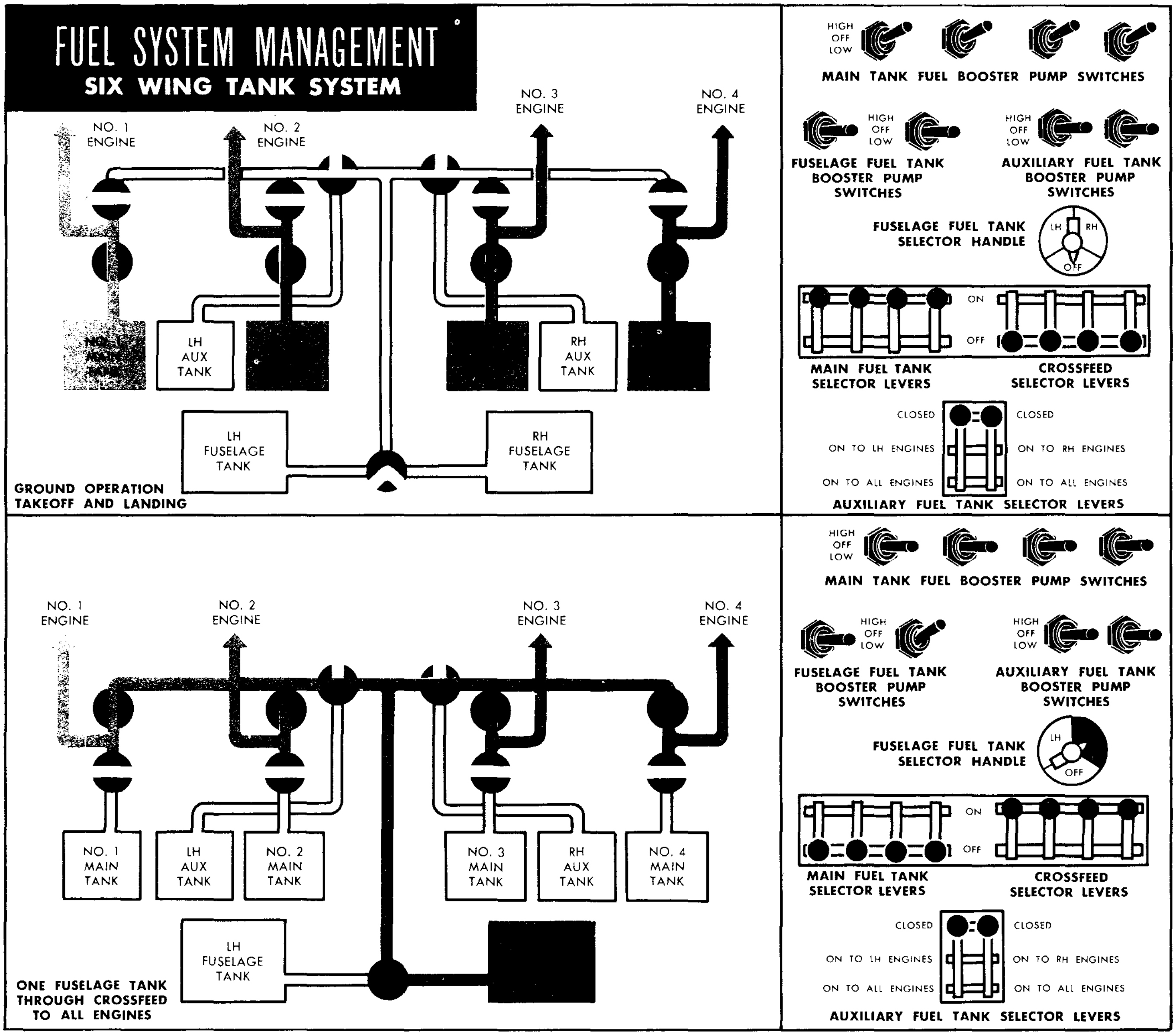
   b. Right fuselage to No. 1 and No. 4 engines (down to 50 gallons); No. 2 and No. 3 engines on main tanks.

   c. Left fuselage to No. 1 engine until 10 gallons remain.

   d. Right fuselage to No. 4 engine until 10 gallons remain.

   e. Left auxiliary to No. 1 and No. 2 engines until 50 gallons remain.

   f. Right auxiliary to No. 3 and No. 4 engines until 50 gallons remain.



X1-251

Figure 7-5

g. Left auxiliary to No. 2 engine until 10 gallons remain; No. 1 engine on No. 1 main tank.

h. Right auxiliary to No. 3 engine until 10 gallons remain; No. 4 engine on No. 4 main tank.

Note

If operating below 1000 feet altitude, do not operate more than two engines from any one fuselage fuel tank unless absolutely necessary.

Note

Should fuel weight distribution become unbalanced due to excessive engine fuel consumption or the auxiliary tanks feeding unevenly, run all engines from the fullest tank until fuel weight distribution is in balance.

CAUTION

Never use both auxiliary fuel tanks to supply fuel to all engines at the same time. This condition will reresult in fuel draining to the tank lowest in position or quantity.

2. Use a straight line system from each main fuel tank to its respective engine, i.e., MAIN TANK No. 1 to No. 1 engine. All landings must be made using main fuel tanks.

CAUTION

It is recommended that landings not be made with more than 1580 gallons integral wing fuel, distributed as follows; 395 gallons in each inboard (No. 2 and 3) main tanks, and 395 gallons in each outboard (No. 1 and 4) main, or outboard main and outboard auxiliary fuel tanks combined. This limitation is necessary in order that the wing may safely withstand the designed basic normal landing requirements.

FUEL USAGE (EIGHT-TANK SYSTEM).

The sequence for using the fuel supply during engine starts, takeoffs, and landing operations will be a straight line system of each main tank to its respective engine, i.e., MAIN TANK No. 1 to engine No. 1, MAIN TANK No. 2 to engine No. 2, MAIN TANK No. 3 to engine No. 3, MAIN TANK No. 4 to engine No. 4. After takeoff and climb, the following sequence will be used in accordance with the amount of fuel in the aircraft:

1. If fuselage fuel tanks are installed for long-range operation, follow steps a through c.
   a. LH fuselage tank through crossfeed to ALL ENGINES until 50 gallons remain. Make final runout of the LH fuselage tank to two engines on same side of the aircraft only, operating other engines on their respective main wing tanks.
   b. When only 10 gallons remain in the LH fuselage tank, select RH fuselage tank through crossfeed to ALL ENGINES until 50 gallons remain. Make a final runout on the RH fuselage tank to two engines on same side of the aircraft only, operating the other engines on their respective main wing tanks.
   c. When only 10 gallons remain in the RH fuselage tank, return the two engines operating from fuselage tank to their respective main wing tanks.
2. AUX TANK No. 1 to engine No. 1, AUX TANK No. 2 to engine No. 2, AUX TANK No. 3 to engine No. 3, and AUX TANK No. 4 to engine No. 4 until depleted; or AUX TANK No. 1 through crossfeed to engines No. 1 and 2, and AUX TANK No. 4 through crossfeed to engines No. 3 and 4 until depleted.

Note

Should fuel weight distribution become unbalanced due to excessive engine fuel consumption or the auxiliary tanks feeding unevenly, run all engines from the fullest tank until fuel weight distribution is in balance.

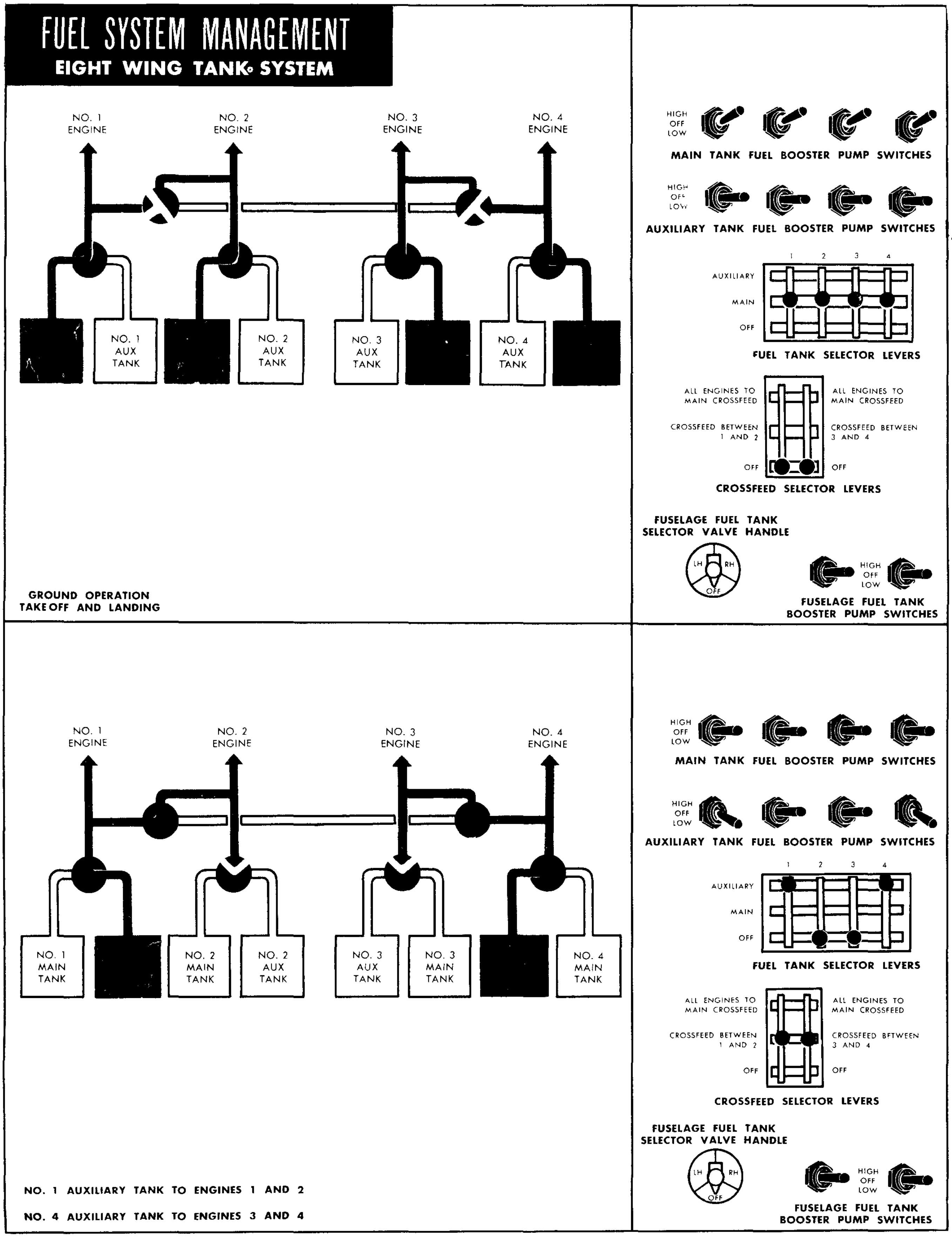


Figure 7-6

X1-252

3. A straight line system of each main tank to its respective engine, i.e., MAIN TANK No. 1 to engine No. 1, MAIN TANK No. 2 to engine No. 2, MAIN TANK No. 3 to engine No. 3, and MAIN TANK No. 4 to engine No. 4 (it must be remembered that the landing is made using these tanks).

CAUTION

It is recommended that landings not be made with more than 1580 gallons integral wing fuel distributed as follows; 395 gallons in each inboard (No. 2 and 3) main tanks, and 395 gallons in each outboard (No. 1 and 4) main, or outboard and outboard auxiliary fuel tanks combined. This limitation is necessary in order that the wing may safely withstand the designed basic normal landing requirements.

RECOMMENDED USE OF BOOSTER PUMPS.

HIGH BOOST OPERATION.

High boost operation of the booster pumps is recommended for the following conditions:

1. Engine starting.
2. Take-off and landing.
3. Engine-driven fuel pump failure.
4. When operating all engines from a fuselage tank.

Note

Before operating the booster pumps on high boost, with the engines not running, use low boost first to minimize fuel surge to the carburetor diaphragm. Always turn booster pumps off one at a time and check the fuel pressure gages to make certain that normal pressure can be maintained by the engine-driven fuel pumps.

LOW BOOST OPERATION.

Low boost operation of the booster pumps is recommended for the following conditions:

1. Oil dilution.
2. Climbing.
3. Fuel flow or pressure fluctuations.
4. Selecting a new fuel supply.
5. Priming cabin heater fuel pump supply line when heater operation is desired. (When heater fuel pump is operating normally, turn booster pump switches to OFF.)
6. When fuel conditioning is required.

FUEL CONDITIONING.

Since the boiling point characteristics of fuel vary with each production run, and each run varies with age and the conditioning it receives, it is very difficult to predict the exact moment and condition under which booster pumps should be applied. The above recommended operating procedures are based upon critical conditions with 43.3°C fuel. As day-to-day flying will seldom result in 43.3° fuel condition, it is recommended that the following procedure be used whenever the cruise altitude is reached with booster pumps on or when new tanks have been selected.

Conditioning the fuel by booster pump agitation covers most of the critical fuel conditions that may occur in the fuel system. Make the following test for fuel stability:

Some time after the aircraft has been stabilized at the cruise altitude, momentarily turn one of the selected booster pumps off and at the same time watch the fuel pressure. If the fuel pressure drops or fluctuates, leave the booster pump in operation for a longer period. If the pressure remains steady, that booster pump may be turned off. Repeat this procedure on the remaining booster pumps.

The fuel system can malfunction as the result of vapor lock, a condition which occurs when the fuel boils or when the fuel is supersaturated with air. The usual indications of a vapor lock start with fuel pressure and fuel flow fluctuations followed by engine rpm surging. This is usually followed by an irregular surge of greater magnitude with extreme fuel pressure and flow fluctuations. In the final stage, the engine rpm surge can become great enough to lead to a complete engine failure.

A vapor lock can be rapidly and completely broken by placing the fuel booster pump switch(s) in the LOW position to deaerate the fuel and force the air and fuel vapor back into solution with the fuel. Continuous use of LOW boost will deaerate the fuel in the tank.

OIL SYSTEM MANAGEMENT.

The nacelle tank oil level should not be permitted to go below 11 gallons. When the oil quantity gage for any one of the nacelle oil tanks indicates that the tank is down to 11 gallons, the oil supply should be replenished not to exceed 17 gallons from the fuselage oil tank (figure 1-21). This is accomplished by placing the fuselage oil selector handle in the required nacelle tank position and holding the fuselage oil transfer pump switch in the ON position until the required amount of oil has been transferred. It will be necessary to monitor the oil quantity gage for the respective tank to make certain it is not overfilled.

CAUTION

Do not hold the oil transfer pump circuit breaker in the ON position if it opens, except in extreme emergency, since this may cause pump motor failure due to overload.

USE OF LANDING WHEEL BRAKES.

TAXIING.

The wheel brakes should never be "dragged" during taxi. Taxi speed should be controlled by intermittent brake application, rather than by holding constant brake pressure. The brakes should be used as little as possible for turning the aircraft except in an emergency or when it is necessary to avoid an obstruction.

LANDING.

To prevent skidding the tires and causing flat spots, use extreme care when applying brakes immediately after touchdown, or at any time there is considerable lift on the wings. Heavy braking action can result in locking a wheel more easily immediately after touchdown than when the same pressure is applied after the full weight of the aircraft is on the wheels. Once a wheel is locked in this manner, and constant pressure is maintained, the wheel will remain locked even though the aircraft momentum is decreased. Proper braking action cannot be expected until the wheels are carrying the entire weight of the aircraft.

Brakes can only stop rotation of the wheels. Stopping the aircraft is dependent upon the amount of friction between the tires and the runway. If maximum braking is required after touchdown, lift should be reduced as soon as possible by raising the wing flaps before applying the brakes. This procedure will permit greater braking action due to increased friction between the tires and the runway.

CAUTION

- Do not use brakes until the nosewheel is on the runway. Braking before the nosewheel is on the runway may cause extreme structural damage.
- If brakes are used during practice landing, 15 minutes should elapse between landings if the landing gear is extended, and 30 minutes when the landing gear is retracted. Additional time should be allowed for cooling if brakes are used for steering or crosswind taxiing.

AFTER LANDING.

The aircraft should not be taxied under any circumstances after excessive use of the brakes, and should not be towed into a crowded parking area until the brakes have been properly cooled. Heat is transferred from the brake to the wheel for an extended period of time after brake application. Peak temperature in the wheels is not attained until 10 to 15 minutes after aircraft stops. Slow taxiing will not reduce the brake temperature adequately and brake application during such a taxi only increases the hazard. Excessive temperature can result in complete breakdown of the wheel and brake structure. In extreme cases, the wheel and tire may fail with explosive force and/or be destroyed by fire. If fire is not evident, the brake should be cooled by applying bromochloromethane (CB) or water in a straight stream as soon as possible after the aircraft stops. Make direct contact with the exposed portion of the brake. Apply coolant in 3 to 5 second bursts. After the brake has cooled, allow the wheel to cool in ambient temperature.

WARNING

To prevent injury, a fire guard should stand in a direct line with the landing gear aft of the wheel. In case of an explosion, parts from the wheel will fly to the side of the wheel.

FLIGHT CHECK RECORDING SYSTEM (EC-54).

For operation of the facilities flight check recording system and flight check procedures see AFM 55-8.

Original Signed By T.H. Sullivan

SECTION VIII

CREW DUTIES

TABLE OF CONTENTS

INTRODUCTION.

This section lists the responsibilities, other than primary functions, of crew members.

PILOT.

You have the responsibility for the issuance of instructions governing all phases of flight operation and for the efficient performance of all duties. It will be your responsibility to insure that a thorough visual inspection of the aircraft is properly conducted before flight. This inspection will be conducted in sufficient time before departure by you or your delegated representative to permit correction of discrepancies without incurring delays. You are responsible for the completion of all release forms pertaining to the aircraft and the flight. You must see that the other crew members understand their specific duties and know when they are to be performed. Also arrange to have all persons briefed on normal and emergency procedures and on correct use of equipment.

COPILOT.

As copilot you must be able to substitute for the pilot in any of his duties. In addition, you will assist the pilot in the completion of all preflight inspections. You will be responsible for additional duties as delegated by the pilot. In the absence of the pilot, you will be responsible for all duties normally assumed by the pilot.

FLIGHT ENGINEER.

When the aircraft is away from its home base, you are responsible for the maintenance, servicing, inspection, and securing the aircraft while on the ground, and for determining that all miscellaneous and emergency equipment is aboard the aircraft and properly installed or stowed before flight. In flight, you may be called upon to perform such duties as the pilot may direct.

RADIO OPERATOR (WHEN ASSIGNED).

As radio operator you must be proficient in the utilization of all radio equipment installed in the aircraft, and in addition, be current in the use of CW and voice procedures. You must be thoroughly familiar with emergency equipment and procedures as they pertain to your duties as a radio operator.

MISSION PLANNING.

1. Communications Requirements—Complete.

   Complete requirements for briefed routes to be flown. Coordinate with crew members, as required, for reporting points, crystal frequency requirements, alternate and emergency airfields, etc.

2. Applicable Pilot's Manuals—Current and Complete.

   Check applicable pilot's manual (Enroute Charts, Enroute Supplements, Terminal Charts) for current and complete contents. Correct publications as required.

3. Communications Kit—Complete.

   Communication flimsy, forms, radio logs, frequency cards, crystals and tool kit (where applicable). ACP's 125B-1, 131, and 135A.

EXTERIOR INSPECTION.

1. Antennas—Checked.

   Inspect all antennas for security of mounts, cleanliness, no grease spots or carbon on stub masts, no cracks on base, and ground wire secure on stub types. Check trailing wire antenna retracted.

2. Static Dischargers—Checked.

   Check all static dischargers for length (at least six inches). Wick should be approximately one inch long and should not be too frayed or ragged.

INTERIOR INSPECTION.

1. Personal Equipment—Stowed.

   Stow all personal equipment not necessary for flight.

2. Spare Fuses—Aboard.

3. Oxygen System—Checked.

   Check mask and regulator for proper operation.

4. Required Publications—Stowed.

   Stow applicable pilot's manuals, mission data, and communications publications.

5. Form 781—Checked.

Check for status of communications equipment.

6. Radio G-File—Checked.

Check for completeness and condition.

7. Frequency Charts—Checked.

Check the VHF/UHF/HF frequency and ILS Glide Slope-Localizer frequency pairing charts for current frequency assignments and channelization.

8. VHF Radio Channelization—Checked.

Check for proper crystals and thumb wheel settings.

9. UHF Radio Channelization—Checked.

Check all channels for proper settings.

10. VHF Radio Operation—Checked.

Check operation of transmitter and receiver, sidetone level, DF tone, and background noise on all channels.

11. VHF Homing Adapter (HC-54)—Checked.

12. UHF Radio Operation—Checked.

Check operation of transmitter and receiver, sidetone level and background noise.

13. UHF/DF—Checked.

Place operations switch to ADF. If signal is not heard, request a short count. Check the UHF/DF pointer for proper bearing of the signal source. Return operations switch to T/R + GUARD.

14. Radio Compass—Checked.

Check control panel for proper alignment. Check operation of receiver on all bands and selector positions. Check indicator for proper operation on LOOP & COMPASS positions with local station. Check operation of CW switch and panel lights.

15. VHF NAV Receiver—Checked.

Tune and identify station by selecting proper channel. Check RMI pointer for proper homing. Set reading indicated by the pointer into the course set window of course indicator. Check vertical bar on the course indicator for centering and TO/FROM window for a TO indication. Set reciprocal reading, indicated by the pointer, in the course set window. Check vertical bar on course indicator for centering and TO/FROM window for a FROM indication.

Note

Check Airmans Guide and use a ground test transmitter if available.

16. Glide Slope Receiver—Checked.

Set localizer frequency in the OMNI receiver. Check glide slope warning flag, glide slope indicator and CDI for movement.

17. Tacan—Checked.

Tune and identify station by selecting proper channel. Check RMI pointer for proper homing. Place function selector switch to T/R and check range indicator. Place the instrument select switch to TACAN and check vertical pointer (CDI) on course indicator for proper indication. Return instrument select switch to VOR-ILS.

18. LF Receiver—Checked.

Check for frequency alignment and reception.

19. Marker Beacon Receiver—Checked.

Check background noise and push-to-test light.

20. HF Command Radio—Checked.

Check operation of transmitter and receiver with air-ground station.

21. Interphone Stations–Checked.

    Check operation of all crew member interphone stations on both NORMAL and CALL positions.

22. Liaison Receiver–Checked.

    Place power switch to KVC. Check dial lights, crystal filter switch, beat frequency knob, CW OSC switch, antenna alignment and reception on all bands.

23. Liaison Transmitter–Checked.

    Check channelization for mission requirement frequencies. Key transmitter and check PA Plate and Grid readings. Check operation with air-ground station.

24. Emergency Radios–Checked.

    Inspect emergency radios for correct stowage and current inspection dates.

BEFORE TAKEOFF.

1. Preflight Inspection–Completed.

2. Form 781–Completed.

   Enter all discrepancies in Form 781 and bring them to the attention of the pilot.

3. Radios–On as required.

4. VHF/UHF, Interphone–Monitor.

5. Radio Log–Initiated.

   Initiate radio log and monitor frequencies as required.

6. Safety Belt–Fastened.

7. IFF/SIF–ON.

   Place IFF/SIF to STANDBY after engine start. Place IFF/SIF to ON when directed by the pilot.

AFTER TAKEOFF — CLIMB.

1. Radio Contact–Established as required.

   Establish contact with, and obtain primary and secondary frequencies from ground station. Send departure report.

INFLIGHT.

1. Radio Log–Maintained.

   Set up log in such a manner that events of mission may be reconstructed.

2. Radios–Monitor.

   Monitor assigned frequencies as required.

3. Reports–Transmitted as required.

   When reporting is required, procedure will be as outlined in current directives and publications.

4. Emergency Communications–As required.

   When circumstances require emergency transmissions, the pilot will authorize type message required. Format and procedures will be as outlined in current directives and publications. Perform inflight maintenance, if possible, to maintain communications.

DESCENT.

1. HF Radio Equipment–As required.

   Turn HF equipment off when not required for approach or landing communications.

2. Trailing Wire Antenna–Retracted.

3. VHF/UHF, Interphone–Monitor.

4. Safety Belt–Fastened.

AFTER LANDING AND POSTFLIGHT.

1. IFF/SIF—OFF.
2. Form 781—Completed.

   Enter all radio discrepancies in Form 781.
3. Radio Log—Completed.

   Complete radio log and have it certified by the pilot.
4. Radio Logs, Codes, and Ciphers—Turned in.

   Collect and turn in to proper authority all logs, codes, and ciphers.

NAVIGATOR (WHEN ASSIGNED).

As navigator, you will aid the pilot in all matters pertaining to flight planning and will perform any other assigned duties. You will be responsible for navigation of the aircraft, using all means available to successfully accomplish the mission. You will perform the following preflight inspection of navigation equipment and report the condition to the pilot.

MISSION PREPARATION.

1. Weather—Briefed.

   Obtain necessary meteorological data for route to include:

   a. Cloud coverage and haze.

   b. Climb winds and winds aloft.

   c. Location of jet streams and unusual weather phenomena.

   d. Temperatures.

   e. Pressure pattern information.

   f. Terminal forecast.
2. Navigation Publications—Checked.

   Check for currency, completion, and condition of Air Almanac, H.O. 249, flight plans, range control charts, and appropriate maps and charts.
3. Routes—Plot.

   Plot complete route on charts. Annotate alternate and emergency airfields, terrain hazards, reporting points, control areas, and warning areas. The current flight planning document will be consulted for information on RESTRICTED and WARNING AREAS, and ADIZ.
4. Equipment—Complete professional kit.
5. Time Check—Obtain.

EXTERIOR INSPECTION.

1. Driftmeter—Checked.

   Check lens and lens housing for damage. Make certain that lens is clean.
2. Radome—Checked.

   Check for proper installation and evidence of any damage.
3. Trailing Wire Antenna—Checked.

   Check the guide and weight for secureness.

INTERIOR INSPECTION (POWER OFF).

1. Form 781—Checked.

   Check for any information pertaining to the aircraft navigation equipment.
2. Celestial Tables (and emergency map kit, if required)—Complete.

3. Oxygen System Checked.

   Check oxygen indicator and mask fittings.

4. Radio and Radar Altimeters—OFF.

5. Radio Compass—OFF.

6. Driftmeter—CAGED and OFF.

7. Loran Equipment—OFF.

8. Compasses—Check current calibration card.

9. Aircraft Clocks—Set.

10. Sextant/Astrocompass and mount—Check and align at all positions.

11. Interrogator (HC-54)—OFF.

12. Search Radar—OFF.

    Control Box:

    a. Function Switch—OFF.

    b. Scan Switch—STOP.

    c. Gain Knob—Fully CCW.

    d. Delay Knob—175 Miles.

    e. STAB Switch—OUT.

    f. Antenna Heater Switch—OUT.

    g. OBS-MAP Switch—OBS.

    h. STC Switch—OUT.

    i. Tune Switch—AFC.

    j. Range Switch—10 Miles.

    k. A-J Switch—OUT.

    l. Tilt Switch—Center position.

    Indicators (both):

    a. Intensity Knob—Fully CCW.

    b. Focus Knob—Fully CCW.

    c. Lights Knob—Fully CCW.

    d. Cursor—Center at Zero.

    Pressure Controls:

    a. Pressurization Switch—NORMAL ON.

    b. Pressure Indicator—Indication normal.

13. Emergency Survival Equipment-Aboard and stowed.

INTERIOR INSPECTION (POWER ON).

1. Circuit Breakers, Fuses, and Spares—Checked.

   Check circuit breakers and fuses in main junction box. Insure that spare fuses are available.

2. Inverter Power Clearance—Received from flight mechanic (N, FM).

   Check with flight mechanic that power is on the line and that inverters are turned on and delivering proper voltage.

3. Table and Dome Lights—ON and set as required.

4. Interphone—Checked.

5. Fluxgate or N-1 Compass—Check for operation against magnetic compass.

6. Driftmeter—ON.

   a. Gyro Switch—ON.

   b. Starting Button—Depress and hold momentarily.

7. Periscopic Sextant and Mount—Checked.

   a. Desiccant—Check.

   b. Halftime Dial—Check for accuracy.

   c. Altitude Averager—Check for accuracy.

d. Sextant—Insert in mount.

e. Electrical Cables—Connect to sextant and mount.

f. Illumination—Check.

g. Mount alignment—Check. If necessary, make alignment correction by turning adjusting ring of the true heading objective lens.

h. Illumination switch—OFF.

i. Averager Actuator—Depress and release.

j. Bubble Increase Knob—Full increase.

k. Sextant Port—Retract sextant and close.

l. Mount, Sextant and Cable—Drain, remove and stow.

8. Driftmeter—Checked.

a. Azimuth Drive Knob—Check alignment.

b. Gyro Caging Knob—Uncage, check and then cage.

c. Gyro Switch—OFF.

9. Radio and Radar Altimeter—Check for operation and calibrate.

10. Interrogator (HC-54)—Checked and ON.

11. Loran Equipment—ON, check calibration, then OFF.

BEFORE TAXI.

1. VHF/UHF and Interphone—Monitor.
2. Time Hack—Given to crew.
3. Fluxgate or N-1 Compass—Cross check with magnetic compass.
4. Search Radar Function Switch—STANDBY.

TAXI.

1. Search Radar—ON.

a. Scope Intensity Knob—Clockwise for distinct trace, after antenna tilt meter deflection.

b. Focus Knob—Adjust until trace is thin and sharp.

c. Scope Intensity Knob—Rotate slowly counter clockwise until sweep is just visible.

d. Function Switch—SEARCH.

e. Scan Knob—FULL.

f. Gain Knob—Clockwise for optimum reception.

g. Antenna Tilt Switch—Adjust for optimum reception.

h. Antenna STAB Switch—STAB.

BEFORE TAKEOFF.

1. Flight Clearance—Monitor and record.
2. Initial Heading—Give to pilot.
3. Altimeter—State Setting (N, P, CP).

   Set to known elevation. Note error in Kollsman dial, apply this as a correction to all subsequent altimeter settings received. Note any difference in altimeter reading and amount of variation from field elevation.

4. Chart Table—Stow.
5. Safety Belt—Fasten.
6. Departure—Monitor.

   Monitor departure with all available radio navigational aids and radar.

CRUISE.

1. Level Off Position—Obtain and record.
2. Heading Check—Obtain.
3. Drift—Obtain.

DESCENT.

1. VHF/UHF and Interphone—Monitor.
2. Descent/Approach Instructions—Monitor.
3. Altimeter—State Setting (N, P, CP).

   Set to barometric pressure as given by controlling facility plus or minus known correction and cross check with other altimeters.
4. Sextant/Astrocompass—Stow.
5. Loran Equipment—OFF.
6. Driftmeter—CAGED and OFF.
7. Chart Table—Stow.
8. Search Radar—As required.
   a. Tilt, Gain, and Intensity—Adjust as required.
   b. Antenna STAB Switch—STAB.
   c. OBS-MAP Switch—Set for best reception.
9. Descent/Approach—Monitor by radar and instruments.

BEFORE LANDING.

1. Navigator's Seat—Secure.
2. Safety Belt—Fasten.
3. Aircraft Position—Monitor alignment with runway on final approach.
4. Heading—Monitor
5. Go-Around—Monitor position.

AFTER LANDING.

1. Search Radar—OFF.
   a. Gain Knob—Fully CCW.
   b. Tilt Switch—Fully UP.
   c. Scan Switch—STOP.
   d. Intensity Knob—Fully CCW (both indicators) (N, P).
   e. Antenna STAB Switch—OUT.
   f. Function Switch—OFF.
   g. Range Switch—10 Miles.
   h. Tune Switch—AFC.
   i. Delay Knob—175 Miles.
   j. OBS-MAP Switch—OBS.
   k. STC Switch—OUT.
   l. A-J Switch—OUT.
   m. Antenna Heater Switch—OUT.
2. Search Radar Pressurization Switch—OFF.
3. Search Radar Pressurization Bleed Valve Knob—Depress and bleed to 30 inches Hg.
4. Interrogator (HC-54)—OFF.
5. Radio Compass—OFF.
6. Navigator's Log—Close.
7. Navigator's Equipment—Stowed.
8. Form 781—Completed.
9. Lights—OFF.
10. Debriefing—Complete.

FLIGHT STEWARD (WHEN ASSIGNED).

As flight steward you are responsible for all activities in the cabin as directed by the pilot. The safety and comfort of the passengers is your prime responsibility. You will determine that all miscellaneous and emergency equipment installed in the cabin is aboard the aircraft and properly installed or stowed before flight. You will determine that the lavatories and galley are properly cleaned, and proper supplies are aboard before flight. In flight, you may be called upon to perform such other duties as the pilot may direct.

BEFORE ENTERING THE AIRCRAFT.

Check with the pilot to ascertain the type of flight and the number of passengers aboard and equip the galley as deemed necessary for the flight.

ON ENTERING THE AIRCRAFT.

1. Accompany the pilot or copilot and assist him in making interior inspection as it pertains to cabin, cargo compartments, lavatories, and galley.
2. Supervise loading of passengers and assist in loading of passenger equipment. Observe and be prepared to notify the pilot of any unusual loading arrangement that might affect the center of gravity of aircraft.
3. When all personnel are aboard, check that main cabin door and cargo door is closed and locked.
4. Check that no smoking rules are observed until NO SMOKING sign is turned off.
5. Prior to takeoff, check that all passengers have fastened seat belts.
6. Report to the pilot, "Passengers secured."
7. Take your position for takeoff with seat belt fastened.

IN FLIGHT.

1. Act as the pilot's safety agent in cabin, keeping constant alert for hazards to safety such as oil leaks, fuel leaks, unusual smoke or flame conditions, interior fires, loose equipment in turbulence, etc.
2. Endeavor to ensure the passengers a safe and comfortable flight by being constantly alert to their actions and needs.
3. Prepare and serve any required inflight meals.
4. Inform the pilot immediately of any unusual conditions observed.

AFTER ENGINES ARE STOPPED.

1. Supervise unloading and safety of all passengers while deplaning.
2. Determine that all switches have been turned off in cabin.

PASSENGER BRIEFING (TYPICAL).

PREDEPARTURE BRIEFING.

Welcome aboard C-54 (Aircraft number and code name). I am (Briefer). Your aircraft commander is (Aircraft Commander). Before arriving at our final destination we will make stops at ________ , ________ , and ________, being on the ground at each base approximately ____ minutes. During the flight we will be cruising at an altitude of ________ feet. Our expected time enroute is ____ hours ____ minutes. We will arrive at ________ at approximately _____ hours (time zone).

The alarm bell will be rung prior to taxiing, to acquaint you with the muffling effect of the engines during their operation. Smoking is not permitted during ground operation, and during takeoff and landing. When lighted, the FASTEN SEAT BELTS and NO SMOKING signs, located on the forward bulkhead/cabin door, must be complied with. At any time these signs are illuminated, please follow their instructions immediately.

During flight it will be appreciated if the passengers remain in their seats as much as possible. Also, the use of any portable electronic devices is PROHIBITED. For your convenience relief facilities are in the rear of the aircraft. Coffee and water are aboard, located ________________.

(When parachutes are aboard).

Should it become necessary to evacuate the aircraft in flight, the alarm bell will sound three short rings which signifies that evacuation is anticipated. All personnel should don their parachutes and be ready to depart the aircraft immediately should the alarm bell sound again. One long ring will be the signal to commence evacuation. HAS EVERYONE BEEN FITTED WITH A PARACHUTE

(When use of oxygen is anticipated).

Oxygen masks are located ________. You will be notified when to don masks should it become necessary to use oxygen. To don the mask (Demonstrate method of donning mask and connecting to outlet as required).

Should difficulty be encountered on takeoff after becoming airborne, time permitting, six short rings on the alarm bell will be sounded to signify that an emergency landing on other than a prepared field is necessary. Prior to touch down, the alarm bell will sound one long ring or perhaps even a steady ring which signals "Brace for impact."

The preferred route of exit in an emergency is through the door by which boarding was accomplished. Should it be impossible to reach the main door, four alternate exits are provided in the passenger cabin. They are clearly outlined in yellow with arrows on the release handles indicating the direction of turn necessary for unlocking. After unlocking, pull the bottom of the window (Emergency Exit) in, allowing the window to slide down. The best course of action is to get rid of the panel by throwing it overboard through the hatch.

After the aircraft has come to a complete stop, unfasten seatbelts and abandon the aircraft. Once outside the aircraft, move away from it at least 50 yards.

After takeoff is made, and the wheels are retracted, you will probably notice the smell of burning rubber. Do not be alarmed as this is only the nose wheel snubber engaging the nose wheel. The smell will last for approximately 10 seconds and then will no longer be noticeable. ARE THERE ANY QUESTIONS?

OVER WATER BRIEFING.

Since a considerable part of our flight is going to be over water, emergency life vests (Mae Wests) have been placed aboard. To don the life vest (demonstrate proper method of donning and adjustment). Also on board are (quantity) (size) life rafts. (Assign passengers to a specific raft). ________ will be the Master Evacuation Controller (MEC) and the Assistant Evacuation Controller (AEC) will be ________ .

Note

A crew member will be assigned as AEC when available. In lieu of a crew member, passengers will be selected before boarding the aircraft to act as AEC as required. The MEC will be responsible for briefing the AEC on his assigned duties in the event of bailout or ditching. The AEC will occupy a designated seat which will be accessible to his ditching station.

Should it become necessary to ditch the aircraft, remain calm and proceed to board the inflated rafts in an orderly manner. Please DO NOT jump into the rafts. After a raft is loaded, release the holding lanyard and paddle away from the aircraft so that the remaining rafts may be loaded. Paddle free of the wings and tail of the aircraft and loiter close by until evacuation of the aircraft is complete, then endeavor to tie the rafts together by using the lanyards provided. From this point on, follow explicitly the instructions of the raft commander.

DESCENT/ARRIVAL BRIEFING.

We will be landing at (airfield) in approximately ___ minutes. The temperature on the ground is ___°F, local time is ___. Please comply with the FASTEN SEAT BELT and NO SMOKING signs when they appear. Remain seated until the aircraft has come to a complete stop in the ramp area. (As soon as the engines have stopped turning and the tail stand is in place, debarkation will commence.) Kindly check in and around your seats to make sure that you are leaving nothing behind.

PASSENGER INFORMATION.

1. Smoking is prohibited during ground operation, takeoffs, landings, when any occupant detects fuel fumes, and when directed by the pilot.
2. Seat belts will be fastened for takeoffs, landings, or as directed by the pilot.
3. Operation of portable electrical or electronic devices is prohibited.
4. Refer to diagram on reverse side (on passenger information cards) for location of emergency exits and equipment.
5. Standard Alarm Bell Signals:

   a. BAILOUT

      Short Rings—Don Parachutes

      1 Long Ring—Bail out.

   b. CRASH LANDING/DITCHING

      6 Short Rings—Fasten Seat Belts Securely.

      1 Long Ring—Brace For Impact

During ditching or crash landing, just prior to contact with surface, passenger will fold arms resting them on their knees. Bend body forward as far as possible and rest head firmly on arms. If available, hold pillow, blanket, or clothing in front of head to cushion impact forces.

ABBREVIATED CHECKLISTS.

The navigator's normal abbreviated checklist is now contained in T. O. 1C-54D-(CL)-1-2.

The radio operator's normal abbreviated checklist is now contained in T. O. 1C-54D-(CL)-1-3.

The flight steward's normal abbreviated checklist is now contained in T. O. 1C-54D-(CL)-1-4.

SECTION IX

ALL-WEATHER OPERATION

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

INTRODUCTION.

This section contains exceptions or additions to the normal operating instructions covered in Section II as well as repetitions necessary for emphasis, clarity, or continuity of thought. Communication, electronic and navigation equipment pertinent to all-weather flying is covered in Section IV. For detailed information regarding systems operation, refer to Section VII.

INSTRUMENT FLIGHT PROCEDURES.

The aircraft has excellent maneuverability characteristics for instrument flying. Stability in all axes is excellent. Before flight, check that all radios and flight instruments are operating properly.

INSTRUMENT TAKEOFF.

Note

- During all critical phases of flight, the instruments will be cross checked for proper indication. The pilot not flying the aircraft will closely monitor the instruments and will advise the pilot at the controls of any malfunction of instruments or deviation from published procedures. Both pilots will be thoroughly familiar with the departure, holding, letdown, low approach, and missed approach phase of flight.
- The navigator will monitor all instrument departures and approaches and advise the pilot of deviations.

Planning for instrument takeoff should include possibility of return to the field, and suitable precautions should be taken, including monitoring of the takeoff by GCA or other instrument facilities. Use the normal takeoff procedures.

Note

If AN/APS-42 radar is installed it is recommended that radar weather observation of the proposed climbout route be made to avoid flying into an area of buildups and possible severe turbulence.

INSTRUMENT CLIMB.

Instrument climb is the same as normal climb. Normal climbing turns should be made at approximately 20 degrees of bank angle. Maximum climbing turns should be limited to 30 degrees of bank angle. In the event a higher altitude is required over a given distance, METO power and 120 percent of the power-off stalling speed is recommended.

PARTIAL PANEL.

In the event of attitude indicator failure the aircraft can still be operated safely but considerably greater skill and concentration are required.

CAUTION

Consider all possible courses of action before attempting an instrument approach while operating partial panel.

TERMINAL HOLDING.

The recommended airspeed for holding is 120 knots IAS, gear UP, flaps 10 degrees, an 2100 rpm.

Note

Refer to Appendix performance data for maximum endurance information (if necessary).

INSTRUMENT APPROACHES.

The general flight characteristics of the aircraft on instrument approaches are excellent and there is no special technique required in handling of the aircraft.

WARNING

- Occasionally TACAN equipment will "Lock-On" to a false bearing which will be 40 degrees or a multiple of 40 degrees in error. These errors can be on either side of the correct bearing. When the TACAN locks-on a false bearing, switching to another channel and then back to the desired channel, or turning the set off and then back on will recycle the search mode. This will most probably result in a correct lock-on.

When using TACAN, cross check for false lock-on with ground radar, airborne radar, VOR, dead reckoning or other available means. These checks are especially important when switching channels or when turning the set on. When false lock-on is suspected follow procedure outlined in TACAN Operation, section IV, for recycling the TACAN search mode.

Note

A false lock-on does not affect the DME display provided by the TACAN equipment.

WARNING

On all except Navy C-54 aircraft and aircraft modified by T.O. 1C-54-572, during a VOR or ILS instrument approach, turn the TACAN set OFF at the TACAN control panel. This will prevent an automatic switchover to TACAN in the event of a VOR or ILS power failure during a VOR or ILS approach.

Note

During a VOR approach using a VORTAC facility it is not necessary to turn the TACAN set OFF, providing the TACAN is selected to the same facility.

INSTRUMENT APPROACH PROCEDURES.

For information pertaining to RANGE, ADF, VOR, ILS, RADAR, and TACAN approach procedures see figure 9-1.

CIRCLING APPROACH PROCEDURES.

The landing gear should remain up, wing flaps at 10 degrees, and airspeed 120 knots IAS. Maintain this configuration after passing the low station. When the landing runway is in sight, maneuver the aircraft at the minimum circling approach altitude to a position where the landing can be made (See figure 9-2). Landing gear and additional flaps will be lowered as the aircraft approaches the turn to final.

AUTOMATIC APPROACH PROCEDURE.

In an automatic approach is anticipated, the autopilot system should be turned on, warmed up, and engaged before commencing the automatic approach. Make the transition to the outer marker in the same manner as in a normal ILS approach. When approaching the outer marker inbound, turn the automatic approach selector switch to LOCALIZER when the CDI begins to deflect. When steady on the localizer, disengage the altitude control (if engaged) prior to intercepting glide path, perform the Before Landing Check at pilot's discretion, and retrim the aircraft by means of the pitch control knob. When the glide slope indicator shows one to two dots above center, bring the aircraft on the glide path with the pitch control knob. When steady on the glide path, turn the automatic approach selector switch to APPROACH. Disengage the autopilot upon reaching prescribed automatic approach minimums. With the exception of the automatic approach feature, the approach should be made in accordance with normal ILS procedures (figure 9-1). See Section IV for operation of the automatic approach equipment.

WARNING

Be prepared to disengage the autopilot in the event of malfunction and continue the approach manually.

ICING .

Before entering known or suspected icing conditions, turn on pitot heaters and anti-icing equipment, and monitor during operation. Should icing become extreme, the clearview windows may be opened and the windshield scraped clear of ice.

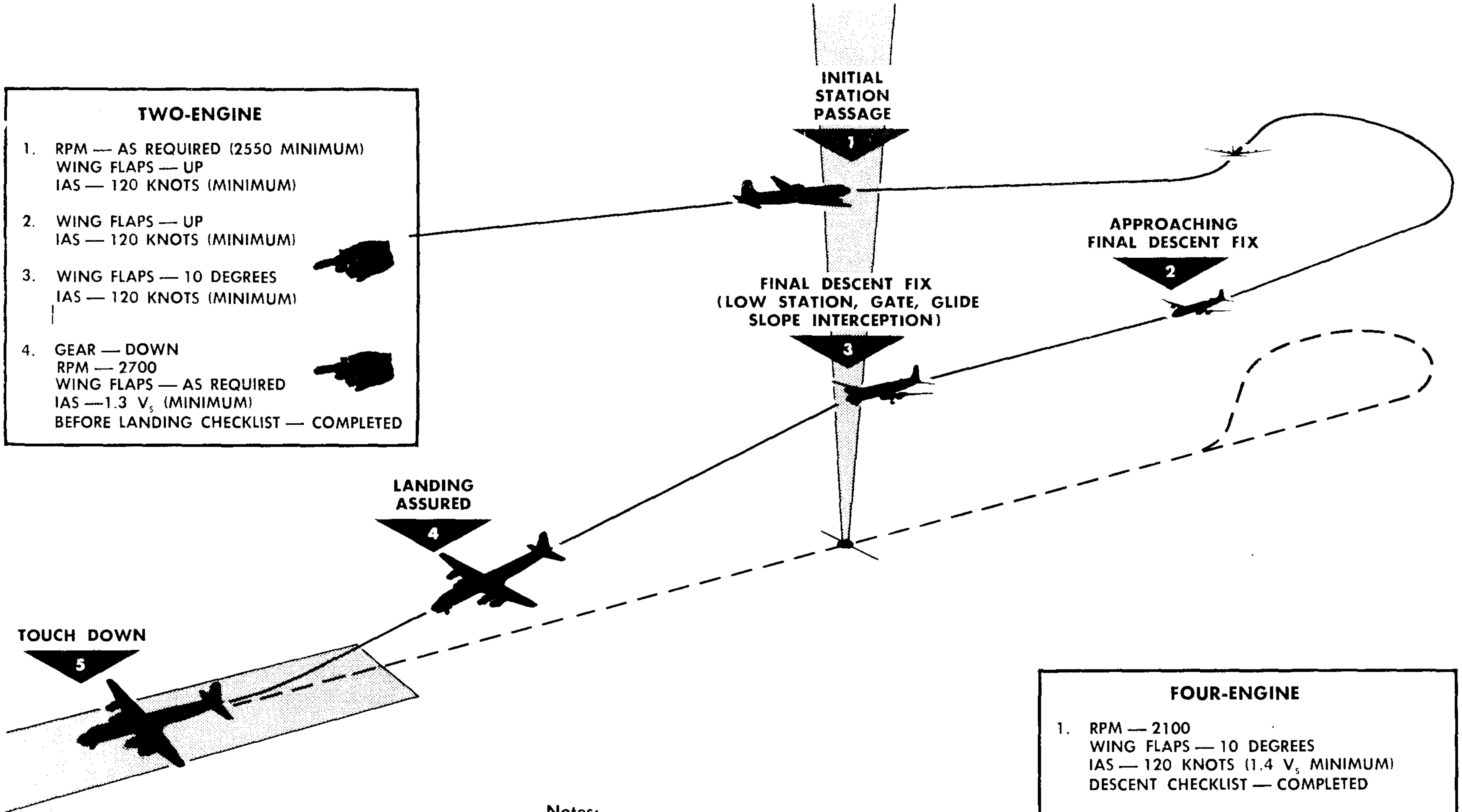
WARNING

Stalling airspeeds increase proportionately to the amount of ice buildup on the wings. During approach or low altitude flights when icing is present, it is imperative that additional airspeed be added as required.

CAUTION

If deicing boots are used, do not operate them continuously, as this may result in ballooning the ice immediately over the boots and render them ineffective. Allow the ice to build up, then turn on the deicing boots to break it off. After the ice is removed, turn the system off until the ice builds up again.

RANGE, ADF, VOR, ILS, RADAR, and TACAN APPROACH–Typical



TWO-ENGINE

1. RPM — AS REQUIRED (2550 MINIMUM)
   WING FLAPS — UP
   IAS — 120 KNOTS (MINIMUM)
2. WING FLAPS — UP
   IAS — 120 KNOTS (MINIMUM)
3. WING FLAPS — 10 DEGREES
   IAS — 120 KNOTS (MINIMUM)
4. GEAR — DOWN
   RPM — 2700
   WING FLAPS — AS REQUIRED
   IAS — 1.3 V_s (MINIMUM)
   BEFORE LANDING CHECKLIST — COMPLETED

THREE-ENGINE

1. RPM — 2300
3. RPM — 2550

Notes:
1. Items not listed for three- and two-engine approach are identical to four-engine approach procedures.
2. This is a typical diagram which is not meant to show the intended flight path but does indicate a chronological order for the items to be performed. These items may be performed before, but in no case later than the point indicated on the diagram.

FOUR-ENGINE

1. RPM — 2100
   WING FLAPS — 10 DEGREES
   IAS — 120 KNOTS (1.4 V_s MINIMUM)
   DESCENT CHECKLIST — COMPLETED
2. WING FLAPS — 20 DEGREES
   IAS — 115 KNOTS (1.4 V_s MINIMUM)
3. GEAR — DOWN
   RPM — 2300
   IAS — 115 KNOTS (1.4 V_s MINIMUM)
   BEFORE LANDING CHECKLIST — COMPLETED
4. WING FLAPS — AS REQUIRED
   IAS — 1.3 V_s MINIMUM
5. IAS — 1.2 V_s MINIMUM

X1-203

Figure 9-1

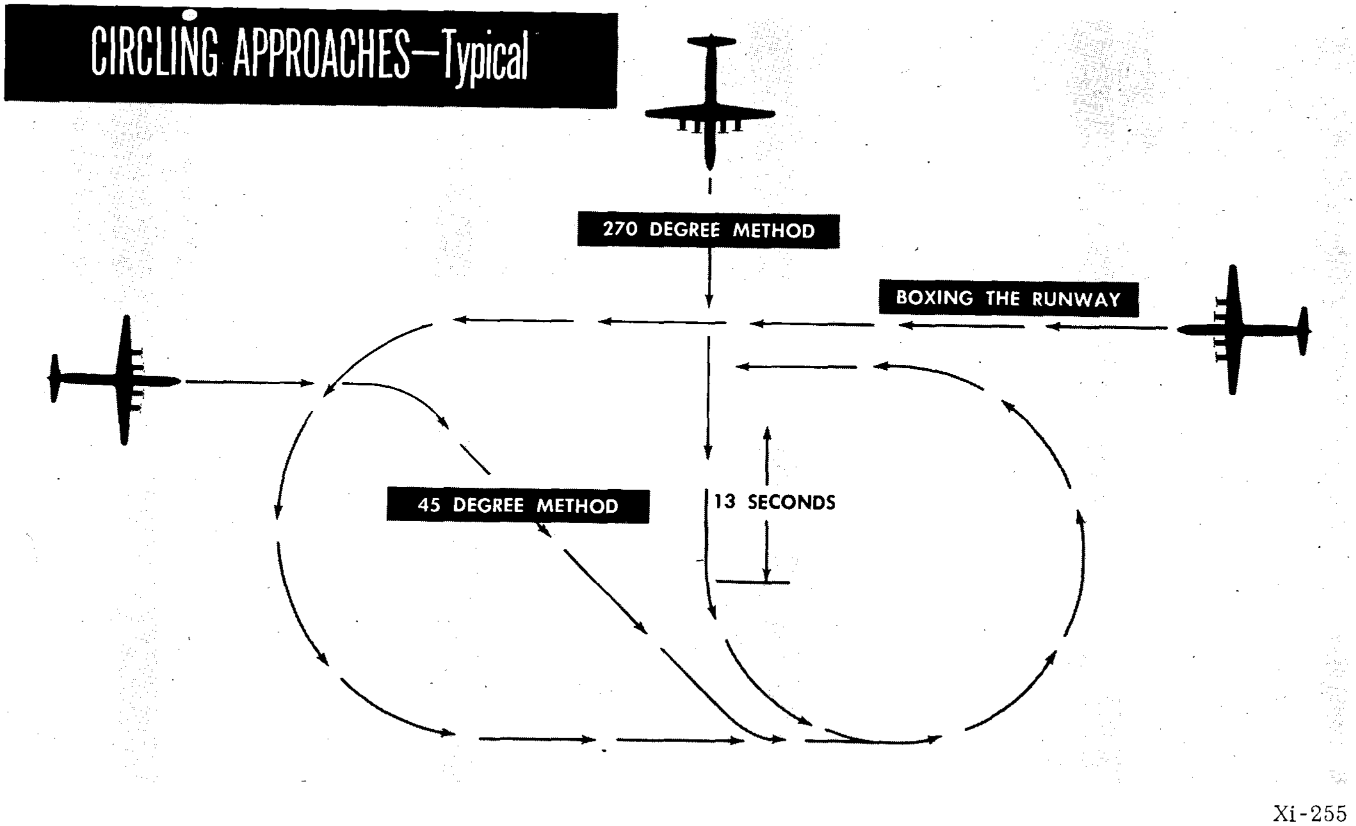


Figure 9-2

- Ice forming on the propeller control pulleys and cables of the propeller governor, may render the propeller controls inoperative. When operating in light icing conditions, it is recommended that the propellers be exercised from 200 rpm above the normal cruise range to 200 rpm below the normal cruise range at 30 minute intervals. In heavy icing conditions, this should be accomplished at least every 15 minutes. It is advisable to exercise elevator and rudder trim tabs frequently to prevent freezing.

Note

- Climb or cruise at 10 to 15 knots above normal airspeeds when in icing conditions; reducing the angle of attack minimizes the accumulation of ice on the under surfaces.

- During flight in icing conditions, carburetor heat should be used as required to maintain proper carburetor air temperature.

- In icing conditions, the nose ram air inlet may become iced over and nose heater operation will stop. To regain nose heater operation, on aircraft not equipped with AN/APS-42 Radar, turn ON the manual nose heater ground blower handled; on aircraft with AN/APS-42 Radar installed, When condition permits (clear of icing, etc) the landing gear will have to be lowered to operate the ground blower to furnish heater air.

TURBULENCE AND THUNDERSTORMS.

Note

Flight through a thunderstorm should be avoided if at all possible. However, should circumstances force a flight into a zone of severe turbulence, the following recommended techniques will aid in reducing structural strain on the aircraft.

Power settings on propeller pitch are the keys to proper flight technique in turbulent air. (Severe turbulence is classed as a condition of sufficient disturbance to make the safety of the aircraft and its occupants the pilot's concern.) In selecting an airspeed for operation in severe turbulence, a compromise must be made between the necessity to keep the airspeed low enough to permit the structure to withstand the greatest possible gusts and the necessity to keep the airspeed high enough to prevent closely approaching the stalling point.

Note

The desired penetration airspeed of the aircraft should be established before entering the storm, and should be 60 KIAS ABOVE THE STALLING AIRSPEED for aircraft gross weight. See figure 6-1 for stalling airspeeds at various gross weights.

APPROACHING THE STORM.

If is imperative that the aircraft be prepared as follows before entering the zone of turbulence (if the storm cannot be seen, its proximity can be detected by radio crash static and radar):

1. Disengage autopilot to permit aircraft respond freely to gust accelerations.
2. Adjust airspeed as necessary for safety in the turbulence.
3. Place hydraulic system bypass handle in DOWN position and landing gear lever in UP position.
4. Position mixture levers to AUTO RICH position (refer to NORMAL FUEL GRADE OPERATING LIMITS, Section V).
5. Position propeller levers and throttles to obtain desired power for penetration of turbulent air.
6. Turn pitot head heaters on and regulate carburetor heat as required.
7. Check all gyro instruments for proper settings.
8. Have all crewmembers and passengers tighten their safety belts.
9. Order radio operator to turn off all equipment rendered useless due to static conditions and to retract trailing wire antenna.
10. Turn white spotlights in pilots' compartment to bright in order to minimize blinding effect of lightening.

WARNING

Do not lower the wing flaps since structural damage may occur.

PENETRATING THE STORM.

Penetrate the storm as follows:

1. Maintain power and propeller pitch settings established before entering storm to maintain a constant airspeed regardless of erratic airspeed indications caused by storm.
2. Devote all attention to flying the aircraft. Concentrate principally upon holding a level attitude by reference to attitude indicator.
3. The altimeter may be unreliable in severe turbulence because of differential barometric pressures. A gain or loss of several hundred feet in a few seconds may be expected. Since the aircraft itself may gain or lose several thousand feet in altitude in severe turbulence, allowance for altimeter error must be made in determining a minimum safe altitude.

Note

Normally, the least turbulent area in a thunderstorm will be an altitude of 6000 feet or less above the terrain. Altitudes between 10,000 and 20,000 feet are usually the most turbulent.

4. Do not rely on airspeed indicator which may be off as much as 50 KIAS as a result of heavy rain partially blocking pitot heads.

5. Use as little elevator control as possible to minimize stresses imposed on the aircraft.

COLD WEATHER PROCEDURES.

The following operating instructions are written to supplement the instructions in Section II, and should be complied with when cold-weather conditions are encountered. The success of cold-weather operation depends greatly upon the preparation made during engine shutdown after the previous flight and postflight procedures, as outlined in the paragraphs on stopping engines and before leaving aircraft in this section; upon these depend the success of the next day's starting operation.

BEFORE ENTERING AIRCRAFT.

It will be the responsibility of the pilot to ensure that appropriate cold weather preparations have been accomplished in accordance with T.O. 1C-54D-2-2 prior to flight.

CAUTION

In cold weather operations, the fuselage oil supply must be diluted or preheated.

a. Check oil drains for oil flow. If oil does not flow, apply external heat to drains and oil tanks. Immersion-type oil heaters may also be used before attempted engine start, to insure oil circulation through system.

b. Preheat engines if outside air temperature has fallen belwo 2°C (35°F) and oil dilution was not accomplished on shutdown. Also preheat engines when air temperature is below -18°C (0°F) even if oil dilution was accomplished at shutdown.

c. The following time requirements for engine heating at various temperatures are rough estimates which will vary with wind velocities and percentage of engine oil dilution. The following tabulation is based on an oil dilution of approximately 25 per cent and no wind.

Degrees C	Degrees F	Heating Time
-6.7° to -18°	20° to 0°	1/2 hour (approx.)
-18° to -32°	0° to -25°	1/2 to 1 hour
-32° to -40°	-25° to -40°	1-1/2 to 2-1/2 hours
-40° to -46°	-40° to -51°	2-1/2 to 3-1/2 hours
-46° to -54°	-51° to -65°	3-1/2 to 5 hours

d. Check for engine stiffness periodically to determine when sufficient heating has been applied. Generally, if an engine is stiff enough to require more than one man to move propeller, it is considered too stiff to start.

e. Check all fuel and oil tank vent lines and crank case breathers for freedom from frozen condensate. Apply heat if necessary.

f. Check that primer shutoff valve opens to allow free flow.

g. Check fuel system for leaks and all fuel drains for free flow. Apply heat when necessary to obtain flow.

h. Remove protective covers from cockpit enclosure and astrodome, and pitot head covers.

i. Remove snow and ice from wings, control surfaces, control surface hinges, propellers, pitot tubes, and heater air ducts.

j. It is extremely important to anticipate accumulation of ice or snow on the surfaces and to prepare surfaces for this condition with isopropyl glycerine, 3609 fluid, and to make a continuous effort to keep surfaces clean.

k. Clean landing gear shock struts of dirt and ice; also check for proper inflation. Wipe shock struts with hydraulic fluid-soaked cloth after they have been cleaned.

l. Check tires for proper inflation.

m. Carefully inspect all openings in aircraft for accumulation of snow.

n. Connect external power source to aircraft electrical system for starting engines and ground-checking electrical equipment.

ON ENTERING AIRCRAFT.

a. Start the pilots' compartment (cockpit) blower and the cabin ground blower (if installed) and heaters to heat the flight instruments, defrost the windshields, and warm the radios, the dynamotors, the inverters, and other equipment with the aircraft.

Note

If the heaters do not ignite by use of the normal starting procedure, it will be necessary to apply external heat in the vicinity of the heaters to get them started. (In the meantime, external heat should be applied to the pilots' compartment to heat the the equipment within.)

b. Operate all the flight control surfaces and trim tabs through full travel three or four times to check ease of operation. When lowering wing flaps during normal preflight, the wing flaps should be lowered in 10 degree increments.

c. Check functioning of those instruments that can be checked without engine operation.

WARNING

In cold weather, make certain all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

BEFORE STARTING ENGINES.

a. Check oil tank sump drain, and apply heat if the flow is unsatisfactory. Preheat should never be considered adequate until oil will flow from the drain.

b. After engines are preheated sufficiently, remove engine covers or shields, heater ducts, and the oil immersion heaters.

STARTING ENGINES.

When starting engines, use the normal starting procedures outlined in Section II, supplemented by the following:

a. After engine has turned freely for 12 blades to insure clearing for hydraulic lock, prime as follows:

(1) For temperatures from 0° C (32° F) down to -21° C (-6° F) prime intermittently for 6 additional blades. A total of 18 blades will be turned before ignition is turned on.

(2) For temperatures below -21°C (-6°F) continuous prime may be required for 6 blades or more after checking engine for hydraulic lock. A total of 18 blades will be turned before ignition is turned on.

Note

Do not use the mixture levers to prime the engines.

b. Turn ignition switch to the BOTH position. After insuring that engine is firing, slowly move the mixture lever from IDLE CUT OFF to AUTO RICH position. Priming should be continued as required until engine is started. Moving mixture lever too rapidly out of IDLE CUT OFF position may result in a surge of fuel that may drown out engine.

Note

An engine tending to become overloaded may often be saved by placing the mixture lever to the IDLE CUT OFF position momentarily until the engine clears out. Do not attempt to assist by pumping the throttle.

c. Discontinue priming as soon as engine is firing normally.

CAUTION

If the engine has not started after 45 seconds of cranking, allow the starter to cool for 3 minutes before attempting another start.

Note

Due to the low output of the magneto at low engine rpm, it may be necessary to continue starter engagement for ignition boost until 600 to 700 rpm is reached.

d. If there is no oil pressure after 30 seconds of operation, shut down engine immediately and investigate.

e. High oil pressure immediately after engine start may be expected. If prolonged, oil dilution may be used to reduce viscosity of the oil.

CAUTION

Dilute oil with care because engine failure can result from over dilution.

f. If outside air temperature is -20°C (-5°F) or below, apply carburetor heat as soon as possible after the engine is started to assist in fuel vaporization and to reduce backfiring or afterfiring.

WARMUP AND GROUND TESTS.

Follow the normal warmup procedures outlined in Section II, with the following supplements:

a. When warming up an engine after oil dilution operation, it is preferable to allow the oil temperatures to rise above 60°C, and to increase the engine speed during the runup, in order to dissipate as much of the fuel as possible to allow the oil to return to its normal viscosity. Below this temperature, and at low engine speeds, very little fuel will be dissipated from the oil. Some deviation from the full open cowl flap position may be necessary during runup to obtain sufficient heated air for carburetor heat.

CAUTION

The full CLOSED position will not be used because of the lack of cooling air for the ignition harness and wiring.

b. Check operation of the windshield alcohol anti-icing pump.

c. Check the operation of the windshield wipers.

d. Check all instruments to see that they are operating within the proper limits.

WARNING

In cold weather, make certain all the instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

e. Check the operation of all deicing boots and the pilots' compartment heating system.

WARNING

Before takeoff in cold weather, remove all snow and ice accumulation from wings, control surfaces, control surface hinges, propellers, pitot tubes, and heater air ducts. Depending on the weight of snow and ice accumulated, takeoff distances and climb-out performance can be seriously affected. The roughness and distribution of the ice and snow could vary stall airspeeds and characteristics to an extremely dangerous degree. Loss of an engine shortly after take-off is a serious enough problem without the added, and avoidable hazard of snow and ice on the wings. In view of the unpredictable and unsafe effects of such a practice, the ice and snow must be removed before flight is attempted.

OPERATION ON SNOW OR ICE.

WARNING

When slush accumulation on the runway is in excess of one half inch in depth, takeoff will not be attempted.

Caution must be exercised when operating on snow or ice since steering and braking effectiveness is reduced.

TAKEOFF.

CAUTION

Pitot heat and windshield heat should be used during takeoff to prevent ice accretion. Do not use surface deicing because of resultant disturbance of airflow over the wing.

a. At subzero temperatures, maximum takeoff power may be reached at a reduced manifold pressure because of the increase in air density. Refer to the Appendix for correct manifold pressure.

b. As the takeoff run is begun, adjust the cowl flaps to the position required to maintain proper cylinder head temperatures. At temperatures of -44° C (-48° F), the cowl flaps will probably have to be fully closed.

c. Carburetor heat should be applied as required, so that the fuel will vaporize properly at -20° C (-5° F) or below temperatures. Regulate the carburetor heat to maintain carburetor air temperatures within the proper limits throughout engine runup, takeoff, climb, and cruise (refer to Operating Limits, Section V).

d. If oil discharge from the engine breather is noted, operate the engine at reduced manifold pressure and rpm; if the oil discharge continues, land at first suitable airfield.

AFTER TAKEOFF.

The landing gear should be cycled after takeoff from a slush-covered runway because of the possibility of the doors freezing shut as a result of slush pickup on the doors. The nosewheel well door is especially susceptible to this condition. If the wheels are lowered with the doors frozen shut, structural damage to the doors will occur.

STOPPING ENGINES.

Oil Dilution Procedure.

a. When cold-weather start is anticipated, engine oil should be diluted with fuel before stopping the engines, provided that engine oil temperature is maintained below 50°C. Above this temperature, dilution is not effective since fuel introduced into the system will vaporize.

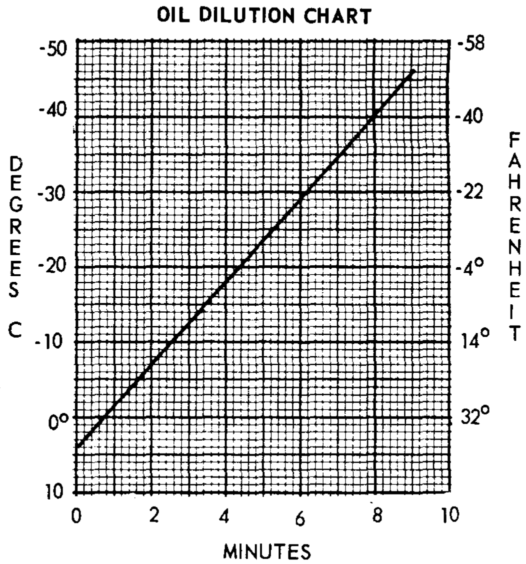
b. If it is necessary to service oil tanks, shut down engines and service them before diluting. Then restart and dilute as follows.

c. Turn fuel booster pump switches to LOW to supply adequate fuel pressure.

d. Operate engines between 1000 and 1200 rpm.

e. Maintain oil temperature below 50° C, and oil pressure above 15 psi. Should oil temperature exceed 50° C during dilution period, stop engine and wait until oil temperature has fallen below 40° C before again starting engine and resuming the dilution operation.

f. Dilute oil, as required by the lowest anticipated air temperature, for the time indicated in the following table. Oil dilution operation is indicated by substantial fuel pressure drop when dilution switch is depressed. Make certain that fuel pressure returns to normal when oil dilution switches are released.



Operate the oil dilution switches 1 minute for each additional 5° C (9° F) below -46° C (-51° F).

Note

If prestarting heat is guaranteed, dilute for only one half the recommended time.

g. Increase engine speed to 1300 rpm and exercise propeller control levers through their entire range a number of times.

h. Depress feathering switch for each propeller until a drop of 300 to 400 rpm is indicated, then pull switch out and make certain that rpm returns to normal.

i. A short acceleration period of approximately 10 seconds at end of dilution run will usually clear the spark plugs from any fouling condition resulting from prolonged idling.

Note

Operate engines at 1500 rpm for approximately 1 minute before stopping engines, to help prevent plug fouling.

j. When dilution is complete, set throttles at approximately 900 rpm, move mixture controls to IDLE CUT OFF and continue to hold the oil dilution switches ON until the engines have stopped. Leave throttles in this position to aid in starting.

Note

During engine warmup, after an oil dilution operation, the oil temperature should be above 60°C. The engine rpm should be increased during the runup to dissipate as much of the dilutant fuel as possible; below this temperature and at low engine speeds very little gasoline will be driven out of the oil. Exercise the propellers and conduct the feathering check.

BEFORE LEAVING AIRCRAFT.

a. Release the parking brake to prevent freezing.

b. Drain condensation from fuel tank drains before the moisture in them freezes. If the fuel tanks are kept filled, condensation in fuel lines and drains will be minimized.

c. The oil tank sumps must be drained of condensation before moisture in them freezes or nondiluted oil congeals in these areas.

d. Inspect the vents and crankcase breathers and remove any existing ice.

e. Clean the landing gear shock struts of dirt and ice. Wipe the shock struts with a hydraulic fluid-soaked cloth after cleaning.

f. Install protective covers to guard against possible collection of snow and ice.

g. If the aircraft is to remain outside in freezing temperatures for a period of more than 4 hours, remove the batteries and stow them in a heated room.

HIGH ELEVATION PROCEDURES.

The following procedures are recommended when operating from fields with an elevation that results in density altitudes of approximately 6000 to 16,000 feet. Experience has proven these procedures to be the most effective for safe and efficient high elevation operations.

STARTING.

The engine is more prone to flooding upon starting at density altitudes above 6000 feet, due primarily to reduction in density of the air flowing through the carburetor. The following techniques should be employed when starting at these altitudes.

a. Use larger throttle openings when starting.

b. Start in low blower.

c. When bringing in the mixture, move it to the AUTO LEAN position.

TAXIING.

Above 6000 feet density altitude, taxiing should be done at 1200 rpm in AUTO LEAN. Care should be taken to avoid damage to the nose gear strut while taxiing at this higher power setting.

If necessary, manually lean mixtures to achieve a smooth idle.

ENGINE RUNUP.

Normal runup procedures will be used at altitudes below 10,000 feet pressure altitude. At altitudes above 10,000 feet, where high blower will be used for takeoff, eliminate high blower check. Advance throttles to 2 inches above field barometric pressure and check power at 2250 (±50) rpm. Expedite runup to maintain cylinder head temperatures as low as possible.

TAKEOFF.

a. At pressure altitudes below 10,000 feet, use low blower and normal takeoff procedures.

b. Above 10,000 feet pressure altitude, shift to high blower at 1700 rpm just prior to advancing the throttles for takeoff. Advance throttles smoothly to 30 inches Hg. manifold pressure, and adjust propellers to 2550 rpm.

c. Release brakes, and advance throttles to METO power manifold pressure. Adjust throttles and propellers as necessary to maintain 1100 brake horsepower. (See Maximum Brake Horsepower Available charts, and METO Power Schedule, in Part 2 of the Appendix.)

d. Use minimum braking and control surface deflection necessary to maintain takeoff heading. Apply only enough forward pressure on control column, to keep the nosewheel in firm contact with the runway, until directional control can be maintained by rudder; delay applying back pressure until just prior to reaching takeoff speed, attempting to obtain takeoff attitude and takeoff speed simultaneously.

e. Retract gear when definitely airborne, raise flaps at prescribed flap retraction airspeed and accelerate to best three-engine climb speed while maintaining a positive rate of climb. Check cylinder head temperatures and adjust cowl flaps. Reduce power to a safe climb power based on surrounding terrain, ambient air temperature, etc., when altitude permits.

APPROACH AND LANDING.

Normal low altitude traffic pattern, approach and threshold-indicated airspeeds are recommended; however, bear in mind that true airspeed increases with altitude for the same indicated airspeed and consequently, the landing ground roll will be appreciably extended at higher elevations. Another factor to consider is the decreased effect of aerodynamic braking (deceleration due to drag) with its resultant increase in the landing ground roll and amount of time/distance used in slowing from threshold to touchdown speed after the decision to land is made. Close adherence to the recommended approach speeds and flap settings are mandatory for the successful completion of either a landing or go-around. Do not use more than 20 degrees of flap until committed to land. After touchdown place mixture in AUTO LEAN and blowers in LOW.

CAUTION

When operating in high blower, do not exceed 2550 rpm on approach, to avoid possibility of overboost in the event of a go-around.