72 O Neill

T.O.1C-97(K)G-1

USAF SERIES

KC-97G aircraft FLIGHT MANUAL

THIS PUBLICATION REPLACES T.O. 1C-97(K)G-1 DATED 1 AUGUST 1958 AND SAFETY OF FLIGHT SUPPLEMENTS IDM, IDN, IDP, IDQ, IDR,1DT,1DV THERETO. SEE BASIC INDEX, T.O. 0-1-1 AND WEEKLY INDEX T.O. 0-1-1A, FOR CURRENT STATUS OF SAFETY OF FLIGHT SUPPLEMENTS.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS PUBLICATION TO THE ATTENTION OF ALL AIR FORCE PERSONNEL CLEARED FOR OPERATION OF SUBJECT AIRPLANE

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

Air Force, Craftsman Press, Seattle, Wn. 11/23/59-13, 700(BAC)

15 OCTOBER 1959

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page.

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 896, CONSISTING OF THE FOLLOWING:

Page No.	*Issue*
Title	Original
A	Original
i thru ix	Original
x Blank	Original
1-1 thru 1-87	Original
1-88 Blank	Original
2-1 thru 2-135	Original
2-136 Blank	Original
2-137 thru 2-139	Original
2-140 Blank	Original
2-141 thru 2-154	Original
3-1 thru 3-89	Original
3-90 Blank	Original
3-91 thru 3-98	Original
4-1 thru 4-194	Original
5-1 thru 5-22	Original
6-1 thru 6-4	Original
7-1 thru 7-48	Original
8-1 thru 8-39	Original
8-40 Blank	Original
8-41	Original
8-42 Blank	Original
8-43 thru 8-77	Original
8-78 Blank	Original
8-79 thru 8-81	Original
8-82 Blank	Original
8-83	Original
8-84	Original
9-1 thru 9-17	Original
9-18 Blank	Original
1A0-1	Original
1A0-2	Original
1A1-1	Original
1A1-2	Original
1A1-3 Blank	Original
1A1-4 thru 1A1-17	Original
1A1-18 Blank	Original
1A2-1 thru 1A2-3	Original
1A2-4 Blank	Original
1A2-5 thru 1A2-17	Original
1A2-18 Blank	Original
1A3-1 thru 1A3-22	Original
1A4-1 thru 1A4-7	Original
1A4-8 Blank	Original
1A5-1 thru 1A5-45	Original
1A5-46 Blank	Original
1A6-1 thru 1A6-5	Original
1A6-6 Blank	Original
1A7-1 thru 1A7-9	Original
1A7-10 Blank	Original
1A8-1 thru 1A8-10	Original
1A9-1 thru 1A9-6	Original
Index:	
1 thru 28	Original

* The asterisk indicates pages changed, added, or deleted by the current change.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

F

USAF ACTIVITIES.—In accordance with T.O. 00-5-2.

USAF

NAVY ACTIVITIES.—Submit request to nearest supply point listed below, using form NavAer 140; NASD, Philadelphia, Pa.; NAS, Alameda, Calif.; NAS, Jacksonville, Fla.; NAS, Norfolk, Va.; NAS, San Diego, Calif.; NAS, Seattle, Wash.; ASD, NSC, Guam.

For listing of available material and details of distribution see Naval Aeronautics Publications Index NavAer 00-500.

TABLE OF CONTENTS

In order that YOU will gain

the MAXIMUM BENEFIT from this manual it is imperative that you read these pages carefully.

What you don't know won't hurt you, it will kill you

SCOPE. This manual contains all the information necessary for safe and efficient operation of the KC-97G. These instructions do not teach basic flight principles, but are designed to provide you with a general knowledge of the airplane, its flight characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and elementary instructions have been avoided.

SOUND JUDGMENT. The instructions in this manual are designed to provide for the needs of a crew inexperienced in the operation of this airplane. This book provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures contained herein.

PERMISSIBLE OPERATIONS. The Flight Manual takes a "positive approach" and normally tells you only what you can do. Any unusual operation or configuration (such as asymmetrical loading) is prohibited unless specifically covered in the Flight Manual. Clearance must be obtained from ARDC before any questionable operation is attempted which is not specifically covered in the Flight Manual.

STANDARDIZATION. Once you have learned to use one Flight Manual, you will know how to use them all. Closely guarded standardization assures that the scope and arrangement of all Flight Manuals are identical.

ARRANGEMENT. The manual has been divided into 10 fairly independent Sections, each with its own table of contents. The objective of this subdivision is to make it easy both to read the book straight through when it is first received and thereafter to use it as a reference manual. The independence of these Sections also makes it possible for the user to rearrange the book to satisfy his personal taste and requirements. The first 3 Sections cover the minimum information required to safely get the airplane into the air and back down again. Before flying any new airplane these 3 Sections must be read thoroughly and fully understood. Section IV covers all equipment not essential to flight but which permits the airplane to perform special functions. Sections V and VI are obvious. Section VII covers lengthy discussions on any technique or theory of operation which may be applicable to the particular airplane in question. The experienced pilot will probably be aware of the information in this Section but he should check it for any possible new information. The contents of the remaining Sections are fairly obvious.

YOUR RESPONSIBILITY. These Flight Manuals are constantly maintained current through an extremely active revision program. Frequent conferences with operating personnel and constant review of UR's, accident reports, flight test reports, etc., assure inclusion of the latest data in these manuals. In this regard, it is essential that you do your part! If you find anything you don't like about the book, let us know right away. We cannot correct an error whose existence is unknown to us.

PERSONAL COPIES, TABS AND BINDERS. In accordance with the provisions of AFR5-13, flight crew members are entitled to have personal copies of the Flight Manuals. Flexible, loose leaf tabs and binders have been provided to hold your personal copy of the Flight Manual. These good-looking, simulated-leather binders will make it much easier for you to revise your manual as well as keep it in good shape. These tabs and binders are secured through your local materiel staff and contracting officers.

HOW TO GET COPIES. If you want to be sure of getting your manuals on time, order them before you need them. Early ordering will assure that enough copies are printed to cover your requirements. Technical Order 00-5-2 explains how to order Flight Manuals, classified supplements thereto, and Safety of Flight Supplements so that you automatically will get all original issue, changes, and revisions. Basically, all you have to do is order the required quantities in the Publications Requirement Table (T.O. 0-3-1). Talk to your Senior Materiel Staff Officer – it is his job to fulfill your Technical Order requests. Make sure to establish some system that will rapidly get the books and Safety of Flight Supplements to the flight crews once they are received on the base.

SAFETY OF FLIGHT SUPPLEMENTS. Safety of Flight Supplements are used to get information to you in a hurry. Safety of Flight Supplements use the same number as your Flight Manual, except for the addition of a suffix letter. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in 10 days. You can determine the status of Safety of Flight Supplements by referring to the Index of Technical Publications (T.O. 0-1-1) and the Weekly Supplemental Index (T.O. 0-1-1A). This is the only way you can determine whether a supplement has been rescinded. The title page of the Flight Manual and title block of each Safety of Flight Supplement should also be checked to determine the effect that these publications may have on existing Safety of Flight Supplements. It is critically important that you remain constantly aware of the status of all supplements – you must comply with all existing supplements but there is no point in restricting the operation of your airplane by complying with a supplement that has been replaced or rescinded. Technical Order 00-5-1 covers some additional information regarding these supplements.

WARNINGS, CAUTIONS, AND NOTES. For your information, the following definitions apply to the "Warnings," "Cautions," and "Notes" found throughout the manual:

WARNING – Operating procedures, practices, etc., which will result in personal injury or loss of life if not carefully followed.

CAUTION – Operating procedures, practices, etc., which if not strictly observed will result in damage to equipment.

NOTE – An operating procedure, condition, etc., which it is essential to emphasize.

COMMENTS AND QUESTIONS. Comments and questions regarding any phase of the Flight Manual program are invited and should be forwarded through your Command Headquarters to Commander, OCAMA, Tinker Air Force Base, Oklahoma. Attention OCNBPF.

CODING

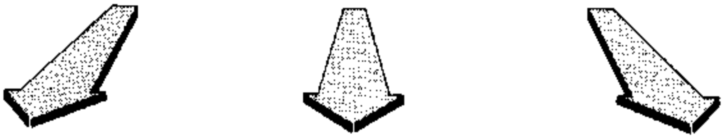
Information on all KC-97G airplanes is covered in this manual. However, some of the information is applicable only to certain groups of airplanes. This information is identified by a code no. reflecting that group of airplanes. Each paragraph applicable only to certain airplanes is coded along the title to the right. Items in illustrations, applicable only to some airplanes are generally coded alongside the nomenclature. When a paragraph or item is not coded it applies to all KC-97G airplanes.

Information which is affected by accomplishment of a TCTO modification, is coded by use of a special symbol bearing the TCTO dash number. When this symbol is used in conjunction with the airplane code no., it adds to or subtracts from that group of airplanes on which the specific TCTO has been incorporated. The TCTO's which are reflected in this manual are listed following the code examples. Most KC-97G airplanes are in the tanker configuration. Therefore with few exceptions, all illustrations showing the whole airplane depict the tanker configuration. In the cases where the purpose of the illustration is not to show the difference between tanker and cargo airplanes, the A/R pod and boom are not coded.

EXAMPLES OF CODES

3147	Indicates information is applicable only to airplane with serial No. AF53-147
▶	Means "THRU" or "AND ON"
3147 ▶	Indicates information is applicable to all airplanes beginning with serial Nos. AF53-147 and on
3147 ▶ **3151**	Indicates information is applicable to airplanes with serial Nos. AF53-147 thru AF53-151
TCTO K553	Indicates information is applicable to airplanes on which T.O. 1C-97(K)-553 has been incorporated
▼ T	Indicates information is applicable to tanker configuration only
Ⓒ	Indicates information is applicable to Cargo configuration only

RELATION BETWEEN



	AIRPLANE CODE NO.	AF SERIAL NO.	AIRPLANE TAIL NO.
EXAMPLE 1	**22701**	52-2701	22701
EXAMPLE 2	**3147**	53-147	30147

TIME COMPLIANCE TECHNICAL ORDERS

NOTE

The following time compliance technical orders (T.C.T.O.'s) are only those which are referred to this publication

TCTO 133	Installation of Periscopic Sextant
TCTO 224	Installation of Throttle Reverse Lock Plate
TCTO 239	DC Electrical Power System Improvement
TCTO 292	Emergency Power Provisions for Pitot Heater
TCTO 299	Landing Gear Safety Switch Revision
TCTO 321	Installation of AN/ARA-25 Direction Finding Group
TCTO 338	Revision of Turbo Control Circuit and Installation of Exhaust Back Pressure Switch
TCTO 515	Modification of Wing Thermal Anti-ice Electrical Circuit
TCTO 526	Modification of Fuel Tank Vent Interconnect Line
TCTO 529	Installation of Improved Emergency Escape Hatch Assemblies
TCTO 531	Replacement of Propeller RPM Manual Control Circuit Breaker
TCTO 531A	Replacement of Propeller RPM Manual Control Circuit Breaker
TCTO 534	Installation of Propeller De-icing Loadmeters
TCTO 541	Installation of B36 Wheels and Brakes
TCTO 558	Installation of Wheel Well Overheat Warning System
TCTO 563	Installation of Type MF-2 Attitude Gyro
TCTO 566	Installation of MB-1 Fire Fighters Oxygen Sets
TCTO 572	Installation of AN/ARN-21
TCTO 582	Installation of Combustion Heater Timers
TCTO 590	Installation of AN/APX-25 Group B Components
TCTO 591	Installation of Anti Collision Lights
TCTO 595	Installation of Fuel Enrichment System
TCTO K211	Installation of AN/APN-69 Rendezvous Radar Set
TCTO K231	Installation of Tail Cone Lights
TCTO K235	Installation of Type B-6A Driftmeter
TCTO K239	Installation of Life Raft Stowage Provisions
TCTO K504	Installation of Type MS-28023-1 Wing Flap Position Indicators
TCTO K509	Inactivation of Ruddevator Anti-ice System
TCTO K513	Installation of Type K-3 Airspeed Indicator
TCTO K520	Installation of Boom Operator's Heat Duct
TCTO K521	External Power Receptacle Circuit Revision
TCTO K526	Installation of Additional Pilot Director Lights
TCTO K528	Modification of the Air Refueling Boom Markings
TCTO K538	Ventilation of Solar APU
TCTO K553	Installation of Aerial Refueling Hydraulic System Surge Dampners
TCTO KG205	Spark Advance Switch Guard Replacement
TCTO KG206	Installation of AN/ARR-36 Radio Receiver replacing BC-348 Equipment
TCTO KG211	Installation of Revised AN/ARC-21 and AN/ART-13 Antenna Systems
TCTO KG502	Restoration of Paired Pulse Function in AN/APN-76C Radar Set
TCTO KG513	Revision of Receiving Antenna Circuit
TCTO KGT507	Installation of Air Refueling Fuel to Engine Fuel System Provisions

A circled checklist number such as ① appearing on a checklist, means that this step must be coordinated with another crew member

The term PLACES preceded by a number, means the number of places in which the particular item appears on the illustration. It does not indicate the quantities of the particular item contained in the airplane.

SYMBOLS AND DEFINITIONS

NOTE

It is not intended that this list include abbreviations used in decals and markings on the airplane.

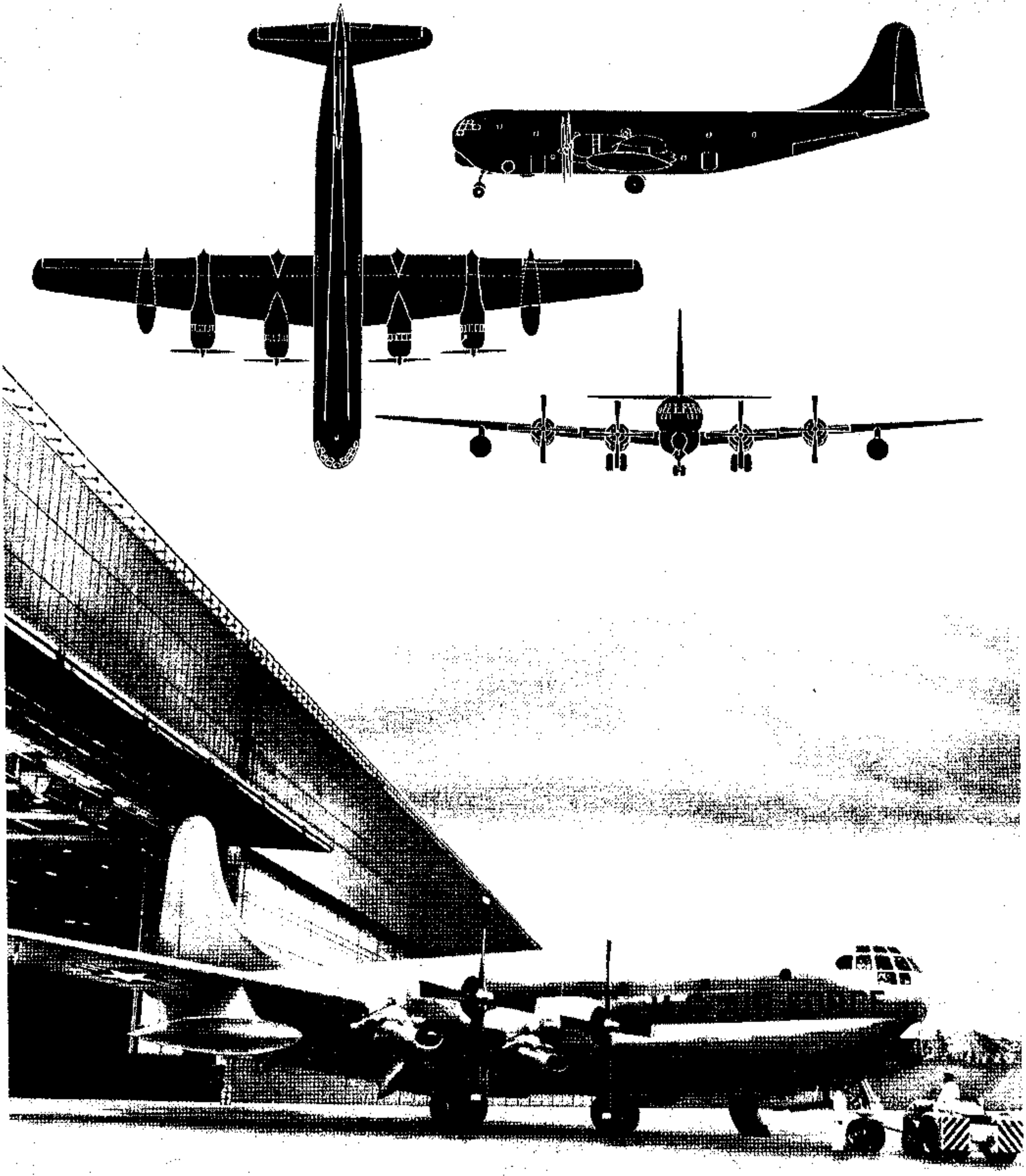
SYMBOL	DEFINITION
AC	Alternating Current
ACCEL	Acceleration
ADF	Automatic Direction Finding
ADI	Anti-Detonation Injection System
ADIZ	Air Defense Identification Zone
ALT	Altitude
AM	Amplitude Modulation (Communication Radios)
AME	Equivalent AM
amp	Ampere
APU	Auxiliary Power Unit
AR	Auto Rich
A/R	Air Refueling
ATA	Actual Time of Arrival
BHP	Brake Horsepower
BMEP	Brake Mean Effective Pressure
(BO)	Boom Operator
°C	Degrees Centigrade
CAS	Calibrated Air Speed (Indicated Airspeed Corrected for Position Error)
CAT	Carburetor Air Temperature (In Degrees Centigrade)
CB	Circuit Breaker
CCW	Counterclockwise Rotation
CFG	Cowl Flap Gap (Inches)
CG, cg	Center of Gravity
CHT	Cylinder Head Temperature, (Degrees Centigrade)
COMP	Compressibility
CONT	Continue or Continued
CORR	Correction or Corrected
(CP)	Copilot
C/R	Climb Rate (Feet Per Minute)
CW	Clockwise Rotation
(CW)	Continuous Wave
CWG	Closed Waste Gate
CWT	Center Wing Tank
CYL	Cylinder
DC	Direct Current
D/F	Direction Finding
DIST	Distance
DN	Down
DR	Dead Reckoning
EAS	Equivalent Air Speed (Calibrated Airspeed Corrected for Compressibility)

SYMBOL	DEFINITION
EBP	Exhaust Back Pressure
ENG	Engine
EPW	Equivalent Performance Weight
EST	Estimated
°F	Degrees Fahrenheit
FF	Fuel Flow
FT, ft	Feet
FWD	Forward
G	Acceleration of Gravity
GAL	Gallons
(GC)	Ground Crew
GCA	Ground Controlled Approach
GMT	Greenwich Mean Time
GPM, gpm	Gallons per Minute
GR	Gross
HF	High Frequency
Hg	Mercury, In Inches, (One Inch Mercury Equals Approximately .49 Pounds per Square Inch)
HR	Hour
IAS	Indicated Airspeed (Instrument Reading Corrected for Instrument Error Only)
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
IN, in	Inches
INST	Instrument
Kts	Knots
LB	Pounds
LOP	Line of Position
LRC	Long Range Cruise
M	Mach Number
MACH	Mean Aerodynamic Chord
MAX	Maximum
MCW	Modulated Continuous Wave
ME	Manifold to Engine
METO	Maximum Except Takeoff
MI	Miles
MIN	Minutes
MP	Manifold Pressure, Inches of Mercury
(N)	Navigator
NAM	Nautical Air Miles
NM	Nautical Miles
NMPP	Nautical Miles Per Pound
No.	Number

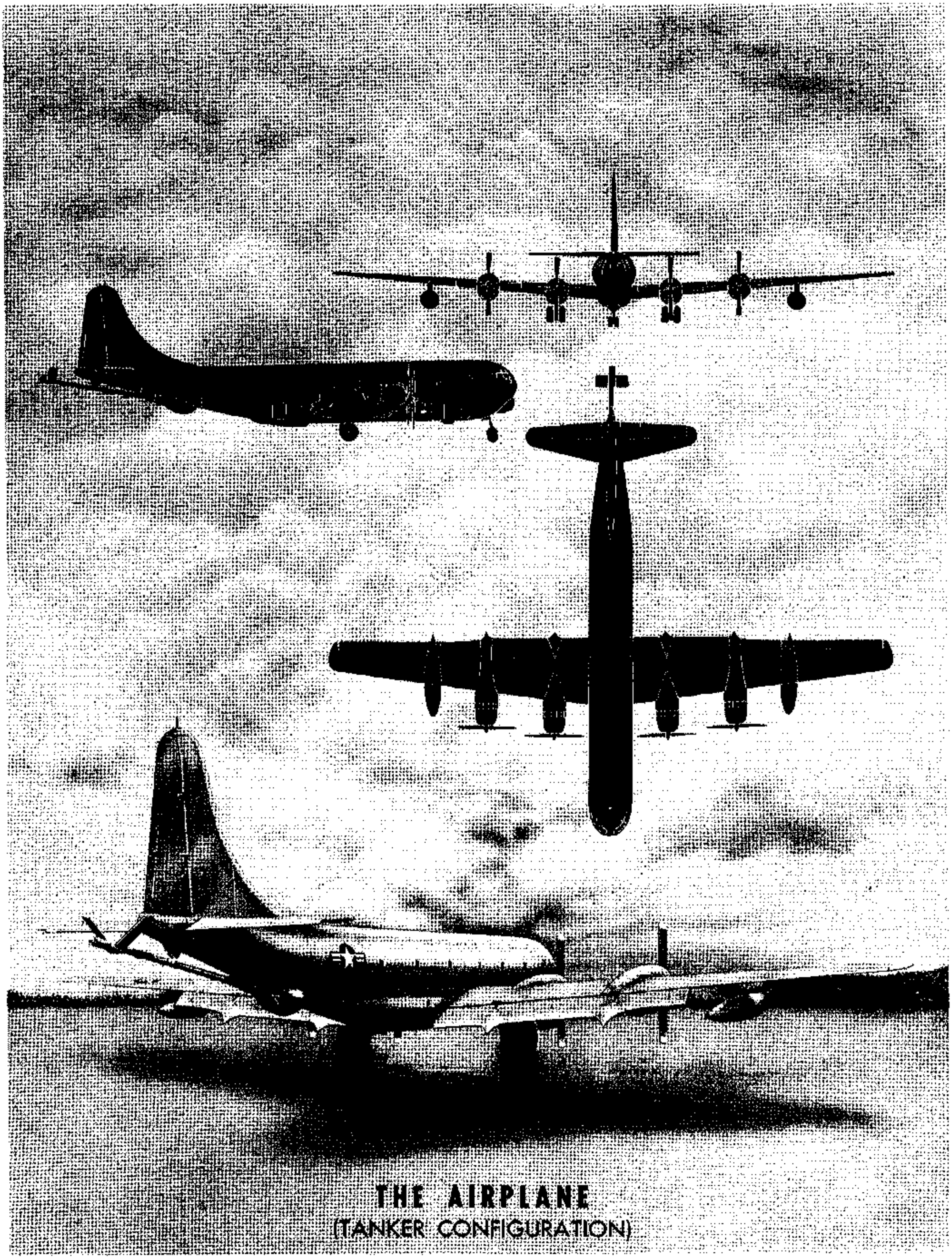
SYMBOLS AND DEFINITIONS

SYMBOL	DEFINITION
OAT	Outside Air Temperature
OWE	Operating Weight Empty
P	Static Pressure In Atmosphere
(P)	Pilot
ph	Pounds Per Hour
pm	Pounds Per Minute
POS	Position
PPI	Plan Position Indicator
PRESS	Pressure
PSI	Pounds Per Square Inch
R/C	Rate of Climb
R/D	Rate of Descent
(RO)	Radio Operator
RPM, rpm	Revolutions Per Minute
SIF	Selective Identification Feature
SL	Sea Level
SPR	Single Point Refueling
SQ	Square
SSB	Single Side Band
STD	Standard
T	Absolute Temperature
t	Temperature °F or °C

SYMBOL	DEFINITION
TAS	True Airspeed, Equivalent Airspeed Corrected for Temperature and Pressure EAS ×
TBS	Turbo Boost Selector
TDC	Top Dead Center
TE	Tank to Engine
TEMP	Temperature
TME	Tank to Manifold to Engine
TO.	Takeoff
TPSI	Torque Pressure In Pounds Per Square Inch
TRPM	Turbosupercharger Revolutions Per Minute
UHF	Ultra High Frequency
V	Velocity
VFO	Variable Frequency Oscillator
VHF	Very High Frequency
VOR	Visual Omni Range
V_W	Wind Velocity, Knots
WT	Weight (Pounds)
XTAL	Crystal
Δ(delta)	Increment
ρ(rho)	Air Density, Slugs Per Cubic Foot
σ(sigma)	Air Density Ratio ρ/ρ_o.

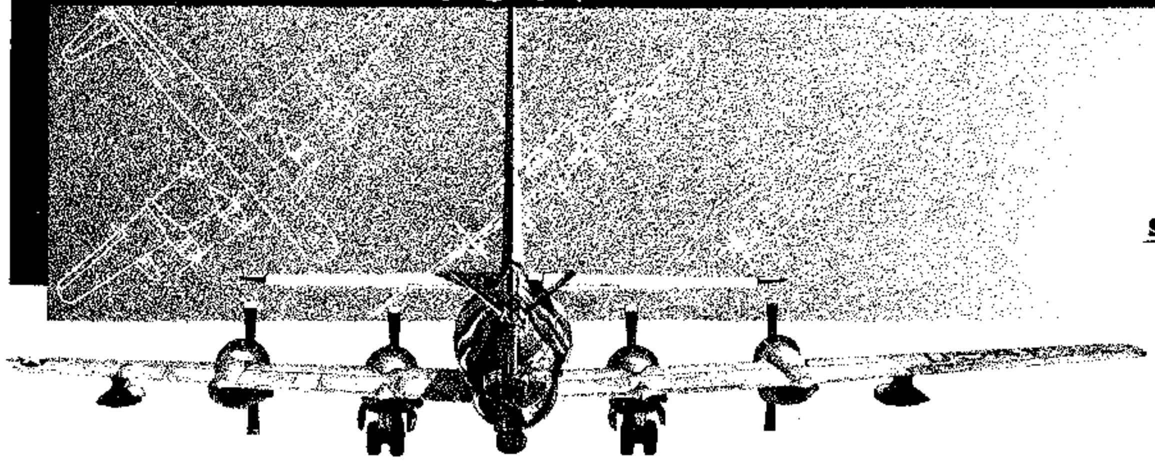


THE AIRPLANE
(CARGO CONFIGURATION)



THE AIRPLANE
(TANKER CONFIGURATION)

DESCRIPTION



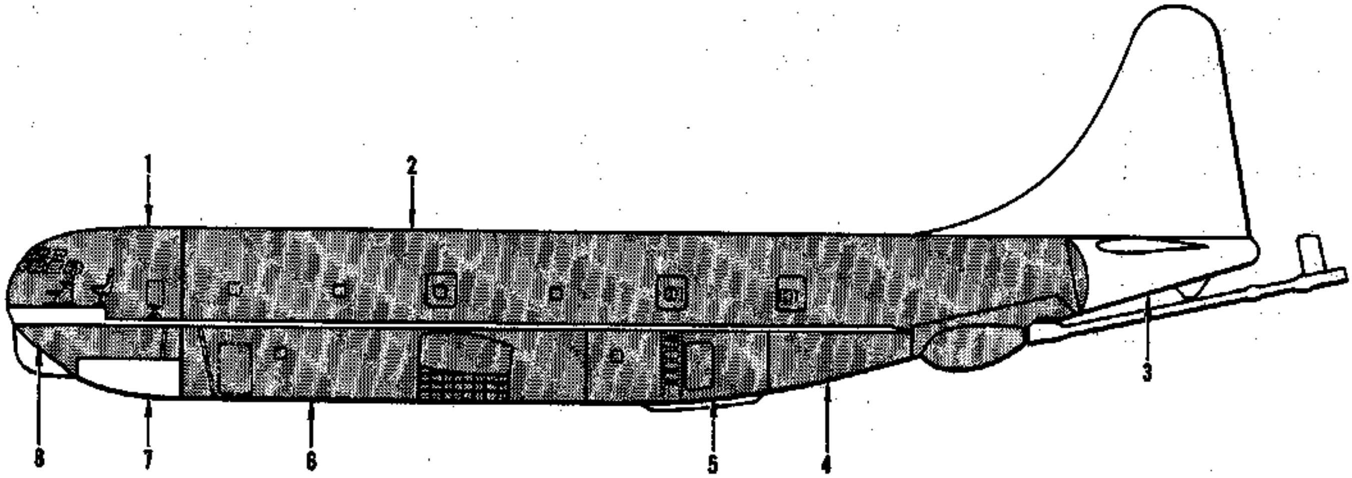
SECTION I

TABLE OF CONTENTS

ITEM	KC-97E	KC-97F	KC-97G
EXTERNAL FUEL TANKS	None	None	One droppable tank under each wing
▼T AIR REFUELING FUEL TANKS	Four tanks in the main cargo compartment	Four tanks in the main cargo compartment	Seven tanks on LH side of main compartment and eight tanks, two on each side of lower fwd and aft compartment
ENGINES	P & W R-4360-65	P & W R-4360-59B	P & W R-4360-59B
TROOP CARRYING CAPACITY	Ⓒ 130 ▼T 34	Ⓒ 130 ▼T 34	Ⓒ 96 ▼T 63

MAIN DIFFERENCES

Figure 1-1



▨ PRESSURIZED AREA

1 CONTROL CABIN
2 MAIN COMPARTMENT
3 TAIL COMPARTMENT (UNPRESSURIZED)
4 STOWAGE COMPARTMENT
5 LOWER AFT COMPARTMENT
6 LOWER FORWARD COMPARTMENT
7 NOSE WHEEL WELL (UNPRESSURIZED)
8 LOWER NOSE COMPARTMENT

COMPARTMENTS

Figure 1-2

AIRPLANE

The Boeing KC-97G airplane is a four engine, long range, high altitude, high speed transport equipped for use primarily as a flying boom tanker for the inflight refueling of other airplanes. Provisions have been incorporated into the airplanes to convert them into cargo carriers or troop transports. The A/R equipment on tanker airplanes is easily removed or installed to permit maximum utilization of the airplane as either a cargo carrier or tanker. The airplane is powered by four Pratt and Whitney R-4360-59B engines. Each engine drives a Hamilton Standard Hydromatic constant speed propeller with full feathering and reversible pitch features. The fuselage is furnished with complete heating, ventilating and pressurizing equipment for use either in flight or on the ground. The following equipment is operated by the main hydraulic system: brakes, nose wheel steering, windshield wipers, rudder boost and on airplanes **22737** ▶ in the tanker configuration, the boom hydraulic system. Airplanes in the tanker configuration also have an independent hydraulic system that operates the A/R fuel pumps and on airplanes **17260** ▶ **22736**, the boom hydraulic system. All other equipment in the airplane is operated electrically. The normal crew consists of the pilot, copilot, navigator, engineer, radio operator on airplanes **17260** ▶ **3177** and all airplanes which do not have the AN/ARC-21 liaison radio installed and operating, and on tanker airplanes a boom operator.

OVERALL DIMENSIONS

Approximate overall dimensions of the airplane are as follows:

Wing Span	141 feet 3 inches
Fuselage Length	110 feet 4 inches
Height (to top of fin)	38 feet 3 inches
Height (fin folded)	26 feet 7 inches
Tread (between struts)	28 feet 6 inches
Tread (between outboard wheels)	32 feet (approx)
Overall Length	
▼ (boom retracted)	117 feet 5 inches
▼ (boom extended)	136 feet 10 inches

See figure 2-3 for minimum turning radius and minimum ground clearance.

GROSS WEIGHT

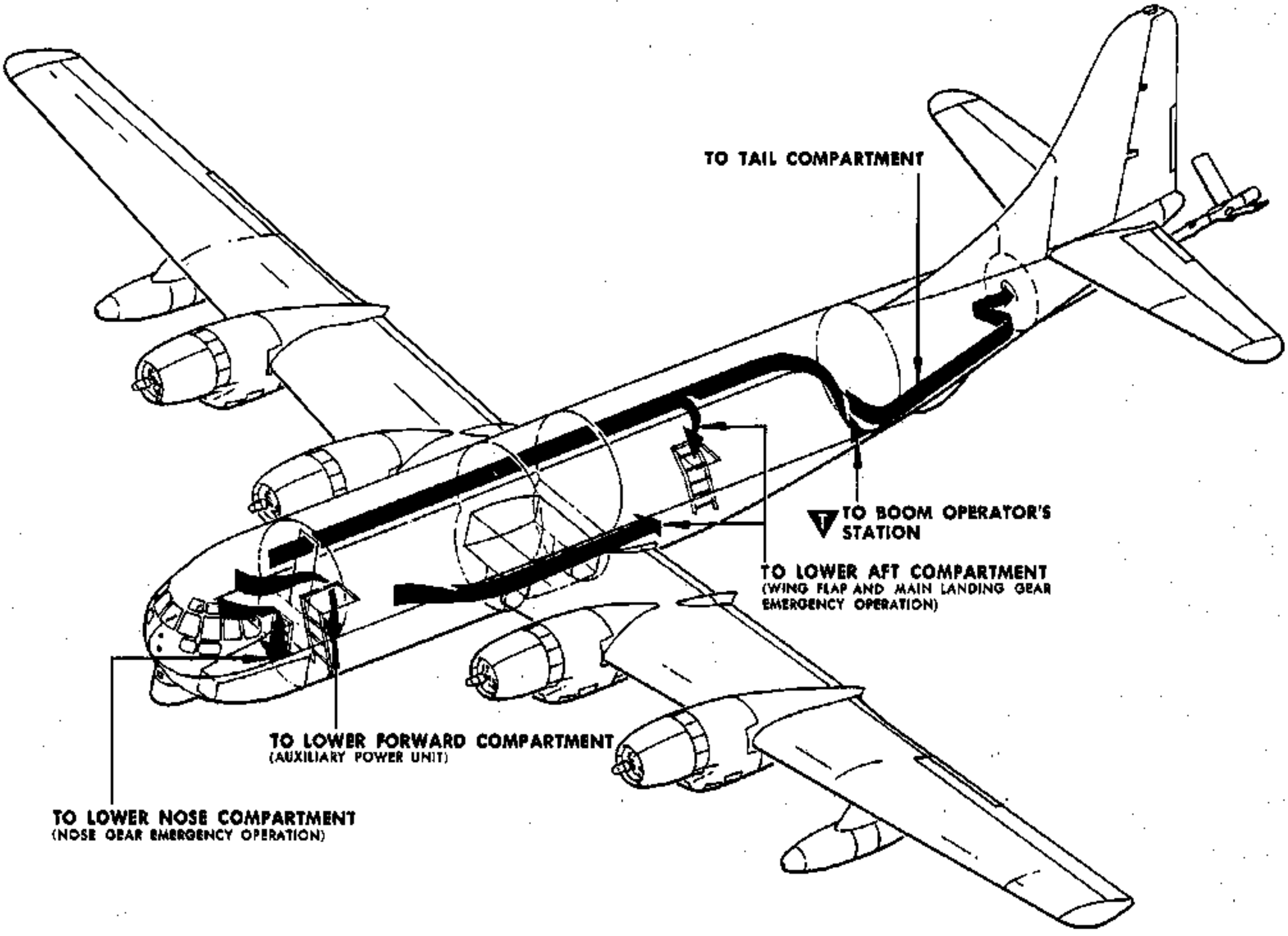
The design gross weight of this airplane is 153,000 pounds. For additional gross weight information see Section V.

SPECIAL FEATURES

Special features of this model are the installation of flying boom air refueling equipment for Code ▼ airplanes, external fuel tanks, and single point refueling. The rudder and vertical fin can be folded onto the horizontal stabilizer for ease of maintenance and to permit the airplane to be housed in average hangars. Structural provisions have also been made for the installation of an aerial delivery system when the airplane is converted for carrying cargo only.

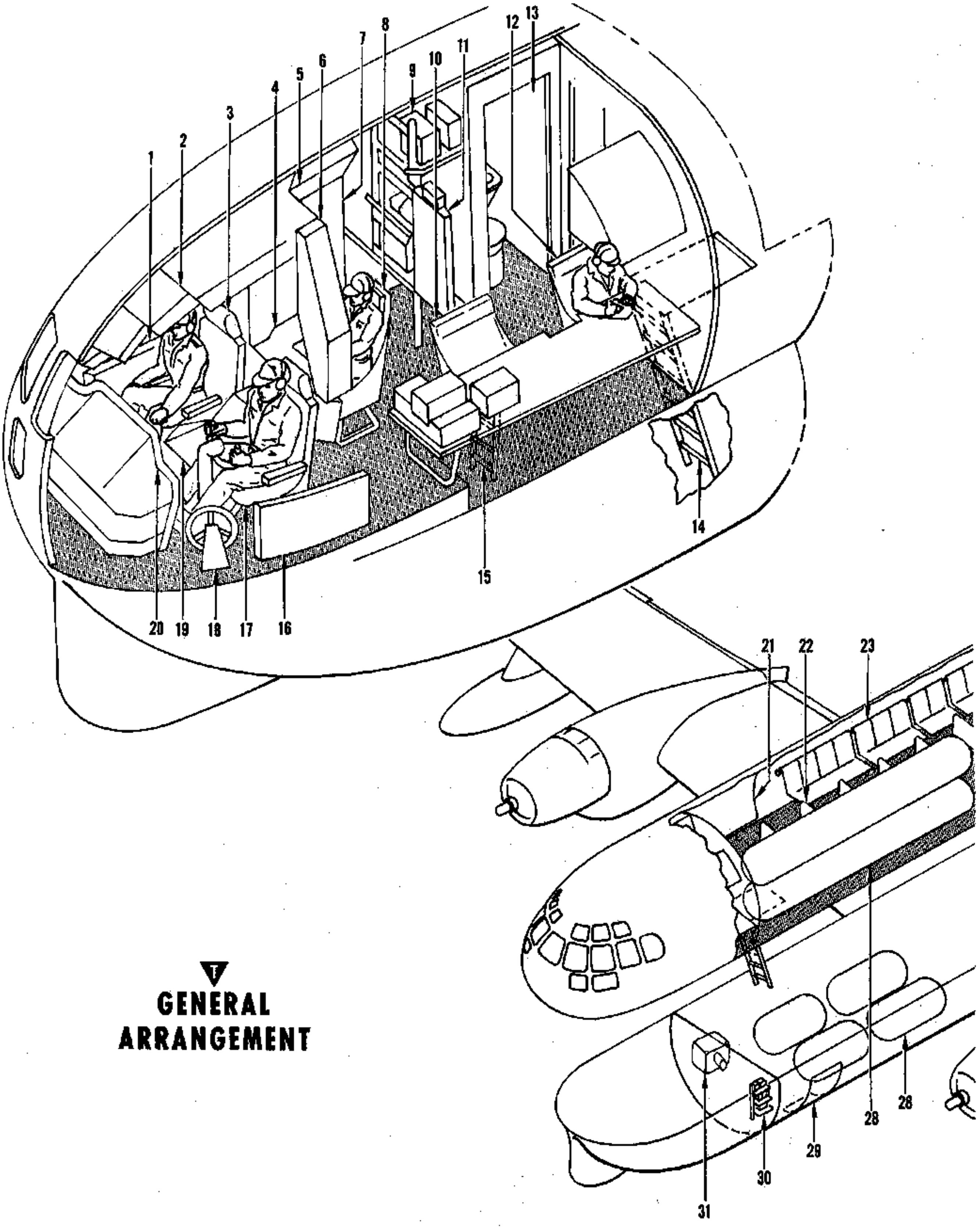
INTERIOR ARRANGEMENT AND CREW MOVEMENT

The fuselage is divided into six pressurized and two unpressurized compartments as shown in figure 1-2. Hatches and ladders are provided for extensive crew movement between compartments as shown in figure 1-3.



CREW MOVEMENT

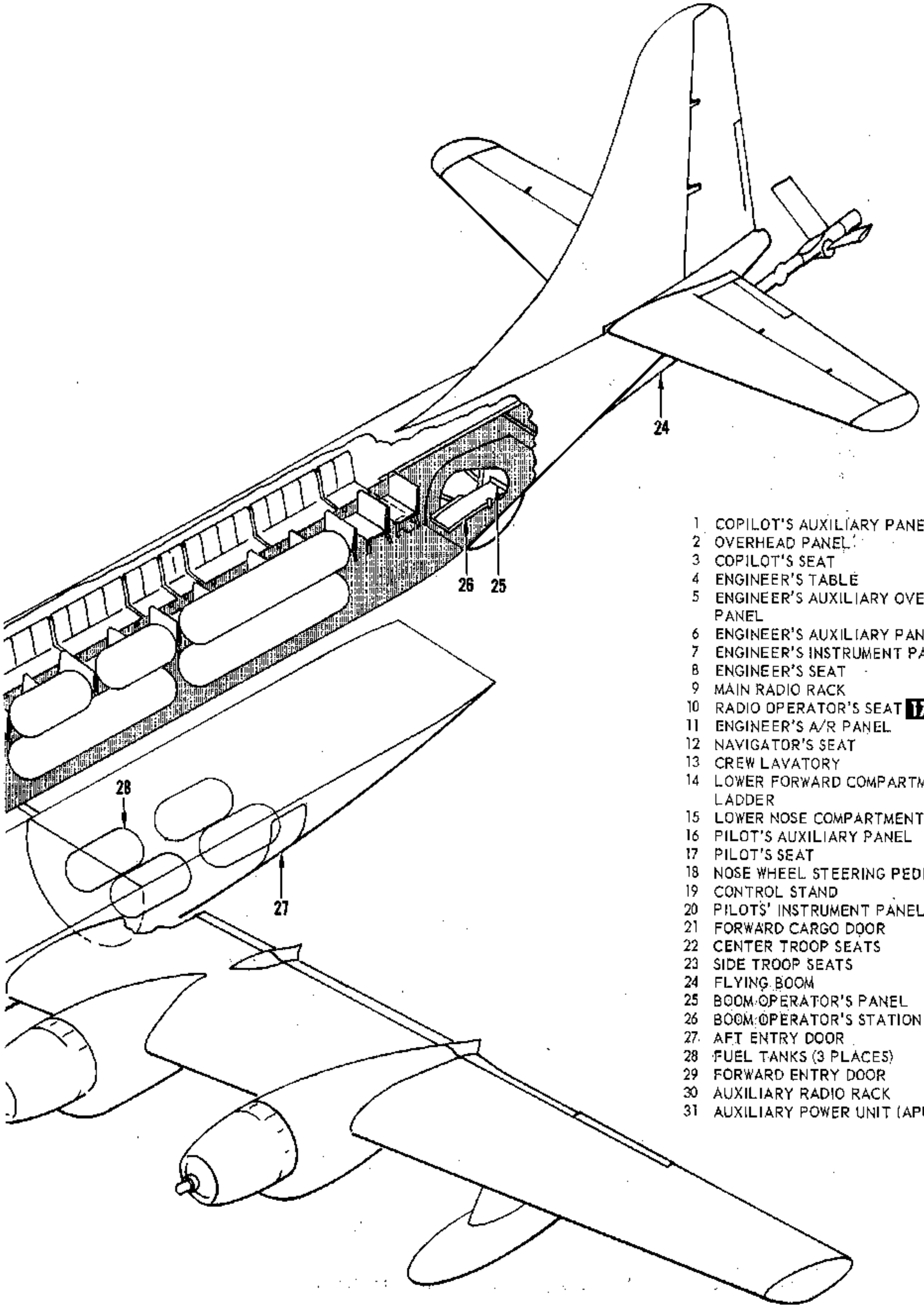
Figure 1-3



GENERAL ARRANGEMENT

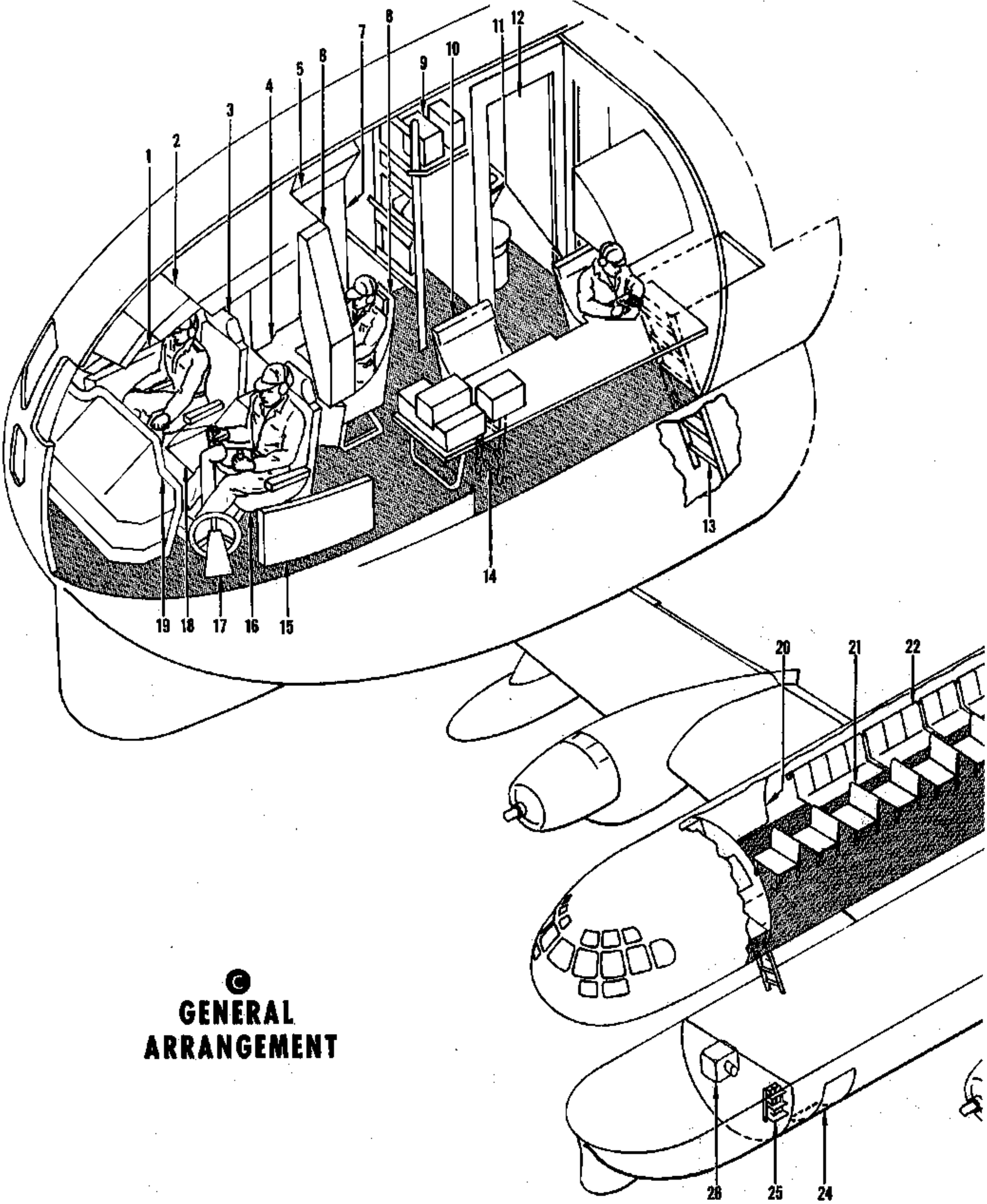
GENERAL ARRANGEMENT

Figure 1-4 (Sheet 1 of 2)



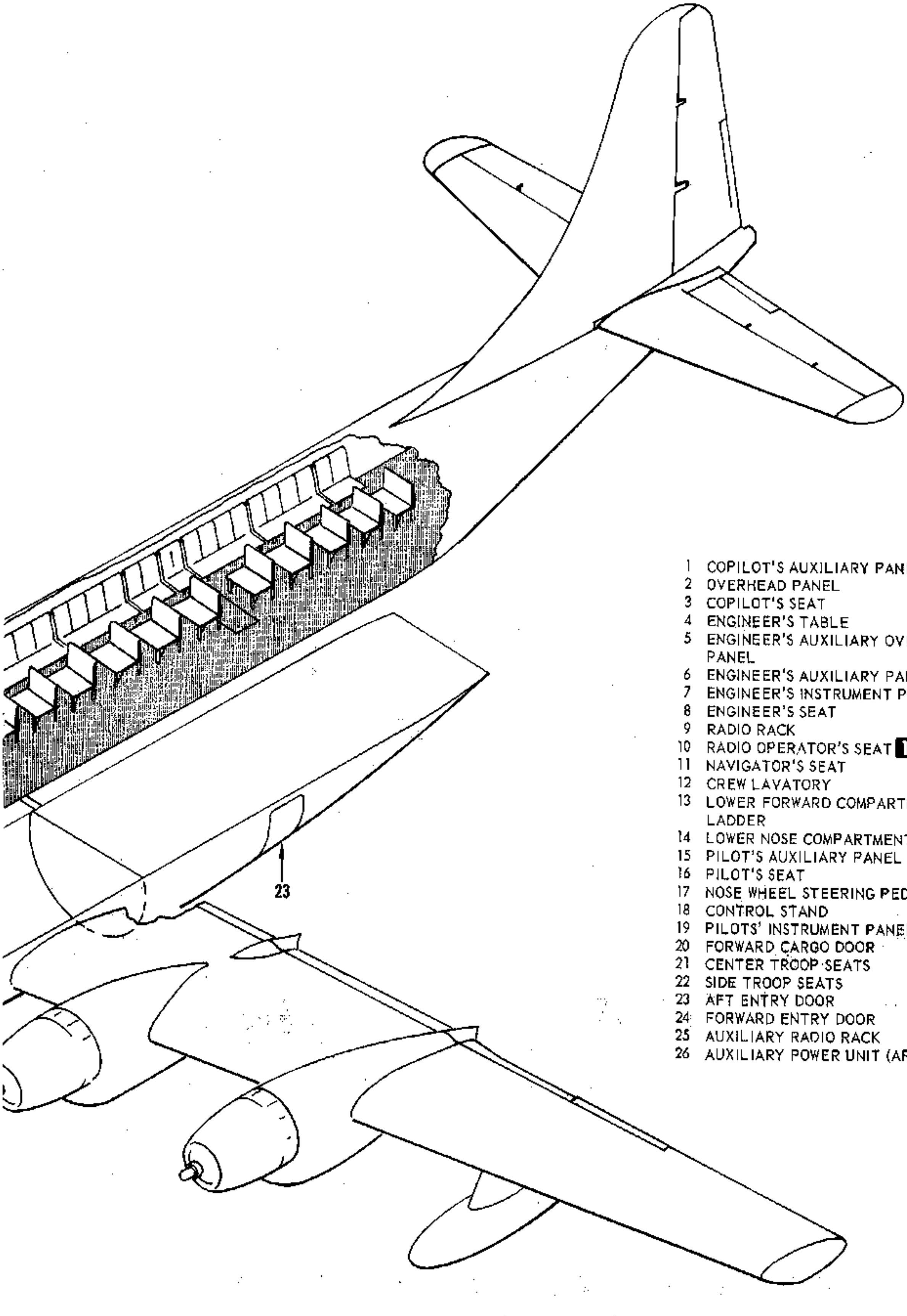
1 COPILOT'S AUXILIARY PANEL
2 OVERHEAD PANEL
3 COPILOT'S SEAT
4 ENGINEER'S TABLE
5 ENGINEER'S AUXILIARY OVERHEAD PANEL
6 ENGINEER'S AUXILIARY PANEL
7 ENGINEER'S INSTRUMENT PANEL
8 ENGINEER'S SEAT
9 MAIN RADIO RACK
10 RADIO OPERATOR'S SEAT **17260 ▶ 3177**
11 ENGINEER'S A/R PANEL
12 NAVIGATOR'S SEAT
13 CREW LAVATORY
14 LOWER FORWARD COMPARTMENT LADDER
15 LOWER NOSE COMPARTMENT LADDER
16 PILOT'S AUXILIARY PANEL
17 PILOT'S SEAT
18 NOSE WHEEL STEERING PEDESTAL
19 CONTROL STAND
20 PILOTS' INSTRUMENT PANEL
21 FORWARD CARGO DOOR
22 CENTER TROOP SEATS
23 SIDE TROOP SEATS
24 FLYING BOOM
25 BOOM OPERATOR'S PANEL
26 BOOM OPERATOR'S STATION
27 AFT ENTRY DOOR
28 FUEL TANKS (3 PLACES)
29 FORWARD ENTRY DOOR
30 AUXILIARY RADIO RACK
31 AUXILIARY POWER UNIT (APU)

Figure 1-4 (Sheet 2 of 2)



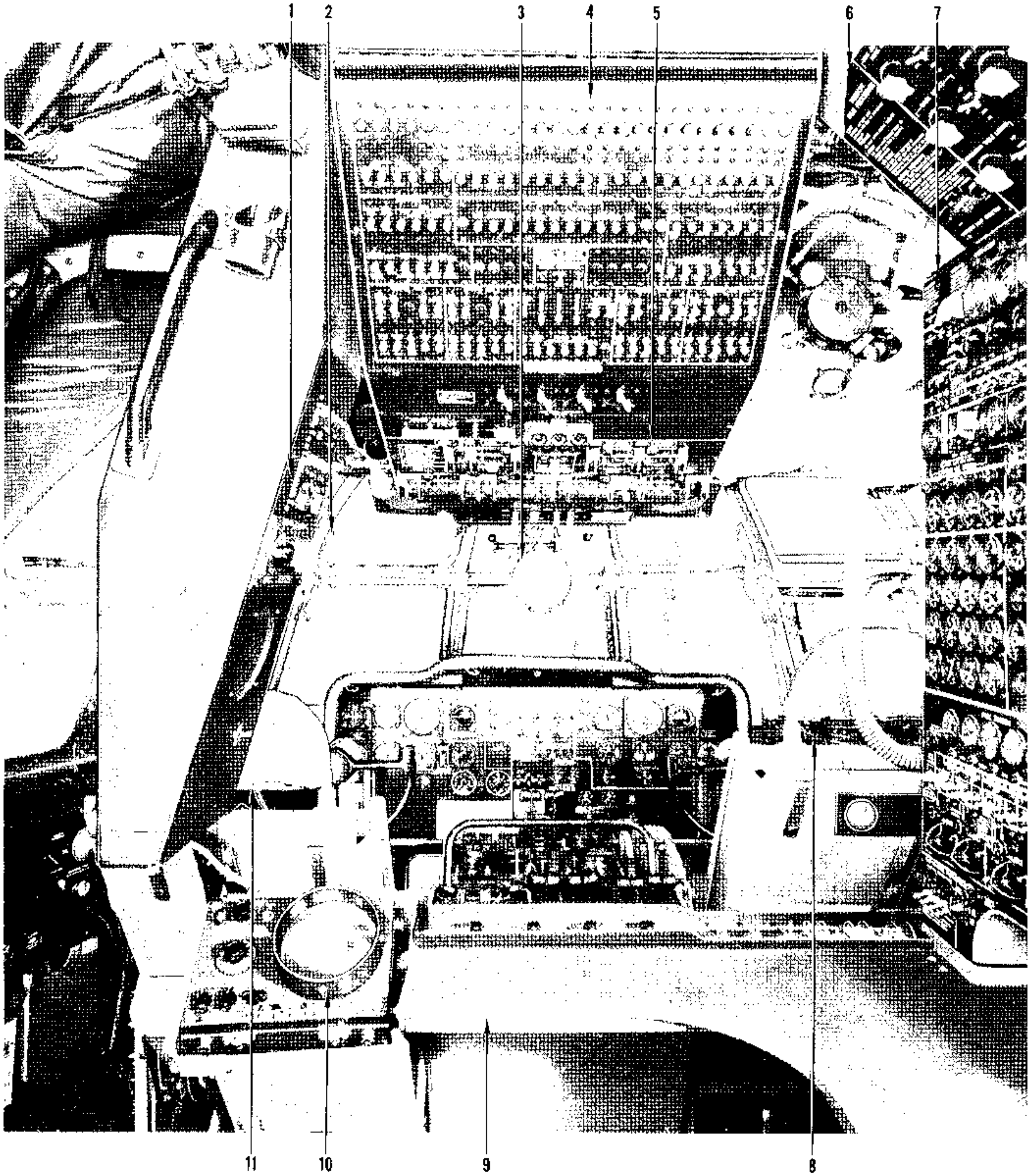
GENERAL ARRANGEMENT

Figure 1-5 (Sheet 1 of 2)



1 COPILOT'S AUXILIARY PANEL
2 OVERHEAD PANEL
3 COPILOT'S SEAT
4 ENGINEER'S TABLE
5 ENGINEER'S AUXILIARY OVERHEAD PANEL
6 ENGINEER'S AUXILIARY PANEL
7 ENGINEER'S INSTRUMENT PANEL
8 ENGINEER'S SEAT
9 RADIO RACK
10 RADIO OPERATOR'S SEAT **17260** ▶ **3177**
11 NAVIGATOR'S SEAT
12 CREW LAVATORY
13 LOWER FORWARD COMPARTMENT LADDER
14 LOWER NOSE COMPARTMENT LADDER
15 PILOT'S AUXILIARY PANEL
16 PILOT'S SEAT
17 NOSE WHEEL STEERING PEDESTAL
18 CONTROL STAND
19 PILOTS' INSTRUMENT PANEL
20 FORWARD CARGO DOOR
21 CENTER TROOP SEATS
22 SIDE TROOP SEATS
23 AFT ENTRY DOOR
24 FORWARD ENTRY DOOR
25 AUXILIARY RADIO RACK
26 AUXILIARY POWER UNIT (APU)

Figure 1-5 (Sheet 2 of 2)



1 ENGINEER'S AUXILIARY PANEL
2 ESCAPE ROPE
3 SEARCH RADAR INDICATOR
4 OVERHEAD CIRCUIT BREAKER PANEL
5 OVERHEAD PANEL
6 ENGINEER'S AUXILIARY OVERHEAD PANEL
7 ENGINEER'S INSTRUMENT PANEL
8 COPILOT'S STATION
9 ENGINEER'S STATION
10 IGNITION ANALYZER
11 PILOT'S STATION

CONTROL CABIN (TYPICAL)

Figure 1-6

ENGINE

The airplane is powered by four Pratt and Whitney R-4360-59B, 28-cylinder air cooled engines. The engines are equipped with a low tension ignition system and a torquemeter indicating system. A spark advance control is installed to improve airplane range. Each engine is equipped with a single-stage, single-speed internal supercharger, and an exhaust-driven turbosupercharger. Water injection is provided for high power settings. Each engine is capable of developing a maximum power (at sea level) of 3250 bhp dry or 3500 bhp using water injection.

CARBURETOR

Each engine is equipped with a Stromberg injection carburetor. The carburetor is a rectangular barrel, downdraft unit incorporating a throttle actuated accelerating pump. It is equipped with a fuel enrichment valve to supply adequate fuel at high power settings, and an automatic mixture control unit to compensate for altitude and carburetor air temperature variations. Mixture control to the engine is regulated by a rotary type idle mixture control, actuated by the throttle in idle range, and a rotary type manual mixture control, actuated by the mixture control lever through a cable system. For details on the carburetor preheat valve, supercharger, and sheltered air door assembly, see INDUCTION SYSTEM and TURBOSUPERCHARGER in this Section.

THROTTLES AND THROTTLE LOCK LEVER

Equipment Connected To The Throttles

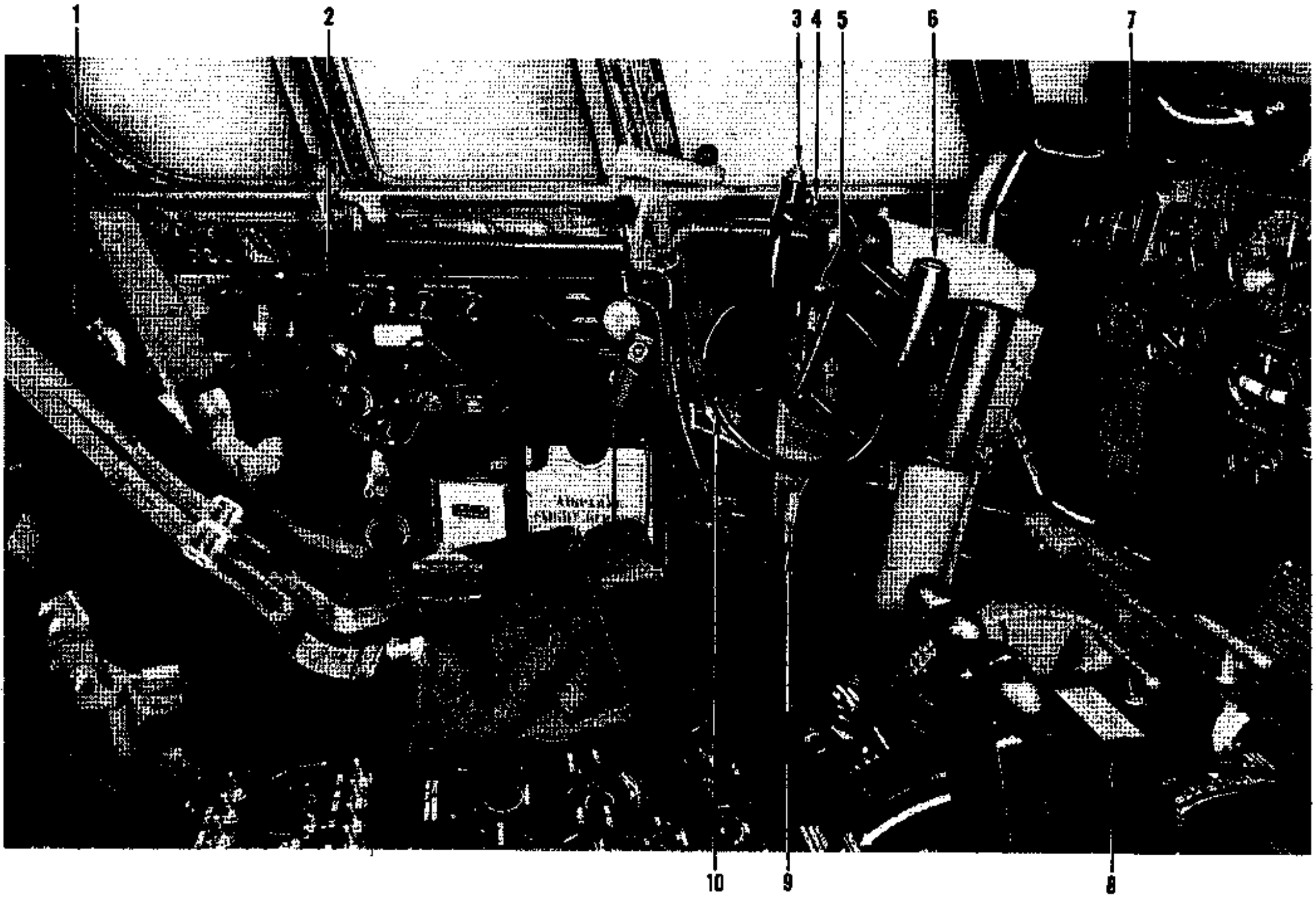
Two sets of throttles (29 and 39, figure 1-16) are on the control stand. One set near the forward end of the stand is for the pilots' use and is interconnected to the other set near the aft end of the stand for the engineer's use. Movement of the throttles automatically actuates the propeller reversing switches, wing flap warning switches, and landing gear warning switches. Movement of the throttles will actuate the respective carburetor controls through a cable system. A reverse throttle lock solenoid prevents propeller reversing during flight. A propeller reverse lock plate (36, figure 1-16) prevents inadvertent reversing of the propellers. A throttle lock lever (13, figure 1-16) to the right of the pilots' throttles, provides a friction braking force to hold the throttles in any desired position. With the water injection pump switch (10, figure 1-16) ON, the water injection (ADI) system operates automatically when the throttles are opened beyond 45 inches manifold pressure, and shuts off when the throttles are closed below 41 inches of manifold pressure. See WATER INJECTION (ADI) SYSTEM in this Section.

Throttle Operation

The pilots' throttles have OPEN--CLOSED--REVERSE OPEN and intermediate positions. The pilots' throttle operation is conventional in the OPEN--CLOSED range. Holding the throttles aft against the CLOSED stop maintains the throttles in forward idle. The throttles can be moved into reverse range by raising the throttle handles 1/4 inch and moving the levers aft beyond the CLOSED stop. A friction can be felt as the propeller reverse pitch switches are actuated. Holding the pilots' throttles forward against the CLOSED stop, while in the reverse range, maintains the throttles in reverse idle. Further movement toward the REVERSE OPEN position opens the throttles. The pilots' throttles must be raised 1/4 inch and moved forward over the CLOSED stop to return the propellers to forward pitch. The engineer's throttles have OPEN--CLOSED and intermediate positions. When the pilots' throttles are moved back into the REVERSE OPEN range, the engineer's throttles move forward into the OPEN range. Once the pilots' throttles are placed in the reverse range, the engineer can control reverse power operation. The pilots' throttles must be moved forward over the CLOSED stop before forward power control is restored to the engineer's throttles. The landing gear warning light will illuminate and the warning horn will sound when any combination of two throttles for engines on opposite sides of the airplane are advanced more than three fourths open in either forward or reverse thrust with the wing flaps in any position except 22 percent to 44 percent and with the weight of the airplane on the landing gear.

PROPELLER REVERSE LOCK

The throttles are equipped with an automatic reverse propeller lock to restrict propeller reversing to ground operation only. The lock, actuated by a solenoid, consists of four mechanical latches which engage the pilots' throttle levers. The throttle lock solenoid is energized by an oleo-actuated relay. The lock is actuated to the UNLOCKED position when any of the landing gear is in contact with the ground. A time delay relay in the solenoid circuit prevents the lock from being actuated to the LOCKED position for a period of eight seconds after the airplane is airborne. This propeller reverse lock operates in conjunction with a propeller reverse warning flag (4, figure 1-16), located at the forward end of the control stand. The propeller reverse lock may be manually unlocked while the airplane is airborne or on the ground by pressing the warning flag. During normal operation, this flag serves as a position indicator for the reverse lock. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel. (See figure 1-34.) For more information concerning this flag see PROPELLER SYSTEM in this Section.



1 PILOT'S SEAT
2 PILOT'S AUXILIARY PANEL
3 PILOT'S MICROPHONE SWITCH
4 AUTOPILOT RELEASE SWITCH
5 NOSE WHEEL STEERING EMERGENCY DISCONNECT BUTTON
6 PILOT'S CONTROL WHEEL
7 PILOTS' INSTRUMENT PANEL
8 CONTROL STAND
9 PARKING BRAKE HANDLE
10 NOSE GEAR STEERING WHEEL

PILOT'S STATION

Figure 1-7

PROPELLER REVERSE LOCK PLATE

2843 ▶ plus TCTO 274 ▶

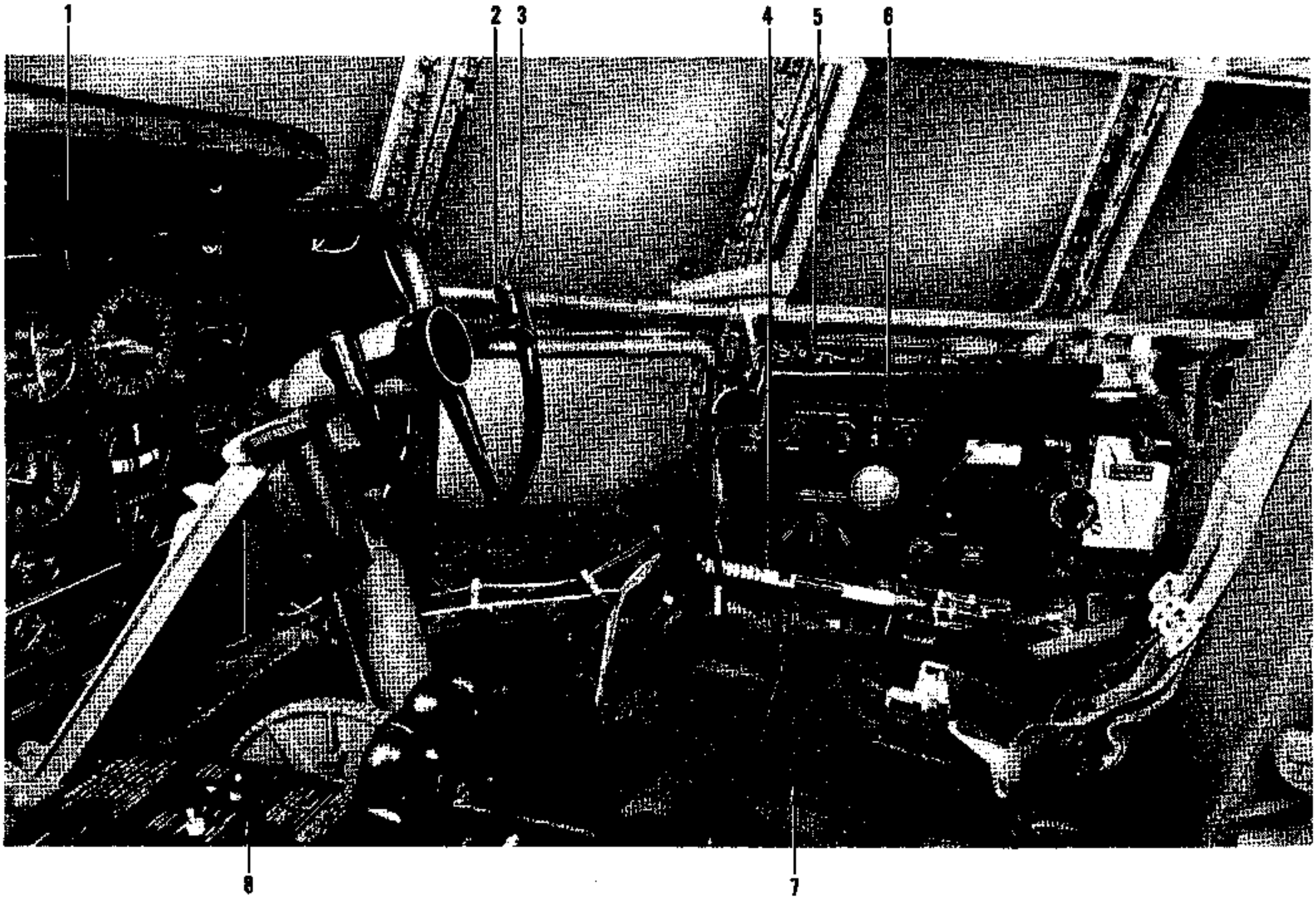
A metal lock plate (36, figure 1-16) on the aft side of the pilots' throttle quadrant prevents the throttle from being moved inadvertently into the propeller reverse range. The lock is hinged on the aft edge and must be opened whenever the throttles are to be operated in the propeller reverse range.

MIXTURE CONTROLS AND MIXTURE LOCK LEVER

Four mixture controls (22, figure 1-16) are on aft end of the control stand. The levers have FUEL CUTOFF--AUTO LEAN--AUTO RICH and intermediate positions. Placing a lever in FUEL CUTOFF shuts off fuel flow at the carburetor. The AUTO LEAN and AUTO RICH carburetor mixture settings are obtained by placing the mixture levers in the appropriate detent position. Manual mixture control may be obtained at other positions using the procedures outlined in NORMAL SPARK CRUISE CONTROL PROCEDURE and SPARK ADVANCE FUEL CONTROL in Section VII. A locking lever (21, figure 1-16) adjacent to the mixture control levers, provides a friction braking force to hold the mixture control levers at any desired position.

INDUCTION SYSTEM

The induction system (figure 1-10) consists of an entry scoop, a sheltered air door and sheltered air inlet



1 PILOTS' INSTRUMENT PANEL
2 AUTOPILOT RELEASE SWITCH
3 COPILOT'S MICROPHONE SWITCH
4 HYDRAULIC HAND PUMP
5 CW KEY
6 COPILOT'S AUXILIARY PANEL
7 COPILOT'S SEAT
8 CONTROL STAND

COPILOT'S STATION

Figure 1-8

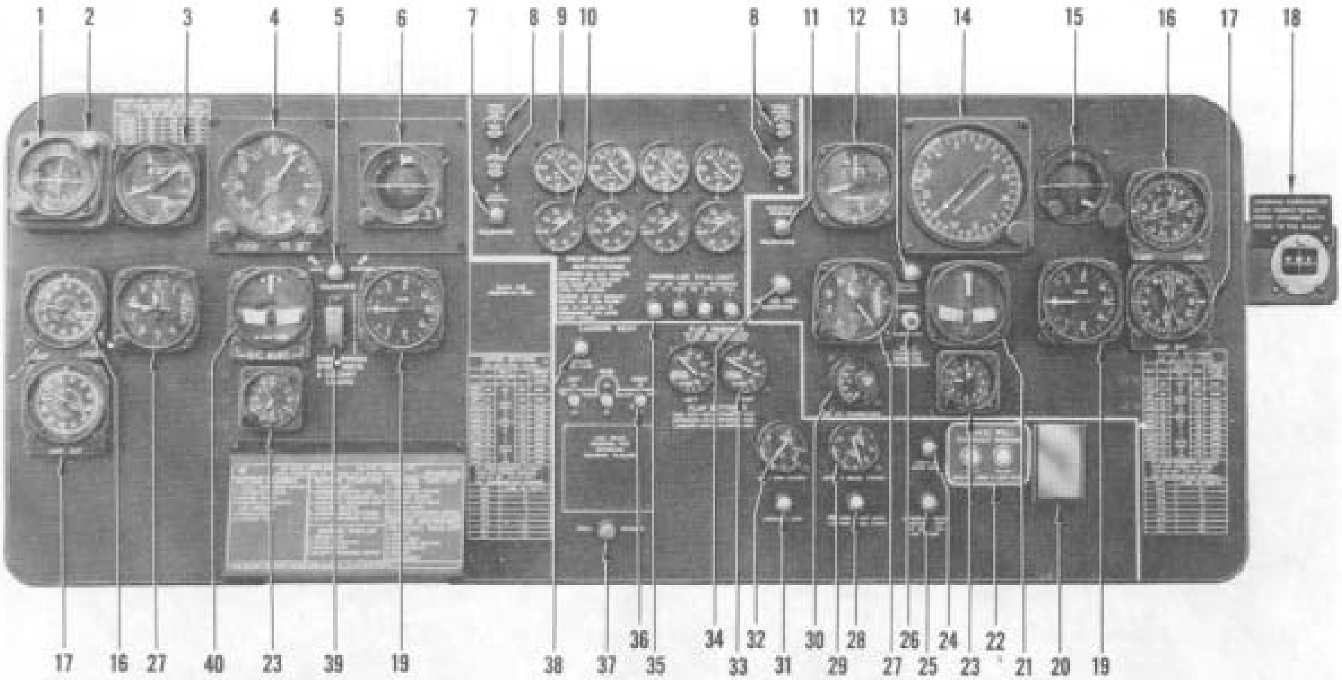
assembly, turbosupercharger, intercooler, carburetor preheat valve, and connecting ducting. Either ram air or supercharged air may be supplied to the carburetor through a bypass door controlled by differential pressure. Supercharged carburetor air temperature is controlled by positioning of the carburetor preheat valve and intercooler flap. For details on turbosupercharger and turbosupercharger controls, see TURBOSUPERCHARGER in this Section.

Sheltered Air Door

An electrically operated sheltered air door and inlet assembly is located aft of the entry scoop on the bottom of the air intake duct. This door enables either ram air or sheltered air to be supplied to the induction system. With the door in the sheltered position, ram air is shut off from the induction system and sheltered air is supplied through the sheltered air inlet. This causes a rapid change of direction in the flow of air as it enters the induction system, which aids in separating moisture particles from the induction air. An air filter is provided in the inlet assembly to filter dust particles from the air.

Carburetor Preheat Valve

An electrically operated gate-type carburetor preheat valve (figure 1-10) is located downstream from the turbocompressor. It is used to preheat supercharged

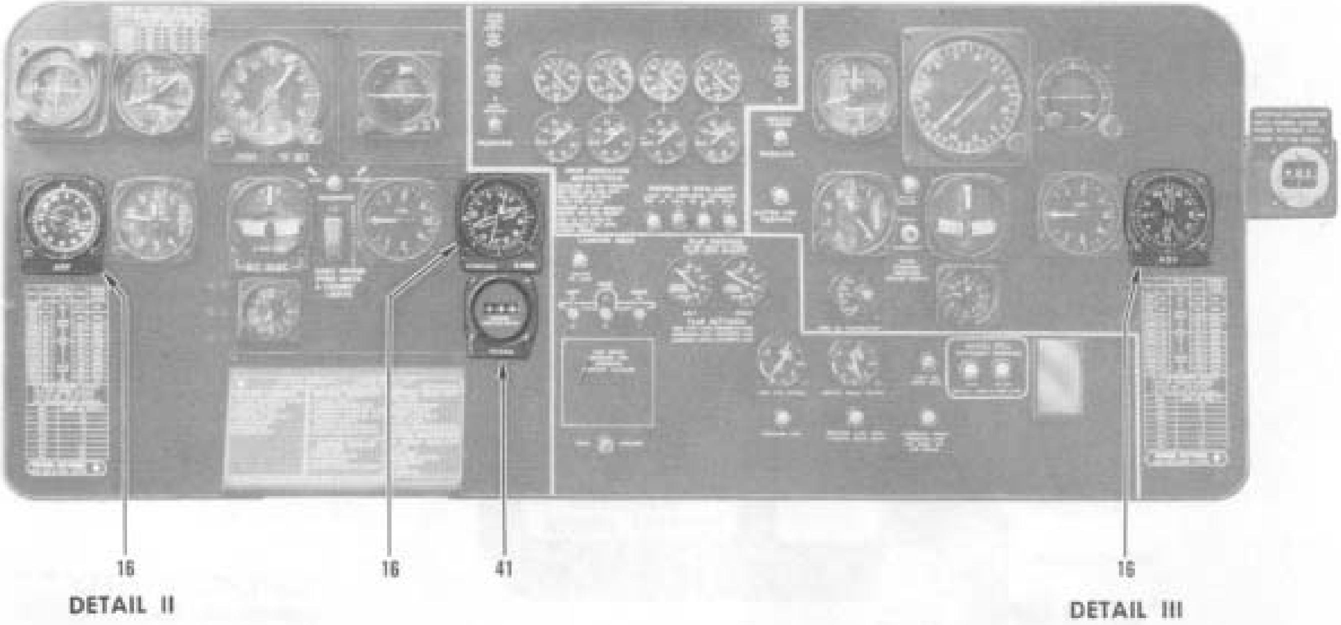


SEE DETAIL I

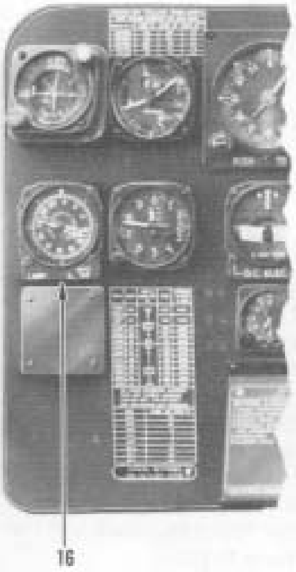
1 COURSE INDICATOR
2 MARKER BEACON LIGHT
3 AIRSPEED INDICATOR
4 PILOT'S DIRECTION INDICATOR
5 PILOTS' INSTRUMENT INVERTER WARNING LIGHT
6 ATTITUDE INDICATOR
7 MAIN INVERTER WARNING LIGHT
8 MANIFOLD PRESSURE PURGE VALVE BUTTONS (2 PLACES)
9 MANIFOLD PRESSURE GAGES
10 TACHOMETER
11 AUTOPILOT INVERTER WARNING LIGHT
12 MAXIMUM ALLOWABLE SPEED INDICATOR
13 DIRECTION INDICATOR REPEATER WARNING LIGHT
14 DIRECTION INDICATOR REPEATER
15 COPILOT'S ATTITUDE INDICATOR
16 RADIO MAGNETIC INDICATOR (RMI) (7 PLACES)
17 RADIO MAGNETIC INDICATOR (RMI) (UHF/DF) (2 PLACES) **3178** ▶LESS TCTO 572 PLUS TCTO 321
18 MAGNETIC COMPASS
19 VERTICAL VELOCITY INDICATOR (2 PLACES)
20 COMPASS CARD HOLDER
21 COPILOT'S TURN AND SLIP INDICATOR
22 WHEEL WELL OVERHEAT WARNING LIGHTS TCTO 558
23 CLOCK (2 PLACES)
24 DOOR WARNING LIGHT
25 EMERGENCY BRAKE LOW PRESSURE WARNING LIGHT
26 DIRECTION INDICATOR REPEATER EMERGENCY POWER SWITCH
27 ALTIMETER (2 PLACES)
28 SERVICE BRAKE LOW PRESSURE WARNING LIGHT
29 HYDRAULIC PRESSURE GAGE SERVICE BRAKE SYSTEM
30 OUTSIDE AIR TEMPERATURE GAGE
31 MAIN HYDRAULIC LOW PRESSURE WARNING LIGHT
32 HYDRAULIC PRESSURE GAGE MAIN HYDRAULIC SYSTEM
33 WING FLAP POSITION INDICATOR **22665** ▶PLUS TCTO K504
34 MASTER FIRE WARNING LIGHT **2930** ▶
35 RPM LIMIT LIGHTS
36 LANDING GEAR POSITION INDICATOR
37 BOOM ENGAGED INDICATOR LIGHT
38 LANDING GEAR WARNING LIGHT
39 PILOT'S INSTRUMENT INVERTER EMERGENCY POWER SWITCH
40 PILOT'S TURN AND SLIP INDICATOR
41 RANGE INDICATOR TCTO K572

PILOTS' INSTRUMENT PANEL

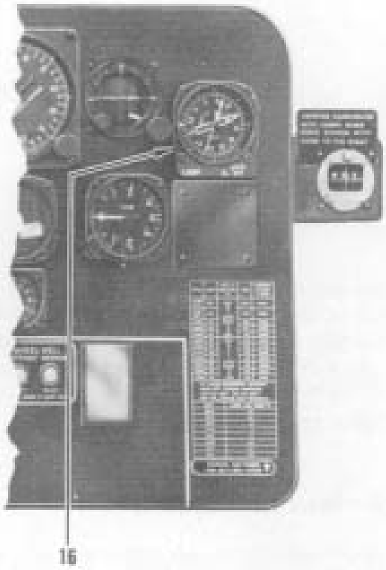
Figure 1-9 (Sheet 1 of 2)



DETAIL I 17260 ▶ 3177 PLUS TCTO 572 LESS TCTO 321

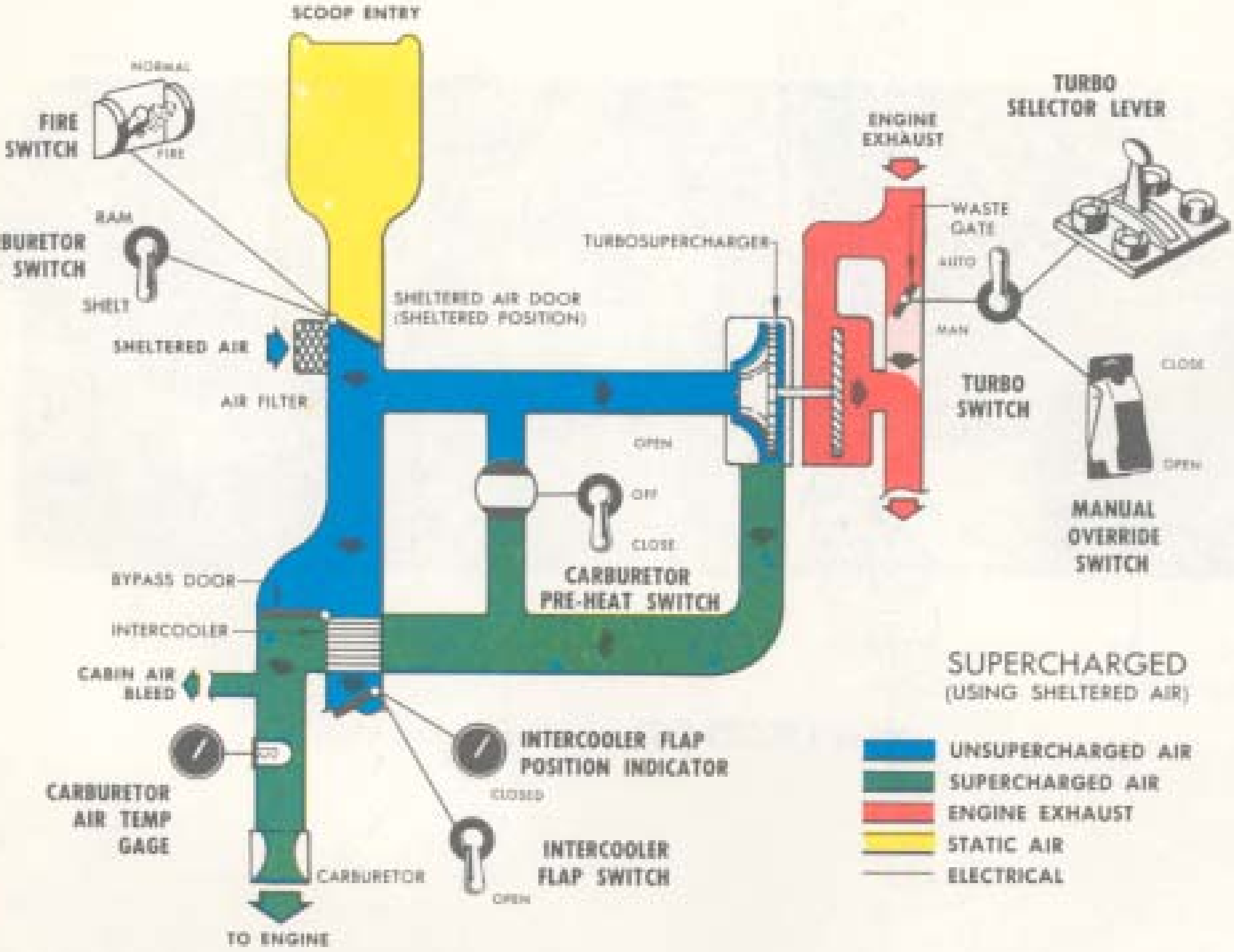


DETAIL II 3178 ▶ PLUS TCTO 572



DETAIL III 3178 ▶ PLUS TCTO 572

Figure 1-9 (Sheet 2 of 2)



INDUCTION SYSTEM

Figure 1-10 (Sheet 1 of 2)

carburetor air. When the valve is in the closed position, all of the supercharged air is directed through the induction system. In the open position, a portion of the supercharged air is bled off and allowed to recirculate through the compressor. This results in higher carburetor air temperature.

Carburetor Air Switches

Four switches (45, figure 1-22) on the engineer's instrument panel, control operation of the sheltered air doors. The switches have RAM--SHELT positions. Gang flappers permit actuation of all four switches to either position at the same time. In the RAM position air enters the air scoop and passes directly into the induction system. In the SHELT position, the shutoff door closes the air intake scoop and allows air to enter the induction system from the bottom of the air scoop. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel and the main circuit breaker panel (figure 1-34).

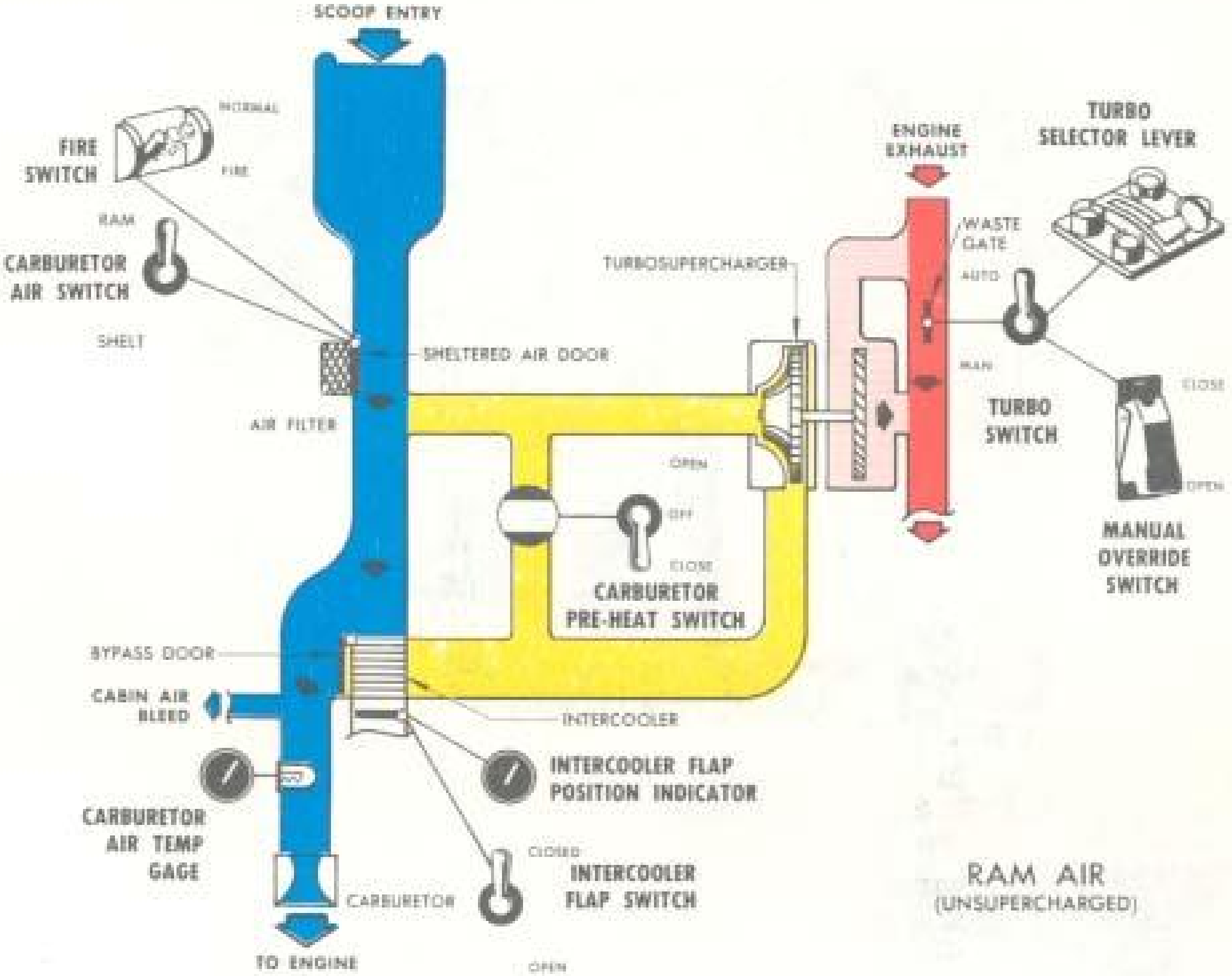


Figure 1-10 (Sheet 2 of 2)

Carburetor Preheat Switches

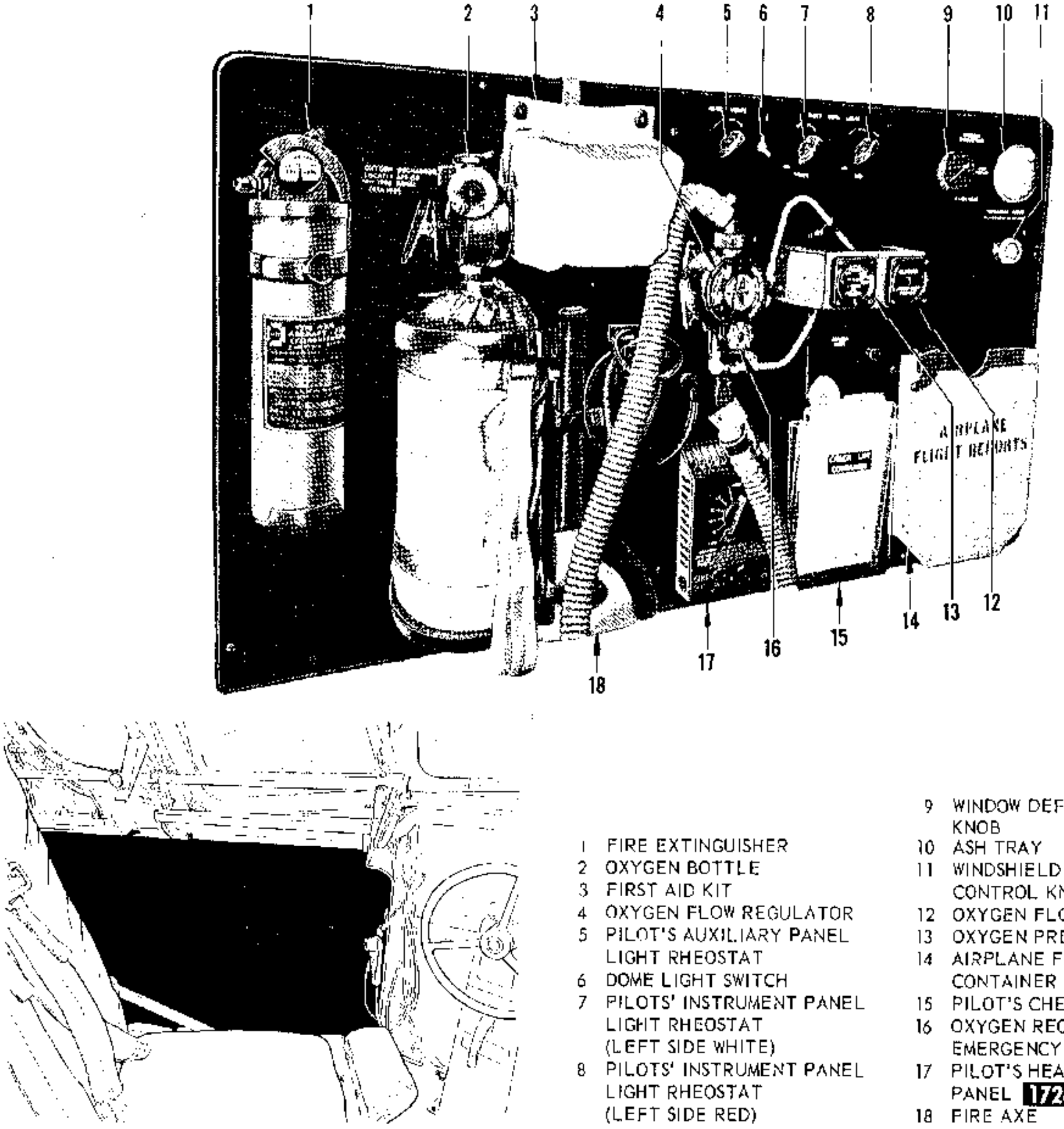
Four OPEN--OFF--CLOSE switches (42, figure 1-22) on the engineer's instrument panel, control the carburetor preheat valves. The switches are spring-loaded only from the OPEN position to the OFF position. Gang flappers permit actuation of all four switches to any position at the same time. The supercharger must be operating before preheat is possible. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

Carburetor Air Temperature Gages

A resistance bulb type carburetor air temperature gage (76, figure 1-22) for each engine induction system is located on the engineer's instrument panel. The gages indicate carburetor inlet air temperature in degrees Centigrade. The circuits are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

Intercooler

An intercooler (figure 1-10) located downstream from the turbocompressor, is used to provide cooling of supercharged air to the carburetor. Intercooler operation is controlled electrically by positioning of the intercooler flap, which limits the amount of ram air passing through the intercooler. Four switches on the engineer's instrument panel control operation of the intercooler flaps.



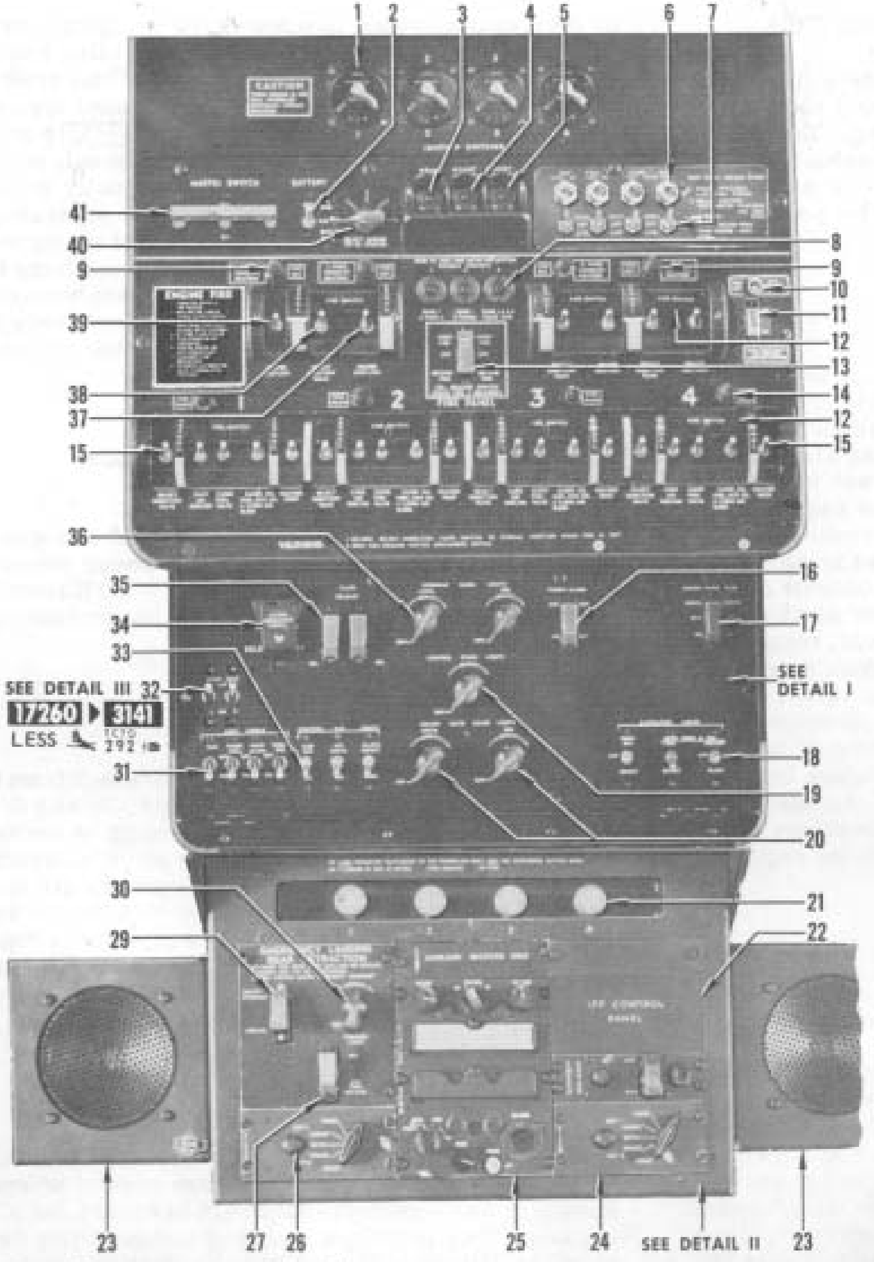
1 FIRE EXTINGUISHER
2 OXYGEN BOTTLE
3 FIRST AID KIT
4 OXYGEN FLOW REGULATOR
5 PILOT'S AUXILIARY PANEL LIGHT RHEOSTAT
6 DOME LIGHT SWITCH
7 PILOTS' INSTRUMENT PANEL LIGHT RHEOSTAT (LEFT SIDE WHITE)
8 PILOTS' INSTRUMENT PANEL LIGHT RHEOSTAT (LEFT SIDE RED)
9 WINDOW DEFROSTING CONTROL KNOB
10 ASH TRAY
11 WINDSHIELD WIPER SPEED CONTROL KNOB
12 OXYGEN FLOW INDICATOR
13 OXYGEN PRESSURE GAGE
14 AIRPLANE FLIGHT REPORT CONTAINER
15 PILOT'S CHECK LIST CONTAINER
16 OXYGEN REGULATOR EMERGENCY VALVE KNOB
17 PILOT'S HEATED SUIT CONTROL PANEL **17260** ▶ **2859**
18 FIRE AXE

PILOT'S AUXILIARY PANEL

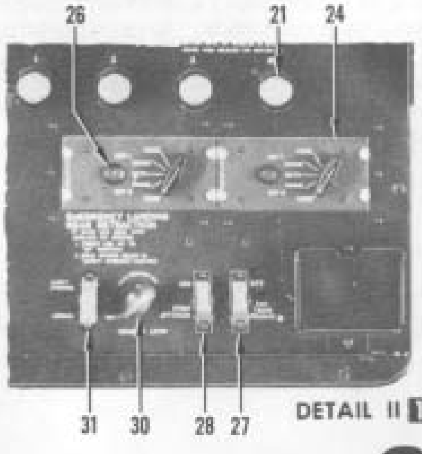
Figure 1-11

INTERCOOLER FLAP SWITCHES

Four OPEN--OFF--CLOSED switches (43, figure 1-22), on the engineer's instrument panel, control the intercooler flaps. The switches are spring-loaded to return to the OFF position from both the OPEN and the CLOSED positions. Holding the switch in the OPEN position increases the amount of flap opening allowing cooling air to pass through the intercooler. Holding the switch in the CLOSED position decreases the amount of flap opening. Gang flappers permit actuation of all four switches to either position at the same time. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

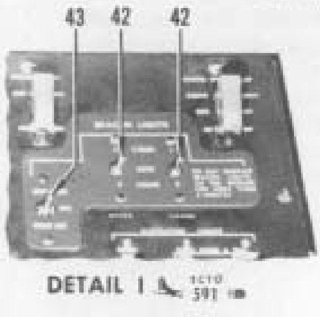


1 IGNITION SWITCHES
2 BATTERY SWITCH
3 PRIMER SWITCH
4 STARTER SWITCH
5 IGNITION BOOST SWITCH
6 HOT FUEL PRIME INDICATOR LIGHTS
7 HOT FUEL PRIME SWITCHES
8 FIRE DETECTOR SYSTEM TEST BUTTONS
9 COMBUSTION HEATER FIRE DETECTOR LIGHT (2 PLACES)
10 APU FIRE WARNING LIGHT
11 APU CO_2 RELEASE SWITCH
12 FIRE SWITCH GANG
13 CO_2 RELEASE SWITCH
14 FIRE WARNING LIGHTS
15 POWER PACKAGE FIRE SWITCHES (GANG BAR) (2 PLACES)
16 EMERGENCY ALARM SWITCH
17 EMERGENCY WING FLAP SWITCHES
18 NAVIGATION LIGHT SWITCHES
19 CONTROL STAND LIGHTS RHEOSTAT
20 PILOTS' INSTRUMENT PANEL LIGHTS RHEOSTAT
21 PROPELLER FEATHERING BUTTONS (2 PLACES)
22 IFF CONTROL PANEL **2901** ▶ **3339**
23 LOUDSPEAKER (2 PLACES)
24 RADIO COMPASS FILTER PANELS (2 PLACES)
25 AUXILIARY LIAISON RECEIVER CONTROL PANEL **3279** ▶ PLUS TCTO KG206
26 RADIO COMPASS FILTER LIGHT (2 PLACES)
27 EXTERNAL FUEL TANKS RELEASE SWITCH (2 PLACES)
28 STRUT JETTISON **17260** ▶ **3195** LESS TCTO 330
29 LANDING GEAR EMERGENCY RETRACTION SWITCH WITH TCTO 299
30 COMPASS LIGHT RHEOSTAT (2 PLACES)
31 MISCELLANEOUS LIGHT SWITCHES (2 PLACES)
32 PITOT HEAT SWITCHES
33 CONTROL CABIN LIGHT SWITCHES
34 CARGO DISCHARGE SIGNAL SWITCH
35 FLARE RELEASE SWITCHES
36 OVERHEAD PANEL LIGHT RHEOSTATS
37 ANTI-ICING HEATER SHUTOFF SWITCH
38 ANTI-ICING HEATER SELECT DIRECTION VALVE SWITCH
39 BODY HEATER FIRE SWITCH
40 ENGINE STARTING SELECTOR SWITCH
41 MASTER SWITCH (DC POWER)
42 ANTI-COLLISION LIGHTS COLOR SELECTOR SWITCHES TCTO 591
43 ANTI-COLLISION LIGHTS SWITCH TCTO 591

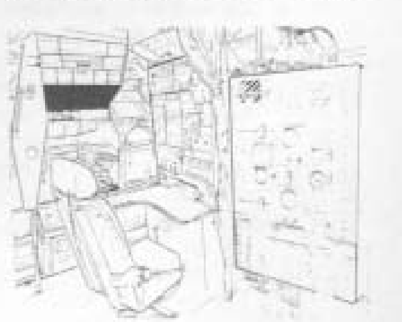


DETAIL II **17260** ▶ **2900**

DETAIL III **3142** ▶ PLUS TCTO 292



DETAIL I TCTO 591



OVERHEAD PANEL

Figure 1-12

INTERCOOLER FLAP POSITION INDICATORS

Four intercooler flap position indicators (74, figure 1-22) on the engineer's instrument panel show intercooler flap positions in inches of opening. The reading is taken from the flap screw driving mechanism. The indicator circuits are supplied with 26 volt AC through the four engine instrument fuses on the AC power panel (figure 1-34).

TURBOSUPERCHARGER

The turbosupercharger (figure 1-10) is an exhaust-driven centrifugal air compressor which is used to maintain carburetor inlet pressure at altitude by compressing intake air above the existing atmospheric pressure. This results in greater power output, fuel economy and better performance of the engine during high altitude cruising operation. The output of the compressor is increased or decreased by closing or opening the wastegate. Closing the wastegate directs more exhaust gases against the turbine which causes the compressor to rotate at higher speeds, resulting in a higher manifold pressure. The wastegate is controlled by an automatic control system, or a manual control system. A small percentage of the compressor output is used to pressurize the cabin. A solenoid brake is incorporated in the wastegate motor which locks the motor when it is not receiving power. An integral oil pump provides lubrication to the turbosupercharger from a separate oil tank mounted inside the engine oil tank.

Turbosupercharger Automatic Control System

The automatic control system regulates the wastegate position to maintain approximately constant carburetor inlet pressure, within the limits set by the governor and, on airplanes **3196**▶ plus 1C10 338, the overboost limiting system. It is composed of an independent wastegate control circuit for each engine, all connected to a single selector control unit. The turbo control unit (figure 1-13) consists of the turbo selector lever (30, figure 1-16) and the turbo calibrating knobs (31, figure 1-16) for each of the wastegate control circuits. Each wastegate control circuit has the following units electrically connected in a bridge circuit: the main turbo selector lever potentiometer, a calibrating knob potentiometer, a potentiometer for the pressure control which senses carburetor inlet pressure, a potentiometer for the governor which limits the maximum turbine rpm, and a balance potentiometer connected to the shaft of the wastegate motor to stabilize the system. An amplifier and the wastegate motor complete the wastegate control circuit. A change in the position of any of the potentiometers unbalances the bridge circuit. This unbalance is transmitted to the amplifier which relays a signal to the wastegate motor until the bridge circuit is re-balanced. The action of the control system is nearly instantaneous. On airplanes **22678**▶ plus those incorporating 1C10 320, the wastegate will automatically open when there is a discontinuity in the amplifier circuit. Each control circuit is separately fused with a 2 amp slow blow fuse located in the turbosupercharger main junction box near the amplifiers in the lower nose compartment. The automatic control system is supplied with 115 volt AC power through either the SUPCHG CONTR circuit breaker or fuse on the AC power panel (figure 1-34).

Turbosupercharger Manual Control System

A manual control system is provided in case of automatic system malfunction. A separate power source, transformer and control switches (figure 1-13) permit the manual control system to transmit power directly to the wastegate motor.

Turbo Selector (TBS) Lever

As the TBS lever (30, figure 1-16) is advanced from 0 toward 10, the wastegate control bridge circuits are unbalanced so that each exhaust wastegate is moved toward the closed position. When the lever is moved toward the zero position the bridge circuits are unbalanced so that the wastegates are driven toward the open position. The output of each compressor is regulated by the automatic control system, once the initial carburetor inlet pressure has been established by positioning the TBS lever.

Turbo Calibrating Knobs

Each of the four calibrating knobs (31, figure 1-16) permits adjustment of its wastegate control bridge circuit to set a uniform manifold pressure for all engines. They provide a means of compensating for small variations in the individual engine and turbosupercharger control characteristics. Each calibrating knob is shielded by a barrier to prevent accidental repositioning. Each barrier has an index mark. Each calibration knob is protected by a 1/16 amp fuse located in the junction box in the floor under the engineer's seat.

Turbo Switches

The turbo switches (28, figure 1-16) have AUTO--MAN positions. When these switches are placed in the AUTO position, the turbosuperchargers are controlled by the automatic system. When placed in the MAN position the turbosupercharger wastegate is controlled by means of the manual override switches.

Manual Override Switches

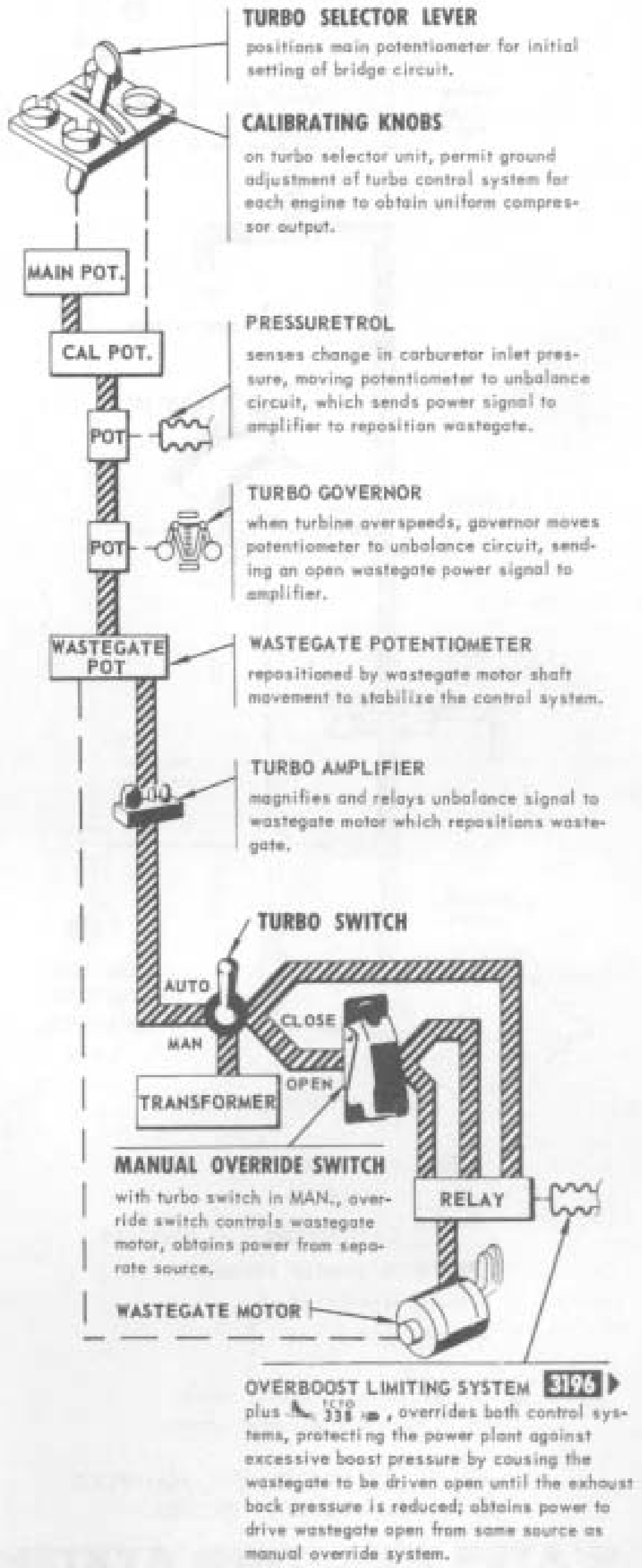
The manual override switches (27, figure 1-16) have CLOSE--OFF--OPEN positions. When the turbo switches are at MAN, nudging the override switches to the CLOSE position causes the wastegate to close which results in a rise in manifold pressure. When the turbo switches are on MAN, nudging the override switches to the OPEN position causes the wastegate to open which results in a drop in manifold pressure. The manual override switches are spring-loaded from the OPEN and CLOSE positions to the OFF position, and may be guarded to the OPEN position. The manual control system is supplied with 115 volt AC power through the TURBO BOOST circuit breaker or fuse on the AC power panel (figure 1-34).

CAUTION

> The manual override switches should be operated with caution because of the fast action of the wastegate motor and the lack of governor overspeed control in the manual system. See TURBOSUPERCHARGER SYSTEM OPERATION, MANUAL CONTROL in Section VII. Do not energize all four wastegate motors with the manual override switches for more than 5 minutes continuous operation to avoid overheating the transformer.

Turbosupercharger Overboost **3196** ▶ plus ✈ TCTO 338 ◀ Limiting System

The overboost limiting system is a safety device to protect the powerplant from the effects of overboost due to an accidental wastegate closure by overriding either the automatic control system or the manual control system. The system consists of an exhaust back pressure sensing switch and a relay (figure 1-13) for each engine. The exhaust back pressure sensing switch, sensing an exhaust back pressure in excess of the maximum operating pressure will cause the relay to connect the wastegate motor directly to the 230 volt open signal of the manual override system transformer. The wastegate will be driven open until the maximum operating pressure is reached. The exhaust back pressure sensing switch will then cause the relay to return the turbosupercharger to its previous control. The circuit breakers for the exhaust back pressure sensing switch and the relay are on the overhead circuit breaker panel (figure 1-34). If the circuit breaker is tripped the wastegate will be driven to the full open position. The wastegate open power source is supplied with 115 volt AC through the TURBO BOOST circuit breaker or fuses on the AC power panel (figure 1-34).



TURBO SELECTOR LEVER
positions main potentiometer for initial setting of bridge circuit.

CALIBRATING KNOBS
on turbo selector unit, permit ground adjustment of turbo control system for each engine to obtain uniform compressor output.

PRESSURETROL
senses change in carburetor inlet pressure, moving potentiometer to unbalance circuit, which sends power signal to amplifier to reposition wastegate.

TURBO GOVERNOR
when turbine overspeeds, governor moves potentiometer to unbalance circuit, sending an open wastegate power signal to amplifier.

WASTEGATE POTENTIOMETER
repositioned by wastegate motor shaft movement to stabilize the control system.

TURBO AMPLIFIER
magnifies and relays unbalance signal to wastegate motor which repositions wastegate.

TURBO SWITCH

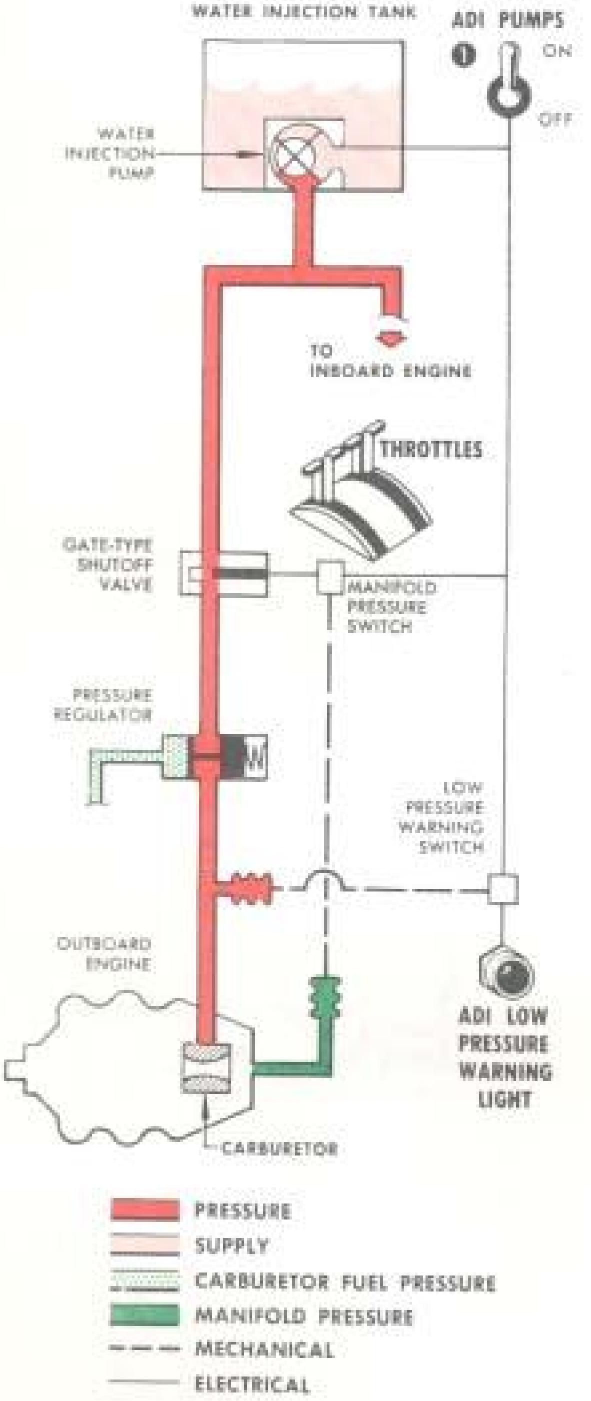
MANUAL OVERRIDE SWITCH
with turbo switch in MAN., override switch controls wastegate motor, obtains power from separate source.

WASTEGATE MOTOR

OVERBOOST LIMITING SYSTEM **3196** ▶ plus ✈ TCTO 338 ◀, overrides both control systems, protecting the power plant against excessive boost pressure by causing the wastegate to be driven open until the exhaust back pressure is reduced; obtains power to drive wastegate open from same source as manual override system.

TURBOSUPERCHARGER CONTROL SYSTEM

Figure 1-13



① This switch operates ADI system for all engines, one engine shown.

ADI PUMPS SWITCH ON, MANIFOLD PRESSURE ABOVE 45 INCHES

WATER INJECTION SYSTEM

Figure 1-14

WATER INJECTION (ADI) SYSTEM

The water injection system (figure 1-14) is used to increase the power output of the engine. The system consists of two 30 US gallon water injection fluid tanks, two water injection pumps, a water injection regulator unit with a gate type shutoff valve on the front wing spar for each engine, and a manifold pressure switch on each engine. With the water injection pump operating, the system is automatically controlled by the regulator unit above 45 inches MP. The manifold pressure switch automatically opens the shutoff valve at 45 inches MP, allowing water injection fluid to flow to the pressure regulator, which controls the flow of fluid to the carburetor. The shutoff valve closes automatically when manifold pressure drops below 41 inches MP. Each water injection tank contains a water-alcohol mixture, given in figure 1-47, and supplies the two engines on that side of the airplane. Duration of the supply at 3500 brake horsepower per engine is approximately 10 minutes.

Water Injection (ADI) Pump Switch

An ADI pump, ON--OFF switch (10, figure 1-16) on the forward end of the control stand energizes the water injection pump circuit. When the water injection pump switch is ON, both pumps supply pressure to a water shutoff valve. Operation is then initiated by manifold pressure. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel and the main circuit breaker panel (figure 1-34).

Water Injection (ADI) Lights

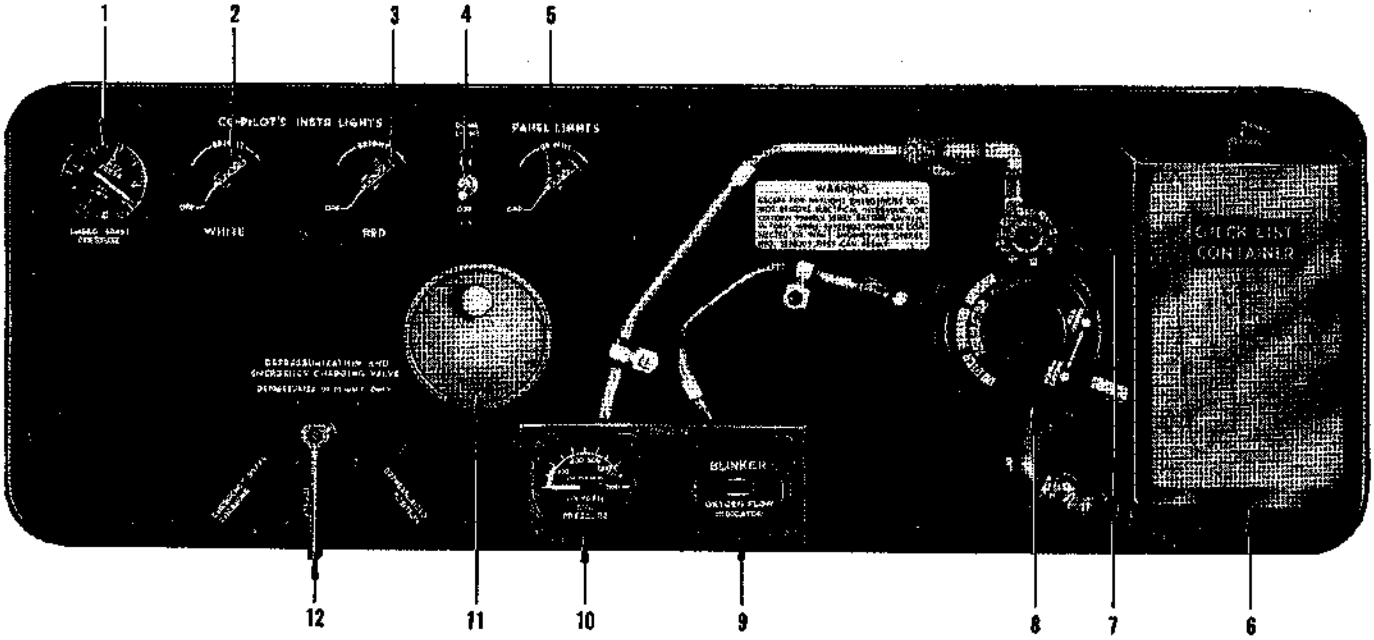
Four amber water injection pressure warning lights (5, figure 1-16) are on the forward end of the control stand. Water injection fluid low pressure at the regulator is indicated if a light remains illuminated at power settings above 45 inches manifold pressure, with the water injection pump switch on. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

ENGINE COOLING SYSTEM

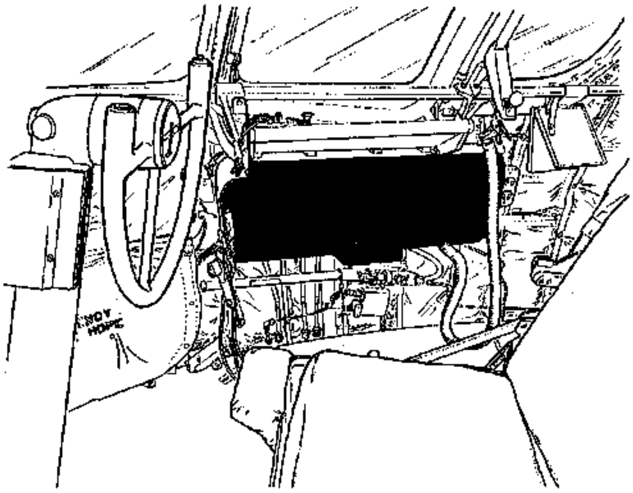
The flow of cooling air for each engine is controlled by two ground-adjustable and seven electrically operated, flight adjustable, cowl flaps. The cowl flaps are actuated by seven jackscrews driven by a single electric motor through a flexible drive shaft system.

Cowl Flaps Switches

Four cowl flap switches (35, figure 1-22) one for each engine, are on the engineer's instrument panel. These



1 EMERGENCY BRAKE SYSTEM PRESSURE GAGE
2 PILOTS' INSTRUMENT PANEL LIGHT RHEOSTAT (RIGHT SIDE WHITE)
3 PILOTS' INSTRUMENT PANEL LIGHT RHEOSTAT (RIGHT SIDE RED)
4 DOME LIGHT SWITCH
5 COPILOT'S AUXILIARY PANEL LIGHT RHEOSTAT
6 COPILOT'S CHECK LIST CONTAINER
7 OXYGEN REGULATOR EMERGENCY VALVE KNOB
8 OXYGEN FLOW REGULATOR
9 OXYGEN FLOW INDICATOR
10 OXYGEN PRESSURE GAGE
11 ASH TRAY
12 DEPRESSURIZATION AND EMERGENCY CHARGING VALVE HANDLE



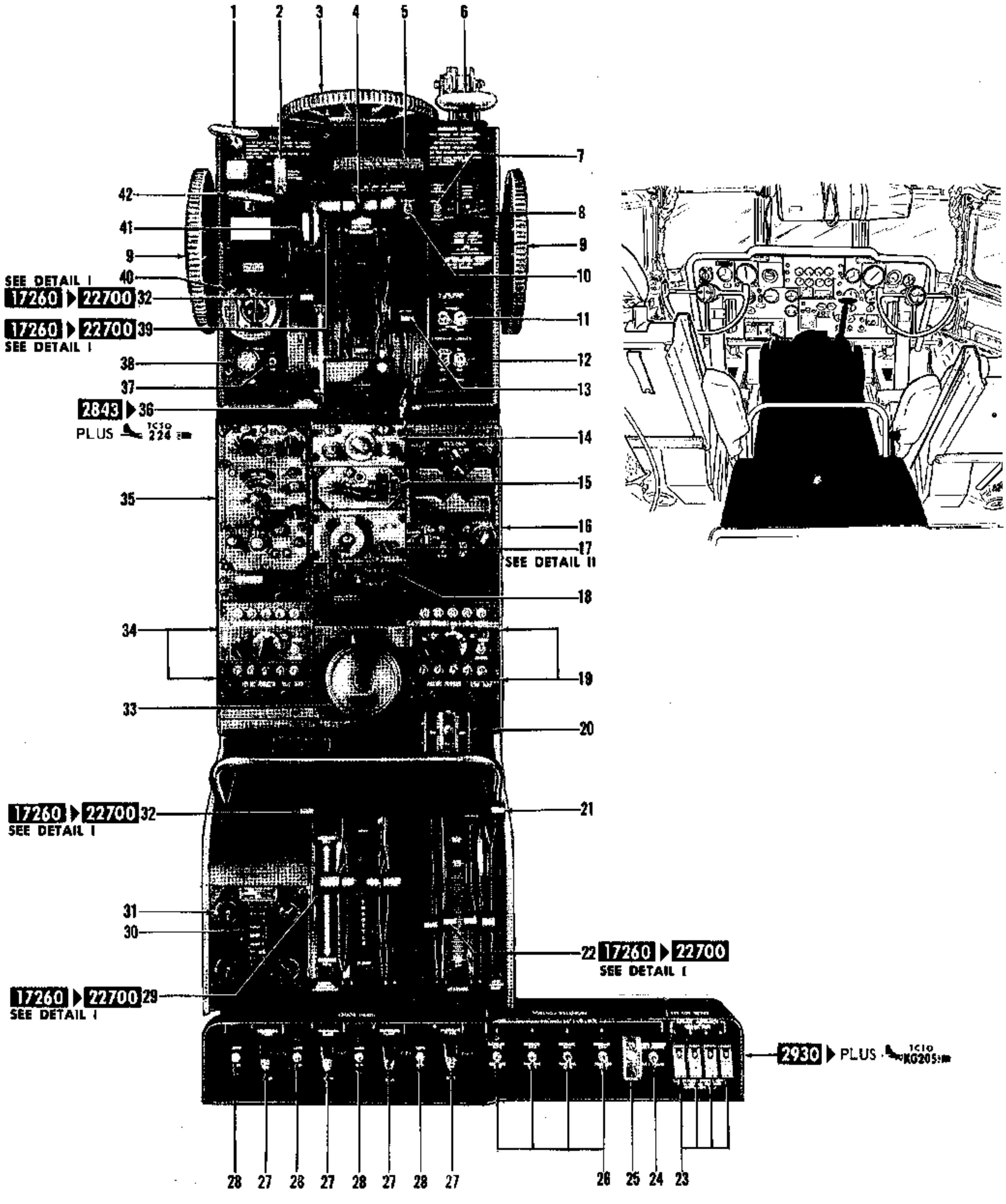
COPILOT'S AUXILIARY PANEL

Figure 1-15

switches electrically control the opening and closing of the cowl flaps. The switches have OPEN--OFF--CLOSE positions and are spring-loaded from the OPEN and CLOSE positions to the OFF position. Gang flappers permit simultaneous actuation of all four switches to either position. The cowl flaps will remain stationary when the switch is released to OFF. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel and the main circuit breaker panel (figure 1-34).

Cowl Flap Position Indicators

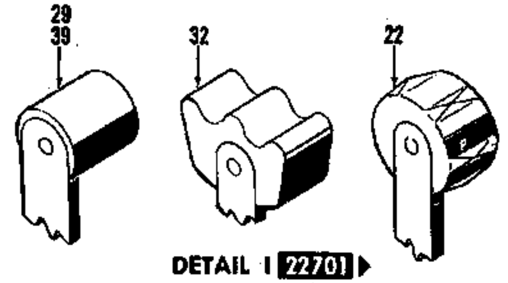
The position of the cowl flaps are indicated in inches of opening by four cowl flap position indicators (78, figure 1-22) on the engineer's instrument panel. The reading is taken from the flap screw driving mechanism. The indicator circuits are supplied with 26 volt AC through the four engine instrument fuses on the AC power panel (figure 1-34).



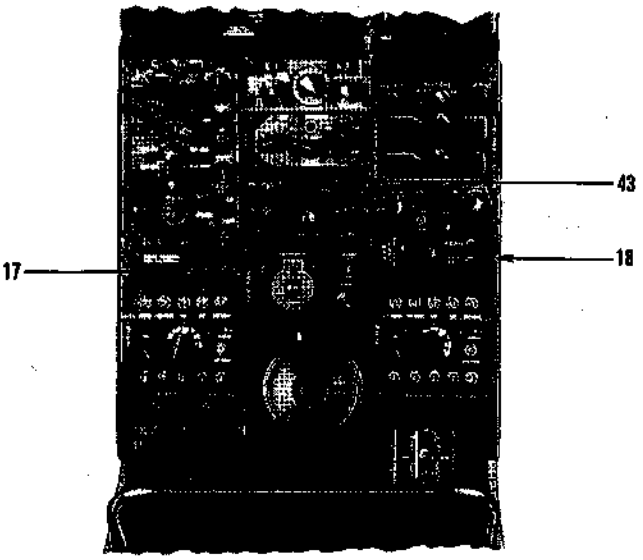
CONTROL STAND

Figure 1-16 (Sheet 1 of 2)

1 AUTOPILOT EMERGENCY DISCONNECT HANDLE
2 RUDDER BOOST PRESSURE SWITCH
3 AILERON TRIM CONTROL WHEEL
4 PROPELLER REVERSE WARNING FLAG
5 WATER INJECTION (ADI) LIGHTS
6 SURFACE LOCK HANDLE
7 LANDING GEAR WARNING HORN RELEASE SWITCH
8 LANDING GEAR SWITCH
9 ELEVATOR TRIM CONTROL WHEEL (2 PLACES)
10 WATER INJECTION (ADI) PUMP SWITCH
11 LANDING LIGHT RETRACTION SWITCHES
12 LANDING LIGHT SWITCHES
13 THROTTLE LOCK LEVER
14 UHF RADIO CONTROL PANEL
15 VHF RADIO CONTROL PANEL
16 LIAISON RADIO CONTROL PANEL
17 VHF NAVIGATION RADIO CONTROL PANEL (2 PLACES)
18 NAVIGATION INSTRUMENT SELECTOR PANEL (2 PLACES)
19 COPILOT'S INTERPHONE CONTROL PANELS
20 WING FLAP SWITCH
21 MIXTURE LOCK LEVER
22 MIXTURE CONTROLS (2 PLACES)
23 SPARK ADVANCE SELECTOR SWITCHES
24 PROPELLER AUTO CONTROL SWITCH
25 PROPELLER RESYNCHRONIZER SWITCH
26 PROPELLER GOVERNOR SELECTOR SWITCHES
27 TURBO MANUAL OVERRIDE SWITCHES (4 PLACES)
28 TURBO SWITCHES (4 PLACES)
29 ENGINEER'S THROTTLES (2 PLACES)
30 TURBO SELECTOR LEVER
31 TURBO CALIBRATING KNOBS
32 MASTER PROPELLER SYNCHRONIZER LEVER (3 PLACES)
33 RUDDER TRIM CONTROL WHEEL
34 PILOT'S INTERPHONE CONTROL PANELS
35 RADIO COMPASS CONTROL PANEL
36 PROPELLER REVERSE LOCK PLATE
37 AUTOPILOT MASTER SWITCH
38 AUTOPILOT CLUTCH SWITCH
39 PILOTS' THROTTLES (2 PLACES)
40 AUTOPILOT TURN AND PITCH CONTROLLER
41 ELEVATOR TRIM TAB INDICATOR
42 EMERGENCY CABIN PRESSURE RELEASE HANDLE
43 UHF NAVIGATION RADIO CONTROL PANEL TCTO 572



DETAIL I 22701 ▶



DETAIL II TCTO 572

Figure 1-16 (Sheet 2 of 2)

FUEL ENRICHMENT SYSTEM

TCTO 595

The fuel enrichment system consists of a carburetor bypass line, metering orifice, solenoid actuated valve and a control switch for each engine to provide richer mixtures to give additional engine cooling during hot weather operations. The system is to be used for meto power climb and during refueling flight to improve airplane performance. This increased overall performance is attained by reduced cowl flap settings at the cost of increased fuel consumption. This increased fuel consumption must be considered in mission planning for the period the system is to be used.

Fuel Enrichment Switches

TCTO 595

Four ON--OFF switches (94, figure 1-22) on a separate panel attached to the left edge of the flight engineer's instrument panel control the fuel enrichment system. When placed in the ON position the solenoid actuated valves will be energized to increase fuel flow approximately 200 pounds per hour. Control power is 28 volts DC through the oil dilution circuit breaker on the overhead circuit breaker panel (figure 1-34).

IGNITION SYSTEM

Four magnetos provide low tension ignition for each engine. The magnetos supply low voltage current through the primary ignition leads to 56 transformer coils which are mounted near the spark plugs. This low voltage is converted into higher voltage and is fed through short leads to the spark plugs. Magnetos are designated L1, L2, R1 and R2, and each magneto furnishes ignition to the left or right spark plug in two rows of cylinders. For example: Rows B and D by the L1 magneto.

NOTE

> The right spark plugs are on the intake side of the cylinders and the left spark plugs are on the exhaust side of the cylinders. Cylinder rows are designated A, B, C and D.

A solenoid operated spark advance system controlled by a switch on the engineer's panel (28 volts) permits spark to be advanced from normal spark to spark advance. The normal setting is used during normal engine operation while the spark advance setting provides more efficient operation for certain cruise control configurations during manual leaning. Two starter vibrators are incorporated in each engine ignition system circuit to boost magneto input at low starting rpm until magneto output is sufficient to operate the engine.

Ignition Switches

Four rotary-type engine ignition switches (1, figure 1-12) are on the overhead panel. Each switch has BOTH--LEFT--RIGHT--OFF positions for the right and left hand magneto circuits.

Ignition Boost Switch

Ignition boost is selected for each engine individually by an engine starting selector switch on the overhead panel. See ENGINE STARTING SELECTOR SWITCH in this Section. Once the engine has been selected the starting vibrators are energized by the boost push button switch (5, figure 1-12) on the starter control base, located on the overhead panel. Depressing the switch provides a hotter spark for starting. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

Spark Advance Selector Switches

A spark advance selector switch (23, figure 1-16) for each engine is provided on the aft end of the control stand. The switches have two positions, NORMAL and SPARK ADVANCE. Each switch is individually guarded to the NORMAL for normal operation. During long range cruise operations the switches can be positioned to SPARK ADVANCE to improve range. When positioned to SPARK ADVANCE the spark timing is advanced. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

NOTE

> The SPARK ADVANCE position is to be used only as outlined in SPARK ADVANCE CRUISE CONTROL PROCEDURE in Section VII.

PRIMING SYSTEM

Engine priming is electrically controlled by a push button switch (3, figure 1-12) adjacent to the starter switch. The starter selector switch controls engine selection. Each engine is primed through a solenoid valve located in the fuel line between the heater tank and the carburetor. This valve when actuated allows fuel to be injected into the engine blower housing for normal or cold weather starts. Fuel is supplied to the primer solenoid by the fuel booster pumps. The primer circuit is supplied with 28 volt DC through a circuit breaker on the overhead panel (figure 1-34).

Hot Fuel Prime System

The airplane is provided with a hot fuel prime system which reduces engine preheat time during cold weather. The system consists of a hot fuel prime tank mounted inside each engine nacelle, and electrical controls in the forward compartment for operating the system. Two heater elements within each hot fuel prime tank, when energized, raise the temperature of the fuel to 220°F (105°C) within three minutes. When only one heater element is energized, the fuel heats to 220°F (105°C) within six minutes.

HOT FUEL PRIME SWITCHES

Four hot fuel prime toggle switches (7, figure 1-12), one for each engine, are provided on the overhead panel. Each switch has three positions, HIGH--OFF--LOW. When positioned to HIGH, both heater elements are energized using 300 amperes. When the switch is positioned to LOW, only one element will be energized using 150 amperes. When the required temperature is reached, the switch should be placed in the OFF position. If this is not done, a heater control relay on the engine nacelle solenoid panel automatically maintains the temperature until the switch has been positioned to OFF. The circuit is provided with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

HOT FUEL PRIME INDICATOR LIGHTS

Four press-to-test lights (6, figure 1-12), are located directly above the four hot fuel prime switches on the overhead panel. Each light will illuminate when it's respective hot fuel prime switch is positioned to HIGH or LOW. The light will automatically go out when the required fuel temperature is reached. The lights are supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

STARTER SYSTEM

Each engine is started by a direct-cranking electrical starter mounted on the engine accessory drive case. The starter is controlled by a starter switch and an engine starting selector switch on the overhead panel.

Engine Starting Selector Switch

A rotary type OFF--1--2--3--4 switch (40, figure 1-12) on the overhead panel, is used to select the engine to be started. When the switch is in the 1--2--3--4 position, starter, primer, and ignition boost circuits are connected to the selected engine. When the switch is in the OFF position, the starter, primer, and ignition boost circuits are disconnected from all engines.

Starter Switch

Direct cranking starters are controlled by a push-button switch (4, figure 1-12) on the overhead panel. The starter, prime and boost switches are grouped on a raised and guarded base. Each switch controls all four engines, through a rotary engine starting selector switch, adjacent to the raised base. The starter control circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

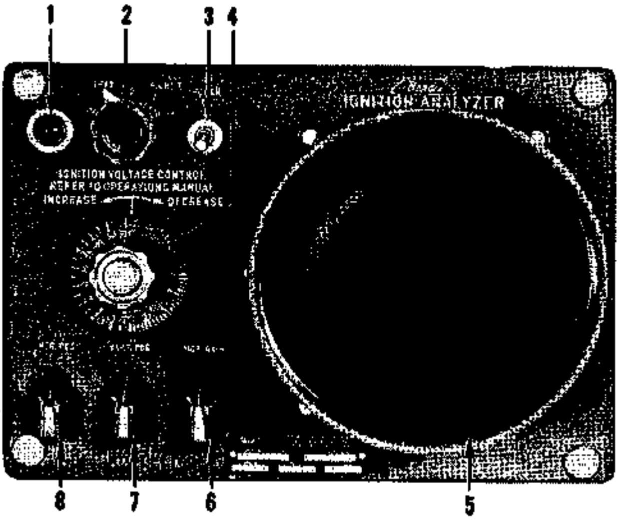
ENGINE INDICATORS

Ignition Analyzer System

The ignition analyzer system provides a means of detection, identification, and location of engine ignition troubles during both flight and ground operation. This analysis of ignition performance is made by interpreting and comparing the magneto voltage wave patterns of a malfunction system with those produced by a properly operating system, each specific trouble producing a characteristic pattern. The system consists essentially of an ignition analyzer, a switch panel assembly, four pick-up or breaker assemblies, a relay and resistor box assembly, four filter units, and connecting leads. The ignition analyzer is located at the left of the engineer's table and directly behind the pilot's seat. The ignition analyzer switch panel is mounted above the ignition analyzer on the engineer's auxiliary panel (3, figure 1-23). The analyzer system is joined to the magneto primary circuits at the ignition switch allowing the varying magneto primary and reflected secondary voltages to be registered as patterns on the analyzer viewing screen. These patterns will form a pattern sequence from left to right across the screen, one pattern for each cylinder fired by the selected magneto. Adjustment of horizontal and vertical position controls on the analyzer determines the position of the wave pattern on the screen; and horizontal and vertical gain controls on the analyzer enlarge the pattern horizontally and vertically for detailed study of the patterns.

POWER SUPPLY

The regulated AC power supply circuit for the ignition analyzer is protected by a fuse or circuit breaker



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

IGNITION ANALYZER

Figure 1-17

(figure 1-34) on the AC power panel. The DC power supply circuit is protected by a circuit breaker on the overhead circuit breaker panel (figure 1-34). A system fuse on the analyzer switch panel (3, figure 1-18) also protects the AC circuit to the analyzer system.

SYSTEM POWER SWITCH

This switch (5, figure 1-18), located on the analyzer switch panel delivers power to the ignition analyzer system. The switch has two positions, ON and OFF. In the ON position the power circuit to the ignition analyzer is closed. In the OFF position this circuit is open.

ANALYZER POWER SWITCH

An ON--OFF switch (3, figure 1-17), on the ignition analyzer, controls power from the analyzer switch panel to circuits within the analyzer housing. In the ON position, this circuit is closed. In the OFF position, it is open. Both the system power switch and the analyzer power switch must be in the ON position to energize the analyzer circuits.

ANALYZER MAGNETO SELECTOR SWITCH

This switch (2, figure 1-17) located on the ignition analyzer, is installed to provide magneto selection when the ignition analyzer is used as a portable unit. The switch in this airborne installation operates in conjunction with the engine and magneto selector switch on the analyzer switch panel and is always positioned to LEFT 1 when the analyzer is being used.

HORIZONTAL POSITION SWITCH

The wave form picture on the analyzer screen is shifted to the left or right by this rotary type switch (8, figure 1-17) on the ignition analyzer.

VERTICAL POSITION SWITCH

The wave form picture on the analyzer is shifted up or down by this rotary type switch (7, figure 1-17) on the ignition analyzer.

HORIZONTAL GAIN CONTROL SWITCH

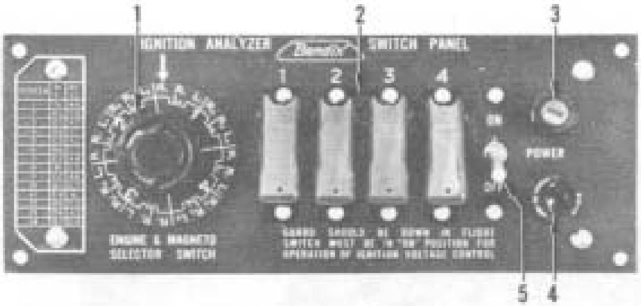
This rotary type switch (6, figure 1-17), located on the ignition analyzer, enlarges the wave form picture in a horizontal direction, thereby spreading out the wave form to permit more detailed observation.

ANALYZER INTERNAL CONTROL PANEL

The internal control panel (figure 1-19), is located inside of the ignition analyzer. On most installations it is accessible through a hinged door in the top of the ignition analyzer. On other installations it is necessary to remove the ignition analyzer housing to gain access to the panel. The following controls are on the panel: a focus knob, bias knob, sync knob, intensity knob, vert. gain knob and a high tension-low tension switch. The intensity knob is used to adjust the intensity of the pattern to the degree of brightness desired. The focus knob is used to adjust the pattern to a sharp, distinct outline. Both the intensity knob and the focus knob are coordinated to give the clearest wave-form image. The bias knob is used to filter out stray signals. The vert. gain knob enlarges the pattern in a vertical direction. The sync knob does not function in this airplane installation. The high tension-low tension switch should be left in the HIGH TENSION position as better operation will result.

NOTE

> Adjustment of the above internal controls is to be made only by qualified electronics personnel if adjustment is required.



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

IGNITION ANALYZER SWITCH PANEL

Figure 1-18

ENGINE AND MAGNETO SELCTOR SWITCH

This switch (1, figure 1-18), on the analyzer switch panel, provides a means of selecting the engine and each individual ignition circuit to be tested by the ignition analyzer. The selector is divided into four numbered quadrants, one quadrant for each engine. Each quadrant is divided into two sectors. Each sector has three switch positions, one position for the magneto firing the left side circuit of two rows or fourteen cylinders, one position for the magneto firing the right side circuit of the same row of cylinders and one position for both of these magnetos. This makes a total of six positions for each engine and a total of twenty-four positions on the selector switch.

RELAY-RESISTOR SWITCHES

Four guarded switches (2, figure 1-18) are located on the ignition analyzer switch panel. In the OFF position these numbered switches connect resistors in the circuits which protect the primary magneto circuits of the four correspondingly numbered engines. In the ON or unguarded position these switches energize relays which by-pass the resistors, thereby allowing the use of the ignition voltage control of the ignition analyzer.

VOLTAGE CONTROL SWITCH

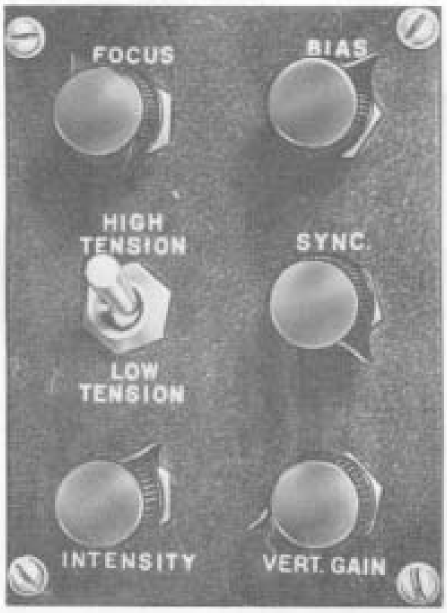
This switch (4, figure 1-17), on the ignition analyzer, enables the flight engineer on a ground check to foresee ignition system difficulties and correct the condition before failure actually occurs. The most common of these failures would be fouling and incorrect gaps of spark plugs. The voltage control is a rotary switch marked with an OFF position with numbered positions from 0 to 50. It is engaged by pulling the knob out and rotating. When released it becomes inoperative, but will remain at the same dial number position. When this switch is engaged a variable shunt resistance is connected across the primary of the magneto being tested. As the switch is moved in the direction of decrease, the magneto load is increased thus reducing voltage at the spark plug. The position of the switch when misfiring or complete stoppage of firing occurs is used as an indication of the condition of the ignition system.

ANALYZER SCREEN

This screen (5, figure 1-17), is a modified cathode-ray oscilloscope which shows the varying magneto primary and reflected secondary voltages as wave form patterns. Ignition performance is analyzed by interpreting and comparing the characteristic magneto voltage wave patterns produced by a malfunctioning system with the wave forms produced by a properly operating system. The operation of this screen is regulated by controls located on the ignition analyzer control panel, the internal control panel, and the ignition analyzer.

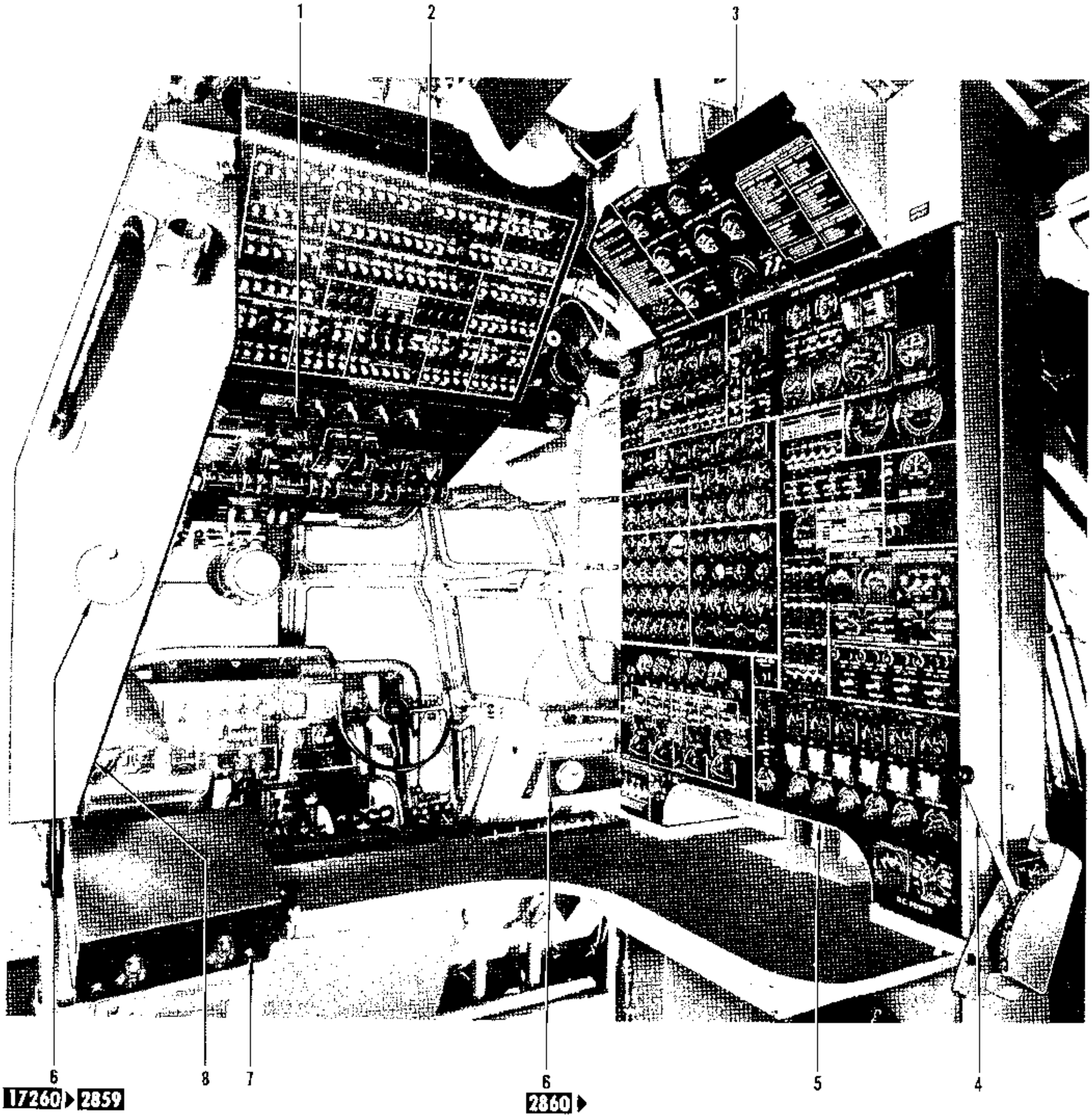
ANALYZER SYSTEM POWER INDICATOR LIGHT

This light (4, figure 1-18) on the analyzer switch panel will illuminate when the system power switch is positioned to ON indicating that power is supplied to the system.



IGNITION ANALYZER INTERNAL CONTROL PANEL

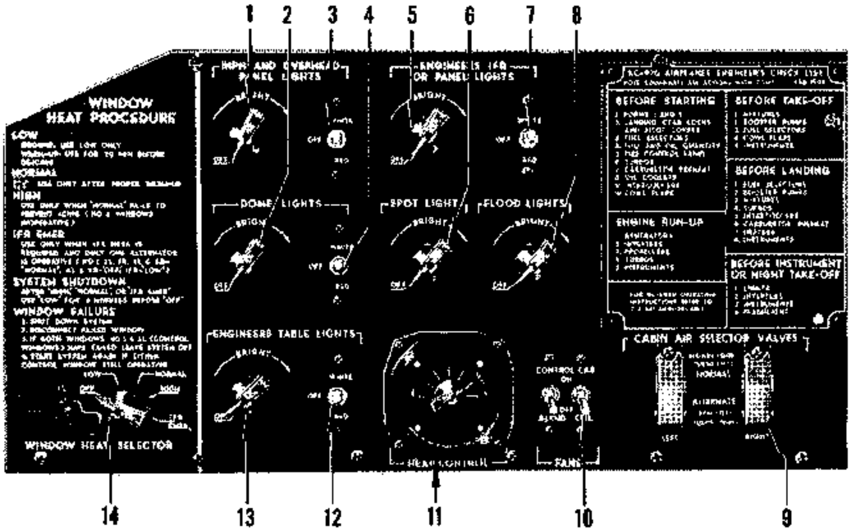
Figure 1-19

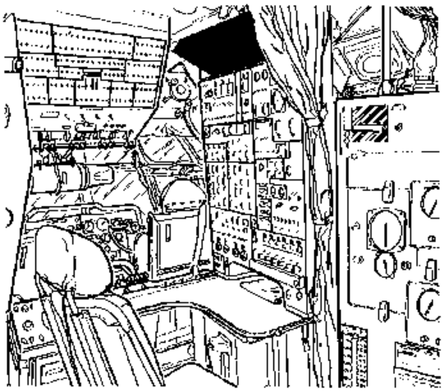


1 OVERHEAD PANEL
2 OVERHEAD CIRCUIT BREAKER PANEL
3 ENGINEER'S AUXILIARY OVERHEAD PANEL
▼ 4 ISODRAULIC HANDLE
5 ENGINEER'S INSTRUMENT PANEL
6 ENGINEER'S ASH TRAY (2 PLACES)
7 IGNITION ANALYZER
8 ENGINEER'S AUXILIARY PANEL

ENGINEER'S STATION (TYPICAL)

Figure 1-20





1 OVERHEAD PANEL LIGHTS RHEOSTAT
2 DOME LIGHTS RHEOSTAT
3 OVERHEAD PANEL LIGHTS CONTROL SWITCH
4 DOME LIGHTS CONTROL SWITCH
▼T 5 ENGINEER'S (A/R) LIGHTS RHEOSTAT
6 SPOT LIGHT RHEOSTAT
▼T 7 ENGINEER'S (A/R) LIGHTS CONTROL SWITCH
8 FLOOD LIGHTS RHEOSTAT
9 CABIN AIR SELECTOR SWITCHES 3106 ▶
10 CONTROL CABIN FAN SWITCHES
11 HEAT CONTROL RHEOSTAT
12 ENGINEER'S TABLE LIGHTS CONTROL SWITCH
13 ENGINEER'S TABLE LIGHTS RHEOSTAT
14 WINDOW HEAT SELECTOR SWITCH

ENGINEER'S AUXILIARY OVERHEAD PANEL

Figure 1-21

ANALYZER POWER INDICATOR LIGHT

This light (1, figure 1-17), located on the ignition analyzer, illuminates when the ignition analyzer is receiving power. The light should be illuminated when the power switch on the ignition analyzer and the power switch on the analyzer switch panel are in the ON position.

Tachometers

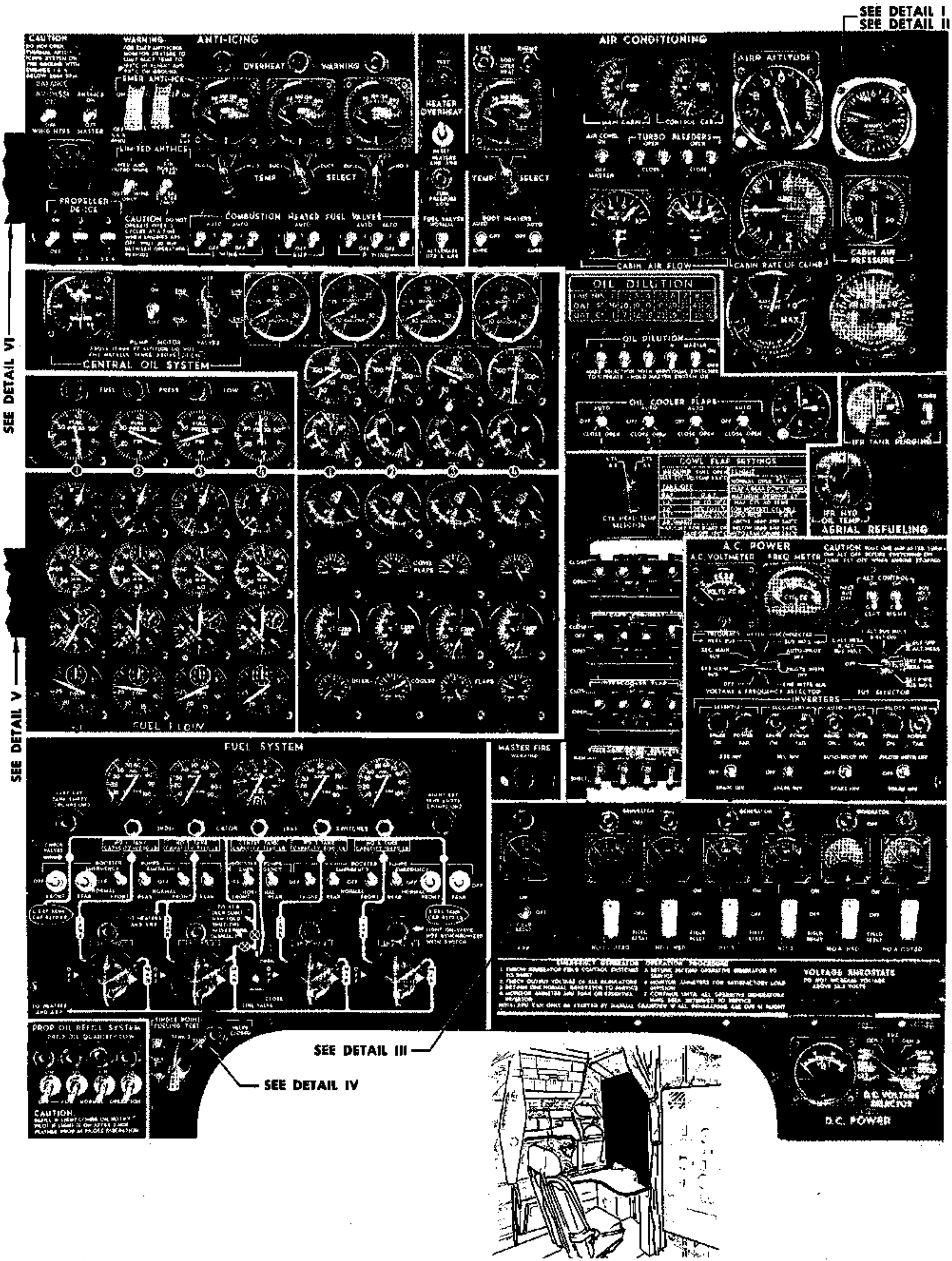
Four single-indicating engine tachometers are on both the pilots' and the engineer's instrument panels (10, figure 1-9 and 81, figure 1-22). The tachometers are generator motor units. Each tachometer generator is engine-driven and generates its own current which controls the indicator motor at a synchronized speed. The pilots' tachometers measure engine speeds in increments of 100 rpm and the engineer's tachometers measure engine speeds in increments of 20 rpm.

Torquemeters

Four individual torquemeters (77, figure 1-22) are on the engineer's instrument panel. The torquemeters indicate torque pressure in psi and are used as a direct means of measuring power output. When combined with engine rpm and a factor, a direct calculation of brake horsepower output at the propeller can be made. The indicating circuit is supplied with 26 volt AC through circuit protection on the AC power panel (figure 1-34).

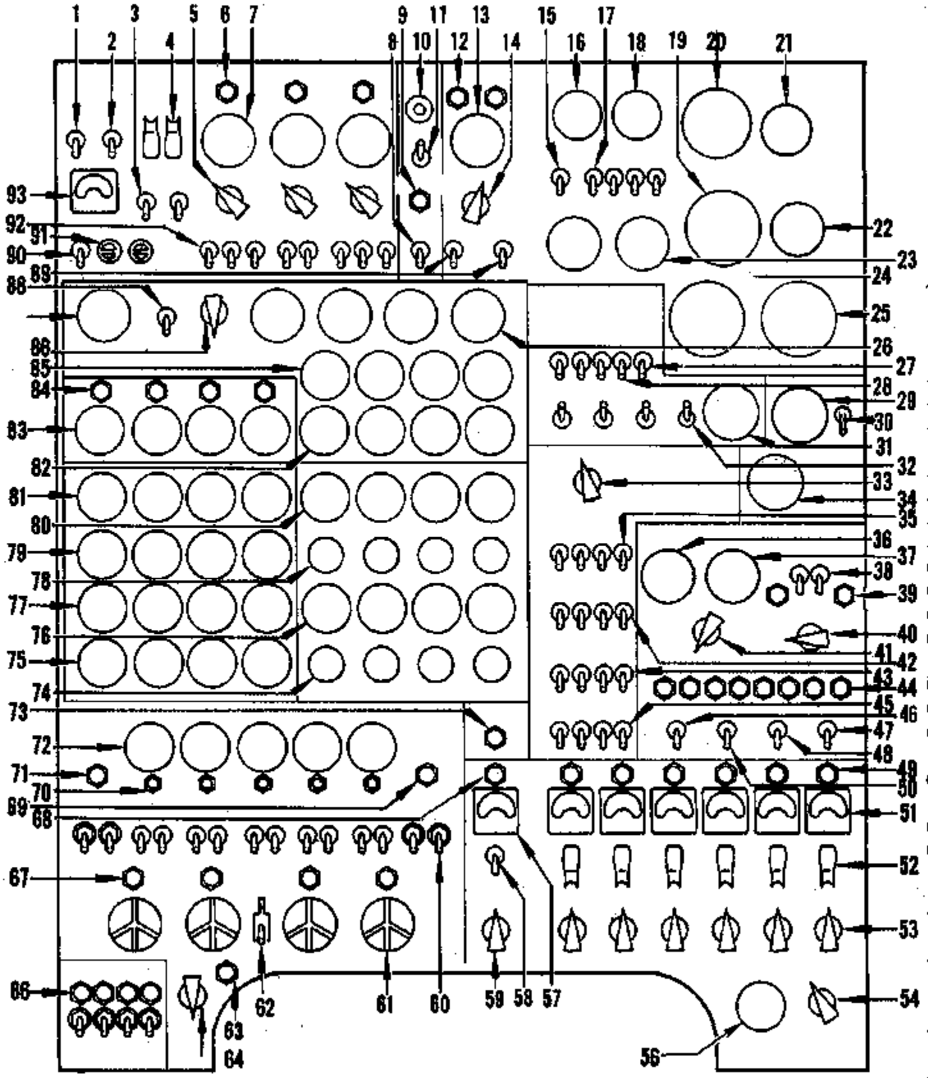
Manifold Pressure Gages and Purge Valve Buttons

Four manifold pressure gages (9, figure 1-9 and 79, figure 1-22) are on both the pilots' and engineer's instrument panel. The manifold pressure gages give a direct reading of manifold pressure in inches of Hg. Four manifold purge valve buttons (8, figure 1-9) on



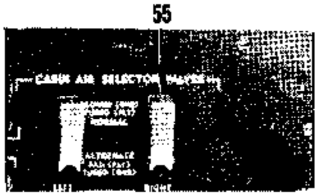
ENGINEER'S INSTRUMENT PANEL

Figure 1-22 (Sheet 1 of 3)

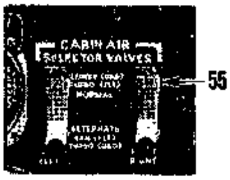


1 BALANCE BY-PASS SWITCH
2 MASTER ANTI-ICE SWITCHES
3 LIMITED ANTI-ICE SWITCHES
4 EMERGENCY ANTI-ICE SWITCHES
5 TEMPERATURE GAGE SELECTOR SWITCHES
6 ANTI-ICE OVERHEAT WARNING LIGHTS
7 ANTI-ICE HEATER AND DUCT TEMPERATURE GAGES
8 HEATER (AND APU) FUEL VALVE SWITCH
9 HEATER (AND APU) FUEL LOW PRESSURE WARNING LIGHT
10 HEATER OVERHEAT TEST SWITCH
11 HEATER OVERHEAT RESET SWITCH
12 BODY HEATER OVERHEAT WARNING LIGHTS
13 BODY HEATER TEMPERATURE GAGE
14 BODY HEATER TEMPERATURE SELECTOR SWITCH
15 AIR CONDITIONING MASTER SWITCH
16 MAIN CABIN TEMPERATURE GAGE
17 TURBO BLEEDER SWITCHES
18 CONTROL CABIN TEMPERATURE GAGE
19 CABIN VERTICAL VELOCITY INDICATOR
20 PRESSURE ALTIMETER **22737** ▶
21 AIRSPEED INDICATOR **3106** ▶
22 CABIN AIR PRESSURE INDICATOR (CABIN ALTIMETER)
23 CABIN AIR FLOW INDICATORS
24 CABIN PRESSURE RATE-OF-CHANGE SELECTOR
25 CABIN ALTITUDE SELECTOR
26 ENGINE OIL TANK QUANTITY GAGES
27 OIL DILUTION MASTER SWITCH
28 OIL DILUTION SELECTOR SWITCHES
T 29 A/R TANK DIFFERENTIAL PRESSURE GAGE **17260** ▶ **3195**
T 30 A/R TANK PURGE SWITCH **17260** ▶ **3195** ▶
31 CLOCK **22701** ▶
32 OIL COOLER FLAP SWITCHES
33 CYLINDER HEAD TEMPERATURE SELECTOR SWITCH
T 34 A/R HYDRAULIC OIL TEMPERATURE GAGE
35 COWL FLAP SWITCHES
36 AC VOLTMETER
37 FREQUENCY METER
38 ALTERNATOR SWITCHES
39 NESA BUS OFF WARNING LIGHTS
40 ALTERNATOR BUS SELECTOR SWITCH
41 AC VOLTAGE AND FREQUENCY SELECTOR SWITCH
42 CARBURETOR PREHEAT SWITCHES
43 INTERCOOLER FLAP SWITCHES
44 INVERTER WARNING LIGHTS
45 CARBURETOR AIR SWITCHES
46 ESSENTIAL INVERTER SWITCH
47 PILOTS' INSTRUMENT INVERTER SWITCH
48 AUTOPILOT INVERTER SWITCH
49 GENERATOR WARNING LIGHTS
50 SECONDARY INVERTER SWITCH
51 DC LOADMETERS
52 GENERATOR SWITCHES
53 GENERATOR VOLTAGE RHEOSTATS
54 DC VOLTMETER SELECTOR SWITCH
55 CABIN AIR SELECTOR SWITCHES (2 PLACES)
56 DC VOLTMETER
57 APU DC LOADMETER
58 APU GENERATOR SWITCH
59 APU GENERATOR RHEOSTAT
60 BOOST PUMP SWITCHES
61 FUEL SELECTOR SWITCHES
62 CENTER TANK LINE VALVE SWITCH
63 SINGLE POINT REFUELING SECONDARY VALVE CLOSED LIGHT
64 SINGLE POINT REFUELING TEST SWITCH
65 PROPELLER OIL REFILL SWITCHES
66 PROPELLER OIL QUANTITY WARNING LIGHTS
67 FUEL VALVE POSITION WARNING LIGHTS
68 APU GENERATOR WARNING LIGHT
69 RIGHT EXTERNAL TANK LOW FUEL FLOW WARNING LIGHT (TANK EMPTY WARNING LIGHT)
70 FUEL QUANTITY GAGE TEST SWITCHES
71 LEFT EXTERNAL TANK LOW FUEL FLOW WARNING LIGHT (TANK EMPTY WARNING LIGHT)
72 FUEL TANK QUANTITY GAGES
73 MASTER FIRE WARNING LIGHT
74 INTERCOOLER FLAP POSITION INDICATORS
75 FUEL FLOWMETERS
76 CARBURETOR AIR TEMPERATURE GAGES
77 TORQUEMETERS
78 COWL FLAP POSITION INDICATORS
79 MANIFOLD PRESSURE GAGES
80 CYLINDER HEAD TEMPERATURE GAGES
81 TACHOMETERS
82 OIL TEMPERATURE GAGES
83 FUEL PRESSURE GAGES
84 FUEL LOW PRESSURE WARNING LIGHTS
85 OIL PRESSURE GAGES
86 OIL TANK SELECTOR SWITCH
87 CENTRAL OIL TANK QUANTITY GAGE
88 OIL TRANSFER PUMP SWITCH
89 BODY HEATER SWITCHES
90 PROPELLER DEICING SWITCH
91 PROPELLER DEICING INDICATORS
92 ANTI-ICING COMBUSTION HEATER FUEL VALVE SWITCHES
93 PROPELLER DEICING SYSTEM LOADMETER
94 FUEL ENRICHMENT SWITCHES ◀ TCTO 595 ▶

Figure 1-22 (Sheet 2 of 3)



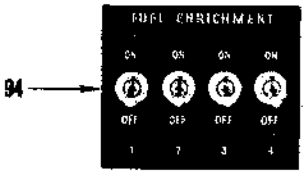
DETAIL I
17260 ▶ 22736



DETAIL II
22737 ▶ 22806

DETAIL III
17260 ▶ 2893

Detail IV
17260 ▶ 22664



DETAIL V
TCTO 595 ▶

DETAIL VI
TCTO 534 ▶

ENGINEER'S INSTRUMENT PANEL (CONT)

Figure 1-22 (Sheet 3 of 3)

the pilots' instrument panel provide a means of removing moisture from the manifold pressure gage lines. At idling speeds, a suction is developed and depressing the valve allows the moisture to be drawn into the engine.

Cylinder Head Temperature Gages

Four cylinder head temperature gages (80, figure 1-22) of the direct current type are on the engineer's instrument panel. The cylinder head temperature gages are resistance bulb type units and indicate cylinder head temperature in degrees Centigrade. There are two resistance bulbs on each engine, one is in cylinder B2 and the other in cylinder A2. The circuits are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

Cylinder Head Temperature Selector Switch

A selector switch (33, figure 1-22) on the engineer's instrument panel allows selection of the desired set of cylinders for cylinder head temperature indication. The selector switch has B2--A2 positions. With the selector switch in either position, each of the cylinder head temperature gages will, for its respective engine, indicate the temperature of the individual cylinder selected. The selector switch is a part of the cylinder head temperature gage circuit, and is protected by the engine instrument circuit breaker on the overhead circuit breaker panel.

Fuel Flowmeters

Each engine has a fuel flowmeter, located on the engineer's instrument panel (75, figure 1-22). The flowmeters show rate of fuel flow in hundreds of pounds per hour. The indicator circuits are supplied with 26 volt AC through the engine instrument fuses in the AC power panel (figure 1-34). The indicator circuits have separate circuit protection on the AC power panel on airplanes 3106 ▶ .

Fuel Pressure Gages

Four fuel pressure gages (83, figure 1-22) on the engineer's instrument panel indicate fuel pressure in psi for each engine. The indicator circuits are supplied with 26 volt AC through the engine instrument fuse on the AC power panel (figure 1-34).

Fuel Low Pressure Warning Lights

A fuel low pressure warning light (84, figure 1-22), adjacent to each fuel pressure gage, illuminates when fuel pressure is low. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

Oil Pressure Gages

Four oil pressure gages (85, figure 1-22) are on the engineer's instrument panel. The gages indicate engine oil pressure in psi. The indicator circuits are supplied with 26 volt AC through the engine instrument fuses on the AC power panel (figure 1-34).

Oil Temperature Gages

A resistance bulb type oil temperature gage for each engine (82, figure 1-22) is on the engineer's instrument panel. The gages indicate engine oil temperature in degrees Centigrade. The indicating circuits are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

PROPELLER SYSTEM

The airplane is equipped with Hamilton Standard, hydromatic propellers having four solid aluminum blades. This propeller has a non-rotating control unit, incorporating an independent oil system, mounted between the engine nose section and the propeller. Controls are provided to automatically snychronize engine speeds, reverse, or feather any or all propellers. Deicing is accomplished through a boot type electric heating element mounted along the leading edge of each blade. Current is transmitted from the airplane 28 volt DC circuit to the heating elements through the slip ring assembly attached to the propeller barrel. An oil replenishing system is provided to replace oil lost from the propeller independent oil system with engine nose section oil.

NOTE

> An external contactor control switch is incorporated in the number one blade of each propeller to terminate unfeathering and unreversing.

PROPELLER GOVERNOR SELECTOR SWITCHES

Four propeller DECREASE RPM--OFF--INCREASE RPM governor selector switches (26, figure 1-16), on the aft end of the control stand are used to manually control and synchronize the propeller speeds for each of the four engines. Normally, the automatic synchronizing system of propeller control is used, but in case of malfunction, operation of the selector switches will override the master lever and synchronizer operation. The selector switches are spring-loaded from the INCREASE RPM and DECREASE RPM positions to the OFF position. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

PROPELLER AUTO CONTROL SWITCH

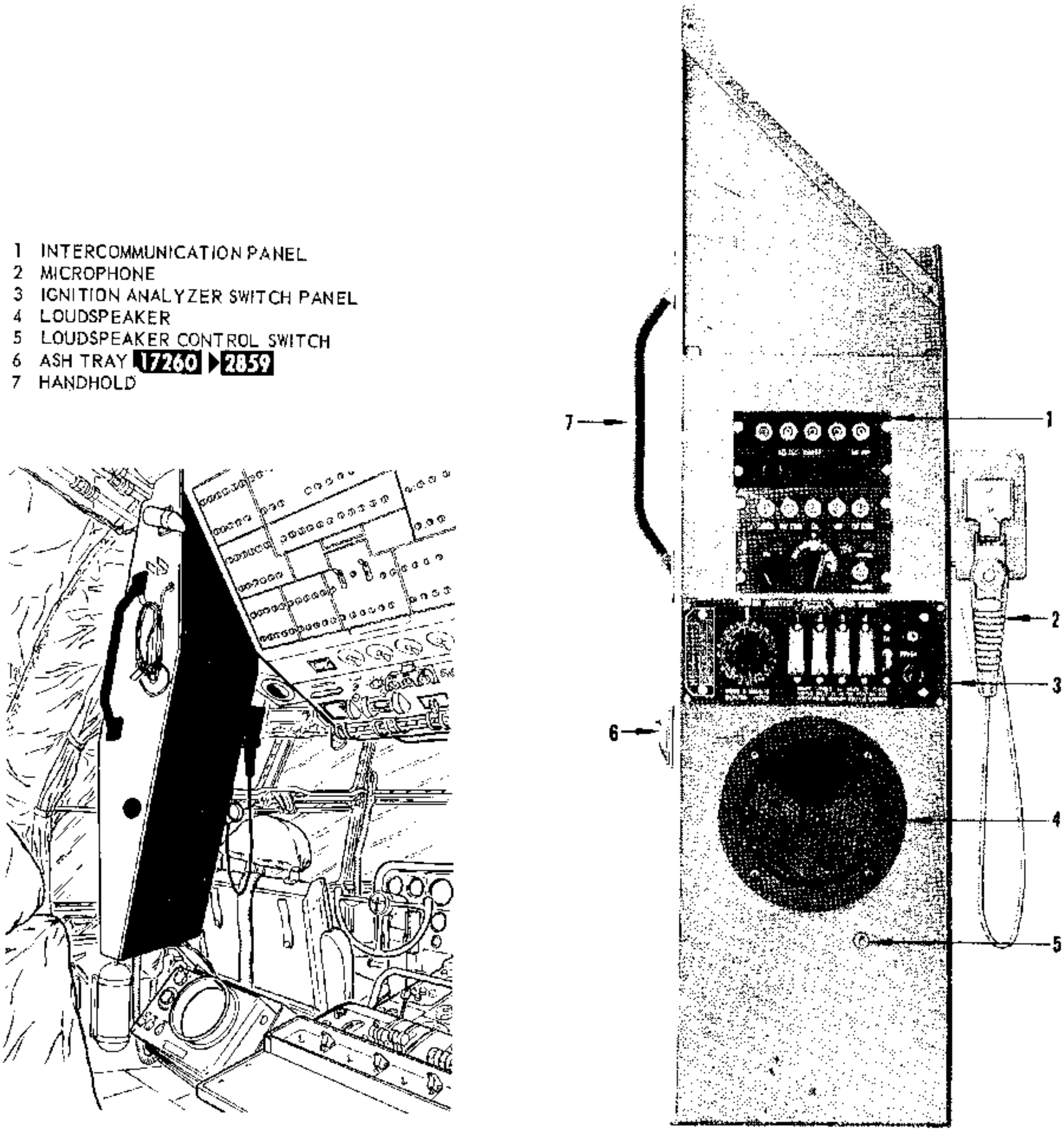
The automatic propeller synchronizing system is referred to No. 1 or No. 2 engine as the master engine by a NO. 1 MASTER--OFF--NO. 2 MASTER switch (24, figure 1-16) on the aft end of the control stand. This switch is used in the propeller synchronizing system to select either engine No. 1 or No. 2 as a master which the other engines follow. Once the master engine has been selected, the other engines act as slaves, synchronizing with the master engine. Alternate selection of a master engine is provided in case of a master engine failure. A safety feature in the synchronizing system limits the range of control the master engine has over the slave engines (plus or minus approximately 175 rpm from the master engine speed). In case of master engine malfunction, this feature prevents the propeller rpm of the slave engines from going either above or below the controlled range. The circuit is supplied with 28 volt DC through an ON--OFF, switch-type circuit breaker on the overhead panel (figure 1-34).

MASTER PROPELLER SYNCHRONIZER LEVER

Two levers (32, figure 1-16) on the control stand, one to the left of the pilots' throttles and the other to the left of the engineer's throttles, are used to operate all four propeller governors simultaneously when selecting desired engine rpm. The levers are interconnected so that movement of one lever throughout the range from DECREASE RPM position to INCREASE RPM position is duplicated by the other lever. Forward movement of the synchronizer levers causes an increase in rpm while aft movement causes a decrease in rpm. The levers are used in conjunction with automatic propeller synchronizing and are operative only when the propeller auto control switch (24, figure 1-16) is in the NO. 1 MASTER or NO. 2 MASTER position. When a propeller synchronizer lever is placed in the full INCREASE RPM position, the master synchronizer motor drives the four propeller governors to their maximum rpm limits. When these limits are reached by all four propellers, a holding relay cuts off all synchronizing action. Synchronizing action will remain off as long as the propeller synchronizer levers are in the full INCREASE RPM position. Thus failure of the master engine on takeoff will have no effect on the speed of the slave engines. Circuit breaker protection is provided by the circuit breaker switch provided for propeller auto control on the overhead circuit breaker panel (figure 1-34).

RESYNCHRONIZER SWITCH

A spring-loaded resync-off switch (25, figure 1-16) on the aft end of the control stand, is used to syn-



ENGINEER'S AUXILIARY PANEL

Figure 1-23

chronize the propellers after rpm selection has been made with the master propeller synchronizer levers. Because of normal tolerances in setting individual governor limits, the slave engines may not be in the synchronizing range (plus or minus 175 rpm from the master engine rpm). In this case the master propeller synchronizer levers will not set the speed of the propellers in proper synchronization, thus causing propeller noise beat. When using the resynchronizer switch, by pushing to RESYNC, holding, and releasing a few times, complete engine synchronization can be obtained. This switch is used immediately after any movement of the master propeller synchronizer levers except when they are in full INCREASE RPM or full DECREASE RPM position. Circuit breaker protection for the resynchronizer switch is the same circuit breaker as used for the auto control switch on the overhead circuit breaker panel (figure 1-34).

PROPELLER FEATHERING BUTTONS

Four guarded propeller feathering buttons (21, figure 1-12) are on the extreme forward end of the overhead panel. The buttons have PUSH FEATHER--PULL UNFEATHER, and neutral positions. The feathering operation is initiated when the feathering button is pushed. After a fixed time, 18 ±2 seconds, a spring action returns the button to the neutral position. The propeller is unfeathered by pulling the feathering button out intermittently for one second intervals until propeller starts windmilling. The unfeathering operation is accomplished as given in RESTARTING ENGINE IN FLIGHT in Section III. The circuit is supplied with 28 volt DC through four feathering circuit breakers and one timer circuit breaker on the overhead circuit breaker panel (figure 1-34). An additional propeller feathering switch for each engine is on the overhead fire panel. See FIRE SWITCHES this Section.

PROPELLER REVERSE THRUST CONTROL

The propeller reverse thrust is controlled by the throttles. See THROTTLES AND THROTTLE LOCK LEVER in this Section.

PROPELLER OIL REFILL SWITCHES

Four ON--OFF switches (65, figure 1-22) on the engineer's instrument panel are used to energize the propeller oil refilling circuit. Placing the switches ON allows engine oil to flow into the propeller oil tank provided the float switch in the propeller oil tank is approximately at the 2.5 or less quart level as indicated by a warning light. When the propeller oil quantity level reaches approximately 4 quarts, the supply of engine oil is automatically shut off by the float switch even though the switch is left in the ON position. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34), which protects both oil refill and warning light circuits.

RPM LIMIT LIGHTS

Four amber rpm limit lights (35, figure 1-9) on the pilots' instrument panel illuminate to show when the maximum or minimum rpm limit settings are reached. The circuit is supplied with 28 volt DC through an ON--OFF, switch-type circuit breaker on the overhead circuit breaker panel (figure 1-34).

PROPELLER OIL QUANTITY WARNING LIGHTS

Four red warning lights (66, figure 1-22) above the refill switches on the engineer's instrument panel are a part of the propeller oil refill circuit and illuminate whenever the float switch drops to approximately the 2.5 quart level regardless of refill switch position and go off when approximately 1.5 quarts have been added; The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34) which protects both warning light and emergency oil refill circuits.

PROPELLER REVERSE WARNING FLAG

A red LOCKED flag (4, figure 1-16) is provided in a housing on the control stand. When the airplane leaves the ground, and all three landing gear oleo switches are actuated, power will be supplied, after an 8 second time delay, to engage a reverse lock on the pilots' throttles, preventing throttle movement into the REVERSE OPEN range. When the lock is engaged, the red flag will pop up and expose the LOCKED marking on the flag, indicating that the propellers cannot be reversed. When any one of the landing gear oleo switches is actuated upon contact with the ground, power is supplied to release the reverse lock and permit throttle movement into the REVERSE OPEN range. When the lock is released, the red flag drops down and an UNLOCKED marking on the housing is exposed, indicating that the propellers can be reversed. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

NOTE

> If the reverse lock does not release automatically on the ground, it may be released manually by pushing down the red flag.

OIL SYSTEM

CENTRAL OIL SYSTEM

This system (figure 1-24) has a central tank in the lower nose compartment with a capacity of 56 US gallons and an expansion space of 2 US gallons. This supply is used to replenish each engine oil tank as needed. The oil is transferred by an electric pump which has a normal pumping capacity of 6 gallons per minute, and is directed to the desired engine tank by a transfer valve. The circuit is supplied with 28 volt DC through a circuit breaker on the forward power panel.

Oil Tank Selector Switch

A rotary switch (86, figure 1-22) on the engineer's instrument panel controls a tank selector valve. The switch has ENG. 1--ENG. 2--OFF--ENG. 3--ENG. 4--OFF positions. When this switch is positioned in any one of the four engine positions oil from the central oil tank will be directed to the desired engine tank. When the switch is positioned to OFF the valve is closed. In case of an electrical selector valve failure, the selector valve can be operated manually by removing four screws, pulling the electrical unit slightly forward and turning it to the desired tank as indicated by an index on the selector valve. The valve is on the forward wing spar, accessible from the lower forward compartment. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

Oil Transfer Pump Switch

An ON--OFF switch (86, figure 1-22). Spring-loaded from the ON position to the OFF position, and adjacent to the tank selector switch on the engineer's instrument panel, is used to turn on or off the central oil tank transfer pump. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

NOTE

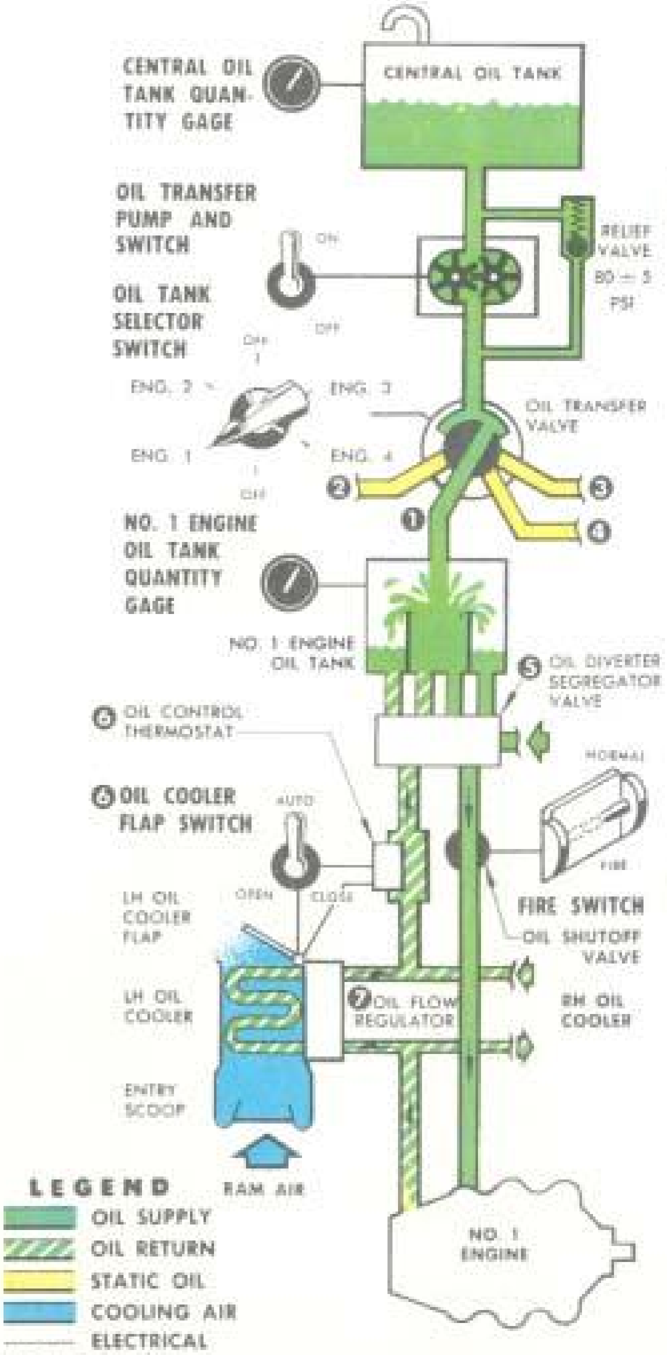
The oil tank selector switch must be in an engine selected position before the transfer pump may be energized.

ENGINE OIL SYSTEM

Each engine has an individual oil system which includes an engine oil tank, two oil coolers, and an oil control thermostat. The engine oil tank has a capacity of 32.5 US gallons and an expansion space of 7 US gallons. Oil cooler flaps switches when in the AUTO position, cause the thermostat to automatically regulate oil temperature by operating the oil cooler flaps to allow the proper amount of cooling air to flow through the oil coolers. An oil dilution system is incorporated into the oil system to aid in cold weather starting.

Oil Diverter Segregator System

The airplane is provided with an oil diverter segregator system which reduces engine warm-up time. This system employs a thermal and pressure operated valve at the base of each engine oil tank. The diverter segregator valve allows oil to flow from and return to the hopper only when the oil temperature is low. Above 125°F (52°C) the valve permits oil to flow from both the hopper and the engine tank. At 155°F (68°C) to 165°F (74°C), oil will flow from the engine oil tank and from the hopper at a ratio of 75 percent and 25 percent respectively. Fuel for dilution is introduced at the thermal valve to obtain a high dilution percentage in the circulatory system. The tank hopper is independent of the engine oil tank except for spill-over at the top of the hopper. A pull chain valve is used to equalize



NOTES
① To No. 1 Engine Oil Tank
② To No. 2 Engine Oil Tank
③ To No. 3 Engine Oil Tank
④ To No. 4 Engine Oil Tank
⑤ Thermostatically controls oil flow to engine oil tank and tank hopper
⑥ Controls RH and LH oil cooler flap
⑦ Allows the oil to by-pass the cooler according to oil pressure and temperature

NO. 1 ENGINE OIL SUPPLY SYSTEM (TYPICAL)
FILLING NO. 1 ENGINE OIL TANK

OIL SUPPLY SYSTEM

Figure 1-24

hopper and tank levels during servicing. See OIL SYSTEM OPERATION, Section VII and oil dilution procedures under SHUT-DOWN under COLD WEATHER PROCEDURES in Section IX.

Oil Cooler Flap Switches

The oil cooler flaps for each engine are operated by OPEN--OFF--AUTO--CLOSE switches (32, figure 1-22) on the engineer's instrument panel. The switches are spring-loaded from the OPEN and CLOSE positions to the OFF position. When a switch is in the AUTO position, the oil coolers automatically maintain oil temperature within the normal operating range. If extreme operating conditions exist or failure of the automatic circuit causes abnormal oil temperatures the oil cooler flaps can be operated by the manual OPEN or CLOSE positions. The flaps are held in any desired position by positioning the switch to OFF. Approximately 15 seconds are required to fully open or close the oil cooler flaps when the manual switch positions are used. The circuits are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

Oil Dilution Switches

One master OFF--ON (spring-loaded OFF) switch and four engine selector OFF--ON switches (27 and 28, figure 1-22) on the engineer's instrument panel energize the oil dilution solenoids, allowing fuel to mix with engine oil before the oil enters the engine. The four engine selector switches select the engines to be diluted. Dilution is then accomplished by use of the master dilution switch. The circuits are supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

Oil Shutoff Valve

A shutoff valve is provided between each engine and engine oil tank. These valves, when closed, will shut off all oil supplied to the engines. The valves are controlled by four fire switches on the overhead panel. See FIRE SWITCHES in this Section.

Oil Quantity Gage

Oil quantity gages (26 and 87, figure 1-22) for each engine oil tank and central oil tank, on the engineer's instrument panel, indicate oil quantity in US gallons. The circuits are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

OIL SPECIFICATION AND GRADE

Refer to figure 1-47 for oil specification and grade.

FUEL SYSTEM

The airplane fuel system (figure 1-26) has four internal main fuel tanks, a center wing tank, and two external fuel tanks. The fuel system is arranged so that the engines may be supplied with fuel either directly from the internal main fuel tanks or from the airplane main fuel manifold. The airplane main fuel manifold can be supplied with fuel from any combination of tanks. The center wing tank and the external fuel tanks may be used with either the airplane main fuel manifold or, on Code ▼ airplanes, the A/R system. The external fuel tanks can be shutoff from the airplane main fuel manifold separately or all auxiliary tanks may be isolated together by positioning of two manual shutoff valves located aft of the rear wing spar in the lower aft compartment. Two submerged fuel boost pumps are provided in each tank. The boost pumps are installed in such a manner that the amount of unavailable fuel in extreme flight attitudes is minimized. The boost pumps are controlled by switches on the engineer's instrument panel. Check valves in the boost pump lines prevent transfer of fuel between tanks. See figure 1-25 for individual fuel tank capacity. The external fuel tanks are attached to underslung struts by bomb rack assemblies. A single switch (27, figure 1-12) on the overhead panel controls the tank release circuit.

SINGLE POINT REFUELING

Two single point refueling receptacles, (5 and 6, figure 4-81) located aft and below the left wing rear spar, are used to refuel all fuel tanks except the external fuel tanks. The airplane main fuel tanks are refueled through the forward receptacle, and on tanker airplanes the A/R tank system are refueled through the aft receptacle. See SINGLE POINT REFUELING, Section IV.

AIR REFUELING ▼

When in the tanker configuration, this airplane is equipped to transfer fuel in flight to receiver type airplanes by means of the A/R system. Fuel for this purpose is carried in fifteen fuselage tanks which are connected to form a forward tank system and an aft tank system. (See 27, figure 1-4 and figure 4-71.) Fuel for air refueling may also be carried in the external fuel tanks and the center wing tank. Additional fuel may be pumped from the main fuel tanks to the A/R system. See AIR REFUELING SYSTEM, Section IV and FUEL SYSTEM OPERATION, Section VII.

TANK	NO. OF TANKS	USABLE FUEL			FULLY SERVICED		
		GAL.	JP-4 LB	GAS LB	GAL.	JP-4 LB	GAS LB
NO. 1	1	1770		10,620	1778.7		10,672.2
NO. 2	1	1520		9120	1533.9		9203.4
NO. 3	1	1520		9120	1533.9		9203.4
NO. 4	1	1770		10,620	1778.7		10,672.2
CENTER	1	1210	7865	7260	1218.1	7917.6	7308.6
RH EXT.	1	*691*	*4491*	*4146*	*699.0*	*4543.5*	*4194.0*
LH EXT.	1	*691*	*4491*	*4146*	*699.0*	*4543.5*	*4194.0*
FWD A/R TANK SYSTEM	7	2898	18,837	17,388	2938.0	19,097.0	17,712.0
AFT A/R TANK SYSTEM	8	2912	18,928	17,472	2952.0	19,188.0	17,712.0

ITALIC FIGURES INDICATE CALCULATED DATA

NOTE:

The weights are based on a given specific gravity at standard day temperature.

USABLE FUEL TOTALS

	GAL	JP-4 LB	GAS LB
Tanks No. 1, 2, 3, and 4	6580		39,480
Tanks No. 1, 2, 3, 4, and Center	7790		46,740
Tanks No. 1, 2, 3, 4, Center and External	*9172*		*55,032*
Tanks FWD and AFT A/R	5810	37,765	34,860
Tanks FWD and AFT A/R, Center and External.	*8402*	*54,613*	*50,412*

FUEL QUANTITY DATA

Figure 1-25

FUEL SPECIFICATION AND GRADE

Refer to figure 1-47 for fuel specification and grade.

FUEL SYSTEM THERMAL RELIEF

The check valves for the main and center wing fuel tanks have bleed holes to provide thermal relief. There are three thermal relief valves having a cracking pressure of 50 ± 5 psi as follows: One relieves the airplane main manifold to No. 2 main fuel tank. One relieves the line between the center wing tank line valve and the manual fuel-shutoff valves to the center wing tank. Another on airplanes 17260▶22664 relieves the line between the manual fuel-shutoff valves and the transfer valves to the aft A/R tank system; or on airplanes 22665▶ this valve relieves the line between the manual fuel-shutoff valves and the external tank manifold shutoff valve to the atmosphere.

FUEL VAPOR RETURN LINES

The fuel vapors from carburetors on engines No. 1 and No. 2 are vented back to main tank No. 2 and the vapors from carburetors on engines No. 3 and No. 4 are vented back to tank No. 3. Normally the rate of return flow is negligible.

FUEL SELECTOR SWITCHES

Four rotary type selector switches (61, figure 1-22) and figure 7-9) on the engineer's instrument panel control the fuel selector valves for the four main fuel tanks. The switches have six positions which permit five combinations as follows:

1. TANK TO ENGINE
2. MANIFOLD TO ENGINE
3. TANK TO MANIFOLD AND ENGINE which also permits fuel flow from TANK AND MANIFOLD TO ENGINE.
4. Two TANK TO MANIFOLD positions
5. OFF

Two shutoff switches for each engine are on the overhead panel. These switches override normal control of fuel selector valves to shut off fuel to the engines. See FIRE SWITCHES in this Section. The selector switches are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

FUEL VALVE POSITION WARNING LIGHTS

Four fuel valve position warning lights (67, figure 1-22), adjacent to the fuel selector switches, illuminate if the valve is not synchronized with the switches. This can be caused by system lag, selector valve failure, or fire switch actuation. The lights are of the push-to-test type. The selector switch and warning light circuits are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

FUEL SYSTEM MANUAL FUEL-SHUTOFF VALVES

Two manual fuel-shutoff valves, No. 1 and No. 2, (figure 1-26) are provided in the fuel system to direct the flow of fuel from the auxiliary tanks to either the airplane main fuel manifold or the A/R system, for Code T airplanes. These valves are located just aft of the rear spar in the lower aft compartment. With the No. 1 valve open and the No. 2 valve closed, the external fuel tanks are shut off from the airplane main fuel manifold. When the center wing tank line valve is opened, fuel will be directed from the center wing tank to the main fuel manifold. With both manual fuel-shutoff valves open, and the A/R transfer valve switches at CLOSED, fuel from the external fuel tanks is directed to the airplane main fuel manifold. Fuel from the center wing tank is also directed to the main fuel manifold when the center wing tank line valve is open. With the No. 1 manual fuel-shutoff valve closed, both external fuel tanks and the center wing tank are shut off from the airplane main fuel manifold. On airplanes with 1C10 KGT507 incorporated, an additional manual fuel-shutoff valve, No. 3 extends the cruising range of the airplane. For location and operation of the No. 3 manual fuel-shutoff valve, refer to Section IV and Section VII.

CENTER WING TANK LINE VALVE SWITCH

An OPEN--CLOSE switch on the engineer's instrument panel (62, figure 1-22 and figure 7-9) controls the center wing tank valve. With the switch OPEN, the No. 1 manual fuel-shutoff valve open, and the No. 2 manual fuel-shutoff valve closed, fuel will flow from the tank into the manifold system. On Code T airplanes if the valve positions are reversed, fuel will flow into the A/R tanks provided the transfer valves are open. With the switch in the CLOSE position fuel cannot be drawn from the center wing tank. The circuit is supplied with 28 volt DC through the center wing tank boost pump circuit breaker on the overhead circuit breaker panel (figure 1-34).

WARNING

> Incorrect positioning of the manual fuel-shutoff valves and on Code T airplanes, the A/R transfer valves, may allow fuel to be transferred to the A/R system. See FUEL SYSTEM OPERATION in Section VII.

BOOST PUMP SWITCHES

Each fuel tank has two fuel boost pumps. These pumps are controlled individually by EMERGENCY--OFF--NORMAL switches (60, figure 1-22 and figure 7-9) on the engineer's instrument panel. When the boost pump switches are on NORMAL with a no-flow condition (engine inoperative), fuel pressure will be 12 to 20 psi. When the boost pump switches are on EMERGENCY with a no-flow condition, fuel pressure will be 24 to 40 psi. When the boost pump switches are on NORMAL with a flow condition (engine operating), fuel pressure will be 24 to 26 psi. When the boost pump switches are on EMERGENCY with a flow condition, fuel pressure will be 24 to 30 psi. When the boost pump switches are OFF, the boost pumps are inoperative. The fuel pressure regulator on the engine driven fuel pump regulates fuel pressure between 24 and 26 psi. However, fuel pressure gage calibration should be applied when checking these tolerances. With the engine operating, and with fuel pressure within limits, it is possible to have a drop in pressure when the boost pump switches are placed in NORMAL. The sudden surge in fuel pressure can cause the bypass valve to seek a new position. This new position can increase the amount of fuel being bypassed and this in turn can result in a drop in fuel pressure. The boost pump switches are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel, (figure 1-34).

EXTERNAL FUEL TANK RELEASE SWITCH

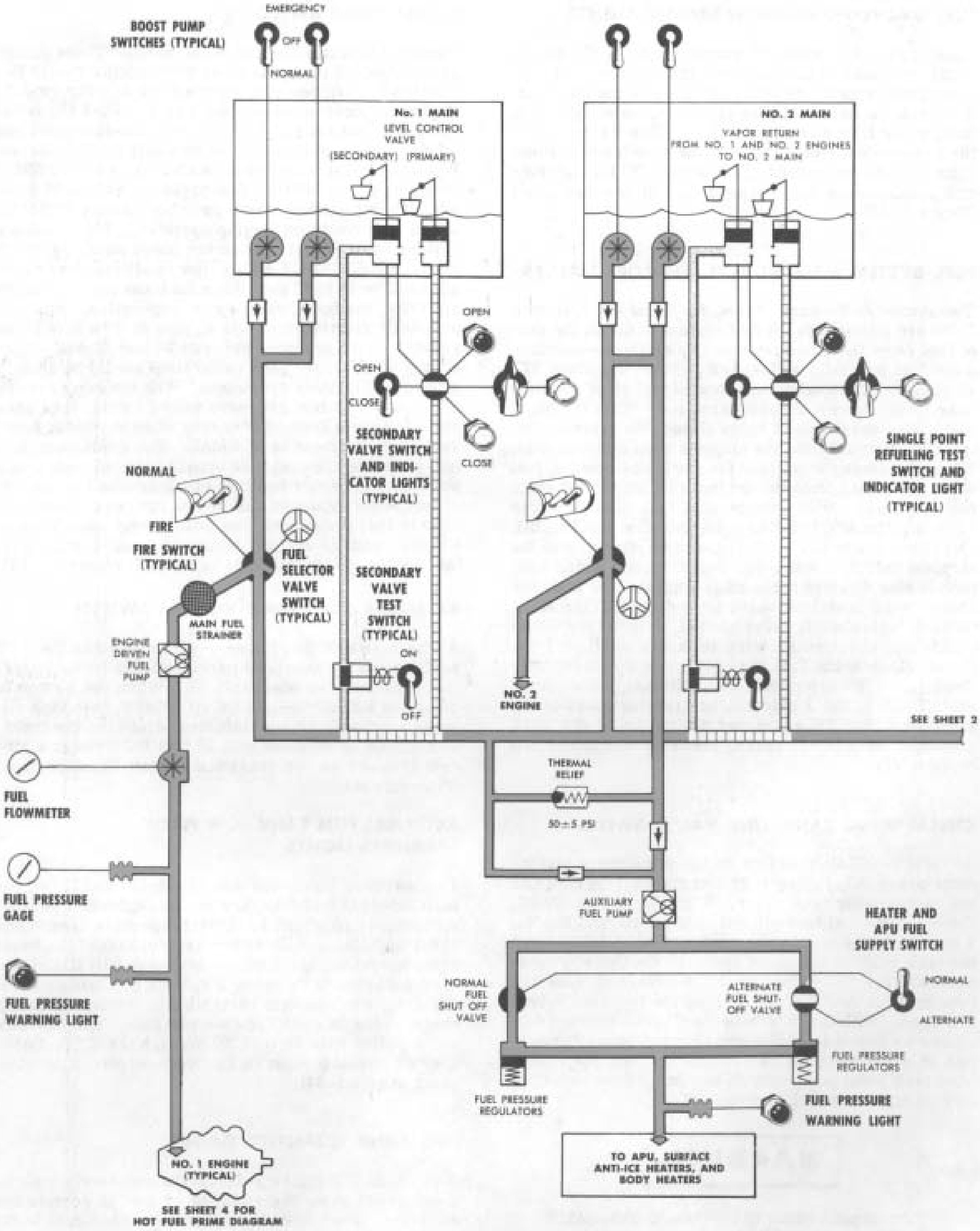
A single switch (27, figure 1-12) guarded to the OFF position, on the overhead panel controls both external fuel tank release mechanisms. When the switch is moved to EXTERNAL TANK RELEASE, both tank release mechanisms are actuated, dropping the tanks. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

EXTERNAL FUEL TANK LOW FLOW WARNING LIGHTS

Two warning lights (69 and 71, figure 1-22) one for each external fuel tank, are on the engineer's instrument panel adjacent to their respective tank boost pump switches. With either external fuel tank boost pump operating, the light for that tank will illuminate when fuel flow falls below 6 gallons per minute from the tank. Each light is controlled by a flow indicating check valve in each tank supply line. The circuits are supplied with 28 volt DC through the EXT. TANK EMPTY circuit breaker on the overhead circuit breaker panel (figure 1-34).

FUEL TANK QUANTITY GAGES

Five gages (72, figure 1-22) on the engineer's instrument panel show the quantity of fuel in pounds for each tank. Push-button test switches (70, figure 1-22) adjacent to the gage are used to show circuit continuity of the fuel quantity indicating circuits. The circuits are supplied with 115 volt AC through circuit protection on the AC power panel (figure 1-34).



AIRPLANE FUEL DISTRIBUTION SYSTEM

Figure 1-26 (Sheet 1 of 4)

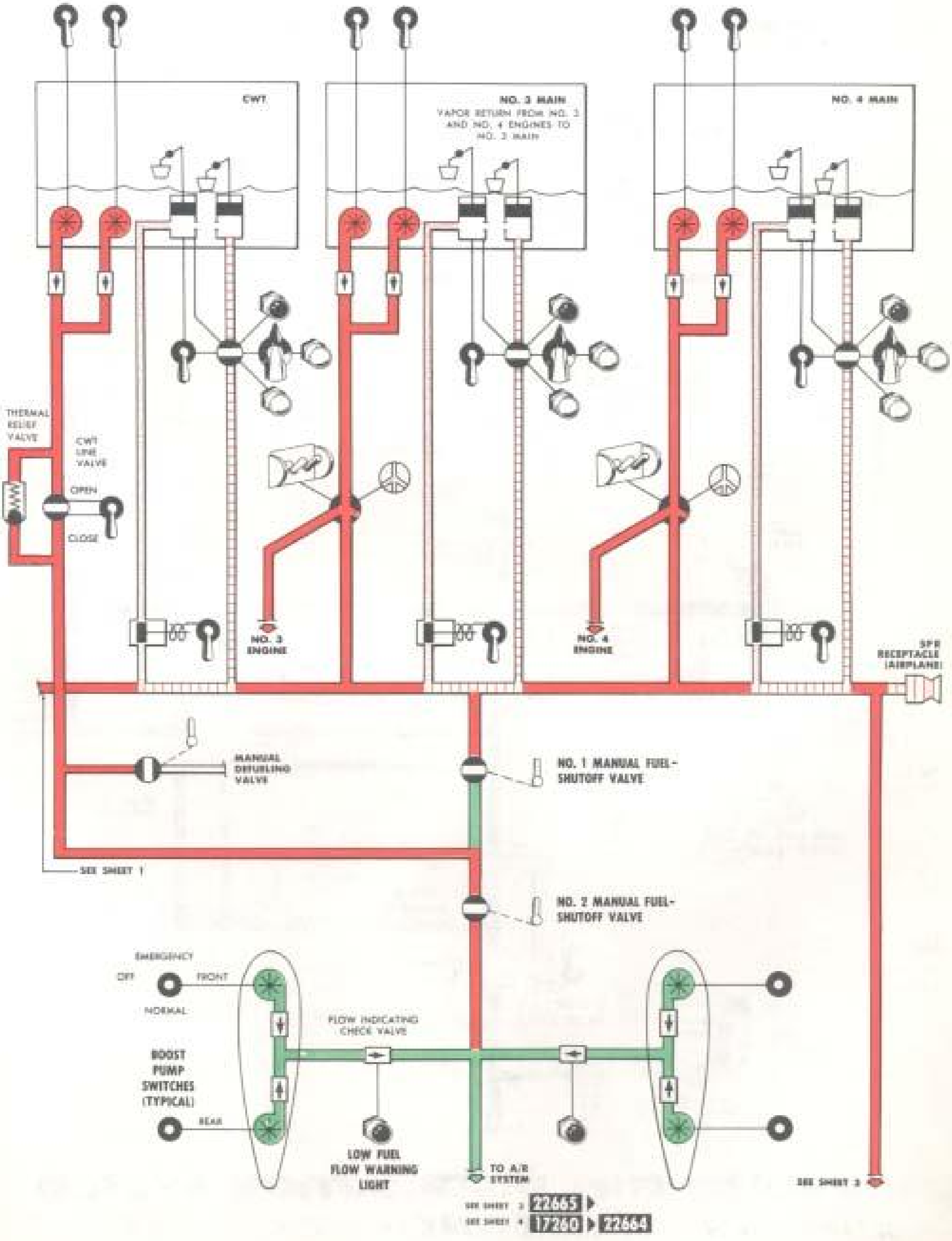
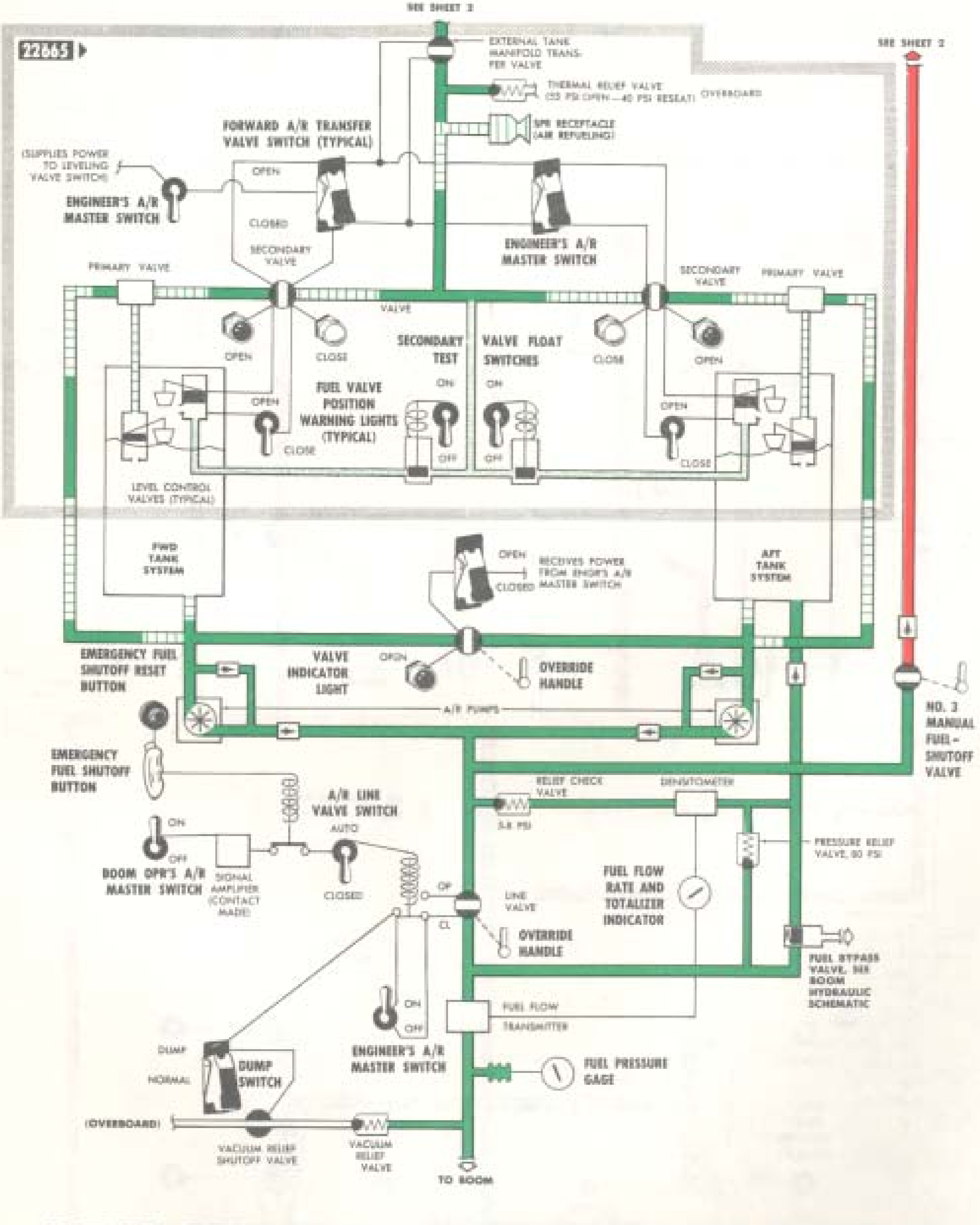
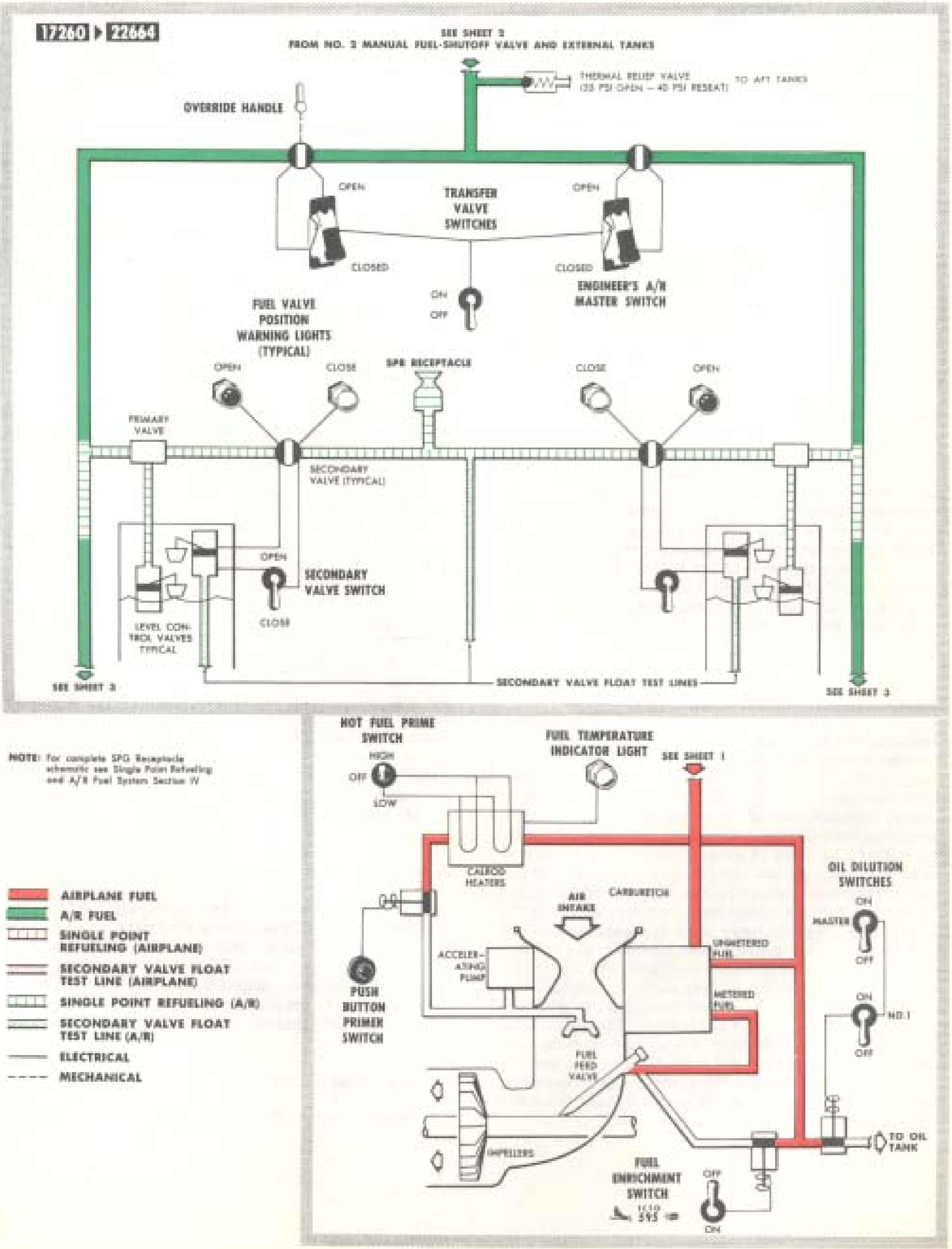


Figure 1-26 (Sheet 2 of 4)



AIRPLANE FUEL DISTRIBUTION SYSTEM (CONT)

Figure 1-26 (Sheet 3 of 4)



NOTE: For complete SPG Receptacle schematic see Single Point Refueling and A/R Fuel System Section IV

Figure 1-26 (Sheet 4 of 4)

ELECTRICAL SYSTEM

The electrical systems are the DC power system, AC power system, and variable frequency AC system. These systems are described in the following paragraphs.

DC POWER SYSTEM

Twenty-eight volt DC power is supplied to the DC distribution system by six engine-driven generators and by an auxiliary power unit. (See Section IV for description and operating instructions for the auxiliary power unit.) Parallel operation on the DC system is accomplished by an equalizing circuit. This circuit is common to all generators operating in parallel and is designed to cause all generators to take an equivalent share of the load. If an unbalance occurs such that one generator has high voltage with respect to the other generators, a current flow will result in the equalizer circuit to cause the generator with high voltage to be lowered and the generator with low voltage to be raised. A battery in the lower forward compartment is provided as an emergency source of direct current power. An external power supply may be connected to the direct-current distribution system through an external power receptacle. Circuit breakers and fuses (figure 1-33) provide circuit protection for all direct-current operated equipment. See figure 7-13 for listing of major direct current operated equipment loads. See figures 1-27 and 1-28 for schematic diagrams of DC power generation and distribution.

Battery

Airplanes not incorporating TCTO 551 have a 24-volt 34 ampere-hour lead-acid battery. Airplanes incorporating TCTO 551 have a 24-volt, 36 ampere-hour nickel-cadmium battery. The battery is in the lower forward compartment of the airplane. Use of battery current is controlled by a switch on the overhead panel. The battery is used in emergencies as a source of power for the flight instrument spare inverter and for the turn-and-slip indicator. See figure 1-28 for a list of other equipment which may be operated from the battery bus. The battery may be connected to the airplane bus on the ground only, however, the battery is connected to the emergency (battery) bus at all times regardless of the battery switch position. The nickel-cadmium battery differs from a lead-acid battery in both principle and operation. The electrolyte in a nickel-cadmium battery is a potassium hydroxide solution. During charging and discharging the specific gravity of the electrolyte does not change, therefore specific gravity measurements cannot be used to determine the state of charge of the battery.

Generators

Each of the six 28 volt, 300 ampere, engine-driven generators is connected to the main power panel through a current limiter. The current limiter protects the bus against a generator or reverse current relay failure. The voltage is regulated automatically by carbon-pile type regulators. Each generator has an overvoltage control unit which will disconnect the generator from the direct-current distribution system in the event of high generator voltage. Two generators are mounted on the accessory section of each outboard engine and one generator is mounted on the accessory section of each inboard engine. The generators normally supply all of the power required for operation of direct-current operated equipment in the airplane, and also supply direct-current power to the inverters.

DC External Power Receptacle

An external power receptacle (17, figure 1-47) for DC power is on the bottom of the fuselage near the forward entry door.

Auxiliary Power Unit

See Section IV for description of the auxiliary power unit and controls.

DC Outlets

There are five 28 volt DC outlets in the airplane located as follows: The first is on the pilot's auxiliary panel; the second is on the aft side of the copilot's auxiliary panel; the third is on the forward side of the control cabin bulkhead, adjacent to the navigator's table; the fourth is adjacent to and aft of the left rear escape hatch; and the fifth is directly across the fuselage on the right side from the fourth. These outlets are used for the interairplane signal lamps.

Airplane Master Switch

The airplane master switch (41, figure 1-12) on the overhead panel completes the control circuit for the battery and generators. This ON--OFF switch must be ON to supply power to the DC power distribution system. If the master switch is off, the circuits to the field coils of the generators are broken and there is no output from the generators.

Battery Switch

The battery switch (2, figure 1-12) is adjacent to the master switch on the overhead panel and has three positions; ON BUS--OFF--BAT CHG. The battery is isolated from the DC power distribution system when the switch is in the OFF position. To preclude the possibility of damage to the battery, the battery switch should be in the OFF position when the airplane is on the ground with the external power connected. When the airplane is on the ground and the battery switch is positioned to ON BUS, the battery is connected to the DC power distribution system. A landing gear actuated oleo switch, opens when the airplane leaves the ground and de-energizes the reverse current relay making it impossible to connect the battery to the DC power distribution system during flight while the battery switch is ON BUS or OFF. When the battery switch is placed in the BAT CHG. position and the master switch is on, the reverse current relay will close to permit charging of the battery when battery voltage is sufficiently less than bus voltage; however the relay is energized by battery power and will not close if the battery voltage is below approximately 18 volts. If the current flow is reversed (battery to bus), the reverse current relay will open to prevent discharging the battery. The battery switch and control circuit is protected by a circuit breaker on the forward power panel, emergency bus (figure 1-34).

Generator Switches

Six individual generator switches (52, figure 1-22) control the engine driven generators. These switches have ON--OFF--FIELD RESET positions and are guarded to the ON position. When a switch is in the ON position the generator delivers power to the DC power distribution system if generator voltage is sufficiently high, but not so high to trip the over-voltage relay, and the master switch is ON. In the OFF position, the generator is disconnected from the distribution system. The FIELD RESET position is used to reset the generator field relay and restore generator operation after the field relay has been tripped by generator overvoltage. The generator control switches are spring-loaded to the OFF position from the FIELD RESET position. The generator field relay control circuits are protected by two circuit breakers on the overhead circuit breaker panel (figure 1-34). Each generator control circuit and each generator field is protected by a circuit breaker on the main circuit breaker panel (figure 1-34).

Generator Voltage Rheostats

Generator voltage rheostats, (53, figure 1-22) one for each generator, are behind a hinged cover on the engineer's instrument panel. The rheostats are to be used in conjunction with the loadmeters and voltmeters for adjusting generator output voltage to equalize generator load distribution.

DC Voltmeter Selector Switch and Voltmeter

A rotary-type switch (54, figure 1-22) and a single direct-current voltmeter (56, figure 1-22) on the engineer's instrument panel provide a means of reading individual generator or direct current bus voltage, as selected by the DC voltmeter selector switch. The switch positions are marked OFF--GEN 1 OUTBD--GEN 1 INBD--GEN 2--BUS--GEN 3--GEN 4 INBD--GEN 4 OUTBD--APU--BATTERY. In the OFF position the switch disconnects the voltmeter from any power source. The output voltage of any of the generators or the battery is determined by rotating the switch to the appropriate position and reading the voltmeter. When the switch is in the BUS position, the voltmeter is connected to the main power panel distribution bus. Each of the circuits from the power sources to the voltmeter selector switch, except the circuit from the auxiliary power unit generator, is protected by a circuit breaker on the main circuit breaker panel (figure 1-34).

Generator Warning Lights

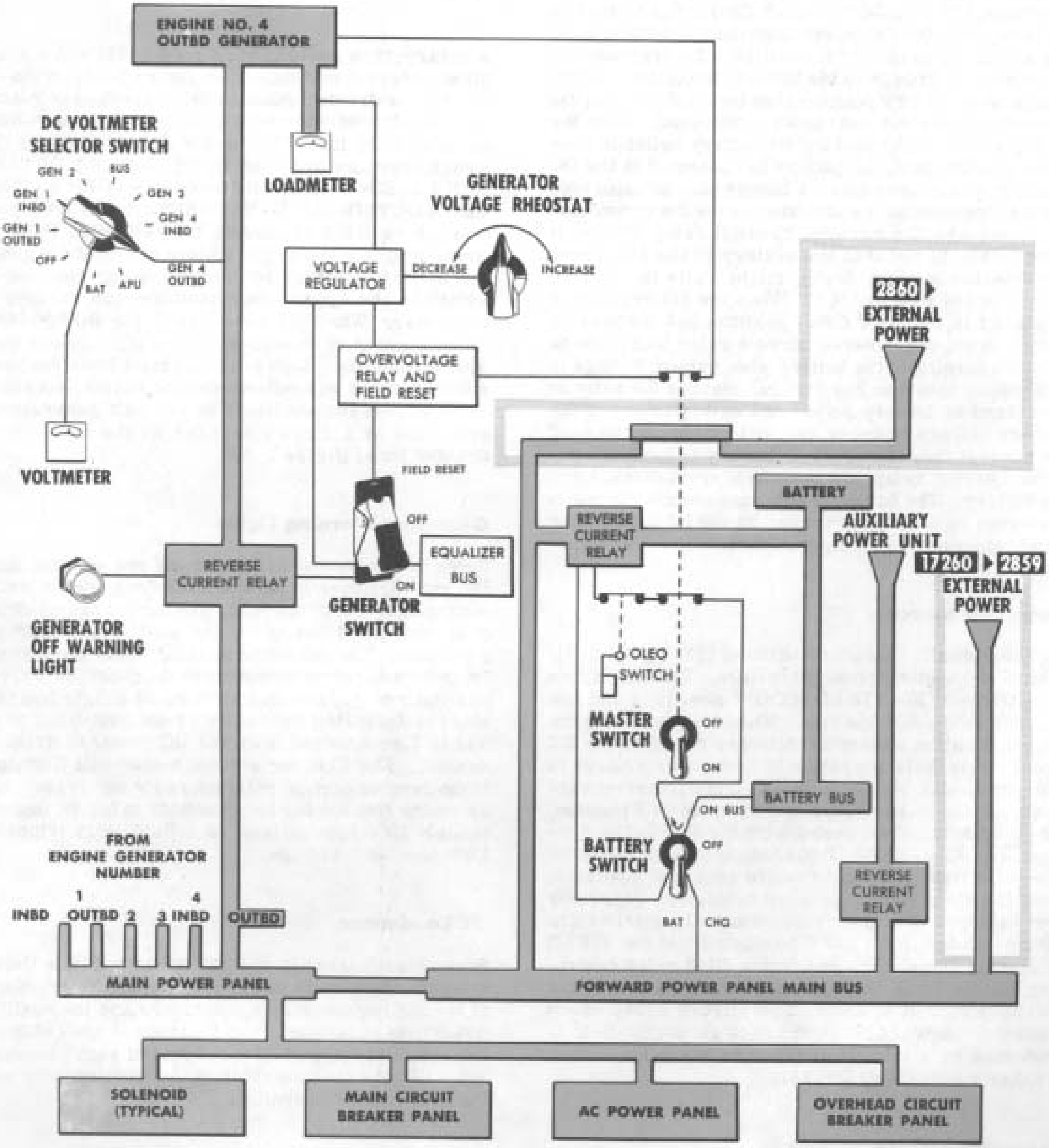
Seven press-to-test generator-off red warning lights (49 and 68, figure 1-22) are on the engineer's instrument panel. Six of the lights are for the engine-driven generators and one is for the auxiliary power unit generator. The generator warning lights are operated by individual relays connected to the generator reverse current relays, and illumination of a light indicates that the indicated generator is not supplying power and is disconnected from the DC power distribution system. The light for any generator will illuminate if the reverse current relay opens for any reason, such as engine rpm too low for generator to cut in, (approximately 1000 rpm or less) or a field relay tripped by high generator voltage.

DC Loadmeter

Seven loadmeters (51 and 57, figure 1-22) on the engineer's instrument panel indicate the output of each of the six engine-drivengenerators and the auxiliary power unit generator. The loadmeters are calibrated in percent of the normal rated load of each generator, and will indicate generator output continuously when the generator is operating.

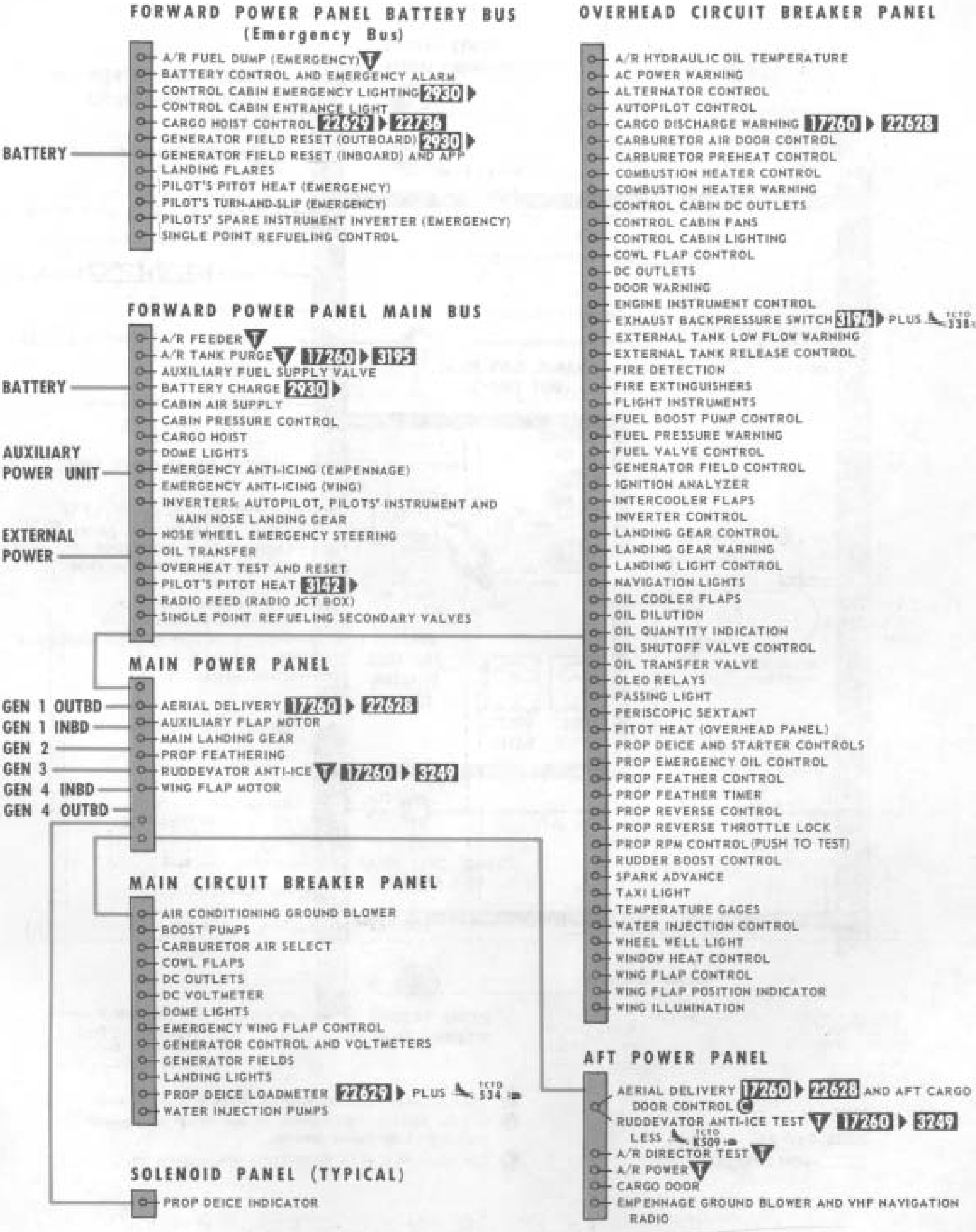
AC POWER SYSTEM

The AC power system consists of three separate groups of inverters; the main inverter system, autopilot inverter system, and pilots' instrument inverter system.



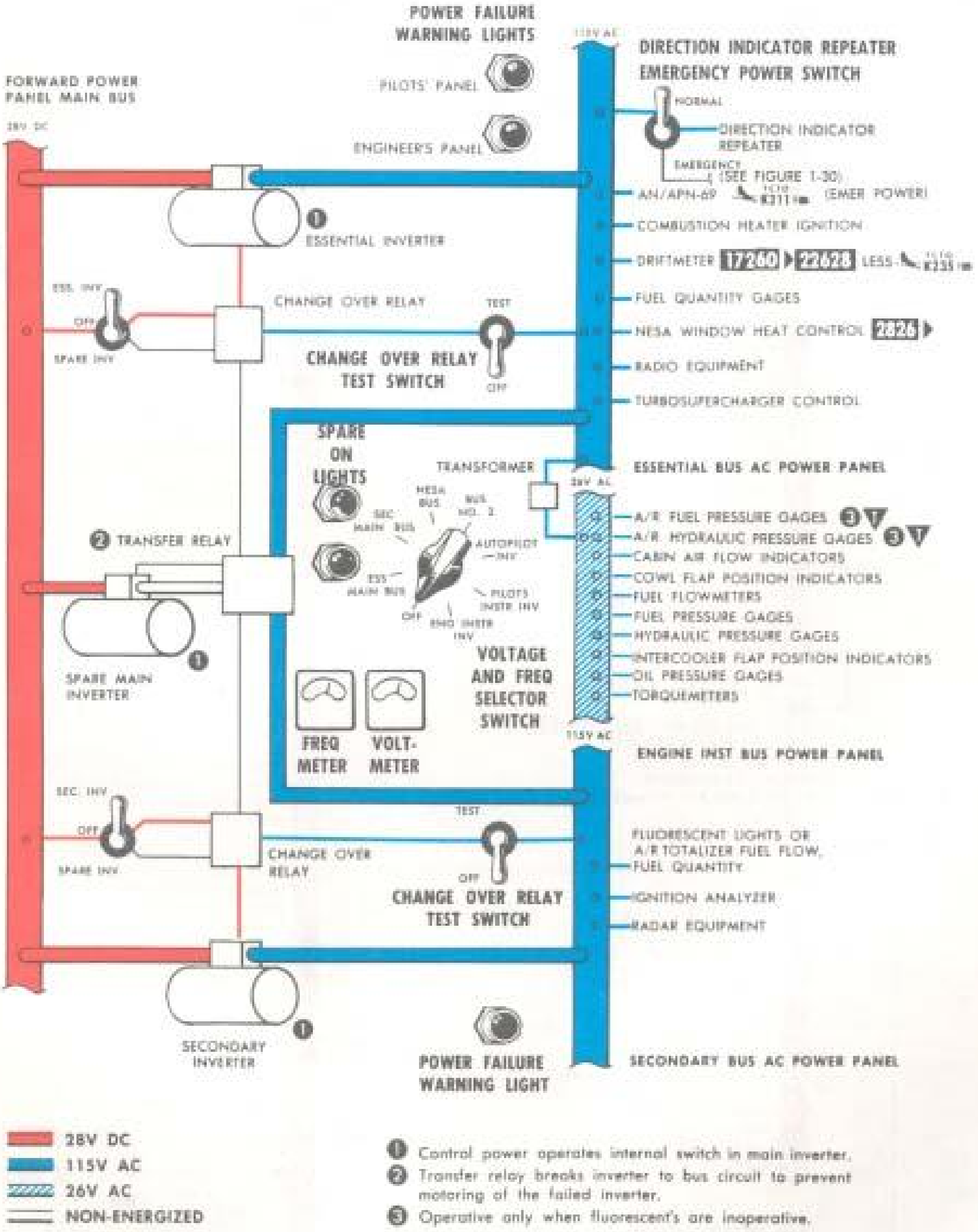
DC POWER GENERATION

Figure 1-27



DC POWER DISTRIBUTION

Figure 1-28



① Control power operates internal switch in main inverter.

② Transfer relay breaks inverter to bus circuit to prevent motoring of the failed inverter.

③ Operative only when fluorescent's are inoperative.

MAIN INVERTER POWER GENERATION AND DISTRIBUTION

Figure 1-29

Main Inverters

2500-VOLT-AMPERE INVERTERS

Three 2500-volt-ampere inverters provide 115-volt, 400-cycle, single phase, alternating current to the essential and secondary AC busses. The inverters are the essential, secondary and spare main. The essential inverter supplies power to the essential bus. The secondary inverter supplies power to the secondary bus.

SPARE MAIN INVERTER

The spare main inverter automatically supplies power to either the essential or secondary bus in the event of essential or secondary main inverter failure. If the essential inverter should fail while the spare main inverter is supplying the secondary bus, the spare main inverter will automatically be changed over to the essential bus.

POWER SUPPLY

Each of the three main inverters receives DC power from the forward power panel (figure 1-34) through a current limiter. See figure 1-29 for a schematic diagram of the main inverter system.

MAIN INVERTER SWITCHES

Two switches (46 and 50, figure 1-22) on the engineer's instrument panel control the three inverters in the main inverter system. One switch with ESS INV--OFF--SPARE INV positions energizes and connects the essential main inverter to the essential bus when in the ESS INV position. The second switch marked SEC INV--OFF--SPARE INV energizes and connects the secondary main inverter to the secondary bus when in the SEC INV position. If the essential main inverter becomes inoperative, the spare main inverter is automatically energized and connected to the essential bus. The SPARE INV position on each switch provides a means of manually disconnecting either the essential or secondary main inverters from their respective busses, and connecting the spare main inverter to the selected bus. When the switches are in the OFF position no power is connected to the busses. If the spare main inverter is supplying the secondary bus, and the essential main inverter switch is moved from either the ESS INV or OFF position to the SPARE INV position, the spare main inverter will be connected to the essential bus; also, if the essential main inverter becomes inoperative while the spare main inverter is supplying the secondary bus, the spare main inverter automatically will be transferred to the essential bus. Each of the two main inverter control circuits is protected by a circuit breaker on the overhead circuit breaker panel (figure 1-34).

MAIN INVERTER WARNING LIGHTS

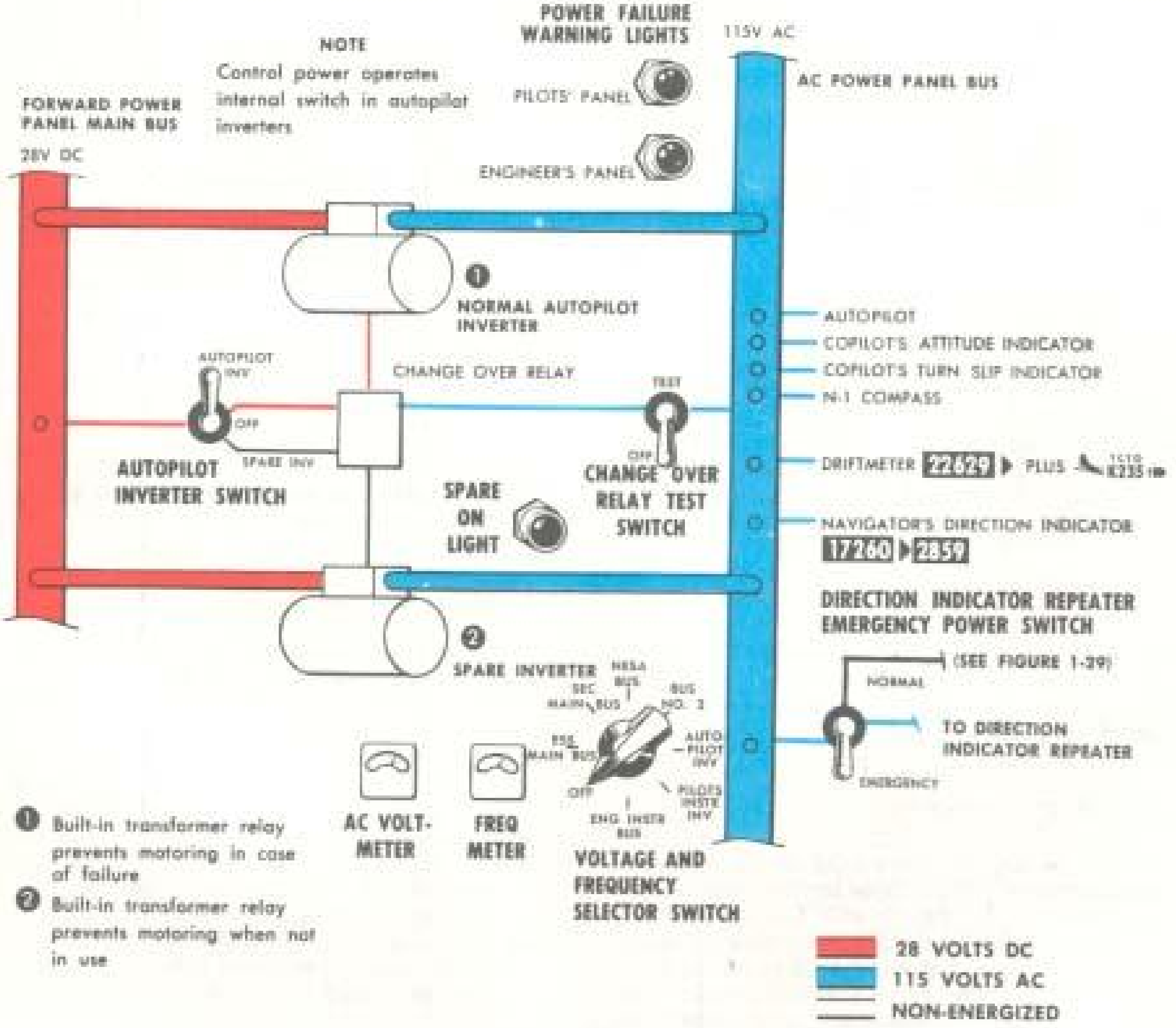
There are five press-to-test main inverter warning lights. Two red lights and two amber lights (44, figure 1-22) are on the engineer's instrument panel and one red light (7, figure 1-9) is on the pilots' instrument panel. In event of failure of the essential main inverter, a red light on the engineer's instrument panel and a red light on the pilots' instrument panel will illuminate. When the spare main inverter automatically assumes the load of the essential main inverter, or when the essential main inverter switch is positioned to SPARE INV, an amber light on the engineer's instrument panel will illuminate and the red warning lights will go out. In event of failure of the secondary main inverter, the second red light will illuminate, and the second amber light will illuminate on the engineer's instrument panel if the spare main inverter automatically assumes the load of the secondary inverter, or if the secondary inverter switch is positioned to SPARE INV. The red warning lights will go out when power is supplied to the bus by the spare main inverter.

Autopilot Inverters

There are two autopilot inverters; a normal and a spare. Each autopilot inverter has a capacity of 750 volt-amperes, and produces 115 volt, 400 cycle, 3 phase alternating current for operation of the autopilot and navigator's directional indicator. Either of the two inverters may be selected for operation. In the event of failure of the normal inverter, the spare inverter is automatically put into operation. The normal inverter will not automatically be put into operation in the event of failure of the spare inverter. Direct-current power for the autopilot inverters is supplied from the forward power panel (figure 1-34) through thermo-circuit breakers. See figure 1-30 for a schematic diagram of the autopilot inverter system.

AUTOPILOT INVERTER SWITCH

A switch (48, figure 1-22) on the engineer's instrument panel, with AUTOPILOT INV--OFF--SPARE INV positions, controls the normal and spare autopilot inverters. When the switch is in the AUTOPILOT INV position, the normal autopilot inverter is energized and supplies power to the autopilot, copilot's attitude indicator, copilot's turn and slip indicator, N-1 compass, the driftmeter on airplanes **22629**▶ plus TCTO K235 and the navigator's directional indicator on airplanes **17260**▶ **2859** . If the normal autopilot inverter becomes inoperative, the spare inverter automatically becomes energized and assumes the load. When the switch is in the SPARE INV position, the spare autopilot inverter supplies power to the autopilot, but if the spare inverter fails, the normal inverter will not be energized automatically. When the switch is in the OFF position no power is supplied to the instruments mentioned above. Each of the two autopilot inverter control cir-



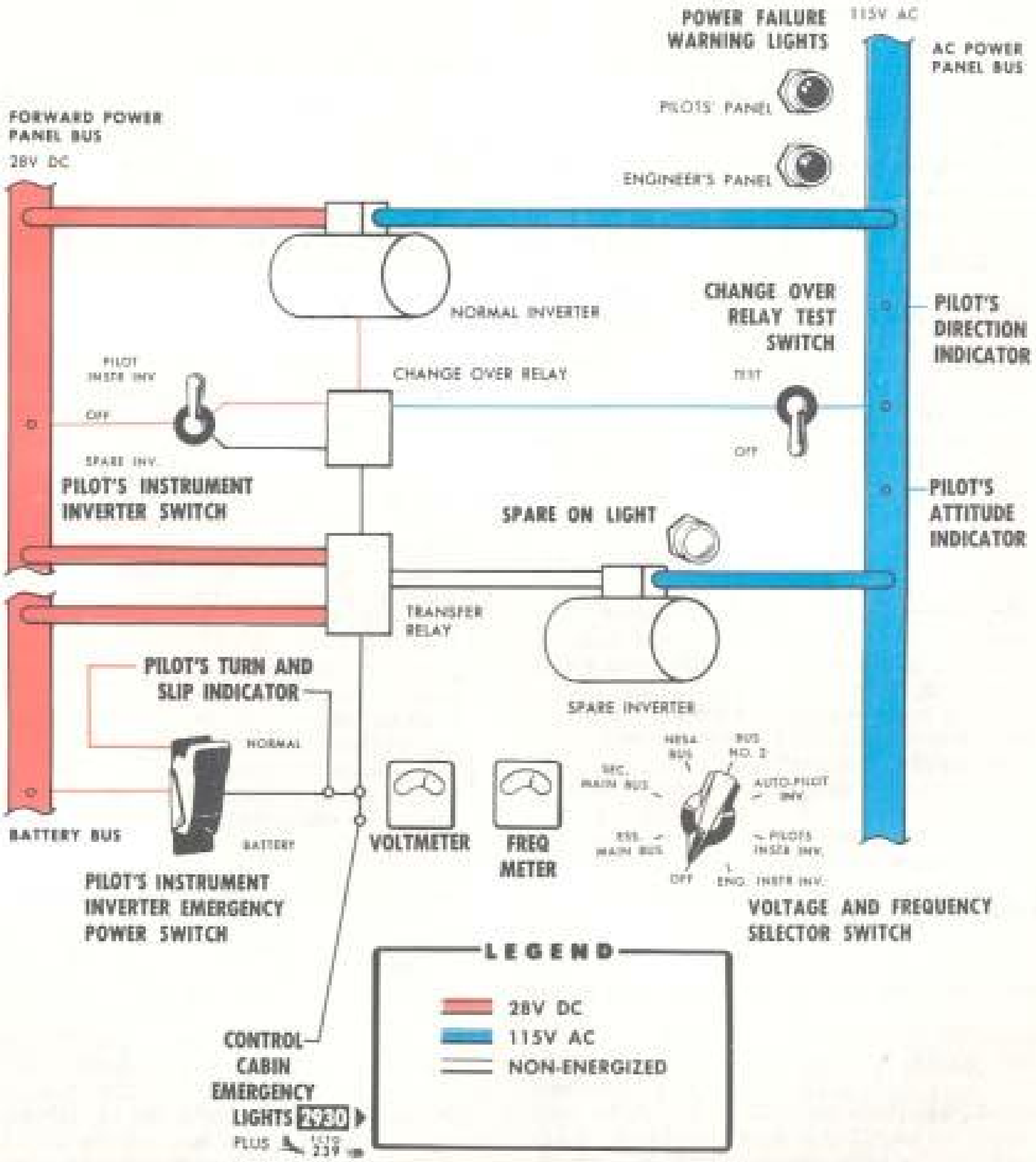
AUTOPILOT INVERTER AC POWER GENERATION AND DISTRIBUTION

Figure 1-30

cuits is protected by a circuit breaker on the overhead circuit breaker panel (figure 1-34).

AUTOPILOT INVERTER WARNING LIGHTS

There are three press-to-test autopilot inverter warning lights. An amber and a red light (44, figure 1-22) are on the engineer's instrument panel, and a red light (11, figure 1-9) is on the pilots' instrument panel. The red warning lights indicate no power is supplied to the autopilot bus. In event of failure of the normal autopilot inverter, the red light on the engineer's instrument panel and the red light on the pilots' instrument panel will illuminate. The amber light on the engineer's instrument panel will illuminate and the red lights will go out when the spare autopilot inverter automatically assumes the load of the normal inverter or if the autopilot inverter switch is positioned to SPARE INV.



PILOTS' INSTRUMENT INVERTER AC POWER GENERATION AND DISTRIBUTION

Figure 1-31

Pilots' Instrument Inverters

There are two pilots' instrument inverters; a normal and a spare. Each of the inverters has a capacity of 100 volt-amperes, and supplies 115-volt, 400 cycle, 3-phase alternating current for the operation of the pilot's directional indicator and attitude indicator. Either of the two inverters may be selected for operation, and in the event of failure of the normal instrument inverter, the spare inverter is automatically put into operation. However, the normal instrument inverter will not be put into operation automatically in event of failure of the spare inverter. Each of the two inverters receives DC power from the forward power panel through circuit breakers. In emergencies, the spare inverter may receive power from the battery through a circuit breaker on the forward power panel (figure 1-34). See figure 1-31 for a schematic diagram of the pilots' instrument inverter system.

PILOTS' INSTRUMENT INVERTER SWITCH

A switch (47, figure 1-22) on the engineer's instrument panel with PILOTS' INSTR INV--OFF--SPARE INV positions controls the normal and spare pilots' instrument inverters. When the switch is in the PILOTS' INSTR INV position, the normal inverter is energized and supplies power to the pilot's direction indicator and attitude indicator. If the normal inverter becomes inoperative, the spare inverter automatically becomes energized and supplies power for the instruments. When the switch is in the SPARE INV position, the spare inverter supplies power to the instruments. The normal inverter will not be energized automatically in case of failure of the spare inverter. When the switch is in the OFF position, no power is supplied to the pilot's direction indicator or attitude indicator. Each of the two inverter control circuits is protected by a circuit breaker on the overhead circuit breaker panel (figure 1-34).

PILOTS' INSTRUMENT INVERTER WARNING LIGHTS

There are three press-to-test pilots' instrument inverter warning lights. A red and an amber light (44, figure 1-22) are on the engineer's instrument panel, and a red light (5, figure 1-9) is on the pilots' instrument panel. In event of failure of the normal pilots' instrument inverter, the red lights on the engineer's instrument panel and pilots' instrument panel will illuminate. The amber light on the engineer's instrument panel will illuminate and the red warning lights will go out when the spare pilots' instrument inverter automatically assumes the load of the normal inverter, or when the pilots' instrument inverter switch is positioned to SPARE INV.

Pilots' Instrument Inverter Emergency Power Switch

This switch (39, figure 1-9) on the pilots' instrument panel, with NORMAL--BATTERY positions, connects power from the battery to the spare pilots' instrument inverter, the pilot's turn and slip indicator and certain control cabin and panel lights when placed in the BATTERY position. For cabin and panel lights on airplanes **2930** ▶ that can be operated on battery power through the pilot's instrument inverter emergency power switch, see figure 4-40. When the switch is in the NORMAL position, power is supplied to the pilots' instrument inverter by the DC power distributing system. The pilots' instrument emergency power control circuit is protected by a circuit breaker on the forward power panel battery emergency bus (figure 1-34).

Direction Indicator Repeater Emergency Power Switch and Warning Light

This switch (26, figure 1-9) with NORMAL--EMERGENCY positions, is located on the pilots' instrument panel. When the switch is in the NORMAL position, power is supplied to the direction indicator repeater from the essential bus on the AC power panel. When the switch is placed in the EMERGENCY position, power is supplied only to the copilot's compass repeater indicator from the normal or spare autopilot inverter, whichever is operating. The direction indicator (gyro compass) repeater warning light (13, figure 1-9) is located on the pilots' instrument panel directly above the repeater switch. In the event of normal power failure the light will illuminate indicating that emergency power is needed to operate the direction indicator repeater. The repeater power circuit is protected by a fuse or circuit breaker on the AC power panel.

AC Voltage and Frequency Selector Switch, Voltmeter and Frequency Meter

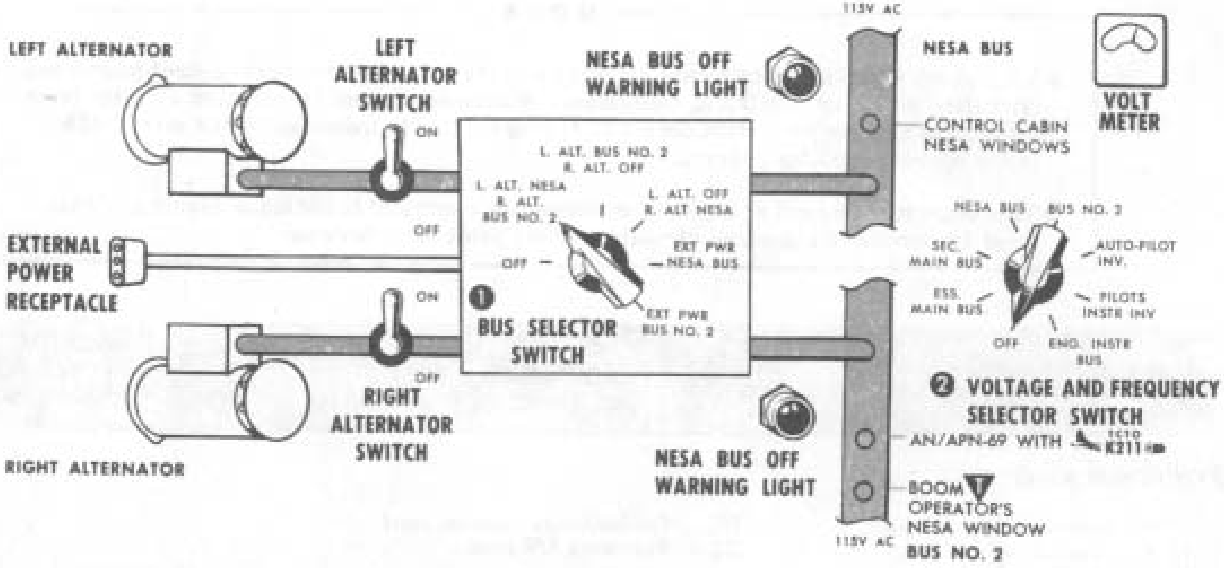
A rotary-type switch (41, figure 1-22); a single alternating-current voltmeter (36, figure 1-22) and a single frequency meter (37, figure 1-22) on the engineer's instrument panel provide a means of reading the output voltage and frequency of each 400 cycle inverter and voltage only of variable frequency alternators, as selected by the switch. The switch has OFF--ESS MAIN BUS--SEC MAIN BUS--NESA BUS--BUS NO. 2--AUTOPILOT INV--PILOTS INSTR INV--ENG INSTR BUS positions. The voltmeter and frequency meter are connected to the power sources as indicated by the switch position, except that the frequency meter is not connected when the switch is in the NESA BUS--BUS NO. 2 ENG INSTR BUS positions. When the switch is in the OFF position neither the AC voltmeter or frequency meter are connected to a power source.

Inverter Changeover Relay Test Switches

These switches (figure 1-34) with TEST--OFF positions, are located on the AC power panel, except on airplanes **3142** ▶ the autopilot inverter changeover relay test switch is located on the autopilot junction shield. This shield is across from the engineer's position on the left side of the airplane near the floor. Each switch is spring-loaded from the TEST position to the OFF position. In the circuits, the changeover relay test switches are located between the AC buses and the changeover relays. In normal operation these switches allow a voltage to be impressed upon the relays when the inverters are in operation. To test a changeover relay, the inverter must be operating and supplying 115 volts AC to the AC bus and the switch must be held in the TEST position for four seconds. This allows time for the circuit to be broken and a heating element to be connected to the main 28 volt DC bus which causes a bimetallic switch to close a circuit to a relay which in turn energizes the spare inverter.

VARIABLE FREQUENCY AC POWER SYSTEM

The variable frequency AC power system provides power for the Nesa windows in the control cabin, and on Code T airplanes in the boom operator's compartment. See figure 1-32 for a schematic diagram of the variable frequency AC power system.



▬ 115V AC FROM ALTERNATOR

① Power flow shown with bus selector switch in L ALT NESA, R ALT BUS No. 2 position

② The frequency meter is inoperative if switch is positioned to NESA BUS or BUS No. 2

VARIABLE FREQUENCY AC POWER GENERATION AND DISTRIBUTION

Figure 1-32

Alternators

Two alternating current generators, one on each inboard engine, supply power through 100 ampere fuses located in the nacelle solenoid panel to the Nesa bus and bus No. 2.

ALTERNATOR SWITCHES

The two alternators are controlled by two ON--OFF switches (38, figure 1-22) on the engineer's instrument panel. When the switches are in the ON position and the engines are running, alternating current of unregulated frequency is delivered to the bus selector switch. The control circuit for each alternator is protected by a circuit breaker on the overhead circuit breaker panel (figure 1-34).

AC External Power Receptacle

An external power receptacle (20, figure 1-47) for variable frequency alternating-current power is in the forward end of the nose wheel well.

Bus Selector Switch

This rotary-type switch (40, figure 1-22), on the engineer's instrument panel, has OFF--L. ALT. NESA-R. ALT. BUS NO. 2--L. ALT. BUS NO. 2-R. ALT. OFF--L. ALT. OFF-R. ALT. NESA--EXT PWR NESA BUS--EXT PWR BUS NO. 2 positions. It directs variable frequency alternating current from the external AC power receptacle or from left or right alternators to the Nesa bus or No. 2 bus as indicated by the switch position. When the switch is in the OFF position, no variable frequency AC power is connected to the busses. Unmarked switch positions are also OFF positions.

Nesa Bus Off Warning Lights

There are two red push-to-test alternator warning lights (39, figure 1-22) on the engineer's instrument panel. The warning lights for the Nesa and No. 2 bus are DC powered. The light for the respective bus will illuminate if that bus does not receive alternator power when the bus selector switch is placed in a position which would energize the bus.

NOTE

- This chart is designed to locate circuit protection devices for both control power and operating power of electrical equipment. Where equipment is operated directly from its control and one protection device is employed, this is indicated by the word "SAME" in the operating power column.
- This chart may be used as a guide for emergency electrical isolation of electrical equipment by opening the desired circuits at their protective devices.

CIRCUIT TITLE	CONTROL POWER	CIRCUIT PROTECTION LOCATION	OPERATING POWER	CIRCUIT PROTECTION LOCATION
▼AIR REFUELING SYSTEM				
A-1 hydraulic oil temperature	DC	Overhead circuit breaker panel	Same	
A-1 pump control	DC	Engineer's A/R panel	Same	
A/R director light test			DC	Aft power panel
A/R dump (Emergency)	DC	Forward power panel	Same	
A/R power			DC	Aft power panel
A/R tank purge **17260** ▶ **3195** less TCTO KG516 ▶	DC	Forward power panel	Same	
Auto fuel bypass valve			DC	Engineer's A/R panel
Manifold transfer valve	DC	Engineer's A/R panel	Same	
Fuel flow totalizer	AC	Engineer s A/R panel	Same	
Gravity fuel dump	DC	Engineer's A/R panel	Same	
Hydraulic pressure gauges **2894** ▶			AC	Engineer's A/R panel
Indicator light test			DC	Aft power panel
Poppet control	DC	Engineer's A/R panel	Same	
Pressure fuel dump	DC	Engineer's A/R panel	Same	
Signal amplifier	DC	Aft power panel A/R	DC	Boom operator's panel
ANTI-ICING				
Anti-ice and air conditioning fuel supply valves	DC	Overhead circuit breaker panel	Same	
Body and Surface Anti-icing heaters	DC	Overhead circuit breaker panel	Same	
Body and Surface Anti-icing heater fuel valves	DC	Overhead circuit breaker panel	Same	
		(Uses heat control circuit protection)	AC	AC power panel
Body and Surface Anti-icing heater ignition				
Emergency anti-icing	DC	Forward power panel	Same	
Empennage ground blower		(Uses empennage heat control circuit protection)	DC	Aft power panel
Heater fuel valve	DC	Forward power panel	Same	
Overheat test	DC	Forward power panel	Same	
Pitot heat; Pitot heat (Copilot's)	DC	Overhead panel	Same	
Pitot heat - (Pilot's) Normal & Emergency	DC	Forward power panel	Same	
Propeller deice	DC	Overhead circuit breaker panel	DC	Main power panel
Ruddevator anti-ice **17260** ▶ **3249** less TCTO KS09 ▶	DC	Engineer's A/R panel	DC	Main power panel
Window heat	DC	Overhead circuit breaker panel	AC	Alternator relay shield
	AC	Alternator relay shield **17260** ▶ **17271**		
	AC	AC power panel **2826** ▶ **2859**		
Window heat (Boom operator's)	DC	Overhead circuit breaker panel	AC	Alternator relay shield
	DC	Boom operator's panel		
AUTOPILOT				
Autopilot inverters	DC	Overhead circuit breaker panel	DC	Forward power panel
Autopilot	DC	Overhead circuit breaker panel	AC	AC power panel
N-1 compass system		(Uses autopilot circuit protection)		

CIRCUIT PROTECTION AND LOCATION

Figure 1-33 (Sheet 1 of 4)

CIRCUIT TITLE	CONTROL POWER	CIRCUIT PROTECTION LOCATION	OPERATING POWER	CIRCUIT PROTECTION LOCATION
CABIN HEATING, VENTILATING, AND PRESSURIZING SYSTEMS				
Body heaters	DC	Forward power panel		
Body heater fuel valves	DC	Forward power panel	Same	
Body heater ignition		(Uses body heat control circuit protection)	AC	AC power panel
Cabin air bleed	DC	Overhead circuit breaker panel	Same	
Cabin pressure control	DC	Forward power panel	Same	
Control cabin fans	DC	Overhead circuit breaker panel	Same	
Ground blowers	DC	Forward power panel	DC	Main circuit breaker panel
Overheat test	DC	Forward power panel	Same	
CARGO				
Aerial delivery motor **17260** ▶ **22628**	DC	Aft power panel	DC	Main power panel
Cargo door	DC	Aft power panel	DC	Aft power panel
Cargo hoist	DC	Cargo hoist shield	DC	Forward power panel
	DC	Forward power panel **22629** ▶ **22736**		
COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT				
IFF radio destruction, without TCTO 590	DC	Forward power panel		
Power distribution			AC	AC power panel
			DC	Forward power panel
Radio and radar equipment	AC	Radio junction box circuit breaker panel	Same	
	DC	Radio junction box circuit breaker panel		
VHF navigation radio (omni)	DC	Aft power panel Aft radio rack junction box		
UHF navigation radio (tacan) TCTO K572	DC	Radio junction box circuit breaker panel	AC	Radio junction box circuit panel
ELECTRICAL SYSTEM				
Alternators	DC	Overhead circuit breaker panel		
Auxiliary power unit	DC	Auxiliary power unit shield		
Battery control	DC	Forward power panel	Same	
Generators	DC	Main circuit breaker panel		
Generator field relays	DC	Overhead circuit breaker panel	Same	
Inverters	DC	Overhead circuit breaker panel	DC	Forward power panel
Voltmeters	AC	AC power panel and alternator relay shield	Same	
	DC	Main circuit breaker panel	Same	
ENGINES				
Carburetor preheat valve	DC	Overhead circuit breaker panel	Same	
Carburetor sheltered air door	DC	Overhead circuit breaker panel	DC	Main circuit breaker panel
Cowl flaps	DC	Overhead circuit breaker panel	DC	Main circuit breaker panel
Engine instruments			AC	AC power panel
			DC	Overhead circuit breaker panel
Exhaust back pressure switch **3196** ▶ plus TCTO 338	DC	Overhead circuit breaker panel	Same	
Ignition analyzer	DC	Overhead circuit breaker panel Control panel and analyzer	AC	AC power panel
Ignition booster	DC	Overhead circuit breaker panel	Same	
Intercooler flaps	DC	Overhead circuit breaker panel	Same	
Oil cooler flaps	DC	Overhead circuit breaker panel	Same	
Primer	DC	Overhead circuit breaker panel	Same	
Spark advance	DC	Overhead circuit breaker panel	Same	
Starters	DC	Overhead circuit breaker panel	DC	Main power panel
Turbosuperchargers	AC	AC power panel	Same	
Water injection	DC	Overhead circuit breaker panel	DC	Main circuit breaker panel

Figure 1-33 (Sheet 2 of 4)

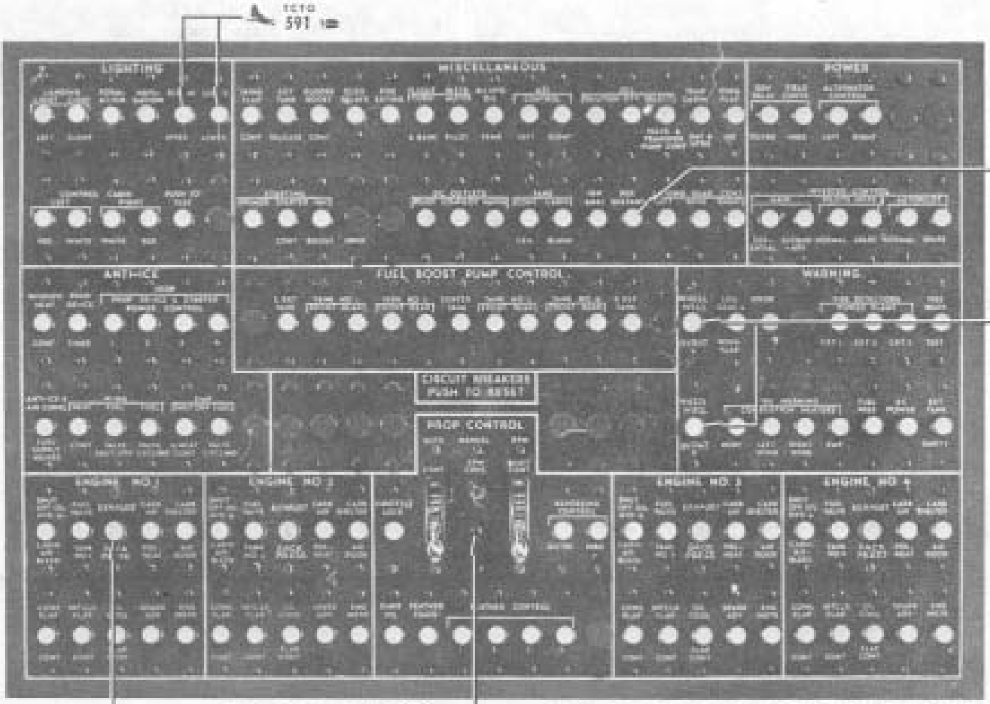
CIRCUIT TITLE	CONTROL POWER	CIRCUIT PROTECTION LOCATION	OPERATING POWER	CIRCUIT PROTECTION LOCATION
FIRE EXTINGUISHING				
Body and Surface Anti-icing heater fire warning	DC	Overhead circuit breaker panel	Same	
Fire detector			DC	Overhead circuit breaker panel
Fire extinguishing	DC	Overhead circuit breaker panel		
Fire warning test	DC	Overhead circuit breaker panel	Same	
FLIGHT CONTROLS				
Emergency wing flaps	DC	Main circuit breaker panel	DC	Main power panel
Rudder boost	DC	Overhead circuit breaker panel		
Wing flaps	DC	Overhead circuit breaker panel	DC	Main power panel
FUEL SYSTEM				
T A/R line valve	DC	Engineer's A/R panel	Same	
Boost pumps	DC	Overhead circuit breaker panel	DC	Main circuit breaker panel
Fuel gages			AC	AC power panel
T Fuel leveling valve(A/R)	DC	Engineer's A/R panel	Same	
Fuel pressure warning			DC	Overhead panel
Fuel selector valves	DC	Overhead circuit breaker panel	Same	
T Fuel shutoff valve (Emergency A/R)			DC	Engineer's A/R panel
T Fuel transfer valves (A/R)	DC	Engineer's A/R panel	Same	
Single point refueling	DC	Forward power panel	Same	
Single point secondary valve	DC	Single point refueling panel	Same	
HYDRAULIC SYSTEM				
Hydraulic pressure gage			AC	AC power panel
Hydraulic shutoff valve	DC	Overhead circuit breaker panel	Same	
INSTRUMENTS				
Attitude Indicator			AC	AC power panel
T Boom position indicator			DC	Boom operator's panel
Directional Indicator			AC	AC power panel
Engine instruments			AC	AC power panel
			DC	Overhead circuit breaker panel
Fuel gages			AC	AC power panel
Hydraulic pressure gage			AC	AC power panel
Temperature cabin, OAT and heater			DC	Overhead circuit breaker panel
Turn and slip indicator (Pilot's)			DC	Overhead circuit breaker panel
Turn and slip indicator (Copilot's)			AC	(Uses autopilot circuit protection)
Voltmeters	DC	Main power panel	Same	
Wing flap position indicator			DC	Overhead circuit breaker panel
LANDING GEAR				
Main landing gear	DC	Overhead circuit breaker panel	DC	Main power panel
Nose landing gear	DC	Overhead circuit breaker panel	DC	Forward power panel
Oleo relays			DC	Overhead circuit breaker panel
Portable auxiliary motor		Uses emergency wing flap circuit protection)		
Warning horn	DC	Overhead circuit breaker panel	Same	

CIRCUIT PROTECTION AND LOCATION (CONT)

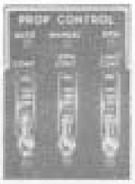
Figure 1-33 (Sheet 3 of 4)

CIRCUIT TITLE	CONTROL POWER	CIRCUIT PROTECTION LOCATION	OPERATING POWER	CIRCUIT PROTECTION LOCATION
LIGHTING				
Anti-collision lights ✈ TCTO 591	AC	AC power panel	DC	Overhead circuit breaker panel
▼ Boom operator's lights	DC	Boom operator's panel	Same	
Control cabin	DC	Overhead circuit breaker panel	Same	
Control cabin entrance light	DC	Forward power panel	Same	
Engineer's refueling panel lights	DC	Overhead circuit breaker panel	Same	
▼ Exterior lights (A/R)	DC	Boom operator's panel	Same	
Fluorescent lights 17260 ▶ 3267	AC	AC power panel	Same	
Formation lights	DC	Overhead circuit breaker panel	Same	
Landing lights	DC	Overhead circuit breaker panel	DC	Main circuit breaker panel
Lower aft compartments	DC	Main circuit breaker panel	Same	
Lower forward compartments	DC	Forward power panel	Same	
Main cargo compartment	DC	Main circuit breaker panel	Same	
Miscellaneous lights	DC	Overhead panel	Same	
Navigation lights	DC	Overhead circuit breaker panel	Same	
Pilot director lights ✈ TCTO K526	DC	Boom operator's panel	DC	Aft power panel
▼ Rendezvous beacon lights 3196 ▶ PLUS ✈ TCTO K231	DC	Boom operator's panel	Same	
MISCELLANEOUS				
DC outlets				Overhead circuit breaker panel Main circuit breaker panel
Driftmeter	AC	AC power panel	Same	
Emergency alarm	DC	Forward power panel	Same	
External tank release	DC	Overhead circuit breaker panel	Same	
Landing flare release	DC	Forward power panel	Same	
Periscopic sextant 2860 ▶ plus ✈ TCTO 133	DC	Overhead circuit breaker panel	Same	
Suit heaters 17260 ▶ 2859	DC	Overhead circuit breaker panel	Same	
NOSE STEERING SYSTEM				
Nose steering emergency valve	DC	Forward power panel	Same	
OIL SYSTEMS				
Oil dilution	DC	Overhead circuit breaker panel		
Oil quantity gage			DC	Overhead circuit breaker panel
Oil shutoff valves	DC	Overhead circuit breaker panel	Same	
Oil transfer pump	DC	Overhead circuit breaker panel	DC	Forward power panel
PROPELLERS				
Auto RPM	DC	Overhead circuit breaker panel		
Emergency oil	DC	Overhead circuit breaker panel	DC	Main power panel
Feathering	DC	Overhead circuit breaker panel	DC	Main power panel
Manual RPM	DC	Overhead circuit breaker panel		
Reversing	DC	Overhead circuit breaker panel		
RPM limit	DC	Overhead circuit breaker panel		
Throttle lock	DC	Overhead circuit breaker panel	Same	
WARNING INDICATORS				
AC power			DC	Overhead circuit breaker panel
Body and surface anti-icing heater fire	DC	Overhead circuit breaker panel	Same	
Cargo discharge signal 17260 ▶ 22628	DC	Overhead circuit breaker panel	Same	
Door closed			DC	Overhead circuit breaker panel
External tank low	DC	Overhead circuit breaker panel	Same	
Fuel flow (tank empty)			DC	Overhead circuit breaker panel
Fire detectors			DC	Overhead circuit breaker panel
Fire detector test	DC	Overhead circuit breaker panel	Same	
▼ Fuel and hydraulic pressure (A/R)			DC	Engineer's A/R panel
Fuel pressure			DC	Overhead circuit breaker panel
▼ Fuel quantity gage test (A/R)	DC	Engineer's A/R panel	Same	
Landing gear and wing flaps			DC	Overhead circuit breaker panel
Wheel well overheat ✈ TCTO 558			DC	Overhead circuit breaker panel

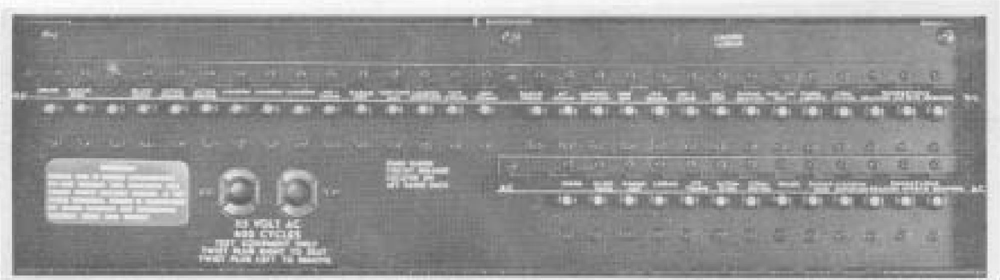
Figure 1-33 (Sheet 4 of 4)



OVERHEAD CIRCUIT BREAKER PANEL

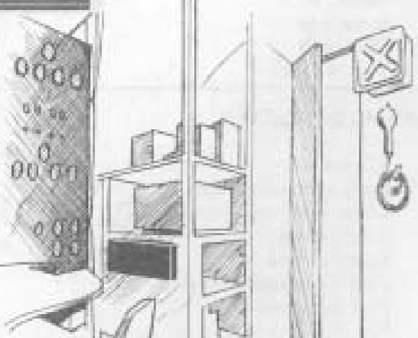


DETAIL I
WITHOUT TCTO 531



RADIO JUNCTION BOX CIRCUIT BREAKER PANEL (TYPICAL)

NOTE: FUSES ARE USED FOR AC PROTECTION ON 17260 ▶ 22700



CIRCUIT BREAKER PANELS LOCATION (TYPICAL)

Figure 1-34 (Sheet 1 of 6)

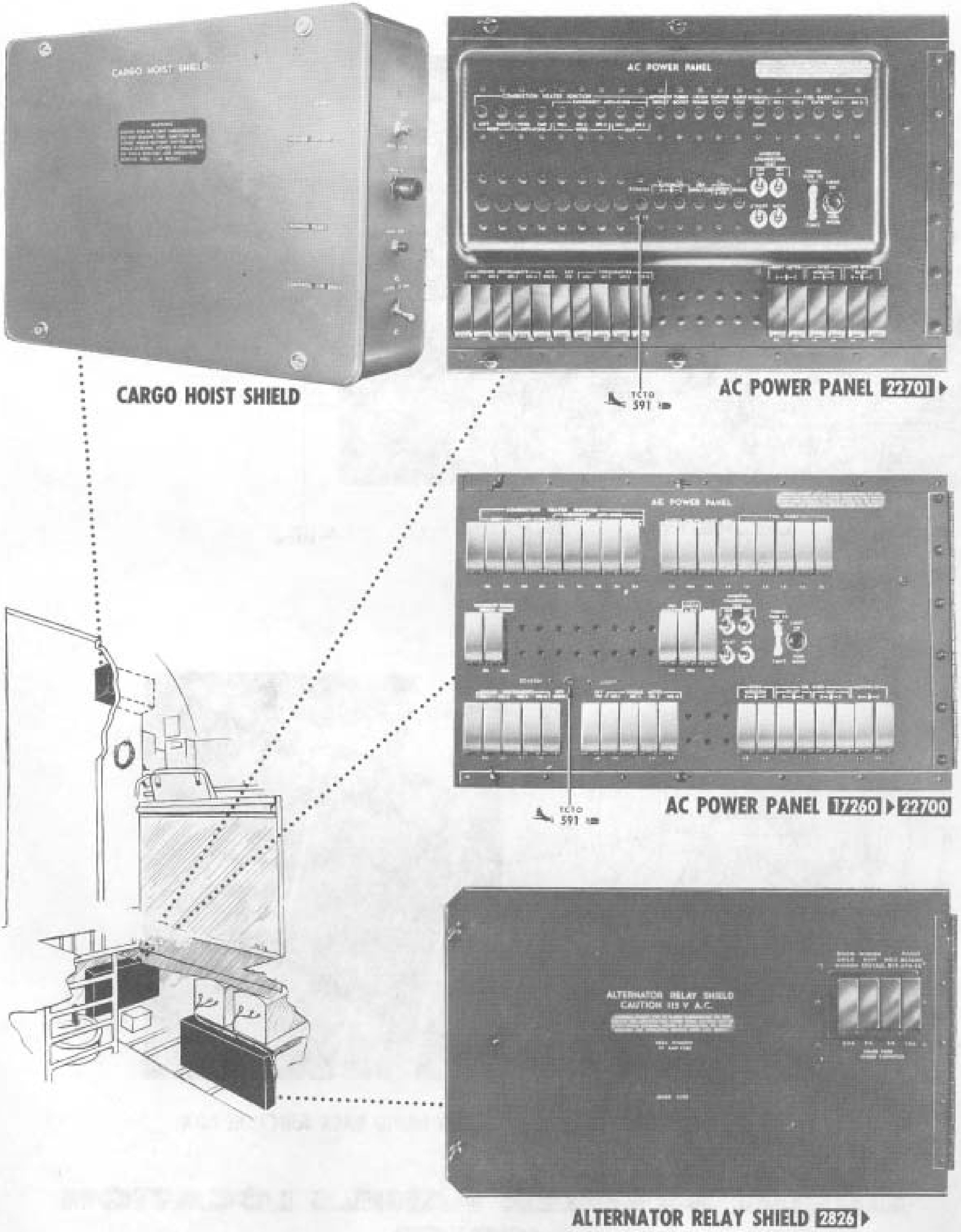
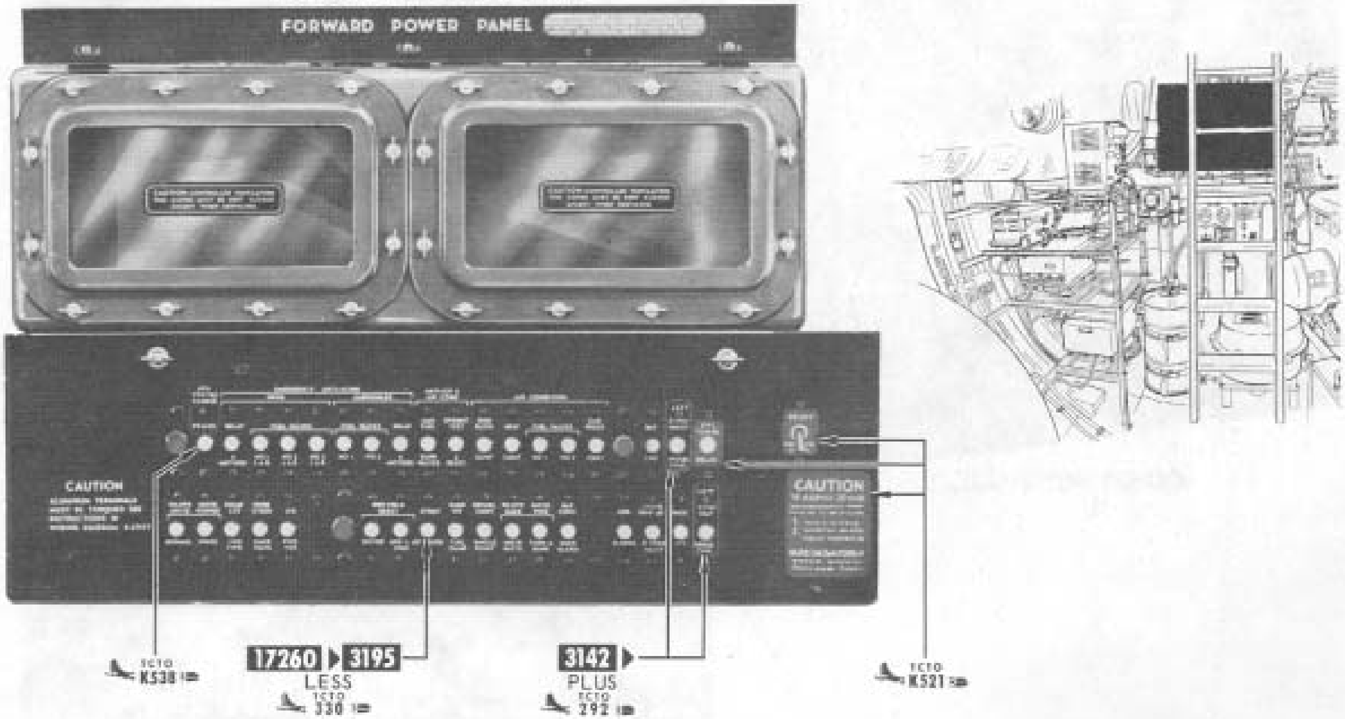
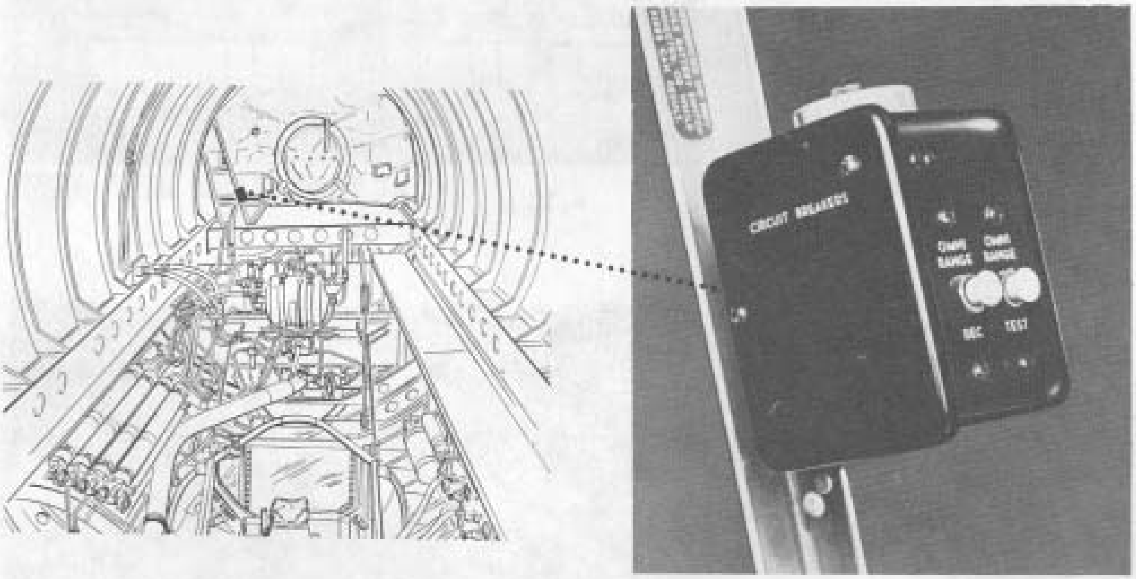


Figure 1-34 (Sheet 2 of 6)

FORWARD POWER PANEL

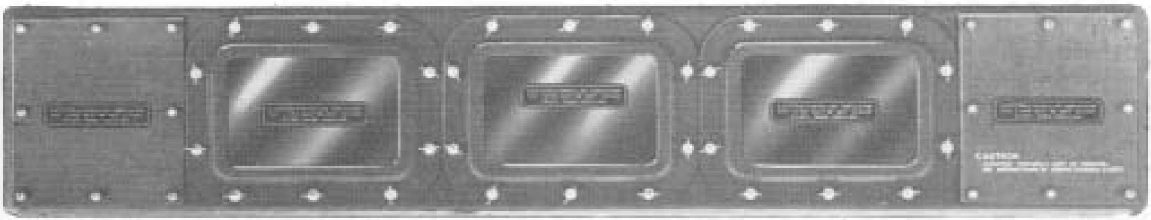




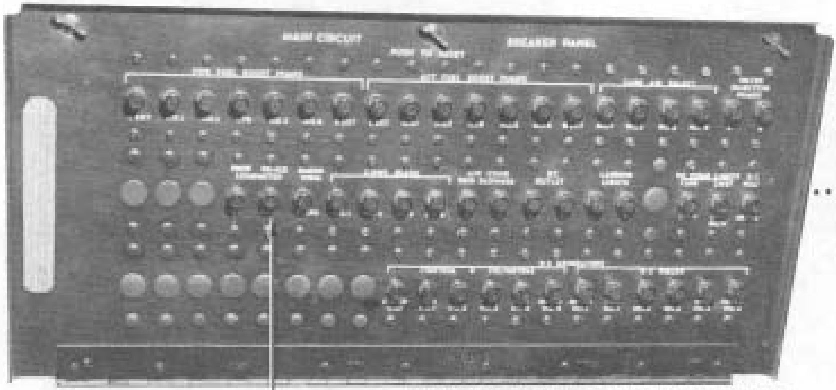
AFT RADIO RACK JUNCTION BOX

CIRCUIT BREAKER PANELS LOCATION (CONT)

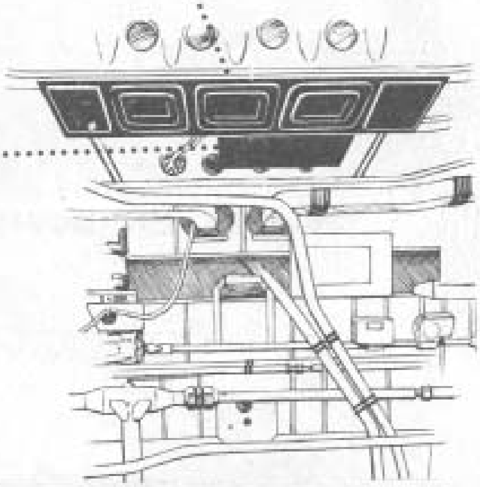
Figure 1-34 (Sheet 3 of 6)

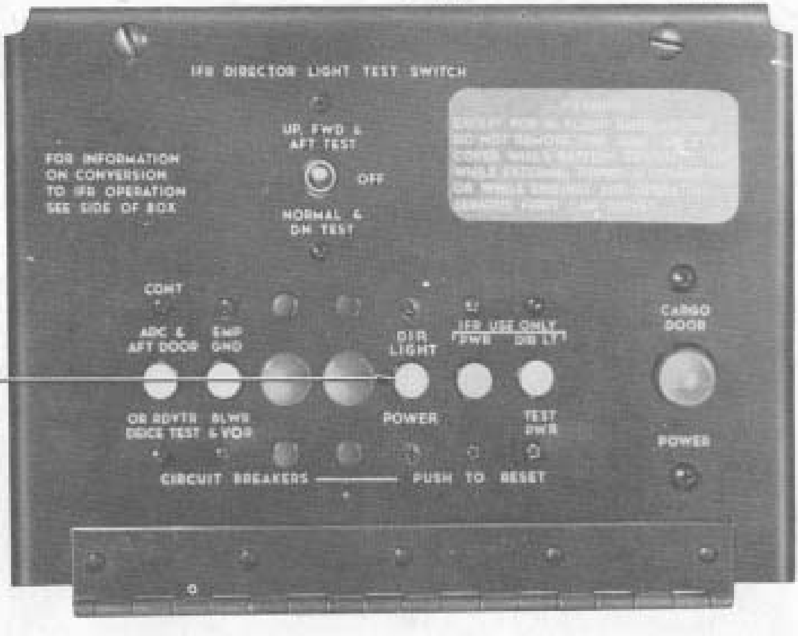


MAIN POWER PANEL

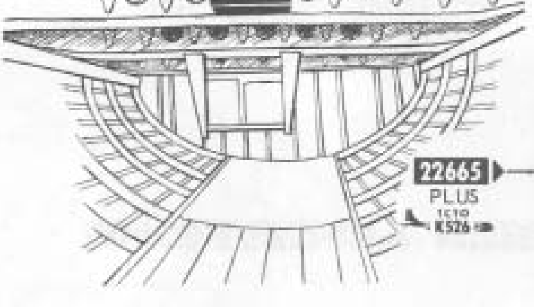


MAIN CIRCUIT BREAKER PANEL





AFT POWER PANEL



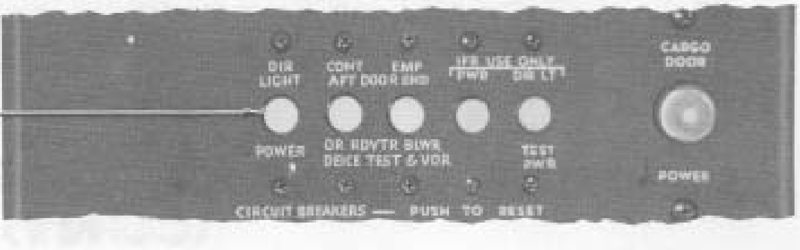
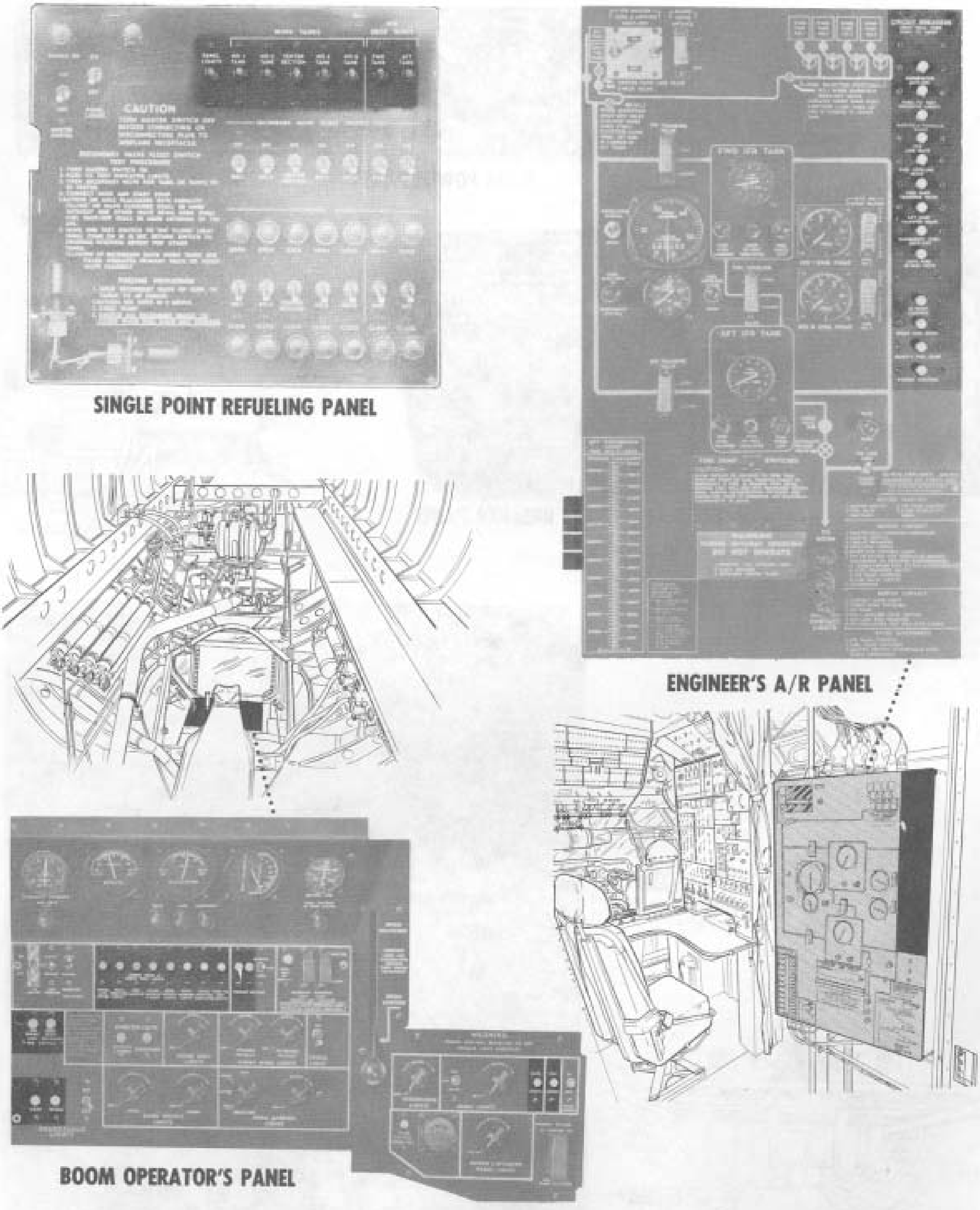


Figure 1-34 (Sheet 4 of 6)



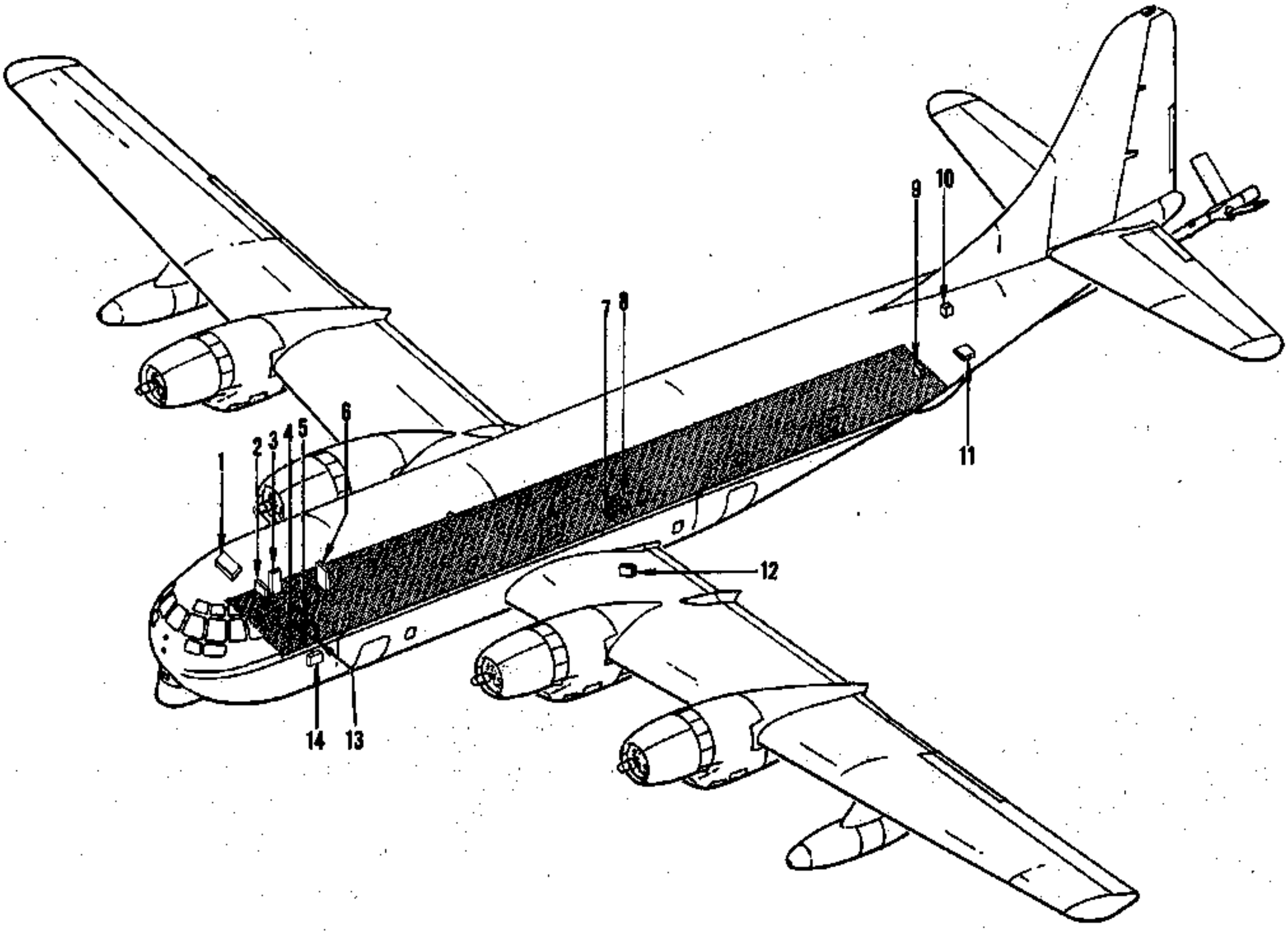
SINGLE POINT REFUELING PANEL

ENGINEER'S A/R PANEL

BOOM OPERATOR'S PANEL

CIRCUIT BREAKER PANELS LOCATION (CONT)

Figure 1-34 (Sheet 5 of 6)



1 OVERHEAD CIRCUIT BREAKER PANEL (DC)
2 RADIO JUNCTION BOX CIRCUIT BREAKER PANEL (AC-DC)
3 ENGINEER'S A/R PANEL (AC-DC)
4 AUXILIARY POWER UNIT CONTROL PANEL (DC)
5 FORWARD POWER PANEL (DC)
6 CARGO HOIST SHIELD (DC)
7 MAIN CIRCUIT BREAKER PANEL (DC)
8 MAIN POWER PANEL (DC)
9 AFT POWER PANEL (DC)
10 AFT RADIO RACK JUNCTION BOX (DC)
11 BOOM OPERATOR'S PANEL (AC-DC) T
12 SINGLE POINT REFUELING PANEL (DC)
13 AC POWER PANEL
14 ALTERNATOR RELAY SHIELD (AC) 2826 ▶

Figure 1-34 (Sheet 6 of 6)

HYDRAULIC SYSTEM

Both the tanker and cargo airplanes are equipped with three separate hydraulic systems. The following titles will be used in all future references to these systems. Only the main system is discussed in this Section.

Main Hydraulic System	Rudder Boost Service Brakes Emergency Brakes Nose Wheel Steering Windshield Wipers
▼ Air Refueling Hydraulic Systems (See Section IV)	Pressure System Boom System Fuel Pump System Isodraulic System
Forward Cargo Door Hydraulic System (See Section IV)	Cargo Door
Ⓒ Aft Cargo Door Hydraulic System (See Section IV)	Cargo Door

MAIN HYDRAULIC SYSTEM

The main hydraulic system supplies power to operate the rudder boost, service brakes, nose wheel steering and windshield wipers; main system pressure is also used to charge the emergency brake system. On airplanes **22737** ▶ the main hydraulic system also drives a pump motor combination which provides pressure to the A/R boom system. Pressure is supplied by two engine-driven pumps, one on each of No. 2 and No. 3 engines. The pumps are set to maintain 1500-1650 psi, and a check valve in each pump pressure line prevents loss of system pressure in the event one pump becomes inoperative. Both engine-driven hydraulic pumps are self lubricated by the flow of hydraulic fluid. Should fluid flow to the pump be stopped for any reason, damage to the pump will result. However, it is not advisable to stop an engine in flight in an effort to save a hydraulic pump. A fluid reservoir in the control cabin holds a normal operating supply of 3.5 US gallons including a 0.5 US gallon reserve for the hand pump. A hand pump is provided to supply pressure to the service brake system in the event of failure of both engine-driven pumps. The hand pump can also be used to recharge the emergency brake system. During in-flight operation the hydraulic system may be depressurized by manually actuating a depressurization valve. The emergency brake system pressure is isolated from the main system by a check valve and is not affected by depressurization.

Depressurization And Emergency Charging Valve Handle

This is a three position valve handle (12, figure 1-15) on the copilot's auxiliary panel and is mechanically linked to a control valve. The three positions are: NORMAL--EMERGENCY BRAKE CHARGING--DEPRESSUIRZED POSITION. With the handle in the NORMAL position, the emergency brake system is isolated and both hydraulic pumps supply pressure to the entire main system. Moving the valve handle to the EMERGENCY BRAKE CHARGING position, system pressure or service brake pressure, whichever is higher, will charge the emergency brake accumulator and in this position pressure will still be supplied to the entire hydraulic system. When the valve handle is moved to the DEPRESSURIZED POSITION main system pressure is discharged directly into the return system leaving only the emergency brake system pressurized. The DEPRESSURIZED position is to be used in flight in the event of a line rupture to save hydraulic fluid and to reduce the danger of fire due to hydraulic fluid contacting electrical equipment.

Hand Pump

A hand pump (4, figure 1-8) below the copilot's auxiliary panel is provided to supply pressure to the service brakes in the event of failure of both engine-driven pumps. The hand pump can also be used to recharge the emergency brake system by first placing the depressurization and emergency charging valve handle in the EMERGENCY BRAKE CHARGING position.

Hydraulic System Pressure Gages

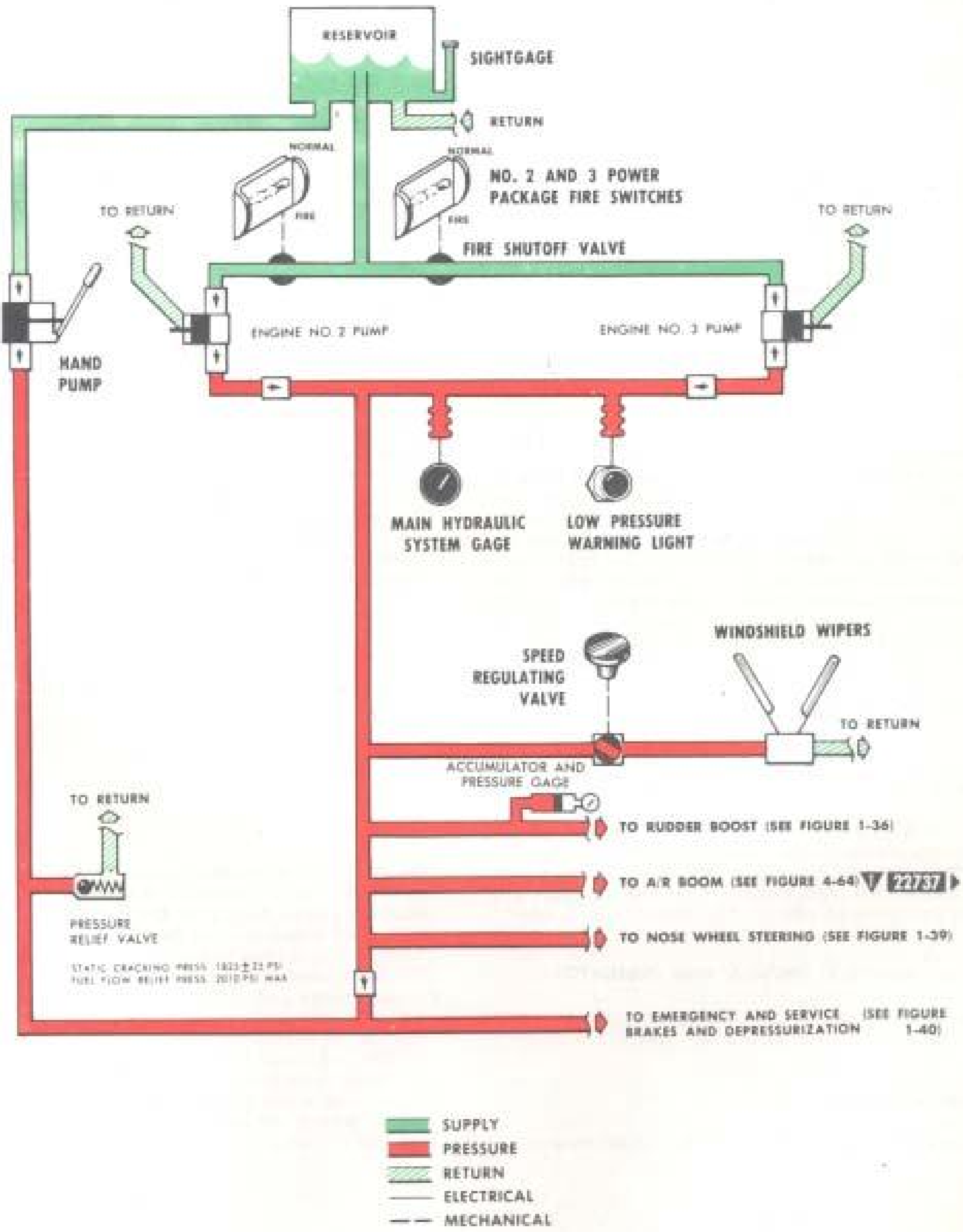
Three gages are provided. Two are on the pilots' instrument panel: one indicates main system pressure (32, figure 1-9) and the other indicates service brake system pressure (29, figure 1-9). A gage (1, figure 1-15) on the copilot's auxiliary panel indicates emergency brake system pressure. All hydraulic pressure gages read in psi, and receive 26 volt AC power through fuses on the AC power panel (figure 1-34).

Hydraulic System Low Pressure Warning Lights

An amber light (31, figure 1-9), adjacent to the main hydraulic system pressure gage will illuminate whenever system pressure falls below 900 psi. Two other lights in the hydraulic system are described in BRAKE SYSTEM in this Section. The warning light is operated by 28 volt DC power from a circuit breaker on the overhead circuit breaker panel (figure 1-34).

HYDRAULIC FLUID SPECIFICATION

Refer to Servicing Diagram (figure 1-47) for hydraulic fluid specification.



MAIN HYDRAULIC SUPPLY SYSTEM

Figure 1-35

FLIGHT CONTROL SYSTEM

The airplane is controlled in flight from either the pilot's or copilot's station by conventionally operated aileron, wing flap, elevator and rudder surfaces. The surfaces are cable-operated except the wing flaps which are operated electrically and the rudder which has a hydraulic boost system in addition to the cable. The rudder cables move the rudder trim tab which aerodynamically positions the rudder surface. Wing flap and rudder boost circuit breakers are on the overhead circuit breaker panel (figure 1-34).

SURFACE LOCK HANDLE

This red handle (6, figure 1-16) on the forward end of the control stand is provided to lock the control surfaces, partially lock the throttles and turn off rudder boost pressure when the surfaces are locked. The handle has UP-LOCKED--DOWN-UNLOCKED positions. Before the lock is effective in the UP-LOCKED position, the ailerons and rudder must be in neutral, the elevators down, and at least two throttles closed for engines on opposite sides of the fuselage (engines 1 and 4 or 2 and 3 etc.). When the surface lock handle is in the UP-LOCKED position the surfaces are locked mechanically and movement of the throttles is restricted to prevent a takeoff with surfaces locked; all four throttles can be advanced to give approximately fifty percent engine power, but the interlock prevents two throttles for engines on the same side of the airplane from being advanced beyond this point. When the surface lock handle is in the DOWN-UNLOCKED position the surfaces are unlocked, throttle movement is unrestricted, and rudder boost can be turned on.

CONTROL COLUMN AND WHEEL

The dual control columns and wheels for elevator and aileron control are conventional. Each control column wheel contains an autopilot release switch and microphone switch (4, 3, figure 1-7) and (2, 3, figure 1-8) on the outboard side of the control column wheels.

TRIM CONTROL WHEELS AND INDICATORS

Trim control wheels and indicators (3, 9, 33, and 41, figure 1-16) are on the control stand.

RUDDER PEDALS

The rudder pedals are conventional in appearance and operation and are hinged for toe operation of the hydraulic brakes. A latch on the outside edge of each rudder pedal permits fore and aft adjustment of the pedal.

RUDDER BOOST SYSTEM

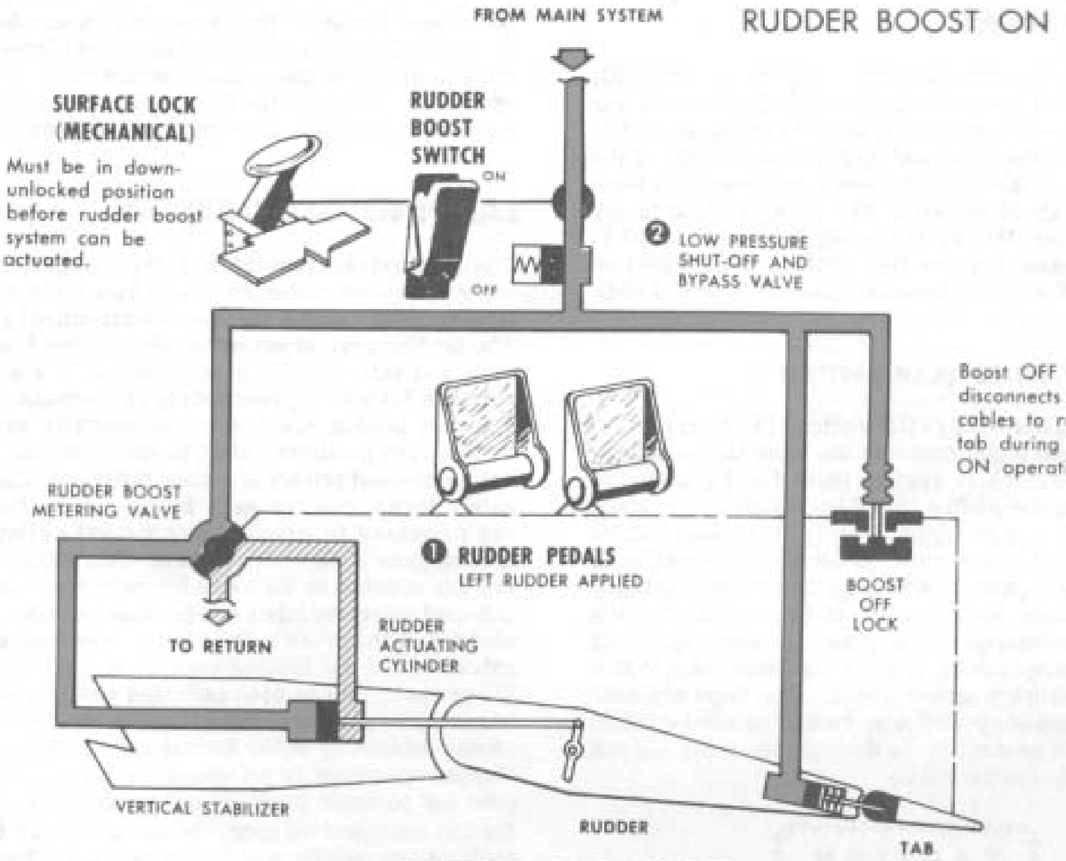
The primary purpose of the rudder boost system (figure 1-36) is to provide effective rudder control at low airspeeds with unsymmetrical power as would occur if an engine failed during takeoff or landing. The main hydraulic system (figure 1-35) provides pressure to operate the rudder boost system. With rudder boost turned on, movement of the rudder pedals controls a metering valve connected to the cables. Hydraulic pressure from the metering valve operates an actuating cylinder which moves the rudder surface. The trim tab is automatically disconnected and locked in a centered position; operation of the rudder trim control wheel adjusts the metering valve for rudder trim during boost on. Since hydraulic pressure supplies the total force required to operate the rudder surface, artificial feel is induced in the rudder boost system by means of coil springs. For a given amount of pedal deflection the rudder surface will assume different positions for the conditions of boost on and boost off; therefore, the rudder boost system should not be turned on or off during any maneuver requiring rudder operation.

NOTE

> If pressure from the main hydraulic system to the rudder boost systems falls below 800 psi, a shutoff and bypass valve (figure 1-36) will stop hydraulic pressure from entering the rudder boost system, and allow normal boost-off operation of the rudder.

Rudder Boost Switch

The rudder boost pressure switch (2, figure 1-16) on the forward end of the control stand has ON--OFF positions and is guarded to ON. This switch opens or closes a shutoff valve in the main hydraulic system pressure line leading to rudder boost actuating units. The rudder boost switch is wired in series with a switch operated by the surface lock handle. The rudder boost system is turned on by positioning the rudder boost switch to ON and the surface lock handle to DOWN-UNLOCKED position. Placing the switch in OFF closes the shutoff valve and automatically depressurizes the rudder boost system; the rudder tab is then cable operated. Power and circuit protection is through the overhead circuit breaker panel (figure 1-34).



LEGEND AND NOTES

▬ PRESSURE
▨ RETURN
— — MECHANICAL
—— ELECTRICAL

❶ When right rudder is applied, pressure line from metering valve to actuating cylinder becomes return line.

❷ Shut-off and bypass valve shuts off when pressure is low.

RUDDER BOOST HYDRAULIC SYSTEM

Figure 1-36

WING FLAP SYSTEM

The electrically operated wing flaps are of the Fowler type. Lowering the flaps moves the left elevator trim tab proportionally to prevent a nose-high condition. Raising the flaps moves the left elevator trim tab proportionally to prevent a nose-low condition. An auxiliary motor (3, figure 1-38) mechanically connected to the normal wing flap motor (4, figure 1-38) is used to raise or lower the flaps if the normal motor fails. This motor is portable and is also used for emergency operation of the main landing gear. A warning horn will sound at any flap setting when any combination of two throttles for engines on opposite sides of the airplane are advanced more than three-fourths open except between 22 percent and 44 percent with the weight of the airplane on the landing gear. Operating DC power for the main and auxiliary wing flap motors is through separate current limiters on the main power panel (figure 1-34). Control circuit protection is through the overhead circuit breaker panel (figure 1-34) for the normal wing flap motor and through a circuit breaker on the main circuit breaker panel for the auxiliary wing flap motor.

WING FLAP SWITCH

The wing flaps are normally controlled by a switch (20, figure 1-16) on the control stand. The switch has DOWN--OFF--UP positions, and is spring-loaded to OFF from both the down and up positions. Holding the switch in UP or DOWN fully raises or lowers the flaps in approximately 25 seconds. The flaps are held in any intermediate position by releasing the switch to OFF. A circuit breaker for the flap control is provided on the overhead circuit breaker panel (figure 1-34).

EMERGENCY WING FLAP SWITCH

A guarded DOWN--OFF-UP switch (17, figure 1-12) on the overhead panel controls the wing flap auxiliary motor. The switch is spring-loaded and guarded to OFF. Holding the switch in UP or DOWN fully raises or lowers the flaps in approximately 25 seconds. Care must be used when the emergency wing flap switch is operated as there are no limit switches on the auxiliary motor circuit and the operation of the motor after the stops are encountered will impose high torsional loads on the flap torque tube system and may result in a burned out auxiliary motor clutch. The flaps are held in any intermediate position by releasing the switch to OFF. Circuit protection is through the main circuit breaker panel (figure 1-34).

CAUTION

Since the emergency wing flap system does not incorporate limit switches, impact loads imposed on the flap drive system at the extremities of wing flap travel are considerably higher than those imposed when the normal wing flap system is operated. Therefore, the use of the emergency wing flap switch should be limited except in event of emergency. Refer to Section III for procedure to be used in emergency wing flap training operations.

WING FLAP POSITION INDICATORS

Two wing flap position indicators (33, figure 1-9) on the pilots' instrument panel register flap position in percent. Failure of the wing flap drive mechanism will be indicated by a difference in the instrument readings. A circuit breaker for the wing flap position indicators is on the overhead circuit breaker panel (figure 1-34).

WING FLAP POSITION MARKINGS

There are three orange color stripes painted on the top side of each wing flap, outboard of the inboard nacelles. These stripes provide a means for visually checking the amount of wing flap travel from the scanners position in the main compartment during flight operation. Each stripe is marked with corresponding numerals indicating the percent of wing flap travel.

LANDING GEAR SYSTEM

The fully retractable tricycle landing gear is electrically operated and consists of two main dual-wheel landing gears and a steerable dual-wheel nose gear. The landing gear is exceptionally friction free in operation and extends fully in approximately 4 seconds and retracts fully in approximately 10 seconds. The main and nose landing gears are mechanically locked in the up and down positions. Only motor or manual operation will unlock and retract or extend the gear. Three ground safety locks, one for each landing gear (figure 1-37) are provided to prevent accidental collapse of the landing gear while on the ground. Red warning streamers are attached to the locks for easy recognition. Oleo actuated safety switches are provided on both main gear oleos and the nose gear oleo to prevent accidental retraction of the landing gear when the airplane is on the ground. These oleo actuated safety switches are wired in series, so that all three switches must be closed before any of the landing gear may be retracted. Manual operation is provided for each main and nose gear and portable auxiliary motor operation is provided for the main landing gear. In an emergency these controls can be quickly and easily reached. The auxiliary flap motor (3, figure 1-38) mounted above the normal wing flap motor, can be removed and used for emergency operation of the main gear; however, the hand crank is simpler and quicker for emergency extension of the gear. To use the motor for landing gear operation, it must be removed from the mounting bracket by the wing bolts and mounted on the landing gear adapter. The motor is controlled by a switch at the top of the motor. The switch has three positions, and is moved in the indicated direction for the required operation. The circuit breaker for the auxiliary flap motor is on the main circuit breaker panel (figure 1-34).

LANDING GEAR SWITCH

A DOWN--OFF--UP switch (8, figure 1-16) on the control stand controls normal landing gear extension or retraction. When the switch is in the UP position, the landing gear will retract provided all wheels are off the ground; when in the DOWN position, the landing gear will extend; and when in the OFF position, the landing gear actuation circuits are de-energized. Three circuit breakers, on the overhead circuit breaker panel (figure 1-34) provide individual circuit breaker protection for each landing gear normal control circuit. Each main landing gear motor receives power through a current limiter in the main power panel (figure 1-34). The nose gear motor receives power through a circuit breaker on the forward power panel (figure 1-34).

EMERGENCY RETRACTION SWITCH

TCTO 299

The landing gear emergency retraction switch (29, figure 1-12) on the overhead panel will permit the landing gear to be retracted should an emergency occur during the takeoff run or landing roll. The switch is spring-loaded and guarded from SAFETY OVERRIDE to the NORMAL position. Holding the switch in the SAFETY OVERRIDE position will override the oleo safety switch circuit. The normal landing gear switch must be in the UP position before the landing gear emergency retraction switch will energize the system. DC power and circuit protection is through the overhead circuit breaker panel (figure 1-34).

WARNING HORN RELEASE SWITCH

The warning horn, on the ceiling above the copilot, will sound if any landing gear is not extended and locked, and any throttle is retarded to less than 1/5 open. It will also sound at any flap setting when any combination of two throttles for engines on opposite sides of the airplane are advanced more than three-fourths open, in either forward or reverse thrust, except between 22 percent and 44 percent with the weight of the ariplane on the landing gear. A NORMAL--HORN RELEASE switch (7, figure 1-16), spring-loaded from HORN RELEASE to the NORMAL position is provided on the control stand. When the switch is actuated to the HORN RELEASE position, the warning horn is silenced until again energized by one of the above conditions. The warning horn will sound for each throttle independent of the others. The warning horn release switch will not silence the horn when the airplane is on the ground. Circuit protection is through the overhead circuit breaker panel (figure 1-34).

EMERGENCY HAND CRANKS

In an emergency, the landing gear can be operated manually by hand cranks. The nose gear crank (2, figure 1-38) is on the underside of the lower nose compartment hatch. The main gear cranks (6, figure 1-38) are adjacent to the emergency operation adapters on each side of the airplane, aft of the rear spar. The number of turns to raise or lower the landing gear are: 490 turns for main gear, 220 turns for nose gear.

CLUTCH HANDLES

Clutch handles (5, figure 1-38) and a clutch lever (1, figure 1-38) are located near the landing gear emergency operation adapters. Operation of the clutches releases the normal landing gear motors and engages the manual systems. The pull handles must be pulled out approximately twelve inches when the manual system is used.

LANDING GEAR POSITION INDICATORS

Three tab-window type indicators (36, figure 1-9) on the pilots' instrument panel show, by interchangeable tabs, the positions of the main and nose gears. When any gear is up and locked, the corresponding UP tab will appear in the window; a landing gear in an intermediate position will be indicated by a tab with slanting alternate red and white stripes; and a down and locked gear will be indicated by a tab showing a symbol of a wheel. When power is off, a slanting red and white stripe tab will show in the window. Power and circuit protection is through the overhead circuit breaker panel (figure 1-34).

LANDING GEAR WARNING LIGHT

A red warning light (38, figure 1-9) on the pilots' instrument panel is illuminated unless all three landing gears are extended and locked or unless all three gears are retracted and locked with all throttles more than 1/5 open. Power and circuit protection is through the overhead circuit breaker panel (figure 1-34).

WHEEL WELL OVERHEAT WARNING LIGHTS

TCTO 558

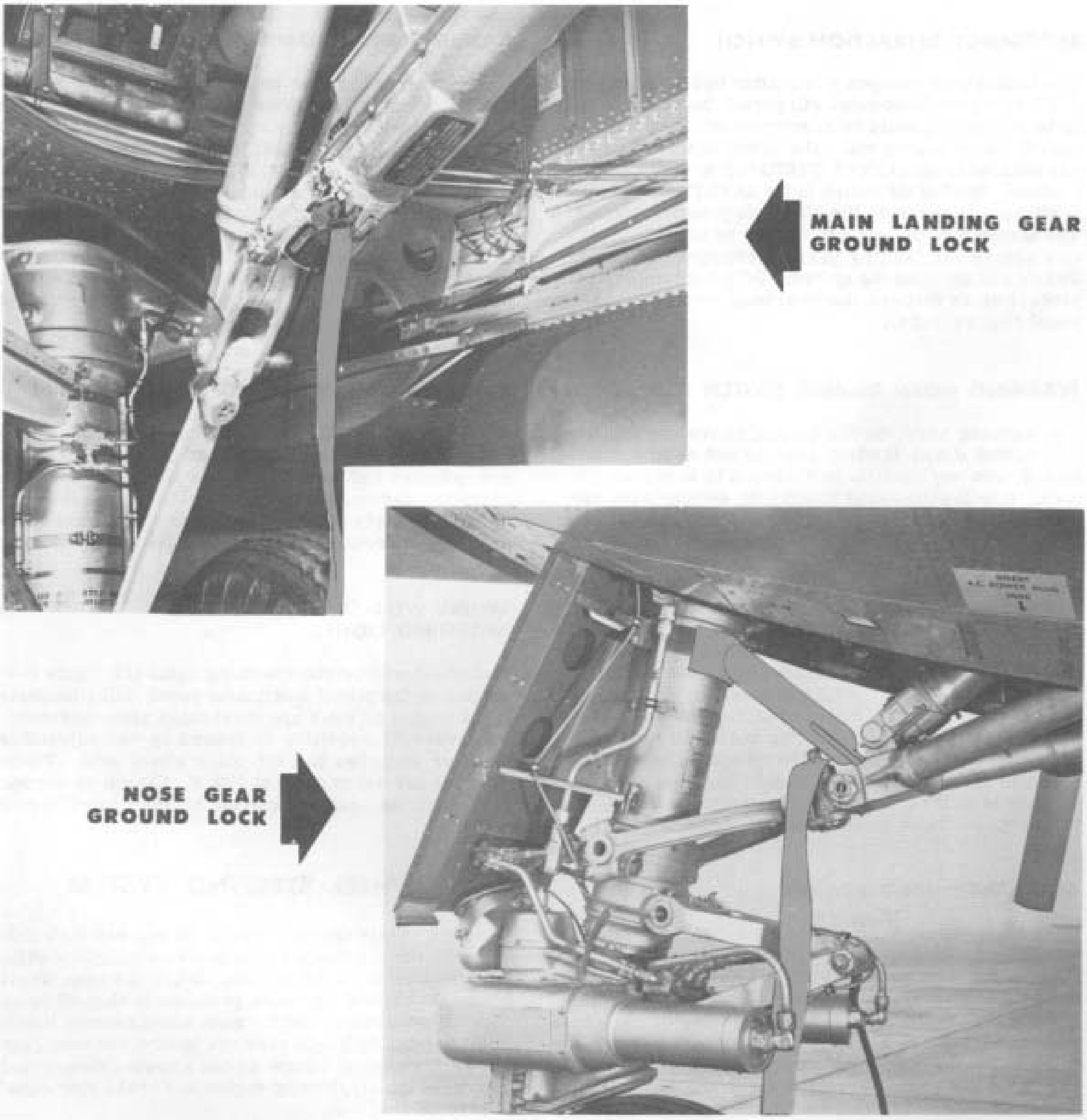
Two wheel well overheat warning lights (22, figure 1-9) located on the pilots' instrument panel, will illuminate if the brakes or tires are overheated when retracted. The overheat condition is sensed by two adjustable detector switches in each main wheel well. These switches are set to close at 200°F. Circuit protection is through the overhead circuit breaker panel (figure 1-34).

NOSE WHEEL STEERING SYSTEM

The nose wheels are steerable to 68 degrees each side of center through hydraulically operated cylinders while the airplane is on the ground. When the nose wheel leaves the ground, hydraulic pressure is shut off by an oleo-actuated valve, and the nose wheel centers itself. In the event of hydraulic pressure failure, the nose gear has a conventional castor action allowing directional control of the airplane by engine and brake operation. See figure 1-39.

NOSE STEERING WHEEL

Nose gear steering is controlled by a steering wheel (10, figure 1-7) mounted on a pedestal forward and

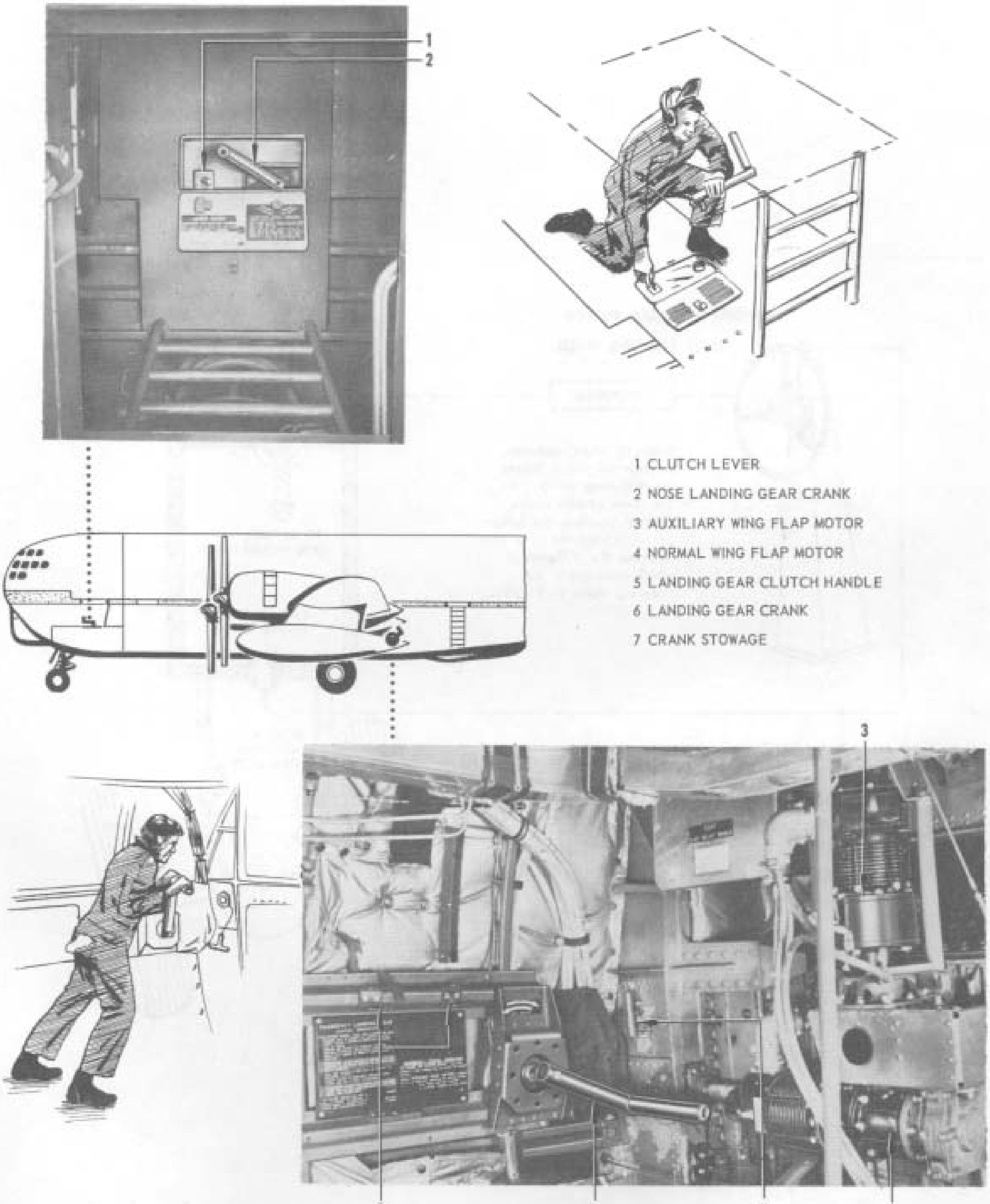


MAIN LANDING GEAR GROUND LOCK

NOSE GEAR GROUND LOCK

LANDING GEAR GROUND SAFETY LOCKS

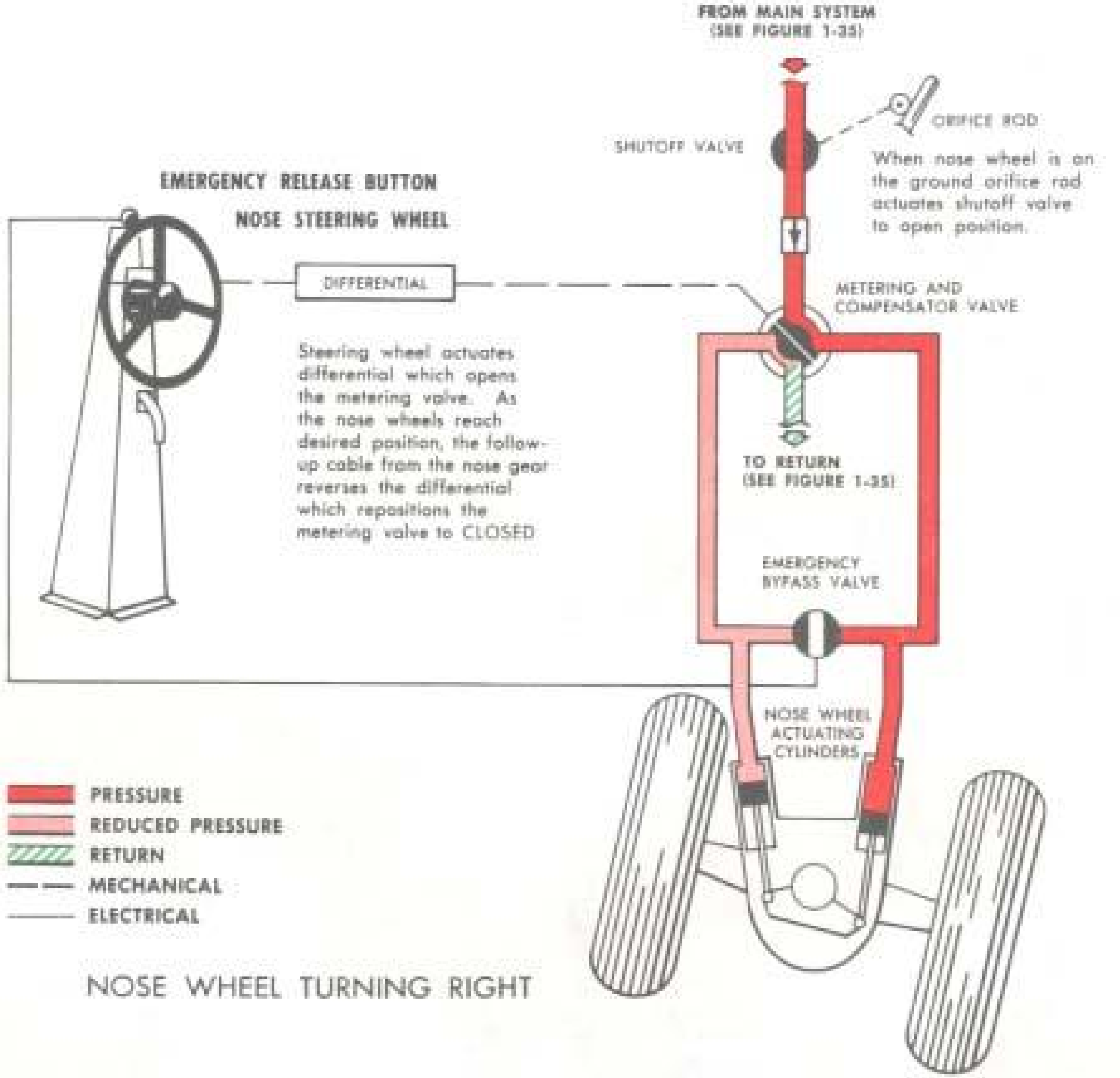
Figure 1-37



1 CLUTCH LEVER
2 NOSE LANDING GEAR CRANK
3 AUXILIARY WING FLAP MOTOR
4 NORMAL WING FLAP MOTOR
5 LANDING GEAR CLUTCH HANDLE
6 LANDING GEAR CRANK
7 CRANK STOWAGE

LANDING GEAR EMERGENCY CONTROLS

Figure 1-38



When nose wheel is on the ground orifice rod actuates shutoff valve to open position.

Steering wheel actuates differential which opens the metering valve. As the nose wheels reach desired position, the follow-up cable from the nose gear reverses the differential which repositions the metering valve to CLOSED.

NOSE WHEEL TURNING RIGHT

NOSE WHEEL STEERING HYDRAULIC SYSTEM

Figure 1-39

to the left of the pilot's control column. An arrow on the wheel and a mark on the pedestal indicate when the nose wheel is centered. The nose wheel turns in the direction selected by the steering wheel and remains in that position until the steering wheel is returned to center. A cable follow-up system will return the nose wheel to its original course should the wheel be deflected momentarily by some obstacle. Nose wheel must be centered before gear will retract.

CAUTION

When the airplane is being towed by the nose wheel and the hydraulic system is charged, do not operate the steering wheel as this action will damage the mechanism.

EMERGENCY DISCONNECT BUTTON

When manually depressed, the push-pull button on the steering pedestal (5, figure 1-7) electrically actuates the bypass valve, bypassing hydraulic fluid pressure past the steering cylinders and allowing the nose wheel to caster. This button is used to release the nose wheel in event of steering system malfunction. An indicator light, within the push-pull button, illuminates when the button is depressed. The button must be raised manually to re-engage the steering mechanism. Power and circuit protection is through the forward power panel (figure 1-34).

NOTE

DC power must be available for operation of the emergency nose wheel disconnect.

BRAKE SYSTEMS

SERVICE BRAKE SYSTEM

Main hydraulic system pressure is used to operate the service brakes. See figure 1-40. Toe pressure on the pilot's or copilot's rudder pedals will actuate the brakes in the conventional manner. However, the brake ports of the copilot's brake metering valves are connected to the return ports of the pilot's brake metering valves. Therefore, hydraulic pressure which enters the brake system due to operation of the copilot's brake metering valves must pass through the pilot's metering valves before reaching the brakes. Whenever the pilot applies slight pedal pressure, additional hydraulic pressure is prevented from entering the brake system due to operation of the brakes by the copilot. In addition the hydraulic pressure that is applied by either pilot returns through the copilot's metering valve. Therefore, when the copilot applies brake pressure, only that portion of the hydraulic pressure applied by the pilot which is in excess of that applied by the copilot will return to the reservoir when the pilot releases his brakes. Hydraulic pressures at the brakes are not additive. If equal brake pedal pressure is applied by both pilot and copilot, the hydraulic pressure which reaches the brakes is identical to that which would have reached the brakes if only the pilot has applied pressure.

NOTE

If the pilot has applied pressure to his brake pedals first, the copilot's brake pedals are rendered inoperative until the pilot has released the pressure on his brake pedals.

CAUTION

Brake action normally should be applied by the pilot. If it becomes necessary for the copilot to apply brakes, the pilot must release his brake pedals. This is necessary to allow copilot's braking action to be effective through the pilot's metering valves.

Hydraulic Fuses

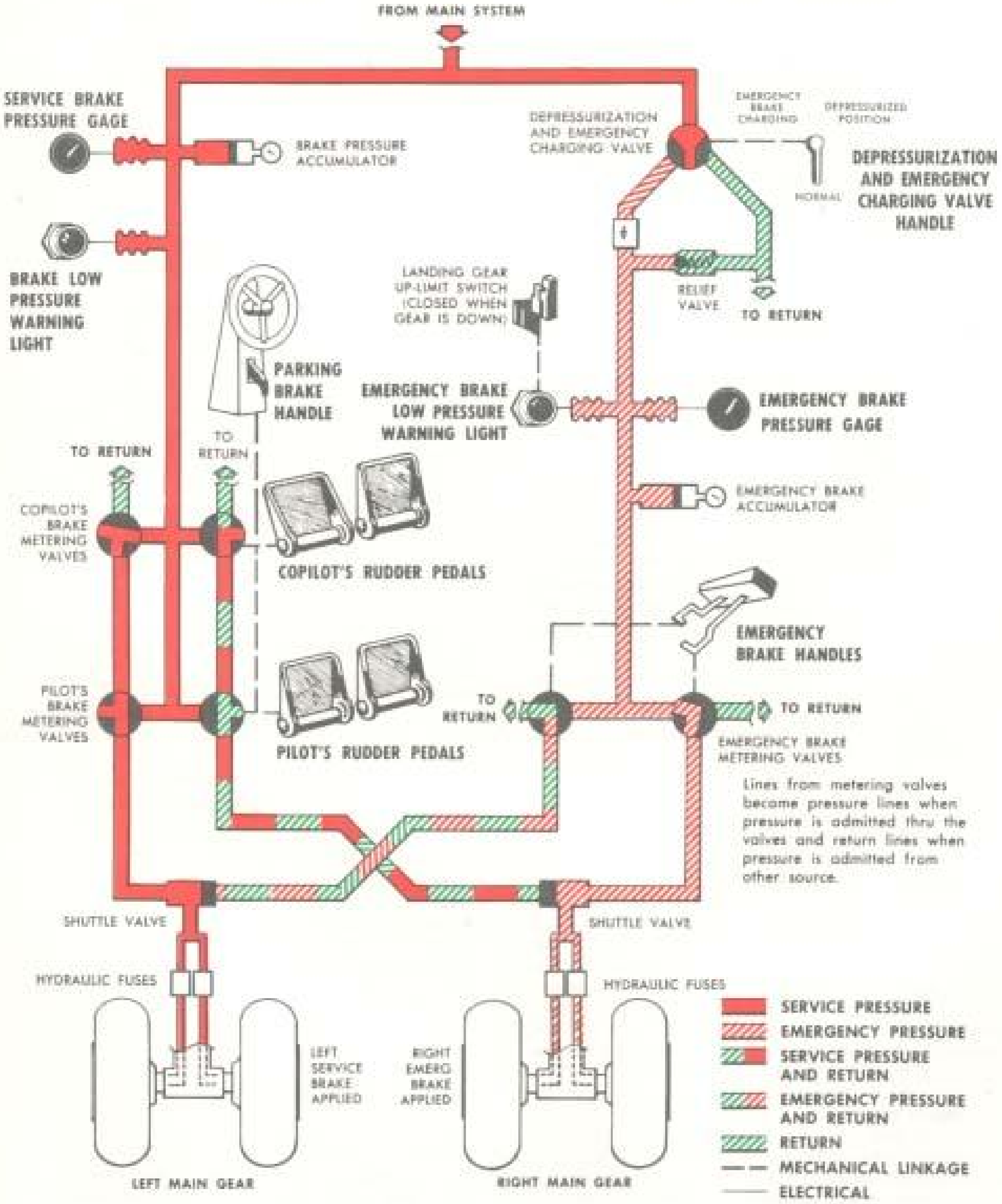
A hydraulic fuse in the brake line to each wheel is designed to shut off the flow of fluid after a quantity of fluid somewhat in excess of that required to operate the brakes has passed the fuse See figure 4-40. Should a brake line rupture, the fuse will close and stop the flow of fluid through the brake line until the brakes are released. When the brakes are released the fuses will reset themselves. If the affected brake is actuated again, a like amount of fluid will be lost until the fuse again shuts off flow.

Parking Brake Handle

A parking brake handle (9, figure 1-7) is on the nose wheel steering pedestal. Parking brakes are set by applying toe pressure to the pilot's rudder pedals and pulling the spring-loaded parking brake handle upward. The parking brakes are automatically released when the pilot's rudder pedals are again depressed.

EMERGENCY BRAKE SYSTEM

The emergency brake system (figure 1-40) stores pressure in an accumulator for emergency operation of the service brakes. The accumulator capacity normally will allow three full applications of the brakes. With 1C-97 541 incorporated, only two full applications of the emergency brakes are available.



Lines from metering valves become pressure lines when pressure is admitted thru the valves and return lines when pressure is admitted from other source.

SERVICE AND EMERGENCY BRAKE SYSTEM

Figure 1-40

Emergency Brake Levers

Two emergency brake levers on the ceiling over the pilots' station are mechanically linked to the emergency metering valves. Pulling handles downward meters hydraulic pressure to the brakes. Each handle controls one main landing gear brake. Handles may be used individually or together.

DEPRESSURIZATION AND EMERGENCY CHARGING VALVE HANDLE

This is a three position handle, with EMERGENCY BRAKE CHARGING--NORMAL--DEPRESSURIZED positions (12, figure 1-15). Moving this handle to the EMERGENCY BRAKE CHARGING position, allows main system pressure to charge the emergency brake accumulator. With the valve handle in this position system pressure will continue to be maintained. For NORMAL--DEPRESSURIZED position operation see MAIN HYDRAULIC SYSTEM this Section.

BRAKE SYSTEM PRESSURE GAGE

A pressure gage for the service brake system (29, figure 1-9) is on the pilots' instrument panel, and a gage for emergency brake system pressure (1, figure 1-15) is on the copilot's auxiliary panel. The gages are marked in psi. Circuit protection and 26 volts AC power is through the AC power panel (figure 1-34).

BRAKE SYSTEM LOW PRESSURE WARNING LIGHTS

Two amber warning lights (28 and 25, figure 1-9) on the pilots' instrument panel are provided for the service and emergency brake systems. The service brake system warning light will illuminate whenever hydraulic pressure is below 900 psi, and the emergency brake system warning light will illuminate whenever emergency brake pressure is below 1250 psi. Both lights are wired so that they operate only when the landing gear is extended. The lights are supplied 28 volt DC power through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

INSTRUMENTS

Only those instruments which are not properly a part of a complete system such as fuel system are listed in figure 1-41. The instruments listed include pitot and static operated instruments, alternating current operated instruments, and direct current operated instruments.

PILOT'S ATTITUDE INDICATOR

The pilot's attitude indicator is installed on the left side of the pilots' instrument panel and is supplied with power from the 115 volt AC pilots' instrument inverters through circuit protection on the AC power panel (figure 1-34). A warning flag marked OFF becomes visible if power

INSTRUMENT	OPERATING POWER	POWER SOURCE	CIRCUIT PROTECTION LOCATION
Airspeed Indicators	Pitot and Static Systems	Pitot and Static Systems	None
Altimeters	Static System	Static System	None
Vertical Velocity Indicators	Static System	Static System	None
❶❷❸ **Pilot's Turn and Slip Indicator**	DC Electric	DC Power Distribution System	Overhead Circuit Breaker Panel
❶❸ **Pilot's Direction Indicator**	Emergency Power AC Electric	Pilots' Instrument Inverter	DC Power Panel AC Power Panel
❶❸ **Pilots Attitude Indicator**	AC Electric	Pilots' Instrument Inverter	AC Power Panel
Outside Air Temperature Gages	DC Electric	DC Power Distribution System	Overhead Circuit Breaker Panel

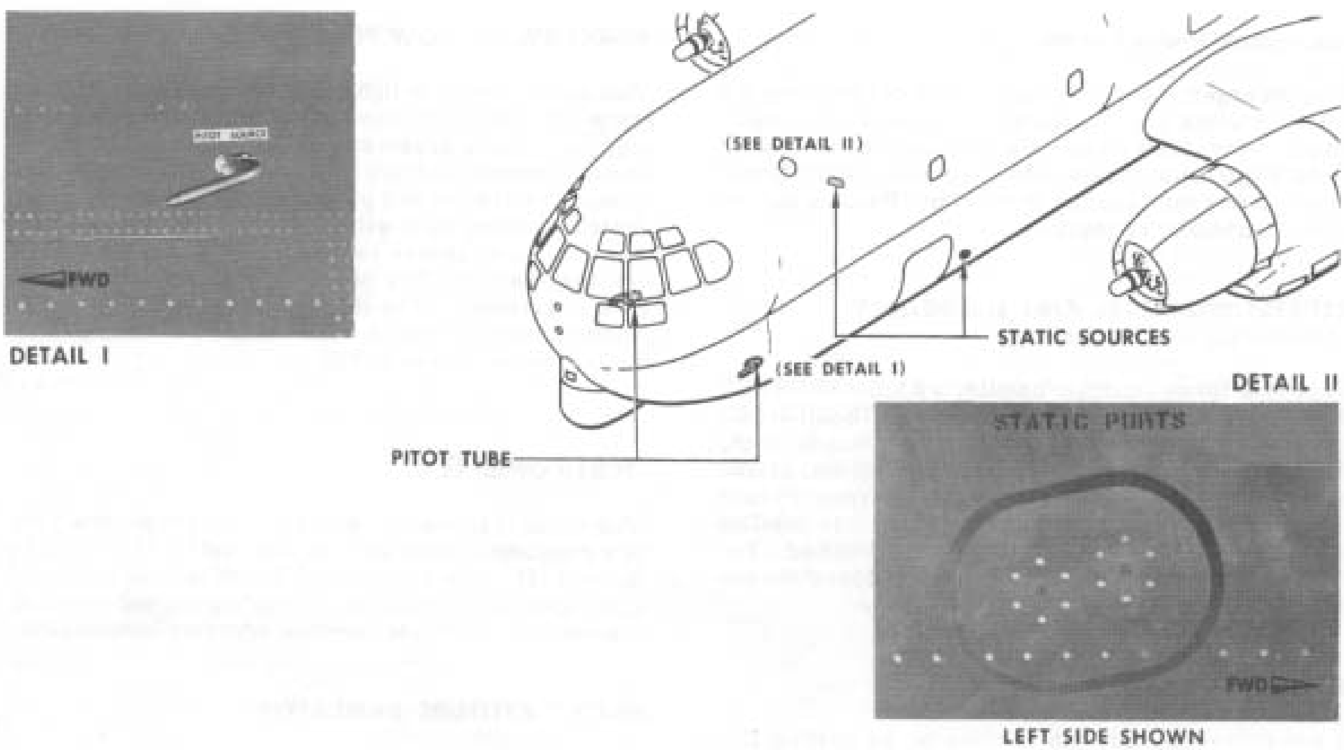
❶ These instruments can be operated by battery power in case of DC power failure if the pilot's instrument inverter emergency power switch is positioned to battery. See figure 1-31.

❷ Pilot's turn-and-slip indicator is calibrated for four minute turns. Copilot's turn-and-slip indicator is calibrated for two minute turns.

❸ For copilot's instruments see figure 1-30 and Autopilot Section IV.

INSTRUMENTS

Figure 1-41



PITOT AND STATIC SOURCES

Figure 1-42

from any phase is cut; however, it does not indicate incorrect readings caused by mechanical malfunction which should be detected by cross referencing the other flight instruments. Should partial or complete power failure occur, the instrument will remain operative until the gyro loses speed, providing adequate time to switch on the gyro instrument emergency power; however, should the instrument become sluggish or the horizon bar waver due to the gyro losing speed, it should be caged until emergency power has been established and the gyro has had sufficient time to regain speed. The instrument may be caged by means of a gyro centering device operated by pulling out the cage knob on the front of the instrument.

On airplanes not incorporating TCTO 563, a type J-8 attitude indicator is installed. The instrument has 360 degrees of freedom in roll and a minimum of ± 80 degrees in pitch. The horizon bar and sphere indicate the degree of climb or dive in reference to a miniature airplane. Maximum horizon bar deflection in climb or dive is approximately 27 degrees. The sphere shows no markings in level flight but CLIMB or DIVE markings appear if the airplnae is climbed or dived over 27 degrees. Concentric lines and circles on the top and bottom of the sphere indicate 70, 80 and 85 degrees of climb and dive. A knob on the front of the instrument adjusts the miniature airplane to indicate zero pitch in a shallow climb or dive. The degree of bank is indicated by the position of the bank index pointer relative to the 10, 20, 30, 60 and 90 degree markings on the case.

On airplanes incorporating TCTO 563, a type MF-2 attitude indicator is installed. It embodies a card type face and a double horizon bar. The degree of climb or dive is indicated by reference of the miniature airplane to the horizon bar. Maximum horizon bar deflection in climb or dive is approximately 27 degrees. A knob on the front of the instrument adjusts the miniature airplane to indicate zero pitch in a shallow climb or dive. The degree of bank is indicated by the position of the bank index pointer relative to the angle of bank markings on the case.

NOTE

After applying power to the type J-8 and MF-2 attitude indicators, a period of 30 seconds should be allowed for the gyro to attain speed. The instrument should then be caged immediately to prevent unnecessary torque stresses on the instrument mechanism.

CAUTION

- Caging of the J-8 and MF-2 attitude indicators should be kept to a minimum. Care should be exercised when caging the instrument on the ground or in the air to avoid undue stresses to the gyro bearings. The airplane should always be in a straight and level attitude when caging the instrument in flight.
- It is possible for the J-8 attitude indicator to erect in the inverted position; therefore, after the J-8 attitude indicator has been energized at least 30 seconds, cage the attitude prior to takeoff to insure proper erection.

WARNING

A slight amount of pitch error in the indication of the J-8 and MF-2 attitude indicators will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error is most noticeable at the time the airplane breaks ground during the takeoff run. At this time, a climb indication error will normally be noticed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual takeoff, but will generally be approximately 1 1/2 bar widths. The erection system will automatically remove the error after the acceleration ceases.

PILOT'S INSTRUMENT INVERTER EMERGENCY POWER SWITCH

For a description of this switch, see AC POWER SYSTEM in this Section.

ALTIMETER

Altimeters are provided, one each, for the pilot, copilot (27, figure 1-9), navigator and on airplanes 22737 ▶ , one for the engineer (20, figure 1-22). The altimeter registers pressure altitude above sea level with compensating mechanisms for variation in station barometric pressure. Three pointers on the altimeter give pressure altitude, the long pointer (4, figure 1-43) indicates hundreds of feet altitude; the broad pointer (2, figure 1-43) indicates thousands of feet, and the small pointer with the triangular index marker on the outer edge of the dial (1, figure 1-43) indicates tens of thousands of feet. The Kollsman window (3, figure 1-43) and the set knob (6, figure 1-43) are interconnected to allow the altimeter to be set to station barometric pressure corrected to sea level pressure. The low altitude warning indicator (5, figure 1-43) is a cross hatched area that comes into view below 16,000 feet.

WARNING

It is possible to misset an altimeter by 10,000 foot increments and still have the proper pressure setting in the Kollsman window. Check all three pointers to be sure the altimeter indicates the proper field elevation before takeoff.

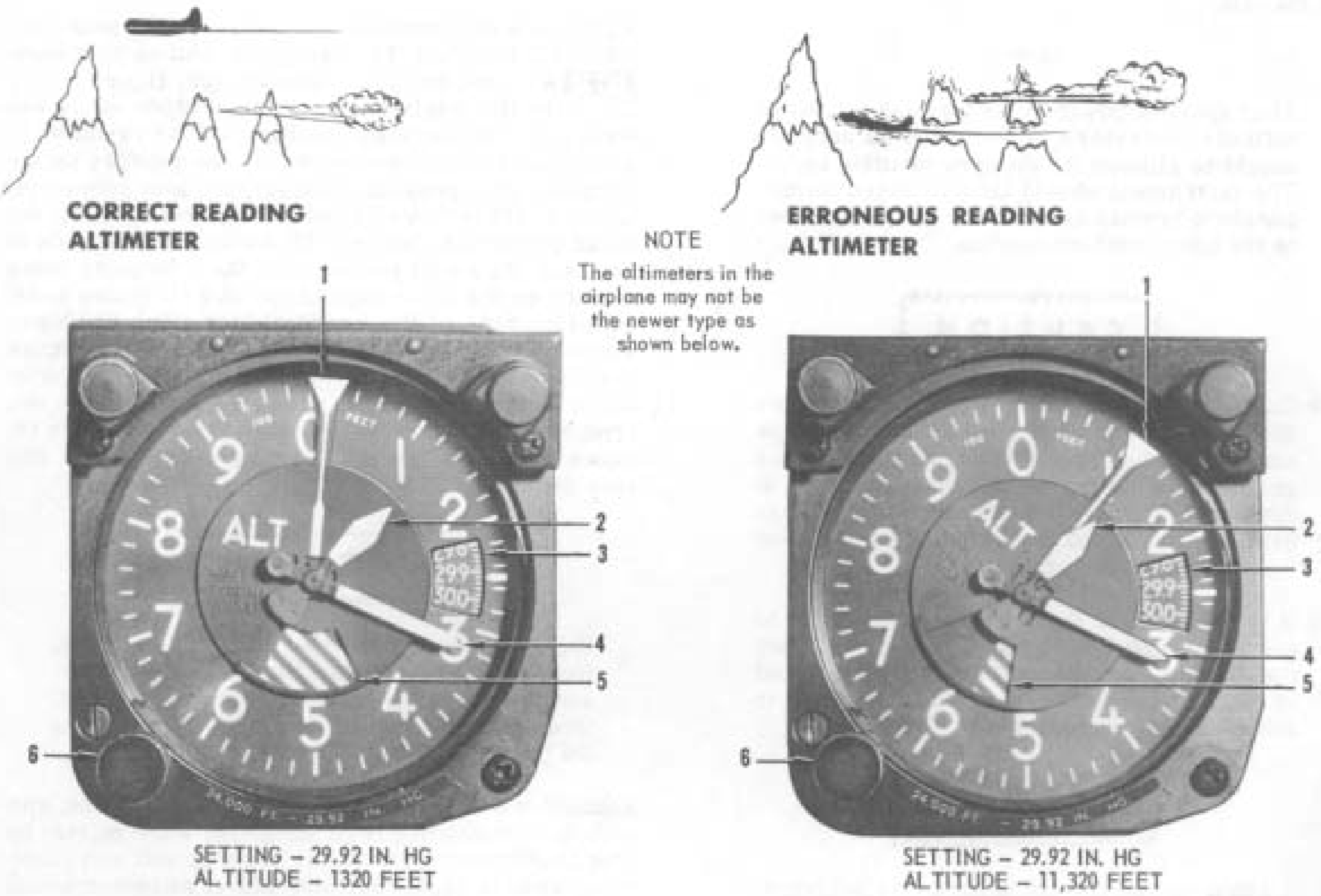
Atmospheric pressure rate of change decreases with altitude. Therefore if an altimeter were misset by plus 10,000 feet at sea level and a takeoff and climb were made to 10,000 feet the misset altimeter would not read 20,000 feet but would read approximately 25,000 feet giving an indication of approximately 15,000 feet more altitude than the airplane actually had. As the airplane climbs higher a greater error would exist. If the altimeter were misread in addition to misset the error could be greater or smaller.

NOTE

Reset altimeter to 29.92 in Hg when climbing through 23,500 feet. Reset altimeter to current setting when descending through 24,000 feet.

EMERGENCY EQUIPMENT

The location of the emergency equipment, except for the engine fire detection and extinguishing systems, is shown in figure 3-1.



CORRECT READING ALTIMETER

SETTING – 29.92 IN. HG
ALTITUDE – 1320 FEET

NOTE
The altimeters in the airplane may not be the newer type as shown below.

ERRONEOUS READING ALTIMETER

SETTING – 29.92 IN. HG
ALTITUDE – 11,320 FEET

NOTE
Altimeter setting is 10,000 feet high

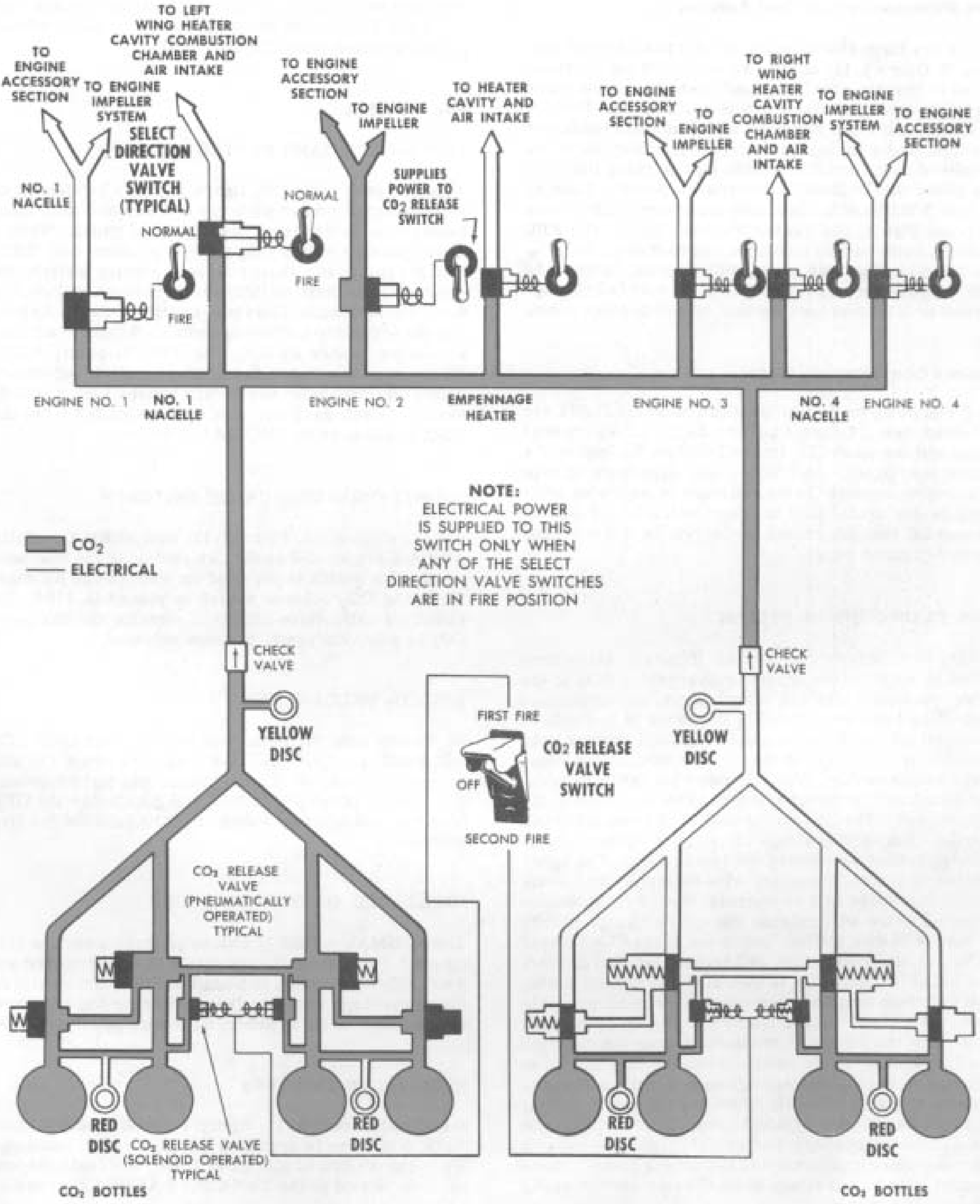
1 TEN THOUSAND FOOT POINTER (INDICATES TENS OF THOUSANDS OF FEET)
2 THOUSAND FOOT POINTER (INDICATES THOUSANDS OF FEET)
3 KOLLSMAN WINDOW
4 HUNDRED FOOT POINTER (INDICATES HUNDREDS OF FEET)
5 LOW ALTITUDE WARNING INDICATOR
6 SET KNOB

ALTIMETER SETTINGS

Figure 1-43

FIRE DETECTOR SYSTEM

An automatic fire detector system is provided to detect a fire condition in any of the power packages or combustion heater areas. The system illuminates red master fire warning lights on the pilots' and engineer's instrument panels if a fire condition exists. The exact area which has a fire condition is indicated by fire warning lights located on the overhead panel (10 and 14, figure 1-12), and on airplanes incorporating TCTO 558 on the pilots' instrument panel (22, figure 1-9). Fire sensing units located behind the exhaust collector ring, around the turbosupercharger, on the engine oil tank, in the accessory section of the power package, in the wing D ducts, in the combustion heater cavities, around the APU and on airplanes incorporating TCTO 558 in the main landing gear wells, cause the fire warning lights to illuminate during a sudden overheat condition such as a fire would cause. The fire detector system is powered from 28 volts DC through circuit breakers on the overhead circuit breaker panel. The master switch must be on to operate the fire detector system. The battery switch must be ON BUS, the master switch must be ON, and the nose gear must be extended and contacting the ground so as to actuate the oleo switch in order to operate the system from battery power.



FIRE EXTINGUISHER SYSTEM

Figure 1-44

Fire Detector System Test Buttons

There are three fire detector system push-to-test buttons (8, figure 1-12) on the fire section of the overhead panel to test the continuity and operation of the three circuits making up the fire detector system. Pushing either circuit 1 and 2 buttons will illuminate the power package fire warning lights on the fire section of the overhead panel and the master fire warning lights on the pilots' and engineer's instrument panels. Pushing circuit 3 button will illuminate the power package fire warning lights, the heater warning lights, the APU warning lights and on airplanes incorporating 1C10 558 the main landing gear wheel well warning lights. The test circuits are operated from 28 volt DC through circuit breakers on the overhead circuit breaker panel.

Master Fire Warning Lights

Two red push-to-test master fire warning lights are provided; one (34, figure 1-9) on the pilots' instrument panel and the other (73, figure 1-22) on the engineer's instrument panel. Both lights will illuminate in case of a sudden increase in temperature in engine or anti-icing heater areas, APU or wheel well area. Power is 28 volt DC through circuit protection on the overhead circuit breaker panel.

FIRE EXTINGUISHER SYSTEM

A CO_2 fire extinguisher system (figure 1-44) is provided to supply two separate charges of CO_2 to the power packages, wing anti-icing heaters, and empennage anti-icing heaters. The CO_2 is stored in two sets of four bottles, each set located in a main landing gear wheel well. Each set of bottles will furnish one complete charge of CO_2. The two upper bottles in each set are fitted with solenoid actuated valves to release the CO_2 charge. The CO_2 charge released from the upper bottles actuates the release valves on the lower bottles through tubing connecting the two bottles. The upper bottles are also connected with tubing so that if one of the solenoids fail to operate, the other solenoid-actuated valve will release the entire charge of CO_2 in the set of four bottles. Actuation of the CO_2 release switch in either direction will release the charge from one set of bottles. CO_2 is then directed through tubing to a common manifold line which serves all probable fire areas. Select direction switches open directional control valves located in the lines between the manifold and fire areas. These valves direct the CO_2 charge to be dispersed in the selected fire area through perforated runs of tubing or directly into the equipment. A CO_2 bottle is also located adjacent to the APU. Actuation of the APU CO_2 release switch (11, figure 1-12) will discharge the entire bottle into the turbine cover. These control switches are located on the fire section of the overhead panel (figure 1-12). All controls are powered by 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

Fire Switches

FIRE SWITCH GANG PLATES

A switch gang plate (12, figure 1-12) is located aft of each group of power package and surface anti-icing heater fire switches on the overhead panel. When a power package switch gang plate is positioned to FIRE, it will actuate the select direction valve switch, the sheltered air door switch, the fuel valve switch, the fuel, oil, hydraulic fluid and cabin air bleed switch, and the propeller feathering switch. When the surface anti-icing heater switch gang plate is positioned to FIRE, it will actuate the surface anti-icing heater select direction valve fire switch and the heater shutoff switch. Each gang plate is spring-loaded from the FIRE position to the NORMAL position.

SELECT DIRECTION VALVE SWITCHES

These switches (15, figure 1-12) with NORMAL--FIRE positions are located on the fire section of the overhead panel. One switch is provided for each power package. When the CO_2 release switch is placed in FIRE, the select direction valve will open, allowing the charge of CO_2 to enter the power package selected.

APU CO_2 RELEASE SWITCH

An on-off toggle switch marked **AUX POWER UNIT CO_2 RELEASE** (11, figure 1-12), when positioned to ON will release the contents of a CO_2 bottle into turbine cover. The switch is spring-loaded and guarded to the OFF position, and when operated, must be held ON for five seconds.

SHELTERED AIR DOOR SWITCHES

The NORMAL--FIRE positions of these switches (15, figure 1-12) control the operation of the sheltered air door. When the switch is placed in FIRE, the sheltered air door stops ram air from entering the induction system. One switch is provided for each power package.

FUEL VALVE SWITCHES

A fuel valve switch (15, figure 1-12) with NORMAL--FIRE positions is provided for each power package. When the switch is placed in FIRE, the fuel selector valve is turned to the TANK TO MANIFOLD position.

When the switch is returned to NORMAL, the fuel selector valve will return to its originally selected position.

FUEL, OIL, HYDRAULIC FLUID AND CABIN AIR BLEED SWITCHES

One switch (15, figure 1-12), with NORMAL--FIRE positions, is provided for each power package. When the switch is placed in FIRE, fuel, oil, and hydraulic fluid are shut off from the power package and the cabin pressurizing air supply from that power package is shut off.

PROPELLER FEATHERING SWITCHES

The NORMAL--FIRE positions of these switches (15, figure 1-12) control the propellers. When the switch is placed in FIRE, the propeller feathers. This switch is spring-loaded to the NORMAL position and will return to NORMAL when released; however, the propeller will feather in the same manner as if the pilots' propeller feathering button were pressed.

ANTI-ICING HEATER SELECT DIRECTION VALVE SWITCHES

These switches (38, figure 1-12), one for each set of anti-icing heaters, are on the fire section of the fire section of the overhead panel. When the CO_2 release valve switch is placed in FIRE position, it actuates the directional control valve to allow CO_2 charge to enter the heater area from the fire extinguisher system manifold.

ANTI-ICING HEATER SHUTOFF SWITCH

These switches (37, figure 1-12), one for each set of anti-icing heaters, are on the fire section of the overhead panel. The switch, when actuated to FIRE, discontinues heater operation by stopping intake air flow and fuel supply to the heaters and de-energizes the heater ignition circuit.

BODY HEATER FIRE SWITCH

One body heater switch (39, figure 1-12) with NORMAL--FIRE positions on the fire section of the overhead panel is used to discontinue heater operation. When this switch is placed to FIRE position it will shut off the fuel supply to the body heaters besides de-energizing the heater ignition circuit. The APU fuel supply will also be shut off. Body heater fires cannot be extinguished from the airplane's fire extinguisher system, but will have to be extinguished with portable hand extinguishers stowed in the airplane.

CO_2 Release Switch

This guarded switch (13, figure 1-12) on the fire section of the overhead panel, releases the two charges of CO_2 when one or more select direction valve switches are positioned to FIRE. It has three positions, FIRST FIRE--OFF--SECOND FIRE. By moving and holding the switch at least 5 seconds to FIRST FIRE position, the charge of CO_2 from the left set of the CO_2 bottles will be released to the predetermined fire area. By moving and holding the switch to SECOND FIRE position for at least 5 seconds the remaining charge of CO_2 will be released.

NOTE

> The select directional valve switches must be ON to release the CO_2 charges. The 5 second holding of the CO_2 release switch allows positioning of the CO_2 release valve.

In order to use battery power to release the CO_2 charges; the master switch must be ON, the battery switch must be ON BUS, and the nose gear must be extended and contacting the ground so the oleo switch is actuated.

CO_2 Discharge Indicator Discs

Discharge indicator discs are provided on the left hand side of the inboard nacelles to visually determine if the CO_2 charge has been released from either set of bottles or any bottles within the set. A ruptured or missing yellow disc indicates the complete set of bottles have been discharged and needs replacing. Missing red discs indicate the bottles have been discharged by thermal expansion. A ruptured or missing aft red disc indicates the outboard bottles have been discharged and need replacing and a ruptured or missing forward red disc indicates the inboard bottles have been discharged and need replacing. There is also a discharge disc for the APU CO_2 bottle located in the skin adjacent to the APU exhaust. If the disc is ruptured or missing the bottle needs replacing.

HAND FIRE EXTINGUISHERS

Airplanes 17260 ▶ 2859 in the tanker configuration have seven hand fire extinguishers (6, figure 3-1) and airplanes 2860 ▶ in the tanker configuration have eight. Airplanes 17260 ▶ 2859 in the cargo configuration have six hand fire extinguishers and airplanes 2860 ▶ in the cargo configuration have seven. These are charged with bromochloromethane which is effective in combating all types of fires. The effective range of the extinguishers is 25 feet, when operated vertically to within 15 degrees from horizontal. One extinguisher is on the pilot's auxiliary panel in the control cabin. In the main compartment, one extinguisher is mounted on the forward bulkhead, another is mounted on the right side of the fuselage just aft of the forward cargo door, another is mounted on the miscellaneous equipment panel at the aft end of the compartment, and a fifth extinguisher is mounted on the right side of the fuselage across from the miscellaneous equipment panel. One extinguisher is located at the boom operator's station, and another on the aft entry door in the lower aft compartment. On airplanes 17260▶2859 , the extra extinguisher is mounted on the forward bulkhead in the lower forward compartment.

On airplanes incorporating 1C10 566 the lower forward compartment fire extinguisher is mounted on the fire fighters panel on the aft side of the radio rack in the lower forward compartment.

WARNING

Repeated or prolonged exposure to high concentrations of Bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken including the use of oxygen when available.

EMERGENCY ALARM BELL

The emergency alarm bells in the airplane are controlled by a single ON-OFF switch (16, figure 1-12) on the overhead panel. One alarm bell is located aft of the forward hatch on the ceiling of the lower forward compartment; another is located on the right side of the main compartment over the wing center section; another is located forward of the lower aft compartment entrance ladder in the lower aft compartment; another is located in the control cabin near the pilot's control column. On Code ▼ airplanes, a fifth alarm bell is located aft of the boom operator's station. On Code Ⓒ airplanes, the fifth alarm bell is located aft of the aft cargo doors. When the switch is positioned to ON, power is supplied from the emergency bus on the forward power panel or from the battery shield causing the bells to ring simultaneously. Circuit protection for the bell is on the forward power panel (figure 1-34).

AXES

There are two hand crash axes. One is located on the pilot's auxiliary panel (18, figure 1-11) and one is located on the miscellaneous equipment panel (8, figure 3-1) at the left side of the main compartment in the rear of the airplane.

EMERGENCY EXITS

Two emergency escape hatches (figure 3-7) are provided on each side of the fuselage. On airplanes not incorporating 1C10 529 the escape hatches are opened inboard by pulling a bar on the lower part of each hatch. On airplanes incorporating 1C10 529 , the escape hatches are opened inboard by pulling a lever marked PULL, located on the upper section of each hatch. See Section III for escape hatch operation. The pilot and copilot are each provided with an emergency exit window. These windows can be opened by pulling a handle inboard and sliding the window aft along a set of tracks. The aft entry door is provided with an emergency release handle for jettisoning the door during flight. The release mechanism overrides the latch and disconnects the winch cable and support arm. The door hinge design is such that as the door falls past the full open position, the hinge will disengage, allowing the door to fall free.

ESCAPE ROPES

Three escape ropes, stowed in bags (1, figure 3-1) are provided for use of crew members to lower themselves from the airplane in an emergency. One is located at the pilot's sliding window, one at the copilot's sliding window, and one at the left escape hatch aft of the trailing edge of the wing.

SIGNAL LAMPS

An interairplane signal lamp (19, figure 4-16) is located on the aft bulkhead on the left side of the control cabin and another is located just aft of the rear escape hatch on the right side of the main compartment. The signal lamp may be plugged into any convenient DC outlet receptacle.

LIFE RAFTS

On airplanes incorporating 1C10 239 four twenty man life rafts (9, figure 3-1) are located throughout the main compartment over the A/R tanks. The rafts are held in place by two straps. There are no special provisions for automatic launching of the rafts. Therefore, in order to launch the rafts, the straps must be unfastened and the rafts must be removed from the airplane through the escape hatches over the wing. After the rafts have been removed from the airplane, they can be inflated by pulling the CO_2 release cable.

DINGY RADIOS

There are two dinghy radios (10, figure 3-1) located on the top left side of the fuselage opposite the aft edge of the forward cargo door. The radios are held in place by straps. To remove the radios, unhook the straps and lower radios.

FIRST AID KITS

17260▶ 22628

There are positions for eight first aid kits (4, figure 3-1) in the airplane. Two first aid kits are in the control cabin: one on the pilot's auxiliary panel, and one on the right side of the cabin to the left of the water tank. Six first aid kits are in the main compartment: two on each side of the fuselage over the wing center section, one on the left side of the forward bulkhead, and one on the miscellaneous equipment panel.

22629▶

There are positions for fifteen first aid kits (4, figure 3-1). Two first aid kits are in the control cabin: one on the pilot's auxiliary panel and one on the right hand side of the cabin to the left of the water tank. There are twelve first aid kits in the main compartment: one is on the left side of the forward bulkhead, two are located just aft of the forward cargo door, three are located on the right hand side of the fuselage over the wing center section, and two are on the left hand side of the fuselage above the escape hatch over the wing center section, two are located over the aft escape hatch on the right hand side, one is located over the aft escape hatch on the left hand side, and one is on the miscellaneous equipment panel forward of the boom operator's station. One first aid kit is in the lower forward compartment opposite the forward entry door.

PYROTECHNIC PISTOL

A single-shot breech-loading double-action, pyrotechnic pistol (12, figure 3-1) and various colored flares are stowed in containers at the forward end of the navigator's table. The pistol is fired from a mount that is protected against cabin pressure loss by a manually operated external door. The pistol can be reloaded and refired repeatedly without removing it from the mount.

LANDING FLARES

Two flare tubes (6, figure 3-1) each containing one three-minute night landing parachute flare, are provided in the tail compartment. The flares are released electrically by actuating two flare release switches (35, figure 1-12) on the overhead panel.

FIRE FIGHTERS OXYGEN SETS

1610 566 ▶

Two sets of oxygen equipment, for use in fighting in-flight fires, are installed in the airplane. One is located on the aft side of the main compartment bulkhead to the right of the doorway, and the other on the aft side of the radio rack in the lower forward compartment. Each set consists of a portable oxygen cylinder equipped with a demand type oxygen regulator and a cylinder pressure indicator. A full-face type oxygen mask, stowed in a canvas container attached to the cylinder harness, incorporates a microphone and plug-in cord providing means of communication.

ENTRY DOORS

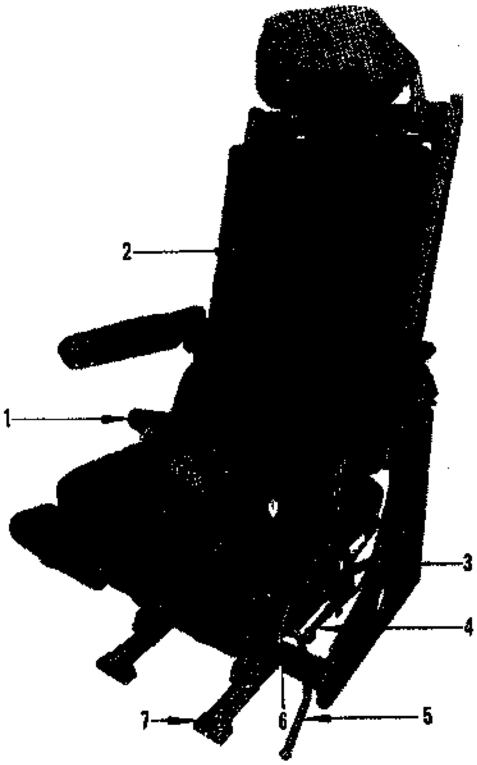
Entrance to the airplane is gained through the two entry doors on the left side of the fuselage. The forward entry door gives access to the lower forward cargo compartment and the aft entry door gives access to the lower aft compartment. These doors may be opened from the outside by placing the hand through an opening, which is covered by a flush type spring-loaded plate on the door, and pressing a trigger on the inner portion on the door. This procedure releases the handle on the outside of the door and it is then slowly lowered to the ground. Steps are built-in the door to allow ease of climbing into the airplane.

SEATS

CREW SEATS AND SAFETY BELTS

The pilot and copilot are provided with identical seats except that the seat controls for the pilot are on the left and for the copilot are on the right. These seats are fully adjustable for height and fore-and-aft-move-

1 SAFETY BELT
2 SHOULDER HARNESS
3 SEAT BACK ADJUSTMENT LEVER
4 SEAT ELEVATION LEVER
5 SEAT FORE AND AFT ADJUSTMENT LEVER
6 SHOULDER HARNESS INERTIA REEL LOCK HANDLE
7 SEAT TRACKS



PILOT'S SEAT

Figure 1-45

ment (figure 1-45). The engineer's and navigator's seats are adjustable for vertical, fore-and-aft and radial movements. (See figure 1-46.) These seats are provided with safety belts and shoulder harnesses. See Section IV for other seats.

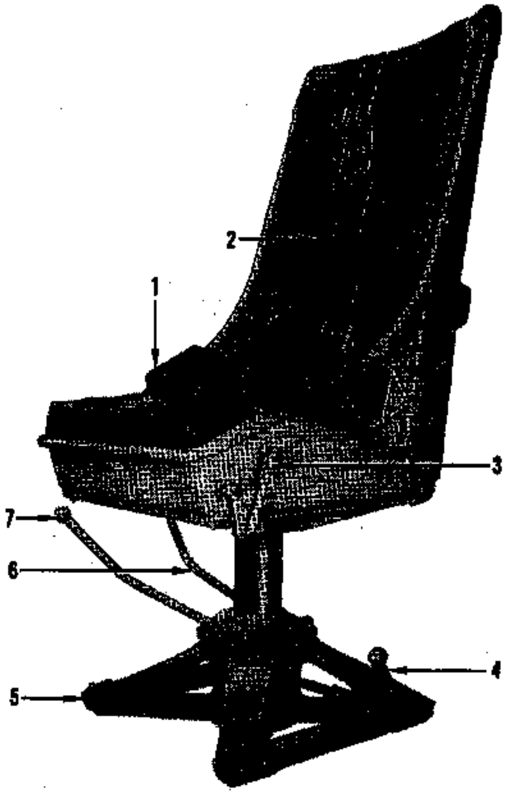
SHOULDER HARNESS INERTIA REEL LOCK HANDLE

A handle with LOCKED and RELEASED positions is located on the left side of the pilots', engineer's and navigator's seats. A latch is provided for positively retaining the handle at either position. By pressing down on the top of the handle, the latch is released and the handle may 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 crew member 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 and then returned to the RELEASED position. When the handle is in the LOCKED position, the reel harness cable is manually locked so that the crew member is prevented from bending forward. This position provides an added safety precaution over and above that of the automatic safety lock.

NOTE

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

1 SAFETY BELT
2 SHOULDER HARNESS
3 SHOULDER HARNESS INERTIA REEL LOCK HANDLE
4 SEAT FORE AND AFT ADJUSTMENT LEVER
5 SEAT TRACKS
6 SEAT ELEVATION LEVER
7 SEAT RADIAL ADJUSTMENT LEVER



ENGINEER'S AND NAVIGATOR'S SEAT

Figure 1-46

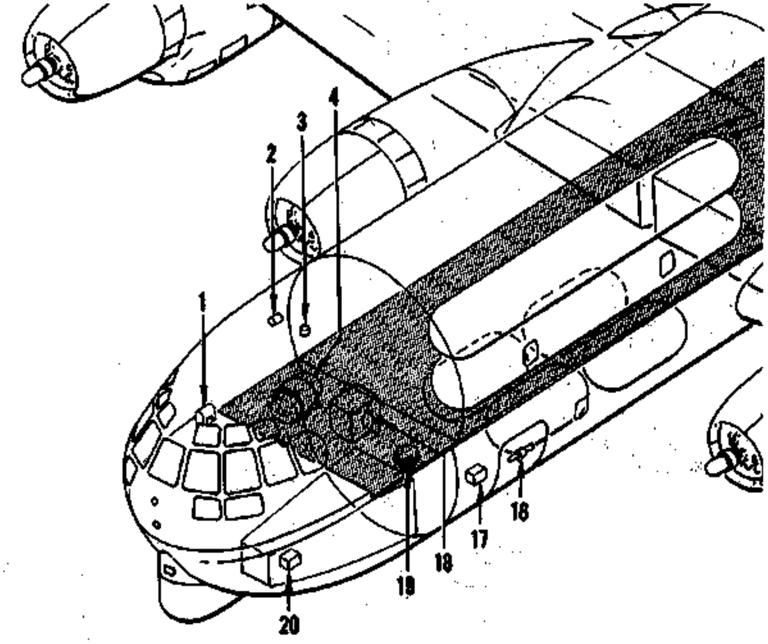
AUXILIARY EQUIPMENT

The following equipment and its operation is described in Section IV, AUXILIARY EQUIPMENT:

1. Cabin Pressurizing, Heating and Ventilating Equipment
2. Anti-Icing Systems
3. Communications and Associated Electronic Equipment
4. Lighting Equipment
5. Oxygen Equipment
6. Autopilot
7. Navigation Equipment
8. Auxiliary Power Unit
9. Single Point Ground Refueling
10. Cargo Loading Equipment
11. Troop Carrying Equipment
12. Air Refueling
13. Miscellaneous Equipment

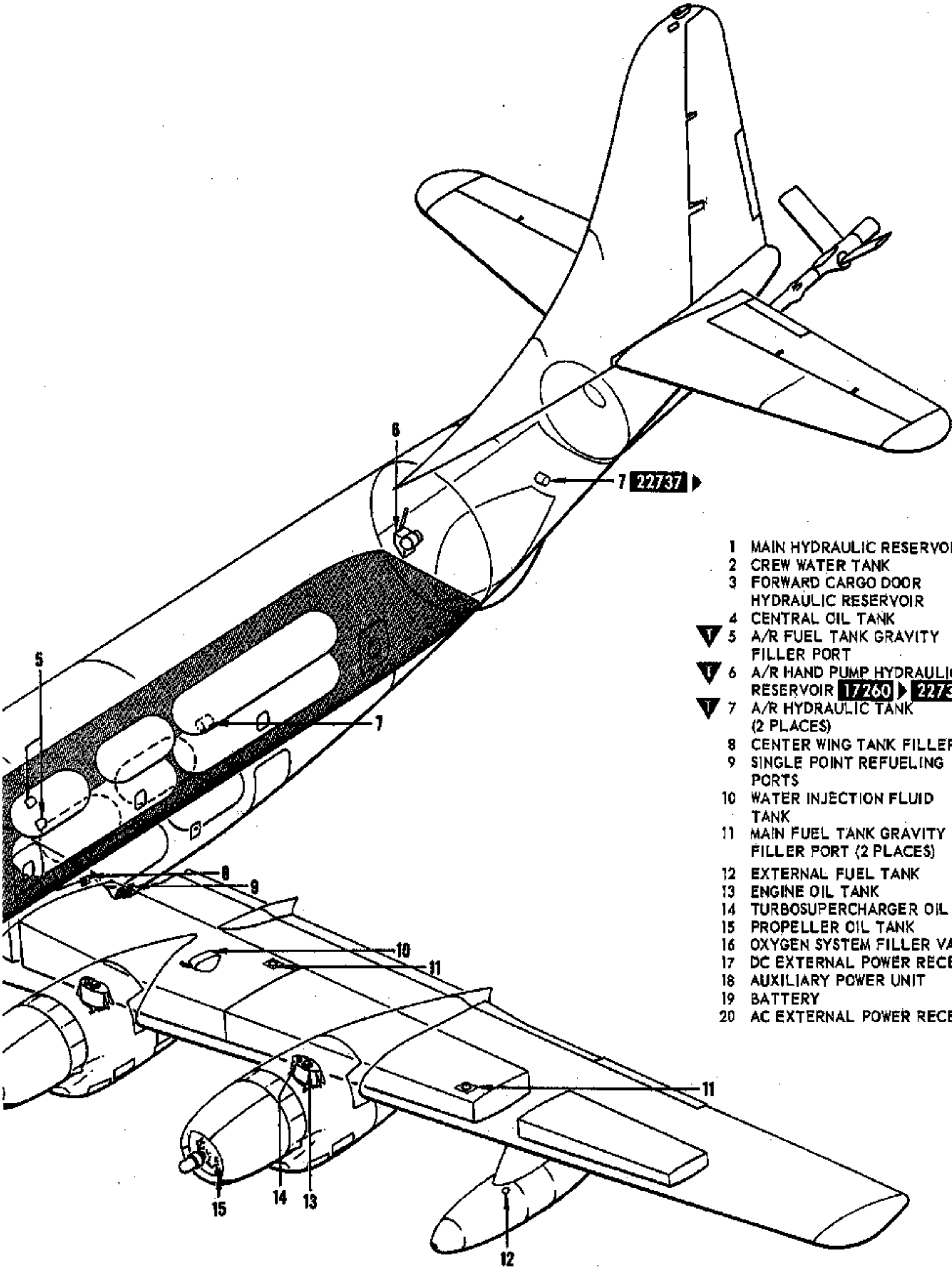
FLUID SPECIFICATIONS

FLUID	SPECIFICATION	NO. OF FILLER POINTS
FUEL	MIL-F-5572, RECOMMENDED GRADE 115/145; ALTERNATE GRADE 100/130	1 CENTER WING TANK 4 MAIN FUEL TANKS 2 EXTERNAL FUEL TANKS 1 SINGLE POINT FOR MAIN TANKS T 1 A/R SINGLE POINT T 2 A/R GRAVITY
ENGINE OIL	MIL-L-6082, GRADE 1100 BEFORE SERVICING INSURE THAT THE ENGINES HAVE BEEN PROPERLY SCAVENGED	4 ENGINE OIL TANKS 1 CENTRAL OIL TANK
PROPELLER OIL MIXTURE	50% MIL-O-6081, GRADE 1010 50% MIL-C-6529A TYPE II (3 PARTS MIL-L-6082A AND 1 PART TYPE I CORROSION PREVENTIVE COMPOUND) INTEGRAL OIL CONTROLS NO. 83153 AND 89619 ONLY 80% MIL-O-5606 20% MIL-O-6083 OIL, PRESERVATIVE FOR HYDRAULIC EQUIPMENT TYPE II CONCENTRATE	4
TURBO OIL	ABOVE -9.4°C (15°F) GROUND TEMPERATURE) USE MIL-L-6082, GRADE 1065 BELOW -9.4°C (15°F) (GROUND TEMPERATURE) USE MIL-O-6081, GRADE 1010	4
AUXILIARY POWER UNIT OIL	MIL-L-7808 (TURBINE)	1 (IN APU UNIT)
HYDRAULIC FLUID	MIL-O-5606 (RED)	1 MAIN HYDRAULIC TANK T 1 A/R HYDRAULIC TANK 1 FORWARD CARGO DOOR TANK C 1 REAR CARGO DOOR TANK
OXYGEN	BB-O-925	1
WATER INJECTION	ABOVE -50°F (-45.5°C) (GROUND TEMPERATURE) USE 50% CLEAN DISTILLED WATER AND 50% ALCOHOL (O-M-232, GRADE A) -50°F (-45.5°C) AND BELOW (GROUND TEMPERATURE) USE 45% CLEAN DISTILLED WATER AND 55% ALCOHOL (O-M-232, GRADE A) ALTERNATE: ABOVE -30°F (-34.4°C) (GROUND TEMPERATURE) USE 50% CLEAN DISTILLED WATER AND 50% ALCOHOL (MIL-A-6091(1) -30°F (-34.4°C) AND BELOW (GROUND TEMPERATURE) USE 33-1/3% CLEAN DISTILLED WATER AND 66-2/3% ALCOHOL (MIL-A-6091(1) FOR INCLUSION OF OIL-EMULSIVE, CORROSION PREVENTIVE SPEC. MIL-C-4339, USE IN THE AMOUNT OF 2/3 OF 1% OF THE TOTAL VOLUME	2



SERVICING

Figure 1-47 (Sheet 1 of 2)



1 MAIN HYDRAULIC RESERVOIR
2 CREW WATER TANK
3 FORWARD CARGO DOOR HYDRAULIC RESERVOIR
4 CENTRAL OIL TANK
▼ 5 A/R FUEL TANK GRAVITY FILLER PORT
▼ 6 A/R HAND PUMP HYDRAULIC RESERVOIR 17260 ▶ 22736
▼ 7 A/R HYDRAULIC TANK (2 PLACES)
8 CENTER WING TANK FILLER PORT
9 SINGLE POINT REFUELING PORTS
10 WATER INJECTION FLUID TANK
11 MAIN FUEL TANK GRAVITY FILLER PORT (2 PLACES)
12 EXTERNAL FUEL TANK
13 ENGINE OIL TANK
14 TURBOSUPERCHARGER OIL TANK
15 PROPELLER OIL TANK
16 OXYGEN SYSTEM FILLER VALVE
17 DC EXTERNAL POWER RECEPTACLE
18 AUXILIARY POWER UNIT
19 BATTERY
20 AC EXTERNAL POWER RECEPTACLE

Figure 1-47 (Sheet 2 of 2)

NORMAL PROCEDURES

SECTION II

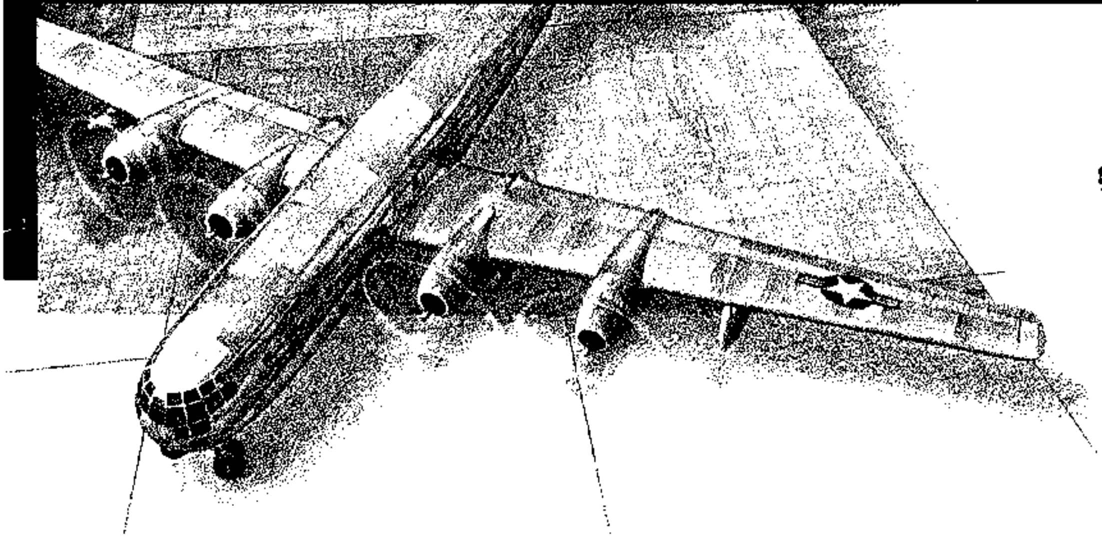


TABLE OF CONTENTS

SCOPE

Procedures outlined in this Section were designed for world-wide operation. For expanded information on operation of the airplane under all weather conditions, refer to Section IX. These procedures and sequences of events will suffice for any type of climatic condition at the time of mission. When the word Climatic is used in the action column only that action which pertains to the present weather should be followed. In general, the purpose of this section is to establish a proper sequence of events and to set forth those procedures and techniques which must be performed in a prescribed manner during a complete flight under normal conditions. The sequence begins when the flight crew arrives at the airplane and does not end until the crew has completed their postflight duties. This provides a comprehensive picture of the requirements of a typical mission.

NOTE

- This section contains text and the pilots' and flight engineer's amplified and condensed checklists. The text is divided into primary paragraphs which form the phases of a normal flight. Each of these paragraphs is usually followed by an amplified checklist for the particular phase of flight. The amplified checklist is presented in a chronological form that will enable the flight crew to complete their inspection, checks, and operation of the airplane in a expedient yet thorough manner. The amplified checklist describes in detail the steps to be completed and is divided into major parts throughout this Section.

- The condensed checklist is to serve only as a reminder. It is numbered the same as the amplified, and repeats the amplified step in condensed form. To show which of the crew is to accomplish each step, code letters will appear after the response as follows:
  (P) Pilot, (CP) Copilot, (N) Navigator, (E) Engineer, (BO) Boom Operator, (RO) Radio Operator and (GC) Ground Crewman. The amplified checklist explains the condensed checklist to be used during airplane operation. A circle around a number denotes that coordination is required between crew members or between crew members and ground crewman.

To prevent undue complication of this section, it will only include normal procedures applicable to the pilot, copilot and flight engineer. Procedures for other crew members will be given only when coordination is required to properly execute a particular function. For specific crew duties of other aircrew members, see Section VIII, Crew Duties.

VISUAL INSPECTION

The aircrew visual inspection procedures outlined in this Section are predicated on the assumption that maintenance personnel have completed all the requirements of the Manual of Inspection Requirements, T.O. 1C-97(K)E(C)-6, for preflight or postflight; therefore, duplicate inspections and operational checks of systems by aircrew members have been eliminated, except for certain items required in the interest of safety of flight.

PROCEDURES AND TECHNIQUES

The procedures and techniques described herein are mandatory and must be performed in the prescribed manner, except where deviations are required in the interest of flying safety.

PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

See Section V, OPERATING LIMITATIONS for flight restrictions and operating limitations.

FLIGHT PLANNING

Determine the required, fuel load, airspeeds, power settings, etc., for the complete mission using the operating data contained in the Appendix to this manual. See Section VIII, CREW DUTIES for additional flight planning requirements.

TYPICAL TIME SCHEDULE

1. Crew Inspection	2:00 Before Takeoff Time, ▼ 2:30 for Air Refueling Missions
2. Final Crew Briefing	:50 Before Takeoff
3. Before Starting Checklist	As Required
4. Engine Start	:35 Before Takeoff Time
5. Taxi	:25 Before Takeoff Time
6. Takeoff	On Time

TAKEOFF AND LANDING DATA CARDS

The takeoff and landing data cards will be completed by the engineer, for use by the pilots during takeoff and landing. The engineer will compute the data from information contained in the Appendix (see Appendix 1, Part 9), and enter it on the cards in bold easily legible form. Both takeoff and landing data will be completed before each flight for use in the event of an emergency landing shortly after takeoff. Landing data otherwise may be completed at any time that landing conditions and time are known.

WEIGHT AND BALANCE

The pilot will obtain the completed Form 365F and check the takeoff and anticipated landing gross weight before flight, as well as the location of the center of gravity. The pilot will ascertain that a check of the loading of the required fuel and payload has been accomplished. See Section V, OPERATING LIMITATIONS and Technical Order 1-1B-40, Manual of Weight and Balance as supplemented by the weight and balance computer, for weight and loading information.

WARNING

Do not attempt a takeoff or landing unless the weight and balance of the airplane are within the operating limits.

ENTRANCE INSTRUCTIONS

Entrance into the airplane is gained through a door on the left side of the lower forward compartment or through a door on the left side of the lower aft compartment. A ladder adjacent to the forward entry door provides access to the main compartment through a hatch in the floor. The control cabin is entered through the forward bulkhead door in the main compartment.

PREFLIGHT

BEFORE INTERIOR INSPECTION

NOTE

The ground crew will be at the airplane at the time of the flight crews' arrival to answer questions as to the status of the airplane and its systems. The ground crew will have the Form 781 available for the pilot, all dust covers and plugs removed, heater access cavity doors open, hydraulic systems depressurized, a maintenance stand positioned at the aft end of the boom, and small maintenance stands available.

① Form 781 - Checked (P, E, GC)

Pilot and engineer check the Form 781 for airplane and equipment status and discuss discrepancies with the ground crew

② Safety Check - Accomplished (E, BO)

Engineer will check that ignition and master switches are off. Boom operator will check that down locks and chocks are in place and that fuel valves are closed

③ APU and Heater Cavities - Climatic (E, BO)

Engineer will check APU for fuel and oil leaks, oil quantity and general condition. Boom operator will check No. 1 and No. 4 heater cavity for heater outlet plugs installed securely, engine preheat switch off and CO_2 discharge disc located on fuselage adjacent to exhaust, and report completion of check to engineer

BEFORE INTERIOR INSPECTION (Cont)

4. Stow Equipment - Stowed (ALL)

All crew members will stow personal equipment prior to crew inspection and/or preflight action

5. Crew Inspection - Completed (P)

NOTE

> Normally the crew inspection will be accomplished at the airplane. The pilot will specify the place of inspection and he should consider such factors as inclement weather, excessive noise, etc. The crew will line up as illustrated in Figure 2-1. Personal equipment will not be displayed. Prior to each flight when receipting for personal equipment the pilot will insure that each crew member and extra crew member has the necessary personal equipment as prescribed by current directives to safely accomplish the mission. If the crew inspection is accomplished at a location other than the airplane, all personal equipment will be transported to the airplane and the first four items of the Before Interior Inspection will be completed prior to initiating preflight action.

a. Fall In - All crew members (P)

Give command, "Fall In" and call the roll of extra crew members if applicable. Have engineer and boom operator report, "Safety Check Completed." Give command "At Ease"

b. Crew - Inspected (P)

Inspect all crew members and extra crew members. Determine that each individual is wearing identification tags and proper flying clothing. Each individual will come to "attention" as he is being inspected by the pilot and return to "at ease" after the inspection is completed

c. Form 781 - Read (as applicable) (P)

Read discrepancies pertinent to the various crew positions

d. Emergency Procedures and Signals - Brief crew and extra crew members (P)

(1) Brief Crew:

  (a) Ditching, Crash Landing and Bail Out Exit(s)

(2) Brief Extra Crew Members:

  (a) Ditching, Crash Landing Positions and Exits

  (b) Bail Out Exit(s)

  (c) Bail Out Sequence

  (d) Smoking Discipline

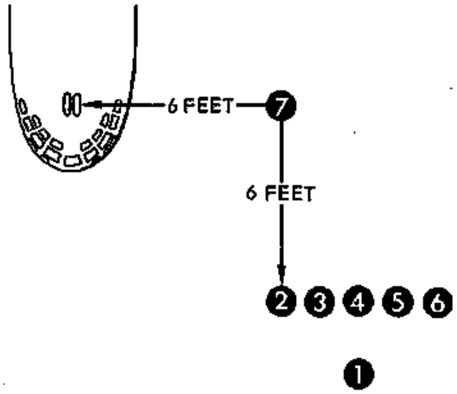
(3) Brief Crew and Extra Crew Members:

  (a) Emergency Signals (alarm bell and interphone)

  (b) Designate Jumpmaster

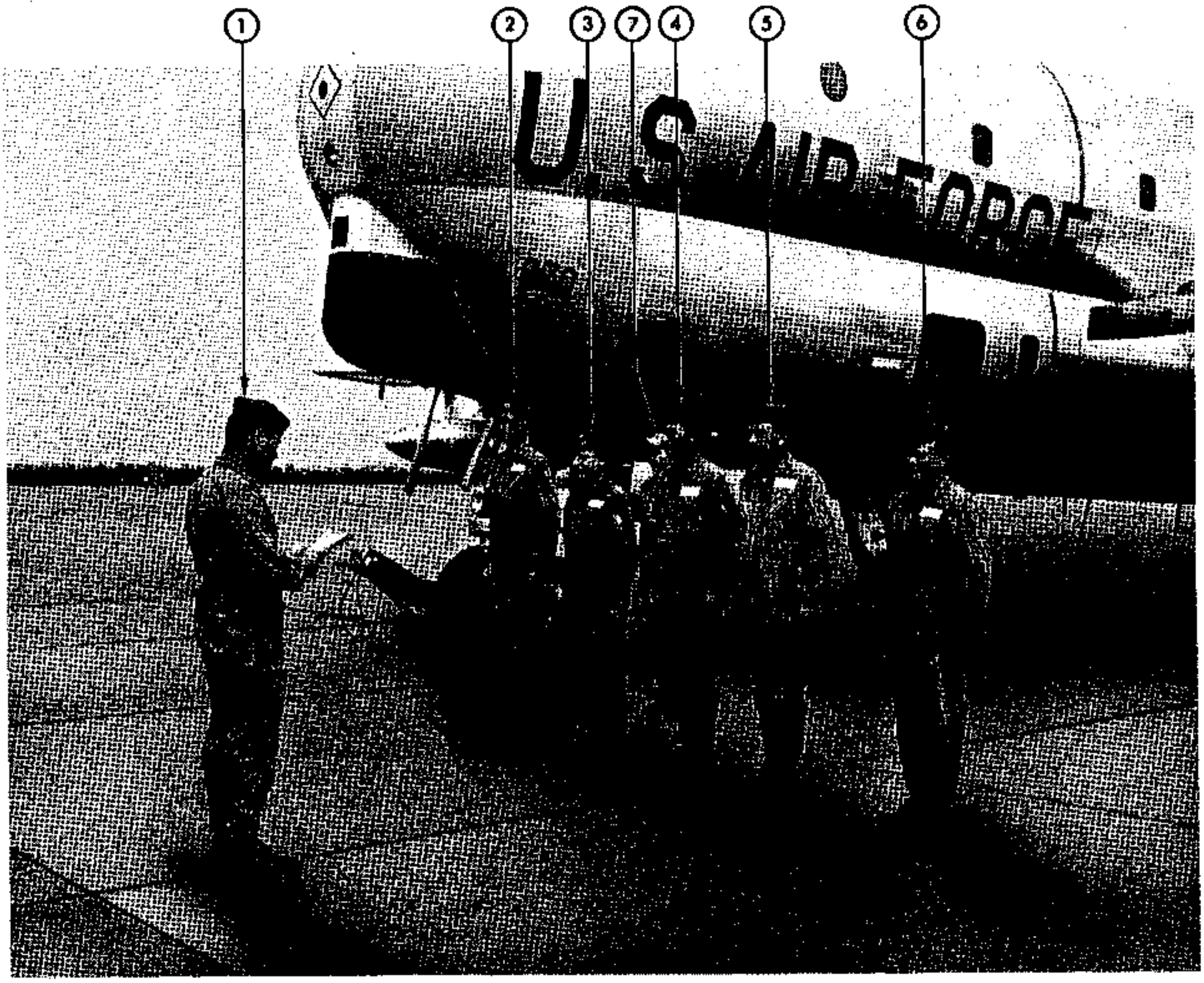
  (c) Secondary Bail Out Exit

  (d) Location of Spare Parachute(s)



PERSONNEL

1. PILOT
2. COPILOT
3. NAVIGATOR
4. ENGINEER
5. BOOM OPERATOR
6. RADIO OPERATOR
7. EXTRA CREW MEMBER(S)



TYPICAL CREW INSPECTION

Figure 2-1

BEFORE INTERIOR INSPECTION (Cont)

e. Emergency Procedure Report - All crew members

Each crew member will come to attention as the pilot approaches, give the following response and then return to "at ease." "My ditching and crash landing position is__________, on bailout I will follow the __________"

f. Safety Discipline - Brief crew and extra crew members (P)

(1) Do not walk through prop arcs

(2) Parachute discipline

(3) Use of safety belts

Instruct crew and extra crew members that walking through propeller arcs is prohibited. Brief that harnesses will be worn throughout the flight and chest packs will be kept in close proximity. Safety belts will be worn for all takeoffs and landings and any other time deemed necessary.

g. Instructions and Questions - Cleared (P)

Give the crew any special instructions not previously covered and order any special checks necessary on preflight. Instruct crew to report any preflight discrepancies that are discovered so that corrective action may be started as soon as possible.

h. Time Hack - By navigator

If an accurate time hack is available at this time, an additional time hack at final crew briefing will not be required

i. Final Crew Briefing Time - Announced (P)

j. Dismiss Crew - Dismissed (P)

PILOTS' PREFLIGHT INSPECTION

The pilot is responsible for the safe operation of the airplane, safety of the crew, and the efficient accomplishment of the assigned mission. Each member of the crew has received a thorough course of technical training pertinent to his particular specialty; therefore, certain duties concerning the preflight inspection should be delegated to each crew member. These duties, when so assigned, are performed under the pilot's supervision. The pilot will normally accomplish the exterior and the interior preflight check.

NOTE

The pilot and copilot begin the interior inspection check of the control cabin. In order to accomplish the fuel dump check, the copilot will be released to operate the emergency hand pump and a ground crew member stationed on a stand at the aft end of the boom will visually check the fuel dump finger centered on the poppet valve. Upon completion of the fuel dump check, the copilot will return to the control cabin to complete the light check at his position and a ground crewman will make a visual walkaround check of the exterior lights and report the light status to the pilot when assuming position on the ground headset. Power on operational check will be made with the ground crewman on the ground headset, copilot beneath the right wing and boom operator beneath the left wing. During the power on operational check, the copilot and boom operator will clear flaps, check torque tubes for excessive oscillation with load on torque tubes and check waste gates for correct operation. During the waste gate check the following standard hand signals will be used. A closed fist will indicate the closed position, and open hand will indicate the open position. Upon completion of these checks the copilot and boom operator are released. The copilot will complete the radio preflight inspection (when a radio operator is not assigned) and then assist the pilot in the remainder of the preflight inspection. When the engineer has completed the remainder of the power on operational check, the ground crewman will remain on the ground headset to assist the boom operator in the air refueling light check as outlined in Section VIII, Boom Operator's checklist. The following action will be required in complying with the response portion of the pilots' preflight inspection checklists.

Condition - A visual check only is required

Security - A physical check is required

Checked - An operational check is required

Interior Inspection

CONTROL CABIN

1. Oxygen Equipment Check - Checked and stowed (P, CP)

   Pilot and copilot check station oxygen pressure for at least 400 psi. For oxygen equipment check, see Section IV

2. Pilot's Instrument Inverter Emergency Power Switch - NORMAL (CP)

3. Gear Switch - DOWN, guard down (CP)

4. Windows, Windshield Wipers - Condition (P, CP)

5. Main Hydraulic Reservoir - Condition and fluid level (CP)

   Insure that hydraulic system has been depressurized. Upon completion of this check the copilot will assist in the fuel dump check

6. Emergency Lights (If applicable) - Checked (P)

   On airplanes **2930** ▶plus those incorporating 1C97 239, to assure that power is available when the pilot's instrument inverter emergency power switch is on BATTERY, the pilot will check any emergency cabin light for proper operation

7. Autopilot Switch - OFF (P)

8. Reverse Warning Flag - Down (P)

9. ADI Switch - OFF (P)

10. APS-42 Aux. Indicator Controls - Full CCW (CP)

11. Gear Emergency Retraction Switch - NORMAL and safetied (P)

12. External Fuel Tank Release Switch - OFF and safetied (P)

PILOTS' PREFLIGHT INSPECTION (Cont)

13. IFF Switch - OFF (P)

14. Pitot Heat Switches - OFF (P)

⑮ Ready for Power - Report received (P, N, E)

Receive report from navigator and engineer that they are ready for power on the airplane

⑯ Alarm Bell Check - Checked (P, N, E, GC)

When the navigator and engineer report "ready for power" the pilot will ring the alarm bell. The alarm bell will be checked with the battery switch in the OFF position and prior to power being applied to the airplane. The alarm bell check is the signal for the navigator to start the APU. If external power is to be used, this is the signal for the ground crew to plug in external power. After power is on the ground crewman will complete a visual walkaround check of exterior lights and report light status to pilot when assuming position on ground headset

17. Radios - On (P)

Turn on all radio equipment on the control stand to allow warm-up for subsequent operational check

⑱ Lights - Checked (P, CP, GC)

The pilots will turn on all exterior lights with the exception of the landing lights which will be extended. The pilots will check all interior and push-to-test lights from their respective positions. Ground crewman will check navigation, taxi, anti-collision 1010 591 (red on Color A), wheel well and wing illumination lights. After ground crewman reports light status on ground interphone, check landing lights. Release copilot for power on operational check

CAUTION

Do not operate anti-collison lights over five minutes during ground operation.

⑲ Pitot Heat - Checked (P, GC)

Turn pitot heat switches ON and have ground crewman check by touch. After ground crewman reports pitot heat status, turn pitot heat switches OFF

⑳ Wing Flaps - Checked (P, GC, CP, BO)

Prior to lowering wing flaps, check with ground crewman and insure that copilot is stationed on right side and boom operator on left side of flap well. Copilot and boom operator will clear wing flaps and check flap torque tubes for excessive oscillation with load on torque tubes.

a. Advance two opposite throttles and check that warning horn blows

b. Extend wing flaps to 65% using normal wing flap switch. Warning horn stops blowing at 22% and starts at 44%

c. Using emergency flap switch, raise wing flaps to 55%, wait ten seconds and lower to 65%

d. Extend wing flaps full down using normal wing flap switch

Upon completion of the wing flap check, turn the ground crewman over to the engineer to complete the power on operational check

21. Autopilot Emergency Disconnect Handle - In place, safetied (P)

22. Rudder Boost Switch - OFF (P)

23. Throttle Lock Lever - UNLOCK (P)

24. Surface Lock Handle - LOCKED (P)

25. Trim Control Wheels - Free movement and zeroed (P)

26. Pilot's Auxiliary Panel - Complete (P)

    Check fire axe; first aid kit; fire extinguisher pressure, and oxygen bottle

27. Instrument Flight Manuals: (P)

    a. Enroute Charts

    b. Enroute Supplements

    c. Terminal Charts

    Check flight manuals and enroute and terminal charts for completeness and currency

28. Portable Oxygen Bottle, Right Side - Security (P or RO)

    Check oxygen pressure for full charge, if radio operator is not aboard

MAIN COMPARTMENT

NOTE

Pilot is not required to check boom pod area.

1. Spare Bulbs - Completeness (P)

   Check spare bulb kit for completeness

2. Cargo Hoist - Condition (P)

   a. Cargo Hoist Shield Cover Secure and Control Circuit Breaker Switch - OFF

   b. Hand Crank - Stowed

   c. Hoist Motor, Drum and Cables - Condition

   d. Hoist Control Cord - Stowed

   e. Snatch Blocks - Stowed

3. Fire Extinguishers - Pressure and security (P)

   Check fire extinguishers for proper pressure and security of mounting during main compartment walkaround

PILOTS' PREFLIGHT INSPECTION (Cont)

MAIN COMPARTMENT (Cont)

4. First Aid Kits - Condition (P)

   Check first aid kits for condition during main compartment walkaround

5. Forward Cargo Door: (P)

   a. Hydraulic Tank - Proper fluid quantity

   b. Selector Handle - As required

      If door is open, selector is left in OPEN position, if closed, selector is left in CLOSE position

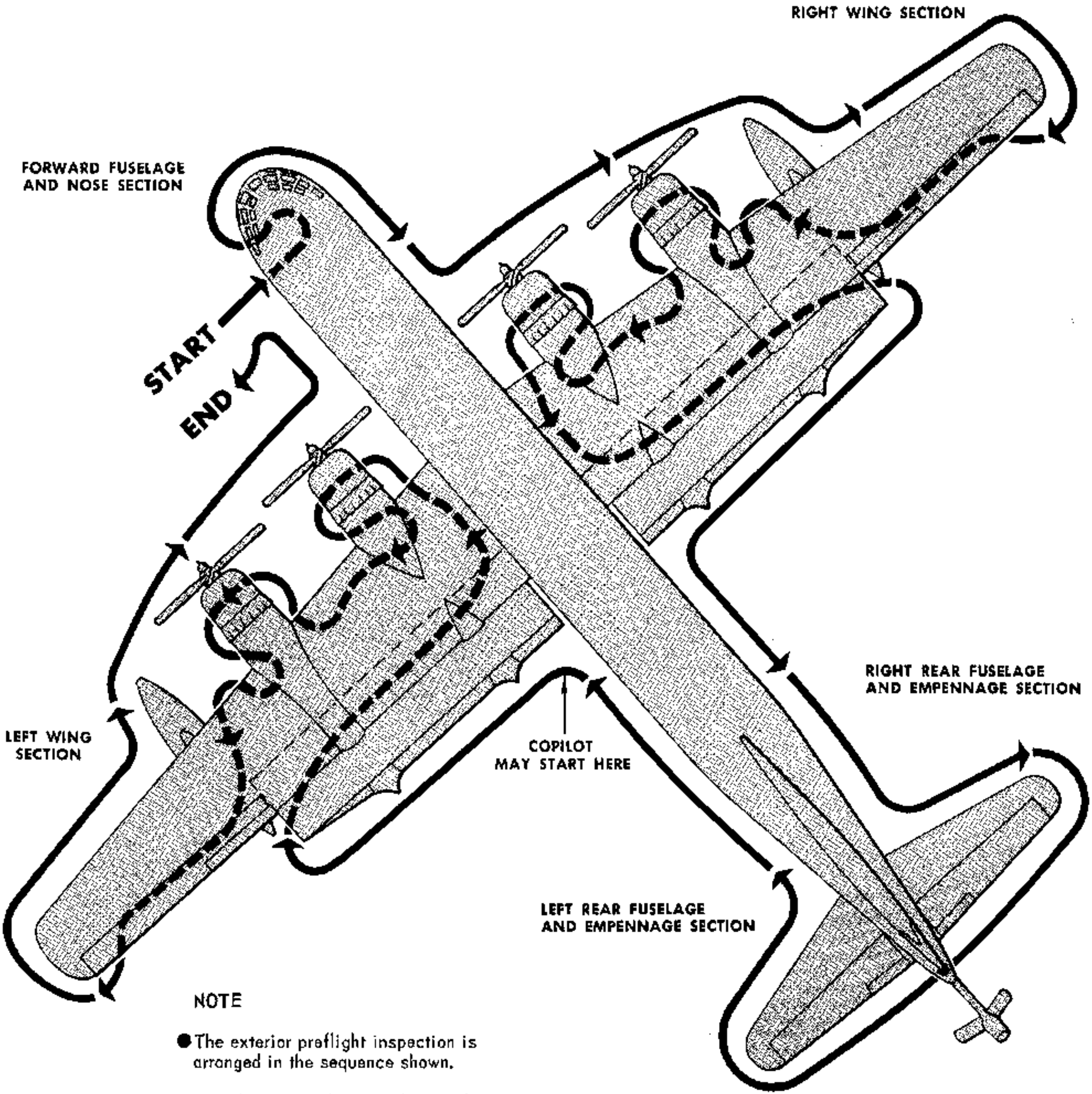
   c. Door - Condition

6. Dinghy Transmitter AN/CRT-3A - Security (if installed) (P)

7. Life Raft - Security (if installed) (P)

8. Cargo - Secured (if applicable) (P)

9. A/R Tanks, Lines and Fittings - Condition (P)



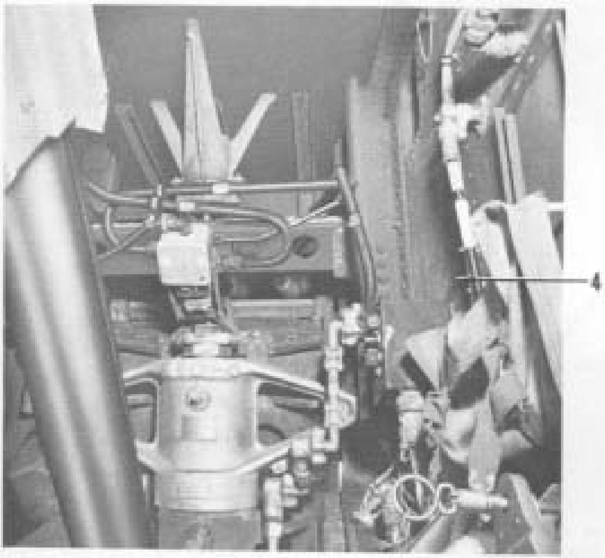
NOTE

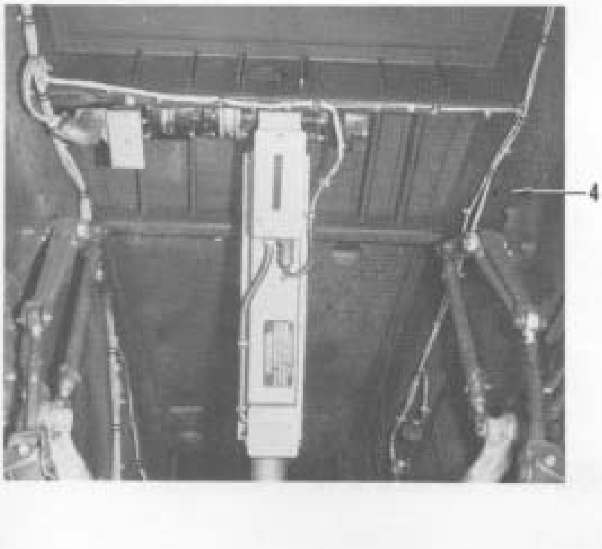
- The exterior preflight inspection is arranged in the sequence shown.
- In order to expedite completion of this inspection, a spit method may be used. Starting at the LEFT WING SECTION the copilot may complete this portion ending at the left static holes.

THE EXTERIOR INSPECTION

Figure 2-2

PILOTS' PREFLIGHT INSPECTION (Cont)





Exterior Inspection

NOTE

If radio operator is not aboard, pilot will visually check all exterior antennas.

FORWARD FUSELAGE AND NOSE SECTION

1. Forward Entrance Door - Condition (P)

   Check door, seals, cables, crank and locks

2. Forward Fuselage - Condition (P)

   Scan the fuselage on the left side for cracks, dents and wrinkles. Inspect drains and vents for any obstructions

3. Left Pitot Tube - Unobstructed (P)

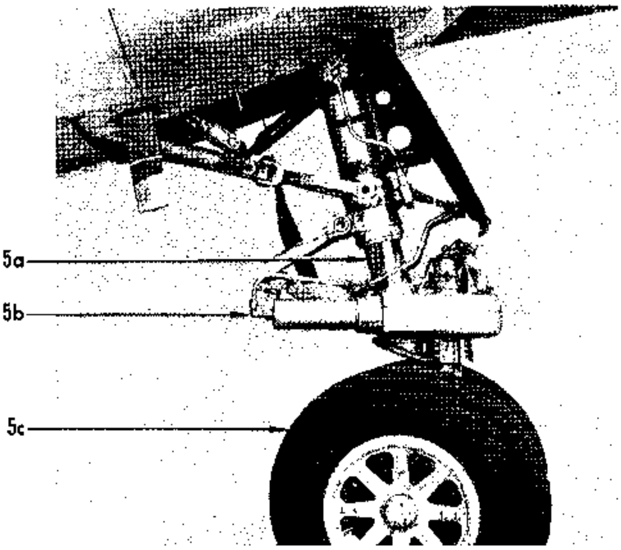
4. Nose Wheel Well - Condition (P)

   Visually check door retraction linkage and assure that push-pull pins are fully inserted. Check safety and oleo switches, nose gear motor, cannon plug and suppressor wires for general condition

Exterior Inspection (Cont)

5. Nose Gear (Left and Right Side) (P)
   a. Oleo Strut - Inflation
   b. Steering Mechanism - Condition
   c. Tires - Conditions, slippage
6. Right Pitot Tube - Unobstructed (P)
7. Forward Fuselage - Condition (P)

   Scan the fuselage on the right side for cracks, dents and wrinkles. Inspect drains and vents for any obstructions. Check lower fuselage
8. Right Static Holes - Unobstructed (P)

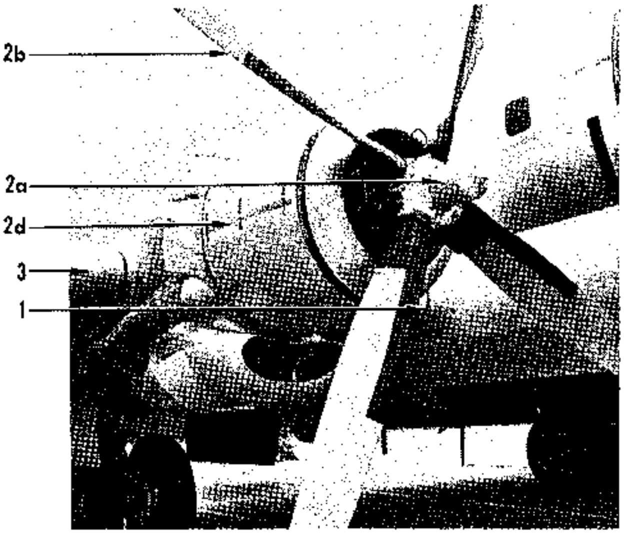


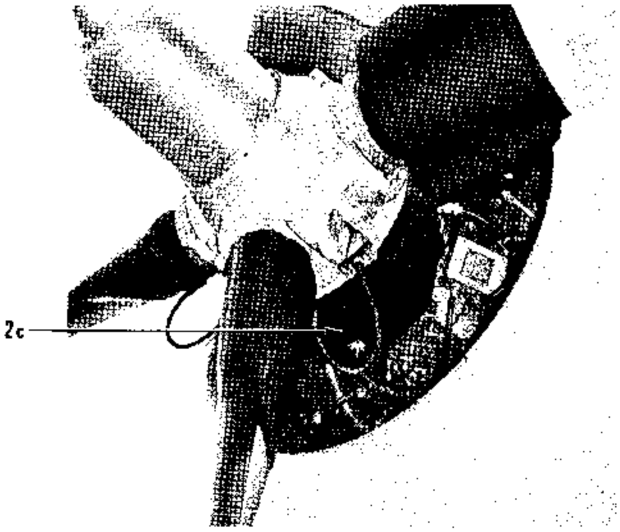
RIGHT WING SECTION

1. Wing Leading Edge to No. 3 Engine - Condition (P)

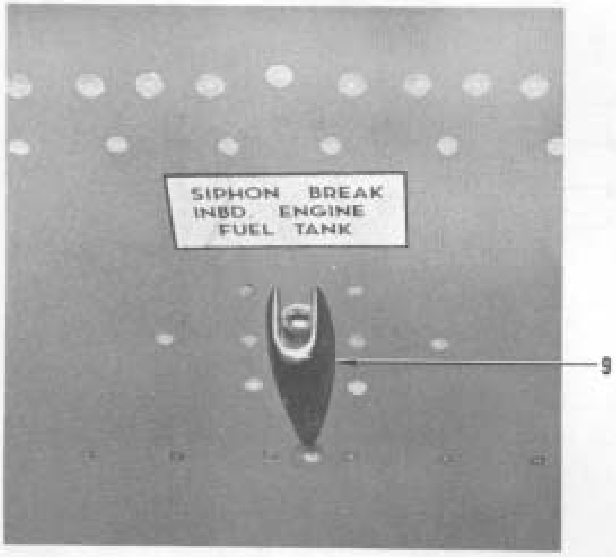
   Check wing leading edge for general condition and check that ground blower intake is unobstructed
2. No. 3 Engine and Prop (P)
   a. Dome - Condition
   b. Prop Blades - Condition
   c. Integral Oil Tank - Leakage, drain plug safetied
   d. Cowling - Condition and fasteners locked
3. Wing Leading Edge - Condition (P)
4. No. 4 Engine and Prop (P)
   a. Dome - Condition
   b. Prop Blades - Condition
   c. Integral Oil Tank - Leakage, drain plug safetied
   d. Cowling - Condition and fasteners locked
5. Wing Leading Edge - Condition (P)

   Check wing leading edge for general condition and that wing heater intake is unobstructed





PILOTS' PREFLIGHT INSPECTION (Cont)



Exterior Inspection (Cont)

6. Wing Tip - Condition (P)

   Check Anti-Ice Exhaust Louvers for cleanliness and any evidence of carbon deposits. Check that navigation light lens is intact

7. Lower Wing Surface and Aileron - Condition (P)

   Check hinges for alignment and clear of foreign material. Check bonding wire condition. Trim tab should have approximately 1 inch droop with controls locked. Check trim tab surface for general condition. Check hinge wire condition. Check general condition of static dischargers. Check for any evidence of fuel leaks around access panels and condition of landing light

8. External Fuel Tank and Strut - Condition (P)

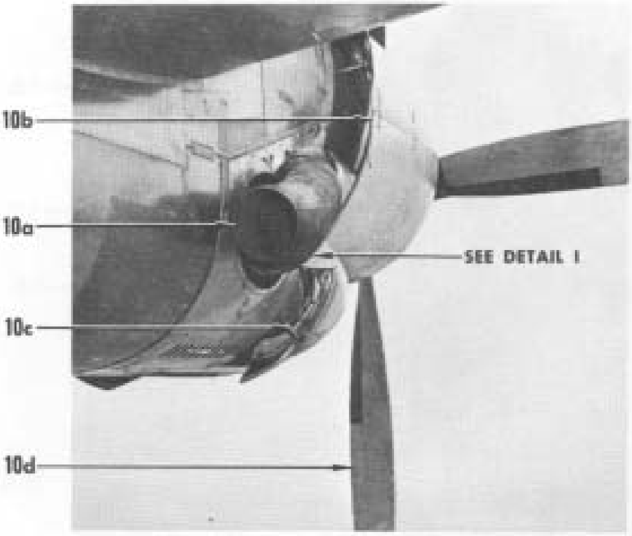
   Check for general condition

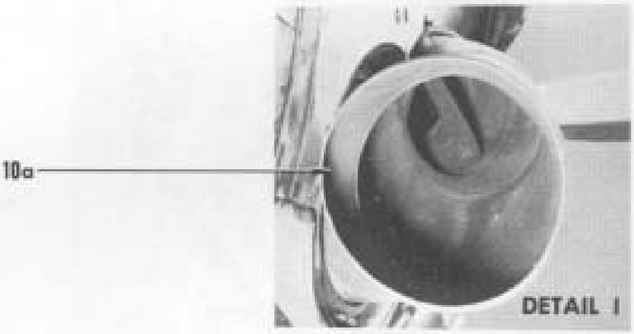
9. Anti-Syphon Scoop - Unobstructed (P)

Exterior Inspection (Cont)

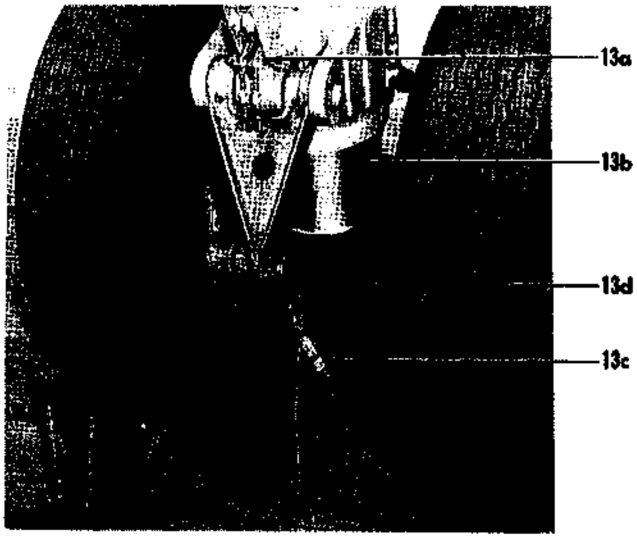
10. No. 4 Engine and Nacelle (P)
    - a. Engine Exhaust System - Condition
    - b. Cowling Right Side - Condition and fasteners locked
    - c. Right Oil Cooler and Cowl Flaps - Condition
    - d. Prop Blades - Condition
    - e. Cowling Left Side - Condition and fasteners locked
    - f. Cowl Flaps, Left Oil Cooler and Intercooler Flaps - Condition
11. Anti-Syphon Scoop - Unobstructed (P)
12. Lower Wing Surface to No. 3 Engine - Condition (P)

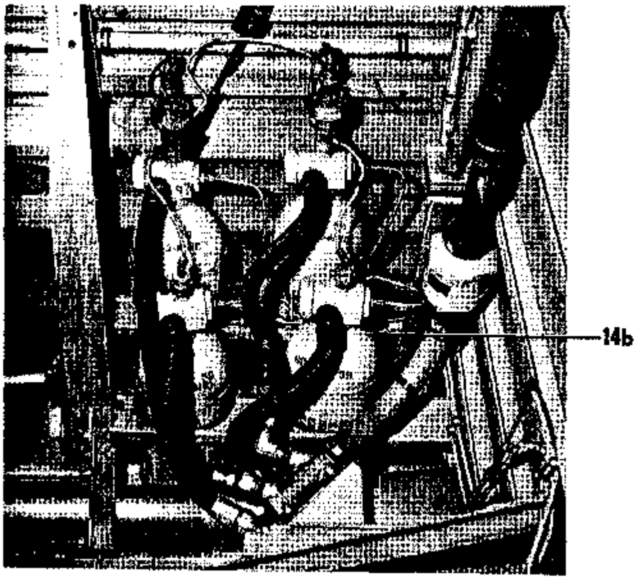
    Check fuel sump boost pump drains and intercooler sump drains for leakage and stains

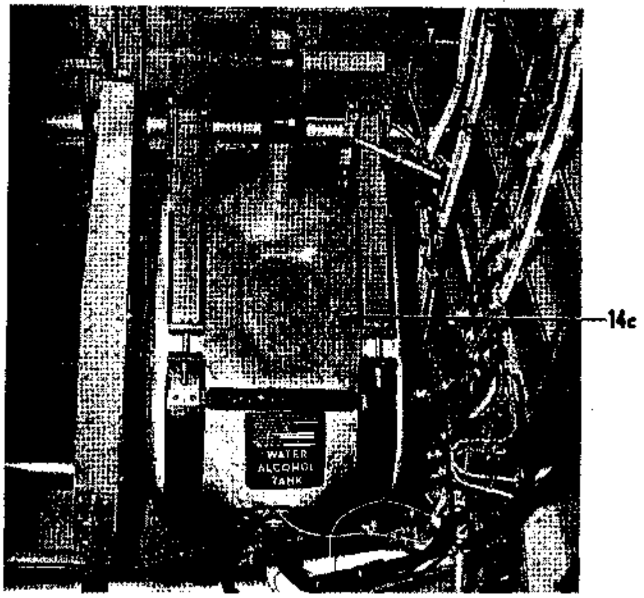




PILOTS' PREFLIGHT INSPECTION (Cont)







Exterior Inspection (Cont)

13. No. 3 Engine and Nacelle: (P)

    a. Safety and Oleo Switch - Condition

    b. Oleo Strut - Inflation

    c. Static Ground Wire - Touching ground

    d. Outboard Tire - Condition, slippage

    e. Outboard Main Wheel Well Door - Condition

    f. Engine Exhaust System - Condition

    g. Right Oil Cooler and Cowl Flaps - Condition

    h. Cowling Right Side - Condition and fasteners locked

    i. Prop Blades - Condition

    j. Cowling Left Side - Condition and fasteners locked

    k. Cowl Flaps, Left Oil Cooler and Intercooler Flaps - Condition

14. Right Main Wheel Well: (P)

    Check for general cleanliness and condition. Wheels and tires should be free of combustible materials

    a. Brake Stator Pins, Hydraulic Lines and Fittings - Condition

       Check brake area, hydraulic lines and fittings, for condition and absence of leaks. If applicable, brake stator pins should extend approximately 1/2 inch

    b. CO_2 System - Condition

       Check electrical connections for condition and that bonding wires are secure

    c. ADI Tank - Quantity

    d. Fuel Vent Interconnects - Condition

Exterior Inspection (Cont)

e. Retraction Mechanism - Condition

Check limit switches for condition and striker plates for excessive play. Check gear motor and cannon plug for condition. Check emergency clutch cable for slack and return spring for proper function. Check that swaged fitting on end of clutch cable is secure. Check door retraction mechanism for general condition

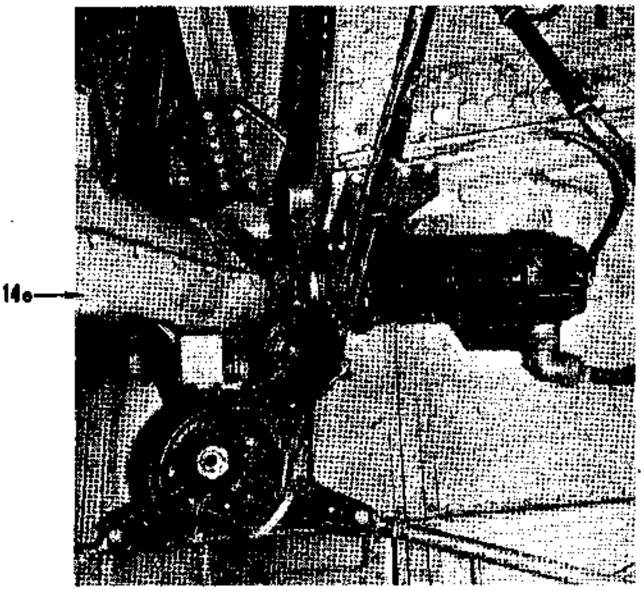
f. Inboard Wheel Well Door - Condition

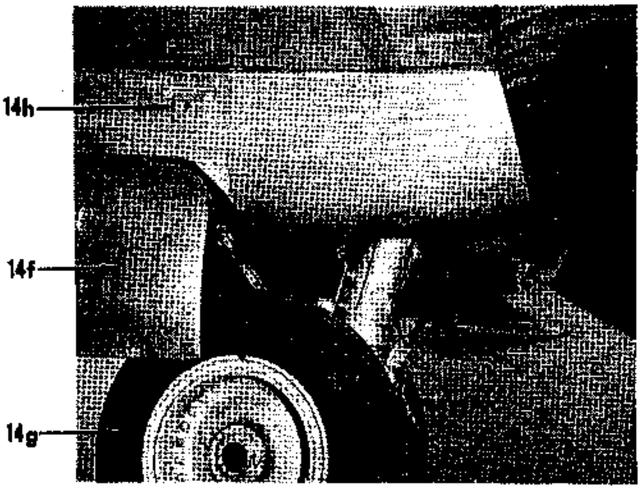
g. Inboard Tire - Condition, slippage

h. CO_2 Discharge Indicator Discs - Condition

15. Lower Wing Surface and Fuselage - Condition (P)

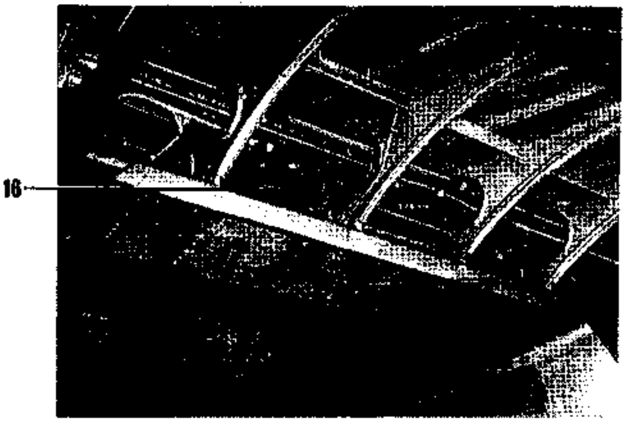
Check fuel sump boost pump drains and interconnector sump drains for leakage and stains. Check fuselage surface for dents, cracks and wrinkles



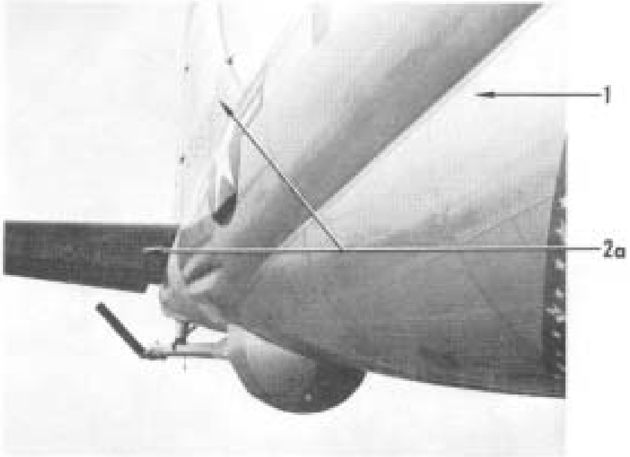


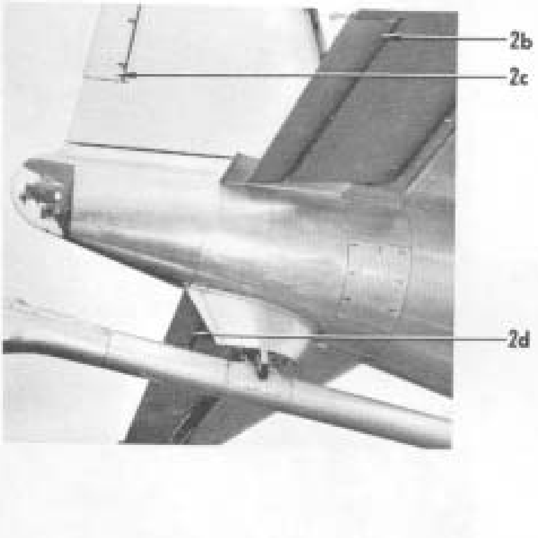
16. Right Wing Flap and Wing Flap Well - Condition (P)

With wing flaps full down check wing flap surfaces for general condition. Check fuel valves, fuel and hydraulic lines for leaks. Check wiring and bonding for condition. Check jackscrews and tracks



PILOTS' PREFLIGHT INSPECTION (Cont)





Exterior Inspection (Cont)

AFT FUSELAGE AND EMPENNAGE SECTION

1. Aft Fuselage Surface - Condition (P)

   Check entire aft fuselage surface for holes, dents, cracks, wrinkles

2. Empennage Condition (P)

   a. Vertical and Horizontal Stabilizer and Exhaust Louvers - Condition

      Check for signs of carbon deposits at exhaust louvers

   b. Elevator - Condition

      With controls locked and wing flaps full down, right elevator trim tab should be 1/4 inch up. Check trim tab hinge pin for condition. Check elevator hinges for proper alignment and absence of foreign materials. Check surface for general condition. Check general condition of static dischargers

   c. Rudder and Tab - Condition

      Check tab hinge pin for condition. Trim tab should be aligned with rudder if controls are locked. Check rudder hinge covers in place and rudder surface for general condition. Check general condition of static dischargers

      NOTE

      Proceed a sufficient distance aft to observe both upper wing and elevator surfaces for general condition. Check for snow, ice and frost.

   d. Elevator - Condition

      With controls locked and wing flaps full down, left elevator trim tab should be 7/8 inch up. Check trim tab hinge pin for condition. Check elevator hinges for proper alignment and absence of foreign materials. Check surface for general condition. Check general condition of static dischargers

e. Horizontal and Vertical Stabilizer and Exhaust Louvers - Condition

Check for signs of carbon deposits at exhaust louvers. Check general condition of static discharger. Check exhaust ports unobstructed

3. Aft Fuselage Surface - Condition (P)

Check entire aft fuselage surface for holes, dents, cracks, and wrinkles

4. Aft Entrance Door - Condition (P)

Check door, seals, cables, crank and locks. Check fire extinguisher if installed. Check emergency jettison handle and linkage for condition

LEFT WING SECTION

NOTE

For split preflight method, copilot starts at this point. See Figure 2-2.

1. Left Wing Flap and Wing Flap Well - Condition (P or CP)

With wing flaps full down check wing flap surfaces for general condition. Check fuel valves, fuel and hydraulic lines for leaks, wiring and bonding for condition. Check jackscrews and tracks

2. Lower Wing Surface and Fuselage - Condition (P or CP)

Check fuselage for dents, cracks, and wrinkles. Check single point refueling port caps installed and secured. Check fuel sump boost pump drains and interconnector sump drain for leakage and stains

3. No. 2 Engine and Nacelle: (P or CP)

a. Safety and Oleo Switch - Condition

b. Oleo Strut - Inflation

c. Static Ground Wire - Touching ground

d. Inboard Tire - Condition, slippage

e. Inboard Main Wheel Well Door - Condition

f. Engine Exhaust System - Condition

g. Right Oil Cooler and Cowl Flaps - Condition

h. Cowling Right Side - Condition and fasteners locked

i. Prop Blades - Condition

j. Cowling Left Side - Condition and fasteners locked

k. Cowl Flaps, Left Oil Cooler and Intercooler Flaps - Condition

4. Left Main Wheel Well (P or CP)

Check for general cleanliness and condition. Wheels and tires should be free of combustible materials

a. Brake Stator Pins, Hydraulic Lines and Fittings - Condition

Check brake area, hydraulic lines and fittings, for condition and absence of leaks. If applicable, brake stator pins should extend approximately 1/2 inch

b. CO_2 System - Condition

Check electrical connections for condition and that bonding wires are secure

c. ADI Tank - Quantity

d. Fuel Vent Interconnects - Condition

e. Retraction Mechanism - Condition

Check limit switches for condition and striker plates for excessive play. Check gear motor and cannon plug for condition. Check emergency clutch cable for slack and return spring for proper function. Check that swaged fitting on end of clutch cable is secure. Check door retraction mechanism for general condition and door pins installed

f. Outboard Main Wheel Well Door - Condition

g. Outboard Tire - Condition, slippage

PILOTS' PREFLIGHT INSPECTION (Cont)

h. CO_2 Discharge Indicator Discs - Condition

5. Lower Wing Surface to No. 1 Engine - Condition (P or CP)

   Check fuel sump boost pump drains and interconnector sump drains for leakage and stains

6. Anti-Syphon Scoop - Unobstructed (P or CP)
7. No. 1 Engine and Nacelle (P or CP)
   - a. Engine Exhaust System - Condition
   - b. Cowling Right Side - Condition and fasteners locked
   - c. Right Oil Cooler and Cowl Flaps - Condition
   - d. Prop Blades - Condition
   - e. Cowling Left Side - Condition and fasteners locked
   - f. Cowl Flaps, Left Oil Cooler, Intercooler Flap - Condition
8. Anti-Syphon Scoop - Unobstructed (P or CP)
9. External Fuel Tank and Strut - Condition (P or CP)
10. Lower Wing Surface and Aileron - Condition (P or CP)

    Check aileron hinges for alignment and clear of foreign material. Check bonding wire condition. Trim tab should have approximately 1 inch droop with controls locked. Check trim tab surface for general condition. Check hinge wire condition. Check general condition of static dischargers. Check for any evidence of fuel leaks around access panels and condition of landing light

11. Wing Tip - Condition (P or CP)

    Check anti-ice exhaust louvers for cleanliness and any evidence of carbon deposits. Check that navigation light lens is intact

12. Wing Leading Edge - Condition (P or CP)

    Check wing leading edge for general condition and that wing heater intake is unobstructed

13. No. 1 Engine and Prop (P or CP)
    - a. Dome - Condition
    - b. Prop Blades - Condition
    - c. Integral Oil Tank - Leakage, drain plug safetied
    - d. Cowling - Condition and fasteners locked
14. Wing Leading Edge - Condition (P or CP)
15. No. 2 Engine and Prop (P or CP)
    - a. Dome - Condition
    - b. Prop Blades - Condition
    - c. Integral Oil Tank - Leakage, drain plug safetied
    - d. Cowling - Condition and fasteners locked
16. Wing Leading Edge to Fuselage - Condition (P or CP)

    Check wing leading edge for general condition and check that ground blower intake is unobstructed

17. Forward Fuselage - Condition (P or CP)

    Check for dents, cracks and wrinkles

18. Left Static Holes - Unobstructed (P or CP)

Passenger Briefing

The pilot in command of the aircraft is responsible for thoroughly briefing the passengers prior to flight. Prior to Final Crew Briefing, the pilot will insure that the passengers are seated aboard the airplane in sufficient time to complete the passenger briefing. The pilot will brief the passengers on the following items:

1. Emergency Alarm Bell Signals

   Brief on signals to be used while on the ground and in the air

2. Ditching and Crash Landing Positions and Exits

   Assign positions and exits according to number of passengers and arrangement of seating

3. Bailout Procedures

   a. Use of Parachutes and Location of Spare Chutes

   b. Primary and Secondary Bailout Exits

   c. Bail Out Sequence

   d. Designate Jumpmaster

   Insure that passengers are properly fitted with parachutes prior to boarding airplane

4. Use of Life Vests and R-1 Suits (if applicable)

   Insure that passengers are familiar with donning and adjustment of equipment prior to boarding airplane

5. Use of Safety Belts

   State when safety belts will be worn

6. Smoking Rules

   Brief on smoking during ground operation, takeoffs, and landings, when fuel fumes are detected, and of danger of setting equipment afire

7. Fuel Tanks

   Caution against damage to tanks through careless use and placement of equipment

8. Compartment Commander

   Designate compartment commander and explain that he is representing the airplane commander

9. Brief route, weather and time enroute

10. Answer any questions

PILOTS' PREFLIGHT INSPECTION (Cont)

Final Crew Briefing

The flight crew will reassemble for final crew briefing at the time announced, in the same order as was established in the crew inspection procedure.

1. Fall In - At ease (P)

   Give the commands, "Fall in, at ease. Preflight Report"

2. Preflight Report - All crew members

   Each crew member will come to attention, report in turn, "Preflight complete" and return to "at ease"

3. Weather - Brief crew members (P)

   Review any changes of flight plan, weather, or any other item pertinent to the flight

4. Time Hack - By navigator (if required) (N)

5. Questions and Comments - Cleared (P)

6. Dismiss Crew - Dismissed

   Give commands, "Crew, Attention." Upon dismissal boom operator will remove all down locks. 'Dismissed to board airplane."

7. Down Locks and Pins - Checked (P)

   After all down locks are removed, the boom operator will proceed to the forward entrance door and display down locks and boom lock pin to the pilot prior to his entering the airplane

Radio Operator Not Aboard

(To be accomplished by Copilot)

MISSION PLANNING

1. Communications Requirements - Complete

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

2. Applicable Pilots' Manuals, Charts - Current and complete

   Check applicable pilots' manuals (Enroute charts, enroute supplements, terminal charts), for current and complete contents. Correct publications as required

3. Communications Kit - Complete

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

INTERIOR INSPECTION (POWER ON)

Lower Forward Compartment

1. Interphone Call Box
   a. Call Box and Connections - Security
   b. NORMAL and CALL Operation - Check
2. IFF - Security
3. Radio Compass - Security
4. Marker Beacon - Security
5. UHF/DF - Security
6. TACAN - Security

Lower Aft Compartment

1. Interphone Call Box(es)
   a. Call Box and Connections - Security
   b. NORMAL and CALL Operation - Check

      On airplanes **22665** ▶ **3213** an additional call box is located at the air refueling hydraulic panel

Main Compartment

1. Omni - Security

   Insure circuit breakers are set
2. Aldis Lamp - Check and stow

   Check operation of aldis lamp and condition of cord and plug. Check filters for proper colors and condition
3. All Interphone Call Boxes
   a. Call Box and Connections - Security
   b. NORMAL and CALL Operation - Check

Control Cabin

1. Aldis Lamp - Check and stow

   Check operation of aldis lamp and condition of cord and plug. Check filters for proper colors and condition
2. Radio "G" File (if applicable) - Condition

   Check radio publications in file for availability and currency

PILOTS' PREFLIGHT INSPECTION (Cont)

3. Interphone Dynamotors - Security
4. Glide Slope Receiver - Security
5. VHF
   a. Transmitter and Receiver - Security
   b. Channelization - Set as required

      Check for proper crystals and thumb wheel settings

   c. J-68/ARC-3 - Security
6. UHF
   a. R/T Unit - Security
   b. Master Control Panel - Security
   c. Channelization - Set as required
7. UHF Tone - Check
8. Navigator's UHF Transfer Switch - Remote
9. Aux. Liaison Receiver
   a. Receiver - Security
   b. Function Switches - Check

      Turn on equipment (MVC-OFF-AVC switch to MVC). Check dial lights, crystal filter switch, BFO switch, CW-VOICE switch, and antenna alignment switch

   c. Reception All Bands - Check
   d. Time Signal - Tune

      Leave receiver on for navigator's time hack

10. Liaison Equipment
    a. R/T Unit - Security
    b. Antenna Coupler - Security
    c. Channelization - Check

       Channelization should be checked for mission requirement frequencies as outlined by current directives

    d. Operation - Check

       When operational checks are permitted they will be in accordance with current directives

11. Copilot's Interphone - Check

    Call ground crewman, engineer or any other crew position

NOTE

Essential inverter must be on for the following check.

12. Radio Compass

    a. Dial Lights, CW Switch and Filter Switches - Check

    b. Alignment - Check

       Check alignment at low end of the high band

    c. Reception All Bands - Check

       Utilize antenna position

    d. Loop Position - Check

       Switch to loop position and check operation of the left-right switch by rotating the switch in both directions and checking both nulls. Adjust volume for an approximate 8 to 10 degree null width

    e. Compass Position - Check

       Switch to compass position and check the RMI No. 1 needle for proper homing. Leave tuned on local navigational station

13. Glide Slope Receiver - Check

    Tune localizer station on the Omni receiver. Check the glide path alarm pointer (red flag) and horizontal bar for movement

NOTE

The first indication of an operating receiver is the disappearance of the glide path alarm pointer (red flag). When sufficient signal is not received the pointer will not disappear.

14. Omni Receiver

    a. Local Station - Tune

    b. RMI Needle No. 2 - Check for homing

    c. TO/FROM Flags - Check

       Set the reading indicated by the pointer of the RMI needle No. 2 into the course set window. Check the vertical bar on the pilot's course indicator for centering and the TO/FROM window for a TO indication. Set the reciprocal reading indicated by the omni needle into the course set window. Check vertical bar on the pilot's course indicator for centering and the TO/FROM window for FROM indication. Leave tuned on local navigational station

PILOTS' PREFLIGHT INSPECTION (Cont)

15. TACAN TCTO 572

a. Instrument Select Switch - TACAN

b. Local Station - Tune

c. RMI Needle No. 1 - Check for homing

d. Range Indicator - Check

e. Course Indicator - Check vertical needle

f. Navigator's RMI Needle No. 2 - Check for homing

Tune in station by selecting the proper channel on the TACAN control panel. Check the No. 1 needle on the pilot's TACAN/VOR RMI for proper homing. Place the function selector switch to T/R and check the range indicator. Place the instrument select switch to TACAN position and check the vertical needle on the pilot's course indicator and the No. 2 needle on the Navigator's RMI for proper homing. Return select switch to VOR-ILS position.

16. VHF

a. Operation - Check

Check operation of transmitter and receiver, side tone level and background noise

NOTE

No transmissions will be made on emergency (distress) frequency channels except for emergency purposes.

b. DF Tone - Check

Check for audible tone when tone button is depressed

17. UHF

a. Operation - Check

Check operation of transmitter and receiver, side tone level and background noise

NOTE

No transmission will be made on emergency (distress) frequency channels except for emergency purposes.

18. UHF/DF

a. UHF Operate Switch - To ADF

b. UHF Channel Selector - Select desired channel

If a signal is not heard, request a short count from control room or tower

c. UHF/DF RMI - Check pointer

Check the UHF/DF pointer for the proper bearing of the signal source

d. UHF Operate Switch - To T/R + GUARD

19. IFF

    a. Selector Switch - OFF

    b. Destructor Switch - OFF and safetied

    c. Emergency Lock Device - Check

    Depress emergency lock device to insure free operation

NOTE

Do not turn selector switch to EMERGENCY position during this operation.

20. Aux. Liaison Receiver

    a. Channel Selector Switch - As desired

    b. Receiver Control Switch - ON

    Wait for warmup, if set goes OFF select another channel

    c. Function Switches - Check

    Check noise control knob, volume control knob, operation selector switch, and CW tuning knob for proper operation

21. All Radios (except VHF/UHF) - OFF

    Leave VHF or UHF radios on and tuned to local tower frequency

22. SIF - Check settings

    Check code on SIF for correct settings

23. MF Command Transmitter(s) ART-13

    a. Transmitter - Security

    b. Dynamotor - Security

    Check reset buttons and fuses in

    c. Channelization - Check

    Channelization should be checked for mission requirement frequencies as outlined by current directives

    d. Operation - Check

    When operational checks are permitted they will be in accordance with current directives

ENGINEER'S PREFLIGHT INSPECTION

This inspection will be accomplished by the flight engineer. Although the engineer may be assisted in the inspection, this in no way relieves him of the responsibility of insuring that every step is properly completed. The following action will be required in complying with the response portion of the preflight inspection checklists:

CONDITION - A visual check only is required

SECURITY - A physical check is required

The preflight inspection begins as the engineer and the crew approach the airplane. The engineer should immediately notice if any obvious maintenance is still in progress and if adequate stands, ground heating equipment, auxiliary power equipment, fire fighting equipment, etc. are available for use.

Interior Inspection

CONTROL CABIN (POWER OFF)

1. Oxygen Equipment Check - Checked and stowed

   See Section IV

2 Safety Belt and Shoulder Harness - Adjusted

3. Circuit Breakers - Set

   All circuit breakers on overhead circuit breaker panel set. Air refueling panel ▼ and radio panel circuit breakers all set

4. All Switches - Off or normal

   Check that inverter and boost pump switches are OFF and all other switches are off or in normal position prior to applying power

5. Instruments - Normal

   Check for proper position of instruments with power off

▼⑥ Fuel Dump - Checked (E, BO)

   Coordinate with boom operator and check operation of fuel dump system on the battery bus. (See Section VIII)

▼ 7. Isodraulic Synchronization - Checked

   See Section VIII

⑧ Report to Pilot - "Ready for power" (E, P)

   Advise Pilot "Ready for power"

CONTROL CABIN (POWER ON)

1. Master and Battery Switches - As required

   If the APU is to be used for preflight, the master switch will be turned ON and the battery switch to ON BUS. If external power is to be used, the master switch will be turned ON and the battery switch will be left OFF

2. External Power or Auxiliary Power Unit - Started and on the line

3. Bus Voltage - Checked

   Place battery switch to BAT. CHG. Check bus voltage to insure 28 volts before any operational checks are started

④ Inverters - Spares and normal - Check output (E, N)

   Check inverters in both spare and normal switch positions for proper voltage and frequency. Leave essential secondary and autopilot inverter switches on normal. Flight instrument inverter switch OFF. Give power clearance to navigator

5. Instruments - Checked

   Check power on indication of all instruments. Check A-2 and B-2 head temperature with cylinder head temperature selector switch

6. SPR Test - Valves closed

   Check secondary valves closed by moving SPR test switch to each tank position; check valve closed light illuminated at each position. Return switch to OFF

7. Oil Transfer Switches - Climatic

   Check oil transfer to each engine except for cold weather operation

8. Heater Overheat System - Checked

   Turn thermal anti-ice master switch on. Turn body heater switches to AUTO. Depress overheat test switch; check overheat and pressure warning lights illuminated. Actuate reset switch; turn body heater switches OFF. Turn anti-ice master switch OFF

CAUTION

If body heaters have been operated, allow three minutes for body heaters to purge before turning air conditioning master switch OFF.

9. Fire Detection System - Check

10. Lights - Checked

    Check the following lights for condition and operation:

    a. Engineer's panel lights

    b. Push-to-test lights

       Check generator, alternator, prop oil quantity, hot fuel prime, APU fire warning lights

ENGINEER'S PREFLIGHT INSPECTION (Cont)

⑪ Interphone - Contact ground crewman (E, GC)

⑫ Waste Gates - AUTO and MAN - Checked (E, GC, CP, BO)

Turbo Switches AUTO, TBS lever full forward (10), waste gates should close; TBS lever zero, waste gates should open. Turbo switches MAN, manually CLOSE and OPEN waste gates using override switches then return turbo switches to AUTO

a. Release copilot and boom operator

⑬ Engine Hydraulic Lock Check - Crank 8 blades (E, GC)

Ground crewman will assure all four props are clear throughout this check

⑭ Engine Doors, Flaps, Shutters - Climatic (E, GC)

Do not perform steps with Climatic response during cold weather, until cylinder head temperature gage indicates 150°C because of possible actuator mechanical failure due to ice formation

Have ground crewman check for operation of all engine flaps and doors through entire range as follows:

Open all engine doors flaps and shutters. Ground crewman reports all actuators open. Operate all switches of each system simultaneously

a. Oil Cooler Flap Switches - Climatic

Oil cooler flap switches CLOSE for approximately 7 seconds, stop. Ground crewman report position; then switches AUTO; flaps should close; ground crewman report position. Manually open them and place switches OFF; leave open for visual checks

b. Intercooler Flap Switches - Climatic

Intercooler flap switches CLOSE and OPEN; leave open for visual checks

c. Cowl Flap Switches - Climatic

Cowl flap switches CLOSE and OPEN

d. Carburetor Air Switches - Climatic

Carburetor air switches to SHELT and RAM

15. Normal Fuel System:

Perform fuel pressure leak test on all engines as follows:

a. Fuel Selector Switches (all positions) - Check (counterclockwise and OFF)

Fuel selector switches in a counterclockwise direction for cycling of valves on all positions

b. Boost Pump Switches Main Wing Tanks - NORMAL (no pressure rise)

Fuel selector switches OFF, turn both boost pump switches for each wing tank to NORMAL; check for zero fuel pressure rise

CAUTION

Carburetors will be subjected to one minute NORMAL boost pressure prior to EMERGENCY boost operation. Do not change fuel selector switches with boost pumps on EMERGENCY, except as outlined in Section III.

c. Fuel Selector Switches - TE (note pressure rise)

d. Fuel Selector Switches - OFF

e. Boost Pump Switches - OFF (pressure holds 10 to 14 psi approximately 10 seconds)

f. Fuel Selector Switches - TE

(1) Main Wing Tank Boost Pumps - Checked

Check each boost pump individually on NORMAL. Turn all eight boost pumps on NORMAL for one minute. Turn one boost pump per tank to EMERGENCY and note that warning lights go out. Turn boost pumps from EMERGENCY to OFF. Note fuel low pressure warning lights on at 23 psi. Turn remaining boost pumps to EMERGENCY. Note fuel pressure. Turn all boost pumps OFF

ⓖ. External Fuel Tank Boost Pumps - Checked (if required) (E, GC)

Turn forward boost pump to NORMAL in each external tank. Open forward A/R transfer valve ▼ or otherwise provide path of flow. Turn forward boost pumps to EMERGENCY. If boost pumps operate, the fuel tank empty warning light will go out. Return forward boost pump switches to NORMAL. Close forward A/R transfer valve ▼ or other valve opened, when the check is complete. Turn forward boost pumps OFF. Repeat above steps using aft boost pumps and aft transfer valve

CAUTION

Do not close transfer valves with external boost pumps on EMERGENCY, as sudden flow stoppage may cause external tank O ring seals to pop out.

h. Fuel Selector Switches - TME

ⓘ. CWT Boost Pumps - Checked (if required) (E, GC)

If fuel suitable for R-4360 engines is carried in the CWT the No. 1 manual fuel shutoff valve should be OPEN. With this configuration, open the CWT line valve and turn CWT boost pump switches separately to NORMAL and EMERGENCY. Fuel pressure should rise on all engine fuel pressure gages

ENGINEER'S PREFLIGHT INSPECTION (Cont)

j. Boost Pump Switches - One on EMERGENCY, all others NORMAL

Turn one boost pump switch on EMERGENCY and all others to NORMAL. Leave in this position for visual check of the fuel system. Notify the ground crewman to advise pilot when the fuel manifold is pressurized

k. Ground Crewman - Released

Notify ground crewman that operational checks are completed and to open sheltered air door assembly panels. Advise ground crewman to return to ground headset to assist boom operator in A/R light check

▼16. A/R Fuel System:

a. A/R Panel - Checked:

(1) Turn A/R master switch ON and check A/R fuel quantity. Level fuel as required

(2) All other switches OFF or NORMAL position

(3) Push-to-test lights

(4) Hydraulic oil supply valve switches OPEN

b. Isodraulic Handle - Full down

17. All Fuel and Oil Quantities - Checked

All fuel and oil quantities will be determined and entered on the flight engineer's log at this time

18. Turbo Amplifiers and Fuses - Checked

a. Amplifiers for condition and security

b. Amplifier fuses for proper amperage rating

c. Spare fuses and amplifier installed and secure

19. Cabin Pressure Relief Valve Crank - Full INCREASE

20. Lavatory - Checked

Lavatory compartment for general condition and adequate water supply (if required)

21. Boom Operator's Oxygen Shutoff Valve - Open

LOWER NOSE COMPARTMENT

1. Emergency [illegible]e Gear Equipment - Security

a. Emergency hand crank for installation and security

b. Nose gear clutch lever for proper position and pressurization plug installed

2 Cabin Pressure Emergency Release Valve - As required

Cabin pressure emergency release valve for condition and security. Leave release valve open or closed as required

3. AC Panel (as applicable) - Fuses and circuit breakers

AC power panel for all fuse switches and/or circuit breakers in normal position

4. Alternator Equipment - Checked

Alternator exciter voltage regulator, fuses and/or circuit breakers for condition and security

5. Inverters - Condition, security

6. Torquemeter Amplifiers - Condition, security

7. Hydraulic Equipment - Checked

   a. Hydraulic panel equipment for leaks and condition

   b. Service brake and emergency accumulator ground service valves closed and safetied, proper preload

   c. All hydraulic units, lines and fittings in lower nose for leakage and condition

8. Central Oil Tank and Pump - Condition, leaks, security

9. General Condition - Checked

Lower nose wire bundles for security and condition, general area for cleanliness and security of equipment

LOWER FORWARD COMPARTMENT

1. General Condition - Checked as checklist progresses

   a. All guard cages for security

   b. Cleanliness, and overall condition

   c. Drain valve on urinal tank closed

2. Battery Shield - Condition, Secured

Battery sump jar serviced and pressure cover on

3. Forward Power Panel - Condition, circuit breakers as required

Forward power panel circuit breakers, current limiters for condition and proper position. Spare current limiters and wrench properly stowed

4. Fire Extinguisher - Pressure, security

Fire extinguisher, pressure, and security of mounting

ENGINEER'S PREFLIGHT INSPECTION (Cont)

5. Central Oil Tank Filler Cap - Security

   Central oil tank filler cap and scupper drain plug for installation

6. Voltage Regulators - Condition

   Voltage regulators, over-voltage relays and field control relays for condition and connections

7. First Aid Kit - Stowed

   First aid kit for installation

8. Compartment Lights - Checked

   Lights checked for condition and operation

9. Fuel Gage Amplifiers - Secured

▼10. Fuel Lines, Connectors, Tanks - Leaks, condition

   As checklist progresses

11. Body Heaters - Condition

    a. For evidence of burning, fuel leakage and overall condition

    b. Cabin heater distribution valve for normal position A or as required

    c. Cabin heater selector valve for normal position D, or as required

12. Differential Pressure Ports - Clear

    Both cabin air differential ports are clear of obstructions

13. Prop De-icer Timer - Security, condition

14. Oil Transfer Valve - Security, condition

    Oil transfer valve for security of mounting and overall condition

CENTER WING SECTION

1. General Condition - Checked as checklist progresses

   All fuel and hydraulic lines, electrical equipment, etc. for general condition

2. No. 1 and No. 2 Manual Fuel Shutoff Valves - Checked

   a. No. 1 Manual fuel shutoff valve normally closed, (must be closed and safety wired if jet fuel is carried in CWT)

   b. No. 2 Manual fuel shutoff valve normally closed, (must be closed and safety wired if jet fuel is carried in external fuel wing tanks and CWT is to be used for airplane fuel system)

3. CWT - Leaks, condition

   a. Tank boost pumps and sensing unit for leaks

   b. Tank for signs of leakage and proper installation of access panels

4. Cabin Pressure Regulators - Condition

   Cabin pressure regulator valves, for open position, safety wiring and general condition

5. Hydraulic Pressure Transmitters - Leaks **22737** ▶

6. Fuel Valves - Checked

   Check center wing line valve and center wing secondary valve closed, condition and security

LOWER AFT COMPARTMENT

1. General Condition - Checked as checklist progresses

   a. Wire bundles, wires, condition of cables, lines and vents on rear spar

   b. Cleanliness and overall condition

2. No. 1 and No. 2 Manual Fuel Shutoff Valves - Checked

   ▼ a. No. 1 manual fuel shutoff valve normally closed (must be closed and safety wired if jet fuel is carried in CWT)

   ▼ b. No. 2 manual fuel shutoff valve normally closed (must be closed and safety wired if jet fuel is carried in external wing tanks and CWT is to be used for airplane fuel system)

3. Main Gear Emergency Equipment - In place

   a. Emergency gear clutch T handles for proper position

   b. Emergency extension gear cranks in place

4. Reverse Current Relays - Condition

   Reverse current relays for condition of mounting and all wires for condition and clear of items which may cause a short

5. Wing Flap Mechanism - Condition

   a. Condition of flap torque tube and universal joints

   b. Emergency wing flap gear motor for proper installation

6. Main Circuit Breaker Panel - Condition, set

7. Main Power Panel - Condition

   a. Current limiters and spares for installation

   b. Wrench for stowed position

ENGINEER'S PREFLIGHT INSPECTION (Cont)

8. Vent Selector Valve Handle - Vent, if installed

▼9. Fuel Tanks, Fuel and Hydraulic Lines - Leaks, condition as checklist progresses

10. Compartment Lights - Checked

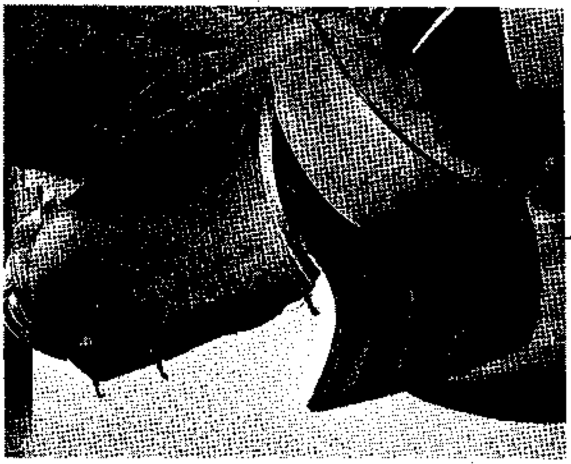
    Lights checked for condition and operation

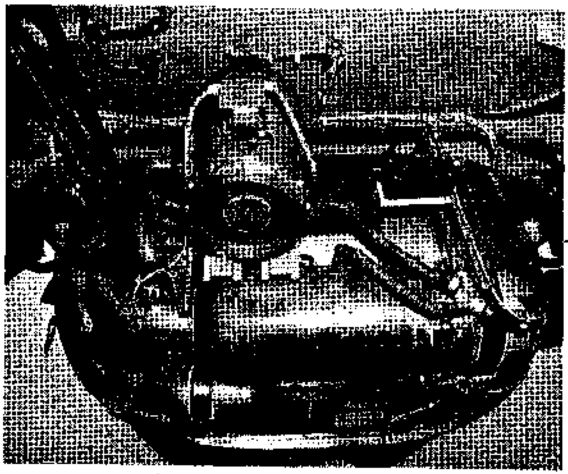
11. Tail Jack and Strut Assembly - Stowed and secure

12. SPR Panel - Switch OFF, cannon plug disconnected, stowed and secured

13. Fire Extinguisher - Pressure, security

    Fire extinguisher pressure and security of mounting





Exterior Inspection

1. Left External Fuel Tank - Checked

   Determine fuel quantity and check security of filler cap

2. No. 1 Nacelle Heater Cavity - Climatic

   With heater cavity doors open, check heater cavity for general conditions, fuel, oil, and hydraulic leaks. Check heater outlet plug installed securely and engine preheat switch OFF. Check surge accumulator pressure 1C10 KS53

3. Engine Nacelles

   All engine nacelle accessory and induction systems as follows:

   a. Air Scoop - Clear

      Air scoop for loose articles, rags, obstruction, etc.

   b. Turbo Impeller - Checked

      Turbo impeller for freedom of movement, and safety of impeller nut

   c. Preheat Valve - Closed

   d. Bypass Door - Free

   e. Hydraulic Pump - Leaks

      Hydraulic pump and accessory section for signs of leaks and general condition

   f. Oil Sump Plug - Safetied

      Oil sump plug for security and proper safety wiring

g. Sheltered Air Door - Security

h. Air Filters - Climatic

Normally installed and secured (Removed for cold weather operation)

4. No. 4 Nacelle Heater Cavity - Climatic

Repeat Step No. 2 on No. 4 nacelle heater cavity

5. Right External Fuel Tank - Checked

Repeat Step No. 1 on right external fuel tank

6. Access Doors - Closed

Have ground crew close heater cavity doors and sheltered air door assemblies

7. Wing Heater Exhausts - Checked

Check that wing heater exhausts extend through nacelle doors

Control Cabin Status (Engineer)

1. Boost Pump Switches - OFF
2. Fuel Selector Switches - TE
3. All Switches - As required
4. Form F - Checked

   Insure that the Form F is prepared in accordance with the actual loading of the airplane
5. Takeoff and Landing Data Cards - Prepared
6. Flight Log - Initiated

   Flight log complete up to Engine Start

[redacted]

PILOTS

NOTE

From this point on through the ENGINE SHUTDOWN checklist, all checklists will be announced on interphone. Items that appear on the amplified checklist, in quotation marks, require interphone communication. Except where otherwise indicated, the pilot will take the necessary action and make the correct response.

1. Check Form 781, TOLD Cards - Checked (P)

Form 781 signed and takeoff data card available for reference

ENGINEER

1. Fire Switches - NORMAL

Check that all engine and heater fire switches are in NORMAL position

BEFORE STARTING ENGINES (Cont)

PILOTS

②Lights as Required - As required (P, CP)

Pilot and copilot will check navigation, wheel well and cockpit lights on as required

3. Gear Switch DOWN - DOWN (CP)

Copilot rechecks landing gear switch is in DOWN position and closes safety cover

4. Check Gear Indicator and Warning Light - Checked

Press landing gear warning light for indication that light is operating. Check indicators for down indication

5. Radios On - On (P or CP)

Turn all radios on; UHF, TACAN, VHF, Omni, Radio Compass, IFF to standby

6. Open Reverse Lock Plate - Opened (CP)

Reverse lock plate will be left open for all ground operation. This will permit reversal of props in the event of brake malfunction and will also make reversing available while taxiing on ice or slick surfaces

ENGINEER

2. Ignition Switches - OFF

3. Overhead Circuit Breakers - Set

4. Heater and Deicer Switches - OFF

5. Master Switch - ON

6. Battery Switch - As required

If external power is used, battery switch will be OFF. If APU is used, battery switch will be ON BUS

7. APU or External Power - Started and on line, voltage checked

8. Essential Inverter Switch - ESS INV, all others OFF

9. Hot Fuel Prime Switches - Climatic (normally HIGH, then OFF)

Place switch to OFF after hot fuel prime indicator light goes out. (Refer to Sections VII and IX for alternate hot fuel prime starting procedures)

CAUTION

If indicator light fails to go out in about three minutes at HIGH, or in about six minutes at LOW, place hot fuel prime switch OFF. Check hot fuel prime tank for overheat condition.

▼10. A/R Panel - Checked

   a. Hydraulic Oil Shutoff Valve Switches - OPEN

   b. Fuel Dump Switches - NORMAL

   c. All Other Switches - NORMAL position

CAUTION

Since the A/R hydraulic pumps are lubricated by the hydraulic oil, shutoff valves must be OPEN at all times during normal operation to prevent burning out the pump and will be closed only in case of fire in either outboard engine or in case of a hydraulic leak.

PILOTS

⑦ Wing Flaps UP - UP (P, CP, GC)

Pilot checks with ground crewman that wing flaps are clear of obstructions and directs copilot to move wing flap switch to UP

8. Depressurization and Emergency Charging Valve Handle NORMAL - NORMAL (CP)

9. Check Nose Steering Disconnect Button - Checked (P)

Depress nose wheel steering emergency disconnect button, check and return to normal

10. Set Parking Brakes - Set (P)

11. Check Service Brake Pressure - Checked (CP)

Copilot checks hydraulic pressure in service brake system If pressure is below 520 psi, the hand pump will be operated until pressure reaches 520 psi to insure parking brakes being set. Check that the essential inverter warning light is not illuminated

12. Radio Call - Completed (CP)

Copilot contacts tower, advises airplane location and requests taxi and takeoff information

⑬ Crosscheck Altimeters - Checked (P, CP, N)

Pilot will announce the altimeter setting, received from the tower, over the interphone. The crew members will then set altimeters and compare readings over interphone. Crew members will check all three pointers on their respective altimeters to assure proper readings. Particular attention will be directed to the position of the 10,000 foot pointer.

ENGINEER

11. Manifold Pressure - Recorded

12. Carburetor Air Switches - Climatic

13. Intercooler Flap Switches - Climatic

In cold weather they will be left as set

14. Cowl Flaps - Climatic

Cowl flaps open except during cold weather when they will be left in position set

15. Cylinder Head Temperature Selector Switch - A-2

16. Oil Cooler Flap Switches - Climatic

Normally AUTO, in cold weather OFF

17. Cabin Pressure Rate-of-Change Selector - MAX

18. Cabin Altitude Selector - Set

Set to desired altitude at which airplane is to be pressurized during flight

19. Cabin Air Selector Switches - NORMAL

20. Turbo Bleed Switches - OPEN

21. Fuel Selector Switches - TE

Check indicator light out

22. Prop Oil Refill Switches - OFF

23. SPR Test - Valves closed, switch OFF

Check that all SPR secondary valves are closed by moving switch to each tank position, check valve closed, light on at each position. Turn SPR secondary valve test switch OFF

24. Mixtures - FUEL CUTOFF

Check and unlock

BEFORE STARTING ENGINES (Cont)

PILOTS

⑭ Engineer's Report - "Ready to start engines" (P, E)

Receive engineer's report

ENGINEER

25. Throttles - Cracked

Throttles cracked (approximately 1 inch for 1000 rpm)

CAUTION

Position throttle prior to raising fuel pressure to preclude possibility of the accelerator pump discharging fuel into the engine which could result in a liquid lock.

26. Prop Synch Lever - Full INCREASE RPM

27. TBS Lever - 0

28. Turbo Switches - AUTO

29. Turbo Override Switches - OPEN, guards down

30. Prop Governor Selector Switches - Full INCREASE RPM (lights on)

31. Prop Auto Control Switch - No. 1 MASTER

Four prop rpm limit lights illuminated

32. Spark Advance Selector Switches - NORMAL

㉝ Report to Pilot - "Ready to start engines" (E, P)

STARTING ENGINES

PILOTS

①Start Engines - Direct engineer to start engines (P, E)

ENGINEER

1. DC Voltmeter Selector Switch - No. 3 engine

2. No. 3 Boost Pump Switch - NORMAL

3. Engine Starting Selector Switch - No. 3

④Start Engines - Climatic (E, P, GC)

When pilot directs that engines be started, the engineer will contact ground crewman on interphone and state; "Ground crewman this is Engineer, ready to start No. 3." Ground crewman replies: "Chocks in place, down locks and pitot covers removed, all props clear, fire guard standing by on No. 3, clear on No. 3." Engineer states: "Turning No. 3." Press starter switch, after 20 blades ignition switch BOTH, ignition boost and prime. The ground crewman will count blades on interphone and report if fuel starts to run out of the blower drain

CAUTION

Do not prime engine before engaging starter. To prevent hydraulic lock, avoid every possibility of liquid fuel collecting in the intake pipes or cylinders.

NOTE

- All normal starts will be made on prime. See SYSTEMS OPERATION, Section VII for starting procedures.
- Twenty blades are required for any start made after a 1-hour shutdown period. Eight blades will insure detection of hydraulic lock and are sufficient for engine starts made within 1 hour of last shutdown.
- For hot fuel prime start procedure refer to ENGINE OPERATION, Section VII.

STARTING ENGINES (Cont)

PILOTS

② Check Hydraulic Pressures - Checked (P, CP)

With No. 3 Engine running, Copilot checks No. 3 hydraulic pump by observing rise in pressure. Turn the depressurization and emergency charging valve to EMERGENCY BRAKE CHARGING, check emergency pressure, return to NORMAL and report to pilot "Hydraulic pressures normal"

③ Engineer's Report - "Starting checklist complete" (P, E)

ENGINEER

5. Oil Pressure - Check

Oil pressure indication immediately and at least 50 psi within 30 seconds or shutdown engine. On interphone state, "Oil pressure up on No. 3." If oil pressure exceeds 200 psi for more than 30 seconds dilute intermittently to reduce oil pressure. If the procedure fails to reduce excessive pressure within 30 seconds discontinue dilution

6. Mixture - AUTO RICH, release primer

After engine rpm has stabilized at 1000 rpm on primer and throttle, bring mixture lever to AUTO RICH position and when 100 rpm drop is noticed, release primer

CAUTION

Be ready to return mixture to FUEL CUTOFF at first sign of failure to continue running; continue cranking; if engine does not start within 1 minute from time of engaging, stop cranking and allow starter to cool for at least one minute before repeating starting procedure; if engine fails to start after second attempt, check engine completely and prepare for new start.

7. Boost Pump Switch - OFF

8. Fuel Pressure - Checked

Check pressure from engine fuel pump

9. Generator Operation - Checked

Generator on the line and taking load

⑩ Repeat on Remaining Engines as Ground Crewman Clears each Engine in Turn - All steps above (E, GC)

11. Starter Selector Switch - OFF

⑫ Report to Pilot - "Starting checklist complete" (E, P)

ENGINE GROUND OPERATION

The ground operation of each engine must be held to an absolute minimum. Engines shall be run only when it is necessary to perform the required checks. An engine should be shutdown when possible during a prolonged check of another engine, to prevent running unnecessarily. Prolonged ground running causes fouling of the spark plugs. Face the airplane into the wind during ground operation to provide better engine cooling. When it is necessary to run an engine on the ground for an extended period of time, it shall be run at field barometric with the prop synch lever in full INCREASE RPM, for a period of one minute, every 10 minutes. Engines must be manually leaned to produce a mixture 25 rpm leaner than best power during ground operation between minimum idle and 1200 rpm. This procedure will act to clear away the fouling deposits in the incipient stages. Refer to Section VII SYSTEMS OPERATION for the procedure to be followed when spark plug fouling conditions are evident.

CAUTION

- Running engines on ground with a 90 degree crosswind of 10 knots and over, can increase normal propeller blade stresses by two to three times. This will also cause engine overheat. Head the airplane into the wind for any ground running.
- Brakes should be used carefully and as little as possible during all ground operation. Dangerous overheating can result without any indications to the pilot.

BEFORE TAXI

PILOTS

①Remove External Power - Removed (if applicable) (P, GC)

After all engines have been started, direct ground crewman to have external power unit disconnected and removed, if used

2. Autopilot Master Switch ON - ON (P)

Check that autopilot inverter warning light is not illuminated

③Alarm Bell, Oxygen and Interphone Check - Check (CP)

Copilot will contact crew members on CALL position and state "Checking alarm bell." He will ring ring bell once after which all crew members, starting from the tail will check in individually and state while on CALL Position," (Crew position) regulator normal, alarm bell loud and clear." Pilot and copilot will recheck station oxygen pressure for at least 400 psi

ENGINEER

1. Battery Switch - ON BUS

After external power is removed, if used

2. Autopilot Inverter - AUTOPILOT INV

Check voltage and frequency

3. Secondary Inverter - SEC. INV

Check voltage and frequency

4. Pilot's Instrument Inverter - PILOT'S INSTR INV

Check voltage and frequency

▼5. A/R Hydraulic Pressure - Checked

A/R hydraulic pressure on No. 1 and No. 4 hydraulic pumps checked for pressure indication

BEFORE TAXI (Cont)

PILOTS

④ Check Flight Controls - Checked (P, CP)

Copilot will unlock controls, visually checking the aileron, elevators, and rudder for full travel, trim tabs for opposite travel. The pilot will turn rudder boost on and apply full right rudder. Release rudder and note return to center of rudder pedals and fluctuation of hydraulic gage. Repeat procedure for full left rudder. The copilot will check the trim tab locked. The copilot will wear headset and lip microphone while checking flight controls. Lip microphone may be keyed using the hand microphone inside the airplane. The pilot will check the left aileron. (Without speakers installed): Pilot will hold copilot's selector switch in CALL position to allow copilot to transmit

⑤ Purge Manifold Pressure Lines - Purged 30 seconds (P, CP)

Pilot and copilot will purge manifold pressure lines for 30 seconds

6. IFF Master Switch - NORMAL (CP)or (N) (as applicable)

7. SIF Control Panel - Set (CP) or (N) (as applicable)

⑧ Set and Uncage Instruments - Set and uncaged (P, CP)

ⓐ N-1 Compass - Synchronized (if applicable) (CP, N)

Check that instrument inverter warning light is not illuminated. Pilot and copilot will reset and uncage all flight instruments, cross check compasses, cage and uncage J-8 attitude indicator. If navigator is not aboard, synchronize N-1 compass according to N-1 COMPASS SYSTEM OPERATION, Section IV

⑨ Check Autopilot Operation - Checked (P, CP)

Push autopilot clutch control button in and check control movement. After checking the follow through of the flight controls, push each pilot's release switch and check release of autopilot, reengage between each release. Autopilot master switch OFF. Copilot will lock flight controls

ENGINEER

6. Air Conditioning Master Switch - ON

Master switch must be ON to supply power to ground blowers and pressure regulators

⑦ Contamination Check - Initiated (E, BO or RO)

a. No. 1 and No. 4 Fuel Selector Valve Switches - (TME)

b. No. 1 or No. 4 Fuel Boost Pump Switch - NORMAL

This may clear the manifold of any contaminated fuel

c. CWT - Checked (if required) (E, BO or RO)

d. External Tanks - Checked (if required) (E, BO or RO)

NOTE

The ground contamination check procedures outlined in Section VII, will be made on all flights where 115/145 fuel for KC-97 engine consumption is carried in the center wing tank and/or external tanks.

8. Magneto Grounding (800-1000 rpm) - L, R, OFF, BOTH

⑨ APU - Started and on line (E, BO or RO)

10. Fire Detection Systems - Test

Advise Pilot - 'Checking fire detection." Check all fire detection systems with engines operating to get a test of the relays with vibration

11. Oil Transfer System - Climatic

During cold weather check for oil congealing. Transfer one gallon of oil to each tank

⑫ Engine Doors, Flaps and Shutters - Climatic (E, GC)

If not previously accomplished, do not perform until cylinder head temperature has reached 150°C

PILOTS

⑩ Dismiss Ground Crewman - Dismissed (P, E,GC)

During cold weather operation, insure that engineer has completed actuator checks prior to dismissing ground crewman. Pilot calls ground crewman and states, "Ground crewman, this is pilot, remove chocks and check that the external power unit is removed. I will taxi after a visual signal from you. You are clear to disconnect interphone"

11. Door Warning Light OFF - OFF (CP)

⑫ Crew Report - "Ready to taxi" (ALL)

Pilot announces over interphone "Crew report, ready to taxi?" The crew will report as follows: Boom Operator, Navigator, Radio Operator **17260** ▶ **3177** and Engineer check in order "Ready to Taxi." Prior to taxiing, the pilot and copilot will review the Taxi checklist items to be accomplished during taxiing

ENGINEER

13. Oil Temperature - Above minimum

⑭ Report to Pilot - "Ready to taxi" (E, P)

TAXI

NOTE

If prop low oil quantity warning light comes on during taxi, run-up or before takeoff, cut engine, return to line and have it checked and re-serviced. This should be accomplished in order to prevent possible prop oil starvation.

PILOTS

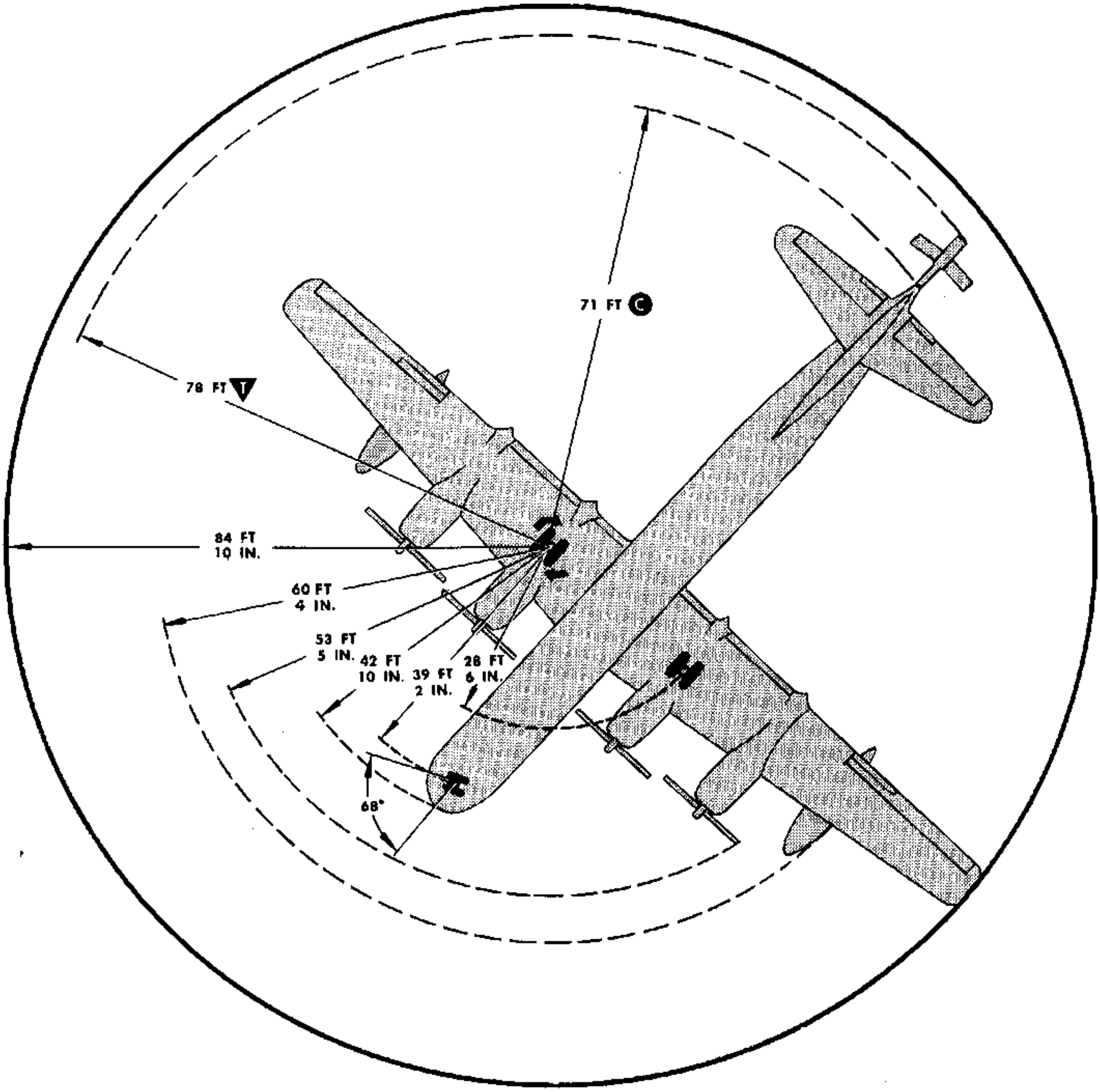
After receiving taxi clearance and visual signal from ground crewman, release parking brake. Advance the throttles to start initial roll.

CAUTION

Do not operate in restricted rpm range of 1250 to 1650 rpm, except when passing thru.

If the brakes still seem to be locked, momentarily depress the copilot's pedals. After the airplane starts rolling, retard throttles to keep engines at a low power adequate for taxiing. When the airplane is clear of congested parking areas and wing walkers are no longer required, the pilot will check the emergency brakes prior to reaching normal taxi speed. Use the brakes to control the speed but do not ride

ENGINEER



NOTE

AVERAGE GROUND CLEARANCE

INBOARD PROPELLERS......1 FOOT 5 INCHES
OUTBOARD PROPELLERS....2 FEET 7 INCHES
EXTERNAL FUEL TANKS.....4 FEET
FUSELAGE...............2 FEET 9 INCHES

MINIMUM TURNING RADIUS

Figure 2-3

TAXI (Cont)

PILOTS

the brakes. Brake action normally should be applied by the pilot. If it becomes necessary for the copilot to apply brakes, the pilot must release his brake pedals. This is necessary to allow copilot's braking action to be effective through the pilot's metering valves. Taxi slowly. Use the steering wheel to control airplane direction, but avoid excessive movement of the nose wheel. Begin a turn with a slight change in nose wheel direction and gradually increase until desired turn is established. Use the same technique to straighten the airplane. If the airplane resists the turn and the nose wheel skips or skids, use an outboard engine to help the airplane turn. When making a sharp turn, allow the airplane to roll while turning to prevent tire damage resulting from pivoting on a locked wheel.

CAUTION

- Thrust reversal, except in cases of emergency, will not be used at any time to back the airplane on the ground.
- In the event an engine stops during taxiing, the engine should not be restarted until a fire guard is posted, except in emergencies.

① Check Normal Brakes - Checked (P, CP)

As soon as the airplane begins to roll, the pilot will check normal braking action, copilot will check hydraulic pressures

② Check Emergency Brakes - Checked, system recharged (P, CP)

When the airplane is clear of congested parking areas and wing walkers are no longer required, the pilot will check the emergency brakes prior to reaching normal taxi speed and then direct the copilot to recharge the emergency brake system

③ Check Instruments - Checked (P, CP)

Pilot and copilot will check turn and slip indicators, directional indicators, ADF indicators, and omni directional indicator (tracking) for correct operation

4. Check Hydraulic Pressure - Checked normal (CP)

ENGINEER

1. Mixtures - Manual lean

Engines must be manually leaned to produce a mixture 25 rpm leaner than best power during ground operation between minimum idle and 1200 rpm. Throttle movement in this range will be made slowly and with caution. Any time 1200 rpm is exceeded the mixtures will be placed in AUTO RICH position

2. Alternator Control Switches - ON

This allows exciter regulators to warm up. Leave alternator bus selector switch OFF

3. Analyzer Power Switches - ON

The secondary inverter must be operating to supply power to the analyzer

4. Spark Advance System - Check (1000 rpm) Proceed as follows:

   a. Set analyzer selector to R-1 magneto position

   b. Place spark advance switch to SPARK ADVANCE and note shift on analyzer pattern

   c. Place spark advance switch to NORMAL and note shift on analyzer pattern

TAXI (Cont)

PILOTS

⑤ Engineer's Report - "Taxi checklist complete" (P, E)

ENGINEER

5. Prop Deicing - Check
   a. Prop Deicing Switch - ON
   b. Prop Deicing Loadmeter and Indicators - Monitor
   c. Prop Deicing Switch - OFF

   After one complete cycle

⑥ Report to Pilot - "Taxi checklist complete" (E, P)

ENGINE RUNUP

PILOTS

1. Center Nose Wheel - Centered (P)

   Park the airplane with nose into the wind and center nose wheel

2. Check Hydraulic Pressure - Checked normal (CP)

3. Set Parking Brakes - Set (P)

④ Check for Brake Overheat - Checked (if required) (P, BO)

At this time if the pilot has used his brakes excessively, he will have a crew member check for an overheat condition

NOTE

A physical inspection of the brakes will be made after an aborted takeoff or at any time after any excessive braking has been used.

▼⑤ A/R Pressure Check - Completed (if applicable) (P, E, BO, N or RO)

Direct engineer and boom operator to accomplish A/R pressure check

WARNING

In the event of a ruptured flex hose or fuel leak during the pressure check, contact tower and request fire fighting equipment, direct engineer to cut engines and turn master switch OFF.

ENGINEER

1. Mixtures - AUTO RICH

▼② A/R Fuel Pressure Check - Completed (when directed by pilot) (E, BO, P)

See Section VIII for operation

PILOTS

⑥ Notify Engineer and Crew - "Ready for runup" - Notified (P)

Prior to the beginning runup, copilot will select and report "Visual reference point established" and check continually during runup for any movement of the airplane. Aft compartment crew members will visually clear area to the rear of airplane prior to runup and report this over interphone. During darkness or poor visibility conditions, taxi lights, wheel well lights and under body lights will be utilized to aid in detecting any movement of the airplane

ENGINEER

3. Prop Operation

During cold weather operation turn the auto control switch to No. 1 MASTER and move the synch lever so that the props are exercised between 1850 and 1100 rpm

a. Manual Controls - Check

(1) Throttles - 1850 rpm

(2) Prop Synch Lever - Full INCREASE RPM

(3) Auto Control Switch - ON

(4) Governor Selector Switches - Full DECREASE RPM

(5) Prop Rpm Limit Lights (4) - ON (tachometer should indicate 1100 ± 50 rpm)

(6) Governor Selector Switches - Full INCREASE RPM

(7) Prop Rpm Limit Lights (4) - ON

NOTE

Operation in either direction requires 8 to 15 seconds.

b. Auto Master Synchronizer - Check

(1) Throttles - 1850 rpm

(2) Prop Synch Lever - Full INCREASE RPM

(3) Auto Control Switch - OFF

(4) Prop Synch Lever - Retard about one inch from Full INCREASE RPM toward DECREASE RPM. Check 4 prop limit lights on, then return lever to full INCREASE RPM

(5) Auto Control Switch - No. 2 MASTER

(6) Prop Synch Lever - Full DECREASE RPM

Tachometers should indicate 1100 ± 50 rpm

ENGINE RUNUP (Cont)

PILOTS

ENGINEER

(7) Prop Synch Lever - Advance to 1850 rpm, and reset throttles to 30 inches Hg.

(8) Resynchronizer Switch - RESYNC momentarily

Repeat if necessary. Tachometer should indicate 1850 rpm

(9) No. 2 Throttle - 1000 rpm

(10) Tachometers - 175 rpm maximum drop

No. 1, 3, 4 engines

(11) No. 2 Throttle - 30 inches Hg.

(12) Resynchronizer Switch - RESYNC momentarily

Repeat if necessary. Tachometers should stabilize at 1850 rpm

(13) Auto Control Switch - No. 1 MASTER

Repeat Steps (9), (10), (11), (12), using throttle for No. 1 engine

(14) Throttles - 1000 rpm

(15) Prop Synch Lever - Full INCREASE RPM

Check rpm limit lights on in 8 to 15 seconds

(16) Governor Selector Switches (4) - DECREASE RPM for approximately 3 or 4 seconds. Check all rpm limit lights out

Wait 3 or 4 seconds before advancing prop synch lever

(17) Prop Synch Lever - Toward DECREASE RPM approximately 2 inches. Then advance to full INCREASE RPM. Check all rpm limit lights on

CAUTION

If rpm limit lights do not illuminate, calibrate switch is probably faulty.

PILOTS

⑦ Prop Operation - Checked (P, E, CP)

After the engineer completes the prop operational check the pilot will check thrust reversal. The pilot will reverse the throttles in pairs, e.g., numbers 1 and 4 and numbers 2 and 3. Hold thrust reversal to an absolute minimum of time to prevent overheating the engines. Open the throttles to approximately 1000 rpm and allow to stabilize. Depress number 1 feathering button momentarily and watch for initial rpm rise. This is positive indication that the thrust has reversed. Receive engineer's report of load indication on his loadmeter. Repeat on other engines. Upon completion of reversal check, return to forward thrust rpm of approximately 1000 rpm.

CAUTION

If a prop sticks in reverse thrust, immediately have engineer cut the engine and investigate, as the engine may overheat.

Upon completion of the reversel check the engineer will set rpm on all engines at 1200. Adjust throttle friction brake. Check that blade switch operation is normal by pulling out on each feathering button and hold for 3 to 4 seconds. Check that respective engine rpm does not change while feathering button is held out, and then release to neutral. Upon completion of the blade switch check, and with all engines set at 1200 rpm, the pilot will check feathering action. Starting with number 1 engine depress the feathering button until a 200 rpm drop is noted and then release feathering button. An initial rpm decrease is a positive indication that the prop has returned to forward thrust. During the feathering check of number 1 engine only, the copilot will check that all prop limit lights remain on. This is to check that the prop holding relay is functioning properly. As each feathering button is depressed the engineer will report load indication on the respective loadmeter and the pilot will state that he has observed the rpm "drop"

ENGINEER

④ Reversal - Check (E, P)

a. Throttles - 1000 rpm

b. Report "Ready to Reverse"

ⓒ Check loadmeters for load indication and report to pilot, "LOAD," when feathering button is depressed

⑤ Prop Feathering - Check (E, P)

a. All Throttles - 1200 rpm

b. Report to pilot "Ready for feathering check"

ⓒ Check loadmeters for load indication and report to pilot, "LOAD" when feathering button is depressed

6. Alternator Voltages - Check

Set inboard engines to 2100 rpm. Turn alternator bus selector switch to L. ALT NESA R. ALT BUS No. 2 and check voltages on both busses. Turn selector OFF when not required for takeoff, then retard throttles

7. Engine Power and Ignition System - Check

a. Throttle (One at a Time) - Field barometric pressure

b. Tachometer - Check 2025 ± 75 rpm

NOTE

The limits stated above are desirable, however, unpredictable location conditions may cause the tolerances to be exceeded even though the prop engine combination is performing satisfactorily. In this case, with the airplane headed into the wind if all engines are not within the above tolerance, the spread between the highest and lowest engine rpm should not exceed 100 rpm

ENGINE RUNUP (Cont)

PILOTS

⑧ Engineer's Report - "Contamination checks, engine runup complete" (P, E)

ENGINEER

c. Torque Pressure and Normal Fuel Flow - Check

d. Ignition Switch - From BOTH to LEFT, note rpm drop, return to BOTH. From BOTH to RIGHT, note rpm drop, return to BOTH

Rpm drops are as follows: normal 45-50 rpm, maximum allowable 80 rpm. Maximum allowable difference between right and left magneto is 20 rpm

CAUTION

Do not exceed maximum allowable CHT for ground operation.

8. Mixtures - Manual lean

⑨ Manual Fuel Shutoff Valves - Check closed (E, BO)

⑩ Report to Pilot - "Contamination checks, engine runup complete" (E, P)

BEFORE TAKEOFF

PILOTS

1. Set Trim Control Wheels - Set (P)

   Set all trim control wheels neutral or as desired for takeoff

2. Autopilot Switch OFF - OFF (P)
3. Rudder Boost ON - ON (P)
4. ADI Switch Climatic - Climatic (CP)

   Normally ON

NOTE

Maximum power, with ADI, will be used for all takeoffs if available. During the initial portion of takeoff roll, the copilot will monitor the ADI lights and will notify the pilot and engineer if any light fails to go out. The pilot, prior to takeoffs, will determine what course he will follow. This will be dependent on gross weight, temperature, altitude, or other pertinent conditions.

ENGINEER

1. Ignition Switches - On BOTH
2. Fuel Enrichment Switches - OFF TCTO 595

CAUTION

Do not use fuel enrichment on takeoff, due to 100 to 300 BHP loss per engine.

3. Prop Synch Lever - Full INCREASE RPM
4. TBS Lever - 0
5. Turbo Switches - MAN
6. Turbo Override Switches - OPEN, 10 seconds then OFF, guards up
7. Prop Governor Selector Switches - Toggle momentarily in DECREASE RPM, then full INCREASE RPM

   Toggle to DECREASE RPM momentarily, note prop rpm limit lights out. Toggle back to INCREASE RPM until lights are on at the INCREASE RPM position

PILOTS

5. Set Throttle Lock Lever - Set (P)

Adjust throttle lock as desired for takeoff

⑥ Set Wing Flaps - Set 33% (P, CP, BO)

In cold weather operate wing flaps through one complete cycle before setting flaps for takeoff. Wing flap switch DOWN until indicators read 33%. At this time aft compartment crew member will report, "Both flaps ______%"

NOTE

Where short runways are a problem, 55% wing flaps may be used for takeoff. See Appendix 1. Under these circumstances the warning horn will sound when the throttles are advanced.

⑦ Instrument Panel Lights as Required - As required (P, CP)

Turn on pilots interior lights as required for good vision, but not enough to cause excessive glare

8. Set Landing Lights - Set as required (CP)

Normally the right landing light will be set at a 45 degree angle and the left light and taxi lights at the discretion of the pilot. Under conditions of restricted visibility, such as haze, fog, snow, or rain, and when pilot is of the opinion that the use of landing lights is a hindrance rather than an aid to visibility, the use of landing lights is not mandatory. Copilot will maintain visual contact with the ground insofar as possible during night and/or weather conditions until a safe altitude has been reached

ENGINEER

8. Prop Auto Control Switch - No. 1 or No. 2 MASTER

9. Generator Switches - ON

Check for load. (Refer to DC ELECTRICAL LOADS, Section VII)

10. Inverters - Check voltages and frequency

Check voltages and frequency of the essential, secondary, autopilot and flight instrument inverters

11. Carburetor Air Switches - Climatic

During periods of dust or high atmospheric humidity and CAT below plus 7°C use SHELT air

12. Intercooler Flap Switches - Climatic

Normally CLOSED, then OFF (When using sheltered air with filters installed, open the intercooler flaps two inches to allow by-pass in case of a clogged filter)

13. Oil Cooler Flap Switches - AUTO

14. Cabin Pressure Rate-of-Change Selector - Set (as desired for mission)

15. Body Heater Switches - OFF

CAUTION

If combustion heaters have been operating, leave ground blowers on for three minutes after turning heater switches OFF to purge combustion chambers of unburned fuel.

16. Boost Pump Switches (Main Tanks) - NORMAL

Turn both boost pumps in each tank on NORMAL, CWT boost pumps OFF and CWT line valve CLOSED

NOTE

It is possible to take off with one boost pump in a wing tank inoperative, provided a normal amount of fuel is carried.

17. Fuel Selector Switches - TE

See FUEL SYSTEM OPERATION, Section VII

BEFORE TAKEOFF (Cont)

PILOTS

⑨ Pilots Briefing - Complete (P, CP, E)

When the engineer reports "Ready for Briefing" the pilot briefs the copilot and engineer. The pilot reads over interphone the takeoff data portion from the takeoff and landing data cards and directs copilot to call off speeds in the sequence in which they occur. The pilot and copilot will review all the items of the Abort Procedure; Takeoff checklist; After Takeoff and Climb checklist, up to and including meto power. After the initial climb has been accomplished with gear and flaps up and meto power set, the pilot will call for the After Takeoff and Climb checklist to assure completion of all the required checks

NOTE

If the airplane is to remain in traffic, review the Go-Around and Landing procedures.

10. Tower Call - Completed (CP)

Obtain clearance to line up on the active

11. Set TACAN TCTO 572 - Set as required (P or CP)

WARNING

If departure is to be made on VOR then turn the TACAN off. This will prevent the automatic switchover to TACAN in event of VOR power failure. This switchover may occur without being noticed by the pilot, since there will be no localizer needle warning flag indicating the VOR failure.

⑫ Close Windows, Hatches and Doors - Closed (P, CP, BO)

Pilot states over interphone, "Close windows, hatches and doors." Boom operator reports, 'Hatches and doors closed and locked"

⑬ Anti-Icing Equipment Climatic - Climatic(P, E)

Direct the engineer to turn on anti-icing equipment as desired. Turn on windshield wipers, if required

ENGINEER

⑱ Report to Pilot - "Ready for briefing" (E, P)

▼ 19. A/R System - As required

If deck fuel is carried check:

a. Engineer's A/R panel in operating position

b. Fuel dump switches cover open

c. Isodraulic handl[illegible]rap unfastened

d. A/R system fuel level checked

20. Lights - As required

Turn on all necessary cockpit lights to insure adequate vision in cockpit and not cause excessive glare

㉑ Prop Deicing Switch - As required (E, P)

Turn prop deicing switch ON at direction of the pilot whenever icing is anticipated

PILOTS

⑭ Fasten Safety Belts and Shoulder Harness - Fastened (ALL)

Pilot states over interphone, "Fasten safety belts and shoulder harness." Crew acknowledges

⑮ Engineer's Report - "Before Takeoff checklist complete" (P, E)

ENGINEER

㉒ Window Heat - As required (E, P)

No higher than necessary, normally LOW

㉓ Surface Anti-Icing Heaters - As required (E, P)

Turn wing and empennage heaters on as required. Check individual heater temperatures periodically while heaters are in operation

㉔ Safety Belt and Shoulder Harness - Fastened (E, P)

㉕ Report to Pilot - "Before Takeoff checklist complete" (E, P)

LINE UP

PILOTS

1. Set or Hold Parking Brakes - Set or hold (P)

Pilot aligns airplane with runway and sets or holds brakes while copilot reads Line-up checklist

② Set Directional Indicators - Set (P, CP)

Pilot and copilot set directional indicators to approximately align with runway heading and set pointer at top of dial

3. Pitot Heat Switches ON - ON (P)

④ Unlock Flight Controls - Unlocked and checked (P, CP)

Copilot unlocks surface lock handle and pushes full down. Pilot checks controls for full, free travel and notes hydraulic fluctuation for indication of rudder boost operation

5. Tower Takeoff Clearance - Received (CP)

Copilot contacts tower for takeoff clearance, if not previously received, stands by on tower frequency and monitors interphone. The pilot switches to interphone only for takeoff

6. Check Reverse Lock Plate Open - Opened (CP)

ENGINEER

1. Mixtures - AUTO RICH (locked)

2. Engine Pressures and Temperatures - Checked

LINE UP (Cont)

PILOTS

⑦ Set Cowl Flaps - Set (P, E)

The pilot will direct the engineer to set cowl flaps for takeoff

WARNING

Leaving the cowl flaps open more than 3 inches will materially reduce takeoff performance and will result in severe buffeting and reduce control effectiveness upon retraction of the wing flaps.

⑧ Crew Takeoff Report - Received (all crew members)

Pilot will announce over interphone, "Takeoff Report." Aft compartment crew member, will report, "Cowl flaps set, ready for takeoff"

Navigator, engineer, and radio operator, 17260 ▶ 3177 report "Ready for takeoff"

9. Anti-Collision Lights ✈ TCTO 597 ON - ON (CP)

CAUTION

Do not operate anti-collision lights over five minutes during ground operation.

10. Landing Lights ON - ON (if required) (CP)

11. Advance Throttles - Advanced (P)

Advance throttles to 30 inches Hg. if runway conditions permit

ENGINEER

③ Cowl Flap Switches - Set (when directed by pilot) (E, P)

Set position as required by OAT

④ Report to Pilot - "Ready for takeoff" (E, P)

TAKEOFF

TAKEOFF PROCEDURE

Good takeoff technique and strict attention to the recommended minimum speed schedules is required in order to obtain the results shown in the takeoff charts of the Appendix. At takeoff weights above 155,000 pounds, it is imperative to hold minimum climbout speeds until a safe altitude is attained since early acceleration requires considerable distances and reduces available climb path slopes. At light to intermediate weights, however, where field lengths and obstacles are not critical, higher speeds than those recommended will provide an additional margin of safety, particularly for climbout. During rough air takeoffs it is suggested that the recommended speeds be increased by 10 knots.

NOTE

> ADI will not be turned off if one or more engines fail to receive ADI unless engine instrument readings indicate it is detrimental to the engine.

Normal Takeoff Technique

On a normal takeoff the pilot will advance the throttles slowly to 30 inches Hg. and release the brakes. While maintaining directional control with the nose wheel steering, gradually advance the throttles to maximum power while the copilot holds the controls and monitors the manifold pressure, rpm, and airspeed. At maximum power, if the resultant fuel pressure is low, the engineer will place one fuel boost pump selector switch per tank to EMERGENCY.

CAUTION

> To reduce the possibility of fuel leakage, return the fuel boost pump switches to NORMAL if the fuel pressure exceeds limitations.

As maximum power is reached and stabilized the engineer will call out "Power checks OK", or cite any exceptions. Low torque performance will be reported as a numerical value. (Takeoff may be made without utilizing ADI at 247 TPSI, if CAT is -24°C or colder, see TPSI limitations in Section V.) As the airplane accelerates the copilot will monitor the airspeed and inform the pilot when an indicated airspeed of 50 knots has been reached, at which time the pilot will take over the controls and release the nose wheel steering if definite rudder control has been attained. The copilot will continue to inform the pilot of takeoff data card airspeeds as they appear in sequence on the takeoff roll and climbout, and when go-no-go speed is reached will close the throttle reverse lock plate.

CAUTION

> At all times during the takeoff and climbout the engineer will check fuel flow and adjust rpm, manifold pressure, and torque pressure so as not to exceed safe operating limitations.

At 5 to 10 knots below takeoff speed the pilot will ease the pressure off of the nose wheel, using back pressure on the controls, and allow the airplane to fly off of the ground.

WARNING

> Do not attempt to manually adjust the fuel mixture during takeoff as this may cause detonation.

Minimum Roll Takeoff Technique

Use of 55% wing flaps instead of 33% decreases takeoff ground roll by 8% to 16% (see Appendix 1). Further reduction may be achieved in emergencies by pulling the airplane off at speeds not exceeding 5 knots below the recommended takeoff speed. When possible allow the airplane to continue roll when taxiing onto runway. Increase power on all engines during the turn, leading with the engines on the outside of the turn. At the time the airplane is lined up with the runway, all engines should be at or near maximum power. Do not use brakes during the turn, gain as much speed as possible during the turn. Any speed that can be gained while taxiing onto the runway will improve initial acceleration and shorten the takeoff roll

Obstacle Clearance Takeoff Technique

Use minimum roll takeoff technique outlined above, except do not reduce takeoff speeds below the recommended schedule. Raise the landing gear as soon as the airplane is safely airborne. Do not accelerate, but maintain minimum climb-out speed, maximum power and takeoff flap setting until obstacles have been cleared. In general, obstacles more than a mile distant from takeoff point are best cleared with 33% flaps, while closer obstacles can be cleared with greater margins using 55% flaps. With 33% flaps, the flaps may be retracted upon reaching 500 feet but no improvement in climb path slope will be achieved. With 55% flaps the acceleration necessary to reach flap retraction speed impairs the climb-out path unless the obstacles to be cleared are over 1000 feet high or over 10 miles from takeoff point. For such distant or high obstacles allow the airplane to accelerate while still maintaining some vertical velocity to the recommended flap retraction speed. The flaps should then be started up and allowed to retract to the desired climb position in one continuous operation without loss of altitude. Have scanners report flap action during retraction. The minimum recommended altitude for flap retraction is an indicated 500 feet above the terrain. However, the above minimum should not apply under emergency conditions when obstacle clearance can be observed visually.

Transition Flying

NOTE

> With the landing wheels remaining in the slip stream (extended), at least 15 minutes should be allowed to elapse between landings or if the landing wheels are retracted into the wheel wells, at least 30 minutes should be allowed between landings to allow adequate time for cooling between brake applications.

See 4 and 3 ENGINE TAKEOFF FLIGHT PATHS in the Appendix for accurate information on possible takeoff flight paths.

Crosswind Takeoff Technique

Use maximum power on all engines during the takeoff roll. Maintain direction during the initial roll stages by means of nose wheel steering. Nose wheel steering effect can be improved by holding the nose wheel down by means of the control column. When sufficient speed has been obtained to allow control with the rudder, discontinue use of the nose wheel steering and use the rudder. Continue with normal takeoff. After takeoff make a coordinated turn to crab into the wind to maintain the runway heading. See CROSSWIND CORRECTION CHART figure 1A1-6 to obtain the runway wind component for crosswind takeoffs.

Night Takeoff Technique

1. Line up with runway for takeoff. Reset directional indicator to nearest 5° increment. Allow airplane to roll ahead a few feet with nose wheel straight

2. Slowly apply maximum power using the nose wheel for steering up to about 52 knots. Then steer with rudder.

3. Maintain direction with the directional indicator

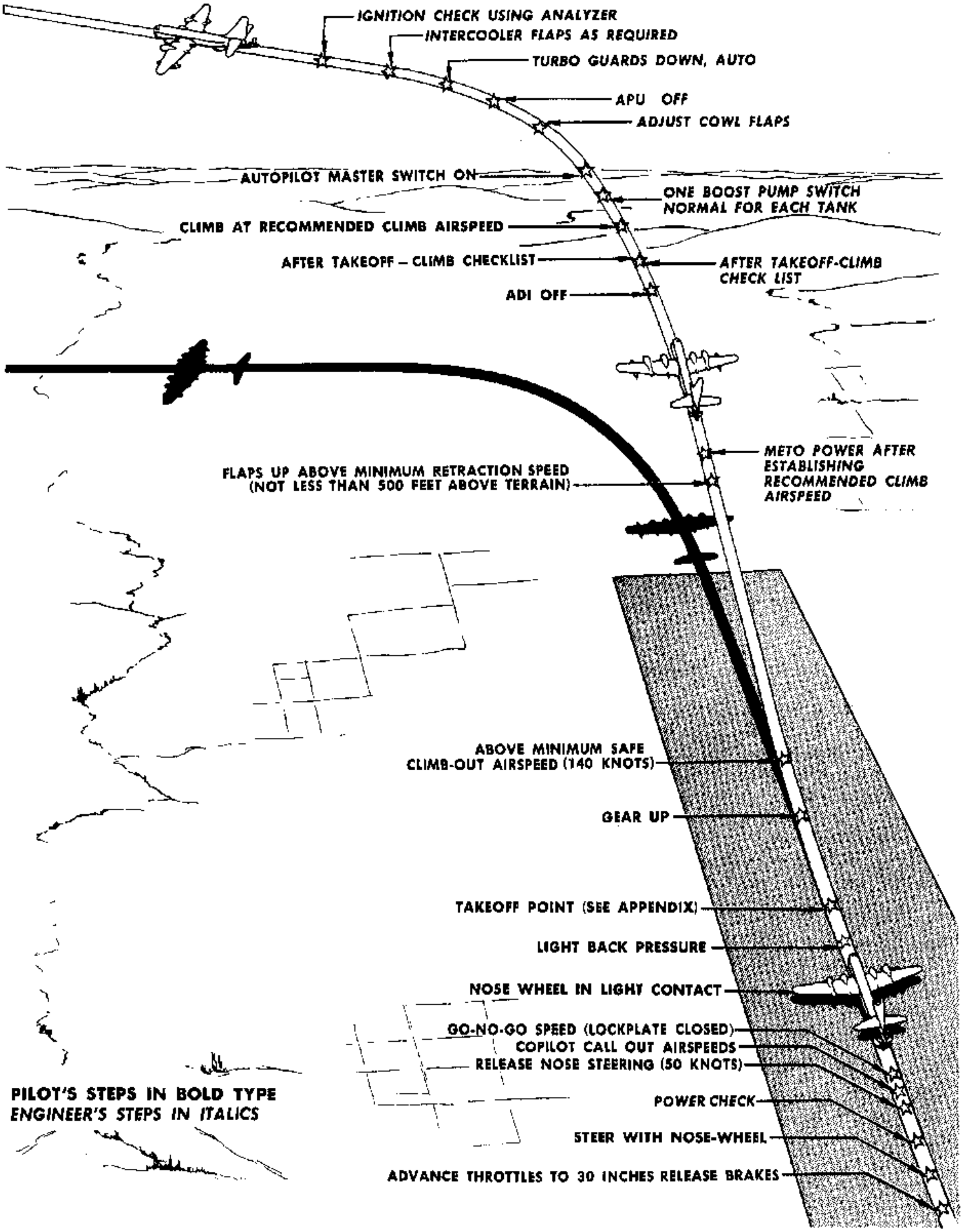
4. At minimum takeoff speed (see Appendix) lift the nose wheel and fly the airplane off the runway with a smooth but definite attitude change as indicated by the attitude indicator

5. Climb-out at 10 knots faster than minimum recommended climb-out speeds

6. Retract landing gear when sure airplane will remain airborne

7. When a safe altitude over all obstructions is reached, accelerate to the minimum flap retraction speed for flap retraction and retract flaps when 500 feet above terrain. While retracting flaps lift the nose sufficiently to maintain a positive vertical velocity at all times. Maintain an attitude which results in a gain of airspeed and altitude at the same time. Continue to increase altitude and airspeed until normal climb speed is reached and a positive vertical velocity is established

8. At maximum gross weight, hold maximum power as long as necessary to establish desired airspeed and climb rate



NORMAL TAKEOFF AND INITIAL CLIMB PROCEDURES

Figure 2-4

TAKEOFF

PILOTS

1. Release Brakes - Released (P)

   Release brakes on navigators time hack, if applicable

2. Release Nose Steering - Released (P)

   The pilot will release nose steering at 50 knots if definite rudder control is attained

3. Airspeeds - Called out (CP)

   Copilot will call acceleration check, go-no-go and takeoff speeds at respective markers or distances and all other speeds as briefed

4. Close Reverse Lock Plate - Closed (CP)

   Copilot closes reverse lock plate at go-no-go speed

ENGINEER

AFTER TAKEOFF — CLIMB

PILOTS

1. Gear Switch UP - UP (CP)

   When the airplane is definitely airborne, the pilot will not brake wheels if TCTO 526 has been complied with, then call and visually signal "gear up." The copilot will raise the gear. The pilot will not level off, but will continue to climb at a reduced rate until the minimum flap retraction speed or 140 knots is reached, whichever is higher, until 500 feet above the terrain. When gear indicators indicate up, the copilot will advise the pilot "gear up"

   CAUTION

   To preclude possible landing gear damage and/or wheel well fire which may be incurred shortly after takeoff as a result of spinning wheels within the wheel well, the following normal operating instructions shall be performed. On airplanes not incorporating TCTO 526, after

ENGINEER

PILOTS

takeoff and immediately prior to moving the landing gear switch from DOWN to UP position, the pilot shall apply normal brake action to stop the spinning of the landing gear wheels. If the pilot should inadvertently move the landing gear switch to the UP position without first braking the wheels, normal brake action should be applied as soon as possible. However, this latter action should not be performed as normal operating procedure due to undesirable impact loads on the landing gear and its associated structural components, introduced through brake application during landing gear retraction.

2. Check Reverse Warning Flag Up - Checked (Flag up) (CP)

After the gear switch has been actuated, the copilot will check the prop reverse lock warning flag for the up position indicating that the props cannot be inadvertently reversed. The lock is timed to actuate approximately eight seconds after the oleo struts have been extended

③ Engineer's Throttles - Notify (P, E)

Notify engineer that he has the throttles. Engineer will acknowledge

④ Wing Flaps Up - Full up (P, CP, BO)

At 500 feet above the terrain and upon reaching flap retraction speed, decrease rate of climb and retract flaps to 20%, then 10% and then to the full up position while accelerating to the recommended climb speed

WARNING

To preclude flying into the ground, maintain a positive rate of climb at all times during flap retraction. Minimum flap retraction altitude is 500 feet unless an emergency exists.

NOTE

The copilot will monitor the dual flap indicators for any indication of unbalanced wing flap movement. In event unusual roll attitude of the airplane is encountered during flap operation immediately correct with aileron and rudder control and simultaneously return the flaps to a symmetrical position.

ENGINEER

① Engineer's Throttles - Acknowledge (E, P)

AFTER TAKEOFF — CLIMB (Cont)

PILOTS

⑤ Meto Power - Set (P, E)

When wing flaps are full up and recommended climb speed has been reached, the pilot will call for meto power

6. Landing Lights OFF - OFF (CP)

Normally the copilot will retract and turn off landing lights at this point. (After approximately one minute the retraction switch will be returned to neutral.) However, landing lights may be retracted and turned off at pilots discretion if the use of landing lights is a hindrance rather than an aid to visibility

7. ADI Switch OFF - OFF (CP)

After meto power is set

⑧ Pilot Monitors Desired Radio - Monitored (P, CP)

Pilot directs copilot to turn on desired mixer switches

9. Autopilot Switch ON - ON (P)

10. Gear Switch OFF - OFF (CP)

After aft compartment crew members have reported gear up, copilot will place gear switch in the OFF position and snap cover down

WARNING

The landing gear will be extended for in-flight inspection, brake and wheel cooling and to preclude possible tire explosion and wheel well fire if a wheel well overheat warning light illuminates or if two or more of the following conditions are observed on inboard engines:

- a. No. 2 or No. 3 Engine Instruments - Erratic readings
- b. Loadmeter - No indication
- c. Low Fuel Pressure Warning Light - On
- d. Engine rpm - Fluctuating
- e. No. 2 or No. 3 Fire Warning Light - On

ENGINEER

② Meto Power - Set (E, P)

Set meto power when requested by pilot. Do not exceed 198 psi torque pressure

3. Boost Pump Switches - NORMAL (one per tank)

Four boost pumps, one per tank, will be on NORMAL for climb, all other boost pump switches OFF

4. Cylinder Head Temperature - Checked (position selector switch depending on hottest cylinder)

5. Cowl Flaps - As required

Set minimum cowl flap opening to obtain desired CHT. On airplanes incorporating ◣ $^{1C79}_{595}$ ■, if over 2 inches of cowl flap gap are required, fuel enrichment will be used as follows:

- a. Fuel Enrichment Switches - ON, after noting fuel flow, fuel pressure and TPSI on each engine
- b. Mixtures - Manual lean

  Manual lean is permissible within the range of fuel flow increase noted when the enrichment system was energized. Do not lean below the fuel flow noted in step a. Mixture should be set to provide desired CHT at 2 inches CFG

- c. Manifold Pressure - Increase

  Increase manifold pressure to compensate for TPSI loss due to fuel enrichment. Do not exceed 53 inches Hg. or 198 TPSI whichever occurs first

NOTE

It may not be possible to regain the original TPSI in all instances; however, a gain will be realized due to the decreased CFG necessary to hold required CHT.

6. Generators, Inverters and Alternators (if on) - Checked for proper voltage and power output

7. APU - OFF, Exhaust valve closed (if required)

8. Carburetor Air Switches - As required

PILOTS

11. Wheel Well Light Switches OFF - OFF (P)

ENGINEER

9. Turbo Switches - Climatic

To place turbos in automatic control. (Maintain carburetor air temperature at plus 20°C if possible, to aid fuel vaporization)

a. TBS Lever - 0

b. Turbo Override Switches - OPEN, guards down

NOTE

This will set up the turbo controls to insure open waste gates in a minimum of time for an emergency.

c. Turbo Switches - AUTO (one at a time)

Monitor MP closely to prevent inadvertent overboost

d. Intercoolers - Open to 2 inches (or as desired)

Accomplish before advancing TBS lever to anticipate CAT rise when turbo is added

e. TBS Lever - Carefully advance as desired

CAUTION

Do not exceed CAT limits when using turbo. When setting up turbo, always advance the TBS lever carefully until a definite rise in manifold pressure or cabin air flow is noted. No rise means malfunction, return the turbo switch for the affected engine to MAN. Investigate when safe altitude is reached by using the TURBOSUPERCHARGER EMERGENCY OPERATION in Section III.

NOTE

It may not always be possible to maintain 53 inches manifold pressure up to high altitudes at 2550 rpm. This may be due to the exhaust back pressure switch limiting available boost indicated by a 4 to 6 inch manifold pressure fluctuation. This will also be observed during hot day operations, however, if only one or two engines are deficient, a malfunction could be suspected.

f. CAT - Control with intercooler flap switches

AFTER TAKEOFF — CLIMB (Cont)

PILOTS

⑫ Anti-Icing Equipment Climatic - Climatic (P,E)

Direct engineer to turn on anti-icing equipment as desired

⑬ Engineer's Report - "After Takeoff-Climb checklist complete" (P, E)

Receive engineer's report

ENGINEER

10. Cabin Pressurization - As desired

Advise crew and begin pressurization after maximum throttle is set for climb. For cold weather operation, maintain a minimum of 2 inches Hg. cabin air flow throughout flight to warm the oil transfer line

11. Analyzer Check - Accomplish

⑫ Prop Deicing Switch - As required (E, P)

Turn prop deicing switch ON at direction of the pilot whenever icing is anticipated

⑬ Window Heat - As required (E, P)

No higher than necessary, normally LOW

⑭ Surface Anti-Icing Heaters - As required (E, P)

Turn wing and empennage heaters ON as required and monitor temperatures. Check individual heater temperatures periodically while heaters are in operation

⑮ Report to Pilot - "After Takeoff-Climb checklist complete" (E, P)

CLIMB

CLIMB PROCEDURE

Climb characteristics of this airplane are good. At normal weights it has a high vertical velocity rate for its size and has good acceleration from takeoff point to climbout speed. Shortly after breaking ground, it will be necessary to roll in some nose down trim, but as climb is established, part of this trim will be removed, continuing the climb with some nose down trim reading. After obstacles have been cleared, the vertical velocity is reduced to allow the airplane to accelerate to minimum flap retraction speed or 140 knots, whichever is greater. At 500 feet above terrain, flaps are retracted in increments to the full up position. When recommended climb speed has been reached, power is reduced to meto power accelerating to the best climb airspeed. These speeds and the corresponding flaps up climb performance are shown in the Appendix climb prediction charts.

CRUISE

PILOTS

① Set Cruise Power - Set (P, E)

Upon reaching cruise altitude, allow airplane to accelerate to cruise airspeed or slightly above and direct engineer to set cruise power. Trim airplane as required

2. Pitot Heat Climatic - Climatic (P)
3. Engage Autopilot - Engaged (if required) (P)

ENGINEER

1. Mixtures - AUTO RICH ✈ TCTO 595 ■
2. Fuel Enrichment Switches - OFF ✈ TCTO 595 ■

③ Power Setting - As required (when directed) (E, P)

Adjust power for long range cruise or as mission requires; refer to Section VII and Appendix

NOTE

For prop operation during flight, see Section VII.

4. Intercoolers and Carburetor Air Switches - As required
5. Turbo - As required
6. Cowl Flaps - As required

Set cowl flaps to minimum gap required for desired cylinder head temperature

7. Fuel Selector Switches and Boost Pumps - As required
8. Analyzer - Check engines every hour

Every hour, or oftener if spark plug fouling is indicated by an erratic torque oscillation or by ignition analyzer, clean spark plugs by method described in IN FLIGHT FOULING PROTECTION, Section VII

CRUISE (Cont)

PILOTS

④ Anti-Icing Equipment Climatic - Climatic (P, E)

Direct engineer to turn on anti-icing equipment as desired

⑤ Engineer's Report - "Cruise checklist complete" (P, E)

Receive engineer's report

NOTE

Copilot will crosscheck the copilot's direction indicator and repeater compasses against the magnetic compass every 30 minutes during magnetic slaved operation of the N-1 compass system. Advise navigator if any variation exists.

ENGINEER

9. Mixtures - As required

For manual leaning process, see SPARK ADVANCE CRUISE CONTROL, figure 7-4

10. Spark Advance - As required

For spark advance procedures see SPARK ADVANCE CRUISE CONTROL, figure 7-4

11. Battery Switch - BAT. CHG. (if applicable)

Check battery switch on BAT. CHG. Switch must be in this position for reverse current relay to operate and maintain battery charge in flight. Check battery voltage periodically with voltmeter selector switch in BATTERY position, and battery switch OFF

⑫ Prop Deicing Switch - As required (E, P)

Turn prop deicing switch ON at direction of the pilot whenever icing is anticipated

⑬ Window Heat - As required (E, P)

No higher than necessary, normally LOW

⑭ Surface Anti-Icing Heaters - As required (E, P)

Turn wing and empennage heaters ON as required and monitor temperatures. Check individual heater temperatures periodically while heaters are in operation

⑮ Report to Pilot - "Cruise checklist complete" (E, P)

16. Observers Report - On the hour .

A report of engine condition, main and lower compartments as briefed will be made by the aft compartment crew member(s) performing scanning duties, if aboard

17. Transfer Oil - As required

See OIL SYSTEM OPERATION, Section VII

FLIGHT CHARACTERISTICS

Refer to Section VI for information regarding airplane flight characteristics. See Section IV for a discussion of pilot technique and airplane characteristics during the air refueling operation, as applying to tanker airplanes.

SYSTEMS OPERATION

Refer to Section VII for detailed information regarding the operation of the following:

1. Engine operation including:
   a. Manual leaning
   b. Spark advance
   c. Spark plug defouling
2. Carburetor anti-icing
3. Turbosuperchargers
4. Cowl flaps
5. Ignition analyzer
6. Propellers
7. Oil system
8. Fuel system
9. Electrical system

▼10. Refer to Section VIII for detailed information regarding the operation of the Air Refueling System

SECONDARY CLIMB

PILOTS

① Notify Engineer - "Start Secondary Climb checklist" (P, E)

ENGINEER

1. Spark Advance Switches - NORMAL (refer to figure 7-4 SPARK ADVANCE CRUISE CONTROL)

NOTE

Do not use spark advance for climb.

2. Mixtures - AUTO RICH
3. Boost Pump Switches - 4 on NORMAL

When 4 tanks are selected one fuel boost pump on NORMAL for each tank selected or as required

4. Fuel Selector Switches - As required
5. Meto Power - Set
6. Intercoolers - As required
7. Turbo - As required
8. Cowl Flaps - As required
9. Fuel Enrichment ◣ TCTO 595 ■ - As required

SECONDARY CLIMB (Cont)

PILOTS

(2) Anti-Icing Equipment Climatic - Climatic (P, E)

Direct engineer to turn on anti-icing equipment as desired

(3) Engineer's Report - "Secondary Climb checklist complete" (P, E)

ENGINEER

(10) Prop Deicing Switch - As required (E, P)

Turn prop deicing switch ON at direction of the pilot whenever icing is anticipated

(11) Window Heat - As required (E, P)

No higher than necessary, normally LOW

(12) Surface Anti-Icing Heaters - As required (E, P)

Turn wing and empennage heaters ON as required and monitor temperatures. Check individual heater temperatures periodically while heaters are in operation

(13) Report to Pilot - "Secondary Climb checklist complete" (E, P)

CAUTION

Secondary climbs should not be made by increasing cruise power with advanced spark as detonation damage will result.

DESCENT

DESCENT TECHNIQUE

Analysis shows that, compared to level flight, the energy derived from descent while maintaining long range cruising speeds provides 2.2 nautical miles additional range for every 1000 feet decrease in altitude. This is virtually independent of the rate of descent used providing cruising speeds are maintained. Refer to the Appendix for discussion.

RAPID DESCENTS

At long range cruising speeds a rate of descent up to 1000 feet per minute may be used without affecting the range an appreciable amount. However, fast descents result in less economical engine operation because of the lower power settings that must be used, but they are used for such a short time that no appreciable decrease in range results unless speeds appreciably higher than long range cruising are used. When descending at speeds other than long range cruising speeds the factor of 2.2 nautical miles per 1000 feet is not correct. It is apparent that descending at very high speeds would reduce this factor considerably.

REQUIRED POWER SETTINGS

If nature of flying conditions in descent requires a large reduction in power, reduce rpm as well as manifold pressure. For descents or other low power maneuvers, or perhaps a simulated engine failure, it is important to cushion the high inertia loads on the master rod bearings which occur at conditions of high rpm and low manifold pressure. As a rule of thumb, it is well to remember that each hundred rpm requires at least one inch Hg. manifold pressure. For example, 23 in. Hg at 2300 rpm.

EFFECT OF COOLING

During descent the cooling required is reduced and consequently the cowl flaps can be closed tighter than in level flight, thus tending to make 2.2 nautical miles per 1000 feet somewhat conservative.

DESCENT

PILOTS

① Complete Radio Call - Completed (P, CP)

Request and receive letdown instructions from ARTC if flying on instrument flight rules. Obtain and notify engineer of landing ETA, runway temperature, dew point and pressure altitude

② Set Altimeters - Set (P, CP, N)

Pilot will announce altimeter setting over interphone. Crew members will set altimeters

3. Set TACAN - Set (as required) (P or CP) TCTO 572

WARNING

While making a VOR instrument or ILS approach on airplanes equipped with both VOR and TACAN equipment turn the TACAN equipment off. This will prevent the automatic switchover to TACAN, in event of VOR-ILS localizer power failure. This switchover may occur without being noticed by the pilot, since there will be no localizer needle warning flag indicating the VOR failure.

ENGINEER

1. Spark Advance Selector Switches - NORMAL
2. Mixtures - As required

DESCENT (Cont)

PILOTS

4. Pitot Heat Climatic - Climatic (P)

⑤ Anti-Icing Equipment Climatic - Climatic (P, E)

Direct engineer to turn on anti-icing equipment as desired

6. Notify Crew - "Prepare for landing" (P)

⑦ Fasten Safety Belts and Shoulder Harness - Fastened (P, CP)

Pilot and copilot fasten safety belts and shoulder harness

⑧ Set Power - Set (P, E)

Direct engineer to establish power for descent as desired

9. Depressurization and Emergency Charging Valve Handle NORMAL - NORMAL (CP)

10. Check Nose Steering Engaged - Engaged (P)

⑪ Check Instruments - Checked (P, CP)

ENGINEER

③ Prop Deicing Switch - As required (E, P)

Turn prop deicing switch ON at direction of the pilot whenever ice is anticipated

④ Window Heat - As required (E, P)

No higher than necessary, normally LOW

⑤ Surface Anti-Icing Heaters - As required (E, P)

Turn wing and empennage heaters ON as required and monitor temperatures. Check individual heater temperatures periodically while heaters are in operation

⑥ Descent Power - Set (when directed) (E, P)

CAUTION

- During descent transfer oil only in accordance with Section VII OIL SYSTEM OPERATION, to prevent overfilling nacelle oil tanks.
- Operation at high rpm and low manifold pressures should be kept to a minimum. Each 100 rpm requires 1 inch MP, or master rod bearing failures may result. This rule is not applicable at 2000 rpm and below.

7. Turbo and Intercoolers - As required

Maintain CAT outside of icing range

8. Cabin Altitude and Rate-of-Change Selector - As required.
Refer to Section IV

9. Cowl Flaps - As required

10. Overhead Panel Circuit Breakers - Checked set

11. Oil Cooler Flap Switches - AUTO

12. Carburetor Air Switches - As required

▼ 13. A/R Fuel Quantity Gages - Checked

PILOTS

⑫ Review Landing, Go-Around, Landing Data Card - Reviewed (P, CP)

Review landing and go-around procedures and review all information on landing data card prior to landing and check appropriate stall speeds according to stall speed placard

⑬ Engineer's Report - "Descent checklist complete" (P, E)

ENGINEER

⑭ Landing Data Card - Present to pilot (E, P)

The data card may be accomplished at any time that landing conditions and time are known

NOTE

During transition flying, data cards will be prepared for every 5000 pound weight change.

⑮ Report to Pilot - "Descent checklist complete" (E, P)

BEFORE LANDING

PILOTS

NOTE

- Refer to Section V for weight and CG limitations.
- On the down wind leg the pilot will call for the Before Landing checklist. The copilot will read off the checklist to the pilot who will give the command of execution. If the airplane remains in the traffic pattern following takeoff, the Descent checklist need not be accomplished.

1. Autopilot OFF - OFF (P)

Pilot will depress autopilot release switch. Insure by slight movement of controls that clutches are released and turn the autopilot master switch OFF

2. Rudder Boost ON - ON (P)

NOTE

To avoid possible violent airplane maneuver, never turn rudder boost on during any maneuver which requires rudder action or excessive rudder trim. Rudder deflection with the same rudder forces differs with boost off.

ENGINEER

BEFORE LANDING (Cont)

PILOTS

③ Anti-Icing Equipment Climatic - Climatic (P, E)

Direct engineer to turn on anti-icing equipment as desired

④ Mixtures RICH - RICH (P, E)

The pilot will direct the engineer to set mixtures RICH, the engineer will report on completion of this action "Mixtures AUTO RICH and locked"

⑤ Rpm - Call for 2350 rpm (use 2550 or 2700 if required with one or more engines inoperative) (P, E)

The pilot will direct the engineer to set 2350 rpm, engineer will respond "rpm 2350." The pilot will make all throttle adjustments from this point on. (2550 or 2700 if required with one or more engines inoperative)

⑥ Gear Switch DOWN - DOWN (four engine operation) (P, CP, E)

The pilot will state on interphone, "Landing gear down. Request visual check." The copilot will place the landing gear switch DOWN and cover in place. A crew member will visually check the main gear and nose gear down, and report checks to engineer. The copilot will check that the landing gear indicators indicate down and check the warning light. The pilot checks landing gear position indicator for down and locked condition. With one or more engines inoperative, gear will be lowered on final approach when certain that the field can be reached

7. Check Hydraulic Pressure and Supply - Checked (CP)

Copilot checks hydraulic supply for proper level (approximately 3.5 gal.) and all three hydraulic pressure gages for normal pressure

ENGINEER

① Prop Deicing Switch - As required (E, P)

Turn prop deicing switch ON at direction of the pilot whenever icing is anticipated

② Window Heat - As required (E, P)

No higher than necessary, normally LOW

3. Surface Anti-Icing Heater Switches - OFF

④ Mixtures - Check AUTO RICH (locked) and report to pilot (E, P)

⑤ RPM - Set 2350 rpm or as directed and report to pilot (E, P)

6. Cowl Flap Switches - OPEN (2 inches)

7. APU - Started and on line

Engineer will direct a crew member to start the APU

NOTE

In case the APU is not operational, the APU exhaust door will be opened. This will prevent any accidental cabin pressurization while on the ground.

PILOTS

8. ADI ON - ON (CP)

To be turned on by copilot, if ADI is available. Advise engineer if ADI is not to be used

9. Check Reverse Lock Plate Closed - Closed (CP)

⑩ Engineer's Report - "Gear checked down visually" (P, E)

⑪ Fasten Safety Belts and Shoulder Harness - All crew members

State over interphone, "Fasten safety belts and shoulder harnesses." Crew members will acknowledge

⑫ Set Wing Flaps - Set 55% (as required with one or more engines inoperative) (P, CP, BO)

Direct Copilot, "Set flaps 55%," Aft crew member will report flap movement and position

CAUTION

With one or more engines inoperative, set wing flaps as required but do not extend flaps over 55% until certain that the field can be reached without increasing power

13. Landing Lights Extended - Extended (as required) (CP)

The pilot will direct the copilot to check the landing lights. Landing lights will be extended and turned on to determine if they are operating. After the check they will be left in the extended position, but turned off until needed on final approach

⑭ State Reversing Intentions - State as desired (P, E)

Pilot announces reversing intentions and engineer will acknowledge; normally props will be reversed; copilot reports; "Before Landing checklist complete to final flap setting"

⑮ Gear Switch DOWN - DOWN (On final if one or more engines inoperative) (request and receive visual check) (P, CP, E)

Extend landing gear on final approach when certain the field can be reached

ENGINEER

⑧ Report to Pilot - "Gear checked down visually" (four engine operation) (E, P)

⑨ Safety Belt and Shoulder Harness - Fastened (E, P)

10. Airplane Fuel Quantity Gages - Checked

11. Boost Pump Switches - Main, NORMAL, center and external, OFF

All boost pump switches except center or external wing tank on NORMAL

12. CWT Line Valve Switch - CLOSE

13. Fuel Selector Switches - TE

14. TBS Lever - Climatic

15. Turbo Switches - Climatic

Leave switches in AUTO if TBS is being used

16. Turbo Override Switches - Climatic

OPEN 10 seconds, (after TBS lever is placed at zero) OFF, guards up

⑰ Report to Pilot - "Gear checked down visually" (one or more engines inoperative) (E, P)

18. Carburetor Air Switches - Climatic

19. Intercooler Flap Switches - Climatic

With filters installed open 2 inches if sheltered air doors in SHELT position

BEFORE LANDING (Cont)

PILOTS

⑯ Engineer's Report - "Before Landing checklist complete" (P, E)

⑰ Set Final Flaps as Required - Set as required (P, CP, BO)

When final flaps are lowered the airspeed will be reduced to the desired final approach speed (use 50 to 75% if snow conditions require, to prevent flap damage)

CAUTION

At a gross weight less than 105,000 pounds, and at 15 to 18.5% MAC, flaps must be limited to 55% throughout the approach to touchdown.

18. Landing Lights ON - ON (if required) (CP)

After turn on final approach if required

ENGINEER

20. Battery Switch - ON BUS

21. Body Heater Switches - OFF

㉒ Report to Pilot - "Before Landing checklist complete, TBS lever at _____ position" (E, P)

23. TBS Lever - 0

Place TBS lever to zero when airplane approaches the flare point

GO-AROUND

PILOTS

1. Notify Crew - Notified (P)

② Set rpm 2700 - Set (P, E)

Direct engineer to increase rpm to 2700

③ Simultaneously: (P, E)

a. Advance Throttles - Advanced (P)

Advance throttles evenly and smoothly to maximum power

ⓑ Set Wing Flaps - Set 55% (P, CP, BO)

Direct copilot to raise wing flaps to 55 percent in one movement

ENGINEER

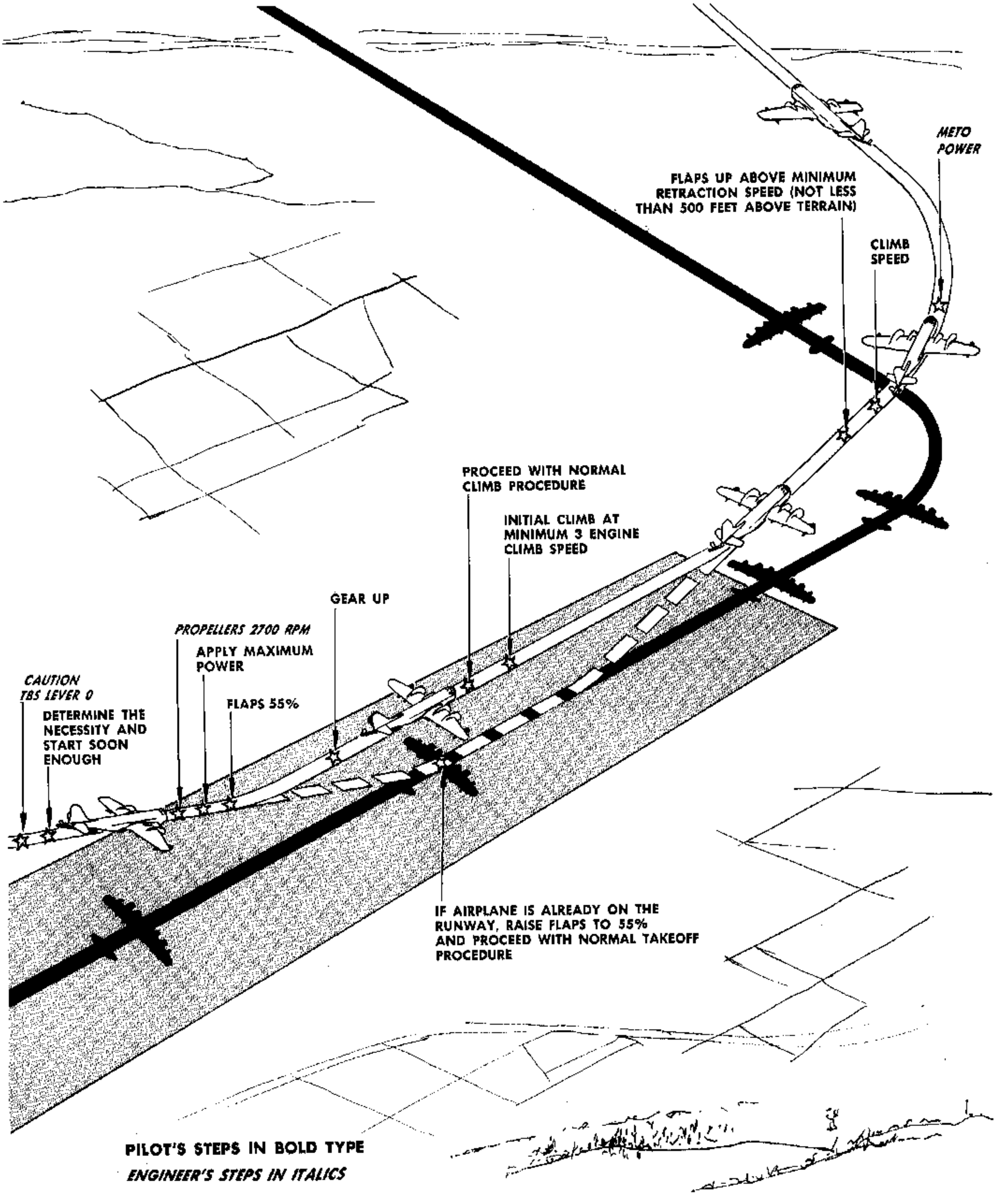
1. TBS Lever - 0

② RPM - Increase to 2700 (E, P)

When directed by pilot, advance prop synch lever to 2700 rpm

③ Power - Even up at maximum power (E, P)

4. Pressures and Temperatures - Checked within limits



PILOT'S STEPS IN BOLD TYPE
ENGINEER'S STEPS IN ITALICS

GO-AROUND PROCEDURE

Figure 2-5

GO-AROUND (Cont)

PILOTS

4. Gear Switch UP - UP (CP)

Signal copilot gear switch UP when it is evident that contact with the runway will not be made

WARNING

The retraction of the landing gear must be started the instant it is certain that the airplane will not touch down. To delay the retraction of the landing gear unnecessarily may result in prolonged operation at near-stall conditions, and the inability to clear obstructions. If a touchdown is inevitable, leave wing flaps at 55 percent and maximum power on, and touch down as lightly as possible. Then proceed as nearly as possible in accordance with takeoff procedures, depending upon the length of runway available, obstructions, etc.

NOTE

In an emergency, the landing gear and wing flaps can be raised simultaneously if three or more generators are operative.

⑤ Engineers Throttles - Notified (P, E)

Notify the engineer that he has the throttles and he will acknowledge

⑥ Wing Flaps UP - Full UP (P, CP, BO)

Direct copilot to retract wing flaps when reaching minimum flap retraction speed, a safe altitude is reached and obstacles are cleared

⑦ Power as Required - As required (P, E)

When a safe go-around altitude and airspeed are obtained, call for power as required, and the after takeoff and climb checklist

ENGINEER

⑤ Engineer's Throttles - Acknowledge (E, P)

6. Cowl Flap Switches - Adjust as required

⑦ Power - Set as called for by pilot (E, P)

TOUCH AND GO LANDING

CAUTION

- Runway conditions will be taken into consideration when making touch and go landings.
- Airplane weight will not exceed the maximum weight for transition as reflected in major command directives.

NOTE

- Touch and Go Landings introduce a significant element of danger because of the many rapid actions which must be executed while rolling on the runway at high speed or while flying within the immediate proximity of the ground. Touch and go will be made only when authorized by the Major Command concerned.
- The pilot will notify the crew of his intention to make a touch and go landing and verbally review the procedure in conjunction with item 14, reversing intentions, of the Before Landing checklist. The scanner(s) will report all flap movement throughout the touch and go landing. The engineer will closely monitor takeoff and landing gross weights. The TOLD Card will be recomputed for every 5000 pound change in actual airplane gross weight.

PILOTS

① Notify Crew - "Touch and go rpm 2700" (P, E)

When ground contact is made, the pilot will notify the crew on interphone as soon as he has made made the decision to continue the touch and go and simultaneously request rpm 2700

2. Set Power - Set (approximately 30 inches Hg.) (P)

Pilot will advance power to approximately 30 inches Hg. to preclude too rapid deceleration of the airplane

3. Set Elevator Trim - Set for takeoff (CP)

④ Set Wing Flaps - Set 33% (P, CP, BO)

Direct copilot to adjust wing flaps to 33 percent in one movement

NOTE

Pilot not flying airplane will reset elevator trim and flaps to takeoff setting. Gear will remain down for touch and go landings.

ENGINEER

① Prop Synch Lever - "Full INCREASE RPM" (4 lights on) (E, P)

On initial touchdown, advance prop synch lever to full INCREASE RPM, checking that four prop rpm limit lights are illuminated

2. Boost Pump Switches (Main Tanks) - NORMAL (EMERGENCY one per tank if required)

CAUTION

To reduce danger of fuel leakage, return boost pump switches to NORMAL if fuel pressure exceeds limits when operating in EMERGENCY position.

TOUCH AND GO LANDING (Cont)

PILOTS

⑤ Set Maximum Power - Set (P, E)

Advance throttles to maximum power. Engineer will even up at maximum power

6. Call Out Airspeeds - Called out (CP)

Copilot reports airspeeds up to and including takeoff airspeed

7. Check Reverse Warning Flag Up - Checked (flag up) (CP)

Copilot will check the prop reverse lock warning flag for the up position

8. Wheel Well Light Switches OFF - OFF (CP)

⑨ Engineer's Throttles - Notify (P, E)

Notify engineer that he has the throttles. Engineer will acknowledge

⑩ Wing Flaps UP - UP (P, CP, BO)

At 500 feet above the terrain and upon reaching flap retraction speed, decrease rate of climb and retract flaps to 20%, then 10% and then to the full up position while accelerating to the recommended climb speed

WARNING

To preclude flying into the ground, maintain a positive rate of climb at all times during flap retraction. Minimum flap retraction altitude is 500 feet unless an emergency exists.

NOTE

- The copilot will monitor the dual flap indicators for any indication of unbalanced wing flap movement. In event unusual roll attitude of the airplane is encountered during flap operation immediately correct with aileron and rudder control and simultaneously return the flaps to a symmetrical position.
- Wing flaps may be left extended at 33 percent at pilot's discretion until the 55 percent flap setting is required on down wind leg.

ENGINEER

③ Power - Even up at maximum power (E, P)

4. Pressures and Temperatures - Checked within limits

⑤ Engineer's Throttles - Acknowledge (E, P)

Engineer acknowledges he has taken control of throttles

6. Cowl Flaps Switches - Adjust as required

PILOTS

⑪ Set Meto Power - Set (P, E)

When remaining in closed traffic after touch and go landing, direct engineer to set "Meto power" when traffic pattern airspeed has been established

12. ADI OFF - OFF (CP)

After meto power is set

⑬ Power as Required - As required (P, E)

Upon reaching traffic altitude direct engineer to set MP and rpm as desired or call "pilots throttles", reduce manifold pressure, and then call for 2350 rpm

ENGINEER

⑦ Meto Power - Set (E, P)

Set power when directed by pilot. Report to pilot when power has been set

8. Boost Pump Switches - NORMAL (one per tank)

Four boost pumps, one per tank, will be on NORMAL for climb, all other boost pump switches OFF

⑨ Power - Set (E, P)

Set power as directed by the pilot and report to pilot when set

---

LANDING

Refer to landing portion of the Appendix.

NORMAL LANDING TECHNIQUE

Every approach and landing should be planned as though reverse thrust were not available.

WARNING

Under no circumstances will thrust be reversed during flight prior to ground contact or an uncontrollable dropping of the airplane may result.

When final flaps are lowered, the airspeed will be reduced to the desired final approach airspeed (26 knots above stalling speed). On all approaches for landing, including instrument approaches, the copilot will monitor the altimeter and vertical velocity indicators. He will advise the pilot whenever the angle of bank exceeds 30°, airspeed falls below computed traffic pattern or final approach speeds, and/or when the airplane appears to be dangerously low to the ground or other obstructions (visual and altimeter cross check). A power-on approach with a rate of descent of approximately 600 feet per minute as the airplane approaches the flareout point is recommended for all landings unless otherwise necessitated by emergencies. Power-off landings should be avoided since this type of landing increases the altitude at which the flare-out must be initiated and thus increases the precision necessary for a satisfactory landing. This is especially true of crosswind landings. The airplane should touch down on the main wheels first with the nose wheel slightly off the runway. Three wheel or nose wheel landings should be avoided. As soon as the airplane is safely on the ground, the nose wheel should be lowered smoothly to the runway. Rudders should be used for directional control as long as possible. When rudder is no longer effective the pilot will use nose wheel steering for directional control. When airplane has slowed to 52 knots, use normal braking action. Slow airplane to normal taxiing speed before turning off the runway to avoid severe side strain on the nose gear.

CAUTION

When landing with a full forward cg, the airplane has a tendency to land in a three point attitude or with nose wheel first. This tendency is partially offset by the use of an 80% wing flap setting. This flap setting is the optimum for best landing speed and elevator control.

LIGHT WEIGHT LANDING TECHNIQUE

When airplane gross weight is below 105,000 pounds and the cg at 15% to 18.5% of MAC, flaps are limited to 55% throughout the approach to touchdown. Reduce airspeed to cross threshold at 150% of power off stall speed. Minimum power must be maintained at 15 inches Hg. on final approach and throughout the flare where a gradual reduction of power is made to contact the ground with main gear first in a slightly nose-up attitude.

WARNING

Do not chop throttle during approach as a setling of the airplane will result.

CAUTION

When landing with the 15% of MAC cg limit in effect, the airplane has a tendency to land in a three point attitude or nose wheel first. The airplane has limited elevator power and light elevator stick force, therefore strict adherence to airspeed, power and flaps are mandatory for adequate control during landing.

HEAVY WEIGHT LANDING TECHNIQUE

Landings up to the maximum allowable takeoff gross weight can be made without exceeding the structural limits of the airplane. However, under heavy weight conditions it is extremely important that the airplane be greased on with a low sinking speed at touchdown. Caution should be observed at these heavy weights, to make the field on the first pass since go-around performance is marginal even with all engines operating. If over 153,000 pounds gross weight, pilot should give consideration to reducing weight if conditions warrant.

MINIMUM ROLL LANDING TECHNIQUE

To make a minimum roll landing, make a normal approach at charted stalling speed, plus 15 knots. Extend the final approach and come in lower with power on and full flaps. Aim short of the runway and begin flare-out before reaching the end of the runway so that touchdown will be as close to the end of the runway as possible. Ease power off and lower nose wheel to ground immediately. Open throttle reverse lock plate, pull throttles back and apply reverse thrust. Continue to apply power at REVERSE OPEN until the airplane comes almost to a stop, then return to normal pitch. Use normal brakes as the airplane speed falls below 52 knots.

CROSSWIND LANDING TECHNIQUE

1. In making a crosswind landing, the following variations have to be taken into consideration:

   a. Velocity of the wind

   b. Condition and length of runway

   c. Wind component (90° - 25 knot wind component maximum)

   d. Gustiness of wind

2. There are three methods of making crosswind approaches:

   a. Lower the up-wind wing

   b. Crab into the wind

   c. Combination of the first two methods

3. A 55% wing flap setting is recommended for best control. This flap setting and an approach airspeed 26 knots above stall make the approach slightly longer than usual. This will enable the pilot to establish a definite ground track along the prolongation of the runway. Just before touchdown on the runway, align the airplane with the runway and level the wings. Under extreme crosswind conditions, raise the flaps as soon as the main gear is on the runway, place the nose wheel on the runway and hold forward pressure on the yoke as this will give positive steering control. On dry runways it is better to set the airplane down on the up-wind landing gear rather than hit the runway in a crabbing attitude. On runways covered with smooth ice or packed snow with no dry spots or ruts, landing in a crab attitude is permissible and will minimize the possibility of losing directional control and sliding off the edge of the runway.

NIGHT LANDING TECHNIQUE

Use normal landing technique. Do not turn on landing lights in a turn. Avoid using landing lights if landing in fog, smoke or thick haze. Under such conditions, reflection of the light from the haze or fog impedes rather than aids vision, making the landing lights useless. Have the copilot monitor airspeed and altitude down the final approach. Leave some power on (15 inches Hg. MP during flare-out and touchdown). The use of the taxi light will greatly aid the pilot in seeing the runway directly in front of the airplane.

LANDING ON SLIPPERY RUNWAYS

When landing on wet or icy runway, touchdown should be made as close to the end of the runway as possible in order to make the maximum use of runway length for slowing the airplane.

Wet Runway

Generally, if runway is well drained, landing on a wet runway is accomplished normally. However, if the runway contains low spots or is covered with water of undetermined depth, use reduced flap position to prevent possible damage to wing flap surfaces. If the runway is slippery or if water conditions are such that directional control of the airplane might be difficult, leave the outboard engines in forward thrust for directional control and decelerate by using reverse thrust on the two inboard engines.

Icy Runway

Extreme care must be exercised when landing on icy runways. A combination of brakes and power setting is required. When landing on a slippery runway, leave the outboard engines in forward thrust for directional control of the airplane and decelerate by using reverse thrust on the two inboard engines. Excessive use of either brakes or power may result in an uncontrollable skid.

THRUST REVERSING TECHNIQUE

1. Thrust reversing will be utilized immediately after all wheels are definitely on the ground. After the airplane has touched down and is rolling straight down the runway, the pilot will notify the copilot to hold the control column slightly forward, release the throttle lock, and open the throttle reverse lock plate. The pilot then will close the throttles to forward thrust idle position, pause momentarily, then lift the throttles over the detent and into the reverse thrust idle position. Reverse thrust is most effective during the initial part of the landing roll. Normally, only the reverse thrust idle position will be used to decelerate the airplane to 52 knots at which time the throttles will be returned to the forward thrust idle position and normal braking used as required. If for emergency reasons power is required in the REVERSE OPEN range, a definite pause should be made in the reverse thrust idle position to allow the prop blades to move past the flat pitch position before moving the throttles on back into the REVERSE OPEN range to obtain the amount of reverse thrust desired. Apply power gradually in the REVERSE OPEN range after ascertaining that all props are in reverse. If an engine starts to die during prop reversal, the engineer will notify the pilot and try to keep the engine running by moving the mixture to a leaner mixture position. The engineer should not move his throttles during the reversing cycle. Refrain from using the nose wheel steering until the ground speed has decreased, to prevent skidding of the nose wheel tires.

2. When landing on runways covered with light dry snow or heavy dust, pilot visibility may be impaired by blowing dust forward of the airplane if reverse thrust is used at low speeds. For more positive feel and control of all throttles, the overhand, palm down, technique for reversing is recommended.

CAUTION

- If a prop oil quantity light is illuminated, do not attempt to use reverse thrust on that engine (or its opposite) as the oil quantity may be insufficient to accomplish reverse thrust.
- In the event an engine is lost during reverse thrust operation or taxiing, the engine will not be restarted until a fire guard is posted, except in emergencies.
- Difficulty in holding controls may be encountered when using reverse thrust below 52 knots.
- If the airplane starts a yaw to either side during any part of the reversing procedure, the following procedures will be accomplished simultaneously.
    a. Rudder will be used primarily to correct the yaw.
    b. The reversed throttles will be brought to the forward thrust position.
    c. Outboards may be used for forward thrust to aid in returning the airplane to the desired track, if necessary.
    d. Apply brakes as necessary.

NORMAL LANDING PROCEDURE AFTER TOUCHDOWN

When ground contact is made, the copilot will unlock the throttle lock lever and open the throttle reverse lock plate. The engineer will move the prop synch lever to full INCREASE RPM and check that all four rpm limit lights are illuminated in anticipation of a possible go-around. The mixtures will be unlocked by the engineer, only after there is no possibility of a go-around, but prior to any thrust reversal. The engineer will open the cowl flaps if reverse thrust will not be used or after reverse thrust is completed. As the pilot moves the throttles back into idle reverse position, the copilot will move the control wheel forward and hold it steady, to prevent any thrashing around if reverse thrust is required. The copilot will then check the hydraulic pressure and report to the pilot "Hydraulic pressure checks OK," or cite exceptions. The pilot will normally begin braking the airplane at 45 to 55 knots indicated airspeed, applying light brake pressure initially and increasing the pressure as required in order to obtain a steady rate of deceleration to the end of the landing roll. The airplane should not be allowed to roll free and then braked heavily near the end of the runway in order to stop. While the airplane is decelerating and if turbos were used up to the flare point, the engineer will place the turbo switches to MAN and the turbo override switches to OPEN, 10 seconds, then OFF, then guards up.

CAUTION

- ●Because of the airplane momentum and the fact that it is light on the ground for some distance after touchdown, it is possible to unintentionally lock a wheel even with very light brake pressure. Apply brakes carefully if needed.
- ●Brake action normally should be applied by the pilot. If it becomes necessary for the copilot to apply the brakes, the pilot must first release his brake pedals. This is necessary to allow the copilot's braking action to be effective through the pilot's brake metering valves.

LANDING

PILOTS

1. Unlock Throttles - Unlocked (CP)

   Copilot unlocks throttle friction lock upon touchdown

2. Open Reverse Lock Plate - Opened (CP)

   Copilot opens lock plate upon touchdown

3. Apply Reverse Thrust - Applied (P)

   Reverse thrust idle will normally be used after all wheels are definitely on the ground and airplane is rolling straight down the runway. Normally return throttles to forward thrust idle at 52 knots and utilize nose wheel steering

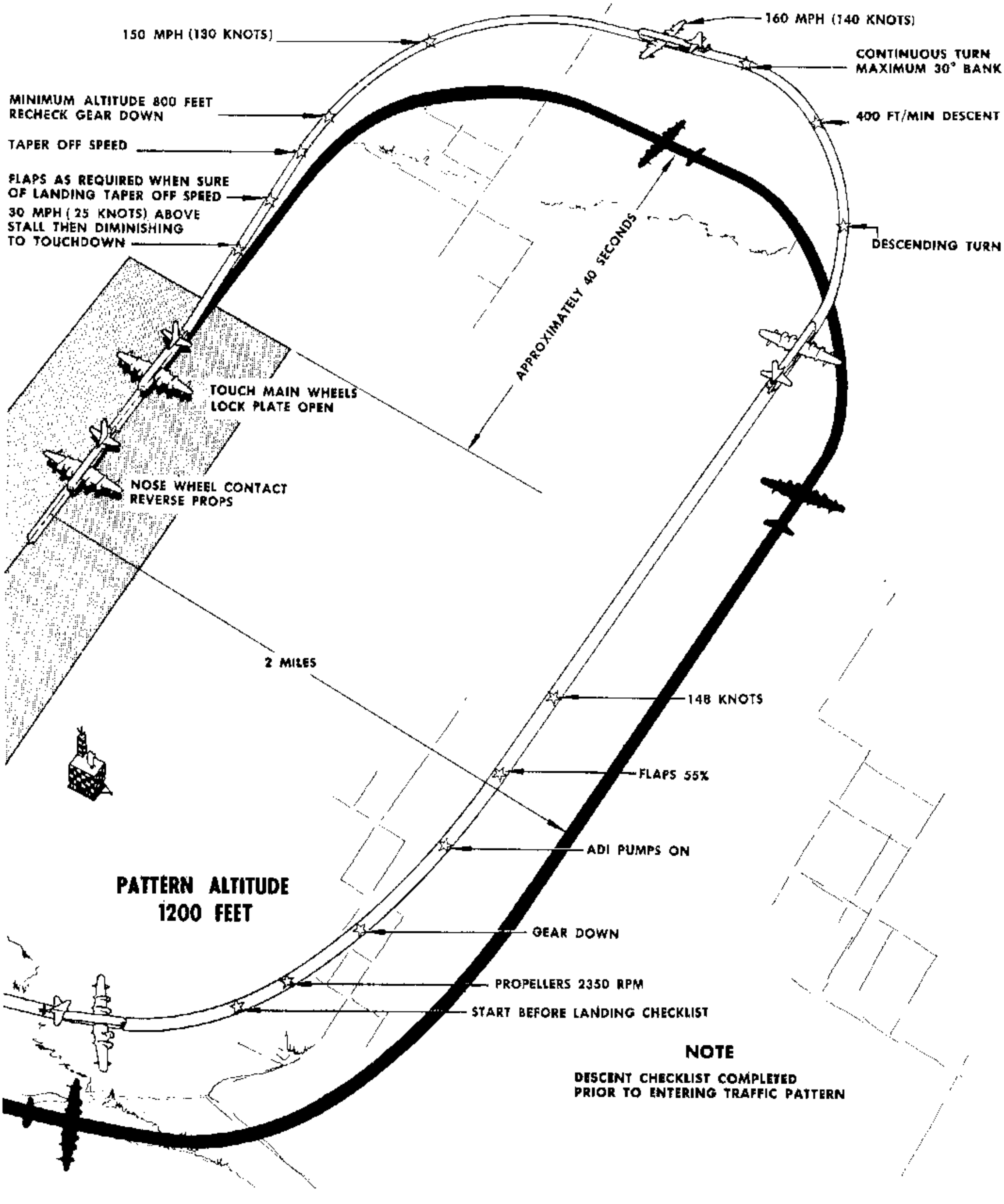
4. Check Hydraulic Pressure - Checked (CP)

   The copilot will check the hydraulic pressure and report to pilot "Hydraulic pressure checks OK"

5. Apply Brakes - Applied (P)

   Normally begin braking at 45 to 55 knots

ENGINEER



NORMAL APPROACH AND LANDING PATTERN

Figure 2-6

AFTER LANDING

PILOTS

(To be performed after airplane is clear of runway and stopped)

1. Set Parking Brakes - Set (P)
2. Lock Controls - Locked (CP)

CAUTION

Controls must be centered and locked with rudder boost on. If the rudder is centered after the surface lock handle is raised, movement of the rudder pedals will depressurize the rudder boost hydraulic system, unlocking the rudder trim tab.

3. ADI Switch OFF - OFF (CP)
4. Landing Light Switches OFF - OFF (CP) (if applicable)

   Landing lights may be used for taxiing as required

5. Anti-Collision Lights OFF - OFF (CP)

CAUTION

Do not operate anti-collision lights over five minutes during ground operation.

⑥ Wing Flap Switch UP - UP (CP, BO)

7. Pitot Heat OFF - OFF (P)
8. Trim Tabs Centered - Centered (P, CP)

   Reset all trim tabs to neutral. If an excessive amount of trim has been required that is not the result of fuel or cargo loading, it will be noted in the Form 781

ENGINEER

1. Boost Pump Switches - OFF
2. Oil Cooler Flap Switches - Climatic

   Normally AUTO, during cold weather OPEN, then OFF

3. Turbo Switches - AUTO
4. Turbo Override Switches - OPEN, guards down
5. Window Heat Selector Switch - OFF
6. Alternator Switches - OFF

   Use following sequence:

   a. Alternator Bus Selector Switch - OFF

   b. Alternator Switches - OFF

7. Prop Deicing Switch - OFF

PILOTS

⑨ Check Forward Thrust - Checked (if required) (P, E)

Direct engineer to check forward thrust if reverse thrust was used

⑩ Engineer's Report - "After Landing checklist complete" (P, E)

Receive engineer's report

⑪ Accomplish Postflight Check - Accomplished (if required) (P, E)

Direct engineer to accomplish postflight engine check at completion of flight. Outboard engines may be shut down at pilot's discretion

ENGINEER

⑧ Forward Thrust - Check, if required (when directed by pilot)(E, P)

a. Prop Synch Lever - Full DECREASE RPM (4 lights on)

Advance throttles to 25 inches Hg; observe rpm governs to approximately 1100 indicating props are in forward thrust and assisting low pitch stops to reseat, then retard throttles

b. Prop Synch Lever - Full INCREASE RPM (4 lights on)

Check four prop rpm limit lights illuminated

9. Mixtures - Manual lean (if immediate takeoff is not anticipated)

⑩ Report to Pilot - "After Landing checklist complete" (E, P)

POSTFLIGHT ENGINE CHECK

PILOTS

ENGINEER

1. Mixtures - AUTO RICH
2. Prop Auto Control Switch - OFF
3. Magneto Ground Check (800-1000 rpm) - L, R, OFF, BOTH

Adjust rpm between 800 and 1000 and check L, R and OFF, watch for drop, turn switch back to BOTH

POSTFLIGHT ENGINE CHECK (Cont)

PILOTS

ENGINEER

4. Engine Power and Ignition System - Check

Obtain field barometric pressure. To accomplish this proceed as follows:

a. Obtain current altimeter setting from pilot

b. Determine field elevation and point off three decimal places from right to left (i.e., 1600 feet becomes 1.6)

c. Subtract this figure from current altimeter setting to obtain field barometric pressure

NOTE

The above three steps may be accomplished during descent.

Advance the throttle for one engine at a time to field barometric pressure. The tachometer should read 2025 ± 75 rpm. Observe torque pressure and normal fuel flow. Accomplish ignition check by turning ignition switch from BOTH to L, note rpm drop, return to BOTH. From BOTH to R, note rpm drop, return to BOTH. (RPM drops 45-50 normal, 80 maximum allowable. Maximum allowable difference between right and left magneto is 20 rpm)

CAUTION

Do not exceed CHT limits during ground operation.

5. Idle Mixture - Checked

With engines set in 800-1000 rpm range and CHT between 175°C and 200°C, move each mixture slowly and evenly toward FUEL CUT-OFF. "Slowly may be defined as the rate of movement which would require 12 to 15 seconds to move the mixtures from AUTO RICH to best power position. This slow movement of the lever is necessary so that the engine can respond to the change in fuel air mixture, and so

PILOTS

ENGINEER

that an accurate reading can be obtained as the best power mixture is reached. If a rise of more than 10 rpm is noted, the idle mixture is too rich. A rapid decrease in rpm indicates too lean a mixture. After a rapid decrease or a maximum rpm rise has been obtained, and the rpm starts to decrease with further leaning of the mixtures, return the mixtures to AUTO RICH

NOTE

> If the airplane is at its home station and the idle mixture is found to be out of adjustment, enter in Form 781. Change of altitude will affect idle mixture, therefore when the airplane is away from the home station the idle mixture should not be reported.

6. Mixtures - Manual lean (if immediate shutdown is not anticipated)

7. Urinal Tank Drain - OPEN

   Have a crew member open the drain valve on the urinal tank prior to reaching parking space

8. Analyzer Switches - OFF

9. Secondary Inverter Switch - OFF

⑩ Report to Pilot - "Postflight engine check complete" (E, P)

ENGINE SHUTDOWN

PILOTS

ENGINEER

1. Autopilot and Flight Instrument Inverter Switches - OFF

2. Air Conditioning Master Switch - OFF

3. Oil Dilution - Climatic

   See Section IX to accomplish oil dilution for the purpose of aiding next engine start when expected OAT is 30°F (-1°C) or below. Enter time period of dilution in Form 781

CAUTION

> After CHT stabilizes below 200°C set throttle to maintain 1000-1200 rpm for a period of one minute to accomplish engine scavenging.

ENGINE SHUTDOWN (Cont)

PILOTS

1. Set Parking Brakes - Set (P)

② Shutdown Engines - Shutdown No. 1, No. 3, No. 4 (P, E)

Pilot directs engineer to shutdown numbers 1, 3, and 4 engines

③ Check No. 2 Hydraulic Pump - Checked and Shutdown No. 2 Engine (P)

With number two engine running, pilot depresses wheel disconnect button and moves nose wheel steering while observing fluctuation of main hydraulic pressure gage. After No. 2 hydraulic pump is checked, pilot directs engineer to shutdown No. 2 engine

④ All Switches OFF or NORMAL - OFF or NORMAL (P and CP)

Retract landing lights

5. Gear Switch DOWN - DOWN (CP)

Gear switch will be left in the DOWN position and cover in place

6. Close Reverse Lock Plate - Closed (CP)

7. Release Parking Brakes - Released (P)

Release parking brakes after assuring that chocks are in place

⑧ Engineer's Report - "Shutdown checklist complete" (P, E)

Receive engineer's report

ENGINEER

④ Engines No. 1, No. 3 and No. 4 - Shutdown (when directed)(E, P)

Shutdown by placing mixtures in FUEL CUTOFF

⑤ After Hydraulic Pump Check - Shutdown No. 2 engine (when directed) (E, P)

With mixture in FUEL CUTOFF

6. Generator Switches - ON

7. Essential Inverter Switch - OFF

8. Oil Cooler Flap Switches - CLOSE and OFF

9. Carburetor Air Switches - SHELT (if required)

10. Fuel Selector Switches - TE

This prevents fuel gravity leveling which could possibly cause overfilling inboard tank

11. Ignition Switches - OFF

12. All Switches - OFF or NORMAL

13. Circuit Breakers:

    a. Turn and Slip - Pulled

    b. Interphone - Pulled

⑭ Report to Pilot - "Shutdown checklist complete" (E, P)

NOTE

Cowl flaps need not be shut below 2 inches after engine shutdown.

ALERT PROCEDURES

SCOPE

Generally, the procedures and techniques used in an alert and scramble situation are the same as those used during normal operation of the airplane. The time element involved demands certain differences in order to accomplish the scramble in minimum time without sacrificing safety of flight.

PROCEDURES AND TECHNIQUES

The procedures and techniques described herein are mandatory for crews operating the airplane under the alert concept. These procedures are not to be used during normal operation and when used under the alert concept must be performed in the prescribed manner, except where deviations are necessary in the interest of flying safety.

INITIAL AIRPLANE PREFLIGHT

Prior to placing or accepting an airplane in an alert status, each crew member will accomplish a complete preflight inspection as outlined in Section II, Normal Procedures (Pilots and Engineer) to include all items of the Engine Run-Up checklist, and Section VIII, Crew Duties (Other Crew Members) of this flight manual and repeated every 72 hours after the crew on alert status accepts the airplane. When the normal preflight inspection is completed and noted discrepancies corrected, it will be placed in a cocked configuration by using the cocking checklists. Once an airplane is placed in a cocked configuration it will be isolated to preclude operation of equipment or possible injury to personnel. The flight crew will uncock the airplane prior to the initiation of the preflight for accepting the airplane in alert status or each 72 hour preflight and prior to the performance of any necessary maintenance. The daily preflight inspection contained herein presumes that the airplane has been completely preflighted and therefore, provides only a brief check of certain items which assure that the airplane continues to be ready for a scramble situation. This preflight checklist is designed so that the airplane can be scrambled, during the daily preflight, in a minimum of time. At the completion of the daily preflight, the airplane is left in a cocked configuration.

ISOLATION OF AIRPLANE

Once an airplane is in the cocked configuration, no one will be allowed in the vicinity of the airplane nor allowed to enter the airplane without approval and presence of an assigned alert crew member.

COCKING

NOTE

Once the airplane has been accepted for alert status, or should the airplane be "uncocked" for any reason, it will be necessary to reaccomplish the COCKING checklist. Should the airplane require maintenance during the time it is in "cocked" configuration, it will be "uncocked" by the flight crew prior to maintenance being performed. Upon completion of required maintenance the airplane will be returned to a "cocked" configuration by the flight crew.

PILOTS

1. Set Parking Brakes - Set (P)
2. Engage Nose Wheel Steering - Engaged (P)
3. Rudder Boost ON - ON (P)
4. Autopilot Master Switch OFF - OFF (P)
5. Gear Switch DOWN - DOWN, guard down (CP)

   Copilot checks landing gear switch is in DOWN position and closes safety cover

ENGINEER

1. Master and Battery Switches - As required

   If external power is used, battery switch will be OFF. If APU is used, battery switch will be ON BUS

2. APU or External Power - Started and on line

   Voltage checked

3. Essential Inverter Switch - ESS. INV

   All others OFF

COCKING (Cont)

PILOTS

6. Check Gear Indicator and Warning Light - Checked (P)

   Press landing gear warning light for indication that light is operating. Check indicators for down indication

⑦ Wing Flaps UP - UP (P, CP, GC)

   Pilot checks with ground crewman that wing flaps are clear of obstructions and directs copilot to move flap switch to UP

8. Lights OFF - OFF (P, CP)

   Turn all interior and exterior lights off

9. Set Radios - Set (P or CP)
   - a. Omni - Set on desired frequency and OFF
   - b. VHF - ON, Set on tower frequency
   - c. UHF - On, Set on control room frequency
   - d. IFF - OFF
   - e. Radio Compass - Set on desired frequency and OFF
   - f. TACAN - Set on desired frequency and OFF TCTO 572

10. Set Trim Control Wheels - Set (P)

    Set all trim control wheels neutral or as desired for takeoff

ENGINEER

4. Fire Switches - NORMAL

   Check that all engine and heater fire switches are in NORMAL position

5. Ignition Switches - OFF

6. Overhead Circuit Breakers - Set

7. Radio Rack Circuit Breakers - Set

8. Heater and Deicer Switches - OFF

▼ 9. A/R Panel Master Switch - ON

   All circuit breakers set, all other switches OFF or NORMAL

10. Generator Switches - ON

11. Alternator Switches and Selector - OFF

12. Carburetor Air Switches - Climatic

    During periods of dust or high atmospheric humidity and CAT below plus 7°C use SHELT air

13. Intercooler Switches - CLOSE and OFF

14. Carburetor Preheat Switches - CLOSE and OFF

15. Cowl Flap Switches - Set (2 inches)

16. Cylinder Head Temperature Selector Switch - A2

17. Oil Cooler Flap Switches - CLOSE and OFF

18. Cabin Pressure Rate-of-Change Selector - MAX

19. Cabin Altitude Selector - Set

    Set to desired altitude at which airplane is to be pressurized during flight

20. Cabin Air Selector Valve Switches - NORMAL

21. Turbo Bleed Switches - OPEN

22. Heater and APU Fuel Valve Switch - NORMAL

PILOTS

ENGINEER

23. Cabin Heat Control Rheostat - Full COOL

24. Window Heat Selector Switch - OFF

25. Fuel Selector Switches - TE

    Check indicator light out

26. Prop Oil Refill Switches - OFF

27. SPR Test - Valves closed, switch OFF

    Check that all SPR secondary valves are closed by moving switch to each tank position, check valve closed, light on at each position. Turn SPR secondary valve test switch OFF

28. Mixtures - FUEL CUTOFF

    Check and unlock

29. Throttles - Cracked

    Throttles cracked (approximately 1 inch for 1000 rpm)

30. Prop Synch Lever - Full INCREASE RPM

31. TBS Lever - 0

32. Turbo Switches - MAN

33. Turbo Override Switches - OPEN, 10 seconds, then OFF, guards up

34. Prop Governor Selector Switches - Full INCREASE RPM

35. Prop Auto Control Switch - No. 1 or No. 2 MASTER

36. Spark Advance Selector Switches - NORMAL

37. DC Voltmeter Selector Switch - No. 3 engine

38. Engine Starting Selector Switch - No. 3

39. Essential Inverter Switch - OFF

40. Panel Lights - Switch red, rheostat 1/2 position

COCKING (Cont)

PILOTS

11. Check Reverse Lock Plate Open - Opened (CP)

⑫ Airplane Secured for Alert - Secured (ALL)

Cocking checklist completed by all crew members

ENGINEER

41. Interphone, VHF, and UHF Circuit Breakers - Pulled

42. APU - OFF

43. Master and Battery Switches - OFF

44. APU Switch - On run position

45. Oil Cooler Flap Switches - AUTO

㊻ Report to Pilot - "Cocking checklist complete" (E, P)

47. Complete Takeoff and Landing Data, and Weight and Balance

---

SCRAMBLE

The scramble checklist is utilized to get the airplane safely airborne in a minimum amount of time. It is imperative that both pilots and engineer be familiar with the procedure outlined in this checklist. This checklist will be used from the flight crews arrival at the airplane after an alert signal is sounded until after the takeoff is made. After becoming airborne normal checklists will be utilized starting with the AFTER TAKEOFF - CLIMB checklist

NOTE

The items prefixed by an asterisk will be accomplished by the radio operator when assigned. Ground heating equipment, ducting, wing and empennage covers will be removed as briefed by the pilot or as per local directives.

SCRAMBLE — BEFORE STARTING ENGINES

PILOT

① Remove Ground Heating Equipment and Covers - Removed (All)

Each crew member and ground crew will remove ground heating equipment, ducting, wing and empennage covers as briefed by pilot or as per local directives

*② Remove and Stow Tail Jack - Removed and stowed (P or RO & BO)

Assist boom operator if radio operator not assigned

ENGINEER

PILOT

(*3) Remove Ground Power Unit - Removed (if applicable) (P or RO & GC)

Assist ground crew if radio operator not assigned

4. Remove Pitot Covers - Removed

5. Lock Forward Entrance Door - Locked

After boarding airplane, check all downlocks aboard and close and lock forward entrance door

6. Don Equipment - Donned

Don equipment and fasten safety belt and shoulder harness and receive "Ready to start engines" report from copilot

COPILOT

① Remove Ground Heating Equipment and Covers - Removed (All)

Remove ground heating equipment, ducting, wing and and empennage covers as briefed by pilot or as per per local directives

2. Open APU Exhaust Port - Opened

③ Start APU - Started (CP, E)

4. Lights ON - ON (As required

All exterior and interior lights on as required

5. Monitor Radio - Monitored

Monitor for instructions and type of alert

ENGINEER

1. Ground Heating Equipment and Covers - Removed (as briefed)

Remove ground heating equipment and covers as briefed

2. Battery and Master Switches - ON

   a. Bus Voltage - Checked

   Place battery and master switch ON and check bus voltage for 28 volts

③ APU - Start (E, CP)

Coordinate with copilot for starting APU

4. UHF, VHF and Interphone C/B - SET

Check that UHF, VHF and interphone circuit breakers are set

5. Essential Inverter Switch - ESS. INV

Check voltage and frequency

6. Personal Equipment - Don

Don all applicable personal equipment

SCRAMBLE — BEFORE STARTING ENGINES (Cont)

COPILOT

⑥ Engineer's Report - "Ready to start engines" (CP, P, E)

Receive engineer's report and advise "Ready to start engines" when pilot arrives at position

7. Don Equipment - Donned

Fasten safety belt and shoulder harness

ENGINEER

⑦ Report to Copilot - "Ready to start engines" (E,P)

SCRAMBLE — STARTING ENGINES

PILOTS

① Start Engines - Direct engineer to start engines (P, E)

Direct engineer to contact ground crewman to receive report and clearance to start engines

② Check Hydraulic Pressures - Checked (P, CP)

With No. 3 engine running, copilot checks No. 3 hydraulic pump by observing rise in pressure. Turn the depressurization and emergency charging valve to EMERGENCY brake charging, check emergency pressure, return to NORMAL and report to pilot "Hydraulic pressures normal"

3. Radio Call - Completed (CP)

   a. Omni, Radio Compass, IFF and SIF On - On (CP)

   Copilot contacts tower, advises airplane location and requests taxi and takeoff information

④ Set Altimeters - Set (P, CP, N)

ENGINEER

1. No. 3 Boost Pump Switch - NORMAL
2. No. 3 Hot Fuel Prime - Climatic

See Section VII for procedure

③ Start Engines - Climatic (E, P, GC)

When pilot directs that engines be started, the engineer will contact ground crewman on interphone and state: "Ground crewman, this is engineer, ready to start No. 3." Ground crewman replies: "Chocks in place, down locks and pitot covers removed, all props clear, fire guard standing by on No. 3, clear on No. 3." Engineer states: "Turning No. 3," press starter switch, after 20 blades, ignition switch BOTH ignition boost and prime. The ground crewman will count blades on interphone and report if fuel starts to run out of the biower drain

CAUTION

Do not prime engine before engaging starter. To prevent hydraulic lock, avoid every possibility of liquid fuel collecting in the intake pipes or cylinders.

PILOTS

⑤ Set and Uncage Instruments - Set and uncaged (P, CP)

ⓐ N-1 Compass - Synchronized (if applicable) (CP, N)

Check that instrument inverter warning light is not illuminated. Pilot and copilot will reset and uncage all flight instruments, cross check compasses, cage and uncage J-8 attitude indicator. If navigator not aboard, synchronize N-1 compass according to N-1 COMPASS SYSTEM OPERATION, Section IV

⑥ Engineer's Report - "Starting checklist complete" (P, E)

ENGINEER

NOTE

- All normal starts will be made on prime. See SYSTEMS OPERATION Section VII for starting procedures.
- Twenty blades are required for any start made after a 1-hour shutdown period. Eight blades will insure detection of hydraulic lock and are sufficient for engine starts made within 1 hour of last shutdown.

④ Repeat on Remaining Engines as Ground Crewman Clears each Engine in Turn - All steps above (E,GC)

5. Starter Selector Switch - OFF

⑥ Report to Pilot - "Starting checklist complete" (E, P)

SCRAMBLE — BEFORE TAXI

PILOTS

① Remove External Power - Removed (if applicable) (P, GC)

After all engines have been started, direct ground crewman to have external power unit disconnected and removed, if used

② Dismiss Ground Crewman - Dismissed (P, E, GC)

Pilot calls ground crewman and states, "Ground crewman, this is pilot, remove chocks and check that external power unit is removed. I will taxi after a visual signal from you. You are clear to disconnect interphone"

3. Door Warning Light OFF - OFF (CP)

④ Crew Report - "Ready to taxi" (All)

Pilot announces over interphone "Crew report, ready to taxi?" The crew will report as follows: Boom operator, navigator, radio operator **17260** ▶ **3177** and engineer check in order "Ready to taxi." The pilot and copilot will review the taxi checklist items to be accomplished during taxiing

ENGINEER

SCRAMBLE — TAXI

PILOTS

① Check Normal Brakes - Checked (P, CP)

As soon as the airplane begins to roll, the pilot will check normal braking action, copilot will check hydraulic pressures

② Check Emergency Brakes - Checked, system recharged (P, CP)

When the airplane is clear of congested parking area and wing walkers are no longer required, the pilot will check the emergency brakes prior to reaching normal taxi speed and then direct the copilot to recharge the emergency brake system

③ Check Instruments - Checked (P, CP)

Pilot and copilot will check turn and slip indicators, directional indicators, ADF indicators and Omni directional indicator (tracking) for correct operation

4. Purge Manifold Pressure Lines - Purged 30 seconds (CP)

Copilot will purge manifold pressure lines 30 seconds

5. ADI Switch Climatic - Climatic (CP)

NOTE

Maximum power, with ADI, will be used for all takeoffs if available. During the initial portion of takeoff roll, the copilot will monitor the ADI lights and will notify the pilot and engineer if any light fails to go out. The pilot, prior to takeoffs, will determine what course he will follow. This will be dependent on gross weight, temperature, altitude, or other pertinent conditions.

ENGINEER

① Inverters - ON and voltage check, notify P and N (E, P, N)

a. Autopilot Inverter - AUTOPILOT INV

Check voltage and frequency

b. Secondary Inverter - ESS. INV

Check voltage and frequency

c. Pilot's Instrument Inverter - PILOT'S INSTR INV

Check voltage and frequency

2. A/R Hydraulic Pressure - Checked

Air refueling hydraulic pressure on No. 1 and No. 4 hydraulic pumps checked for pressure indication

3. Air Conditioning Master Switch - ON

Master switch must be ON to supply power to ground blowers and pressure regulators

4. Alternator Control Switches - ON

This allows exciter regulators to warm up. Leave alternator bus selector switch off

5. Analyzer Power Switches - ON

The secondary inverter must be operating to supply power to the analyzer

6. Intercooler Flap Switches - Climatic

Normally CLOSED then OFF. (When using sheltered air with filters installed, open the intercooler flaps two inches to allow bypass in case of a clogged filter)

7. Cabin Pressure Rate-of-Change Selector - SET (As desired for mission)

8. Body Heater Switches - OFF

CAUTION

If combustion heaters have been operating, leave ground blowers on for several minutes after turning heater switches OFF to purge combustion chambers of unburned fuel.

PILOTS

⑥ Anti-Icing Equipment Climatic - Climatic (P, E)

Direct the engineer to turn on anti-icing equipment as desired. Turn on windshield wipers, if required

⑦ Engineer's Report - "Taxi checklist complete" (P, E)

ENGINEER

9. Boost Pump Switches (Main Tanks) - NORMAL

Turn both boost pumps in each tank on NORMAL, center wing tank boost pumps OFF and center wing tank line valve CLOSED

10. Fuel Selector Switches - TE

See FUEL SYSTEM OPERATION, Section VII

▼ 11. A/R System - As required

If deck fuel is carried check:

a. Engineer's A/R panel in operating position

b. Fuel dump switches cover open

c. Isodraulic handle strap unfastened

d. A/R system fuel level checked

⑫ Prop Deicing Switch - As required (E, P)

Turn prop deicing switch ON at direction of pilot whenever icing is anticipated

⑬ Window Heat - As required (E, P)

No higher than necessary, normally LOW

⑭ Surface Anti-Icing Heaters - As required (E, P)

Turn wing and empennage heaters on as required. Check individual heater temperatures periodically while heaters are in operation

15. Carburetor Air Switches - Climatic

During periods of dust or high atmospheric humidity and CAT below plus 7°C use SHELT air

16. Safety Belt and Shoulder Harness - Fastened

17. Engine Pressures and Temperatures - Checked

⑱ Report to Pilot "Taxi checklist complete" (E,P)

SCRAMBLE — BEFORE TAKEOFF

PILOTS

1. Set Throttle Lock Lever - Set (P)

Adjust throttle lock lever as desired for takeoff

② Set Wing Flaps - Set 33% (P, CP, BO)

In cold weather operate wing flaps through one complete cycle before setting flaps for takeoff. Wing flap switch DOWN until indicators read 33%. At this time aft compartment crew member will report, "Both flaps ______%"

NOTE

Where short runways are a problem 55 percent wing flaps may be used for takeoff. See Appendix I. Under these circumstances the warning horn will sound when the throttles are advanced.

③ Fasten Safety Belts and Shoulder Harness - Fastened (All)

Pilot states over interphone, "Fasten safety belts and shoulder harness"

4. Tower Call - Completed (CP)

Obtain clearance to take the active for takeoff

5. Set TACAN - Set as required (P)

WARNING

If departure is to be made on VOR then turn the TACAN off. This will prevent the automatic switchover to TACAN in event of VOR power failure. This switchover may occur without being noticed by the pilot, since there will be no localizer needle warning flag indicating the VOR failure.

6. Anti-Collision Lights ON - ON (CP)

CAUTION

Do not operate anti-collision light over five minutes during ground operation.

ENGINEER

1. Ignition Switches - On BOTH
2. Mixtures - AUTO RICH (locked)
3. Exercise Props - Climatic

   During cold weather operation, move the master synchronizer lever so that the props are exercised between 1850 and 1100 rpm

4. Prop Synch Lever - Full INCREASE RPM
5. Prop Governor Selector Switches - Full INCREASE RPM

   Toggle to DECREASE RPM momentarily, note prop rpm limit lights out. Toggle back to INCREASE RPM until lights are on at the INCREASE RPM position

6. Prop Auto Control Switch - No. 1 or No. 2 MASTER
7. Oil Temperature - 65° minimum

PILOTS

⑦ Close Windows, Hatches and Doors - Closed (P, CP, BO)

Pilot states over interphone, "Close windows, hatches and doors." Boom operator reports, "Hatches and doors closed and locked"

8. Pitot Heat Switches ON - ON (P)

⑨ Unlock Flight Controls - Unlocked (P, CP)

Copilot unlocks surface lock handle and pushes full down. Pilot checks controls for full, free travel and notes hydraulic fluctuation for indication of rudder boost operation

⑩ Set Cowl Flaps - Set (P, E)

The pilot will direct the engineer to set cowl flaps for takeoff

WARNING

Leaving the cowl flaps open more than 3 inches will materially reduce takeoff performance and will result in severe buffeting and reduce control effectiveness upon retraction of wing flaps.

11. Landing Lights ON - ON (if required) (CP)

Normally the right landing light will be set at 45° angle and the left light and taxi lights at the discretion of the pilot. Under conditions of restricted visibility, such as haze, fog, snow, or rain, and when the pilot is of the opinion that the use of landing lights is a hindrance rather than an aid to visibility, the use of landing lights is not mandatory. Copilot will maintain visual contact with the ground insofar as possible during night and/or weather conditions until a safe altitude has been reached

⑫ Crew Takeoff Report - Received (All)

Pilot will announce over interphone, "Takeoff report." Aft compartment crew member, if aboard, will report, "Cowl flaps set, ready for takeoff." Navigator and radio operator 17260 ▶ 30177 report, "Ready for takeoff," Engineer reports, "Before Takeoff checklist complete, ready for takeoff"

ENGINEER

⑧ Cowl Flaps - Set (when directed) (E, P)

Set position as required by OAT

⑨ Report to Pilot - "Before takeoff checklist complete, ready for takeoff" (E, P)

AFTER TAKEOFF — CLIMB

Refer to Normal After Takeoff and Climb Checklist

PILOTS' DAILY PREFLIGHT

While airplane is in alert status, a daily preflight will be accomplished using this checklist unless the initial or 72 hour preflight is required. Navigator will start APU if required.

① Form 781 - Checked (P, E, CP)

Pilot and engineer will check Form 781 for airplane and equipment status and discuss discrepancies with ground crewman and crew members concerned

② Takeoff and Landing Data Card - Checked (P, CP, E)

Check completed takeoff and landing data card and discuss with copilot and engineer

3. Check Oxygen Pressure - Checked (P, CP)

Pilot and copilot check station oxygen pressure for at least 400 psi

4. Gear Switch DOWN - DOWN, guard down (CP)

5. Trim Tab Control Wheels - Free movement and zeroed (P)

6. Windows, Windshield Wipers - Condition (P, CP)

7. Interphone - Checked (P, CP)

Check interphone with headset and lip mike by calling any crew position

⑧ Flaps Full DOWN - DOWN (P, CP, GC, BO)

Prior to lowering wing flaps, check with GC and insure that copilot and boom operator are stationed at each wing flap well. Copilot and boom operator will clear wing flaps prior to lowering

RADIO PREFLIGHT CHECK

To be accomplished by the copilot if radio operator not assigned. Only a check on the operational frequency is required.

1. VHF - Checked
2. UHF - Checked
3. Omni - Checked
4. Radio Compass - Checked
5. TACAN - Checked TCTO 572

EXTERIOR INSPECTION

NOTE

If weather conditions permit, remove pitot covers and dust plugs (if installed) to insure that openings are unobstructed.

Forward Fuselage and Nose Section

1. Nose Gear (Left and Right Side) (P)
   a. Oleo Strut - Inflation
   b. Tires - Condition
2. Right Static Holes - Unobstructed in front of wing

Right Wing Section

1. No. 3 Engine and Prop: (P)
   a. Integral Oil Tank - Leakage, drain plug safetied
2. No. 4 Engine and Prop: (P)
   a. Integral Oil Tank - Leakage, drain plug safetied
3. Wing Tip - Condition (P)

   Check anti-ice exhaust louvers for cleanliness and any evidence of carbon deposits. Check that navigation light lens is intact
4. Lower Wing Surface and Aileron - Condition (P)

   Check hinges for alignment and clear of foreign material. Check bonding wire condition. Trim tab should have approximately 1 inch droop with controls locked. Check trim tab surface for general condition of static dischargers. Check for any evidence of fuel leaks around access panels and condition of landing light
5. External Tank and Strut - Condition (P)

   Check for general condition
6. Anti-Syphon Scoops - Unobstructed (P)
7. Right Wheel Well: (P)
   a. Oleo Strut - Inflation
   b. Tires - Condition
   c. Brake Hydraulic Lines and Fittings - Condition
   d. CO_2 Discharge Indicator Discs - Condition

EXTERIOR INSPECTION (Cont)

8. Lower Wing Surface and Fuselage - Condition (P)

   Check fuel sump boost pump drains and interconnector sump drains for leakage and stains. Check fuselage surface for dents, cracks and wrinkles

9. Right Flap and Flap Well - Condition (P)

   With flaps full down check flap surfaces for general condition. Check fuel valves, fuel and hydraulic lines for leaks. Check wiring and bonding for condition. Check jackscrews and tracks. Insure manifold is pressurized

Aft Fuselage and Empennage Section

1. Empennage - Condition (P)

   a. Vertical and Horizontal Stabilizer and Exhaust Louvers - Condition

      Check for signs of carbon deposits at exhaust louvers. Check general condition of static dischargers

   b. Elevator - Condition

      With controls locked and wing flaps full down, right elevator trim tab should be 1/4 inch up. Check trim tab hinge pin for condition. Check elevator hinges for proper alignment and absence of foreign materials. Check surface for general condition. Check general condition of static dischargers

   c. Rudder and Tab - Condition

      Check tab hinge pin for condition. Trim tab should be aligned with rudder if controls are locked. Check rudder hinge covers in place and rudder surface for general condition. Check general condition of static dischargers

NOTE

Proceed a sufficient distance aft to observe both upper wing and elevator surfaces for general condition. Check for snow, ice and frost.

   d. Elevator - Condition

      With controls locked and wing flaps full down, left elevator trim tab should be 7/8 inch up. Check trim tab hinge pin for condition. Check elevator hinges for proper alignment and absence of foreign materials. Check surface for general condition. Check general condition of static dischargers

   e. Horizontal and Vertical Stabilizer and Exhaust Louvers - Condition

      Check for signs of carbon deposits at exhaust louvers. Check general condition of static discharger. Check exhaust ports unobstructed if covers not installed. Check heater air intake port unobstructed if cover not installed.

Left Wing Section

For split prelfight method copilot starts at this point

1. Left Flap and Flap Well - Condition (P or CP)

   With flaps full down check flap surfaces for general condition. Check fuel valves, fuel and hydraulic lines for leaks, wiring and bonding for condition. Check jackscrews and tracks

2. Lower Wing Surface and Fuselage - Condition (P or CP)

   Check fuselage for dents, cracks and wrinkles. Check single point refueling port caps installed and secured. Check fuel sump boost pump drains and interconnector sump drain for leakage and stains

3. Left Wheel Well: (P or CP)

   a. Oleo Strut - Inflation

   b. Tires - Condition

   c. Brake Hydraulic Lines and Fittings - Condition

   d. CO_2 Discharge Indicator Discs - Condition

4. Lower Wing Surface to No. 1 Engine - Condition (P or CP)

   Check fuel sump boost pump drains and interconnector sump drains for leakage and stains

5. Anti-Syphon Scoops - Unobstructed (P or CP)

6. External Tank and Strut - Condition (P or CP)

   Check for general condition

7. Lower Wing Surface and Aileron - Condition (P or CP)

   Check hinges for alignment and clear of foreign material. Check bonding wire condition. Trim tab should have approximately 1 inch droop with controls locked. Check trim tab surface for general condition. Check hinge wire condition. Check general condition of static dischargers. Check for any evidence of fuel leaks around access panels and condition of landing light

8. Wing Tip - Condition (P or CP)

   Check anti-ice exhaust louvers for cleanliness and any evidence of carbon deposits. Check that navigation light lens is intact

9. No. 1 Engine and Prop: (P or CP)

   a. Integral Oil Tank - Leakage, drain plug safetied

10. No. 2 Engine and Prop: (P or CP)

    a. Integral Oil Tank - Leakage, drain plug safetied

11. Left Static Holes - Unobstructed (P or CP)

⑫ Cocking Checklist - Complete (P or CP)

   Insure that all crew members have completed their respective cocking checklist upon completion of their daily preflight and that the airplane is secured for alert

ENGINEER'S DAILY PREFLIGHT

1. Starter Selector Switch - OFF
2. Master and Battery Switches - As required

   If external power is used, battery switch will be OFF. If APU is used, battery switch will be ON BUS
3. APU or External Power - Started and on line

   Voltage checked
4. Interphone Circuit Breakers - Set

⑤ Engine Hydraulic Lock Check - Crank 8 blades (E, GC)

Ground crewman will assure all four prop are clear throughout this check

⑥ Inverters - Spares and Normal - Check output (E, N)

Check inverters in both spare and normal switch positions for proper voltage and frequency. Leave essential, secondary and autopilot inverter switches on NORMAL. Flight instrument inverter switch OFF. Give power clearance to navigator

7. Main Tank Fuel Manifold - Pressurized

   Turn one boost pump on EMERGENCY, and all others to NORMAL. Leave in this position for visual check of the fuel system. Notify the ground crewman to advise pilot when the fuel manifold is pressurized
8. External Tank Lines - Pressurized
9. Fuel Lines, Connectors, and Tanks - Leaks, condition

   Check all fuel lines, connectors, and tanks for leaks and condition as checklist progresses
10. TOLD Card - Recomputed using latest weather information
11. Complete cocking checklist

UNCOCKING

PILOTS

No uncocking required by either pilot

ENGINEER

1. Starter Selector Switch - OFF
2. Circuit Breakers - Pulled

   Pull turn and slip circuit breakers

TAXI BACK

If a practice scramble has been executed where a takeoff is not accomplished, utilize the normal AFTER LANDING and ENGINE SHUTDOWN checklists. Uncock the airplane if maintenance is to be performed, or direct the crew to accomplish the COCKING checklist if the airplane is to be returned to alert status.

KC-97G
PILOTS' CONDENSED CHECKLISTS

PREFLIGHT

BEFORE INTERIOR INSPECTION

① Form 781 - Checked (P, E, GC)
② Safety Check - Accomplished (E, BO)
③ APU and Heater Cavities - Climatic (E, BO)
4. Stow Equipment - Stowed (ALL)
5. Crew Inspection - Completed (P)
    a. Fall In - All crew members (P)
    b. Crew - Inspected (P)
    c. Form 781 - Read (As applicable) (P)
    d. Emergency Procedures and Signals - Brief crew and extra crew members (P)
        (1) Brief Crew:
            (a) Ditching, Crash Landing and Bail-Out Exit(s)
        (2) Brief Extra Crew Members:
            (a) Ditching, Crash Landing Positions and Exits
            (b) Bail-Out Exit(s)
            (c) Bail-Out Sequence
            (d) Smoking Discipline
        (3) Brief Crew and Extra Crew Members:
            (a) Emergency Signals (alarm bell and interphone)
            (b) Designate Jumpmaster
            (c) Secondary Bail-Out Exit
            (d) Location of Spare Parachutes
    e. Emergency Procedure Report - All crew members
    f. Safety Discipline - Brief crew and extra crew members (P)
        (1) Do not walk through prop arcs
        (2) Parachute discipline
        (3) Use of safety belts
    g. Instructions and Questions - Cleared (P)
    h. Time Hack - By navigator
    i. Final Crew Briefing Time - Announced (P)
    j. Dismiss Crew - Dismissed (P)

T.O. 1C-97(K)G-1
15 OCTOBER 1959

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

PILOTS' PREFLIGHT INSPECTION

Interior Inspection

CONTROL CABIN

1. Oxygen Equipment Check - Checked and Stowed (P, CP)
2. Pilot's Instrument Inverter Emergency Power Switch - NORMAL (CP)
3. Gear Switch - DOWN, guard down (CP)
4. Windows, Windshield Wipers - Condition (P, CP)
5. Main Hydraulic Reservoir - Condition and fluid level (CP)
6. Emergency Lights (if applicable) - Checked (P)
7. Autopilot Switch - OFF (P)
8. Reverse Warning Flag - Down (P)
9. ADI Switch - OFF (P)
10. APS-42 Aux. Indicator Controls - Fully CCW (P)
11. Gear Emergency Retraction Switch - NORMAL and safetied (P)
12. External Fuel Tank Release Switch - OFF and safetied (P)
13. IFF Switch - OFF (P)
14. Pitot Heat Switches - OFF (P)

⑮ Ready for Power - Report received (P, N, E)
⑯ Alarm Bell Check - Checked (P, N, E, GC)
17\. Radios - On (P)
⑱ Lights - Checked (P, CP, GC)
⑲ Pitot Heat - Checked (P, GC)
⑳ Wing Flaps - Checked (P, GC, CP, BO)
   a. Advance two opposite throttles and check that warning horn blows
   b. Extend wing flaps to 65% using normal wing flap switch. Warning horn stops blowing at 22% and starts at 44%
   c. Using emergency flap switch, raise wing flaps to 55%, wait ten seconds and lower to 65%
   d. Extend wing flaps full down using normal wing flap switch

CONTROL CABIN (Cont)

21. Autopilot Emergency Disconnect Handle - In place, safetied (P)
22. Rudder Boost Switch - OFF (P)
23. Throttle Lock Lever - UNLOCK (P)
24. Surface Lock Handle - LOCKED (P)
25. Trim Control Wheels - Free movement and zeroed (P)
26. Pilot's Auxiliary Panel - Complete (P)
27. Instrument Flight Manuals: (P)
    a. Enroute Charts
    b. Enroute Supplements
    c. Terminal Charts
28. Portable Oxygen Bottle, Right Side - Security (P or RO)

MAIN COMPARTMENT

1. Spare Bulbs - Completeness (P)
2. Cargo Hoist - Condition (P)
    a. Cargo Hoist Shield Cover Secure and Control Circuit Breaker Switch - OFF
    b. Hand Crank - Stowed
    c. Hoist Motor, Drum and Cables - Condition
    d. Hoist Control Cord - Stowed
    e. Snatch Blocks - Stowed
3. Fire Extinguishers - Pressure and security (P)
4. First Aid Kits - Condition (P)
5. Forward Cargo Door: (P)
    a. Hydraulic Tank - Proper fluid quantity
    b. Selector Handle - As required
    c. Door - Condition
6. Dinghy Transmitter AN/CRT-3A - Security (if installed) (P)
7. Life Raft - Security (if installed) (P)
8. Cargo - Secured (if applicable) (P)
9. A/R Tanks, Lines and Fittings - Condition (P)

T.O. 1C-97(K)G-1
15 October 1959

3

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

Exterior Inspection

FORWARD FUSELAGE AND NOSE SECTION

1. Forward Entrance Door - Condition (P)
2. Forward Fuselage - Condition (P)
3. Left Pitot Tube - Unobstructed (P)
4. Nose Wheel Well - Condition (P)
5. Nose Gear: (Left and Right Side) (P)
   a. Oleo Strut - Inflation
   b. Steering Mechanism - Condition
   c. Tires - Condition, slippage
6. Right Pitot Tube - Unobstructed (P)
7. Forward Fuselage - Condition (P)
8. Right Static Holes - Unobstructed (P)

RIGHT WING SECTION

1. Wing Leading Edge to No. 3 Engine - Condition (P)
2. No. 3 Engine and Prop (P)
   a. Dome - Condition
   b. Prop Blades - Condition
   c. Integral Oil Tank - Leakage, drain plug safetied
   d. Cowling - Condition and fasteners locked
3. Wing Leading Edge - Condition (P)
4. No. 4 Engine and Prop (P)
   a. Dome - Condition
   b. Prop Blades - Condition
   c. Integral Oil Tank - Leakage, drain plug safetied
   d. Cowling - Condition and fasteners locked
5. Wing Leading Edge - Condition (P)
6. Wing Tip - Condition (P)
7. Lower Wing Surface and Aileron - Condition (P)
8. External Fuel Tank and Strut - Condition (P)
9. Anti-Syphon Scoop - Unobstructed (P)

(Cont)

RIGHT WING SECTION (Cont)

10. No. 4 Engine and Nacelle (P)
    a. Engine Exhaust System - Condition
    b. Cowling Right Side - Condition and fasteners locked
    c. Right Oil Cooler and Cowl Flaps - Condition
    d. Prop Blades - Condition
    e. Cowling Left Side - Condition and fasteners locked
    f. Cowl Flaps, Left Oil Cooler and Intercooler Flaps - Condition
11. Anti-Syphon Scoop - Unobstructed (P)
12. Lower Wing Surface to No. 3 Engine - Condition (P)
13. No. 3 Engine and Nacelle (P)
    a. Safety and Oleo Switch - Condition
    b. Oleo Strut - Inflation
    c. Static Ground Wire - Touching ground
    d. Outboard Tire - Condition, slippage
    e. Outboard Main Wheel Well Door - Condition
    f. Engine Exhaust System - Condition
    g. Right Oil Cooler and Cowl Flaps - Condition
    h. Cowling Right Side - Condition and fasteners
    i. Prop Blades - Condition
    j. Cowling Left Side - Condition and fasteners locked
    k. Cowl Flaps, Left Oil Cooler and Intercooler Flaps - Condition
14. Right Main Wheel Well (P)
    a. Brake Stator Pins, Hydraulic Lines and Fittings - Condition
    b. CO_2 System - Condition
    c. ADI Tank - Quantity
    d. Fuel Vent Interconnects - Condition
    e. Retraction Mechanism - Condition
    f. Inboard Wheel Well Door - Condition
    g. Inboard Tire - Condition, slippage
    h. CO_2 Discharge Indicator Discs - Condition
15. Lower Wing Surface and Fuselage - Condition (P)
16. Right Wing Flap and Wing Flap Well - Condition (P)

T.O. 1C-97(K)G-1
15 October 1959

5

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

AFT FUSELAGE AND EMPENNAGE SECTION

1. **Aft Fuselage Surface - Condition (P)**
2. **Empennage Condition (P)**
   a. **Vertical and Horizontal Stabilizer and Exhaust Louvers - Condition**
   b. **Elevator - Condition**
   c. **Rudder and Tab - Condition**
   d. **Elevator - Condition**
   e. **Horizontal and Vertical Stabilizer and Exhaust Louvers - Condition**
3. **Aft Fuselage Surface - Condition (P)**
4. **Aft Entrance Door - Condition (P)**

LEFT WING SECTION

1. **Left Wing Flap and Wing Flap Well - Condition (P or CP)**
2. **Lower Wing Surface and Fuselage - Condition (P or CP)**
3. **No. 2 Engine and Nacelle (P or CP)**
   a. **Safety and Oleo Switch - Condition**
   b. **Oleo Strut - Inflation**
   c. **Static Ground Wire - Touching ground**
   d. **Inboard Tire - Condition, slippage**
   e. **Inboard Main Wheel Well Door - Condition**
   f. **Engine Exhaust System - Condition**
   g. **Right Oil Cooler and Cowl Flaps - Condition**
   h. **Cowling Right Side - Condition and fasteners locked**
   i. **Prop Blades - Condition**
   j. **Cowling Left Side - Condition and fasteners locked**
   k. **Cowl Flaps, Left Oil Cooler and Intercooler Flaps - Condition**

(Cont)

LEFT WING SECTION (Cont)

4. Left Main Wheel Well (P or CP)
   a. Brake Stator Pins, Hydraulic Lines and Fittings - Condition
   b. CO_2 System - Condition
   c. ADI Tank - Quantity
   d. Fuel Vent Interconnects - Condition
   e. Retraction Mechanism - Condition
   f. Outboard Main Wheel Well Door - Condition
   g. Outboard Tire - Condition, slippage
   h. CO_2 Discharge Indicator Discs - Condition
5. Lower Wing Surface to No. 1 Engine - Condition (P or CP)
6. Anti-Syphon Scoop - Unobstructed (P or CP)
7. No. 1 Engine and Nacelle (P or CP)
   a. Engine Exhaust System - Condition
   b. Cowling Right Side - Condition locked
   c. Right Oil Cooler and Cowl Flaps - Condition
   d. Prop Blades - Condition
   e. Cowling Left Side - Condition and fasteners locked
   f. Cowl Flaps, Left Oil Cooler, Intercooler Flap - Condition
8. Anti-Syphon Scoop - Unobstructed (P or CP)
9. External Fuel Tank and Strut - Condition (P or CP)
10. Lower Wing Surface and Aileron - Condition (P or CP)
11. Wing Tip - Condition (P or CP)
12. Wing Leading Edge - Condition (P or CP)
13. No. 1 Engine and Prop (P or CP)
    a. Dome - Condition
    b. Prop Blades - Condition
    c. Integral Oil Tank - Leakage, drain plug safetied
    d. Cowling - Condition and fasteners locked
14. Wing Leading Edge - Condition (P or CP)
15. No. 2 Engine and Prop (P or CP)
    a. Dome - Condition
    b. Prop Blades - Condition
    c. Integral Oil Tank - Leakage, drain plug safetied
    d. Cowling - Condition and fasteners locked
16. Wing Leading Edge to Fuselage - Condition (P or CP)
17. Forward Fuselage - Condition (P or CP)
18. Left Static Holes - Unobstructed (P or CP)

T.O. 1C-97(K)G-1
15 October 1959

7

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

Passenger Briefing

1. Emergency Alarm Bell Signals
2. Ditching and Crash Landing Positions and Exits
3. Bail-out Procedures:
   a. Use of Parachutes and Location of Spare Chutes
   b. Primary and Secondary Bail-out Exits
   c. Bail-Out Sequence
   d. Designate Jumpmaster
4. Use of Life Vests and R-1 Suits (if applicable)
5. Use of Safety Belts
6. Smoking Rules
7. Fuel Tanks
8. Compartment Commander
9. Brief route, weather and time enroute
10. Answer any questions

Final Crew Briefing

1. Fall In - At ease (P)
2. Preflight Report - All crew members
3. Weather - Brief crew members (P)
4. Time Hack - By navigator (if required) (N)
5. Questions and Comments - Cleared (P)
6. Dismiss Crew - Dismissed
7. Down Locks and Pins - Checked (P)

Radio Operator Not Aboard (By CP)

MISSION PLANNING

1. Communications Requirements - Complete
2. Applicable Pilots Manual, Charts - Current and Complete
3. Communications Kit - Complete

INTERIOR INSPECTION (POWER ON)

Lower Forward Compartment

1. Interphone Call Box
   a. Call Box and Connections - Security
   b. NORMAL and CALL Operation - Check
2. IFF - Security
3. Radio Compass - Security
4. Marker Beacon - Security
5. UHF/DF - Security
6. TACAN - Security

Lower Aft Compartment

1. Interphone Call Box(es)
   a. Call Box and Connections - Security
   b. NORMAL and CALL Operation - Check

Main Compartment

1. Omni - Security
2. Aldis Lamp - Check and stow
3. All Interphone Call Boxes
   a. Call Box and Connections - Security
   b. NORMAL and CALL Operation - Check

Control Cabin

1. Aldis Lamp - Check and stow
2. Radio "G" File (if applicable) - Condition
3. Interphone Dynamotors - Security
4. Glide Slope Receiver - Security
5. VHF
   a. Transmitter and Receiver - Security
   b. Channelization - Set as required
   c. J-68/ARC-3 - Security
6. UHF
   a. R/T Unit - Security
   b. Master Control Panel - Security
   c. Channelization - Set as required

(Cont)

Control Cabin (Cont)

7. UHF Tone - Check
8. Navigator's UHF Transfer Switch - Remote
9. Aux. Liaison Receiver
   a. Receiver - Security
   b. Function Switches - Check
   c. Reception all Bands - Check
   d. Time Signal - Tune
10. Liaison Equipment
    a. R/T Unit - Security
    b. Antenna Coupler - Security
    c. Channelization - Check
    d. Operation - Check
11. Copilot's Interphone - Check
12. Radio Compass
    a. Dial Lights, C W Switch and Filter Switches - Check
    b. Alignment - Check
    c. Reception all Bands - Check
    d. Loop Position - Check
    e. Compass Position - Check
13. Glide Slope Receiver - Check
14. Omni Receiver
    a. Local Station - Tune
    b. RMI Needle No. 2 - Check for homing
    c. TO/FROM Flags - Check
15. TACAN TCTO 572
    a. Instrument Select Switch - TACAN
    b. Local Station - Tune
    c. RMI Needle No. 1 - Check for homing
    d. Range Indicator - Check
    e. Course Indicator - Check
    f. Navigator's RMI Needle No. 2 - Check for homing
16. VHF
    a. Operation - Check
    b. DF Tone - Check
17. UHF
    a. Operation - Check
18. UHF/DF
    a. UHF Operate Switch - To ADF
    b. UHF Channel Selector - Select desired channel
    c. UHF/DF RMI - Check pointer
    d. UHF Operate Switch - To T/R + GUARD

(Cont)

Control Cabin (Cont)

19. IFF
    a. Selector Switch - OFF
    b. Destructor Switch - OFF and safetied
    c. Emergency Lock Device - Check
20. Auxiliary Liaison Receiver
    a. Channel Selector Switch - As desired
    b. Receiver Control Switch - ON
    c. Function Switches - Check
21. All Radios (except VHF/UHF) - OFF
22. SIF - Check settings
23. MF Command Transmitter(s) ART-13
    a. Transmitter - Security
    b. Dynamotor - Security
    c. Channelization - Check
    d. Operation - Check

BEFORE STARTING ENGINES

1. Check Form 781, TOLD Cards - Checked (P)
② Lights as Required - As required (P, CP)
3. Gear Switch DOWN - DOWN (CP)
4. Check Gear Indicator and Warning Light - Checked (P)
5. Radios On - On (P or CP)
6. Open Reverse Lock Plate - Open (CP)
⑦ Wing Flap UP - UP (P, CP, GC)
8. Depressurization and Emergency Charging Valve Handle NORMAL - NORMAL (CP)
9. Check Nose Steering Disconnect Button - Checked (P)
10. Set Parking Brakes - Set (P)
11. Check Service Brake Pressure - Checked (CP)
12. Radio Call - Completed (CP)
⑬ Crosscheck Altimeters - Checked (P, CP, N)
⑭ Engineer's Report - "Ready to start engines" (P, E)

STARTING ENGINES

① Start Engines - Direct engineer to start engines (P, E)
② Check Hydraulic Pressures - Checked (P, CP)
③ Engineer's Report - "Starting checklist complete" (P, E)

CUT ON DOTTED LINE

BEFORE TAXI

① Remove External Power - Removed (if applicable) (P, GC)
2. Autopilot Master Switch ON - ON (P)
③ Alarm Bell, Oxygen and Interphone Check - Checked (CP)
④ Check Flight Controls - Checked (P, CP)
⑤ Purge Manifold Pressure Lines - Purged 30 seconds (P, CP)
6. IFF Master Switch - NORMAL (CP) or (N) as applicable
7. SIF Control Panel - Set (CP) or (N) as applicable
⑧ Set and Uncage Instruments - Set and uncaged (P, CP)
  ⓐ N-1 Compass - Synchronized (if applicable) (CP,N)
⑨ Check Autopilot Operation - Checked (P, CP)
⑩ Dismiss Ground Crewman - Dismissed (P, E, GC)
11. Door Warning Light Off - Off (CP)
⑫ Crew Report - "Ready to Taxi" (ALL)

TAXI

① Check Normal Brakes - Checked (P, CP)
② Check Emergency Brakes - Checked, recharged system (P, CP)
③ Check Instruments - Checked (P, CP)
4. Check Hydraulic Pressure - Checked normal (CP)
⑤ Engineer's Report - "Taxi checklist complete" (P, E)

ENGINE RUNUP

1. Center Nose Wheel - Centered (P)
2. Check Hydraulic Pressure - Checked normal (CP)
3. Set Parking Brakes - Set (P)
④ Check for Brake Overheat - Checked (if required) (P, BO)
▼⑤ A/R Pressure Check - Completed (if applicable) (P, E, BO, N or RO)
⑥ Notify Engineer and Crew - "Ready for runup - Notified (P)
⑦ Prop Operation - Checked (P, E, CP)
⑧ Engineer's Report - "Contamination checks, engine runup complete" (P, E)

BEFORE TAKEOFF

1. Set Trim Control Wheels - Set (P)
2. Autopilot Switch OFF - OFF (P)
3. Rudder Boost ON - ON (P)
4. ADI Switch Climatic - Climatic (CP)
5. Set Throttle Lock Lever - Set (P)
⑥ Set Wing Flaps - Set 33% (P, CP, BO)
⑦ Instrument Panel Lights as Required - As required (P, CP)
8. Set Landing Lights - Set as required (CP)
⑨ Pilots Briefing - Complete (P, CP, E)
10. Tower Call - Completed (CP)
11. Set TACAN - Set as required (P or CP)
⑫ Close Windows, Hatches and Doors - Closed (P, CP, BO)
⑬ Anti-Icing Equipment Climatic - Climatic (P, E)
⑭ Fasten Safety Belts and Shoulder Harness - Fastened (ALL)
⑮ Engineer's Report - "Before Takeoff checklist complete" (P, E)

LINE UP

1. Set or Hold Parking Brakes - Set or hold (P)
② Set Directional Indicators - Set (P, CP)
3. Pitot Heat Switches ON - ON (P)
④ Unlock Flight Controls - Unlocked and checked (P, CP)
5. Tower Takeoff Clearance - Received (CP)
6. Check Reverse Lock Plate Open - Opened (CP)
⑦ Set Cowl Flaps - Set (P, E)
⑧ Crew Takeoff Report - Received (all crew members)
9. Anti-Collision Lights On - On (CP) ▲ TCTO 591
10. Landing Lights On - ON (if required) (CP)
11. Advance Throttles - Advanced (P)

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

TAKEOFF

1. Release Brakes - Release (P)
2. Release Nose Steering - Release (P)
3. Airspeeds - Called out (CP)
4. Close Reverse Lock Plate - Closed (CP)

AFTER TAKEOFF — CLIMB

1. Gear Switch UP - UP (CP)
2. Check Reverse Warning Flag Up - Checked (Flag Up) (CP)
③ Engineer's Throttles - Notify (P, E)
④ Wing Flaps Up - Full up (P, CP, BO)
⑤ Set Meto Power - Set (P, E)
6. Landing Lights Off - Off (CP)
7. ADI OFF - OFF (CP)
⑧ Pilot Monitors Desired Radio - Monitored (P, CP)
9. Autopilot Master Switch ON - ON (P)
10. Gear Switch OFF - OFF (CP)
11. Wheel Well Light Switches OFF - OFF (P)
⑫ Anti-Icing Equipment Climatic - Climatic (P, E)
⑬ Engineer's Report - "After Takeoff - Climb checklist complete" (P, E)

CRUISE

① Set Cruise Power - Set (P, E)
2. Pitot Heat Climatic - Climatic (P)
3. Engage Autopilot - Engaged (if required) (P)
④ Anti-Icing Equipment Climatic - Climatic (P, E)
⑤ Engineer's Report - "Cruise checklist complete" (P,E)

SECONDARY CLIMB

① Notify Engineer - "Start Secondary Climb checklist" (P, E)
② Anti-Icing Equipment Climatic - Climatic (P, E)
③ Engineer's Report - "Secondary Climb checklist complete" (P, E)

DESCENT

① Complete Radio Call - Completed (P, CP)
② Set Altimeters - Set (P, CP, N)
3. Set TACAN TCTO 572 - Set (as required) (P or CP)
4. Pitot Heat Climatic - Climatic (P)
⑤ Anti-Icing Equipment Climatic - Climatic (P, E)
6. Notify Crew - "Prepare for landing" (P)
⑦ Fasten Safety Belts and Shoulder Harness - Fastened (P, CP)
⑧ Set Power - Set (P, E)
9. Depressurization and Emergency Charging Valve Handle NORMAL - NORMAL (CP)
10. Check Nose Steering Engaged - Engaged (P)
⑪ Check Instruments - Checked (P, CP)
⑫ Review Landing, Go-Around, Landing Data Card - Reviewed (P, CP)
⑬ Engineer's Report - "Descent checklist complete" (P, E)

CUT ON DOTTED LINE

BEFORE LANDING

1. Autopilot OFF - OFF (P)
2. Rudder Boost ON - ON (P)
③ Anti-Icing Equipment Climatic - Climatic (P, E)
④ Mixtures RICH - RICH (P, E)
⑤ Rpm - Call for 2350 rpm (use 2550 or 2700 if required with one or more engines inoperative) (P, E)
⑥ Gear DOWN - DOWN (four engine operation) (P, CP, E)
7. Check Hydraulic Pressure and Supply - Checked (CP)
8. ADI ON - ON (CP)
9. Check Reverse Lock Plate Closed - Closed (CP)
⑩ Engineer's Report - "Gear checked down visually" (P, E)
⑪ Fasten Safety Belts and Shoulder Harness - All crew members
⑫ Set Wing Flaps - Set 55% (as required, with one or more engines inoperative) (P, CP, BO)
13. Landing Lights Extended - Extended (as required) (CP)
⑭ State Reversing Intentions - State as desired (P, E)
⑮ Gear Switch DOWN - DOWN (On final if one or more engines inoperative request and receive visual check (P, E)
⑯ Engineer's Report - "Before Landing checklist complete" (P, E)
⑰ Set Final Flaps as Required - Set as required (P, CP, BO)
18. Landing Lights ON - ON (if required) (CP)

GO-AROUND

1. Notify Crew - Notified (P)
② Set rpm 2700 - Set (P, E)
③ Simultaneously: (P, E)
   a. Advance Throttles - Advanced (P)
   ⓑ Set Wing Flaps - Set 55% (P, CP, BO)
4. Gear Switch UP - UP (CP)
⑤ Engineers Throttles - Notified (P, E)
⑥ Wing Flaps UP - Full UP (P, CP, BO)
⑦ Power As Required - As required (P, E)

TOUCH AND GO LANDING

① Notify Crew - "Touch and go rpm 2700" (P, E)
2. Set Power - Set (approximately 30 inches Hg.) (P)
3. Set Elevator Trim - Set for takeoff (CP)
④ Set Wing Flaps - Set 33% (P, CP, BO)
⑤ Set Maximum Power - Set (P, E)
6. Call Out Airspeeds - Called Out (CP)
7. Check Reverse Warning Flag Up - Checked (flag up) (CP)
8. Wheel Well Light Switches OFF - OFF (CP)
⑨ Engineer's Throttles - Notify (P, E)
⑩ Wing Flaps UP - UP, (P, CP, BO)
⑪ Set Meto Power - Set (P, E)
12. ADI Switch OFF - OFF (CP)
⑬ Power as Required - As required (P, E)

LANDING

1. Unlock Throttles - Unlocked (CP)
2. Open Reverse Lock Plate - Opened (CP)
3. Apply Reverse Thrust - Applied (P)
4. Check Hydraulic Pressure - Checked (CP)
5. Apply Brakes - Applied (P)

AFTER LANDING

1. Set Parking Brakes - Set (P)
2. Lock Controls - Locked (CP)
3. ADI OFF - OFF (CP)
4. Landing Light Switches OFF - OFF (CP) (if applicable)
5. Anti-Collision Lights OFF - OFF (CP)
⑥ Wing Flap Switch UP - UP (CP, BO)
7. Pitot Heat Switch OFF - OFF (P)
8. Trim Tabs Centered - Centered (P, CP)
⑨ Check Forward Thrust - Checked (if required) (P, E)
⑩ Engineer's Report - "After Landing checklist complete" (P, E)
⑪ Accomplish Post Flight Check - Accomplished (P, E)

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

ENGINE SHUTDOWN

1. Set Parking Brakes - Set (P)
② Shutdown Engines - Shutdown No. 1, No. 3, No. 4 (P, E)
③ Check No. 2 Hydraulic Pump - Checked and Shutdown No. 2 Engine (P)
④ All Switches OFF or NORMAL - OFF or NORMAL (P and CP)
5. Gear Switch DOWN - DOWN (CP)
6. Close Reverse Lock Plate - Closed (CP)
7. Release Parking Brakes - Released (P)
⑧ Engineer's Report - "Shutdown checklist complete" (P, E)

KC-97G
ENGINEER'S CONDENSED CHECKLISTS

BEFORE INTERIOR INSPECTION

① Form 781 - Checked (E, P, GC)
② Safety Check - Accomplished (E, BO)
③ APU and Heater Cavities - Climatic (E, BO)
4. Stow Equipment - Stowed (all)
5. Crew Inspection - Completed

ENGINEER'S PREFLIGHT INSPECTION

Interior Inspection

CONTROL CABIN (POWER OFF)

1. Oxygen Equipment Check - Checked and stowed
2. Safety Belt and Shoulder Harness - Adjusted
3. Circuit Breakers - Set
4. All Switches - Off or normal
5. Instruments - Normal
▼T ⑥ Fuel Dump - Checked (E, BO)
▼T 7. Isodraulic Synchronization - Checked
⑧ Report to Pilot - Ready for power (E, P)

CONTROL CABIN (POWER ON)

1. Master and Battery Switches - As required
2. External Power or Auxiliary Power Unit - Started and on the line
3. Bus Voltage - Checked
④ Inverters - Spares and normal - Check output (E, N)
5. Instruments - Checked

(Cont)

CUT ON DOTTED LINE

CONTROL CABIN (POWER ON) (Cont)

6. SPR Test - Valves closed
7. Oil Transfer Switches - Climatic
8. Heater Overheat System - Checked
9. Fire Detection System - Checked
10. Lights - Checked
    a. Engineer's panel lights
    b. Push-to-test lights

⑪ Interphone - Contacts ground crewman (E, GC)
⑫ Waste Gates - AUTO and MAN - Checked (E, GC, CP, BO)
    a. Release copilot and boom operator

⑬ Engine Hydraulic Lock Check - Crank 8 blades (E, GC)
⑭ Engine Doors, Flaps, Shutters - Climatic (E, GC)
    a. Oil Cooler Flap Switches - Climatic
    b. Intercooler Flap Switches - Climatic
    c. Cowl Flap Switches - Climatic
    d. Carburetor Air Switches - Climatic

15. Normal Fuel System:
    a. Fuel Selector Switches (all positions) - Check (counterclockwise and OFF)
    b. Boost Pump Switches Main Wing Tanks - NORMAL (no pressure rise)
    c. Fuel Selector Switches - TE (note pressure rise)
    d. Fuel Selector Switches - OFF
    e. Boost Pump Switches - OFF (pressure holds 10 to 14 psi) (approximately 10 seconds)
    f. Fuel Selector Switches - TE
        (1) Main Wing Tank Boost Pumps - Checked
    ⓖ External Fuel Tank Boost Pumps - Checked (if required) (E, GC)
    h. Fuel Selector Switches - TME
    ⓘ CWT Boost Pumps - Checked (if required) (EGC) (E, GC)
    j. Boost Pump Switches - One on EMERGENCY, all others NORMAL
    k. Ground Crewman - Released

(Cont)

CONTROL CABIN (POWER ON) (Cont)

▼ 16. A/R Fuel System:
    a. A/R Panel - Checked:
        (1) Turn A/R master switch ON and check A/R fuel quantity. Level fuel as required
        (2) All other switches OFF or NORMAL position
        (3) Push to test lights
        (4) Hydraulic oil supply valve switches OPEN
    b. Isodraulic Handle - Full down
17. All Fuel and Oil Quantities - Checked
18. Turbo Amplifiers and Fuses - Checked
    a. Amplifiers for condition and security
    b. Amplifier fuses for proper amperage rating
    c. Spare fuses and amplifier installed and secure
19. Cabin Pressure Relief Valve Crank - Full INCREASE
20. Lavatory - Checked
21. Boom Operator's Oxygen Shutoff Valve - Open

LOWER NOSE COMPARTMENT

1. Emergency Nose Gear Equipment - Security
    a. Emergency hand crank for installation and security
    b. Nose gear clutch lever for proper position and pressurization plug installed
2. Cabin Pressure Emergency Release Valve - As required
3. AC Panel (as applicable) - Fuses and circuit breakers
4. Alternator Equipment - Checked
5. Inverters - Condition, security
6. Torquemeter Amplifiers - Condition, security
7. Hydraulic Equipment - Checked
    a. Hydraulic panel equipment for leaks and condition
    b. Service brake and emergency accumulator ground service valves closed and safetied, proper preload
    c. All hydraulic units, lines and fittings in lower nose for leakage and condition
8. Central Oil Tank and Pump - Condition, leaks, security
9. General Condition - Checked

T.O. 1C-97(K)G-1
15 October 1959

3

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

LOWER FORWARD COMPARTMENT

1. General Condition - Checked as checklist progresses
   a. All guard cages for security
   b. Cleanliness, and overall condition
   c. Drain valve on urinal tank closed
2. Battery Shield - Condition, Secured
3. Forward Power Panel - Condition, circuit breakers as required
4. Fire Extinguisher - Pressure, security
5. Central Oil Tank Filler Cap - Security
6. Voltage Regulators - Condition
7. First Aid Kit - Stowed
8. Compartment Lights - Checked
9. Fuel Gage Amplifiers - Secured
10. ▼ Fuel Lines, Connectors, Tanks - Leaks, condition
11. Body Heaters - Condition
    a. For evidence of burning, fuel leakage and over-all condition
    b. Cabin heater distribution valve for normal position A or as required
    c. Cabin heater selector valve for normal position D, or as required
12. Differential Pressure Ports - Clear
13. Prop Deicer Timer - Security, condition
14. Oil Transfer Valve - Security, condition

CENTER WING SECTION

1. General Condition - Checked as checklist progresses
2. Heater Control Packs - Condition
3. CWT - Leaks condition
   a. Tank boost pumps and sensing unit for leaks
   b. Tank for signs of leakage and proper installation of access panels
4. Cabin Pressure Regulators - Condition
5. Hydraulic Pressure Transmitters - Leaks 22737 ▶
6. Fuel Valves - Checked

LOWER AFT COMPARTMENT

1. General Condition - Checked as checklist progresses
   a. Wire bundles, wires, condition of cables, lines and vents on rear spar
   b. Cleanliness and overall condition
2. No. 1 and No. 2 Fuel Manual Shutoff Valves - Checked
   T a. No. 1 manual fuel shutoff valve normally closed (must be closed and safety wired if jet fuel is carried in center wing tank)
   T b. No. 2 manual fuel shutoff valve normally closed (must be closed and safety wired if jet fuel is carried in external fuel tanks and center wing tank is to be used for airplane fuel system)
3. Main Gear Emergency Equipment - In place
   a. Emergency gear clutch T handles for proper position
   b. Emergency extension gear cranks in place
4. Reverse Current Relays - Condition
5. Wing Flap Mechanism - Condition
   a. Condition of flap torque tube and universal joints
   b. Emergency wing flap gear motor for proper installation
6. Main Circuit Breaker Panel - Condition, set
7. Main Power Panel - Condition
   a. Current limiters and spares for installation
   b. Wrench for stowed position
8. Vent Selector Valve Handle - Vent (if installed)

T 9. Fuel Tanks, Fuel and Hydraulic Lines - Leaks, condition as checklist progresses

10. Compartment Lights - Checked
11. Tail Jack and Strut Assembly - Stowed and secure
12. SPR Panel - Switch OFF, cannon plug disconnected, stowed and secure
13. Fire Extinguisher - Pressure, security

CUT ON DOTTED LINE

Exterior Inspection

1. Left External Fuel Tank - Checked
2. No. 1 Nacelle Heater Cavity - Climatic
3. Engine Nacelles
   a. Air Scoop - Clear
   b. Turbo Impeller - Checked
   c. Preheat Valve - Closed
   d. Bypass Door - Free
   e. Hydraulic Pump - Leaks
   f. Oil Sump Plug - Safetied
   g. Sheltered Air Door - Security
   h. Air Filters - Climatic
4. No. 4 Nacelle Heater Cavity - Climatic
5. Right External Fuel Tank - Checked
6. Access Doors - Closed
7. Wing Heater Exhausts - Checked

Control Cabin Status

1. Boost Pump Switches - OFF
2. Fuel Selector Switches - TE
3. All Switches - As required
4. Form F - Checked
5. Takeoff and Landing Data Cards - Prepared
6. Flight Log - Initiated

BEFORE STARTING ENGINES

1. Fire Switches - NORMAL
2. Ignition Switches - OFF
3. Overhead Circuit Breakers - Set
4. Heater and Deicer Switches - OFF
5. Master Switch - ON
6. Battery Switch - As required
7. APU or External Power - Started and on line, voltage checked
8. Essential Inverter Switch - ESS INV, all others OFF
9. Hot Fuel Prime Switches - Climatic (normally HIGH, then OFF)

▼10. A/R Panel - Checked
   a. Hydraulic Oil Shutoff Valve Switches - OPEN
   b. Fuel Dump Switches - NORMAL
   c. All Other Switches - NORMAL position

11. Manifold Pressure - Recorded
12. Carburetor Air Switches - Climatic
13. Intercooler Flap Switches - Climatic
14. Cowl Flaps - Climatic
15. Cylinder Head Temperature Selector Switch - A-2
16. Oil Cooler Flap Switches - Climatic
17. Cabin Pressure Rate-of-Change Selector - MAX
18. Cabin Altitude Selector - Set
19. Cabin Air Selector Valve Switches - NORMAL
20. Turbo Bleed Switches - OPEN
21. Fuel Selector Switches - TE
22. Prop Oil Refill Switches - OFF
23. SPR Test - Valves closed, switch OFF
24. Mixtures - FUEL CUTOFF
25. Throttles - Cracked
26. Prop Synch Lever - Full INCREASE RPM
27. TBS Lever - O
28. Turbo Switches - AUTO
29. Turbo Override Switches - OPEN, guards down
30. Prop Governor Selector Switches - Full INCREASE RPM (lights on)
31. Prop Auto Control Switch - No. 1 MASTER
32. Spark Advance Selector Switches - NORMAL

㉝ Report to Pilot - "Ready to start engines" (E, P)

T.O. 1C-97(K)G-1
15 October 1959

7

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

STARTING ENGINES

1. DC Voltmeter Selector Switch - No. 3 engine
2. No. 3 Boost Pump Switch - NORMAL
3. Engine Starting Selector Switch - No. 3
④ Start Engines - Climatic (E, P, GC)
5. Oil Pressure - Check
6. Mixtures - AUTO RICH, release primer
7. Boost Pump Switch - OFF
8. Fuel Pressure - Checked
9. Generator Operation - Checked
⑩ Repeat on Remaining Engines as Ground Crewman Clears each Engine in Turn - All steps above (E, GC)
11. Starter Selector Switch - OFF
⑫ Report to Pilot - "Starting checklist complete" (E,P)

BEFORE TAXI

1. Battery Switch - ON BUS
2. Autopilot Inverter - AUTOPILOT INV
3. Secondary Inverter - SEC. INV
4. Pilot's Instrument Inverter - PILOT'S INSTR IN
▼ 5. A/R Hydraulic Pressure - Checked
6. Air Conditioning Master Switch - ON
⑦ Contamination Check - Initiated (E, BO or RO)
    a. No. 1 and No. 4 Fuel Selector Valve Switches - TME
    b. No. 1 or No. 4 Fuel Boost Pump Switch - NORMAL
    c. CWT - Checked (if required) (E, BO or RO)
    d. External Tanks - Checked (if required) (E, BO or RO)
8. Magneto Grounding (800-1000 rpm) - L, R, OFF, BOTH
⑨ APU - Started and on line (E, BO or RO)
10. Fire Detection Systems - Test
11. Oil Transfer System - Climatic
⑫ Engine Doors, Flaps and Shutters - Climatic (E, GC)
13. Oil Temperature - Above minimum
⑭ Report to Pilot - "Ready to taxi" (E, P)

TAXI

1. Mixtures - Manual lean
2. Alternator Control Switches - ON
3. Analyzer Power Switches - ON
4. Spark Advance System - Check (1000 rpm)
   a. Set analyzer selector to R-1 magneto position
   b. Place spark advance switch to SPARK ADVANCE and note shift on analyzer pattern
   c. Place spark advance switch to NORMAL and note shift on analyzer pattern
5. Prop Deicing - Check
   a. Prop Deicing Switch - ON
   b. Prop Deicing Loadmeter and Indicators - Monitor
   c. Prop Deicing Switch - OFF

⑥ Report to Pilot - "Taxi checklist complete" (E, P)

CUT ON DOTTED LINE

ENGINE RUNUP

1. Mixtures - AUTO RICH
▼② A/R Fuel Pressure Check - Completed (when directed by pilot) (E, BO, P)
3. Prop Operation
   a. Manual Controls - Check
      (1) Throttles - 1850 rpm
      (2) Prop Synch Lever - Full INCREASE RPM
      (3) Auto Control Switch - ON
      (4) Governor Selector Switches - Full DECREASE RPM
      (5) Prop Rpm Limit Lights (4) - ON (tachometer should indicate 1100 ± 50 rpm)
      (6) Governor Selector Switches - Full INCREASE RPM
      (7) Prop Rpm Limit Lights (4) - ON
   b. Auto Master Synchronizer - Check
      (1) Throttles - 1850 rpm
      (2) Prop Synch Lever - Full INCREASE RPM
      (3) Auto Control Switch - OFF
      (4) Prop Synch Lever - Retard about one inch from Full INCREASE RPM toward DECREASE RPM. Check 4 prop limit lights on, then return lever to full INCREASE RPM
      (5) Auto Control Switch - No. 2 MASTER
      (6) Prop Synch Lever - Full DECREASE RPM
      (7) Prop Synch Lever - Advance to 1850 rpm, and reset throttles to 30 inches Hg.
      (8) Resynchronizer Switch - RESYNC momentarily
      (9) No. 2 Throttle - 1000 rpm
      (10) Tachometers - 175 rpm maximum drop
      (11) No. 2 Throttle - 30 inches Hg.
      (12) Resynchronizer Switch - RESYNC momentarily
      (13) Auto Control Switch - No. 1 MASTER
      (14) Throttles - 1000 rpm
      (15) Prop Synch Lever - Full INCREASE RPM
      (16) Governor Selector Switches (4) - DECREASE RPM for approximately 3 or 4 seconds. Check all rpm limit lights out
      (17) Prop Synch Lever - Toward DECREASE RPM approximately 2 inches. Then advance to full INCREASE RPM. Check all rpm limit lights on

ENGINE RUNUP (Cont)

④ Reversal - Check (E, P)
  a. Throttles - 1000 rpm
  b. Report "Ready to Reverse"
  ⓒ Check loadmeters for load indication and report to pilot, "LOAD," when feathering button is depressed
⑤ Prop Feathering - Check (E, P)
  a. All Throttles - 1200 rpm
  b. Report to pilot "Ready for feathering check"
  ⓒ Check loadmeters for load indication and report to pilot, "LOAD" when feathering button is depressed
6. Alternator Voltages - Check
7. Engine Power and Ignition System - Check
  a. Throttle (one at a time) - Field barometric pressure
  b. Tachometer - Check 2025 ± 75 rpm
  c. Torque Pressure and Normal Fuel Flow - Check
  d. Ignition Switch - From BOTH to L, note rpm drop, return to BOTH. From BOTH to R, note rpm drop, return to BOTH
8. Fuel Mixtures - Manual lean
⑨ Manual Fuel Shutoff Valves - Check closed (E, BO)
⑩ Report to Pilot - "Contamination checks engine runup complete" (E, P)

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

BEFORE TAKEOFF

1. Ignition Switches - On BOTH
2. Fuel Enrichment Switches - OFF ▲ 1C10 595 ▶
3. Prop Synch Lever - Full INCREASE RPM
4. TBS Lever - O
5. Turbo Switches - MAN
6. Turbo Override Switches - OPEN, 10 seconds then OFF, guards up
7. Prop Governor Selector Switches - Toggle momentarily in DECREASE RPM, then full INCREASE RPM
8. Prop Auto Control Switch - No. 1 or No. 2 MASTER
9. Generator Switches - ON
10. Inverters - Check voltages and frequency
11. Carburetor Air Switches - Climatic
12. Intercooler Flap Switches - Climatic
13. Oil Cooler Flap Switches - AUTO
14. Cabin Pressure Rate-of-Change Selector - Set (as desired for mission)
15. Body Heater Switches - OFF
16. Boost Pump Switches (Main Tanks) - NORMAL
17. Fuel Selector Switches - TE

⑱ Report to Pilot - "Ready for Briefing" (E, P)

▼19. A/R System - As required (If deck fuel carried)
   a. Engineer's A/R panel in operating position
   b. Fuel dump switches cover open
   c. Isodraulic handle strap unfastened
   d. A/R system fuel level checked

20. Lights - As required

㉑ Prop Deicing Switch - As required (E, P)

㉒ Window Heat - As required (E, P)

㉓ Surface Anti-Icing Heaters - As required (E, P)

㉔ Safety Belt and Shoulder Harness - Fastened (E, P)

㉕ Report to Pilot - "Before Takeoff checklist complete" (E, P)

KC-97G
TAKEOFF DATA CARD

TAKEOFF DATA

ACCEL CHECK ______ IAS ______ MARKER

GO NO-GO ______ IAS ______ MARKER

TAKEOFF ______ IAS ______ DISTANCE

MIN CL-OUT ______ IAS

FLAPS UP ______ IAS

MIN 3 E CL ______ IAS

BEST 3 E CL ______ IAS

4 E CLIMB ______ IAS

CONDITIONS

PRED TPSI ______ TAKEOFF BHP ______

MP TPSI ______ EQ PERF WT ______

CRIT FLD LGTH ______

ACT. GR WT ______ FLD PA ______

RUNWAY LENGTH ______ OAT. ______

FLAP POS ______ DEW PT ______

T.O. 1C-97(K)G-1
15 October 1959

13

CUT ON DOTTED LINE

LINE UP

1. Mixtures - AUTO RICH (locked)
2. Engine Pressures and Temperatures - Checked
③ Cowl Flap Switches - Set (when directed by pilot)
④ Report to Pilot - "Ready for takeoff" (E, P)

AFTER TAKEOFF — CLIMB

① Engineer's Throttles - Acknowledge (E, P)
② Meto Power - Set (E, P)
3. Boost Pump Switches - NORMAL (one per tank)
4. Cylinder Head Temperature - Checked (position selector switch depending on hottest cylinder)
5. Cowl Flaps - As required
    a. Fuel Enrichment Switches - ON after noting fuel flow, fuel pressure and TPSI on each engine 1C10 595
    b. Manifold Pressure - Increase 1C10 K595
6. Generators, Inverters and Alternators (if on) - Checked for proper voltage and power output
7. APU - OFF, Exhaust valve closed (if required)
8. Carburetor Air Switches - As required
9. Turbo Switches - Climatic
    a. TBS Lever - O
    b. Turbo Override Switches - OPEN guards down
    c. Turbo Switches - AUTO (one at a time)
    d. Intercoolers - Open to 2 inches (or as desired)
    e. TBS Lever - Carefully advance as desired
    f. CAT - Control with intercooler flap switches
10. Cabin Pressurization - As desired
11. Analyzer Check - Accomplish
⑫ Prop Deicing Switch - As required (E, P)
⑬ Window Heat - As required (E, P)
⑭ Surface Anti-Icing Heaters - As required (E, P)
⑮ Report to Pilot - "After Takeoff - Climb checklist complete" (E, P)

T.O. 1C-97(K)G-1
15 October 1959

14

CUT ON DOTTED LINE

CRUISE

1. Mixtures - AUTO RICH ✈ 1C10 595 ➡
2. Fuel Enrichment Switches - OFF ✈ 1C10 595 ➡
③ Power Setting - As required (when directed) (E, P)
4. Intercoolers and Carburetor Air Switches - As required
5. Turbo - As required
6. Cowl Flaps - As required
7. Fuel Selector Switches and Boost Pumps - As required
8. Analyzer - Check engines every hour
9. Mixtures - As required
10. Spark Advance - As required
11. Battery Switch - BAT. CHG. (if applicable)
⑫ Prop Deicing Switch - As required (E, P)
⑬ Window Heat - As required (E, P)
⑭ Surface Anti-Icing Heaters - As required (E, P)
⑮ Report to Pilot - "Cruise checklist complete" (E,P)
16. Observers Report - On the hour
17. Transfer Oil - As required

SECONDARY CLIMB

1. Spark Advance Switches - NORMAL (refer to figure 7-4 SPARK ADVANCE CRUISE CONTROL)
2. Mixtures - AUTO RICH
3. Boost Pump Switches - 4 on NORMAL
4. Fuel Selector Switches - As required
5. Meto Power - Set
6. Intercoolers - As required
7. Turbo - As required
8. Cowl Flaps - As required
9. Fuel Enrichment - As required ✈ 1C10 595 ➡
⑩ Prop Deicing Switch - As required (E, P)
⑪ Window Heat - As required (E, P)
⑫ Surface Anti-Icing Heaters - As required (E, P)
⑬ Report to Pilot - "Secondary Climb checklist complete" (E, P)

KC-97G
LANDING DATA CARD

LANDING GR WT ____________________

LANDING DIST ____________________

MIN APPR . . . . IAS ____________________

GO AROUND TPSI ____________________

FLAPS UP. . . . IAS ____________________

EMERGENCY DATA

EMERGENCY APPR SPEED. . . . IAS ____________________

3 ENG GO-AROUND DATA	**BEST IAS**	**R/C (+ OR —)**
GEAR UP-FLAPS UP		
GEAR UP-FLAPS 55%		
GEAR DN-FLAPS 55%		

2 ENG GO-AROUND DATA	**BEST IAS**	**R/C (+ OR —)**
GEAR UP-FLAPS		

T.O. 1C-97(K)G-1
15 October 1959

16

CUT ON DOTTED LINE

DESCENT

1. Spark Advance Selector Switches - NORMAL
2. Mixtures - As required
③ Prop Deicing Switch - As required (E, P)
④ Window Heat - As required (E, P)
⑤ Surface Anti-Icing Heaters - As required (E, P)
⑥ Descent Power - Set (when directed) (E, P)
7. Turbo and Intercoolers - As required
8. Cabin Altitude and Rate-of-Change Selector - As required
9. Cowl Flaps - As required
10. Overhead Panel Circuit Breakers - Checked set
11. Oil Cooler Flap Switches - AUTO
12. Carburetor Air Switches - As required
▼13. A/R Fuel Quantity Gages - Checked
⑭ Landing Data Card - Present to pilot (E, P)
⑮ Report to Pilot - "Descent checklist complete" (E,P)

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

BEFORE LANDING

① Prop Deicing Switch - As required (E, P)
② Window Heat - As required (E, P)
3. Surface Anti-Icing Heater Switches - OFF
④ Mixtures - Check AUTO RICH (locked) and report to pilot (E, P)
⑤ RPM - Set 2350 rpm or as directed and report to pilot (E, P)
6. Cowl Flap Switches - OPEN (2 inches)
7. APU - Started and on line
⑧ Report to Pilot - "Gear checked down visually" (four engine operation (E, P)
⑨ Safety Belt and Shoulder Harness - Fastened
10. Airplane Fuel Quantity Gages - Checked
11. Boost Pump Switches - Main, NORMAL center and external, OFF
12. Center Tank Line Valve Switch - CLOSE
13. Fuel Selector Switches - TE
14. TBS Lever - Climatic
15. Turbo Switches - Climatic
16. Turbo Override Switches - Climatic
⑰ Report to Pilot - "Gear checked down visually" (one or more engines inoperative) (E, P)
18. Carburetor Air Switches - Climatic
19. Intercooler Flap Switches - Climatic
20. Battery Switch - ON BUS
21. Body Heater Switches - OFF
㉒ Report to Pilot - "Before Landing Checklist complete TBS lever at ________ position" (E, P)
23. TBS Lever - O

GO-AROUND

1. TBS Lever - O
② RPM - Increase to 2700 (E, P)
③ Power - Even up at maximum power (E, P)
4. Pressures and Temperatures - Checked within limits
⑤ Engineer's Throttles - Acknowledged (E, P)
6. Cowl Flap Switches - Adjust as required
⑦ Power - Set as called for by pilot (E, P)

AFTER LANDING

1. Boost Pump Switches - OFF
2. Oil Cooler Flap Switches - Climatic
3. Turbo Switches - AUTO
4. Turbo Override Switches - OPEN, guards down
5. Window Heat Selector Switch - OFF
6. Alternator Switches - OFF
   a. Alternator Bus Selector Switch - OFF
   b. Alternator Switches - OFF
7. Prop Deicing Switch - OFF

⑧ Forward Thrust - Check, if required (when directed by pilot) (E, P)
   a. Prop Synch Lever - Full DECREASE RPM (4 lights on)
   b. Prop Synch Lever - Full INCREASE RPM (4 lights on)

9. Mixtures - Manual lean (if immediate takeoff is not anticipated)

⑩ Report to Pilot - "After Landing checklist complete" (E, P)

TOUCH AND GO LANDING

① Prop Synch Lever - Full INCREASE RPM (4 lights on) (E, P)

2. Boost Pump Switches (Main Tanks) - NORMAL (EMERGENCY one per tank if required)

③ Power - Even up at maximum power (E, P)

4. Pressures and Temperatures - Checked within limits

⑤ Engineer's Throttles - Acknowledged (E, P)

6. Cowl Flaps Switches - Adjust as required

⑦ Meto Power - Set (E, P)

8. Boost Pump Switches - NORMAL (one per tank)

⑨ Power - Set (E, P)

CUT ON DOTTED LINE

POSTFLIGHT ENGINE CHECK

1. Mixtures - AUTO RICH
2. Prop Auto Control Switch - OFF
3. Magneto Ground Check (800-1000 rpm) - L, R, OFF, BOTH
4. Engine Power and Ignition System - Check
   a. Obtain current altimeter setting from pilot
   b. Determine field elevation and point off three decimal places from right to left (i.e. 1600 feet becomes 1.6)
   c. Subtract this figure from current altimeter setting to obtain field barometric pressure
5. Idle Mixture - Checked
6. Mixtures - Manual lean (if immediate shutdown is not anticipated)
7. Urinal Tank Drain - OPEN
8. Analyzer Switches - OFF
9. Secondary Inverter Switch - OFF

⑩ Report to Pilot - "Postflight engine check complete" (E, P)

ENGINE SHUTDOWN

1. Autopilot and Flight Instrument Inverter Switches - OFF
2. Air Conditioning Master Switch - OFF
3. Oil Dilution - Climatic

④ Engines No. 1, No. 3 and No. 4 - Shutdown (when directed) (E, P)

⑤ After Hydraulic Pump Check - Shutdown No. 2 engine (when directed) (E, P)

6. Generator Switches - ON
7. Essential Inverter Switch - OFF
8. Oil Cooler Flap Switches - CLOSE and OFF
9. Carburetor Air Switches - SHELT (if required)
10. Fuel Selector Switches - TE
11. Ignition Switches - OFF
12. All Switches - OFF or NORMAL
13. Circuit Breakers:
    a. Turn and Slip - Pulled
    b. Interphone - Pulled

⑭ Report to Pilot - "Shutdown checklist complete" (E, P)

KC-97G
PILOTS' CONDENSED ALERT CHECKLISTS

COCKING

1. Set Parking Brakes - Set (P)
2. Engage Nose Wheel Steering - Engaged (P)
3. Rudder Boost ON - ON (P)
4. Autopilot Master Switch OFF - OFF (P)
5. Gear Switch DOWN - DOWN, guard down (CP)
6. Check Gear Indicator and Warning Light - Checked (P)
⑦ Wing Flaps UP - UP (P, CP, GC)
8. Lights OFF - OFF (P & CP)
9. Set Radios - Set (P or CP)
   a. Omni - Set on desired frequency and OFF
   b. VHF - ON, Set on tower frequency
   c. UHF - ON, Set on control room frequency
   d. IFF - OFF
   e. Radio Compass - Set on desired frequency and OFF
   f. TACAN TCTO 572 on - Set on Desired frequency and OFF
10. Set Trim Control Wheels - Set (P)
11. Check Reverse Lock Plate Open - Opened (CP)
⑫ Airplane Secured for Alert - Secured (All)

T.O. 1C-97(K)G-1
15 OCTOBER 1959

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

SCRAMBLE

SCRAMBLE — BEFORE STARTING ENGINES
PILOT

① Remove Ground Heating Equipment and Covers - Removed (All)
*② Remove and Stow Tail Jack - Removed and stowed (P or RO & BO)
*③ Remove Ground Power Unit - Removed (if applicable) (P or RO & GC)
4. Remove Pitot Covers - Removed
5. Lock Forward Entrance Door - Locked
6. Don Equipment - Donned

SCRAMBLE — BEFORE STARTING ENGINES
COPILOT

① Remove Ground Heating Equipment and Covers - Removed (All)
2. Open APU Exhaust Port - Opened
③ Start APU - Started (CP, E)
4. Lights On - On (As required)
5. Monitor Radio - Monitored
⑥ Engineer's Report - "Ready to start engines" (CP, P, E)
7. Don Equipment - Donned

SCRAMBLE — STARTING ENGINES

① Start Engines - Direct engineer to start engines (P, E)
② Check Hydraulic Pressures - Checked (P, CP)
3. Radio Call - Completed (CP)
  a. Omni, Radio Compass, IFF and SIF On - On (CP)
④ Set Altimeters - Set (P, CP, N)
⑤ Set and Uncage Instruments - Set and uncaged (P, CP)
  ⓐ N-1 Compass - Synchronized (if applicable) (CP, N)
⑥ Engineer's Report - "Starting checklist complete" (P, E)

SCRAMBLE — BEFORE TAXI

① Remove External Power - Removed (if applicable) (P, GC)
② Dismiss Ground Crewman - Dismissed (P, E, GC)
3. Door Warning Light Off - Off (CP)
④ Crew Report - "Ready to taxi" (All)

SCRAMBLE — TAXI

① Check Normal Brakes - Checked (P, CP)
② Check Emergency Brakes - Checked, system recharged (P, CP)
③ Check Instruments - Checked (P, CP)
4. Purge Manifold Pressure Line - Purged 30 seconds (CP)
5. ADI Switch Climatic - Climatic (CP)
⑥ Anti-Icing Equipment Climatic - Climatic (P, E)
⑦ Engineer's Report - "Taxi checklist complete" (P, E)

CUT ON DOTTED LINE

SCRAMBLE — BEFORE TAKEOFF

1. Set Throttle Lock Lever - Set (P)
② Set Wing Flaps - Set 33% (P, CP, BO)
③ Fasten Safety Belts and Shoulder Harness - Fastened (All)
4. Tower Call - Complete (CP)
5. Set TACAN - Set as required (P)
6. Anti-Collision Light ON - ON (CP)
⑦ Close Windows, Hatches and Doors - Closed (P, CP, BO)
8. Pitot Heat Switches ON - ON (P)
⑨ Unlock Flight Controls - Unlocked (P, CP)
⑩ Set Cowl Flaps - Set (P, E)
11. Landing Lights ON - ON (if required) (CP)
⑫ Crew Takeoff Report - Received (All crew members)

PILOTS' DAILY PREFLIGHT

① Form 781 - Checked (P, E, GC)
② Takeoff and Landing Data Card - Checked (P, CP, E)
3. Check Oxygen Pressure - Checked (P, CP)
4. Gear Switch DOWN - DOWN, guard down (CP)
5. Trim Tab Control Wheels - Free
6. Windows, Windshield Wipers - Condition (P, CP)
7. Interphone - Checked (P, CP)
⑧ Flaps Full Down - Down (P)

RADIO PREFLIGHT CHECK

(By CP if no RO)

1. VHF - Checked
2. UHF - Checked
3. Omni - Checked
4. Radio Compass - Checked
5. TACAN - Checked TCTO 572

EXTERIOR INSPECTION (Pilots)

Forward Fuselage and Nose Section

1. Nose Gear (Left and Right Side) (P)
   a. Oleo Strut - Inflation
   b. Tires - Condition
2. Right Static Holes - Unobstructed (P)

Right Wing Section

1. No. 3 Engine and Prop: (P)
   a. Integral Oil Tank - Leakage, drain plug safetied
2. No. 4 Engine and Prop: (P)
   a. Integral Oil Tank - Leakage, drain plug safetied
3. Wing Tip - Condition (P)
4. Lower Wing Surface and Aileron - Condition (P)
5. External Tank and Strut - Condition (P)
6. Anti-Syphon Scoops - Unobstructed (P)
7. Right Wheel Well: (P)
   a. Oleo Strut - Inflation
   b. Tires - Condition
   c. Brake Hydraulic Lines and Fittings - Condition
   d. CO_2 Discharge Indicator Discs - Condition
8. Lower Wing Surface and Fuselage - Condition (P)
9. Right Flap and Flap Well - Condition (P)

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

Aft Fuselage and Empennage Section

1. Empennage - Condition (P)
   a. Vertical and Horizontal Stabilizer and Exhaust Louvers - Condition
   b. Elevator - Condition
   c. Rudder and Tab - Condition
   d. Elevator - Condition
   e. Horizontal and Vertical Stabilizer and Exhaust Louvers - Condition

Left Wing Section

1. Left Flap and Flap Well - Condition (P or CP)
2. Lower Wing Surface and Fuselage - Condition (P or CP)
3. Left Wheel Well : (P or CP)
   a. Oleo Strut - Inflation
   b. Tires - Condition
   c. Brake Hydraulic Lines and Fittings - Condition
   d. CO_2 Discharge Indicator Discs - Condition
4. Lower Wing Surface to No. 1 Engine - Condition (P or CP)
5. Anti-Syphon Scoops - Unobstructed (P or CP)
6. External Tank and Strut - Condition (P or CP)
7. Lower Wing Surface and Aileron - Condition (P or CP)
8. Wing Tip - Condition (P or CP)
9. No. 1 Engine and Prop: (P or CP)
10. No. 2 Engine and Prop: (P or CP)
11. Left Static Holes - Unobstructed (P or CP)
12. Cocking Checklist - Complete (P and CP)

KC-97G
ENGINEER'S CONDENSED ALERT CHECKLISTS

COCKING

1. Master and Battery Switches - As required
2. APU or External Power - Started and on line
3. Essential Inverter Switch - ON
4. Fire Switches - NORMAL
5. Ignition Switches - OFF
6. Overhead Circuit Breakers - Set
7. Radio Rack Circuit Breakers - Set
8. Heater and Deicer Switches - OFF
9. ▼ A/R Panel Master Switch - ON
10. Generator Switches - ON
11. Alternator Switches and Selector - OFF
12. Carburetor Air Switches - Climatic
13. Intercooler Switches - CLOSE and OFF
14. Carburetor Preheat Switches - CLOSE and OFF
15. Cowl Flap Switches - Set (2 inches)
16. Cylinder Head Temperature Selector Switch - A2
17. Oil Cooler Flap Switches - CLOSE and OFF
18. Cabin Pressure Rate-of-Change Selector - MAX
19. Cabin Altitude Selector - Set
20. Cabin Air Selector Valve Switches - NORMAL
21. Turbo Bleed Switches - OPEN
22. Heater and APU Fuel Valve Switch - NORMAL
23. Cabin Heat Control Rheostat - Full COOL
24. Window Heat Selector Switch - OFF
25. Fuel Selector Switches - TE
26. Prop Oil Refill Switches - OFF
27. SPR Test - Valves closed, switch OFF
28. Mixtures - FUEL CUTOFF
29. Throttles - Cracked
30. Prop Synch Lever - Full INCREASE RPM
31. TBS Lever - O

(Cont)

T.O. 1C-97(K)G-1
15 OCTOBER 1959

1

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

COCKING (Cont)

32. Turbo Switches - MAN
33. Turbo Override Switches - OPEN, 10 seconds, then OFF, guards up
34. Prop Governor Selector Switches - Full INCREASE RPM
35. Prop Auto Control Switch - No. 1 or No. 2 MASTER
36. Spark Advance Selector Switches - NORMAL
37. DC Voltmeter Selector Switch - No. 3 engine
38. Engine Starting Selector Switch - No. 3
39. Essential Inverter Switch - OFF
40. Panel Lights - Switch red, rheostat 1/2 position
41. Interphone, VHF, and UHF Circuit Breakers - Pulled
42. APU - OFF
43. Master and Battery Switches - OFF
44. APU Switch - On run position
45. Oil Cooler Flap Switches - AUTO

㊻ Report to Pilot - "Cocking checklist complete" (E,P)

47. Complete Takeoff and Landing Data, and Weight and Balance

SCRAMBLE

SCRAMBLE — BEFORE STARTING ENGINES

1. Ground Heating Equipment and Covers - Removed (as briefed)
2. Battery and Master Switches - ON
   a. Bus Voltage - Checked

③ APU - Start (E, CP)

4. UHF, VHF and Interphone C/B - SET
5. Essential Inverter Switch - ESS. INV
6. Personal Equipment - Don

⑦ Report to Copilot - "Ready to start engines" (E, P)

SCRAMBLE — STARTING ENGINES

1. No. 3 Boost Pump Switch - NORMAL
2. No. 3 Hot Fuel Prime - Climatic

③ Start Engines - Climatic (E, P, GC)

④ Repeat on Remaining Engines as Ground Crewman Clears each Engine in Turn - All steps above (GC)

5. Starter Selector Switch - OFF

⑥ Report to Pilot - "Starting checklist complete" (E, P)

SCRAMBLE — TAXI

① Inverters - ON and voltage checked (notify crew) (E, P, N)
  - a. Autopilot Inverter - AUTO-PILOT INV
  - b. Secondary Inverter - SEC. INV
  - c. Flight Instrument Inverter - PILOTS INSTR INV

▼ 2. A/R Hydraulic Pressure - Checked

3. Air Conditioning Master Switch - ON
4. Alternator Control Switches - ON
5. Analyzer Power Switches - ON
6. Intercooler Flap Switches - Climatic
7. Cabin Pressure Rate-of-Change Selector - SET (As desired for mission)
8. Body Heater Switches - OFF
9. Boost Pump Switches (Main Tanks) - NORMAL
10. Fuel Selector Switches - TE

▼ 11. A/R System - As required
  - a. Engineer's A/R panel in operating position
  - b. Fuel Dump switches cover open
  - c. Isodraulic handle strap unfastened
  - d. A/R system fuel level checked

⑫ Prop Deicing Switch - As required (E, P)

⑬ Window Heat - As required (E, P)

⑭ Surface Anti-Icing Heaters - As required (E, P)

15. Carburetor Air Switches - Climatic
16. Safety Belt and Shoulder Harness - Fastened
17. Engine Pressures and Temperatures - Checked

⑱ Report to Pilot "Taxi checklist complete" (E, P)

T.O. 1C-97(K)G-1
15 October 1959

3

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

SCRAMBLE — BEFORE TAKEOFF

1. Ignition Switches - On BOTH
2. Mixtures - AUTO RICH (locked)
3. Exercise Props - Climatic
4. Prop Synch Lever - Full INCREASE RPM
5. Prop Governor Selector Switches - Full INCREASE RPM
6. Prop Auto Control Switch - No. 1 or No. 2 MASTER
7. Oil Temperature - 65° minimum

⑧ Cowl Flaps - Set (when directed)
⑨ Report to Pilot - "Before takeoff checklist complete, ready for takeoff" (E, P)

ENGINEER'S DAILY PREFLIGHT

1. Starter Selector Switch - OFF
2. Master and Battery Switches - As required
3. APU or External Power - Started and on line
4. Interphone Circuit Breakers - Set

⑤ Engine Hydraulic Lock Check - Crank 8 blades (E, GC)
⑥ Inverters - Normal and Spares - Check output (E, N)

7. Main Tank Fuel Manifold - Pressurized
8. External Tank Lines - Pressurized
9. Fuel Lines, Connectors, and Tanks - Leaks, condition
10. TOLD Card - Recomputed using latest weather information
11. Complete cocking checklist

UNCOCKING

1. Starter Selector Switch - OFF
2. Circuit Breakers - Pulled

T.O. 1C-97(K)G-1
15 October 1959

4

EMERGENCY PROCEDURES

SECTION III

TABLE OF CONTENTS

CREW COORDINATION

An emergency requires the full, coordinated effort of each crew member. Emergency procedures should be practiced at every opportunity so the crew will become proficient in every procedure. A well trained crew will know the problem and if properly indoctrinated, will react correctly and effectively under any condition. The copilot will make all power changes as directed by the pilot during any emergency, except engine separation.

EMERGENCY SIGNALS

If time and circumstances permit, the crew should be advised of the emergency, given instructions, and acknowledgment received, by interphone. (See also BREAKAWAY this Section.)

On The Ground

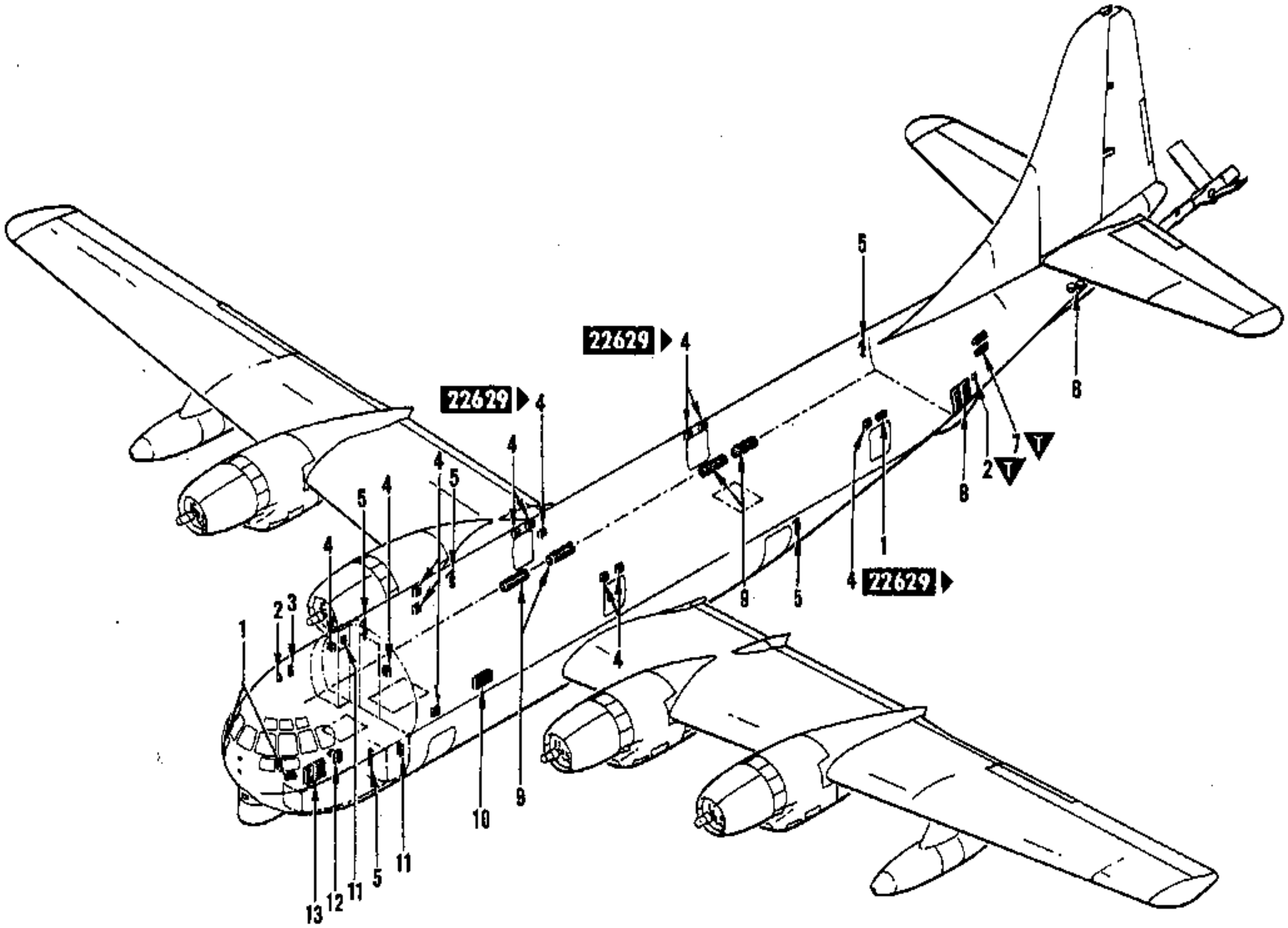
1. Prepare to abandon airplane: Three short rings.
2. Abandon airplane: One long sustained ring.

In The Air

1. Prepare to bail out: Three short rings on the alarm bell.
2. Bail out: One long sustained ring.
3. Prepare for ditching or crash landing: Six short rings on the alarm bell.
4. Ditching or crash landing: One long sustained ring.
5. Ditching or crash landing immediately after takeoff: One long sustained ring.

Use of the following terms in the emergency checklists will be interpreted as follows:

1. Notify: Informing crew orally of an existing or



1 ESCAPE ROPES (2 PLACES)
2 PORTABLE OXYGEN CYLINDER RECHARGER (2 PLACES)
3 PORTABLE OXYGEN CYLINDER
4 FIRST AID KIT (8 PLACES)
5 FIRE EXTINGUISHER (5 PLACES)
6 LANDING FLARES
7 EMERGENCY PANEL (FIRE EXTINGUISHER AND OXYGEN CYLINDER)
8 MISCELLANEOUS EQUIPMENT PANEL (AXE, FIRST AID KIT AND FIRE EXTINGUISHER)
9 LIFE RAFTS (2 PLACES) 3214 ▶ PLUS TCTO K239
10 DINGY RADIOS
11 FIRE FIGHTERS' OXYGEN SETS (2 PLACES) WITH TCTO 566
12 PYROTECHNIC PISTOL AND SIGNAL FLARE
13 PILOT'S AUXILIARY PANEL (AXE, FIRST AID KIT, FIRE EXTINGUISHER, PORTABLE OXYGEN CYLINDER RECHARGER AND PORTABLE OXYGEN CYLINDER)

EMERGENCY EQUIPMENT

Figure 3-1

impending emergency which does not require use of alarm bell signals.

2. Alert: Informing crew orally and by use of alarm bell to indicate necessity of initiating preparatory action for abandonment of the airplane, ditching or crash landing.

3. Warn: Informing crew orally and by use of alarm bell to indicate necessity to execute bail-out or brace for impact.

NOTE

> The urgency of certain emergencies requires immediate and insticitnive action by the aircrew member. These checklist items are depicted in bold print and will be memorized by the appropriate aircrew member. Following the completion of bold print items, the applicable checklist will be completed in its entirety.

BREAKAWAY

The airplane call sign once plus the word Breakaway three times is used to declare an emergency condition in either the tanker or receiver airplane, and may be announced by any crew member in either airplane. At any time "BREAKAWAY" is announced over the radio, the following action will be accomplished immediately by the crew members as listed:

Tanker pilot -- Simultaneously climb straight ahead and increase power as necessary.

Tanker boom operator -- Actuate the disconnect switch on the ruddevator control stick and move boom away from receiver when nozzle is released from receptacle. Boom operator may then stow boom.

Receiver pilot -- Actuate disconnect switch on control wheel and reduce power. Drop down and aft of tanker until entire tanker airplane is in sight and receiver airplane is clear of boom. The receiver pilot should use caution not to overrun the tanker. If overrunning does occur, under no conditions should a turn, either right or left, be made.

Receiver copilot -- Actuate disconnect switch on control wheel and, upon pilot's request, move gear lever to DOWN position to lower gear.

ENGINE FAILURE

FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS

The flight characteristics of the airplane remain excellent even when engine failures occur. Only at maximum power and slower airspeeds does the airplane require a great amount of trim to compensate for the turning action caused by engine failure. Very little trimming of the airplane is needed at cruise power. The rudder boost system when operating enables directional control to be maintained down to minimum control speeds, (figure 3-2) with only light to moderate rudder pedal forces. The airplane is fully controllable with rudder boost off at all takeoff speeds from the unstick point onward except at very light gross weights, but requires considerably higher rudder pedal forces. Aileron control and trim tabs are effective at all times during takeoff and cruise conditions. The most critical time to encounter engine loss is during takeoff after the go-no-go point is reached and a safe stop cannot be accomplished. Directional control must be maintained if a safe takeoff is to be made. Minimum control speed with rudder boost on will generally be lower than takeoff speed if the failed engine can be feathered; however nose wheel steering should be used until positive rudder control is attained.

Symptoms Indicating Engine Failure

Symptoms indicating engine failure include low torque pressure, low fuel flow, decreasing cylinder head temperature, low oil pressure, dropping off of manifold pressure and rpm. Airplane yaw or loss of performance is the primary index of power loss however. See Appendix for recommended cruise procedure for 2 and 3 engine operation.

Control of Yaw

The most adverse conditions for maintaining constant headings occur at low airspeeds with unsymmetrical power. The speeds shown in figure 3-2 are for zero yaw and slight angle of bank required to hold a heading. Lower speeds may be maintained by holding a maximum bank angle of 5 degrees and full rudder with the airplane flying in a yawed attitude. The values shown are for sea level standard conditions, 3500 bhp per engine on the operating engines, and windmilling props on the inoperative engines. Flap position does not affect minimum control speeds. Feathering the inoperative props or decreasing power will reduce the minimum control speeds. The 5 degrees bank conditions reduce the values shown by 5 to 10 knots and feathering by 7 to 10 knots. Normally, flight at the speeds given for minimum control should not occur except at relatively light gross weights during takeoff, approach to landing, or go-around. If cruising speeds are never allowed to fall below best holding speeds, minimum control speeds are no problem in cruise even in emergency conditions.

Reduction of Airspeed

To describe the control problem as airspeed is reduced, zero yaw might be maintained with rudder and aileron applied as necessary to keep the wings almost level, the dead engine side being kept a little high, until a maximum rudder deflection is reached. If further reduction in speed occurs, additional aileron deflection can be used to bring the dead engine side higher, until full aileron deflection is reached. Then, if airspeed is reduced further, the airplane can no longer maintain a constant heading and will turn toward the dead engine side. Some buffeting is to be expected before the minimum control speed is reached, particularly when props are windmilling on the inoperative engines. Under some conditions at the higher weights, stalling speeds may be reached before full deflection of the controls. If control is lost momentarily, while flying in the region of minimum control speeds, it can be regained by differential throttling and increasing airspeed.

ENGINE FAILURE DURING TAKEOFF - TAKEOFF REFUSED

See Abort under TAKEOFF AND LANDING EMERGENCIES this Section.

ENGINE FAILURE/FIRE — TAKEOFF CONTINUED

The following checklist incorporates engine failure, engine fire and cleanup procedures to be followed after go-no-go point has been passed and safe stop cannot be accomplished. The appropriate action will be accomplished depending upon the existing emergency. After the completion of the bold print items for the applicable emergency, the appropriate checklist will then be accomplished which will include the clean-up items.

PILOTS

IF ENGINE FAILURE

①. ***DETERMINE FAILED ENGINE — DETERMINED (P, E)***

Receive engineer's report

2. ***RETARD THROTTLE (AFFECTED ENGINE) — RETARDED (P)***

If engine fails after go-no-go speed is reached and takeoff is to be continued

3. ***FEATHER PROP (AFFECTED ENGINE) — FEATHERED (CP)***

If correct engine has been selected, direct the copilot to push the proper feathering button

(PROCEED TO STEP 4)

ENGINEER

IF ENGINE FAILURE

①. ***FAILED ENGINE — DETERMINE (NOTIFY PILOT) (E, P)***

Use instruments, particularly torque meter, to assist pilot; report to pilot

2. ***MIXTURE (AFFECTED ENGINE) — FUEL CUTOFF***

(PROCEED TO STEP 3)

PILOTS

IF ENGINE FIRE

① ***DETERMINE FIRE LOCATION — DETERMINED (P, E, BO)***

To preclude premature action in the event of a malfunctioning or defective engine fire warning system, the pilot should, if circumstances permit, cross-check with the engineer for engine instrument indications and with aft compartment crew members for visual indications

② ***GANG BAR AFFECTED ENGINE — GANG BARRED (P, E)***

If fire exists direct engineer to gang bar affected engine

③ ***RELEASE CO_2 — RELEASED (P, E)***

Direct engineer to discharge CO_2 as necessary. If fire still exists after all CO_2 has been expended, dependent upon conditions the pilot must decide whether to abandon the airplane, crash land or attempt to land on the airfield

ENGINEER

IF ENGINE FIRE

① ***FIRE LOCATION — DETERMINE (NOTIFY PILOT) (E, P, BO)***

② Affected Engine - Gang Bar (when directed) (E, P)

a. Mixture (affected engine) - FUEL CUTOFF

ⓑ CO_2 - Release (when directed) (E, P)

............................ENGINE FAILURE/FIRE — TAKEOFF CONTINUED............................

4. ***GEAR UP — UP (CP)***

Direct copilot to retract gear when airplane is definitely airborne

⑤ ***DUMP FUEL — DUMPED (P, E)***

Direct engineer to dump fuel if performance is critical

6. ***JETTISON TANKS — JETTISONED (IF NECESSARY) (P)***

NOTE

If the external wing tanks are less than half full they may strike and cause some damage to the flaps, if extended.

③ A/R Fuel - Dump (if directed) (E, P)

ENGINE FAILURE/FIRE — TAKEOFF CONTINUED (Cont)

PILOTS

CLEAN-UP

7. Wing Flaps Up - UP (CP)

Direct copilot to retract flaps when reaching minimum flap retraction speed. For flight path clearance, see Appendix I.

NOTE

- In event unusual roll attitude of airplane is encountered during flap operation, immediately correct with aileron control and simultaneously return flaps to a symmetrical position.
- Check for synchronization of wing flap position pointers; if pointers get out of synchronization, immediately move wing flap switch to opposite position until the pointers are again synchronized, then move switch to OFF.

8. Maintain Best Three Engine Climb Speed - Maintained (P)

Maintain maximum power until best 3 engine climb speed is attained.

⑨ Power as Required - As Required (P, E)

10. Notify Crew of Emergency - Notified (P)

⑪ Complete Engine Shut-down Clean-up - "Complete Engine Shut-down Clean-up" (P, E)

12. ADI Off - OFF (CP)

⑬ Engineer's Report - "Engine Shut-down Complete" (P, E)

ENGINEER

④ Power - Set (when directed) (E, P)

⑤ Engine Shut-down Clean-up - Complete (when directed) (E, P)

See engine shutdown cleanup this Section.

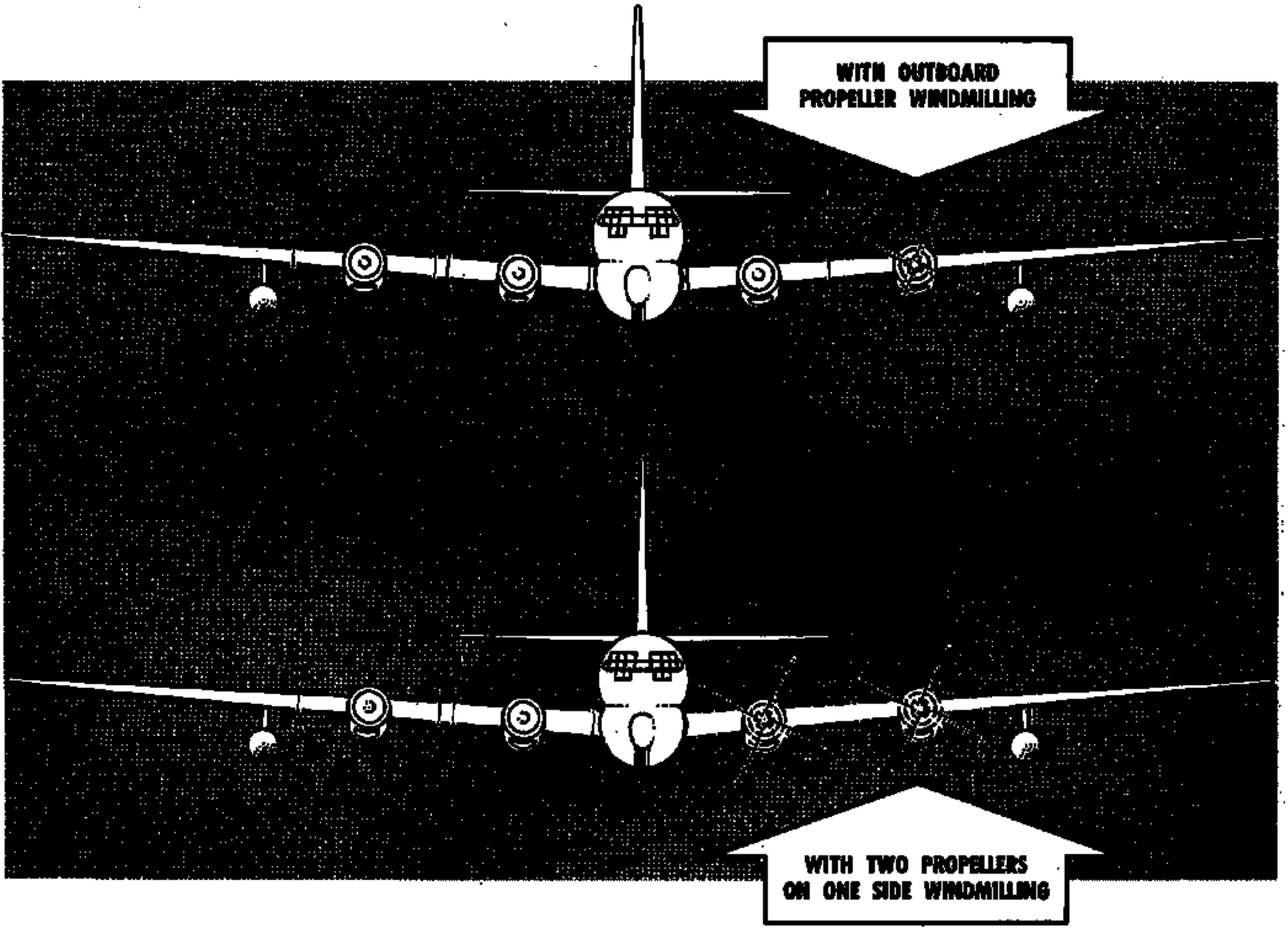
CAUTION

Do not restart engine until cause of failure has been determined and corrected.

TO MAINTAIN DIRECTION

You Need These Speeds:

Rudder Boost ON — 95 knots
Rudder Boost OFF — 125 knots



Rudder Boost ON — 120 knots
Rudder Boost OFF — 165 knots

NOTE
See FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS for detailed information

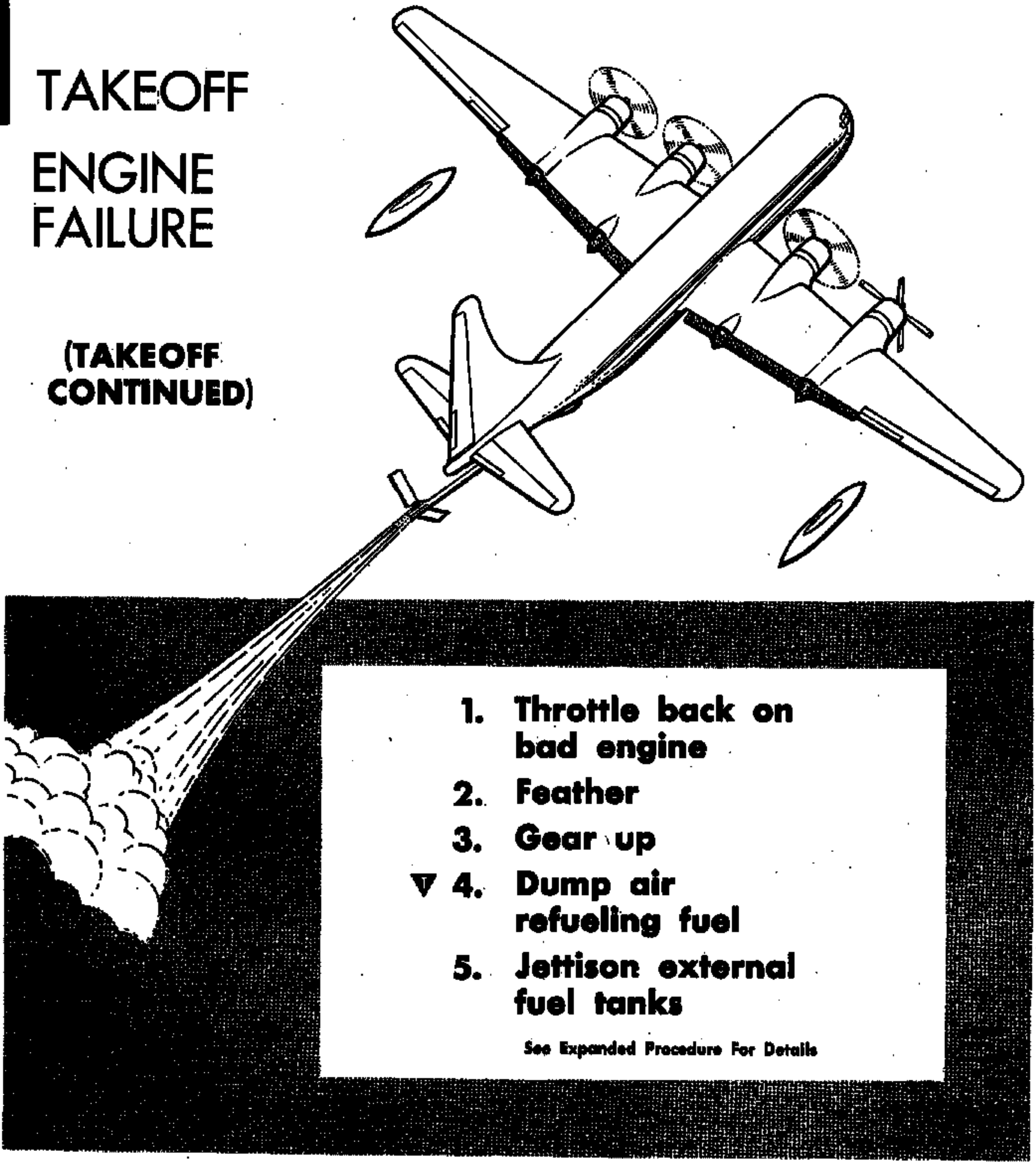
MINIMUM CONTROL SPEEDS

Figure 3-2

TAKEOFF

ENGINE FAILURE

(TAKEOFF CONTINUED)



1. **Throttle back on bad engine**
2. **Feather**
3. **Gear up**
4. ▼ **Dump air refueling fuel**
5. **Jettison external fuel tanks**

See Expanded Procedure For Details

TAKEOFF ENGINE FAILURE PROCEDURE

Figure 3-3

ENGINE FAILURE DURING FLIGHT

PILOTS

① ***DETERMINE FAILED ENGINE — DETERMINED (P, E)***

Receive engineer's report and disengage autopilot clutch

2. ***RETARD THROTTLE (AFFECTED ENGINE) — RETARDED (P)***

3. ***FEATHER PROP (AFFECTED ENGINE) — FEATHERED (CP)***

If correct engine has been selected, direct the copilot to push the proper feathering button

NOTE

The prop can also be feathered by actuation of the fire gang switch; however, since this switch also actuates the oil shutoff valve, its general use is not recommended unless fire is present.

4. Rudder Boost On - ON (P)

⑤ Power as Required - As required (P, CP, E)

Copilot will make power settings as required. Insure that engineer reports out of spark advance prior to changing power

6. Notify Crew - Notified (P)

⑦ Jettison Cargo and Fuel - Jettisoned (P, E, BO)

Have crew jettison cargo and engineer dump fuel if performance is critical

⑧ Complete Engine Shutdown Clean-Up - "Complete Engine Shutdown Clean-Up" (P, E)

9. Autopilot as Required - As required (P)

⑩ Power as Required - As required (P, E)

Request engineer to adjust power on remaining engines as required

⑪ Engineer's Report - "Engine Shutdown Complete" (P, E)

ENGINEER

① ***FAILED ENGINE — DETERMINE (NOTIFY PILOT) (E, P)***

Use instruments, particularly torque meter, to assist pilot; report to pilot

2. ***MIXTURE (AFFECTED ENGINE) — FUEL CUTOFF***

③ ***IF IN SPARK ADVANCE (E, P)***

   a. ***MIXTURE (ALL OTHER ENGINES) — AUTO LEAN***

   b. ***SPARK ADVANCE SELECTOR SWITCHES — NORMAL (ALL ENGINES)***

   c. ***MIXTURES — AUTO RICH (ALL OTHER ENGINES)***

   Notify pilot when out of spark advance

④ Fuel - Dump (when directed) (E, P)

See FUEL DUMPING this Section

⑤ Engine Shutdown Clean-Up - Complete (when directed) (E, P)

See engine shutdown clean-up in this Section

⑥ Power - Set (when directed) (E, P)

CAUTION

Do not restart engine until cause of failure is determined and corrected.

ENGINE SHUT-DOWN CLEANUP

ENGINEER (Only)

1. If Master Prop Feathered:

   Indicated by a slight rpm drop on remaining engines

   a. Auto Control Switch - Other Position

   b. Resynchronizer Switch - Actuate (momentarily)

2. Governor Selector Switch - DECREASE RPM (feathered Propeller)

   Hold until the RPM limit light indicates the low rpm limit

3. Boost Pump Switches - OFF (or as required)
4. Fuel Selector Switch - As required
5. Generator Switch(es) - OFF
6. Alternator Switch (if applicable) - OFF
7. Turbo Bleeder Switch - CLOSED
8. When Engine has Cooled Sufficiently:

   a. Oil Cooler Flaps Switch - CLOSE then OFF

   b. Cowl Flaps Switch - SET (3/4 inches)

   c. Intercooler Flaps Switch - CLOSED

9. Ignition Switch - OFF
10. Throttle - OPEN (full forward)
11. Turbo Switch - MAN
12. Turbo Override Switch - OPEN (10 seconds then OFF)
13. Select Direction Valve Switch - NORMAL

⑭. Report to Pilot - "Engine Shut-Down Complete" (E, P)

RESTARTING ENGINE DURING FLIGHT

CAUTION

Do not restart an engine unless it can be determined that it will be safe to do so.

PILOTS

①. Restart Engine - "Restart Number _____" (P, E)

Direct engineer

ENGINEER

①. Restart Engine Procedure - Commence (when directed) (E, P)

PILOTS

2. Reduce Airspeed - Reduced (160 knots IAS) (P)

   The airspeed should be reduced prior to unfeathering the prop to minimize the possibility of prop overspeeding

③ Receive Engineer's Report - Received "Ready to Unfeather" (P, E)

4. Pull Out Feathering Button - Pulled Out (CP)

   Pull out feathering button until rpm rise is observed

ENGINEER

2. Gang Bar Switches - NORMAL

③ Hydraulic Lock - Check (8 blades) (E, BO)

   Crank engine through continuously for a count of 8 blades to check for hydraulic lock

4. Throttle (affected engine) - Close (to approximately 1/2 inch open)

   CAUTION

   Adjust throttle cautiously to avoid engine back-fire which can cause damage to the engine.

5. Governor Selector Switch (feathered prop) - DECREASE RPM

   Hold until RPM limit light indicates the low rpm limit

6. Turbo Switch - MAN

7. Turbo Override Switch - OPEN (guard down)

8. Turbo Calibrating Knob - Full counterclockwise

9. Fuel Selector Switch - TE

10. Boost Pump Switch - NORMAL (at least one)

11. Oil Cooler Flap Switch - AUTO

12. Ignition Switch - BOTH

⑬ Report to Pilot - "Ready to Unfeather (E, P)

   CAUTION

   Watch for oil pressure rise and if no rise re-feather the prop.

14. Mixture - AUTO RICH (at 800 rpm)

   NOTE

   Advance throttle enough to get a positive reading on the torque meter to insure the engine is running.

RESTARTING ENGINE DURING FLIGHT (Cont)

PILOTS	ENGINEER
	15. Warm up Engine - As required (at 1400 rpm with appropriate MP)
	16. Cowl Flaps - Set as required
	17. Intercooler Flaps - Set as required
	18. When Operating Oil Temperature is reached:
	a. Turbo Switch - AUTO
	b. RPM and Throttle - Increase slowly to desired power
	c. Turbo Calibrating Knob - Turn clockwise to desired manifold pressure
	d. Prop Resynchronizer Switch - RESYNC (momentarily)
	19. Turbo Bleeder Switch - Check OPEN
	20. Generator Switches - ON
	21. Alternator Switch (if applicable) - ON
⑤ Engineer's Report - "Restarting Engine Checklist Complete" (P, E)	㉒ Report to Pilot - "Restarting Engine Checklist Complete (E, P)

FUEL PRESSURE DROP – ENGINE OPERATING NORMALLY

ON THE GROUND

If the fuel pressure drops below the minimum operating limits during ground operation, but the engine continues to operate normally, stop the airplane, set the select direction valve switch to FIRE. Shut-down immediately. Do not takeoff, investigate the cause and have it corrected.

IN THE AIR

If the fuel pressure drops below the minimum operating limits during flight, but the engine continues to operate normally, the cause may be one or more of the following: an instrument failure, clogged pressure lines, or a fuel leak. All applicable fuel systems and engine instruments should be checked for any signs of irregular indications. All applicable main and air refueling system switches, circuit breakers, and valves should be visually checked for correct position.

NOTE

> If this does not correct the trouble, the following possible course of action, of which course No. 1 is generally the best, will depend upon the prevailing circumstances. Such factors as the known condition of the airplane, the remaining engines, stage and requirements of the mission, and power requirements should all be considered.

1. Shut-down the engine, if it is not needed to sustain flight or to reach a destination safely, by placing the mixture lever in the FUEL CUTOFF position and complete the ENGINE FAILURE DURING FLIGHT checklist.
2. Continue the engine in operation at or above cruising speed while maintaining a fire watch if the engine is needed to sustain flight or to maintain altitude, and it cannot be determined if an actual leak exists. However, prior to power reduction for entrance to the landing pattern, shut-down the engine by placing the

mixture lever in the FUEL CUTOFF position if the engine is not absolutely essential to affect a safe, partial power, landing.

3. Continue the engine in normal operation if a fuel line failure check as outlined in TO CHECK A SUSPECTED LEAK IN THE AIRPLANE FUEL SYSTEM this Section, indicates no fuel leak present.

LANDING WITH ONE OR MORE ENGINES INOPERATIVE

One Engine Inoperative

If an inboard engine is inoperative, no rudder trim will be required. However, if an outboard prop is feathered some trim will be required. It is important to note that with an outboard engine windmilling, a minimum of 95 knots IAS with rudder boost on, or 125 knots IAS with rudder boost off, is required to maintain control.

Two Engines Inoperative

With two engines windmilling on one side the situation becomes much more critical. A minimum of 120 knots IAS is required with rudder boost on and 165 knots IAS with rudder boost off in order to maintain a heading. With symmetrical engines inoperative, control is not affected; however, when both inboard engines are inoperative, the engine driven hydraulic pumps will not be operating. In this connection, with the two inboard props feathered, several brake applications will be available from the service brake system after landing if the brake pedals, rudder boost and windshield wipers are not used after engine failure. On airplanes incorporating TCTO 541, only two full brake applications are available. The hand pump may be used to maintain pressure in the service brake system, or emergency brake system if the depressurization and emergency charging valve handle is in the EMERGENCY BRAKE CHARGING position.

Approach

If one engine is inoperative make a normal approach at normal airspeeds. If two engines are inoperative make the approach slightly higher than normal, with airspeeds 10 knots higher than normal approach speeds. Use the normal DESCENT and BEFORE LANDING checklist keeping in mind that one or more engines are inoperative and that the landing gear will be lowered on final approach when certain the field can be reached.

Landing At A High Gross Weight

Every attempt consistent with safety, should be made to lighten the airplane when a landing is to be made at a high gross weight (see Section V.). Each crew membe will be in his crash landing position. The rescue facilities will be alerted. Make the airplane touchdown a smooth and light as possible.

GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE

The procedure for GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE is the same as the GO-AROUND procedure for all engines operative given in Section II, except flaps may be retracted at minimum flap retraction speed. Directional control may be maintained by use of rudder trim at pilot's discretion.

CAUTION

> Generally it is not considered feasible to attempt a two engine go-around when the flaps are full down and the weight is above 130,000 pounds gross. 500 feet of altitude can easily be lost during the period after the go-around decision has been made and the airplane is being changed from approach to climbout configuration and attitude. The decision to go-around should be made before descending to 500 feet if possible, as the altitude lost may cause the airplane to settle in. When weighing the possibilities for go-around in terms of altitude, airspeed, gross weight, airplane configuration, wind conditions, runway facilities and visibility, the pilot should always consider the advantages of a controlled crash landing as against an unsuccessful go-around, especially if airplane performance is critical or altitude is marginal (about 500 feet or less above the ground).

TAKEOFF WITH ONE ENGINE INOPERATIVE

This type takeoff is not recommended, but may be accomplished in extreme emergency. Refer to the appendix for information on takeoff distance with one engine inoperative. To make the takeoff, hold the brakes and establish maximum power on symmetrical engines. Release the brakes and use nose wheel steering for directional control. As the rudder begins to take effect begin to increase power on the other operating engine, up to maximum power as soon as the rudder can be used to offset the unsymmetrical thrust. Retract the gear when safely airborne and use rudder trim as required.

PRACTICE OF EMERGENCY PROCEDURES

Emergency flight procedures will be demonstrated or practiced only under the safest operating conditions and strictest control. No emergency procedures will be practiced during adverse weather, darkness, or hen runway conditions are below maximum safety onditions. An adequate airspeed and altitude will be etained throughout the practice maneuver in case an ctual emergency should develop. A simulated field levation will be set up as a base point and traffic atterns flown at the normal altitude above the base oint. 5000 feet above the terrain is the minimum ltitude for the demonstration or practice of all unusual maneuvers and emergency procedures except the PRACTICE TAKEOFF ENGINE FAILURE and LANDING AND GO-AROUND procedures. Descents below the published GCA minimum altitudes will not be made during LANDING AND GO-AROUND practice maneuvers. Simulated emergency landings and takeoffs will be made only when a fully qualified instructor pilot has immediate access to the controls. The airplane commander will direct the copilot to alert all crew members prior to practice maneuvers to be especially watchful during the entire period.

Practice Maneuvers With One Or More Engines Inoperative

Retarding the desired throttle or throttles to 15 inches MP will simulate prop feathered condition. Retarding the desired throttle or throttles to idle will simulate a windmilling prop.

CAUTION

Although the above conditions will approximate the drag of an engine failure, they may cause engine bearing damage. In order to minimize engine bearing damage the throttle or throttles should be advanced as soon as corrective action has been initiated because lubricating oil flow to the bearing is virtually cut off by reverse bearing loading. Manifold pressure of less than 1 inch per 100 rpm will cause engine bearing damage. The longer the engine is operated at low power and high rpm the greater will be the extent of the bearing damage. Also the lower the manifold pressure and the higher the rpm the more the damage.

The checklist procedure for engine failure may be accomplished by touching the controls without actually completing the operation called for.

WARNING

During takeoff or while airborne, do not, except in an emergency and then only with extreme caution, move any engine throttle back into the idle range unless the reverse pitch warning flag shows the word LOCKED and the throttle reverse lock plate is closed.

REQUIRED POWER SETTINGS. If nature of flying conditions in descent requires a large reduction in power, reduce rpm as well as manifold pressure. For descents or other low power maneuvers, or perhaps a simulated engine failure, it is important to cushion the high inertia loads on the master rod bearings which occur at conditions of high rpm and low manifold pressure. As a rule of thumb, it is well to remember that each hundred rpm requires at least one inch Hg manifold pressure. For example, 23 in. Hg at 2300 rpm. Operation at high rpm and low manifold pressure should be kept to a minimum.

PRACTICE TAKEOFF ENGINE FAILURE. If the engine failure is simulated, use rudder and ailerons to maintain directional control. Use trim tabs to reduce control forces during climbout. Climb out at 3 engine climb speed for 33-1/3 percent flap. Raise the wing flaps when a safe airspeed and altitude are reached. Do not hurry wing flap retraction as the airplane will climb easily gaining altitude smoothly and rapidly.

TURNS WITH ENGINE FAILURE. After the airplane is trimmed for inoperative engine practice try some turns. Turns may be made safely in either direction if sufficient airspeed is maintained. Any varying of airspeed will change the effect of the trim and make handling of the airplane during the turn more difficult.

EFFECT OF PROP PITCH ON TRIM. To determine the drag effect of an unfeathered prop, retard two throttles on one side to 25 inches MP and set the prop blades for those engines to a higher pitch position using manual decrease rpm. Trim the airplane for this condition. Now change the prop pitch, on the engines throttled back, to a lower pitch position (2500 rpm). As the blade angle flattens out the drag on that side of the airplane will increase, upsetting the trim and causing the airplane to turn into the throttled engines. Return the prop controls to the full decrease rpm position and the airplane will level out.

EFFECT OF SPEED ON TRIM. Retard the throttle of an outboard engine and trim the airplane for a constant airspeed condition. Take feet off the rudder pedals and ease the control column back. As the speed decreases note that the preset trim loses effect and the airplane begins to turn into the throttled engine. Push the control column forward past the neutral position. As the airspeed builds up to a higher value than that at which the trim was preset, the airplane will begin to turn in the opposite direction as the trim effect increases.

EFFECT OF POWER REDUCTION ON TRIM. Retard two throttles on one side to 30 inches MP. Trim the airplane for this condition. With feet off the rudder pedals, ease the control column back. As the speed decreases the airplane will turn into the throttled engines. Counteract this condition by retarding the throttles of the operating engines slowly. Direction can be maintained by this means up to the stall buffet region.

PRACTICE LANDING AND GO-AROUND. Landings and go-arounds under inoperative engine conditions may be simulated at altitude by flying a traffic pattern over a basic landing altitude. If any altitude is lost gain it back on downwind leg, but never at the expense of airspeed. Roll out most of the trim as touchdown point is reached. During go-around practice, note the altitude lost between the time you decide to go-around and the time you are safely in a climb condition. Try a simulated go-around from a point 50 feet above simulated touchdown with the airspeed 20 knots above stalling speed. Determine whether a go-around under these conditions can be made without losing the 50 feet. Note airplane acceleration characteristics during the simulated go-around.

PROPELLER FAILURE

The 34G60 solid Dural Prop is a hydromechanical design in which oil pressure opposes the inherent tendency of the blades to rotate to flat pitch. If the pitch lock is effective, movement to flat pitch, due to loss of governing, will be retarded above 2600 rpm and essentially stopped at 3100 rpm. Over-speeds above 3100 rpm then indicate leakage in the dome assembly which will make feathering difficult if not impossible. As rpm increases the blade twisting forces also increase until at 3800 rpm maximum available oil pressure is required for control. At higher rpm, feathering cannot be accomplished since available oil pressure is limited. A leak in transfer passages or dome assembly may further limit available oil pressure, thereby reducing the rpm at which feathering will occur. Therefore, every safe means of reducing prop overspeed must be used to bring the rpm back to a controllable range.

PROP OVERSPEED ON TAKEOFF

If an overspeed occurs during takeoff, the first decision required is whether to continue or abort. If the blades are at mechanical low pitch stop, as indicated by less than 3300 rpm with full power, an airplane control problem is not indicated and some power may be obtained from the engine at reduced throttle setting. I this case, continuing the takeoff may be preferred to last minute abort with unsymmetrical reversing a possibility. However, when operating from long runways this airplane may be capable of safely stopping in th remaining distance, even after the normal decision poin is passed. In any case of prop control loss, an abort i justified and a safe stop is preferred to continuing the takeoff. A prop with the pitch lock engaged (3100 rpm) can possibly be reversed and should be used if required to effect a safe stop. In the event of governor failure, the prop blade angle is limited by the pitch lock or low pitch stop so that some power may be obtained from the engine.

WARNING

When takeoff performance is critical, it is recommended that the prop be permitted to overspeed allowing pitchlock to engage (approximately 3100 RPM). On climbout, rpm will increase approximately 50 RPM with each 10 knots increase in IAS. No attempt should be made to reduce RPM with throttle prior to pitch lock engaging since a relatively ineffective flat blade angle at reduced throttle will result.

PROP RUNAWAY ON TAKEOFF

A flat pitch runaway prop has never been known to occur on this airplane and such an occurrence is considered extremely remote. However, if it does, the power off windmilling drag will make flight virtually impossible. The takeoff should be aborted if possible. If rpm is observed to be increasing rapidly above 3500 rpm, step 3 of the following procedure should be performed immediately. This step which combines feathering and engine freezing action will probably result in prop separation, will provide the only chance of regaining control of the airplane.

PROP OVERSPEED/RUNAWAY — TAKEOFF CONTINUED

The following procedure applies when overspeed occurs beyond the point of safe stoppage and the takeoff must be continued.

PILOTS

1. *RETARD THROTTLE (AFFECTED ENGINE) — RETARDED TO 2900 (P)*

   After pitch lock has engaged (3100 rpm) maintain 2900 rpm and land as soon as possible.

2. *FEATHER PROP (AFFECTED ENGINE) — FEATHERED (CP)*

   If retarding throttle is ineffective and rpm is below 3500, rpm may be reduced by intermittent (one second) application of the feathering button until rpm is reduced to 2700

CAUTION

- Do not pull out feathering button beyond neutral position to unfeathering position.
- If rpm is above 3500 direct copilot to push the proper feathering button and hold it in.

③ *GANG BAR AFFECTED ENGINE — GANG BARRED (DIRECT ENGINEER IF RPM INCREASES RAPIDLY ABOVE 3500) (P, E)*

If prop control cannot be regained by use of throttle or intermittent feathering and if prop cannot be fully feathered, gang barring which includes engine freezing and probable prop separation will provide the only chance of reducing drag in time to avoid an uncontrolled crash

4. *GEAR UP — UP (CP)*

   Direct copilot to retract gear when the airplane is definitely airborne

⑤ *DUMP FUEL — DUMPED (P, E)*

Direct engineer to dump fuel if performance is critical

ENGINEER

1. *SIMULTANEOUSLY:*
   - a. *PROP OIL — REPLENISH*
   - b. *GOVERNOR SELECTOR SWITCH — DECREASE RPM (NOT BELOW 2700)*
   - ⓒ *PILOT — NOTIFY (E, P)*

     Notify pilot if rpm can or cannot be decreased

② Affected Engine - Gang Bar (when directed) (E, P)

3. Mixture (Affected Engine) - FUEL CUTOFF (After prop is feathered)

④ Fuel - Dump (when directed) (E, P)

PILOTS

6. ***JETTISON TANKS — JETTISONED (IF NECESSARY) (P)***

NOTE

If the external tanks are less than half full they may strike and cause some damage to the flaps, if extended.

....................CLEAN-UP....................

7. Wing Flaps Up - UP (CP)

Direct copilot to retract flaps when reaching minimum flap retraction speed. For flight path clearance see Appendix

NOTE

- In the event unusual roll attitude of airplane is encountered during flap operation, immediately correct with aileron control and simultaneously return the flaps to a symmetrical position.
- Check for synchronization of wing flap position pointers; if pointers get out of synchronization, immediately move wing flap switch to opposite position until the pointers are again synchronized; then move switch to OFF.

8. Maintain Best Three Engine Climb Speed - Maintained (P)

Maintain maximum power until best 3 engine climb speed is attained

⑨ Power as Required - As required (P, E)

10. Notify crew of Emergency - Notified (P)

⑪ Complete Engine Shut-Down Clean-Up" (P, E)

Direct Engineer

12. ADI Off - OFF (CP)

⑬ Engineer's Report - "Engine Shutdown Complete" (P, E)

ENGINEER

⑤ Power - Set (when directed) (E, P)

CAUTION

Reduce rpm on the three engines not affected by overspeed, with prop governor selector switch. Reduce rpm on engine with malfunctioning prop with throttle, to not less than 1 inch manifold pressure per 100 rpm. Reducing rpm below 2550 on affected engine with either feathering button or manual decrease switch may unseat the flyweight valve and cause a secondary overspeed.

⑥ Engine Shut-Down Clean-Up - Complete (when directed) (E, P)

ENGINE FREEZING

Engine freezing is a hazardous undertaking at best and must be considered a last resort measure only. It should be noted that freezing does not reduce drag below that of a windmilling (against low pitch stop) prop. Unfortunately, the 34G60 Dural prop will generally separate from the airplane when rapid freezing is attempted at high rpm. As a result, a runaway prop has become a serious emergency. However, freezing with Dural props has been accomplished at low rpm. Some reasons for freezing might be:

1. Unbalance from cuff or tip damage.
2. High rate of oil loss.
3. Continued high speed windmilling may cause ultimate seizure after more nose section heating has been realized.

The decision to freeze and the manner in which it is to be accomplished must be made by the airplane Commander. If the decision is made to freeze the engine, the following procedures are recommended, which utilize successful past experience to provide the best means for controlling the 34G60 Dural Prop.

1. Use intermittent freezing to reduce rpm.
2. Complete the process by continuous freezing before nose heating makes separation imminent.

PROPELLER OVERSPEED DURING FLIGHT

When flying at high altitude or airspeed, an overspeeding prop which does not exceed 3300 rpm indicates the pitch lock is effective and feathering should be possible. Maximum potential of the pitch lock is obtained by causing the prop to lock in as high a blade angle as possible. This is done by maintaining power until the pitch lock engages or 3300 rpm is reached. The pilot should be ready to immediately reduce power if the pitch lock is not effective. If the pitch lock is effective, limited operation in fixed pitch may be used in an emergency. However, this is beyond the normal design intent of the pitch lock which will slowly leak and increase rpm. It is preferable to feather the defective prop while it is still in the controllable speed range.

PROP RUNAWAY DURING FLIGHT

In this case, loss of oil pressure from the dome or transfer area is indicated by failure of the pitch lock. Primary emphasis must be given to rpm reduction to effect feathering. Complete engine shut-down, airspeed and altitude reduction will materially aid in regaining prop control. Figure 1A7-2 indicates the effect on rpm. Minimum airspeeds and maximum rates of descent are obtained with extended wing flaps. The amount of flap extension used depends on minimum control speed, terrain clearance or weather problems. Windmilling speeds with extended wing flaps can be as much as 800 rpm less than with the flaps up, which may make feathering possible.

PROP OVERSPEED/RUNAWAY DURING FLIGHT

PILOTS	ENGINEER
	1. *SIMULTANEOUSLY:* a. *PROP OIL — REPLENISH* b. *GOVERNOR SELECTOR SWITCH — DECREASE RPM (NOT BELOW 2700)*
1. *RETARD THROTTLES — RETARDED (P)* NOTE ● At low altitude, retard the throttle for the affected prop only. ● During A/R, simultaneously execute the BREAKAWAY procedure and retard the throttle for the affected prop only. After attaining vertical separation, retard remaining throttles, if necessary.	

PILOTS

2. ***REDUCE AIRSPEED — REDUCED (TO MINIMUM) (P)***

Reduce to minimum consistent with safe flight, approximately 20 knots above stall speed. Flaps should be lowered to obtain minimum safe flight, (55%) if the IAS is below the placard flap extension speeds

③ ***RECEIVE ENGINEER'S REPORT — RECEIVED (P, E)***

If engineer has regained prop control, terminate the overspeed procedure and closely monitor affected prop. If pitch lock has engaged, refer to continuous operation in fixed pitch

4. ***RPM ABOVE 3300 (RUNAWAY)***

ⓐ ***MIXTURE LEVER (AFFECTED ENGINE) — FUEL CUTOFF (P, E)***

Direct engineer

b. ***FEATHER PROP (AFFECTED ENGINE) — FEATHERED (CP)***

Direct copilot to depress the feathering button

c. Initiate Descent - Initiated (P)

If the prop cannot be feathered and descent is practical, descend to a lower altitude at minimum airspeed as a denser air will help reduce the windmilling rpm. Extension of the landing gear will permit a more rapid descent

d. Feather Prop (Affected Engine) - Feathered (hold in) (CP)

Direct copilot to depress feathering button and hold in

4. RPM Below 3300 (Overspeed)

a. Use Intermittent Feathering Action - Intermittent Feathering (to 2700) (CP)

If maximum power is required and engineer reports that he cannot reduce rpm with prop governor selector switch, rpm may be decreased by intermittent (one second) applications of the feathering button until rpm is reduced to 2700. If pitch lock has engaged refer to CONTINUOUS OPERATION in FIXED PITCH

ENGINEER

ⓒ ***PILOT — NOTIFY (E, P)***

Notify pilot if rpm can or cannot be decreased

②Mixture Lever (affected engine) - FUEL CUTOFF (when directed) (E, P)

ROP OVERSPEED/RUNAWAY DURING FLIGHT (Cont)

PILOTS

5. Notify Crew - Notified (P)

6. Continuous Operation in Fixed Pitch

WARNING

- Operation in pitch lock is considered to be an emergency condition. Feather engine (if possible) and land at nearest suitable airfield.

- If an overspeed occurs after an oil refill light that cannot be extinguished, continuous operation in pitch lock should only be attempted in extreme emergencies.

    a. Retard Throttle to 2550 - Retarded (2550) (P)

    b. Decrease Airspeed/Altitude - Decreased (P)

    Decrease airspeed and altitude as necessary to set up desired manifold pressure and rpm balance

⑦ Complete Engine Shut-Down Clean-Up - "Complete Engine Shut-Down Clean-Up" (if required) (P, E)

⑧ Power As Required - As required (P, E)

⑨ Engineer's Report - "Engine Shut-Down Complete" (if required) (P, E)

ENGINEER

③ Engine Shut-Down Clean-Up - Complete (when directed) (E, P)

See Engine Shut-Down Clean-Up this Section

④ Power - Set (when directed) (E, P)

PROP REVERSAL DURING FLIGHT

If a prop reverses in flight, the windmilling drag will be similar to a low pitch stop forward windmilling prop. If reversal was due to inadvertent crew action, it should be returned to forward pitch by feathering. If due to control failure, there is danger of going to flat pitch on the recovery attempt. It may be best to cut the engine with the mixture lever and hold the prop in reverse by reverse idle throttle. The engine turning backward will probably freeze due to oil pump reverse running. Windmilling rpm can be controlled by slow airspeed, low altitude, and possibly by toggling minimum rpm on the prop. Land as soon as possible.

CONTINUOUS OPERATION IN FIXED PITCH

Manifold pressure should not be decreased to less than one inch per 100 rpm. During fixed pitch operation with constant manifold pressure and altitude, a reduction of 10 knots IAS will reduce engine speed approximately 50 rpm. A reduction of altitude will allow an increase in manifold pressure at a given rpm during fixed pitch operation with constant airspeed. Internal seal leakage should be anticipated during constant operation in fixed pitch. This is indicated by a gradual increase in rpm with a constant airspeed, altitude and throttle setting.

NOTE

If feathering action is available, pitch may be increased to produce the desired power condition by the following sequence:

1. Increase engine speed with throttle to 2800 rpm.
2. Decrease rpm to 2700 with intermittent (one second) applications of the feathering button.
3. Repeat Steps 1 and 2 above until a power setting of 50 inches of manifold pressure and 2700 rpm is obtained.
4. Retard throttle to desired rpm for cruise.

WARNING

Operation in pitch lock is considered to be an emergency condition. A landing should be made at the nearest suitable airfield.

INADVERTENT PITCH LOCK

Inadvertent pitch lock can occur during go-arounds or other maneuvers in which rapid throttle advancement is made causing engine overspeed. This will be evident if rpm follows throttles when meto power is set or further power reductions are made.

Climb to 1500 feet above terrain and use the following procedures to reset bleed valves:

ENGINEER (Only)

1. Affected Engine
   a. RPM - Reduce to 1500
   b. RPM - Return to 2550
   c. Throttle - Retard 10 Hg

   If RPM does not follow bleed valves have been reset.
2. Step 1 - Repeat on remaining engines

ENGINE SEPARATION DURING FLIGHT

In the event an engine is separated from the airplane without warning, it is recommended that the following procedure be used:

WARNING

Switches and controls (except CO_2) for the separated engine or engine with nacelle explosion or fire should not be operated except to turn off equipment. Action to the contrary may cause the entire circuit to be shorted out, causing loss of controls to good engines.

PILOTS

① ***GANG BAR (AFFECTED ENGINE) — GANG BARRED (P. E)***

Direct engineer

ENGINEER

① Affected Engine - Gang Bar (when directed) (E, P)

For nacelle of missing engine

ENGINE SEPARATION DURING FLIGHT (Cont)

PILOTS	ENGINEER
2. ***RUDDER BOOST SWITCH ON — ON (P)*** NOTE Do not hesitate to use full available travel of these control surfaces even though considerable buffeting is experienced. Vibration from tail buffeting is not of a nature or magnitude to cause failure of any primary structure essential to continued flight of the airplane.	
③ ***RPM 2500 (REMAINING ENGINES) — DIRECT ENGINEER RPM 2550 (P, E)*** NOTE This step is included so manifold pressure can be immediately increased or reduced as required. In addition a power reduction on the clean side will be accentuated by increased prop drag.	② RPM (remaining engines) - Increase Manually to 2550 (when directed) (E, P)
4. ***ALERT CREW — ALERTED (P, CP)*** Alert crew by means of interphone on CALL position. Copilot executes three short rings on the alarm bell	
⑤ ***POWER AS REQUIRED—AS REQUIRED (P, E)*** Direct engineer to make necessary power changes. Use unsymmetrical power as required to aid directional control NOTE Do not hesitate to exceed meto power as needed for either control or performance.	③ Power - Set (when directed) (E, P) Make RPM changes manually
⑥ ***OPEN COWL FLAPS—OPENED (CLEAN SIDE) (P, E)*** Direct engineer if additional drag on that side is required for directional control	④ Cowl Flaps (clean side) - OPEN (when directed) (E, P)
7. ***SET WING FLAPS — SET (CP)*** Direct copilot to set flaps as required to reduce buffeting or to improve elevator control. Usually 10% to 20% is sufficient to eliminate all but extremely severe buffeting, but more may be required. See also BUFFETING in Section VI.	

FIRE

ENGINE FIRE DURING ENGINE STARTING

PILOTS

1. *SIMULTANEOUSLY:*
   a. ***CALL TOWER — CALLED (CP)***

   Have tower dispatch fire trucks

   b. ***ALERT CREW — ALERTED (C, CP)***

   Alert crew of fire emergency and location by means of the interphone. Copilot will execute three short rings on the alarm bell

② ***ABANDON AIRPLANE — ABANDONED (P)***

If fire is out of control notify personnel by means of the interphone on CALL position, to abandon airplane. Copilot will execute one long ring on the alarm bell

ENGINEER

① ***FIRE LOCATION — DETERMINE (NOTIFY PILOT) (E, P)***

2. ***PRIMING — STOP***
3. ***CRANKING — CONTINUE***
4. ***CRANKING — STOP (IF FIRE CONTINUES)***
5. ***ALL MIXTURES — FUEL CUTOFF***
6. ***AFFECTED ENGINE — GANG BAR***
7. ***CO_2 — RELEASE***

   Hold CO_2 release switch in FIRST FIRE position 5 seconds. After engine stops and fire is still not extinguished, move CO_2 release switch to SECOND FIRE position, hold 5 seconds

⑧ ***FIRE STATUS — REPORT (E, P)***

Report to Pilot

9. Master and Ignition Switches - Off

ENGINE FIRE DURING FLIGHT

Any crew member seeing a fire will use the interphone CALL position to announce, "SMOKE and/or FLAME ON NO. _____ ENGINE." Engineer will advise the pilot of the engine on fire.

WARNING

- If an engine fire occurs while the wing flaps are extended, the wing flaps should be promptly retracted provided flight performance permits such action without further endangering the airplane.
- In flight, battery power is unavailable to discharge the CO_2.

PILOTS

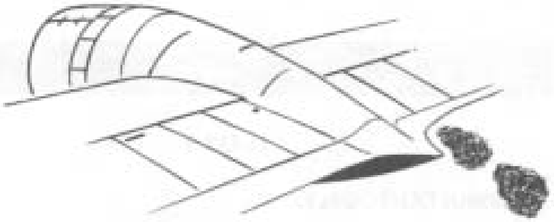
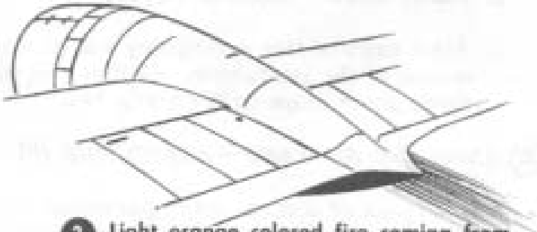
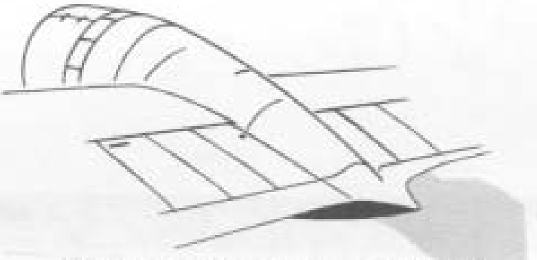
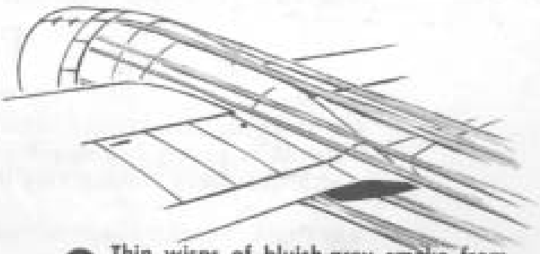
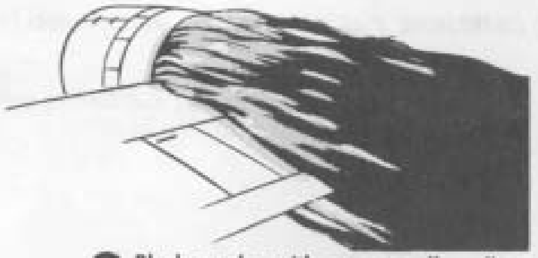
① ***DETERMINE FIRE LOCATION — DETERMINED (P, E)***

If airplane drag is not critical and fire is on inboard engine extend the landing gear

ENGINEER

① ***FIRE INDICATION — REPORT OR ACKNOWLEDGE (E, P, BO)***

Report or acknowledge any indication of an engine fire, using CALL position on interphone, to pilot

CAUSE	ACTION	
Detonation, afterfire and/or backfire. Also fouled plugs or failing valves. If fuel pump drive shaft is broken, engine gets insufficent fuel and mixture leans excessively. Indicated generally by high CHT high CAT fluctuating MP, fuel flow and in some cases fluctuating cabin airflow. Lean mixtures cause high CHT. High CAT produces detonation. Fluctuation in MP, fuel flow, cabin airflow will result from violent back-fire. If detonation continues, engine failure and fire is imminent.	Turn on fuel boost if fuel pressure below normal. Decrease CAT and CHT and enrich mixture, checking for proper rpm and MP correlation. Increase airspeed.	 ① **Puffs of black smoke from exhaust.**
On ground at idling speeds, indicates mixture too rich. In flight, usually at high power settings, this can occur and indicates too rich mixture. There will be no instrument indications.	On ground, increase throttle and blow fire out. In flight, move mixture control slightly to lean mixture.	 ② **Light orange colored fire coming from exhaust.**
Damaged or worn-out piston rings permitting cylinder to pump oil. Also caused by leaking impeller seal allowing oil to seep into induction system. At night this condition appears as fire, however, it is only hot oil burning in exhaust stack and exhaust stream. No instrument indication, but slight power loss will usually occur.	No in-flight action possible. Record in Form 781 and monitor condition.	 ③ **Bluish smoke coming from exhaust.**
Oil leaking onto exhaust stacks and vaporizing. Not a dangerous condition providing oil leak is not excessive. In some cases, leaking oil in turbo shrouds and turbosupercharger area will ignite. Oil leak in supercharger area can cause fire along full length of nacelle. No instrument indications except for possible drop in oil quantity.	Normally, no action is necessary unless fire develops. If fire occurs, feather propeller, removing source of heat and fuel, and fire should go out.	 ④ **Thin wisps of bluish-grey smoke from exhaust and cowl flap area.**
Fuel fire in accessory section generally caused by broken fuel line. Low fuel pressure and abnormally high CHT are instrument indications. Fire warning lights will come on. Engine operation may be erratic, depending upon malfunction.	Use fire procedure. Prepare to abandon airplane if fire does not go out.	 ⑤ **Black smoke with orange-yellow flame coming from accessory section.**

ENGINE SMOKE AND FLAME IDENTIFICATION

Figure 3-4 (Sheet 1 of 2)

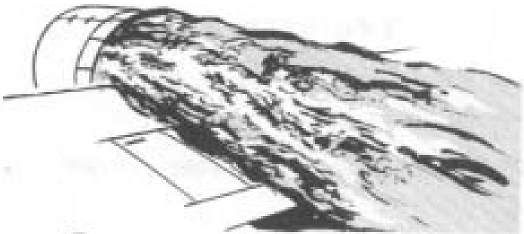
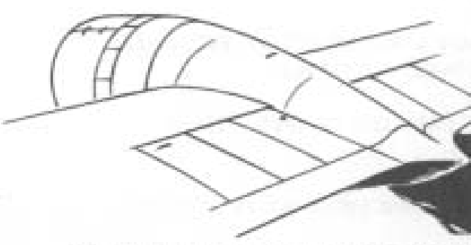
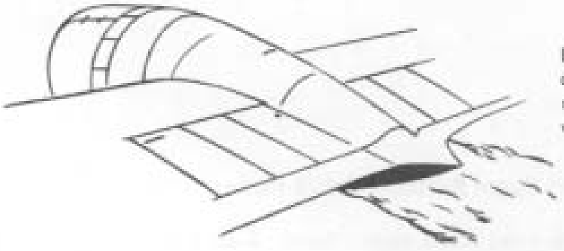
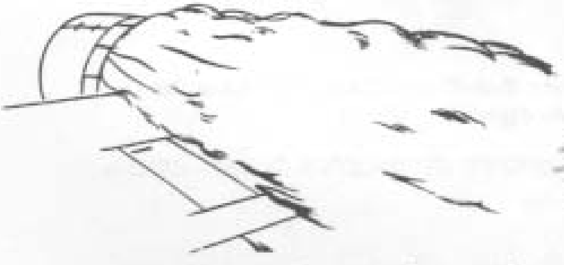
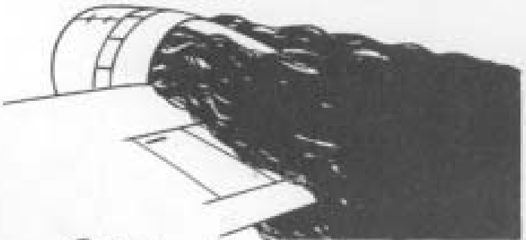
	CAUSE	ACTION
 **6** Grey smoke coming from cowl flap of forward engine section.	Cylinder failure or exhaust stack failure. If condition results in blown cylinder head or open exhaust stack, fire and black smoke will appear in exhaust stream.	During takeoff or when more than 3-engine power is required for safety, reduce power slightly and let engine operate until safe altitude and airspeed is attained, then feather propeller.
 **7** Black smoke coming from exhaust.	Induction fire. Instruments will indicate sudden drop of MP and rpm. This loss will be regained due to action of automatic controls on prop and turbosupercharger, but definite power loss occurs. This could be mistaken for power or turbo surge. CAT is not reliable indicator because instrument records temperature of air flowing through carburetor, not induction system heat.	Close throttle, use fire procedure and fire should be extinguished without damaging engine.
 **8** Dense white smoke coming from exhaust.	Induction fire in advanced stages. Very dangerous condition. Magnesium accessory section has probably ignited. CAT. will rise rapidly to maximum reading.	Action in (7) above should have been taken to extinguish fire before it reaches this stage. Use fire procedure. Alert crew for bailout. IF FIRE DOES NOT GO OUT WITHIN 30 SECONDS IT MAY BE BEST TO ORDER CREW TO BAILOUT AS FIRE WILL PROBABLY CAUSE EXPLOSION IN WING.
 **9** Dense white smoke coming from cowl flap areas.	Indicates induction fire has burned through intake pipe and it is possible engine may fall off its mounts.	Fire has progressed to extremely dangerous stage. THERE IS NO REMEDIAL ACTION. Prepaire to abandon airplane.
 **10** Black smoke coming from accessory section.	Oil fire in accessory section. Fire detector lights should come on for area affected. CAT. will be abnormally high, accompanied by loss of power. If fire has burned through intercooler, smoke will come out of intercooler flaps.	Use engine fire procedure.

Figure 3-4 (Sheet 2 of 2)

NGINE FAILURE DURING FLIGHT (Cont)

PILOTS

②.) ***GANG BAR AFFECTED ENGINE — GANG BARRED (P, E)***

If fire exists direct engineer to gang bar the affected engine.

3. ***ALERT CREW — ALERTED (P, CP)***

Alert crew by means of interphone on CALL position. Copilot executes three short rings on the alarm bell

④ ***RELEASE CO_2 — RELEASED (P, E)***

Direct engineer to discharge CO_2 as necessary

5. ***FIRE NOT EXTINGUISHED:***

   a. ***USE BAIL-OUT PROCEDURE***

6. Fire Extinguished:

   a. Rudder Boost On - ON (P)

   ⓑ Power as Required - As required (P, CP, E)

   Insure engineer reports out of spark advance prior to copilot making power adjustment

   ⓒ Complete Engine Shut-Down Clean-Up - Complete Engine Shut-Down Clean-Up" (P, E)

   ⓓ Engineer's Report - "Engine Shut-Down Complete" (P, E)

   e. Land as soon as possible (P)

ENGINEER

② ***AFFECTED ENGINE — GANG BAR (WHEN DIRECTED) (E, P)***

3. ***MIXTURE (AFFECTED ENGINE) — FUEL CUTOFF***

④ ***IF IN SPARK ADVANCE: (E, P)***

   a. ***MIXTURES (ALL OTHER ENGINES) — AUTO LEAN***

   b. ***SPARK ADVANCE SELECTOR SWITCHES (ALL ENGINES) — NORMAL***

   c. ***MIXTURES (ALL OTHER ENGINES) — AUTO RICH***

   Notify pilot when out of spark advance

⑤ CO_2 - Release (when directed) (E, P)

6. Cowl Flaps Switch - Set (2 inches)

Open cowl flaps approximate 2 inches

⑦ Engine Shut-Down Clean-Up - Complete (when directed) (E, P)

See ENGINE SHUT-DOWN CLEAN-UP this Section

CAUTION

If an abrupt rise in the rate of fuel flow occurs, while operating at a constant power a fuel line rupture and leak between the fuel selector valve and engine is indicated. Utilize the ENGINE FIRE procedures as outlined above. Direct the engineer to conduct a line check if desired. See TO CHECK A SUSPECTED LEAK IN THE AIRPLANE FUEL SYSTEM, this Section.

FUSELAGE/ELECTRICAL FIRE DURING FLIGHT

PILOTS

The pilot will initiate the following procedures if a fuselage or electrical fire is observed or reported.

1. ***NOTIFY CREW — NOTIFIED (P)***

Notify crew of fire location and emergency by means of the interphone on CALL position

② ***OXYGEN MASKS ON — ON (100%) (ALL CREW MEMBERS)***

Direct crew to set regulators on 100% oxygen

③ ***DETERMINE FIRE CAUSE — DETERMINE (P, N, RO, BO)***

a. ***SHUTOFF SYSTEM FEEDING FIRE — SHUTOFF (FUEL, OIL, OR ELECTRICAL)***

b. ***DIRECT ENGINEER TO DEPRESSURIZE THE AIRPLANE, IF REQUIRED***

WARNING

Repeated or prolonged exposure to high concentrations of Bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken including the use of oxygen when available.

4. ***FIRE REPORTED NOT EXTINGUISHED:***

a. ***USE BAIL-OUT PROCEDURE***

5. Electrical Fire: (Source Not Found)

a. Instrument Emergency Power Switch to Battery - Battery (P)

ⓑ Set RPM 2350 - Set 2350 (P, CP)

Copilot will set rpm 2350

ENGINEER

① ***FIRE INDICATION — REPORT OR ACKNOWLEDGE (E, P)***

Report or acknowledge to pilot, using the CALL position on interphone, any indication of a fuselage or electrical fire. If body heater fire exists as indicated by fire warning light, gang bar heaters and advise pilot.

2. ***OXYGEN MASK — ON (REGULATOR 100%)***

③ ***CAUSE OF FIRE — DETERMINE AND REPORT (E, P)***

When cause of fire is determined, report source to pilot. If fire is determined to be of electrical origin, applicable equipment will be turned OFF or circuit breakers and fuses pulled. If source of fire is reported as a result of fuel system failure shut off applicable system feeding the fire

4. Electrical Fire: (Source Not Found)

a. Mixture - AUTO RICH

b. Cowl Flap Switches - Set (2 inches)

USELAGE/ELECTRICAL FIRE DURING FLIGHT (Cont)

PILOTS	ENGINEER
c. Rudder Boost On - ON (P)	
ⓓ Airplane Master Switch Off - OFF (P, E) Direct Engineer **CAUTION** When all electrical power is turned off, the propellers will be in constant rpm, the turbo wastegates and fuel valves will remain positioned as they were prior to power off.	ⓒ Airplane Master Switch - OFF (when directed) (E, P)
ⓔ Turn off all Electrical Equipment - Turned OFF Switches, Circuit Breakers (except emergency bus) (All) Direct crew to turn off all switches and pull all circuit breakers except those on the emergency bus	ⓓ All Electrical Equipment - Turn OFF Switches, Pull Circuit Breakers (except those on emergency bus when directed) (All) e. Turbo Switches - MAN f. Turbo Override Switches - OFF
ⓕ Airplane Master Switch On - ON (P, E)	ⓖ Airplane Master Switch - ON (when directed) (E, P) h. Generator Switches - ON (one at a time) i. Essential and Pilot's Instrument Inverter Switches - ON
ⓖ Essential and Other Equipment On - ON (P,E) If fire is extinguished have engineer turn master switch on and resume normal instrument power operation, after pilots instrument inverter is turned on. Turn on essential equipment and other equipment as needed, carefully observing equipment, instruments or wiring. As soon as fault is detected, isolate this circuit or equipment by disconnecting or leaving inoperative	ⓙ Switches and Circuit Breakers - ON (One at a time) (for essential equipment) (All) Carefully observe equipment and instruments. As soon as fault is detected, isolate this circuit or equipment by disconnecting or leaving inoperative
i. Eliminate Smoke and Fumes - Eliminated (P) Use SMOKE OR FUMES procedure in this Section to clear the airplane	

WING AND EMPENNAGE FIRE DURING FLIGHT

PILOTS

1. *ALERT CREW — ALERTED (P, CP)*

   Alert crew by means of interphone on CALL position. Copilot executes three short rings on alarm bell

② *RELEASE CO₂ — RELEASED (P, E)*

   Direct engineer to discharge Second CO_2 charge if necessary

3. *FIRE NOT EXTINGUISHED:*

   a. *USE BAIL-OUT PROCEDURES*

4. Fire Extinguished:

   a. Land as Soon as Possible (P)

WARNING

To prevent a recurrence of the fire do not restart affected heaters.

ENGINEER

① *FIRE INDICATION — REPORT OR ACKNOWLEDGE (E, P)*

   Report or acknowledge any indication of a wing or empennage fire, using the CALL position on interphone to pilot

2. *AFFECTED HEATERS — GANG BAR*

3. *CO₂ — RELEASE FIRST FIRE*

   Report fire status to pilot

④ CO_2 - Release Second Fire (when directed) (E, P)

5. Fire Extinguished:

   a. CO_2 Directional Valve Switch - NORMAL

WHEEL WELL FIRE DURING FLIGHT

If a wheel well overheat warning light illuminates, fire or explosion occurs, the pilot will initiate the following procedure:

1. *ALERT CREW — ALERTED (P, CP)*

   Alert crew by means of interphone on CALL position. Copilot executes three short rings on alarm bell.

2. *GEAR DOWN — DOWN (CP)*

   If performance is critical, consideration should be given to extend only the affected gear.

3. *GANG BAR AFFECTED ENGINE — GANG BARRED (P, E)*

   Direct engineer to gang bar affected inboard engine if fire exists.

4. Land Airplane - Land at Nearest Airfield (P)

   The pilot should anticipate failure of both tires c landing and utilize as much of the runway as possible. See BOTH TIRES ON ONE MAIN GEA FLAT, this Section.

ELECTRICAL FIRE

In the event of a short circuit that may be detected b fire, smoke, excessive amperage load or overheatin of any electrical wiring or equipment, causing an electrical fire use procedures outlined in FUSELAGE ELECTRICAL FIRE.

SMOKE AND FUME ELIMINATION

PRESSURIZED OR UNPRESSURIZED

If smoke or fumes are observed or reported the pilot will initiate the following procedures:

PILOTS

① ***OXYGEN MASKS ON — ON (100%) (ALL)***

Direct crew to set regulators to 100% oxygen

2. ***PULL CABIN PRESSURE RELEASE — PULLED (P)***

③ ***OPEN MAIN COMPARTMENT HATCHES — OPEN (P, N, RO, BO)***

Open per EMERGENCY EXITS, figure 3-7. Direct crew to open wing hatches

④ Open Floor Hatches - Opened (P,N, RO, BO)

Direct crew to open if fumes are discovered in the lower compartments

5. Increase Airspeed - Increased (as desired) (P)

To assist ventilation

⑥ Determine if Smoke and Fumes Eliminated - Determined (ALL)

ENGINEER

① ***SMOKE OR FUMES INDICATION — REPORT OR ACKNOWLEDGE (E, P)***

Report or acknowledge to pilot any indication of smoke or fumes, using the CALL position on interphone

2. ***OXYGEN MASK — ON (REGULATOR 100%)***

3. Turbo Bleeder Switch - CLOSE (if engine fire)

4. Air Conditioning Master Switch - ON

5. Cabin Air Selector Switches - ALTERNATE

FUEL FUMES

If fuel fumes are observed or reported, initiate the following procedures:

PILOTS

① ***OXYGEN MASKS ON — ON (100%) (ALL)***

Direct crew to set regulator on 100%

ENGINEER

① ***FUEL FUMES INDICATION — REPORT/OR ACKNOWLEDGE (E, P)***

Report or acknowledge to pilot any indications of fuel fumes, using the CALL position on interphone

2. ***OXYGEN MASK — ON (REGULATOR 100%)***

2. ***INSTRUMENT EMERGENCY POWER SWITCH TO BATTERY — BATTERY (P)***

③. ***SET RPM 2350 — SET 2350 (P, CP)***

Copilot will set rpm to 2350

4. ***RUDDER BOOST ON — ON (P)***

⑤. ***AIRPLANE MASTER SWITCH OFF — OFF (P, E)***

Direct engineer to turn master switch OFF

6. ***PULL CABIN PRESSURE RELEASE — PULLED (P)***

⑦. ***OPEN MAIN COMPARTMENT HATCHES — OPENED (P, N, RO, BO)***

Open per EMERGENCY EXITS, figure 3-7. Direct crew to open hatches

NOTE

To reduce fume accumulation in the control cabin due to airflow effects, close the cabin pressure emergency release valve after the overwing hatches have been opened.

⑧. Open Floor Hatches - Opened (P, NO, RO, BO)

9. Increase Airspeed - Increased (P)

Increase to assist ventilation

⑩. Fuel Fumes Cleared, Master Switch On - ON (P, E)

When crew reports airplane and lower nose compartment is free of fumes, have engineer turn the airplane master switch ON and restore normal power to flight instruments

3. ***MIXTURE — AUTO RICH***

4. ***COWL FLAP SWITCHES — SET (2 INCHES)***

5. ***CABIN AIR SELECTOR SWITCHES — ALTERNATE (IF TURBOS NOT USED)***

6. ***A/R TRANSFER AND LINE VALVE SWITCHES — CLOSE***

⑦. Airplane Master Switch - OFF (when directed) (E, P)

8. All Electrical Switches - Turn OFF

9. Turbo Switches - MAN

10. Turbo Override Switches - OFF

11. Fuel Fumes Cleared:

   ⓐ. Airplane Master Switch - ON (when directed) (E, P)

   b. Generator Switches - ON (one at a time)

   c. Inverter Switches - ON (as required)

   d. Other Equipment - ON (as required)

WARNING

Do not operate any of the following when fuel fumes are present near the equipment.

A/R system
Interaircraft signal lamp
Radio compass
Pull marker beacon circuit breaker
Radio Altimeter
Search radar
IFF radio

Loran radio
Localizer and VOR receiver
Glide slope receiver
Control cabin cooling fan
Cabin heaters
APU
Tacan

XPLOSIVE DECOMPRESSION

When an explosive decompression occurs, the cabin ressure is reduced to the outside pressure in less han one second. Any explosive decompression affects ll crew members and can be extremely dangerous if ccurring at high altitudes. Following are some of the ffects accompanying explosive decompression:

1. Rush of air from lungs.
2. A momentary dazed sensation that passes immediately.
3. Possible gas pains.
4. Anoxia if oxygen equipment is not immediately available.

Following are precautions to observe in pressurized compartments:

1. Maintain a safe pressure differential.
2. Have oxygen equipment immediately available.
3. Have heavy flight clothing available.

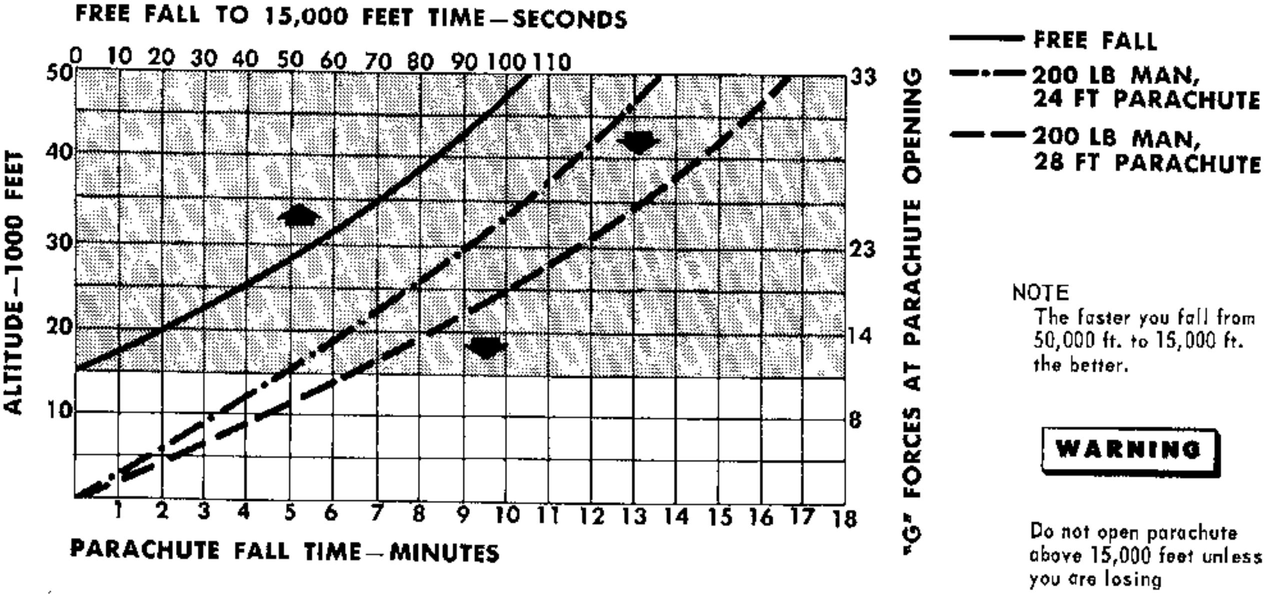
If an explosive decompression occurs the pilot should try to ascertain the cause of the trouble and if it cannot be fixed in flight, he should decide whether to continue on his mission or to descend to a safe altitude immediately.

BAIL-OUT

NOTE

It is mandatory that during the crew briefing, prior to each mission, the briefing include the primary and secondary exits to be used for bail-out, method of removing hatches; the order or sequence in which all personnel will exit for bail-out; and pertinent special instructions to extra personnel.

When bail-out is required or decided upon, try to plan bail-out before the last minute. Over water bail-out is not recommended unless visual contact is made with adequate surface help. If surface help is available, head the airplane in a direction to allow the crew to drift onto the course and just ahead of the rescue vessel. If no rescue vessels are in the vicinity, bail-out should be used only as a last resort because of the extreme difficulty of getting the crew together in the water. The large life rafts offer more elaborate survival and signalling equipment than do one man rafts. In any but the warmest seas, a man will survive only a few hours if kept afloat by means of a life vest only. Wearing an exposure suit will increase this time but still cannot compare with the time of survival possible in a life raft. Exposure suits available in the airplane should be put on if time permits; it takes about a minute to put on a suit. Exposure suits should be worn over flying clothing, then put on Mae Wests and parachute harness; mittens will be found in the leg pockets. When the bail-out order is given, if time permits, crew members should check each other to see that all straps and packs are properly adjusted, and release all available life rafts just prior to bail-out. If time permits, the pilot should make two runs dropping half the crew each time. The best altitude for bail-out is about 2000 feet and at as slow an airspeed as practical.



NOTE
The faster you fall from 50,000 ft. to 15,000 ft. the better.

WARNING

Do not open parachute above 15,000 feet unless you are losing consciousness.

TIME OF DESCENT FROM 50,000 FT

Figure 3-5

BAIL-OUT

PILOTS (Only)

1. ***ALERT CREW — ALERTED (P, CP)***

Alert crew by means of interphone on CALL position. Copilot executes three short rings on the alarm bell.

NOTE

If time permits have personnel don exposure suits and Mae Wests if applicable.

2. ***AUTOPILOT SWITCH ON — ON (P)***

3. ***PULL CABIN PRESSURE RELEASE — PULLED (P)***

4. ***REDUCE AIRSPEED — REDUCED (P)***

⑤ ***OPEN HATCHES — OPENED (P, BO)***

Direct aft crew members to open bail-out hatch(es)

6. ***WARN CREW — WARNED (P, CP)***

Give bailout order on interphone on CALL position. Copilot executes the long ring on the alarm bell.

7. ***ENGAGE AUTOPILOT — ENGAGED (P)***

After jumpmaster reports that all personnel have bailed out, engage autopilot just before leaving. Don check pack and adjust parachute harness. Attach survival kit if time permits.

EMERGENCY DESCENT

PILOTS

1. ***CLOSE THROTTLES — CLOSED (P)***

② ***SET RPM 2000 — SET (P, E)***

CAUTION

At 2000 rpm and below the 1 inch Hg per 100 rpm rule may be disregarded

3. ***GEAR DOWN — DOWN (CP)***

Direct copilot to extend gear.

ENGINEER

1. ***COWL FLAP SWITCHES — SET (3 INCHES)***

2. ***MIXTURES — AUTO RICH***

EMERGENCY DESCENT (Cont)

PILOTS

4. ***WING FLAPS FULL DOWN — FULL DOWN (CP)***

Direct copilot to extend flaps full down.

NOTE

Landing gear and wing flaps can be started down immediately after closing throttles from normal cruising speed; speed will be down to wing flap extension speed by the time flaps are fully extended.

5. ***MAINTAIN SPEED — MAINTAINED (155 KNOTS) (P)***

⑥ ***OXYGEN MASK ON — ON (IF REQUIRED) (ALL)***

Direct crew.

ENGINEER

3. ***OXYGEN MASK — ON (IF REQUIRED)***

NOTE

The pilot will initiate the emergency descent recovery at 1000 feet above planned level off altitude. Recovery is accomplished by raising the wing flaps to 55%, retracting the landing gear and then raising the wing flaps to the full UP position. Establish power as required.

TAKEOFF AND LANDING EMERGENCIES (EXCEPT DITCHING)

ABORT

If an emergency occurs prior to go-no-go speed (for go-no-go speed see appendix)

PILOTS (Only)

1. ***CLOSE THROTTLES — CLOSED (P)***
2. ***REVERSE PROPS — REVERSED (SYMMETRICAL ENGINES) (P)***
3. ***APPLY BRAKES — APPLIED (P)***

(See STOPPING DISTANCE Chart in Part 3 of the Appendix)

In extreme cases retract the landing gear using normal and emergency switches.

NOTE

A physical inspection of the brakes will be made after an aborted takeoff or at any time after any excessive braking has been used.

CRASH LANDING AFTER TAKEOFF

PILOTS

1. ***GEAR UP — UP (CP)***

   Direct copilot to raise gear

2. ***LOCK SHOULDER HARNESS — LOCKED (P & CP)***

   Pilot and copilot manually lock inertia reel.

3. ***WING FLAPS FULL DOWN — FULL DOWN (CP)***

   Signal copilot to lower flaps full down. Land as slow as possible.

4. ***WARN CREW — WARNED (P & CP)***

   Notify personnel by interphone on CALL position for crash landing: copilot executes one long sustained ring on alarm bell.

⑤ ***SIMULTANEOUSLY:***

   a. ***CLOSE THROTTLES — CLOSED (P, E)***

   b. ***AIRPLANE MASTER SWITCH OFF — OFF (P, E)***

   Direct engineer to turn airplane master switch OFF just as ground contact is made.

ENGINEER

1. ***SHOULDER HARNESS — LOCK***

② ***SIMULTANEOUSLY:***

   a. ***MIXTURE LEVERS AND IGNITION SWITCHES — FUEL CUTOFF AND OFF (E, P)***

   Move mixture levers to FUEL CUTOFF, turn ignition switches OFF, when pilot closes throttles.

   b. ***AIRPLANE MASTER SWITCH — OFF (WHEN DIRECTED) (E, P)***

CRASH LANDING

When a crash landing is to be made, the pilot should alert the crew by interphone and with six short rings on the alarm bell and give orders to prepare for a crash landing. A crew member will notify other personnel and will assist in positioning and securing the passengers. All personnel not located in the main compartment should proceed thereto immediately. No passengers should be allowed aft of station 790. The location and number of positions providing the maximum safety in a crash landing are shown in figure 3-6, except that the center troop seats will not be occupied. The personnel normally occupying the center troop seats should take up positions on the floor. The side troop seats should be occupied first, as shown in figure 3-6, and all other personnel should take up positions on the floor, facing forward, (except those seated against bulkhead 230) with floor safety belts fastened and with their arms locked around their knees.

NOTE

- Figure 3-6 should not be interpreted as restricting the number of passengers which can be carried, but only to show the location and

CRASH LANDING (Cont)

number of positions which afford the maximum safety in the event of a crash landing.

- On a prepared runway, land with as much of the landing gear as possible in preference to a gear up belly landing. With nose gear only extended, it is advisable to retract it and make a belly landing. On an unprepared runway, land with gear fully retracted.

PILOTS

1. Alert Personnel - Alerted (P, CP)

Alert personnel by means of interphone on CALL position. Copilot executes six short rings on the alarm bell.

② Reduce Gross Weight - Reduced (P, E, BO)

a. Dump A/R Fuel - Dumped (if aboard)

b. Dump Airplane Fuel - Dumped (if required)

c. Jettison Cargo - Jettisoned (if aboard)

Direct engineer to dump A/R fuel if aboard. Have engineer transfer airplane fuel for dumping if required. Direct aft compartment crew members to jettison cargo if aboard.

Reduce gross weight as much as possible, at pilot's discretion, give all non-essential personnel permission to bail out.

NOTE

Before jettisoning reduce speed below 131 knots IAS, lower wing flaps to 55% to attain a tail high attitude. Have cargo jettisoned through the rear escape hatches to avoid danger of damaging the horizontal stabilizer

WARNING

When utilizing the rear hatch(es) for jettisoning, do not open either of the overwing hatches as the increased volume and velocity of air entering these hatch(es) will render its use extremely hazardous.

3. Jettison Tanks - Jettisoned (if unprepared runway) (P)

If landing is to be accomplished on an unprepared runway, jettison external fuel tanks in accordance

ENGINEER

① Fuel - Dump (when directed) (E, P, BO)

Begin dumping A/R fuel if on board. (See FUEL DUMPING in this section.) Transfer airplane fuel for dumping if directed by pilot.

2. APU - Turn OFF

3. Body and Surface Anti-icing Heater Switches - OFF

PILOTS

with instructions given under EXTERNAL FUEL TANK JETTISONING in this Section.

NOTE

Do not jettison external wing tanks if they are empty and the runway has been prepared with foam.

④ Open Windows, Door, Exits - Opened (P, CP, BO)

Open, remove, and secure pilot's and copilot's windows; have crew open and release emergency exits (figure 3-7); unlock front and aft entrance door safety pins and have floor hatch open or removed. If time permits pull single point refueling circuit breaker, flare release circuit breaker, fuel dump circuit breaker, and close air refueling vent valve (if applicable).

5. Order Personnel to Crash Landing Positions - Ordered (P)

Order personnel by interphone on CALL position to take crash landing positions, and brace themselves. Check that all personnel in lower compartments have been moved to main compartment and braced for crash landing. See figure 3-6 for crash landing positions.

⑥ Fasten and Lock Safety Belts and Shoulder Harness - Fastened and locked (P, CP, N, E)

ENGINEER

④ Safety Belt and Shoulder Harness - Fasten and lock (E, P)

CAUTION

The crew member is prevented from bending forward when the inertia reel lock handle is in the LOCKED position; therefore all switches not readily accessible should be cut before moving the handle.

PILOTS

⑦ Mixtures Rich - RICH (P, E)

The pilot will direct the engineer to set mixture auto rich, the engineer will repeat upon completion of this action, "Mixtures auto rich and locked."

⑧ RPM - Call for 2350 rpm (P, E)

The pilot will direct the engineer to set 2350 rpm. Engineer will respond "rpm 2350." The pilot will make all throttle adjustments from this point on.

ENGINEER

⑤ Mixtures - AUTO RICH and LOCKED (when directed) (E, P)

Report to pilot

⑥ RPM - Set 2350 (when directed) (E, P)

Report to pilot

RASH LANDING (Cont)

PILOTS

9. Gear Down - DOWN (CP)

Direct copilot to place gear switch down and obtain visual check of gear that will extend.

a. Nose Gear Only Retracted - Hold nose up (after touchdown)

With nose gear only retracted, hold the nose of the airplane up as long as possible then ease it down to the runway.

b. One Main Gear Retracted - Make contact on nose gear and extended main gear

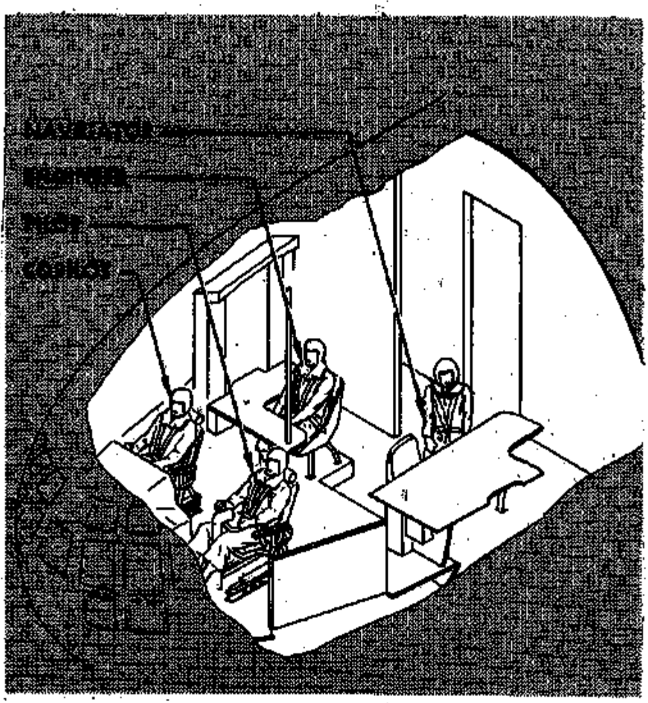
With one main gear retracted, make contact on the nose gear and extended main gear simultaneously; hold control column forward and use aileron to hold the wing tip off the ground as long as possible - be prepared for a ground loop.

NOTE

Use reverse thrust only over extended gear with caution.

ENGINEER

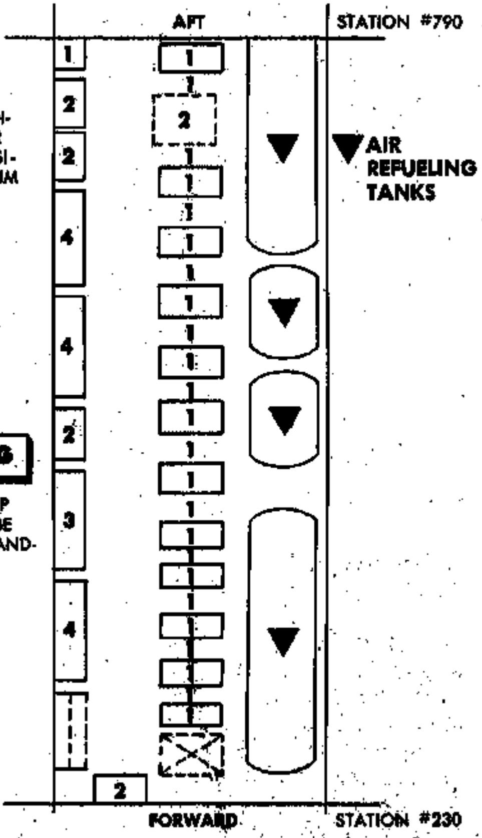
7. Cowl Flap Switches - OPEN (2 inches)



NOTE
THE NUMBERS INDICATE THE NUMBER AND SPECIFIC POSITIONS OF MAXIMUM SAFETY

WARNING

THE CENTER TROOP SEATS WILL NOT BE USED IN CRASH LANDINGS



DITCHING AND CRASH LANDING POSITIONS

Figure 3-6

PILOTS	ENGINEER
c. One Main Gear Down - Make contact on one main gear	
With one main gear and nose gear retracted make contact with the one gear; hold up nose and use aileron to keep the wing up as long as possible.	
d. All Landing Gear Retracted - Flare out close to ground, normal landing attitude	
With both main gear and nose gear retracted flare out close to ground and maintain normal landing attitude.	
10. Set Wing Flaps - Set (55%) (CP)	
Direct copilot to extend wing flaps to 55%	
11. ADI ON - ON (CP)	
12. Wing Flaps Full Down - Full DOWN on final approach (CP)	8. Boost Pump Switches - OFF
Direct copilot to extend flaps full down.	
13. Warn Personnel - Warned (P & CP)	
Notify personnel by interphone on CALL position to brace for crash landing. Copilot executes one long ring on the alarm bell just prior to impact.	
14. Land as Slow as Possible: (P)	9. Simultaneously:
ⓐ Close Throttles - Closed (P, E)	ⓐ Mixtures and Ignition Switches - FUEL CUTOFF and OFF (E, P)
	Move mixture controls to FUEL CUTOFF, turn ignition switches OFF when pilot closes throttles.
ⓑ Airplane Master Switch Off - OFF (at ground contact) (P, E)	ⓑ Airplane Master Switch - OFF (when directed) (E, P)
Direct engineer to turn airplane master switch OFF just as ground contact is made.	

LANDING WITH LESS THAN 55% OF WING FLAPS

When a landing is made with less than 55 percent flap, approach speed should be maintained at least 35 knots above the flaps up power-off stalling speed. The airplane should be flown so that the flare-out is made close to the ground. The amount of flare-out required will be less than that needed for a full flap or 55 percent flap landing for two reasons: First, with considerable power on and flaps up, the approach will be flatter than normal; and second, the pitch attitude of the airplane during a flaps-up approach is much nearer the landing attitude. The attitude of the airplane after flare-out should be held as close to a three point attitude as possible. It is much easier to bring the nose up in landings with reduced flap settings and there will be a tendency to land with the tail somewhat lower than with the flaps full down. With power on contact the ground with the main wheels slightly before the nose wheel touches down. A partial flap (less than 55 percent) or flaps-up landing should be considered as an emergency landing. Caution must be observed if this type of landing is practiced for pilot check-out and also during conditions of high gross weights, unsymmetrical power, high altitude fields, etc.

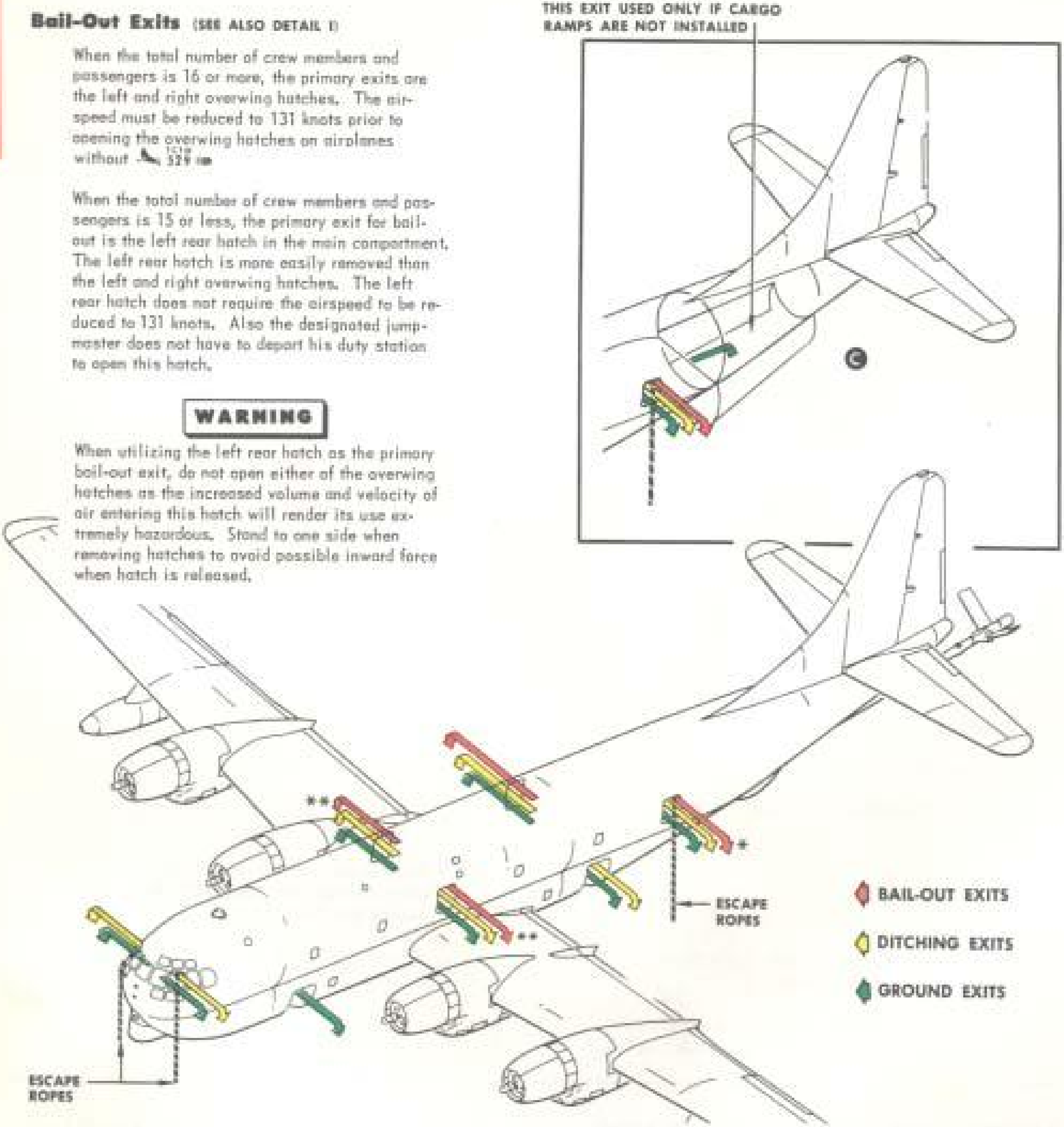
Bail-Out Exits (SEE ALSO DETAIL I)

When the total number of crew members and passengers is 16 or more, the primary exits are the left and right overwing hatches. The airspeed must be reduced to 131 knots prior to opening the overwing hatches on airplanes without 1C-97 529

When the total number of crew members and passengers is 15 or less, the primary exit for bail-out is the left rear hatch in the main compartment. The left rear hatch is more easily removed than the left and right overwing hatches. The left rear hatch does not require the airspeed to be reduced to 131 knots. Also the designated jumpmaster does not have to depart his duty station to open this hatch.

WARNING

When utilizing the left rear hatch as the primary bail-out exit, do not open either of the overwing hatches as the increased volume and velocity of air entering this hatch will render its use extremely hazardous. Stand to one side when removing hatches to avoid possible inward force when hatch is released.



WARNING

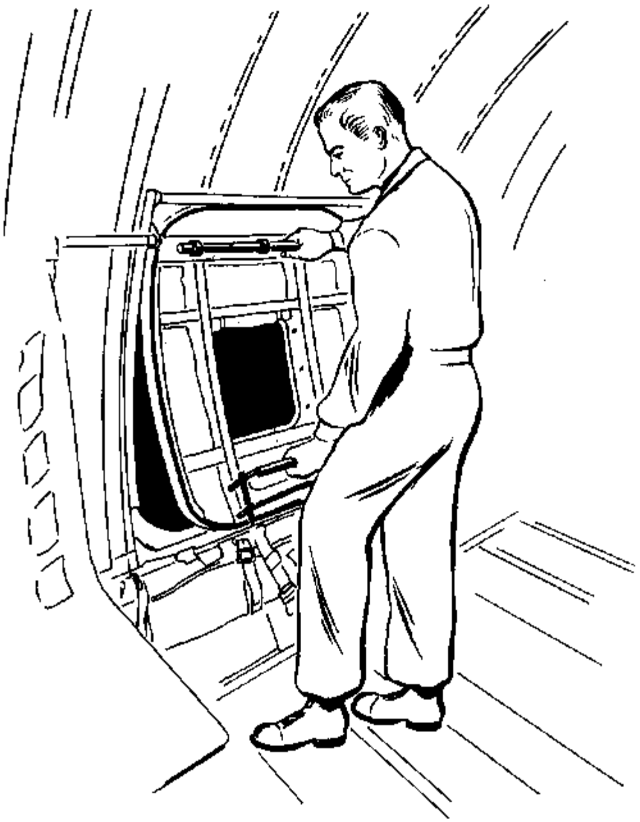
Stow boom before leaving the airplane in flight so that personnel will be less likely to hit it during bail-out.

* The bail-out sequence is: All passengers, navigator, radio operator, engineer, copilot, boom operator and pilot

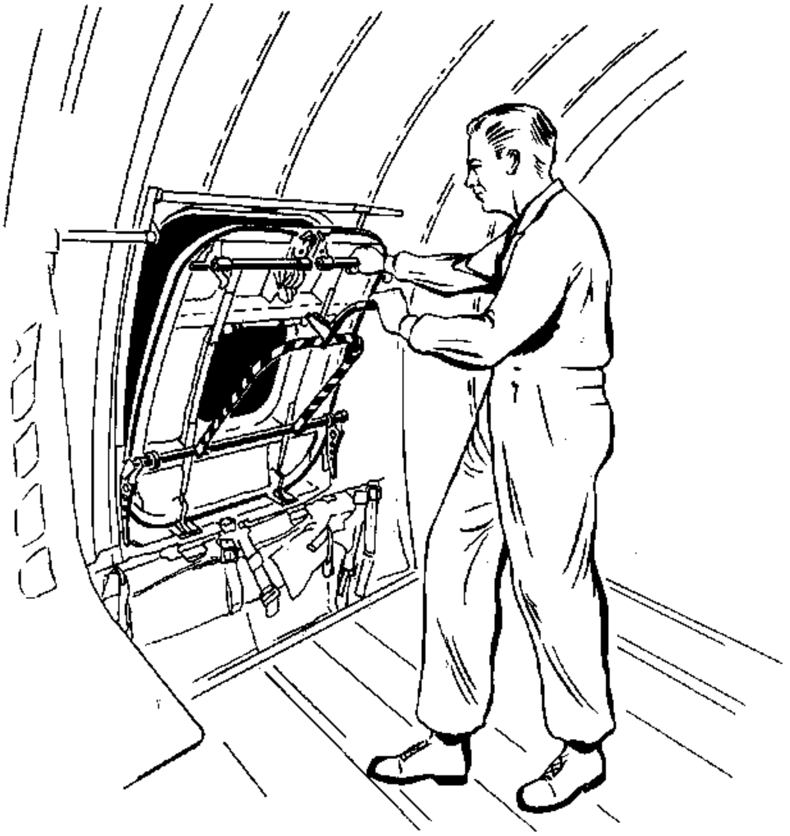
** One half of all passengers, engineer and copilot use right hatch. Remainder of passengers and fligh crew use left hatch.

EMERGENCY EXITS

Figure 3-7 (Sheet 1 of 2)



OPENING EMERGENCY EXITS ON AIRPLANES NOT INCORPORATING TCTO 529



OPENING EMERGENCY EXITS ON AIRPLANES WITH TCTO 529

DETAIL I

Figure 3-7 (Sheet 2 of 2)

LANDING WITHOUT BRAKES

Prior to landing the pilot will direct an aft compartment crew member to open or remove the floor hatch(es) and unlock the forward and aft entrance door safety pins. Land with wing flaps full down and make contact with he main gear first and ease the nose wheel onto the runway as rapidly as possible. After nose wheel makes contact move all four throttles to REVERSE OPEN. In extreme cases, retract the landing gear if necessary. After touchdown the engineer will turn off alternator and inverter switches (except essential inverter) and turn master air conditioning switch off.

CAUTION

After airplane is stopped, utilize towing facilities. If towing facilities are not available and taxiing is absolutely necessary, follow EMERGENCY TAXIING INSTRUCTIONS, this Section.

LANDING WITH FLAT TIRE

Nose Gear Tire Flat

With one or both wheel tires flat, relocate movable equipment and cargo to move the cg to the aft limit. Crew assume crash landing stations. Make a normal approach and landing. After touchdown hold the nose wheel off as long as possible, then lower it gently. Do not use brakes or reverse thrust unless necessary. Do not taxi.

One Main Gear Tire Flat

Make a normal approach and landing. The one good tire should be able to carry the load if a smooth landing is made. The airplane may be taxied off the runway with one tire flat.

Both Tires Flat On One Main Gear

Relocate all movable equipment forward if possible to move the cg toward the forward limit thus throwing more weight on the nose wheel for positive steering. Make a normal approach and landing, but keep the flat tire off the ground as long as possible. The airplane will try to turn into the flat tire side, therefore land the airplane with the good tires along the edge of the runway so that the width of the runway is available for the veering tendency during the landing roll. Use aileron to help keep the weight off the flat tires after touchdown. Use throttles, brakes on the good tire side and nose wheel steering to maintain a straight landing roll. Do not attempt to taxi.

EMERGENCY TAXIING INSTRUCTIONS

If, while taxiing, the hydraulic system and emergency brakes fail, the hydraulic pressure cannot be raised with the hand pump and towing facilities are not available, use prop reverse thrust action for braking the airplane. Since the steering system will usually be inoperative when the brakes fail, it will be necessary to use the engines for steering the airplane, as the nose wheel will caster freely. To maintain maximum control during emergency taxiing, open the throttle reverse lock plate on airplanes **2843** ▶ plus those incorporating 1C10 224, move the inboard engine throttles to REVERSE OPEN range and then close the outboard engine throttles to a low idling speed until the airplane slows to a safe speed for taxiing. Next reduce power on the inboard engines and idle the outboard engines at 1000 rpm. While taxiing leave the inboard engines in reverse thrust until the airplane is clear of obstructions. To provide governed forward speed of the airplane, increase the speed of the outboard engines to overcome the action of the reverse thrust engines.

CAUTION

Continued or repeated use of reverse thrust may cause overheating with subsequent engine damage.

When the airplane is clear of all obstructions, again operate the inboard engines to stop the airplane. Have the engineer place the mixture levers for the outboard engines in the FUEL CUTOFF position. While this is being done, move the inboard engine throttles to the forward idle position to return the prop to normal pitch.

EMERGENCY ENTRANCE

See figure 3-8.

DITCHING

The airplane is well suited for ditching because of the body configuration, with a high-rounded nose, upswept empennage, and boat-like lower fuselage. In ditching, it may not be necessary to abandon the airplane. Under most conditions it will be better to remain on the airplane which provides an excellent platform for survival and rescue.

DITCHING EQUIPMENT

The pilot will brief the crew and passengers on ditching positions (see figure 3-6) and exits (see figure 3-8) before each over-water flight and ascertain that the following equipment is on board and stowed in the proper places:

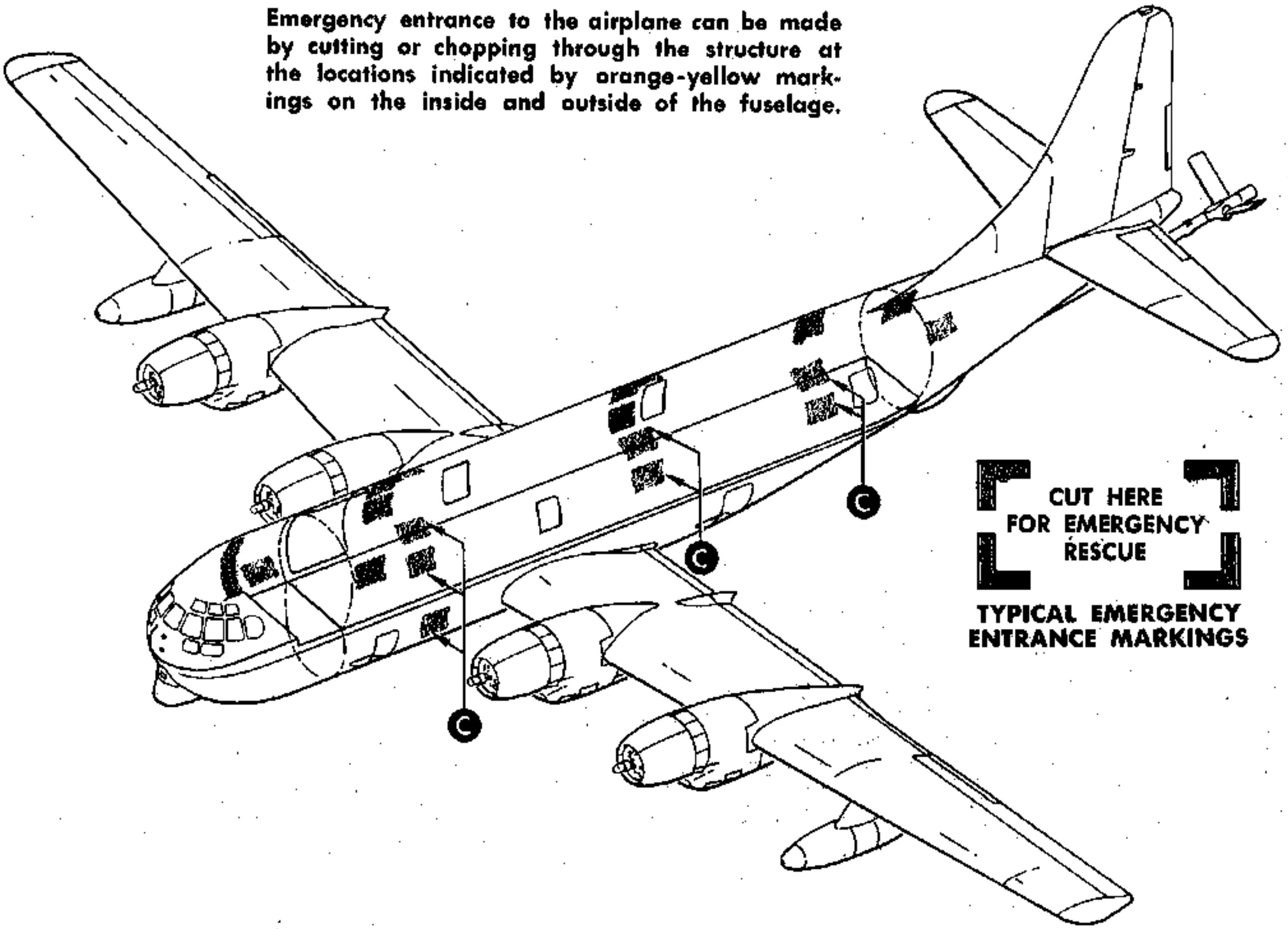
1. Lift rafts - The number and type of rafts on board will be governed by the number of persons on board the airplane. On airplanes **3214**▶ , plus those incorporating TCTO K239▶ , there are four 20 man rafts stowed above the Air Refueling tanks in the main cabin (see figure 3-1.).
2. Life vests - At least one life vest will be available for each person on board. Each crew member and passenger will test inflate his life vest by mouth, check seals on the CO_2 cartridges, and check that container caps are screwed down tightly before each flight. Crew members and passengers will wear life vests during all over-water takeoffs and landings and at any time the pilot deems it necessary.
3. Blankets
4. Dinghy radio
5. Drift signals
6. Emergency water
7. Exposure suits
8. First aid kits
9. Flares
10. Flashlights
11. Hand axes
12. One man life rafts
13. Survival kits
14. URC-4 Radio

DITCHING PREPARATION

When it becomes apparent that ditching is necessary, the pilot gives warning signal on alarm bell (6 short rings) and orders the crew to prepare for ditching. A crew member notifies other personnel to prepare for ditching and assists in positioning and securing the personnel. Personnel not located in the main compartment should proceed thereto immediately, and all personnel should don exposure suits if time permits. No passengers should be allowed aft of station 790. The

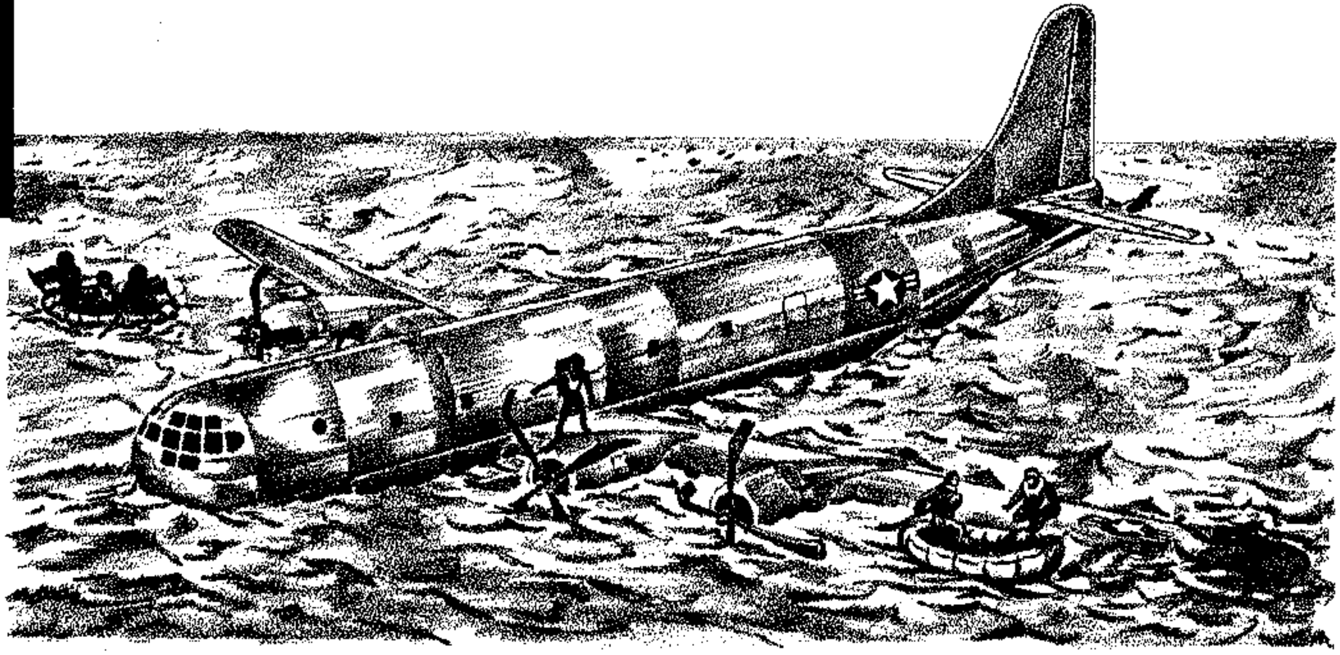
NOTE

Emergency entrance to the airplane can be made by cutting or chopping through the structure at the locations indicated by orange-yellow markings on the inside and outside of the fuselage.



EMERGENCY ENTRANCES

Figure 3-8



Crew Member	Duty	Provide	Position	Exit
PILOT	Warn crew to prepare for ditching, giving approximate time left. Take emergency action on radio (transmit "Mayday" three times, identification three times, request fix or bearing). Check and don life vest, fasten shoulder harness and safety belt. Check control cabin windows closed.	Parachute, flashlight, axe, first aid kit and URC-4 radio	Pilot's seat.	Overwing hatch Take command of No. 1 raft.
COPILOT	Jettison external fuel tanks, ring alarm bell, maintain contact with crew, check and don life vest, safety belt and shoulder harness. At night turn "on" all emergency lights. On airplanes 2901▶ IFF to EMERGENCY.	Parachute, flashlight, first aid kit, and URC-4 radio if radio operator is not assigned	Copilot's seat.	Overwing hatch. Take command of No. 2 (if applicable).
ENGINEER	Dump air refueling fuel. Check emergency cabin pressure release valve to make certain they are closed and locked. Secure all equipment in control cabin.	Parachute, flashlight, first aid kit, water.	Engineer's seat.	Overwing hatch.

DITCHING CHART

Figure 3-9 (Sheet 1 of 2)

Crew Member	Duty	Provide	Position	Exit
NAVIGATOR	Determine position, flight time, nature of emergency, number of personnel on board. If radio operator not on board transmit SOS and above information. On airplanes 17260 ▶ 2900, IFF to EMERGENCY. Obtain D/F service, bearings, fixes, etc. Switch auxiliary liaison transmitter to REMOTE.	Navigation kit, flashlight, pyrotechnic pistol and flares.	Navigator's seat. (If shoulder harness not installed, ditch in main compartment with boom operator).	Overwing hatch
BOOM OPERATOR ▼ **LEFT SCANNER Ⓒ**	Stow and latch boom, turn off all air refueling equipment, take charge of main compartment, close floor hatches, remove and secure emergency exit hatches, supervise and instruct passengers in ditching procedures. Jettison cargo.	Life raft, flashlight, axe, first aid kit, dinghy radio, water.		Overwing hatch
RADIO OPERATOR **17260 ▶ 3177**	Obtains information from the navigator and transmits SOS followed by position, flight time, nature of emergency, and the number of personnel on board. Obtains D/F service, bearings, fixes, etc. Upon completion switch auxiliary liaison transmitter to REMOTE.	Parachute, flashlight, first aid kit and dinghy radio.	All crew members and passengers not assigned specific locations should take up positions in the main compartment as shown in figure 3-6.	Overwing hatch.
PASSENGERS OR ADDITIONAL CREW MEMBERS	As briefed.	As briefed.		

WARNING

Do not inflate the life rafts inside the airplane; when they are inflated they will not pass through the exits.

CAUTION

Extreme care should be taken when launching rafts to prevent damage of the rafts by ragged edges of flaps or leading edge of wings.

NOTE

- If time permits exposure suits will be donned in accordance with the procedure outlined in Section III, Overwater Bail Out.
- With a normal crew, launch No. 1 raft from downwind side of wing. Secure raft lanyard prior to passing raft through escape hatch. This will prevent raft from blowing away. Additional rafts will be designated No. 2, No. 3, etc. if more than one raft is launched due to passenger requirements. A minimum of one crew member will be designated for each raft.
- Remain in the vicinity of the airplane until it sinks.

Figure 3-9 (Sheet 2 of 2)

side troop seats should be occupied first, as shown in figure 3-6. Only one person should be seated in each of the center troop seats. All other passengers will take up positions on the floor, facing forward, (except those seated against the forward bulkhead of the main compartment) with floor safety belts fastened and their arms around their knees. The total number of positions providing maximum safety are: 22 in the side troop seats, 12 in the center troop seats, and 16 on the floor. The lower compartment doors should not be opened. Open the hatches in the main compartment and stow them securely inside the airplane. Jettison external wing tanks, all loose, unnecessary equipment and cargo. Place emergency equipment and life rafts near the emergency exits that open over the wing, and secure them in position. If the APU is running, turn it off and close the exhaust valve. Turn off the cabin heaters and check that the floor hatches are closed. Turn on all exterior lights to assist in rescue.

NOTE

> The preceding recommendations, or figure 3-6, are not to be interpreted as restricting the number of passengers which can be carried, but only to indicate the location and number of those positions which provide the maximum safety in the event that ditching the airplane becomes necessary.

DITCHING METHOD

Experience has shown that the best results are obtained by use of the following procedure:

1. Ditch while power is available. Power will allow the pilot to choose the most favorable spot and condition for ditching.
2. Ditch at the lowest possible forward speed. At the time of surface contact, attempt to have the lowest possible forward speed consistent with safe control of the airplane. This will reduce the landing impact.

WARNING

> Under no circumstances should the airplane be stalled in. The resulting leaks and structural damage would greatly reduce the safety of the ditching operation.

3. Ditch at the lowest possible rate of descent. One hundred feet per minute is recommended.
4. Feather the two inboard props, if practical, to provide greater safety.
5. Ditch the airplane 5 degrees nose high. This is the normal landing attitude and gives the best distribution of landing shock over the fuselage.
6. Use a flap setting of 55 percent. This flap setting is recommended in most cases; however, the primary object is a low rate of descent with as low a forward speed as possible. The use of more than 55 percent flaps is not desirable because it becomes increasingly difficult to get the desired 5 degree nose-up attitude with greater flap angles. Flap setting should be varied according to the weight of the airplane and the power available.
7. Avoid contact in a nose down position. Flare out just above the water and maintain an approximate normal landing attitude at impact.
8. In daylight, it is recommended that the airplane be ditched on the top of a swell, parallel to the swells unless the wind is high. If the wind is high, ditch into the wind to take advantage of the lowered forward speed.

Power Off And Partial Power Ditching

In ditching with one or more engines inoperative, use the following procedure:

1. With two engines operative on the same side of the airplane, use power on the inboard engine only.
2. If No. 2 and No. 4 or No. 1 and No. 3 engines are operative, considerable power may be used for control.
3. With symmetrical power conditions, use power as required to give the flattest approach and the lowest possible forward speed.
4. On let-down with any engine inoperative, it is advisable to hold the speed 25 knots above stalling speed until flare-out, at which time the speed will be reduced to just above the stalling speed as the 5-degree nose high landing attitude is assumed.

Crosswind Ditching

Crab the airplane with the rudder to kill the drift. Hold the wings level. Use a landing attitude of 5 degrees nose high with 55 percent wing flaps.

Night Ditching

Night ditching must be conducted with the aid of instruments to establish the proper attitude of the airplane.

1. Hold the wings level to avoid digging a wing into the sea and cartwheeling the airplane.
2. If power is available, drop flares and use landing lights to examine the sea surface. If conditions are favorable, choose a ditching heading as previously recommended. If impossible to judge the surface conditions, head into the wind and use knowledge of the prevailing winds or wind fix.
3. Make an instrument let-down, holding the air speed 25 knots above stalling speed, at the lowest possible rate of descent.
4. The landing attitude, with power available, should be 5 degrees nose high with 55 percent wing flap. If no power is available or unsymmetrical power is used, no wing flaps will be employed.
5. After choosing a ditching heading, if power is available, drop remaining flares in a line; make a procedure turn; and land alongside the flares.

DITCHING PROCEDURE

SEA CONDITION	AVERAGE WIND SPEED	HEIGHT OF SEA
DITCH ON TOP OF A SWELL, PARALLEL TO THE SWELLS		
Calm to slight - No white caps	0-11 Knots	0-4 Feet
Moderate - Scattered white caps	11-18 Knots	4-8 Feet
Rough - Frequent white caps	18-23 Knots	8-13 Feet
Very Rough - Continuous white caps and spray	23-30 Knots	13-20 Feet
DITCH INTO THE WIND		
High - Extensive white caps and blowing spray	30-38 Knots	20-30 Feet
Very High - Continuous blowing spray, sea surface looks white	38-44 Knots	30-45 Feet

NOTE

- ●Wind velocity will be greater than average for a given sea condition and wave height when a storm is building and vice versa when a storm is abating.
- ●The smooth water side of white caps is upwind.

PILOTS

1. Alert Crew - Alerted (P, CP)

   Alert crew by means of the interphone on CALL position. Copilot executes six short rings on the alarm bell. Advise approximate time remaining.

2. Have IFF Turned to Emergency - IFF Emergency (CP or N)

③ Position Passengers - Positioned (P, BO)

Have crew members check that all personnel in lower compartments have been moved to the main compartment and are seated with safety belts fastened.

④ Open Escape Hatches - Opened (P, BO, RO)

Have crew members open the escape hatches in the main compartment and stow them securely inside the airplane. Check floor hatches closed.

ENGINEER

ITCHING PROCEDURE (Cont)

PILOTS

5. Jettison Tanks - Jettisoned (P)

Jettison external fuel tanks in accordance with instructions given under EXTERNAL FUEL TANK JETTISONING in this Section.

⑥ Jettison Cargo and Dump Fuel - Jettisoned and Dumped (if necessary) (P, E, BO)

⑦ Don Exposure Suits - Donned (ALL) (if time permits)

Have crew and passengers don exposure suits.

⑧ Don Life Vests - Donned (ALL)

Have crew and passengers don life vests.

9. Turn on Exterior Lights - On (P, CP)

Turn on all exterior lights to assist in rescue.

⑩ Fasten and Lock Safety Belts and Shoulder Harness - Fastened and Locked (P, CP)

Pilot and copilot fasten safety belts and shoulder harness and lock inertia reel.

11. Order Personnel to Ditching Positions - Ordered (P)

Order crew to ditching positions by means of interphone on CALL position. Crew members will fasten safety belts, shoulder harnesses, and lock inertia reel (if applicable).

⑫ Feather Inboard Prop - Feathered (if practical) (P, CP, E)

Have engineer position mixture levers to FUEL CUTOFF for affected engines.

13. Set Wing Flaps - Set (CP)

Direct copilot to extend flaps as desired. 55% flap setting is recommended. Flap setting should be varied according to the weight of the airplane and power available.

At night, do not use wing flaps if no power is available or if unsymmetrical power is used.

ENGINEER

① A/R Fuel - Dump (when directed) (E, P)

2. Cabin Pressure Relief and Release Valves - CLOSE and LOCK

3. Control Cabin - Secure (all loose equipment)

4. APU - OFF and ports CLOSED

5. Body and Surface Anti-icing Heaters - OFF

6. Cabin Air Selector Switches - NORMAL

7. Safety Belt and Shoulder Harness - Fasten and Lock

PILOTS

14. Maintain Lowest Rate of Descent - Maintained (P)

    100 feet per minute is recommended.

15. Maintain Speed Above Stall - Maintained (25 Knots above stall) (P)

    Maintain 25 knots above stall until flare-out.

16. Landing Lights Extended and On - Extended and ON (if required) (CP)

17. Warn Personnel - Warned (P, CP)

    Warn crew and personnel by interphone on CALL position to brace for impact. Copilot executes one long sustained ring on the alarm bell just prior to impact.

18. Flare-Out Just Above Water - Flare-Out (P)

    The landing attitude, with power available, should be 5 degrees nose high. Maintain an approximate normal landing attitude at impact. Avoid contact in a nose down position.

19. Hold Wings Level - Level (P)

    Hold the wings level to avoid digging a wing into the sea and cart-wheeling the airplane.

20. Proceed to Emergency Exit (P, CP)

    Provide required equipment

ENGINEER

8. Proceed to Emergency Exit

   Provide required equipment

EMERGENCY JETTISONING

EXTERNAL FUEL TANK JETTISONING

Move the external fuel tanks release switch to the EXTERNAL TANK RELEASE position.

WARNING

> The external fuel tanks are unstable when less than half full and may strike the wing surfaces, especially if the wing flaps are extended.

In the event that the external fuel tanks must be jettisoned when less than half full, and time permits, check the wing flaps fully retracted and stabilize the airspeed within the ranges quoted before jettisoning tanks.

WEIGHT	AIRSPEED (IAS)
120,000 lb	185-200 knots
140,000 lb	195-215 knots
160,000 lb	215-230 knots

▼FUEL DUMPING

Fuel dumping may be accomplished by either of two methods, pressure or gravity. The gravity dumping method may be used in the event of failure of the air refueling fuel pumping system or if both outboard engines are inoperative. If air refueling fuel pump hydraulic pressure is lost during dumping on airplanes **22737** ▶ , dumping will be accomplished automatically y the gravity method since the boom nozzle poppet is eld open by the airplane hydraulic system.

NOTE

> In the event of hydraulic pressure loss in the boom system, the poppet valve may be opened by the use of the emergency hand pump system.

▼ PRESSURE FUEL DUMPING

Pressure fuel dumping requires a completely charged boom hydraulic system for maximum effectiveness. This is necessary because hydraulic pressure is required to open and hold open the boom nozzle poppet valve. Even though there may be sufficient pressure available to open the poppet valve before fuel flow is started, the force due to the weight of fuel flowing past the valve will tend to close the valve. Thus, maximum boom pressure will give maximum flow weight before inadvertent nozzle poppet closure. The A/R master switch and the hydraulic pressure switch must be OFF during takeoff and climb to prevent damage to the A/R pumps and gear boxes due to pressure surges at high engine RPM. Therefore, the engineer must advance the isodraulic handle slowly until the hydraulic pressure builds up.

NOTE

> To insure capability of pressurization the A/R hydraulic depressurization valve must be CLOSED. On airplanes **22737** ▶ the airplane hydraulic system depressurization and charging valve must also be in the NORMAL position. The poppet control, pressure fuel dump and the gravity fuel dump circuit breakers must all be set to accomplish pressure fuel dumping.

Use the following procedure for pressure fuel dumping:

ENGINEER (Only)

1. ***FUEL DUMP SWITCHES — DUMP***
2. ***ISODRAULIC HANDLE — ADVANCE***

CAUTION

> To prevent damage to the A/R system, do not exceed a maximum of 5400 pounds per minute fuel flow during air operation.

3. ***FUEL FLOW — MONITOR***
4. Fuel Dumping Complete:
    a. Isodraulic Handle - Retard (to OFF)
    b. Fuel Dump Switches - NORMAL

REACTIVATING FUEL DUMP SYSTEM AFTER NOZZLE POPPET CLOSURE

ENGINEER (Only)

Reactivate the fuel dump system after an inadvertent nozzle poppet closure as follows:

1. ***ISODRAULIC HANDLE — RETARD (TO O)***
2. ***FUEL DUMP SWITCHES — NORMAL***
3. ***A/R MASTER SWITCH — OFF***
4. ***FUEL DUMP PROCEDURE — FOLLOW***

    Limit fuel flow to 200 ppm below poppet closure flow rate.

WARNING

> In an actual emergency, dump fuel with the boom in the stowed position.

NOTE

- In the event fuel dumping is required with low hydraulic pressure, the engineer will position his fuel dump switches to DUMP and wait momentarily for hydraulic pressure to build up before advancing the isodraulic handle.
- During fuel dump other than emergency, it is recommended that the boom be lowered to the trail position prior to fuel dumping. This will eliminate the necessity of boom inspections after flight to clear any fuel or vapors that may have collected under the boom fairing.
- A pressure fuel dump rate of approximately 6000 pm may be expected. With one outboard engine inoperative, 60 percent of the above figure should be realized.

▼ Gravity Fuel Dumping

With this method of dumping the fuel dump rate may reach 2600 ppm, depending primarily upon the amount of fuel in the air refueling tanks and the airplane attitude. The poppet control, the gravity fuel dump and line valve circuit breakers must all be set to accomplish gravity dumping. After the boom is lowered to the trail position, raise the nose of the airplane to a slight nose high attitude if possible, and direct the engineer to position the fuel dump switches to the dump position.

CARGO JETTISONING

When cargo jettisoning becomes necessary, consideration should be given to all the factors involved so as not to compound the emergency. The cabin should be depressurized before any of the hatches are opened, using the emergency cabin pressure release handle located on the engine control stand. Oxygen masks should be worn at all times if at an altitude requiring the use of oxygen equipment. The boom operator should check the boom stowed and latched to prevent possible damage by jettisoned cargo. The external fuel tanks should be jettisoned, but only after checking the wing flaps fully retracted. If possible, the airspeed should be reduced to 131 knots IAS and the wing flaps lowered to 55 percent to attain a tail high attitude, in order to prevent possible damage to the horizontal stabilizer by jettisoned cargo.

NOTE

> The cargo hoist may be used if necessary to move cargo, but only if there are no fuel fumes present.

On the tanker configuration the rear cabin escape hatches are generally considered the best jettisoning exits.

WARNING

- When using the rear cabin escape hatches, the overwing hatches should not be opened as the volume and velocity of air entering these hatches will make their use hazardous. If for any reason the overwing hatches on airplanes not incorporating 1C10 529 are used, the airspeed should be reduced to 131 knots IAS prior to opening.
- On cargo configuration, with or without the aerial delivery installation, the rear cargo door should be considered the primary jettisoning exit. Only in extreme emergencies should the forward cargo doors be used. In jettisoning cargo, care should be taken that it is jettisoned in such an order that the c.g. limits are not exceeded.

SYSTEMS EMERGENCY OPERATION

FUEL SYSTEM

Fuel Tank Leak

ENGINEER (Only)

1. Boost Pump Switches (Leaking Tank) - EMERGENCY
2. All Fuel Selector Switches - TME
3. All Other Main Wing Tank Boost Pump Switches - One on NORMAL (each tank)
4. CWT Secondary Valve - OPEN (manually)

   If fuel is to be transferred into this tank.
5. Fuel Quantity Gages - Monitor
6. Leaking Tank Nearly Empty:
   a. CWT Valve - CLOSE
7. Leaking Tank Empty:
   a. Fuel Selector Switch - ME
   b. Boost Pump Switches (Leaking Tank) - OFF

CAUTION

> Do not operate boost pumps on an empty tank as this would damage pumps.

8. Fuel Management - As Required

Fuel Line Failure, Airplane Main Fuel Manifold

ENGINEER (Only)

1. ***ALL FUEL SELECTOR SWITCHES — TE***
2. ***MAIN WING TANK FUEL BOOST PUMP SWITCHES — ONE ON NORMAL (EACH TANK)***

③ Line Check - Conduct (E, P) (if required)

Coordinate with pilot if a fuel manifold line check is desired.

To Check A Suspected Leak In The Airplane Fuel System

The following are inflight procedures to check for a possible leak in the engine fuel system. Check all applicable lines, valves, switches, circuit breakers, and nacelles visually if possible.

Between The Fuel Selector Valve And The Engine

1. Shut-down affected engine per procedure ENGINE FIRE DURING FLIGHT in this Section.
2. Turn fuel tank selector switch to TE.

3. Turn boost pump switch to NORMAL.
4. When fuel pressure stabilizes turn boost pump switch to EMERGENCY.
5. When fuel pressure stabilizes again turn fuel selector switch to OFF.
6. Turn boost pump switch to OFF.

If pressure due to trapped fuel remains constant or drops slowly, no fuel leaks are indicated and the engine can be restarted by the procedure for RESTARTING ENGINE IN FLIGHT in this Section. Monitor the engine for erratic operation. Reduce power if necessary, or turn fuel boost pump on EMERGENCY. If there is an indication of a fuel leak: (noted by a rapid or immediate drop in fuel pressure)

1. Move fire gang bar switches to FIRE.
2. Maintain a watch for fire, fuel fumes or visual indication of fuel leakage, if possible.

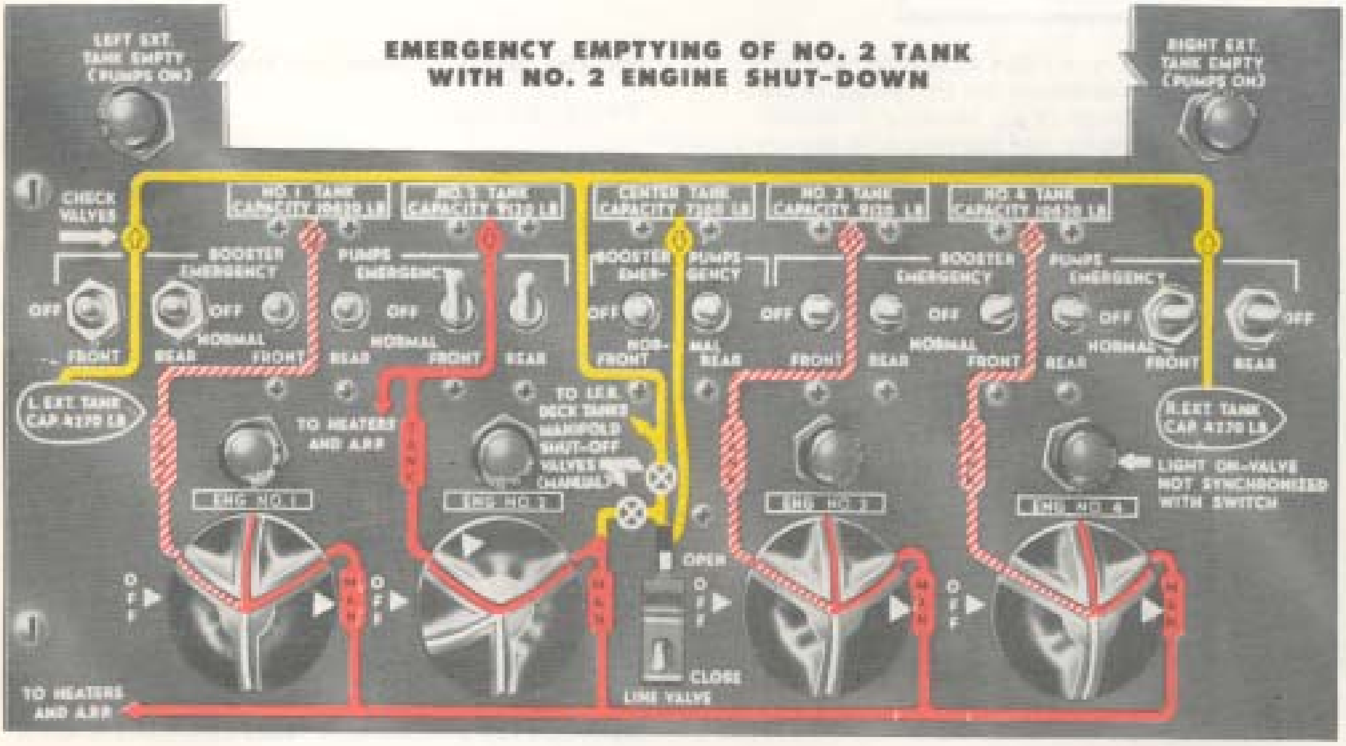
In The Fuel Manifold

To check a suspected leak in the fuel manifold:

1. Turn all engine fuel selector switches to TE.
2. Stop one engine with mixture lever and feather prop.
3. Turn boost pump switches for that engine to NORMAL.
4. When pressure stabilizes turn these boost pump switches to EMERGENCY.
5. When pressure stabilizes again turn fuel selector switch OFF.
6. Turn these boost pump switches OFF.
7. Observe the fuel pressure for about 10 seconds. If the fuel pressure remains constant or drops slowly continue this procedure.
8. Turn the fuel selector switch to TME.
9. Again turn boost pump switches for the stopped engine to NORMAL.
10. When pressure stabilizes turn these boost pump switches to EMERGENCY.
11. When pressure stabilizes again, turn fuel selector switch to ME.
12. Turn these boost pump switches to OFF.
13. Observe fuel pressure indicator (should the pressure drop slowly, although somewhat faster than in Step 7, no leaks are indicated).
14. Restore engine to operation per the procedure RESTARTING ENGINE IN FLIGHT in this Section.

Engine Driven Fuel Pump Failure

In the event an engine driven fuel pump fails, turn both boost pump switches to EMERGENCY, or use boost pumps as necessary to maintain fuel pressure within operating limits for the tank that is supplying the engine.



🟥 PRIMARY FLOW
▨ SECONDARY FLOW
🟨 NO FLOW

FUEL SYSTEM EMERGENCY OPERATION

Figure 3-10

ELECTRICAL SYSTEM

See figure 3-12.

HYDRAULIC SYSTEM

Failure Of Engine Driven Pump

Failure of one main hydraulic system engine driven pump will not be noticed with No. 2 and 3 engines operating since the remaining engine driven pump is adequate for the maintenance of system pressure. In the event both hydraulic pumps fail, turn off the rudder boost and windshield wiper systems to conserve main system pressure. Use the hydraulic hand pump to maintain service brake pressure. If necessary the emergency brake system may be recharged from main system or service brake system pressure, whichever is higher.

Line Rupture

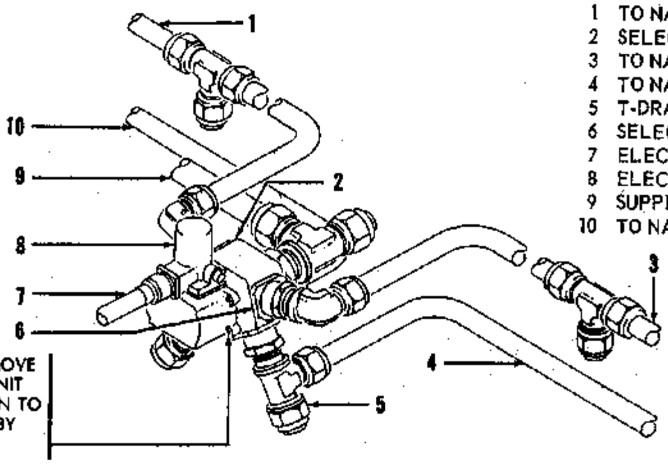
In the event of main system line reputure when the system is pressurized, move the depressurization and emergency charging valve handle to the DEPRESSURIZED position. This will depressurize all systems with the exception of the emergency brake system, and will reduce the danger caused by hydraulic fluid spray. With the valve in the DEPRESSURIZED position, the emergency brakes may be used during the landing roll, but cannot be recharged from the main system or by means of the hand pump.

Nose Wheel Steering Failure

If the nose wheel steering mechanism is malfunctioning and the direction of the airplane is uncontrollable, actuation of the nose wheel steering emergency disconnect button will bypass the hydraulic pressure used for steering and allow the nose wheel to caster freely. When the botton is actuated a light within the button is illuminated. The nose wheel will also caster freely if the pressure in the main hydraulic system is lost.

Emergency Brake Operation

Two hand operated levers for emergency brake operation are above the pilot on the overhead structure. When using the emergency brakes, apply steadily. Do not pump the hand levers as this action will rapidly lower the hydraulic pressure in the emergency system. Only three full applications of the emergency brakes are available, on airplanes incorporating 1010 541, only two full applications of the emergency brakes are available.



1 TO NACELLE NO. 4 OIL TANK
2 SELECTOR VALVE
3 TO NACELLE NO. 1 OIL TANK
4 TO NACELLE NO. 2 OIL TANK
5 T-DRAIN (TYPICAL) REMOVE CAP TO DRAIN
6 SELECTOR INDEX FOR MANUAL OPERATION
7 ELECTRICAL LEAD TO SELECTOR SWITCH
8 ELECTRICAL UNIT
9 SUPPLY LINE FROM TRANSFER PUMP
10 TO NACELLE NO. 3 OIL TANK

FOR MANUAL OPERATION REMOVE 4 SCREWS, PULL ELECTRICAL UNIT SLIGHTLY FORWARD, AND TURN TO DESIRED TANK AS INDICATED BY SELECTOR INDEX

MANUAL OPERATION OF THE CENTRAL OIL SYSTEM SELECTOR VALVE

Figure 3-11

ALTERNATING CURRENT FAILURES

Essential inverter power failure will affect the following:

1. Air Refueling (IFR) Fuel Pressure Gages
2. APN-69 plus ✈1C10 K211 (Emergency)
3. Autopilot Repeater Indicator
4. Cabin Air Flow Indicator.
5. Combustion Heater Ignition
6. Cowl Flap Position Indicators
7. Driftmeter **17260** ▶ **22628** less ✈1C10 K235
8. Fuel Flowmeters
9. Fuel Pressure Gages
10. Fuel Quantity Gages
11. Glide slope indicator
12. High Range Radio Altimeter
13. Hydraulic Pressure Gages **2894** ▶
14. Instrument Transformer
15. Intercooler Flap Position Indicators
16. Loran Receiver
17. Nesa Window Heat Control **2826** ▶
18. Oil Pressure Gages
19. Radio Magnetic Indicator (RMI)
20. Torquemeters
21. Turbosupercharger Control

Secondary inverter power failure will affect the following:

▼ 1. Air Refueling (IFR) Fuel Flow and Totalizer Indicator
▼ 2. Air Refueling (IFR) Fuel Quantity Gage
3. Fluorescent Lights
4. IFF Transmitter
5. Ignition Analyzer
6. Radar Equipment
   a. APN-12
   b. APN-76
   c. APS-42

Inverter failure indications and emergency action. . . . . . If the essential inverter fails, an automatic change-over relay connects the spare main inverter to the essential bus, regardless of whether or not the secondary bus is energized. The essential bus red light will flash on, followed by the essential bus amber warning light as the spare inverter takes over. If the secondary inverter fails, the secondary bus red light will flash on, an automatic change-over relay starts the spare main inverter and connects it to the secondary bus. The secondary bus amber warning light goes on and the red light goes out. If either automatic change-over relay fails, place the corresponding inverter switch in the SPARE INV position. Wait three seconds at OFF before switching to SPARE INV. If two main inverters fail, at least one bus is de-energized. The corresponding power failure red warning light remains illuminated.

Alternator failure will affect the following:

1. APN-69 plus ✈1C10 K211
2. Nesa Glass

Emergency action. . . . If an alternator fails, turn on the good alternator and set the selector switch to the desired position. If both alternators fail no further action can be taken. Operate APN-69 on essential inverter power.

ELECTRICAL SYSTEM EMERGENCY OPERATION

Figure 3-12 (Sheet 1 of 4)

ALTERNATING CURRENT FAILURES (CONT)

Instrument transformer failure will affect the following:

1. Cabin Air Flow Indicator
2. Cowl Flap Position Indicators
3. ▼ Engineer's and Boom Operator's A/R (IFR) Fuel Pressure Gages
4. Fuel Flowmeter
5. Fuel Pressure Gages
6. Hydraulic Pressure Gages
7. Intercooler Flap Position Indicators
8. Oil Pressure Gages
9. Torquemeters

Emergency action. . . . . Control engine power by manifold pressure gages and tachometers. Use AUTO LEAN or AUTO RICH mixture setting to control fuel flow. Set cowl flaps by visual observation. Hydraulic and fuel pressure warning lights will still function in the event of a system malfunction.

Flight instrument inverter power failure will affect the following:

1. Pilot's Attitude Indicator
2. Pilot's Directional Indicator

Failure indications and emergency action. . . . . . If the normal flight instrument inverter fails, the instrument inverter red light will flash on; an automatic change-over relay starts the spare instrument inverter. The instrument inverter amber warning light goes on as the red light goes out. If the instrument inverter change-over relay fails, place the flight instrument inverter switch in the SPARE INV position. If both instrument inverters fail the pilot's directional indicator and attitude indicator cease to function. The flight instrument inverter power failure red warning lights go on. Place the gyro instrument emergency power switch to BATTERY if failure is due to a d-c power failure.

Autopilot inverter power will affect the following:

1. Autopilot
2. Autopilot Repeater Indicators
3. Copilot's Attitude Indicator
4. Copilot's Turn and Slip Indicator
5. Driftmeter **22629** ▶ plus TCTO K235 ■
6. Master Direction Indicator
7. N-1 Compass

DC ELECTRICAL SYSTEM EMERGENCY OPERATION

Direct Current Instruments

1. Carburetor Air Temperature Gage
2. Cylinder Head Temperature Gage
3. Oil Quantity Gage
4. Oil Temperature Gage
5. Outside Air Temperature Gage
6. Pilot's Turn and Slip Indicator
7. Wing Flap Position Indicator

In emergency the battery bus can supply. . . .

1. ▼ Air Refueling Fuel Dump Circuit **17260** ▶ **3195**
2. APU Starting (On ground only)
3. Cabin Entrance Light
4. Emergency Alarm System
5. Emergency Control Cabin Lights **2930** ▶
6. Flight Instrument Spare Inverter
7. Generator Field Reset **2930** ▶
8. IFF Radio Destructors
9. Landing Flare Release
10. Pilot's Turn and Slip Indicator
11. Single Point Ground Refueling

Figure 3-12 (Sheet 2 of 4)

DC ELECTRICAL SYSTEM EMERGENCY OPERATION (Cont)

Generator Failure

❶In the event a generator warning light illuminates, indicating a power malfunction, check for a tripped field control relay. To accomplish this check, turn the voltmeter selector switch to the tripped generator position; if the meter indicates two to three volts, the field relay has tripped. To reclose the field relay, move the respective generator switch to RESET and then to OFF, adjust the voltage to 28 volts (if voltage cannot be adjusted down to 28 volts, an overvoltage condition exists and the generator must be made inoperative by leaving the switch in the OFF position and removing the voltage regulator), move the generator switch to ON, and readjust the voltage to equalize the load. If the generator field control relay trips again, repeat the above procedure. If, at that time, it is impossible to parallel the generator or if the field relay trips, turn generator switch OFF and remove the voltage regulator. Leave generator switch OFF until the cause of the failure has been determined and corrected.

❷ In the event of generator failure (negative, zero, residual, or fluctuating voltage and zero, negative, or fluctuating amperage) the following procedure will apply:
a. Generator switch - OFF, b. Voltage regulator - REMOVED, c. Observe respective engine closely for symptoms of fire, d. Trouble shoot system as required.

Three generator Operation. . . . . Three generators will supply enough power to operate all the d-c equipment including inverters under normal conditions. See DC ELECTRICAL LOADS chart in Section VII. As a precautionary measure the loadmeters should be checked frequently, especially when propeller deicers are operating.

Two generator Operation. . . . Operation with two generators will require more care, but under most conditions sufficient d-c power is available. With propeller deicers operating, the auxiliary power plant must be started; all non essential d-c equipment and the secondary inverter should be turned off. During landing, prior to extending the wing flaps or landing gear, the propeller deicers should be turned off. Do not extend or retract gear and wing flaps at the same time. Complete the operation of one system prior to operating the next system. Monitor d-c loadmeters continually. NOTE: The landing gear may be lowered individually by pulling individual gear control circuit breakers when considered necessary.

Failure of all generators. . . . If all generators fail it will be the result of a d-c system fault or short circuit causing progressive overloading. In event of this, proceed as follows:

❶Turn off all inverters and all d-c equipment. Do not move engine controls except throttles and mixture controls which should be set to AUTO RICH.

❷The following equipment must be turned off:
a. Inverters, b. Alternators, c. All radios, d. Boost pumps, e. Heater switches, f. Autopilot, g. Turbo boost switch to MAN, turbo manual override switch OFF, h. All lights except pilots' white instrument panel lights, i. Do not operate any switches or controls except to set to the OFF position, j. Turn generator switches OFF.

❺ Place gyro instrument emergency power switch to BATTERY to operate spare instrument inverter, pilot's turn and slip Indicator and, airplanes **2930** ▶ plus 1C10 K235 ◀ emergency lights.

❹ In the lower forward compartment manually reset generator field control relays that are easily accessible by means of the push button on each relay box. The remaining relays can then be reset electrically. On code **2930** ▶ airplanes all relays can be reset electrically. Do not move generator switches to ON. Check all generator voltages with voltmeter.

❺Turn on one generator showing normal voltage. Carefully monitor loadmeter and turn on essential inverter. Turn on a second operative generator and observe loadmeters for satisfactory load division. Continue until all operative generators are on the d-c bus system. Be alert for sudden changes in engine operation as the control circuits are re-energized.

❻Turn on the ADF for use as a range and navigation receiver. In orderly sequence add essential equipment, one unit at a time, constantly monitoring loadmeters to detect unusual fluctuations. Continue to nearest landing field. Consider advisability of manually extending landing gear if two or less generators are operative. Do not use propeller deicers on landing. Do not use propeller reverse, during landing, unless absolutely necessary. If propeller reversing is required reverse the inboard propellers only to prevent sudden bus failure with the possibility of unsymmetrical reverse thrust and a consequent loss of directional control.

Number of generators required for take off . . . ❶Recommend one operative generator per engine.

ELECTRICAL SYSTEM EMERGENCY OPERATION (CONT)

Figure 3-12 (Sheet 3 of 4)

DC ELECTRICAL SYSTEM EMERGENCY OPERATION (Cont)

VISUAL INDICATION (Generator Switch ON)

GENERATOR WARNING LIGHTS		LOADMETERS		VOLTMETERS		PROBABLE CAUSE	ACTION
Failed Generator	Other Generators	Failed Generator	Other Generators	Failed Generator	Other Generators		
ON	OFF	ZERO	ABOVE NORMAL	ZERO	NORMAL	Internal generator failure	Move generator switch to OFF, no other action posible in flight.
ON	OFF	ZERO	ABOVE NORMAL	2 to 3 VOLTS	NORMAL	Open generator field or open voltage regulator	Follow action below, if field retrips, move generator switch to OFF, leave OFF.
ON	OFF	ZERO	ABOVE NORMAL	2 to 3 VOLTS	NORMAL	Overvoltage on one generator	Move the respective generator switch to RESET and then to OFF, adjust the voltage to 28 volts (if voltage cannot be adjusted down to 28 volts, an overvoltage condition exists and the generator must be made inoperative by leaving the switch in the OFF position and removing the voltage regulator), move the generator switch to ON, and readjust the voltage to equalize the load. If the generator field control relay trips again, repeat the above procedure. If, at that time, it is impossible to parallel the generator or if the field relay trips, turn generator switch OFF and remove the voltage regulator. Leave generator switch OFF until the cause of the failure has been determined and corrected.
ON	PROGRESSIVELY ON	ZERO	ABOVE NORMAL	2 to 3 VOLTS	NORMAL THEN 2 to 3 VOLTS WHEN LIGHTS COME ON	Overvoltage due to improper paralleling with progressive overloading	Turn off all inverters and d-c equipment. In the lower forward compartment manually reset a generator field control relay that is easily accessible. Reset remaining relays by means of the generator switches. All relays can be reset electrically. Do not move generator switches to ON. Check all generator voltages with voltmeter. Turn on one generator showing normal voltage. Use rheostat to adjust to normal voltage when necessary. Carefully monitor loadmeter and turn on essential inverter. Turn on second operative generator and observe loadmeters for satisfactory load division. Continue until all operative generators are on the bus.
ON OR OFF DEPENDING ON AMOUNT OF UNDERVOLTAGE	OFF	VERY LOW	ABOVE NORMAL	LOW	NORMAL	Undervoltage on one generator due to improper paralleling	If warning light is OFF, turn rheostat up slightly to rebalance load. If warning light is ON, turn generator switch OFF, diagnose difficulty, raise voltage with rheostat.
OFF	OFF	VERY HIGH	ZERO OR REVERSED	NORMAL	NORMAL OR SLIGHTLY HIGH	Loss of paralleling circuit with resulting instability	Move failed generator switch OFF, check other loadmeters for proper load distribution. If another generator takes load move all but one generator switch OFF. Do not make more than one attempt to place each generator on bus. Turn OFF all unnecessary electrical equipment.
ON	OFF	OFF SCALE	ABOVE NORMAL	LOW	NORMAL	Ground fault on generator leads	Move failed generator switch OFF, leave OFF. Pull field control circuit breaker.
OFF	OFF	OFF SCALE	HIGH OR OFF SCALE	VERY LOW	LOW	Ground fault on generator leads with welded reverse current relay	Turn master switch and all generator switches OFF. Pull field control circuit breakers. Turn master switch ON. Reset one circuit breaker at a time, checking each voltage and loadmeter. Low voltage and high percent load will indicate faulty generator, leave that generator switch OFF, turn other switches ON.
(These indications might be followed by blown current limiter - see next item)							
ON	OFF	ZERO	ABOVE NORMAL	NORMAL	NORMAL	Open circuit in power feed (blown current limiter)	Move generator switch OFF, leave OFF, monitor loads to make sure remaining generators are not overloading.
OFF	OFF	OFF SCALE	OFF SCALE	LOW	LOW	Ground fault on main bus	Move all generator switches to OFF, leave OFF.

Figure 3-12 (Sheet 4 of 4)

TURBOSUPERCHARGER EMERGENCY OPERATION

Engine Overboost

A rapid rise in manifold pressure often accompanied by the engine overspeeding usually indicates a turbosupercharger control system failure. On airplanes **3196** ▶, plus those incorporating ✈ TCTO 338 ▶, an overboost may be indicated by an increase of several inches manifold pressure especially if at a cruise power setting. Positive indication of failure will be no response to control by means of the turbo boost selector lever when the system is under automatic control.

ENGINEER (Only)

1. ***IMMEDIATELY AND SIMULTANEOUSLY:***

   a. ***THROTTLE (AFFECTED TURBO) — RETARD***

   NOTE

   A sudden closing of the throttles when above 2300 bhp may cause backfire which may damage the induction system.

   b. ***TURBO OVERRIDE SWITCH (FOR AFFECTED TURBO) — OPEN (GUARD DOWN)***

   NOTE

   In order that this procedure be effective, the manual override switches should have been positioned to OPEN (guards down) when the turbo switches were positioned to AUTO and remain OPEN (guards down).

   c. ***TURBO SWITCH (AFFECTED TURBO) — MAN***

   NOTE

   - This action will transfer control of the wastegate to the manual override switch and cause the wastegate to be driven to the full open position.
   - Do not disturb the turbo boost selector lever setting.

2. Turbo Amplifier Fuse - Have checked

   a. If Blown - Replace

   b. Amplifier (If Fuse Not Blown) - Replace

3. Amplifier - Warm up

   Warm for at least one minute

4. Turbo to Automatic Control - Return

Return to automatic per the procedure MANUAL TO AUTOMATIC CONTROL, ONE OR MORE TURBOS in Section VII.

5. Malfunction still indicated:

   a. Perform Step 1 again

⑥ Manual Control - Use (at Pilot's discretion) (E, P)

   Coordinate with pilot to determine the need for operation in manual control.

Manual Control

The override system may be used to control the turbosupercharger for an extended period of time if the automatic control system is inoperative and the pilot decides that conditions are such that manual operation is necessary. For manual operation see Section VII.

CAUTION

If the required manifold pressure cannot be obtained by actuating the turbo override switch to the CLOSE position; a leak is indicated somewhere in the exhaust system between the engine and the turbo. Continued operation with a closed wastegate will permit hot exhaust gases to escape through the leak, constituting a fire hazard.

Failure On All Four Engines Simultaneously

If a failure occurs in the automatic turbo control system to all four engines simultaneously, the trouble is probably electrical. Accomplish Step 1 of ENGINE OVERBOOST this Section for all the turbosuperchargers. Check the SUPCHG CONTR circuit breaker or fuse on the AC power panel and the turbo amplifier fuses located in the lower nose compartment. Replace any blown fuses and reset the circuit breaker. Allow the amplifiers to warm-up for at least one minute. Then return the system to automatic control per the procedure MANUAL TO AUTOMATIC CONTROL, ALL TURBOS in Section VII. If the automatic control system still does not operate properly, control all the turbosuperchargers per procedure AUTOMATIC TO MANUAL CONTROL in Section VII.

Complete Electrical Failure

If a complete electrical (AC power) failure occurs, a solenoid brake in the wastegate motor will hold the wastegate in the approximate position set at the time of power failure. Accomplish Step 1 of ENGINE OVERBOOST this Section for all the turbos. When the power is restored, allow the amplifiers to warm-up for at least one minute. If the amplifiers do not warm-up, check all system circuit breakers and fuses. Return the system to automatic control per procedure MANUAL TO AUTOMATIC CONTROL, ALL TURBOS in Section VII. If the automatic control system still does not operate properly, control all the turbos per procedure AUTOMATIC TO MANUAL CONTROL in Section VII.

Turbo Lubrication Failure

In the event clear (honey-colored) oil is detected leaking in the vicinity of a nacelle, the following procedure is recommended:

1. Advise the Pilot - Turbo oil leakage
2. At the Pilot's Discretion Either (For The Affected Engine):
   a. Wastegate - Open
   b. Prop - Feather

WING FLAP SYSTEM

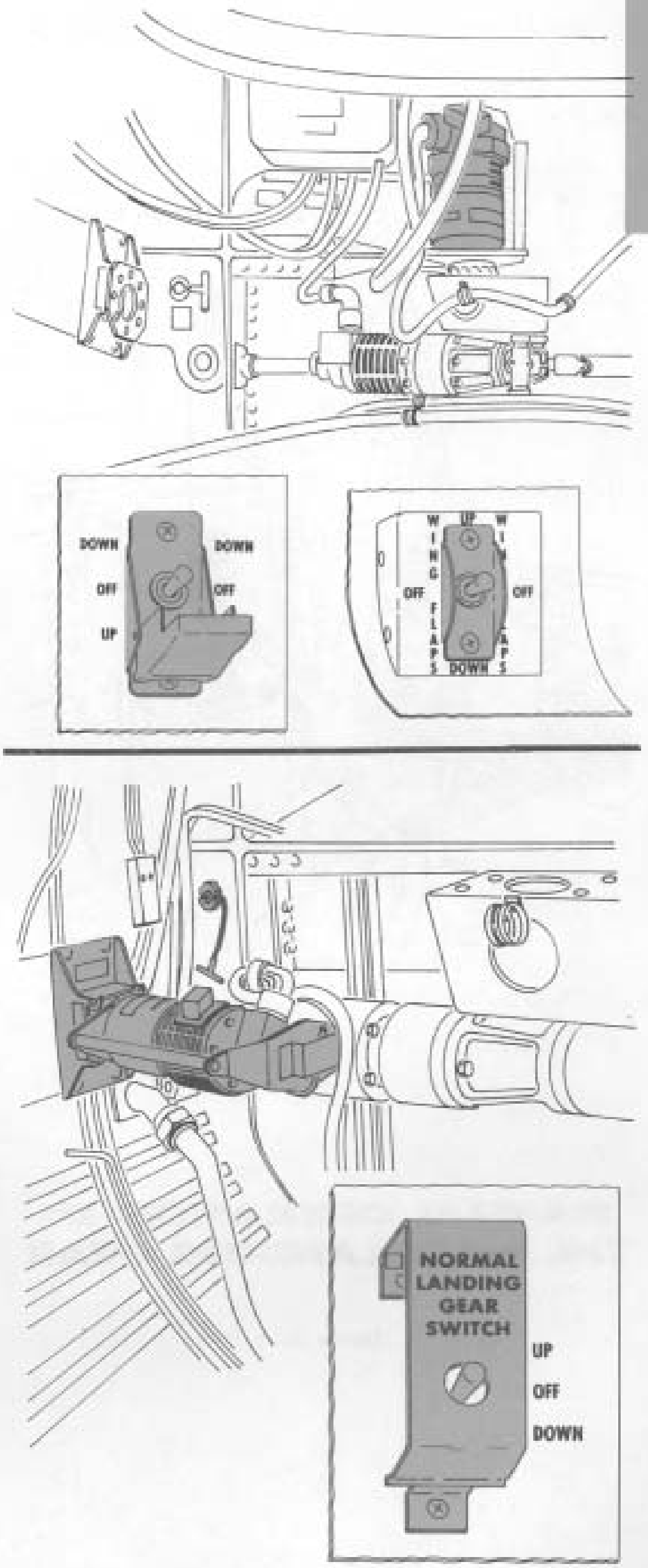
TO OPERATE THE WING FLAPS

1. Normal wing flap switch OFF.
2. Use the emergency wing flap switch on the overhead panel to raise or lower the flaps to the desired position as indicated on wing flap position indicator.

CAUTION

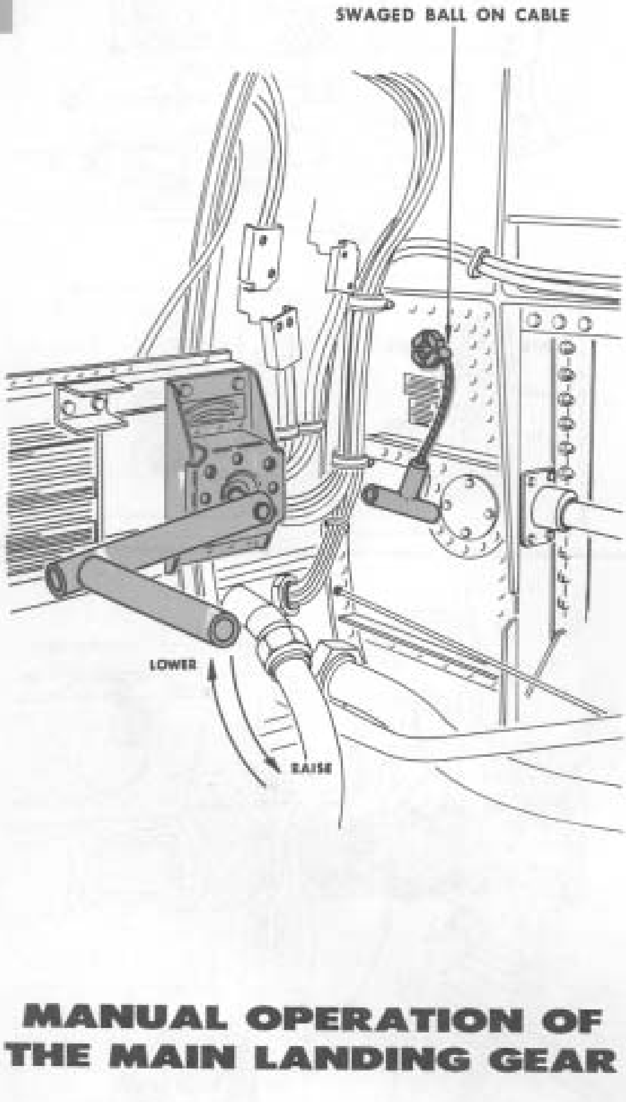
> Limit switches are not actuated when emergency wing flap switch is used. If full flap travel is desired, return switch to the OFF position 10 percent before stops are contacted to prevent possible damage to the flap torque tube system and auxiliary motor clutch.

3. Assigned scanner reports flap position to pilot.
4. Milk the flaps the last 10 percent (coordinate with assigned scanner), and return switch to OFF position after the stops are contacted.



USING THE AUXILIARY FLAP MOTOR

Figure 3-13



MANUAL OPERATION OF THE MAIN LANDING GEAR

Figure 3-14

LANDING GEAR SYSTEM

Main Landing Gear Operation With Aux Flap Motor

NOTE

> Aircrew member in lower aft compartment will establish interphone contact with the pilot before initiating manual gear operation.

If the main landing gear motor should fail, raise or lower the gear as follows:

1. Normal landing gear switch OFF. Pull landing gear control circuit breaker.
2. Pull the emergency wing flap control circuit breaker.

WARNING

> The control circuit breaker for the portable auxiliary flap motor, located on the main dc circuit breaker panel, must be pulled whenever the motor is not secured. Accidental actuation of the portable flap motor switch when the motor is not secured may cause damage to the airplane or injury to the operator.

3. Pull the red handle, near each emergency landing gear hand crank receptacle out and seat the swaged ball in the slot to disengage the motor clutch and to engage the manual clutch.
4. Install portable auxiliary flap motor, reset emergency wing flap control circuit breaker and operate the switch on the motor in the direction indicated on the switch cover.
5. Run the motor until the landing gear stops are hit and the motor clutch starts slipping (approximately 60 seconds required).
6. Always release the clutch handle immediately after emergency operation is complete; return portable auxiliary flap motor to normal stowed position for emergency wing flap operation.

Manual Gear Lowering—Main Gear (All Crew Members)

1. Establish Interphone Contact - Established

2. Check Landing Gear Switch OFF - Checked OFF

   Have co-pilot check landing gear switch OFF

3. Pull Control Circuit Breaker - PULLED

   Have engineer pull applicable control circuit breaker.

4. Pull Red T Handle Out and Seat Swaged Ball - Pulled and seated

   Seat swaged ball in slot to disengage motor clutch and to engage manual clutch

5. Insert Emergency Hand Crank - Inserted

6. Rotate Ten Turns in Down Direction - Rotated

7. Snap Red T Handle Forward - Snapped forward

8. Oscillate Emergency Hand Crank Rapidly - Oscillated

   a. Allow Free Fall (5 seconds)

   Rapidly oscillate emergency hand crank to free manual clutch; gear will lower by gravity after clutch is disengaged

CAUTION

After manual clutch is released do not attempt to re-engage manual clutch or operate gear for five seconds. This allows time for gear to free fall and prevent damage to clutch mechanism or injury to operator which would result if manual clutch were re-engaged while gear was free falling.

9. Pull Red T Handle Out and Seat Swaged Ball - Pulled and seated

   This will re-engage the manual clutch

10. Rotate Emergency Hand Crank in Down Direction - Rotated

    Rotate until stops are hit and the lock is engaged

11. Check for Safe Indication - Checked

    Check with pilot for safe indication.

CAUTION

Make certain down lock is engaged. Lock can be felt snapping into position after stops are contacted.

12. Reset Red T Handle and Oscillate Emergenc Hand Crank - Reset and Oscillated

    Always reset the red handle and oscillate emergency hand crank after emergency operation i completed to allow electrical operation of th landing gear

13. Stow Emergency Hand Crank - Stowed

14. Reset Control Circuit Breaker - RESET

    Have engineer reset applicable control circuit breaker

15. Gear Switch - DOWN

    Cover in place

Manual Raising of Main Landing Gear

CAUTION

If the normal gear retraction system fails, the gear will not be manually retracted unless a gear down condition is unsafe. If a manual practice procedure is performed, gear must be operated through one complete cycle electrically before a landing, to assure correct normal operation.

1. Landing gear switch OFF. Pull landing gear control circuit breaker.

2. Pull the red handle to engage the manual clutch.

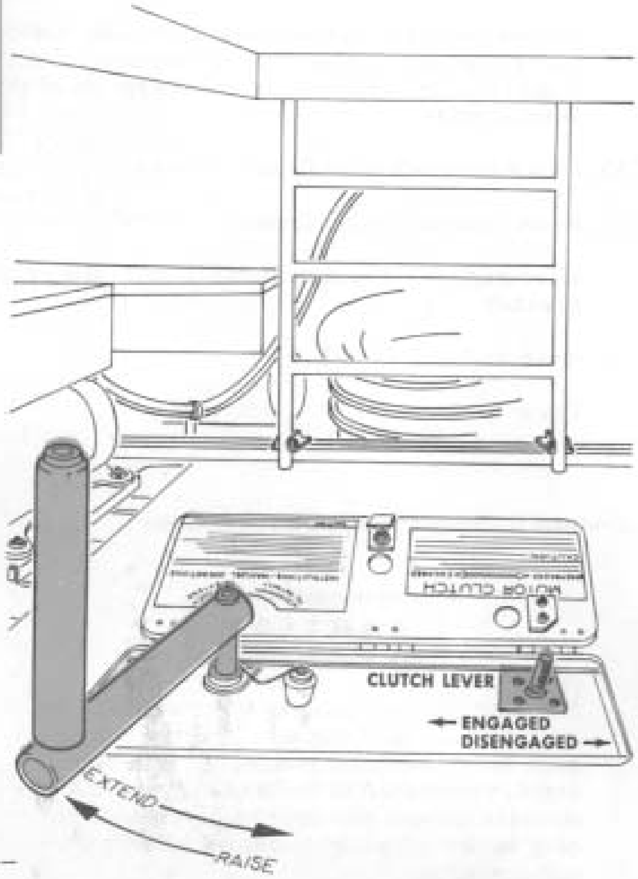
3. Insert the emergency hand crank and rotate it in the direction indicated until the stops are contacted and the lock is engaged (490 turns are required).

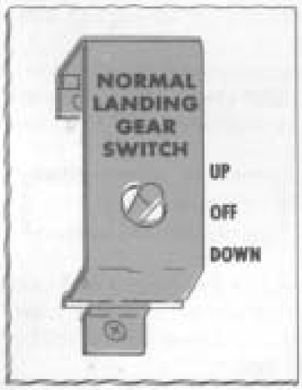
CAUTION

- Always reset the red handle and oscillate emergency hand crank after emergency operation is completed to allow electrical operation of the landing gear.
- When presence of ice is suspected, turn emergency hand crank 3 turns in both extend and retract directions prior to pulling red T handle.

NOTE

Aircrew member in lower aft compartment will establish interphone contact with the pilot before initiating manual gear operation.





LANDING GEAR SWITCH OFF DURING MANUAL OPERATION

MANUAL OPERATION OF THE NOSE GEAR

Figure 3-15

Manual Gear Lowering—Nose Gear (All Crew Members)

1. Check Landing Gear Switch Off - Checked OFF

   Have copilot check landing gear switch OFF

2. Pull Control Circuit Breaker - PULLED

   Have engineer pull the nose gear control circuit breaker.

3. Disengage Motor Clutch - Disengaged
4. Remove Rubber Plug - Removed
5. Engage Emergency Hand Crank - Engaged

   Engage the crank through the two keyed sections by pressing down on the crank hub for the first full turn.

6. Rotate Five Turns in Down Direction - Rotated
7. Remove Emergency Hand Crank - Removed

   a. Allow Free Fall (5 Seconds)

8. Re-engage and Rotate Emergency Hand Crank - Re-engaged and rotated

   Re-engage the crank and rotate in down direction until the gear hits the stops the lock will then set with a perceptible snap.

9. Re-engage Motor Clutch - Re-engaged

   If clutch does not engage, return clutch lever to DISENGAGED, insert crank and back off approximately 180 degrees or 360 degrees to change alignment of clutch dogs, then move clutch lever to ENGAGED. After clutch lever is moved to engaged position be certain that full travel to the down and locked position is accomplished by turning crank to down position until stops are contacted and the lock is engaged.

10. Check for Safe Indication - Checked

    Check with pilot for safe indication

11. Stow Emergency Hand Crank - Stowed
12. Replace Rubber Plug - Replaced
13. Reset Control Circuit Breaker - RESET

    Have engineer reset nose gear control circuit breaker

14. Gear Switch Down - DOWN

    Cover in place

Manual Raising of Nose Gear

CAUTION

If normal gear retraction system fails, the gear will not be manually retracted unless a gear down condition is unsafe.

1. Landing gear switch OFF.

2. Pull the nose gear control circuit breaker.

3. Disengage the motor clutch.

4. Remove the rubber plug from the socket and engage the emergency hand crank through the two keyed sections by pressing down on the crank hub for the first full turn.

5. Crank the gear up; approximately 220 turns of the emergency hand crank are required to return nose gear fully retracted.

6. Return motor clutch to the engaged position.

CAUTION

Always return motor clutch to the engaged position. To prevent damage to motor by overspeeding, do not operate motor with clutch disengaged.

7. Remove the emergency hand crank and replace the rubber plug.

8. Reset nose gear circuit breaker.

NAVIGATOR'S EMERGENCY PROCEDURES

FUSELAGE/ELECTRICAL FIRE

①Fire Indication - Report or acknowledge (N, P)

Crew member discovering any indication of a fuselage or electrical fire will use the interphone CALL function to alert other crew members.

2. Oxygen - Mask on and regulator 100%

Use walk-around bottle if necessary

③Cause of Fire - Determine and report (N, P, RO, BO)

When cause of fire is determined, notify pilot. If fire is determined to be of electrical origin, applicable equipment will be turned off and/or circuit breakers and fuses pulled. If source of fire is result of fuel system failure, coordinate with engineer on positioning applicable fuel valves.

4. Runner - Navigator (electrical fire of undetermined source)

If fire is of undetermined electrical origin, it will be necessary to turn the master switch OFF. At this time, the navigator assumes duty of relaying pilot's instructions to other crew members.

5. If Fire Accessible - Fight with hand fire extinguisher

WARNING

Repeated or prolonged exposure to high concentrations of Bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken including the use of oxygen when available.

⑥Fire Status - Report to pilot (N, P, BO, RO)

One crew member will notify the pilot when fire has been extinguished and if any smoke or fumes are present. Should fire become uncontrollable, immediately notify pilot so bail-out procedures may be initiated.

SMOKE, FUMES, FUEL FUMES ELIMINATION

①Smoke or Fumes Indication - Report or acknowledge (N, P)

Crew member discovering any indication of smoke or fumes will use the interphone CALL function to alert the other crew members.

2. Oxygen - Mask on and regulator 100%

3. Runner - Navigator (only when fuel fumes reported)

If fuel fumes are reported, the interphone becomes inoperative when the engineer turns master switch OFF. At this time, navigator assumes duty of relaying pilot's instructions to other crew members.

④ Hatches - Open as directed by pilot (N, P, BO, RO)

If smoke or fumes are present in lower compartment, open floor hatches to assist in ventilation after opening the emergency exit hatches as directed by pilot.

⑤ Status of Smoke or Fumes - Report to pilot (N, P, BO, RO)

One crew member will notify pilot when smoke or fumes no longer exist or that ventilation has not been successful.

⑥ Electrical Equipment - All switches OFF (N, RO, E)

If master switch has been turned OFF due to presence of fuel fumes, turn all electrical equipment switches OFF prior to turning master switch ON.

7. Switches and Circuit Breakers (for essential equipment) - ON (one at a time)

If smoke or fumes resulted from an electrical fire of undetermined source, turn equipment on as needed, carefully observing the equipment and wiring. When fault is detected, isolate circuit or equipment by disconnecting or leaving inoperative.

BAIL-OUT

① Warning Signal - Acknowledge (N, CP)

If time permits, the warning signal of three short rings on the alarm bell will be acknowledged on interphone.

2. Anti-Exposure Suit, Life Vest, Parachute, and Harness - Check for proper fit

Don anti-exposure suit and life vest as applicable prior to adjusting parachute and harness.

3. IFF - EMERGENCY 17260▶ 2900, 3340▶

4. Position Report - Prepare

   a. Position and Time - Determine and record

   ⓑ Pilot's Intentions - Determine and record (N, P)

   c. Course and Ground Speed - Determine and record

   d. Number of Personnel on Board - Determine and record

   e. Nature of Emergency - Determine and record

   ⓕ Assistance Desired - Determine and record (N, P)

   g. Type Airplane - Record

   h. Altitude - Record

5. Set Radio Channelization - Set (N, CP)

Coordinate with copilot to ascertain that proper channel is set on the radio to be used for distress message.

6. Distress Message - Transmit

Navigator will establish contact with last ground facility utilized. If contact cannot be made, navigator will establish contact on an emergency frequency. Transmit "Mayday" three times, identification three times, and emergency position report. Request fix or bearing service if desired.

7. Individual Survival Kits or One-Man Life Raft - Attach

8. Additional Survival Equipment - Release

Release additional survival kits, emergency radios, and multiple place life rafts as applicable between personnel as they leave the airplane.

9. Bail Out in Sequence - On command (one long ring)

Bail out through left rear emergency exit when 15 or less persons are on board. Use left overwing emergency exit when 16 or more persons are on board.

DITCHING/CRASH LANDING

① Warning Signal - Acknowledge (N, CP)

If time permits, the warning signal of six short rings on the alarm bell will be acknowledged on interphone.

2. IFF - EMERGENCY **17260**▶ **2900**▶, **3340**▶

3. Position Report - Prepare

   a. Position and Time - Determine and record

   ⓑ Pilot's Intentions - Determine and record (N, P)

   c. Course and Ground Speed - Determine and record

   d. Number of Personnel on Board - Determine and record

   e. Nature of Emergency - Determine and record

   ⓕ Assistance Desired - Determine and record (N, P)

   g. Type airplane - Record

   h. Altitude - Record

④ Set Radio Channelization - Set (N, CP)

Coordinate with copilot to ascertain that proper channel is set on the radio to be used for distress message.

5. Distress Message - Transmit

Navigator will establish contact with last ground facility utilized. If contact cannot be made, navigator will establish contact on an emergency frequency. Transmit "Mayday" three times, identification three times, and emergency position report. Request fix or bearing service if desired.

⑥ Absolute Altitude - Give to pilot (ditching only) (N, P)

Navigator will obtain accurate absolute altitude and give to pilot. Pilot will set absolute altitude on his pressure altimeter.

7. Parachute Harness - Remove

⑧ Ditching/Crash Landing Preparation - Complete (N, BO, RO)

Assemble navigation kit, pyrotechnic pistol and flares, and flashlight. Assist other crew members in securing emergency equipment near emergency exits and jettisoning unnecessary equipment and cargo.

9. Anti-Exposure Suit and Life Vest - Don (ditching only)

10. Ditching/Crash Landing Position - Assume

11. After Impact - Abandon airplane by appropriate exit

After airplane has come to complete stop, abandon airplane by appropriate exit. Assist other crew members in removing emergency equipment and launching life rafts (if applicable).

RADIO OPERATOR'S EMERGENCY PROCEDURES

FUSELAGE/ELECTRICAL FIRE

① Fire Indication - Report or acknowledge (RO, P)

Crew member discovering any indication of a fuselage or electrical fire will use the CALL function of the interphone to alert other crew members.

2. Oxygen - Mask on and regulator 100%

Use walk-around bottle if necessary.

③ Cause of Fire - Determine and report (RO, P)

When cause of fire is determined, report to pilot. If fire is determined to be of electrical origin, applicable equipment will be turned OFF and/or circuit breakers and fuses pulled. If source of fire is result of fuel system failure, coordinate with engineer on positioning applicable fuel valves.

4. If Fire Accessible - Fight with hand fire extinguishers

WARNING

Repeated or prolonged exposure to high concentrations of Bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken including the use of oxygen when available.

⑤ Fire Status - Report to pilot (RO, P, N, BO)

One crew member will relay information to pilot when fire has been extinguished and if there is any presence of smoke or fumes remaining. Should fire become uncontrollable, immediately notify pilot so bail-out procedures may be initiated.

SMOKE, FUMES, FUEL FUMES ELIMINATION

① Smoke or Fumes Indication - Report or acknowledge (RO, P)

Crew member discovering any indication of smoke or fumes will use the CALL function of the interphone to alert the other crew members.

2. Oxygen - Mask on regulator 100%

Use walk-around bottle if necessary.

③ Hatches - Open as directed by pilot (RO, P, N, BO)

If smoke or fumes are present in lower compartments, open floor hatches to assist in ventilation, after opening the main compartment emergency exits as directed by the pilot.

④ Status of Smoke or Fumes - Report to pilot (RO, P, N, BO)

One crew member will report to pilot when smoke and/or fumes no longer exist or that ventilation has not been successful.

⑤ Electrical Equipment - All switches **OFF** (RO, N, E)

If master switch has been turned OFF due to presence of fuel fumes, turn all electrical equipment switches OFF prior to turning master switch ON.

6. Switches and Circuit Breakers (for essential equipment) - ON (one at a time)

If smoke or fumes resulted from an electrical fire of undetermined source, turn equipment on as needed, carefully observing the equipment and wiring. When fault is detected, isolate circuit or equipment by disconnecting or leaving inoperative.

BAIL-OUT

① Warning Signal - Acknowledge (RO, P)

If time permits, the warning signal of three short rings on the alarm bell will be acknowledged.

2. IFF - EMERGENCY (if applicable)

Turn IFF to EMERGENCY if the control is installed at the radio position and the navigator is not aboard.

3. Survival Equipment, Harness, and Parachute - Check for proper fit

Don anti-exposure suit and life vest for over water bail-out when time permits, before adjusting harness and parachute.

4. Distress Message - Transmit (time permits)

Obtain position report from navigator and transmit distress message on last frequency worked or on emergency frequency.

5. Emergency Exits - Open

With 15 or less persons aboard assist in opening the left rear emergency exit, with 16 or more aboard assist in opening the over wing emergency exits.

6. Individual Survival Kit - Attach to harness

7. Rafts and Dinghy Radios - Release on command (one long ring)

8. Bail Out in Sequence - On command (one long ring)

CRASH LANDING

① Warning Signal - Acknowledge (RO, P)

If time permits, the warning signal of six short rings on the alarm bell will be acknowledged on interphone.

2. IFF - EMERGENCY (if applicable)

Turn IFF to EMERGENCY if the control is installed at the radio position and the navigator is not aboard.

3. Distress Message - Transmit (time permits)

Obtain position report from navigator and transmit distress message on last frequency worked or on emergency frequency.

4. Emergency Exit Hatches - Remove and secure

5. Door Safety Lock Pins - Unlock (forward and aft doors)

6. Cargo and Loose Equipment - Jettison (rear emergency exits)

FWD 190

7. Assume Crash Landing Position - Safety belt fastened

8. After Impact - Abandon airplane by appropriate exit

After airplane comes to complete stop, abandon airplane by appropriate exit. Assist other personnel to abandon the airplane.

DITCHING

1. Warning Signal - Acknowledge (RO, P)

If time permits, the warning signal of six short rings on the alarm bell will be acknowledged on interphone.

2. IFF - EMERGENCY (if applicable)

Turn IFF to EMERGENCY if the control is installed at the radio position and the navigator is not aboard.

3. Distress Message - Transmit (time permits)

Obtain position report from navigator and transmit distress message on last frequency worked or on emergency frequency.

4. Floor Hatches - Closed

5. Emergency Exit Hatches - Remove and secure

6. Cargo and Loose Equipment - Jettison (rear emergency exits)

7. Emergency Equipment - Secure near emergency exits

8. Parachute Harness - Remove

9. Anti-Exposure Suit and Life Vest - Don

10. Assume Ditching Position - Safety belt fastened

11. After Impact - Abandon airplane by appropriate exit

After airplane comes to complete stop, abandon airplane by appropriate exit. Assist other crew members in removing emergency equipment and launching rafts.

BOOM OPERATOR'S EMERGENCY PROCEDURES

FUSELAGE/ELECTRICAL FIRE

① Fire Indication - Report to crew or acknowledge (All)

Crew member discovering any indication of a fuselage or electrical fire will use the CALL function of the interphone to alert other crew members.

2. Oxygen - Mask on and regulator 100%

Use walk-around bottle if necessary.

③ Cause of Fire - Determine and report (BO, P)

When cause of fire is determined, report source to pilot. If fire is determined to be of electrical origin, applicable equipment will be turned off and/or circuit breakers and fuses pulled. If source of fire is result of fuel system failure, coordinate with engineer on positioning applicable fuel valves.

4. If Fire Accessible - Fight with hand fire extinguishers

WARNING

Repeated or prolonged exposure to high concentrations of Bromochloromethane (CB) or decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken including the use of oxygen when available.

⑤ Fire Status - Report to pilot (BO, P, RO, N)

One crew member will inform the pilot when fire has been extinguished and if there is any smoke or fumes remaining. Should fire become uncontrollable, immediately notify pilot so bail-out procedures may be initiated.

SMOKE, FUMES, FUEL FUMES ELIMINATION

① Smoke or Fumes Indication - Report to crew or acknowledge (All)

Crew member discovering any indication of smoke or fumes will use the CALL function of the interphone to alert the other crew members.

2. Oxygen - Mask on and regulator 100%

Use walk-around bottle if necessary.

③ Hatches - Open as directed by pilot (BO, P, RO, N)

If smoke or fumes are present in lower compartments, open floor hatches to assist in ventilation, after opening the emergency exit hatches as directed by pilot.

④ Status of Smoke or Fumes - Report to pilot (BO, P, N, RO)

One crew member will report to pilot when smoke and/or fumes no longer exist or that ventilation has not been successful.

5. Fuel Valves - CLOSE

On airplanes **17260** ▶ **22664**, visually check that the following valves are CLOSED: line valve, No. 1 and No. 2 manual fuel-shutoff valves, and transfer valves.

On airplanes **22665** ▶, visually check that the following valves are CLOSED: line valve, No. 1 and No. 2 manual fuel-shutoff valves, external tank manifold shutoff valve, and secondary valve.

⑥ Electrical Equipment - All switches OFF (BO, RO, N, E)

If master switch has been turned OFF due to presence of fuel fumes, turn all electrical equipment switches OFF prior to turning master switch ON.

7. Switches and Circuit Breakers (for essential equipment) - ON (one at a time)

If smoke or fumes resulted from an electrical fire of undetermined source, turn equipment on as needed, carefully observing the equipment and wiring. When fault is detected, isolate circuit or equipment by disconnecting or leaving inoperative.

BAIL-OUT

Three short rings on the alarm bell

① Prepare to Bail-out Signal - Acknowledge (BO, P)

2. Boom - Stow and latch

3. Survival Equipment - Check

Check passengers and other crew members for required equipment and proper fit. Don exposure suit if time permits.

④ Emergency Exits - Open (BO, P)

One long ring on the alarm bell

⑤ Life Rafts - Release (BO, P)

If overwater bail-out, release life rafts just prior to bailing out.

⑥ Inform Pilot - "All personnel have departed" (BO, P)

7. Jumpmaster - Bail out

Follow the copilot on bail out.

CRASH LANDING

Six short rings on the alarm bell

① Crash Landing Signal - Acknowledge (BO, P)

2. Boom - Stow and latch

③ Emergency Exit Hatches - Remove and stow (BO, P)

4. Loose Equipment - Jettison

⑤ Boom Hydraulic System - Depressurize (BO, E)

Depressurize boom hydraulic system after fuel dump is complete.

6. Entry Doors - Unlock

Unlock entry door safety pins.

7. Floor Hatches - Remove and stow

8. Circuit Breakers - Pull (if time permits)

Pull single point refueling, flare release, and fuel dump circuit breakers. Close air refueling vent valve (if applicable).

9. Crash Landing Positions - Check

Check that all personnel in lower compartments have been moved to main compartment and braced for crash landing. Boom operator will then assume crash landing position, prior to 10 second warning on the alarm bell and/or interphone.

10. Exit - Any available

DITCHING

Six short rings on the alarm bell

① Ditching Signal - Acknowledge (BO, P)

2. Boom - Stow and latch

3. All A/R Light Switches - ON

4. APU Exhaust Door - CLOSED

5. Floor Hatches - Closed

⑥ Emergency Exit Hatches - Remove and stow (BO, P)

Remove emergency exit hatches and secure.

⑦ Cargo and Fuel - Jettison and dump (BO, P, E)

8. Survival Equipment - Security

Secure survival equipment near the overwing hatches.

9. Ditching Positions - Check

Check that all personnel in lower compartments have been moved to main compartment and braced for ditching. Boom operator will then assume ditching position prior to 10 seconds warning on the alarm bell and/or interphone.

10. Exit - Overwing emergency exit

Boom operator will provide life raft, flashlight, crash axe, first aid kit, dinghy radio, and water.

KC-97G PILOTS' EMERGENCY CONDENSED CHECKLIST

ENGINE FAILURE

ENGINE FAILURE/FIRE — TAKEOFF CONTINUED

IF ENGINE FAILURE

① DETERMINE FAILED ENGINE — DETERMINED (P, E)
2. RETARD THROTTLE (AFFECTED ENGINE) — RETARDED (P)
3. FEATHER PROP (AFFECTED ENGINE) — FEATHERED (CP) (PROCEED TO STEP 4)

IF ENGINE FIRE

① DETERMINE FIRE LOCATION — DETERMINED (P, E, BO)
② GANG BAR AFFECTED ENGINE — GANG BARRED (P, E)
③ RELEASE CO_2 — RELEASED (P, E)

..... ENGINE FAILURE/FIRE — TAKEOFF CONTINUED .....

4. GEAR SWITCH UP — UP (CP)
⑤ DUMP FUEL — DUMPED (P, E)
6. JETTISON TANKS — JETTISONED (IF NECESSARY) (P)

....................CLEAN-UP....................

7. Wing Flaps Up - UP (CP)
8. Maintain Best Three Engine Climb Speed - Maintained (P)
⑨ Power as Required - As required (P, E)
10. Notify Crew of Emergency - Notified (P)
⑪ Complete Engine Shut-down Clean-up - "Complete Engine Shut-down Clean-up" (P, E)
12. ADI Switch Off - OFF (CP)
⑬ Engineer's Report - "Engine Shut-Down Complete" (P,E)

ENGINE FAILURE DURING FLIGHT

①. ***DETERMINE FAILED ENGINE — DETERMINED (P, E)***
2. ***RETARD THROTTLE (AFFECTED ENGINE) — RETARDED (P)***
3. ***FEATHER PROP (AFFECTED ENGINE) — FEATHERED (CP)***
4. Rudder Boost On - ON (P)
⑤. Power as Required - As required (P, CP, E)
6. Notify Crew - Notified (P)
⑦. Jettison Cargo and Fuel - Jettisoned (P, E, BO)
⑧. Complete Engine Shutdown Clean-Up - "Complete Engine Shutdown Clean-Up" (P, E)
9. Autopilot as Required - As required (P)
⑩. Power as Required - As required (P, E)
⑪. Engineers Report - "Engine Shutdown Complete" (P, E)

RESTARTING ENGINE DURING FLIGHT

①. Restart Engine - "Restart Number   " (P, E)
2. Reduce Airspeed - Reduce (160 knots IAS) (P)
③. Receiver Engineer's Report - Received "Ready to Unfeather" (P, E)
4. Pull Out Feathering Button - Pulled out
⑤. Engineer's Report - "Restarting Engine Checklist Complete" (P, E)

T.O. 1C-97(K)G-1
15 October 1959

2

PROPELLER FAILURE

PROPELLER OVERSPEED/RUNAWAY—TAKEOFF CONTINUED

1. ***RETARD THROTTLE (AFFECTED ENGINE) — RETARDED TO 2900 (P)***
2. ***FEATHER PROP (AFFECTED ENGINE) — FEATHERED (CP)***
③ ***GANG BAR AFFECTED ENGINE — GANG BARRED (DIRECT ENGINEER IF RPM INCREASES RAPIDLY ABOVE 3500) (P, E)***
4. ***GEAR UP — UP (CP)***
⑤ ***DUMP FUEL — DUMPED (P, E)***
6. ***JETTISON TANKS — JETTISONED (IF NECESSARY) (P)***
7. Wing Flaps Up - UP (CP)
8. Maintain Best Three Engine Climb Speed - Maintained (P)
⑨ Power as Required - As required (P, E)
10. Notify crew of Emergency - Notified (P)
⑪ Complete Engine Shut-Down Clean-Up - "Complete Engine Shut-down Clean-Up" (P, E)
12. ADI Off - OFF (CP)
⑬ Engineer's Report - "Engine Shut-down Complete" (P, E)

— PROPELLER OVERSPEED/RUNAWAY DURING FLIGHT —

1. ***RETARD THROTTLES — RETARDED (P)***
2. ***REDUCE AIRSPEED — REDUCED (TO MINIMUM) (P)***

③ ***RECEIVE ENGINEER'S REPORT — RECEIVED (P, E)***

4. ***RPM ABOVE 3300 (RUNAWAY)***
   - ⓐ ***MIXTURE LEVER (AFFECTED ENGINE) — FUEL CUTOFF (P, E)***
   - b. ***FEATHER PROP (AFFECTED ENGINE) — FEATHERED (CP)***
   - c. Initiate Descent - Initiated (P)
   - d. Feather Prop (Affected Engine) - Feathered (Hold in) (CP)
4. RPM Below 3300: (Overspeed)
   - a. Use Intermittent Feathering Action - Intermittent Feathering (to 2700) (CP)
5. Notify Crew - Notified (P)
6. Continuous Operation in Fixed Pitch
   - a. Retard Throttle to 2550 - Retarded (2550) (P)
   - b. Decrease Airspeed/Altitude - Decreased (P)

⑦ Complete Engine Shut-Down Clean-Up - "Complete Engine Shut-Down Clean-Up" (P, E)

⑧ Power as Required - As required (P, E)

⑨ Engineer's Report - "Engine Shut-Down Complete" (P, E)

T.O. 1C-97(K)G-1
15 October 1959

4

ENGINE SEPARATION DURING FLIGHT

① *GANG BAR (AFFECTED ENGINE) — GANG BARRED (P. E)*
2. *RUDDER BOOST SWITCH ON — ON (P)*
③ *RPM 2500 (REMAINING ENGINES) — DIRECT ENGINEER RPM 2550 (P, E)*
4. *ALERT CREW — ALERTED (P, CP)*
⑤ *POWER AS REQUIRED-AS REQUIRED (P,E)*
⑥ *OPEN COWL FLAPS-OPENED (CLEAN SIDE) (P,E)*
7. *WING FLAPS SET-SET (CP)*

FIRE

ENGINE FIRE DURING ENGINE STARTING

1. *SIMULTANEOUSLY:*
   - a. *CALL TOWER — CALLED (CP)*
   - b. *ALERT CREW — ALERTED (C, CP)*
② *ABANDON AIRPLANE — ABANDONED (P)*

ENGINE FIRE DURING FLIGHT

① *DETERMINE FIRE LOCATION — DETERMINED (P, E)*
② *GANG BAR AFFECTED ENGINE — GANG BARRED (P, E)*
3. *ALERT CREW — ALERTED (P, CP)*
④ *RELEASE CO_2 — RELEASED (P, E)*
5. *FIRE NOT EXTINGUISHED:*
   - a. *USE BAIL-OUT PROCEDURE*
6. Fire Extinguished:
   - a. Rudder Boost Switch On - ON (P)
   - ⓑ Power as Required - As required (P, CP, E)
   - ⓒ Complete Engine Shut-Down Clean-Up - "Complete Engine Shut-Down Clean-Up" (P, E)
   - ⓓ Engineer's Report - "Engine Shut-Down Complete" (P, E)
   - e. Land as soon as possible (P)

T.O. 1C-97(K)G-1
15 October 1959

5

FUSELAGE/ELECTRICAL FIRE DURING FLIGHT

1. ***NOTIFY CREW — NOTIFIED (P, CP)***
② ***OXYGEN MASKS ON — ON (100%) (ALL CREW MEMBERS)***
③ ***DETERMINE FIRE CAUSE — DETERMINE (P, N, RO, BO)***
   a. ***SHUTOFF SYSTEM FEEDING FIRE — SHUTOFF (FUEL, OIL OR ELECTRICAL)***
   b. ***DIRECT ENGINEER TO DEPRESSURIZE THE AIRPLANE, IF REQUIRED***
4. ***FIRE REPORTED NOT EXTINGUISHED:***
   a. ***USE BAIL-OUT PROCEDURE***
5. Electrical Fire: (Source Not Found)
   a. Instrument Emergency Power Switch to Battery - Battery (P)
   ⓑ Set RPM 2350 - Set 2350 (P, CP)
   c. Rudder Boost Switch On - ON (P)
   ⓓ Airplane Master Switch Off - OFF (P, E)
   ⓔ Turn Off all Electrical Equipment - Turned OFF (All) Switches, Circuit Breakers (except emergency bus)
   ⓕ Airplane Master Switch On - ON (P, E)
   ⓖ Essential and Other Equipment On - ON (P, E)
6. Eliminate Smoke and Fumes - Eliminated (P)

WING AND EMPENNAGE FIRE DURING FLIGHT

1. ***ALERT CREW — ALERTED (P, CP)***
② ***RELEASE CO_2 — RELEASED (P, E)***
3. ***FIRE NOT EXTINGUISHED:***
   a. ***USE BAIL-OUT PROCEDURES***
4. Fire Extinguished:
   a. Land as Soon as Possible (P)

WHEEL WELL FIRE DURING FLIGHT

1. ***ALERT CREW — ALERTED (P, CP)***
2. ***GEAR DOWN — DOWN (CP)***
③ ***GANG BAR AFFECTED ENGINE — GANG BARRED (P, E)***
4. Land Airplane - (Land at Nearest Airfield) (P)

T.O. 1C-97(K)G-1
15 October 1959

6

SMOKE AND FUME ELIMINATION

PRESSURIZED OR UNPRESSURIZED

① ***OXYGEN MASKS ON — ON (100%) (ALL)***
2. ***PULL CABIN PRESSURE RELEASE — PULLED (P)***
③ ***OPEN MAIN COMPARTMENT HATCHES — OPEN (ALL)***
④ Open Floor Hatches - Open (P, RO, BO)
5. Increase Airspeed - Increased (as desired) (P)
⑥ Determine if Smoke and Fumes Eliminated - Determined (ALL)

FUEL FUMES

① ***OXYGEN MASKS ON — ON (100%) (ALL)***
2. ***INSTRUMENT EMERGENCY POWER SWITCH TO BATTERY — BATTERY (P)***
③ ***SET RPM 2350 (P, CP)***
4. ***RUDDER BOOST SWITCH ON — ON (P)***
⑤ ***AIRPLANE MASTER SWITCH OFF — OFF (P, E)***
6. ***PULL CABIN PRESSURE RELEASE — PULLED (P)***
⑦ ***OPEN MAIN COMPARTMENT HATCHES — OPENED (P, N, RO, BO)***
⑧ Open Floor Hatches - Opened (P, N, RO, BO)
9. Increase Airspeed - Increased (P)
⑩ Fuel Fumes Cleared, Master Switch On - ON (P, E)

BAIL-OUT

1. ***ALERT CREW — ALERTED (P, CP)***
2. ***AUTOPILOT SWITCH ON — ON (P)***
3. ***PULL CABIN PRESSURE RELEASE — PULLED (P)***
4. ***REDUCE AIRSPEED — REDUCED (P)***
⑤ ***OPEN HATCHES — OPENED (P, BO)***
6. ***ORDER BAIL-OUT — ORDERED (P, CP)***
7. ***ENGAGE AUTOPILOT — ENGAGED (P)***

T.O. 1C-97(K)G-1
15 October 1959

7

EMERGENCY DESCENT

1. *CLOSE THROTTLES — CLOSED (P)*
② *SET RPM 2000 — SET (P, E)*
3. *GEAR DOWN — DOWN (CP)*
4. *WING FLAPS FULL DOWN — FULL DOWN (CP)*
5. *MAINTAIN SPEED — MAINTAINED (155 KNOTS) (P)*
6. *OXYGEN MASK ON — ON (IF REQUIRED) (ALL)*

TAKEOFF AND LANDING EMERGENCIES (EXCEPT DITCHING)

ABORT

1. *CLOSE THROTTLES — CLOSED (P)*
2. *REVERSE PROPS — REVERSED (SYMMETRICAL ENGINES) (P)*
3. *APPLY BRAKES — APPLIED (P)*

CRASH LANDING AFTER TAKEOFF

1. *GEAR UP — UP (CP)*
2. *LOCK SHOULDER HARNESS — LOCKED (P & CP)*
3. *WING FLAPS FULL DOWN — FULL DOWN (CP)*
4. *WARN CREW — WARNED (P & CP)*
⑤ *SIMULTANEOUSLY:*
    a. *CLOSE THROTTLES — CLOSED (P, E)*
    b. *AIRPLANE MASTER SWITCH OFF — OFF (P, E)*

T.O. 1C-97(K) G-1
15 October 1959

8

CRASH LANDING

1. Alert Personnel - Alerted (P, CP)
② Reduce Gross Weight - Reduced (P, E, BO)
    a. Dump A/R Fuel - Dumped (if aboard)
    b. Dump Airplane Fuel - Dumped (if required)
    c. Jettison Cargo - Jettisoned (if aboard)
3. Jettison Tanks - Jettisoned (if unprepared runway) (P)
④ Open Windows, Door, Exits - Opened (P, CP, BO)
5. Order Personnel to Crash Landing Positions - Ordered (P)
⑥ Fasten and Lock Safety Belts and Shoulder Harness - Fastened and locked (P, CP, N, E)
⑦ Mixtures Rich - RICH (P, E)
⑧ RPM - Call for 2350 rpm (P, E)
9. Gear Switch Down - DOWN (CP)
    a. Nose Gear Only Retracted - Hold nose up (after touchdown)
    b. One Main Gear Retracted - Make contact on nose gear and Extended main gear
    c. One Main Gear Down - Make contact on one main gear
    d. All Landing Gear Retracted - Flare out close to ground, normal landing attitude
10. Set Wing Flaps - Set (55%) (CP)
11. ADI ON - ON (CP)
12. Wing Flaps Full DOWN - Full DOWN on final approach (CP)
13. Warn Personnel - Warned (P & CP)
14. Land as Slow as Possible: (P)
    ⓐ Close Throttles - Closed (P, E)
    ⓑ Airplane Master Switch Off - OFF (P, E)

DITCHING

SEA CONDITION	AVG WIND SPEED	HT OF SEA
DITCH ON TOP OF A SWELL, PARALLEL TO THE SWELLS		
Calm to slight - No white caps	0-11 Knots	0-4 Feet
Moderate - Scattered white caps	11-18 Knots	4-8 Feet
Rough - Frequent white caps	18-23 Knots	8-13 Feet
Very Rough - Continuous white caps and spray	23-30 Knots	13-20 Feet
DITCH INTO THE WIND		
High - Extensive white caps and blowing spray	30-38 Knots	20-30 Feet
Very High - Continuous blowing spray, sea surface looks white	38-44 Knots	30-45 Feet

DITCHING PROCEDURE

1. Alert Crew - Alerted (P, CP)
2. Have IFF Turned to Emergency - IFF Emergency (CP or N)
③ Position Passengers - Positioned (P, BO)
④ Open Escape Hatches - Opened (P, BO, RO)
5. Jettison Tanks - Jettisoned (P)
⑥ Jettison Cargo and Dump Fuel - Jettisoned and Dumped (if necessary) (P, E, BO)
⑦ Don Exposure Suits - Donned (ALL) (if time permits)
⑧ Don Life Vests - Donned (ALL)
9. Turn on Exterior Lights - On (P, CP)
⑩ Fasten and Lock Safety Belts and Shoulder Harness - Fastened and locked (P, CP)
11. Order Personnel to Ditching Positions - Ordered (P)
⑫ Feather Inboard Prop - Feathered (if practical) (P, CP, E)
13. Set Wing Flaps - Set (CP)
14. Maintain Lowest Rate of Descent - Maintained (P)
15. Maintain Speed Above Stall - Maintained (25 knots above stall) (P)
16. Landing Lights Extended and On - Extended and ON (if required) (CP)
17. Warn Personnel - Warned (P, CP)
18. Flare-Out Just Above Water - Flare-Out (P)
19. Hold Wings Level - Level (P)
20. Proceed to Emergency Exit (P, CP)

T.O. 1C-97(K)G-1
15 October 1959

10

KC-97G
ENGINEER'S EMERGENCY CONDENSED CHECKLIST

ENGINE FAILURE

ENGINE FAILURE/FIRE — TAKEOFF CONTINUED

IF ENGINE FAILURE

① ***FAILED ENGINE — DETERMINE (E, P) (NOTIFY PILOT)***
2. ***MIXTURE (AFFECTED ENGINE) — FUEL CUTOFF (PROCEED TO STEP 3)***

IF ENGINE FIRE

① ***FIRE LOCATION — DETERMINE (E, P, BO) (NOTIFY PILOT)***
② Affected Engine - Gang Bar (when directed) (E, P)
  a. Mixture (affected engine) - FUEL CUTOFF
  ⓑ CO_2 - Release (E, P) (when directed)

……. **ENGINE FAILURE/FIRE — TAKEOFF CONTINUED** …….

③ A/R Fuel - Dump (if directed) (E, P)
④ Power - Set (when directed) (E, P)
⑤ Engine Shut-down Clean-up - Complete (when directed) (E, P)

T.O. 1C-97(K)G-1
15 OCTOBER 1959

ENGINE FAILURE DURING FLIGHT

① ***FAILED ENGINE — DETERMINE (NOTIFY PILOT) (E, P)***
② ***MIXTURE (AFFECTED ENGINE) — FUEL CUTOFF***
③ ***IF IN SPARK ADVANCE (E, P)***
  a. ***MIXTURES — AUTO LEAN (ALL OTHER ENGINES)***
  b. ***SPARK ADVANCE SELECTOR SWITCHES — NORMAL (ALL ENGINES)***
  c. ***MIXTURES — AUTO RICH (ALL OTHER ENGINES)***
④ Fuel - Dump (when directed) (E, P)
⑤ Engine Shutdown Clean-Up - Complete (when directed) (E, P)
⑥ Power - Set (when directed) (E, P)

ENGINE SHUT-DOWN CLEANUP

1. If Master Prop Feathered:
   a. Auto Control Switch - Other Position
   b. Resynchronizer Switch - Actuate (momentarily)
2. Governor Selector Switch - DECREASE RPM (feathered Prop)
3. Boost Pump Switches - OFF (or as required)
4. Fuel Selector Switch - As required
5. Generator Switch(es) - OFF
6. Alternator Switch (if applicable) - OFF
7. Turbo Bleeder Switch - CLOSED
8. When Engine has Cooled Sufficiently:
   a. Oil Cooler Flaps Switch - CLOSE then OFF
   b. Cowl Flaps Switch - SET (3/4 Inches)
   c. Intercooler Flaps Switch - CLOSED
9. Ignition Switch - OFF
10. Throttle - OPEN (full forward)
11. Turbo Switch - MAN
12. Turbo Override Switch - OPEN (10 Seconds then OFF)
13. Select Direction Valve Switch - NORMAL

⑭ Report to Pilot - "Engine Shut-Down Complete" (E,P)

2

T.O. 1C-97(K)G-1
15 October 1959

RESTARTING ENGINE DURING FLIGHT

① Restart Engine Procedure - Commence (when directed) (E, P)
2. Gang Bar Switches - Normal
③ Hydraulic Lock - Check (6 blades) (E, BO)
4. Throttle (affected engine) - Close (to approximately 1/2 inch open)
5. Governor Selector Switch (feathered prop) - DECREASE RPM
6. Turbo Switch - MAN
7. Turbo Override Switch - OPEN (guard down)
8. Turbo Calibrating Knob - Full counterclockwise
9. Fuel Selector Switch - TE
10. Boost Pump Switch - Normal (at least one)
11. Oil Cooler Flap Switch - AUTO
12. Ignition Switch - BOTH
⑬ Report to Pilot - "Ready to Unfeather (E, P)
14. Mixture - Auto Rich (at 800 rpm)
15. Warm up Engine - as required (at 1400 rpm with appropriate mp)
16. Cowl Flaps - Set as required
17. Intercooler Flaps - Set as required
18. When Operating Oil Temperature is reached:
    a. Turbo Switch - AUTO
    b. RPM and Throttle - Increase slowly to desired power
    c. Turbo Calibrating Knob - Turn clockwise to desired manifold pressure
    d. Prop Resynchronizer Switch - RESYNC (momentarily)

19. Turbo Bleeder Switch - Check OPEN
20. Generator Switches - ON
21. Alternator Switch - ON
㉒ Report to Pilot - "Restarting Engine Checklist Complete" (E, P)

T.O. 1C-97(K)G-1
15 October 1959

3

PROPELLER FAILURE

PROP OVERSPEED/RUNAWAY – TAKEOFF–CONTINUED

1. ***SIMULTANEOUSLY:***
   a. ***PROP OIL — REPLENISH***
   b. ***GOVERNOR SELECTOR SWITCH — DECREASE RPM (NOT BELOW 2700)***
   ⓒ ***PILOT — NOTIFY (E, P)***

② Affected Engine - Gang bar (when directed) (E, P)
3. Mixture (Affected Engine) - FUEL CUTOFF (After prop is feathered)
④ Fuel - Dump (when directed) (E, P)
⑤ Power - Set (when directed) (E, P)
⑥ Engine Shut-Down Clean-Up - Complete (when directed) (E, P)

PROP OVERSPEED/RUNAWAY DURING FLIGHT

1. ***SIMULTANEOUSLY:***
   a. ***PROP OIL — REPLENISH***
   b. ***GOVERNOR SELECTOR SWITCH — DECREASE RPM (NOT BELOW 2700)***
   ⓒ ***PILOT — NOTIFY (E, P)***

② Mixture (Affected Engine) - FUEL CUTOFF (when directed) (E, P)
③ Engine Shut-Down Clean-Up - Complete (when directed) (E, P)
④ Power - Set (when directed) (E, P)

INADVERTENT PITCH LOCK

1. Affected Engine
   a. RPM - Reduce to 1500
   b. RPM - Return to 2550
   c. Throttle - Retard 10 Hg
2. Step 1 - Repeat on remaining engines

ENGINE SEPARATION DURING FLIGHT

① Affected Engine - Gang bar (when directed) (E, P)
② RPM (Remaining Engines) - Increase manually to 2550 (when directed) (E, P)
③ Power - Set (when directed) (E, P)
④ Cowl Flaps (Clean Side) - Open (when directed) (E, P)

FIRE

ENGINE FIRE DURING ENGINE STARTING

1. ***FIRE LOCATION — DETERMINE (NOTIFY PILOT) (E, P)***
2. ***PRIMING — STOP***
3. ***CRANKING — CONTINUE***
4. ***CRANKING — STOP (IF FIRE CONTINUES)***
5. ***ALL MIXTURES — FUEL CUTOFF***
6. ***AFFECTED ENGINE — GANG BAR***
7. ***CO_2 — RELEASE***
8. ***FIRE STATUS — REPORT (E, P)***
9. Master and Ignition Switches - Off

ENGINE FIRE DURING FLIGHT

① ***FIRE INDICATION—REPORT OR ACKNOWLEDGE (E, P, BO)***
② ***AFFECTED ENGINE — GANG BAR (WHEN DIRECTED) (E, P)***
3. ***MIXTURE (AFFECTED ENGINE) — FUEL CUTOFF***
④ ***IF IN SPARK ADVANCE: (E, P)***
  a. ***MIXTURES (ALL OTHER ENGINES) — AUTO LEAN***
  b. ***SPARK ADVANCE SELECTOR SWITCHES (ALL ENGINES) — NORMAL***
  c. ***MIXTURES (ALL OTHER ENGINES) — AUTO RICH***
⑤ CO_2 - Release (E, P) (when directed)
6. Cowl Flaps Switch - Set (2 inches)
⑦ Engine Shut-Down Clean-Up - Complete (when directed) (E, P)

FUSELAGE/ELECTRICAL FIRE DURING FLIGHT

① ***FIRE INDICATION — REPORT OR ACKNOWLEDGE (E, P)***
2. ***OXYGEN MASK — ON (REGULATOR 100%)***
③ ***CAUSE OF FIRE — DETERMINE AND REPORT (E, P)***
4. Electrical Fire: (Source Not Found)
  a. Mixtures - AUTO RICH
  b. Cowl Flap Switches - Set (2 inches)
  ⓒ Airplane Master Switch - OFF (when directed) (E, P)
  ⓓ All Electrical Equipment - Turn OFF, Switches, Pull Circuit Breakers (except those on emergency bus when directed) (All)
  e. Turbo Switches - MAN
  f. Turbo Override Switches - OFF
  ⓖ Airplane Master Switch - ON (when directed) (E, P)
  h. Generator Switches - ON (one at a time)
  i. Essential and Pilot's Instrument Inverter Switches - ON
  ⓙ Switches and Circuit Breakers - ON (One at a time) (for essential equipment) (All)

WING AND EMPENNAGE FIRE DURING FLIGHT

① ***FIRE INDICATION — REPORT OR ACKNOWLEDGE (E, P)***
2. ***AFFECTED HEATERS — GANG BAR***
3. ***CO_2 — RELEASE FIRST FIRE***
④ CO_2 - RELEASE SECOND FIRE (when directed) (E, P)
5. Fire Extinguished:
    a. CO_2 Directional Valve Switch - NORMAL

SMOKE AND FUME ELIMINATION

PRESSURIZED OR UNPRESSURIZED

① ***SMOKE OR FUMES INDICATION — REPORT OR ACKNOWLEDGE (E, P)***
2. ***OXYGEN MASK — ON (REGULATOR 100%)***
3. Turbo Bleeder Switch - CLOSE (if engine fire)
4. Air Conditioning Master Switch - ON
5. Cabin Air Selector Switches - ALTERNATE

FUEL FUMES

① ***FUEL FUMES INDICATION — REPORT/OR ACKNOWLEDGE (E, P)***
2. ***OXYGEN MASK — ON (REGULATOR 100%)***
3. ***MIXTURES — AUTO RICH***
4. ***COWL FLAP SWITCHES — SET (2 INCHES)***
5. ***CABIN AIR SELECTOR SWITCHES — ALTERNATE (IF TURBOS NOT USED)***
6. ***A/R TRANSFER AND LINE VALVE SWITCHES — CLOSE***
⑦ Airplane Master Switch - OFF (when directed) (E, P)
8. All Electrical Switches - Turn OFF
9. Turbo Switches - MAN
10. Turbo Override Switches - OFF
11. Fuel Fumes Cleared:
    ⓐ Airplane Master Switch - ON (when directed) (E, P)
    b. Generator Switches - ON (one at a time)
    c. Inverter Switches - ON (as required)
    d. Other Equipment - ON (as required)

T.O. 1C-97(K)G-1
15 October 1959

7

EMERGENCY DESCENT

1. *COWL FLAP SWITCHES — SET (3 INCHES)*
2. *MIXTURES — AUTO RICH*
③ *OXYGEN MASK — ON (IF REQUIRED)*

TAKEOFF AND LANDING EMERGENCIES (EXCEPT DITCHING)

CRASH LANDING AFTER TAKEOFF

1. *SHOULDER HARNESS — LOCK*
② *SIMULTANEOUSLY:*
  a. *MIXTURE LEVERS AND IGNITION SWITCHES — FUEL CUTOFF AND OFF (E, P)*
  b. *AIRPLANE MASTER SWITCH — OFF (WHEN DIRECTED) (E, P)*

CRASH LANDING

1. Fuel - Dump (E, P, BO) (when directed)
2. APU - Turn OFF
3. Body and Surface Anti-icing Heater Switches - OFF
④ Safety Belt and Shoulder Harness - Fasten and lock
⑤ Mixture Levers - AUTO RICH and LOCKED (when directed) (E, P)
6. RPM - Set 2350 (when directed) (E, P)
7. Cowl Flap Switches - OPEN (2 inches)
8. Boost Pump Switches - OFF
9. Simultaneously:
  ⓐ Mixture and Ignition Switches - FUEL CUTOFF and OFF (E, P)
  ⓑ Airplane Master Switch - OFF (E, P)

T.O. 1C-97(K)G-1
15 October 1959

8

DITCHING

DITCHING PROCEDURE

① A/R Fuel - Dump (when directed) (E, P)
2. Cabin Pressure Relief and Release Valves - Close and lock
3. Control Cabin - Secure (all loose equipment)
4. APU - OFF and ports CLOSED
5. Body Heaters - OFF
6. Cabin Air Selector Switches - NORMAL
7. Safety Belt and Shoulder Harness - Fasten and lock
8. Proceed to Emergency Exit

EMERGENCY JETTISONING

PRESSURE FUEL DUMPING

1. ***FUEL DUMP SWITCHES — DUMP***
2. ***ISODRAULIC HANDLE — ADVANCE***
3. ***FUEL FLOW — MONITOR***
4. Fuel Dumping Complete:
   a. Isodraulic Handle - Retard (to OFF)
   b. Fuel Dump Switches - NORMAL

REACTIVATING FUEL DUMP SYSTEM AFTER NOZZLE POPPET CLOSURE

1. ***ISODRAULIC HANDLE — RETARD (TO O)***
2. ***FUEL DUMP SWITCHES — NORMAL***
3. ***A/R MASTER SWITCH — OFF***
4. ***FUEL DUMP PROCEDURE — FOLLOW***

T.O. 1C-97(K)G-1
15 October 1959

9

SYSTEMS EMERGENCY OPERATION

FUEL SYSTEM

Fuel Tank Leak

1. Boost Pump Switches (Leaking Tank) - EMERGENCY
2. All Fuel Selector Switches - TME
3. All Other Main Wing Tank Boost Pump Switches - One on NORMAL (each tank)
4. CWT Secondary Valve - OPEN (manually)
5. Fuel Quantity Gages - Monitor
6. Leaking Tank Empty:
   a. CWT Valve - CLOSE
7. Leaking Tank Empty:
   a. Fuel Selector Switch - ME
   b. Boost Pump Switches (Leaking Tank) - OFF
8. Fuel Management - As required

Fuel Line Failure, Airplane Main Fuel Manifold

1. ***ALL FUEL SELECTOR SWITCHES — TE***
2. ***MAIN WING TANK FUEL BOOST PUMP SWITCHES — ONE ON NORMAL (EACH TANK)***

③ Line Check - Conduct (if required) (E, P)

TURBOSUPERCHARGER EMERGENCY OPERATION

Engine Overboost

1. ***IMMEDIATELY AND SIMULTANEOUSLY:***
   a. ***THROTTLE (AFFECTED TURBO) — RETARD***
   b. ***TURBO OVERRIDE SWITCH (FOR AFFECTED TURBO) — OPEN (GUARD DOWN)***
   c. ***TURBO SWITCH (AFFECTED TURBO) — MAN***
2. Turbo Amplifier Fuse - Have checked
   a. If Blown - Replace
   b. Amplifier (If Fuse Not Blown) - Replace
3. Amplifier - Warm up
4. Turbo to Automatic Control - Return
5. Malfunction Still Indicated:
   a. Perform Step 1 again.

⑥ Manual Control - Use (at Pilot's discretion)

Turbo Lubrication Failure

1. Advise the Pilot - Turbo oil leakage
2. At the Pilot's Discretion Either (For The Affected Engine):
   a. Wategate - Open
   b. Prop - Feather

KC-97G
EMERGENCY CHECKLIST
ALL CREW MEMBERS

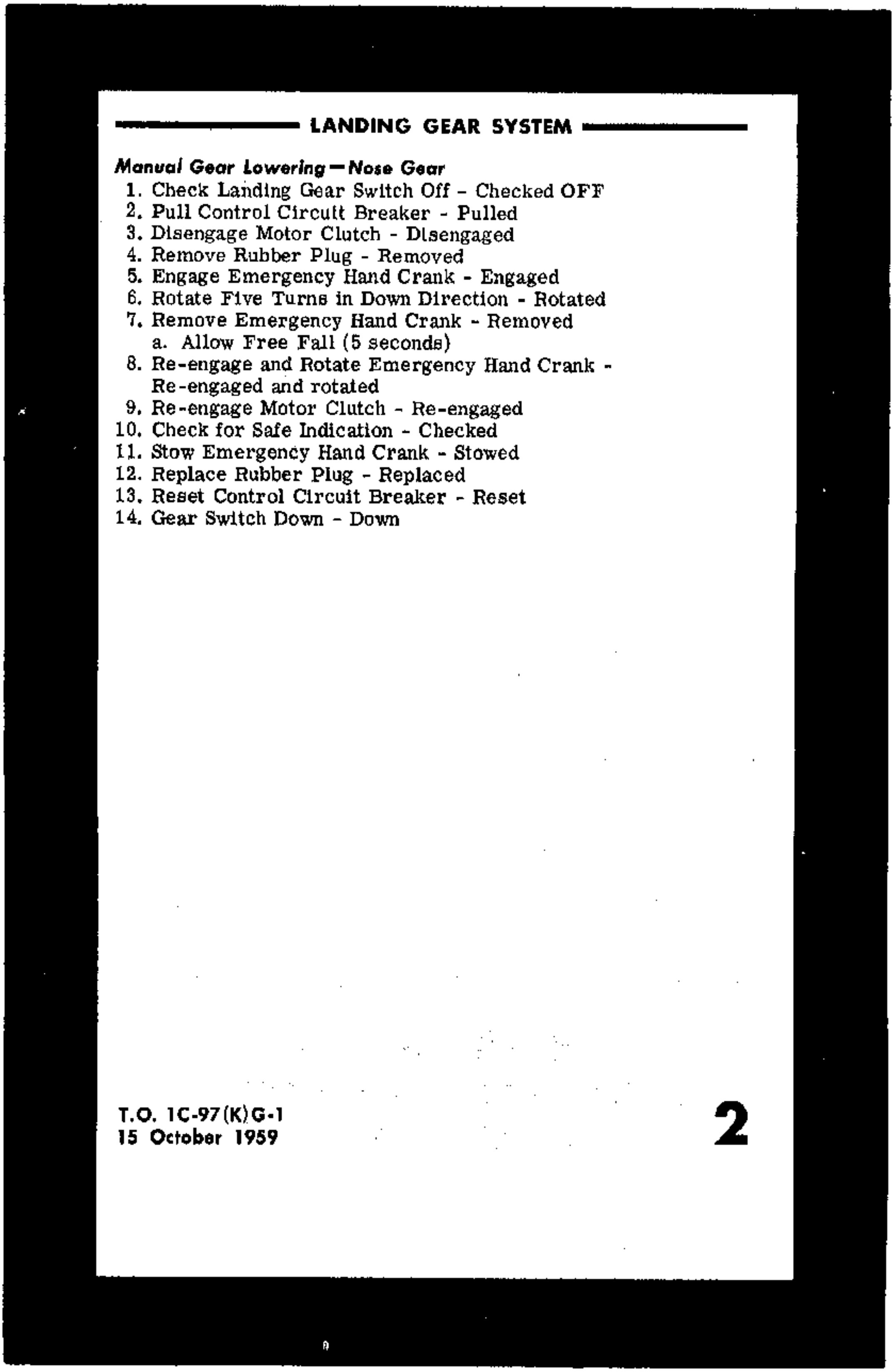
LANDING GEAR SYSTEM

Manual Gear Lowering—Main Gear

1. Establish Interphone Contact - Established
2. Check Landing Gear Switch Off - Checked OFF
3. Pull Control Circuit Breaker - Pulled
4. Pull Red T Handle Out and Seat Swaged Ball - Pulled and seated
5. Insert Emergency Hand Crank - Inserted
6. Rotate Ten Turns in Down Direction - Rotated
7. Snap Red T Handle Forward - Snapped forward
8. Oscillate Emergency Hand Crank Rapidly - Oscillated
    a. Allow Free Fall (5 secs.)
9. Pull Red T Handle Out and Seat Swaged Ball - Pulled and seated
10. Rotate Emergency Hand Crank in Down Direction - Rotated
11. Check for Safe Indication - Checked
12. Reset Red T Handle and Oscillate Hand Crank - Reset and Oscillated
13. Stow Emergency Hand Crank - Stowed
14. Reset Control Circuit Breaker - Reset
15. Gear Switch Down - Down

T.O. 1C-97(K)G-1
15 OCTOBER 1959

1



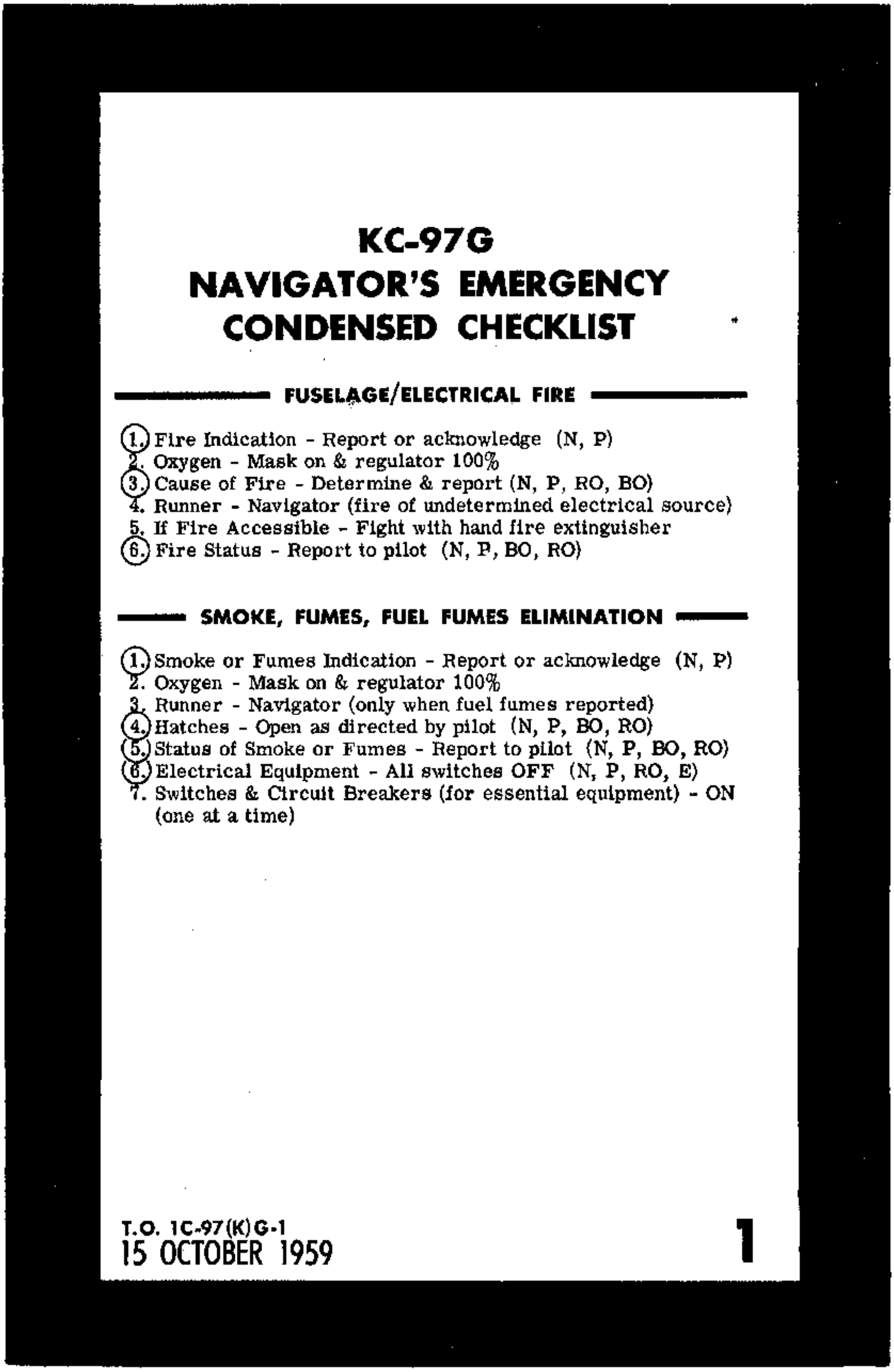
LANDING GEAR SYSTEM

Manual Gear Lowering—Nose Gear

1. Check Landing Gear Switch Off - Checked OFF
2. Pull Control Circuit Breaker - Pulled
3. Disengage Motor Clutch - Disengaged
4. Remove Rubber Plug - Removed
5. Engage Emergency Hand Crank - Engaged
6. Rotate Five Turns in Down Direction - Rotated
7. Remove Emergency Hand Crank - Removed
   a. Allow Free Fall (5 seconds)
8. Re-engage and Rotate Emergency Hand Crank - Re-engaged and rotated
9. Re-engage Motor Clutch - Re-engaged
10. Check for Safe Indication - Checked
11. Stow Emergency Hand Crank - Stowed
12. Replace Rubber Plug - Replaced
13. Reset Control Circuit Breaker - Reset
14. Gear Switch Down - Down

T.O. 1C-97(K)G-1
15 October 1959

2



KC-97G
NAVIGATOR'S EMERGENCY CONDENSED CHECKLIST

FUSELAGE/ELECTRICAL FIRE

① Fire Indication - Report or acknowledge (N, P)
2. Oxygen - Mask on & regulator 100%
③ Cause of Fire - Determine & report (N, P, RO, BO)
4. Runner - Navigator (fire of undetermined electrical source)
5. If Fire Accessible - Fight with hand fire extinguisher
⑥ Fire Status - Report to pilot (N, P, BO, RO)

SMOKE, FUMES, FUEL FUMES ELIMINATION

① Smoke or Fumes Indication - Report or acknowledge (N, P)
2. Oxygen - Mask on & regulator 100%
3. Runner - Navigator (only when fuel fumes reported)
④ Hatches - Open as directed by pilot (N, P, BO, RO)
⑤ Status of Smoke or Fumes - Report to pilot (N, P, BO, RO)
⑥ Electrical Equipment - All switches OFF (N, P, RO, E)
7. Switches & Circuit Breakers (for essential equipment) - ON (one at a time)

T.O. 1C-97(K)G-1
15 OCTOBER 1959

1

BAIL-OUT

① Warning Signal - Acknowledge (N, CP)
2. Anti-Exposure Suit, Life Vest, Parachute, & Harness - Check for proper fit
3. IFF - EMERGENCY 17260 ▶ 2900, 3340 ▶
4. Position Report - Prepare
   a. Position & Time - Determine & record
   ⓑ Pilot's Intentions - Determine & record (N, P)
   c. Course & Ground Speed - Determine & record
   d. Number of Personnel on Board - Determine & record
   e. Nature of Emergency - Determine & record
   ⓕ Assistance Desired - Determine & record (N, P)
   g. Type Airplane - Record
   h. Altitude - Record
5. Set Radio Channelization - Set (N, CP)
6. Distress Message - Transmit
7. Individual Survival Kits or One Man Life Raft - Attach
8. Additional Survival Equipment - Release
9. Bail Out in Sequence - On command (one long ring)

DITCHING/CRASH LANDING

① Warning Signal - Acknowledge (N, CP)
2. IFF - EMERGENCY 17260 ▶ 2900, 3340 ▶
3. Position Report - Prepare
   a. Position & Time - Determine & record
   ⓑ Pilot's Intentions - Determine & record (N, P)
   c. Course & Ground Speed - Determine & record
   d. Number of Personnel on Board - Determine & record
   e. Nature of Emergency - Determine & record
   ⓕ Assistance Desired - Determine & record (N, P)
   g. Type Airplane - Record
   h. Altitude - Record
④ Set Radio Channelization - Set (N, CP)
5. Distress Message - Transmit
⑥ Absolute Altitude - Give to pilot (ditching only) (N, P)
7. Parachute Harness - Remove
⑧ Ditching/Crash Landing Preparation - Complete (N, BO, RO)
9. Anti-Exposure Suit & Life Vest - Don (ditching only)
10. Ditching/Crash Landing Position - Assume
11. After Impact - Abandon airplane by appropriate exit

T.O. 1C-97(K)G-1
15 October 1959

2

KC-97G
RADIO OPERATOR'S EMERGENCY CONDENSED CHECKLIST

FUSELAGE/ELECTRICAL FIRE

① Fire Indication - Report or acknowledge (RO, P)
2. Oxygen - Mask on & regulator 100%
③ Cause of Fire - Determine and report (RO, P)
4. If Fire Accessible - Fight with hand fire extinguisher
⑤ Fire Status - Report to pilot (RO, P, N, BO)

SMOKE, FUMES, FUEL FUMES ELIMINATION

① Smoke or Fumes Indication - Report or acknowledge (RO, P)
2. Oxygen - Mask on & regulator 100%
③ Hatches - Open as directed by pilot (RO, P, N, BO)
④ Status of Smoke or Fumes - Report to pilot (RO, P, N, BO)
⑤ Electrical Equipment - All switches OFF (RO, N, E)
6. Switches and Circuit Breakers (for essential equipment) - ON (one at a time)

BAIL-OUT

① Warning Signal - Acknowledge (RO, P)
2. IFF - EMERGENCY (if applicable)
3. Survival Equipment, Harness, & Parachute - Check for proper fit (if applicable)
4. Distress Message - Transmit (time permits)
5. Emergency Exits - Open
6. Individual Survival Kit - Attach to harness
7. Rafts & Dinghy Radios - Release on command (one long ring)
8. Bail Out in Sequence - On command (one long ring)

T.O. 1C-97(K)G-1
15 OCTOBER 1959

1

CRASH LANDING

1. Warning Signal - Acknowledge (RO, P)
2. IFF - EMERGENCY (if applicable)
3. Distress Message - Transmit (time permits)
4. Emergency Exit Hatches - Remove & secure
5. Door Safety Lock Pins - Unlock (forward & aft doors)
6. Cargo & Loose Equipment - Jettison (rear emergency exits)
7. Assume Crash Landing Position - Safety belt fastened
8. After Impact - Abandon airplane by appropriate exit

DITCHING

1. Warning Signal - Acknowledge (RO, P)
2. IFF - EMERGENCY (if applicable)
3. Distress Message - Transmit (time permits)
4. Floor Hatches - Closed
5. Emergency Exit Hatches - Remove & secure
6. Cargo & Loose Equipment - Jettison (rear emergency exits)
7. Emergency Equipment - Secure near emergency exits
8. Parachute Harness - Remove
9. Anti-Exposure Suit & Life Vest - Don
10. Assume Ditching Position - Safety belt fastened
11. After Impact - Abandon airplane by appropriate exit

T.O. 1C-97(K)G-1
15 October 1959

2

KC-97G
BOOM OPERATOR'S EMERGENCY CONDENSED CHECKLIST

FUSELAGE/ELECTRICAL FIRE

① Fire Indication - Report to crew or acknowledge (All)
2. Oxygen - Mask on & regulator 100%
③ Cause of Fire - Determine & report (BO, P)
4. If Fire Accessible - Fight with hand fire extinguishers
⑤ Fire Status - Report to pilot (BO, P, RO, N)

SMOKE, FUMES, FUEL FUMES ELIMINATION

① Smoke or Fumes Indication - Report to crew or acknowledge (All)
2. Oxygen - Mask on & regulator 100%
③ Hatches - Open as directed by pilot (BO, P, RO, N)
④ Status of Smoke or Fumes - Report to pilot (BO, P, RO, N)
5. Fuel Valves - CLOSE
⑥ Electrical Equipment - All switches OFF (BO, RO, N, E)
7. Switches and Circuit Breakers (for essential equipment) - ON (one at a time)

BAIL-OUT

Three short rings on the alarm bell

① Prepare to Bail-out Signal - Acknowledge (BO, P)
2. Boom - Stow & latch
3. Survival Equipment - Check
④ Emergency Exits - Open (BO, P)

One long ring on the alarm bell

⑤ Life Rafts - Release (BO, P)
⑥ Inform Pilot - "All personnel have departed" (BO, P)
7. Jumpmaster - Bail out

T.O. 1C-97(K)G-1
15 OCTOBER 1959 **1**

CRASH LANDING

Six short rings on the alarm bell.

① Crash Landing Signal - Acknowledge (BO, P)
2. Boom - Stow & latch
③ Emergency Exit Hatches - Remove & stow (BO, P)
4. Loose Equipment - Jettison
⑤ Boom Hydraulic System - Depressurize (BO, E)
6. Entry Doors - Unlock
7. Floor Hatches - Remove & stow
8. Circuit Breakers - Pull (if time permits)
9. Crash Landing Positions - Check
10. Exit - Any available

DITCHING

Six short rings on the alarm bell.

① Ditching Signal - Acknowledge (BO, P)
2. Boom - Stow & latch
3. All A/R Light Switches - ON
4. APU Exhaust Door - CLOSE
5. Floor Hatches - Close
⑥ Emergency Exit Hatches - Remove & stow (BO, P)
⑦ Cargo & Fuel - Jettison & dump (BO, P, E)
8. Survival Equipment - Security
9. Ditching Positions - Check
10. Exit - Overwing emergency exit

T.O. 1C-97(K)G-1
15 October 1959

2

AUXILIARY EQUIPMENT

SECTION IV

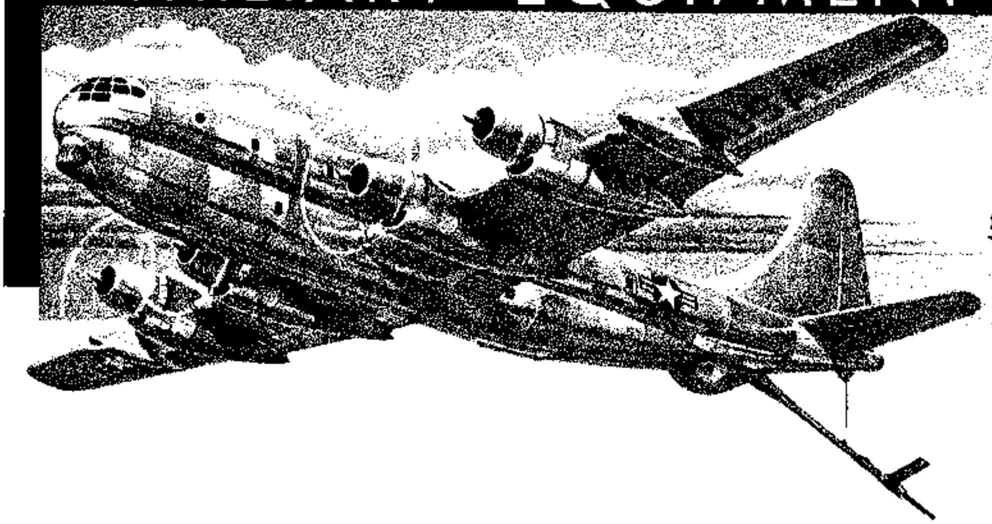


TABLE OF CONTENTS

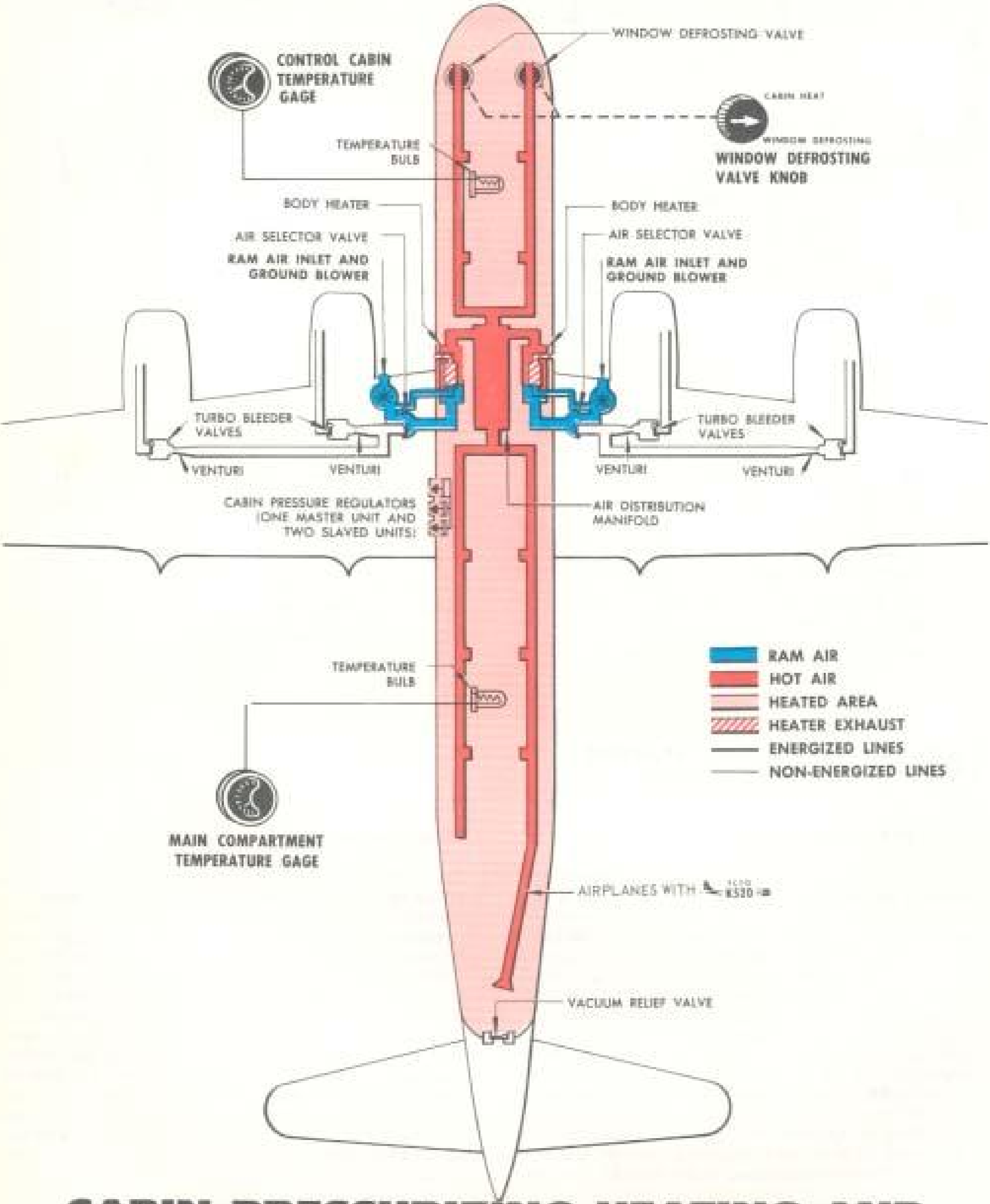
CABIN PRESSURIZING, HEATING, AND VENTILATING SYSTEM

CABIN PRESSURIZING

Cabin pressurizing allows the crew to perform their duties at altitude with maximum efficiency. Pressurizing air (figure 4-1) is bled from the turbosupercharger of each engine and is supplied to the cabin through venturi tubes which limit the air flow and thereby prevents excessive flow which would result in starvation of the engines. Control of the cabin pressure altitude and pressure rate-of-change is accomplished by metering the discharge of air from cabin to atmosphere through three cabin pressure regulators. These regulators automatically maintain the selected cabin pressure altitude and pressure rate-of-change when the selections are within the capabilities of the pressurizing system. A cabin altitude should be selected to maintain comfort and convenience. The recommended cabin altitude, to maintain conditions for efficient crew operation, is 8000 feet for day and 5000 feet for night.

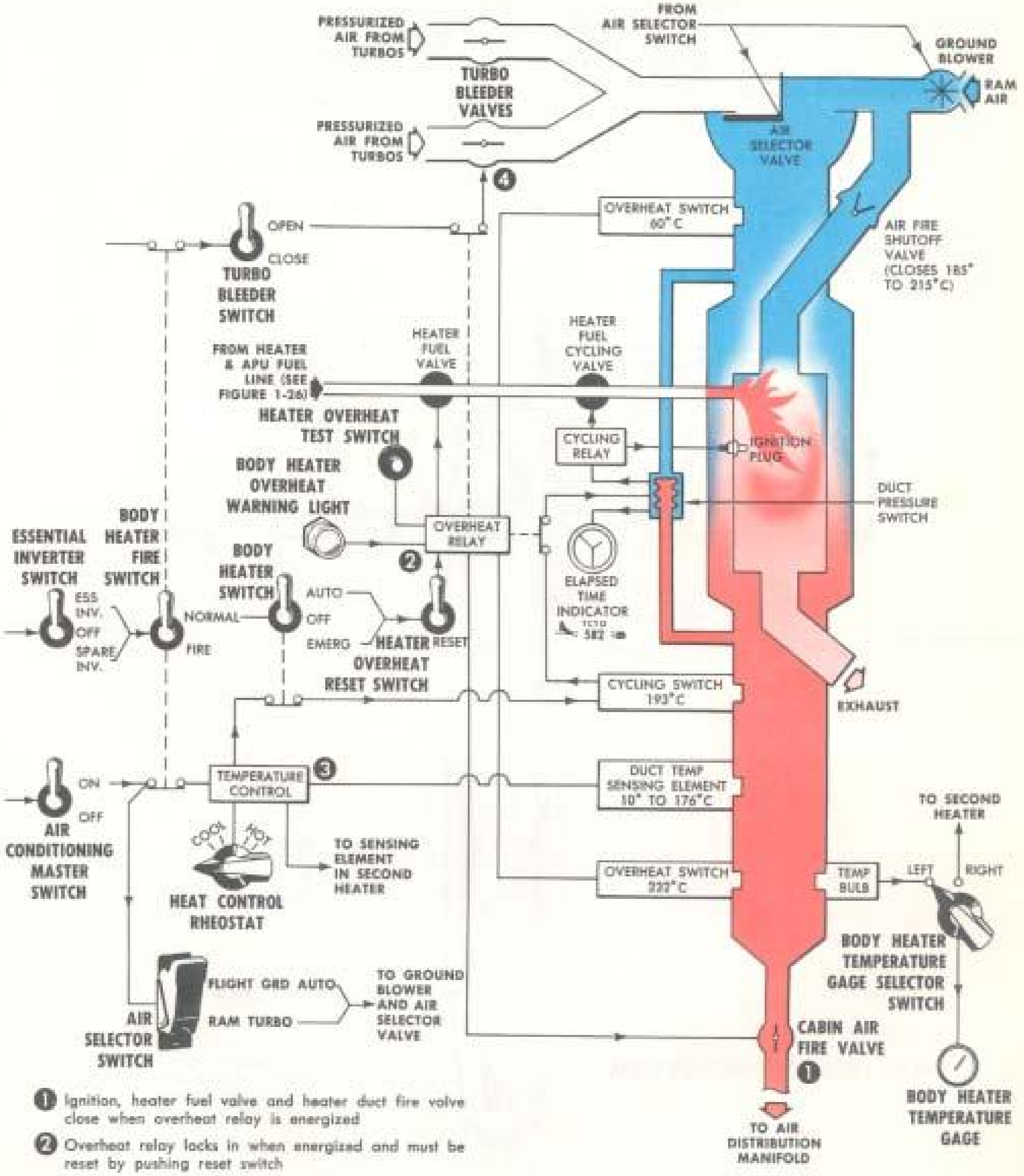
Cabin Pressure Regulation

Three methods of preventing structural damage as a result of excessive positive or negative pressure are incorporated into the system. The cabin pressure regulators automatically limit the differential pressure between cabin and atmosphere to 13.4 inches Hg (approximately 15,000 feet altitude differential) regardless of the cabin altitude setting. A cabin pressure relief valve in the forward end of the lower nose compartment will automatically dump cabin air into the nose wheel well whenever a cabin pressure regulator malfunction increases the differential pressure above 14 inches Hg. This valve can be adjusted when it is desired to manually control the cabin pressure. A fully automatic vacuum relief valve, located in the tail compartment bulkhead, opens when cabin pressure is less than ambient pressure.



CABIN PRESSURIZING, HEATING AND VENTILATION

Figure 4-1 (Sheet 1 of 4)



① Ignition, heater fuel valve and heater duct fire valve close when overheat relay is energized

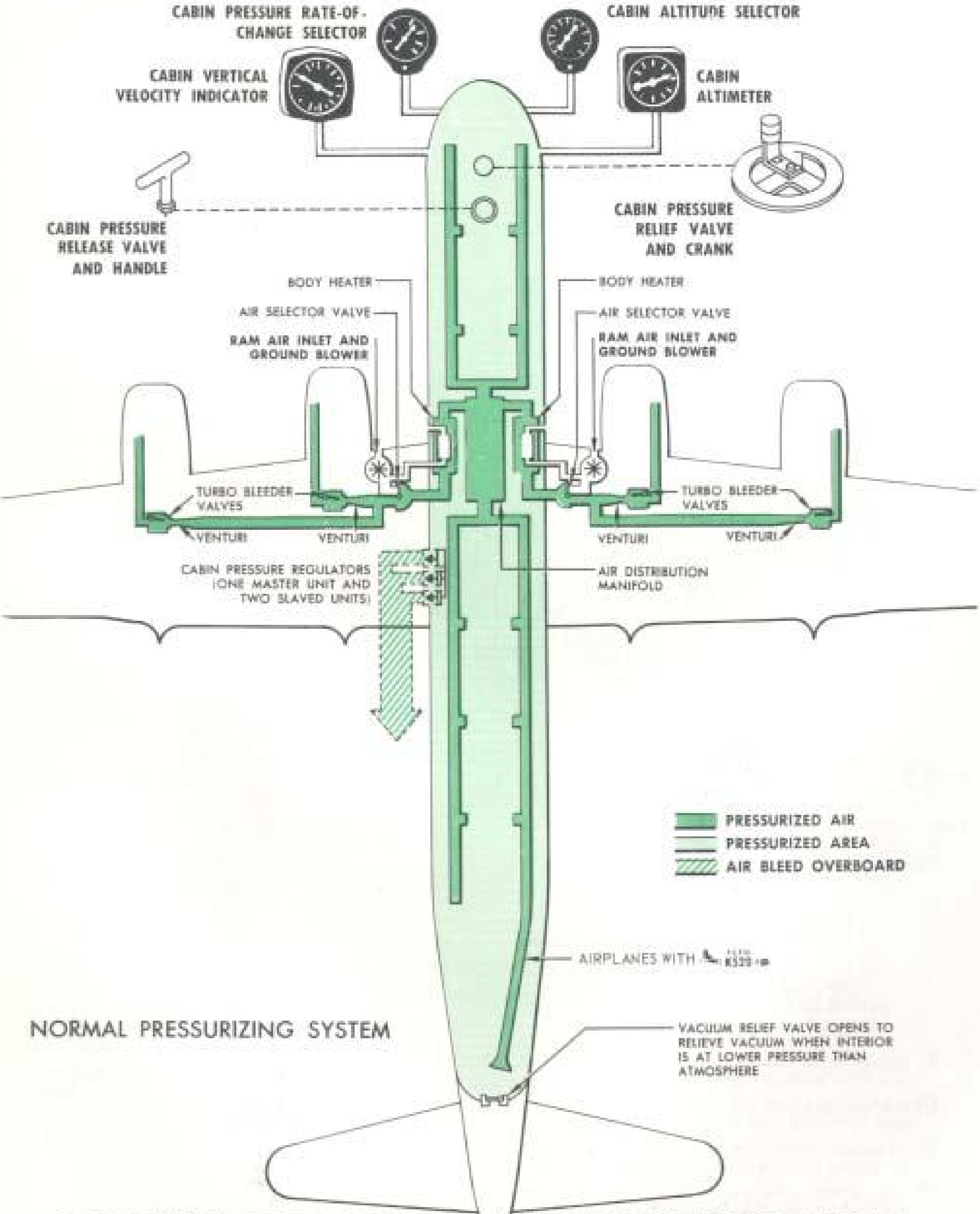
② Overheat relay locks in when energized and must be reset by pushing reset switch

③ Temperature control circuit cycles heater on and off as required to maintain selected temperature

④ Turbo bleeder valves close: when the body heater fire switch is placed to FIRE; when the turbo bleeder switch is placed to CLOSE; or when the overheat relay closes

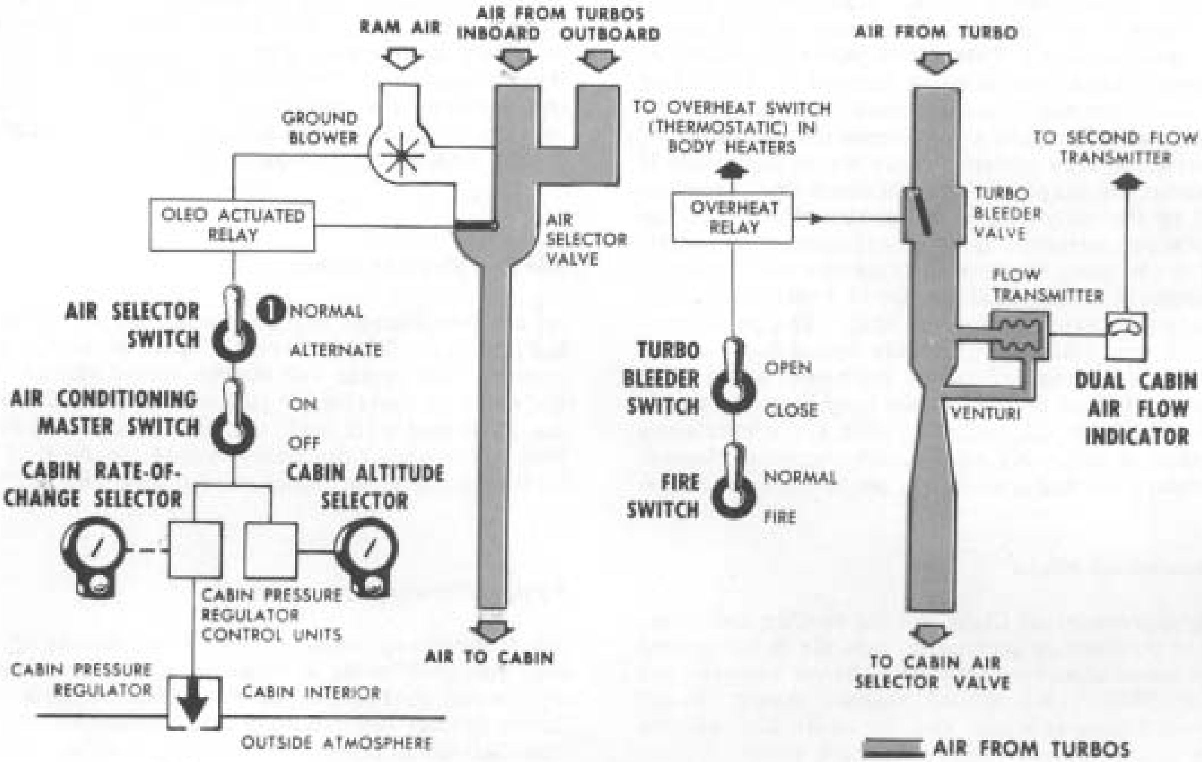
BODY HEATER SYSTEM

Figure 4-1 (Sheet 2 of 4)



CABIN PRESSURIZING, HEATING AND VENTILATION (CONT)

Figure 4-1 (Sheet 3 of 4)



CONTROL OF AIR SELECTOR VALVES (TYPICAL)

CONTROL OF TURBO BLEEDER VALVES (TYPICAL)

		DURING FLIGHT	ON THE GROUND
① AIR SELECTOR SWITCH POSITION	**NORMAL**	Air Selector Valve CLOSED Turbo air directed to cabin	Air Selector Valve OPEN Ground blower air directed to cabin
	ALTERNATE	Air Selector Valve OPEN Ram air directed to cabin	Air Selector Valve CLOSED Turbo air directed to cabin

Figure 4-1 (Sheet 4 of 4)

CABIN HEATING AND VENTILATING

Pressurized Flight

During pressurized flight, air for cabin heating, including control cabin window defrosting, is obtained from the turbosuperchargers. (Ram air can be selected during flight; however, the ram air will not maintain pressurization.) This air is passed through two combustion-type body heaters located on the ceiling of the lower forward compartment. A cabin air distribution manifold (figure 4-3), between the body heaters, directs the heated air into ducts which distribute it throughout the airplane. The heaters are turned on and off by the body heater switches and maintain the temperature selected on the heat control rheostat. Fuel for the body heaters is from the No. 2 tank or the manifold. This fuel supply is controlled by an auxiliary fuel panel in the left wing. The panel contains a normal and an alternate set of fuel-shutoff valves and fuel regulators for the heaters and APU. Further control of the fuel to the body heaters is provided by fuel cycling valves which are electrically actuated by an automatic temperature control or through temperature sensing elements in the heaters and ducts.

Unpressurized Flight

During unpressurized flight, air for heating and ventilating is obtained by picking up ram air in the ground blower inlets when the cabin air selector switches are in the ALTERNATE position. This air passes through the ground blower ducts and the cabin air selector valves into the normal pressurizing lines.

Ground Operations

During ground operations, air for heating and ventilating is supplied from either the turbosuperchargers or two ground blowers. The ground blowers draw fresh air through an inlet in the leading edge of each inboard wing, by the blowers, and through the cabin air selector valves into the normal pressurizing lines. This air is also ducted to the combustion chambers of the body heaters. Fusible fire valves in the combustion air lines will close if reverse combustion air flow creates an overheat condition. Oleo actuated switches prevent use of the ground blowers when the airplane is airborne.

Cabin Air Circulation

Two electrically operated control cabin fans (1, figure 4-15), circulate the air in the control cabin. The bulkhead mounted fan located above and aft of the navigator's station draws air from the main compartment through the fan housing to vanes which can be adjusted to deflect the air. A door at the end of the housing can be closed against spring pressure to completely close the vent opening. The second fan is above and aft of the engineer's station and directs air flow forward between the pilots' seats at head level. See CONTROL CABIN FAN SWITCHES in this Section.

Air Fire Shutoff Valve

An air fire shutoff valve is in the air intake of each body heater. The valve is a split butterfly valve, hinged in the center and spring-loaded closed. When the valve is installed it is wired open with solder-ing wire that will melt if a fire occurs in the air line upstream of the heaters (see figure 4-1). The melting point of the solder varies from 185° to 215°C.

System Power Requirements

All electrical controls in the cabin pressurizing, heating, and ventilating system use direct current. All equipment operates on direct current except the ignition system and cabin air flow indicators which use alternating current from the main inverter essential bus.

PRESSURIZING, HEATING, AND VENTILATING CONTROLS

Air Conditioning Master Switch

The air conditioning master switch (4, figure 4-3), marked ON--OFF, is on the engineer's instrument panel. Power to the heat control rheostat and the cabin air selector switches is provided when the air conditioning master switch is in the ON position. When the switch is in the OFF position, these circuits are de-energized. The master switch receives power through circuit breakers on the forward power panel.

Fire Switches

See FIRE EXTINGUISHER SYSTEM in Section I for descriptions of these switches.

Cabin Altitude Selector

A cabin altitude selector (12, figure 4-3) is on the engineer's instrument panel. This selector has a dial and needle showing the cabin pressure altitude selection in either inches Hg or 1000 feet of altitude. A knurled knob at the bottom of the dial is used to adjust the needle to the desired cabin pressure altitude. This setting is electrically transmitted to the cabin pressure regulators which automatically maintain the selected setting until a maximum differential pressure of 13.4 inches Hg is reached. Power for the cabin altitude selector control circuit is obtained through a circuit breaker on the forward power panel (figure 1-34).

Cabin Pressure Rate-of-Change Selector

A cabin pressure rate-of-change selector (13, figure 4-3) is on the engineer's instrument panel. This selector is similar in appearance to the cabin altitude selector except that it shows the cabin pressure rate-of-change in either inches Hg per minute or 100 feet of altitude per minute. The knurled knob is used to set the cabin pressure rate-of-change which the cabin pressure regulators are to maintain during any change in cabin altitude. Power for the selector is obtained through a circuit breaker on the forward power panel (figure 1-34).

Turbo Bleeder Switches

Four turbo bleeder switches (6, figure 4-3), one for each turbo bleeder valve, are on the engineer's instrument panel. The switches have two positions: OPEN and CLOSE. When the switches are positioned to CLOSE, the turbo bleeder valves are locked in the closed position. When the switches are positioned to OPEN, the turbo bleeder valves are unlocked and operate as swing check valves. Air from the turbos can pass through the body heater units to the cabin, but reverse flow of air will cause the check valves to close. Placing the body heater fire switch in the FIRE position closes the respective turbo bleeder valve and makes the turbo bleeder switch ineffective. Power to the turbo bleeder switches is obtained through a circuit breaker on the overhead circuit breaker panel (figure 1-34) and an oil, fuel, hydraulic oil, and cabin air bleeder fire-shutoff switch (15, figure 1-12) on the overhead panel.

Cabin Air Selector Switches

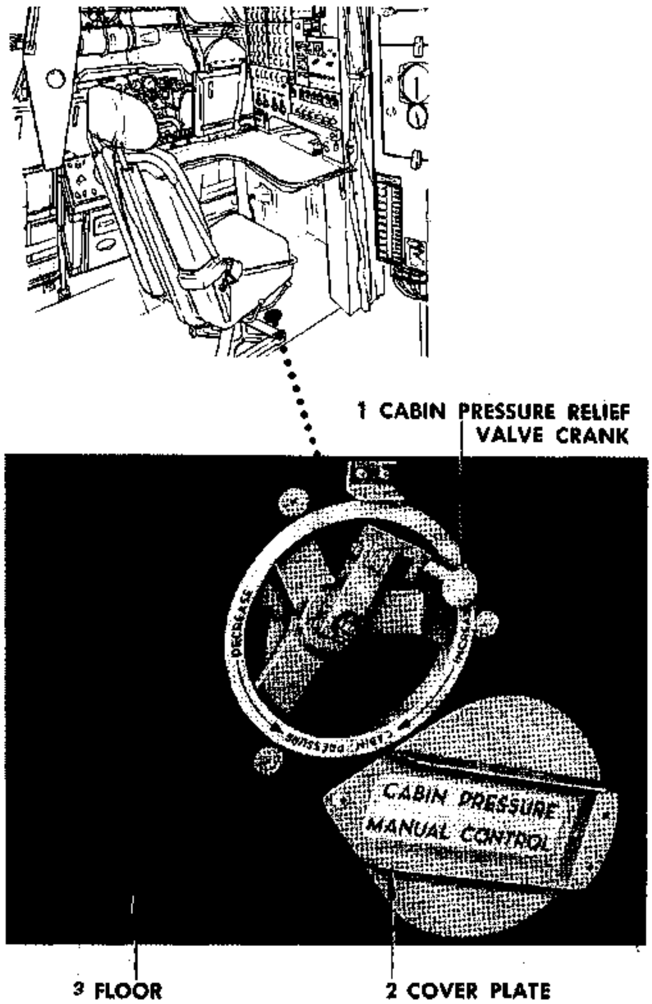
On airplanes 17260 ▶ 22806 two guarded switches (55, figure 1-22), marked NORMAL--ALTERNATE, are on the engineer's instrument panel. On airplanes 3106 ▶ , these two switches (9, figure 1-21) are on the engineer's auxiliary overhead panel. The switches are used to control the left and right cabin air selector valves and the ground blowers. When the switches are in the NORMAL position and the airplane is on the ground, cabin air is supplied by the ground blowers. During flight, with the switches in the NORMAL position, the cabin air is supplied by the turbosuperchargers. When the switches are in ALTERNATE position, cabin air is supplied during flight by ram air passing through the ground air blower duct. When the airplane is on the ground and the switches are in the ALTERNATE position cabin air is supplied by the turbosuperchargers. The ground blower power circuits are protected by circuit breakers on the main circuit breaker panel (figure 1-34).

Body Heater Switches

Two body heater switches (16, figure 4-3), marked AUTO--OFF--EMERG, are on the engineer's instrument panel. These switches control the fuel and ignition circuits for the combustion-type body heaters. Each of the following switches must be in their normal or on position to energize the body heaters: (1) the body heater fire switch, (2) the air conditioning master switch, and (3) the essential inverter switch. With the body heater switches on AUTO, the fuel and ignition circuits are energized through an automatic temperature control circuit. The temperature control starts and stops the heaters to maintain a duct outlet temperature between 10° to 176°C (50° to 350°F) depending upon the setting of the heat control rheostat. If the automatic temperature control does not operate satisfactorily, the body heater switches may be moved to the EMERG position. In this position, the automatic temperature control is cut-out and the cycling switch is operative. The cycling switch prevents the outlet duct temperature from exceeding 193°C (380°F). When using the EMERG position, the cabin temperature can be controlled by periodically switching from EMERG to OFF. The body heater switches receive power through circuit breakers on the forward power panel. The ignition for the body heaters receives power through fuses on the A-C power panel.

Heat Control Rheostat

A heat control rheostat (11, figure 1-21), marked with COOL and HEAT ranges, is on the engineer's auxiliary



CABIN PRESSURE RELIEF VALVE CRANK

Figure 4-2

overhead panel. This rheostat is used to set the operating cycle of the body heaters, thereby controlling the overall heat output. Power to the heat control rheostat is supplied through the air conditioning master switch, body heater fire switch, and a circuit breaker on the forward power panel (figure 1-34). The heat control rheostat is inoperative when the body heater switches are on EMERG. See BODY HEATER SWITCHES in this Section. If a dangerous overheat condition arises, overheat switches either upstream or downstream of the heaters will close and energize overheat relays. When these relays are energized they close the cabin air fire valves downstream of the heaters, close the heater fuel valve, de-energize the ignition, and will illuminate the heater overheat warning lights. The relays lock out the heaters until the overheat condition is eliminated and a reset switch is actuated.

Heater Overheat Test Switch

This switch (1, figure 4-3), on the engineer's instrument panel, is used to test the overheat protection and warning circuits for the body and surface anti-icing heaters. Depressing the test switch simulates an overheat condition by actuating the overheat relay for each heater. The overheat relays will then turn on all overheat warning lights, turn off the ignition for each heater, and close all fuel and air valves to completely isolate each heater. After actuating the test switch, the heaters remain inoperative until the heater overheat reset switch is momentarily held to RESET. See HEATER OVERHEAT RESET SWITCH in this Section.

NOTE

- Actuating the heater overheat test switch when the heaters are in operation will shut down all heaters.
- Actuation of the heater overheat test switch will close the turbo bleed valves and heater duct fire valves when the body heater switches are ON. Pressurizing air flow must be restored by positioning the heater overheat reset switch to RESET momentarily.

Heater Overheat Reset Switch

When any body or surface anti-ice heater is deactivated due to an overheat condition or by actuation of the heater overheat test switch, the unit (or units) remains shutoff. Momentarily placing the heater overheat reset switch (19, figure 4-3) to the RESET position restores heater operation - providing the overheat condition no longer exists. This switch is operative when the essential inverter switch and the body heater switches are ON. Circuit protection is through circuit breakers on the forward power panel.

Heater and APU Fuel Supply Switch

This switch (17, figure 4-3) on the engineer's instrument panel, selects one of two fuel valves and regulators through which fuel from the No. 2 wing tank or manifold is taken for the operation of the surface anti-icing heaters, body heaters, and the auxiliary power unit (see figure 1-26). With this switch in the NORMAL position, fuel for the heaters and APU is taken through one regulator. With the switch in the ALTERNATE position, heater and APU fuel is drawn through the alternate regulator. The circuit breaker for this switch is on the overhead circuit breaker panel (figure 1-34).

Cabin Pressure Relief Valve Crank

A crank (1, figure 4-2) recessed in the floor under the engineer's seat is mechanically linked to the cabin pressure relief valve. This crank is used to manually control the escape of air from the cabin in case the automatic cabin pressure regulators malfunction. The recess is marked with INCREASE and DECREASE arrows to indicate the cabin pressure change that will result when the crank is rotated. Cabin pressure is increased if manual control is rotated clockwise and decreased if rotated counterclockwise. The cabin pressure relief valve crank must be rotated to the full increase position following any use of the crank during flight.

Cabin Pressure Release Valve Handle

A handle (42, figure 1-15) on the control stand is cable connected to the cabin pressure release valve (2, figure 4-4). Pulling this handle approximately 8 inches opens the valve and rapidly dumps the cabin pressure into the nose wheel well. The valve and handle are reset by relatching a hinged plate on the valve. (This latch is readily accessible behind the ladder in the lower nose compartment.)

Cabin Air Distribution Manifold

A manifold with a selector valve lever (20, figure 4-3) and a distribution valve lever (21, figure 4-3) is between the body heaters in the lower forward compartment. The selector valve lever positions are marked D and E and the lever is held in place by a spring which is attached to pins marked F and G. In case of a heater failure, the selector valve is used to mix the flow of heated air with unheated air. The normal position is with the selector valve lever on D and the spring on pin F; the mixing (emergency) position is with the selector valve lever on E and the spring on pin G. The distribution valve lever controls the ratio of flow of mixed air between the control cabin and main compartment. The distribution valve lever positions are marked A (normal) and B (emergency) with additional positions between and beyond these two. The airflow to the control cabin is increased in relation to the airflow to the aft compartments as the distribution valve lever is rotated counterclockwise. When the lever is in position A the entire output of the left body heater and a part of the output of the right body heater is supplied to the control cabin and forward areas. However, if either heater has failed and it is desired to have heat in the aft compartments, the distribution valve lever should be moved to position B. The accompanying diagrams in figure 4-3 show the air flow with one heater inoperative and the selector and distribution valves set as indicated.

NOTE

> During extreme cold weather operation with one heater inoperative, better heating results can be obtained by increasing air flow and shutting off the turbo bleeds on the side of the airplane of the inoperative heater.

Control Cabin Fan Switches

Two switches (10, figure 1-21) on the engineer's auxiliary overhead panel are used to control the ceiling fan and the bulkhead fan in the control cabin. These switches are OFF in the down position and ON in the up position. Power is supplied to the switches through two circuit breakers on the overhead circuit breaker panel (figure 1-34).

Cabin Air Pressure Indicator (Cabin Altimeter)

A cabin altimeter (11, figure 4-3) on the engineer's instrument panel indicates the cabin pressure altitude in thousands of feet. This indicator does not show cabin differential pressure.

Cabin Vertical Velocity Indicator

A cabin vertical velocity indicator (10, figure 4-3) on the engineer's instrument panel indicates the rate of pressure change in the cabin in thousands of feet per minute.

Cabin Air Flow Indicators

Two dual reading cabin air flow indicators (14, figure 4-3) are on the engineer's instrument panel. These gages measure a differential pressure at venturi tubes in each line (figure 4-1) down stream of each turbo bleeder valve and are calibrated in inches Hg. The green band (1 to 3 inches Hg) shown on the face of each indicator is the normal operating range. Part throttle and high turbo boost may cause pressures in excess of the green range. High power operations may cause this condition also, if excessive cabin leaks prevail.

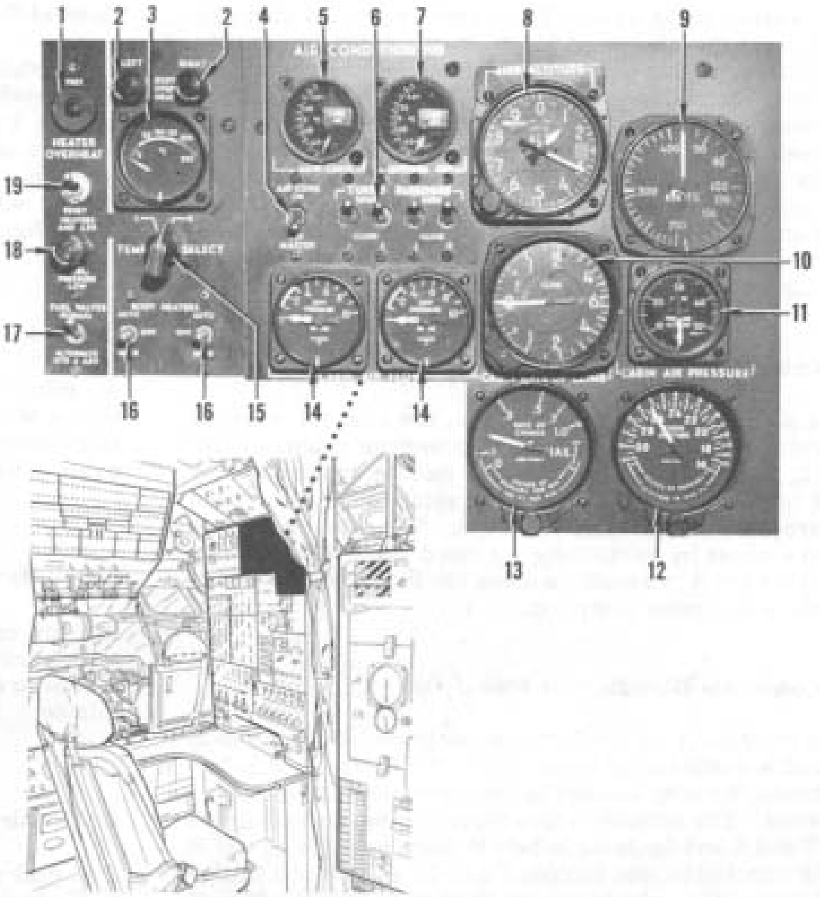
Cabin Temperature Gages

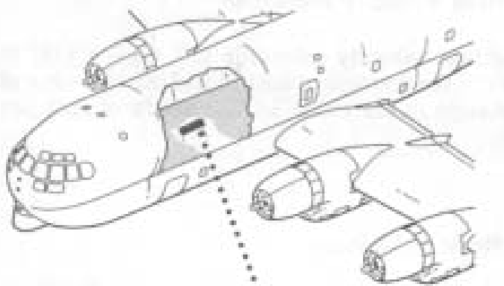
The control cabin and main compartment temperatures are indicated in degrees Centigrade by cabin temperature gages (5 and 7, figure 4-3) on the engineer's instrument panel. The indicating circuits are protected by a circuit breaker on the overhead circuit breaker panel (figure 1-34).

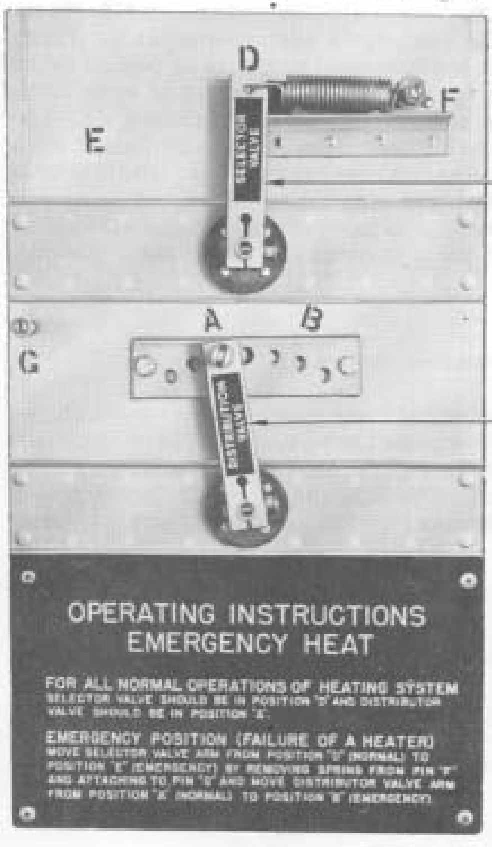
Body Heater Elapsed Time Indicators ✈ TCTO 582

Airplanes incorporating ✈ TCTO 582 have an elapsed time indicator for each body heater in the lower nose compartment mounted on the bulkhead near the ladder. The indicators automatically log the operating time of the heaters.

1. HEATER OVERHEAT TEST SWITCH
2. BODY HEATER OVERHEAT WARNING LIGHTS (2 PLACES)
3. BODY HEATER TEMPERATURE GAGE
4. AIR CONDITIONING MASTER SWITCH
5. MAIN CABIN TEMPERATURE GAGE
6. TURBO BLEEDER SWITCHES
7. CONTROL CABIN TEMPERATURE GAGE
8. PRESSURE ALTIMETER **22737**▶
9. AIRSPEED INDICATOR **3106**▶
10. CABIN VERTICAL VELOCITY INDICATOR
11. CABIN AIR PRESSURE INDICATOR (CABIN ALTIMETER)
12. CABIN ALTITUDE SELECTOR
13. CABIN PRESSURE RATE-OF-CHANGE SELECTOR
14. CABIN AIR FLOW INDICATORS (2 PLACES)
15. BODY HEATER TEMPERATURE GAGE SELECTOR
16. BODY HEATER SWITCHES (2 PLACES)
17. HEATER AND APU FUEL SUPPLY SWITCH
18. HEATER AND APU LOW FUEL PRESSURE WARNING LIGHT
19. HEATER OVERHEAT RESET SWITCH
20. MANIFOLD SELECTOR VALVE LEVER
21. MANIFOLD DISTRIBUTION VALVE LEVER



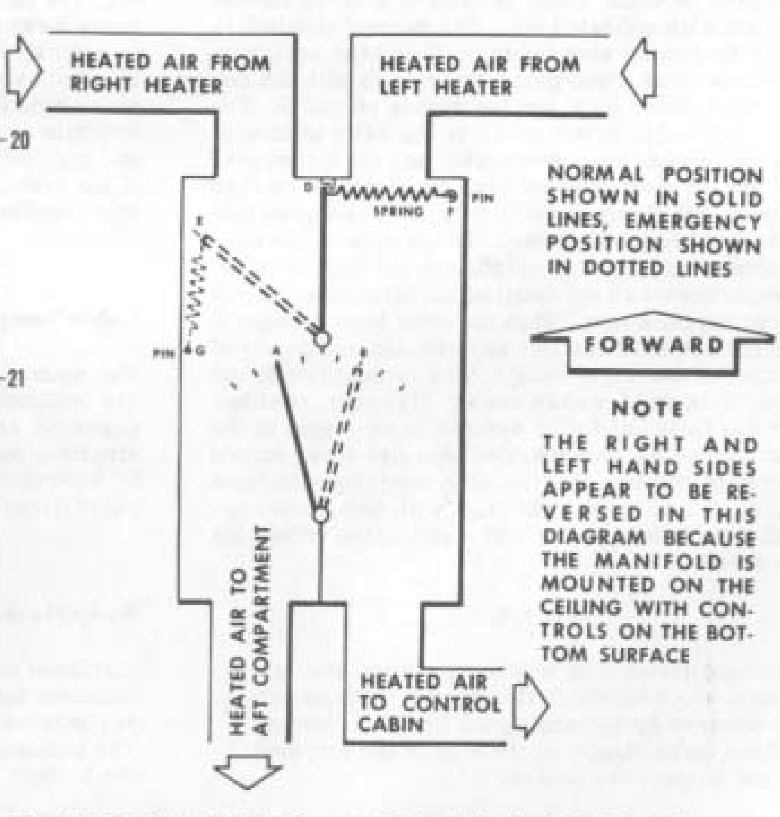




OPERATING INSTRUCTIONS
EMERGENCY HEAT

FOR ALL NORMAL OPERATIONS OF HEATING SYSTEM SELECTOR VALVE SHOULD BE IN POSITION 'D' AND DISTRIBUTOR VALVE SHOULD BE IN POSITION 'A'.

EMERGENCY POSITION (FAILURE OF A HEATER) MOVE SELECTOR VALVE ARM FROM POSITION 'D' (NORMAL) TO POSITION 'E' (EMERGENCY) BY REMOVING SPRING FROM PIN 'F' AND ATTACHING TO PIN 'G' AND MOVE DISTRIBUTOR VALVE ARM FROM POSITION 'A' (NORMAL) TO POSITION 'B' (EMERGENCY).



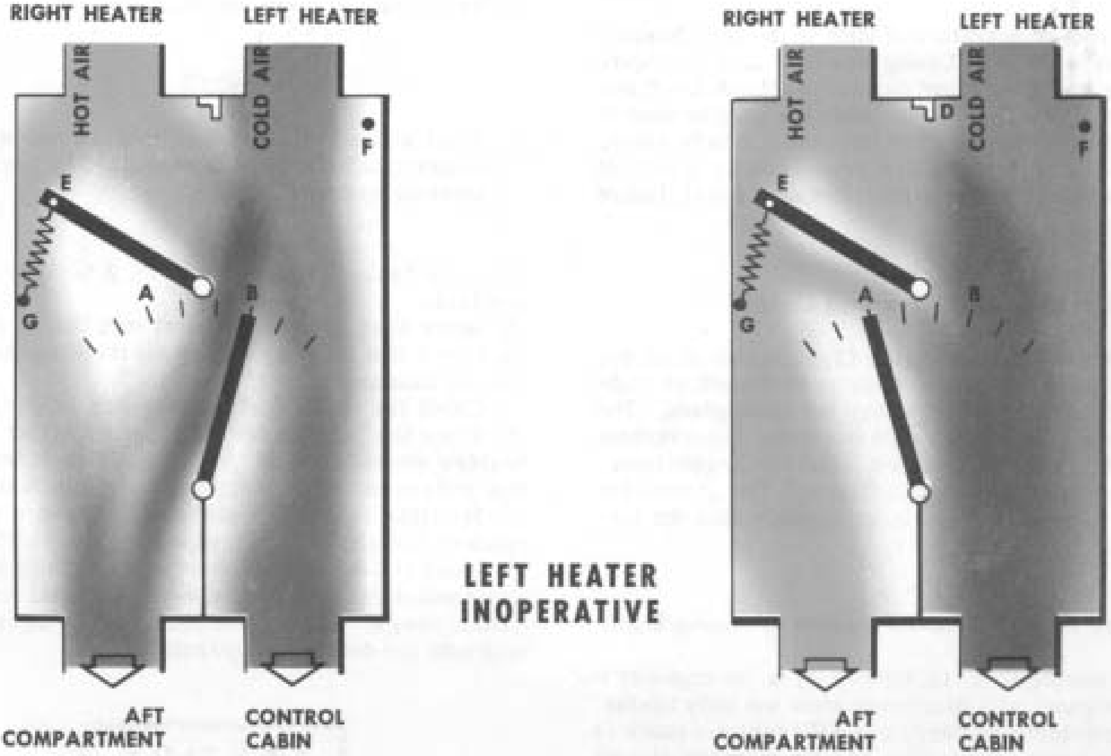
NORMAL POSITION SHOWN IN SOLID LINES, EMERGENCY POSITION SHOWN IN DOTTED LINES

NOTE

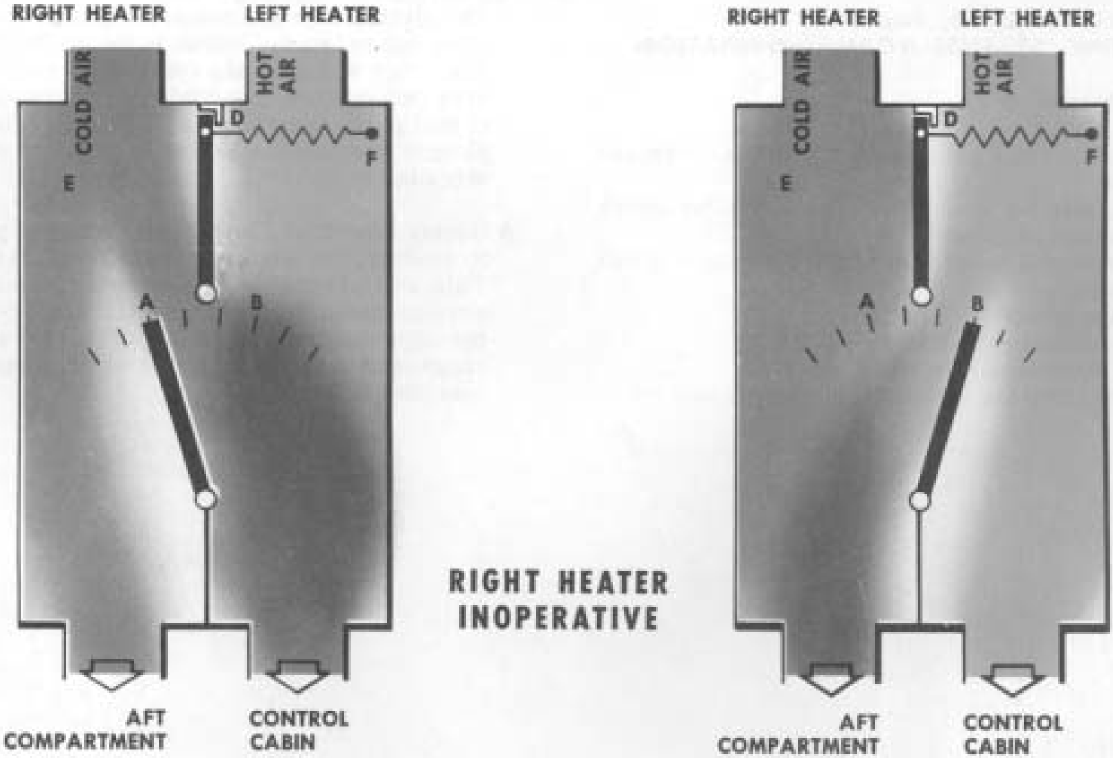
THE RIGHT AND LEFT HAND SIDES APPEAR TO BE REVERSED IN THIS DIAGRAM BECAUSE THE MANIFOLD IS MOUNTED ON THE CEILING WITH CONTROLS ON THE BOTTOM SURFACE

AIR CONDITIONING CONTROLS

Figure 4-3 (Sheet 1 of 2)



LEFT HEATER INOPERATIVE



RIGHT HEATER INOPERATIVE

Figure 4-3 (Sheet 2 of 2)

Body Heaters Temperature Gage and Selector Switch

The outlet duct temperature of each of the body heaters is indicated in degrees Centigrade by a gage (3, figure 4-3) on the engineer's instrument panel. A L--R selector switch (15, figure 4-3) under the gage is used to select the heater on which the indication is to be taken. The indicating circuits are protected by a circuit breaker on the overhead circuit breaker panel (figure 1-34).

Body Heater Overheat Warning Lights

Two red press-to-test lights (2, figure 4-3) on the engineer's instrument panel show when the left or right body heater overheat relays have been energized. The lights remain illuminated, even when the overheat condition has been eliminated, until the heater overheat reset switch has been actuated. The circuit for the lights is protected by circuit breakers on the forward power panel.

Heater and APU Fuel Low Pressure Warning Light

An amber warning light (18, figure 4-3) on the engineer's instrument panel will illuminate when the body heater, surface anti-icing heaters, and APU fuel pressure is less than 12 psi. Protection for the warning circuit is provided by a circuit breaker on the overhead circuit breaker panel (figure 1-34).

CABIN PRESSURIZING, HEATING, AND VENTILATING SYSTEMS NORMAL OPERATION

Ground Operation

The following steps are necessary to obtain ground ventilation:

1. Check cabin air distribution manifold valve levers in their normal positions
2. Have external power connected to airplane or engines running
3. Airplane master switch ON
4. Air conditioning master switch ON
5. Cabin air selector switches NORMAL
6. Control cabin fan switches ON, if desired

With ground ventilation obtained, the following steps are necessary to obtain heating:

1. Energize the main inverter system

NOTE

Fuel will not flow to the heaters unless the heater ignition circuit is energized by the main inverter system.

2. Have fuel pressure from No. 2 tank or manifold available
3. Move heat control rheostat into the HEAT range
4. Check that the body heater overheat warning lights are not illuminated
5. Check the heater fuel valve switch NORMAL
6. Place the body heater switches to AUTO; the body heaters should now be operating. Check that heater fuel pressure warning light is not illuminated
7. Monitor the body heater temperature gage; the heaters should cycle at approximately 175°C
8. When the desired cabin temperature is being approached, rotate the heat control rheostat toward the COOL range. Adjust the rheostat as necessary to maintain the desired temperature

CAUTION

- Turn off body heaters before starting engines. The electrical power required to start the engines will reduce the voltage to the ground blowers. This will increase the fuel/air ratio. An over rich mixture may not burn. Accumulation of fuel in the heaters may cause a fire or explosion when normal power is restored to the circuits.
- During takeoff and for several minutes prior to landing, the heaters should be turned off. This will prevent overheat conditions from arising because of low ventilating air-flow through the heaters on takeoff or reversed combustion air-flow during reversed propeller operation on landing.

Flight Operation

There are several combinations of pressurizing, heating, and ventilating available during flight. These are: Ram air ventilating with or without heating, and pressurizing with or without heating. The steps necessary to obtain ram air ventilation and the steps necessary to set up heating during either ram air ventilating or pressurizing are the same as those used during ground operation. To set up pressurizing during flight, or on the ground before the start of a flight, the following steps should be used:

1. If possible, determine the cruise altitude and destination altitude before flight; decide on a cabin altitude for the flight
2. Check that all cabin openings are closed including the cabin pressure relief valve, cabin pressure release valve, and the cabin pressure check points (figure 4-4)

NOTE

Some cabin pressure check points can only be checked on the ground.

3. Check that the shutoff cocks on the cabin pressure regulators are open
4. Set the desired altitude at which airplane is to be pressurized during flight

WARNING

Do not pressurize with a cracked inner pane of a Nesa window. If cracking appears on the inner pane during pressurized flight, reduce altitude and depressurize to reduce the possibility of a blowout.

5. Check that the heater overheat warning lights are not illuminated
6. During warmup set the cabin rate-of-change selector to the MAX position for at least 3 minutes, then return it to O; this will allow time for the cabin pressure regulators to adjust themselves to the cabin altitude selection
7. Turbo bleeder switches OPEN; check that cabin air flow comes within the green range
8. During flight, monitor the cabin altimeter, cabin vertical velocity indicator, and cabin air flow indicators; when changing the cabin altitude selector, first return the cabin rate-of-change selector to O, reset the cabin altitude selector, then reset the cabin rate-of-change selector
9. During let-down, select a cabin altitude slightly above destination station elevation so that the cabin will be unpressurized during landing

Shut-Down

Shut-down body heaters by positioning the body heater switches to OFF.

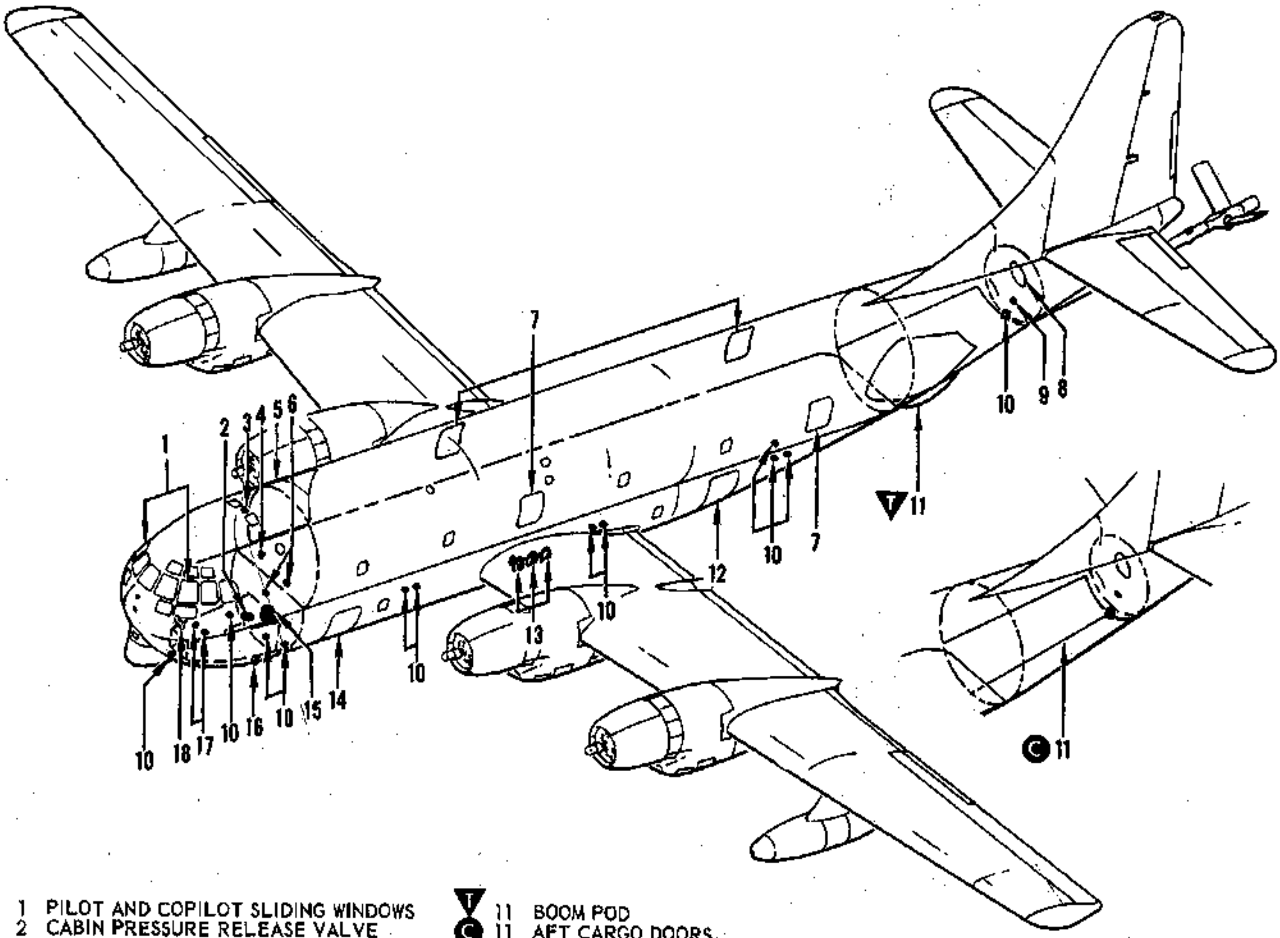
CAUTION

Heaters must be purged with air after being shut-down. During flight, heaters are purged automatically by ram air to the combustion chambers and by the normal flow of cabin ventilating air over the heaters. However, on the ground, special care must be taken to purge the heaters with the ground blowers to prevent residual heat from causing an overheat condition. After body heater switches are shut OFF, allow ground blowers to operate for several minutes before turning air conditioning master switch OFF.

CABIN PRESSURIZING, HEATING, AND VENTILATING SYSTEMS EMERGENCY OPERATION

Excessive Pressure

A cabin pressure regulator malfunction resulting in an excessive pressure will cause the cabin pressure relief valve to open. When this occurs a loud hissing noise can be heard. If the malfunction cannot be corrected immediately, the cabin pressure should be manually controlled at once by turning the cabin pressure relief valve crank in the desired direction.



1 PILOT AND COPILOT SLIDING WINDOWS
2 CABIN PRESSURE RELEASE VALVE
3 SEXTANT DRAIN
4 PYROTECHNIC PISTOL MOUNT
5 FORWARD CARGO DOOR
6 AUXILIARY POWER UNIT INTAKE AND EXHAUST VALVES
7 EMERGENCY EXIT HATCHES (2 PLACES)
8 TAIL COMPARTMENT ACCESS DOOR
9 VACUUM RELIEF VALVE
10 DRAIN PLUGS (7 PLACES)
T 11 BOOM POD
C 11 AFT CARGO DOORS
12 AFT ENTRY DOOR
13 CABIN PRESSURE REGULATORS
14 FORWARD ENTRY DOOR
15 BATTERY SHIELD
16 DRIFTMETER DOME
17 PRESSURE TEST INLETS
18 CABIN PRESSURE RELIEF VALVE

CABIN PRESSURE LEAKAGE CHECK POINTS

Figure 4-4

Insufficient Pressure

In the event that cabin pressure falls below 19 inches Hg (12,000 feet indicated on the cabin altimeter), the following steps should be taken:

1. All crew members must use oxygen
2. Check air conditioning circuit breakers set on overhead circuit breaker panel and forward power panel
3. Check cabin openings for closure as shown in figure 4-4
4. Check that heater overheat warning lights are not illuminated
5. Check that the cabin air flow is within the green range; if flow is low, readjust power settings (if possible) to bring it into the green range
6. If malfunction can be corrected, repressurize in the normal manner

Insufficient Heating

The possible malfunctions that could result in insufficient heating, are covered in the following paragraphs. If the heater fuel pressure warning light illuminates, proceed as follows:

1. Check circuit breakers set
2. Position heater fuel supply switch to ALTERNATE
3. If fuel pressure is still low, check for fuel leaks in heater area
4. If operation of the heaters is necessary, turn the fuel boost pump switch to EMERGENCY for the No. 2 tank or any tank supplying the fuel system manifold

CAUTION

Operation of the boost pumps in EMERGENCY should be limited to prevent extreme shortening of boost pump life.

5. If the heater fuel pressure light remains illuminated with boost pump in EMERGENCY, turn heater switches OFF and return boost pump switch to original position

If a heater temperature is too low, proceed as follows:

1. Move the heat control rheostat to the maximum HEAT position
2. Check circuit breakers set
3. Actuate heater overheat reset switch to RESET
4. If heater does not come up to temperature, position the body heater switch for the malfunctioning heater to EMERGENCY. Monitor heater manually

If a low cabin temperature occurs with normal heater duct discharge temperatures, proceed as follows:

1. If in pressurized flight, check cabin air flow
2. If in unpressurized flight, position the cabin air selector switches to ALTERNATE

If either body heater overheat warning light illuminates, proceed as follows:

1. Position the respective body heater switch OFF; this will prevent damage which could result if the heater lock-out circuit failed
2. Allow heater to cool
3. Check circuit breakers set
4. Reposition body heater switch to AUTO; actuate heater overheat reset switch to RESET
5. If heater still overheats, repeat procedure but reposition the body heater switch to EMERG after the cooling period
6. If heater still overheats, reposition body heater switch to OFF

If one of the body heaters cannot be retained in operation, proceed as follows for best equal heat distribution:

1. Move the distribution manifold selector valve lever from position D to position E by moving the spring from pin F to pin G
2. Move the distribution valve lever from position A to position B. See figure 4-3 for other combinations of heat distribution
3. Close turbo bleeds on inoperative heaters

Minor Smoke or Fume Elimination

The pilot will initiate the following procedures:

1. Set the cabin altitude selector to an altitude above the airplane altitude
2. Set cabin pressure rate-of-change selector on MAX
3. Adjust TBS lever to obtain ventilation air flow of 5 inches differential pressure on the cabin air flow indicator

ANTI-ICING SYSTEMS

SURFACE ANTI-ICING SYSTEM

The surface anti-icing system acts as a deicer as well as an anti-icer since it can be used to remove snow and ice when the airplane is on the ground as well as to prevent (or remove) ice in flight. The surface anti-icing system is divided into three components consisting of a pair of heaters in the empennage and a group of three heaters in each wing. The heaters produce heated air for anti-icing. Air is taken into the heaters through ram air scoops in the leading edges of the wings and the dorsal fin. This air is heated by fuel combustion in the heaters. Fuel is supplied from either the No. 2 tank or the manifold. The heated air is then directed to corrugated inner surfaces of the wing and empennage. Heat transfer to the outer surface of the leading edges accomplishes the anti-icing. The heaters are turned on manually, but once started, the systems operate automatically with automatic cycling of the heaters, individually or in groups, to maintain proper outlet air temperature. Fuel for the heaters is taken from the No. 2 tank or from the manifold. See CABIN HEATING AND VENTILATING in this Section for a description of the fuel system. Automatic warning lights indicate overheat and fuel low pressure conditions. Differential pressure switches in each system turn off the heaters in the event that there is not sufficient air through the heaters to maintain proper combustion. In addition to heating air for surface anti-icing, the wing heaters are also used for preheating the engines. See COLD WEATHER PROCEDURES in Section IX. In the empennage system, automatically controlled blowers provide sufficient air flow for ground operation. To provide sufficient air flow for ground operation of the wing systems, it is necessary to operate the outboard engines at 2000 rpm or more, or to use external blowers. A blower in the skate area supplies the required air flow to the wing heaters when these heaters are used to preheat the engines. See ENGINE PREHEAT SWITCH in this Section.

Anti-Ice Master Switch

This switch (2, figure 1-22) on the engineer's instrument panel, controls the automatic regulating system. In the ON position, the cycling switches, differential pressure switches, empennage ground blowers, overheat control and warning systems all operate. When this switch is in the OFF position, there is no automatic regulation of the surface anti-icing system. A circuit breaker for the circuit is located on the overhead circuit breaker panel (figure 1-34).

Heater Fuel Valve Switches

These eight switches (92, figure 1-22) control the individual heater fuel valves. The action of the valves is controlled by the automatic regulating system when the switches are in the AUTO position. The valves are closed when the switches are in the OFF position. These switches are on the engineer's instrument panel; their circuit breakers on the overhead circuit breaker panel (figure 1-34).

Heater and APU Fuel Supply Switch

For a description of this switch see CABIN HEATING AND VENTILATING in this Section.

Limited Anti-Ice Switches

These two switches (3, figure 1-22), on the engineer's instrument panel, control selective deicing. The switch for the wing systems, when in the OUTBD WING ONLY position shuts off the heated air to the inboard wing sections. When this switch is at the INBD & OUTBD WING position, both inboard and outboard wing sections are deiced. The empennage switch, when set at DORSAL & STAB ONLY, shuts off the flow of heated air to the vertical stabilizer. When at the FIN DORSAL STAB position, all the empennage leading edges are deiced. Circuit breakers for the limited anti-icing circuits are on the overhead circuit breaker panel (figure 1-34).

Heater Overheat Test Switch

See CABIN HEATING AND VENTILATING in this Section for a description of this switch.

Heater Overheat Reset Switch

See CABIN HEATING AND VENTILATING in this Section for a description of this switch.

Balance Bypass Switch

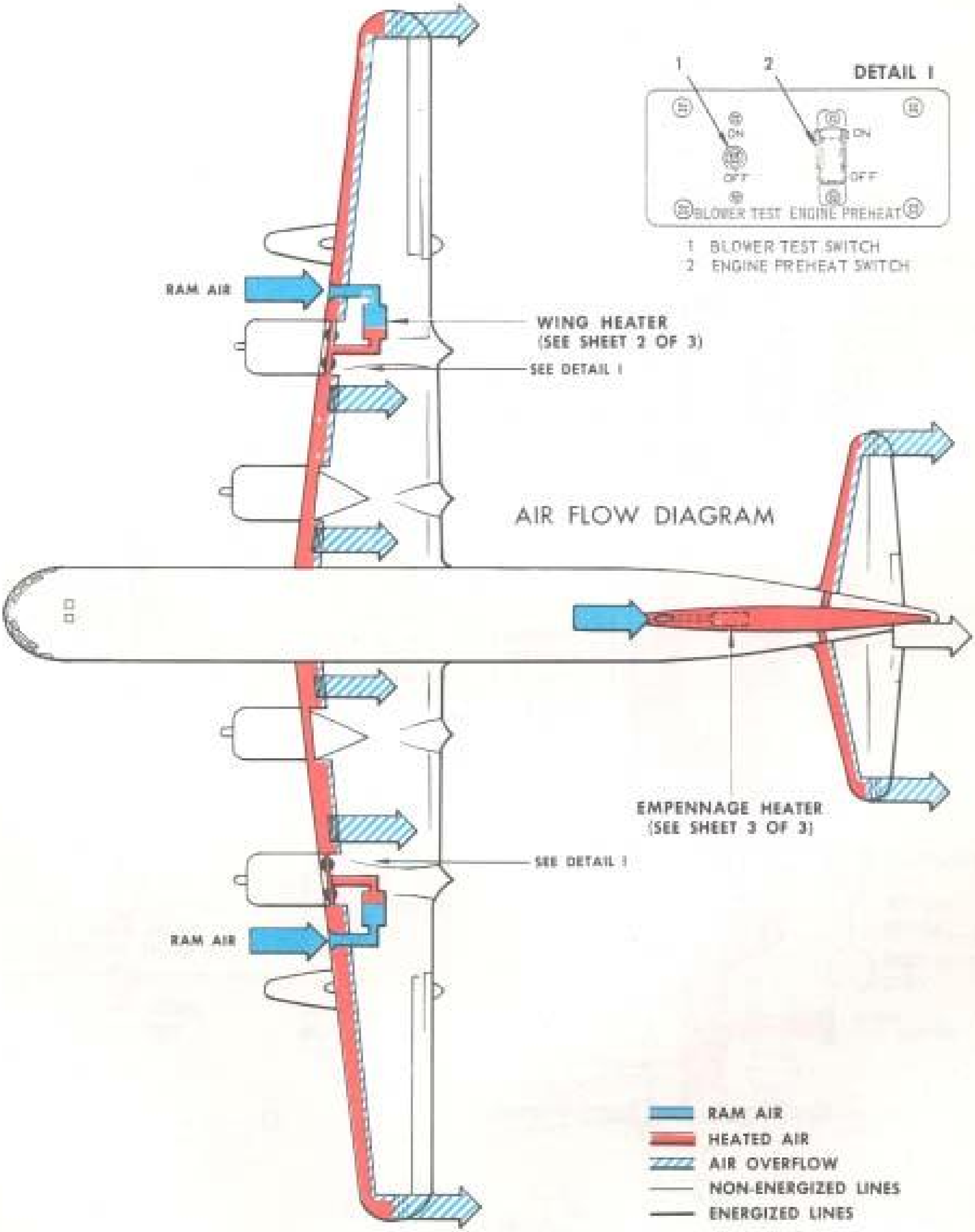
This switch (1, figure 1-22) on the engineer's instrument panel, is spring-loaded to the OFF position. When the switch is held in the ON position, the heat balance control and the differential pressure switches in the wing systems are bypassed, allowing the heaters to operate on lower than normal airflow at a maximum duct temperature of 93°C. This also allows operation of a heater in one wing without operating the opposite wing heater, thus permitting tests of the wing anti-ice system with one ground test cart. A circuit breaker for the anti-ice ground operation circuit is on the overhead circuit breaker panel (figure 1-34).

Emergency Anti-Ice Switches

These two switches (4, figure 1-22) on the engineer's instrument panel, control emergency operation of the anti-icing system and are guarded to the OFF position. In the ON position, these switches directly operate the anti-icing systems for the wings and empennage by bypassing the lockout controls of the overheat relays and the differential pressure switches. In the OFF position the emergency anti-icing circuits are inoperative. Circuit breakers are on the forward power panel (figure 1-34).

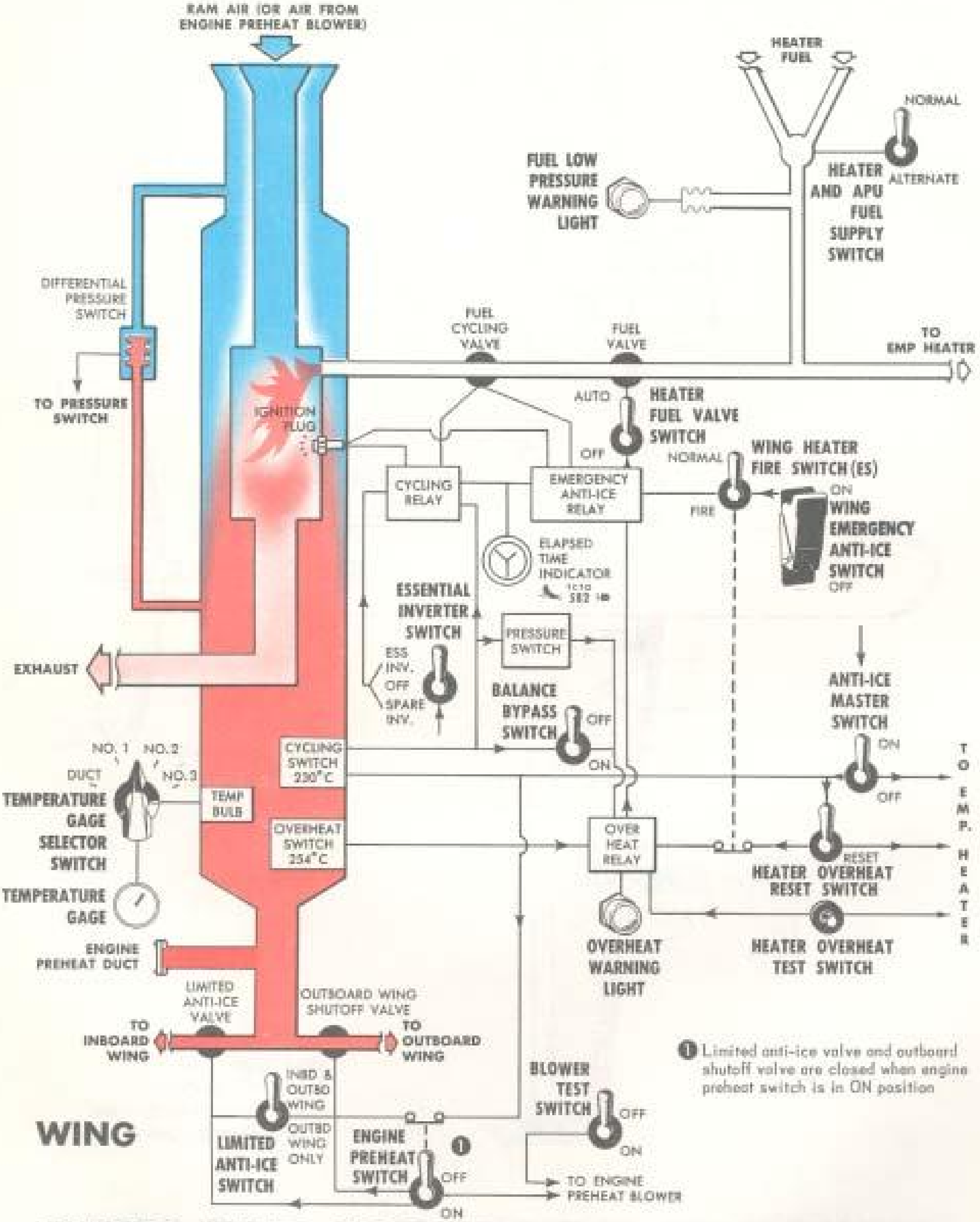
Anti-Ice Overheat Warning Lights

Three red press-to-test lights (6, figure 1-22) on the engineer's instrument panel, indicate actuation of the overheat relays for the wing and empennage anti-icing systems. The relays actuate when there is an overheat condition or when the heater overheat test switch is depressed. The lights remain illuminated, even when the overheat condition has been eliminated, until the heater overheat reset switch is actuated. The warning lights are protected by circuit breakers on the overhead circuit breaker panel (figure 1-34).



WING AND EMPENNAGE ANTI-ICING DISTRIBUTION

Figure 4-5 (Sheet 1 of 3)



① Limited anti-ice valve and outboard shutoff valve are closed when engine preheat switch is in ON position

WING AND EMPENNAGE ANTI-ICING DISTRIBUTION (CONT)

Figure 4-5 (Sheet 2 of 3)

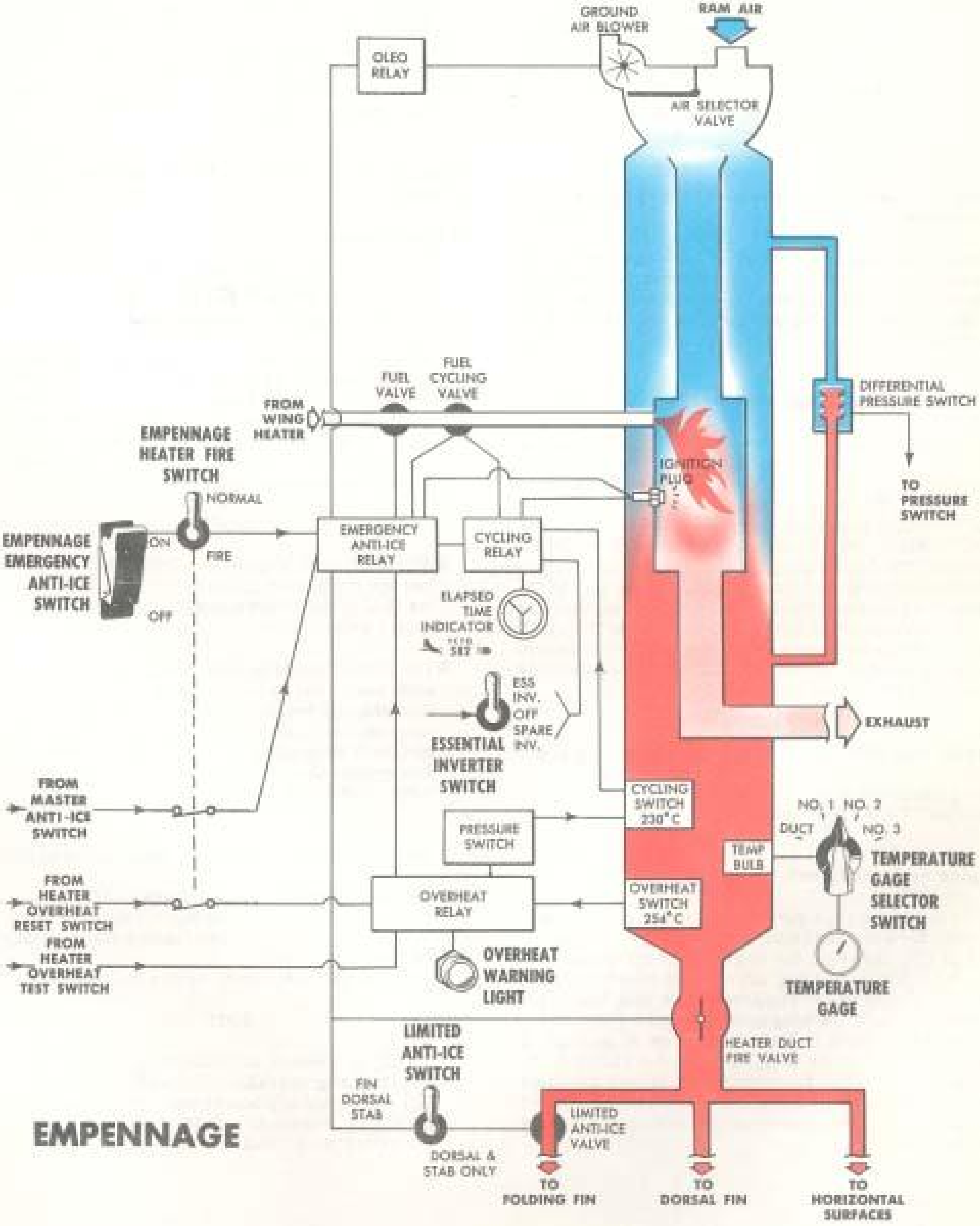


Figure 4-5 (Sheet 3 of 3)

Anti-Icing Heater and Duct Temperature Gages

Three temperature gages (7, figure 1-22) on the engineer's instrument panel, indicate in degrees Centigrade the temperature of heated air in the combustion heaters and in the ducts delivering air to the wings and empennage. The temperature gages are all protected by a single circuit breaker on the overhead circuit breaker panel (figure 1-34).

Wing and Empennage Heaters Elapsed Time Indicators ✈ 1C10 582

Airplanes incorporating ✈ 1C10 582 have an elapsed time indicator for each heater in the lower nose compartment mounted on the forward side of the bulkhead. The indicators automatically log the operating time of the combustion-type heaters.

Temperature Gage Selector Switches

Three rotary-type selector switches (5, figure 1-22) on the engineer's instrument panel connect duct and heater temperature sensing circuits with their temperature indicators. The wing switches have DUCT--NO. 1--NO. 2--NO. 3 positions. The empennage switch has DUCT--NO. 1--NO. 2--DUCT positions. In the DUCT position, the heater outlet air duct sensing circuits are connected to their corresponding gages. In the numbered positions, the temperature sensing circuits of the corresponding numbered heaters in the wings and empennage are connected to their respective gages. A circuit breaker for the indicator is on the overhead circuit breaker panel (figure 1-34).

Heater and APU Low Fuel Pressure Warning Light

For a description of this light see CABIN HEATING AND VENTILATING in this Section.

Engine Preheat Switch

These switches (2, figure 4-5), one in each outboard nacelle, have two positions: ON and OFF. Placing the switch ON, turns on the engine preheat blower and closes the wing anti-icing valves. The blower supplies the high volume of air required by the wing heater for combustion; and, the wing anti-icing valves are closed so that the air from the heater will flow to the engines instead of through the wing. Placing the switch to the guarded OFF position de-energizes the blower and opens the wing anti-ice valves. Each switch receives power through a circuit breaker on the respective nacelle solenoid panel.

Blower Test Switch

The engine preheat blowers in the outboard nacelles can be tested with the blower test switches (1, figure 4-5). The switch is spring-loaded to OFF. Holding the switch in the ON position energizes the blower. The test switches are protected by circuit breakers on the respective nacelle solenoid panels.

SURFACE ANTI-ICING SYSTEM NORMAL OPERATION

Flight Operation

WARNING

Wing anti-icing heaters should not be operated after loss of hydraulic fluid from the A/R hydraulic system (supplied by the outboard engines), if hydraulic fluid loss cannot be isolated by normal procedures or unless it can be definitely determined that the hydraulic fluid is not entering the heater cavity.

NOTE

- AC power must be available from the essential bus for the heater ignition system. Fuel will not flow to the heaters unless the essential inverter switch is ON.
- The system should be turned on as soon as possible when icing is encountered. If icing is anticipated, the system should be turned on in advance so that no delay will result in bringing the surface leading edges up to proper temperature. The system should be kept on during the entire duration of the icing condition.

1. Position heater and APU fuel supply switch to NORMAL
2. Position all heater fuel switches to AUTO
3. Position wing limited anti-ice switch to INBD & OUTBD WING, and empennage limited anti-ice switch to FIN DORSAL STAB
4. Position anti-ice master switch to ON

NOTE

Check each heater and duct temperature frequently during operation. Turn OFF the heater fuel switch for any heater that approaches the maximum temperature limit, or any heater indicating an unusually low temperature.

5. If a heater overheat warning light illuminates during operation, check all heater temperatures, and turn OFF the fuel switch for any heater near the maximum temperature limit. Use the overheat reset switch to start the remaining heaters of that system
6. If the heater and APU fuel pressure warning light illuminates, position the heater and APU fuel supply switch to ALTERNATE
7. If the light remains illuminated, turn a No. 2 boost pump switch, or a boost pump switch for any other tank set to MANIFOLD to EMERGENCY

CAUTION

Operation of boost pumps in EMERGENCY should be limited to prevent extreme shortening of boost pump life.

8. If the fuel pressure warning light remains illuminated, turn all heater fuel switches OFF

Ground Operation

The empennage anti-icing system is operated on the ground in the same manner as in flight. In order to operate the wing anti-icing systems on the ground, proceed as follows:
1. Operate the outboard engines at 2000 rpm or above
2. Hold balance bypass switch in the ON position while operating the heaters
3. Operate the heaters as in flight operation

To operate the wing heaters for preheating the engines refer to COLD WEATHER PROCEDURES in Section IX.

CAUTION

When operating heaters on the ground, be sure that heaters are purged after heater shutdown by maintaining 2000 rpm for two minutes to prevent residual heat from causing an overheat condition.

NOTE

If the wing anti-icing systems are to be operated while the engines are not running, external power and external blowers must be used. It is not necessary to use the balance bypass switch when external blowers are used.

SURFACE ANTI-ICING SYSTEM EMERGENCY OPERATION

Flight Operation

1. Place emergency anti-ice switches to ON
2. Turn all heater fuel switches to AUTO
3. Check heater temperatures frequently, since there are no overheat lockout controls in the emergency circuits
4. Manually cycle any heater approaching the maximum temperature limit

If the heater fuel pressure warning light illuminates, proceed as follows:
1. Check circuit breakers set
2. Position heater fuel supply switch to ALTERNATE
3. If operation of the anti-icing systems is necessary, turn a No. 2 fuel tank boost pump switch, or a boost pump switch for any tank supplying the manifold, to EMERGENCY

CAUTION

Operation of the boost pumps in EMERGENCY should be limited to prevent extreme shortening of boost pump life.

4. If the heater warning light remains illuminated with boost pump in EMERGENCY, turn heaters off and return boost pump switch to original position

Ground Operation

For checking emergency operation of the wing heaters, have outboard engines running at or above 2000 rpm, and operate as in emergency flight condition. For checking emergency operation without running the airplane outboard engines, use external auxiliary power and external ground blowers for the wings. Then proceed as in emergency flight operation.

PROPELLER DEICING SYSTEM

The propellers on this airplane are electrically deiced by means of prop blade heating elements using d-c power. Controlled by a single switch, this system deices the propellers one at a time by means of a timer. All blades of one propeller are deiced simultaneously. During operation of the system, the propeller being deiced is indicated by two tab-window type indicators on the engineer's instrument panel.

Propeller Deicing Switch

This switch (90, figure 1-22), on the engineer's instrument panel, operates the propeller deicing system. In the ON position current from the timer energizes relays which furnish power from the nacelle solenoid panels to the blade heating elements. In the OFF position, the propeller deicing system is inoperative. The circuit breaker is on the overhead circuit breaker panel (figure 1-34).

Propeller Deicing Indicators

Two dual tab-window indicators (91, figure 1-22) indicate that the deicing timer is functioning. Each indicator has an OFF tab as well as two numbered tabs. One indicator has tabs for No. 1 and No. 2 propellers and the other indicator has tabs for No. 3 and No. 4 propellers. As the timer cam closes a propeller deicing system circuit, its numbered tab will appear in the indicator window. Because of the propeller deicer timer , these two indicators alternate in operation. The indicators are protected by circuit breakers on the nacelle solenoid panels.

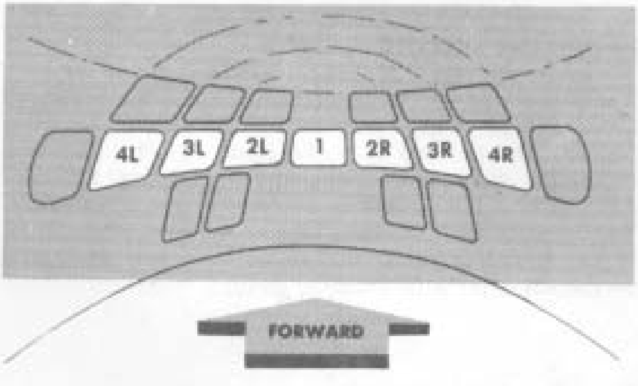
Propeller Deicing System Loadmeter

A propeller deicing system loadmeter (93, figure 1-22) on the engineer's instrument panel, indicates the amount of current going through the circuit. The loadmeter is graduated in percent, and is protected by a circuit breaker on the main circuit breaker panel.

PROPELLER DEICING SYSTEM OPERATION

Flight Operation

Place the propeller deicer switch in the ON position and check propeller deicer indicators occasionally for proper cycling. (The normal cycle is two minutes long, each propeller being heated for thirty seconds.) On airplanes **22629** ▶ plus those incorporating TCTO 534, frequently observe the propeller de-icing loadmeter through ON cycle for proper current flow to ascertain that propellers are being deiced properly. If the loadmeter needle does not stay in the green range or flickers abnormally, it is an indication of possible failure of the circuit in one or more blades and failure to deice with subsequent propeller unbalance.



ELECTRICALLY HEATED WINDOWS (CONTROL CABIN)

Figure 4-6

WARNING

On airplanes **22629** ▶ plus those incorporating TCTO 534, if any one propeller deicing loadmeter reading deviates from the average by more than 10 per cent, pull the appropriate propeller deicing circuit breaker. Retain the circuit breaker in this position for the remainder of the flight. Malfunction of the propeller deicing circuit may lead to blade failure.

Ground Operation

For ground operation with engines running, operate the system as in normal flight.

CAUTION

When the airplane engines are not running, do not operate the propeller deicing system as serious damage to the propeller blades may result.

WINDOW ANTI-ICING SYSTEM

Seven of the windows in the center row in the control cabin and the boom operator's center window are deiced by means of electrical (Nesa) window heat. The control cabin windows are assigned numbers as shown in figure 4-6. Windows No. 1 and 2L are control windows which automatically regulate the temperature of all the heated control cabin windows. AC power for heating the windows is supplied by two engine-driven alternators. DC control power is supplied from the generators. The use of this alternator power is determined by a bus selector switch and the voltage delivered to the windows is determined by a window heat selector switch. When either the pilot's or copilot's sliding window is open, power is cut off to all Nesa heaters. The other windows in the control cabin can be defrosted by heated air from the cabin heating system. See WINDOW DEFROSTING CONTROL KNOB in this Section.

Window Defrosting Control Knob

A single knob (9, figure 1-11), on the pilot's auxiliary panel, controls the window defrosting valves. The knob has CABIN HEAT and WINDOW DEFROSTING positions. When the knob is turned to the WINDOW DEFROSTING position, heated air from the cabin heating and pressurizing air ducts is directed through defrosting ducts to the six upper and four lower windows in the control cabin. When the knob is in the CABIN HEAT position, heated air is directed to the cabin heat outlet ducts.

Window Heat Selector Switch

This switch (14, figure 1-21) on the engineer's auxiliary overhead panel, has OFF--IFR (Air Refueling) EMER--HIGH--NORMAL--LOW positions. When in the HIGH, NORMAL or LOW position, variable frequency ac power from the Nesa bus in the alternator relay shield (figure 1-34) is directed to the control cabin heated windows (figure 4-6) and power from bus No. 2 in the alternator relay shield is directed to the boom operator's window heat selector switch. On ▼ airplanes, when in the IFR (Air Refueling) EMER position, power from the Nesa bus is directed to the boom operator's window heat selector switch as well as to the control cabin windows. The IFR (Air Refueling) EMER position should not be used on Ⓒ airplanes. As the switch is turned from LOW to HIGH, increasing voltages are applied to the control cabin windows. When the switch is in the IFR (Air Refueling) EMER position, a normal voltage is applied to the control cabin windows. Windows 4L and 4R do not receive power when the switch is in either the HIGH or IFR (Air Refueling) EMER positions. The temperature of the Nesa windows will cycle between 38°C and 43°C in all positions. The LOW, NORMAL, and HIGH positions of the selector switch control the voltage to the window heaters and regulate the rate of heating.

Boom Operator's Window Anti-Ice Switch

This switch (14, figure 4-69), on the boom operator's panel, has LOW--OFF--NORMAL positions. The LOW position is used to warm the boom operator's center window slowly and the NORMAL position is used for all other conditions requiring window heating. The circuit protection for this circuit is on the boom operator's panel (next to the switch).

WINDOW ANTI-ICING SYSTEM NORMAL OPERATION

For normal operation in flight, turn window heat selector switch to NORMAL only after a 20 minute warmup of the windows with the window heat selector switch in the LOW position. Before turning the window heat switch OFF, operate window heating with the switch in the LOW position for 5 minutes. Windows 3L and 3R must be closed before any control cabin windows can be heated. For ground operation, use LOW heat only. These steps are necessary to prevent damage to the window glass.

CAUTION

Nesa windows should be operated at as low a temperature as possible without impairing deicing or affecting safety. Excessive temperature reduces service life and contributes to cracking and layer separation.

WINDOW ANTI-ICING SYSTEM EMERGENCY OPERATION

When the control cabin windows are not being deiced sufficiently with the engineer's window heat selector switch in the NORMAL position, turn the selector switch to HIGH. Windows No. 4L and 4R do not receive current for anti-icing when the window heat selector switch is in the HIGH position. To operate the control cabin system with a window failure, shut the system off and disconnect inoperative windows at the upper and lower power leads of each window. Then, if either control window, No. 1 or No. 2L are still operating, start the system again. However, if both control windows are inoperative, leave the system off.

If power to the boom operator's Nesa window fails, ▼, turn the engineer's window heat selector switch to IFR (Air Refueling) EMER.

NOTE

When the engineer's selector switch is in IFR (Air Refueling) EMER position, windows 4L and 4R do not receive power, and the remaining control cabin windows receive normal voltage only. The boom operator's window will receive low voltage only.

PITOT HEAD ANTI-ICING SYSTEM

Ice formation on the pitot heads is prevented or removed electrically by 28 v dc heating elements in each of the two pitot heads.

Pitot Heat Switches

Airplanes **17260** ▶ **3141** less those incorporating 1610 292 have two ON--OFF switches (32, figure 1-12) on the overhead panel to operate the pitot heaters. The left switch controls the pitot heater in the pilot's airspeed indicating system, and the right switch controls the pitot heater in the copilot's airspeed indicating system. Power is supplied from the 28 volt DC bus and circuit protection is through the switches, which are circuit breaker type. On airplanes **3142** ▶ plus those incorporating 1610 292, the pilot's pitot heater switch has EMER--OFF--NORM positions. When in the EMER position, power is supplied from the battery bus. Circuit protection is provided for this switch by circuit breakers on the forward power panel (figure 1-34).

PITOT HEAD ANTI-ICING SYSTEM OPERATION

In flight, turn the pitot heaters on by turning pitot heat switches to ON (or NORM, as applicable). To prevent burning out the heater element, ground operation of the pitot heaters should be limited to brief maintenance checks; extreme cold weather ground operation; and takeoffs during rain, snow, and instrument conditions.

▼RUDDEVATOR ANTI-ICING SYSTEM

The ruddevators on the air refueling boom are electrically anti-iced. Rubber boots containing heating elements are on the leading edges of the ruddevators. Anti-icing is controlled by a switch on the engineer's air refueling panel. The anti-icing control circuit is protected by a circuit breaker on the engineer's air refueling panel (figure 4-72) and the anti-ice heating elements are protected by fuses on the main power panel (figure 1-34).

▼Ruddevator Anti-Ice Switch **17260** ▶ **3249** less ✈ 1C10 K509 ▶

This switch (1, figure 4-70) has ON--OFF positions and is guarded to the OFF position. When in the ON position, 28 volt dc power is supplied continuously to the ruddevator anti-ice heating elements. An oleo actuated switch keeps the system de-energized when the airplane is on the ground.

▼Ruddevator Anti-Ice Test Switches **17260** ▶ **3249** less ✈ 1C10 K509 ▶

Two switches (on the ADC relay shield, in the ceiling of the lower aft compartment) are for ground maintenance tests of the ruddevator anti-icing system. The switches receive power through circuit breakers on the aft power panel.

CAUTION

To prevent damage to the rubber boots and heating elements, do not operate the ruddevator anti-ice test switches for more than 40 seconds.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

WARNING

- Due to high voltages within electronic equipment, do not attempt inflight maintenance of electronic equipment beyond checking circuit breakers and fuses. Locations of all electronic equipment circuit breakers can be determined from figure 1-33 and figure 4-39.
- ▼ Do not operate unnecessary electrical or electronic equipment during air refueling.

NOTE

No transmission will be made on emergency (distress) frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

All electronic equipment used for communications, navigation, and identification is listed in figure 4-9. The communication radios are connected through a radio junction box to the interphone so that individual selection of the receivers and transmitters can be made at each crew member's interphone control panel. A master d-c radio and radar power circuit breaker is on the forward power panel (figure 1-34). Circuit protection for radio a-c circuits is on the a-c power panel (figure 1-34).

INTERPHONE (AN/AIC-10)

The interphone ties all communications facilities together on a common channel. The particular control panel or panels at each station determine the facilities available for talking and listening. Regular crew stations have control panels with switchinch arrangements that permit speech communication between crew members, transmission and reception on the liaison, VHF, and UHF radios, and reception of the signals from the navigation equipment. Stations of limited use have auxiliary interphone installations that limit the user to talking or listening to other crew members. The location of all interphone equipment is shown in figure 4-9. On tanker airplanes, two interphone control panels, marked NORMAL CONTROL and AUX CONTROL, are installed at the boom operator's station. In case of failure of one panel, the other may be used by means of the NORMAL-AUX switch located between the two panels. Radio range filter control panels, which allow the operator selective filtering of voice and range signals, are provided for the pilot, copilot and navigator. Eight auxiliary control panels are connected to the interphone and call lines only. These are located in the nose wheel well, the rear wing spar, APU, overwing emergency exit hatches, left and right scanner's stations, and boom operator's compartment (aft cargo door Ⓒ), and on airplanes **22665** ▶ **3213** , the A/R hydraulic panel. Airplanes **17260** ▶ **22664** have an additional auxiliary control panel forward of the right scanner's station. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

Interphone Controls

NORMAL-AUXILIARY LISTEN SWITCH. Each interphone control panel has a NORMAL--AUX LISTEN switch (2, figure 4-8) that is safetied to NORMAL. In the NORMAL position, all the facilities on the control panel operate in the normal manner. There is a small amplifier for each control panel. If the amplifier at the user's station fails, the AUX LISTEN operation is an emergency measure for listening. Switching to AUX LISTEN bypasses the amplifier, makes the volume control ineffective, and makes it possible to listen but not talk. Operation in this function is with reduced signal strength (no amplification) with a subsequent reduction in volume. There is a definite switching priority of the mixing switches and the selector switch during individual control panel operation in AUX LISTEN. The left mixer switch has first priority. While this switch is in the ON (up) position no other circuit is connected, regardless of the position of the other switches. Placing the left switch OFF (down) passes priority to the switch immediately to the right. Priority continues to pass to the right in this manner as each switch is shut off. All switches to the left of the switch controlling the function the user wants to listen to must be down. Placing all mixing switches down enables the selector switch to control the selection of equipment.

INTERPHONE SELECTOR SWITCH. A rotary selector switch (3, figure 4-8) on the interphone control panel is for the selection of one facility for talking and listening. Switch markings are CALL--INTER--COMM UHF--LIA--COMM VHF--COMM MF. Rotating the selector to the spring loaded CALL position enables the user to interrupt all other interphone activity to talk to the crew (regardless of the arrangement of switches on the control panels at the various stations). When using the CALL function, the selector must be held in the CALL position to talk and released to INTER to listen. The user can talk without pressing the mike switch when utilizing the headset with boom-type mike attached. However, when the hand mike is used, the mike switch must be used when the switch is on the CALL position to contact all stations. INTER position allows communication between all crew stations. COMM UHF position allows the operator to receive on the UHF radio and transmit when his respective mike switch is pressed. LIA position allows crew members to receive liaison radio signals and to transmit when his respective mike switch is depressed. COMM VHF allows the operator to receive on the VHF radio and transmit when his respective mike switch is pressed. COMM MF allows voice transmission or code transmission. The copilot and navigator are provided with a key for code transmission. When using the COMM MF position on the interphone selector switch, the operator should ascertain that his mixer switch is not in the LIA position.

INTERPHONE MIXER SWITCHES. Five mixer toggle switches (1, figure 4-8) are on the interphone control panel. These switches have INTER--UHF COMM--LIA--ADF--VHF COMM positions. When the NORMAL--AUX LISTEN switch is in the NORMAL position, the on position of each toggle switch mixes the signal from the respective equipment separately or simultaneously with the facility selected by the interphone selector switch. This allows the crew member to monitor incoming signals from the various equipment without changing the selector switch position. The on position of the INTER mixer switch allows monitoring of the interphone. The on position of the UHF COMM mixer switch allows monitoring of signals from the UHF command receiver. The on position of the LIA mixer switch allows signals from the liaison receiver to be monitored. The on position of the ADF mixer switch allows monitoring of signals from the radio compass receiver. The on position of the VHF COMM mixer switch allows audio signals from the VHF radio receiver to be monitored. In addition, five other mixer switches are on the interphone mixer switch panel. (See 5, figure 4-8). The additional mixer switches are marked: APN-69 MONITOR--AUX REC--MARKER--APN-76 MONITOR--VHF NAV--TACAN. These switches allow monitoring of signals from their respective receiver. The APN-69 MONITOR mixer switch is used only at the navigator's station and only on airplanes **3250** ▶ plus those incorporating 1C10 K211. The APN-76 MONITOR mixer switch is used only at the navigator's station and only on airplanes **3142** ▶. The TACAN mixer switch is used only at the pilot's stations and only on airplanes incorporating 1C10 K572.

INTERPHONE VOLUME KNOB. A volume knob (4, figure 4-8) on the interphone control panel and auxiliary interphone control panel allows regulation of volume level received at that station. The volume knob is ineffective when the NORMAL-AUX LISTEN switch is in the AUX LISTEN position. The counterclockwise limit of the knob gives minimum volume operation. The maximum volume before peak clipping, is obtained with the knob at approximately the midposition. Advancing the knob beyond this point results in clipping the speech peaks and increasing the average power of a speech signal when needed to overcome noise at a listener's station. (Peak clipping excludes sharp sound pressures from the ear of a listener during high average output; however, the greater power makes more noticeable the electrical background noise in the system.) Normally the volume control should be set to midposition except on the auxiliary interphone control panel which normally should be set to maximum clockwise position. The volume levels of the various equipment connected to the interphone should then be set for comfortable listening using the individual equipment volume controls.

AUXILIARY INTERPHONE CALL BUTTON. The function of the CALL button (6, figure 4-8) on the auxiliary interphone control panel is the same as the CALL function of the selector switch on the interphone control panels at each crew station. This is an emergency provision that enables a crew member to talk to the rest of the crew on the interphone regardless of the switch arrangements on the control panels at the various stations. Pressing the CALL button interrupts all other interphone activity and permits the user to talk without using the press-to-talk switch.

TYPE AND DESIGNATION	USE	PRIMARY OPERATOR	RANGE	CONTROL LOCATION	REMARKS
INTERPHONE **AN/AIC-10**	Intercrew communication plus use with radio and navigation equipment	All crew members	Intraplane only except when used in conjunction with other equipment	All crew stations. Call boxes located at various positions in airplane	No control switches to turn interphone on or off. Operative whenever airplane has electrical power
VHF RADIO **AN/ARC-3**	Short range, two-way voice and code communication	Pilot	Up to 135 miles at 10,000 feet, characterized by line-of-sight conditions	Control stand	Remote tuning on 8 channels
UHF RADIO **AN/ARC-27**	Short range, two-way voice and code communication	Pilot	Line-of-sight. Range varies with altitude in respect to receiving station	Master control at navigator's station and the 19 channel aux control on control stand. On airplanes 3178 ▶ master control is on main radio rack	Master control LOCAL-REMOTE switch must be on REMOTE for operating pilots' control. Remote tuning on 19 channels 1750 frequencies can be selected manually
UHF DIRECTION FINDER **AN/ARA-25** 3178 ▶ PLUS TCTO 321	Receives signals for directional bearing and homing, both air to air and air to ground	Pilot	Line-of-sight. Range depends upon power of transmitting stations and conditions	ADF position on UHF radio panel on control stand	Used with UHF radio set AN ARC-27
LIAISON RADIO **AN/ARC-21** AIRPLANES WITHOUT TCTO 1-1-666	Long range, two-way voice and code communications	Copilot	Range depends upon transmitting frequency and conditions. Up to several thousand miles	Control stand	20 preset channels. CW & MCW keying provided for copilot. Key on copilot's auxiliary panel.
LIAISON RADIO **AN/ARC-65** AIRPLANES WITH TCTO 1-1-666	Long range, two-way voice and code communications	Copilot	Range depends on mode selected, operating frequency, and conditions. Up to several thousand miles	Control stand	20 preset channels. CW & MCW keying provided for copilot. Key on copilot's auxiliary panel. Either amplitude modulation (AM) or single sideband (SSB) operation
MF COMMAND (AUX LIAISON) TRANSMITTER **AN/ART-13**	Long range voice and code transmission	Navigator	Range depends upon transmitting frequency and conditions. Up to several thousand miles	Navigator's station	Used as an auxiliary liaison and special transmitter for rendezvous
AUX LIAISON RECEIVER **BC-348** 17260 ▶ 3278 LESS TCTO KG206	Long range voice and code reception	Navigator	Reception depends upon power of transmitting station and conditions	Main radio rack	For additional monitoring requirements
AUX LIAISON RECEIVER **AN/ARR-36** 3279 ▶ PLUS TCTO KG206	Long range voice and code reception	Pilot	Reception depends upon power of transmitting station and conditions	Overhead panel	For additional monitoring requirements
RADIO COMPASS **AN/ARN-6**	Receives signals for directional bearings, homing and radio range flying	Pilot and navigator	Depends upon power of transmitting station and conditions	Control stand and navigator's station	Control may be transferred between pilot and navigator

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

Figure 4-7 (Sheet 1 of 3)

TYPE AND DESIGNATION	USE	PRIMARY OPERATOR	RANGE	CONTROL LOCATION	REMARKS
MARKER BEACON AN/ARN-12	Receives location marker signals on radio navigation beams	Automatic		Beacon light is on pilot's course indicator	
VHF NAVIGATION RADIO (OMNI) AN/ARN-14	VHF radio-navigation aids	Pilot	Line-of-sight	Control stand (Omni control panel and instrument select switch)	Indication on course indicator on pilots' instrument panel and on pilots' and navigator's RMI'S
GLIDE SLOPE RECEIVER AN/ARN-18	Indicates glide angle for instrument approach	Pilot	Short range, line-of-sight	Control stand (Omni control panel)	Indication on course indicator on pilots' instrument panel
UHF NAVIGATION RADIO (TACAN) AN/ARN-21 AIRPLANES WITH TCTO 572 ▶	Provides continuous bearing and distance data to ground beacon	Pilot	195 NAM within line-of-sight	Control stand (Tacan control panel and instrument select switch)	Bearing displayed on RMI'S and on pilot's course indicator. Range data displayed on range indicator on pilot's instrument panel. Requires N-1 compass data
DINGHY TRANSMITTERS AN/CRT-3A	Emergency transmitter to send signals when forced down	Any crew member	Range depends upon transmitting frequency, location, etc. Up to several thousand miles maximum under ideal conditions at 8364KC. 200-300 miles optimum on 500 KC	Stowed forward of life raft supports in main compartment	
RADIO ALTIMETERS SCR-718C	Indicates distance from airplane to surface	Navigator	0-40,000 feet	Navigator's station	
LORAN AN/APN-70	Provide accurate fixes for navigation	Navigator	Up to 1400 miles depending upon conditions and time of day	Navigator's station	
IFF AN/APX-6 AIRPLANES WITHOUT TCTO 590 ▶ **AN/APX-25** AIRPLANES WITH TCTO 590 ▶	Aircraft recognition (Identification Friend or Foe)	Navigator 17260 ▶ 2900, 3340 ▶ Pilot 2901 ▶ 3339	Line-of-sight	Navigator's station 17260 ▶ 2900, 3340 ▶ pilot's station 2901 ▶ 3339	
SEARCH RADAR AN/APS-42	Search and navigation radar	Navigator	200 miles maximum	Navigator's station	For obstacle detection and navigation
▼ **RADAR BEACON AN/APN-69** 3232 ▶ PLUS TCTO K021 ▶	Sends signals to other airplane for rendezvous	Navigator	Up to 205 miles	Navigator's station	Sends signals when triggered by search radar of approaching airplane. Signals are displayed on search radar of approaching airplane
▼ **RENDEZVOUS RADAR AN/APN-12**	Rendezvous radar transmitter-receiver	Navigator	Up to 350 miles	Navigator's station	Sends signals to and receives signals from AN/APN-76 transponder in other airplane or ground station

Figure 4-7 (Sheet 2 of 3)

TYPE AND DESIGNATION	USE	PRIMARY OPERATOR	RANGE	CONTROL LOCATION	REMARKS
T RENDEZVOUS RADAR AN/APN-76	Rendezvous radar transponder	Navigator	Up to 350 miles	Navigator's station	Sends signals to approaching airplane when triggered by signals from AN/APN-12 radar in approaching airplane.
RADAR PRESSURIZING EQUIPMENT	Pressurizes radar sets to provide satisfactory operation at high altitudes	Navigator		Navigator's station	
STATIC DISCHARGERS AN/ASA-3	Discharges static electricity to air			Wing tips and tail surfaces, boom ruddevators and boom nozzle hood	

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT (CONT)

Figure 4-7 (Sheet 3 of 3)

CONTROL WHEEL MIKE SWITCH. This switch (7, figure 4-8) is on the pilots' control wheels. When the switch is depressed, the respective crew member's mike is connected to the facility selected by the interphone selector switch. The switch allows the crew member to listen and talk over the interphone without removing his hands from the control wheel to operate switches on the control panel.

FOOT MIKE SWITCHES. Airplanes **17260** ▸ **3177** have foot operated mike switches on the floor of the navigator's, engineer's, and radio operator's stations for their use. On airplanes **3178** ▸ a second foot operated switch is at the navigator's station for convenience. When the foot switch is depressed, transmission is possible only through the equipment indicated by the interphone selector switch on the individual's interphone control panel.

RADIO RANGE FILTER SWITCH. This three-position rotary filter switch (8, figure 4-8) is on the radio range filter control panel. The switch has VOICE--RANGE--BOTH positions for ADF-1 use. RANGE position allows radio compass range signals to be heard at their full volume level and the voice signals reduced to a lower level. The VOICE position allows the voice signals to be heard at their full intensity while the range signals are reduced. The BOTH position disconnects the filter and allows both radio range and voice signals to be heard at equal intensity. The switch also has these positions for ADF-2, however, the switch is inoperative for ADF-2 RANGE or ADF-2 VOICE positions.

LOUDSPEAKER SWITCH. Loudspeakers at each of the major crew stations are turned on and off by an ON--OFF switch (9, figure 4-8) on the base of the speaker. With the switch ON, the speakers maintain the volume level set by the volume knob on the interphone control panel regardless of the airplane altitude. With the switch OFF, no sound will be heard through the loudspeakers, unless a signal is originated using the CALL function.

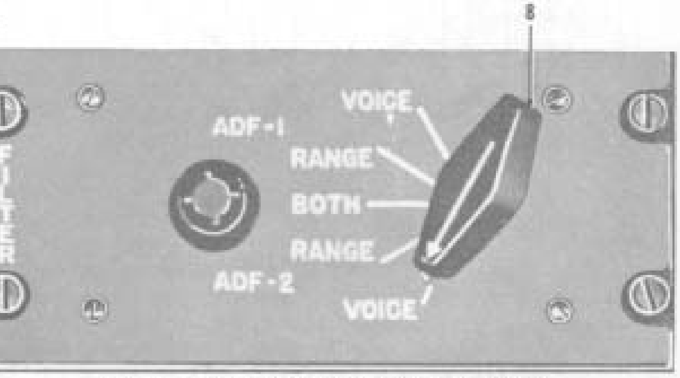
Normal Operation of the Interphone

INTERCOMMUNICATIONS. Communication between crew members may be accomplished as follows:

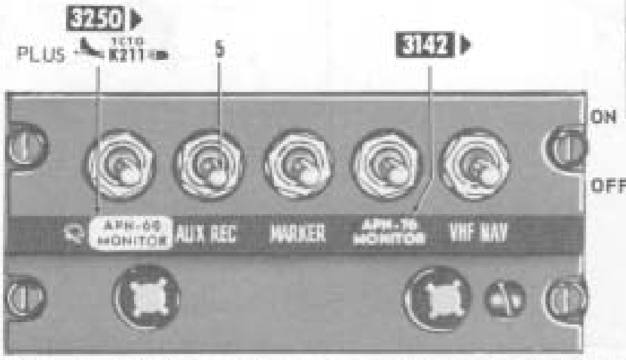
1. Place the NORMAL--AUX LISTEN switch on the interphone control panel in NORMAL and move the interphone selector switch to INTER position. On the pilots' panels, move all mixer switches to OFF (down). The interphone is now set up for normal communication between crew members
2. The pilot or copilot may communicate with other stations by depressing his control wheel mike switch. The navigator may use his foot switch to permit use of his mike. Volume of signals received may be regulated by the volume knob
3. Call all crew members from the pilot's or copilot's station by depressing the control wheel mike switch on the pilots' control wheel or by placing the pilots' interphone selector switch to CALL. Call by other crew members may be made by positioning their interphone selector switch to CALL. Call from stations

1 INTERPHONE MIXER SWITCHES
2 NORMAL-AUX LISTEN SWITCH (2 PLACES)
3 INTERPHONE SELECTOR SWITCH
4 INTERPHONE VOLUME KNOB (2 PLACES)
5 AUXILIARY MIXER SWITCHES
6 AUXILIARY INTERPHONE CALL BUTTON
7 CONTROL WHEEL MIKE SWITCH
8 RADIO RANGE FILTER SWITCH
9 LOUDSPEAKER SWITCH

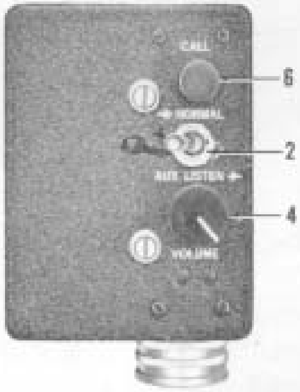
INTERPHONE CONTROL PANEL



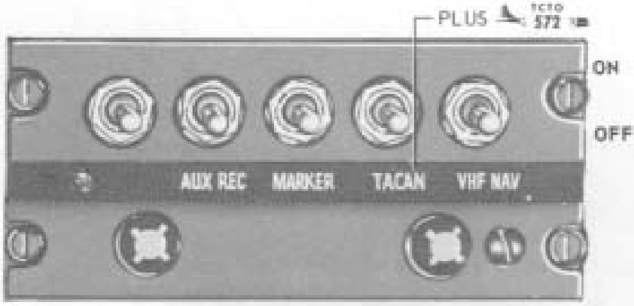
RADIO RANGE FILTER CONTROL PANEL



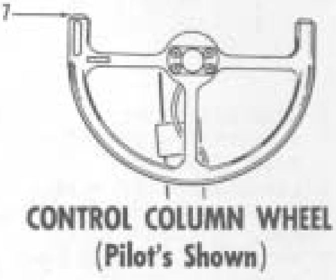
INTERPHONE MIXER SWITCH PANEL (Navigator's Station)



AUXILIARY INTERPHONE CONTROL PANEL



INTERPHONE MIXER SWITCH PANEL (Pilot's Stations)

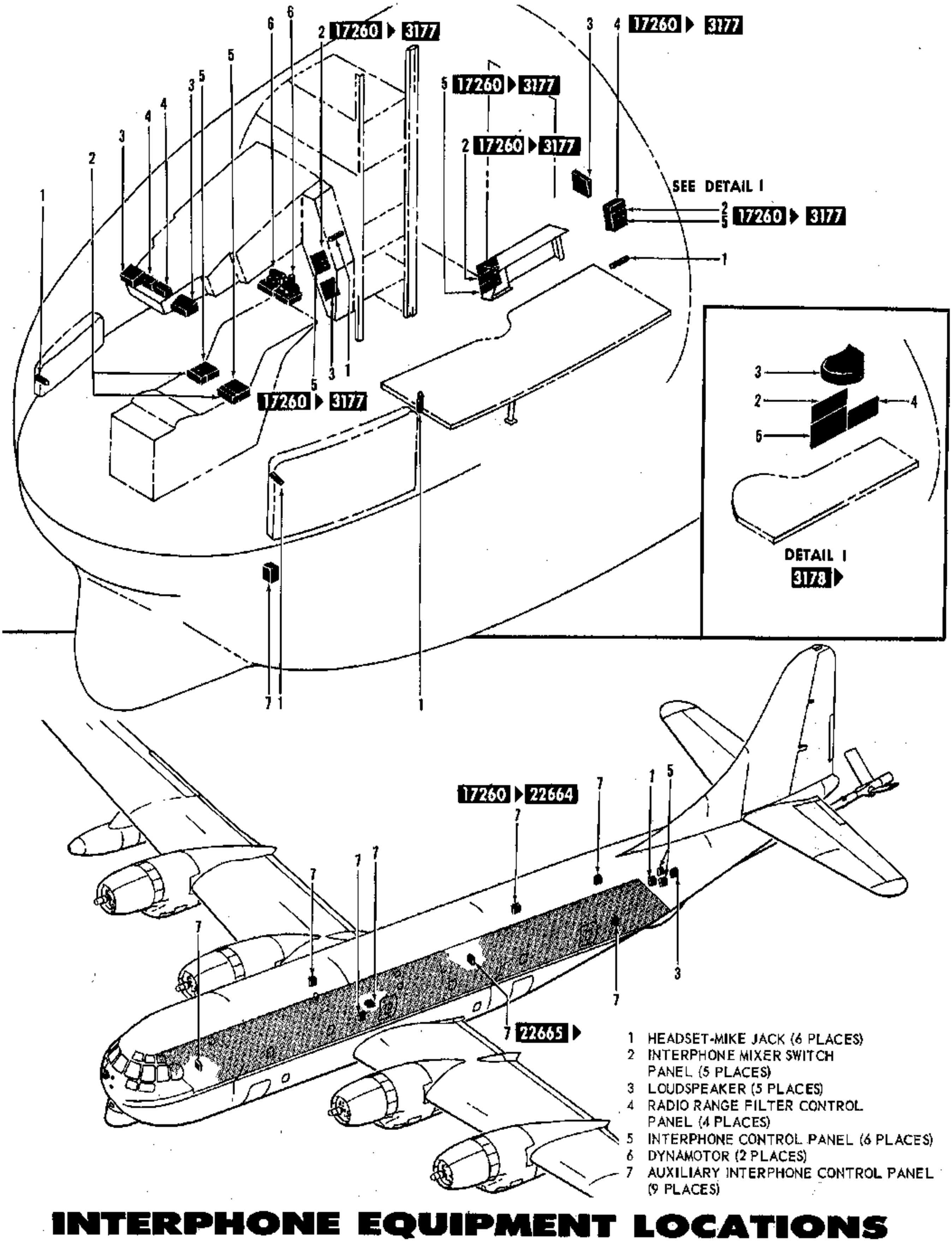


CONTROL COLUMN WHEEL
(Pilot's Shown)

LOUD SPEAKER

INTERPHONE CONTROL PANELS

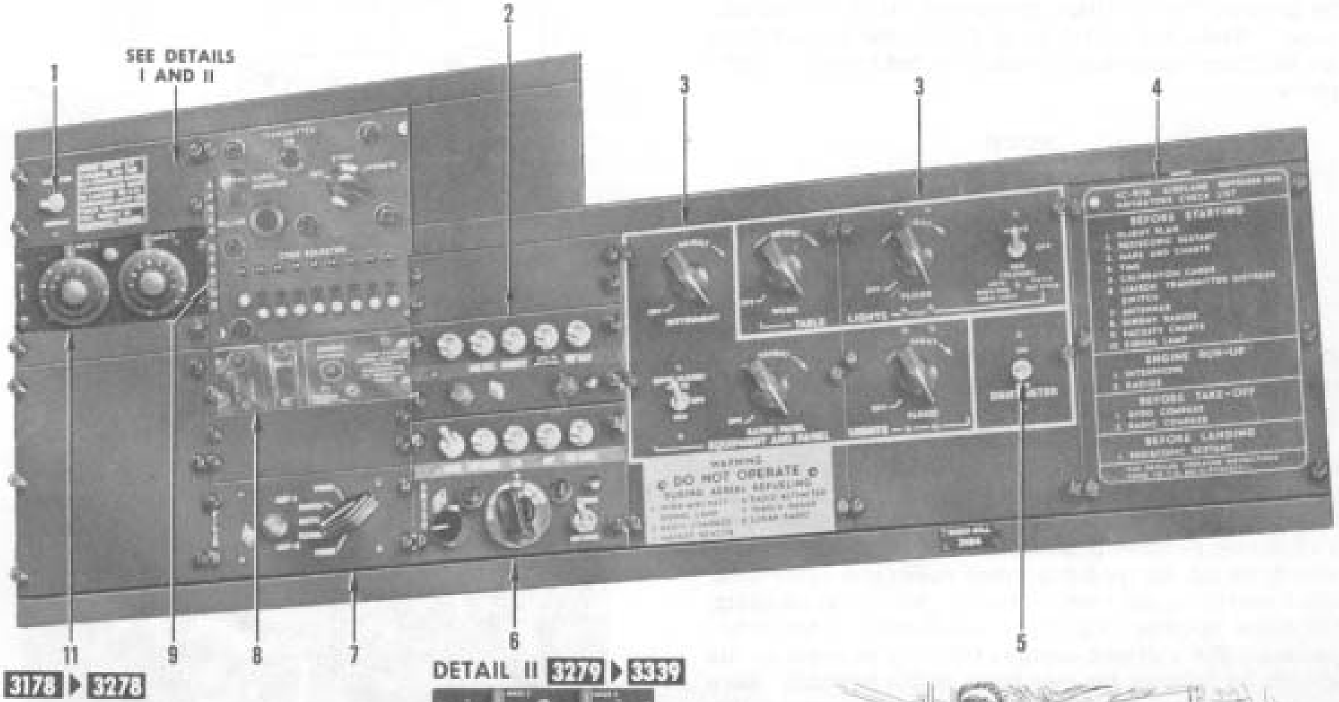
Figure 4-8

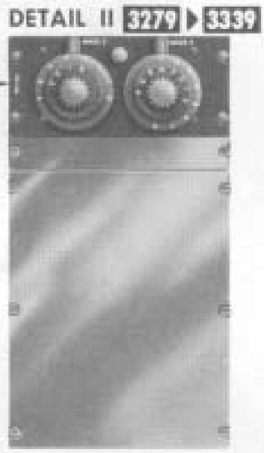


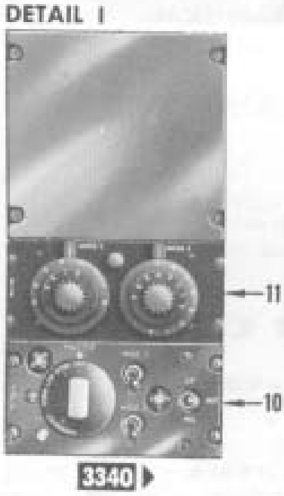
1 HEADSET-MIKE JACK (6 PLACES)
2 INTERPHONE MIXER SWITCH PANEL (5 PLACES)
3 LOUDSPEAKER (5 PLACES)
4 RADIO RANGE FILTER CONTROL PANEL (4 PLACES)
5 INTERPHONE CONTROL PANEL (6 PLACES)
6 DYNAMOTOR (2 PLACES)
7 AUXILIARY INTERPHONE CONTROL PANEL (9 PLACES)

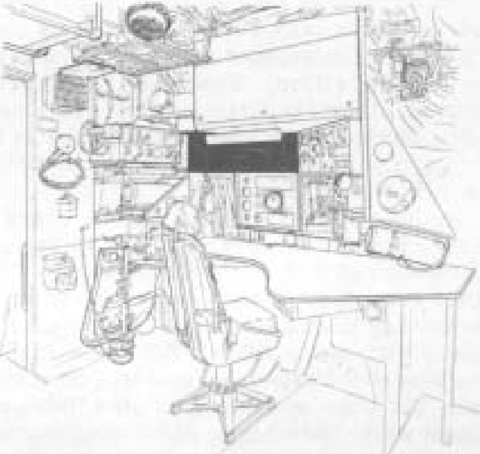
INTERPHONE EQUIPMENT LOCATIONS

Figure 4-9









1 AUXILIARY LIAISON NORMAL/MONITORING SWITCH 3178 ▶ 3278
2 INTERPHONE MIXER SWITCH PANEL (SEE FIGURE 4-8)
3 LIGHT SWITCHES (2 PLACES)
4 NAVIGATOR'S CHECKLIST
5 DRIFTMETER SWITCH
6 INTERPHONE CONTROL PANEL (SEE FIGURE 4-8)
7 RADIO RANGE FILTER CONTROL PANEL (SEE FIGURE 4-8)
8 RADAR BEACON POWER CONTROL PANEL AN/APN-69 (SEE FIGURE 4-32) 3232 ▶ PLUS TCTO K211
9 RADAR BEACON CONTROL PANEL AN/APN-69 (SEE FIGURE 4-32) 3232 ▶ PLUS TCTO K211
10 IFF CONTROL PANEL (SEE FIGURE 4-30) 3340 ▶
11 SIF CODER CONTROL PANEL (3 PLACES) (SEE FIGURE 4-30) TCTO 590

NAVIGATOR'S INTERPHONE AND LIGHT PANELS 3178 ▶

Figure 4-10

with auxiliary interphone control panels may be made by pressing the auxiliary interphone call button on that panel. While any switch is on CALL, the signals from all auxiliary equipment are disconnected from the interphone

NOTE

> The microphones used with this equipment are gradient microphones. Satisfactory results will therefore be obtained only when the talker's lips are very close to or touching the moisture barrier of the microphone.

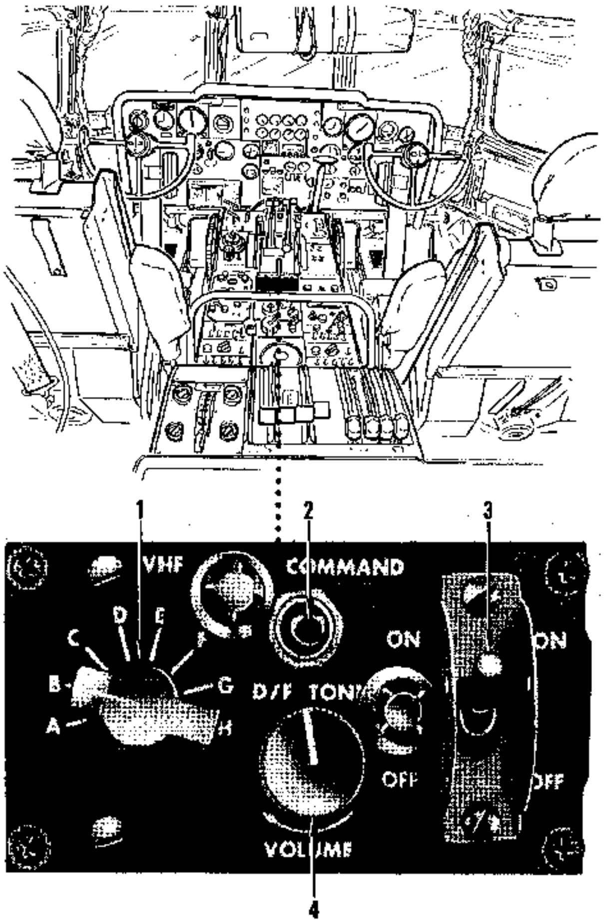
INTERPHONE/RADIO COMMUNICATION. Operation of the radio facilities in conjunction with the interphone may be accomplished as follows:

1. The command radios as well as intercommunication between crew members may be heard by placing the proper mixer switch marked UHF COMM or VHF COMM to ON. The pilot and copilot may transmit over a command radio by positioning the interphone selector switch to the desired command radio and using their mike switch on the control wheel. When transmitting, the crew member will hear a sidetone in his headphones. The sidetone enables the user to regulate his speech by hearing his own voice in the headset. Each crew member may receive command conversation by placing his interphone selector switch to the desired command position. The crew members may also listen to other facilities while receiving command radio (selected by the interphone selector in the desired command position) by positioning the desired mixer switch in the ON position
2. Radio compass signals may be heard along with other communication facilities by placing the mixer switch marked ADF in the ON position. The pilot may select reception of both range and voice signals by positioning the radio range filter switch to BOTH. When positioned to ADF-1 VOICE or ADF-1 RANGE, reception of the selected signal will be more predominant. The crew member may also listen to other facilities while listening to radio compass (selected by the ADF mixer switch) by placing the desired mixer switches in the ON position
3. Liaison radio (AN/ARC-21) reception may be heard separately by positioning the interphone selector switch to LIA. All crew members may transmit over the liaison radio by placing their respective interphone selector switches to LIA and using their mike switch

Emergency Operation of the Interphone

To contact all stations in an emergency, place a call as follows:

1. The pilot or copilot will position his interphone selector switch to CALL
2. Other crew members place their interphone selector switch to CALL
3. A crew member at a station with an auxiliary interphone control panel presses his call button



VHF RADIO CONTROL PANEL

1 CHANNEL SELECTOR SWITCH
2 D/F TONE BUTTON
3 VHF POWER SWITCH
4 VHF VOLUME KNOB

VHF RADIO CONTROLS

Figure 4-11

In the event of amplifier failure at any crew station, as evidenced by intercommunication silence or unintelligible signals from all facilities, proceed as follows:

1. Place NORMAL--AUX LISTEN switch in AUX LISTEN position (this will necessitate breaking the safety wire)
2. Place all mixer switches in OFF position and turn interphone selector switch to the desired listening facility
3. If the desired listening facility cannot be selected by the interphone selector switch: turn ON appropriate mixer switch. If more than one mixer switch is ON, the facility heard will be that of the farthest left switch which is in the ON position

VHF RADIO (AN/ARC-3)

The VHF radio is for air to air or air to ground voice or modulated code communications. Range of the equipment is characterized by line-of-sight and by atmospheric conditions. The set operates in a frequency range of 100 to 156 megacycles. Eight crystal controlled channels are provided and may be selected at a control panel (figure 4-11) on the control stand. Channelization crystal changes are possible and only limited to the availability of crystals in the sets frequency range. The radio is turned on and off with the power switch on the control panel. Since the radio is connected to the interphone, the interphone selector switch and mixer switch must be in the appropriate COMM VHF position to transmit or receive. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-34). Additional circuit protection for the set is provided by fuses on the VHF power junction box (J-68/ARC-3) on top of the main radio rack.

VHF Radio Controls

VHF POWER SWITCH. The VHF radio is turned on and off by positioning the power switch (3, figure 4-11) on the VHF radio control panel, to the desired position.

CHANNEL SELECTOR SWITCH. A channel selector switch (1, figure 4-11) on the VHF radio control panel is for selection of one of the eight lettered channels available. The switch has positions marked A through H.

D/F TONE BUTTON. In addition to supplying a tone for direction-finding purposes, this button (2, figure 4-11) on the VHF radio control panel may be used as a key when MCW operation is desired. Maximum keying speed is limited to approximately 15 words per minute.

VHF VOLUME KNOB. A volume knob (4, figure 4-11) on the VHF radio control panel is to adjust the sound level through the interphone.

Normal Operation of the VHF Radio

The VHF radio can be operated from any crew station that has an interphone control panel; however, the channelization and power are controlled at the pilots' station only. Operation of the set is as follows:

1. Place the power switch ON
2. Ascertain that selector switch on interphone control panel is on COMM VHF
3. Allow 30 to 45 seconds for set to reach normal operating temperature
4. Test set for sidetone by pressing the microphone switch
5. Release microphone switch. Place channel selector switch on any desired channel. The receiver will continuously monitor selected channel
6. Adjust sound level with the VHF volume knob. Clockwise rotation increases volume. Counterclockwise rotation decreases volume
7. To turn the set off, position the power switch to OFF

NOTE

To select proper VHF crystals when crystal charts are not available, the following procedure will be used:

1. Transmitter - To find the proper transmitter crystal for a particular channel, divide the desired operating frequency by 18.
2. Receiver - The proper receiver crystal for a particular channel will be determined in the following manner:

$$FC = \frac{FO - 12}{H}$$

FC = Crystal Frequency
FO = Operating Frequency Desired
H = Harmonic

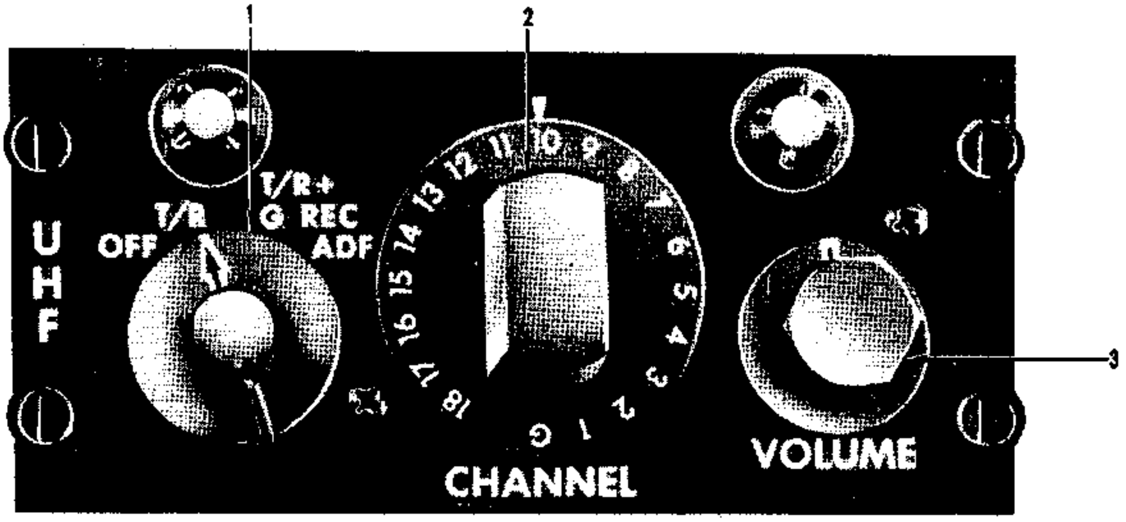
The correct value of (H) is given in the following table:

Operating Frequency (MCS)	Receiver Harmonic (H)
100 - 108	11
108 - 116	12
116 - 124	13
124 - 132	14
132 - 140	15
140 - 148	16
148 - 156	17
156 -	18

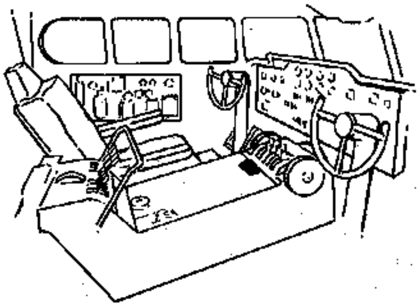
The receiver thumb wheel setting for each channel must be set on the desired operating frequency.

Emergency Operation of the VHF Radio

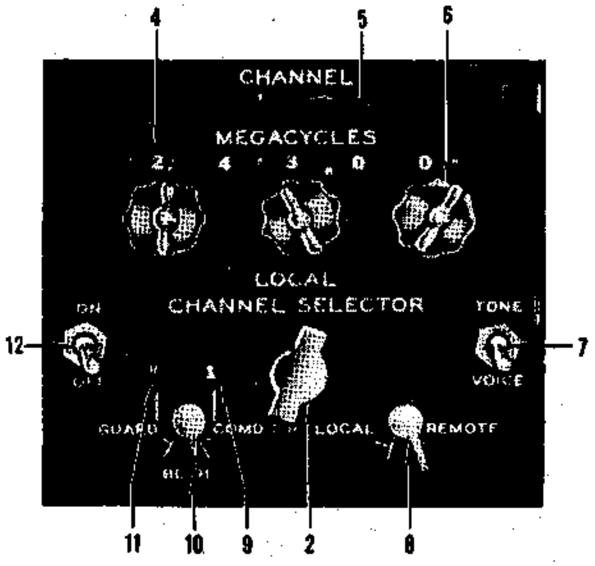
If an obstruction has caused the defective operation of a desired channel, place the channel selector switch to a different frequency and return immediately to the desired channel. This will often correct the difficulty. A crystal failure on one frequency will not affect all frequencies.



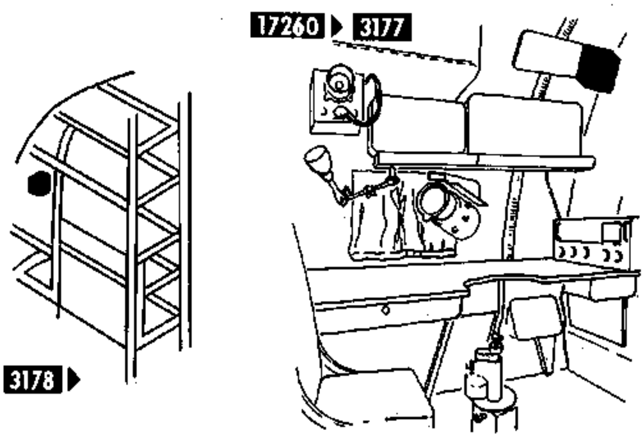
UHF RADIO CONTROL PANEL



1 PILOTS' UHF OPERATION SWITCH
2 CHANNEL SELECTOR SWITCH (2 PLACES)
3 VOLUME KNOB
4 FREQUENCY WINDOW
5 CHANNEL WINDOW
6 FREQUENCY SELECTOR KNOBS
7 TONE--VOICE SWITCH
8 CONTROL TRANSFER SWITCH
9 CHANNEL SELECTOR WINDOW
10 NAVIGATOR'S UHF OPERATION SWITCH
11 GUARD RECEIVER MODE WINDOW
12 UHF POWER SWITCH



UHF RADIO
MASTER CONTROL PANEL



UHF RADIO CONTROLS

Figure 4-12

UHF RADIO (AN/ARC-27)

A UHF radio provides voice or modulated code communication from plane to plane or plane to ground. A guard receiver is used to facilitate constant monitoring of a frequency channel other than the channel being used by the main receiver and transmitter. Two separate panels are used to control the set, one by the navigator and another by the pilots. The UHF radio master control panel is above the navigator's radio and radar control panels on airplanes **17260** ▶ **3177**, and on airplanes **3178** ▶, this panel is on the main radio rack. The UHF radio control panel utilized by the pilot is on the control stand. Any 19 available channels may be preset at the UHF radio master control panel within the frequency range of the set (225 to 399.9 megacycles). The master control panel has facilities for manually selecting any one of 1750 available frequencies. Control power is 28 volt dc. Circuit protection for the set is on the radio junction box circuit breaker panel.

UHF Radio Controls

UHF POWER SWITCH. A power switch (12, figure 4-12) on the UHF radio master control panel has ON--OFF positions. ON position supplies power to operate the radio. (The power switch must be ON and the control transfer switch must be on REMOTE to make the pilots' panel operative.) OFF position de-energizes the equipment.

FREQUENCY SELECTOR KNOBS. The UHF radio master control panel has three frequency knobs (6, figure 4-12) to allow manual selection of 1750 different operating frequencies.

TONE--VOICE SWITCH. A two-position TONE--VOICE switch (7, figure 4-12) on the UHF radio master control panel is used for selecting tone or voice operation of the UHF transmitter.

NOTE

> To use manual tone, the navigator's transfer switch must be in the LOCAL position.

UHF VOLUME KNOB. A volume knob (3, figure 4-12) on the UHF control panel provides means for adjusting the audio output from the UHF radio receiver to the interphone.

CONTROL TRANSFER SWITCH. A two-position switch (8, figure 4-12), on the UHF radio master control panel, is for transfer of control of the set. LOCAL position allows control only by the navigator at the UHF radio master control panel. REMOTE position transfers control to the UHF radio control panel on the control stand, for the pilots' use.

CHANNEL SELECTOR SWITCH. Channel selector switches (2, figure 4-12) on the master control panel and the pilots' control panel have channel positions numbered from 1 to 18 - for the selection of one of 18 preset frequencies. The pilots' control panel selector switch also has a "G" position for selection of the guard frequency for both transmission and reception on the UHF radio. The selector switch on the master control panel has an "M" position to permit selection of any frequency with the manual selector knobs.

UHF OPERATION SWITCH. Each UHF radio control panel has a UHF operation selector switch (1 and 10, figure 4-12) for selecting different transmitting and receiving operations. The switch on the master control panel has three positions and the switch on the pilots' control panel has four positions. See figure 4-13 for an explanation of the switch positions.

UHF Radio Indicators

FREQUENCY WINDOWS. There are five frequency windows (4, figure 4-12) on the UHF radio master control panel. The numbers in the windows indicate the selected frequency of the transmitter and main receiver.

CHANNEL WINDOW. A window (5, figure 4-12) on the UHF master control panel indicates the channel to which the transmitter and receiver are tuned. The number appearing in the window is the number of the preset channel selected on the panel which has control.

GUARD RECEIVER MODE WINDOW. A window (11, figure 4-12) on the UHF radio master control panel indicates the operation of the guard receiver. When the navigator's UHF operation switch is placed in the GUARD position the symbol T/R will appear in the window. This indicates that both the transmitter and main receiver will transmit and receive only on the frequency of the guard channel. When the switch is placed in the BOTH position, the letter R appears in the window. This indicates that the guard receiver is on and will receive signals transmitted on the guard frequency while operating on any other frequency with the main receiver-transmitter. When the switch is placed in the COMD T/R position, the word OFF appears in the window. This indicates that the guard receiver is off but the main transmitter and receiver are on and will operate on the frequency selected by the channel selector switch.

CHANNEL SELECTOR WINDOW. A window (9, figure 4-12) on the UHF radio master control panel indicates the channel selection of the channel selector switch. Also when the navigator's UHF operation switch is in the GUARD position, the word OFF appears in the window indicating that the main transmitter and receiver will not be operating on a channel selected by the channel selector switch on the master control panel.

Normal Operation of the UHF Radio

The UHF radio may be operated from any crew station that has an interphone control panel; however, the channelization and power are controlled only at either the pilots' or navigator's position, depending upon the position of the control transfer switch. In the LOCAL position, the UHF radio is controlled from the UHF radio master control panel. In the REMOTE position, the radio is operated from the UHF radio control panel on the control stand. Navigator operation of the radio (transfer switch in the LOCAL position) is as follows:

1. Place the UHF power switch (12, figure 4-12) to the ON position

CAUTION

Allow at least one minute for the set to warm-up before operating to preclude damage to the equipment. Warmup time should be extended when voltage input is below normal.

2. Place the interphone controls to the desired position for UHF radio operation
3. Select mode of operation with the navigator's UHF operation switch. See figure 4-13 for possible modes
4. Select channel desired with channel selector switch on master control panel. Preset frequency will appear in frequency windows (4, figure 4-12). Channel number selected will also appear in window next to channel selector
5. If some frequency other than those preset is desired, select M with channel selector switch. Turn frequency selector knobs until desired frequency appears in the frequency windows
6. In normal operation, the tone--voice switch is in VOICE. In TONE position, the radio set will transmit a continuous tone

Pilot operation of the UHF radio (transfer switch in the REMOTE position) is as follows:

1. Select mode of operation desired with pilots' UHF operation switch (1, figure 4-12)
2. Select any of 18 preset channels with the channel selector switch on the UHF control panel at the pilots' station. This switch also has a G position which sets transmitter and main receiver to guard frequency
3. Adjust volume to desired level

NOTE

Tone modulation is not available from UHF control panel on the control stand.

4. If the radio is to be turned off, turn pilots' UHF operation switch to OFF if the control transfer switch is in the REMOTE position. It is necessary to turn UHF power switch to OFF if the control transfer switch is in the LOCAL position

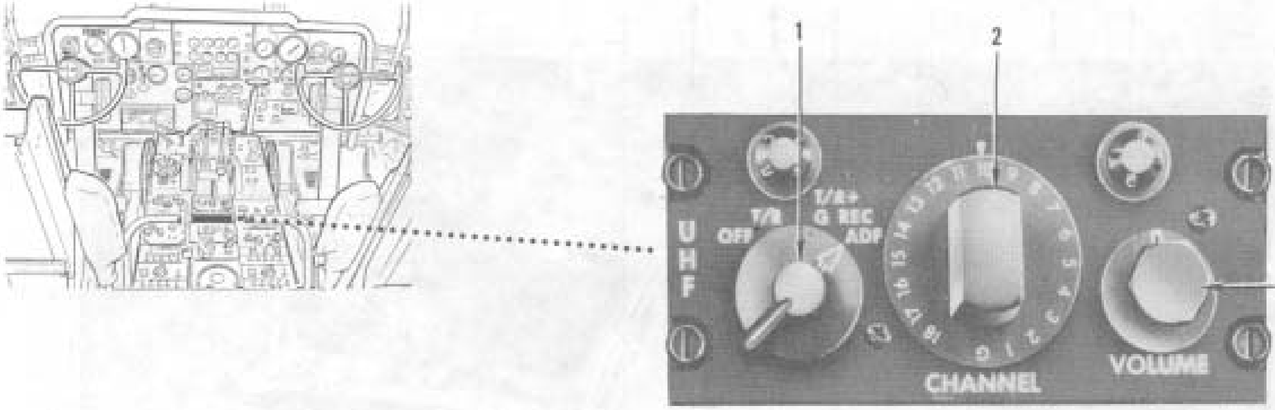
Emergency Operation of the UHF Radio

If an obstruction has caused the defective operation of a desired channel, place the channel selector switch to a different frequency and return immediately to the desired channel. This will often correct the difficulty. A crystal failure on one frequency will not affect all frequencies. Try operation at a different frequency.

OPERATOR	OPERATION SWITCH POSITION	EQUIPMENT OPERATION
PILOT	OFF	Primary power off (if navigator's transfer switch is in REMOTE)
	T/R	Transmitter on standby, main receiver on, ADF on standby
	T/R + G REC	Transmitter on standby, main receiver on, guard receiver on, ADF on standby
	ADF	ADF (AN/ARA-25) antenna connected, ADF operation ready
NAVIGATOR	GUARD	Transmitter on guard channel in standby. Main receiver on guard channel. Guard receiver off
	COMD-T/R	Transmitter on standby. Main receiver on. Guard receiver in standby
	BOTH	Transmitter on standby. Main receiver on, guard receiver on

OPERATION SWITCH POSITIONS (UHF RADIO)

Figure 4-13



* THIS SWITCH MUST BE IN ADF POSITION IN ORDER TO ALLOW DIRECTION FINDING TO FUNCTION

*1 PILOTS' UHF OPERATION SWITCH
2 CHANNEL SELECTOR SWITCH
3 VOLUME KNOB

UHF DIRECTION FINDER CONTROLS

Figure 4-14

In case the channel selector switch becomes inoperative, the equipment may be operated using the channel selector switch on the UHF radio master control panel at the navigator's station. If neither channel selector switch functions properly, the navigator should turn the channel selector switch on the master control panel to M and adjust the knobs to the desired frequency.

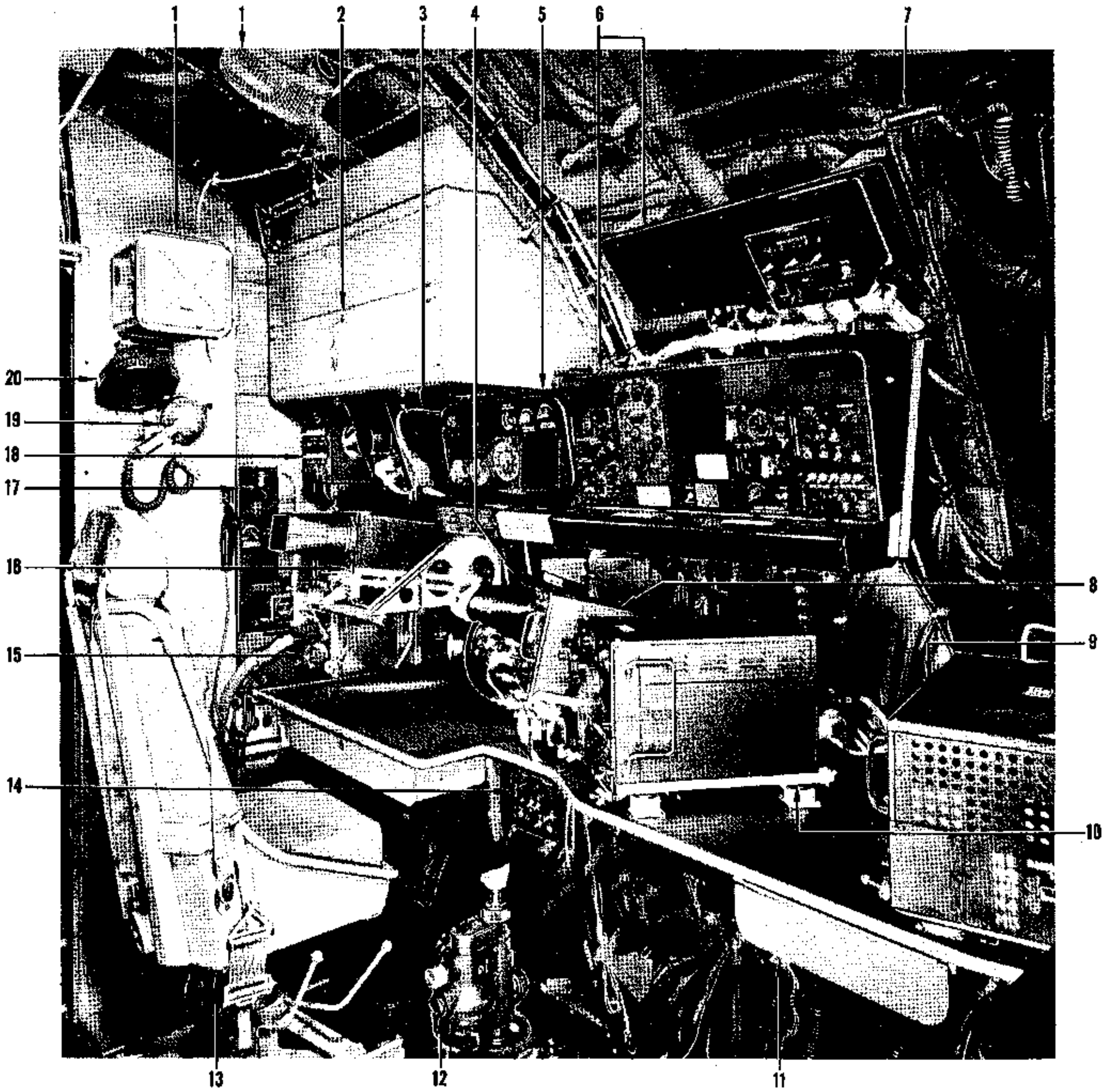
DIRECTION FINDER (AN/ARA-25)

The direction finder indicates the relative bearing of radio signals in the frequency range of 225 to 400 megacycles. The signals are received by the UHF command radio set (AN/ARC-27), using the direction finder antenna. The direction finder is controlled from the UHF radio control panel when the pilot's UHF operation switch (1, figure 4-12) is positioned to ADF. Bearing of the received signal is indicated by the No. 1 pointers of the pilots' UHF D/F radio magnetic indicators (RMI) (17, figure 1-9) on airplanes not incorporating TCTO 572. On airplanes with TCTO 572 the bearing indication is displayed on the No. 2 pointers of RMI's marked 1. ADF--2.UHF DF. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

Normal Operation of the Direction Finder

The direction finder (AN/ARA-25) is made operative by the following procedure:

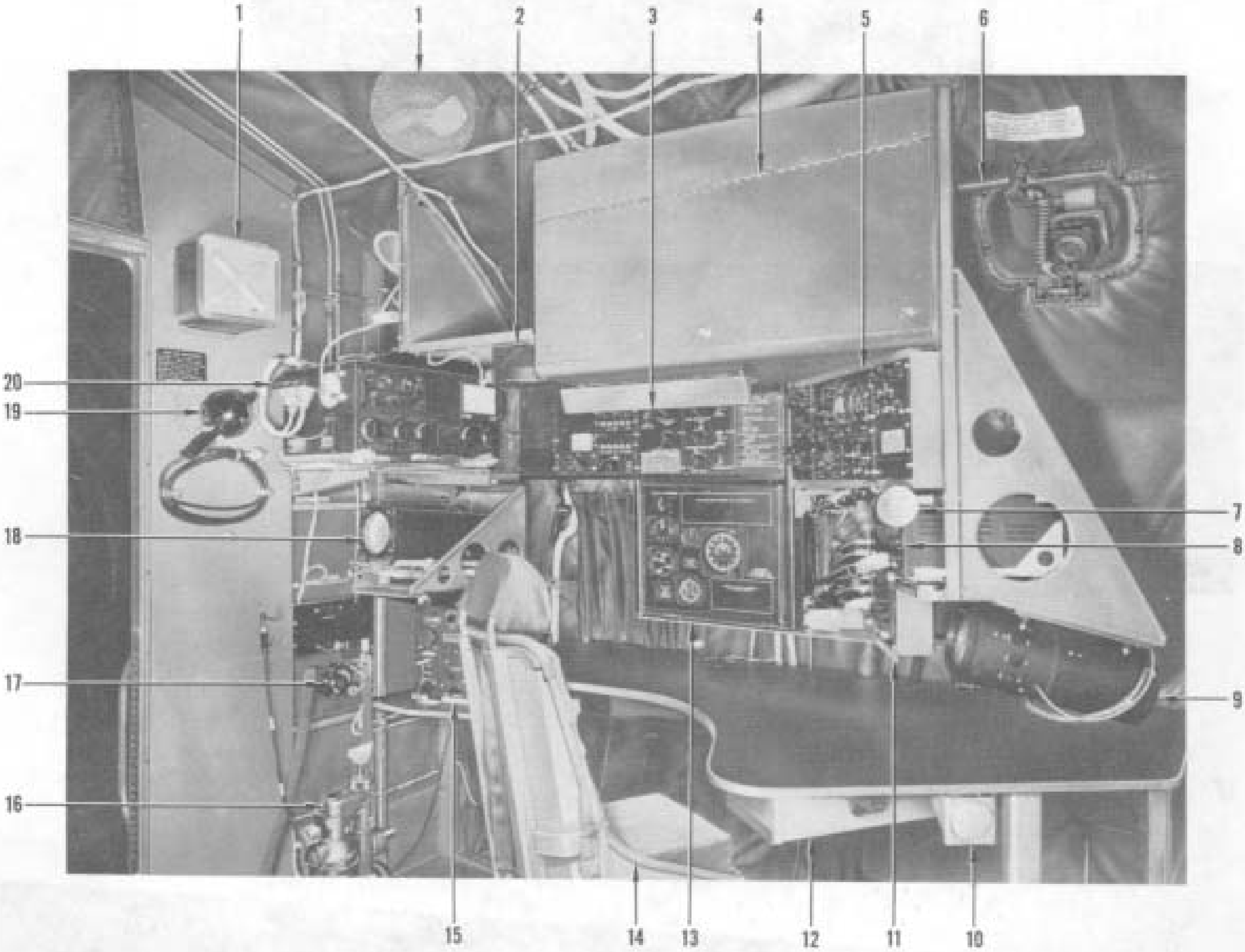
1. Rotate pilots' UHF operation switch to ADF as shown in figure 4-14. (The control transfer switch on the UHF radio master control panel must be in REMOTE)
2. Select the desired frequency with the channel selector switch
3. Allow 3 minutes warmup period if the pilots' UHF operation switch was in OFF
4. If the direction finder is being used for homing, fly the airplane to keep the UHF D/F pointer of the radio magnetic indicator under the reference index at the top of the instrument
5. If the direction finder is being used for direction finding, observe the direction of signal source (relative bearing of source) as indicated on the azimuth scale under the arrow of the UHF D/F pointer of the radio magnetic indicator
6. Turn off the equipment by placing the UHF operation switch in OFF. This turns off the AN/ARA-25 direction finder and the UHF radio. Standby operation of the direction finder is achieved by placing the UHF operation switch in T/R or T/R + G REC



1 VENTILATING FAN (2 PLACES)
2 NAVIGATOR'S STOWAGE CABINET
3 RADIO ALTIMETER (FIGURE 4-26)
4 SEARCH RADAR INDICATOR (FIGURE 4-31)
5 NAVIGATOR'S INSTRUMENT PANEL (FIGURE 4-46)
6 NAVIGATOR'S RADIO AND RADAR PANELS (FIGURE 4-17)
7 PYROTECHNIC PISTOL DOOR HANDLE
▼8 RENDEZVOUS RADAR INDICATOR PANEL (FIGURE 4-33)
9 MF COMMAND TRANSMITTER (FIGURE 4-19)
10 LORAN CONTROL UNIT (FIGURE 4-27)
11 NAVIGATOR'S TABLE DRAWER
12 DRIFTMETER (FIGURE 4-49 OR 4-51)
13 NAVIGATOR'S SEAT
▼14 RENDEZVOUS RADAR CONTROL PANEL (FIGURE 4-35)
15 OXYGEN REGULATOR
16 LORAN INDICATOR (FIGURE 4-27)
17 NAVIGATOR'S AUXILIARY PANEL
18 NAVIGATOR'S INTERPHONE PANELS
19 SIGNAL LAMP
20 LOUD SPEAKER

NAVIGATOR'S AND RADIO OPERATOR'S STATION 17260 ▶ 3177

Figure 4-15

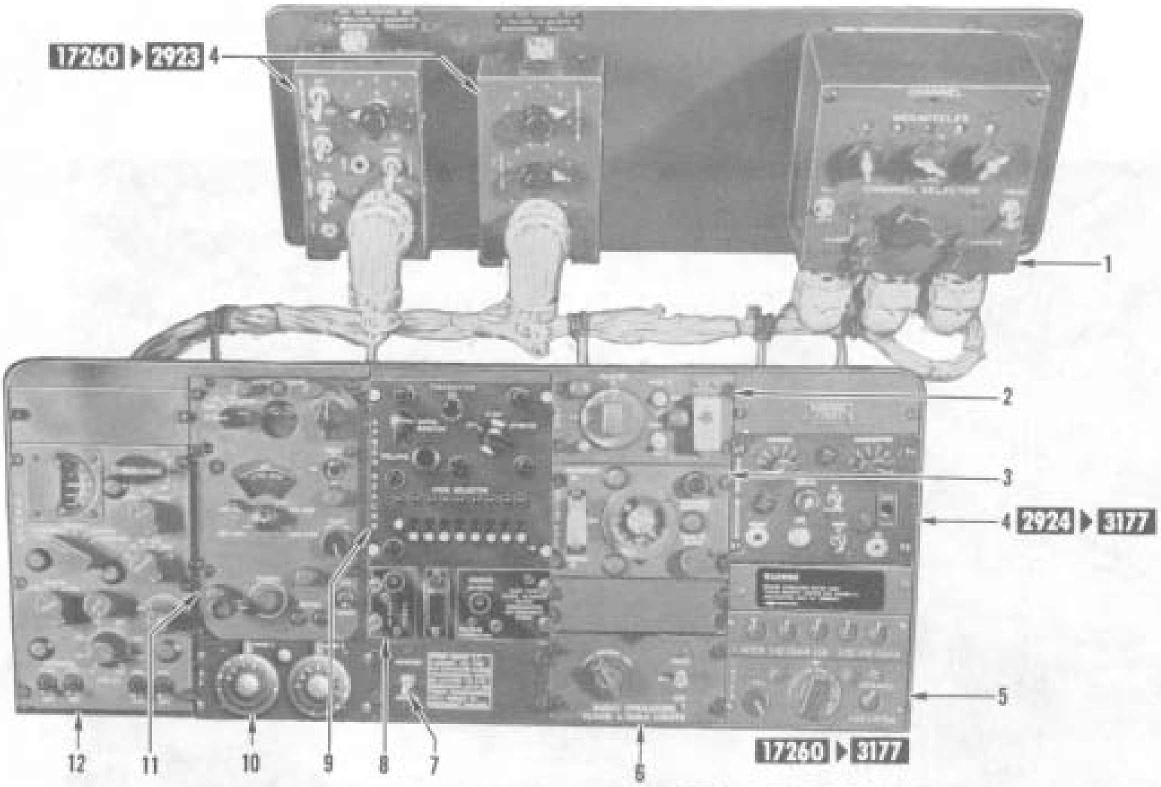


1 VENTILATING FAN (2 PLACES)
2 LOUDSPEAKER
3 NAVIGATOR'S INTERPHONE AND LIGHT PANEL (FIGURE 4-10)
4 NAVIGATOR'S STOWAGE CABINET
5 NAVIGATOR'S RADIO AND RADAR PANELS (FIGURE 4-17)
6 PYROTECHNIC PISTOL DOOR HANDLE
7 NAVIGATOR'S TABLE LAMP
8 RADIO ALTIMETER
9 SEARCH RADAR INDICATOR (FIGURE 4-31)

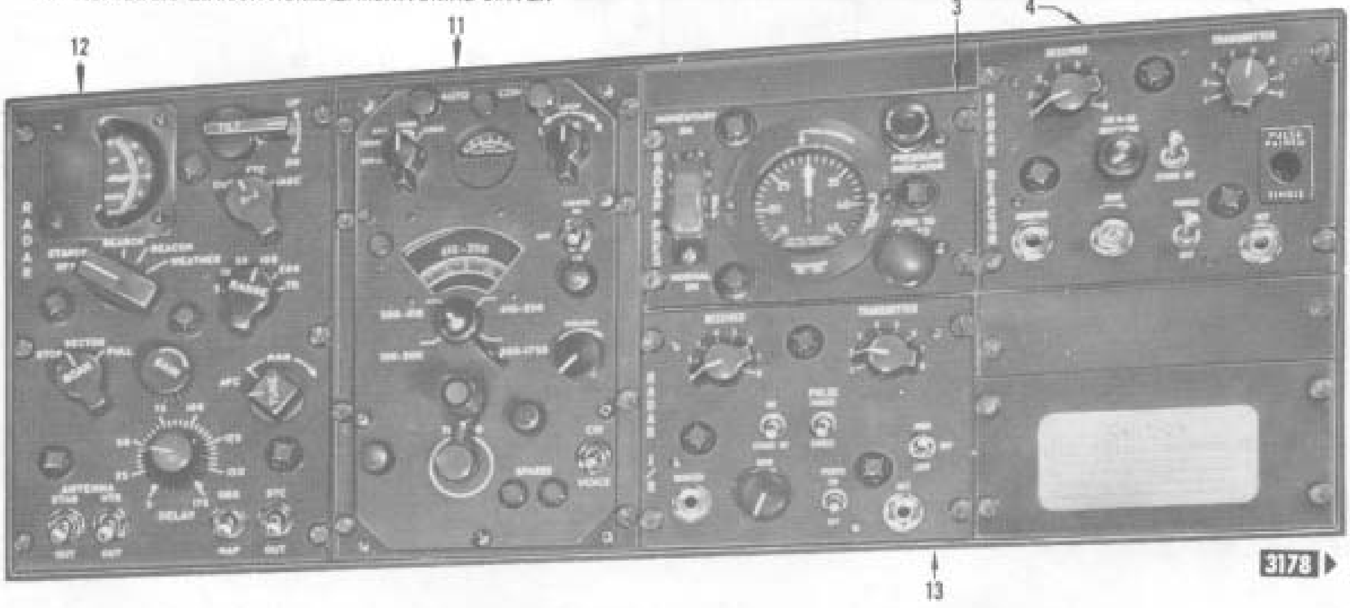
10 ASH TRAY
▼11 RENDEZVOUS RADAR INDICATOR (FIGURE 4-33)
12 NAVIGATOR'S TABLE DRAWER
13 NAVIGATOR'S INSTRUMENT PANEL (FIGURE 4-46)
14 NAVIGATOR'S SEAT
15 LORAN CONTROL UNIT (FIGURE 4-27)
16 DRIFTMETER (FIGURE 4-51)
17 OXYGEN REGULATOR
18 LORAN INDICATOR (FIGURE 4-27)
19 SIGNAL LAMP
20 MF COMMAND TRANSMITTER (FIGURE 4-19)

NAVIGATOR'S STATION 3178▸

Figure 4-16

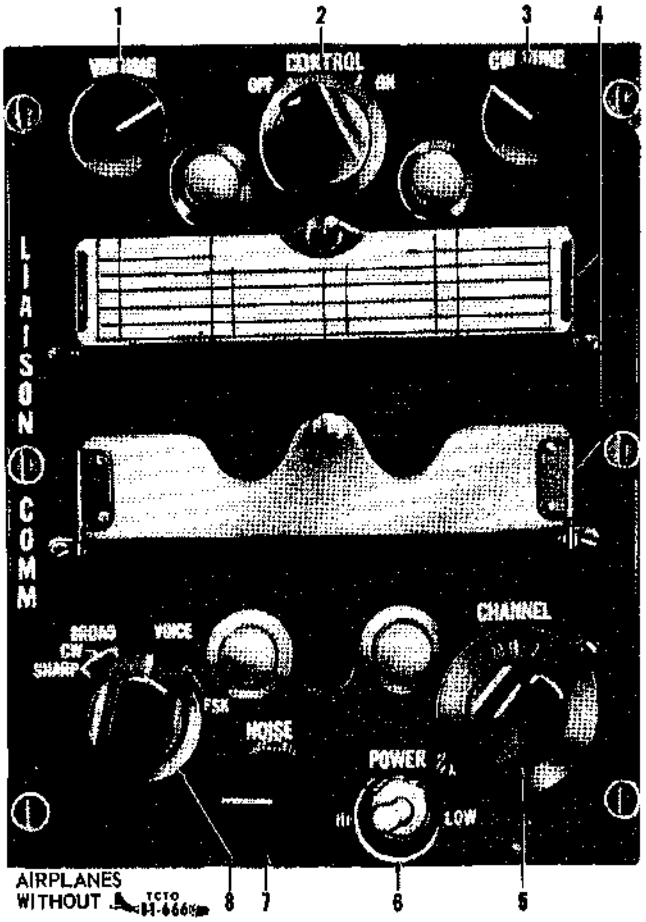


1 UHF RADIO MASTER CONTROL PANEL (FIGURE 4-12)
2 IFF CONTROL PANEL (FIGURE 4-30) 17260 ▶ 2900
3 RADAR PRESSURIZING CONTROL PANEL (2 PLACES) (FIGURE 4-36)
▼4 RENDEZVOUS RADAR CONTROL PANEL (AN/APN-76) (3 PLACES) (FIGURE 4-35)
5 INTERPHONE CONTROL PANEL (FIGURE 4-8)
6 RADIO PANEL LIGHT CONTROLS
7 AUXILIARY LIAISON NORMAL/MONITORING SWITCH
▼8 RADAR BEACON POWER CONTROL PANEL (FIGURE 4-32) 3232 ▶ PLUS TCTO K211
▼9 RADAR BEACON CONTROL PANEL (FIGURE 4-32) 3232 ▶ PLUS TCTO K211
10 SIF CODER CONTROL PANEL (FIGURE 4-30) TCTO 590
11 RADIO COMPASS CONTROL PANEL (2 PLACES) (FIGURE 4-22)
12 SEARCH RADAR CONTROL PANEL (2 PLACES) (FIGURE 4-31)
▼13 RENDEZVOUS RADAR CONTROL PANEL (AN/APN-12) (FIGURE 4-33)



RADIO AND RADAR CONTROL PANELS

Figure 4-17

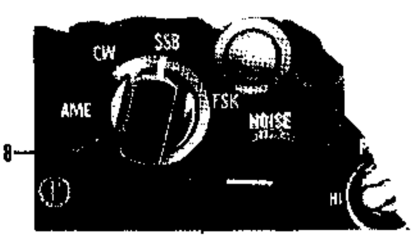


AIRPLANES WITHOUT TCTO 1-1-666

SEE DETAIL 1

AN/ARC-21

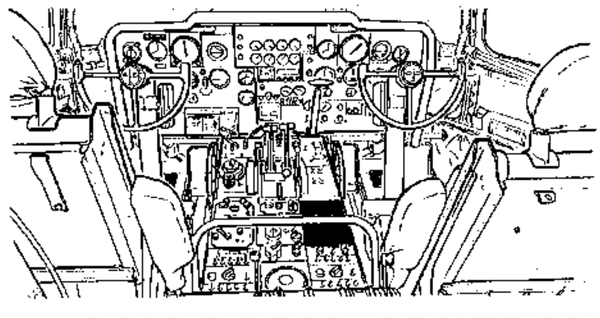
1 VOLUME KNOB
2 CONTROL SWITCH
3 CW TUNING KNOB
4 PRESETTING DRUM COVERS
5 CHANNEL SELECTOR SWITCH
6 HI-LOW POWER SWITCH
7 NOISE CONTROL KNOB
8 OPERATION SELECTOR SWITCH (2 PLACES)



DETAIL 1

AIRPLANES WITH TCTO 1-1-666

AN/ARC-65



LIAISON RADIO CONTROLS

Figure 4-18

LIAISON RADIO

(AN/ARC-21) on airplanes without TCTO 1-1-666

(AN/ARC-65) on airplanes with TCTO 1-1-666

The liaison radio operates over a range of frequencies from 2 to 24 megacycles giving a total of 44,000 usable frequencies. The control panel for the liaison radio (shown in figure 4-18) is on the control stand. The set permits long range two-way voice and code communication from airplane to airplane or from airplane to ground. The radio is turned on and off by a control switch on the liaison radio control panel. Twenty channels may be preset on the control panel and individually selected with the channel selector switch. A time delay of up to 15 seconds is incorporated in the set to delay operation while the set is tuning after a channel change. Therefore, the crew member operating the set should not expect immediate communication after changing channels. The receiver immediately tunes to the selected channel; however, initial tuning of the transmitter is delayed until a mike switch is used. In addition to voice communications, the liaison radio has facilities for communication by continuous wave telegraphy (CW). The set also has provisions for operating a teletypewriter although this equipment is not provided. The radio is connected to the interphone; therefore, to transmit and receive on the liaison radio the interphone selector switch and mixer switch must be placed in the appropriate LIA position. Control power is 28 volt dc and operating power is 115 volt ac with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

On airplanes incorporating TCTO 1-1-666, the AN/ARC-21 is replaced by an AN/ARC-65 liaison radio which has the additional capability of single sideband (SSB) transmission and reception. Both sets use the same control panels and all but one of the controls (the operation selector switch) have the same function.

NOTE

> The single sideband (SSB) capability gives improved reception and increased range. The major difference between single sideband and conventional radio transmissions is the form of the transmitted wave. Conventional radio signals consist of a carrier wave, an upper sideband, and a lower sideband. A carrier wave is the unmodulated output of the transmitter. In itself, the carrier conveys no information. It is only when the carrier is modulated (varied by speech through the microphone) that it is possible to transmit a message. Modulation of the carrier sets up new frequencies both above and below the frequency of the carrier. The new frequencies, called side frequencies, make up narrow bands known as sidebands. These sidebands contain all the information. The band higher than the carrier frequency is called the upper sideband and the band lower than the carrier frequency is the lower sideband. For single sideband transmission, the carrier wave is suppressed and signals travel on one sideband. By suppressing the carrier all the

power is used to transmit information - resulting in greater range. Likewise, suppression of the carrier makes the set less susceptible to interference from static or jamming. Facilities using amplitude modulated (AM) radios cannot receive single sideband transmissions satisfactorily and single sideband reception of AM broadcasts has distorted pitch. To maintain compatibility with existing facilities, there is a separate unit in the receiver for AM reception and a carrier wave may be transmitted with the upper sideband to transmit "equivalent" AM.

Liaison Radio Controls

CONTROL SWITCH (LIAISON RADIO). A two-position ON--OFF rotary switch (2, figure 4-18) on the liaison radio control panel, is used to turn the equipment on and off. The control switch is also a protective device that returns the switch to OFF when there are faults in the equipment.

VOLUME KNOB. A volume knob (1, figure 4-18) on the liaison radio control panel provides a means for adjusting the volume from the liaison radio to the interphone system during voice operation and signal sensitivity during CW operation.

CHANNEL SELECTOR SWITCH. A channel selector switch (5, figure 4-18) on the liaison radio control panel has channel positions numbered from 1 to 20 providing selection of any of the preset frequencies.

HI--LOW POWER SWITCH. A two-position switch (6, figure 4-18), marked POWER, is on the liaison radio control panel. The switch has HI--LOW positions and provides a means of selecting the power output in a 10 to 1 proportion. The HI position will normally be used when maximum range transmissions are desired. The LOW position is used when shorter range transmissions are desired.

NOISE CONTROL KNOB. A knob (7, figure 4-18), marked NOISE, is on the liaison radio control panel. The knob allows adjustment of the background noise level of the receiver during voice operation. The knob should be adjusted for best reception of voice signals.

PRESETTING DRUMS. Two presetting drums in the liaison radio control panel provide means for manually presetting the frequency of each channel as selected by the channel selector switch. Each drum is protected by hinged covers (4, figure 4-18). A special tool for the presetting operation is stowed inside the top drum cover. A card mounted on the face of the top drum cover is used to record frequency values of each channel as the presetting operation is accomplished.

CW TUNING KNOB. A CW tuning knob (3, figure 4-18) on the liaison radio control panel is used to adjust the CW beat frequency when receiving CW signals.

OPERATION SELECTOR SWITCH (LIAISON RADIO). A rotary-type selector switch (8, figure 4-18) on the liaison radio control panel has CW SHARP--CW BROAD--VOICE--FSK positions and is used to select the type of liaison radio operation desired. CW SHARP position provides CW operation with a narrow band width to increase intelligibility of signals. CW BROAD provides CW operation with 7-kilocycle band width for general operation. VOICE position allows voice transmission and reception of the liaison radio. FSK position is provided for teletypewriter operation, although this equipment is not provided. On airplanes incorporating ▲$^{1C10}_{1-1-646}$, the switch has AME--CW--SSB--FSK positions for use in single sideband operation. With the switch on SSB, the set transmits and receives single sideband type radio waves. Placing the switch on AME (equivalent AM), permits communication with standard AM radios.

Normal Operation of the Liaison Radio

FREQUENCY PRESETTING. Frequencies can be preset on the control panel (with the equipment turned off). Normally, all presetting operations will be performed before flight; however, if presetting during flight is necessary, the operation can be accomplished as follows:

1. Loosen two screws holding drum covers in position and open covers
2. Remove presetting tool from clip inside top drum cover
3. Place channel selector so that the number of the channel to be preset appears on the left side of the frequency drum. Disregard the channel number that appears in the selector window

4. Using the presetting tool, move the four buttons, one at a time, to a position under the respective numbers. This is done by sliding the socket end of the tool over the buttons and moving them along the drum to coincide with the desired numbers
5. Move the top drum left button to coincide with the figure representing thousands of kilocycles
6. Move the top drum right button to coincide with the figure representing hundreds of kilocycles
7. Move the bottom drum left button to coincide with the figure representing tens of kilocycles
8. Move the bottom drum right button to coincide with the figure representing units and halves of kilocycles
9. Record the frequency (just set) adjacent to the applicable channel number on the card mounted on the top drum cover
10. Turn the channel selector switch to the next channel number to be preset and repeat Steps 4 through 9. Preset remaining channels in the same manner
11. Close drum covers and tighten holding screws

NOTE

If the drum cover doors on the control panel are not securely closed, a door interlock switch will remain open and prevent operation of the liaison radio.

VOICE COMMUNICATION. The liaison radio control panel has controls necessary for all types of liaison radio operation. Liaison radio voice communication can be accomplished by the following procedure:
1. Place interphone selector switch in LIA to receive and transmit liaison radio signals
2. Place liaison radio control switch to ON

NOTE

- A 40-second period is required after turning on equipment before the radio is ready for operation. The first 30 seconds allow for tube warmup and the remaining 10 seconds allow for automatic turning.
- If automatic tuning is not accomplished in the normal 40-second period, the control switch will go to OFF and must be returned to ON position.
- At extremely low operating temperatures (approximately -55°C) the liaison radio control switch may return to OFF in 40 seconds. If this happens, select another channel and return control switch to ON. Repeat this procedure until the control switch stays on, then allow the equipment to warmup for 15 minutes. During the warmup period, do not change channel or transmit. After the warmup, proceed with normal operation.
- The AN/ARC-65 liaison radio requires a warm-up time of approximately 10 to 15 minutes to give optimum performance.

3. Turn the channel selector switch to the channel of the desired frequency and rock the knob slightly to feel the switch click into its seat. The channel in use will be shown by the middle figure in the selector window
4. Rotate the operation selector switch to VOICE
5. Place power switch in HI or LOW depending on desired range of transmissions

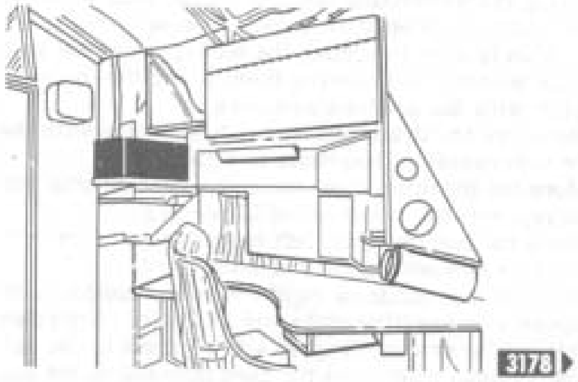
NOTE

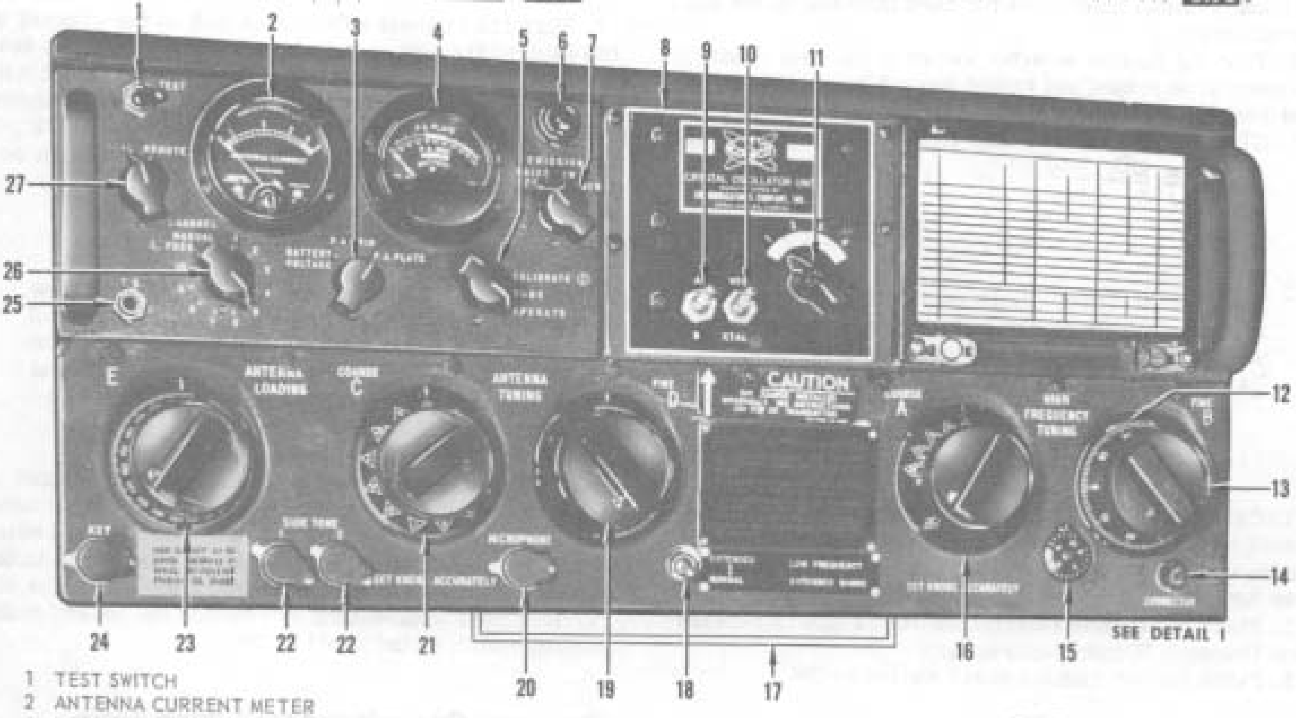
Should the air pressure within the equipment be reduced by leakage or other means, an aneroid switch will automatically shift the equipment to low power to reduce the possibility of electrical arcing within the equipment. There is no indication when this occurs.

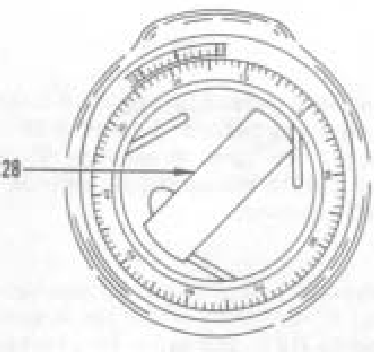
6. Depress the mike switch to transmit and release to receive. Adjust the volume for proper audio level and the noise control for a slight background noise in absence of signals. A sidetone will be heard in the headset when talking if the transmitter is on the air
7. Turn the equipment off by rotating the liaison radio control switch on the panel to OFF

Emergency Operation of the Liaison Radio

When a frequency selection cycle is not completed in the normal time interval, causing the liaison radio control knob to return to OFF position, a second try preferably on another channel is recommended. If tuning is normal, return to the initially selected channel. Malfunction within the equipment is indicated by the liaison radio control knob moving to OFF position. If damage to the equipment is less important than getting the message through, transmission or reception can be resumed by holding the knob in ON position. If no sidetone is heard when attempting to transmit, the transmitter is not on the air.







DETAIL I

1 TEST SWITCH
2 ANTENNA CURRENT METER
3 BATTERY-P.A. GRID-P.A. PLATE SWITCH
4 TUNING METER
5 CTO (CALIBRATE-TUNE-OPERATE) SWITCH
6 PILOT LIGHT
7 EMISSION SWITCH
8 CDA-T OSCILLATOR
9 A-B SWITCH
10 VFO-XTAL (VARIABLE FREQUENCY OSCILLATOR-CRYSTAL) SWITCH
11 LOW FREQUENCY CHANNEL SELECTOR
12 DIAL B VERNIER
13 DIAL B (HIGH FREQUENCY FINE TUNING)
14 CORRECTOR KNOB
15 DIAL B REVOLUTION COUNTER
16 DIAL A (HIGH FREQUENCY COARSE TUNING)
17 CALIBRATION TABLES STOWAGE
18 LOW FREQUENCY EXTENDED RANGE SWITCH
19 DIAL D (ANTENNA TUNING FINE ADJUSTMENT)
20 MICROPHONE JACK
21 DIAL C (ANTENNA TUNING COARSE ADJUSTMENT
22 SIDETONE JACK (2 PLACES)
23 DIAL E (ANTENNA LOADING ADJUSTMENT)
24 KEY JACK
25 T.S. (THROTTLE SWITCH) JACK
26 CHANNEL SELECTOR SWITCH
27 LOCAL-REMOTE SWITCH
28 LOCKING BAR

MF COMMAND TRANSMITTER

Figure 4-19

MF COMMAND TRANSMITTER (AN/ART-13)

The auxiliary liaison transmitter (figure 4-19) can be used for transmitting voice, modulated continuous wave telegraphy (MCW), or continuous wave telegraphy (CW). Transmitting frequencies are in the range of 2000 to 18,000 kilocycles and either 200 to 1500 kc or 300 to 500 kc depending upon the type of oscillator installed. If a crystal control unit (CDA-T) is installed, the low frequency range is 300 to 500 kc and the selection of frequencies in this range is limited to those frequencies for which crystals are provided. When using a variable frequency oscillator (VFO), the low frequency range is 200 to 1500 kc and transmission is possible on frequencies other than crystal frequencies. (With a VFO, the frequency is derived with respect to a crystal check frequency and the master oscillator is not crystal stabilized.) The transmitter may operate either with crystal frequency control or VFO frequency control. For VFO operation, ten frequencies in the high frequency range can be preset to correspond with the ten numbered positions of the channel selector switch. During crystal operation, on transmitters having a CDA-T unit installed, there are provisions for presetting 24 frequencies. The 24 available frequencies consist of 10 frequencies in the high frequency range for each position of the A--B switch and 4 frequencies in the low frequency range (using the low frequency channel selector). A channel selector switch is used to select one of the preset frequencies or one channel that permits manual selection of any desired frequency. The transmitter automatically tunes (auto-tune) to a selected preset channel, but a manually selected frequency must be manually tuned. Dials A and B are used to select the frequency for each preset channel or to obtain a frequency manually. Dial A is the coarse frequency control and dial B is the fine frequency control. Dial B has a movable vernier, which is set to zero for the crystal check point and the operating frequency is obtained by moving the dial with respect to the vernier. While obtaining a crystal check point during crystal operation in the high frequency range, dials A and B must be tuned to the crystal frequency. The lowest crystal frequency given on the calibration chart on the transmitter determines the settings of the dials for this tuning. All of the controls for turning on the power, selecting the frequency, tuning the transmitter, and turning the antenna are on the transmitter - there are no remote controls. Any crew member can make a voice transmission by pressing a microphone switch when the respective interphone selector switch is on COMM MF (or by plugging a mike into the microphone jack). Code transmissions are made by using the key at the copilot's or the navigator/radio operator's stations or by connecting a key to the key jack on the transmitter. Control power is 28 volt dc with circuit protection located on the dynamotor unit (DY-17/ART-13) and on the radio junction box circuit breaker panel.

MF Command Transmitter Controls

EMISSION SWITCH. The emission switch (7, figure 4-19) is used to turn the equipment on and off and to select the desired mode of transmission. The switch positions are: OFF--VOICE--CW--MCW. The local--remote switch must be on LOCAL for the switch to be operative. Refer to LOCAL--REMOTE SWITCH in this Section.

CHANNEL SELECTOR SWITCH. The channel selector switch (26, figure 4-19) permits selection of any one of ten preset, high frequency channels and one low frequency channel. If a CDA-T unit is installed, selection of the preset channel for the low frequency range is also controlled by the low frequency channel selector (11, figure 4-19). In addition, a position marked MANUAL is provided where the frequency control knobs can be rotated freely without disturbing the preset positions. The switch sets the auto-tune system into operation when a preset channel is selected so that the channel automatically tunes. The selector switch is effective when the local--remote switch is on LOCAL. Refer to LOCAL--REMOTE SWITCH in this Section.

LOCAL--REMOTE SWITCH. This switch (27, figure 4-19) is used to transfer operation of the channel selector switch and the emission switch to a remote station. There are no control panels for remote control of the transmitter; therefore, the switch should be kept on LOCAL to make the channel selector and emission switches operative. The red pilot light (6, figure 4-19) indicates the position of the local--remote switch. When the set is energized and the switch is on LOCAL, the light is lit at all times except when the auto-tune is cycling. The light goes out when the switch is placed to REMOTE.

CTO SWITCH. This switch (5, figure 4-19) has three positions: CALIBRATE, TUNE, and OPERATE. When on CALIBRATE, the variable frequency oscillator is turned on to permit calibration. (In this position, the power amplifier is not energized so that set does not transmit during tuning.) In the TUNE position, the equipment is operated at reduced power to prevent damage to the P.A. tube during preliminary tuning and loading of the antenna circuits. The switch is placed on OPERATE after final tuning has been completed and the equipment operates at full power. The switch should be left in OPERATE except during tuning.

LOW FREQUENCY EXTENDED RANGE SWITCH. This two position switch (18, figure 4-19) permits the transmitter to operate in lower than normal frequencies. In the NORMAL position, the equipment operates at the usual frequencies. In the EXTENDED position, the transmitter is capable of operating in the frequency range of 1670 to 2000 kilocycles.

BATTERY--P.A.GRID--P.A.PLATE SWITCH. This switch (3, figure 4-19) serves to switch the tuning meter (4, figure 4-19) to the desired circuit. For tuning and normal operation, the switch should be left on the P.A. (power amplifier) PLATE position. Refer also to TEST SWITCH in this Section.

FREQUENCY CONTROL DIALS. The dials (13, 16, 19, 21, and 23, figure 4-19), labelled A, B, C, D, and E, are used to manually select a frequency and to change the preset frequencies. High frequency tuning dials A and B, the corrector knob, vernier scale, and revolution counter provide a means of calibrating and tuning the variable frequency oscillator to the desired operating frequency. Dials C and D are the coarse and fine antenna tuning controls respectively. Dials C and D, are used in conjunction with dial E to properly tune the antenna. The antenna is loaded after calibration and initial tuning have been completed. The dials turn freely when the channel selector switch (26, figure 4-19) is set on MANUAL. When the channel selector is on any other position, the dials are positioned by loosening the locking bar (28, figure 4-19) in the center of each knob and then rotating them to the settings obtained from the calibration tables. After the dials are adjusted, the locking bars are tightened. To lock the dials, first note the exact dial reading as obtained in the tuning procedure. Then rotate the dial one quarter turn counterclockwise and return to (but not past) the exact desired setting. Hold the dial on the setting and tighten the locking bar.

CORRECTOR KNOB. The corrector knob (14, figure 4-19) provides an accurate zero line on the vernier scale which serves as an index or indicator mark for the fine tuning of the B dial. The corrector knob moves the vernier scale clockwise or counterclockwise as required to establish the correct setting as noted in the calibration tables for each frequency to be tuned.

T.S. JACK. This jack (25, figure 4-19) is a provision for a microphone switch - used with "hot" mike installations. (The T.S., throttle switch, terminology is a carry-over from other types of airplanes having microphone switches on the throttle.)

TEST SWITCH. The antenna current meter (2, figure 4-19) and the tuning meter (4, figure 4-19) are operative when the test switch (1, figure 4-19) is held to the TEST position. The switch is spring-loaded to an unmarked OFF position.

LOW FREQUENCY CHANNEL SELECTOR. The rotary selector switch (11, figure 4-19) is used to select one of four available crystal controlled frequencies in the low frequency range. The selector is operative when the VFO--XTAL switch (10, figure 4-19) is on XTAL, and the channel selector switch (26, figure 4-19) is on L. FREQ. When using the low frequency channel selector, dial A must be set on position 13, and dial C on position 8. (Dial B has no function when using any of the low frequency units.) Calibration charts are not required when using the CDA-T unit, as its output is directly coupled to the power amplifier. Meter readings for low frequency crystal operation, as with high frequency crystal operation, will be lower than VFO operation.

A--B SWITCH. To obtain 2 frequencies for each of the 10 channels, place the A--B switch (9, figure 4-19) to each of its positions. The switch is operative when the VFO--XTAL switch (10, figure 4-19) is in the XTAL position.

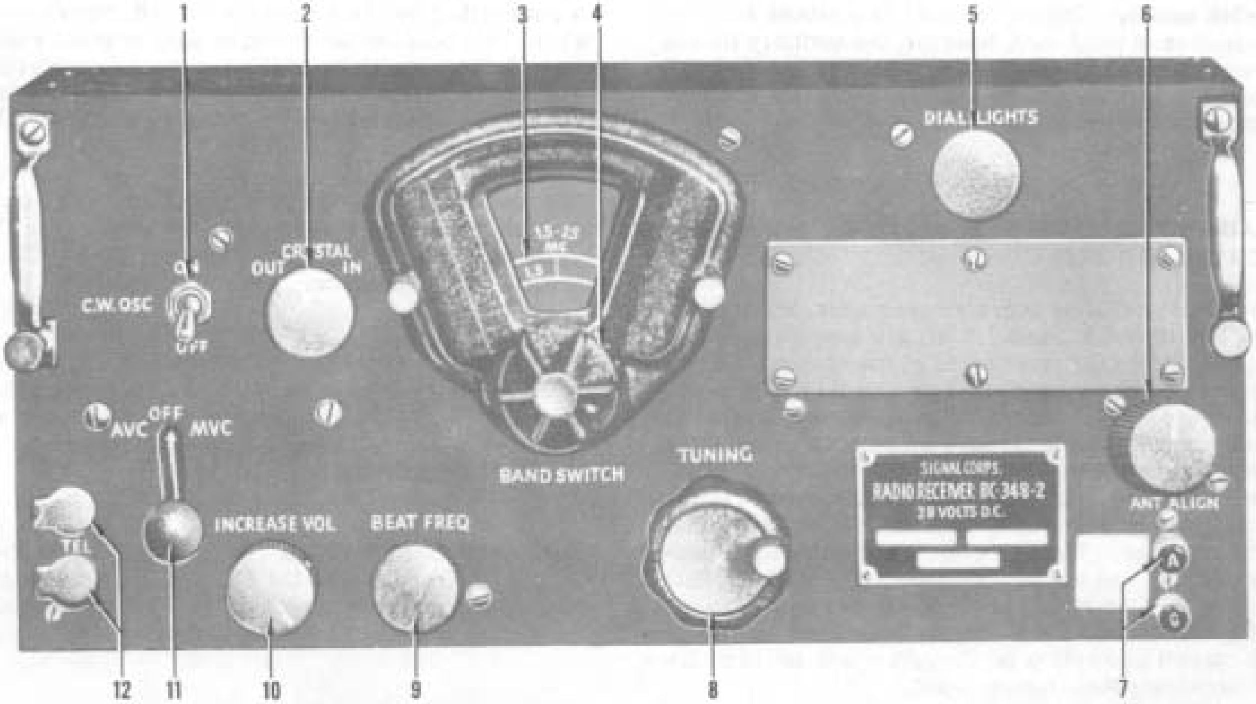
Tuning Procedures for MF Command Transmitter

For VFO operation:

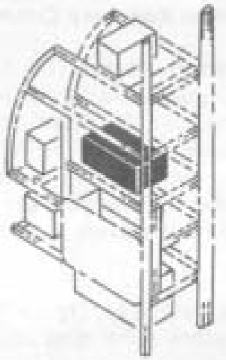
1. Check all dials locked. Place LOCAL--REMOTE switch to LOCAL. Place emission switch to VOICE. VFO--XTAL switch to VFO. Low frequency extended range switch to NORMAL
2. Select desired channel; wait for complete cycling of auto-tune system before using set. (Red pilot light will illuminate indicating cycle is complete)
3. Unlock all dials
4. Set dial C on 1
5. Find the desired frequency in the calibration tables, set dials A and B to the settings of the nearest crystal check point marked in heavy black type
6. Check the normal/monitor switch on the navigator's radio and radar panel in the NORMAL position
7. Place CTO switch to CALIBRATE. Rotate dial B back and forth until zero beat (aural-null signal) is obtained
8. Place CTO switch to TUNE
9. Turn corrector knob to position vernier scale index to the crystal check point setting for dial B
10. Set dial B to the reading obtained for the desired operating frequency in the calibration tables, utilizing the vernier scale index as zero reference. Recheck dial A for proper operating frequency setting. Lock dials A and B
11. Place emission switch to CW
12. Place battery--P.A. grid--P.A. plate switch to P.A. PLATE
13. Set dials C, D and E to the values obtained from the 60 foot antenna calibration tables
14. If dial C is on position 7 or below:
    a. Hold test switch closed and rotate dial E for minimum dip on P.A. Plate meter
    b. Place CTO switch to OPERATE
    c. If the plate current meter reading is above the area marked CW, move dial D a few divisions lower and re-adjust dial E for minimum plate current. If the plate current meter reading is below the area marked CW, move dial D a few divisions higher and re-adjust dial E for minimum plate current
15. If dial C is on position 8 or above:
    a. Hold test switch closed and rotate dial D for minimum dip on P.A. Plate meter
    b. Place CTO switch to OPERATE
    c. If the plate current meter reading is above the area marked CW, move dial E a few divisions lower and re-adjust dial D for minimum plate current. If the plate current meter reading is below the area marked CW, move dial E a few divisions higher and re-adjust dial D for minimum plate current.

NOTE

If a minimum dip is not obtained on P.A. Plate meter by rotating the specified dial, set control C to the next higher position and rotate dial D or E as required.



1 C.W. OSC SWITCH
2 CRYSTAL FILTER SWITCH
3 DIAL SCALE
4 BAND SWITCH
5 DIAL LIGHT RHEOSTAT
6 ANTENNA ALIGNMENT KNOB
7 ANTENNA AND GROUND BINDING POSTS
8 TUNING KNOB
9 BEAT FREQUENCY KNOB
10 VOLUME KNOB
11 POWER SWITCH
12 TEL. JACKS



BC-348 AUXILIARY LIAISON RECEIVER CONTROLS 17260 ▸ 3278 LESS ECTO KG206

Figure 4-20

16. Lock dials C, D and E
17. Place emission switch to VOICE. The equipment is now ready for operation

For crystal operation:
The tuning procedure for crystal operation is essentially the same as for VFO OPERATION outlined above. Meter readings will be lower.

Auxiliary Liaison Normal/Monitoring Switch

On airplanes **17260** ▸ **3177** , the auxiliary liaison normal/monitoring switch (8, figure 4-17) is on the navigator's radio and radar control panels. On airplanes **3178** ▸ **3278** , the switch (1, figure 4-10) is on the navigator's interphone and light panel. The switch is used with the MF command (auxiliary liaison) transmitter and the BC-348 auxiliary liaison receiver. Normally, the BC-348 auxiliary liaison receiver is disabled when the transmitter is being used, however, the auxiliary liaison normal/monitoring switch when positioned to MONITOR allows the receiver to be heard at the same time the transmitter is being operated.

AUXILIARY LIAISON RECEIVER (BC-348) 17260 ▶ 3278 less 1C10 KG206!

The BC-348 receiver operates over a frequency range from 200 to 500 KC and 1.5 to 18.0 megacycles. All controls are on the front panel of the receiver, where they may be easily operated by airplane personnel. (See figure 4-20.) Antenna, ground, and headphone connections are made through a connector plug on the back of the receiver. The receiver is capable of voice, tone and CW reception. Manual or automatic volume control may be selected by a switch on the front panel of the receiver. The receiver is not intended for remote control and no provision has been made for this operation. The receiver is on the main radio rack (9, figure 1-4 and 1-5). Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

BC-348 Auxiliary Liaison Receiver Controls

POWER SWITCH. A power switch (11, figure 4-20) with AVC--OFF--MVC positions is on the auxiliary liaison receiver control panel. Placing the switch to AVC (automatic volume control) or MVC (manual volume control) selects a method of regulating the volume and turns on the power to energize the equipment. With the switch in the OFF position, no power is supplied to the receiver.

BAND SWITCH. A band switch (4, figure 4-20) on the BC-348 control panel allows the operator to change the frequency band.

TUNING KNOB. Reception is accomplished by tuning the receiver to the desired signal by use of the tuning knob (8, figure 4-20) on the BC-348 control panel. The frequency to which the receiver is tuned is indicated at all times on the dial scale.

VOLUME KNOB. The volume level of the audio signal is controlled by the volume knob (10, figure 4-20). When the receiver is operated with manual volume control, the sensitivity of the receiver is controlled. When automatic volume control is desired, the level of the audio signal fed into the output tube is controlled.

C.W. OSC SWITCH. This switch (1, figure 4-20) on the auxiliary liaison receiver control panel has ON--OFF positions. The CW oscillator is turned ON for CW, or OFF for voice reception.

DIAL LIGHT RHEOSTAT. This knob (5, figure 4-20) on the auxiliary liaison receiver control panel adjusts the brilliancy of dial illumination. The dial lamps may be adjusted for any desired degree of illumination or turned off completely.

BEAT FREQUENCY KNOB. This knob (9, figure 4-20) adjusts the frequency of the CW oscillator and allows the operator to adjust the tone of the received signal to the pitch he considers the most suitable.

CRYSTAL FILTER SWITCH. This control (2, figure 4-20) on the auxiliary liaison receiver control panel, inserts a crystal filter into the circuit when turned to the IN position. This filter increases the selectivity of the receiver, enabling reception through heavy interference.

TEL. JACKS. Dual output is provided through two open circuit phone jacks (12, figure 4-20). These jacks are connected to the output circuit of the receiver and permit headphone reception by the operator.

ANTENNA AND GROUND BINDING POSTS. The antenna is connected to the binding post marked A, while the ground lead is connected to the binding post marked G, (7, figure 4-20) on the auxiliary liaison receiver control panel.

ANTENNA ALIGNMENT KNOB. This knob (6, figure 4-20) on the auxiliary liaison receiver control panel is provided to allow the operator to align the antenna for best signal reception.

BC-348 Auxiliary Liaison Receiver Indicators

DIAL SCALE. This scale (3, figure 4-20) on the auxiliary liaison receiver control panel is adjusted by the band switch and tuning knob. The frequency set in with these knobs appears in the dial scale window.

Normal Operation of the BC-348 Auxiliary Liaison Receiver

17260 ▶ **3278** less ✈ ICTO KG206!

The auxiliary liaison receiver is put into operation as follows:

1. Place AUX REC interphone mixer switch (figure 4-8) to ON (up)
2. Set power switch (11, figure 4-20) to MVC. Allow set approximately 30 seconds to warm up
3. Adjust volume knob (10, figure 4-20) until a slight background noise is heard
4. Set band switch (4, figure 4-20) to the frequency band in which signals can be heard
5. Rotate the tuning knob (8, figure 4-20) with reference to the dial scale (3, figure 4-20), tune in the desired signal

NOTE

> All tuning should be done with the power switch set on MVC and with the volume knob advanced only enough to give the desired signal strength. In the absence of a signal, the setting of the volume can be judged by the loudness of the background noise. On MVC with the volume set at maximum, very strong carrier waves will block the receiver and intelligible signals cannot be received.

6. Set power switch to AVC. The desired signal should still be heard
7. With the beat frequency knob (9, figure 4-20) at zero position (arrow on knob pointing up), place the C.W. OSC switch ON position. An audible beat note should be heard which should vary in pitch when the beat frequency adjustment is changed
8. With the C.W. OSC switch in the ON position, place the crystal filter switch (2, figure 4-20) to IN. Noise should be greatly reduced and the signal can be tuned out by a much smaller movement of the tuning knob than when the crystal filter switch is in the OUT position
9. Turn the dial light rheostat (5, figure 4-20) and observe if control of illumination is secured with both dial lights functioning
10. When the receiver is not being used, turn the power switch to OFF

Modulated Signal Reception of the BC-348 Auxiliary Liaison Receiver

For the reception of modulated signals in the frequency bands covered by this receiver, proceed as follows:

1. Turn the power switch to MVC
2. Place the C.W. OSC switch to the OFF position
3. Position the crystal filter switch to OUT

NOTE

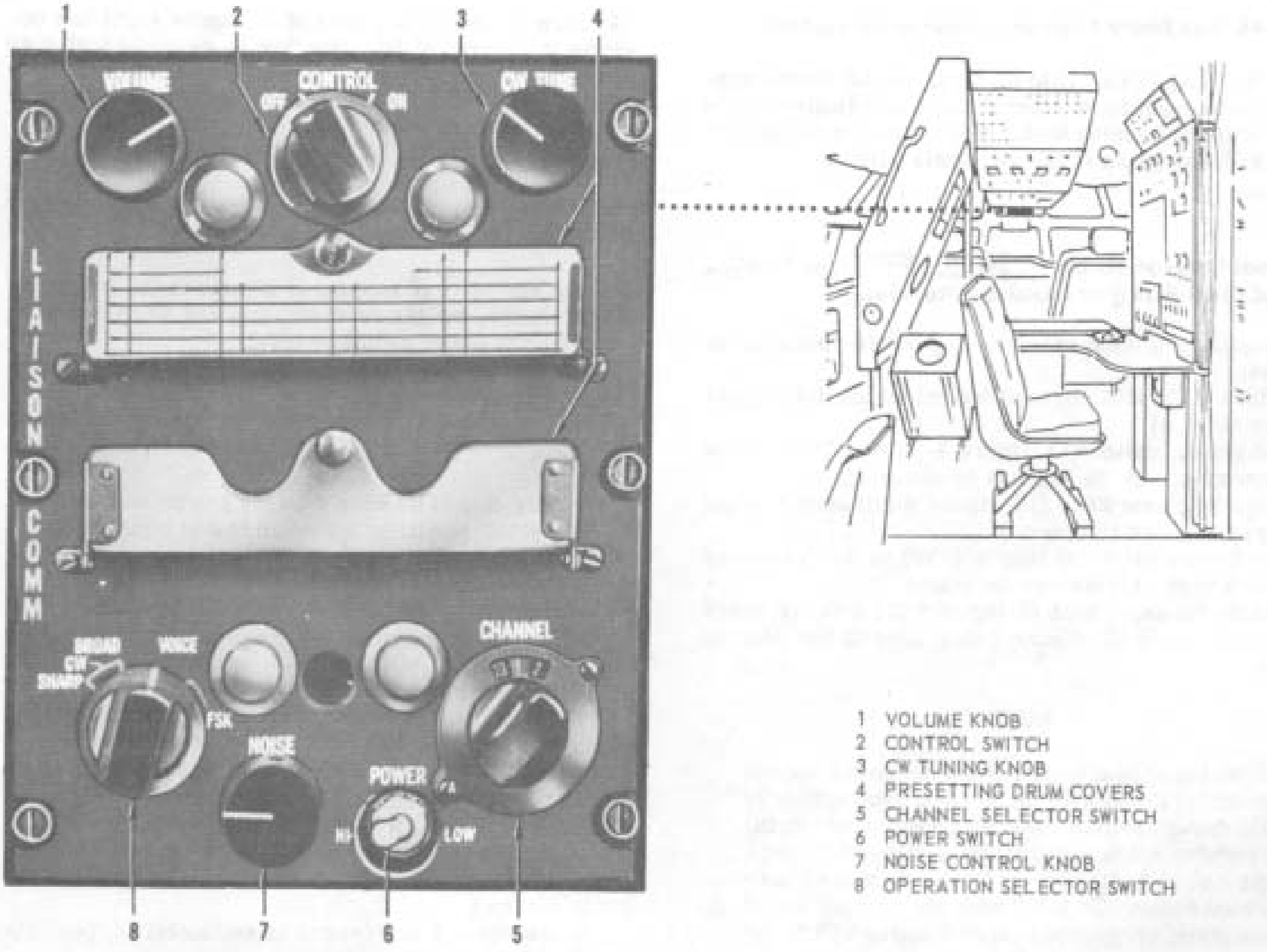
> Tuning should be done with the power switch in the MVC position and with the volume knob advanced only as far as required for a comfortable output level.

4. Allow set to warmup (approximately 30 seconds) before adjusting volume knob until the background noise can be heard
5. Turn tuning knob until frequency of the desired signal is reached and signal is heard in the headphones. Turn tuning knob slowly back and forth until the position at which the signal is received is the strongest found
6. If automatic volume control is desired, position power switch to AVC and readjust volume knob for the desired output
7. In the event interference is encountered, position crystal filter switch to IN

CW Reception of the BC-348 Auxiliary Liaison Receiver

For reception of the CW signals, proceed as follows:

1. Turn power switch to MVC
2. Place C.W. OSC switch to the ON position
3. Position beat frequency knob to the zero beat position (arrow on knob pointing up)
4. Proceed as instructed for the reception of modulated signals and when the signal is tuned in, adjust beat frequency knob to the position producing the most satisfactory tone
5. Automatic volume control may be used by switching the power switch to AVC



1 VOLUME KNOB
2 CONTROL SWITCH
3 CW TUNING KNOB
4 PRESETTING DRUM COVERS
5 CHANNEL SELECTOR SWITCH
6 POWER SWITCH
7 NOISE CONTROL KNOB
8 OPERATION SELECTOR SWITCH

AN/ARR-36 AUXILIARY LIAISON RECEIVER CONTROLS 3279 ▶ plus TCTO KG206

Figure 4-21

AUXILIARY LIAISON RECEIVER (AN/ARR-36) 3279 ▶ plus TCTO KG206

The AN/ARR-36 is a remote controlled radio receiver that provides CW, voice, and frequency shift reception in the frequency range from 2 to 23.9 megacycles in 500-cycle steps giving a total of 44,000 usable frequencies. Any 20 of the 44,000 possible frequencies can be set up, in any order, for selection by the operator through the use of a channel selector switch on the control panel. The auxiliary liaison receiver control panel (25, figure 1-12) is on the overhead panel. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

AN/ARR-36 Auxiliary Liaison Receiver Controls

OPERATION SELECTOR SWITCH. A rotary-type selector switch (8, figure 4-21) on the auxiliary liaison receiver control panel has CW SHARP--CW BROAD--VOICE--FSK positions. This switch is used to select a type of reception on the auxiliary liaison receiver. The CW SHARP position provides CW reception on a narrow band width to increase intelligibility of signals. CW BROAD has a 7-kilocycle band for general CW reception. VOICE is for voice reception. The FSK position is a provision for a teletypewriter and is not used.

CONTROL KNOB. This knob (2, figure 4-21) with OFF--ON positions serve to turn the receiver on or off. The control switch is also a protective device that returns the switch to OFF when there are faults in the equipment.

VOLUME KNOB. This knob (1, figure 4-21) on the auxiliary liaison receiver control panel, controls the loudness of received signals.

CW TUNING KNOB. The CW tuning knob (3, figure 4-21) on the auxiliary liaison receiver control panel is used to adjust the tuning when receiving CW signals.

CHANNEL SELECTOR SWITCH. This switch (5, figure 4-21) on the auxiliary liaison receiver control panel is used for selecting any one of the 20 preset frequencies.

PRESETTING DRUM COVERS. These covers (4, figure 4-21) are on the auxiliary liaison receiver control panel. The covers are held closed by thumb screws, which enclose the drums on which the desired frequencies are preset. A matte-surfaced plastic sheet for recording the preset channel is mounted on the top cover.

POWER SWITCH. This switch (6, figure 4-21) on the auxiliary liaison receiver control panel is not operative.

NOISE CONTROL KNOB. This knob (7, figure 4-21) is on the auxiliary liaison receiver control panel. The control is operative only when the operation selector switch is in the VOICE or FSK positions. This is a limited-range sensitivity or squelch control for adjusting the nose threshold when receiving voice or frequency shift keying signals.

Normal Operation of the AN/ARR-36 Auxiliary Liaison Receiver

The AN/ARR-36 auxiliary liaison receiver is put into standby operation when airplane is airborne as follows:

1. Set channel selector switch to the desired channel
2. Turn control knob to ON. If control returns to OFF in approximately 40 seconds, select another channel. Repeat this procedure until control remains ON. Do not change channel for 15 minutes. After this warm-up period, proceed with normal operating procedures
3. Turn operation selector switch to the desired type of operation
4. Adjust the noise control knob to the point where characteristic noise is not objectionable when no signals are being received. Reducing the noise too much may prevent hearing signals

To receive voice signals using the AN/ARR-36 auxiliary liaison receiver, proceed as follows:

1. Place AUX REC interphone mixer switch ON (up)
2. Set operation selector switch to VOICE
3. While receiving voice signals, adjust the volume for satisfactory loudness of signals in the headphones
4. When no signals are being received, adjust the noise control until the receiver background noise is not objectionable. Reducing the level below this point may result in the loss of weak signals.

NOTE

The CW tuning knob is inoperative during VOICE or FSK operation.

To receive CW signals using the AN/ARR-36 auxiliary liaison receiver, proceed as follows:

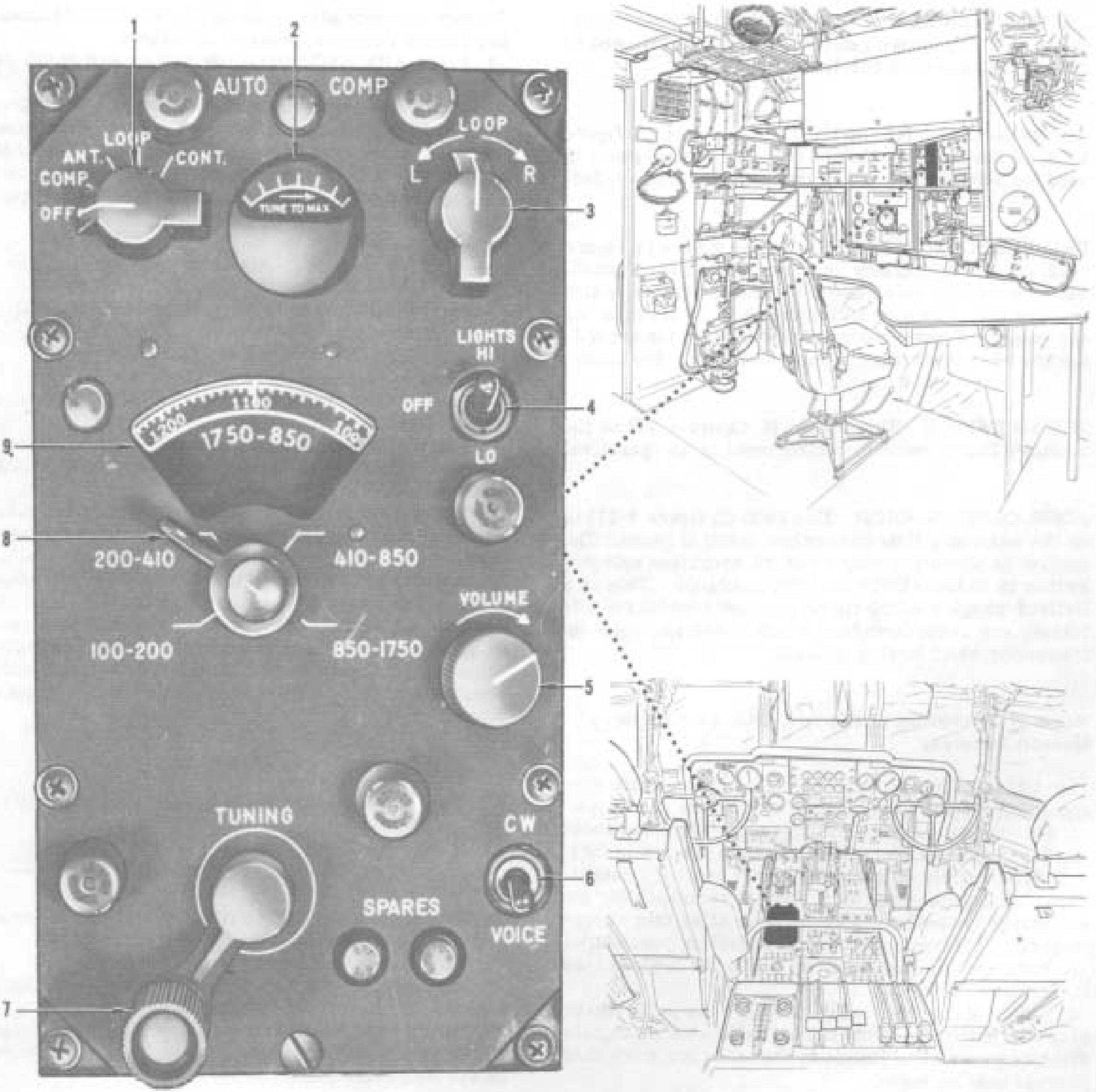
1. Place AUX REC interphone mixer switch ON (up)
2. Set the operation selector switch to the CW-BROAD position
3. While receiving CW signals, adjust the volume knob for satisfactory loudness of signals in the headphones
4. Adjust the CW tuning knob for an easily readable pitch of the received signals
5. If an unusually high noise level from interference or jamming makes reception difficult, switch the operation selector switch to CW SHARP. This may require readjustment of the CW tuning knob for desirable signal pitch

NOTE

The noise control is inoperative during CW operation.

To turn off AN/ARR-36 auxiliary liaison receiver, proceed as follows:

1. Turn control knob to OFF
2. For emergency shutoff of the receiver, turn control switch to ON then OFF if in the ON position
3. Turn off the airplane power source. The airplane power source can then be turned on again and the receiver will remain off



RADIO COMPASS (ADF) CONTROL PANEL

1 FUNCTION SWITCH
2 TUNING METER
3 LOOP SWITCH
4 LIGHT SWITCH
5 VOLUME KNOB
6 MODULATION SWITCH
7 TUNING CRANK
8 BAND SWITCH
9 FREQUENCY DIAL

RADIO COMPASS (ADF) CONTROLS

Figure 4-22

RADIO COMPASS (AN/ARN-6)

The low frequency radio compass is a navigational aid for the pilot and navigator. The radio compass may be used for automatic direction finding or as a homing device on any signal transmitted at a frequency from 100 to 1750 kilocycles. This set is also used as a receiver for low frequency range reception. Indicators for the set are on the pilots' instrument panel and the navigator's instrument panel. Control panels for the set are on the control stand for the pilot, and on the radio and radar control panels at the navigator's station, for use by the navigator. Operating power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

NOTE

> The radio compass should not be used as a navigational aid until the loop has been compensated.

Radio Compass Controls

FUNCTION SWITCH. A function switch (1, figure 4-22) on the pilots' and navigator's radio compass panels is used to turn the radio compass equipment on and off, select the mode of operation, and transfer control of the radio compass to the pilots' or navigator's panel as desired. The switch positions are labelled OFF--COMP--ANT--LOOP--CONT and function as follows (the first four effective only from the radio compass panel having control): OFF turns off the radio compass equipment. COMP provides homing and automatic direction finding (ADF) operation. ANT connects the sense antenna to provide for receiver operation only. LOOP is used for aural-null direction finding and receiver operation. CONT is spring-loaded for momentary operation to transfer control from one radio compass panel to the other each time either switch is actuated.

NOTE

> Control is indicated to be at the pilots' radio compass panel when one of the three operation positions of the pilots' function switch is in use and his frequency dial and tuning meter are illuminated when the indicator light switch is on HI or LO. Another indication of control will be a deflection of the tuning meter pointer away from its clockwise stop when the equipment has warmed up approximately 15 seconds. The indication of control at the navigator's panel is the same as the pilot's.

LOOP SWITCH. A rotary loop switch (3, figure 4-22) on the pilots' and navigator's radio compass panels provides manual control of rotation of the radio compass loop antenna. Turning the switch toward L or R rotates the loop counterclockwise or clockwise, respectively, provided the radio compass function switch is in LOOP position. The radio compass loop switch is spring-loaded to the center (off) position. The rate of loop rotation is proportional to the knob displacement from the center position and varies from approximately 5 degrees per second minimum to approximately 40 degrees per second maximum.

TUNING CRANK. A tuning crank (7, figure 4-22) on the pilots' and navigator's radio compass panels selects the desired station, the frequency of which is indicated on the calibrated dial.

LIGHT SWITCH. An indicator light control switch (4, figure 4-22) on the radio compass panel has HI--OFF--LO positions. HI and LO positions vary the indicator light intensity. OFF position turns off the lights.

BAND SWITCH. A band switch (8, figure 4-22) on the pilots' and navigator's radio compass panels selects any one of four receiver operating bands of frequencies. The switch positions are 100 to 200, 200 to 410, 410 to 850, and 850 to 1750 kilocycles. When a band is selected, the dial calibration is selected accordingly.

VOLUME KNOB. A volume knob (5, figure 4-22) on the pilots' and navigator's radio compass panels is provided as a means for adjustment of the audio level to the interphone.

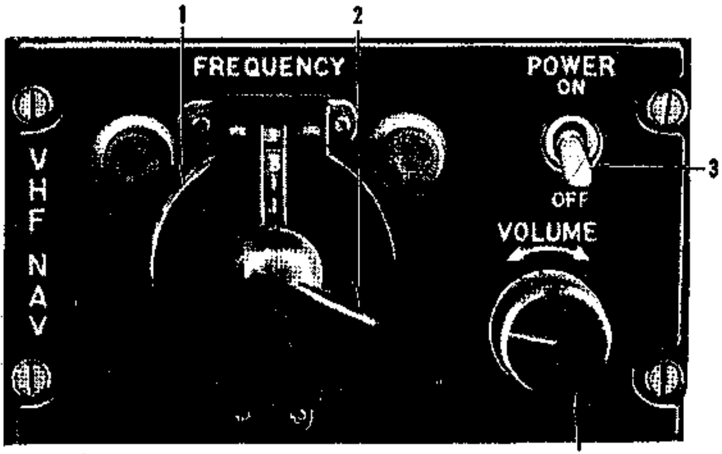
MODULATION SWITCH. A switch (6, figure 4-22) with CW--VOICE positions on the pilot's and navigator's radio compass panels is for selection of either code or voice reception.

Radio Compass Indicators

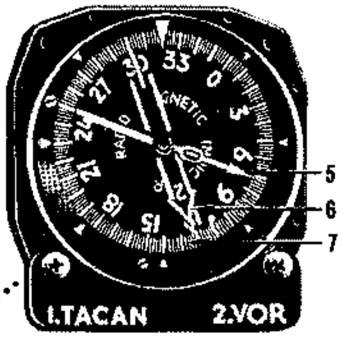
TUNING METER. A tuning meter (2, figure 4-22) is provided on the radio compass panels to indicate maximum signal strength during the process of tuning in a station.

FREQUENCY DIAL. A dial scale (9, figure 4-22) on the pilots' panel shows the frequency to which the radio compass is tuned.

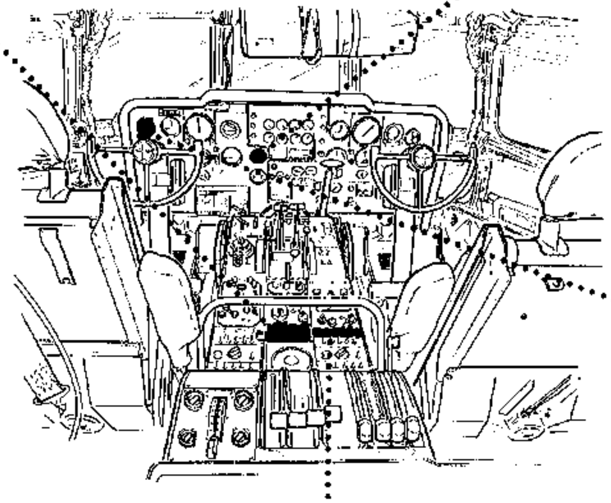
RADIO MAGNETIC INDICATOR (RMI). The ADF needle on the pilot's and navigator's RMI's indicates the direction of a tuned station relative to the airplane's heading. Refer to RADIO MAGNETIC INDICATOR under VHF NAVIGATION RADIO (OMNI) INDICATORS in this Section.

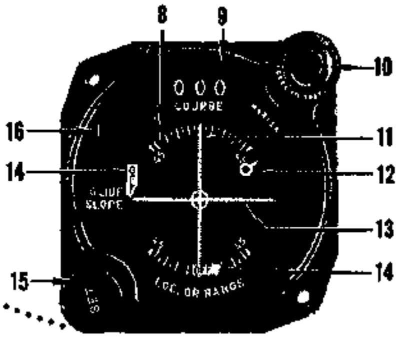


VHF NAVIGATION CONTROL PANEL



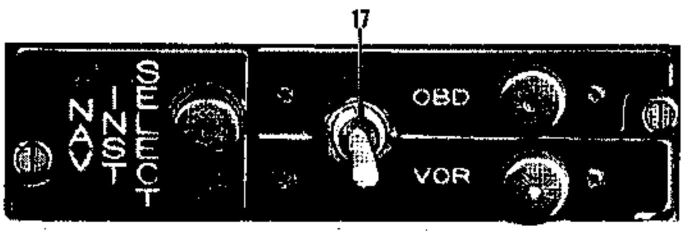
RADIO MAGNETIC INDICATOR (RMI)





PILOT'S COURSE INDICATOR

INSTRUMENT SELECT SWITCH SEE DETAIL I
AIRPLANES INCORPORATING TCTO 572



NAVIGATION INSTRUMENT SELECTOR PANEL
AIRPLANES NOT INCORPORATING TCTO 572
DETAIL I

1	FREQUENCY SELECTOR KNOB (WHOLE MEGACYCLE)
2	FREQUENCY SELECTOR KNOB (TENTH MEGACYCLE)
3	POWER SWITCH
4	VOLUME KNOB
5	RMI NO. 1 NEEDLE (TACAN INDICATION)
6	RMI NO. 2 NEEDLE (OMNI INDICATION)
7	ROTATING COMPASS CARD
8	HEADING POINTER SCALE
9	COURSE SET WINDOW
10	MARKER BEACON LIGHT
11	LOCALIZER OR RANGE NEEDLE
12	RELATIVE HEADING POINTER
13	GLIDE SLOPE NEEDLE
14	FLAG ALARM (2 PLACES)
15	COURSE SET KNOB
16	TO/FROM WINDOW
17	OBD--VOR SELECTOR SWITCH
18	INSTRUMENT SELECT SWITCH

VHF NAVIGATION RADIO (OMNI) CONTROLS AND INDICATORS

Figure 4-23

Normal Operation of Radio Compass

The radio compass is made operative by the following procedure:

1. Place the function switch to ANT

CAUTION

Aural and sensing function may be affected by the simultaneous operation of the rendezvous radar sets (AN/APN-12 and APN-76).

NOTE

If ANT position of the function switch does not turn on the radio compass equipment, move function switch momentarily to CONT and return to ANT.

2. Place the appropriate interphone controls to the desired positions for reception of the radio compass receiver. See INTERPHONE SYSTEM, this Section
3. Select desired frequency band and use tuning crank to tune station and obtain maximum swing of tuning meter
4. Place function switch in desired (type of operation) position
5. Turn off equipment by placing function switch in OFF

Emergency Operation of Radio Compass

In the event of failure of the radio magnetic indicator or indicator circuits which prevent a compass reading, bearings may be taken from the azimuth scale at the bottom of the loop assembly. These readings, however, will only indicate direction to the station as measured from the airplane heading.

MARKER BEACON (AN/ARN-12)

A marker beacon receiver is used as a navigational and landing aid. When flying over a beacon, a signal may be heard through the interphone system and is shown visually by an amber marker beacon light (2, figure 1-9). The beacon light (10, figure 4-23) is on the pilot's course indicator on the pilot's instrument panel. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

Marker Beacon Controls And Operation

No controls are available for the marker beacon receiver. The receiver is automatically operated by DC power and will operate continuously as long as power is available from the DC power distribution system.

VHF NAVIGATION RADIO (OMNI) (AN/ARN-14)

A VHF navigation radio (omni) receiver provides navigation information and comprises a portion of the instrument landing system (ILS). A course indicator on the pilots' instrument panel provides visual course and heading indication with respect to the localizer beam or a selected VOR radial. If a localizer or omnirange signal is being received, a small warning flag in the bottom of the indicator will disappear from view to provide positive indication of station reception. Radio magnetic indicators on the pilots' instrument panel, one each for the pilot and copilot, and one for the navigator, indicate bearing to the omni station. A switch (18 or 17, figure 4-23) must be positioned VOR to provide signals to the pilot's course indicator and the navigator's radio magnetic indicator. Control power is 28 volt dc with circuit protection on the aft radio rack junction box (figure 1-34).

OMNI And Localizer Controls

FREQUENCY SELECTOR KNOBS. Two rotary selector knobs (1 and 2, figure 4-23) on the VHF NAV control panel provide control of localizer and omni range frequency selection. The knobs may be turned either clockwise or counterclockwise. Frequencies between 108.0 and 135.9 megacycles provide 280 channels for selection. Tuning a localizer frequency automatically causes the proper glide slope channel to be selected simultaneously to provide ILS cross-pointer information.

POWER SWITCH. The omni receiver is turned on and off by a two-position power switch (3, figure 4-23) on the VHF NAV control panel.

VOLUME KNOB. A volume knob (4, figure 4-23) on the VHF NAV control panel is used to adjust the audio level from the omni receiver to the interphone.

COURSE SET KNOB. A course set knob (15, figure 4-23) on the pilot's course indicator is used to set the magnetic bearing of a desired course in the three upper tab windows (course set window).

OBD-VOR SELECTOR SWITCH. Airplanes not incorporating TCTO 572. This switch (17, figure 4-23) on the navigation instrument selector panel is on the control stand. The switch which is operative only in the VOR position at this time, allows signals to be fed to the pilot's course indicator (1, figure 1-9) and the navigator's radio magnetic indicator (figure 4-23). Information will be furnished for the OBD position when available. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

INSTRUMENT SELECT SWITCH. Airplanes incorporating TCTO 572. Input signals to the pilot's course indicator and navigator's radio magnetic indicator are selected by the instrument select switch (18, figure 4-23). When the switch is in the VOR-ILS position, signals from the VHF navigation radio are applied to the indicators. In the TACAN position, the indicator input is from the UHF navigation radio. The indicator light is illuminated to show which system is operating the course indicator. The other switch position marking is left dark to aid in determining which radio system is operating the instruments.

VHF Navigation Radio (OMNI) Indicators

PILOT'S COURSE INDICATOR. The pilot's course indicator on airplanes not incorporating TCTO 572, give a composite display of VHF navigation or approach information (Omni or ILS). On airplanes incorporating TCTO 572, the course indicators display either VHF (Omni or ILS) or UHF (TACAN) navigation information dependent upon the position of the instrument select switch. The indicator (figure 4-23) is on the pilot's flight instrument panel. The course set knob (15, figure 4-23), marked SET, permits the pilot to set up a magnetic course to reach a VOR, TVOR, or TACAN omni directional range station. In addition, radials from stations to the right or left of course can be selected for navigational reference. The selected course appears in the course set window (9, figure 4-23). The LOC or RANGE needle (11, figure 4-23) indicates the lateral position of the airplane relative to the selected station radial or ILS localizer beam. The displacement of the vertical bar from center indicates the direction of turn to position the airplane on the selected course. The GLIDE SLOPE needle (13, figure 4-23), operative only when the set is on an ILS frequency, shows the vertical position of the airplane on the glide path. Both needles operate in the same manner, maintaining a center position when "on course" and deviating from center when "off course". The relative heading pointer (12, figure 4-23) is an N-1 compass repeater that is oriented by the course set knob to show the heading of the airplane relative to the selected radial. When the relative heading pointer is centered, the heading of the airplane is the same as the course shown in the course set window. If the pointer is deflected to the left or right, the airplane heading is to the left or right the number of degrees indicated on the pointer scale. Deviation of the heading pointer from the vertical index indicates the crab angle of the airplane when the vertical bar is centered. The TO/FROM indicator (16, figure 4-23) indicates FROM when the airplane is on or near the selected radial and TO when the airplane is on or near the reciprocal radial. (Radials are established as outbound magnetic bearings from the station.) The TO/FROM indicator is blank during ILS operation or upon loss of signal. There are flag alarms (14, figure 4-23) for the LOC or RANGE and GLIDE SLOPE needles. The OFF flag is visible when the respective pointer is unreliable because of a weak signal or the equipment is de-energized. The flag moves out of sight when the pointer is reliable. Each course indicator has a marker beacon light (10, figure 4-23). The light is operated by the marker beacon receiver. During ILS operation, the LOC or RANGE needle operates independent of the heading set in the course set window.

NOTE

The heading pointer of the course indicator receives heading reference information from the N-1 compass system and will perform only the above functions when the N-1 compass system is operating in the magnetic slaved operational mode. When the N-1 system is in directional indicator operational mode the heading pointer will give only heading referenced to a preselected gyro datum and will be of no use for localizer and omni range operations unless synchronized with magnetic compass data.

RADIO MAGNETIC INDICATOR (RMI). The radio magnetic indicator is a composite display of airplane heading, radio compass or direction finder (ADF) station bearing, and omni range station bearing. Airplanes **17260**▶ **3177** have two RMI's (16, figure 1-9) and airplanes **3178**▶ plus those incorporating TCTO 321▶ have four RMI's on the pilots' instrument panel. Another RMI (figure 4-24) is on the navigator's instrument panel. The indicator receives heading reference information from the N-1 compass which rotates the circular compass card so that the heading of the airplane will always be under the reference index at the top of the instrument. The No. 2 pointer is the azimuth indicator for the omni receiver and indicates the bearing to the omni range from the airplane as measured from magnetic North whether the N-1 compass system is in magnetic slaved operational mode or directional indicator mode. The No. 2 needle receives synchro excitation voltage only through the N-1 compass; however, in the event of failure of power to the N-1, a relay is energized which provides an alternate source of excitation voltage. In effect, this makes the No. 2 needle completely independent of the N-1. When the omni radio is operating properly and the C-1 amplifier is receiving power, the No. 2 needle always indicates magnetic bearing to the station regardless of the mode of operation of the N-1 compass or if the N-1 compass is inoperative. The directional information to the omni radio is obtained from a phase difference between two rotating antennas in the ground installation. It is oriented to magnetic North for convenience only. The only function of the N-1 compass, as it affects the No. 2 needle, is to keep the airplane heading at the top of the rotating compass card; that is, the needle points physically in the direction of the station as well as to the number on the card which is the magnetic bearing to the station.

Normal Operation of VHF Navigation Radio (OMNI)

The VHF navigation radio (omni) is made operative by placing the power switch in the ON position and inoperative by placing the power switch in OFF position.

Emergency Operation of VHF Navigation Radio (OMNI)

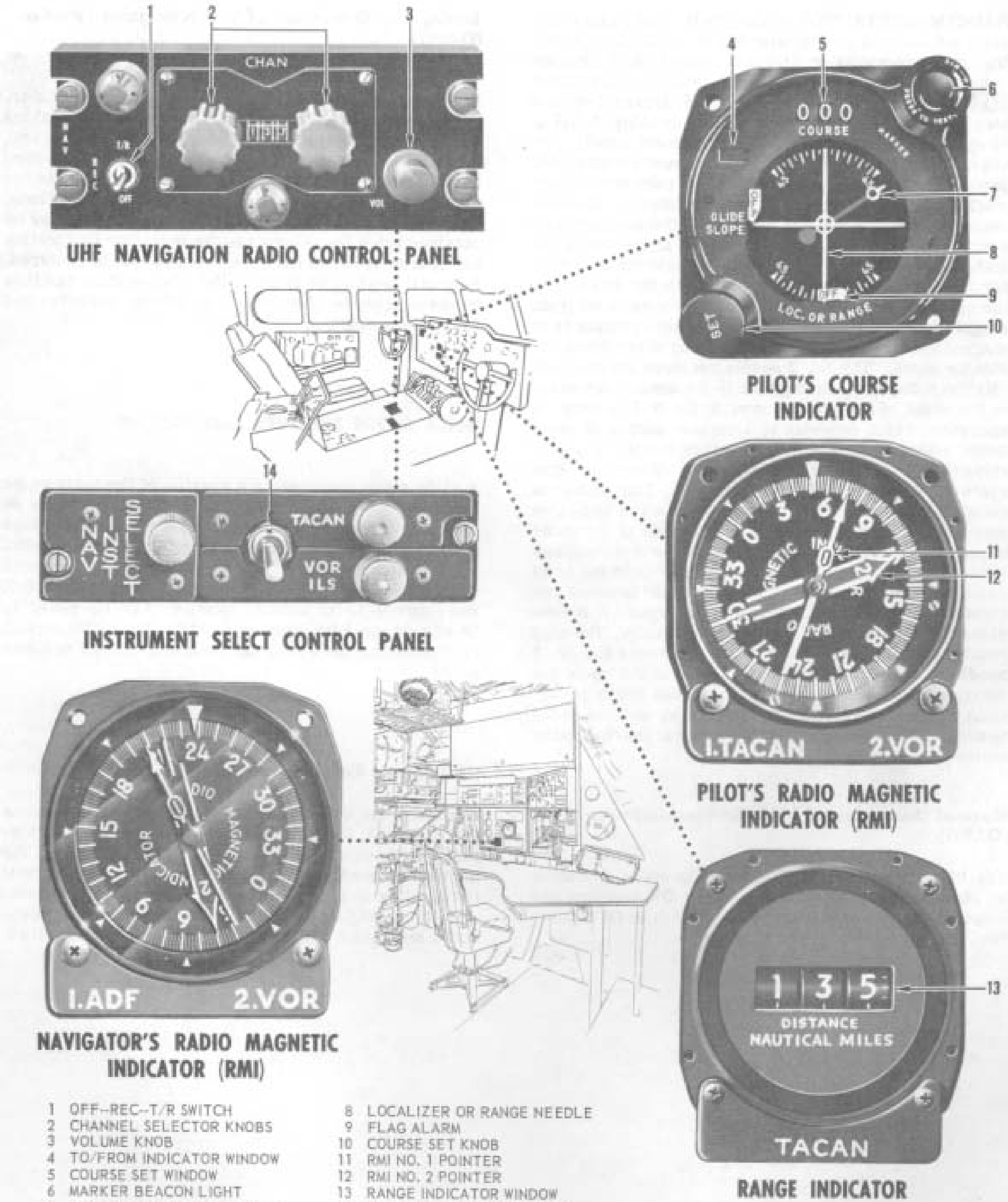
In event of failure of the C-1 signal power amplifier, the pilots' and navigator's radio magnetic indicators will become inoperative. When such a failure occurs, directional indication from the rotating compass card and the No. 1 and 2 needles for the radio magnetic indicator will not be available. Under these conditions, bearing information from the omni receiver may be obtained from the pilot's course indicator by rotating the course set knob until the vertical bar is centered. Magnetic bearing to or from the omni-station can then be determined by observing the to/from indicator and the counter reading.

GLIDE SLOPE RECEIVER (AN/ARN-18)

A glide slope receiver is a portion of the instrument landing system (ILS). The pilot's course indicator on the pilots' instrument panel provides visual glide slope indication along with the localizer indication. Control of glide slope equipment is automatic through normal operation of VHF navigation radio (omni) equipment. See figure 4-38 for antenna location. Control power is 28 volt dc, operating power is 115 volt ac with circuit protection on the radio junction box circuit breaker panel.

Glide Slope Receiver Indicator

A glide slope horizontal needle in the pilot's course indicator (13, figure 4-23) provides indication of airplane position relative to the glide slope beam. The horizontal needle will be centered on the indicator if the airplane is flying on the beam during an approach. A warning flag on the left side of the indicator moves out of sight when a glide slope signal is being received.



1 OFF–REC–T/R SWITCH
2 CHANNEL SELECTOR KNOBS
3 VOLUME KNOB
4 TO/FROM INDICATOR WINDOW
5 COURSE SET WINDOW
6 MARKER BEACON LIGHT
7 RELATIVE HEADING POINTER
8 LOCALIZER OR RANGE NEEDLE
9 FLAG ALARM
10 COURSE SET KNOB
11 RMI NO. 1 POINTER
12 RMI NO. 2 POINTER
13 RANGE INDICATOR WINDOW
14 INSTRUMENT SELECT SWITCH

UHF NAVIGATION RADIO (TACAN) CONTROLS AND INDICATORS AIRPLANES WITH TCTO 572

Figure 4-24

Normal Operation of Glide Slope Receiver

The glide slope receiver is turned on and off and tuned remotely through normal use of the VHF navigation radio (omni) equipment. The power switch (3, figure 4-23) for the VHF navigation radio starts and stops operation of the glide slope equipment. When the omni and localizer frequency selector knobs (1 and 2, figure 4-23) are set to a designated ILS localizer frequency, the glide slope equipment is automatically tuned to the proper glide slope channel. Glide slope equipment is in a standby condition when VHF omni-range frequencies are used.

Emergency Operation of Glide Slope Receiver

Emergency operation does not differ from normal operating procedure.

UHF NAVIGATION RADIO (TACAN) (AN/ARN-21) TCTO 572

Airplanes incorporating TCTO 572 have a UHF navigation radio that operates in conjunction with surface navigation beacons. The radio and a surface beacon together comprise a radio navigation system, called TACAN, that enables the airplane to obtain continuous indications of distance and bearing to a selected station. The radio has five components: receiver-transmitter, antenna, control panel, range indicator, and azimuth indicators (pilot's course indicators and radio magnetic indicators) (figure 4-24). Operating controls for the radio are on the control panel, marked NAV, on the control stand. The panel has two channel selector knobs (marked CHAN), a tone level control for the station identity code (marked VOL), and the OFF--REC--T/R switch for energizing the equipment. There are one hundred twenty six channels available. The ground stations continuously transmit radio pulses. These pulses are detected by the receiver and translated into bearing information. TACAN supplies bearing data to the pilot's course indicator and radio magnetic indicators. For distance information the TACAN transmitter radiates pulses known as distance interrogation pulses. These signals are detected by the ground station and cause the ground station transmitter to respond with "distance reply" pulses. The receiver detects the distance reply pulses, measures the time difference between the interrogation pulse and the reception of the reply pulse, and converts this time difference into a nautical miles meter reading. Distance information is shown on the range indicator (figure 4-24). TACAN information is connected to the pilot's course indicator and radio magnetic indicators when the instrument select switch (14, figure 4-24) is in TACAN position. The TACAN mixer switch on the interphone mixer switch panel must be ON (up) to hear the station identity code on the interphone. This navigation system requires heading data from the N-1 compass. Both 28 volt DC and 115 volt AC power are used in the operation and control of the set with circuit protection through circuit breakers on the radio junction box circuit breaker panel.

WARNING

On airplanes having both VHF and UHF navigation radios, turn off the UHF navigation radio (TACAN) when making a VOR or ILS approach. There is an automatic change-over to TACAN in the event of power failure to the VHF navigation radio (omni). This change-over may occur without being noticed by the pilot since there is no distinctive indication of such a failure.

UHF Navigation Radio (TACAN) Controls TCTO 572

OFF--REC--T/R SWITCH. Placing the OFF--REC--T/R toggle switch (1, figure 4-24) in the OFF position, turns off all power to the set. When the switch is in REC (receive) position, the set supplies only bearing information. Bearings are displayed on the pilot's radio magnetic indicator and on the navigator's RMI. Bearing data is also supplied to the pilot's course indicator to give position indications with respect to the selected radial. When the switch is placed in the T/R (transmit-receive) position, the equipment is in full operation with both bearing and distance information displayed. The distance to the station is displayed by the range indicator on the pilots' center instrument panel.

CHANNEL SELECTOR KNOBS. The two channel selector knobs (2, figure 4-24) select one of 126 operating channels. The right knob determines the unit digit of the channel number and the left knob determines the tens and or hundreds digit. The selected channel number is displayed in the window, between the knobs.

VOLUME KNOB. The knob (3, figure 4-24), marked VOL, controls the volume of the three-letter Morse code beacon identification signal.

INSTRUMENT SELECT SWITCH. Input signals to the pilot's course indicator and navigator's radio magnetic indicator are selected by the instrument select switch (14, figure 4-24). When the switch is in the VOR-ILS position, signals from the VHF navigation radio are applied to the indicators. In the TACAN position, the indicator input is from the UHF navigation radio. The indicator light is illuminated to show which system is operating the course indicator. The other switch position marking is left dark to aid in determining which radio system is operating the instruments.

COURSE SET KNOB. A course set knob (10, figure 4-24) on the pilot's course indicator is used to set the magnetic bearing of a desired course in three-digit display windows.

UHF Navigation Radio (TACAN) Indicators TCTO 572

RANGE INDICATOR. The range indicator on the pilots' instrument panel displays the slant range in nautical air miles to the selected ground beacon station. When the equipment is searching for a satisfactory range signal, the indicator drum counters (13, figure 4-24) are partially covered by a red bar and the counters move too rapidly for a reading to be obtained. When the equipment has locked on to a reliable range signal, the red bar disappears and the counters move slowly as determined by airplane flight. Maximum reading of the range indicator will be 195 nautical air miles.

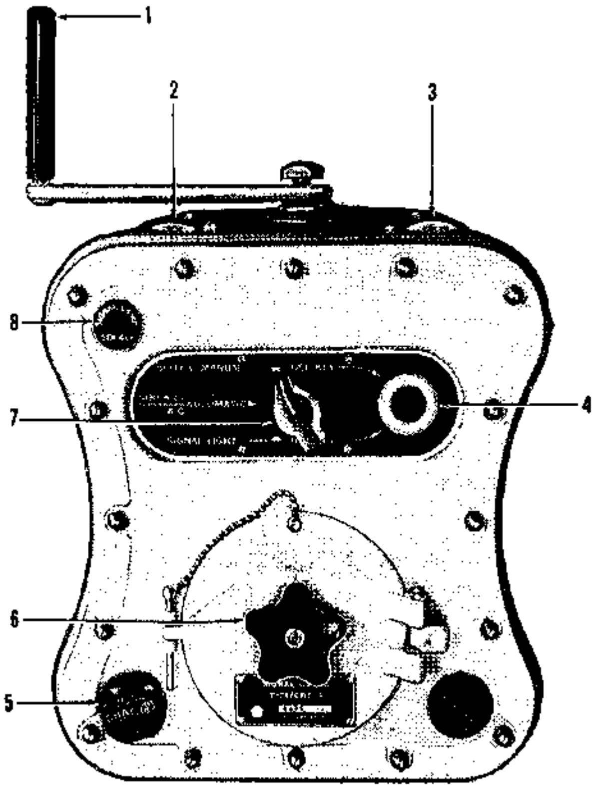
PILOT'S COURSE INDICATOR. The pilots' course indicator, (figure 4-24) provides a composite display of the UHF navigation radio bearing information when the instrument select switch is in TACAN position. Deviation from the selected course to the ground beacon is shown by the vertical pointer. The selected course to the beacon is shown in the three-digit course set window. The course is selected by turning the SET knob. When the vertical pointer signals are not reliable, a vertical pointer flag alarm labelled OFF appears. A heading pointer shows relationship of the airplane heading to the selected bearing. With the vertical pointer centered, the heading pointer indication is the crab angle of the airplane. An amber indicator light illuminates when the marker beacon receiver operates. A to/from flag indicates whether the course selected is to or from the TACAN beacon station.

NOTE

> The pilot's course indicator operates in conjunction with either the VHF navigation radio (omni) or the UHF navigation radio (TACAN), depending on the position of the instrument select switch. The switch must be in TACAN position for the UHF navigation radio to operate the indicator.

RADIO MAGNETIC INDICATOR (RMI). Bearing information of the UHF navigation radio is displayed on two radio magnetic indicators or RMI's (figure 4-24) one on the pilots' instrument panel and one RMI on the navigator's instrument panel. On the pilots' instrument panel, the radio magnetic indicators which have the marking 1. TACAN show UHF navigation radio bearing with the No. 1 pointer. The navigator's radio magnetic indicator shows UHF navigation radio bearing on the No. 2 pointer when the instrument select switch is in the TACAN position. The pointers rotate continuously when the equipment is not locked on a reliable beacon bearing signal.

AZIMUTH INDICATOR. This indicator is mounted next to the forward power panel. It displays the relative bearing to the TACAN beacon station. Since this information is presented on the radio magnetic indicators, the azimuth indicator is not normally used in flight.



DINGHY TRANSMITTER

1 HAND CRANK
2 RADIO OUTPUT LIGHT
3 SPEED INDICATOR LIGHT
4 KEY
5 GROUND LEAD
6 ANTENNA REEL
7 SELECTOR SWITCH
8 SIGNAL LAMP SOCKET

DINGHY TRANSMITTER CONTROLS

Figure 4-25

Normal Operation of UHF Navigation Radio (TACAN) TCTO 572

To obtain bearing information from the UHF navigation radio, move the OFF--REC--T/R switch to the REC position and select the channel of the appropriate ground beacon station. Place the instrument select switch in the TACAN position. When the radio magnetic indicator TACAN pointers stop rotating, the search cycle of the equipment is completed and the pointers indicate the bearing of the beacon. The pilot's course indicator may be used to indicate deviation of the airplane from the selected course by turning the course set knob. To obtain range information in addition to bearing information, move the OFF--REC--T/R switch to T/R and read the range to the beacon in nautical air miles on the range indicator after the red bar disappears. To identify the beacon station, move the TACAN interphone mixer switch to the ON position and listen for the code signal. Adjust the volume of the signal as desired by turning the VOL knob on the UHF navigation radio control panel. To turn the equipment off, move the OFF--REC--T/R switch to the OFF position.

Emergency Operation of UHF Navigation Radio (TACAN)

TCTO 572

In event of failure of the C-1 signal power amplifier, the pilots' and navigator's radio magnetic indicators will be inoperative. When such a failure occurs, directional indication from the rotating compass card and the No. 1 and No. 2 needles for the radio magnetic indicators will not be available. Under these conditions, bearing information may be obtained from the pilot's course indicator by turning the course set knob until the vertical pointer is centered. Magnetic bearing to or from the beacon can then be read in the course marker window. The to/from flag will indicate whether the bearing is to or from the beacon. Partial failure of the equipment may not impair other functions. If the warning flag is not visible, the indication can be considered reliable.

DINGHY TRANSMITTER (AN/CRT-3A)

Two manually operated dinghy transmitters (11, figure 3-1) are provided for emergency transmission of automatic or manual modulated code or light signals.

Dinghy Transmitter Controls

HAND CRANK. Power is generated by turning a hand crank, (1, figure 4-25) at the top of the transmitter.

KEY. The key (4, figure 4-25) on the transmitter is utilized to manually key the transmitter or signal light, when the selector switch is in MANUAL or SIGNAL LIGHT positions respectively.

GROUND LEAD. This lead (5, figure 4-25) on the bottom of the transmitter serves as a ground for the set and can be placed in water or buried in soil.

ANTENNA REEL. The antenna reel (6, figure 4-25) on the transmitter is provided to reel or unreel the desired antenna length.

SELECTOR SWITCH. The selector switch (7, figure 4-25) has AUTOMATIC--MANUAL positions. The switch should be on AUTOMATIC for at least 5 minutes of each of the International Distress Listening periods to enable D/F stations to make an accurate fix of the sets location. The switch should be placed on MANUAL occasionally (2 or 3 times hourly) and the call letters of the distressed airplane keyed to permit D/F stations or search craft homing on 500 kc signal to distinguish between your signals and those of any other set sending out signals on the same frequency.

SIGNAL LAMP SOCKET. This socket (8, figure 4-25) is provided to allow signal lamp to be plugged in. The light is used at night to enable search craft to sight exact location of distress party using it.

Dinghy Transmitter Indicators

RADIO OUTPUT LIGHT. This light (2, figure 4-25) on the transmitter should glow after approximately one minute of operation, indicating that transmission is taking place.

SPEED INDICATOR LIGHT. A speed indicator light (3, figure 4-25) on the transmitter, indicates by illumination when the proper cranking speed has been reached.

Automatic Radio Transmission of the Dinghy Transmittter

To start the transmitter, proceed as follows:

1. Set the selector pointer to 500 K.C.-8364 K.C. AUTOMATIC
2. To start transmission, rotate the crank in a clockwise direction at approximately 80 to 100 revolutions per minute. When sufficient speed has been attained, the lamp marked SPEED INDICATOR KEEP LIGHTED on the top of the transmitter will light. Faster crank speeds are ineffective since the transmitter contains automatic voltage regulation, and undesirable since they speed up the transmitter code characters.
3. Continue cranking. Allow at least 20 seconds for the filaments of the vacuum tubes to heat, after which time the radio output light should flash on and off with the keying of the transmitted signal. There are no further adjustments
4. In the 500 K.C.-8364 K.C.-AUTOMATIC selector switch position, the transmitter automatically sends a signal consisting of six groups of SOS followed by a sustained dash of about 20 seconds duration. This occurs first on 500 kilocycles and then on 8364 kilocycles, automatically switching from one frequency to the other about every 40 or 50 seconds

To stop the transmitter, stop cranking

General Instructions for Transmission:

1. Most shore stations and even some ship and airplane stations maintain continuous watch, therefore, if no timepiece is available the exact time for transmission is not of great concern
2. Transmit for at least 5 minutes at a time to enable stations to determine bearings after the signal is heard
3. Transmit at least once every half hour during the day. Many short transmissions, close together, are better than one continuous transmission for hours followed by a long period of silence. An airplane using the radio transmissions as a guide for the rescue needs frequency signals so it can keep on the correct course
4. Transmit both at night and during the day to take advantage of the changes in range. Always transmit several times in the periods near dawn and near dusk
5. Radio stations engaged in the rescue operation may be far from the life raft and from each other. They must communicate with each other and with rescue agencies close by before the rescue can be accomplished. The operator, therefore, must not use all of his strength the first day
6. Transmit continuously if a ship or airplane is heard or sighted. At night, use both radio transmission and the signal lamp as circumstances warrant
7. Share the work of cranking. Interchange hands to ease the effort. If possible, let others crank the transmitter while one man holds it between his legs

Manual Radio Transmission

To start the transmitter for manual transmission, proceed as follows:

1. Set the selector switch pointer to the 500 KC MANUAL position
2. To start transmission, rotate the crank in a clockwise direction at approximately 80 to 100 revolutions per minute. When sufficient speed has been attained, the lamp marked SPEED INDICATOR KEEP LIGHTED located on the top of the transmitter will light. Faster crank speeds are ineffective, since the transmitter contains automatic voltage regulation. Continue cranking for about 20 seconds to allow the filaments to heat
3. To transmit a signal, the push button marked KEY must be pressed. This button is manipulated most conveniently by the operator with one of the first two fingers of the left hand. If another person is present, he might telegraph with his right hand while the other cranks. The indicator lamp marked RADIO OUTPUT should light when the key is depressed. This light provides a means for visually monitoring the message transmitted. The International Morse Code is printed on the top of the transmitter.

To stop the transmitter, proceed as follows:

1. To stop transmission for a few moments only, release the key button; continue cranking
2. To stop operation completely, merely stop cranking

General Instructions for Manual Transmission:

1. Send slowly, about five words per minute at most. It is difficult to send readable code with this transmitter
2. Monitor the transmission by reading the radio output light as a blinker
3. At intervals transmit a sustained dash to enable planes which may be homing on the transmission to get a bearing
4. Use manual keying only when you have a particular message to send
5. Never use manual keying alone; switch to AUTOMATIC for five minute intervals occasionally. Transmission on 8364 kilocycles, available on automatic keying only, gives the greatest range

OPERATION OF SIGNAL LAMP. A signal lamp may be used for visual signaling at night if an airplane is heard. This does not require the antenna.

1. Obtain the signal lamp from the accessory bag. Plug the cord attached to the signal lamp into the signal lamp socket at the upper left corner of the transmitter panel
2. Strap the transmitter between the legs
3. Set the selector switch knob at the SIGNAL LIGHT position
4. Strap the signal lamp on top of the head with the straps under the chin. The lamp is nondirectional, and its light may be seen from any direction
5. Depress the push-button key
6. Crank the transmitter at a speed where maximum brilliancy of the signal light is obtained

NOTE

If the lamp bulb does not light or if it burns out during use, unscrew the dome of the signal lamp, replace the bulb with the spare bulb supplied in the space clip next to the socket, and then replace the dome.

7. To telegraph with the signal light, manipulate the push-button key

WARNING

No radio transmission occurs when the signal lamp is used.

RADIO ALTIMETER (SCR-718C)

The radio altimeter is used in airplanes for determining height above terrain. The nominal range of the equipment is 0 to 50,000 feet, although the altimeter is only accurate to 40,000 feet. The set operates on a frequency from 400 to 2400 cps. The indicator and all controls are on the face of the set. The altimeter (figure 4-26) is at the navigator's station. Operating power is 115 volt ac with circuit protection on the radio junction box circuit breaker panel.

Radio Altimeter Controls

SCALE SWITCH. This switch (1, figure 4-26) on the face of the radio altimeter has TIMES TEN--TIMES ONE positions. In the TIMES TEN position, the lobe on the indicator travels one revolution for 50,000 feet. In the TIMES ONE position, the lobe travels one revolution for each 5000 feet.

TIMES TEN ZERO ADJUSTMENT KNOB. This knob (2, figure 4-26) on the radio altimeter adjusts the zero lobe to zero when the scale switch is positioned to TIMES TEN.

TIMES ONE ZERO ADJUSTMENT KNOB. This knob (4, figure 4-26) on the radio altimeter adjusts the zero lobe to zero when the scale switch is positioned to TIMES ONE.

CIRCLE SIZE KNOB. The circle size knob (5, figure 4-26) on the radio altimeter adjust the physical size of the circular trace on both the TIMES ONE and TIMES TEN positions. Normally, the adjustment is made only on the TIMES ONE position, to place the trace under the etched circle on the face of the scope. On the TIMES TEN position, the trace will then fall approximately 1/4 inch inside the etched circle, but the reference lobe can still be easily read.

REC GAIN KNOB. This knob (6, figure 4-26) on the radio altimeter has ON--OFF positions. The knob serves a double purpose. In the extreme counterclockwise position, the set is OFF and no power is applied. When the knob is turned clockwise from the extreme counterclockwise position to the ON position, power to all components of the radio altimeter will be applied. Further rotation of the knob adjusts the lobe height.

Radio Altimeter Indicators

INDICATOR FACE. The indicator face (3, figure 4-26) on the radio altimeter has a scale which ranges from 1 to 5, allowing altitude to be read up to 50,000 feet.

PILOT LIGHT. A pilot light (7, figure 4-26) on the radio altimeter will light when the components of the set are energized.

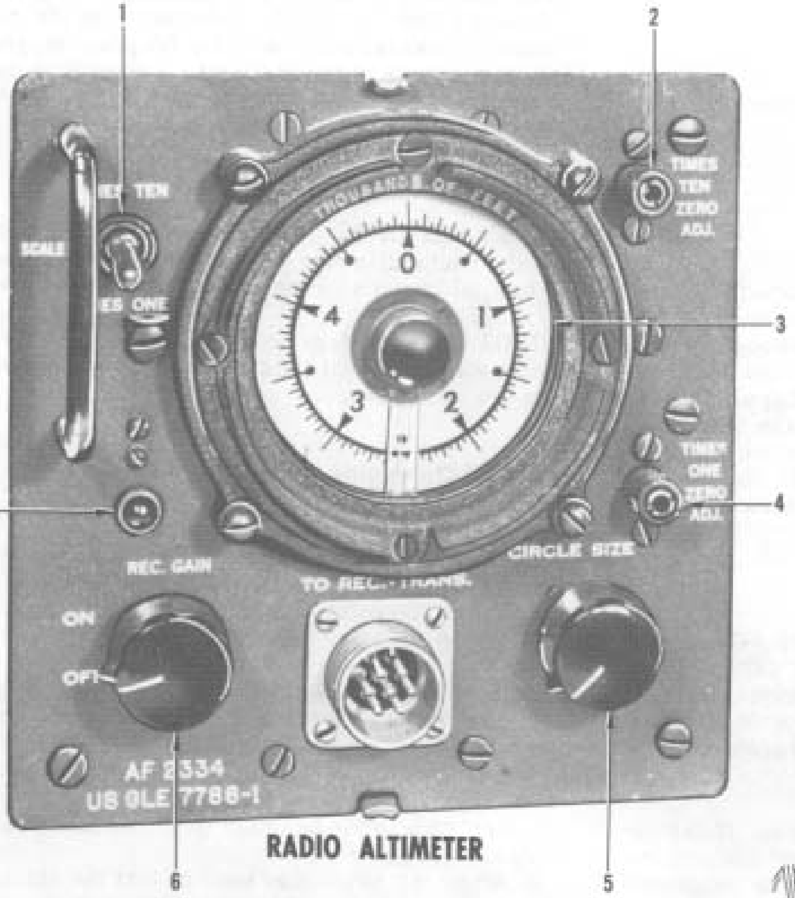
Normal Operation of Radio Altimeter

To start the set, proceed as follows:

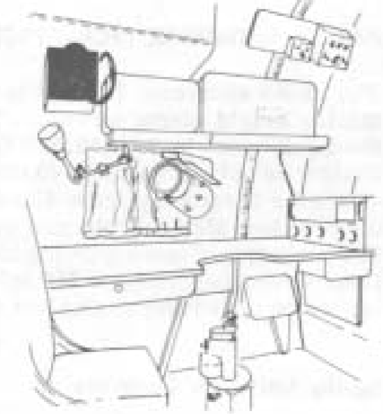
1. Turn the rec. gain knob clockwise, about one-half turn from the OFF position to the ON position
2. Check the pilot light on, indicating equipment is energized

To operate the radio altimeter, proceed as follows:

1. After turning the equipment on, allow about 3 minutes or more, if possible, for the tubes to reach their operating conditions; then turn rec. gain knob until a trace in the form of a green circle with one or more pulses on it appears on the indicator face. Set scale switch in TIMES ONE position
2. Adjust the circle size knob so that the circle trace is barely visible as a luminous ring at the outer edge of the black calibrated scale
3. Adjust the rec. gain knob so that a pulse approximately 1/4 inch high appears on the circle trace near 0 on the calibrated scale
4. With the scale switch in the TIMES TEN position, check that the circle trace is about 1/4-inch inside the black calibrated scale
5. Adjust the times ten zero adjustment knob until the reference pulse is at zero
   a. After warmup, wait until the voltage to the equipment is normal (between 110 and 120 volts). If this cannot be read on a voltmeter, it may be estimated by judging the speed of the airplane engines, which should be greater than idling but less than takeoff speed



1 SCALE SWITCH
2 TIMES TEN ZERO ADJUSTMENT KNOB
3 INDICATOR FACE
4 TIMES ONE ZERO ADJUSTMENT KNOB
5 CIRCLE SIZE KNOB
6 REC. GAIN KNOB
7 PILOT LIGHT



RADIO ALTIMETER CONTROLS

Figure 4-26

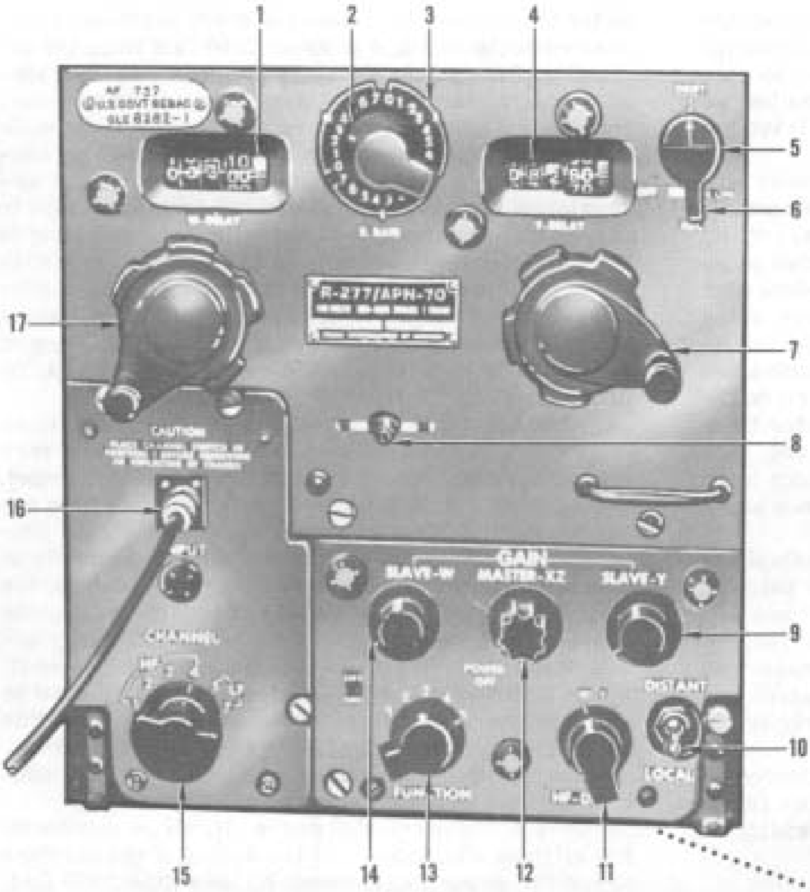
b. Set the scale switch to the TIMES ONE position
c. Adjust the times one zero adj. knob so that the reading point of the reference pulse is set to zero on the indicator scale. This should be done just as the wheels of the airplane are about to leave the ground
d. As the airplane climbs, the reflected pulse will move away from zero and decrease in amplitude
e. At an altitude of several hundred feet, turn up the rec. gain control so that the reflected pulse (a new pulse appearing near zero) is 1/4-inch high
f. The reference pulse is due to leakage in the transmitter-receiver unit and between the transmitter and receiver antenna systems (cables and antennas); it may not be exactly at zero on the indicator scale. Record its exact position for later use. When reading altitude, adjust the rec. gain control so that the reflected pulse is 1/4-inch high, disregarding any slight shift of the reference pulse to the left
g. For zero adjustment during flight, adjust the rec. gain control so that the reference pulse is 1/4-inch high. Then use the times one zero adj. knob if necessary to set the pulse to the reading recorded in f above. This may be necessary to compensate for the effects of temperature and humidity changes; changes in barometric pressure have negligible effect on the zero setting. After making this adjustment, set the rec. gain control so that the reflected pulse is 1/4-inch high before reading altitude. Do not add or subtract the reading of the reference pulse

To read altitude, proceed as follows:

1. The black circular scale on the indicator is provided with a 0 to 5000 foot altitude calibration. Calibration marks are provided for every 50 feet of altitude and are sufficiently widely spaced so that readings can be estimated to the nearest 25 feet. To read the position of any pulse, determine the point along the scale where the counterclockwise edge of the pulse intersects the luminous green circle, making sure that the rec. gain control is set so that the pulse to be read is 1/4-inch high. Following takeoff, the reflection pulse travels clockwise around the scale as airplane height above terrain increases. Until the airplane reaches 5000 feet, read height merely by noting the positions of the pulse
2. When the airplane reaches 5000 feet, the reflected pulse will have progressed completely around the scale and returned to 0. As height above terrain increases further, up to 10,000 feet, the reflected pulse will travel clockwise on a second encirclement of the scale and 5000 feet must be added to the indication of the pulses
3. When the airplane reaches 10,000 feet, the reflected pulse will have completed a second encirclement of the scale, and one further clockwise encirclement will take place for each additional 5000 feet of altitude attained. Similarly, a counterclockwise encirclement will take place for each drop of 5000 feet sustained. To obtain actual height above terrain at any time, add 5000 feet to the indication of the pulses for every previous clockwise encirclement and subtract 5000 feet from the indication of the pulses for every previous counterclockwise encirclement of the scale by the reflected pulse. However, it generally is more practicable to estimate the approximate height above terrain (by use of an aneroid altimeter such as a Kollsman and knowledge of approximate terrain height above sea level) and then to determine the exact height above terrain by adding to the reading of the indicator pulses an appropriate multiple of 5000 feet, such as that the total closely checks the estimated height. For instance, if the estimated height above terrain is 25,000 feet and the indication of the pulses is 1275 feet, then the exact height is 25,000 plus 1275 feet, that is 26,275 feet
4. When using this set remember that the large times one circle (5000 foot scale) is merely an expanded vernier on the small times ten circle (50,000 foot scale). On the small circle it is possible to read to within approximately 500 feet and the scale switch should generally be left in the TIMES TEN position, especially at high altitudes. When greater accuracy is required, the large circle reading must be taken into consideration as follows: With the scale switch in the TIMES TEN position, read the reflected pulse position on the small circle to the next lower 5000 foot mark (indicated by dots and arrowheads on the indicator scale). Note this reading and switch to the TIMES ONE position; add the new reading to the one obtained previously. The large circle can, with practice, be read within 25 feet
5. This set is not designed for use as an extremely low altitude altimeter. As the height of the airplane above the ground decreases to less than 1000 feet, reduce the gain as required to prevent the reflected pulse from becoming too broad and more than 1/4-inch high. While doing this, at about 500 feet the reference pulse will begin to be affected by the reduced gain and will begin to decrease in amplitude. By careful adjustment of the rec. gain control, it will be possible to see the reflected pulse move in to zero, the reference or zero pulse having completely disappeared by the time the airplane lands

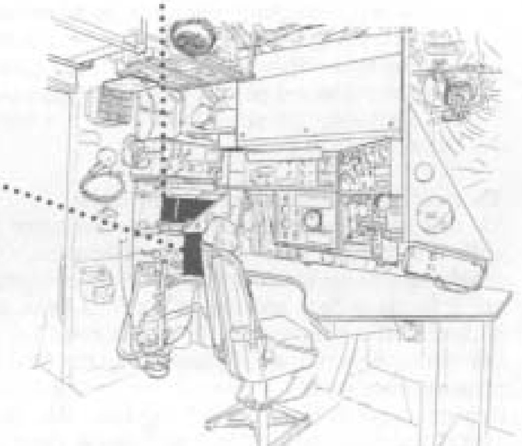
When using the radio altimeter, the following precautions should be observed:

1. Effect of Terrain. Flying over rough terrain will produce fluctuating indications, and flying over water will produce relatively steady indications
2. Blind Spots. At altitudes of 5000 feet and all multiples thereof, the reflected pulse will occupy the same position as the reference pulse. The pulses will appear to merge and cause a blind spot, that is, a region about 250 feet wide in which the position of the reflected pulse cannot be determined accurately
3. Accuracy. When the radio set is operating properly, the deviation of its indication from exact height above terrain is less than 50 feet. When improper operation causes the error to become greater than stated above, such improper operation is almost always shown by the indicator circle becoming oval in shape
4. Receiver Gain. Turning the rec. gain knob up



LORAN CONTROL UNIT

LORAN INDICATOR



1 W-DELAY REVOLUTION COUNTER
2 R-RATE SWITCH
3 R-RATE INDICATOR
4 Y-DELAY REVOLUTION COUNTER
5 DRIFT CONTROL
6 AUTOMATIC DRIFT CONTROL (ADC) SWITCH
7 Y-DELAY CRANK
8 L--R SWITCH
9 SLAVE-Y GAIN CONTROL
10 LOCAL--DISTANT SWITCH
11 HF-DELAY SWITCH
12 MASTER-XZ GAIN AND POWER SWITCH
13 FUNCTION SWITCH
14 SLAVE-W GAIN CONTROL
15 CHANNEL SWITCH
16 ANTENNA CONNECTION
17 W-DELAY CRANK
18 LORAN SCOPE
19 FOCUS ADJUSTMENT
20 BRILLIANCE ADJUSTMENT

NOTE

There are additional adjustments (not shown) on the side of the control unit and the indicator for tuning the Loran. These adjustments are positioned with a screw driver. The adjustments are:

Control Unit

PED. DUR. (Pedestal Duration)
SLOW SW. HOR. CENT. (Slow Sweep Horizontal Center)
MED. TO FAST SW. HOR. CENT. (Medium to Fast Sweep Horizontal Center)
SLOW SW. AMPL. (Slow Sweep Amplitude)
FAST SW. AMPL. (Fast Sweep Amplitude)
MED. SW. AMPL. (Medium Sweep Amplitude)

Indicator

ASTIGMATISM
VERT CENTER (Vertical Center)

LORAN CONTROLS

Figure 4-27

higher than is necessary for a satisfactory image will result in a blurred or fuzzy trace

5. Dives, Climbs, and Banks. Sharp banks, dives and turns may flatten out the reflected pulse, or the pulse may disappear completely during the bank or dive

6. Observable Defects:
   a. A circle trace which is not truly circular will cause inaccurate readings
   b. A circle trace that is off center will cause inaccurate readings
   c. Shifting of the reference pulse will cause inaccurate readings unless compensated for as stated in Step 4, NORMAL OPERATION OF THE RADIO ALTIMETER, this Section

7. Excessive Altitude. Use of the radio set at heights above sea level greater than 40,000 feet may result in impaired operation, although the accuracy of its indication will not be diminished. Use at heights above sea level greater than 45,000 feet may result in permanent damage. This damage would be caused if the reduction in air pressure were sufficient to allow voltage breakdown between closely-spaced circuits carrying high potential difference

CAUTION

Before disconnecting any unit or cable of the equipment, and before removing the fuse, be sure the altimeter is turned off.

To turn the radio altimeter off, proceed as follows:

1. Turn the rec. gain knob fully counterclockwise to the OFF position

LORAN (AN/APN-70)

The loran radio receiving set is used by the operator to receive and interpret loran signals. The set serves as a navigational aid and operates over the standard high-frequency band from 1700 to 2000 kc, and on the low-frequency bands of 170 to 190 kc and 90 to 110 kc. Controls for the set are on the front of the receiver. The loran control unit and loran indicator (10 and 16, figure 4-15) are at the navigator's station. Operating power is 115 volt ac and control power is 28 volt dc. Circuit breakers for the set are on the radio junction box circuit breaker panel (figure 1-34).

Loran Controls

W-DELAY AND Y-DELAY CRANKS. These cranks (7 and 17, figure 4-27) are on the loran control unit. Each crank, when turned, operates the delay revolution counter. The cranks have two speeds, the one in use being determined by position of the crank shaft. The shaft is movable in a plane perpendicular to the front panel of the receiver, and when pushed in will turn its counter at the rate of one thousand units per revolution of the crank. One revolution will cause a change of one hundred units in the reading when the crank shaft is pulled out.

R-RATE SWITCH. This switch (2, figure 4-27) on the loran control unit serves as a pulse repetition rate selector.

DRIFT CONTROLS. The loran set has a manual drift adjustment and an automatic drift adjustment. The drift control (5, figure 4-27) on the loran control unit, may be used as a manual drift adjustment for synchronizing the receiving equipment with the transmitter. For most operating conditions, an ADC (Automatic Drift Control) system is preferable to manual operation. The ADC switch (6, figure 4-27), with ON--OFF positions, is on the lower portion of the drift control, and operates independently.

L--R SWITCH. This switch (8, figure 4-27) on the loran control unit, moves the received signals to the left or to the right in order that they may be properly positioned to obtain readings.

MASTER-XZ GAIN AND POWER SWITCH. This switch (12, figure 4-27) on the loran control unit serves a double purpose. The switch applies power to the set when switch action is felt as the gain control is turned in a clockwise direction from its extreme counterclockwise position. Power is disconnected when the control is returned the extreme counterclockwise position. The master-xz gain control sets the level of the master pulse, or pulses, as viewed on the indicator screen.

SLAVE-Y AND SLAVE-W GAIN CONTROLS. These controls (9 and 14, figure 4-27) are on the loran control unit. They operate in a manner determined by the channel switch and the HF-delay switch to set the level of the slave pulses.

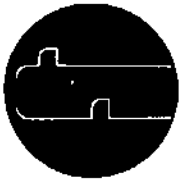
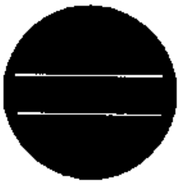
FUNCTION SWITCH. This switch (13, figure 4-27) on the loran control unit determines the presentation on the loran scope.

LOCAL--DISTANT SWITCH. This switch (10, figure 4-27) with LOCAL--DISTANT positions is on the loran control unit. The purpose of the switch is to adjust the signal of the antenna coupler. When a signal is being received from a distance, the switch is used in the DISTANT position to permit maximum signal input to the antenna coupler. When the switch is placed in the LOCAL position, it reduces the input to prevent overloading.

HF-DELAY SWITCH. This switch (11, figure 4-27) on the loran control unit sets the level of the slave pulses. The switch also determines the variable delay circuits in use in the HF positions of the channel switch.

CHANNEL SWITCH. The channel switch (15, figure 4-27) is on the loran control unit. The switch along with the R-rate switch selects desired station.

FOCUS ADJUSTMENT. This knob (19, figure 4-27) on the loran indicator is used to focus signals on the loran scope.

STEP	SWITCH	SWITCH POSITION	SCOPE	REMARKS	ADJUSTMENTS
1	Master XZ – Gain & Power W–Delay Crank Y–Delay Crank Channel Function R–Rate HF–Delay	CW to ON 11,000 11,000 1 1 HO W		Adjust until 2 traces appear. Adjust for clear and distinct traces. M. trace has a pedestal about 5/16" tall. Center traces vertically and horizontally. Adjust traces until ends are 1/4" from edge of scope	BRILL FOCUS ASTIGMATISM VERT CENTER SLOW SW HOR CENTER SLOW SW AMPL
2	Function	2		Two traces appear about 1 1/4" apart Center them and adjust ends for 1/4" from edge of screen	MED TO FAST SW HOR CENTER MED SW AMPL
3	Function	3		Adjust for right edge of trace 1/4" from edge of scope.	FAST SW AMPL
4	Function	4		Traces separated by 1/4" vertically	No adjustment. Note in Form 781 if faulty
5	Function	5		Use W–delay crank to superimpose pips. Count 2 zeros on last two digits of W–counter. Crank above or below 11,000 to separate traces.	W–DELAY CRANK
6	Function R–Rate	2 H–7, H–6, etc. See table		Adjust W–delay at fine speed until lower trace disappears	W–DELAY CRANK
7	HF–Delay R–Rate	Y Same as step 6		Adjust Y–delay at fine speed until lower trace disappears	Y–DELAY CRANK

TRACE MUST DISAPPEAR AT FOLLOWING SETTINGS (+10 microseconds)

BASIC RATE	STATION RATE							
	7	6	5	4	3	2	1	0
H	13025	13075	13125	13175	13225	13275	13325	13375
L	18025	18075	18125	18175	18225	18275	18325	18375
S	23025	23075	23125	23175	23225	23275	23325	23375

APN–70 LORAN CALIBRATION CHART

Figure 4-28 (Sheet 1 of 2)

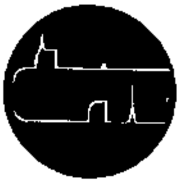
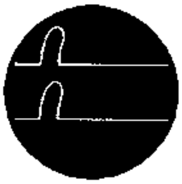
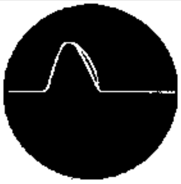
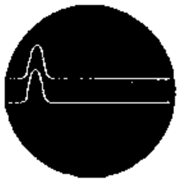
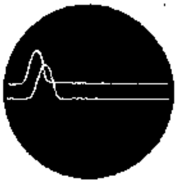
STEP	SWITCH	SWITCH POSITION	SCOPE	REMARKS	ADJUSTMENTS
8	Function R–Rate HF–Delay	5 H7 W		Markers must be superimposed and appear as one trace for W–delay values of: 00500 02000 05000 08500 11500	W–DELAY CRANK
9	HF–Delay	Y		Markers must be superimposed and appear as one trace for Y–delay values of: 00600 02100 05100 09000 11000	Y–DELAY CRANK
10	Local–Distant R–Rate Function HF–Delay	DISTANT As desired 1 W		Use Loran chart station information to determine usable readings to obtain pips. Adjust W–delay near expected reading. Adjust for signals twice the height of pedestals. Use L--R switch to position upper pip to the left of lower pip. If no signal appears on lower trace, hold L--R switch until signal also appears on lower trace, then place upper pip on leading edge of upper pedestal	W–DELAY CRANK MASTER XZ–GAIN & POWER SWITCH SLAVE–W GAIN CONTROL L--R SWITCH
11	ADC Drift Control	As required As required		Use drift controls to hold signals steady. Position pip on lower pedestal leading edge with W–delay crank	L--R SWITCH DRIFT CONTROL ADC SWITCH W–DELAY CRANK
12	Function	2		Align lower expanded signal with upper signal	W–DELAY CRANK
13	Function	3		Adjust both signals for same height. Superimpose leading edges of signals. Switch to function 4 if signals fluctuate too much	MASTER XZ–GAIN & POWER SWITCH SLAVE–W GAIN CONTROL W–DELAY CRANK
14	Function	4		Navigation along a Loran LOP, on-course indication. W–Delay reading gives Loran LOP	W–DELAY CRANK
15	Function	4		Navigation along a Loran LOP, off-course indication	
16	HF-Delay	Y		Check other stations in same manner using Y–Delay	Y-DELAY CRANK

Figure 4-28 (Sheet 2 of 2)

BRILLIANCE ADJUSTMENT. The brill knob (20, figure 4-27) on the loran indicator is used to adjust brilliance of the signal displayed on the loran scope.

Loran Indicators

W-DELAY AND Y-DELAY REVOLUTION COUNTERS. These counters (1 and 4, figure 4-27) are on the loran control unit. The counters indicate a direct reading of delay time in microseconds.

R-RATE INDICATOR. This indicator (3, figure 4-27) on the loran control unit indicates channel selected by use of channel and R-rate switches.

LORAN SCOPE. The scope (18, figure 4-27) on the loran indicator displays the signals to be interpreted by crew members.

Normal Operation of the Loran

To start the loran set, proceed as follows:

1. Apply power to the set by turning the master-xz gain and power switch in a clockwise direction from the extreme counterclockwise position. When the power switch operates, the panel will be illuminated. Determine that the blower starts when the loran is turned on. The set requires cooling air to prevent overheating some equipment components.
2. Allow the equipment to warm up for about one minute. As soon as the presentation on the loran scope becomes stable, the equipment is ready for use

For HF (High Frequency) reception, proceed as follows:

1. After the set has been turned on and allowed a short warmup period, set the three gain controls at the center of their rotation, and local--distant switch to DISTANT, and the drift control to its center position

NOTE

> The local--distant switch is normally used in the DISTANT position, which affords greater sensitivity than the LOCAL position. The latter is used in the presence of high interfering signals, when flying in the vicinity of a loran transmitter, or when a better signal to noise or interference ratio is obtained in that position.

2. Turn the ADC switch to the OFF position
3. Refer to the loran charts for the approximate geographical location of the airplane and determine at which position the channel and R-rate switches are to be set
4. Set the channel and R-rate switches as determined from the chart
5. Set the function switch to position 1. Two traces should appear on the screen of the loran scope, with a pedestal on each trace. See figure 4-28.
6. Set the HF-delay switch to W, and adjust the master-XZ and slave-W gain controls for signals twice the amplitude of the pedestals

NOTE

- When signals are very weak, it may be advisable to preset the delay controls to the expected reading. If only one station's signal appears, place it on one of the pedestals, using the L--R switch, and locate the other station's signal by placing the function switch in position 2 and investigating either the upper or the lower trace, as the case may be. This practice may aid in the identification of ground or sky waves, since corresponding pulses should appear nearly in alignment if the estimate is close. If either the master or the slave station is double-pulsed, the appearance of the signals should make it possible to distinguish one from the other. Also, a weak signal is sometimes easier to detect if it is drifting across the trace. Therefore, if trouble is encountered in locating a weak signal, try holding the L--R switch to one side or the other while looking for the pulse.
- If the delay setting is past either end of its range for a given position of the R-rate switch, no pedestal will appear on the lower trace in FUNCTION 1, and there will be no lower trace in positions 2, 3, and 4 of the function switch. If the pedestal is not visible, turn the W-delay crank until the entire pedestal appears on the lower trace.

7. Adjust the drift control to hold the pulses stationary on the scope, and use the L--R switch to position one of the pulses on the leading edge of the upper pedestal. Turn the ADC switch to the ON position

NOTE

> The ADC (Automatic Drift Control) circuits hold the repetition rate of the loran receiving set synchronized to that of the transmitting group when a signal is properly positioned on the leading edge of either pedestal. This prevents the received pulses from drifting across the screen of the loran scope and obviates continual adjustment of the drift control. The ADC switch should be left in the ON position once the drift control has been set, except when excessive noise causes bothersome pulse jitter.

8. Rotate the drift control in both directions to check the ADC action, and return the control to its original position. If the ADC circuits are functioning normally, rotation of the drift control will not cause the signal to drift from the edge of the pedestal

9. If the ADC action is satisfactory, proceed with Step 10; if not, place the local--distant switch to the LOCAL position and observe the signals and ADC action there. Leave the switch in the position which gives the better operating characteristics

10. Use the W-delay crank in the high-speed position (shaft pushed in) to position the leading edge of the slave pedestal (on the lower trace) under the slave pulse

NOTE

To determine the Indicated Time Difference, the master received pulse must be situated on the leading (left) edge of the master (top) pedestal. When it is in that position, there will be one pulse on each trace; the master pulse on the top trace and the slave pulse on the bottom trace. If the slave pulse should be situated on the master pedestal there will be two pulses on the upper trace and none on the lower. If this should occur, use the L--R switch to situate the master pulse at the leading edge of the master (top) pedestal.

11. Turn to FUNCTION 2

12. Use the W-delay crank in the slow-speed position (shaft pulled out), to vertically align the expanded pulses

13. Turn to FUNCTION 3

14. Adjust the master-XZ and slave-W gain controls so that the two pulses are of the same height as nearly as possible

15. Superimpose the two pulses by use of the W-delay crank. Align the pulses, the leading edges especially, as closely as possible

NOTE

Matching by superimposition is often difficult when either signal is weak compared to the noise level. The operator must mentally average the fluctuating signals and align the averages. This is often most easily and accurately done in FUNCTION 4.

16. The Indicated Time Difference may now be read on the W-delay counter

17. Using the Indicated Time Difference established on the W-delay counter, locate the position of the airplane on one loran line-of-position

18. Select another pair of loran transmitting stations which have a service area including the approximate location of the airplane

19. Set the channel and R-rate switches to the values obtained from the chart

20. Turn the ADC switch to the OFF position

21. Set the HF-delay switch to the Y position

22. Repeat Steps 7 through 20 to obtain the second Indicated Time Difference. Use the Y-delay crank and slave-Y gain control whenever the W-delay crank and slave-W gain control are mentioned

23. The intersection of the two loran lines-of-position determines the location of the airplane. Allowance should be made for the distance the airplane has traveled between the two readings

For LF (Low Frequency) reception, proceed as follows:

1. Place channel switch in position 5 or 7

NOTE

Due to the recovery time of the pedestal generator circuits, the width of a slave pedestal on FUNCTION 1 at channel positions 5 and 7 (the channels with which dual presentation is used) becomes progressively narrower as the corresponding delay crank is rotated in the counterclockwise direction from the point where the counter reading is approximately 02600. At a counter reading of about 02000 the pedestal width is approximately three-fourths the normal value and, as rotation of the delay crank is continued, becomes narrower still until, at a reading of about 01800, the pedestal disappears. The length of the corresponding slave trace in function positions 3 and 5 is dependent upon the width of the pedestal, and those traces will become increasingly shorter in the same ratio as the pedestal becomes progressively narrower. The other function positions (3 and 5) are not affected. Since loran readings below 02000 are not used with triad reception, the accuracy of the counter reading is not affected. Also, since the pulse match is always made near the left edge of the screen, the decrease in slave-trace length on function positions 2 and 4 has no effect on operation.

2. After the loran has been turned on and allowed to warm up for approximately one minute, set the gain controls to the center of their rotation, the local--distant switch to DISTANT, and the drift control to its center position

3. Turn the ADC switch to the OFF position

NOTE

The local--distant switch is normally used in the DISTANT position, which affords greater sensitivity than the LOCAL position. The latter is used in the presence of high interfering signals, when flying in the vicinity of a loran transmitter, or when a better signal to noise or interference ratio is obtained in that position.

4. Refer to the loran charts and determine the settings of the channel and R-rate switches from the approximate geographical location of the airplane
5. Set the channel and R-rate switches to the positions determined from the charts
6. Set the function switch to position 1. Two traces and four pedestals (two on each trace) should be present on the loran scope

NOTE

> If a delay setting is past either end of the range for a given setting of the R-rate switch, no slave delay pedestal for that delay control will be seen in FUNCTION 1, and the trace corresponding to that pedestal will not appear in positions 2, 3, or 4 of the function switch. If only one pedestal should appear on the upper trace, turn the Y-delay crank until the entire second pedestal is visible. If only one pedestal should appear on the lower trace, use the W-delay crank to bring the second pedestal within range. (The HF-delay switch is inoperative in the LF settings of the channel switch and may be left in either position.)

7. Use the gain controls to adjust the amplitude of the received pulse to approximately twice that of the pedestals, and adjust the drift control to hold the signals stationary on the indicator screen

NOTE

- The master-XZ gain control determines the amplitude of the signals occurring in the interval between the beginning of either trace and the end of the first pedestal. The slave-W gain control sets the signal level on the remainder of the upper trace, while the slave-Y gain control sets the signal level on the remainder of the lower trace.

- When signals are very weak, it may be advisable to preset the delay controls to the expected reading. If only one station's signal appears, place it on one of the pedestals, using the L--R switch, and locate the other station's signal by placing the function switch in position 2 and investigating either the upper or the lower trace, as the case may be. This practice may aid in the identification of ground or sky waves, since corresponding pulses should appear nearly in alignment if the estimate is close. If either the master or the slave station is doublepulses, the appearance of the signals should make it possible to distinguish one from the other. Also, a weak signal is sometimes easier to detect if it is drifting across the trace. Therefore, if trouble is encountered in locating a weak signal, try holding the L--R switch to one side or the other while looking for the pulse.

8. Position a pulse on the leading edge of any of the pedestals by use of the L--R switch, and turn the ADC switch to the ON position

NOTE

> The ADC (Automatic Drift Control) circuits hold the repetition rate of the loran set synchronized to that of the transmitting group when a signal is properly situated on the leading edge of a pedestal. This prevents the received pulses from drifting across the screen of the loran scope and obviates continual adjustment of the drift control. The ADC switch should be left in the ON position once the drift control has been set, except when excessive noise causes bothersome pulse jitter.

9. Rotate the drift control in both directions to check the ADC action, and return the control to its original position. If the ADC circuits are functioning normally, rotation of the switch will not cause the signal to drift from the pedestal

10. If the ADC action is satisfactory, proceed with Step 11; if not, operate the local--distant switch to the DISTANT position and observe the signals and ADC action there. Leave the switch in the position which gives the better operating characteristics
11. Use the L--R switch to position the master station pulse X, followed by the ghost pulse X, on the leading (left) edge of the master (first) pedestal on the upper trace. This will automatically position the Z master pulse on the leading edge of the master (first) pedestal on the lower trace. If the X pulse and its ghost should appear on the lower trace, hold the L--R switch to either side until the pulse-ghost combination drifts off the lower trace and reappears on the upper. Then, properly position them

NOTE

> If the received pulses should drift at any time during the remainder of the procedure, use the drift control to stop the signal motion and the L--R switch to reposition the pulses.

12. Use the W-delay crank in its high-speed position to move the leading edge of the slave (second) pedestal on the lower trace beneath the slave pulse

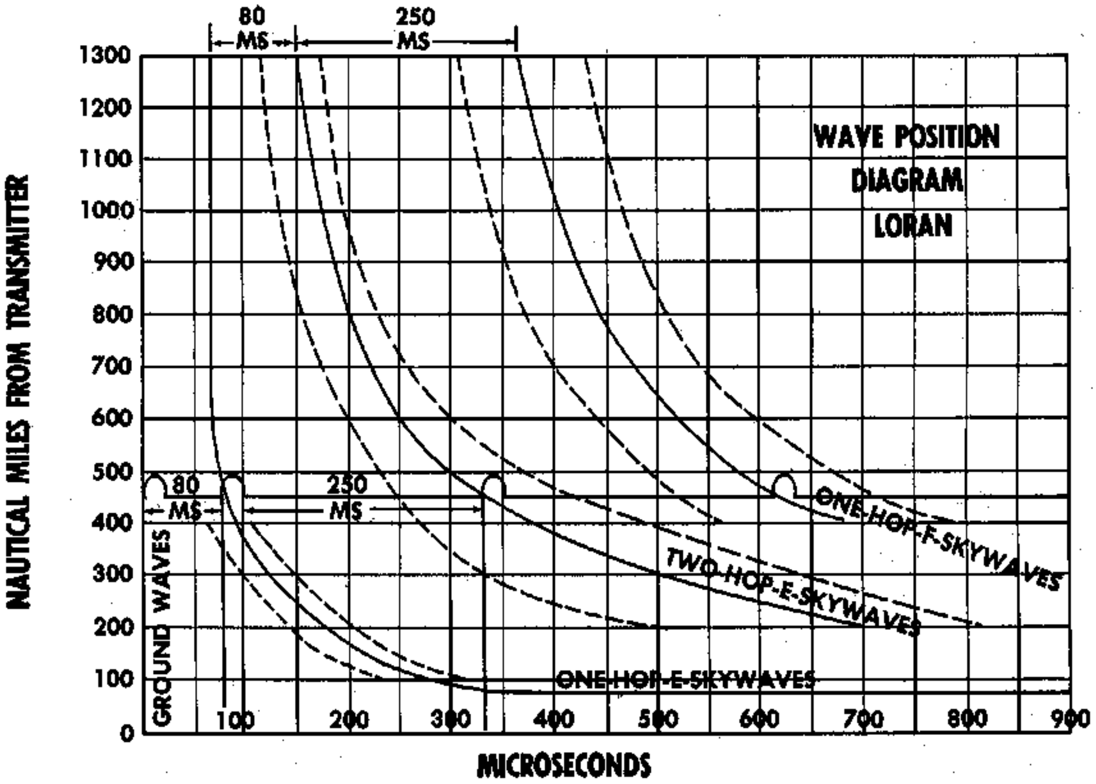
NOTE

> When the shaft of a delay crank is pushed in, the crank is in its high-speed position. When pulled out as far as it will go, it is in the slow-speed position.

13. Use the Y-delay crank in its high-speed position to situate the leading edge of the slave pedestal on the upper trace beneath the slave pulse
14. Turn the function switch to position 2

NOTE

To obtain special correction used to correct a ground wave and one-hop-E sky wave match, enter the diagram with the distance from the transmitter that the sky wave is coming from. The correction will be found by going across the diagram horizontally to the right from the ground wave line to the one-hop-E sky wave. If the one-hop-E sky wave is coming from the slave station the correction is subtracted from the reading. If it is coming from the master station the correction is added to the reading.



LORAN WAVE POSITION DIAGRAM

Figure 4-29

15. Use the W-delay crank in the slow-speed position to vertically align the expanded pulses on the two upper traces
16. Use the Y-delay crank in the slow-speed position to vertically align the expanded pulses on the two lower traces
17. Turn the function switch to position 3
18. Use the W-delay crank to superimpose the two pulses on the upper trace. Use the slave-W gain control to make the amplitude of the two pulses exactly the same. Align the pulses, especially the leading edges, as closely as possible
19. Use the Y-delay crank to superimpose the two pulses on the lower trace. Use the slave-Y gain control to make the amplitude of the two pulses exactly equal. Align the pulses, especially the leading edges, as closely as possible.

NOTE

Matching by superimposition is very difficult when either signal is weak compared to the noise level. The operator must mentally average the fluctuating signals and match the averages. This is often most easily and accurately done with the function switch turned to position 4.

20. Use the Indicated Time Difference readings to find the two loran lines-of-position on the chart. The intersection of the two lines-of-position determines the location of the airplane at the time the readings were taken

To turn off the loran set, proceed as follows:
1. Turn the master-xz gain and power switch in a counterclockwise direction until the switch operates and the panel lights go out

Emergency Operation of the Loran

IF ONE DELAY CHANNEL DEFECTIVE. In normal operation, the two readings required to determine the location of the airplane are made by separate delay channels. If one of the delay channels should become defective, both readings may be obtained from the channel which is functioning properly.

For reception of HF signals:
1. Place the HF-delay switch to the position which still functions properly and take the first reading using the normal procedure
2. Set the channel switch and R-rate switch to receive the second transmitting system
3. Use the same HF-delay setting and the same delay crank to obtain the second reading. Since the two readings are not made simultaneously, allowance must be made for the time elapsed between the two

For reception of LF signals:
1. Take the first reading using the L--R switch to position the master pulse on leading (left) edge of the upper trace master pedestal if the W-delay channel is the one functioning normally, or on the leading edge of the lower trace master pedestal if the Y-delay channel is the good one. (If sky wave, or combined ground and sky wave reception is used, trains of pulses will be present and the normal precautions must be observed)
2. Return the function switch to position 1.
3. Hold the L--R switch to the right. The received signals will move to the right of the screen and will disappear at the right edge of the trace. The signals will reappear at the left edge of the other trace and drift toward the master pedestal. The first pulse to reappear in this manner will be the other slave pulse, and the second pulse is the other master pulse. Position the second master pulse at the leading edge of the master pedestal used to obtain the first reading
4. Using the good delay channel, take the second reading
5. Determine the location of the airplane, making allowance for the time elapsed between the two readings

IF THE ANTENNA COUPLER UNIT IS DEFECTIVE: The antenna for the loran receiver is also used by the MF command transmitter on airplanes **17260** ▶ **3177** less those incorporating TCTO KG211 or the liaison radio and the auxiliary liaison receiver on airplanes **3178** ▶ less those incorporating TCTO KG513. It may be possible to operate on one or more of the HF channels by utilizing the antenna coupler outputs provided for these other radios. Channel 1 is the closest to the band of frequencies which the antenna coupler is designed to pass. Channels 3, 2, and 4 are progressively farther from this band.
1. If the antenna coupler is accessible, remove the plug from the LORAN jack and connect it to the COMM or AUX jack. When using either the COMM or AUX jack, the radio equipment normally connected to the jack must be turned on to energize some circuits in the coupler. If the antenna coupler is not accessible, it may be possible to disconnect the antenna from the MF command or a liaison radio (as applicable) and reconnect it to the jack, marked INPUT, on the loran control unit

NOTE

> The local--distant switch will be inoperative when using an antenna connection that is different from the normal connection.

2. If the reception of the other radio equipment, having the same antenna as the loran, is affected by a defective antenna coupler, it will be necessary to bypass the coupler. If the antenna lead-in is accessible, connect the antenna directly to the jack, marked INPUT, on the loran control unit. Also, it may be possible to use any other antenna in the same way.

IF THE SCOPE PRESENTATION IS UNUSABLE:
Determine whether or not the condition is external to the set by:

1. Disconnecting the antenna connector from the jack, marked INPUT, on the loran control unit. If the interference persists, the loran receiver is defective; if not, the disturbance is coming in on the input. (If the antenna coupler is accessible, try the same test with its antenna connection
2. Try other positions of the channel switch. (This should be done even if the defect is found to be in the loran receiver. One channel may be defective and the others all right)
3. Reception may be possible in spite of interference by proper use of the gain and drift controls. (Manual drift control will probably be preferable to automatic control under such conditions)

Emergency Adjustments of the Loran

IF SWEEP LENGTH IS DEFECTIVE IN FUNCTION 1:
Adjust the traces to a length of approximately four inches with the SLOW SW. AMPL. control

IF SWEEP LENGTH IS DEFECTIVE IN FUNCTIONS 2, 3, 4, or 5:

1. Turn the function switch to the 2 or 4 position and adjust the MED. SW. AMPL. control for a trace length of approximately four inches
2. Turn the function switch to the 3 or 5 position and adjust the FAST SW. AMPL. control to obtain a trace of approximately four inches

IF THE HORIZONTAL CENTERING IS DEFECTIVE IN FUNCTION 1:
Use the SLOW SW. HOR. CENT. control to position the traces

IF THE HORIZONTAL CENTERING IS DEFECTIVE IN FUNCTIONS 2, 3, 4, or 5:
Use the MED. TO FAST SW. HOR. CENT. control to position the traces. The one adjustment covers the four positions

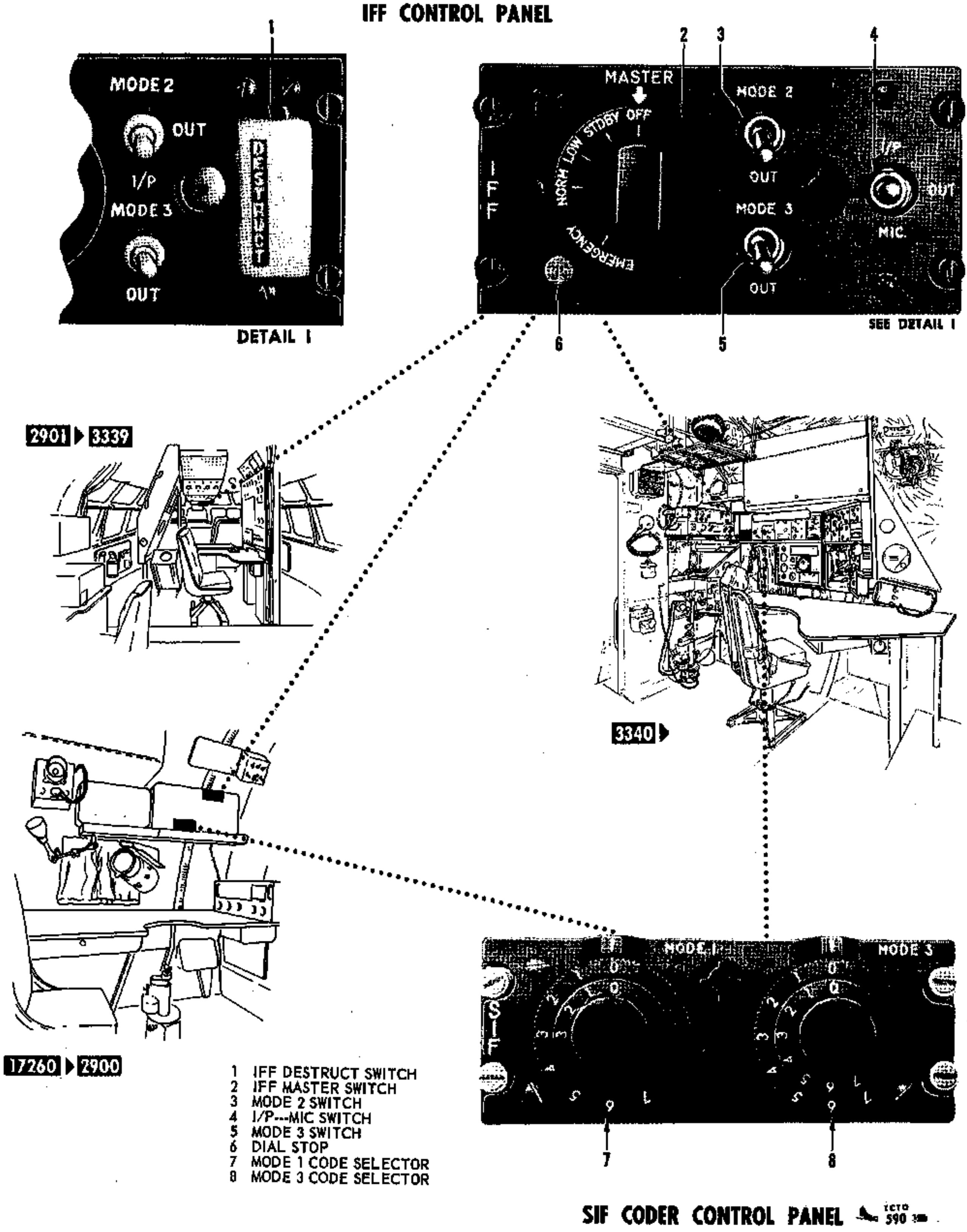
IF THE PEDESTAL DURATION (WIDTH OF THE PEDESTAL) REQUIRES EMERGENCY ADJUSTMENT:

1. Turn the function switch to position 5
2. Superimpose the fixed and movable marker pips by use of the proper delay crank. (The adjustment may be made with either single or dual presentation. If dual presentation is used, it is only necessary to superimpose one set of marker pips)
3. Set the PED. DUR. adjustment at the point where exactly four superimposed marker pips are visible on the indicator scope. (The positive pips are the ones extending above the trace)

IF THE VERTICAL CENTERING IS DEFECTIVE:
Use the VERT. CENTER control to position the traces. Make the adjustment with the function switch on position 1. The single adjustment covers all positions of the function switch

IF THE TRACE DEFINITION IS POOR AND THE FOCUS ADJUSTMENT DOES NOT CORRECT THIS CONDITION:

1. Turn the channel switch to position 7. (Use channel switch position 1 for loran control units having R-277A or R-277B on the nameplate at the center of the panel)
2. Turn the function switch to position 1
3. Turn the slave-W and the slave-Y gain controls full CCW
4. Turn the master-XZ gain and power switch to its minimum gain position (CCW), but do not turn off the set
5. Use the FOCUS and ASTIGMATISM adjustments to obtain the best overall definition of the traces
6. Rotate the function switch through the rest of its positions, noting the trace definition in each position
7. Repeat step 5



1 IFF DESTRUCT SWITCH
2 IFF MASTER SWITCH
3 MODE 2 SWITCH
4 I/P---MIC SWITCH
5 MODE 3 SWITCH
6 DIAL STOP
7 MODE 1 CODE SELECTOR
8 MODE 3 CODE SELECTOR

IFF CONTROLS

Figure 4-30

IFF (AN/APX-6 on airplanes without TCTO 590) (AN/APX-25 on airplanes with TCTO 590)

Airplanes can be detected at great ranges by means of radar echoes, but radar echoes do not identify the targets (as friend or foe). The IFF transponder (receiver-transmitter) is a signalling device for radar echo identification. The receiver turns on the transmitter momentarily each time it picks up coded challenges from suitably equipped surface or airborne radar. The reply from the transmitter accompanies the display of the associated echo on the indicators of the challenging radar - thereby identifying the echo. The three functions of the IFF are: (1) to automatically identify the airplane whenever it is challenged by friendly radar, (2) to identify a specific friendly airplane within a group, and (3) to serve as a means of indicating a distress condition. Transponder operation may be in an emergency code or a combination of three normal codes - called "modes". On airplanes 17260 ▶ 2900, the IFF control panel (2, figure 4-17) is on the navigator's radio and radar control panels. On airplanes 2901 ▶ 3339, the panel (20, figure 1-12) is on the overhead panel, and on airplanes 3340 ▶, the panel is on the navigator's radio and radar control panels (10, figure 4-10). There are two types of AN/APX-6 IFF control panels in use. Early airplanes have panels with a destruct switch (see detail 1 of figure 4-30) and later airplanes have the panel shown in figure 4-30.

On airplanes incorporating TCTO 590, the basic AN/APX-6 IFF is modified by the addition of coder equipment to make a set that is designated as the AN/APX-25 IFF. The coder equipment gives the transponder a "selective identification feature" known as SIF. The SIF is a system of signals consisting of coded mode 1, 2, and 3 transponder replies. It is possible to select one of 32 different mode 1 replies, one of 400 mode 2 replies, and one of 64 mode 3 replies. The mode 2 code selector consists of an array of four switches on the coder on the auxiliary radio rack near the forward entry door. These switches for coding mode 2 are not normally adjusted by the flight crew. Mode 1 and mode 3 code selectors are on the SIF coder control panel. A switch, S-103, on the transponder unit must be in the MOD position to permit SIF operation. The SIF coder control panel (11, figure 4-10) is on the navigator's interphone and lights panel. The coder is operative when the IFF master switch is on LOW or NORM and a mode (or modes) is selected. Checkout of the IFF on the ground requires special equipment; therefore, the set is normally tested in flight. Electrical power for the SIF is obtained from the AN/APX-6. The AN/APX-6 IFF requires 28 volt dc control power and 115 volt ac operating power. Circuit protection for the IFF is on the radio junction box circuit breaker panel (figure 1-34).

IFF Controls and Operation

IFF MASTER SWITCH. A master switch (2, figure 4-30) on the IFF control panel has EMERGENCY--NORM--LOW--STDBY--OFF positions. By rotating the master switch clockwise any of the five positions may be selected. In the OFF position, no electrical power is applied to the set, although this position does not disconnect power from the destructor firing circuit. In the STDBY position, the set is turned on, and the tubes are heated and ready for immediate operation, but the transponder receiver is not sensitized, and no replies can be transmitted. When the master switch is positioned to LOW, the set operates at reduced sensitivity and replies will be transmitted upon receipt of strong interrogation signals, ordinarily from nearby interrogator-responders. In the NORM position, the transponder receiver is given full sensitivity and the transponder operates with maximum performance. With the master switch at EMERGENCY, the set is fully sensitized, and the distinctive emergency reply is transmitted upon receipt of any mode of interrogation, regardless of the settings of the mode switches (3 and 5, figure 4-30) on the IFF control panel. In order to position the master switch to EMERGENCY, the dial stop (6, figure 4-30) on the IFF control panel must be pressed while turning the switch to EMERGENCY.

MODE 2 SWITCH. On airplanes 17260 ▶ 3177 less those incorporating TCTO K590, this switch (3, figure 4-30) on the IFF control panel has MODE 2--OUT--I/P positions. In the MODE 2 position, the transponder accepts mode 2 interrogations received at any time, and these interrogations are answered automatically. In the OUT position, mode 2 no interrogations are accepted, when the switch is positioned to I/P, the transponder will reply to MODE 2 interrogations. On airplanes 3178 ▶ plus those incorporating TCTO 590, the switch has only MODE 2 and OUT positions. The I/P function is controlled by the I/P--MIC switch.

MODE 3 SWITCH. This switch (5, figure 4-30) on the IFF control panel has MODE 3--OUT positions. In the MODE 3 position, the transponder accepts mode 3 interrogations, and these interrogations are answered automatically. When the switch is positioned to OUT, no mode 3 interrogations are accepted.

NOTE

Place the IFF in operation by turning the master switch to NORM. In this position the airplane transponder will reply to mode 1 interrogations only. If the mode 2 switch is turned to MODE 2 position, the transponder will alternately reply to mode 1 and mode 2 interrogations. If the mode 3 Switch is turned on too, the transponder will reply to interrogations on all three modes. The following code words will be used when referring to IFF operations:

Code	Meaning
Parrot	IFF Mark X
Squawk	Turn IFF on NORM (Mode 1)
Squawk 2	Turn IFF to Mode 2
Squawk 3	Turn IFF to Mode 3
Squawk Emergency	Turn IFF to EMERGENCY
Squawk Flash	Turn IFF to I/P
Squawk Low	Turn IFF to LOW
Squawking	Showing IFF in Mode and Position Indicated
Parrot Lazy	Turn IFF to STDBY
Parrot Bent	IFF inoperative
Strangle Parrot	Turn off IFF

IFF DESTRUCT SWITCH **17260** ▶ **3177** LESS TCTO 590 . This switch (1, figure 4-30) is a two position ON--OFF switch, protected against accidental operation by a guard, which is normally wired down. If any possibility exists of the transponder falling into the hand of the enemy, the destruct switch should be operated to destroy the equipment. When the switch is positioned to ON, three small destructors will explode rendering the set inoperative. The explosion is not severe enough to injure personnel or damage the airplane, providing the equipment is correctly installed. In the OFF position, no voltage will be supplied to explode the equipment

WARNING

The destructor should be fired whenever you are forced to land in unfamiliar territory where an immediate and adequate US guard appropriate for CONFIDENTIAL gear is not actually known to be available. When any doubt exists about the friendliness of the territory, the destructor should be fired before you land.

NOTE

The IFF destruct switch is operative even though the IFF master switch is in the OFF position.

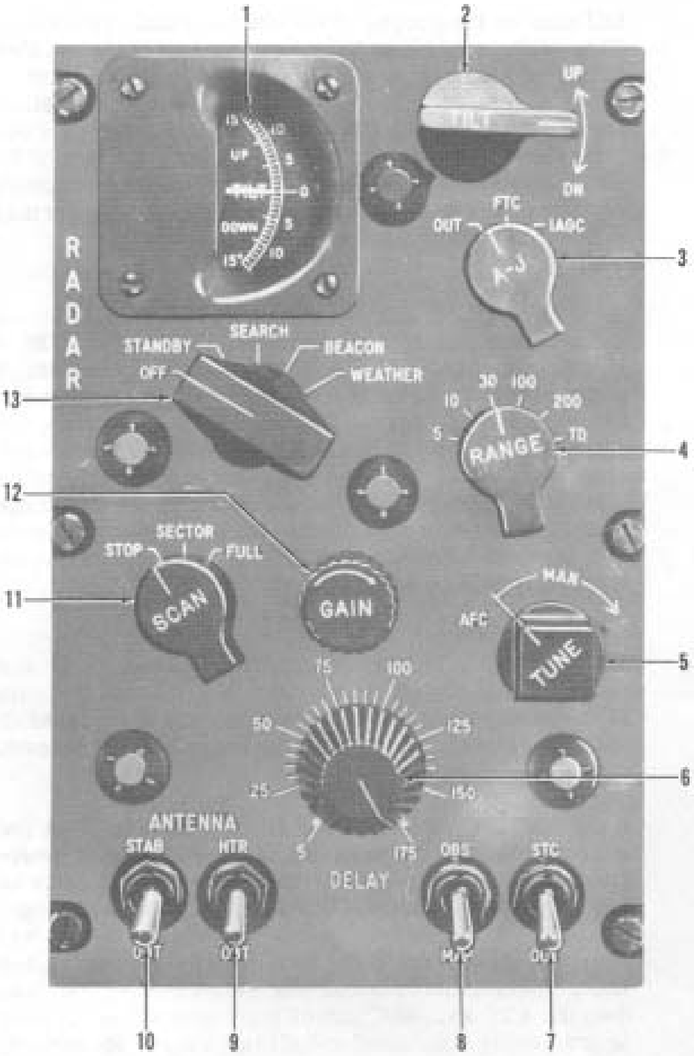
I/P--MIC SWITCH **3178** ▶ plus TCTO 590 . The I/P--MIC switch (4, figure 4-30) controls special mode 2 replies for identification of the airplane position to an interrogating radar. To send the special reply, the switch may either be held in the spring-return I/P position or the switch may be left in the MIC position and the special reply will be sent when the UHF radio transmitter is keyed. The special mode 2 reply will be transmitted in reply to interrogations for 30 seconds after the I/P switch or mike switch is released. The IFF master switch must be on LOW or NORM for the switch to be operative.

TCTO 590

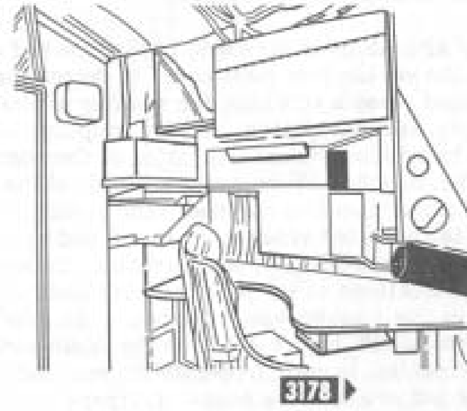
MODE 1 CODE SELECTOR. The mode 1 code selector (7, figure 4-30) consists of two concentric knobs. The outer knob has eight positions (0 through 7 inclusive) and the inner knob has four positions (0 through 3 inclusive). One of the 32 mode 1 codes available can be selected by positioning the knobs with respect to the pointer above the knob. For a numerical code designation such as "52," the outer knob would be positioned to 5 and the inner knob at 2. For the selector to be operative, the IFF master switch must be on LOW or NORM.

TCTO 590

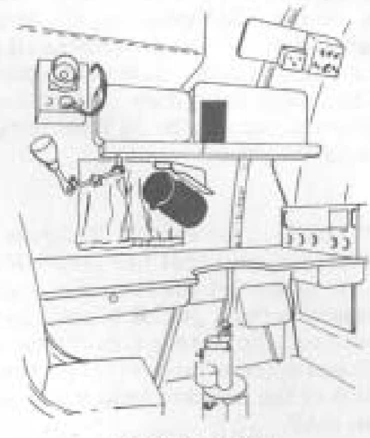
MODE 3 CODE SELECTOR. The mode 3 code selector (6, figure 4-30) consists of two concentric knobs. Both knobs have eight positions (0 through 7 inclusive). To select one of the 64 mode 3 codes, position the knobs with respect to the pointer above the knob. For a numerical code designation such as "45," set the outer knob to 4 and the inner knob to 5. For the selector to be operative, the IFF master switch must be on LOW or NORM and the mode 3 switch must be on MODE 3.



SEARCH RADAR CONTROL PANEL



1 TILT METER
2 TILT SWITCH
3 A--J SWITCH
4 RANGE SWITCH
5 TUNE SWITCH
6 DELAY KNOB
7 STC SWITCH
8 OBS--MAP SWITCH
9 ANTENNA HEATER SWITCH
10 ANTENNA STAB SWITCH
11 SCAN SWITCH
12 GAIN KNOB
13 FUNCTION SWITCH
14 SEARCH RADAR SCOPE
15 SCOPE INTENSITY KNOB
16 SCOPE LIGHT KNOB
17 FOCUS KNOB
18 CURSOR SCREEN-ROTATING KNOB



SEARCH RADAR INDICATOR

SEARCH RADAR CONTROLS

Figure 4-31

SEARCH RADAR (AN/APS-42)

The AN/APS-42 is an airborne navigation and search radar. The set has four main uses: to detect obstacles which could cause a collision, for spotting weather disturbances, for navigation, and for mapping terrain. The set provides a visual indication of the position of cities, landmarks, shorelines, islands, ships, other airplanes, and cloud formations. The position of such targets is indicated visually in range and azimuth in relation to the heading of the airplane. Coded radar beacon indications can also be received and are presented in the conventional spaced code groups. A control panel (12, figure 4-17) on the radio and radar control consoles, is used to operate the set. Indications from the set are fed to a scope (4, figure 4-15 and 9, figure 4-16) at the navigator's station and to a second scope (3, figure 1-6) at the pilots' station. Control power is 28 volt dc, operating power is 115 volt ac with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

Search Radar Controls

ANTENNA HEATER SWITCH. This switch (9, figure 4-31), with HTR and OUT positions, is on the search radar control panel. This switch energizes a resistance heater on airplanes **17260**▶ **2859** , when the switch is in the HTR position. When ambient temperature is of the order of -10°C (+14°F) or less, the antenna heaters should be energized. On airplanes **2860**▶ , no heaters are installed in the antennas, and radar functions are de-energized in these airplanes, when the switch is positioned to HTR.

FUNCTION SWITCH. This switch (13, figure 4-31) is on the search radar control panel. The switch has OFF--STANDBY--SEARCH--BEACON--WEATHER positions. In the STANDBY position, there is no transmission or reception of the radar set. In the SEARCH position, objects such as airplanes, surface vessels, rivers, land, landmarks, and the like, are indicated up to a distance of approximately 200 nautical miles. In the BEACON position, signals from beacon stations only are displayed on the search radar indicators. The beacon presentations in range and azimuth provide navigational information to determine the course and location of the airplane. In the WEATHER position, the search radar indicators show cloud formations and storm fronts indicative of the surrounding weather conditions. Signal strength from cloud formations, indicated in relative brightness on the scope, is dependent upon the moisture content or density of the cloud formation. Indications as interpreted by the observer from light or thin formations are therefore less apparent than those from more dense or heavy formations. In the TD (target discrimination) position, any 30-mile sector of range may be expanded to full size on the scopes of the search radar indicators. This feature permits the observer to obtain greater detail of terrain or objects. OFF position aids in securing the set. Airplanes **2860**▶ have provisions for utilizing IFF-IR (Identification of Friend or Foe-Interrogator Responder) signals from separate IFF-IR equipment. When this feature is utilized, the signals are presented on the search radar scopes, in a normal manner for interpretation by the operator.

SCAN SWITCH. A scan switch (11, figure 4-31) on the search radar control panel has STOP--SECTOR--FULL positions. In the STOP position, the search radar antenna mechanism is de-energized and no antenna scan takes place. In the SECTOR position, the antenna scans a 120 degree sector, 60 degrees each side of the heading of the airplane. Display is automatically offset on all ranges except the 200-mile position. In the FULL position, the antenna will scan 360 degrees although only 240 degrees of display on the scope will be available.

GAIN KNOB. This knob (12, figure 4-31) is on the search radar control panel. The knob adjusts the gain of the receiver portion of the set to control the level of the video signals supplied to the search radar scopes.

A--J SWITCH. The A--J switch (3, figure 4-31) on the search radar control panel has OUT--FTC--IAGC positions. In the OUT position, the FTC and IAGC circuits are inoperative. In the FTC (fast time constant) position, the FTC circuit is operative reducing clutter and sharpening up targets displayed on the scope. In the IAGC (instantaneous automatic gain control) position, both the FTC and IAGC circuits are operative. Clutter is practically eliminated and all targets are sharpened.

ANTENNA STAB SWITCH. This switch (10, figure 4-31) on the search radar control panel has STAB--OUT positions. In the STAB position, the antenna stabilization mechanism performs compensating motion in both the pitch and roll axis. In the OUT position, the antenna stabilizing mechanism does not function, and the search radar antenna remains in its fixed upright position relative to the airplane.

OBS--MAP SWITCH. This switch (8, figure 4-31) on the search radar control panel has OBS--MAP positions. In the OBS (obstacle) position, the search radar antenna radiates a normal pencil beam. In the MAP (mapping) position, the antenna radiates an equal-energy-return beam (cosecant-squared beam). The BEACON position of the function switch provides automatic change to MAP.

TILT SWITCH. This switch (2, figure 4-31) with UP--DOWN positions is on the search radar control panel. The UP and DOWN positions are momentary, whereas the switch is spring-loaded to the center position. In the center or rest position, the tilt mechanism of the search radar is inoperative. In the UP position, the antenna is tilted upward continuously, elevating the beam. In the DOWN position the antenna is tilted downward continuously, depressing the beam.

NOTE

The limits of elevation and depression are reached by holding the tilt switch in the UP and DOWN positions respectively. Releasing the tilt switch causes the antenna to remain in the elevated or depressed position arrived at when the tilt switch was released. The degree of elevation or depression is indicated by the tilt meter. The limits of elevation or depression are set by physical stops and a friction clutch that functions automatically and independently of the tilt switch.

RANGE SWITCH. This switch (4, figure 4-31) on the search radar control panel has five range positions and a TD position. The switch may select any of the first five range positions which vary from 5 to 200 nautical miles. By selecting TD (target discrimination), a 30-mile range sector is presented on the search radar scopes. This 30-mile range selector is manually and continuously variable to start at any desired point between 5 and 175 miles in range.

DELAY KNOB. The delay knob (6, figure 4-31) is on the search radar control panel. This control, which is calibrated in nautical miles, provides manual adjustment in range of a marker spot which appears in presentation with first five settings of range switch. The control also provides manual adjustment of start of 30-mile range sector when the range switch is in the TD position.

TUNE SWITCH. This switch (5, figure 4-31) on the search radar control panel has AFC--MAN positions. With the control in the AFC position (full counterclockwise), AFC circuits are operative. In the MAN position, the manual tuning equipment is put into operation to control the tuning of the local oscillators.

STC SWITCH. This switch (7, figure 4-31) on the search radar control panel is a two-position OUT--STC control. In the OUT position, STC (sensitivity time control) circuits are inoperative with receiver gain functioning normally. In the STC position, STC circuits are operative to reduce the intensity of nearby targets and clutter. Effect is noted in the first three to four miles of range with a 10-mile maximum adjustment.

SCOPE INTENSITY KNOB. The scope intensity knob (15, figure 4-31) on the search radar indicator is used to adjust the intensity of the display on the search radar scope.

SCOPE LIGHT KNOB. This knob (16, figure 4-31) on the search radar indicator varies the brightness of the illuminating lights for observing cursor marks and the azimuth scale. The knob also varies the brightness of the range marker and TD lights on the upper rim of the search radar scope.

FOCUS KNOB. This knob (17, figure 4-31) on the search radar indicator is used for focusing or sharpening the display on the search radar scope.

CURSOR SCREEN-ROTATING KNOB. This knob (18, figure 4-31) on the search radar indicator is used to rotate the cursor lines to the desired azimuth positions.

Search Radar Indicators

SEARCH RADAR SCOPE. The search radar scope (14, figure 4-31) on the search radar indicator displays the signals to be interpreted by the operator.

Normal Operation of Search Radar

The search radar set is put into normal operation when the airplane is airborne as follows:

1. Place the antenna heater switch to OUT
2. Turn the function switch from OFF to STANDBY. Wait until the normal operating delay of approximately three minutes is over. When the needle on the tilt meter can be moved from the zero degree calibration by operating the tilt switch, this time delay is complete

CAUTION

- When starting the search radar set at low ambient temperature, either in flight or on the ground, the procedure should be varied to prevent possible damage to the equipment. Before turning the function switch from OFF to STANDBY, first place the range switch to 100 and the scan switch to FULL. Then place the function switch to STANDBY and wait five minutes (ten minutes at ambient temperature below -20 degrees C) before operating any other controls of the radar set. This permits initial rotation of the antenna at its slowest speed and prevents overloading the antenna drive motor and gear train. When the antenna system is operating normally after the specified time period, turn the range switch to 10 and the function switch to either SEARCH, BEACON, or WEATHER position, depending on the type of operation desired.

- Turning the function switch to any other position beyond STANDBY, with the range switch on 100 or beyond, before the radar set has reached full operating temperature can cause severe damage to electronic circuits and may render the set completely inoperative.

NOTE

There is no sweep on the search radar scopes during the time delay period.

3. Adjust the scope intensity knob on the search radar indicators so that the sweep line appears plainly on the scope
4. Adjust the focus knob on the indicators so that the sweep line appears sharp and clear. Alternately readjust the focus knob and the scope intensity knob until a clear, sharp, sweep line is obtained
5. Rotate the scope intensity knob slowly counterclockwise until the sweep line is just visible on the screen. The set should now operate in any desired function

Search operation is accomplished by the following procedure:

1. Set the function switch to the SEARCH position
2. Place the scan switch in the FULL position. The type of scanning performed will be shown on the search radar scopes with the sweep trace rotating a full 360 degrees around their centers. With the antenna scanning, the range marks appear as circles centered about the beginning of the sweep. From these circles, target ranges are determined
3. Observation of specific objects in the direction of the airplane heading is slightly improved by utilizing sector scan. General coverage of the area is obtained with the full scan condition
4. Rotate the gain control clockwise thus causing moving object and fixed echoes to appear on the indicator screen. Adjust the gain control for the best display, that is, for clearest viewing and highest degree of definition. For optimum adjustment after the proper setting of the gain control, reduce the intensity so that the sweep trace is just barely visible
5. Utilize the A--J switch to obtain better definition of targets. Heavy masses of objects or sea return that may obscure lesser objects will be materially reduced by setting the A--J switch to FTC position. Further sharpening of the display may be obtained by utilizing the IAGC position. Utilize the position that gives the clearest indication and readjust the gain control if necessary. The A--J switch should not be used, however, unless necessary to obtain proper definition, since its use reduces the over-all sensitivity of the video circuits and makes small objects, such as approaching airplanes more difficult to detect on the longer ranges
6. Place the STC switch on the STC position. This will reduce the intensity of nearby objects, ground clutter, and sea return. The STC circuits are effective up to 10 miles of range. Utilize the STC switch position (STC or OUT) that gives the clearest indications
7. Place the antenna stab switch in the STAB position. This activates the roll-and pitch-stabilization mechanism and circuits, maintaining the antenna in its normal position relative to the horizon regardless of the roll or pitch of the airplane
8. Observe the two antenna beam pattern conditions from the displays by placing the OBS--MAP switch alternately in the OBS and MAP positions. When the airplane is airborne, terrain objects will be more apparent on lesser ranges when the OBS--MAP switch is in the MAP position. The mapping beam which has an equal-energy-return pattern, is utilized to its best advantage when the antenna is set at zero tilt and the stabilizer is in operation. The OBS position utilizes the pencil beam which is generally used to observe objects at the longer ranges or at the same approximate altitude as the airplane. When observation of a particular object is desired, the antenna tilt switch may be used for the desired elevation or depression angle necessary for the best indicator presentations
9. Operate the tilt switch in the UP and DOWN positions and note the tilt action and degree of tilt of the search radar antenna as indicated by the tilt meter. Optimum detection and indication with the mapping beam is generally obtained when the antenna tilt is set at zero. The normal tilt setting of the antenna when the OBS (pencil) beam is used, is zero degrees. This condition is normal for observing obstacles or objects in the same approximate altitude as the airplane, and the longer range ground targets. Such objects may include mountain ranges and peaks, clouds, or other airplanes. It should be noted that under these conditions, nearby terrain objects are less clear on the indicator than when using the map beam. Other degrees of antenna tilt may be used at the discretion of the operator. These conditions generally involve the observation of particular objects which require elevation or depression of the antenna for best indication. Other conditions may be those which require simultaneous observation of airborne objects requiring a compromise setting of the antenna tilt angle
10. Adjust the light control on the indicator for satisfactory illumination of range-marker lights and cursor
11. Set the range switch to the desired range. Different range settings may require slight readjustment of the antenna tilt for the desired beam coverage. When the range switch is in the TD position, the 30-mile range

sector, manually variable by means of the delay control, is displayed on the search radar scope. This range sector affords the operator a magnified presentation of objects on the longer ranges

12. Turn the tune switch to MAN and check whether sharper tuning may be obtained manually than with AFC

13. Rotate the cursor screen by means of the knurled knob to find the exact azimuth bearing of targets

The beacon function is employed to find navigational and homing information from radar beacons at ranges up to 200 nautical miles. During beacon operation, the equipment is responsive only to X-band radar signals, and does not display normal radar targets. Since the beacon indications are in terms of range and azimuth, the navigator may employ this information for plotting a course. If homing is desired the pilot will head the airplane so that the beacon signal appears in the zero-degree heading on the indicator. Other courses may also be conveniently plotted from two or more beacon signals. During beacon operation, the mapping beam is automatically selected.

Beacon operation is accomplished as follows:

1. Set the function switch to BEACON
2. Set the range switch to the desired range where beacons are expected. A picture of all the beacon stations within the range of the equipment may be secured by utilizing the 200-mile maximum range. The lesser range positions may be used when looking for beacon stations of known locations. When homing on a beacon, the range settings should be correspondingly reduced to provide optimum indications as the airplane approaches the beacon location. For reading distant beacons, the range switch may be placed in the TD position, thus providing an amplified view within a 30-mile range sector. Intermittent rather than continuous operation on beacon is recommended to avoid overloading the beacon transmitter
3. Utilize antenna stabilization by placing the antenna stab switch in the STAB position
4. Adjust the brightness of the indicator edge lights and range-marker lamps by means of the scope light knob for best viewing conditions of indicator presentations and the azimuth scale
5. Adjust the scan switch to the position giving the type of scanning desired, SECTOR or FULL. If the beacon station is being used for homing, or is within a sector of 120 degrees ahead of the airplane, sector scan may be preferred
6. Adjust the gain control for the best presentation of beacon signals
7. Adjust the tilt switch for best signal response
8. The range may be determined from the range marker rings. All ranges of beacon stations are referenced from the indicator origin to the first line of arc of the beacon signal

The weather function provides indication of surrounding weather conditions from cloud and storm-front formations. Locations of formations are presented on the indicator screen in terms of range and azimuth in the same manner as that for the search function. Indication presentations also show the relative character and size of cloud and storm-front formations, thus providing the pilot with useful information for determining this course. Weather operation is accomplished as follows:

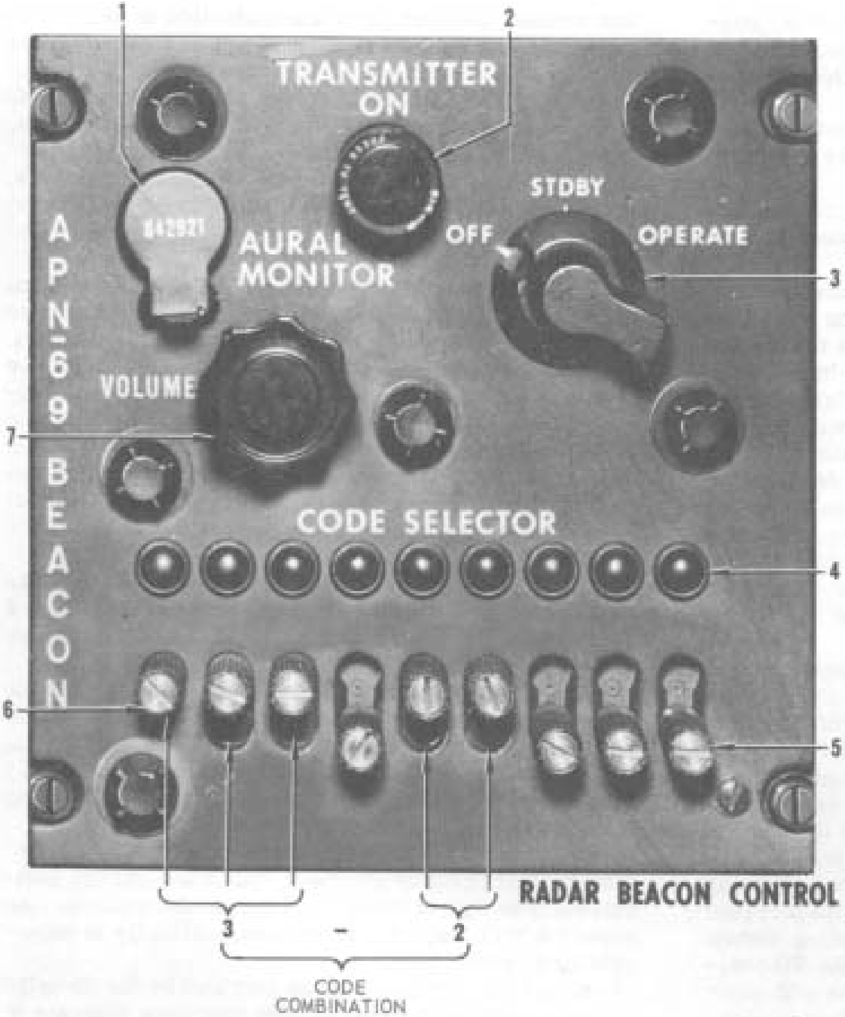
1. Place the function switch in the WEATHER position
2. Place the range switch in the proper position to cover the range within which information is desired. When making the initial survey of the area, it may be preferable to make observations in the maximum 200-mile range, and then to select the lesser range or the 30-mile TD sector to observe particular formations
3. Adjust the scan switch to the position giving the type of scanning desired, SECTOR or FULL. If storm avoidance is of primary concern, place the scan switch in the SECTOR position
4. Place the OBS--MAP switch in OBS position. The obstacle or pencil beam provides best presentation of cloud and storm-front formations, since it eliminates ground targets and clutter
5. Adjust antenna tilt to the zero tilt position with the tilt switch. Vary the antenna slightly with the tilt switch for the most clearly defined presentation. On OBS operation, ground indications may be practically eliminated by means of the tilt adjustment providing the best analysis of weather conditions
6. Heavy clouds and storm fronts having higher moisture content produce stronger and more intense indications than lighter clouds and lighter formations. An experienced operator has no great difficulty in interpreting presentations
7. Amplified presentations, as provided by the 30-mile TD range sector, provide a more complete analysis of the formations. TD operation of the equipment for weather is the same as in the search function

To place the equipment in standby, turn the function switch to the STANDBY position.

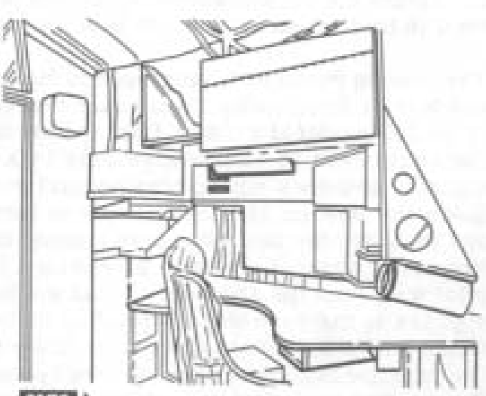
Securing the Search Radar

The search radar set is turned off by the following procedure:

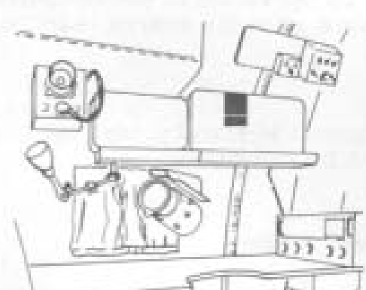
1. Range switch to 10
2. Gain knob full counterclockwise
3. Scan switch stopped with trace at 180 degrees
4. Intensity knobs fully CCW
5. Antenna stab switch in OUT position
6. Function switch in the OFF position to completely de-energize the equipment



RADAR BEACON CONTROL PANEL


3178 ▶

RADAR BEACON POWER CONTROL PANEL


17260 ▶ 3177

1 AURAL MONITOR JACK
2 TRANSMITTER-ON INDICATOR LIGHT
3 OFF--STDBY--OPERATE SWITCH
4 CODE SELECTOR INDICATORS
5 CODE SELECTOR SWITCHES
6 COMMON CODE SELECTOR
7 VOLUME KNOB
8 POWER SELECTOR SWITCH

RADAR BEACON CONTROLS 3232 ▶ PLUS K211

Figure 4-32

RADAR BEACON (AN-APN-69) 3232 ▶ plus ✈ TCTO K211

The radar beacon is used primarily as a navigational aid for air refueling rendezvous. Two control panels are used to operate the set. On airplanes 17260 ▶ 3177, the panels (8 and 9, figure 4-17) are on the navigator's radio and radar control panel. On airplanes 3178 ▶, the panels (8 and 9, figure 4-10) are on the navigator's interphone and lights control panel. After the equipment is energized and the desired code has been selected, the beacon operates automatically. During flight, coded reply signals are transmitted whenever the beacon responds to interrogation pulses from any suitably equipped radar. The beacon's response is indicated by a distinctive display on the scope of the interrogating radar. From this display, the operator of the interrogating radar may identify the beacon-equipped airplane and determine its range and bearing. The response of the beacon is also indicated by a tone on the interphone. The tone can be heard by the navigator if the APN-69 MONITOR interphone mixer switch is ON (up). The reply code is established by positioning the code selector switches at the bottom of the control panel. There are 52 usable codes available. A typical code is selected as follows: For this example, the code designated 3-2 will be used. Three dash two indicates that the beacon will transmit three code elements (pulses), pause, and then transmit two code elements. Each knob on the bottom of the control panel represents one code element. The code elements are numbered from one to nine starting from the left. The first knob is stationary so the first code element is always transmitted. Therefore, the second and third knobs (first two movable code selector switches) must be up (on) to give three successive pulses, the fourth knob must be down (off) to give the correct pause, the fifth and sixth knobs must be up to give the final two pulses of the code, and the remaining knobs must be down. See figure 4-32. (The correct pause is obtained if one code element is removed from a series - one switch down.) The selected code is indicated by the indicator lights above the knobs. For the code used in the above example, the first, second, third, fifth, and sixth lights would be lit. The set is turned on and off with the off--stdby--operate switch and is operative when the transmitter-on light is illuminated. Operating power is 115 volt AC and control power is 28 volt DC with circuit protection on the radio junction box circuit breaker panel (figure 1-34) and the alternator relay shield (figure 1-34).

NOTE

> The radar beacon may trigger itself occasionally which will be indicated on the interphone by an intermittent click on buzz. When the beacon is triggered by a radar set whose antenna is scanning, a buzz will be heard in the headset at the scanning frequency of the radar antenna. This scanning frequency will be quite low, sometimes as low as four scans per minute. If the radar is not scanning but is directed on the beacon, a tone of approximately 300 cycles per second will be heard.

Radar Beacon Controls

OFF--STDBY--OPERATE SWITCH. This switch (3, figure 4-32) has three positions: OFF--STDBY--OPERATE. When the switch is OFF, the beacon equipment is de-energized except for the panel lights and the code selector indicators. Refer to CODE SELECTOR INDICATORS in this Section. Placing the switch on STDBY energizes all circuits, except the high-voltage circuits, after a 30-second delay. Switching to OPERATE makes the beacon completely energized and ready for automatic operation after a 3-minute delay. If the switch has been on STDBY for at least three minutes, the beacon will be completely operative as soon as the switch is placed on OPERATE. When it is desired to discontinue operation temporarily, turning the switch to STDBY keeps the beacon ready for immediate use.

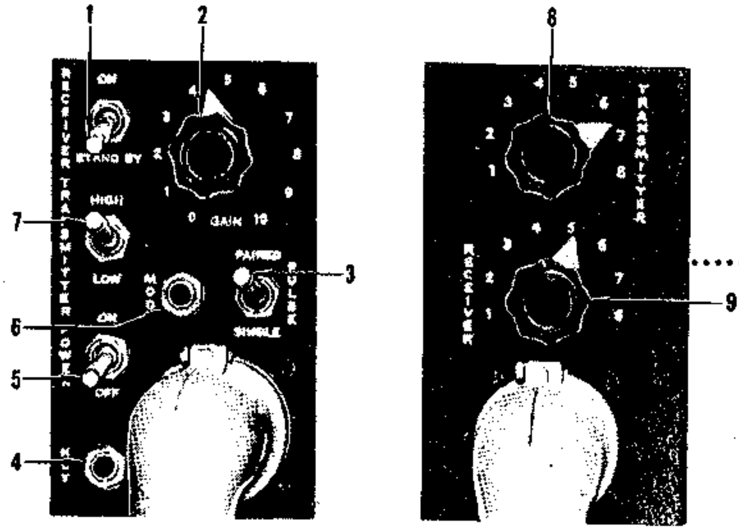
CODE SELECTOR SWITCHES. Eight code selector switches (5, figure 4-32) on the radar beacon control panel are used to establish the desired code response of the beacon system. The switches are operated by pulling the associated spring-loaded knobs outward and then lifting upward to the on position or downward to the off position. Transmission of a code element occurs only when the corresponding switch knob is in the up position. When the switch knob is down, the corresponding code element is absent from the transmitted code.

COMMON CODE SELECTOR. A common code selector (6, figure 4-32) on the radar beacon control panel, which corresponds to the first code element is stationary. This first code element is common to all code combinations.

VOLUME KNOB. A volume knob (7, figure 4-32) on the radar beacon control panel adjusts the volume of the beacon tone into the interphone. The volume of the tone is also controlled by the interphone volume knob.

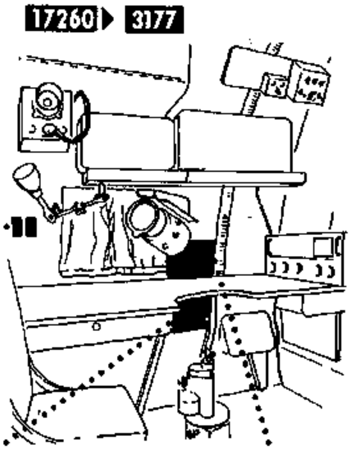
AURAL MONITOR JACK. A jack (1, figure 4-32) on the radar beacon control panel is used for test purposes. When a headset is connected to the jack, random noise (or periodic triggering of the system) may be heard and is indicative of beacon operation.

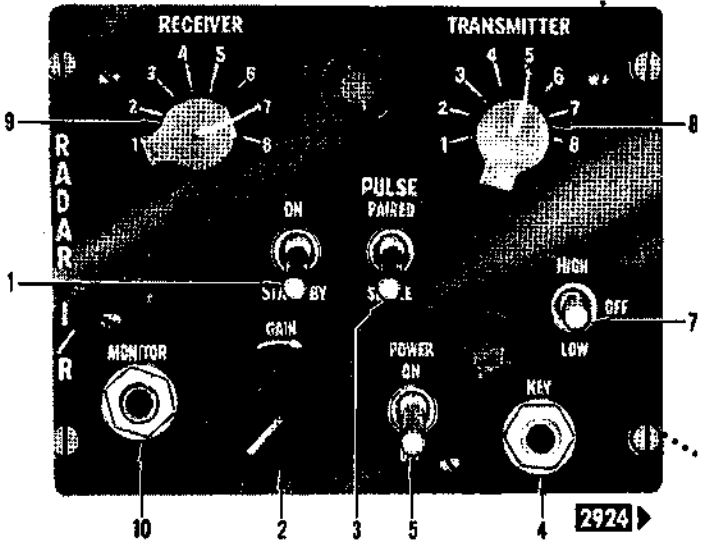
POWER SELECTOR SWITCH. This switch (8, figure 4-32) on the radar beacon power control panel has NORM--EMERG positions. The switch is spring-loaded to the NORM position and is protected by a guard. In this position, power to the APN-69 radar beacon set is from the alternator bus No. 2. In the event of failure of the alternator bus No. 2, the radar beacon set may be made operative by placing the power selector switch to the EMERG position. Power will then be supplied by the airplane's essential inverter. However, when the switch is in EMERG, the glide slope receiver (AN/ARN-18), loran (AN/APN-70), and



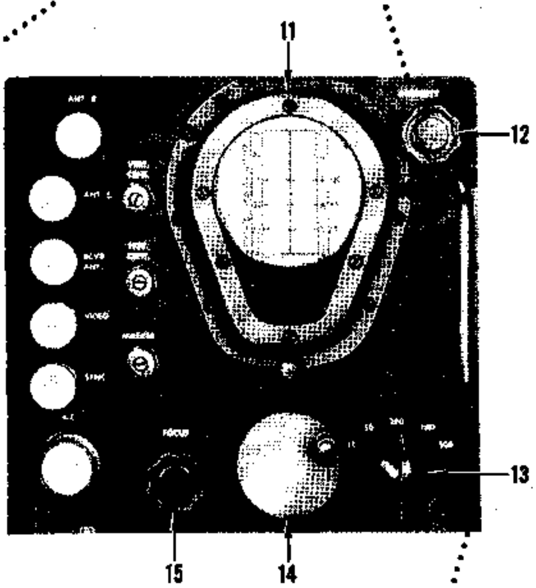
17260 ▶ 2923

RENDEZVOUS RADAR CONTROL PANELS


17260 ▶ 3177

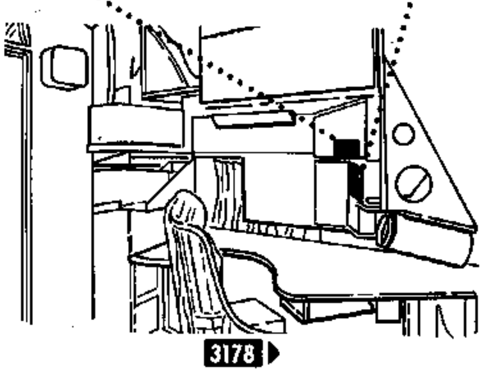


2924 ▶



RENDEZVOUS RADAR INDICATOR PANEL

1 RECEIVER SWITCH (2 PLACES)
2 GAIN KNOB (2 PLACES)
3 PULSE SELECTOR SWITCH (2 PLACES)
4 KEY JACK (2 PLACES)
5 POWER SWITCH (2 PLACES)
6 MODULATOR JACK
7 TRANSMITTER SWITCH (2 PLACES)
8 TRANSMITTER CHANNEL SELECTOR SWITCH (2 PLACES)
9 RECEIVER CHANNEL SELECTOR SWITCH (2 PLACES)
10 MONITOR JACK
11 RENDEVOUS RADAR INDICATOR
12 INTENSITY KNOB
13 RANGE SELECTOR SWITCH
14 DELAY KNOB
15 FOCUS KNOB


3178 ▶

RENDEZVOUS RADAR (AN/APN-12) CONTROLS

Figure 4-33

the radio altimeter (SCR-718C) will be disconnected. When the switch is in the NORM position, circuit protection is from the alternator relay shield (figure 1-34). When the EMERG position is selected, circuit protection is from the ac power panel (figure 1-34). When the switch is in either position, operating power is 115 volt ac.

Radar Beacon Indicators

TRANSMITTER-ON INDICATOR LIGHT. A green indicator light (2, figure 4-32), marked TRANSMITTER ON, is on the radar beacon control panel. When the master power switch is turned to OPERATE, and a three minute warmup period has elapsed, the green press-to-test TRANSMITTER ON indicator light illuminates indicating that the radar beacon is ready for automatic operation.

CODE SELECTOR INDICATORS. Nine code selector indicators (4, figure 4-32) are on the bottom of the radar beacon control panel. The navigator's radio panel lights control controls the brilliance of the indicators. Each code selector switch (5, figure 4-32) controls its respective indicator. The indicators, when illuminated, indicate the presence of a code element inserted in the beacon response.

Normal Operation of the Radar Beacon

The radar beacon equipment is made inoperative and inoperative by the following procedure:

1. Place the off--stdby--operate switch to STDBY
2. Allow approximately 3 minutes for warmup and place off--stdby--operate switch to OPERATE. After the warmup period, the transmitter-on light is energized and the system is ready for automatic operation and will reply to interrogating pulses of the proper characteristics
3. Set the code selector switches to the desired reply code. As an example of a 3-2 code, the first (which is the stationary one and is common to all code combinations), second, third, fifth, and sixth switch knobs would be placed in the up position. All other switch knobs would be in the down position. This would be a five-element code. Do not insert more than six code elements, including the first stationary element, at one time
4. If it is desirable to monitor the beacon system operation, the navigator may do so by use of the APN-69 MONITOR interphone mixer switch
5. If it is desired to discontinue operation temporarily, turn off--stdby--operate switch to STDBY. In this manner, the equipment is kept ready for immediate use
6. To make inoperative, reset code selector switches to down position and turn off--stdby--operate switch to OFF

NOTE

> A suppressor cable connecting the AN/APN-69 radar beacon and AN/APS-42 search radar synchronizer unit prevents blanking of the search radar indicators by temporarily inactivating the AN/APN-69 radar beacon.

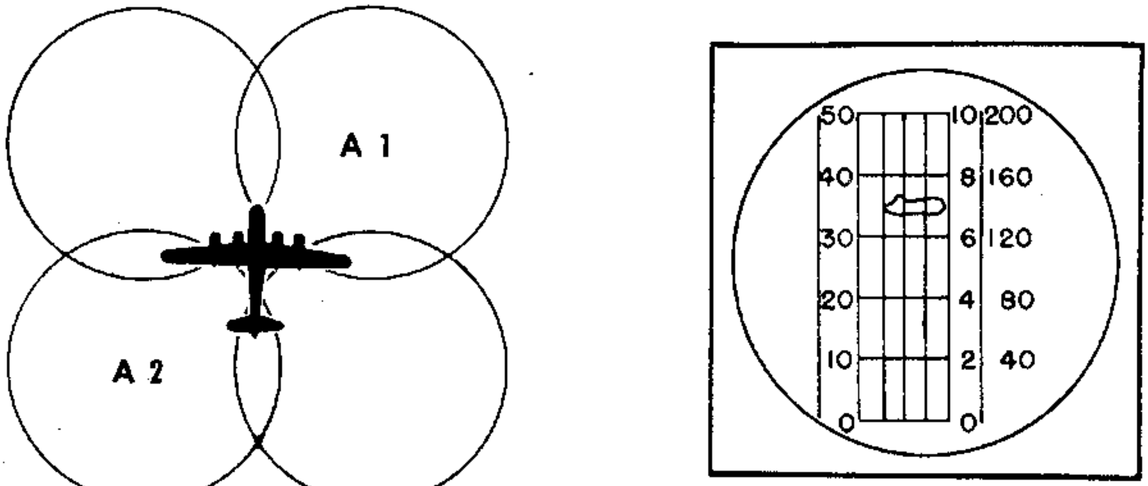
RENDEZVOUS RADAR (AN/APN-12)

The AN/APN-12 rendezvous radar is used for recognition and navigation by interrogation of ground beacons or transponders (AN/APN-76). The return signal is displayed on the rendezvous radar indicator, indicating range and quadrantal location of the transponder with respect to the AN/APN-12. The AN/APN-12 receiving antennas give the receiving pattern illustrated in figure 4-34. The signals received by the AN/APN-12 receiving antennas are displayed on an indicator with an L-type scan. The center vertical trace indicates range, with zero range at the bottom (except when operating on 10D and 50D) and increasing up the scope. Range is read from the bottom of the scope to the bottom of the received signal using the etched lines on the face of the scope as range markers. Signals will appear as horizontal indications unbalanced to the left, unbalanced to the right or centered across the vertical trace. By comparison of left and right signal amplitude, quadrantal position of the receiver airplane may be determined. If the signal is centered on the vertical trace, the receiver airplane is in one of four possible positions: dead ahead, dead astern, or directly abeam of either wing. When the signal is unbalanced to the right, the receiver airplane is located in quadrants A_1 or A_2. In this situation, with the receiver airplane approaching the tanker airplane, the receiver should be directed to correct to the right in order to balance the received signal across the vertical trace of the scope. When the signal becomes balanced, the receiver should be directed to turn to the heading or reciprocal heading of the tanker airplane, whichever is applicable. Conversely, when the signal is unbalanced to the left the receiver should be directed to correct to the left until the received signal is balanced or centered across the vertical trace. Airplanes 17260▶2923 have the two control panels for the set adjacent to the loran indicator; on airplanes 2924▶3177 , only one control panel (14, figure 4-15) under the navigator's table is used, and on airplanes 3178▶, the control panel (13, figure 4-17) is on the navigator's radio and radar control panels. Control power is 28 volt dc, operating power is 115 volt ac, with circuit protection on the radio junction box circuit breaker panel.

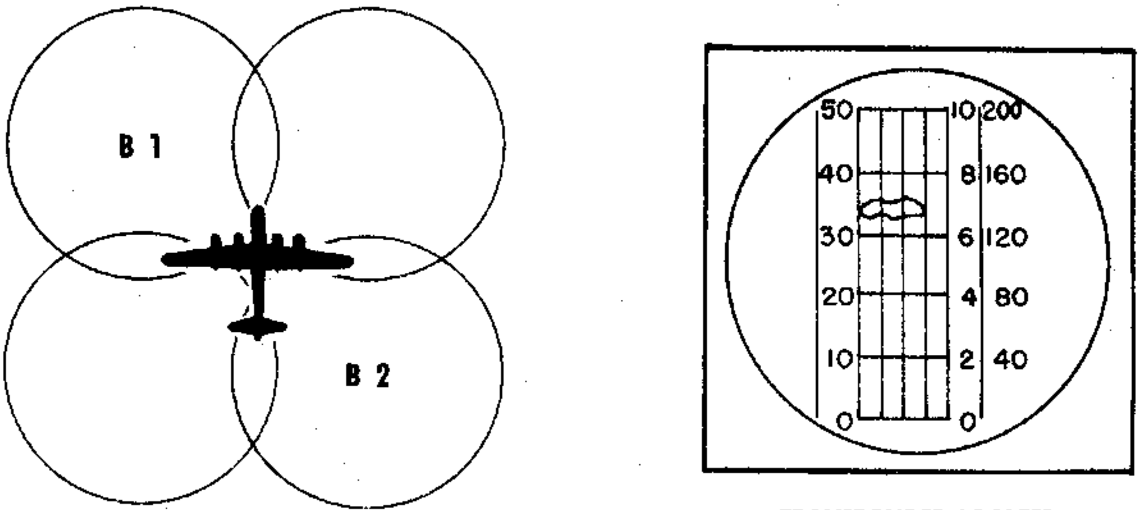
AN/APN-12 Rendezvous Radar Controls

POWER SWITCH. This switch (5, figure 4-33) on the AN/APN-12 rendezvous radar control panels has ON--OFF positions. The switch is used to turn the set on and off.

TRANSMITTER SWITCH. This three-position toggle switch (7, figure 4-33) on the control panels has HIGH--OFF--LOW positions. The switch is used to select high or low operating ranges when in the desired position. When the switch is in the center or OFF position, no transmission is possible.



TRANSPONDER LOCATED
IN ONE OF QUADRANTS
LABELED A



TRANSPONDER LOCATED
IN ONE OF QUADRANTS
LABELED B

RECEIVING PATTERNS (AN/APN-12)
SCOPE

Figure 4-34

RECEIVER SWITCH. This switch (1, figure 4-33) on the control panels has ON and STANDBY positions. ON position energizes the receiver. When in STANDBY, the receiver tubes are kept hot and the receiver is in readiness for instant operation.

PULSE SELECTOR SWITCH. This switch (3, figure 4-33) on the control panels has PAIRED and SINGLE positions. The switch is used to provide paired pulse or single pulse operation.

GAIN KNOB. The gain control (2, figure 4-33) on the control panels is a knob controlled potentiometer. The control is used for the purpose of controlling receiver gain.

TRANSMITTER CHANNEL SELECTOR SWITCH. This switch (8, figure 4-33) on the control panels is used to select any of the eight preset frequencies. Each channel position is labeled on the panels to inform the operator on which channel the transmitter is operating.

RECEIVER CHANNEL SELECTOR SWITCH. This switch (9, figure 4-33) on the control panels is used for selecting any one of the eight preset frequencies of the receiver. Each channel position is labeled.

KEY JACK. This jack, (4, figure 4-33) on the control panels allows a keying device to be plugged into the panel and automatically switches the beacon transmitter on and off in accordance with a predetermined code.

MONITOR JACK. A monitor jack (10, figure 4-33) on the control panels provides a headphone connection to allow monitoring of the equipment during operation.

MODULATOR JACK. This jack (6, figure 4-33) on the panels permits audible monitoring of the transmitter triggering circuits. The jack is also used when the radar set is being operated as a beacon without the use of the indicator, by plugging a headphone into the jack and listening to a popping noise.

AN/APN-12 Rendezvous Radar Indicator

RENDEZVOUS RADAR INDICATOR. This indicator (11, figure 4-33) is on the rendezvous radar indicator panel. The indicator provides a visual representation of distance and direction, with respect to the line of flight and a ground beacon station.

Normal Operation of AN/APN-12 Rendezvous Radar

To start the AN/APN-12 set, proceed as follows:

1. Place the transmitter switch on the control panels in the OFF (mid) position
2. Place the power switch on the control panels in the ON position
3. When operating as an interrogator-responser, place the on--off switch, on the rendezvous radar indicator panel in the ON position. (This step applies only to those indicator panels which have an on--off switch - some panels do not have this switch.)

NOTE

Allow one minute for warmup before attempting to operate the equipment.

To stop the AN/APN-12 set, proceed as follows:

1. Turn gain and intensity knobs full counterclockwise
2. Place the power switch (on the control panel) in the OFF position

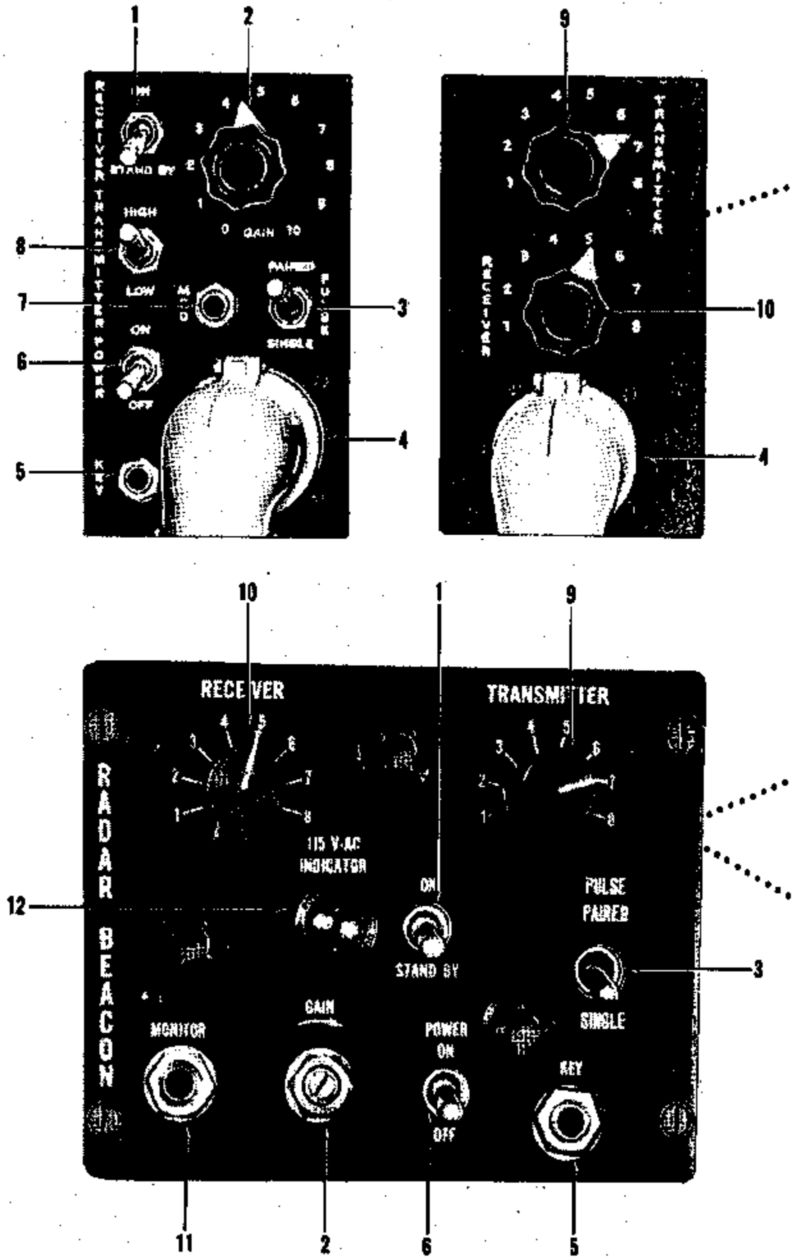
To operate the AN/APN-12 set as an interrogator-responser, proceed as follows:

1. Remove the top cover of Receiver-Transmitter RT-316/APN, by loosening the four slide fasteners
2. Using a screwdriver, rotate the BEACON--IR switch, located in the top of Receiver-Transmitter RT-316/APN, to the IR position
3. Replace the top cover of Receiver-Transmitter RT-216/APN
4. Start the equipment
5. Place the pulse selector switch in the SINGLE position
6. After approximately one minute, place the transmitter switch in the HIGH position
7. Adjust the focus and intensity controls, on rendezvous radar indicator panel until a clear, well-defined trace is obtained on the display screen
8. Place the receiver switch in the ON position
9. Adjust the gain control until grass appears in the trace on the display screen on the rendezvous radar indicator. The appearance of grass indicates proper operation of the receiver, and the rectangular-shaped pulse at the base line indicates proper operation of the transmitter
10. Check operation of the receiver for each position of the receiver channel selector switch
11. Place the receiver and transmitter channel selector switches on the assigned channels
12. When the airplane is within the range of a ground transponder beacon, a signal should appear on the rendezvous radar indicator, showing the distance from the beacon and whether or not the airplane is on course. (See figure 4-34.) If the signal on the right of the center line is larger, the beacon is to the right of the airplane and the pilot should be directed to the right until the right- and left-hand signals are equal

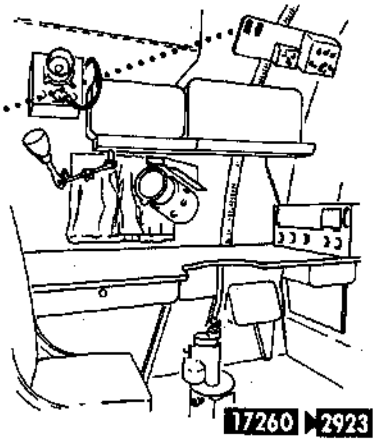
NOTE

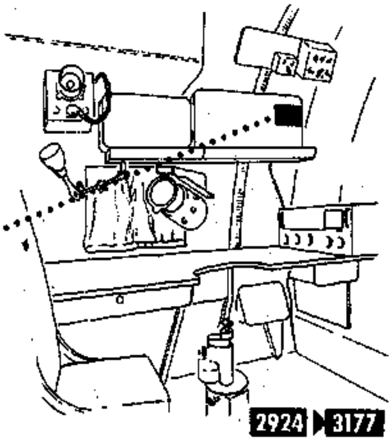
Range is read to the bottom edge of the receiver signal pulse.

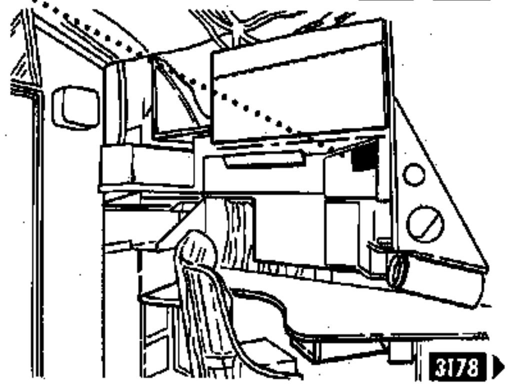
13. As the airplane approaches the beacon, the received signal gradually approaches the zero line on the indicator. At the time the airplane is directly over the beacon, the received signal collapses



AN/APN-76 RENDEZVOUS RADAR CONTROL PANELS


17260 ▶2923


2924 ▶3177


3178 ▶

1 RECEIVER SWITCH (2 PLACES)
2 GAIN KNOB (2 PLACES)
3 PULSE SELECTOR SWITCH (2 PLACES) 3214 ▶ PLUS 1CTO KG502
4 RECEPTACLE (2 PLACES)
5 KEY JACK (2 PLACES)
6 POWER SWITCH (2 PLACES)
7 MODULATOR JACK
8 TRANSMITTER SWITCH
9 TRANSMITTER CHANNEL SELECTOR SWITCH (2 PLACES)
10 RECEIVER CHANNEL SELECTOR SWITCH (2 PLACES)
11 MONITOR JACK
12 AC POWER INDICATOR LIGHT

RENDEZVOUS RADAR (AN/APN-76) CONTROLS

Figure 4-35

To operate the AN/APN-12 set as beacon (transponder), proceed as follows:

1. Perform operations 1 through 10 as mentioned for interrogator-responser operation.
2. Remove the top cover of receiver-transmitter RT-316/APN, by loosening the four slide fasteners
3. Using a screwdriver, rotate the BEACON--IR switch, located on the top of receiver-transmitter RT-316/APN, to the BEACON position
4. Replace the top cover of receiver-transmitter RT-316/APN
5. Place the receiver and transmitter channel selector switches on the assigned channels
6. Set the gain knob to maximum (10) position. If the flashing of the base line on the rendezvous radar indicator exceeds an average of once per second, reduce the setting of the receiver gain knob until this condition exists. When the radar set is being operated as a beacon without the indicator, it will be necessary to listen to the popping noise with headphones plugged into the MOD jack. When the beacon is interrogated by weak signals, it may be necessary to set the receiver gain control higher than herein described. Reliable beacon operation can be obtained with random noise triggering rates considerable in excess of once per second; however, the gain knob setting should be held at a minimum which will give satisfactory operation with the weakest signals expected. Lower settings of the gain knob will eliminate random noise triggering, but will also limit operation of the beacon to strong signals

NOTE

> Since receiver sensitivity may vary from one channel to another, it will probably be necessary to reset the gain control in accordance with above instructions when the receiver is switched to another channel.

7. Place the pulse selector switch in either the SINGLE or PAIRED position as desired
8. The MOD jack, also permits audible monitoring of the transmitter triggering circuits. It is thus possible for the operator to determine when his beacon is being interrogated by listening for the steady tone in the headphones

Operation of the AN/APN-12 set for communication:

1. Insert a plug which is attached to a key, into the key jack
2. Operate AN/APN-12 as interrogator-responsor
3. The associated ground equipment can be keyed for a reply and the keyed response observed on the rendezvous radar indicator

NOTE

> A suppressor cable connecting the AN/APN-76 and AN/APN-12 rendezvous radar units, prevents the AN/APN-76 set from firing when the AN/APN-12 set interrogates.

RENDEZVOUS RADAR (AN/APN-76)

This radar set is an airborne radar beacon. When properly interrogated, the beacon responds automatically to airplanes equipped with rendezvous radar AN/APN-12 or an equivalent interrogator-responser radar unit operating within the frequency range of 160 to 240 megacycles. The airplane equipped with the interrogator-responser unit can thereby home on the beacon signal to aid in a rendezvous. On airplanes **17260**▶ **2923**, the control panels for the set (4, figure 4-17) are above the navigator's radio and radar control panels. On airplanes **2924**▶**3177** one control panel (4, figure 4-17) is used to operate the set. On airplanes **3178**▶ the control panel has been moved to the latest configuration of the navigator's radio and radar control panels. (See figure 4-17.) Control power is 28 volts dc, operating power is 115 volts dc with circuit breakers on the radio junction box circuit breaker panel (figure 1-34).

AN/APN-76 Rendezvous Radar Controls

TRANSMITTER SWITCH. This three-position switch (8, figure 4-35) on the rendezvous radar control panel (AN/APN-76) provides a means of using high or low transmitter power or placing the transmitter on standby. In the HIGH or LOW position it energizes the keying relay, permitting the transmitter modulator circuit to operate. In the center position, the OFF position, the transmitter is on standby.

POWER SWITCH. This switch (6, figure 4-35) with ON--OFF positions is on the rendezvous radar control panels (AN/APN-76). The switch when positioned to ON controls the a-c and d-c voltage to the receiver transmitter.

PULSE SELECTOR SWITCH **3213**▶PLUS ICTO KG502 . This switch (3, figure 4-35) has PAIRED--SINGLE positions and is on the rendezvous radar control panels (AN/APN-76). The switch allows the operator to transmit either single or paired pulses from the set.

RECEIVER SWITCH. This switch (1, figure 4-35) on the rendezvous radar control panels (AN/APN-76) has ON--STANDBY positions. Movement of the switch places the receiver in either a standby or operating condition.

GAIN KNOB. The gain knob (2, figure 4-35) on the rendezvous radar control panel (AN/APN-76) varies the sensitivity of the receiver.

TRANSMITTER CHANNEL SELECTOR SWITCH. This switch (9, figure 4-35) on the rendezvous radar control panels (AN/APN-76) permits selection of any one of eight preset transmitter frequencies.

RECEIVER CHANNEL SELECTOR SWITCH. This switch (10, figure 4-35) on the rendezvous radar control panels (AN/APN-76) permits selection of any one of eight preset receiver frequencies.

AN/APN-76 Rendezvous Radar Indicator

AC POWER INDICATOR LIGHT. This light (12, figure 4-35) on the rendezvous radar control panel will illuminate when ac power is available for the equipment.

Normal Operation of AN/APN-76 Rendezvous Radar

The radar set is made operative and inoperative by the following procedure:

1. Place the power switch to ON
2. Allow approximately 3 minutes for warmup and place the receiver switch to ON
3. To make inoperative, place the power switch to OFF and the receiver switch to STANDBY

RADAR PRESSURIZING SYSTEM

Pressurizing equipment supplies pressurized air to the search radar set (AN/APS-42) for satisfactory operation at high altitudes. The equipment is controlled by a switch on the radar pressurizing control panel (3, figure 4-17) on the navigator's radio and radar control panels. Pressure is maintained at the proper level by a pressure operated switch within the system. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-34).

Radar Pressurizing System Controls

CONTROL SWITCH. This switch (4, figure 4-36) on the radar pressurizing control panel has MOMENTARY ON--OFF--NORMAL ON positions. The switch, guarded to the NORMAL ON position, controls operation of the connected air system. With the switch in the NORMAL ON position, intermittent operation of connected equipment is automatic with results indicated on the control panel. Switch positions MOMENTARY ON and OFF are used for testing and emergency.

BLEEDER VALVE KNOB. A knob (3, figure 4-36) on the radar pressurizing control panel is marked PUSH TO BLEED. When the knob is pushed in, it mechanically actuates a valve to discharge system compressed air into the cabin. The bleeder valve knob is spring-loaded to the extended (bleeder valve closed) position.

Radar Pressurizing System Indicators

PUMP PRESSURE INDICATOR LIGHT. A green indicator light (2, figure 4-36) on the radar pressurizing control panel, when illuminated, indicates that the compressor is operating.

RADAR PRESSURE GAGE. A radar pressure gage (1, figure 4-36) on the radar pressurizing control panel indicates system air pressure in inches of mercury. A mask assembly with red and green range markings, leakage test, and calibration marks is fitted over the face of the indicator. The leakage test and calibration marks are used only for ground and flight test of the system after maintenance work has been accomplished.

Normal Operation of Radar Pressurizing System

The radar pressurizing system must be turned on whenever the search radar set is to be operated and left on throughout the operation of the set. At all other times, radar pressurizing should be off. Operation of the system is as follows:

1. Place the radar pressurizing control switch to NORMAL ON; pump pressure indicator light should come on and remain on until pressure builds up to within the green operating range on the radar pressure gage. When pressure stabilizes within the green operating range, the search radar set may be turned on
2. After the search radar set has been turned OFF, place the radar pressurizing control switch to OFF

Emergency Operation of Radar Pressurizing System

FAILURE OF AUTOMATIC PRESSURE REGULATION. In the event the pressure regulator switch malfunctions or fails and continued operation of the search radar set is essential, radar pressurizing may be maintained by manual control.

1. Place the radar pressurizing control switch in OFF
2. Bring pressure within green operating range on the radar pressure gage either by holding the pressurizing control switch in MOMENTARY ON, or by pushing and holding in the pressure bleed valve knob
3. Whenever the pressure drops to the low limit of the green operating range, hold the radar pressurizing control switch in MOMENTARY ON until the pressure builds up to the high limit. Repeat this procedure as necessary to maintain the pressure within the limits of the green operating range

NOTE

In an extreme emergency only, when pressure cannot be maintained in the green operating range but can be kept within the upper and lower limits of the red (marginal) range on the radar pressure gage, the search radar set may be kept in operation by manual tuning of the units.

INABILITY TO MAINTAIN PRESSURE. If failure of the compressor, broken lines, or similar difficulty, makes it impossible to maintain proper pressure either by automatic or manual means, proceed as follows:

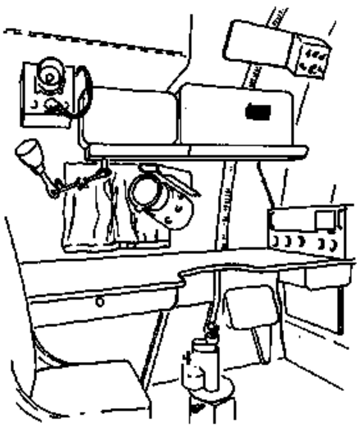
1. Place the radar pressurizing control switch in OFF
2. Turn off the search radar set

CAUTION

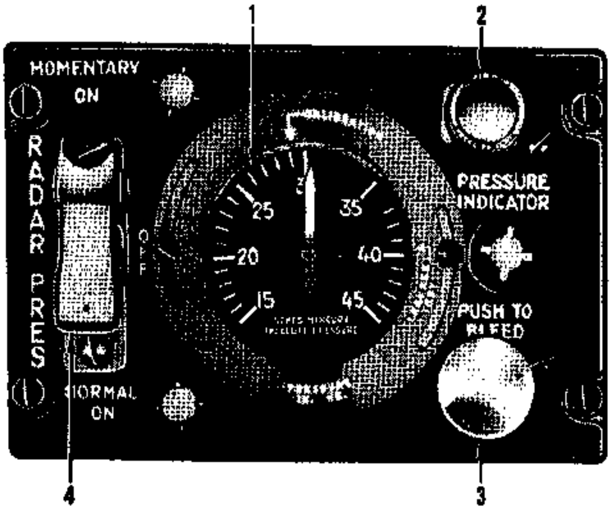
Continued operation of the search radar set after failure of the radar pressurizing system is likely to result in damage to the search radar components.

STATIC DISCHARGERS

Static dischargers are provided to discharge static electricity from the airplane to the air. The dischargers are tufts of braid located on the wing tips, empennage and ruddevators. (See figure 4-37.)

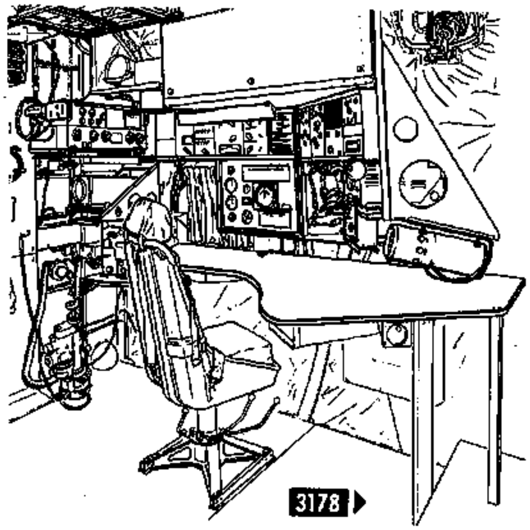


17260 ▶ 3177



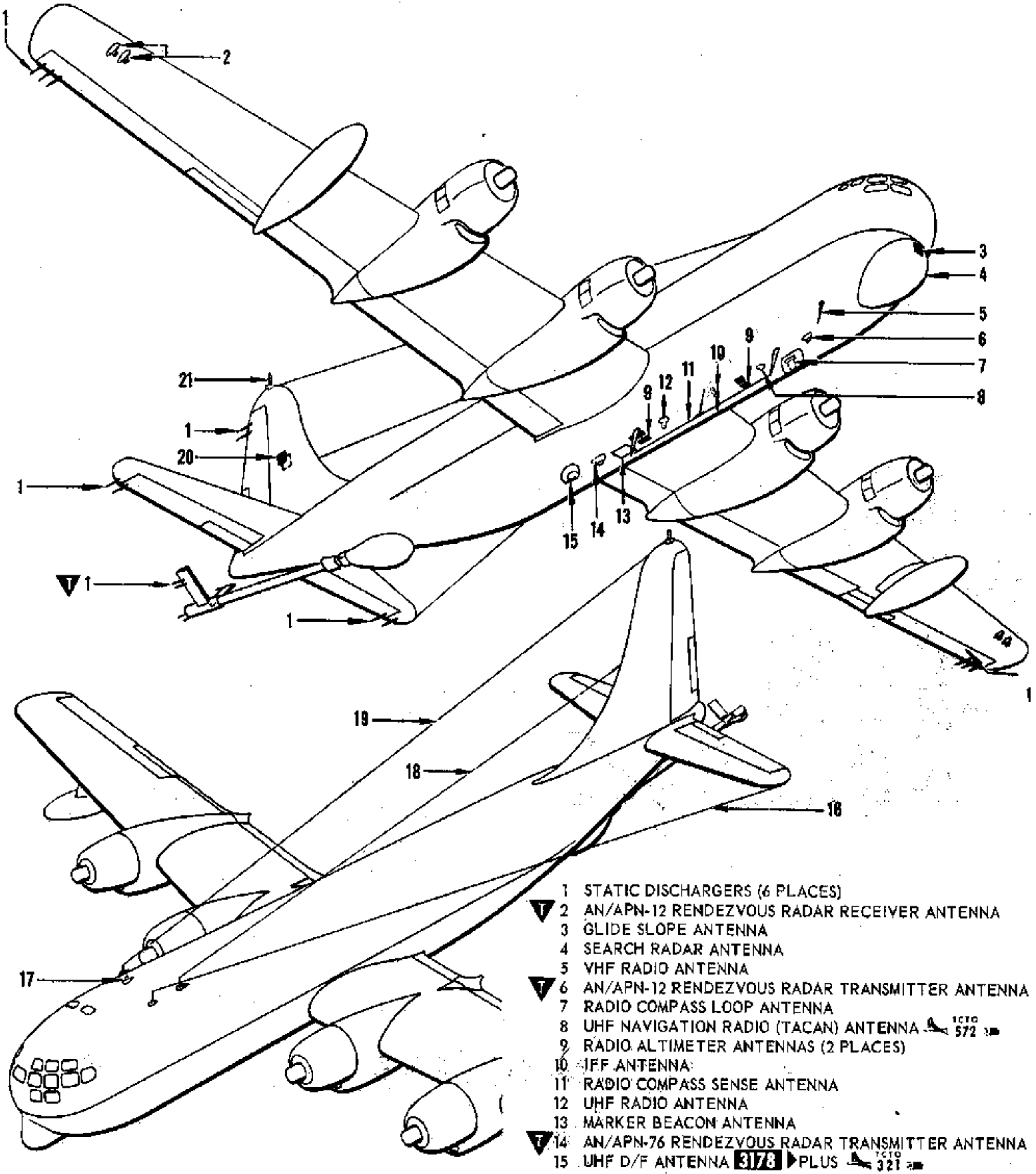
RADAR PRESSURIZING CONTROL PANEL

1 RADAR PRESSURE GAGE
2 PUMP PRESSURE INDICATOR LIGHT
3 BLEEDER VALVE KNOB
4 CONTROL SWITCH



RADAR PRESSURIZING CONTROLS

Figure 4-36



1 STATIC DISCHARGERS (6 PLACES)
▼ 2 AN/APN-12 RENDEZVOUS RADAR RECEIVER ANTENNA
3 GLIDE SLOPE ANTENNA
4 SEARCH RADAR ANTENNA
5 VHF RADIO ANTENNA
▼ 6 AN/APN-12 RENDEZVOUS RADAR TRANSMITTER ANTENNA
7 RADIO COMPASS LOOP ANTENNA
8 UHF NAVIGATION RADIO (TACAN) ANTENNA ✈ TCTO 572 ➡
9 RADIO ALTIMETER ANTENNAS (2 PLACES)
10 IFF ANTENNA
11 RADIO COMPASS SENSE ANTENNA
12 UHF RADIO ANTENNA
13 MARKER BEACON ANTENNA
▼ 14 AN/APN-76 RENDEZVOUS RADAR TRANSMITTER ANTENNA
15 UHF D/F ANTENNA 3178 ▶PLUS ✈ TCTO 321 ➡
16 MF COMMAND RADIO ANTENNA, AUXILIARY
LIAISON, LORAN 17206 ▶ 3177 LESS ✈ TCTO KG211 ➡
▼ 17 RADAR BEACON ANTENNA 3232 ▶PLUS ✈ TCTO K211 ➡
18 LIAISON RADIO, LORAN, AUXILIARY LIAISON 3178 ▶
LESS ✈ TCTO KG513 ➡
19 MF COMMAND RADIO ANTENNA 3178 ▶
PLUS ✈ TCTO KG211 ➡ AND ✈ TCTO KG513 ➡
20 VHF NAVIGATION RADIO (OMNI) ANTENNA
▼ 21 AN/APN-76 RENDEZVOUS RADAR RECEIVER ANTENNA

ANTENNA LOCATIONS

Figure 4-37

NAME	SYSTEM	AMP	TYPE	LOCATION
AN/APS-42 SEARCH RADAR				
RADAR NAV	DC	5	CIRCUIT BREAKER	RADIO RACK
RADAR NAV	AC	15	17260 ▶ 22700 FUSE	RADIO RACK
		15	22701 ▶ CIRCUIT BREAKER	RADIO RACK
RADAR PRESS	DC	5	CIRCUIT BREAKER	RADIO RACK
RADAR FEED	AC	25	17260 ▶ 22700 FUSE	AC POWER PANEL
		25	22701 ▶ CIRCUIT BREAKER	AC POWER PANEL
801	AC	5	FUSE	SYNCH, UNIT, LEFT FRONT
802	AC	3	FUSE	SYNCH, UNIT, RIGHT FRONT
401	AC	10	FUSE	RT UNIT, TOP
(NOTE: FUSE 401 IS INACTIVE ON LATER SETS)				
402	AC	8	FUSE	RT UNIT, MIDDLE
403	AC	3	FUSE	RT UNIT, BOTTOM
AN/APN-12 RENDEZVOUS RADAR				
INTGTR	DC	5	CIRCUIT BREAKER	RADIO RACK
INTGTR	AC	3	17260 ▶ 22700 FUSE	RADIO RACK
		5	22701 ▶ CIRCUIT BREAKER	RADIO RACK
RADAR FEED	AC	25	17260 ▶ 22700 FUSE	AC POWER PANEL
		25	22701 ▶ CIRCUIT BREAKER	AC POWER PANEL
AN/APN-76 RENDEZVOUS RADAR				
RESPNDR	DC	5	CIRCUIT BREAKER	RADIO RACK
RESPNDR	AC	3	17260 ▶ 22700 FUSE	RADIO RACK
		5	22701 ▶ CIRCUIT BREAKER	RADIO RACK
RADAR FEED	AC	25	17260 ▶ 22700 FUSE	AC POWER PANEL
		25	22701 ▶ CIRCUIT BREAKER	AC POWER PANEL
AN/APN-11 RADAR BEACON 17260 ▶ 3231 LESS 1C10 K211				
BEACON		5	CIRCUIT BREAKER	RADIO RACK
BEACON		5	CIRCUIT BREAKER	RADIO RACK
AN/APN-69 RADAR BEACON 3232 ▶ PLUS 1C10 K211				
RDZ BEACON	DC	5	CIRCUIT BREAKER	RADIO RACK
RDZ BEACON	AC	10	17260 ▶ 22700 FUSE	RADIO RACK
		10	22701 ▶ CIRCUIT BREAKER	RADIO RACK
RADAR BEACON APN-69	AC	15	17260 ▶ 22700 FUSE	ALTERNATOR RELAY SHIELD
		15	22701 ▶ CIRCUIT BREAKER	ALTERNATOR RELAY SHIELD
RADIO FEED	AC	15	17260 ▶ 22700 FUSE	AC POWER PANEL
		15	22701 ▶ CIRCUIT BREAKER	AC POWER PANEL
RADAR FEED	AC	25	17260 ▶ 22700 FUSE	AC POWER PANEL
		25	22701 ▶ CIRCUIT BREAKER	AC POWER PANEL
501	DC	1	FUSE	FRONT RT UNIT
502	AC	6	FUSE	FRONT RT UNIT
503	AC	3	FUSE	FRONT RT UNIT
504	AC	3	FUSE	FRONT RT UNIT

NAVIGATION EQUIPMENT CIRCUIT BREAKERS AND FUSES

Figure 4-38 (Sheet 1 of 3)

NAME	SYSTEM	AMP	TYPE	LOCATION
RADIO ALTIMETER				
ALTIMETER	AC	3	17260 ▶ 22700 FUSE	RADIO RACK
		5	22701 ▶ CIRCUIT BREAKER	RADIO RACK
RADIO FEED	AC	15	17260 ▶ 22700 FUSE	AC POWER PANEL
		15	22701 ▶ CIRCUIT BREAKER	AC POWER PANEL
LINE AMPL	AC	1 1/2	FUSE	RT UNIT
B-3 DRIFTMETER 17260 ▶ 22628 LESS TCTO K235				
DRIFTMETER	AC	1	17260 ▶ 22628 FUSE	AC POWER PANEL
B-6A DRIFTMETER 22629 ▶ PLUS TCTO K235				
DRIFTMETER A	AC	2	22629 ▶ 3141 FUSE	AC POWER PANEL
		2	3142 ▶ FUSE	AUTOPILOT POWER PANEL
DRIFTMETER C	AC	2	22629 ▶ 3141 FUSE	AC POWER PANEL
		2	3142 ▶ FUSE	AUTOPILOT POWER PANEL
AN/APN-70 LORAN				
LORAN	DC	5	17260 ▶ 22700 CIRCUIT BREAKER	RADIO RACK
REC ANT	DC	5	22701 ▶ CIRCUIT BREAKER	RADIO RACK
LORAN	AC	5	17260 ▶ 22700 FUSE	RADIO RACK
		5	22701 ▶ CIRCUIT BREAKER	RADIO RACK
RADIO FEED	AC	15	17260 ▶ 22700 FUSE	AC POWER PANEL
		15	22701 ▶ CIRCUIT BREAKER	AC POWER PANEL
PERISCOPIC SEXTANT 2860 ▶ PLUS TCTO 133	DC	5	CIRCUIT BREAKER	ENGINEER'S OVERHEAD PANEL
AN/ARN-14 VHF NAVIGATION RADIO (OMNI)				
OMNI REC		10	CIRCUIT BREAKER	AFT RADIO RACK (TAIL CONE)
OMNI TEST		5	CIRCUIT BREAKER	AFT RADIO RACK (TAIL CONE)
ENP-GND BLOWER & VOR	DC	35	CIRCUIT BREAKER	LOWER AFT MAIN POWER PANEL
OBD-VOR NAV WITHOUT TCTO 572	DC	5	CIRCUIT BREAKER	RADIO RACK
VOR-ILS NAV WITH TCTO 572	DC	5	CIRCUIT BREAKER	RADIO RACK
AN/ARN 21 UHF NAVIGATION RADIO (TACAN) WITH TCTO 572				
TACAN	AC	5	22701 ▶ CIRCUIT BREAKER	RADIO RACK
TACAN	AC	5	17260 ▶ 22700 FUSE	RADIO RACK
TACAN	DC	5	CIRCUIT BREAKER	RADIO RACK
VOR-ILS NAV	DC	5	CIRCUIT BREAKER	RADIO RACK

NAVIGATION EQUIPMENT CIRCUIT BREAKERS AND FUSES (CONT)

Figure 4-38 (Sheet 2 of 3)

NAME	SYSTEM	AMP	TYPE	LOCATION
AN/ARN-6 RADIO COMPASS				
NO. I COMPASS	DC	5	CIRCUIT BREAKER	RADIO RACK
OUTSIDE AIR TEMPERATURE GAGE				
TEMP CABIN, OAT AND HEATERS	DC	5	CIRCUIT BREAKER	ENGINEER'S OVERHEAD PANEL
N-1 COMPASS				
AUTOPILOT REPEAT	AC	3	17260 ▶ 22700 FUSE	AC POWER PANEL
		5	22701 ▶ CIRCUIT BREAKER	AC POWER PANEL
AUTOPILOT A	AC	5	17260 ▶ 22700 FUSE	AC POWER PANEL
		5	22701 ▶ 3177 CIRCUIT BREAKER	AC POWER PANEL
		5	3178 ▶ CIRCUIT BREAKER	AUTOPILOT POWER PANEL
AUTOPILOT C	AC	5	17260 ▶ 22700 FUSE	AC POWER PANEL
		5	22701 ▶ 3177 CIRCUIT BREAKER	AC POWER PANEL
		5	3178 ▶ CIRCUIT BREAKER	AUTOPILOT POWER PANEL
AUTOPILOT	DC	10	CIRCUIT BREAKER	ENGINEER'S OVERHEAD PANEL
AUTOPILOT INV	DC	5	CIRCUIT BREAKER	ENGINEER'S OVERHEAD PANEL
PANEL LIGHTS				
PANEL LIGHTS	DC	5	CIRCUIT BREAKER	RADIO RACK
NAV TABLE AND INSTRUMENT LIGHTS				
CONTROL CABIN LEFT RED-WHITE	DC	15	CIRCUIT BREAKER	ENGINEER'S OVERHEAD PANEL

Figure 4-38 (Sheet 3 of 3)

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Taxi	2	On fuselage nose and nose landing gear	Overhead panel	Overhead panel (Same as switch)
Passing Light (Red)	1	On fuselage nose	Overhead panel	Overhead panel (Same as switch)
Landing	2	Under each outboard wing aft of rear spar	Control stand	Overhead panel and Main C/B panel
Navigation	6	Wing tips, tail cone, top and bottom of fuselage	*Two switches on overhead panel	Overhead panel
Formation	9	Three on the upper surface of each wing, three on top of fuselage	Overhead panel	Overhead panel
Wing Illumination	2	One on each side of fuselage	Overhead panel	Overhead panel (Same as switch)
Anti-Collision TCTO 591	8	Top and bottom of fuselage, opposite wing leading edge	Overhead panel	Main C/B panel (lights) AC power panel (motors)
▼ **Boom Marking**	4	In boom nozzle hood	Two switches on boom operator's panel	Boom operator's panel
▼ **Boom Nozzle**	2	In boom nozzle hood	Two switch type rheostats on boom operator's panel	Boom operator's panel
▼ **Boom Chock**	1	Beside boom stowing chock	Boom operator's panel	Boom operator's panel (Same as switch)
▼ **Receiver Director Sta. 350**	10	Fuselage underside	Boom operator's panel	Boom operator's panel
▼ **Receiver Director Sta. 750** TCTO K526	18			
▼ **Inboard Nacelle Underwing**	4	Fuselage underside	Boom operator's panel	Boom operator's panel
▼ **Outboard Nacelle Underwing**	2	Fuselage underside	Boom operator's panel	Boom operator's panel
▼ **Underbody**	1	Fuselage underside	Boom operator's panel	Boom operator's panel
Wheel Well	3	One in each wheel well	Overhead panel	Overhead panel (Same as switch)
▼ **Rendezvous Beacon** 3196 ▶PLUS TCTO K231	2	Tail cone	Boom operator's panel	Boom operator's panel
		NOTE:	*Lights on wing and tail can be set for STEADY or FLASH; lights on fuselage remain on steady at all times lights are on.	

EXTERIOR LIGHTING

Figure 4-39

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Pilots' . . .				
Pilots' Instrument Panel (Right Side White)	3	Top of panel under crash pad hood	**Rheostat switch on pilot's auxiliary panel	Overhead panel
Pilots' Instrument Panel (Right Side Red)	4	Top of panel under crash pad hood	Switch type rheostat on copilot's auxiliary panel	Overhead panel
Pilots' Instrument Panel (Left Side White)	3	Top of panel under crash pad hood	**Rheostat switch on copilot's auxiliary panel	Overhead panel
Pilots' Instrument Panel (Left Side Red)	4	Top of panel under crash pad hood	Switch type rheostat on pilot's auxiliary panel	Overhead panel
Pilots' Instrument Panel (Center White)	4	Top of panel under crash pad hood	**Switch type rheostat on overhead panel	Overhead panel
● **Pilot's Instrument Panel (Center Red) 2930** ▶ PLUS ✈ TCTO 239	5	Top of panel under crash pad hood	Switch type rheostat on overhead panel	Overhead panel
Pilots' Control Column (Red)	2	Top forward side of control column	Same rheostat used for pilots' instrument panel left side red lights	Overhead panel
Copilot's Control Column (Red)	2	Top forward side of control column	Same rheostat used for pilots' instrument panel right side red lights	Overhead panel
Copilot's Auxiliary Panel (Red)	3	In tube at top of auxiliary panel	Switch type rheostat on copilot's auxiliary panel	Overhead panel
Pilot's Auxiliary Panel (Red)	3	In tube at top of auxiliary panel	Switch type rheostat on pilot's auxiliary panel	Overhead panel
Pilot's Dome (White)	1	Overhead	**Switch on pilot's auxiliary panel	Overhead panel
Copilot's Dome (White)	1	Overhead	**Switch on copilot's auxiliary panel	Overhead panel
● **Pilot's Map. (Red or White) 2930** ▶ PLUS ✈ TCTO 239	1	Left side of overhead panel	Switch type rheostat on side of overhead panel	Overhead panel
● **Copilot's Map. (Red or White) 2930** ▶ PLUS ✈ TCTO 239	1	Right side of overhead panel	Switch type rheostat on side of overhead panel	Overhead panel
● **Pilot's Compass Panel (Red) 2930** ▶ PLUS ✈ TCTO 239	1	Right side of pilots' instrument panel	Switch type rheostat on overhead panel	Overhead panel
Overhead Panel (White)	5	Vertical step portion of the panel sections	**Switch type rheostat on overhead panel	Overhead panel
● **Overhead Panel (Red) 2930** ▶ PLUS ✈ TCTO 239	7	Vertical step portion of the panel sections	Switch type rheostat on overhead panel	Radio junction box
● **Pilot's and Copilot's Interphone Filter 2930** ▶ PLUS ✈ TCTO 239	2	On filters	Same rheostat switch on overhead panel as for red overhead panel lights	Overhead panel
Pilot's and Copilot's Electronic Control Panel	22	On control panels for interphone, radio compass, VHF radio, liaison, UHF radio, and VHF navigation radio	Same rheostat switch on overhead panel as for control stand lights	Radio junction box

INTERIOR LIGHTING

Figure 4-40 (Sheet 1 of 5)

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Pilots' . . . (Cont)				
Pilot's and Copilot's Electronic Control 2901 ▶	6	On control panels for IFF and auxiliary liaison receiver	Same rheostat switch on overhead panel as for red overhead panel lights	Overhead panel
Navigator's . . .				
Navigator's Table Flood 3178 ▶	6 red 3 white	Over navigator's table, under instrument mount	RED--OFF--WHITE switch and rheostat switch on navigator's interphone and light panel	Overhead panel
Navigator's Table Work	1 white	Over navigator's table	Rheostat switch on navigator's: instrument panel interphone and light panel	Overhead panel
Navigator's Instrument 17260 ▶ 3177	4 red 3 white	In shield above and below instrument panel	***RED--OFF--WHITE switch and rheostat switch on navigator's: instrument panel auxiliary panel	Overhead panel
Navigator's Instrument Panel Flood 3178 ▶	2 red 1 white	In shield above instrument panel	RED--OFF--WHITE switch and rheostat switch on navigator's interphone and light panel	Overhead panel
Navigator's Instrument Lights 3178 ▶	14	In individual instruments	Rheostat switch on navigator's interphone and light panel	Overhead panel
Navigator's Radio Panel 17260 ▶ 3177	3 red 2 white	In light shield below panel	***RED--WHITE switch and rheostat switch on navigator's radio panel	Overhead panel
Navigator's Electronic Panel 17260 ▶ 3177 ▶	21 to 27	On control panels for interphone, radio compass, and also IFF on airplanes 17260 ▶ 2900, 3340 ▶	Rheostat switch on navigator's instrument panel	Radio junction box
Navigator's Radio Panel 3178 ▶ 3177		In individual electronic equipment	Rheostat switch on navigator's interphone and light panel	Radio junction box
Navigator's Auxiliary 3178 ▶	2 white	On aft end of instrument panel flood shield over oxygen regulator	Instrument panel flood rheostat switch on navigator's interphone and light panel	Overhead panel

INTERIOR LIGHTING (CONT)

Figure 4-40 (Sheet 2 of 5)

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Engineer's . . .				
Engineer's Table (White)	2	Over the engineer's table; under engineer's instrument panel	Switch and rheostat switch on engineer's auxiliary overhead panel	Overhead panel
Engineer's Table (Red)	3	Over the engineer's table; under engineer's instrument panel	Switch and rheostat switch on engineer's auxiliary overhead panel	Overhead panel
Engineer's Instrument Spot (Red)	1	On support post at engineer's station	Switch type rheostat on engineer's auxiliary overhead panel	Overhead panel
Engineer's Instrument Flood (Red)	2	At ceiling near center of fuselage	Switch type rheostat on engineer's auxiliary overhead panel	Overhead panel
● **Engineer's Dome (Red and White)** 2930 ▶ PLUS ✈ 1C10 239	1 each	Overhead at engineer's station	Switch and rheostat switch on engineer's auxiliary overhead panel	Overhead panel
● **Overhead Panel Spot (Red or White)**	4	On right and left side of control stand	Switch and rheostat on engineer's auxiliary overhead panel	Overhead panel
▼ **Engineer's A/R Panel Lights (1 Red and 1 White)** 2930 ▶ PLUS ✈ 1C10 239	2	Above engineer's auxiliary panel	Rheostat and color switch on engineer's auxiliary overhead panel	Overhead panel
● **Engineer's Interphone Control Panel** 2930 ▶ PLUS ✈ 1C10 239	4	On interphone control panel	Same switch and rheostat switch on engineer's auxiliary overhead panel as for engineer's overhead panel spot lights	Overhead panel
Boom Operator's . . .				
▼ **Boom Operator's Dome Lights (Same as Main Compartment Dome Lights)**				
▼ **Boom Operator's Spotlights (Red or White)**	2	Right and left of boom operator's station	Color switch on boom operator's panel	Boom operator's panel
▼ **Boom Operator's Panel Lights (White)**	4	Forward edges of boom operator's panel	Rheostat switch and color switch on boom operator's panel	Boom operator's panel
▼ **Boom Operator's Panel Lights (Red)**	7	Forward and aft edges of boom operator's panel	Rheostat switch and color switch on boom operator's panel	Boom operator's panel

Figure 4-40 (Sheet 3 of 5)

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Boom Operator's . . . (Cont)				
▼ **Boom Operator's Oxygen and Nitrogen Panel Floodlights (Red)**	2	Right and left side of boom operator's compartment	Rheostat switch and color switch on boom operator's panel	Boom operator's panel
▼ **Boom Operator's Oxygen Panel Floodlights (Red) 3106 ▶**	1	Left side of boom operator's compartment	Rheostat switch and color switch on boom operator's panel	Boom operator's panel
Compartment . . .				
▲ **Main Compartment Fluorescent 17260 ▶ 3267**	14	Overhead	*Adjacent to each right side light for five forward lights; adjacent to each left side light for two aft lights	AC power panel
Main Compartment Dome Lights	9	Overhead	One rheostat switch on right side of fuselage for each three lights; also one switch near control cabin door, one switch on right side of fuselage aft section and one switch on boom operator's panel each controlling all nine lights	Main circuit breaker panel
Lower Forward Compartment Dome	2	Overhead	Overhead in lower forward compartment adjacent to hatch	Forward power panel
Lower Aft Compartment Dome	3	Overhead	Overhead in aft compartment	Main circuit breaker panel
Stowage Compartment Dome	1	Overhead	Overhead in stowage compartment	Main circuit breaker panel
Tail Compartment Dome	2	Overhead	Forward side of pressure bulkhead on LH side above tail compartment access door	Main circuit breaker panel
Lower Nose Compartment	2	Overhead	Switch adjacent to light aft of hatch	Forward power panel
Spot Extension	2	One at auxiliary power unit and one in lower nose compartment	Switch on light	Forward power panel
Emergency Cabin Lights (Flashlights) 17260 ▶ 3141	8	One at each normal and emergency exit	Switch on lights	None

INTERIOR LIGHTING (CONT)

Figure 4-40 (Sheet 4 of 5)

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Control Cabin Miscellaneous . . .				
Entrance	1 white	Overhead in control cabin	One at top of ladder in lower forward cargo compartment and one in control cabin adjacent to the entrance light	Forward power panel
Aft Cabin Dome	2 red 1 white	Overhead in control cabin	***ON--OFF switch on navigator's: auxiliary panel support bracket for auxiliary liaison transmitter at control cabin bulkhead	Overhead panel
Dais Step	2 red	One under navigator's table and one near bottom of back side of engineer's panel	On overhead panel	Overhead panel
Crew Lavatory Dome	1 red 1 white	Overhead in crew lavatory	***In lavatory	Overhead panel

NOTE

* The master light switch at the aft side of control cabin door must be on to operate these lights

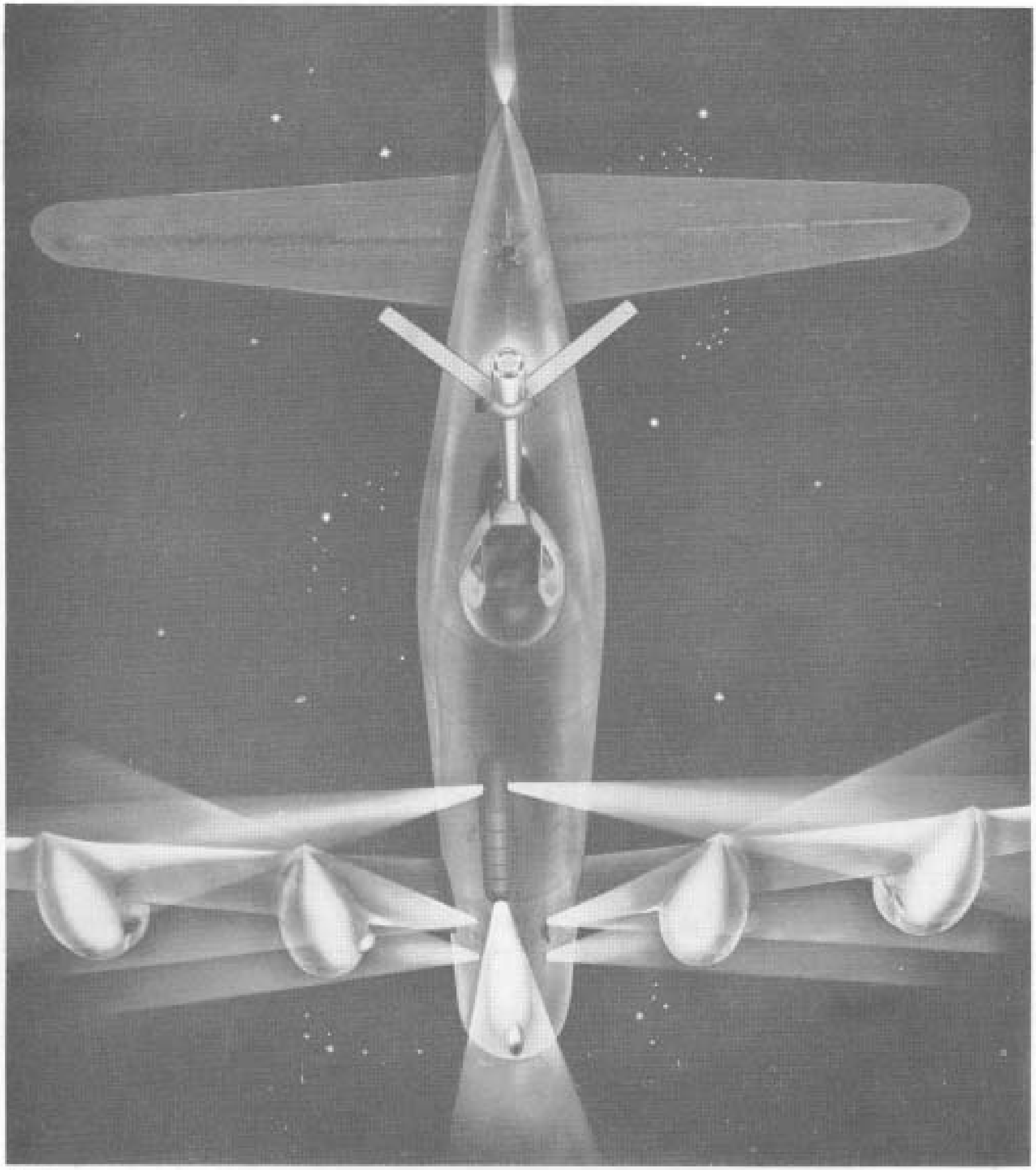
** Lights will illuminate to full intensity regardless of rheostat position when a master control cab lights switch on the overhead panel is positioned to WHITE BRIGHT

*** White lights will illuminate only when the master control cab aft light switch on the overhead panel is positioned to AFT WHITE

● These lights can be operated from battery power when the gyro instrument emergency power switch is in the BATTERY position

▲ Fluorescent lights are inoperative when the airplane is in the tanker configuration

Figure 4-40 (Sheet 5 of 5)



▼

AIR REFUELING FLOODLIGHTS ILLUMINATION

Lighted Area as Seen From Receiver Airplane

Figure 4-41

LIGHTING EQUIPMENT

EXTERIOR LIGHTS

The exterior lights all operate on DC power. See figure 4-39 for a listing of the lights, their locations and their switch and circuit breaker locations. A special group of exterior lights are provided for underbody illumination during night A/R missions. Figure 4-41 shows tanker A/R floodlighting as seen from a receiver airplane.

NOTE ICTO K591

> The anti-collision lights should be turned OFF during flights through conditions of reduced visibility where the pilot could experience vertigo as a result of the rotating reflections of the lights against the clouds. In addition, the lights would be ineffective as an anti-collision lights during these conditions since it could not be observed by pilots of other airplanes.

INTERIOR LIGHTS

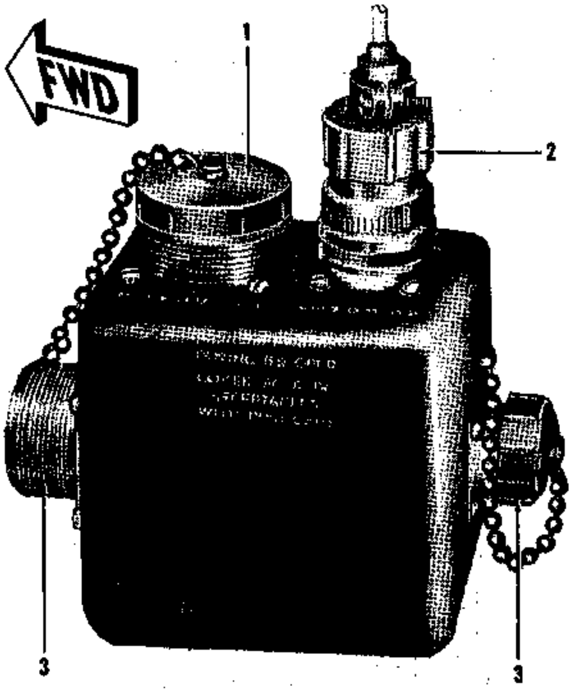
See figure 4-40 for a listing of interior lights, their locations and their switch and circuit breaker locations. A box of spare lamps is mounted on the aft left side of the control cabin bulkhead. Only the fluorescent lights operate on AC power. See figure 4-42.

NOTE

> Airplanes **3250**▶ do not have fluorescent lights, and on all other airplanes the fluorescent lights are inoperative when the airplane is in the tanker configuration.

OXYGEN SYSTEM

A gaseous oxygen system is installed for crew use in case of cabin pressurizing system failure. The oxygen system consists of two completely independent 400 psi systems. One system supplies the navigator, engineer, and copilot. The other system supplies the pilot, and on Code ▼T airplanes, the boom operator, boom instructor, and boom trainee. The pilot can be isolated in his system by a line shutoff valve. On airplanes **17260**▶ **3177** , no oxygen outlet is provided for the radio operator, therefore he must utilize a walk-around bottle, provided at the pilot's and copilot's stations, in the event use of oxygen becomes necessary. A common filler valve, figure 4-44 located inside the lower forward compartment just aft of the forward entry door is used to service both systems. Two G-1 cylinders, one for each system, are located in the lower nose compartment. Provision is also made for the installation of two additional G-1 cylinders near the top of the lower nose compartment if the additional oxygen is needed for the crew systems. These cylinders, when installed, are also filled from the common filler valve. On Cargo airplanes, a blinker type flow indicator and a diluter-demand regulator are provided for at each crew station. In addition to the aforementioned equipment, the pilot and copilot have an oxygen pressure gage provided for at their stations. On Tanker airplanes, a blinker type flow indicator and a diluter-demand regulator exist at all crew stations including the boom operator and two assistants. The pilot, copilot, and boom operator have an oxygen pressure gage at their stations in addition to the normal equipment on these airplanes. A pressure of 450 psi should not be exceeded when filling the oxygen system to 425 psi. Before takeoff, a minimum of 400 psi system pressure is required. Portable oxygen bottles are provided as shown in figure 3-1. In the control cabin, one



1 DC POWER RECEPTACLE
2 AC POWER RECEPTACLE
3 DUMMY RECEPTACLE

NOTE:
To transfer power from the engineer's A/R panel to the fluorescent light box, unscrew the two cannon plugs on the bottom of the engineer's A/R panel and attach them to the two receptacles on top of the fluorescent light box. This transfer should be made with power off.

FLUORESCENT LIGHT BOX

Figure 4-42

NOTE

This illustration shows the procedure for connecting the oxygen hose and does not necessarily reflect the type of head gear, oxygen mask and oxygen mask straps to be used.

1 WRAP MASK MALE CONNECTOR TIE-DOWN STRAP TWICE AROUND CHEST STRAP AS CLOSE TO SNAP AS POSSIBLE, AND FASTEN TO CONNECTOR

WARNING

- Failure to double loop the connector tie-down strap around the parachute chest strap may permit the tie-down strap to slip into and open the chest strap snap during egress.
- Do not wrap the tie-down strap around the chest strap snap.

2 CONNECT HOSE, LISTEN FOR CLICK AND CHECK THAT SEALING GASKET IS ONLY HALF EXPOSED

OXYGEN HOSE CONNECTION

Figure 4-43 (Sheet 1 of 2)

3 ATTACH ALLIGATOR CLIP TO THE END OF THE MASK MALE CONNECTOR STRAP

WARNING

Do not attach alligator clip to the parachute harness as this may prevent quick separation during egress. The force required to pull the clip loose from the parachute harness is considerably greater than from the tie-down strap.

4 PUT ON OXYGEN MASK AND CHECK OXYGEN FLOW INDICATOR
ATTACH BAILOUT BOTTLE HOSE TO MALE CONNECTOR (IF CARRIED)

Figure 4-43 (Sheet 2 of 2)

portable bottle, and recharger assembly are on the pilot's auxiliary panel, and one portable bottle and recharger assembly are forward of the engineer's instrument panel. On Code ▼ airplanes, a third portable bottle and recharger assembly is located forward of the boom operator's panel. Approximate oxygen duration for each crew member is shown in figure 4-45.

OXYGEN EQUIPMENT

Regulator Diluter Lever

A NORMAL OXYGEN--100% OXYGEN lever is located on each oxygen regulator. With the lever in the NORMAL OXYGEN position, the regulator automatically supplies the proper mixture of oxygen and air to the user up to a cabin altitude of 34,000 feet. Above 34,000 feet cabin altitude 100% pure oxygen is supplied the user. With the lever in the 100% OXYGEN position, the air intake port is closed and pure oxygen is supplied to the user for emergency use. The diluter lever is left in the NORMAL position except when treating for hypoxia, shock, noxious fumes or for denitrogenation.

Regulator Emergency Valve Knob

An emergency valve knob (16, figure 1-11) is provided on the regulator and is always safety-wired closed. This valve, when opened, supplies a continuous flow of 100% oxygen to the mask for emergency use.

Boom Operator's Shutoff Valve

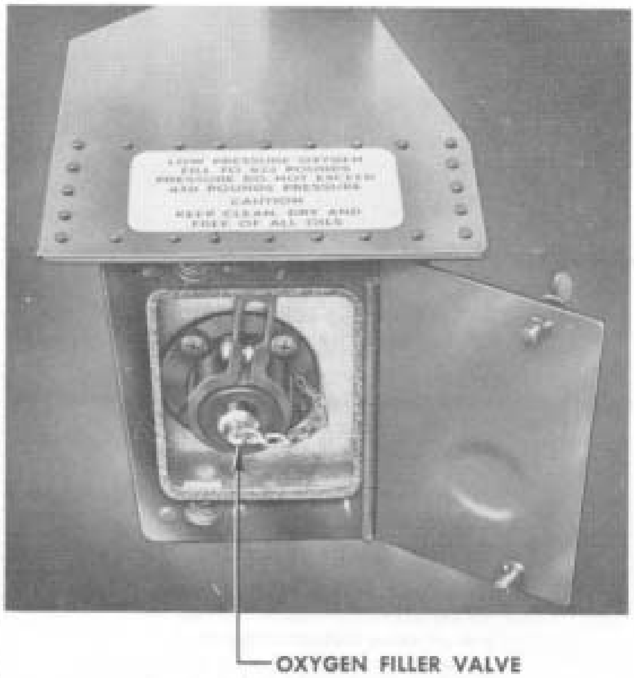
This handle operated valve is located in the oxygen line of the system which supplies the pilot and then runs aft to provide oxygen at the boom operator's station. When opened, this valve allows the boom operator, boom instructor, and boom trainee to use oxygen from the pilot's oxygen system. When the valve is closed, no oxygen will flow to these boom stations.

Oxygen Pressure Gages

Oxygen pressure gages (13, figure 1-11) are provided at the pilot's and copilot's station on all airplanes, and also at the boom operator's station on Tanker airplanes. The gages indicate system pressure in psi.

Oxygen Flow Indicators

A blinker-type oxygen flow indicator (12, figure 1-11) is provided near each crew member's oxygen regulator unit. Opening and closing of luminescent segments as the crew member breathes indicates normal flow of oxygen.



OXYGEN FILLER VALVE

Figure 4-44

OXYGEN SYSTEM NORMAL OPERATION

Oxygen Equipment Check

NOTE

The following procedure applies to each member unless otherwise noted.

1. Oxygen Pressure - 400 psi (minimum) (P, CP, BO)
2. Oxygen Hose - Blow gently into end of hose

If there is a resistance to blowing, the regulator is satisfactory, little or no resistance indicates a faulty demand diaphragm, diluter air valve or leaking mask to regulator hose.

WARNING

When performing the oxygen equipment check at low ambient temperatures, caution must be observed when blowing into the end of the oxygen hose. At temperatures near or below freezing the cold metal connector on the end of the oxygen tubing may stick to the operator's lips causing injury.

3. Mask - Don and connect mask hose to regulator

Oxygen Duration —HOURS

▼

Pilot

Boom Operator

Boom Instructor

Boom Trainee

•

Cylinders: 1 Type G-1
Crew: 4

CABIN ALTITUDE—FEET	GAGE PRESSURE—PSI							
	400	350	300	250	200	150	100	BELOW 100
30,000	1.1 **1.13**	0.9 **1.0**	0.8 **0.8**	0.6 **0.7**	0.5 **0.5**	0.3 **0.3**	0.2 **0.2**	EMERGENCY Descend to Altitude Not Requiring Oxygen
25,000	0.8 **1.1**	0.75 **0.9**	0.6 **0.8**	0.5 **0.6**	0.4 **0.5**	0.23 **0.3**	0.2 **0.2**	
20,000	0.6 **1.2**	0.53 **1.0**	0.5 **0.8**	0.4 **0.7**	0.3 **0.5**	0.2 **0.3**	0.1 **0.2**	
15,000	0.55 **1.4**	0.5 **1.2**	0.4 **1.1**	0.3 **0.8**	0.23 **0.6**	0.2 **0.4**	0.1 **0.2**	
10,000	0.4 **1.9**	0.4 **1.7**	0.3 **1.4**	0.23 **1.1**	0.2 **0.8**	0.1 **0.5**	0.1 **0.3**	

Light Figures Indicate Diluter Lever 100%

Black Block Figures Indicate Diluter Lever NORMAL

Oxygen Duration —HOURS

Copilot

Engineer

Navigator

•

Cylinders: 1 Type G-1
Crew: 3

CABIN ALTITUDE—FEET	GAGE PRESSURE—PSI							
	400	350	300	250	200	150	100	BELOW 100
30,000	1.5 **1.5**	1.2 **1.3**	1.1 **1.1**	0.8 **0.9**	0.7 **0.7**	0.4 **0.4**	0.3 **0.3**	EMERGENCY Descend to Altitude Not Requiring Oxygen
25,000	1.1 **1.5**	1.0 **1.2**	0.8 **1.1**	0.7 **0.8**	0.5 **0.7**	0.3 **0.4**	0.3 **0.3**	
20,000	0.8 **1.6**	0.7 **1.3**	0.7 **1.1**	0.5 **0.9**	0.4 **0.7**	0.3 **0.4**	0.1 **0.3**	
15,000	0.7 **1.9**	0.7 **1.6**	0.5 **1.5**	0.4 **1.1**	0.3 **0.8**	0.3 **0.5**	0.1 **0.3**	
10,000	0.5 **2.5**	0.5 **2.3**	0.4 **1.9**	0.3 **1.5**	0.3 **1.1**	0.1 **0.7**	0.1 **0.4**	

NOTE: As an airplane ascends to high altitudes, where the temperature is normally quite low, the oxygen cylinders become chilled. As the cylinders grow colder, the oxygen gage pressure is reduced, sometimes rather rapidly. With a 100°F decrease in temperature in the cylinders the gage pressure can be expected to drop 20 per cent. This rapid fall in pressure is occasionally a cause of unnecessary alarm. All the oxygen is still there, and as the airplane descends to warmer altitudes, the pressure will tend to rise again, so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the airplane is in level flight, or while it is descending, is not ordinarily due to falling temperature, of course. When this happens, leakage or loss of oxygen must be suspected.

OXYGEN DURATION

Figure 4-45

4. Diluter Lever - NORMAL, check for free flow of oxygen
5. Diluter Lever - 100% OXYGEN, check for free flow of oxygen
6. Diluter Lever - NORMAL
7. Emergency Valve - Closed and safetied
8. Mask - Remove and stowed
9. Oxygen Bottle - Serviced (if applicable) (BO)

In Flight

The regulator diluter lever on each crew member's pressure regulator should be in the NORMAL OXYGEN position except when operating under emergency conditions.

OXYGEN SYSTEM EMERGENCY OPERATION

With symtoms of hypoxia, or if smoke or fumes should enter the cabin, set the regulator diluter lever to 100% OXYGEN. If the regulator becomes inoperative, open the emergency valve by turning the red emergency knob counterclockwise.

WARNING

When the regulator diluter lever is placed in the 100% OXYGEN position or the emergency valve control knob is turned on, inform the pilot immediately because these actions will substantially reduce the duration of oxygen.

If the oxygen regulator becomes completely inoperative, disconnect the mask from the oxygen system and connect to a portable bottle.

WARNING

If the regulator becomes completely inoperative, the pilot should be informed immediately so that he can descend to an altitude not requiring oxygen.

AUTOPILOT

The airplane is equipped with a type F-1 electrically operated autopilot. The autopilot, when engaged, provides a system of automatic control which holds the airplane on any selected magnetic heading and returns it to this heading when momentary displacements occur, and simultaneously keeps the airplane stabilized in pitch and bank. While under autopilot control, the airplane can be made to climb, dive, and execute coordinated turns. Power for operation of the autopilot is provided by the autopilot inverter system. The autopilot inverter must be operating before the autopilot can be used. The DC control circuit is protected by a circuit breaker on the overhead circuit breaker panel (figure 1-34). Circuit protection is provided for the operating power circuits on the AC power panel (figure 1-34).

AUTOPILOT EQUIPMENT

N-1 Compass System

The N-1 compass system provides directional signals for autopilot control. The autopilot may be used during either slaved magnetic operation or directional indicator operation. See N-1 COMPASS SYSTEM OPERATION in this Section.

Copilot's Turn and Slip Indicator

The copilot's turn and slip indicator (21, figure 1-9), which is calibrated for two minute turns and functions as a rate control gyro unit, is located on the right side of the pilots' instrument panel, and automatically transmits a rate of turn signal to the rudder servo to stabilize the airplane in yaw. The unit serves as a conventional turn and slip indicator when the autopilot inverter is operating, even though the autopilot is not energized.

Copilot's Altitude Indicator

The copilot attitude indicator (15, figure 1-9), which functions as a vertical gyro control unit, is located on the right side of the pilots' instrument panel, and automatically transmits signals to the aileron and elevator servos, returning the airplane to the proper attitude in pitch or roll whenever displacement occurs with reference to the vertical seeking gyro. A caging knob located on the lower right corner of the unit is used to erect the axis of the gyros in the vertical gyro control unit and the remote gyro flux gage compass to the vertical axis of the airplane. When the autopilot is energized, but not engaged, the vertical gyro control unit serves as a conventional attitude indicator. The master direction indicator, copilot's attitude indicator, and copilot's turn and slip indicator operate continuously when the autopilot inverter is operating, even though the autopilot master switch is not in the ON position.

Autopilot Master Switch

An ON--OFF switch (37, figure 1-16) is located on the control stand. When the switch is in the ON position, power is supplied to the autopilot servo motors. When the switch is in the OFF position, the autopilot servos are de-energized.

Autopilot Clutch Switch

A push button switch (38, figure 1-16), located on the control stand, is used to engage the autopilot. When the switch is pushed in, four electrically operated clutches, one in each of the servos and one in the master direction indicator, are engaged. This connects the autopilot to the airplane control surfaces and permits signals from the master direction indicator to control the heading of the airplane.

Autopilot Release Switches

A push button type switch (4, figure 1-7 and 2, figure 1-8), located on each pilot's control wheel, is used to disengage the autopilot. When this switch is depressed, the autopilot clutch switch pops out, releasing the clutches and fully disengaging all automatic control.

Autopilot Emergency Disconnect Handle

An autopilot emergency disconnect handle (1, figure 1-16), located on the control stand, is used to manually disengage the servos from the control system of the airplane in event of electrical failure or other emergencies. When the handle is pulled, the servo pulleys are released and will turn freely when control surfaces are operated manually.

Autopilot Turn and Pitch Controller

An autopilot turn and pitch controller (40, figure 1-16) is provided on the control stand for maneuvering the airplane when the autopilot is engaged.

PITCH WHEEL

A knurled pitch wheel is located on the right side of the controller and UP--DOWN markings are provided above the wheel. When this wheel is rotated toward UP, the airplane will climb. When the wheel is rotated toward DOWN the airplane will dive. A climb or dive attitude up to 40 degrees is possible.

BANK TRIM WHEEL

A knurled bank trim wheel, marked LEFT--RIGHT is located on the left forward quarter of the controller. When this wheel is rotated in the RIGHT direction, the airplane will bank to the right. When the wheel is rotated in the LEFT direction, the airplane will bank to the left. Banks up to 10 degrees are possible. Do not use the bank trim wheel for making minor corrections to level wings or a change in heading will result.

TURN KNOB

A turn knob, located on the top of the controller, is provided with a central detent position. When the knob is rotated to the right from this central detent position, the airplane will make a right turn. When the knob is rotated to the left from the detent position, the airplane will make a left turn. As long as the knob is out of the detent position, the airplane will continue to make a coordinated turn. When the knob is returned to the detent position, the airplane will resume level flight.

AUTOPILOT NORMAL OPERATION

In order to prevent the autopilot from inadvertently engaging during critical flight conditions, the following precautions must be observed.

1. Do not place the autopilot master switch in the ON position until a safe altitude has been reached
2. The autopilot master switch must be in the OFF position during all refueling contacts
3. The autopilot master switch must be in the OFF position prior to landing

WARNING

Do not use autopilot during A/R operations. Inadequate or erratic autopilot functioning while in contact with a receiver airplane can result in structural damage to one or both airplanes.

Slave Magnetic Autopilot Operation

During slaved magnetic operation of the N-1 compass system, the airplane, when on autopilot control, will fly a magnetic heading. Operation of the autopilot during slaved magnetic operation of the N-1 compass is as follows:

1. Check that the N-1 compass system is on slaved magnetic operation. See N-1 COMPASS SYSTEM OPERATION in this Section
2. Engage the autopilot as described below

CAUTION

Do not operate the synchronizer knob when on autopilot control. If synchronization of the heading pointer has been accomplished in a direction opposite that indicated by the arrow on the synchronizer knob, the heading pointer will be 180° off from the correct magnetic heading. This can be checked by comparing the master direction indicator heading with the magnetic compass. Synchronizing 180° off from the correct heading is an unstable condition which, if left alone, will correct itself at a rate of approximately 3° per minute. During this time the airplane will alter course at the same rate and assume the new heading as described above. The heading pointer should not be repositioned during or immediately after turns as the system will remain in synchronization during and at the completion of the turn.

Direction Indicator Autopilot Operation

During directional indicator operation of the N-1 compass system, the airplane, when on autopilot control, will fly a gyro heading and approximate a great circle route (under a no wind condition). Directional indicator autopilot operation is especially useful in regions where the horizontal component of the earth's magnetic field is so weak or distorted as to be unreliable. Directional indicator autopilot operation is as follows:

1. Check that the N-1 compass system is on directional indicator operation. See N-1 COMPASS SYSTEM OPERATION in this Section
2. Set the desired reference heading on the indicator
3. Engage the autopilot as described below

NOTE

During directional indicator operation the heading on the master direction indicator is not referenced to the geographical coordinate system. If a constant gyro heading is maintained the airplane will fly a great circle route. Once the gyro heading is set, the synchronizer knob should not be adjusted at any time the autopilot is engaged.

Engaging The Autopilot

1. Check copilot's attitude indicator erected and uncaged
2. Check clutch switch out. Check autopilot inverter switch at AUTOPILOT INV
3. Turn autopilot master switch ON. Allow 1 minute for amplifier warm-up
4. Center the turn control and pitch controller
5. Trim airplane to fly hands off
6. Engage autopilot by pushing clutch switch in

CAUTION

Pilot must keep safety belt fastened when engaging autopilot to prevent being thrown from the seat in the event of autopilot malfunction. Maintain straight and level flight when engaging the autopilot and turn the autopilot off in the event of any uncontrolled action of the airplane.

Turns And Banks

Rotate the turn knob until the desired rate of turn is obtained. The bank attitude of the airplane may be changed by rotating the bank-trim wheel. Do not adjust bank trim during turns.

Climbs Or Dives

Rotate the pitch wheel to obtain the desired climb or dive rate.

Disengaging The Autopilot

The autopilot is disengaged by pressing either of the autopilot release switches, or by pulling out the autopilot clutch switch. The autopilot may also be disengaged by caging the copilot's attitude indicator. To prevent a disengage transient oscillation, check and adjust pitch control to center before disengagement.

AUTOPILOT EMERGENCY OPERATION

If the autopilot cannot be disengaged by pressing the autopilot release switches, or by pulling out the clutch switch, or by caging the copilot's attitude indicator, pull the autopilot emergency disconnect handle. The handle will pull out approximately eight inches. If the above steps fail, turn autopilot master switch and autopilot inverter switch OFF.

NOTE

If the autopilot emergency disconnect handle has been pulled, the autopilot cannot be re-engaged while in flight.

Autopilot Inverter Failure

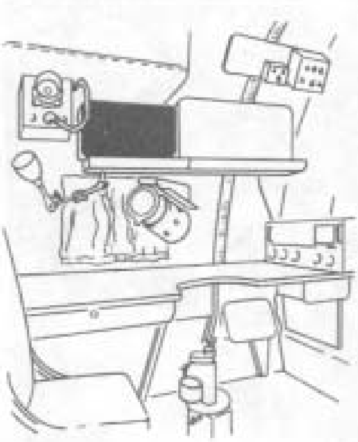
If the normal autopilot inverter fails, the spare inverter is automatically energized by the inverter changeover relay. If the changeover relay fails, as indicated by continued illumination of the red warning light, place the autopilot inverter switch in the SPARE INV position. If both autopilot inverters fail, the autopilot, copilot's turn and slip indicator and attitude indicator, the master direction indicator, and on airplanes **22629** ▶ plus those incorporating 1C10 K235, the driftmeter will cease to function. The red warning light indicating autopilot inverter failure will remain illuminated regardless of the position of the autopilot inverter switch. If the autopilot is engaged, pull the autopilot emergency disconnect handle. On airplanes **3250** ▶ , when operating on autopilot, the clutch switch will automatically disengage in the event of autopilot inverter failure.

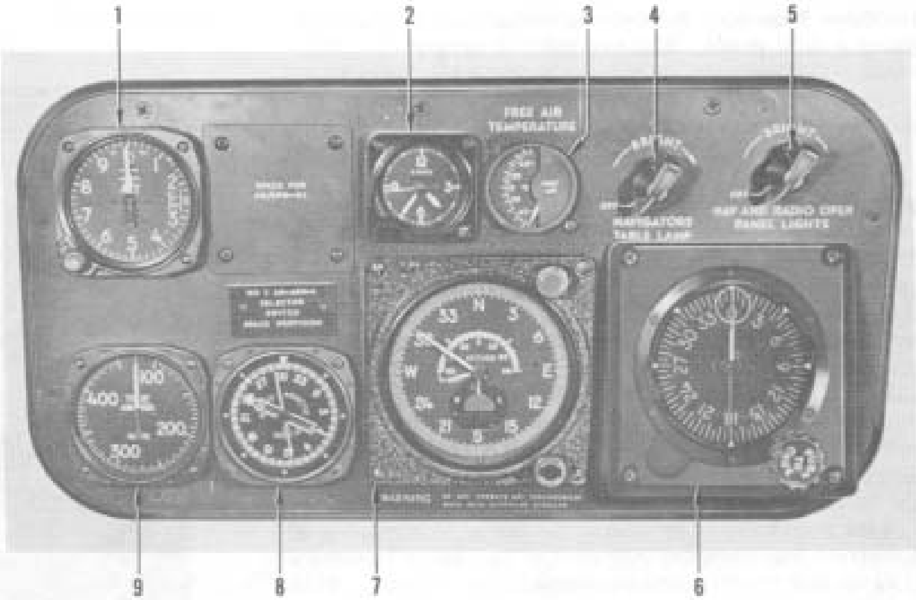
NAVIGATIONAL EQUIPMENT AND SYSTEMS

NAVIGATOR'S INSTRUMENT

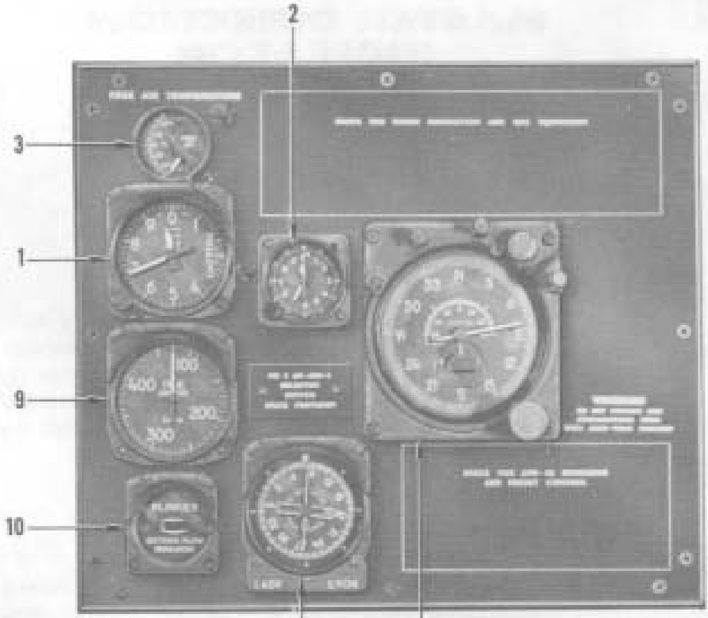
On airplanes **17260** ▶ **3177** , the navigator's instrument panel (figure 4-46) has a master directional indicator (N-1 Compass System), a radio magnetic indicator, an true airspeed indicator, an outside air temperature gage, an altimeter, a clock, two rheostats for operation of the navigator's flood and panel lights, and a directional indicator. The directional indicator only appears on airplanes **17260** ▶ **2859** . On airplanes **3178** ▶ ; the same instruments appear on the navigator's instrument board; however, the rheostats as well as the directional

17260 ▶3177

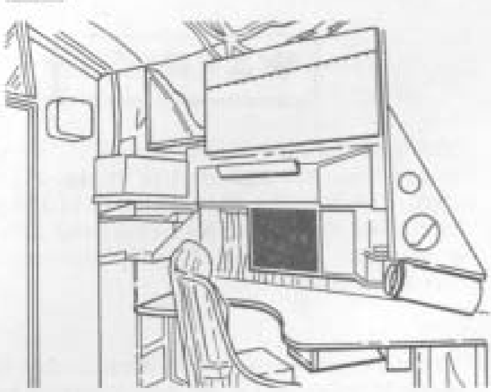




1 ALTIMETER (2 PLACES)
2 CLOCK (2 PLACES)
3 OUTSIDE AIR TEMPERATURE GAGE (2 PLACES)
4 NAVIGATOR'S TABLE LAMP RHEOSTAT
5 NAVIGATOR'S PANEL LIGHT RHEOSTAT
6 DIRECTION INDICATOR 17260 ▶2859
7 MASTER DIRECTION INDICATOR (N-1 COMPASS SYSTEM) (2 PLACES)
8 RADIO MAGNETIC INDICATOR (RMI) (2 PLACES)
9 TRUE AIRSPEED INDICATOR (2 PLACES)
10 OXYGEN FLOW INDICATOR



3178 ▶



NAVIGATOR'S INSTRUMENT PANEL

Figure 4-46

indicator have been deleted. Rheostats are on the navigator's light panel. The navigator's oxygen flow indicator which appears on the navigator's auxiliary panel (17, figure 4-15) on airplanes **17260** ▶ **3177**, now appears on this navigator's instrument board.

N-1 COMPASS SYSTEM

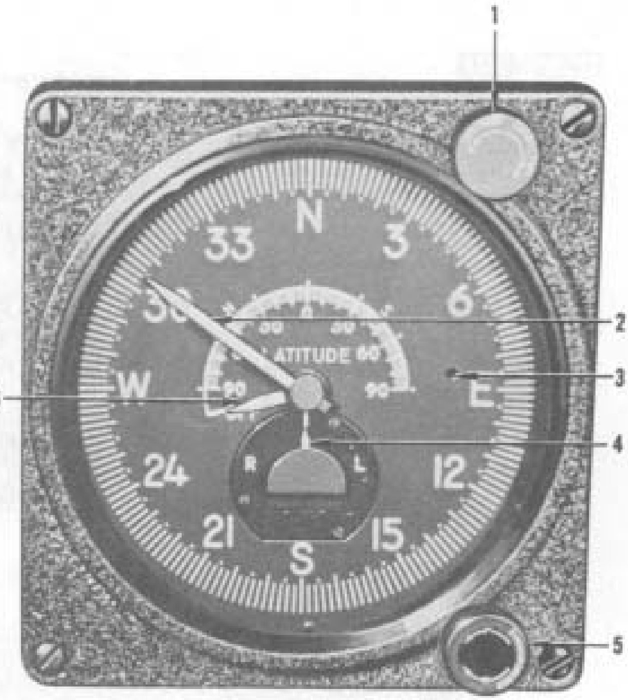
The basic component of the N-1 compass system is a gyro that can be controlled by two methods. The two methods are: (1) Magnetic-slaved operation whereby the gyro is used to stabilize magnetic heading indications and (2) Directional gyro operation using a manually selected correction to compensate for apparent gyro drift. (An uncorrected gyro appears to drift due to the rotation of the earth.) When operated as a directional gyro, corrected for latitude, the compass indicates the heading of the airplane relative to any arbitrary reference selected by the operator. Using this method of operation removes the influence of the earth's magnetism so that the compass functions in any locality. This is especially useful where the earth's magnetic field is too weak or distorted for magnetic-slaved operation. When operated as a magnetic slaved compass and the heading pointer is properly synchronized, the heading indication is the airplane's magnetic heading. This method of operation may be used in any locality except in high latitudes or in areas where severe magnetic distortion occurs. The controls for the system are on the master direction indicator (figure 4-47). The system is energized whenever there is 28 volt DC and 115 volt AC power on the airplane and the autopilot inverter in ON. The N-1 compass system furnishes heading data to the autopilot navigator's master direction indicator (figure 4-47), copilot's directional indicator (14, figure 1-9), and the radio magnetic indicators (RMI) at the pilot's, copilot's, and navigator's stations (17, figure 1-9 and 8, figure 4-46). Circuit protection is on the overhead circuit breaker panel (figure 1-34), marked FLIGHT INSTRUMENT, AUTO PILOT and the AC power panel (figure 1-34) marked DIRECTIONAL GYRO.

WARNING

The synchronizer knob should not be adjusted at any time the autopilot is engaged, since the autopilot reacts very rapidly to the signals received from the N-1 compass and an uncontrolled action of the airplane may result.

NOTE

The copilot's direction indicator displays the same heading as the master direction indicator within one degree and the radio magnetic indicator headings are within 2-1/2 degrees of the master direction indicator.



1 LATITUDE CORRECTION CONTROL KNOB
2 HEADING POINTER
3 CORRECTION INDICATOR PORT
4 ANNUNCIATOR POINTER
5 SYNCHRONIZER KNOB
6 LATITUDE CORRECTION POINTER

MASTER DIRECTION INDICATOR

Figure 4-47

Master Direction Indicator Controls

HEADING POINTER

The heading pointer (2, figure 4-47) indicates the correct magnetic heading while the compass is in magnetic-slaved operation (providing the pointer is properly synchronized), or deviations from a preselected heading during directional gyro operation. Heading indications are accurate within ± 1/2 degree.

LATITUDE CORRECTION CONTROL KNOB

The function of this knob (1, figure 4-47) is to switch from magnetic-slaved operation to directional-gyro operation or vice versa, and to adjust the latitude correction setting. Refer to LATITUDE CORRECTION POINTER.

LATITUDE CORRECTION POINTER

The latitude correction control knob (1, figure 4-47) positions the latitude correction pointer (6, figure 4-47) with respect to the latitude scale at the center of the master indicator dial face. The scale has an OFF position and is marked in 2 degree increments clockwise from 90 degrees N through 0 degrees to 90 degrees S. When the pointer is in the OFF position, the compass operates as a magnetic slaved compass. Moving the pointer to the latitude scale switches the compass to the directional gyro mode of operation and corrections are applied to the gyro to maintain accurate headings for the latitude selected. The indicated latitude should be ± 1 degree from the airplane's position and should be changed to mid-latitude for each 2 degrees change in latitude.

SYNCHRONIZER KNOB

During directional-gyro operation, the synchronizer knob (5, figure 4-47) is used to set the heading pointer to any desired position (usually repositioned for grid navigation reference). During magnetic-slaved operation, the compass maintains synchronization automatically; however, when the compass is first energized or changed from DG to MAG operation, the annunciator may indicate that the heading pointer is not synchronized with the earth's magnetic field. The knob may be turned in the direction indicated by the annunciator to bring the compass into synchronization more rapidly.

NOTE

> Rotation of this knob in flight affects all systems using N-1 compass heading information and will cause the airplane to turn when the autopilot is engaged.

ANNUNCIATOR (N-1 Compass)

The annunciator, operative only during magnetic-slaved operation, consists of a dial and pointer (4, figure 4-47). The pointer indicates the direction in which to rotate the synchronizer knob to align the heading pointer with the earth's magnetic field. When the pointer is centered the compass is synchronized. A 30 degree deflection of the pointer from center indicates that the heading pointer has an error of approximately 3 to 5 degrees.

CORRECTION INDICATOR PORT

The intermittent appearance of the small white dot behind the correction indicator port (3, figure 4-47) indicates that the compass system is being corrected. During directional gyro operation, the white dot rotates CW in North latitudes and CCW in South latitudes; and, the setting of the lattitude correction pointer governs the rate of correction. The corrections applied during magnetic-slaved operation keeps the gyro "slaved." In this mode of operation, the white dot rotates CW when the annunciator is in the R area and CCW when in the L area.

N-1 Compass System Operation

The N-1 compass system is energized whenever the autopilot inverter is operating. The system should be allowed to warm-up for 10 minutes after being energized so that the gyros may stabilize.

SLAVED MAGNETIC OPERATION

The N-1 compass system is put into slaved magnetic operation as follows:

1. Check that the autopilot inverter is operating
2. Allow 10 minutes for the system to warm-up and the gyros to stabilize.
3. Rotate the latitude correction control knob on the master direction indicator so that the latitude correction pointer is at the OFF position. This slaves the indicator to the remote compass transmitter
4. Synchronize the heading pointer by rotating the synchronizer knob in the direction indicated by the annunciator pointer

NOTE

> It is merely necessary to rotate the synchronizer knob until the annunciator pointer is approximately centered, then allow 1 or 2 minutes for the system to drive into synchronization.

5. Check the indication of the heading pointer against the copilot's magnetic compass to avoid an ambiguous heading

CAUTION

> If synchronization is accomplished in a direction opposite that indicated by the arrow on the synchronizer knob, the heading pointer will be 180° off the correct magnetic heading. This is an unstable condition which will correct itself if left alone, at an approximate rate of 3° per minute. If the airplane is on autopilot control, it will change its heading at approximately 3° per minute and assume the new heading. See AUTOPILOT NORMAL OPERATION in this Section. Do not synchronize the heading pointer during or immediately after turns, or whenever the autopilot is engaged.

6. Check the correction indicator (white dot) occasionally. Rotation of the dot indicates the system is operating properly

DIRECTION INDICATOR OPERATION

Direction indicator operation is to be used when the earth's magnetic field is too weak or distorted to be reliable. Such as in regions near the earth's magnetic poles. Direction indicator operation is initiated as follows:

1. Rotate the latitude correction control knob clockwise until the latitude correction pointer indicates the latitude of the airplane position. This isolates the remote compass transmitter from the system and switches to direction indicator operation
2. As the airplane changes position, the latitude correction pointer should be reset progressively to the new latitude

NOTE

Setting the mid-latitude every 2° will generally be sufficient for proper operation.

3. The reference heading may be set as desired by engaging and rotating the synchronizing knob

CAUTION

Do not reposition the heading pointer at any time the autopilot is engaged, as erroneous headings may result. Set the desired reference heading on the indicator before engaging the autopilot.

4. Observe the correction indicator (white dot) occasionally, for proper operation. The dot will rotate clockwise in north latitudes and counterclockwise in south latitudes

PERISCOPE SEXTANT AND MOUNT 2860 ▶ plus FC10 133

A periscopic sextant is stowed on the lower forward side of the engineer's instrument panel support, just aft of the copilot's seat. Access to the periscopic sextant is from the crew passageway outboard of the engineer's panel. When being used, the sextant is mounted on a support on the ceiling of the control cabin. The periscopic sextant mount is between the overhead windows in the control cabin. A receptacle on the mount is provided to furnish power to the sextant. Control power is 28 volt DC with circuit protection on the overhead circuit breaker panel.

Periscopic Sextant And Mount Controls

ILLUMINATION SWITCH

This on-off toggle switch (21, figure 4-48) on the mount controls illumination. The illumination of the bubble and the azimuth scale of the mount is adjustable by rheostat. No adjustment is provided to control the illumination of the mount counter, sextant counter, averager indices or the navigator's watch.

EYEPIECE

The eyepiece (8, figure 4-48) on the sextant is adjustable from -2 to +2 diopters for focusing.

FILTER ADJUSTMENT SELECTOR

This selector (11, figure 4-48) on the sextant allows the operator to select filters of various densities, so that the intensity of the sun's light may be adequately reduced.

DRAIN PLUG

This plug (20, figure 4-48) on the mount is provided at the two point in the shutter retraction well for draining any water which might have collected in the mount.

CRANK

A crank (15, figure 4-48) on the mount is provided to set indications on the azimuth counter. As the crank is turned, a slight hesitation can be felt at each 10° mark - a useful feature when a setting is to be made.

LOCKING LEVER

This lever (18, figure 4-48) on the mount, when unlocked allows the sextant and mount to be rotated freely. When the lever is locked, the sextant should not rotate in any direction.

DIFFUSER LEVER

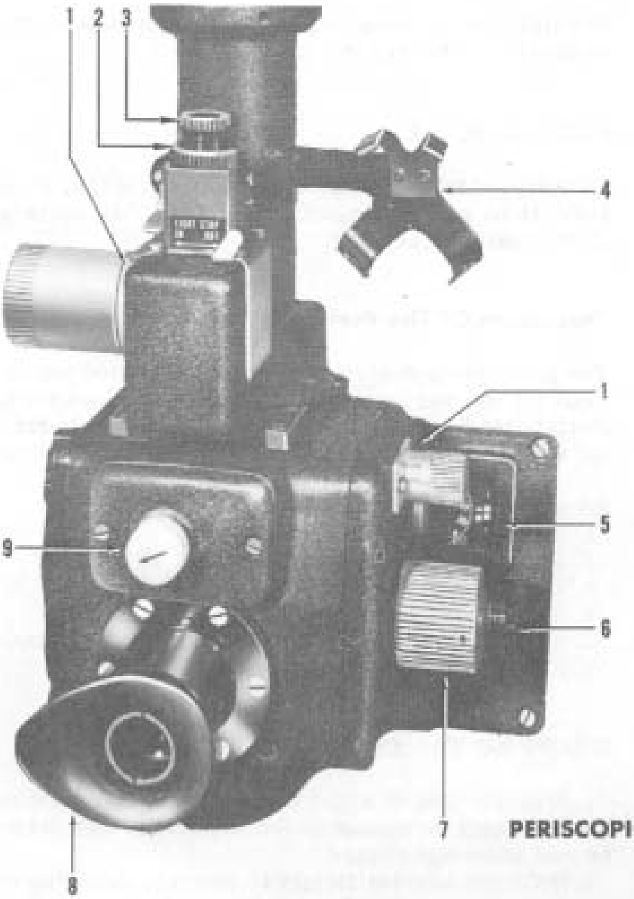
This lever (10, figure 4-48) on the sextant, when operated, obstructs the image of the scale when true heading readings are not required. This however does not detract from the effective illumination of the bubble.

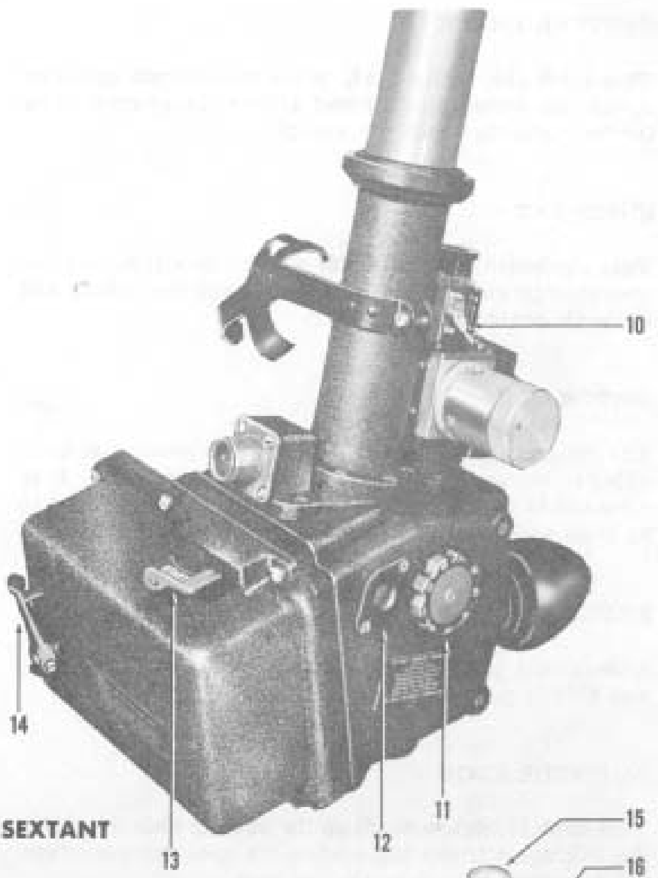
AVERAGER WINDING LEVER

This lever (14, figure 4-48) is on the sextant and allows the operator to wind the averager.

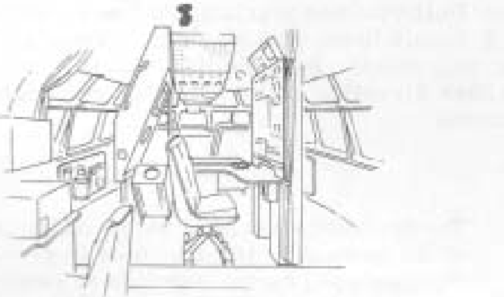
ACTUATION LEVER

This lever (13, figure 4-48) on the sextant is provided to start and stop the averager.

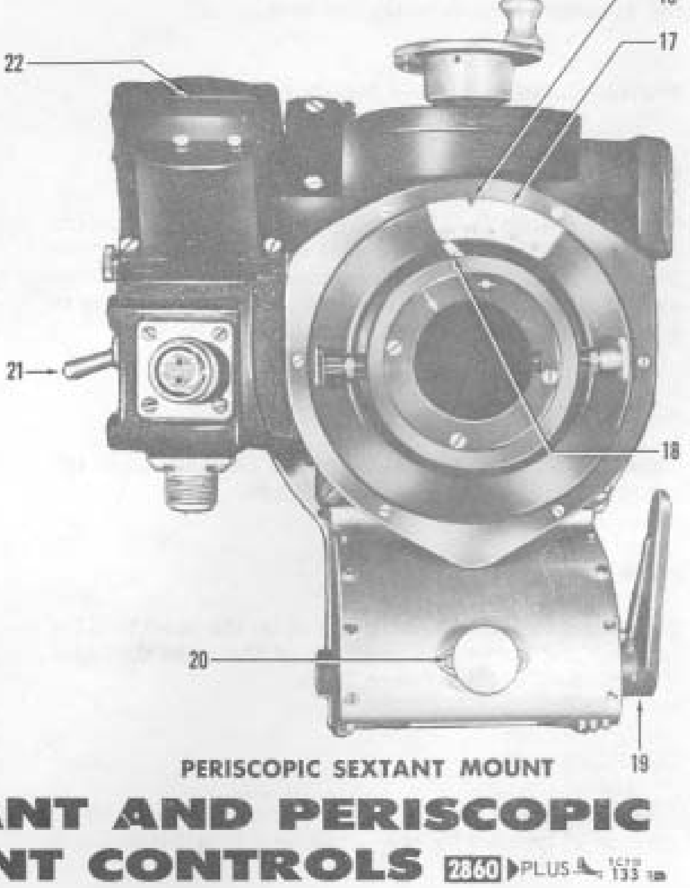




PERISCOPIC SEXTANT



1 LAMP (2 PLACES)
2 PROJECTION LENS LOCKING RING
3 PROJECTION LENS ADJUSTMENT RING
4 WATCH CLIP
5 HALFTIME DIAL AND AVERAGER INDICATOR
6 ALTITUDE COUNTER
7 ALTITUDE KNOB
8 EYEPIECE
9 RHEOSTAT
10 DIFFUSER LEVER
11 FILTER ADJUSTMENT SELECTOR
12 DESICCANT
13 ACTUATION LEVER
14 AVERAGER WINDING LEVER
15 CRANK
16 LUBBER LINE
17 AZIMUTH SCALE
18 LOCKING LEVER
19 SHUTTER LEVER
20 DRAIN PLUG
21 ILLUMINATION SWITCH
22 AZIMUTH COUNTER



PERISCOPIC SEXTANT MOUNT

PERISCOPIC SEXTANT AND PERISCOPIC SEXTANT MOUNT CONTROLS 2860 ▶PLUS 133

Figure 4-48

SHUTTER LEVER

This lever (19, figure 4-48) on the mount when operated opens the mount shutter and allows the sextant to be further inserted into the mount.

RHEOSTAT

This rheostat (9, figure 4-48) on the sextant, allows the operator to control the illumination of the bubble and azimuth scale.

WATCH CLIP

The watch clip (4, figure 4-48) on the sextant is provided to securely hold special navigator watches. It is mounted in such a position as to allow the watch face to be read with the eye in line with the eyepiece position.

DESICCANT

A desiccant (12, figure 4-48) is located on the sextant and aids in preventing moisture.

ALTITUDE KNOB

This knob (7, figure 4-48) on the sextant aids in finding the average altitude angle when the opeartor recenters the averager indices using the knob.

Periscopic Sextant And Mount Indicators

HALF TIME DIAL AND AVERAGER INDICATOR

This indicator (5, figure 4-48) is on the periscopic sextant. This is a time dial graduated in seconds indicating the half time of an observation, which indication may be added directly to the time of start to give the mean time of the average altitude.

ALTITUDE COUNTER

This counter (6, figure 4-48) on the sextant allows the operator to read the average altitude.

AZIMUTH COUNTER

This counter (22, figure 4-48) is on the mount. This counter indicates the position of the azimuth scale with respect to the lubbers line.

LUBBERS LINE

A lubbers line (16, figure 4-48) on the mount which may be aligned with the airplanes longitudinal axis to establish a lubbers line, provides indication of azimuth on the scale.

AZIMUTH SCALE

An independently rotatable azimuth scale (17, figure 4-48) is on periscopic sextant mount. This scale indicates azimuth heading.

Operation Of The Periscopic Sextant

The procedures described below are detailed instructions on the various operational techniques for the Periscopic Sextant. Personnel not completely familiar with the equipment should study them carefully.

Six procedures are discussed

1. Inserting the sextant
2. Forming and adjusting the bubble
3. Time dial check
4. Altitude average check
5. Alignment of sextant and mount in the airplane
6. Removal of the sextant from the mount

INSERTING THE SEXTANT IN THE MOUNT

1. With the line of sight locking lever on mount unlocked, insert the sextant as far as possible with arrows on tube and mount aligned
2. Hold the sextant firmly to prevent dropping and rotate the lower ring of mount counterclockwise (looking up, toward mount) until it hits a stop
3. Pull out knob marked, To Insert, Remove--Pull
4. Rotate lower ring on mount further allowing knob to seat itself. Be sure the sextant cannot rotate in either direction with the line of sight locking lever locked

NOTE

> The provision of stops in the retracted position of the sextant is intended only to prevent its being dropped during insertion or removal. It is not advisable to leave the sextant in the retracted position for any extended period, particularly during rough weather. When the sextant is removed from the mount, it should be returned to the carrying case and secured.

5. Open the mount shutter with lever
6. Insert sextant further until knob marked To Retract Sextant-Pull snaps into place
7. Make connections between the mount and the sextant with the electrical cable

WARNING

> In the case of pressurized airplane, do not open the shutter of mount until after the sextant has been inserted to its retracted position.

FORMING AND ADJUSTING THE SIZE OF THE BUBBLE.

Focusing Sextant
With switch on the mount in the ON position, adjust the intensity of illumination with rheostat by looking through the eyepiece and rotating the rheostat knob. Focus on the reticle image, by turning eyepiece and the bubble will be in focus.

To Form A Bubble In The Field Of View:
1. Set increase bubble knob to minimum position
2. Tilt sextant to the right
3. Slowly rotate the knob
4. A bubble will be formed at the notch, visible on the right hand side of the field of view
5. Rotate knob slowly back and forth until proper size bubble is obtained
6. Move sextant to vertical position, i.e. when the bubble is in the center of the field of view
7. Slowly rotate knob to maximum increase position

Bubble Already Formed And Of The Desired Size:
1. Under this condition, there is nothing to do except to put the bubble in focus by turning the eyepiece
2. Check to be sure the increase bubble knob is in maximum increase position

Bubble In Field Of View Is Too Large:
1. With sextant in the vertical position, rotate increase bubble knob to maximum position
2. Tilt sextant to the right and center the bubble in the notch
3. Slowly rotate the knob to reduce the size of the bubble
4. If the travel of the knob is reached without reducing bubble to the desired size, repeat cycle
5. When desired bubble size is obtained, move sextant to vertical (bubble located near intersection of reticle)
6. Slowly rotate knob to maximum increase position

Bubble In The Field Of View Is Too Small:
1. Knob is rotated to minimum increase position with sextant vertical
2. Tilt sextant to right and center the bubble in the notch
3. Slowly rotate the knob, to increase size of bubble
4. If the travel of the knob is reached without increasing bubble to the desired size, repeat cycle
5. When desired bubble size is obtained, return sextant to vertical and slowly rotate knob to maximum increase position. Suggested size of bubble is about 1-1/2 to 2 degrees (the sun appears to subtend about one degree)

NOTE

Little or nothing will happen to bubble size unless it is resting in the notch when the knob is turned. Tilting the sextant will permit the fluid level in the air chamber to uncover the transfer port allowing air to be drawn into the bubble chamber for bubble formation. In the vertical position the fluid level in the air chamber will be above the transfer port and fluid instead of air will be drawn into the bubble chamber. Except when adjusting the bubble, the increase bubble knob is to be kept at full increase at all times. The knob encloses a compensation system for changes and variations in temperature and pressure. When the knob is set at maximum position, the compensation system has its full range. When the sextant is not in use, location or size of the bubble is not important.

TIME DIAL CHECK

Fully depress the averager rewind lever and release slowly. Averager will operate for three seconds, then stop automatically. Time dial should indicate zero. Depress and release the averager actuating button, noting time to nearest second when sextant starts. Note time when shutter clicks closed. The time dial should read 59 when shutter clicks since shutter closes two seconds before averager stops. Double dial reading since it indicates half time and compare to watch reading. The readings should agree within plus or minus two seconds.

ALTITUDE AVERAGER CHECK

To check the accuracy of the altitude averager, proceed with the following steps:
1. Depress and release the averager rewind lever

CAUTION

This should wind the averager, zero the time dial and raise the shutter. Do not change altitude setting during three-second interval immediately after releasing the averager rewind lever.

2. Turn the altitude knob until exactly 13°00' is set in the altitude counter
3. Start the sextant by depressing and releasing the averager actuating button
4. Stop sextant when time reads exactly 15
5. Reset altitude counter to exactly 12°00' and restart sextant
6. Stop sextant when time dial reads 30
7. Reset altitude counter to exactly 8°00' and restart sextant
8. Stop sextant when time dial reads 45
9. Reset altitude counter to exactly 7°00' and restart sextant. When time cycle for averager is complete, the averager stops automatically
10. Rotate altitude knob until red blocks on altitude counter are aligned. Altitude counter should read 10°00' plus or minus 2 minutes

Alignment Of Sextant And Mount With Airplane

ADJUSTMENT OF AZIMUTH COUNTER AND SCALE ON MOUNT

1. Set 000.0 degrees in the azimuth counter
2. With the sextant in the operating position, the diffuser lever in out position, the line of sight locking lever open, sight forward. Focus on the reticle image by turning eyepiece. Sighting through the sextant eyepiece and ignoring all other objects, the azimuth scale as read against the lubbers line should agree to within 0.1 degree with the setting on the azimuth counter to assure proper alignment of the mount. Recheck to see that the aximuth counter reading has not been changed inadvertently

OPTICAL ADJUSTMENT OF PROJECTION LENS ASSEMBLY

1. With sextant in the operating position in the mount the diffuser lever must be in the out position and the true heading scale will be visible in the lower part of the field of view
2. Rotate sextant until lubbers line and vertical reticle line are coincident or nearly coincident. Ignore all other objects in the field of view
3. Lock line of sight locking lever
4. Check for parallax between lubbers line and vertical reticle line keeping bubble near center of reticle pattern

NOTE

> Parallax, as it applies here, is the apparent movement of the image of the lubbers line (or azimuth scale), relative to the vertical line of the reticle, or vice versa, as the operator's head is moved from side to side. Parallax is to be avoided.

5. If satisfied that no parallax exists, the sextant and mount are to be considered as optically adjusted but not aligned. If no satisfied, proceed as follows:
   a. Loosen the projection lens locking ring and rotate the projection lens so that it moves either up or down. The lubbers line will appear to move in an elliptical path, making a complete cycle for each revolution of the lens
   b. Rotate the lens as many times as necessary to position the lubbers line at one of the uppermost positions in its elliptical path, and at the same time produce a sharp image of the lubbers line plus a distinct lack of parallax as described in the above note
   c. With the locking ring loosened, be sure the lubbers line is at the uppermost position of its travel in an elliptical path as the projection lens is rotated back and forth. Disregard the relative position of the vertical line of the reticle and lubbers line. Lock the projection lens locking ring without further movement of the projection lens

ALIGNMENT OF SEXTANT AND MOUNT

1. The relative bearing of the vertical stabilizer is 180°00' and affords the easiest point on which to check sextant alignment with the longitudinal axis of the airplane

NOTE

> Relative bearing is defined as the angle between the airplane's longitudinal axis and the line-of-sight to the object (Vertical stabilizer).

2. Small errors may be introduced by parallax when sighting on a nearby object such as the vertical stabilizer. (The average of several settings may be used, if desired, to improve accuracy when using a nearby object)
3. Crank the azimuth counter to read exactly 000.0 degree
4. With the sextant inserted in the mount, the line-of-sight locking lever unlocked and the bubble centered in the field, sight on the vertical stabilizer and lock the line-of-sight locking lever. Sighting on the stabilizer may involve both adjusting the altitude control knob and rotating the sextant in azimuth. Select a suitable filter so that both stabilizer and azimuth scale can be seen simultaneously

NOTE

> If lighting conditions do not permit simultaneous viewing of both stabilizer and scale, it may be necessary to change the filter adjustments to use a darker filter to see the scale.

If more light is required against the azimuth scale than is provided by the sextant, use of a flashlight or C-4 type cockpit light is recommended. If scale is blurred, the eyepiece of the sextant should be focused. During darkness it may be necessary to use an aldis lamp to illuminate the vertical stabilizer

5. When sighting as described above, the vertical line of the reticle, stabilizer and 180° on the azimuth scale should coincide
6. If an error greater than 1/4 degree exists between the stabilizer and 180 degrees on the azimuth scale as viewed through the eyepiece, it may be corrected by rotating the projection lens which is mounted on top of the bubble cell. This may be done in the following manner:
   a. Loosen the projection lens locking ring.
   b. Sight through the eyepiece and rotate the projection lens in either direction until the 180 degree

mark of the azimuth scale is brought to coincide with the vertical line of the reticle and the stabilizer

NOTE

Rotation of the projection lens will cause the image of the azimuth scale and the lubbers line to appear to move in an elliptical path, giving two settings (high and low) where coincidence will occur. The higher of the settings should be selected.

c. Secure the projection lens with the lock ring
d. The projection lens has a range of approximately 2 to 3 degrees which should be sufficient to allow proper alignment. If unable to properly align, record the difference. This difference will have to be applied in the same direction to any heading read during flight. If this condition occurs on only one sextant, the sextant may require overhaul. If this condition occurs with several sextants in the same mount, it is indicative of the lubbers line of the mount not being in alignment with the longitudinal axis of the airplane

Removal Of Sextant From The Mount

1. Turn switch to the OFF position, and disconnect the electrical cable
2. Holding the sextant securely with one hand, pull out knot marked. To Retract Sextant--Pull and lower the sextant to the retracted position
3. Close the mount shutter
4. Holding the sextant securely with one hand, pull out knob marked, To Insert, Remove--Pull and rotate the lower ring on the mount counterclockwise until arrows on tube and mount are aligned
5. Sextant will then be free to be lowered until completely removed
6. Turn it to the carrying case and secure as shown

CAUTION

Before replacing sextants in the carrying case always press actuating lever or button, allowing the averager to run down and always rotate bubble knob to maximum increase position.

DRIFTMETERS

An electrically driven gyro-stabilized driftmeter (12, figure 4-15 and 16, figure 4-16) is installed at the navigator's station. The driftmeter provides an accurate means of determining angle and degree of deviation from a predetermined course of flight. It also furnishes data from which ground speed and wind velocity can be determined. On airplanes **17260** ▶ **22628** less those with TC10 K235 incorporated, the B-3 driftmeter is used. On airplanes **22629** ▶ plus those with TC10 K235 incorporated, the B-6A driftmeter replaces the type B-3. On airplanes **17260** ▶ **3177**, the driftmeter gyromotor is turned on and off by an ON--OFF switch on the navigator's auxiliary panel (17, figure 4-15) at the navigator's station. On airplanes **3178** ▶, the gyromotor driftmeter switch (5, figure 4-10) is located on the navigator's interphone and light panels. The motor is protected by a fuse on the AC power panel (figure 1-34).

B-3 Driftmeter **17260** ▶ **22628** less TC10 K235

RHEOSTAT KNOB

A rheostat knob and pointer (2, figure 4-49) on the top of the upper gyro housing, is used to turn the three-volt lamp on and off and to control its brightness.

GYRO SWITCH

A switch (3, figure 4-49) for starting and stopping the gyro is mounted on the side of the lower gyro housing.

GYRO CAGING KNOB

The caging knob (4, figure 4-49) located at the bottom of the lower gyro housing operates a mechanism which holds the gyro in a vertical position when it is not in use, or when it is tipped too far from the vertical during maneuvers.

SLOW-MOTION KNOB

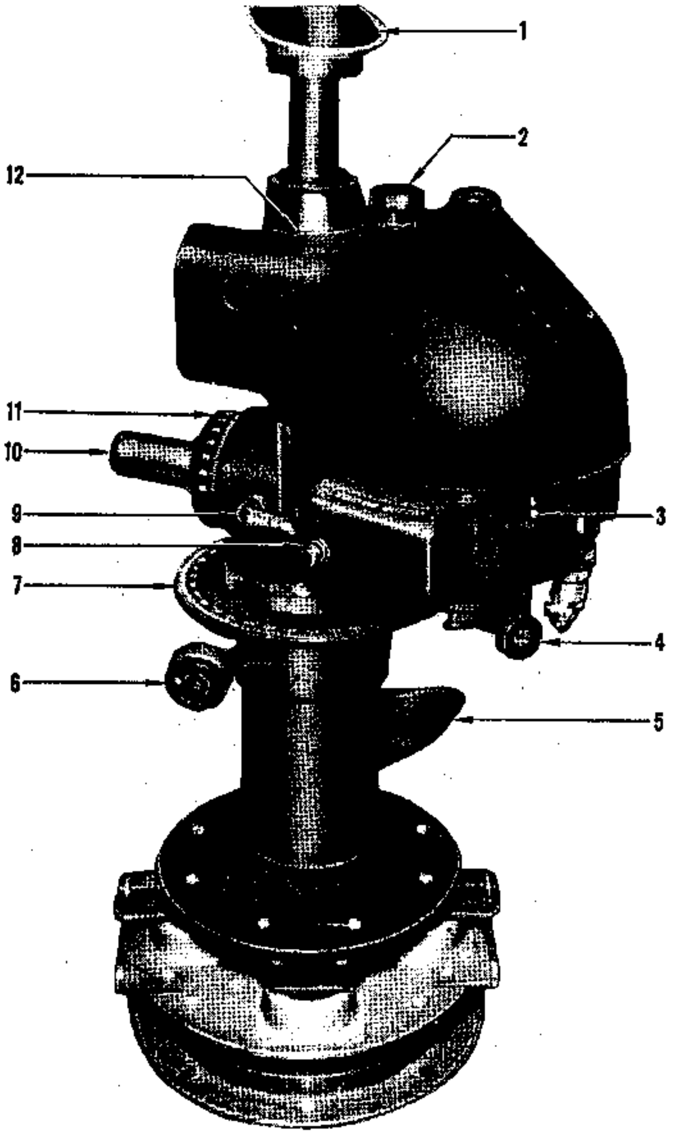
The slow-motion knob (6, figure 4-49) mounted on the stationary housing just beneath the azimuth scale, provides a means of fine adjustment of rotation of the instrument. It operates by means of a worm-gear mechanism which may be disengaged for free rotation of the driftmeter.

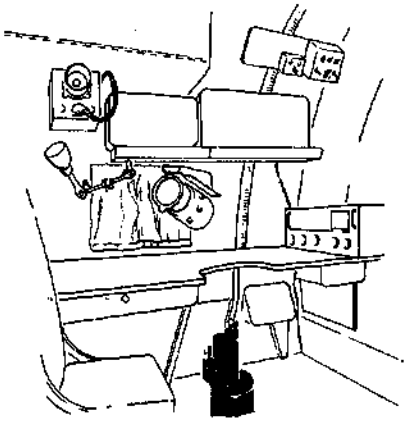
EYEPIECE ADJUSTING RING

Mounted on top of the gyro optics case and holding whichever of the alternate eyepiece assemblies is in use is the eyepiece adjusting ring (12, figure 4-49). Turn as required for clarity of focus.

SHADE GLASS LEVER

The lever (9, figure 4-49) mounted on the filter housing controls a shade glass. By operation of the lever, the





DRIFTMETER B-3

1 EYEPIECE
2 RHEOSTAT KNOB
3 GYRO SWITCH
4 GYRO CAGING KNOB
5 HIGH ALTITUDE EYEPIECE
6 SLOW-MOTION KNOB
7 AZIMUTH DIAL
8 PUSH-BUTTON SWITCH
9 SHADE GLASS LEVER
10 LINE OF SIGHT HANDLE
11 LINE OF SIGHT DIAL
12 EYEPIECE ADJUSTMENT RING

DRIFTMETER B-3 17260 ▶ 22628 LESS 1CTO K235

Figure 4-49

shade glass may be interposed in the optical system to reduce the intensity of light when the ground image is too bright.

PUSH-BUTTON SWITCH

When pressed, the push button switch (8, figure 4-49) on the transformer housing momentarily provides power to start the gyro.

LINE OF SIGHT HANDLE

This handle (10, figure 4-49) on the driftmeter turns a prism at the bottom of the driftmeter tube and directs the operator's line-of-sight away from the vertical.

LINE OF SIGHT DIAL

This dial (11, figure 4-49) on the driftmeter is graduated in 1-degree increments over a range of from 16 degrees forward to 87 degrees rearward of the vertical.

AZIMUTH SCALE

An azimuth dial (7, figure 4-49) graduated in 1-degree increments through 360 degrees, is on the driftmeter. This dial remains fixed when the instrument is rotated.

RETICLE ANGLE IN DEGREES	FACTOR K (FOR GROUND SPEED IN KNOTS)
16.9	0.176
16.8	0.175
16.7	0.174
16.6	0.173
16.5	0.172
16.4	0.171
16.3	0.170
16.2	0.169
16.1	0.167
16.0	0.166
15.9	0.165
15.8	0.164
15.7	0.163
15.6	0.162
15.5	0.161
15.4	0.160
15.3	0.159
15.2	0.158
15.1	0.157
15.0	0.156
14.9	0.155
14.8	0.154
14.7	0.153
14.6	0.152
14.5	0.151
14.4	0.150
14.3	0.148
14.2	0.147
14.1	0.146
14.0	0.145
13.9	0.144

FORMULA:

1. Factor for 0 = 1,184 X 1/2 TAN RETICLE ANGLE

2. $\frac{\text{ABSOLUTE ALT}}{\text{Time in sec's}} = \frac{\text{GS in Knots}}{\text{Factor K}}$

K FACTORS FOR GROUND SPEED BY TIMING ZERO ANGLE METHOD

(B-3 DRIFTMETER) 17260 ▶ 22628 LESS TCTO K235

Figure 4-50

Operation Instructions Of The B-3 Driftmeter

BEFORE TAKEOFF

1. See that the window in the objective end of the instrument and the top lens of the eyepiece are clean. For cleaning purposes, use a clean cotton or linen cloth. To remove sand or grit, brush the surfaces lightly with a small, clean paint brush, or a loose fold of cloth. Do not attempt to clean any other glass surfaces in the instrument

2. To prevent possible breakage of the driftmeter glass by stones, set the instrument at zero on the drift scale before takeoff (or landing)

3. Keep the gyro switch in the OFF position and the gyro caged. To cage the gyro, pull out the caging knob and move it as far as possible toward the caged position. Pull the knob out gently--heavy handling will strain the caging mechanism

IN FLIGHT

1. With the airplane in normal level flight, close the switch on the junction box to start the inverter

2. Switch on the gyro, and allow it to run for from 3 to 5 minutes before uncaging

3. Uncage the gyro by pulling out the caging knob and moving it to the uncaged position. Do not uncage the gyro when the gyro motor is stationary or running slowly, since the gyro and reticle moving freely in the housing may become damaged. If a turn is started while the gyro is uncaged, do not attempt to cage it during the turn. Wait until the turn is completed, then cage the gyro. To prevent damage to the gyro, it is advisable to cage it before the driftmeter is tipped more than 15 degrees from the vertical. To bring the gyro back to vertical if it has been tipped more than 15 degrees in a flight maneuver, it is necessary to run through cage-uncage cycle

4. Always cage the gyro before switching off power to the instrument and keep it caged when it is not in use

5. When sighting through the eyepiece, turn the rheostat knob to adjust the illumination of the reticle lines

6. By means of the ocular housing holder on the upper gyro housing, adjust the focus of the eyepiece until the reticle lines are sharp and clear

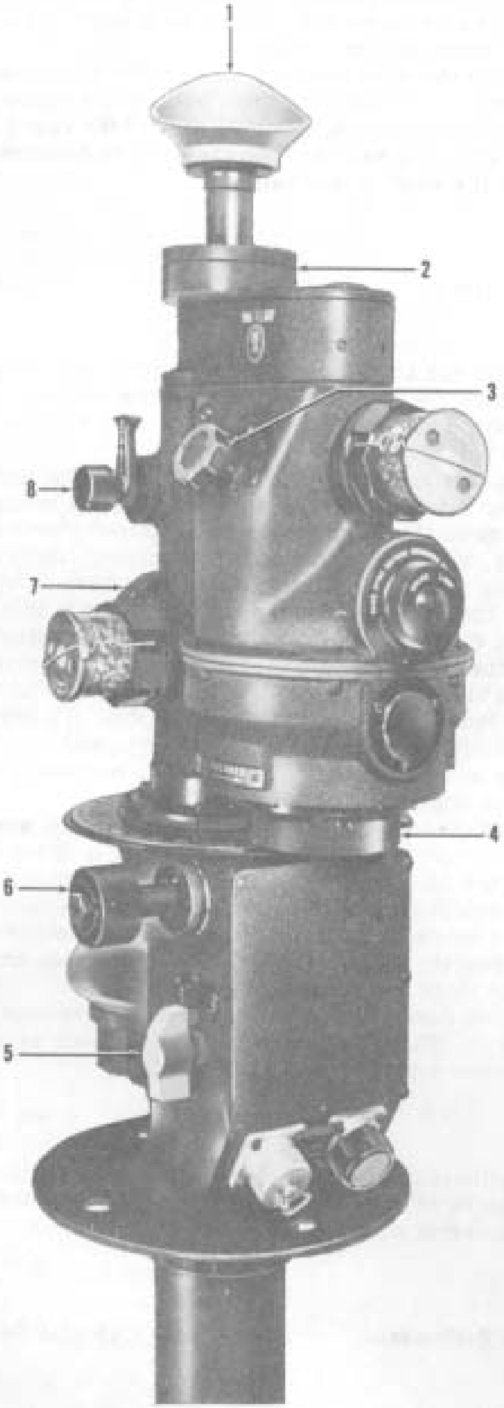
7. Upon completion of driftmeter observations, cage the gyro. Turn the gyro switch off, and then switch off the power supply

NOTE

> A chart indicating K factors for ground speed timing of zero angle method for the B-3 driftmeter is shown in figure 4-50.

B-6A Driftmeter 22629 ▶ plus TCTO K235

Operation of the driftmeter is dependent upon seven controls: the rotary switch located on the box side of the stationary pedestal case; the reticle light switch on the upper gyro case; the gyro caging knob on the underside of the lower gyro case; the azimuth drive knob on the box side of the pedestal case; the rotating handle protruding from the side of the line-of-sight case; a filter selector knob and handle mounted on the line-of-sight case, and an eyepiece adjusting ring assembled under the eyepiece of the optics case. Purpose and operation of these seven controls is as follows:



1 EYEPIECE
2 EYEPIECE ADJUSTING RING
3 RETICLE LIGHT SWITCH
4 GYRO CAGING KNOB
5 ROTARY SWITCH
6 AZIMUTH DRIVE KNOB
7 LINE OF SIGHT HANDLE
8 FILTER SELECTOR KNOB AND HANDLE

DRIFTMETER B-6A

22629 ▶ PLUS TCTO K235

3178 ▶

22629 ▶ 3177 PLUS TCTO K235

DRIFTMETER B-6A

Figure 4-51

ROTARY SWITCH

The rotary switch, (5, figure 4-51) located on the stationary pedestal case, activates the gyro and erection system. A switch plate mounted under the knob establishes the central position as OFF, the left position of the pointer knob as ON, 28 volt DC and the right position as ON, 115 volt AC. A detent stop secured to the underside of the selector knob limits the switch operation to the applicable and corresponding power source. To put driftmeter in operation, turn switch to applicable ON position and allow a ten minute warm-up period prior to uncaging gyro.

RETICLE LIGHT SWITCH

The reticle light switch (3, figure 4-51) located on the pedestal case operates a rheostat to control the brightness of the reticle field. Switch knob turns left to dim and right to brighten reticle lights. A switch plate under the knob identifies the DIM and BRIGHT positions with corresponding arrows. Adjust lighting as observation conditions require.

GYRO CAGING KNOB

The gyro caging knob (4, figure 4-51) is located on the under side of the gyro case between the gyro case and the electrical box of the pedestal case. Except when the driftmeter is in use, gyro must remain caged. When gyro is caged, gyro caging knob is turned full right. Turn knob left to uncage. Uncage gyro ten minutes after rotary switch has been turned on.

CAUTION

> Driftmeter is designed for use during reasonably level flight. Do not uncage gyro during taxi, takeoff or landing. Do not uncage gyro when roll or pitch exceeds 35 degrees.

AZIMUTH DRIVE KNOB

The azimuth drive knob (6, figure 4-51) is located on the side of the pedestal case and is mounted on a worm gear shaft. When the worm gear is normally engaged, the entire mobile section of the driftmeter is held stationary. Turning the azimuth drive knob revolves the worm gear, permitting fine adjustment after the general line of sight is obtained. Pull out the azimuth drive knob and move shaft through keyway to disengage the gear. This permits the rotating section to swing free in the pedestal case and rotate until the desired line-of-sight is obtained. Replace knob in original position to engage gears and obtain final fine adjustment by turning knob.

LINE OF SIGHT HANDLE

The handle assembly (7, figure 4-51) which protrudes from the line-of-sight case mounts a calibrated dial and contains a detent arrangement where a spring mounted ball assembly attached to the line-of-sight case registers at three points. These points are located at 0, 50 and 70.9 degrees. When the dial on the handle registers zero at the lubber line at the base of the handle, the prisms in the objective head of the driftmeter reflect an image which is straight down and perpendicular to the center line of the airplane. A pulley assembly in the handle assembly connects with extension rods which operate the prisms mounted in the main bracket at the objective end of the driftmeter. When the dial on the handle registers 35 degrees, the cables of the pulley assembly are of equal lengths.

FILTER SELECTOR KNOB AND HANDLE

Mounted on the line-of-sight case are the handle and knob assembly (8, figure 4-51) which permit selection between polarized and clear filters and adjustment to the amount of polarization required for any given flight condition. The clear glass and polarized filters are mounted perpendicular to each other in the line-of-sight case. Movement of the handle alternates the use of clear or polarized filter. Imprints on the handle identify the two positions as SHADE GLASS. With the polarized filter in position, movement of the knob, turning a worm gear, controls the amount of polarization desired at a specified time.

EYEPIECE ADJUSTING RING

Mounted on the top of the gyro optics case and holding whichever of the alternate eyepiece assemblies is in use is the eyepiece adjusting ring (2, figure 4-51). Turn as required for clarity of focus.

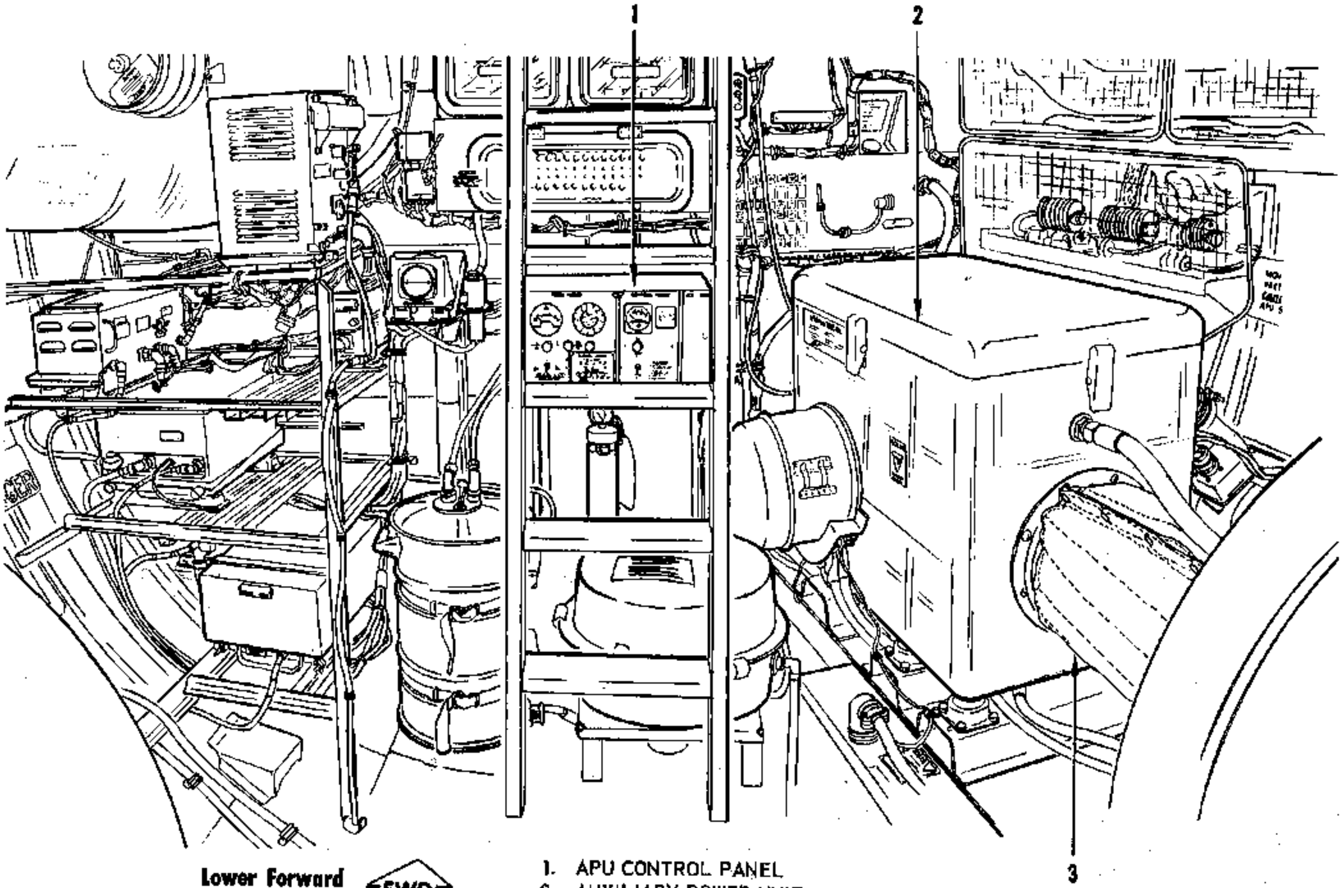
B-3 And B-6A Driftmeter Alignment Check

To obtain maximum accurate utilization of the driftmeter, it is necessary to check for proper alignment with the longitudinal axis of the airplane. This may be accomplished by cross checking the driftmeter alignment with the alignment of the periscopic sextant after the sextant has been properly aligned on the vertical stabilizer of the airplane. The following steps apply in accomplishing this alignment.

1. Correctly align the periscopic sextant as outlined in this Section
2. Set 000.0 degree in azimuth counter of periscopic sextant
3. Sight on object approximately 045 degrees left of the nose, at least 400 feet from the airplane using the periscopic sextant. Record the bearing and subtract from 360 degrees

NOTE

> The object should be at least 400 feet from the airplane to minimize the error to less than one degree. Using this distance will compensate for the offset distance of the driftmeter location from the sextant mount.



1. APU CONTROL PANEL
2. AUXILIARY POWER UNIT
3. EXHAUST DUCT

AUXILIARY POWER UNIT

Figure 4-52

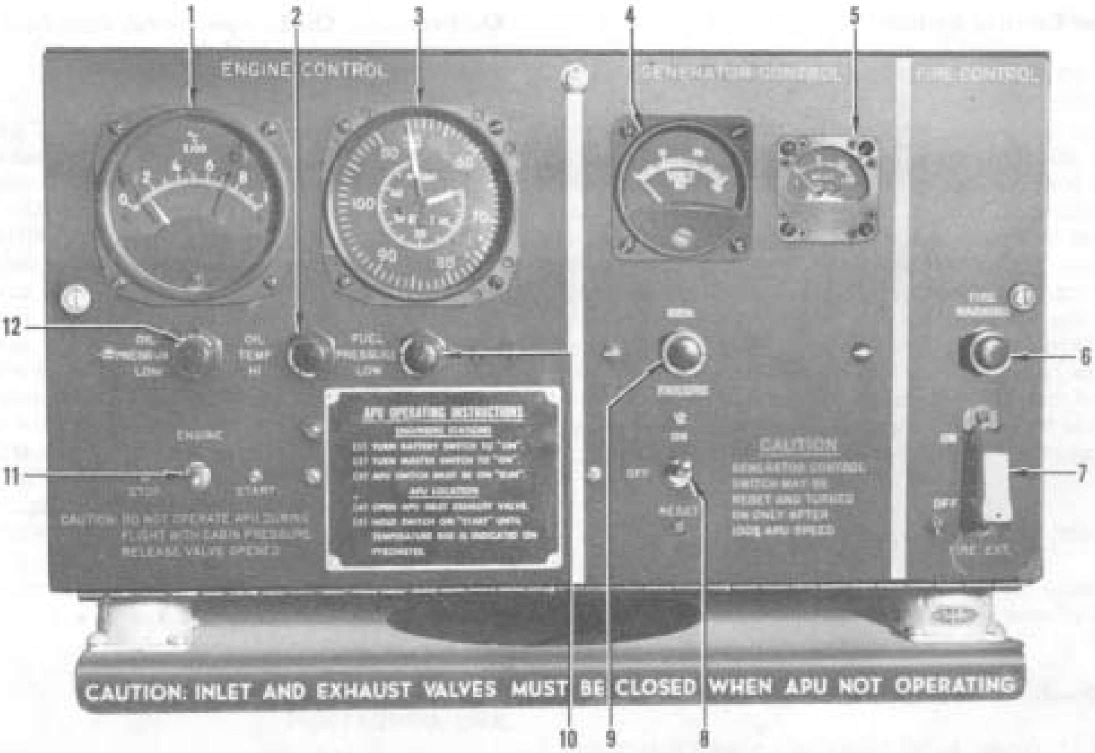
4. Rotate trail angle knob of driftmeter to maximum trail position
5. Disengage azimuth drive knob and sight on previously selected object
6. Compare this bearing with relative bearing obtained from periscopic sextant
7. If bearings do not agree, loosen set screws on driftmeter pointer and adjust to read same bearing obtained from periscopic sextant
8. The difference may be applied to all drift readings as a correction if it is not practical to adjust driftmeter pointer prior to flight

The following is a sample problem showing the figures obtained and the manner in which corrections are applied:

1. Bearing obtained from periscopic sextant is 045 degrees to the left of the nose
2. 360 minus 045 equals 315 degrees relative bearing
3. Bearing obtained from driftmeter is 313 degrees relative bearing
4. Correct pointer of driftmeter to read 315 degrees or apply 2 degrees right correction to all drift correction readings obtained in flight, i.e. -4 drift correction becomes -6, a +4 drift correction becomes +2

AUXILIARY POWER UNIT

A gasoline turbine-driven auxiliary power unit (figure 4-52) is in the lower forward compartment. The APU drives a 28-volt, 500-ampere, direct current generator, which is also used as a starting motor. The APU will operate to attitudes of 20,000 feet with generator output of 14 kilowatts at 28 volt DC. At altitudes under 10,000 feet, the generator can provide a five minute supply of 17.4 kilowatts at 28 volt DC (approximately 620 amp). Fuel is supplied from the tank No. 2 or from the fuel manifold and is automatically shutoff whenever the APU is not operating. The APU has a self-contained oil supply. An air intake duct allows air to flow to the turbine compressor, while an exhaust duct provides means for exhausting products of combustion. A valve in each duct is connected by a rod and linkage to operate together (open or close) from a manual control handle next to APU. The handle is spring-loaded to the OPEN or to the CLOSED position to prevent valve gates from creeping. The intake duct valve actuates a microswitch in the control circuit to prevent APU operation with the intake and exhaust ducts closed. The APU provides necessary electrical power to operate a blower unit in each outboard nacelle. These blowers



1 TURBINE DISCHARGE TEMPERATURE INDICATOR
2 OIL HIGH TEMPERATURE WARNING LIGHT
3 TACHOMETER
4 DC VOLTMETER
5 DC LOADMETER
6 FIRE DETECTION LIGHT
7 CO_2 RELEASE SWITCH
8 GENERATOR CONTROL SWITCH
9 GENERATOR WARNING LIGHT
10 FUEL LOW PRESSURE WARNING LIGHT
11 ENGINE START-STOP SWITCH
12 OIL LOW PRESSURE WARNING LIGHT

APU CONTROL PANEL

Figure 4-53

are used in conjunction with wing anti-icing heaters for preheating the airplane engines. By preheating the engines, engine starts may be made at ambient temperatures of -65°C. For cold weather engine preheating instructions, refer to COLD WEATHER PROCEDURES in Section IX. The APU can also be used as a standby electrical power source for takeoff and landing, or as an emergency power source during flights up to 20,000 feet (cabin must be depressurized). On airplanes with TCTO K538 incorporated, a blower is installed in the airplane to pressurize the turbine compartment. The turbine compartment is pressurized to prevent exhaust fumes from entering control cabin. The blower also aids in cooling the APU compartment. The blower as incorporated by TCTO K538 is operable only when the airplane is in flight. With TCTO K554 incorporated in the airplane, the blower may also be ground operated.

APU CONTROLS AND INDICATORS

The operating controls and indicators for the APU are located on a panel below the forward power panel. The panel (figure 4-53) is divided in three sections. The sections are engine control, generator control, and fire control. The engine control section governs the operation of the turbine while the generator control provides for starting and stopping the generator, provides visual indication of generator voltage level, load level and failure. The fire control provides fire warning and a switch for actuating the APU fire extinguisher.

Engine Start -- Stop Switch

This switch (11, figure 4-53) controls the operation of the turbine. In the ON position the generator functions as a motor to start the turbine, provided the APU generator switch (58, figure 1-22) on the engineer's instrument panel is in the ON (RUN) position, the battery switch (2, figure 1-12) is in the ON position and the airplane master switch (41, figure 1-12) on the overhead panel is in the ON position. Once the turbine is energized, the switch is returned to a center neutral position. In the OFF position the switch stops the turbine. The switch is spring-loaded to return to the center neutral position unless manually held in place.

Generator Control Switch

This ON--OFF--RESET switch (8, figure 4-53) is a three-position toggle switch with a momentary function in the reset direction. When the turbine is operating at full speed and the switch is placed in the RESET, then in the ON position, the generator will deliver full load to the airplane DC bus. If the generator has failed, the switch must be thrown in the RESET position momentarily and then to the ON position. On airplanes with TCTO K538 incorporated, with the generator control switch in the ON position, the ventilating blower will energize through the oleo relay switches, provided the airplane is in flight. On airplanes with TCTO K554 incorporated, and the generator control switch in the ON position, the blower will energize through the oleo relay switches when the airplane is in flight or on the ground.

Tachometer

This indicator (3, figure 4-53) presents the speed of the turbine in percentage of rated speed.

Turbine Discharge Temperature Indicator

This gage (1, figure 4-53) provides a visual indication of turbine exhaust temperature. If the turbine discharge temperature exceeds 600°C as indicated by the gage, the APU will automatically shutoff.

DC Loadmeter

This indicator (5, figure 4-53) is a DC ammeter calibrated from -0.1 through 0 through 0.5 through 1.0 to 1.25. The meter is read as percentage of full load; the 1.0 position being 100 percent or full-load indication.

DC Voltmeter

This indicator (4, figure 4-53) is calibrated from 0 to 30 volts. The meter will indicate approximately 28 volts when the generator is supplying current to the airplane.

Generator Failure Warning Light

This red press-to-test light (9, figure 4-54) will glow when the generator has failed.

Oil Pressure, Oil Temperature, And Fuel Pressure Warning Lights

The APU has warning lights instead of gages for oil temperature, oil pressure, and fuel pressure. These red press-to-test lights are operative when the APU generator switch (58, figure 1-22) on the engineer's instrument panel is in the ON (RUN) position, the battery switch (2, figure 1-12) and airplane master switch (41, figure 1-12) on the overhead panel are in the ON positions, and the duct valves are open. The fuel pressure and oil pressure warning light (10 and 12, figure 4-53) will remain illuminated until fuel and oil pressures build up during starting. Illumination of either one of these two warning lights while the APU is operating will be accompanied by automatic shutdown of the APU. If the oil high temperature light comes on, the APU must be shutdown manually. (High oil temperatures warning light (2, figure 4-53) will usually be caused by engine malfunctioning and will eventually result in automatic shutdown of the engine.)

APU OPERATION

The APU can be operated only with the cabin depressurized and at altitudes up to 20,000 feet. No external DC power source is required, as the APU will operate off battery power. In general, the APU is started before the nacelle covers and blower hoses are installed.

Pre-Start Check

1. Open skate doors on No. 1 and No. 4 nacelles and check that heater outlet plugs are installed securely
2. Check engine pre-heat switch OFF
3. Remove top cover from APU and check for fuel and oil leaks, then replace cover
4. Check oil level with dip stick provided in forward end of gear box
5. Clear exhaust path of personnel, equipment or foreign material and install exhaust deflector if required
6. Check fire extinguisher thermal blowout indicator disc, located on the fuselage adjacent to exhaust. Check tailpipe alignment

Starting Instructions

WARNING

When the airplane is descending, the APU may be started only after the cabin has been depressurized.

1. Place airplane master switch to ON
2. Place battery switch to ON
3. Place APU generator switch on the engineer's panel to ON (RUN)
4. Check the battery voltage and if below the minimum of 22.5 volts, provide external power source
5. Open APU inlet and exhaust valves

CAUTION

Inlet and exhaust valves must be closed when the APU is not in use.

6. Press engine START--STOP switch to START position and release. When the turbine reaches 102% speed, as shown on the tachometer, place the generator control switch momentarily at RESET then to ON

CAUTION

The generator control switch must not be thrown to RESET then ON until turbine speed has reached 102%.

7. Place battery switch to BAT CHG until battery voltage has been replenished
8. Circuit protection is through two 325-amp current limiters wired in parallel, giving a total of 650-amp circuit protection. The APU generator will continuously deliver 500 ampere, depending on the generator load, with fuel consumption between 8 and 12 gallons per hour

NOTE

When operating continuously, shut-down and check oil level once daily.

Ground Operation Shutdown Procedure

1. Turn off all airplane electrical equipment
2. Place battery switch to BAT CHG and replenish battery voltage
3. Check all press-to-test lights for operation
4. Turn battery switch to OFF position
5. Turn airplane master switch to OFF position

CAUTION

Prior to closing air inlet and exhaust valves, allow sufficient time for the turbine and compressor to come to rest. This will normally occur 10 to 20 seconds after shutdown.

6. Turn engine START--STOP switch to OFF position
7. Turn the generator control switch to the OFF position
8. Close inlet and exhaust valves when APU has stopped
9. Remove exhaust deflector if necessary

In-Flight Shutdown Procedures

1. Turn engine START--STOP switch to OFF position
2. Turn generator control switch to the OFF position
3. Close inlet and exhaust valves when APU has stopped

CAUTION

- Prior to closing air inlet and exhaust valves, allow sufficient time for the turbine and compressor to come to rest. This will normally occur 10 to 20 seconds after shutdown.
- When the airplane is ascending, the APU must be stopped when airplane approaches cabin pressurizing altitude.
- When opening or closing the inlet-exhaust valves, extreme care must be taken so as not to damage the equipment in such a way that the microswitch is not tripped. If this microswitch is not tripped, it is possible to actuate the start circuit of the APU with both the air inlet and exhaust valves closed. This could result in the collapsing of the inlet duct and overheating of the turbine and the exhaust system.

CARGO LOADING EQUIPMENT

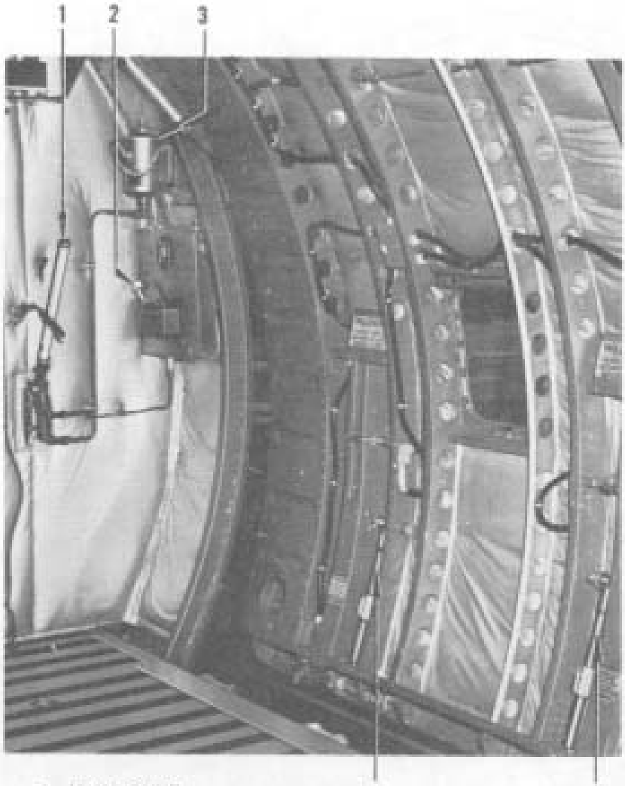
The principal function of Code ▼ airplanes is to refuel other airplanes in flight, although they can also be used to carry cargo and troops with the refueling equipment installed. This is possible due to the compact arrangement of the refueling tanks which provides a considerable amount of cargo space in the main compartment. As can be seen in figure 4-57, there is sufficient cargo space available to carry large items of cargo. The location of tanks on the left side of the compartment leaves an adequate number of tie-down fittings available, an unobstructed cargo door, access to all escape hatches, and a DC electrically operated cargo hoist that can be used in loading cargo. The principal function of Code Ⓒ airplanes, is to carry cargo or troops due to the vast amount of space and the large number of tie-down fittings available. The cargo space available can be utilized to carry the larger types of either jet or reciprocating engines. Similar items of bulk cargo of equal density and size may also be loaded and carried. Other pieces of equipment can be loaded and carried as shown in figure 4-54. If heavy and bulky cargo is mounted on full swiveling dolly wheels it can be loaded with the least amount of effort. The cargo hoist can be conveniently used as the necessary towing force to pull cargo into the compartment. The cargo hoist is capable of lifting 2500 pounds with a single line or 5000 pounds with a double line and is capable of producing a towing force of 7500 pounds with a triple line configuration. The triple line is rigged by hooking the hoist cable into the cross bar at the end of the trolley and installing a snatch block on the cable. The triple line is rigged by first traversing the trolley to station 726 and locking in place and rigging the cable with two snatch blocks. With the adequate number of tie-down rings, the cargo should always be secured to avoid shifting. Shifting cargo can be hazardous to the extent of moving the airplane CG out of prescribed limits while in severe turbulence, or can be hazardous to crew members if it should happen to move forward into the control cabin during very rapid deceleration periods such as crash landings and ditching operations. For more detailed information concerning cargo loading and tie-down, see the latest Technical Order titled, Manual of Cargo Loading Instructions, T.O. 1C-97A-9. Other information applicable to cargo loading can be found in the Manual of Weight and Balance Data, AN 01-B-40. Also see Section V of this manual for weight and CG limitations.

FORWARD CARGO DOOR CONTROLS AND OPERATION

The forward cargo door is located on the right side of the main compartment. See figure 4-55 for controls. A web strap safety gate is provided for installation across the door opening to protect personnel from accidentally falling out of the airplane. It should always

CARGO LOADING

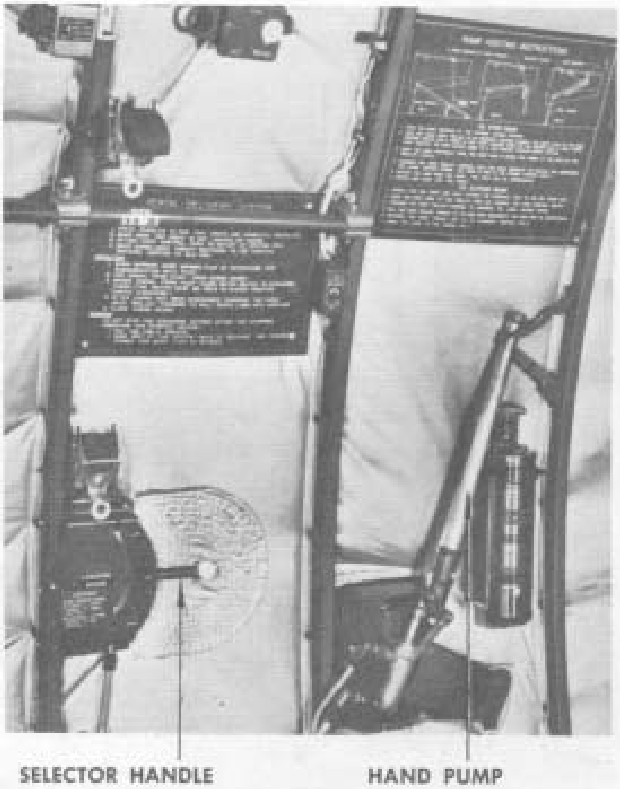
Figure 4-54



1 HAND PUMP
2 SELECTOR HANDLE
3 RESERVOIR
4 LOCK HANDLES
(2 PLACES)

FORWARD CARGO DOOR CONTROLS

Figure 4-55



AFT CARGO DOOR CONTROLS

Figure 4-56

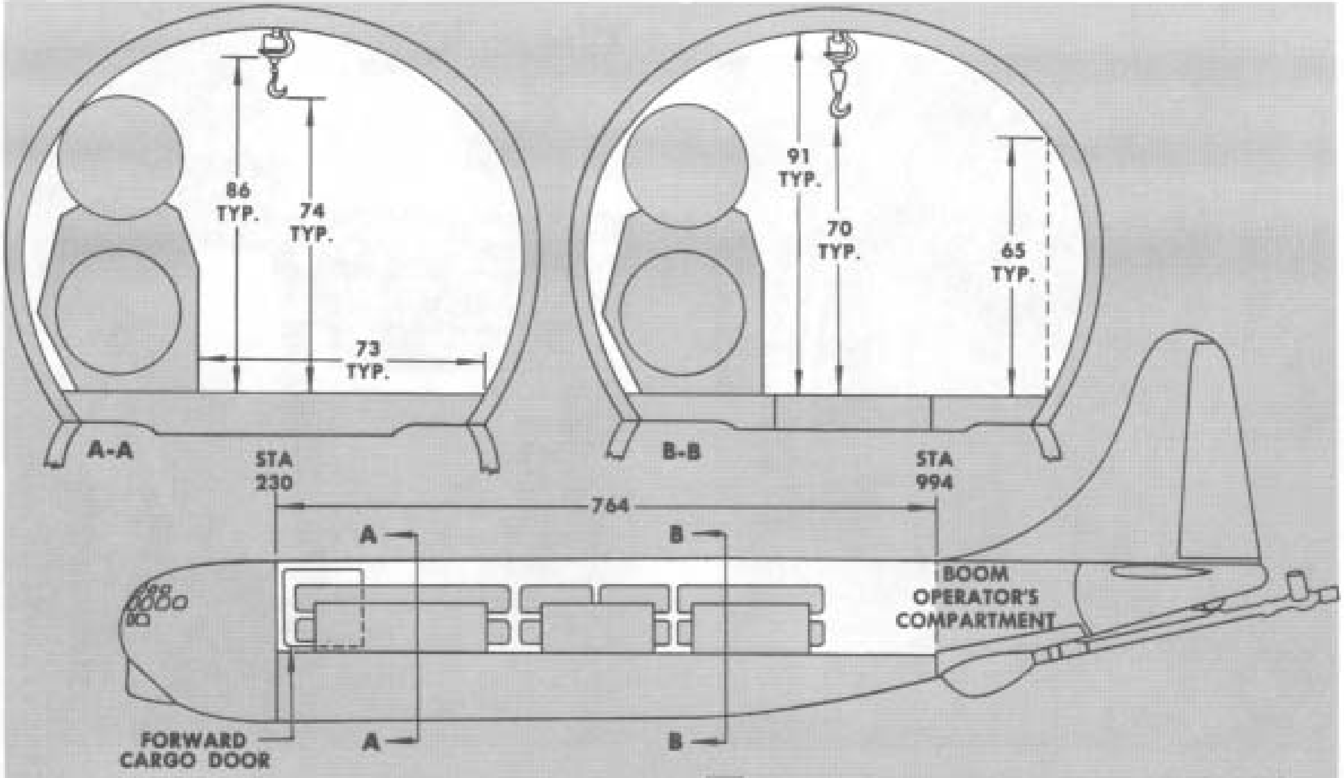
be placed across the opening while the door is open and not being used for loading. It is stowed on the aft edge of the door frame, when it is not in use; however, it can be left in place when the door is closed. The door is operated by an independent hydraulic system. Hydraulic pressure is supplied by a hand pump. The system is controlled by a OPEN--NEUTRAL--CLOSE selector handle located adjacent to the door (figure 4-55). The door is opened from a closed and locked position by placing the door lock handles at the bottom of the door from a full up position to a full down position, placing the selector handle to OPEN, and operating the hand pump until the door stops moving up. Closing the door is accomplished by placing the selector handle to NEUTRAL and letting the door fall slowly closed to a free hanging position. By placing the selector handle in CLOSE and operating the hand pump, the door will move to a full closed position where the door lock handles can be rotated to a full up position to lock the door securely. The door can be stopped at any time during the closing travel by placing the selector handle back to OPEN. There are electrical switches on the door which will illuminate a door open light on the pilots' instrument panel if the door is not completely closed and locked; however, electrical DC power must be on.

CAUTION

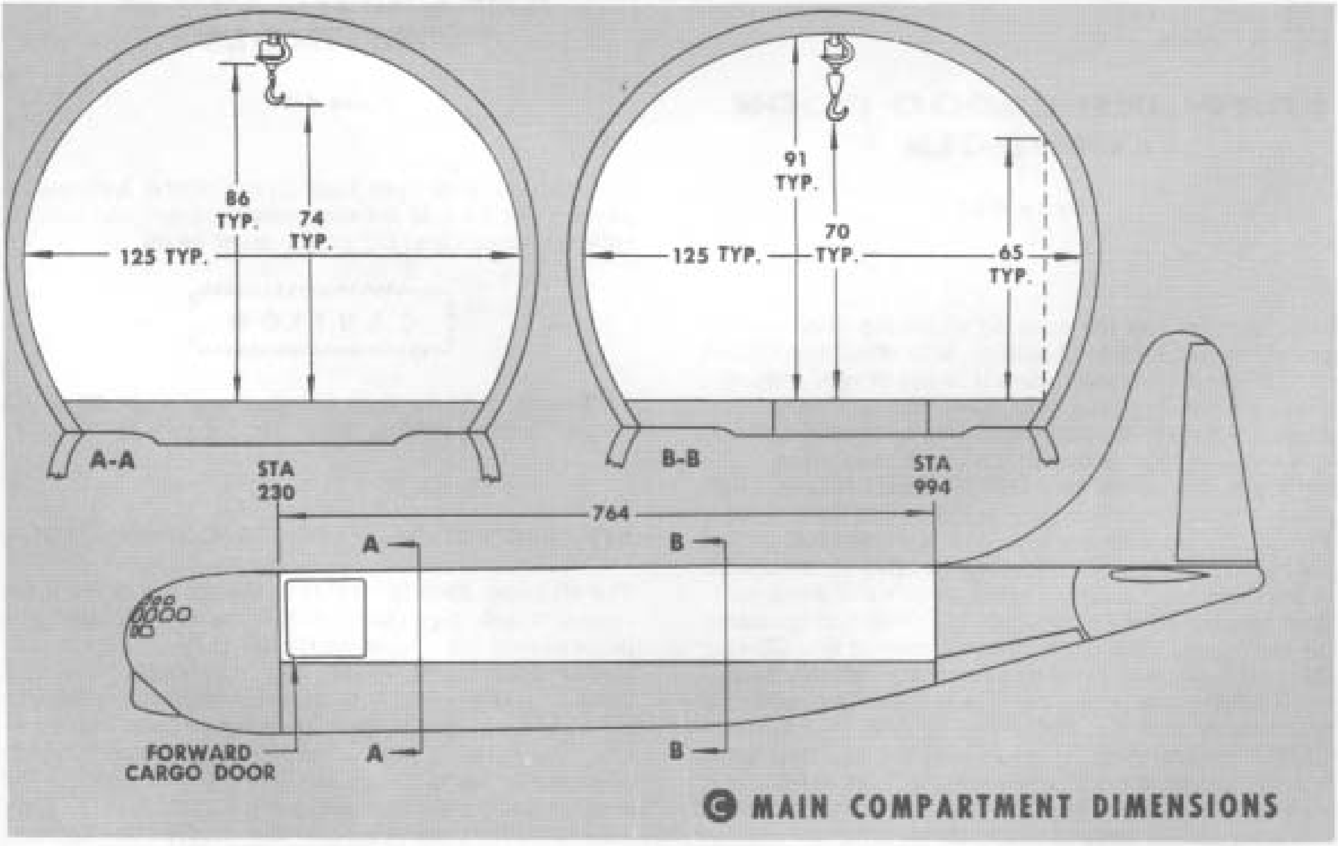
During flight the door selector handle should be on CLOSE position, and hydraulic pressure up.

AFT CARGO DOOR CONTROLS AND OPERATION

The aft cargo door is located in the aft end of the main compartment. See figure 4-56 for controls. Hydraulic pressure for operating the aft cargo doors is furnished by its own electric pump, controlled by a CLOSE--OFF--OPEN cargo door selector handle on the right rear side of the main compartment (figure 4-56). The cargo door selector handle is connected both electrically and mechanically to the power unit. In the event of pump failure, a hand pump (figure 4-56) is provided near the cargo door selector handle. The hydraulic oil reservoir is contained within the power unit in the aft stowage compartment.



T MAIN COMPARTMENT DIMENSIONS

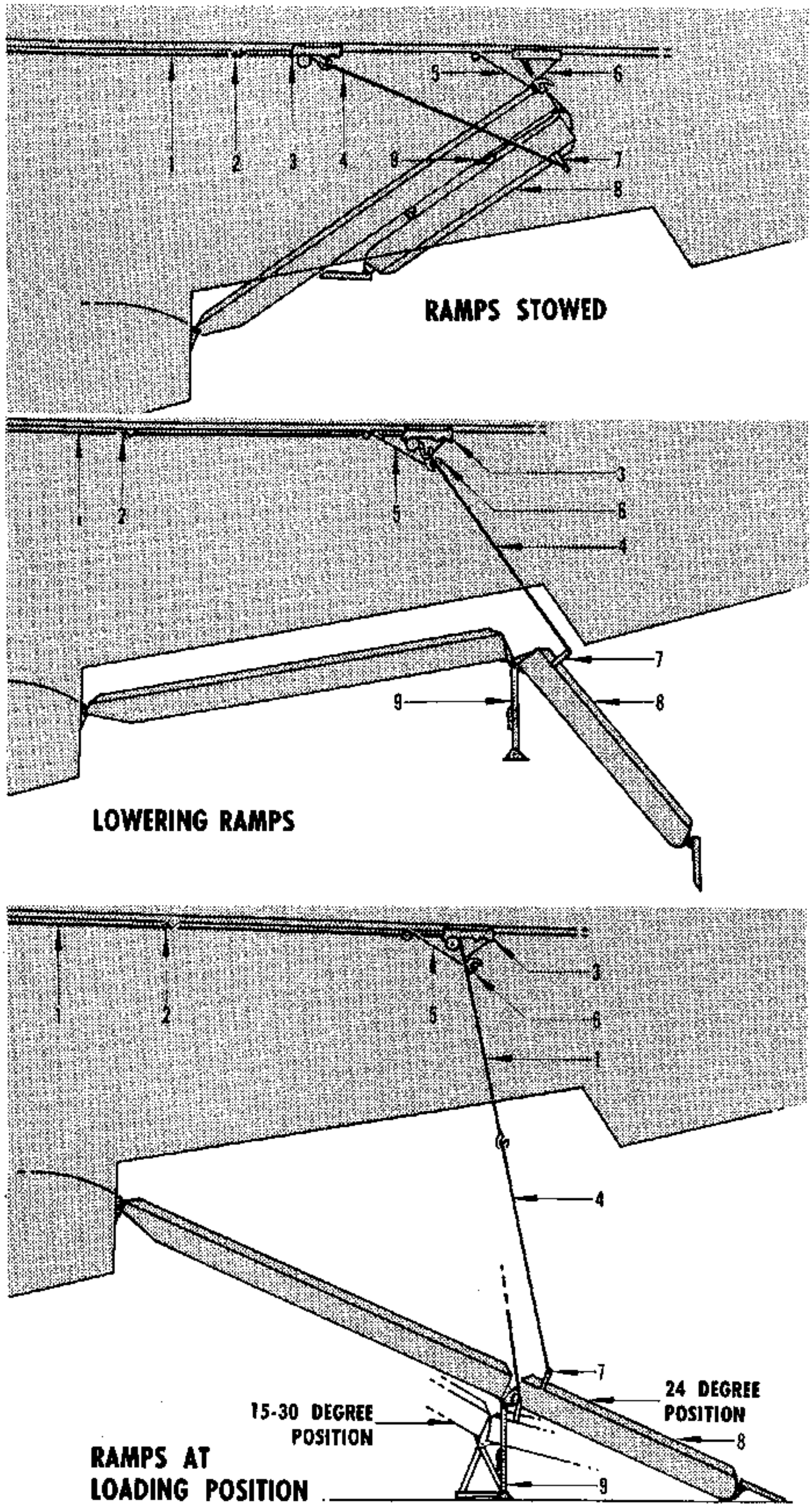


C MAIN COMPARTMENT DIMENSIONS

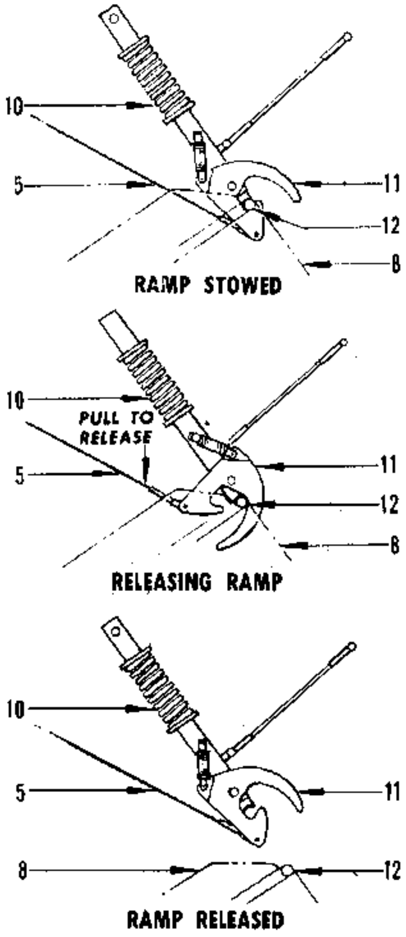
MAIN COMPARTMENT DIMENSIONS

Figure 4-57

1 CARGO HOIST CABLE (4 PLACES)
2 RAMP RELEASE HANDLE (3 PLACES)
3 CARGO HOIST TROLLEY (3 PLACES)
4 RAMP HOISTING CABLE (3 PLACES)
5 RAMP RELEASE CABLE (6 PLACES)
6 RAMP STOWAGE SUPPORT (3 PLACES)
7 RAMP HOISTING TUBE (3 PLACES)
8 RAMP (6 PLACES)
9 RAMP SUPPORT STRUT (3 PLACES)
10 RAMP STOWAGE SUPPORT SPRING (3 PLACES)
11 RAMP LOCK (3 PLACES)
12 RAMP LOCK PIN (3 PLACES)



DETAIL I RAMP STOWAGE SUPPORT



CARGO LOADING RAMPS ©

Figure 4-58

DOOR WARNING SYSTEM

A door warning system indicates when the forward entry door, forward cargo door, aft entry door, and on Code Ⓒ airplanes, aft cargo doors are not closed and locked. The forward and aft entry doors each have one door closed warning switch and one door locked warning switch. The aft cargo door has three door locked warning switches and the forward cargo door has two door locked and two handle closed warning switches and two door latch switches. All are push button switches wired in parallel, and are in the open position when all doors are closed. If any switch is left closed, a door warning light (24, figure 1-9) on the pilots' instrument panel will illuminate. The door warning circuit is protected by a circuit breaker on the overhead panel. Prior to takeoff, check that all doors are closed and locked. If a warning light illuminates before takeoff, all doors should be unlocked, opened, closed, and locked. If the warning light remains on and all warning switches are found to be in the locked position, the circuit should be checked for a malfunction before takeoff. If the door warning light illuminates during flight, decrease the cabin differential pressure by selecting a higher cabin altitude. If visual inspection of the door locking mechanisms indicates that the doors are locked, pressurized flight may be continued at reduced pressure.

MAIN COMPARTMENT T

The manner in which the A/R tanks are installed on the left side of the fuselage leaves room for carrying cargo or troops while the airplane is fully equipped with refueling provisions. Figure 4-57 illustrates the basic dimensions of available cargo space.

CAUTION

Cargo and personal equipment will not be placed closer than six inches to heater ducts in the cargo compartment.

CARGO RAMPS Ⓒ

There are two cargo-loading ramps which are lowered for use through the aft cargo doors and provide a ramp from the ground to the floor of the compartment. The two ramps are adjustable laterally to accommodate rolling equipment with different treads. The support in the center of the ramp is also adjustable and will provide either a constant 24-degree slope, or a 15-degree slope of the lower part of the ramp and a 30-degree slope of the upper part of the ramp to accommodate rolling equipment requiring large vertical clearance. The cargo-loading ramps are lowered with the cargo hoisting equipment as shown in figure 4-58.

CARGO LOADING SUPPORT STRUT

The cargo loading support strut is provided for support of the fuselage at the tail skid jacking pad when loading cargo. On airplanes 17260 ▶ 22700 the jack-strut base is stowed in the aft stowage compartment and the support strut is stowed on the ceiling of the rear end of the lower aft compartment. On airplanes 22701 ▶ the support strut is not stowed in the airplane when in the tanker configuration. The support strut should be used as a support only and, when used with other jacks, it should always be raised and lowered first.

CARGO FLOOR

The floor in the main compartment is subjected to great stresses imposed by heavy cargo and rough cargo handling. The floor has load limits which should not be exceeded. Various types of cargo could exert loads on the floor which could dent or puncture floor panels and distort the floor beams if it is resting on small contact areas or in the center of a single beam. The floor in the main compartment can be loaded up to 200 pounds per square foot. The floor and the seats in the lower forward and lower aft compartments can be loaded up to 100 pounds per square foot. The main compartment floor can also support concentrated loads of 200 pounds per square inch without damage to the floor panels or floor beams if the concentrated loads do not exceed the floor beam capacities. The floor beam capacities will vary depending on where the concentrated load is applied to the beam, number of beams used, and the location of the beams in the fuselage.

CARGO TIE-DOWN FITTINGS AND DEVICES

There are several hundred tie-down fittings of nine different types, located throughout the airplane. Cargo is tied down with standard Air Force tie-down devices. Four different types are used to secure the cargo from moving. There are the 1250 pound capacity type A-1 web straps, the 5000 pound capacity B-1 cables, the 10,000 pound capacity type C-2 chains with turnbuckles, and the 25,000 pound capacity D-1 chains with turnbuckles. Stowage is provided for all devices. The A-1 devices hang on the sidewall, the B-1 devices are stowed in fabric bags on the sidewall, and the C-2 and D-1 devices are stowed in a wooden box at the aft end of the main compartment. Periodic testing is required on all tie-down devices.

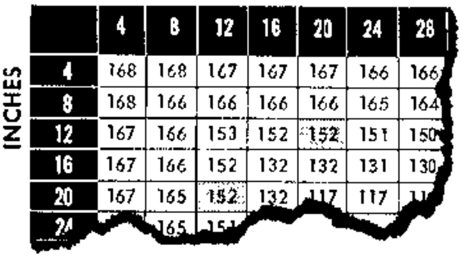
AERIAL DELIVERY SYSTEM 17260 ▶ 22628

Provisions are made on this airplane for the kit installation of an aerial delivery system, when the airplanes are in the cargo configuration.

NOTES (Applicable Only to Sheets 1 and 2)

The charts are based on clearances only and do not consider the difficulties of loading heavy cargo which would require use of the cargo hoist. It has also been assumed that packages may be turned to any position without damage to their contents. A minimum clearance of one inch has been allowed between any package and the structure or fixed equipment of the airplane.

EXAMPLE (Applicable Only to Sheets 1 and 2)



INCHES

INCHES	4	8	12	16	20	24	28
4	168	168	167	167	167	166	166
8	168	166	166	166	166	165	164
12	167	166	153	152	152	151	150
16	167	166	152	132	132	131	130
20	167	165	152	132	117	117	
24		165					

USE OF CHART

(Applicable Only to Sheets 1 and 2)

To determine if a package 12 x 20 x 140 will go through the forward cargo hatch, locate the 12 and 20 dimensions in the left vertical and top horizontal rows of figures on the chart (see example). The intersection of rows headed by 12 and 20 gives the maximum length package of this cross section which can be loaded -- in this case 152 inches. Since the package being checked is only 140 inches long, it can be loaded.

FORWARD ENTRY DOOR

INCHES

INCHES	4	8	12	16	20	24	28	32	34
4	214	214	214	214	214	214	210	180	160
8	214	214	214	214	214	214	210	150	135
12	214	214	190	190	180	170	170	130	120
16	214	214	190	140	130	125	120	115	110
20	214	214	180	130	120	115	110	110	105
24	214	214	170	125	115	105	100	95	95
28	210	210	170	120	110	100	95	90	85
32	180	150	130	115	110	95	90	80	80
36	140	130	110	100	100	90	80	75	70
40	130	110	110	100	95	85	70	65	65
44	120	110	100	95	90	80	70	60	60
48	100	80	70	70	70	65	60	55	55
52	90	80	70	50	50	50	50	40	40

Ⓒ AFT ENTRY DOOR

INCHES

INCHES	4	8	12	16	20	24	28	32	34
4	200	200	200	200	200	200	185	160	150
8	200	200	200	200	200	180	160	145	130
12	200	200	190	180	165	155	140	130	115
16	200	200	180	155	145	135	125	115	110
20	200	200	165	145	125	120	115	105	95
24	200	180	155	135	120	110	105	95	90
28	185	160	140	125	115	105	95	90	80
32	160	145	130	115	105	95	90	80	70
36	140	125	115	105	95	90	85	75	
40	120	120	110	100	90	85	80	65	
44	120	110	100	90	85	80	70		
48	100	95	90	85	80	75	60		

FORWARD CARGO FLOOR HATCH

INCHES

INCHES	4	8	12	16	20	24	28	32	36	40	42
4	168	168	167	167	167	166	166	90	80	72	69
8	168	166	166	166	165	165	164	90	80	72	69
12	167	166	153	152	152	151	150	89	80	72	69
16	167	166	152	132	132	131	130	89	79	72	68
20	167	165	152	132	117	117	116	88	79	71	68
24	166	165	151	131	117	105	104	88	79	71	68
28	166	164	150	130	116	104	96	87	78	70	67

Ⓒ AFT CARGO FLOOR HATCH

INCHES

INCHES	4	6	12	16	20	24	28	32	36
4	155	155	155	155	155	155	155	155	150
8	155	130	130	130	130	130	125	125	125
12	155	130	110	110	110	110	105	105	105
16	155	130	110	95	95	95	95	95	95
20	155	130	110	95	85	85	80	80	80
24	155	130	110	95	85	70	70	70	70
26	155	130	110	95	85	70	55	55	55

PACKAGE DIMENSIONS

Figure 4-59 (Sheet 1 of 3)

FORWARD CARGO DOOR

INCHES

INCHES	6	12	18	24	30	36	42	48	54	60	66	72
6	714	←			→	714	667	611	557	529	431	291
12	↑	578	564	546	517	499	471	439	414	383	338	246
18		564	419	409	396	379	365	347	328	309	280	214
24		546	409	327	319	309	298	286	273	254	238	190
30	↓	517	396	319	267	261	252	244	234	225	208	171
36	714	499	379	309	261	225	219	213	205	198	181	157
42	667	471	365	298	252	219	194	189	183	177	167	144
48	611	439	347	286	244	213	189	170	166	161	153	131
54	557	414	328	273	234	205	183	166	152	148	141	117
60	529	383	309	254	225	198	177	161	148	135	128	113
66	431	338	280	238	208	181	167	153	141	128	117	107
70	372	288	253	219	193	174	158	145	133	121	110	101
72	291	246	214	190	171	157	144	131	117	113	107	92
76	282	239	207	184	166	151	139	125	112	107	101	83

AFT CARGO DOOR—30° RAMP

INCHES

INCHES	6	12	18	24	30	36	42	48	54	60	66	72	78	84
6	730	←											→	730
12	730	←											→	730
18	730	←											→	730
24	730	←											→	730
30	730	←											→	730
36	730	←		→	730	630	630	620	620	610	594	578	569	545
42	730	←		→	730	630	500	495	494	485	472	455	440	350
48	730	←		→	730	620	495	408	402	394	382	371	359	263
54	730	←		→	730	620	494	402	339	331	323	313	303	206
60	730	←		→	730	610	485	394	331	287	280	271	239	157
66	730	←		→	730	594	472	382	323	280	245	237	185	123
72	730	←		→	730	578	455	371	313	271	237	200	151	100
78	730	←		→	730	569	440	359	303	239	185	151	100	
84	730	←		→	730	545	350	263	206	157	123	100		
90	730	←	→	730	500	300	196	150	106					
96	730	730	712	270	166	100								

PACKAGE DIMENSIONS (CONT)

Figure 4-59 (Sheet 2 of 3)

▼ FORWARD CARGO DOOR

EXPLANATION

This chart represents the approximate maximum width, height, and length of any rectangular shaped object that can be loaded thru the forward cargo door. The chart is based on the internal dimensions of the KC-97G airplane (with tanker kit) with no allowance being made for handling difficulties and for protruding items except the door actuator brackets. Other protruding items such as fire extinguishers and first aid kits may be removed if necessary.

WIDTH IN INCHES

HEIGHT IN INCHES	6	12	18	24	30	36	42	48	54	60	66	72
6	709	408	300	234	192	166	142	127	114	103	92	85
12	709	405	297	232	191	165	141	126	113	102	91	85
18	709	403	295	230	190	163	140	125	112	101	90	85
24	709	390	288	228	188	161	139	124	111	100	89	84
30	570	376	281	223	186	159	138	123	110	99	88	83
36	535	361	272	217	182	157	137	122	109	98	87	82
42	493	344	262	212	178	154	136	121	108	97	86	81
48	454	323	250	205	173	151	133	119	107	96	85	80
54	418	304	240	197	168	147	131	117	106	95	84	79
60	382	285	228	189	163	143	128	113	103	93	83	77
66	350	268	217	182	158	139	125	110	101	91	82	76
72	242	202	172	149	133	121	106	92	83	77	76	66
76	242	202	172	149	133	121	106	92	83	74	68	62

NOTE

Due to the configuration of the airplane and the varying methods of loading, the dimensions are not the absolute maximum. If a cargo's dimensions are close to those defined by the table, it is advisable to make a trial loading before deciding whether the cargo item may be loaded or not.

USE OF CHART

The left side of the chart contains values for the vertical dimension as cargo enters the door. The top of the chart contains values for the horizontal dimension as cargo enters the door. It will be noted that a 30 in. high by 60 in. wide box cannot exceed approximately 99 in. in length while a 60 in. high by 30 in. wide box cannot be approximately 163 in. in length. Irregular shaped objects can be approximated by entering the chart with the outside dimensions of the objects concerned.

Figure 4-59 (Sheet 3 of 3).

CARGO HOIST

The airplane is equipped with a cargo hoist which is mounted at the top of the fuselage at the forward end of the main compartment. The cargo hoist trolley will be stowed aft of the boom operator's compartment. The DC electrically operated hoist has two cable systems; one drives a trolley along a monorail at the top of the main cargo compartment and the other hoists loads from the trolley. The hoist is controlled by a portable control box which can be plugged into any one of three receptacles along the right side of the fuselage. This box has five push-buttons; UP--DOWN--FWD--AFT--EMERGENCY STOP, which operate the cargo hoist for respective operations. On and off controls are on the cargo hoist shield directly below the hoist motor. The cargo hoist has manual operation features in case of electrical failure. The loading capacity of the hoist is 2500 pounds on a single cable. If increased capacity is needed, a mechanical advantage will have to be used. This is done by the use of a snatch block to make a double line configuration of the hoisting cable between the load and the cargo hoist trolley. With this arrangement the hoist will have a hoisting capacity of 5000 pounds which is the absolute maximum for hoisting and should never be exceeded. An additional snatch block is furnished so a triple line configuration can be used for towing loads up to 7500 pounds; however, the trolley has to be positioned at station 726 and the trolley lock on top of monorail engaged at all times.

Cargo Hoist Controls

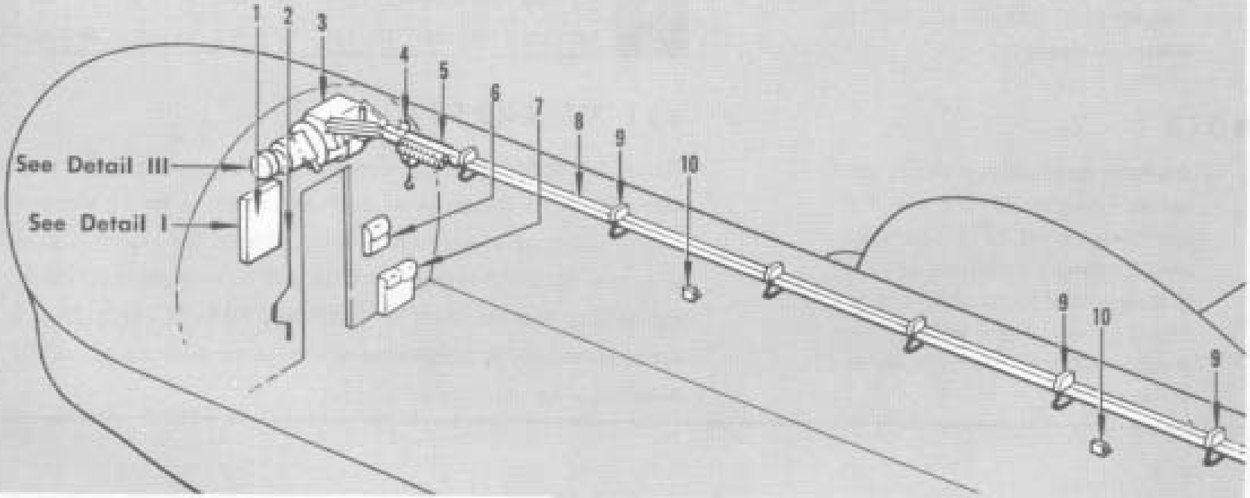
BRAKE RELEASE LEVER

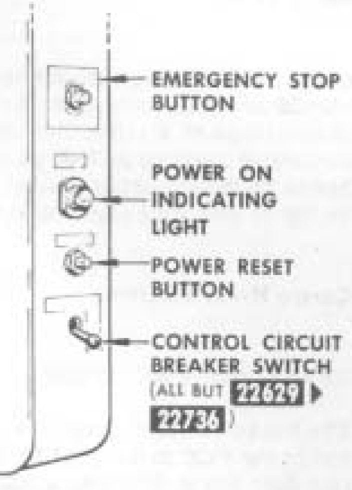
The brake release lever (29, figure 4-60) on the left end of the hoist motor, can be lifted to release the friction disc brake to lower a load on the hoist manually.

CAUTION

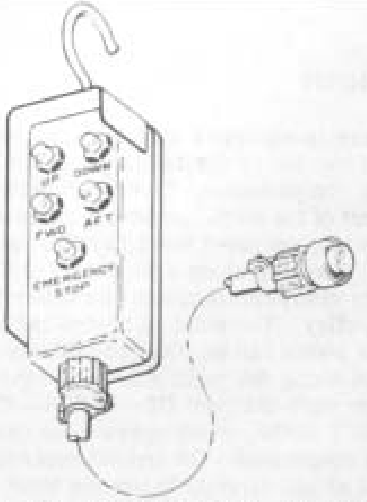
Always lift the brake release lever slowly to avoid dropping a load. Do not lower a load at more than the normal rate.

1 CARGO HOIST SHIELD
2 CARGO HOIST HAND CRANK (STOWED)
3 CARGO HOIST
4 FORWARD TROLLEY LIMIT SWITCH
5 CARGO HOIST TROLLEY
6 PORTABLE CARGO HOIST CONTROL BOX CONTAINER
7 SNATCH BLOCK CONTAINER
8 MONORAIL
9 CABLE SUPPORT HOOK (5 PLACES)
10 PORTABLE CARGO HOIST CONTROL BOX RECEPTACLE (3 PLACES)
11 CARGO HOIST TROLLEY LOCK
12 PORTABLE CARGO HOIST CONTROL BOX
13 AFT TROLLEY LIMIT SWITCH
14 TRAVERSING CABLE (2 PLACES)
15 TRAVERSING CABLE TENSION SPRINGS
16 CABLE SHEAVE
17 HOISTING CABLE (2 PLACES)
18 HOISTING HOOK
19 ROTARY ACTUATOR
20 ROTARY ACTUATOR EXTENSION ARM
21 CLUTCH THRUST SCREW ARM
22 TRAVERSING DRUM
23 LEVEL WINDER
24 LIMIT SWITCH BOLT
25 HOISTING DRUM
26 LEVEL WINDER LIMIT SWITCH
27 HAND CRANK DRIVE
28 CARGO HOIST MOTOR
29 BRAKE RELEASE LEVER





DETAIL I
CARGO HOIST SHIELD



DETAIL II PORTABLE CARGO HOIST CONTROL BOX

CARGO HOIST SYSTEM

Figure 4-60 (Sheet 1 of 2).

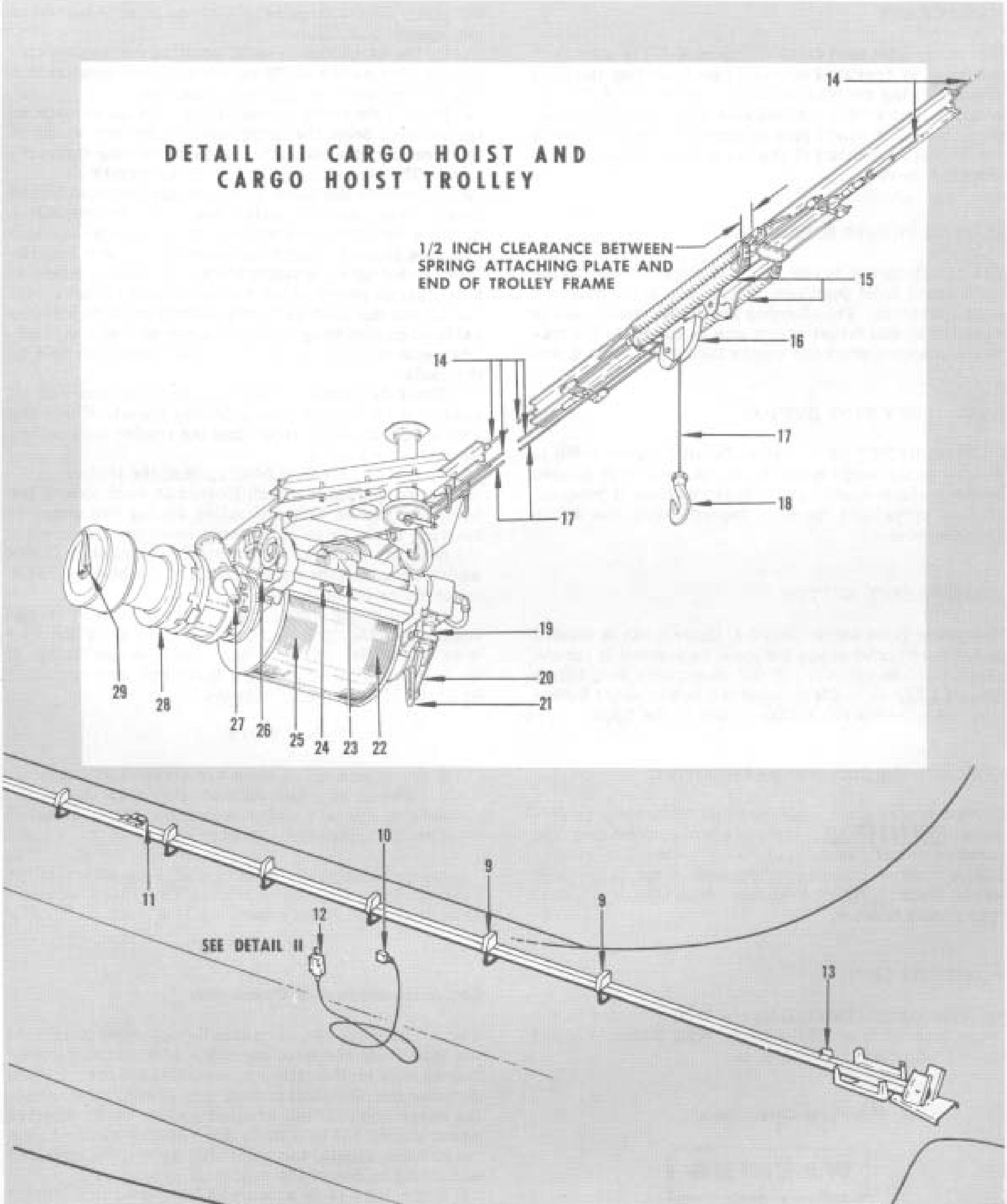


Figure 4-60 (Sheet 2 of 2)

HAND CRANK

The cargo hoist hand crank (2, figure 4-60) is used when the hoist is operated manually by inserting the hand crank into the receptacle on the motor (27, 4-60) and rotating it in either a clockwise or counterclockwise direction. The hand crank is stored on the left side of the forward bulkhead of the main cargo compartment when not in use.

CLUTCH THRUST SCREW ARM

The clutch thrust screw arm (21, figure 4-60) on the right end of hoist positions the clutches in the hoist for each operation. The clutches are in the hoist position when the clutch thrust screw arm is up and in the traverse position when the clutch thrust screw is down.

EMERGENCY STOP BUTTON

An EMERGENCY STOP button (Detail I, figure 4-60) is located on the cargo hoist shield and another is located on the portable control box. These buttons, if pressed, stop all cargo hoist operation regardless of what action is taking place.

POWER RESET BUTTON

The power reset button (Detail I, figure 4-60) is located on the cargo hoist shield and must be pressed in for the cargo hoist to operate. If the emergency stop button (Detail I, figure 4-60) is used the power reset button must be pressed to restore power to the hoist.

CONTROL CIRCUIT BREAKER SWITCH

Circuit protection for the cargo hoist controls on airplanes 22629 ▶ 22736 is through a circuit breaker on the forward power panel (figure 1-34). On all other airplanes, control circuit protection is on the cargo hoist shield (Detail I, figure 4-60) through an ON--OFF switch type circuit breaker.

POWER ON LIGHT

An amber light (Detail I, figure 4-60), located on the cargo hoist is in use if the power reset button is in and the circuit breaker switch is on.

Cargo Hoist Electrical Operation

WARNING

Do not operate cargo hoist when fuel fumes are present.

The cargo hoist is operated from either an external DC power source or the airplane auxiliary power unit. With DC power on the airplane, the cargo hoist is turned on and operated as follows:

1. On the cargo hoist shield, position the control circuit breaker switch to ON and press power reset switch. The amber power on light will illuminate
2. Remove the portable control box from its stowage on the bulkhead below the cargo hoist and connect to any of the three receptacles on the right side of main compartment. The cargo hoist is now ready to operate
3. To operate the hoist, press the desired push button switch on the portable control box to get the respective hoisting or traversing action. If the emergency stop button is pressed, cargo hoist operation will stop regardless of what action is taking place. To restore power to hoist, press power reset button on cargo hoist shield
4. Always maintain sufficient cable tension on hoisting cable when operating the hoist under no load condition. The cable will foul on the drum if no tension is held on the cable
5. There is a limit switch located at the fore and aft ends of the monorail to stop trolley travel. Check the switch operation the first time the trolley approaches its fore or aft limit
6. Do not jam hoisting hook against the trolley
7. There is a limit switch located on each side of the hoisting drum to stop unwinding all but two wraps of hoisting cable or to stop cargo hoist operation when the hoisting drum is fully wound with cable. Check switch operation the first time all of the hoisting cable is let out or taken in
8. Before lifting a heavy load over six inches, change from a hoisting cycle to a traversing cycle. If the load does not settle over 1/2 inch, continue operating. If excessive settling or dropping is noticed, stop operating hoist until it is properly adjusted

NOTE

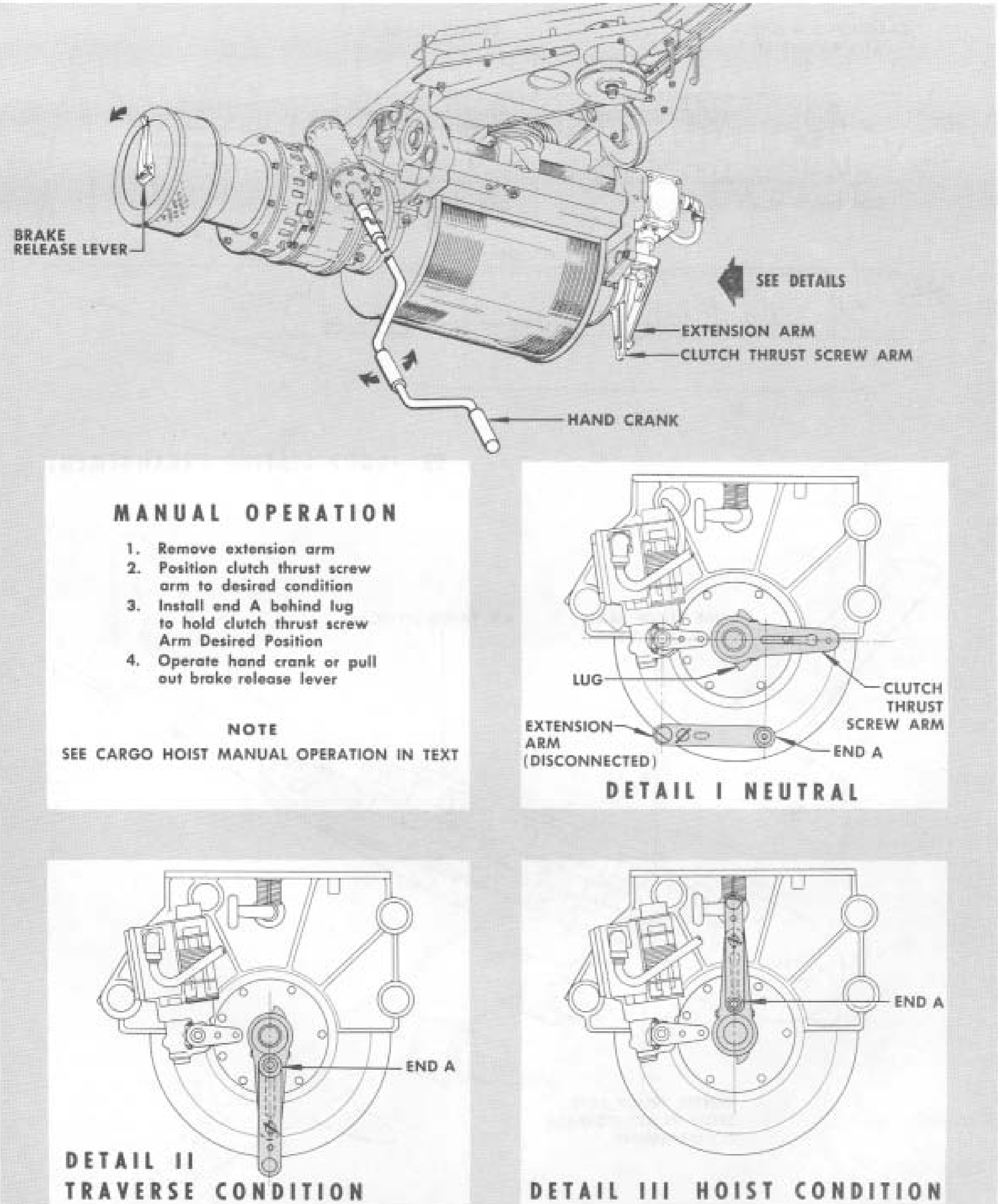
> If there are more than six strands of cable broken in any one inch length, hoist is not safe to operate under maximum rated load. Cable replacement is necessary.

9. Cargo hoist power is turned off by positioning the control circuit breaker switch to OFF. Place the portable control box to its stowed position

Cargo Hoist Manual Operation

The cargo hoist can be manually operated to relieve the load from the hoisting cable in event of a power failure or a malfunctioning electrical circuit. Before deciding the electrical circuit is malfunctioning, press the cargo hoist circuit breaker switch on the forward power panel. If this does not restore power to the cargo hoist shield, the hoist will have to be operated according to one of the following procedures:

1. If the load is in a desired location for lowering and was being hoisted at the time of failure, pull out on the brake release lever on the end of the cargo hoist motor and load will lower at a moderate lowering speed
2. If the load is in a desired location for lowering but was being traversed at the time of failure, position the clutch thrust screw arm on the right end of the cargo



MANUAL OPERATION

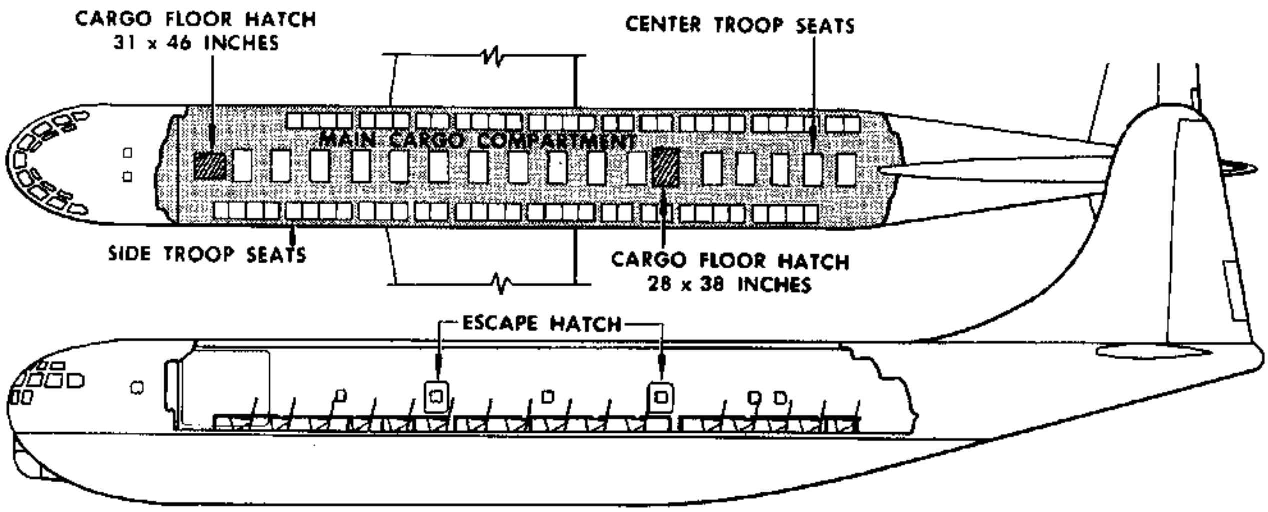
1. Remove extension arm
2. Position clutch thrust screw arm to desired condition
3. Install end A behind lug to hold clutch thrust screw Arm Desired Position
4. Operate hand crank or pull out brake release lever

NOTE

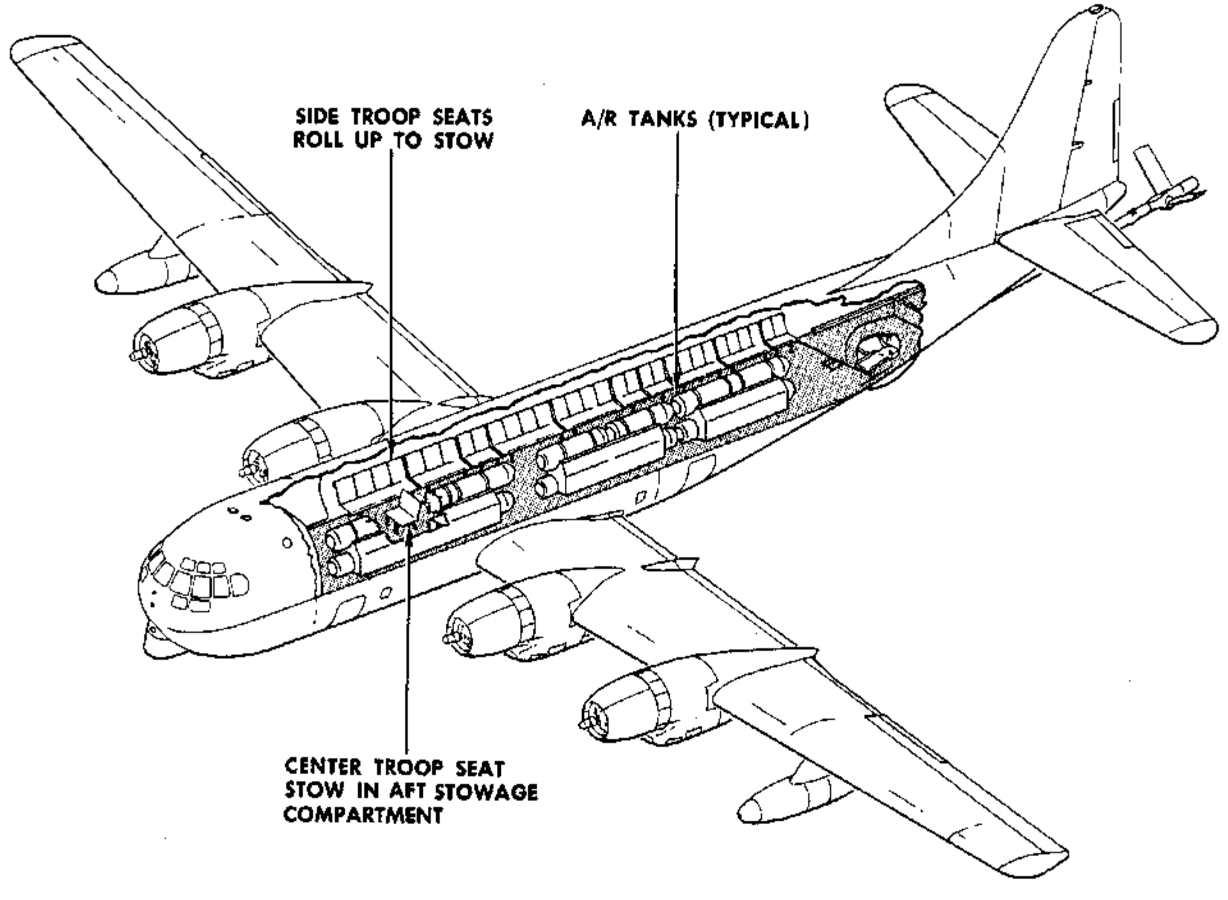
SEE CARGO HOIST MANUAL OPERATION IN TEXT

CARGO HOIST MANUAL OPERATION

Figure 4-61



Ⓒ TROOP SEATING ARRANGEMENT



T TROOP SEATING ARRANGEMENT

TROOP SEATING ARRANGEMENT

Figure 4-62

hoist as shown in Detail III, figure 4-61. Pull out on the brake release lever thrust on the end of the cargo hoist motor and the load will lower at a moderate lowering speed

3. If the load is not in a desired location for lowering and was being traversed at the time of failure, attach and operate hand crank as shown in figure 4-61 to screw arm on the right end of the hoist as shown in Detail III and follow procedure 1 above

4. If the load is not in a desired location for lowering and was being hoisted at the time of failure, position the clutch thrust screw arm on the right end of the hoist as shown in Detail II, figure 4-61. Attach and operate the hand crank to position load at desired location. Reposition the clutch thrust screw arm to a hoisting condition as shown in Detail III. Pull out on the brake release lever on the cargo hoist motor and the load will lower at a moderate lowering speed

NOTE

> When the clutch thrust screw arm is in the position shown in figure 4-61, Detail III (hoist condition), operating the hand crank as shown in figure 4-61, Detail I will provide slack in the hoisting cable to disconnect the hoisting hook.

TROOP CARRYING EQUIPMENT

On Code ▼ airplanes, in addition to carrying cargo, troop seats may be installed to carry personnel. There are permanently installed roll-up type troop seats attached to the right side of the fuselage and fold-up type troop seats which can be installed in the center of the cargo compartment next to the refueling tanks. Due to the installation of A/R tanks in the lower forward and lower aft compartment, no space is available to carry troops in these sections. The total seating capacity of these airplanes is 63. See figure 4-62. Code Ⓒ airplanes can carry 96 fully equipped troops in the main compartment (figure 4-62). These troops are accommodated by two types of seats; 64 men are seated in roll-up canvas seats along each side of the main compartment, and 32 men in removable tube-and-canvas folding seats in the center of the main compartment. Each seat is fitted with a safety belt. Due to the configuration of Code Ⓒ airplanes, no provisions have been made to carry troops in either the lower forward or lower aft compartments. For troop seating arrangement, see figure 4-62.

AIR REFUELING (A/R) SYSTEM

This airplane is equipped to transfer fuel in flight to receiver type airplanes by means of the A/R system. Fuel is carried in fifteen fuselage tanks, figure 4-62, which are interconnected to form two tank systems. Additional fuel can be pumped into the tanks from the main wing tanks, center wing tank and the external fuel tanks provided certain valves are properly positioned. Two hydraulically driven fuel pumps, each capable of better than 300 gallons of fuel per minute output, are gravity fed from the two tank systems. The two pumps are controlled by a hydraulic metering valve (figure 4-63), which is actuated by the isodraulic (isolated hydraulic) system, (figure 4-63). Fuel flows from the pumps through a series of control valves, a flow measuring venturi and out through a self-sealing poppet valve in the boom nozzle. The boom, when not in contact with a receiver airplane, can be extended or retracted hydraulically by the boom operator. Lowering and hoisting of the boom through the upward 8° of travel is also accomplished hydraulically. Movement of the boom when in a lowered position is controlled by the boom operator by actuating a control stick which is mechanically linked to the ruddevator surfaces. The A/R electrical system operates on power received from the airplane 28 volt DC system and the 115 volt AC system. In addition, hydraulic pressure is used to operate a fuel bypass valve and a fuel dump actuator. The A/R hydraulic system can be more readily understood if considered as four component systems; hydraulic pressure system, hydraulic fuel pump system, isodraulic system and the boom hydraulic system.

17260 ▶ 22736

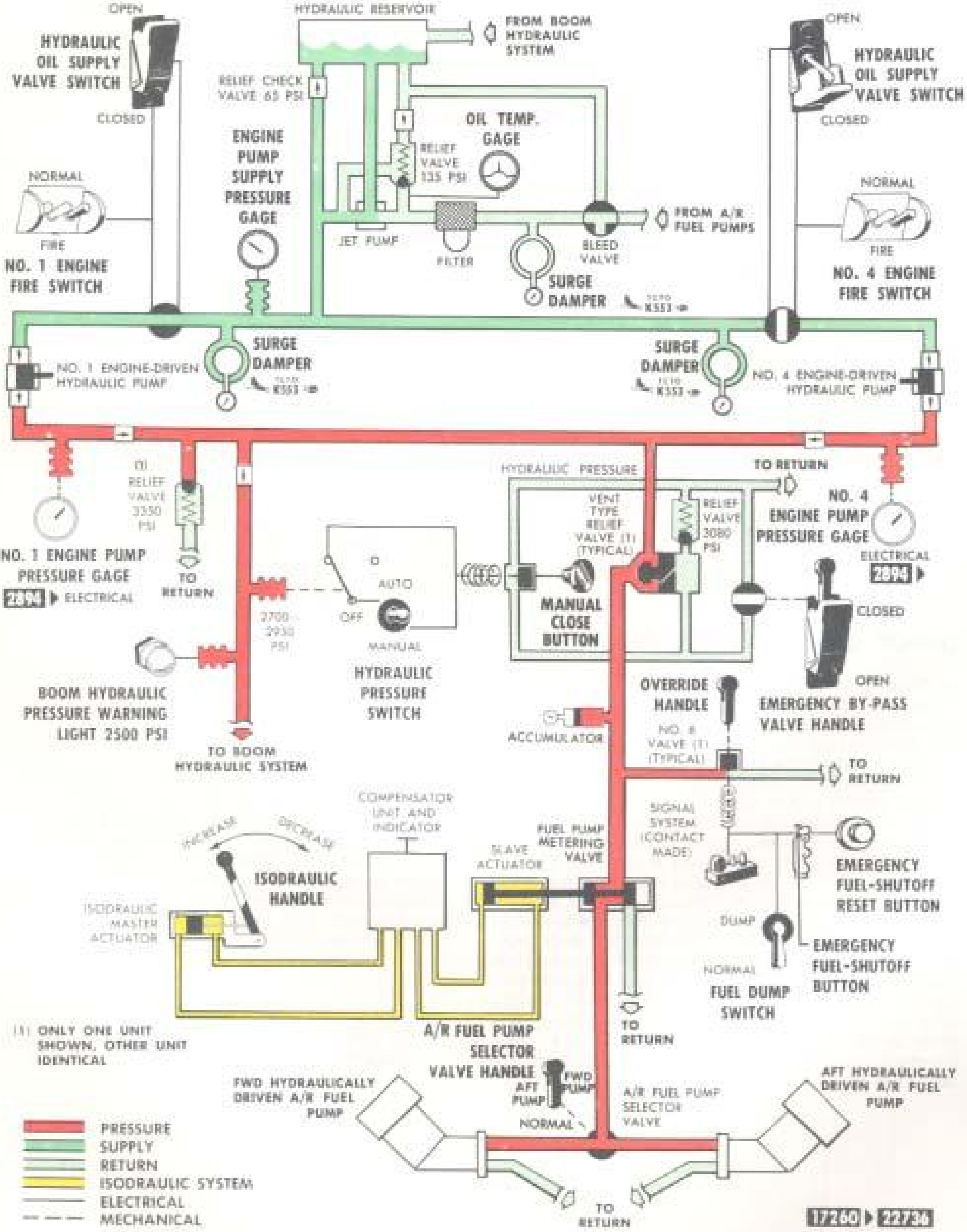
The A/R hydraulic system (figure 4-63) is independent of the airplane hydraulic system and is used primarily to pump fuel, and to lower, extend, retract and hoist the boom.

22737 ▶

The A/R fuel pump hydraulic system and the boom hydraulic system are separated into two integral parts. The fuel pumps are driven by hydraulic pressure from the A/R engine-driven hydraulic pumps (figure 4-63). The boom hydraulic system is connected to the airplane hydraulic system through a hydraulic motor-pump combination which raises airplane hydraulic system pressure to the high pressure level required for boom operation (figure 4-64).

NOTE

> Hydraulic drain valves must not be opened during flight, because discharged hydraulic fluid will deteriorate the pod seals and cloud the boom operator's window.



MAIN A/R HYDRAULIC SYSTEM

Figure 4-63 (Sheet 1 of 2)

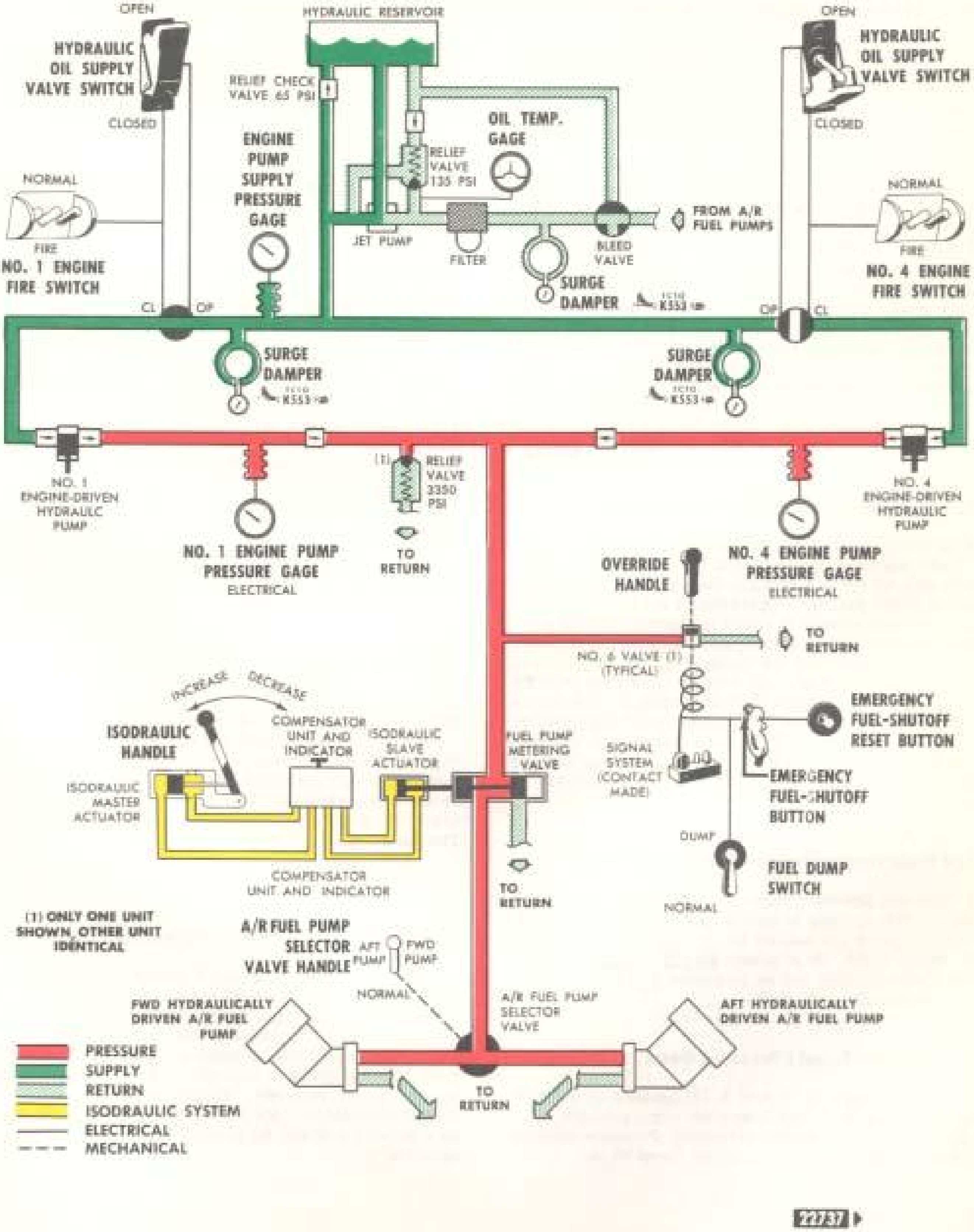


Figure 4-63 (Sheet 2 of 2)

A/R HYDRAULIC PRESSURE SYSTEM

The basic components of the hydraulic pressure system (figure 4-63) are an 8 US gallon reservoir which supplies hydraulic fluid to two engine-driven pumps, one on No. 1 engine and one on No. 4 engine. Oil temperature is automatically controlled by two oil coolers one each in No. 1 and No. 4 nacelles. A jet type hydraulic pump (7, figure 4-73) is used to provide a positive supply of hydraulic oil to the engine-driven pumps. On airplanes **17260** ▶ **22736** service hydraulic reservoir to a maximum of 6 gallons, and on airplanes **22737** ▶ , 3 1/2 gallons lower aft compartment, and 6 gallons for reservoir at boom operator's station (pod depressurized). Airplanes with TCTO K553 incorporated have surge dampers (accumulators) installed in the A/R hydraulic system. One damper is added in the supply line upstream from the hydraulic oil supply shutoff valve in each of the outboard nacelles. The other damper is added in the return line between the bleed valve (7, figure 4-73) and the filter (5, figure 4-73) on the A/R hydraulic panel. This damper replaces a low pressure accumulator on airplanes **17260** ▶ **22736** .

A/R Hydraulic Oil Supply Valve Switches

A hydraulic shutoff valve is located in the supply line of each engine-driven A/R hydraulic pump. The valves will shut off the flow of oil to the pumps in case of fire in the power package. Operation of the valves is rapid and they will remain in either the open or closed position without continuous application of power. Two NORMAL--FIRE switches (15, figure 1-12) on the overhead panel control the shutoff valves. See also POWER PACKAGE FIRE SWITCHES in Section I. The valves can be closed with the two hydraulic oil supply valve switches (4, figure 4-70) on the engineer's A/R panel. The switches have OPEN--CLOSE positions and are guarded to OPEN. Power for all four switches is 28 volt DC.

A/R Main Hydraulic System Pressure Gages

A hydraulic pressure gage in the pressure line of each engine-driven pump indicates system pressure in psi. The two gages are located on the engineer's A/R panel (5, figure 4-70). On airplanes **17260** ▶ **2893** the gages and direct reading and on airplanes **2894** ▶ the gages are electrically operated.

Engine Pump Supply Pressure Gage

A pressure gage (4, figure 4-73) located on the A/R hydraulic panel in the lower aft compartment indicates engine pump supply pressure. Pressure reading during cruise operation should be above 50 psi.

A/R Hydraulic Oil Temperature Gage

This gage (34, figure 1-22) on the engineer's instrument panel shows the temperature of the return oil from the A/R fuel pumps. Its temperature bulb (3, figure 4-73) is located in the oil return line.

A/R FUEL PUMP AND ISODRAULIC HYDRAULIC SYSTEMS

Hydraulic system pressure is used to drive two hydraulic motors (figure 4-63) which are mechanically engaged to the two fuel pumps. Each of the pump and motor units is enclosed in a fuel pump chamber. One pump chamber is located in each lower compartment. Fluid flow to the motors is through the fuel pump metering valve, pump selector valve, and flow restrictors. Fluid return from the fuel pump motors is to the pressurized engine-driven pump supply system. Case drain fluid is returned to the reservoir. There are three basic units in the isodraulic (isolated hydraulic) system. The control unit, functioning as a hydraulic pump, forces fluid through a compensator unit, and into a slave unit (11, figure 4-73), which actuates the fuel pump metering valve through a mechanical linkage. The compensator acts as a reservoir and pressure accumulator; and the slave unit acts as a simple actuating cylinder.

Isodraulic Handle

This handle (4, figure 1-20 and figure 4-63) is part of the isodraulic control unit and is located at the aft end of the engineer's instrument panel. Movement of the handle through positions numbered 1 through 10 hydraulically controls the fuel pump metering valve (figure 4-63) which, in turn controls the fuel pump rpm. The handle also has an OFF position.

A/R Fuel Pump Selector Valve Handle

This handle, (figure 4-63 and 6, figure 4-72) located at the aft end of the right aft fuel tank in the lower aft compartment, controls hydraulic fluid flow from the fuel pump metering valve to the forward, the aft, or both fuel pump hydraulic motors. This selector valve cannot be positioned to shut off fluid flow to both pump motors simultaneously. Handle positions are FWD PUMP--NORMAL--AFT PUMP. The valve handle acts as a pointer and will be placed toward the A/R pump selected.

A/R BOOM HYDRAULIC SYSTEM

17260 ▶ 22736

The A/R boom hydraulic system (figure 4-64) is pressurized by the main A/R hydraulic system. If boom system pressure falls below normal, the boom hydraulic pressure switch will energize the hydraulic pressure control valves in the main pressure system causing two vent type relief valves to restrict hydraulic fluid flow to the fuel pump motors. These two vent type relief valves (4, figure 4-72) assure a constant pressure supply to the A/R boom hydraulic system. A manually operated emergency bypass valve (1, figure 4-72) is provided to permit opening of the vent type relief valves in case a malfunction of the solenoid operated pressure control valve holds them in the close position. If the solenoid valve will not actuate to the close position it cah be held closed manually by the manual close button (5, figure 4-72).

22737 ▶

The A/R boom hydraulic system is connected to the airplane hydraulic system through a hydraulic motor-pump combination which raises airplane hydraulic system pressure to the high pressure level required for boom operation (figure 4-64).

17260 ▶

Fluid pressure is used to hoist the boom through its upper 8° of travel and to extend and retract the boom. Two hydraulic motors are mechanically connected to the boom hoist cable drum. One motor is used to hoist and lower the boom; the other motor is used to maintain a constant tension on the boom cable. The rate at which the boom can be lowered is automatically controlled by a flow restrictor in the hoist motor pressure line. Extension and retraction of the boom is accomplished by the telescope hydraulic motor which is mechanically linked to the boom by a chain and cable system. Hydraulic pressure is also used to actuate a mechanical linkage which will unseat the boom nozzle poppet permitting fuel to be dumped should an emergency condition exist. Fuel trapped in the extended boom is returned to the tanks through a hydraulically actuated fuel bypass valve as the boom retracts. Provisions are made to hoist and retract the boom by actuating a hand pump located in the boom operator's compartment. This operation will be performed only if failure of the hydraulic system should occur.

Boom Hoist Lever

The hoist lever (42, figure 4-69 and figure 4-64) located to the left of the boom operator's panel has DOWN--OFF--UP positions. The hoist lever controls the direction and rate of flow of fluid to or from the hoist motor. With the hoist lever in the UP position the motor raises the boom. OFF hydraulically locks the hoist motor, and vertical motion of the boom is prevented. In the DOWN position the lever allows the motor to rotate in the reverse direction as gravity lowers the boom. In flight a boom actuated snub switch automatically transfers control from the hoist lever to the ruddevators when the boom is lowered approximately 8° below the stowed position. On the ground, full elevation travel is controlled by the hoist lever. In this condition the snub switch is de-energized by the landing gear oleo actuated relays even though the boom operator's master switch is ON.

Boom Telescoping Lever

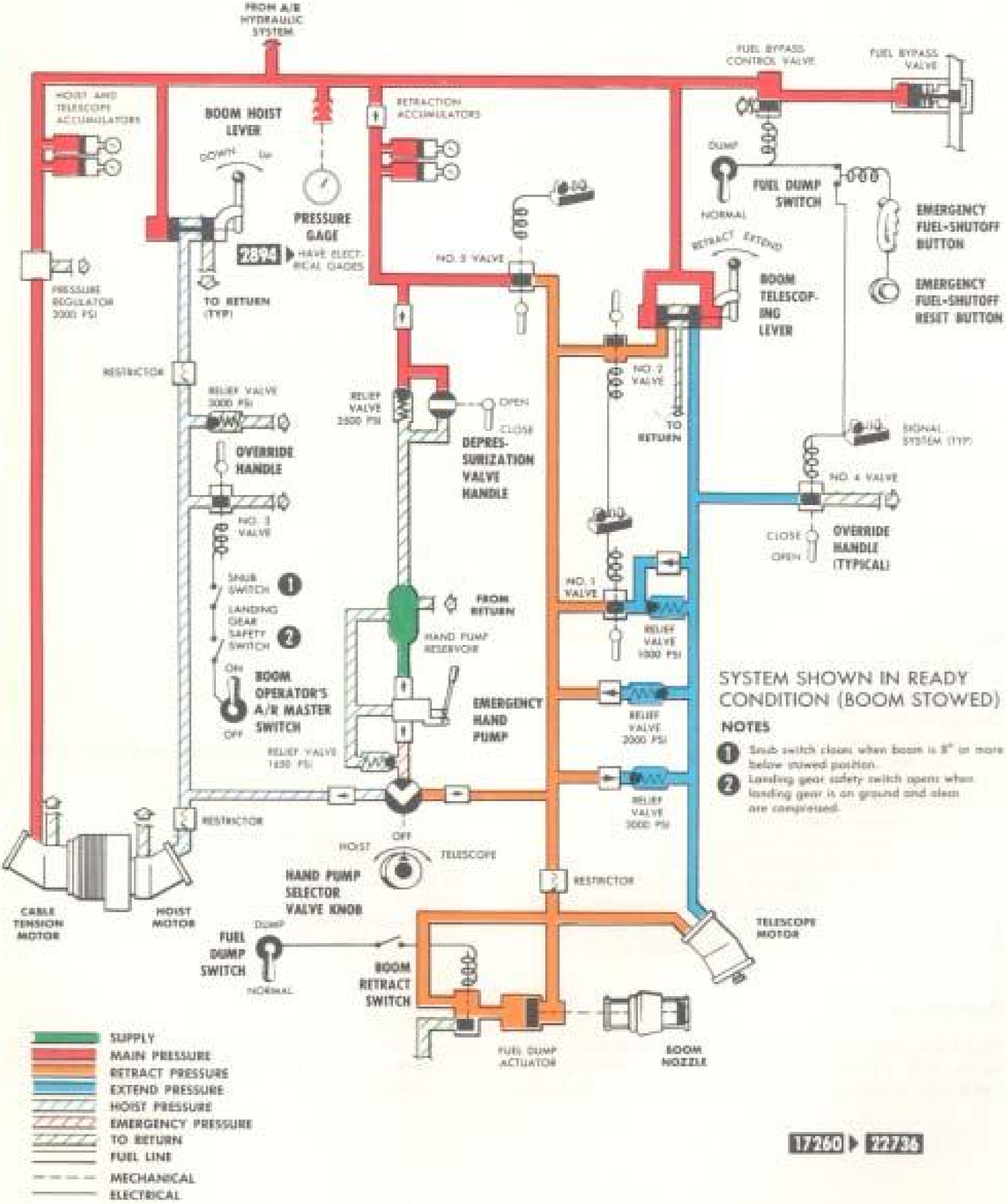
The boom telescoping lever (figure 4-64 and 3, figure 4-69) with RETRACT--NEUTRAL--EXTEND positions is located on the left side of the boom operator's panel. This lever controls the fluid rate and direction of flow to a reversible hydraulic motor which telescopes the sliding member of the boom. As the lever is moved in the EXTENDED direction the rate of extension of the boom is increased, reaching a maximum extension rate at full EXTEND. Movement of the lever in the RETRACT direction increases the rate of retraction of the boom, reaching a maximum retraction rate at RETRACT. In the NEUTRAL position telescoping of the boom is prevented unless the tanker and receiver airplanes are in contact made; in this condition the telescoping control is inoperative, and the boom is allowed to extend and retract according to the relative displacements of the two airplanes.

Boom Hydraulic System Depressurization Valve Handle

A boom hydraulic system depressurization valve (11, figure 4-65) with an OPEN--CLOSED control handle in the boom operator's compartment, provides for depressurization of the boom hydraulic system. The normal operating position of the handle is the CLOSED position which allows the system to be pressurized.

NOTE

This valve handle must be at CLOSED to provide hydraulic pressure to actuate the boom nozzle poppet valve for fuel dumping and to provide hydraulic pressure for boom operation.



SYSTEM SHOWN IN READY CONDITION (BOOM STOWED)

NOTES

1. Snub switch closes when boom is 8" or more below stowed position.
2. Landing gear safety switch opens when landing gear is on ground and oleos are compressed.

17260 ▶ 22736

A/R BOOM HYDRAULIC SYSTEM

Figure 4-64 (Sheet 1 of 2)

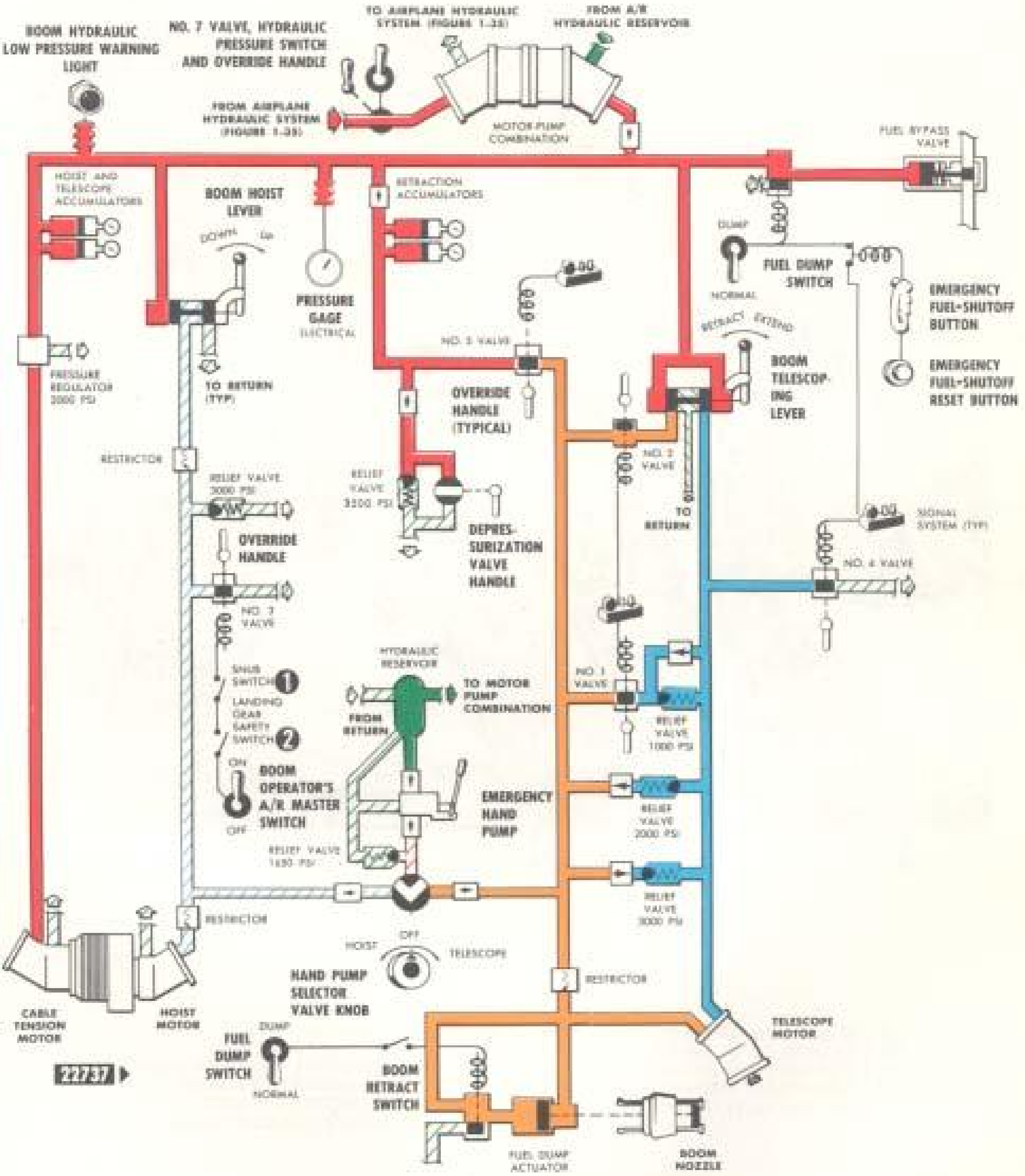
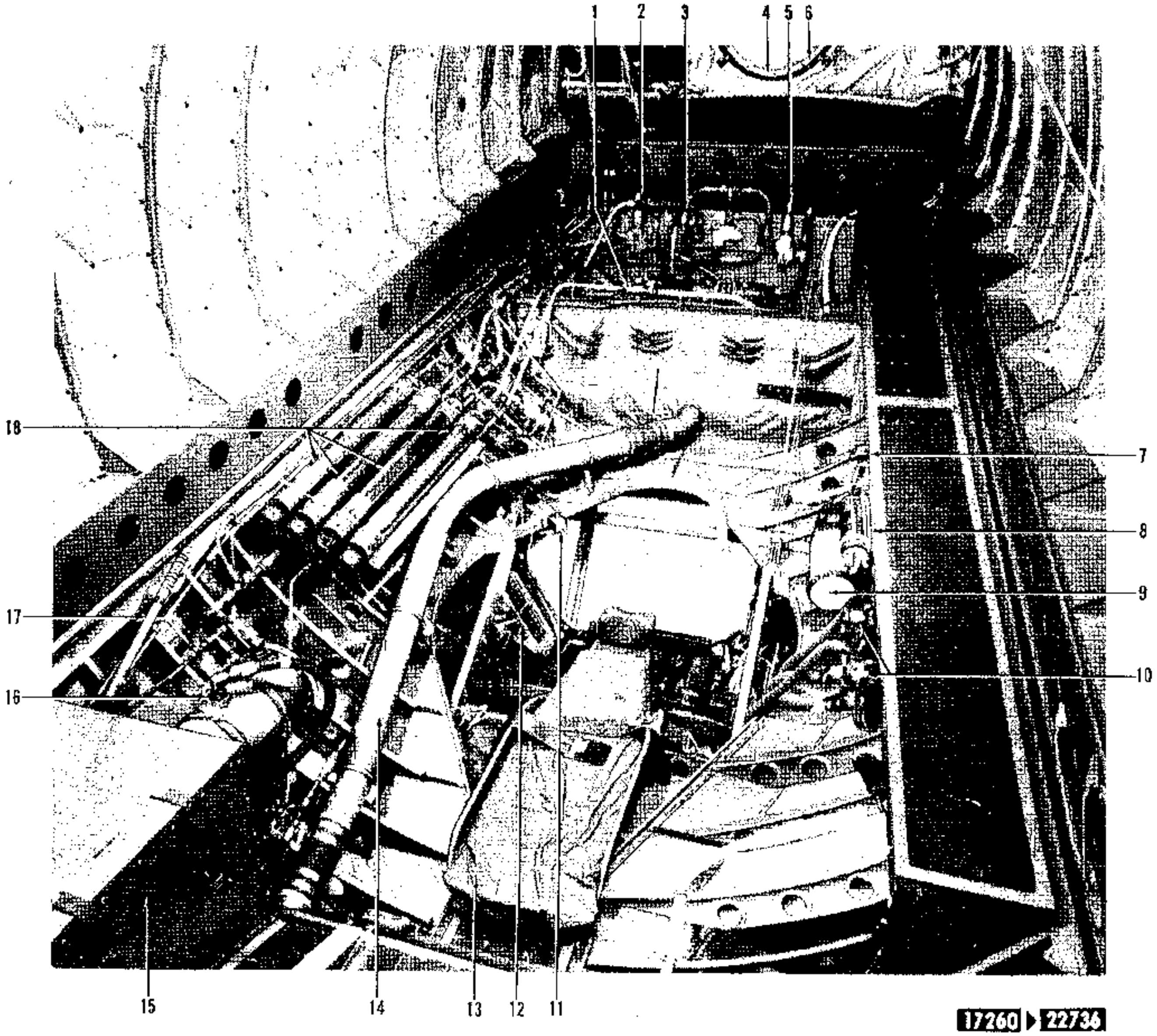


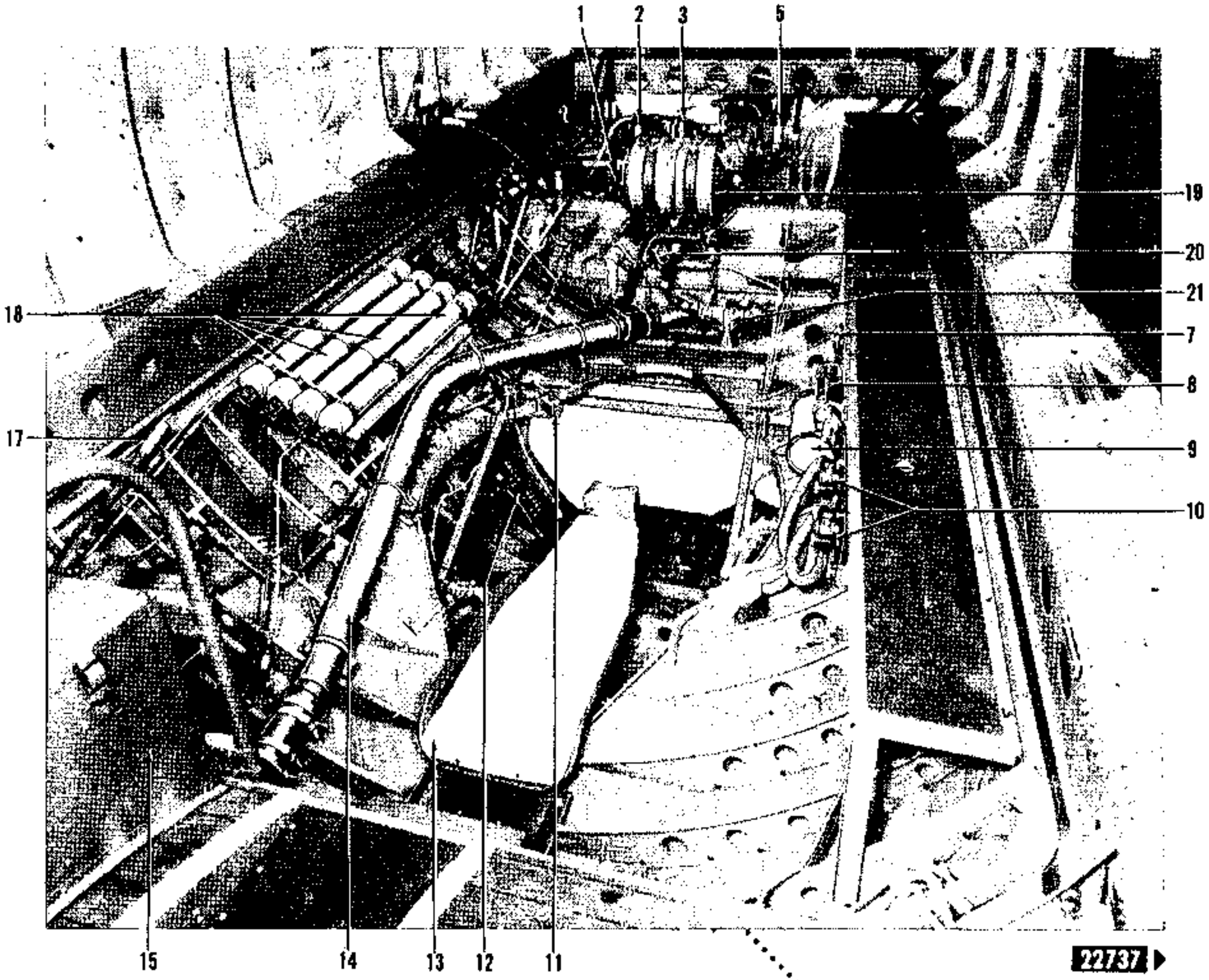
Figure 4-64 (Sheet 2 of 2)

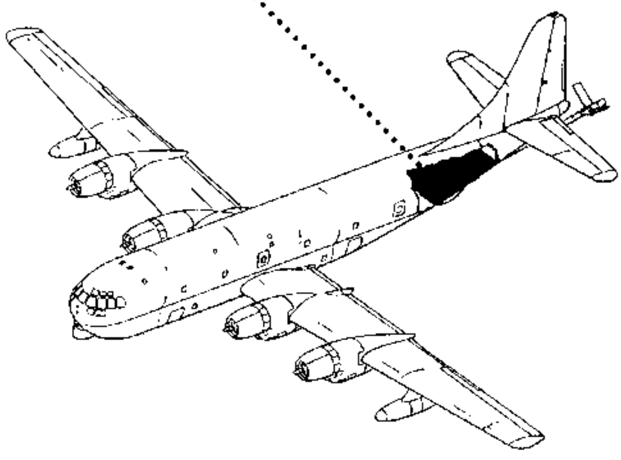


1 NO. 2 SOLENOID VALVE (2 PLACES)
2 NO. 5 SOLENOID VALVE (2 PLACES)
3 NO. 1 SOLENOID VALVE (2 PLACES)
4 TAIL COMPARTMENT HATCH
5 NO. 4 SOLENOID VALVE (2 PLACES)
6 NO. 3 SOLENOID VALVE (LOCATED AFT OF HATCH)
7 OXYGEN BOTTLE RECHARGER (2 PLACES)
8 FIRE EXTINGUISHER (2 PLACES)
9 OXYGEN BOTTLE (2 PLACES)
10 OXYGEN REGULATORS (2 PLACES)

BOOM OPERATOR'S COMPARTMENT

Figure 4-65 (Sheet 1 of 2)





11 DEPRESSURIZATION VALVE HANDLE (2 PLACES)
12 INTERPHONE CONTROL PANELS (2 PLACES)
13 BOOM OPERATOR'S PLATFORM (2 PLACES)
14 REFUELING LINE (2 PLACES)
15 CARGO TIEDOWN EQUIPMENT STOWAGE (2 PLACES)
16 HAND PUMP RESERVOIR 17260 ▶ 22736
17 HAND PUMP (2 PLACES)
18 ACCUMULATORS (2 PLACES)
19 BOOM SYSTEM HYDRAULIC RESERVOIR 22737 ▶
20 NO. 7 SOLENOID VALVE 22737 ▶
21 MOTOR-PUMP COMBINATION 22737 ▶

Figure 4-65 (Sheet 2 of 2)

Boom Hydraulic Pressure Switch

17260 ▶ 22736

An AUTO--OFF--MANUAL switch (7, figure 4-69) on the boom operator's panel provides control to pressurize the boom hydraulic system. The switch is spring-loaded to OFF from the MANUAL position. With the switch in AUTO the boom hydraulic system pressure will be maintained between 2700 psi and 2950 psi. If the system pressure cannot be maintained due to malfunction of the hydraulic pressure switch, or clogging of the flow restrictor, the boom system pressure can be maintained by holding the switch in MANUAL as required.

22737 ▶

An ON--OFF switch (7, figure 4-69) on the boom operator's panel controls the No. 7 solenoid valve located between the airplane hydraulic system and the boom hydraulic system. When the switch is in the ON position, the valve is opened, allowing the airplane hydraulic system to drive the boom hydraulic system pressurizing motor.

Boom System Emergency Hand Pump

The emergency hand pump, (figure 4-64 and 17, figure 4-65) located in the boom operator's compartment, can be used to retract, extend and hoist the boom in the event of failure of the engine-driven hydraulic pumps. Fluid is supplied to the hand pump from a reservoir which is an integral part of the boom hydraulic system return. See FUEL DUMP CHECK Section VIII, for boom extension procedure.

NOTE

Before attempting to hoist or retract boom during flight using the boom system emergency hand pump, the A/R master switch must be in the OFF position.

Emergency Hand Pump Selector Valve Knob

This valve (figure 4-64) is used to control the flow of fluid from the emergency hand pump. It can be positioned from its OFF position to the HOIST or TELESCOPE position. The selector knob is mechanically linked to the selector valve.

Boom Hydraulic Pressure Gage

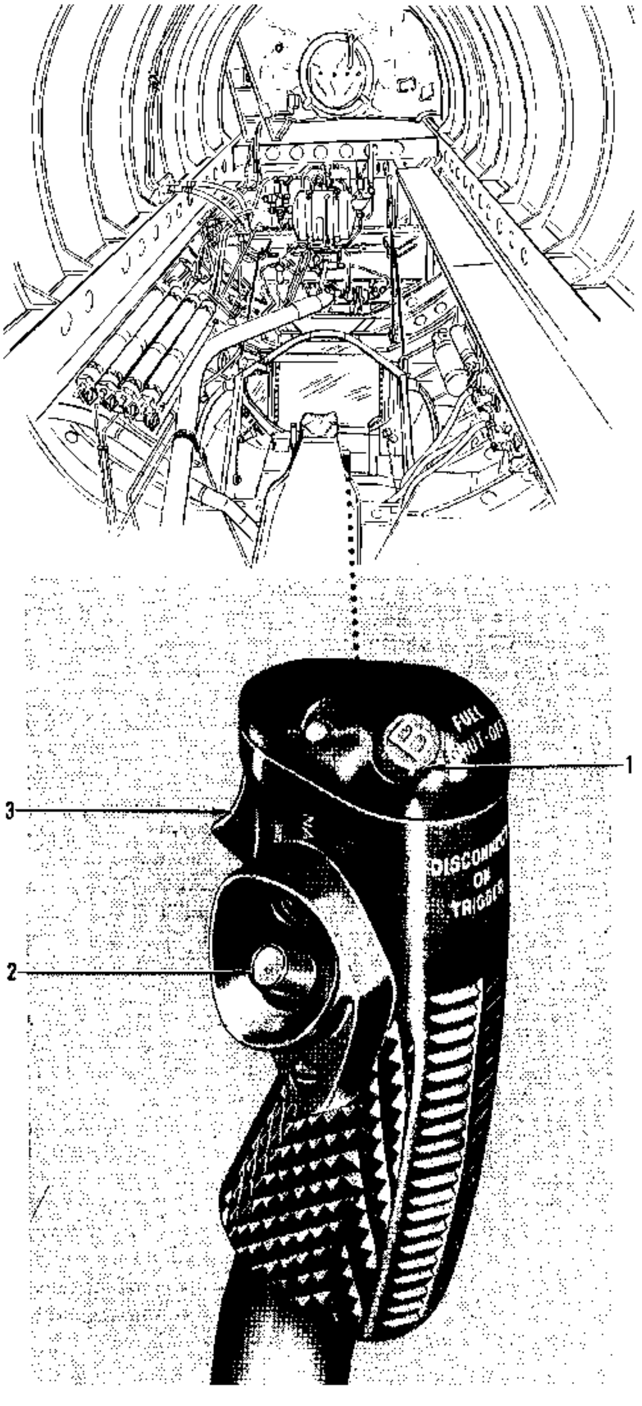
A hydraulic pressure gage (6, figure 4-69) on the boom operator's panel indicates boom hydraulic system pressure. Normal operating range is 2700 to 2950 psi. On airplanes **17260 ▶ 2893** the pressure gages are direct pressure reading and on airplanes **2894 ▶** they are electrical. Power is supplied from the 26 volt AC instrument transformer for the electrical gages.

Boom Hydraulic Low Pressure Warning Light

An amber warning light (5, figure 4-69) on the boom operator's panel will illuminate when boom system pressure falls below 2500 psi and goes out when boom system pressure returns to 2600 psi. Power is supplied from the 28 volt DC aft power panel.

A/R BOOM

The A/R boom consists of two concentric tubular sections which will extend from a minimum length of 28 feet to a maximum length of 47 feet. To permit movement in azimuth and elevation a yoke and trunnion attachment is used to attach the boom to the underside of the fuselage near the tail. A flexible hose couples the high capacity fuel system with the boom. A boom operator controls the boom with an airplane type control stick which is connected by cables to the ruddevator surfaces. The slipstream acting on these control surfaces provides the necessary force to position the boom while in flight. Telescoping of the boom is accomplished through a reversible hydraulic motor. During the contact made condition the boom actuates limit switches which automatically initiate disconnect when the boom reaches the boundary of the operating envelope (figure 4-79). Voluntary disconnects may be initiated by either the receiver pilot or the boom operator. The pilot director lights which are installed on



1 A/R EMERGENCY FUEL-SHUTOFF BUTTON
2 MICROPHONE SWITCH
3 DISCONNECT SWITCH

RUDDEVATOR CONTROL STICK

Figure 4-66

the under side of the fuselage are also boom actuated. These lights direct the receiver pilot toward a smaller operating envelope known as the nominal contact position. Raising and lowering the boom on the ground and raising the boom through the last 8° of upward travel while in flight is accomplished with a hydraulically operated hoist. A hydraulic cable tension motor maintains tension on the hoist cable while the boom is being controlled aerodynamically.

Ruddevator Control Stick

In flight, the ruddevator control stick (figure 4-66) located to the right and slightly below the boom operator's platform, provides aerodynamic control of elevation and azimuth boom position. A control lock is provided and should be engaged when the boom is stowed. On airplanes **3250** ▶, the boom envelope has an azimuth of 30° and an elevation of 43°. To assist the boom operator in controlling the boom, while in the area of greatest deflection, an elevation assist trim wheel has been incorporated to relieve pressures on the ruddevator control stick. Turning the elevation assist trim wheel downwards will increase the boom assist by placing increased tension on the load reduction spring. This will be shown by an indicator pin, mounted integrally with the elevation assist trim wheel housing, moving to the right. Rotating the elevation assist trim wheel upwards will decrease the boom assist. When boom is within approximately 10° of stowed position, care should be exercised by boom operator of the aerodynamic forces on boom ruddevators.

CAUTION

Boom operator should turn elevation assist trim wheel approximately one revolution downward from the full decrease position when boom is approximately 10° from stowed position to prevent boom slamming into stowage support. Failure to do so will result in structural damage to boom and stowage support.

Ruddevator Control Stick Lock

The ruddevator control stick lock located on the bulkhead aft of the ruddevator control stick, locks the ruddevator control stick in a neutral position. To lock the control stick, the control lock is pulled forward, and the control stick is moved into a recess in the lock.

Boom Latching Lever

The latching lever (28, figure 4-69) with BOOM LATCHED--BOOM UNLATCHED positions controls a cable actuated latch which secures the boom. With the boom hoisted against the stowage support, placing the lever in the BOOM LATCHED position secures the boom. To release the boom it is necessary to apply a hoisting force on the boom to release pressure on the latch before moving the lever to the BOOM UNLATCHED position. The latching lever is located on the right side of the boom operator's panel.

Boom Position Indicators

Three instruments (9, 11, 13, figure 4-69) on the boom operator's panel indicate azimuth, elevation and telescoping positions of the boom. A circuit breaker on the boom operator's panel protects the electrical circuit connecting the indicators and their respective transmitters.

A/R ELECTRICAL SYSTEM

The A/R electrical system operates on power received from the tanker's main 28 volt DC system and the 115 volt AC system. Power requirements during air refueling place a heavy load on the airplane's electrical system, and all electrically powered equipment that is nonessential to flight or the A/R operation should be turned off. Electrically powered units in the A/R system include fuel shutoff valves, hydraulic valves, lighting and a signal amplifier.

Signal System

The tanker signal system is an electrical system which works in conjunction with a signal system in the receiver airplane to set up the automatic features of the boom hydraulic and fuel systems for contact made and disconnect. In the ready for contact condition the tanker signal system de-energizes the fuel pump and the line valve circuits. Upon contact made the signal amplifier completes the fuel pump and line valve circuits and also locks the telescope control out of the hydraulic system to allow the boom to extend or retract as necessary. During contact made, coils in the boom nozzle and in the receiver receptacle inductively couple the two signal systems so that signals originating in either system may be transmitted to the other. The coupling of the signal systems allows either the receiver pilot or the boom operator to initiate a disconnect. If one of the boom position limit switches or the fuel pressure limit switch is actuated, an automatic disconnect is initiated. At disconnect the signal system automatically controls the fuel cutoff and returns telescoping control to the boom operator; if the telescope at disconnect switch (8, figure 4-69) is in AUTO the boom will automatically retract.

A/R Numbered Valves

A/R numbered solenoid valves No. 1, 2, 4, and 5 in conjunction with the boom operator's telescoping lever, control the extension and retraction of the boom. Since these valves are controlled by the signal system, and since their functions are related, they should be considered simultaneously. Solenoid valves No. 1 and 5 are normally closed, and open when energized by the signal system. Valves No. 2, 4, and 6 are normally open, and close when energized. When the signal system is in the contact made condition, valves No. 1 and 4 are open and valves No. 2 and 5 are closed. In this condition the boom cannot be extended or retracted manually with the boom telescoping lever. When the signal system is in the disconnect condition, with the boom operator's telescope at disconnect switch in the AUTO position, valves No. 1 and 2 are closed and valves No. 4 and 5 are open. In this condition the boom is retracted automatically and the boom cannot be extended or retracted manually. With the telescope at disconnect switch in the MANUAL position, valves No. 1, 2, and 4 are closed and valves No. 5 and 6 are open. In this condition the boom does not retract automatically but may be manually retracted. In this condition the boom cannot be manually extended. (See figures 4-63 and 4-72). On all airplanes hoisting of the boom is controlled by the normally closed solenoid valve No. 3, snub switch, and the boom operator's hoist control lever. While in flight, and the signal system in either the ready or disconnect condition, the boom is lowered approximately 8° from the stowed position with the hoist motor. Beyond this 8° point the snub switch is closed to actuate solenoid valve No. 3 to the open position, bypassing the hoist motor and allowing boom movement to be controlled by the ruddevators. As the boom is flown up to within approximately 8° below the stowed position solenoid valve No. 3 again closes, due to the action of the snub switch, and the boom may be hoisted to its stowed position. See figure 4-67 for the solenoid valve positions under various conditions.

VALVE NO.	NORMAL DE-ENERGIZED POSITION	READY FOR CONTACT	CONTACT MADE	TOWING RECEIVER	EMERGENCY FUEL DUMP	17260 ▶ 22700 MANUAL DISCONNECT	22701 ▶ MANUAL DISCONNECT	AUTO DISCONNECT
1	Closed	Closed	Open	Open	Closed	Closed	Closed	Closed
2	Open	Open	Closed	Closed	Closed	Open	Closed	Closed
3	Closed	▷	Open	Open	Open	▷	▷	▷
4	Open	Closed	Open	Open	Open	Closed	Closed	Open
5	Closed	Closed	Closed	Closed	Open	Closed	Open	Open
6	Open	Open	Closed	Closed	Closed	Open	Open	Open

▷ Open in flight when boom is more than 8° below stowed position, closed at all times on ground

SOLENOID VALVE POSITIONS

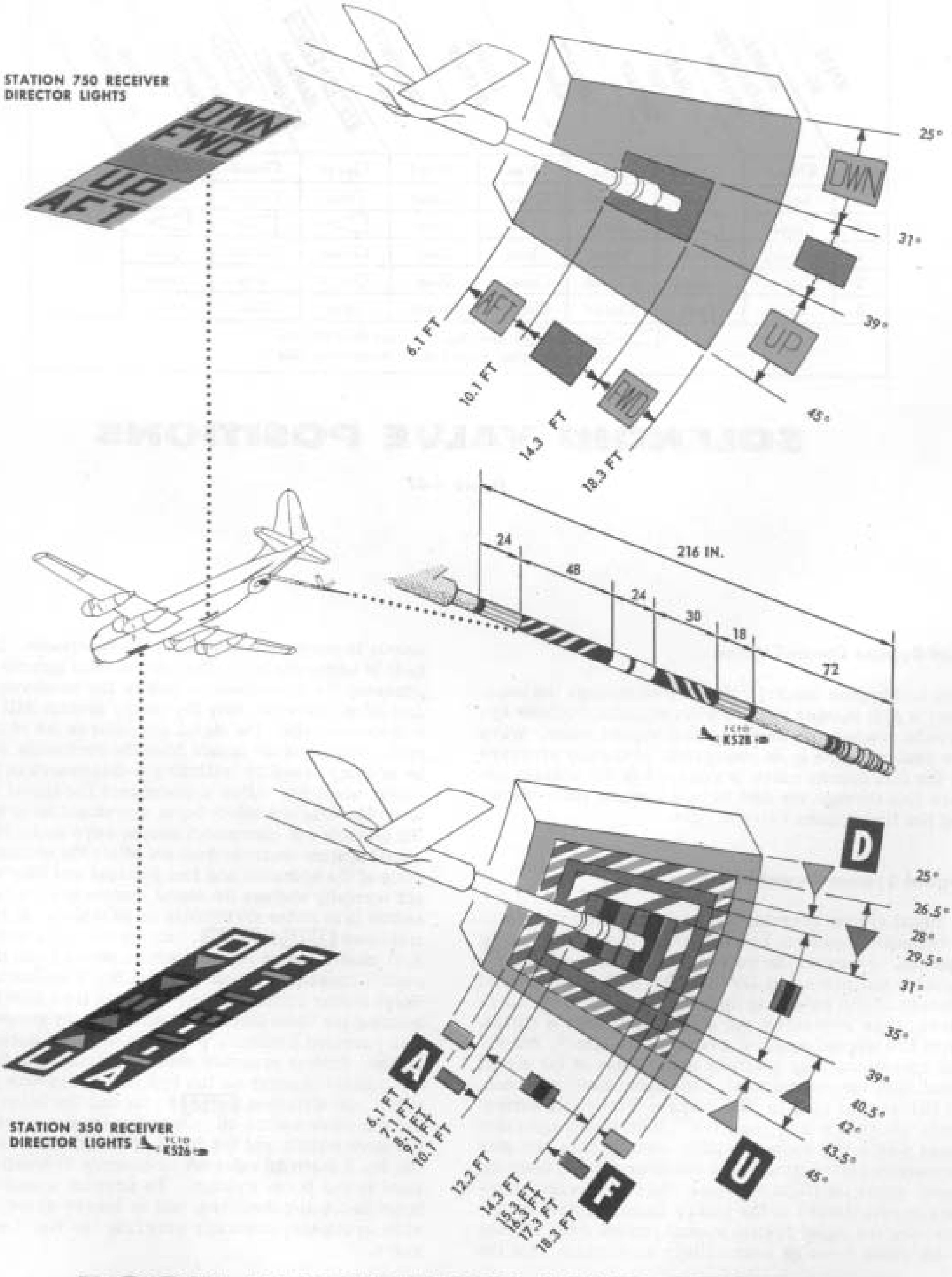
Figure 4-67

Fuel Bypass Control Valve

The fuel bypass control valve, wired through the engineer's A/R master switch, when energized allows hydraulic pressure to close the fuel bypass valve. When the control valve is de-energized, hydraulic pressure to the fuel bypass valve is relieved to the system return line through the fuel bypass control valve allowing the fuel bypass valve to open.

Signal System Override

A signal system override has been installed to serve as a secondary system in event of failure of the signal system. An override switch on the boom operator's panel when placed at OVERRIDE will allow manual control of the refueling operation by the boom operators, thus replacing the signal amplifier's duties. With the signal system override in effect, refueling operations may continue without use of the signal amplifier, the restrictions of the boom limit switches, or the signal coil in the nozzle since all normal limit switches are inactive. The boom operator must watch the boom position instruments and give corrective information to the receiver pilot to keep the boom within its flight envelope while in contact. Contact is established in the tanker signal system by depressing the signal system manual contact switch on the telescoping lever as soon as it is ascertained that the nozzle is properly contacted in the receptacle. Disconnect is accomplished in the conventional manner by depressing the disconnect switch on the ruddevator control stick; however, only the tanker system will go into a disconnect since the signal amplifier is out of the circuit. Release of the nozzle from the receptacle can only be accomplished by initiating a disconnect in the receiver airplane. After a disconnect the signal system override does not affect boom movement as it would if the telescope at disconnect switch were at AUTO. The signal system override does not affect the normal operation of the hydraulic and fuel systems and they will react normally whether the signal system manual override switch is in either OVERRIDE or NORMAL. In flight on airplanes 17260 ▶ 22736, turning the boom operator's A/R master switch off will remove power from the snub switch consequently closing the No. 3 solenoid valve. Hoist motor control of the boom is then possible for hoisting the boom from any position, to the stowed position provided hydraulic pressure does not become depleted. System pressure should be recharged by using the manual plunger on the hydraulic pressure control valve. On airplanes 22737 ▶, turning the boom operator's master switch off, not only removes power from the snub switch and the No. 3 solenoid valve, but also the No. 7 solenoid valve which controls hydraulic pressure to the boom system. To prevent accumulators from becoming depleted, and to insure system pressure available, manually override the No. 7 solenoid valve.



BOOM MARKINGS AND RECEIVER DIRECTOR LIGHTS

Figure 4-68

A/R Exterior Lighting

Lights (figure 4-41) are installed on the fuselage and boom to illuminate the exterior of the airplane and boom for night operations. Four lights, flush mounted in the fuselage skin, illuminate the underside of the wing to the inboard nacelles. A flush mounted boom chock light illuminates the stowage chock. The boom nozzle hood contains lights to illuminate the nozzle and boom color bands. On Airplanes **3196** ▶ plus those airplanes with 1C10 K231 incorporated, two A/R rendezvous beacon lights are mounted in the tail cone, one vertically and one horizontally. On airplanes incorporating 1C10 591, two sets of anti-collision lights, one set on top and one set on bottom, are mounted on the fuselage opposite the wing leading edge. These lights are used as anti-collision and rendezvous lights. The anti-collision light switch (43, figure 1-12) on the overhead panel has UPPER ON--OFF--BOTH ON positions. The anti-collision light color selector switches (42, figure 1-12) provide a means for individual or multiple color selection. Four colors, red, blue, green and amber with ground changing provisions are only provided with two filters of each color. The two color selector switches are decalled UPPER and LOWER and each switch has three position COLOR A--BOTH--COLOR B. The light and color combination, as self explanatory as decalled. Three lights mounted on the aft pilot director lights assembly illuminate the fuselage and trailing edges of the wings. These lights provide visual identification for the receiver airplanes. Receiver director lights assemblies, (figure 4-68) which provide visual command signals for the receiver pilots, are mounted on the underside of the fuselage aft of the wing. On airplanes incorporating 1C10 K526, additional receiver director lights assemblies are installed on both sides of the under-fuselage forward of the wing. A selector switch (46, figure 4-69) on the receiver director lights panel, located at the boom operator's station, permits selection of either the aft receiver director lights assemblies or the receiver director lights assemblies of the forward installation. The receiver director lights are normally actuated automatically, during contact, by movements of the A/R boom (figure 4-68), however, manual override switches are installed on the boom operator's panel to permit manual operation if necessary. Circuit protection is provided through a circuit breaker on the aft power panel.

CAUTION

To preclude the possibility of fire, the boom nozzle and boom marking lights will not be illuminated during a fuel dumping operation.

NOTE

3196 ▶ plus 1C10 K231

- To prevent blistering of the plastic tail cone due to excessive heat from the rendezvous beacon lights, do not operate these lights for more than 1 minute while the airplane is on the ground. These lights have six colored discs which may be changed on the ground only.

1C10 591

- To prevent blistering of the plastic cone due to excessive heat from the anti-collision lights, do not operate these lights for more than 5 minutes while the airplane is on the ground.

All lights are controlled by ON--OFF switches, rheostats, and rheostat type switches on the boom operator's panel (figure 4-69). The boom operator also has an ON--OFF switch to operate a compartment dome light.

A/R Electrical Circuit Protection

Circuit breakers for the A/R equipment are located on the boom operator's panel, the engineer's A/R panel, the AC power panel, the forward power panel, aft power panel and the overhead circuit breaker panel.

Engineer's A/R Master Switch

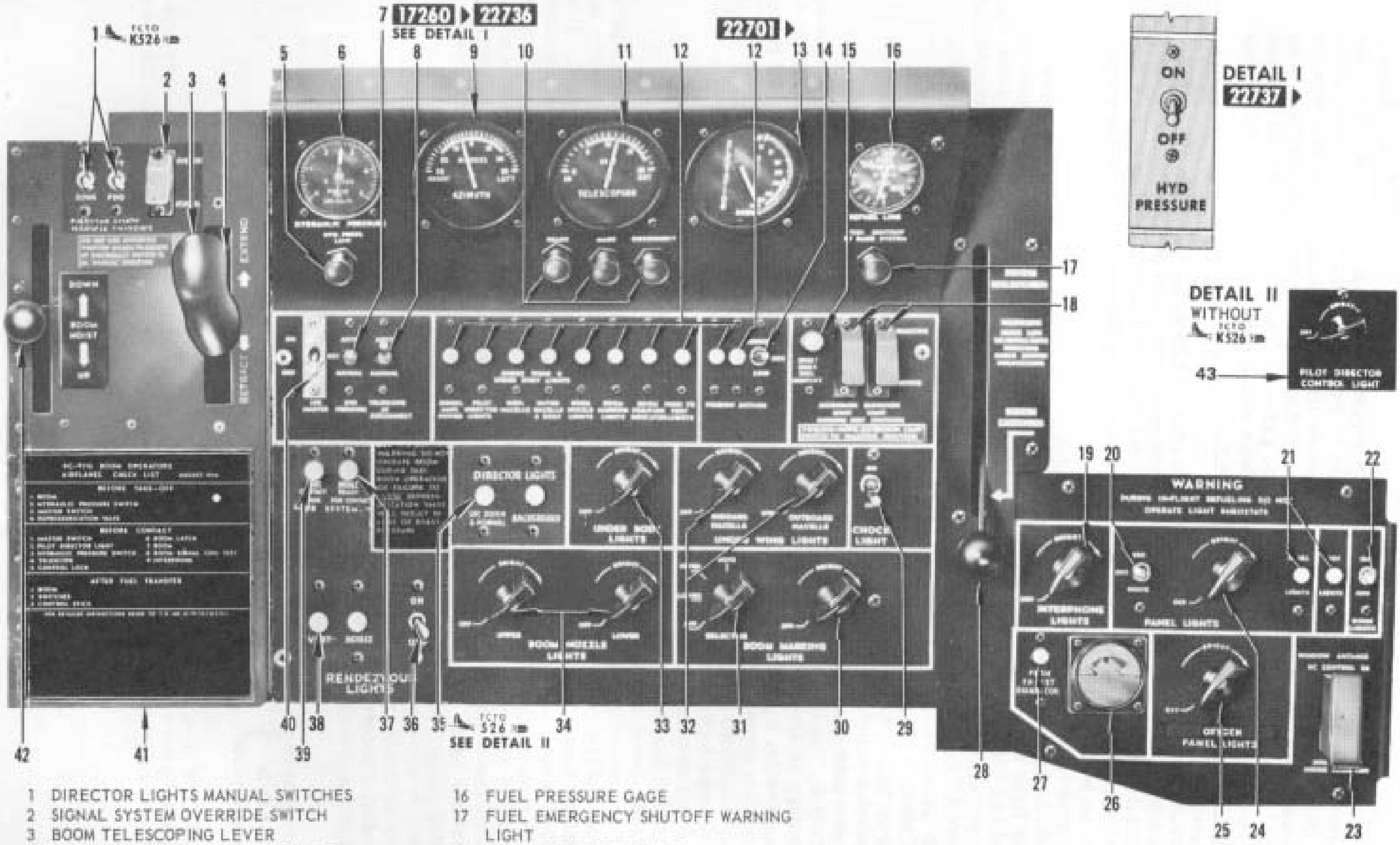
When the ON position, this ON--OFF switch (20, figure 4-70) on the engineer's A/R panel supplies power to all the switches and indicator lights on the panel. This switch also controls power to the fuel bypass control valve. When the switch is OFF, the fuel bypass control valve is prevented from closing and all controls and indicators on the engineer's A/R panel are de-energized (except the AC continuous reading hydraulic pressure gages on airplanes **2894** ▶).

NOTE

The engineer s A/R panel must be thoroughly checked for proper switch positioning before placing the master switch in the ON position.

Boom Operator's A/R Master Switch

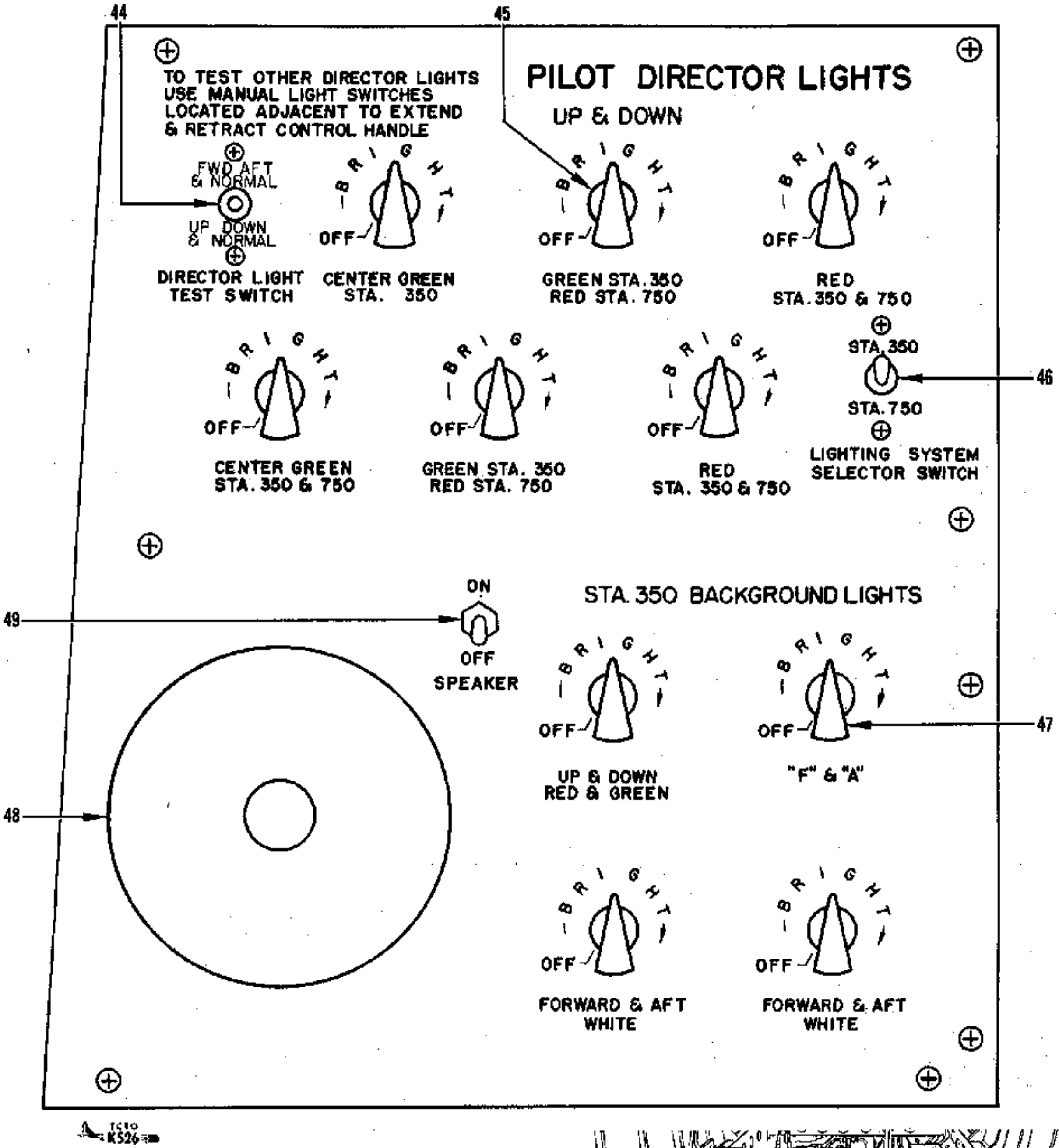
When in the ON position, this circuit breaker type-ON--OFF switch (40, figure 4-69) located on the boom

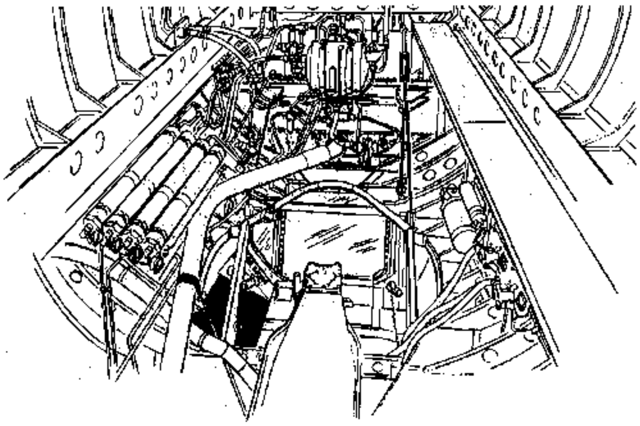


BOOM OPERATOR'S PANEL

Figure 4-69 (Sheet 1 of 2)

1 DIRECTOR LIGHTS MANUAL SWITCHES
2 SIGNAL SYSTEM OVERRIDE SWITCH
3 BOOM TELESCOPING LEVER
4 SIGNAL SYSTEM MANUAL CONTACT TRIGGER SWITCH
5 BOOM HYDRAULIC PRESSURE WARNING LIGHT
6 BOOM HYDRAULIC PRESSURE GAGE
7 BOOM HYDRAULIC PRESSURE SWITCH
8 TELESCOPE AT DISCONNECT SWITCH
9 BOOM AZIMUTH INDICATOR
10 CONTACT LIGHTS
11 BOOM TELESCOPING INDICATOR
12 CIRCUIT BREAKERS (2 PLACES)
13 BOOM ELEVATION INDICATOR
14 WINDOW ANTI-ICE SWITCH
15 A/R EMERGENCY FUEL-SHUTOFF RESET BUTTON
16 FUEL PRESSURE GAGE
17 FUEL EMERGENCY SHUTOFF WARNING LIGHT
18 LIMIT CUTOUT SWITCHES
19 INTERPHONE LIGHT RHEOSTAT
20 PANEL LIGHT SWITCH
21 CIRCUIT BREAKERS
22 DOME LIGHT SWITCH
23 WINDOW ANTI-ICE FUSE **17260** ▶ **22700**
24 PANEL LIGHT RHEOSTAT
25 OXYGEN PANEL LIGHTS RHEOSTATS
26 BOOM SIGNAL COIL TEST VOLTMETER
27 PUSH TO TEST SIGNAL COIL BUTTON
28 BOOM LATCHING LEVER
29 CHOCK LIGHT SWITCH
30 BOOM MARKING LIGHT RHEOSTAT
31 BOOM MARKING LIGHT SELECTOR SWITCH
32 UNDERWING LIGHT RHEOSTATS
33 UNDERBODY LIGHT RHEOSTAT
34 BOOM NOZZLE LIGHT RHEOSTATS
35 RECEIVER DIRECTOR LIGHTS CIRCUIT BREAKERS
36 RENDEZVOUS LIGHTS SWITCH
37 SIGNAL SYSTEM RESET BUTTON
38 RENDEZVOUS BEACON LIGHT CIRCUIT BREAKERS **3196** ▶ PLUS TCTO K231
39 SIGNAL AMPLIFIER TEST BUTTON
40 AIR REFUELING MASTER SWITCH
41 CHECKLIST
42 BOOM HOIST LEVER
43 RECEIVER DIRECTOR LIGHT RHEOSTAT





44 RECEIVER DIRECTOR LIGHTS TEST SWITCH
45 RECEIVER DIRECTOR LIGHTS RHEOSTAT (TYPICAL)
46 RECEIVER DIRECTOR LIGHTS ASSEMBLY SELECTOR SWITCH
47 BACKGROUND LIGHTS RHEOSTAT (TYPICAL)
48 BOOM OPERATOR'S RADIO LOUDSPEAKER
49 RADIO LOUDSPEAKER SWITCH

Figure 4-69 (Sheet 2 of 2)

operator's panel, when placed in the ON position performs the following functions:

1. Supplies power to the signal amplifier
2. Illuminates the ready for contact indicator light
3. Energizes solenoid valve No. 4, permitting manual telescoping of the boom
4. Energizes solenoid valve No. 3 provided the elevation snub switch and left landing gear safety switch are closed, thus permitting free fall of the boom
5. Supplies power to the A/R hydraulic circuitry

Signal System Manual Contact Switch

The trigger type contact switch (4, figure 4-69) on the telescope control handle is used to manually put the signal system into a contact made condition when the signal system manual override switch is placed in the OVERRIDE position. The manual override switch permits the signal system to operate without the use of the signal amplifier, boom limit switches, and signal coil in the boom nozzle.

Disconnect Switch

Pressing this trigger type disconnect switch (3, figure 4-66) on the hand grip of the ruddevator control stick initiates a disconnect in the signal system whether in ready for contact or contact made.

Signal Amplifier Test Button

A press-to-test button (39, figure 4-69) on the boom operator's panel, when depressed, advances the signal system to a contact made condition for an operational check of the signal system.

Signal System Reset Button

A push-to-reset button (37, figure 4-69) on the boom operator's panel, when depressed, will advance the signal system to the ready condition from either the made or disconnect condition.

Limit Cutout Switches

Two guarded INACTIVE--ACTIVE limit cutout switches (18, figure 4-69) on the boom operator's panel, when in the INACTIVE position will cut out the elevation and extension limits on the boom for ground test purposes. The extension limit cutout switch will not cut out the retraction limit switch, and neither switch will cut out the azimuth limit switches. The ACTIVE position is used during all flight operations to restore the limits and prevent structural damage.

CAUTION

When TCTO 526 have been incorporated in the airplane, the extension limit switch will deactivate the retraction (6 foot) limit.

Telescope-At-Disconnect Switch

The AUTO--MANUAL telescope-at-disconnect switch (8, figure 4-69) located on the boom operator's panel, selects control of boom telescoping at disconnect. The AUTO position results in automatic telescoping of the boom when the signal system advances to a disconnect condition. When in the MANUAL position at disconnect, the boom will remain static until the boom telescoping lever is moved to the RETRACT position. Regardless of the position of the AUTO--MANUAL telescope switch, the boom cannot be extended at disconnect.

CAUTION

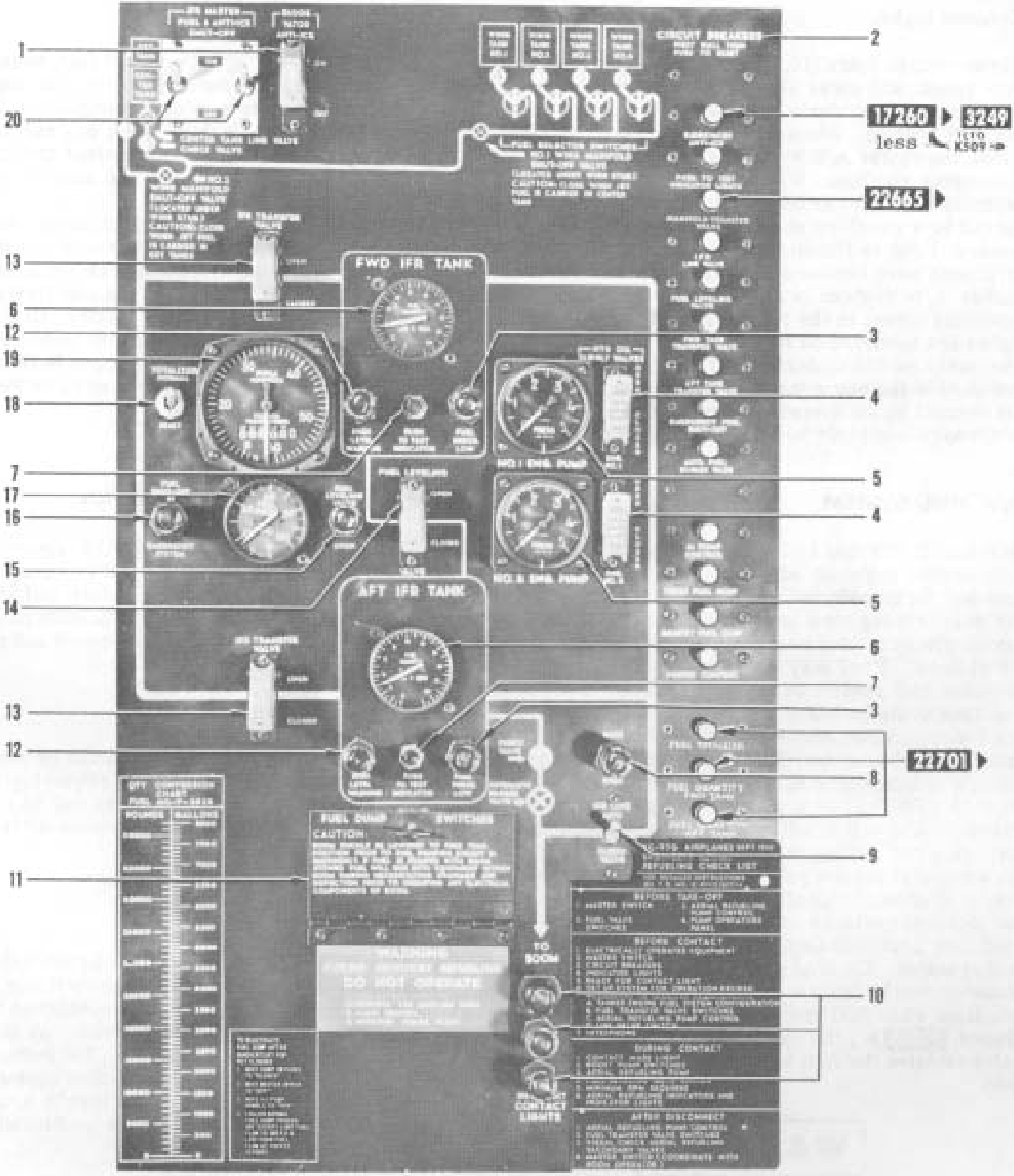
With the boom empty, do not select automatic retracting with less than 6 feet of the boom either extended or stowed. This insures that the peak retracting rate has dropped off before the boom strikes the stop. With manual control of the boom, do not allow the boom to strike the stops at high retraction rates.

Signal System Override Switch

This NORMAL--OVERRIDE switch (2, figure 4-69) is on the boom operator's panel. When the switch is in the OVERRIDE position manual control by the boom operator replaces the signal amplifier's duties and refueling operations may continue without use of the boom limit switches and the signal coil in the boom nozzle. When the switch is in the NORMAL position, the function of the signal amplifier is restored. The switch receives 28 volt DC power through a circuit breaker on the boom operator's panel.

Boom Signal Coil Test Voltmeter

This instrument (26, figure 4-69) is used in conjunction with the push-to-test signal coil button (27, figure 4-69) to determine if the boom signal coil circuit is operating properly. The instrument face is marked to indicate whether the signal coil is electrically open, good or shorted when the test button is depressed.



1 RUDDEVATOR ANTI-ICE SWITCH 17260 ▶ 3249 less 1CTO K509
2 CIRCUIT BREAKERS
3 A/R FUEL LOW PRESSURE WARNING LIGHT (2 PLACES)
4 HYDRAULIC OIL SUPPLY VALVE SWITCHES (2 PLACES)
5 A/R MAIN HYDRAULIC SYSTEM PRESSURE GAGES (2 PLACES)
6 A/R FUEL QUANTITY GAGES (2 PLACES)
7 A/R FUEL QUANTITY INDICATOR PUSH-TO-TEST BUTTONS (2 PLACES)
8 A/R LINE VALVE POSITION LIGHT
9 A/R LINE VALVE SWITCH
10 A/R CONTACT LIGHTS
11 A/R FUEL DUMP SWITCHES (BEHIND COVER) (2 PLACES)
12 A/R FUEL HIGH LEVEL WARNING LIGHT 2894 ▶ 22664
13 A/R TRANSFER VALVE SWITCHES
14 A/R FUEL LEVELING VALVE SWITCH
15 A/R FUEL LEVELING VALVE LIGHT
16 A/R EMERGENCY FUEL-SHUTOFF LIGHT
17 A/R FUEL PRESSURE GAGE
18 TOTALIZER RESET SWITCH
19 A/R FUEL FLOW AND TOTALIZER INDICATOR
20 A/R MASTER SWITCHES

ENGINEER'S A/R PANEL

Figure 4-70

Contact Lights

Three contact lights (10, figure 4-70) on the engineer's A/R panel, and three similar lights (10, figure 4-69) on the boom operator's panel indicate the condition of the A/R system. When the blue ready light is illuminated, the tanker A/R system is ready for contact with a receiver airplane. When the green made light is illuminated contact has been made and fuel can be transferred to a receiver airplane. When the amber disconnect light is illuminated the tanker and receiver airplanes have broken contact and the fuel flow in the tanker A/R system is stopped. To provide a visual condition signal to the receiver pilot, a set of contact lights are installed on the aft end of the director light assembly on the underbody of the tanker. They are actuated in the same manner, and in conjunction with, the contact lights described above. Circuit protection is through a circuit breaker on the aft power panel.

A/R FUEL SYSTEM

A/R fuel is carried in 16 fuselage tanks (figure 4-62) with usable capacity of 5810 US gallons. Additional fuel may be transferred into the A/R fuel system from the center wing tank and from the two external fuel tanks, giving a total usable A/R fuel capacity of 8402 US gallons. Fuel may also be transferred from the airplane fuel system to the A/R system. Each of the two tank systems has a fuel pump chamber located in the lower compartments into which fuel is gravity fed from the tanks. A fuel leveling line between the pump chambers interconnects the two systems. The normal flow of A/R fuel is from the pumps through check valves, a line valve, a flow measuring venturi, and out through a self sealing poppet valve in the boom nozzle. An automatic bypass valve protects the A/R fuel system at disconnect by allowing the fuel to flow back to the aft fuselage tanks as soon as a disconnect is initiated, and prevents fuel flow into the aft tanks during fuel transfer. On airplanes 17260▶ 22664 , two A/R transfer valves isolate the A/R tanks from the engine manifold when fuel is not being transferred. On airplanes 22665▶ , the external tank manifold transfer valve isolates the A/R tanks from the main fuel manifold.

WARNING

> When fuel unsuitable for R-4360 engines is carried in the A/R tanks only, the A/R transfer valve switches must be in the CLOSED position at all times except when required to be opened to accomplish preflight checks or fuel transfer.

NOTE

> In the event of a ruptured flex hose, or fuel leak, during ground operation, the boom operator will inform pilot and engineer. Engineer will close line valve. Pilot will call tower and request fire fighting equipment and direct engineer to cut engines and master switches.

All electrical controls and indicators receive 28 volt DC power except the fuel pressure gages and on airplanes 2894▶ the hydraulic pressure gages which receive 26 volt AC power and the fuel flow and totalizer and fuel quantity gages which receive 115 volt AC power. The fuel dump switch normally receives 28 volt DC power. If a power failure occurs in this circuit, the fuel dump circuit will automatically receive power from the battery.

A/R Fuel Leveling Valve Switch

This OPEN--CLOSED switch (14, figure 4-70) on the engineer's A/R panel is used to open and close the leveling valve between the forward and aft A/R tanks. The switch is guarded in the CLOSED position. In the OPEN position the fuel in the forward and aft A/R tanks will seek its own level.

NOTE

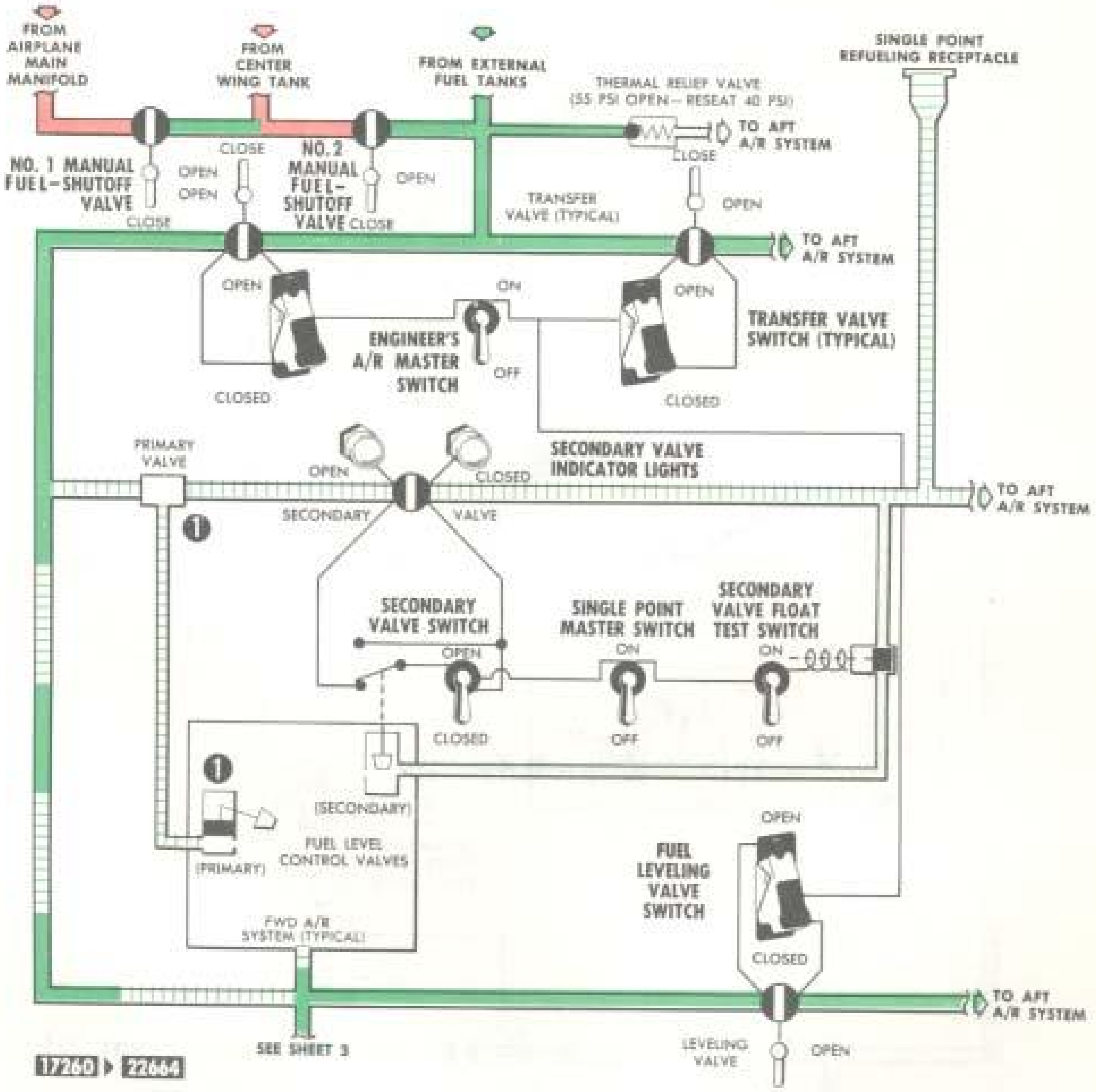
> The fuel leveling valve should be kept closed except during operations requiring leveling. This will prevent CG shifts due to fuel flowing between tanks during climbs or let-downs.

A/R Line Valve Switch

An AUTO--CLOSED switch (9, figure 4-70) on the engineer's A/R panel controls the A/R line valve during contact made. If the switch is positioned to AUTO, the valve will open at contact made. At disconnect the valve will automatically close. The switch should then be positioned to CLOSED to prevent opening of the A/R line valve during boom operator's hydraulic boom checks. Whenever the switch is positioned to CLOSED, the No. 6 valves will open.

NOTE

> Airplanes should be checked individually for this condition because some airplanes do not have the No. 6 valves wired through the line valve switch.



🟩 AIRPLANE FUEL
🟥 A/R FUEL
▥ SINGLE POINT REFUELING
═ SECONDARY VALVE FLOAT TEST LINE
— ELECTRICAL
- - - - MECHANICAL LINKAGE

NOTES

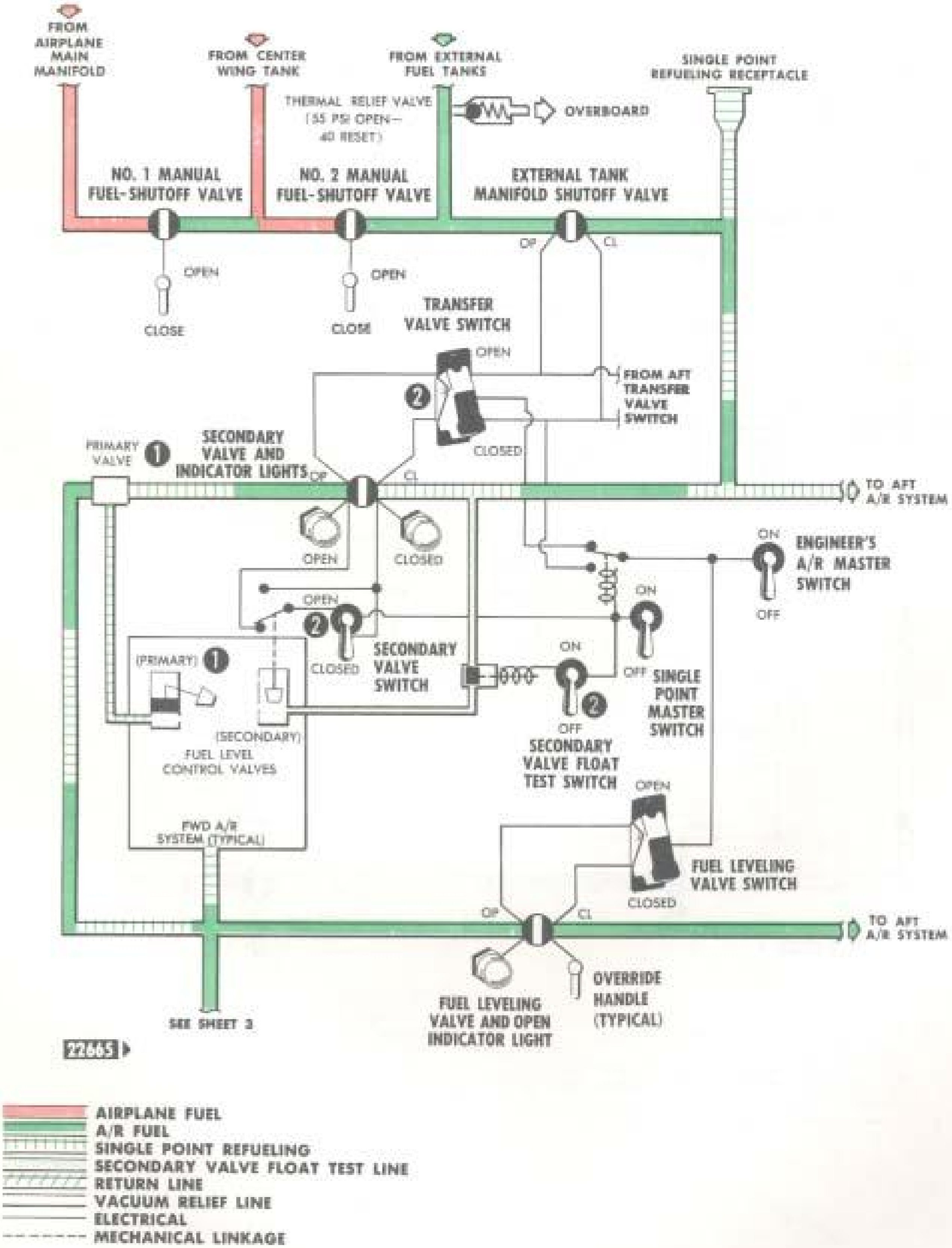
① Forward A/R system shown, aft A/R system identical.

When fuel reaches desired level, the primary fuel level control valve will close and the back pressure in that line will close the primary valve. Forward A/R system shown, aft A/R system identical

② When the single point refueling panel is connected, the transfer valve switches are inoperative in the refueling operation of the A/R tanks. The secondary valves and float test valves are then controlled from the single point refueling panel.

A/R FUEL SYSTEM

Figure 4-71 (Sheet 1 of 3)



A/R FUEL SYSTEM (CONT)

Figure 4-71 (Sheet 2 of 3)

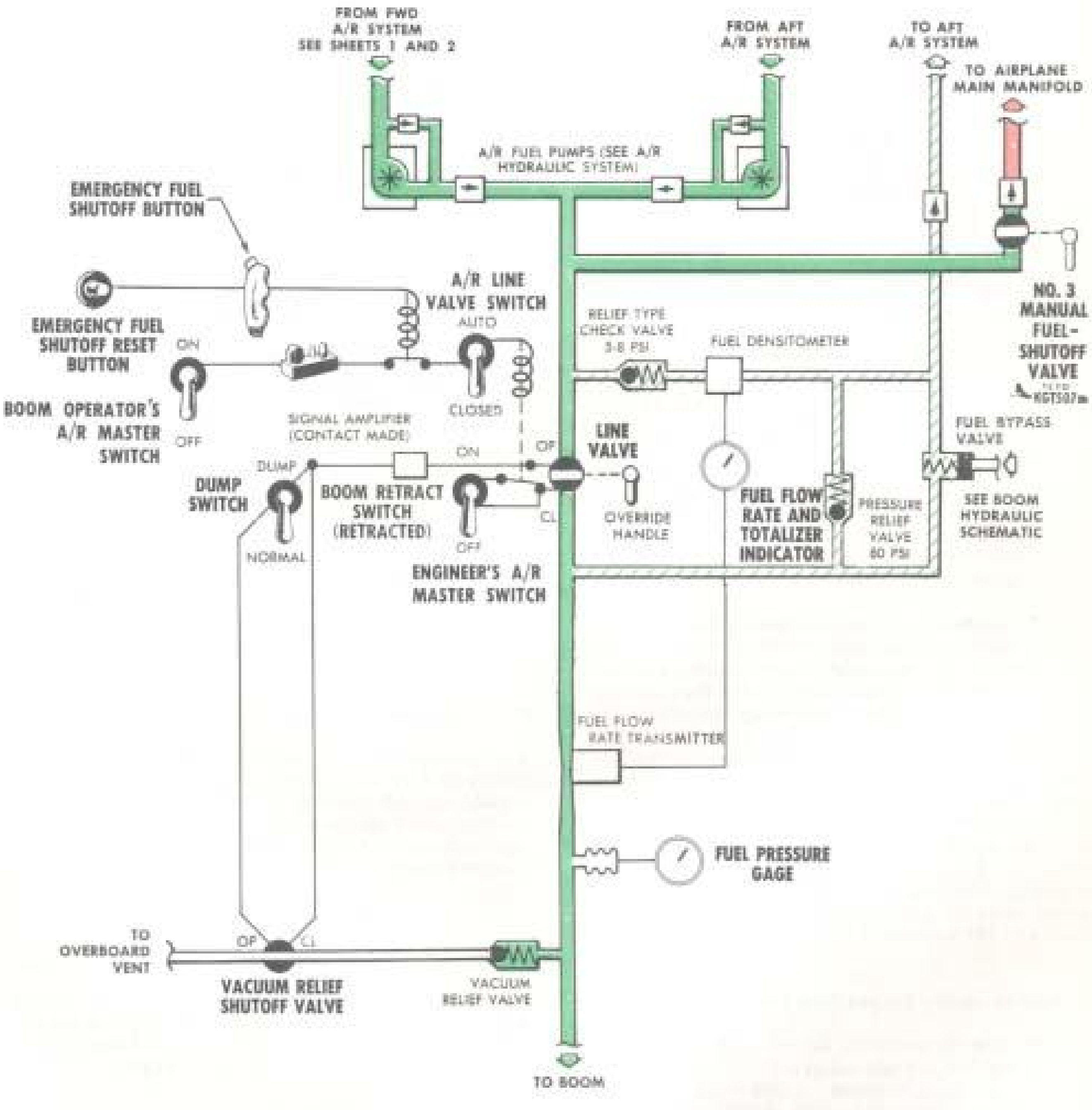


Figure 4-71 (Sheet 3 of 3)

A/R Fuel Bypass Valve

The A/R fuel bypass valve is a spring-loaded open, hydraulically operated, gate-type valve. It is located between the A/R manifold, (downstream of the line valve) and the aft tank system. The purpose of this valve is to permit fuel trapped in the boom at disconnect to be returned to the aft tank system, during boom retraction. When the engineer's A/R master switch is placed in the ON position, the A/R fuel bypass valve is hydraulically closed by actuation of the solenoid controlled A/R fuel bypass control valve. The bypass valve remains closed during ready and contact-made, and is opened at disconnect. The bypass valve is also opened by the emergency fuel shutoff button when in contact-made and remains open until the emergency fuel shutoff reset button is depressed. See figure 4-71.

A/R Transfer Valve Switches

17260 ▶ 22664

Two OPEN--CLOSED switches (13, figure 4-70) on the engineer's A/R panel control the A/R tank transfer valves. When both the switches are in the OPEN position, the valves are opened and fuel can be transferred from the airplane fuel system to the A/R tanks. Positioning the valve switches to CLOSED closes the valves and prevents fuel flow between the manifold system and the A/R tanks.

22665 ▶

The A/R transfer valve switches control the secondary valves of the A/R single point refueling system as well as the external tank manifold transfer valve. The forward transfer valve switch controls the forward tank system secondary valve, and the aft transfer valve switch controls the aft tank system secondary valve. To transfer fuel from the airplane system to the A/R tanks, the A/R transfer valve switches must be at OPEN. When either transfer valve switch is positioned to OPEN the respective secondary valve and the external tank manifold transfer valve located between the manual fuel shutoff valves and the A/R tank system are opened, allowing fuel flow. Fuel flow is then dependent upon the position of the manual fuel shutoff valves and the fuel level in the A/R fuel tanks.

A/R Fuel Quantity Gages And Test Buttons

Two fuel quantity gages (6, figure 4-70) on the engineer's A/R panel indicate the quantity of fuel in pounds in the two A/R tank systems. A test button (7, figure 4-70) is located adjacent to each quantity gage.

Manual Fuel-Shutoff Valves

These OPEN--CLOSED valves are manually operated. The No. 1 manual fuel-shutoff valve controls fuel flow from the center wing tank manifold to the main airplane fuel manifold. The No. 2 manual fuel-shutoff valve controls fuel flow from the external tanks to the center wing tank manifold. On airplanes with 1C10 KGT507 incorporated the No. 3 manual fuel-shutoff valve controls fuel flow from the A/R fuel pumps to the main airplane fuel manifold.

External Tank Manifold Shutoff Valve

This motor operated valve (figure 4-71) is actuated by either of the transfer valve switches (13, figure 4-70) on the engineer's A/R panel. When this valve is closed and No. 1 and No. 2 manual fuel-shutoff valves are open, the external fuel tanks are connected to the airplane fuel system. With No. 1 and No. 2 manual fuel-shutoff valves closed and this valve open, the external fuel tanks are connected to the A/R fuel system. This valve must be open when it is desired to transfer fuel between the airplane and the A/R fuel system. See also A/R TRANSFER VALVE SWITCHES in this Section.

A/R Emergency Fuel-Shutoff Button

A thumb operated button (1, figure 4-66) on the hand grip of the ruddevator control stick provides the boom operator with a fuel shutoff control during contact made. A momentary depression of this button shuts off the A/R pumps, closes the line valve and opens the bypass valve.

A/R Emergency Fuel-Shutoff Reset Button

This button (15, figure 4-69) on the boom operator's panel is used to restart fuel flow which has been shut off by the emergency fuel-shutoff button.

Manual Override Handles

The A/R line valve and leveling valve are motor driven sliding gate type valves equipped with CLOSED--OPEN manual override handles. By means of these override handles, which also serve as valve position indicators, the valve can be placed in full OPEN or full CLOSED provided there is no electrical power to the valves.

A/R Fuel Pressure Gages

Two fuel pressure gages (17, figure 4-70) and 16, figure 4-69) on the engineer's A/R panel and the boom operator's panel respectively, indicate the fuel pressure in pounds per square inch in the A/R fuel line.

A/R Fuel Flow And Totalizer Indicator

A combination fuel flow and totalizer indicator (19, figure 4-70) is mounted on the engineer's A/R panel. Fuel flow is indicated in pounds per minute and the fuel totalizer indicates the quantity of fuel transferred in pounds. A totalizer NORMAL--RESET switch (18, figure 4-70) is adjacent to the fuel flow and totalizer indicator. The switch must be in the NORMAL position for the totalizer to indicate the quantity of fuel transferred. Placing the switch in the RESET position resets the totalizer to zero.

A/R Emergency Fuel-Shutoff Lights

Two amber lights will illuminate when the fuel flow in the A/R system has been shut off by depression of the boom operator's emergency fuel-shutoff button. One light (17, figure 4-69) is on the boom operator's panel and the other (16, figure 4-70) is on the engineer's A/R panel.

A/R Fuel Low Pressure Warning Lights

Two amber lights (3, figure 4-70) on the engineer's A/R panel will illuminate when the fuel pressure drops below 10 psi at the forward and aft A/R fuel pumps.

A/R Fuel High Level Warning Lights 2894 ▶ 22664

Two amber lights (12, figure 4-70) on the engineer's A/R panel will illuminate when the forward and aft A/R tanks are full and the transfer valves are open. These lights are used by the engineer during transfer of fuel from center wing, external fuel tanks, or wing tanks to the A/R tank system.

A/R Line Valve Position Light

An amber light (8, figure 4-70) on the engineer's A/R panel, will illuminate when the A/R line valve is open.

A/R Fuel Leveling Valve Light

An amber light (15, figure 4-70) on the engineer's A/R panel will illuminate when the fuel leveling valve is open.

FUEL DUMP SYSTEM

Provisions have been made to dump A/R fuel from the A/R fuel tanks in cases of emergency. Fuel is pumped through the boom nozzle in the same manner as fuel is transferred to a receiver airplane. The fuel dump system is hydraulically and electrically controlled.

Fuel Dump Hydraulic System

The fuel dump hydraulic system consists of a hydraulically actuated cylinder, a solenoid actuated hydraulic valve, and the necessary tubing interconnecting the system with the boom hydraulic system (figure 4-64). With the fuel dump control valve in the de-energized position fluid pressure is applied to both sides of the two port actuating cylinder, causing the piston to move aft due to the larger area on the forward side of the piston. When the fuel dump control valve is energized, fluid pressure is relieved from the forward side of the actuating cylinder piston, causing the piston to move forward. This movement of the piston actuates the dump finger which depresses the nozzle poppet valve. When the piston moves aft the nozzle poppet is released and the actuating linkage is locked in the stowed position. In the event it becomes impossible to dump fuel by pressure fuel dumping, gravity fuel dumping would automatically take place when the dump switch is positioned to DUMP.

Fuel Dump Electrical System

The forward power panel normally supplies 28 volt DC power to the dump circuit, however in case of any failure of the forward power panel, power is automatically supplied to the fuel dump circuits directly from the battery. The system consists of a fuel dump switch, two fuel dump relays, a time-delay relay, a power transfer relay and a solenoid operated valve.

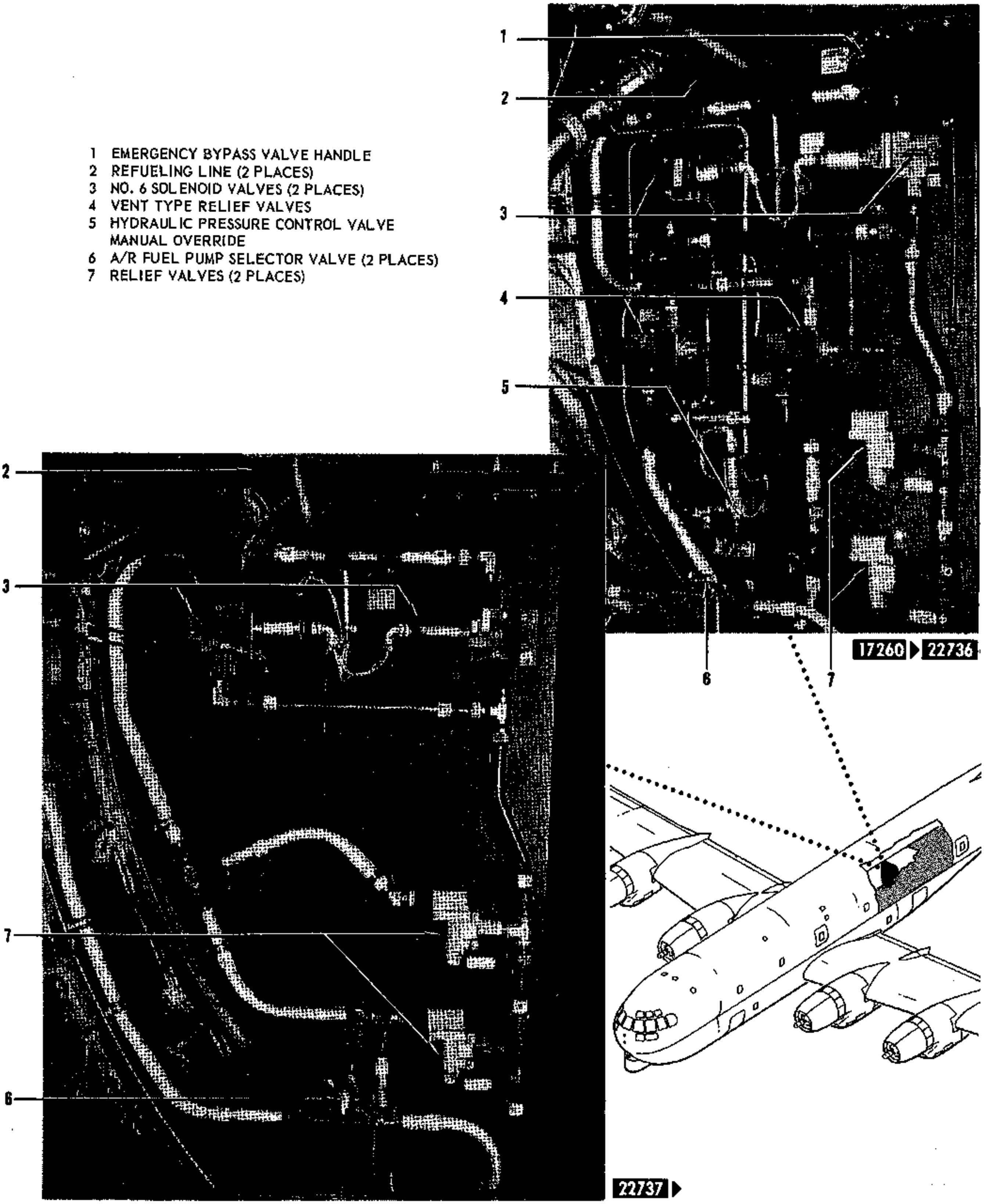
Fuel Dump Switches

Three NORMAL--DUMP switches (11, figure 4-70) guarded to the NORMAL position, are located on the engineer's A/R panel. Circuit protection is through three circuit breakers on the engineer's A/R panel. These are the pressure and gravity fuel dump and poppet control circuit breakers. These three switches are interconnected with a bar to act as one. Actuation of the fuel dump switch automatically overrides any existing condition of the A/R signal system. When the dump switch is placed in the dump position the following occurs:

1. 28 volt DC power from either the forward power panel or the battery will supply the electrical power
2. The boom hydraulic system will become pressurized
3. Provide power to snub switch
4. Boom disconnect relay energized which:
    a. Interrupts power to No. 4 solenoid valve (open)
    b. Energizes the No. 2 solenoid valve (closed)
    c. Energizes the No. 5 solenoid valve (open)
    d. Interrupts power circuit of contact-made relay (At this time the boom will automatically retract, provided the boom hydraulic system depressurization valve is closed)
5. When the boom is retracted and the fuel dump relay No. 2 is energized, the following happens:
    a. Boom nozzle poppet valve opens (hydraulically)
    b. Fuel bypass valve closes, vacuum relief line shutoff valve closes
    c. Contact fuel relay energized which:
        (1) Energizes the A-1 fuel pump pressure warning light circuits
        (2) Energizes No. 6 solenoid valves (closed)
        (3) Fuel line valve energized (open)
6. Advance A-1 fuel pump control lever to jettison fuel

Fuel Dumping

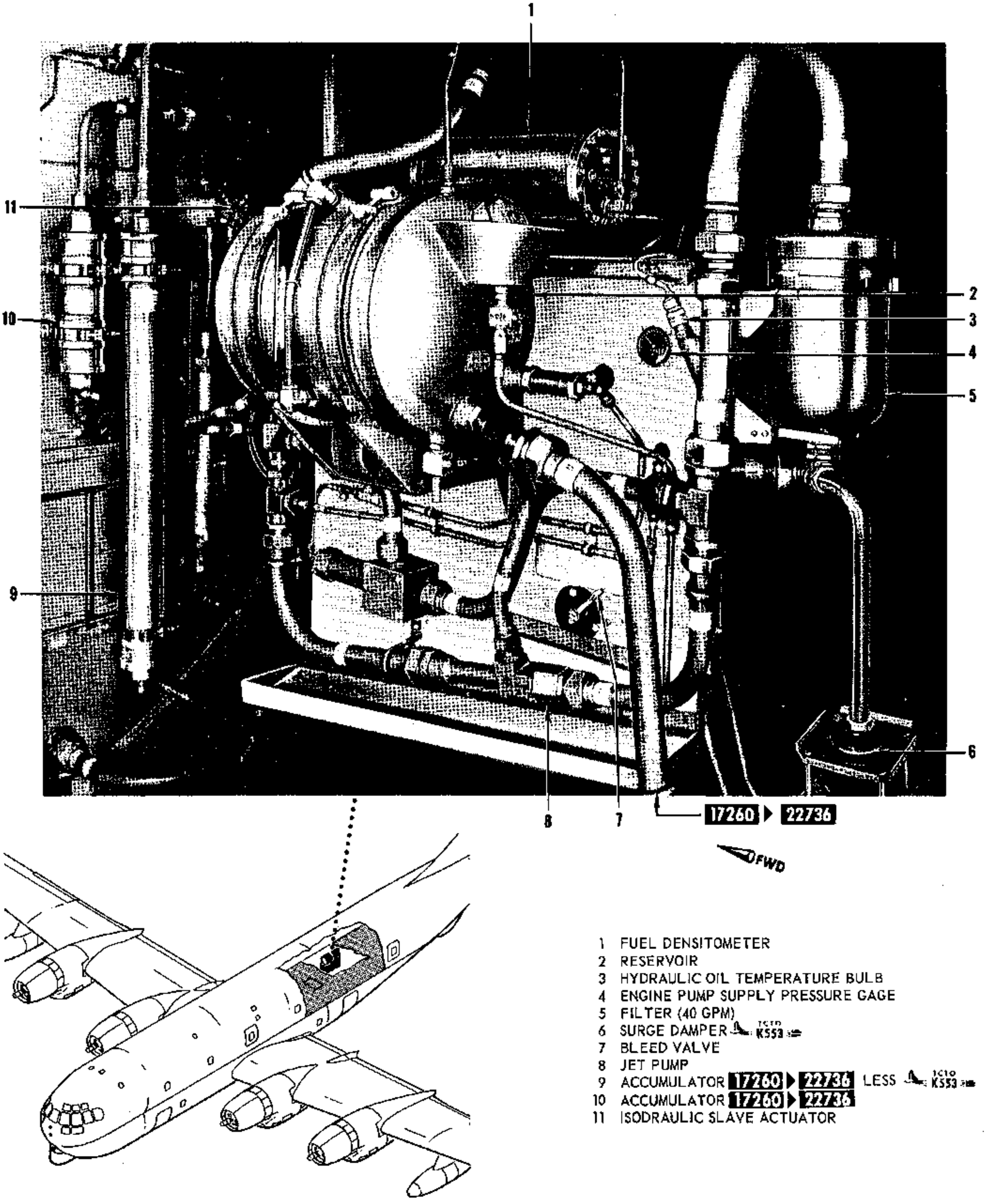
For fuel dumping procedure see FUEL DUMPING, Section III.



1 EMERGENCY BYPASS VALVE HANDLE
2 REFUELING LINE (2 PLACES)
3 NO. 6 SOLENOID VALVES (2 PLACES)
4 VENT TYPE RELIEF VALVES
5 HYDRAULIC PRESSURE CONTROL VALVE MANUAL OVERRIDE
6 A/R FUEL PUMP SELECTOR VALVE (2 PLACES)
7 RELIEF VALVES (2 PLACES)

A/R HYDRAULIC PANEL

Figure 4-72



1 FUEL DENSITOMETER
2 RESERVOIR
3 HYDRAULIC OIL TEMPERATURE BULB
4 ENGINE PUMP SUPPLY PRESSURE GAGE
5 FILTER (40 GPM)
6 SURGE DAMPER ✈ TCTO K553
7 BLEED VALVE
8 JET PUMP
9 ACCUMULATOR **17260** ▶ **22736** LESS ✈ TCTO K553
10 ACCUMULATOR **17260** ▶ **22736**
11 ISODRAULIC SLAVE ACTUATOR

A/R HYDRAULIC PANEL

Figure 4-73

AIR REFUELING TERMINOLOGY

Air Refueling (A/R) - The refueling of an airplane in flight by another airplane

A/R Area - An area designated for A/R operations with boundaries as outlined in appropriate SAC Manuals

A/R Control Time - The briefed time that the receiver should arrive over the tanker orbit point

A/R Boom Envelope - That area behind the tanker in which the receiver must fly to remain in contact with tanker

A/R Initial Point - A point located along an extension of the receiver's intended A/R track, and upstream approximately 150 nautical miles from the tanker orbit point

A/R Rendezvous - The operation employed to enable the receiver to reach the observation position by either electronic radio or visual means. The various types of rendezvous are as follows:

Buddy - That rendezvous normally made when tanker and receiver takeoff from the same base and either electronic or visual contact is maintained

Converging Course - That rendezvous normally used when the tanker and receiver approach the rendezvous point on converging course for simultaneous arrival at the rendezvous point on A/R track

Emergency - The rendezvous procedure to be followed due to either radio communications or electronic failure

Head On - That rendezvous normally used when the tanker and receiver approach on reciprocal tracks and observation position is attained by tanker completing a 180° heading change

Point - That rendezvous normally made when the tanker arrives in the A/R area before the receiver and a tanker orbit is planned

A/R System Normal Operation - Both tanker and receiver using normal signal system

A/R Time - Planned elapsed time from rendezvous point to completion point

Alternate Refueling Area - That area in which air refueling will be conducted when the designated area cannot be used

Base Altitude - A reference altitude at which lead airplane of formation (or single airplane for individual air refueling) will fly at initial contact

Breakaway - The command used by either tanker or receiver flight crew members to indicate need for emergency disconnect and separation of airplanes

Completion Point - The planned geographical point where A/R operation is complete

Contact - That configuration in which the A/R equipment is connected and fuel may be transferred

Contact Position - The stabilized position of the receiver airplane within the boom envelope where it is possible for the boom operator to make contact

Descent Air Refueling - Air refueling during a descending flight path

Descent Range - That distance between tanker and receiver at which receiver initiates descent in order to arrive in the observation position at rendezvous point

Disconnect - The command that necessitates tanker and receiver separation, but not warranting a BREAKAWAY

Emergency Reverse Flow Air Refueling - The transfer of fuel from receiver to tanker airplane

End A/R Time - The planned time the receiver commader sets course to continue his primary mission

Formating Airspeed - An airspeed or Mach number at which air refueling will be initiated

Head On Separation Distance - The slant range distance used in conjunction with the 180° head on rendezvous to determine the tanker start turn point

Head On Separation Point - A variable point used in conjunction with the 180° head on rendezvous where the tanker initiates a turn onto A/R heading

Head On Start Turn Point - That point at which tanker will initiate a turn in order to roll out on A/R track with receiver in trail and visual contact established

Individual Rendezvous and Air Refueling - The procedure employed for rendezvous and air refueling between individual tanker and receiver airplanes

Level Flight Air Refueling - Air Refueling while flying at a constant altitude

Manual Boom Latching (MBL) - Both tanker and receiver A/R systems in manual operation

Mass Rendezvous and Air Refueling - The procedure employed for rendezvous and air refueling between tanker and receiver forces using one or more orbit and rendezvous point(s) simultaneously in the same A/R area

Multiple Orbit/Rendezvous Point Pattern - That pattern of orbit/rendezvous points used for mass rendezvous air refueling when more than one orbit/rendezvous A/R points are used

Observation Position - Receiver's stabilized position (approximately 100 ft) behind and slightly below assigned tanker

Offload/Onload - That amount of fuel transferred between tanker and receiver airplanes

Orbit Departure Time - That time at which tanker(s) will depart the orbit point to effect the planned rendezvous

Radio Silence - Use of visual signals to accomplish air refueling without the aid of verbal commands

Receiver/Tanker Departure Point - The two points located on a line approximating the A/R track and separated by approximately 300 nautical miles from which receiver and tanker respectively depart toward each other to effect a 180° head on rendezvous

Rendezvous Equipment - All available electronic/radio equipment installed in tanker and receiver airplanes

Rendezvous Point - A planned geographical point along the receiver's and tanker's intended A/R track (downstream from the tanker orbit point) where receiver should reach the observation position

Rendezvous Time - The planned time for the receiver to reach the observation position

Tanker Manual Operation - Receiver A/R system in Normal. Tanker A/R system in manual operation

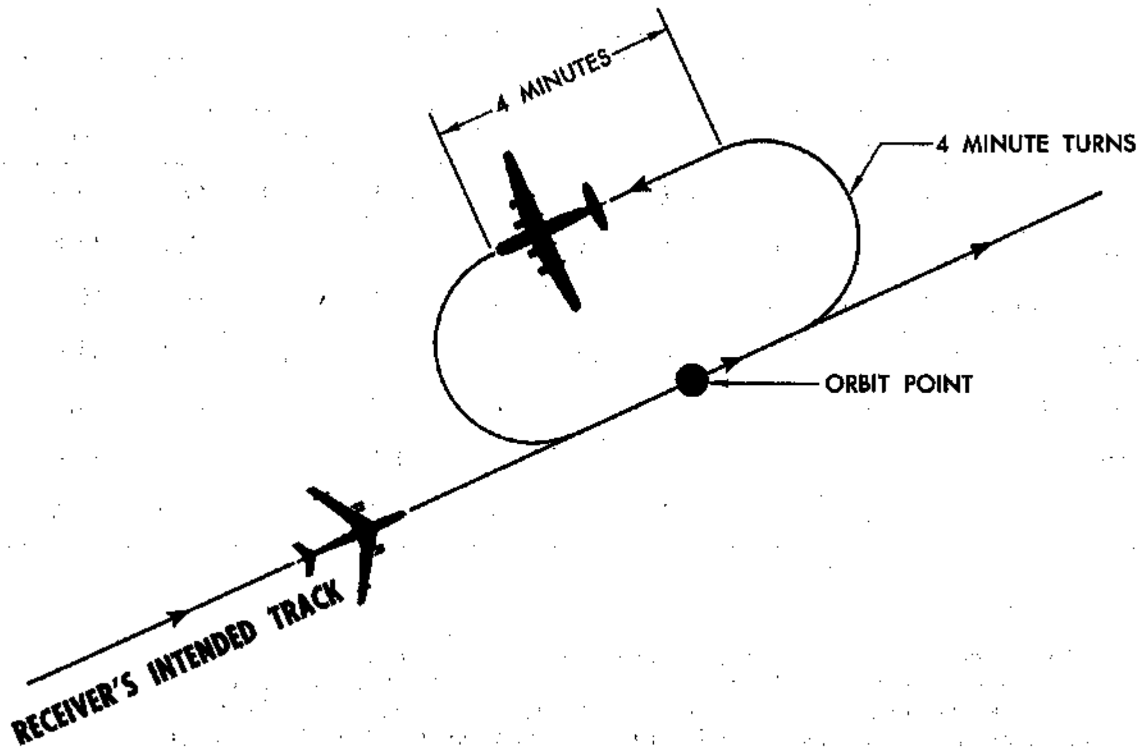
Tanker Orbit Pattern - The pattern flown by tanker near the orbit point while awaiting arrival of receiver

Tanker Orbit Point - A point along the receiver's intended track where tanker(s) will orbit. This point will be located upstream from the intended A/R point

AIR REFUELING OPERATIONS

Rendezvous Procedures

Tanker airplane will orbit over the designated orbit point in a race track pattern to the left and parallel to the receiver's refueling track. See figure 4-74



TANKER ORBIT PATTERN

Figure 4-74

The orbit pattern will be flown utilizing four-minute legs and four-minute turns; however, the navigator may vary the length of leg or rate-of-turn to effect orbit departure time

Tanker navigator will insure that rendezvous equipment is turned on a minimum of thirty minutes prior to receiver's ETA for the rendezvous point. The APN-69 radar beacon will be used as the primary method of electronic rendezvous, with the APN-12 Rendezvous Radar or APN-76 Rendezvous Radar being monitored for back-up when installed. To prevent erroneous electronic indications being used, it is imperative that tanker and receiver attempt to identify and confirm each other's electronic signal as soon as possible. In no case should this identification be completed later than the receiver's arrival at the refueling IP.

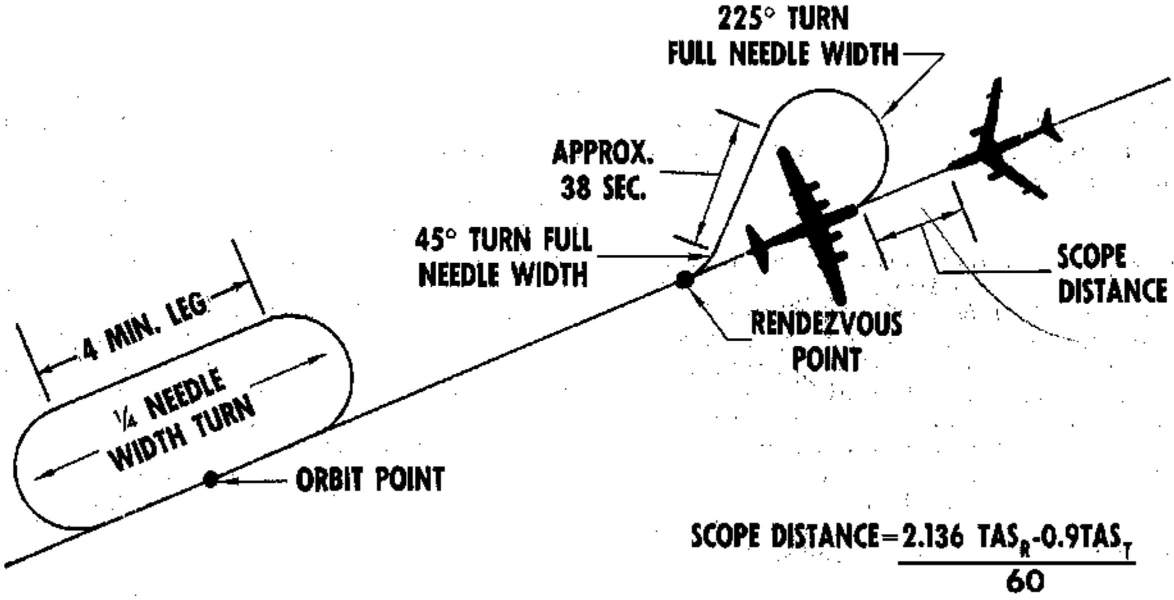
The tanker navigator will control the orbit departure time so as to depart the orbit on refueling course and arrive at the rendezvous point simultaneously with the receiver. Orbit departure time will normally be based on receiver's latest ETA for the rendezvous point; however, the separation distance as indicated by the rendezvous equipment must be monitored to revise orbit departure time if necessary. This will insure that tanker and receiver both fly the same course during the critical stages of rendezvous, which will provide planned rate of closure, accurate descent range, and best antenna positioning for rendezvous equipment. In all cases it must be clearly established between tanker and receiver what equipment is being used for the rendezvous, and the relative reliability of the indications upon which the information is being based. See RENDEZVOUS EQUIPMENT COMPATABILITY, Figure 4-76.

Full Needlewidth Turn

Tanker TAS	Receiver TAS											
	200	220	240	280	320	360	400	440	480	520	560	600
200	4.1	4.8	5.5	6.9	8.4	9.8	11.2	12.6	14.0	15.5	16.9	18.4
220	3.8	4.5	5.2	6.6	8.1	9.5	10.9	12.3	13.7	15.2	16.6	18.1
240	3.5	4.2	4.9	6.3	7.8	9.2	10.6	12.0	13.4	14.9	16.3	17.8
260	3.2	3.9	4.6	6.0	7.5	8.9	10.3	11.7	13.1	14.6	16.0	17.5
280	2.9	3.6	4.3	5.7	7.2	8.6	10.0	11.4	12.8	14.3	15.7	17.2
300	2.6	3.3	4.0	5.4	6.9	8.3	9.7	11.1	12.5	14.0	15.4	16.9
320	2.3	3.0	3.7	5.1	6.6	8.0	9.4	10.8	12.2	13.7	15.1	16.6

NOTE

- These tables are computed for both airplanes to arrive at the same point at the same time. Add desired lead or subtract desired trail to achieve desired separation of airplanes at completion of turn. If it is desired to use a one-half needlewidth turn in this procedure, double the values in this table and hold straight leg twice as long.
- At start of turn if indication shows receiver left or right make a 1/2 needle width 180 degree turn into the signal. Utilization of the table above will provide for six mile separation upon completion of turn.



$$\text{SCOPE DISTANCE}=\frac{2.136\ TAS_R-0.9TAS_T}{60}$$

TABLE OF RANGES FOR HEAD-ON RENDEZVOUS

Figure 4-75

KC-97	B-47	B-52	B-57
APN-12 Range & Relative Position Only	APN-76 Rendezvous Radar (Transponder)	APN-76 Rendezvous Radar (Transponder)	Classified Refer to SACM 55-10
APN-76 Transponder			
APN-69 Radar Beacon	APS-23 Search Radar APS-64 Search Radar	ASQ-38 Search Radar APS-64 Search Radar	
APS-42 Search Radar	APN-69 Radar Beacon	APN-69 Radar Beacon	
ARA-25 UHF/DF	ARC-27 UHF Radio	ARC-27 UHF Radio	
ARC-27 UHF Radio		ARA-25 UHF/DF	
ART-13 MF XMTR	ARN-6 Radio Compass RCVR	ARN-6 Radio Compass RCVR	
ARC-3 VHF Radio	ARN-14 Omni RCVR	ARN-14 Omni RCVR	
Anti-Collision Lights ✈ TCTO 591 ◀ Rendezvous Beacon Lights 3196 ▶ plus ✈ TCTO K231 ◀	Visual	Visual	Visual
Pyrotechnics	Visual	Visual	Visual

RENDEZVOUS EQUIPMENT COMPATABILITY

Figure 4-76

When the receiver is effecting the rendezvous, utilizing signals from the tanker's APN-69 radar beacon, the tanker must be advised when receiver approaches 12 mile range.

When the APN-12 or APN-76 is used to accomplish the rendezvous, the tanker navigator will transmit course corrections and range to the receiver. Ranges will be transmitted every 20 nautical miles to a minimum of 100 nautical miles, and thereafter every 10 nautical miles until a point 5 nautical miles from descent range, after which range to descent point will be called in one nautical mile increments. After calling the descent range, the tanker will continue to call ranges every ten nautical miles down to ten nautical mile range, after which point the range will be called in one nautical mile increments until visual contact is established. Course corrections may be transmitted at any time regardless of range.

Rendezvous Equipment Failure Procedures

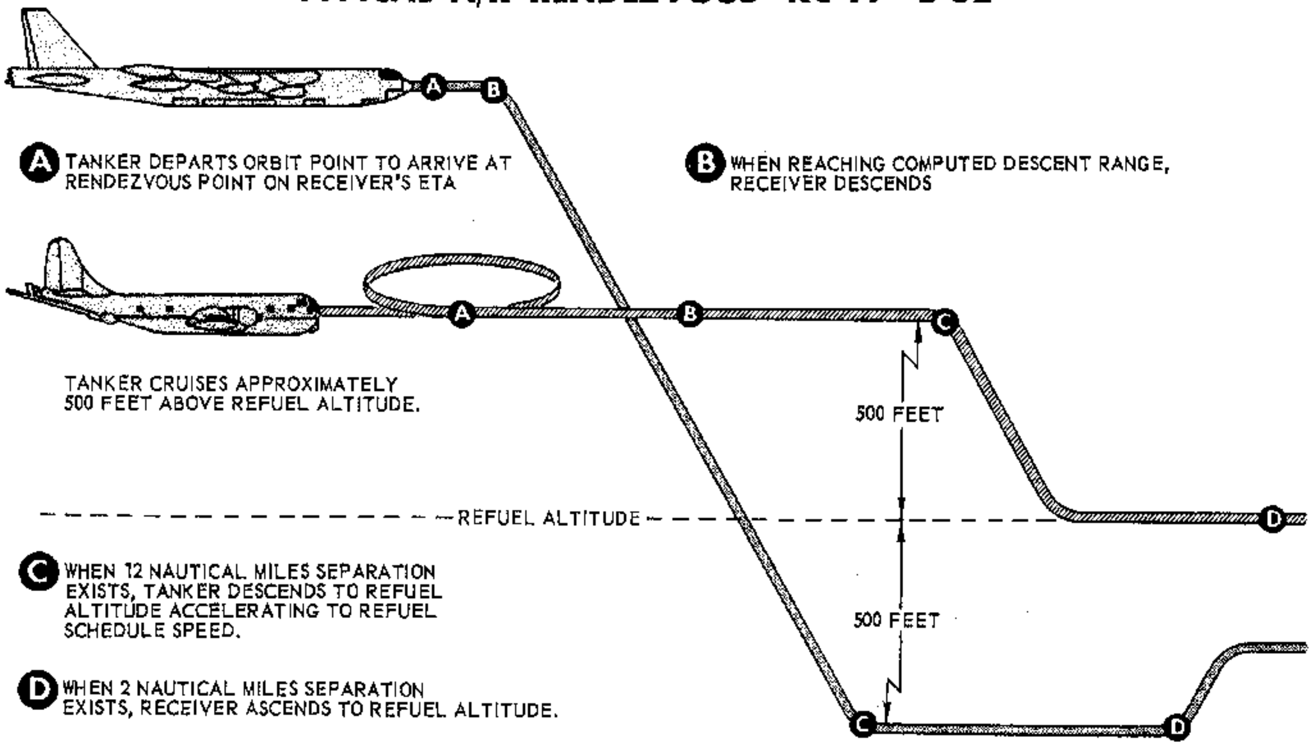
When equipment malfunctions prevent an electronic rendezvous, the following action will be taken:

1. Receiver will transmit to tanker an ETA to rendezvous point based on latest known information
2. Tanker will depart the orbit point to make good the receiver's latest ETA to the rendezvous point. Should radio failure prevent receiver transmitting an ETA to the tanker, the flight planned rendezvous ETA will be made good by both tanker and receiver
3. When the tanker arrives at the rendezvous point, an attempt will be made to establish visual contact. If visual contact is established with receiver, proceed with normal A/R operations. If visual contact is not established, tanker will orbit the rendezvous point until visual contact with the receiver is made or low fuel makes departure imperative

Air Refueling (A/R) Procedures

1. The tanker will arrive at the orbit point 500 feet above refueling altitude (altimeter setting 29.92 in. Hg unless otherwise briefed) and maintain this altitude until the receiver has approached within 12 nautical miles. The refueling altitude may be limited either by tanker or receiver. When higher performance receiver airplanes (for example, the B-47) are refueled or, if for any other reason it is difficult to obtain the desired airspeed (for example, if the tanker has had to feather a propeller), a constant descent will provide higher airspeeds without impeding the contact. If this condition exists, shortly after fuel transfer has commenced the tanker pilot will gradually nose the tanker down as required to obtain the desired gradual increase in speed. It should not be necessary to exceed 150 to 300 feet per minute rate of descent. The flight crews prior to contact will have agreed upon the desired initial and final airspeeds and approximate duration of the contact. With this information, the tanker pilot can increase airspeed with ample accuracy by varying the rate of descent. Caution must be exercised not to exceed 250 mph IAS since ruddevator control of the boom becomes critical above this speed. See figure 4-77 for A/R Rendezvous Profile.
2. The tanker accelerates to the formating speed by descending 500 feet to the refueling altitude when the receiver has approached within 12 nautical miles. The receiver's speed advantage enables it to close and formate with the tanker. The formating speed is a function of the receiver and tanker gross weights. Good operational planning is required to insure that both airplanes will be at compatible gross weights and air speed schedules during refueling
3. The receiver levels out 500 feet below refueling altitude and decelerates to 50 knots IAS above the tanker's long range cruising speed. In the clean configuration this deceleration should require an average of two minutes. At the end of the deceleration period, the tanker should be two nautical miles ahead of the receiver. When the tanker is stabilized on course, speed, and altitude, the receiver pulls up into the observation position
4. Holding contact during descent is not difficult although slightly more so than level flight contact. Rates of descent of 500 to 700 feet per minute have been demonstrated in smooth air with high performance receivers
5. Hold elevator corrections to a minimum. Make corrections gently and slowly

TYPICAL A/R RENDEZVOUS—KC-97—B-52



A TANKER DEPARTS ORBIT POINT TO ARRIVE AT RENDEZVOUS POINT ON RECEIVER'S ETA

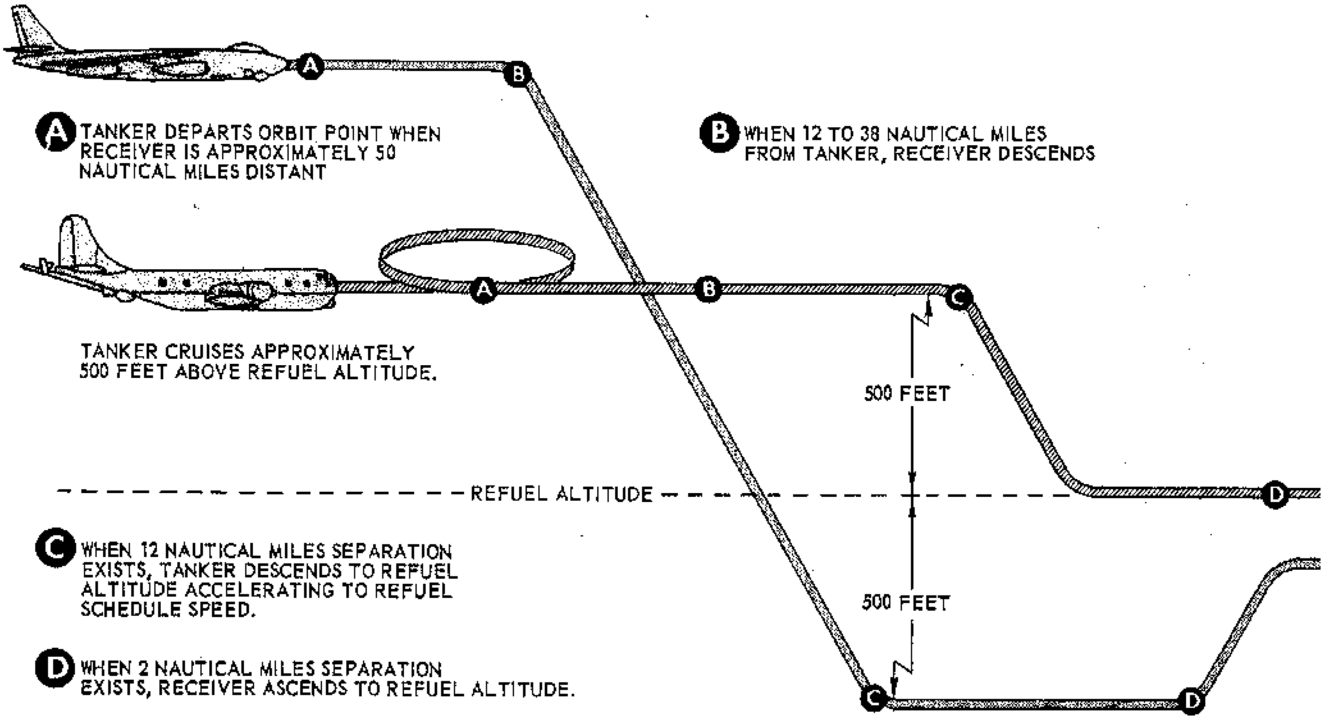
B WHEN REACHING COMPUTED DESCENT RANGE, RECEIVER DESCENDS

TANKER CRUISES APPROXIMATELY 500 FEET ABOVE REFUEL ALTITUDE.

C WHEN 12 NAUTICAL MILES SEPARATION EXISTS, TANKER DESCENDS TO REFUEL ALTITUDE ACCELERATING TO REFUEL SCHEDULE SPEED.

D WHEN 2 NAUTICAL MILES SEPARATION EXISTS, RECEIVER ASCENDS TO REFUEL ALTITUDE.

TYPICAL A/R RENDEZVOUS—KC-97—B-47



A TANKER DEPARTS ORBIT POINT WHEN RECEIVER IS APPROXIMATELY 50 NAUTICAL MILES DISTANT

B WHEN 12 TO 38 NAUTICAL MILES FROM TANKER, RECEIVER DESCENDS

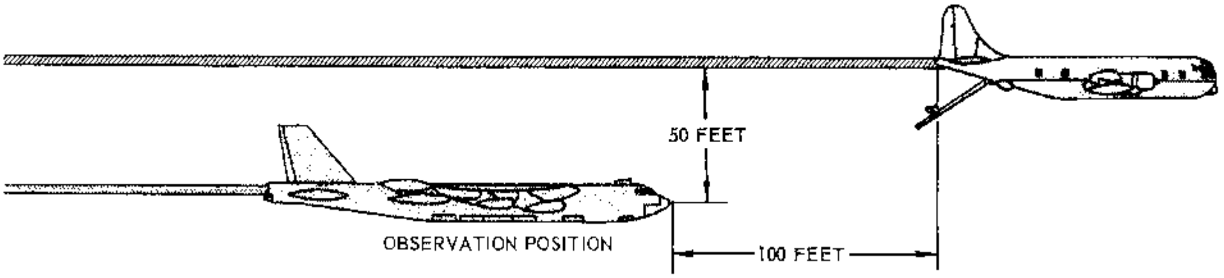
TANKER CRUISES APPROXIMATELY 500 FEET ABOVE REFUEL ALTITUDE.

C WHEN 12 NAUTICAL MILES SEPARATION EXISTS, TANKER DESCENDS TO REFUEL ALTITUDE ACCELERATING TO REFUEL SCHEDULE SPEED.

D WHEN 2 NAUTICAL MILES SEPARATION EXISTS, RECEIVER ASCENDS TO REFUEL ALTITUDE.

A/R RENDEZVOUS PROFILE

Figure 4-77 (Sheet 1 of 2)



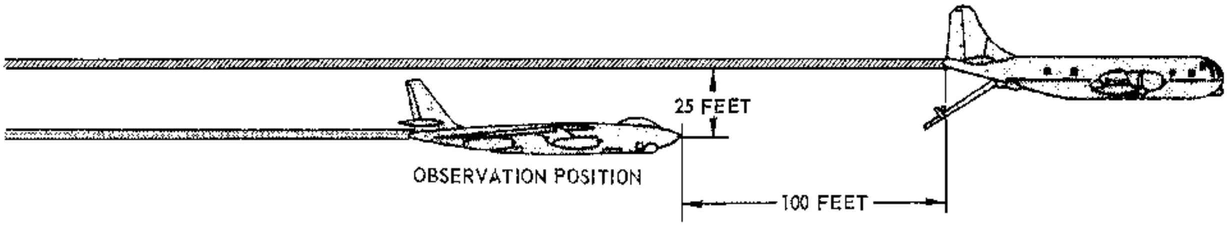


Figure 4-77 (Sheet 2 of 2)

ITEM	DURING RENDEZVOUS	DURING CONTACT
Navigation Lights	Bright Flashing (N)	Dim Steady (N)
Anti-Collision Lights	Both On (N) (D)	Top On (D) (N) Bottom Off (D) (N)
Under Body Light	Bright (N) Off (D)	Bright (N) Off (D)
Under Wing Lights	Bright (N) Off (D)	Bright (N) Off (D)
Boom Marking Lights	Off (D) (N)	Upper Set On (B) B-47 (N) Lower Set On (B) B-52 (N)
Receiver Director Lights	Off (D) (N)	Sta.750 Set On (B) (N) Full Intensity (D) Sta.350 Set to Full Intensity (D) (N) TC10 K5268
Boom Nozzle Lights	Off (D) (N)	Lower Set On (B) (N)
Interior Lights	Optional	No Bright Lights (N)
Rendezvous Beacon Light	On (D) (N)	Off (D) (N)

(B) Position is the first letter in the word BRIGHT located above each rheostat on the boom operator's panel

(D) Day

(N) Night

EXTERIOR LIGHTING DURING AIR REFUELING

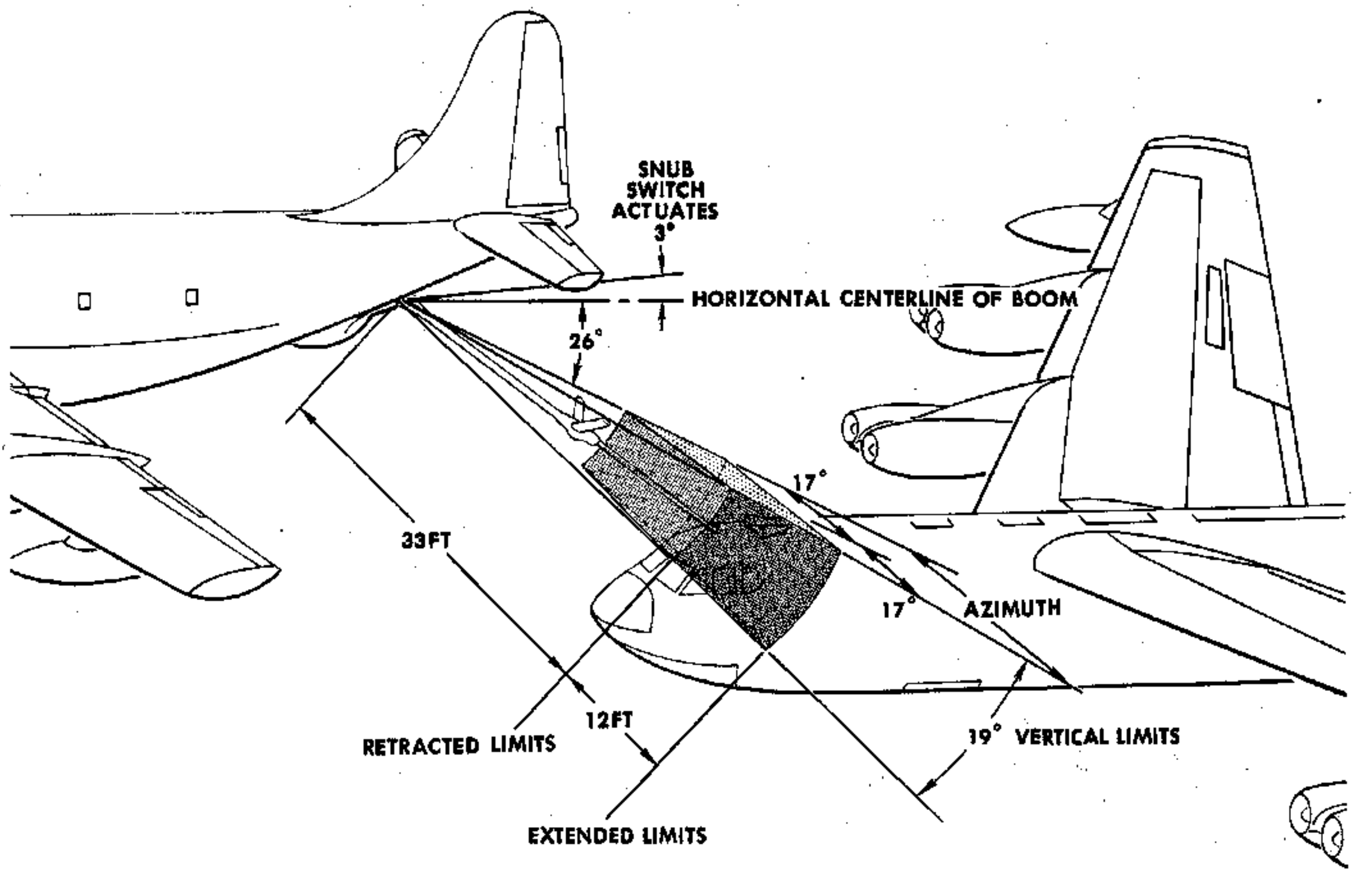
Figure 4-78

TANKER PILOT TECHNIQUE

FLYING AT CONSTANT ALTITUDE. The tanker is essentially a platform for the flying boom. The tanker pilot must therefore, fly the airplane in such a manner as to provide the most stable platform possible. During the time that contact is being established, flight at constant attitude is important for two reasons: to provide a stable platform for accurate operation of boom and to make it easier for the receiver pilot to get into the contact position and remain in the envelope. After contact is established the tanker pilot should continue to maintain a stable attitude and in particular refrain from excessive rudder and elevator control. This must be kept in mind especially while the tanker is flying formation on another airplane. Establishing and maintaining contact in smooth air is relatively easy. However, smooth air rarely occurs and in the mild to moderate turbulence which will generally prevail, it is important that care be exercised in flying the tanker. As the boom is lowered in preparation for contact, the tanker pilot will observe that the airplane will slow down about 5 knots and become slightly nose heavy. The airplane should then be retrimmed and power set up for the desired refueling airspeed for the particular receiver. Additional trim may be required as the receiver gets within 15 feet of the contact position since the bow wave of large receivers makes the tanker slightly nose heavy. It is a most important requirement that the tanker pilot make no power changes after the receiver starts to move in for contact.

AIRSPEED. As fuel is off-loaded from the tanker, the tanker airspeed will slowly increase. This is advantageous for the following reasons:

1. Refueling may be initiated at lower airspeeds. This is important when the tanker is beginning a high altitude transfer at high gross weight. Also it is less difficult for the boom operator to make contact at lower airspeed.
2. Tanker engine cooling is improved as the refueling progresses because during an extended transfer, it might become critical at high altitude and high gross weight.
3. The receiver is assisted in maintaining a comfortable margin above stalling speed as its gross weight increases. This, of course, is particularly important when receivers having higher stalling speeds than the tanker, are used. Adjustment of power will be limited to 1/2 in. Hg per engine, across the board. If the tanker is operating below meto power, a slight increase in MP will assure safe stall margin for the receiver; however, if the tanker is operating at meto power and off-loading of fuel does not result in sufficient increase in airspeed, a slight descent must be initiated.
4. If a disconnect is experienced before transfer is completed, the tanker pilot should maintain the airspeed and rate of descent scheduled for that period of off-load when the disconnect occurred until a new contact is established; then resume briefed airspeed increase when transfer starts.
5. An increase in airspeed, if possible, will minimize inadvertent disconnects resulting from turbulence.

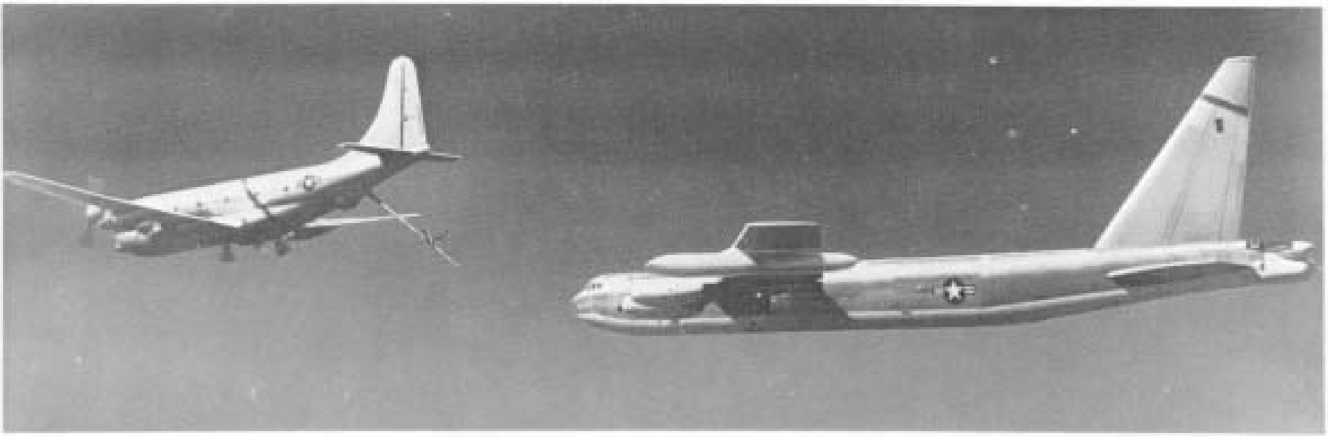


BOOM ENVELOPE LIMITS

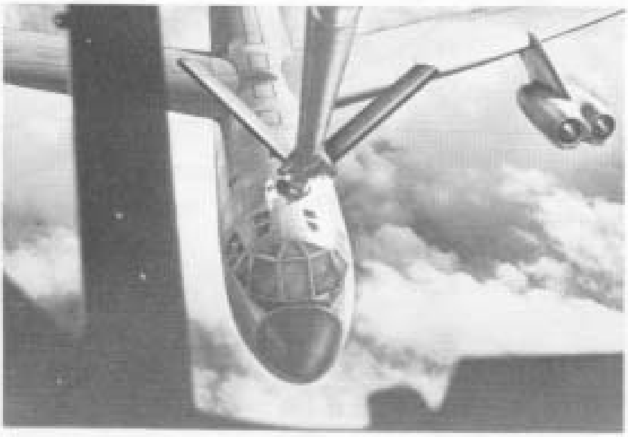
Figure 4-79

TURNS IN CONTACT. Moderate turns for navigational purposes can be made while in contact. There will usually be continuous slight tanker pitching because of nudging by the receiver airplane, even in smooth air. Therefore, it is most important that the tanker pilot remember to hold as steady an attitude as possible without large or sudden control movements. During the actual fuel transfer period, as the tanker gross weight decreases, the average attitude will slowly become more nose down when the constant altitude procedure recommended for comparable performance receivers is followed.

ROUGH AIR. In rough weather, strong gusts require immediate corrective action, but airplane pitching, yawing, or rolling due to moderate gusts should be ignored unless return to original attitude does not occur. The reason is that for two similar airplanes flying in such close formation, the gust effect on each is approximately the same. If the tanker pilot were to fight the controls, overcontrolling would usually occur resulting in inadvertent disconnect due to tanker and receiver airplane movements getting out of phase with each other. Momentary changes of airspeed due to turbulence or other causes should be disregarded. If, during a constant altitude refueling, the altitude goes beyond a tolerance of ± 200 feet, the pilot should edge back toward the nominal desired altitude by a change in power, but holding the same airspeed. To sum up rough air pilot technique; in the first of two extremes the pilot makes little or no effort to offset, with elevator movement, the pushing and pulling of the receiver. In such a case the tanker and receiver continue to pitch until they get out of phase and go to automatic disconnect. In the second



OBSERVATION POSITION



BEFORE CONTACT—
Seen From Tanker

KC-97—B-52

CONTACT—
Seen From Tanker

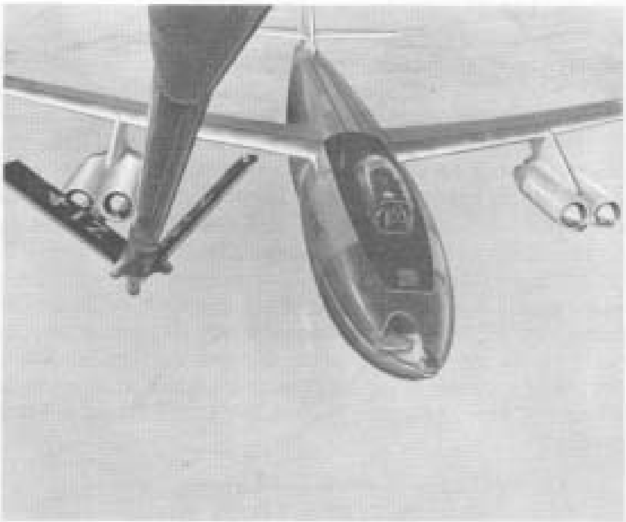
A/R FORMATING

Figure 4-80 (Sheet 1 of 2)

Photograph to be Furnished When Available

OBSERVATION POSITION

BEFORE CONTACT—
Seen From Tanker



KC-97—B-47

CONTACT—
Seen From Tanker

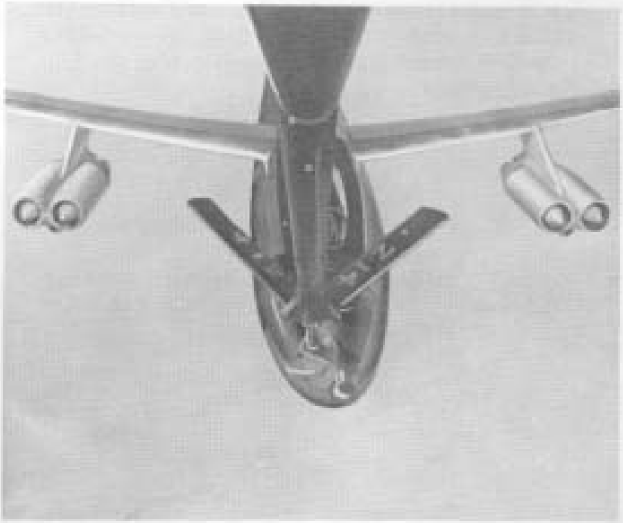


Figure 4-80 (Sheet 2 of 2)

extreme the tanker pilot fights the controls to hold absolutely constant altitude, thereby forcing the receiver pilot to work much harder to hold the green light position. Good tanker flying requires that the pilot operate somewhere between these two extremes. It has been found that an increase in airspeed, if possible, will minimize inadvertent disconnects resulting from turbulence.

USE OF THROTTLE. Comparable performance receivers may not have sufficient power to maintain speed for contact during the latter part of a large fuel transfer at high gross weight. In this case it may be desirable for the copilot to reduce manifold pressure not more than 1/2 inch across the board on one engine at a time, repeating the power reduction every few seconds. If more abrupt power changes are made, the receiver airplane is likely to inadvertently disconnect by overrunning the tanker. Information to date indicates that the maximum practical altitude for refueling certain jet type receivers may be below 20,000 feet and the optimum altitude for such transfers below 15,000 feet. At the higher altitudes, tanker maximum level flight refueling airspeeds have forced the jet receivers to operate on the back side of their power required curves. With power requirements for the receivers as high as 95 to 100 percent rpm the jet receivers do not have sufficient power adjustment available to hold contact during the latter stages of the transfer. It has also been found that with meto power on the tanker (resulting in approximately 190 knots in level flight) certain jet fighter receivers, with gear extended for stability reasons cannot close in on the tanker at 25,000 feet, even with 100 percent rpm. In such cases the descent procedure is recommended to enable the receiver to be flown at higher airspeeds in a more normal attitude, easing the difficulty of holding contact.

WARNING

Do not use autopilot during an A/R operation. Inadequate or erratic autopilot functioning while in contact with the receiver airplane can result in structural damage to one or both of the airplanes.

NOTE

- For A/R performance data, see the Appendix.
- The word BREAKAWAY has been established and reserved for use as a code word to indicate an emergency condition.

A/R ORAL COMMUNICATIONS

When the receiver reaches the observation position, the boom operator, when directed by the tanker pilot, will establish radio contact with the receiver and use the following communications throughout the air refueling.

1. Establish radio contact. "(Receiver call sign) this is (tanker call sign) boom operator, radio check." After call from receiver pilot state "Tanker ready." Receiver pilot acknowledges by stating "Receiver ready
2. Voice procedure for normal contacts
   a. Prior to contact. Boom operator will begin communications when receiver reaches approximately 50 feet. Direction will preceed distance for receiver to move and will be given in 10 feet increments until receiver reaches approximately 10 feet from end of boom. Example: Fwd 50, Fwd 40, Fwd 30, Fwd 20, Fwd 10. When receiver reaches approximately 10 feet from end of nozzle all corrections will be given in (feet) small increments for receiver to move. Example: Up 4, Fwd 8, Up 2, Fwd 6, Fwd 4, Fwd 2. When contact is established state "Tanker Contact." Receiver pilot acknowledges by stating "Receiver Contact." With boom nozzle in receiver receptacle and either the tanker or receiver A/R system does not advance to contact, the boom operator or receiver pilot will call "Disconnect"
   b. During Contact. Communications during A/R operation will be held to an absolute minimum.
3. Voice procedure for Tanker Manual Operation.
   a. Receiver briefing
      (1) Tanker Manual Operation. "(Receiver call sign) the following contacts will be made in Tanker Manual Operation. All boom limit switches are inoperative. Receiver must initiate all disconnects. Tanker Ready." Receiver pilot will acknowledge transmission by stating "Receiver ready"
      (2) Manual Boom Latching. "(Receiver call sign) the following contacts will be made in Manual Boom Latching. All boom limit switches inoperative and receiver pilot must initiate all disconnects." Receiver will acknowledge transmission by stating "Receiver ready"
   b. For voice procedure prior to contact refer to 2a above
   c. During contact. Communication during A/R operation will be held to an absolute minimum
   d. Disconnect. Use the command words "Disconnect" or "Breakaway," as the case warrants, before receiver reaches normal envelope limits.
4. Breakaway. When a crew member aboard either the tanker or receiver determines that an emergency

exists, the crew member will transmit on A/R frequency" 'Airplane call sign' Breakaway, Breakaway, Breakaway"

A/R VISUAL SIGNALS

1. In the event of radio communication failure, or radio silence contacts, the following visual signals will be used:

   a. Up-and-down movement of the boom ending in trail position extended to 10 feet means that the tanker is ready for contact. The receiver should check his signal system and move into contact position

   b. Boom retracted, up-and-down movement of the boom ending in stowed position indicates that there is a malfunction in the tanker that will be fixed shortly. The receiver should remain in the observation position until malfunction is corrected or until the receiver deems it necessary to depart

   c. Side-to-side movement of the boom ending in trail position with the boom extended 10 feet indicates that the tanker is fully operative and request that the receiver check his A/R system

   d. Side-to-side movement of the boom with the boom retracted and ending with the boom in trail indicates that prescribed fuel load has been transferred

   e. Side-to-side movement of the boom ending with the boom in stowed position indicates that the tanker's A/R system is completely inoperative

   f. The need for a disconnect, when the situation does not warrant a BREAKAWAY, will be indicated by receiver director lights being turned OFF. Receiver pilot observing that all receiver director lights go out will immediately initiate a disconnect and return to the observation position.

   g. The need for emergency BREAKAWAY by tanker will be indicated by receiver director lights being turned off and on rapidly. Receiver pilot will immediately initiate disconnect and institute breakaway procedure

   h. Should the receiver pilot desire BREAKAWAY, he will simultaneously initiate the disconnect, close slipway door(s) and institute breakaway procedure

   i. To indicate termination of air refueling the receiver will turn upper anti-collision lights ON

2. If necessary to use Manual Operation, in the event of communications failure, the following visual signals will be used:

CAUTION

In the event of communications failure, or tanker boom position instrument failure, except in case of an emergency, refueling operations will be discontinued.

a. Boom operator will indicate use of Tanker Manual Operation by trailing fully extended boom. The receiver pilot will acknowledge by:

B-47	Flashing both landing lights
B-52	Flash A/R overwing lights (night) or aldis lamp/flashlight (day)
B-57	Flashing flashlight
B-58	Flashing flashlight

b. Boom operator will then retract boom into ready position and stand by for contact

c. Should the receiver pilot desire to initiate Manual Boom Latching, he will pull into observation position and:

B-47	Flash both landing lights
B-52	Flash IFR overwing lights (night) or aldis lamp/flashlight (day)

d. Receiver will remain in the observation position until his signal has been acknowledged by the boom operator (one up-and-down movement of the boom fully extended ending with the boom in the ready position).

CAUTION

- Manual Boom Latching - Receiver pilot must initiate all disconnects when operating in manual boom latching

- Tanker Manual Operation - Receiver pilot must initiate all disconnects when operating in Tanker Manual Operation.

TOWING

When refueling fighters, it may be desirable to tow. After approval of both tanker and receiver pilots, place the extension limit cutout switch to INACTIVE. Telescope at disconnect switch will be in MANUAL to prevent the receiver from being pulled in by the automatic retraction of the boom in case of a malfunction. The receiver pilot must ease slowly into tow position (fully extended boom) to prevent a brute force pull out. Disconnect can be accomplished by either the boom operator or receiver pilot, or by exceeding the elevation, or azimuth limits.

CAUTION

> On airplanes with TCTO K526 incorporated, when the extension limit cutout switch is positioned to INACTIVE, the retraction and extension limit switches are de-activated.
>
> On airplanes without TCTO K526 incorporated, when the extension limit cutout switch is positioned to INACTIVE, the extension limit only is deactivated.

PRACTICE DRY CONTACTS

To prevent excessive wear of the A/R fuel bypass valve during practice dry contacts, the following procedure will be followed:

1. Prior to dry contact operation, actuate the emergency fuel shutoff button
2. Upon completion of dry contact operation, or prior to actual fuel transfer operation, press reset emergency fuel shutoff button

This procedure will facilitate any number of dry contacts without operation of the A/R fuel bypass valve.

A/R SYSTEM MANUAL OPERATION

SIGNAL SYSTEM FAILURE. In the event that normal preparation for refueling reveals a malfunctioning signal system, change the signal amplifier. Personnel experienced in refueling can complete the fuel transfer by manual operation of the A/R system. The normal system of the receiver may be used in conjunction with manual operation of the tanker, provided it is clearly understood what configurations are being used. The main point to be remembered by all refueling crews is that when either system is in manual operation, the receiver must initiate the disconnect. When the receiver is operating in emergency boom latching, the tanker must be in "manual".

CAUTION

> - This procedure shall be attempted only by personnel who are experienced in normal air refueling and have been checked out on this procedure by qualified instructor personnel.
> - Receiver pilot must initiate all disconnects when receiver is operating in emergency boom latching. Except in case of an emergency, emergency boom latching will not be used without radio contact between the two airplanes and/or tanker boom position instruments operative.

For Tanker Manual Operation or Manual Boom Latching, the boom operator establishes contact as follows:

1. Place Emergency Override Switch to OVERRIDE

WARNING

> The emergency override switch depowers the signal amplifier, and thus discontinues limit switch operation

2. Place Telescope-at-Disconnect Switch to MANUAL.
3. Inform pilot, "Receiver in observation position, standing by to lower boom"
4. When requested by pilot lower boom and extend ten feet
5. Establish radio contact with receiver. A/R ORAL COMMUNICATIONS are outlined in A/R PROCEDURES in this Section
6. Talk receiver pilot into correct position or utilize the manual Receiver Director Light Switches. A steady red light will indicate a large correction and a flashing red light will indicate a small correction in the direction indicated by the Red Receiver Director Lights
7. When receiver has stabilized in position, insert boom nozzle and hold nozzle in receptacle
8. Actuate Emergency Contact Trigger Switch
9. Report, "Tanker Contact"
10. Receiver Pilot States, "Receiver Contact"
11. Proceed with normal A/R methods. Advise receiver pilot of corrective action to be used to stay within A/R envelope
12. When fuel transfer has been completed, call for "Disconnect" and when receiver pilot states, "Receiver Dis-

connect", or nozzle is free in receptacle, press Disconnect Switch

NOTE

> When receiver is operating in emergency boom latching, actuation of the Disconnect Switch only initiates a disconnect in the tanker signal system. The nozzle will remain in the receiver receptacle secured by the toggles until the receiver pilot initiates a disconnect.

13. When the nozzle is free from the receptacle, manually retract the boom
14. Initiate POST REFUELING CHECKLIST, if no additional refueling contacts are to be made

A/R SYSTEM EMERGENCY PROCEDURE

AIR REFUELING FUEL SYSTEM FAILURE. In the event of a fuel leak in the A/R system of either the tanker or the receiver airplane, a disconnect should be initiated immediately and all A/R equipment will be turned off. The flight crew will determine the source of the leak and, if possible, make immediate repairs. If the trouble cannot be remedied, no further contacts will be made. If at any time fuel is being transferred and a steady stream of fuel is being pumped overboard from the receiver, or the receptacle of the receiver is filled with fuel, an immediate disconnect will be made.

RETRACTING A WET BOOM WHEN FUEL BYPASS VALVE IS INOPERATIVE. When the fuel bypass valve is inoperative, retract the wet boom as follows:

1. Reset signal system to READY and fully extend boom to decrease fuel pressure
2. Pull line valve circuit breaker
3. Manually open line valve
4. Retract boom a distance sufficient to build up a fuel pressure of 50 psi
5. After fuel pressure drops approximately 10 psi, retract some more until fuel pressure is again at 50 psi
6. Repeat step (5) until boom is fully retracted. This procedure may take 15 minutes or more to complete

NOTE

> Opening of pet cock in fuel drain line in pod area will reduce boom retraction time to a few minutes.

7. Restore line valve and circuit breaker to original configuration

HYDRAULIC PRESSURE SYSTEM FAILURE. A ruptured hydraulic line on the pressure side of the engine-driven A/R hydraulic pump will be indicated by a lowering of fluid in the main A/R hydraulic reservoir and a drop in hydraulic pressure indicated by the hydraulic pressure gages on the engineer's A/R panel. After determining the pump with the ruptured line proceed as follows:

1. Place hydraulic oil supply valve switch to CLOSED
2. Refill A/R hydraulic oil reservoir if necessary
3. Land as soon as possible

In the case where a hydraulic system leak cannot be determined by direct observation, but is only noted by a gradual lowering of the fluid in the A/R hydraulic reservoir, the following is recommended to determine if the leak can be stopped by use of the hydraulic oil supply valves:

1. Position No. 1 engine hydraulic oil supply valve on the engineer's A/R panel to CLOSED
2. Note if there is continued lowering of the fluid in the hydraulic reservoir. If fluid loss has ceased, leave the valve switch at CLOSED

CAUTION

> To prevent unnecessary damage to the pump do not leave the valve closed for more than one minute unless it stops the loss of fluid.

3. If the leakage continues, reopen the No. 1 engine valve and position No. 4 engine hydraulic oil supply valve to CLOSED. If the leak is forward of the pressure line check valves, (figure 4-63) this will stop further loss of fluid. Leave the valve closed. In order to provide sufficient lubrication and cooling for the engine-driven pumps, the valve closed time for any one operation should be limited to one minute, with a four minute period between repeat operations of the same valve. In any case, if either valve is left closed or if all hydraulic fluid is lost, land as soon as possible to minimize damage to the engine-driven pumps.

WARNING

> Wing anti-icing heaters should not be operated after loss of hydraulic fluid from the A/R system supplied by the outboard engines if hydraulic fluid loss cannot be isolated by normal procedures or unless it can be definitely determined that the hydraulic fluid is not entering the heater cavity.

FUEL FUMES VENTILATION PROCEDURE. See SMOKE AND FUME ELIMINATION in Section III.

ENGINE FAILURE. An engine failure on the tanker is more serious than a receiver engine failure. A tanker engine failure will probably cause the receiver to overrun the tanker, whereas, a receiver engine failure will merely result in extension of the boom and possible separation. The tanker pilot should at all times when flying in formation be ready to increase power immediately on the good engines in case of an engine failure.

JAMMED RUDDEVATORS. If ruddevators become jammed in flight, the following procedures will be followed:

1. Retract boom

2. Adjust airspeed to conform with existing emergency
3. Remove the electrical connector to No. 3 solenoid valve or pull the oleo relay circuit breaker
4. Move the ruddevator control stick up and down, and at the same time move the hoist lever back and forth. When the ruddevator control stick is moved up, move the hoist lever to the UP position. These operations should be continued until the ruddevators are released

BOOM RETRACTION MECHANISM FAILURE. If the boom retraction mechanism malfunctions, necessitating a landing with a partially or fully extended boom, the following steps should be taken:

1. Retract the boom as far as possible; any retraction from the fully extended position will greatly relieve the stresses on the boom, latch, and latch support
2. Land with a dry boom
3. Make as smooth a landing as possible to prevent excessive whipping action on the boom
4. After any landing with boom extended, have the boom, stowing mechanism, and chock attachments to the fuselage carefully checked for structural damage

B-52 Rendezvous And A/R Operation

1. Rendezvous and A/R procedures are as outlined in RENDEZVOUS PROCEDURES AND A/R PROCEDURES. Figure 4-77 shows a typical A/R rendezvous profile for B-52 - KC-97.
2. For rendezvous equipment available, see RENDEZVOUS EQUIPMENT COMPATIBILITY, Figure 4-76. For photographs of observation position, before contact position (as seen from tanker) and contact position (as seen from tanker), see figure 4-80.
3. For maximum formating altitude and speed charts, see Appendix

REFUELING THE B-52

Air refueling the B-52 should, where possible, be accomplished in level flight. The B-52 is a large airplane, the tanker should therefore, be handled as smoothly as possible to avoid any unnecessary maneuvering of the receiver airplane.

The B-52 has the receptacle located in a slipway in the center and on the top of the fuselage, three feet behind the pilot's overhead windows. It is covered by doors when not required. Care should be exercised to avoid damage to slipway doors, no difficulty should be found in extending the boom into the receptacle; however, it should be borne in mind that the receiver pilot may have restricted vision due to structural members above his windshield. For night refueling the B-52 carries lights to illuminate the upper surfaces of the wings and the slipway. Fuel transfer to the receiver airplane is straight forward although the rate of flow may be limited by fuel transfer considerations within the receiver airplane. At disconnect the receiver airplane should be directly astern of the tanker, and care should be taken to avoid striking the slipway doors and lights when the boom is released.

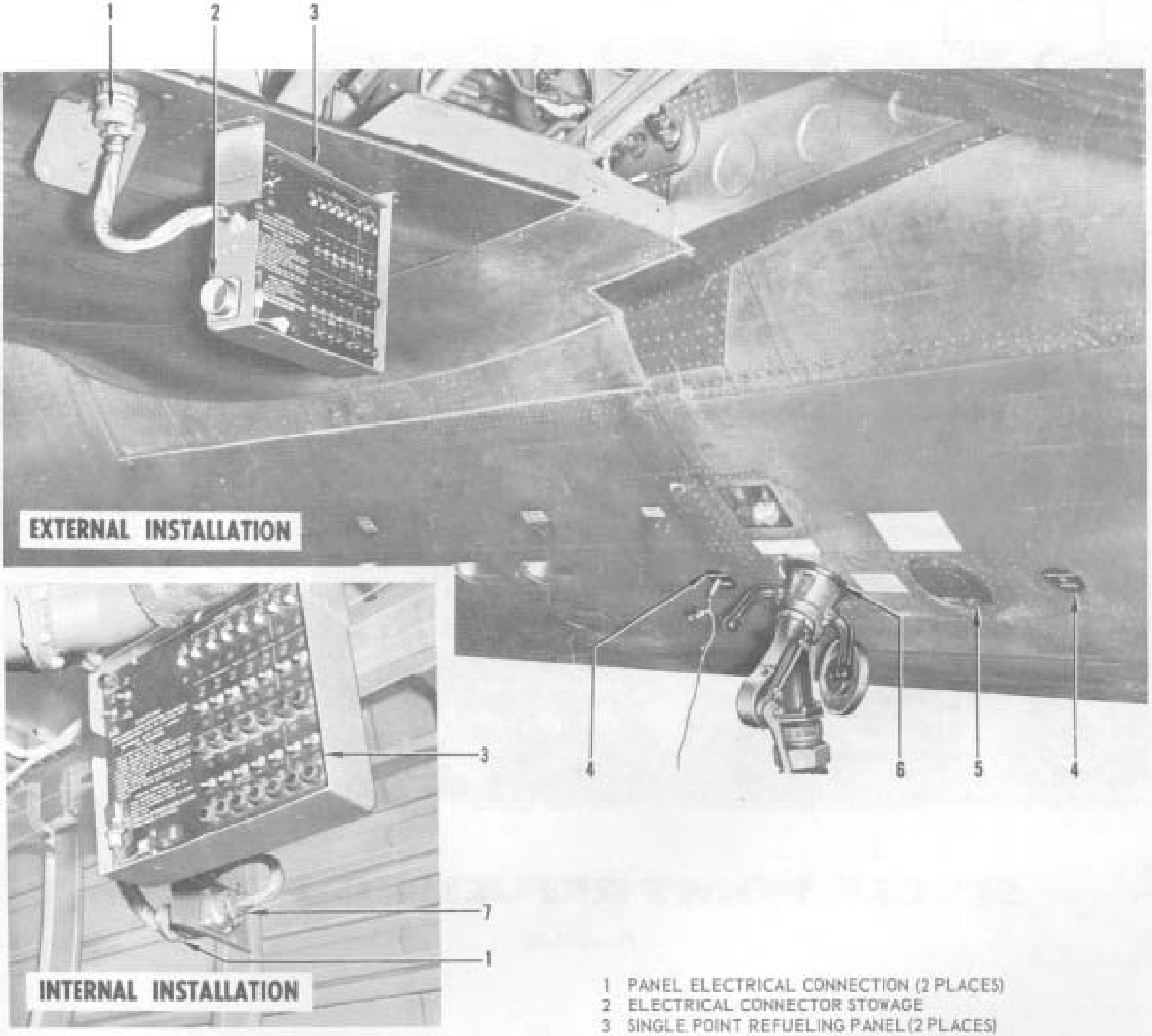
B-47 Rendezvous And A/R Operations

1. Rendezvous and A/R procedures are as outlined in RENDEZVOUS PROCEDURES, AND A/R PROCEDURES. Figure 4-77 shows a typical A/R rendezvous profile for B-47 - KC-97
2. For rendezvous equipment available, see RENDEZVOUS EQUIPMENT COMPATIBILITY, Figure 4-76. For photographs of observation position, before contact position (as seen from tanker) and contact position (as seen from tanker), see Figure 4-80
3. For maximum formating altitude and speed charts, see Appendix

Refueling The F-101

With boom type refueling, no difficulties of any kind are encountered in maintaining a steady platform during contacts. No changes or bow wave effect is noticed from the receiver airplane as the receiver moves into position. The receiver airplane is considered to be very stable and has excellent maneuverability during contacts.

The F-101 has the receptacle located behind the pilot's canopy approximately twenty-five feet from the nose of the airplane. The receptacle is quite small and there is no slipway aid in guiding the nozzle. As the F-101 moves into position the boom should be flown at approximately 30° in elevation until the canopy passes underneath the nozzle. Boom control is more effective as contact is established with the boom being flown above 33°. Because of the size of the receptacle and the absence of a slipway, the boom should be extended into the receptacle very slowly to avoid damage to the airplane fuselage and receptacle. Due to the rapid acceleration of the F-101 and the small target the receptacle presents, the receiver pilot should be cautioned to make the last few feet of forward corrections very slowly. There are no difficulties encountered with boom control at any of the limit disconnects; however, limit disconnects should be attempted to check the normal operation of the systems of both airplanes. The F-101 can be refueled at a higher fuel pressure than other receivers. Tests indicate pressures can be used up to 65 psi without disconnects. At the present time, the F-101 has no emergency override provisions, and the pilot's disconnect switch is very inconveniently located in the cockpit. The boom operator must use extreme caution when refueling at night. The present lighting equipment in the F-101 is very poor. There are no lights that illuminate the upper surfaces, and midway between the canopy and receptacle is a bright, white light that is quite blinding. The receiver pilot should be requested to turn his lights to steady. Lighting is very limited on the top of the fuselage, around the receptacle and tail surfaces. Upon disconnect, caution must be exercised in clearing the boom away from the receiver. The telescope-at-disconnect switch will be in manual for all contacts made with fighter type receivers.

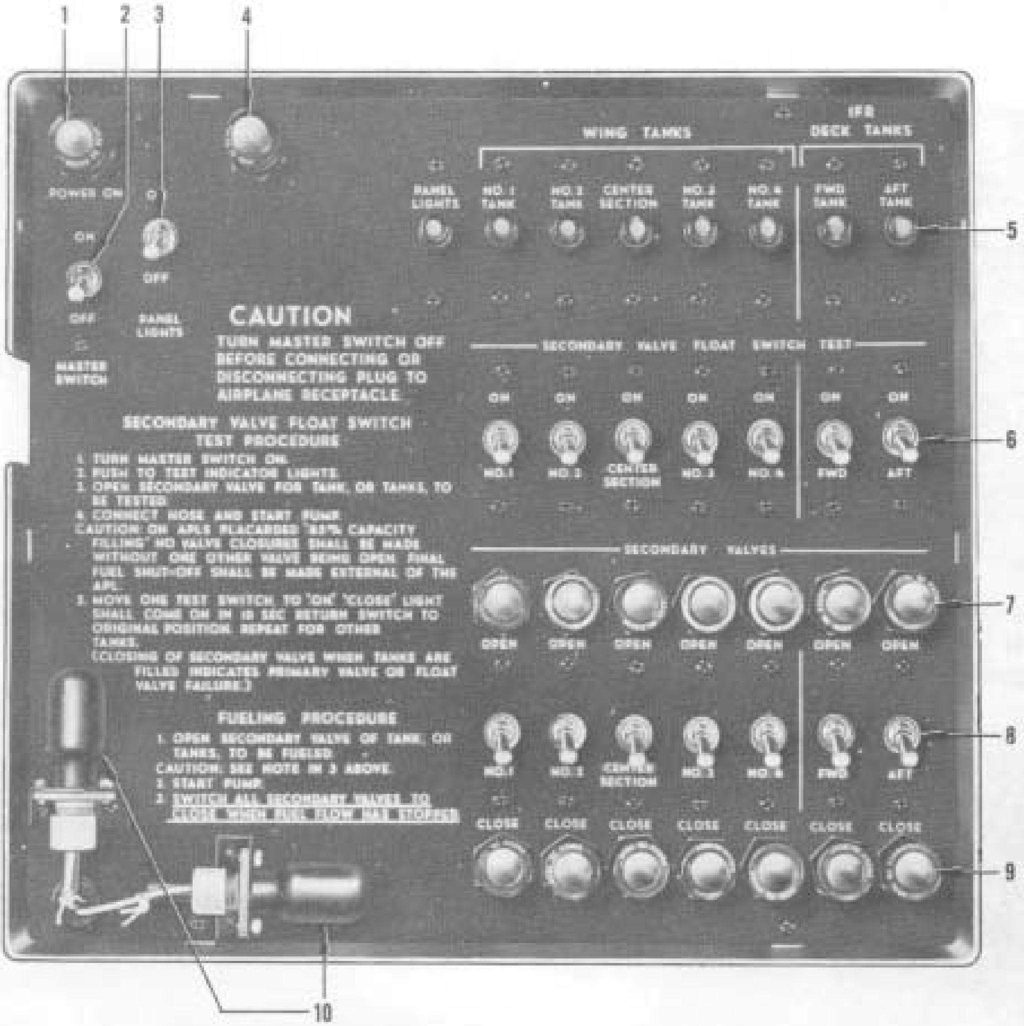


1 PANEL ELECTRICAL CONNECTION (2 PLACES)
2 ELECTRICAL CONNECTOR STOWAGE
3 SINGLE POINT REFUELING PANEL (2 PLACES)
4 GROUND CONNECTION (2 PLACES)
▼ 5 A/R SINGLE POINT RECEPTACLE
6 SINGLE POINT REFUELING NOZZLE IN AIRPLANE SINGLE POINT RECEPTACLE
7 RANGE EXTENSION RECEPTACLE

KGT507

SINGLE POINT REFUELING

Figure 4-81



CAUTION

TURN MASTER SWITCH OFF BEFORE CONNECTING OR DISCONNECTING PLUG TO AIRPLANE RECEPTACLE.

SECONDARY VALVE FLOAT SWITCH TEST PROCEDURE

1. TURN MASTER SWITCH ON.
2. PUSH TO TEST INDICATOR LIGHTS.
3. OPEN SECONDARY VALVE FOR TANK, OR TANKS, TO BE TESTED.
4. CONNECT HOSE AND START PUMP.

CAUTION: ON APLS PLACARDED '85% CAPACITY FILLING' NO VALVE CLOSURES SHALL BE MADE WITHOUT ONE OTHER VALVE BEING OPEN. FINAL FUEL SHUT-OFF SHALL BE MADE EXTERNAL OF THE APL.

5. MOVE ONE TEST SWITCH TO 'ON' 'CLOSE' LIGHT SHALL COME ON IN 10 SEC RETURN SWITCH TO ORIGINAL POSITION. REPEAT FOR OTHER TANKS.

(CLOSING OF SECONDARY VALVE WHEN TANKS ARE FILLED INDICATES PRIMARY VALVE OR FLOAT VALVE FAILURE.)

FUELING PROCEDURE

1. OPEN SECONDARY VALVE OF TANK, OR TANKS, TO BE FUELED.

CAUTION: SEE NOTE IN 3 ABOVE.

2. START PUMP.
3. SWITCH ALL SECONDARY VALVES TO CLOSE WHEN FUEL FLOW HAS STOPPED.

1 POWER ON TEST LIGHT
2 MASTER SWITCH
3 PANEL LIGHT SWITCH
4 A/R TANK VENT LIGHT
5 CIRCUIT BREAKERS
6 SECONDARY VALVE FLOAT SWITCH TEST SWITCHES
7 SECONDARY VALVE OPEN INDICATOR LIGHT
8 SECONDARY VALVE SWITCHES
9 SECONDARY VALVE CLOSED INDICATOR LIGHT
10 PANEL LIGHTS

SINGLE POINT REFUELING PANEL

Figure 4-82

SINGLE POINT REFUELING

All fuel tanks except the external fuel tanks may be filled through the single point refueling system. Two single point refueling ports are provided on the lower left hand side of the fuselage aft of the left wing rear spar. The forward port is used to refuel the airplane wing tanks; on airplanes in the tanker configuration the aft port will refuel the A/R tanks. A grounding jack adjacent to each port is provided for grounding filler hoses.

SINGLE POINT REFUELING EQUIPMENT

CAUTION

If fuel other than grades 115/145 or 100/130 is to be carried in the center wing tank, this tank must be gravity filled to avoid contaminating the airplane main fuel manifold.

Single Point Refueling Panel

To control the refueling operation, a portable single point refueling panel must be mounted forward of the trailing edge of the wing and inboard of the No. 2 nacelle by four quick-disconnect fasteners. An electrical receptacle for the single point refueling panel is located on the underside of the left wing inboard of the No. 2 nacelle (figure 4-81). On airplanes **22665** ▶, when the single point refueling panel is connected electrically, transfer relays automatically disconnect control of the secondary valves from the transfer valve switches on the engineer's A/R panel and close the external tank manifold transfer valve (figure 4-71). On airplanes with TCTO KGT507 incorporated, a cannon plug receptacle is installed in lower aft compartment. The receptacle provides electrical connection to the single point refueling panel so the switches on the panel may be monitored inside the airplane.

Fuel Flow Control

As fuel enters the single point refueling ports its flow is controlled by the following units; a primary and secondary valve in the supply line of each tank and a fuel lever control assembly, containing a primary and secondary unit in each tank. If the primary valve, which is float controlled, fails to close, the secondary valve float switch is energized, closing the circuit to the secondary valve. The secondary valve then closes, stopping the flow into the tank, and the secondary valve closed light on the single point refueling panel will illuminate.

WARNING

When carrying jet fuel or contaminated grade 115/145 or 100/130 fuel in the center wing tank, the No. 1 manual shutoff valve must be safety wired in the closed position. When carrying fuel other than uncontaminated grade 115/145 or 100/130 in the external wing tanks but not in the center wing tank, the No. 2 manual shutoff valve must be safety wired in the closed position. This is to prevent contamination of the airplane fuel system. When it is desired to use these fuel tanks for the airplane system, all contaminated fuel must be drained and flushed out before refilling with grade 115/145 or 100/130 fuel.

Single Point Master Switch

The master switch (2, figure 4-82) on the single point refueling panel has ON--OFF positions, and energizes the controls on the single point refueling panel when positioned to ON.

Secondary Valve Switches

Each secondary valve switch (8, figure 4-82) on the single point refueling panel has OPEN--CLOSE positions. When in the OPEN position, the secondary valve will be controlled by the secondary fuel level control switch.

Secondary Valve Float Switch Test Switches

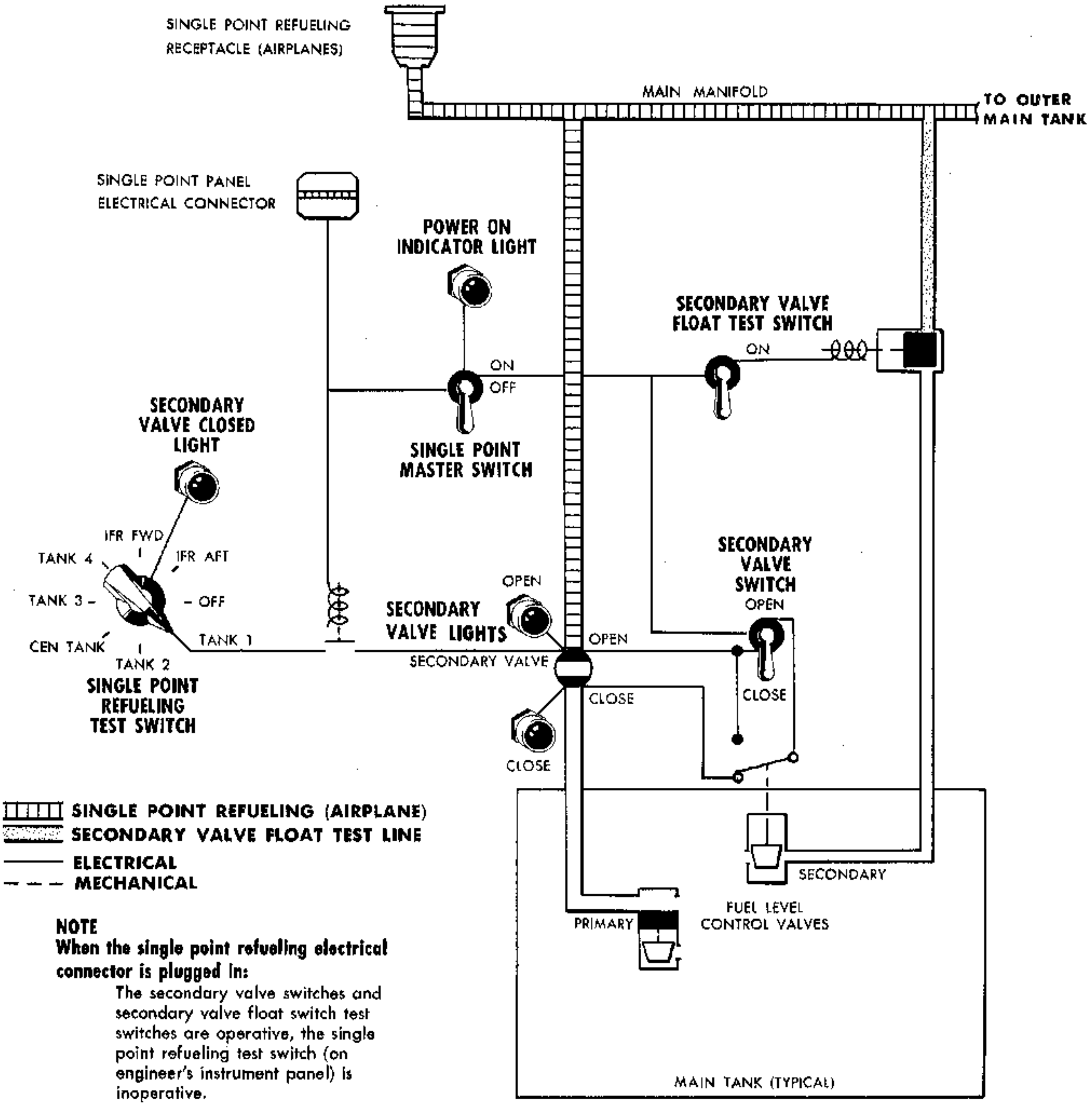
Each secondary valve float test switch (6, figure 4-82) on the single point refueling panel has ON--OFF positions and is spring-loaded to OFF. When the switch is in the ON position the test circuit for the secondary fuel level control switch is energized, flooding the secondary fuel level control switch which simulates a full tank condition.

Single Point Refueling Secondary Valve Closed Light

A single point refueling secondary valve closed light (63, figure 1-22) on the engineer's instrument panel is used to indicate that all the secondary valves are in the closed position. The light is controlled by the single point refueling test switch. Illumination of the light indicates the valve selected by the single point refueling test switch is in the closed position.

Single Point Secondary Valve Test Switch

The single point secondary valve test switch (64, figure 1-22) is on the engineer's instrument panel adjacent to the single point refueling secondary valve closed light. The test switch is used to test the position of each secondary valve in the single point refueling system. By rotating the test switch to different tank positions, each secondary valve can be tested to determine whether it is in the open or closed position. If a secondary valve has been inadvertently left in the open position the single point refueling valve closed light will not illuminate, indicating the secondary valve is in the



IIIII SINGLE POINT REFUELING (AIRPLANE)
▨ SECONDARY VALVE FLOAT TEST LINE
—— ELECTRICAL
– – – MECHANICAL

NOTE
When the single point refueling electrical connector is plugged in:
The secondary valve switches and secondary valve float switch test switches are operative, the single point refueling test switch (on engineer's instrument panel) is inoperative.

SINGLE POINT REFUELING SYSTEM (AIRPLANE)

Figure 4-83

open position. Holding the switch in the desired position will close the secondary valve and the light will illuminate. This switch is inoperative when the single point refueling panel is connected. On airplanes **22665** ▶ , the single point secondary valve switch is inoperative for the forward and aft A/R tank systems. The engineers control of the combination secondary transfer valves is thru the transfer valve switches (13, figure 4-69) only.

Power On Test Light

A push-to-test light (1, figure 4-82), above the master switch on the single point refueling panel, illuminates when pressed if power is being supplied to the single point refueling control panel.

Secondary Valve Indicator Lights

Each secondary valve has two push-to-test type valve position indicator lights on the single point refueling panel. The upper light (7, figure 4-82) is illuminated when the secondary valve is open and the lower light (9, figure 4-82) is illuminated when the secondary valve is closed.

SINGLE POINT REFUELING SYSTEM NORMAL OPERATION

CAUTION

- To prevent damage to the fuel distribution system when refueling with a hydrant system, the amount of fuel to be added must not exceed 85 percent of the total capacity of the tanks being serviced, minus the quantity of fuel already in these tanks. Make final shutoff with the hydrant system, not by means of any airplane valve. Complete the refueling by use of the standard gravity method or on airplanes **22737** ▶ and those having decals which permit use of the hydrant system by use of an F-6 truck.
- Do not exceed a fuel flow rate of 600 gallons per minute or a fuel pressure of 50 psi (whichever occurs first) during single point refueling operation, as surge pressure at valve closure may cause airplane fuel valve failure.

Refueling the airplane by use of the single point refueling system is accomplished as follows:

1. Remove the refueling panel from its stowed position in the lower aft cargo compartment and fasten it to the underside of the wing inboard of the No. 2 nacelle by means of the four quick-disconnect fasteners. On airplanes with TCTO KGT507 ▶ incorporated, a cannon plug receptacle is installed in the lower aft compartment. This receptacle provides electrical connection to the single point refueling panel so the switches on the panel may also be monitored inside the airplane.

WARNING

- To prevent arcing and possible subsequent explosion, power should be removed from the airplane bus before connecting or disconnecting the electrical plug and should be off the bus during refueling. Use battery power only for single point refueling.
- Check master switch on single point refueling panel in OFF position before inserting electrical plug in receptacle.

2. Insert the electrical plug in the plug receptacle.
3. Position master switch on the single point refueling panel to ON
4. Press the power on indicator light. The light should illuminate, indicating that power is supplied to the panel
5. Connect refueling hose grounding lead to grounding jack
6. Insert the refueling nozzle

CAUTION

- Before starting to refuel the airplane through the single point refueling system check that fuel selector switches on the engineer's instrument panel are off. This will isolate the engines from the manifold line, thus relieving the carburetors from undue pressure.
- Before filling the A/R system, check leveling valve closed, vent valve open (if applicable). Fuel load in aft tank system must not exceed that in forward tank system.

7. Press all circuit breakers on the single point refueling panel
8. Position secondary valve switch to OPEN for tank or tanks to be filled; remaining secondary valve switches to CLOSE

9. Start fuel flow. The fuel will flow into the tanks selected
10. Hold test switch, for secondary fuel lever control switch test, to ON for tanks to be tested, for 10 seconds. The secondary valve close light should illuminate

CAUTION

The valves of at least one tank must remain open to prevent fuel pressure surge.

Stopping Fuel Flow

As the fuel level rises in the tank, the primary float control unit or the secondary float switch will close the primary or secondary fuel valve respectively. This stops the fuel flow and leaves the proper amount of expansion space in the tank. Closing of a secondary valve (indicated by illumination of secondary valve closed light) when tanks are filled indicates failure of the primary valve or the primary valve float control unit. The secondary valve switches must be positioned to CLOSE when refueling is complete.

Partial Filling

For tanks that are being fueled to less than full the fueling operation is controlled by the hydrant valve only. When the desired quantity of fuel has been delivered to the tank or tanks being fueled place the hydrant valve to CLOSE.

WARNING

- Place master switch on single point refueling panel OFF before removing electrical plug from plug receptacle. With master switch ON, possible arcing at receptacle may cause an explosion if fuel fumes are present.
- Drain approximately one quart of fuel from the aft single point refueling receptacle drain line to provide thermal relief.

MISCELLANEOUS EQUIPMENT

SEATS

The navigator's seat is adjustable for vertical and rotational movement. On airplanes **3178** ▶, the seat is also adjustable fore and aft along a set of tracks. The seat is equipped with a safety belt and shoulder harness. The shoulder harness has an inertia reel and lock mechanism. See Section II for details of inertia reel and lock operation. A left auxiliary troop seat, including a safety belt, near the left rear escape hatch is for the boom operator when he is not engaged in air refueling.

NAVIGATOR'S SIGHTING STOOL

This stool is located in the control cabin for the navigator to stand on when using the periscopic sextant. This stool is adjustable for vertical movement and has a locking pin for securing it to the control cabin floor.

COMPARTMENT HATCHES

There are four hatches in the airplane other than emergency escape hatches. These hatches provide access between compartments. One hatch in the control cabin floor provides access to the lower nose compartment; one hatch in the forward end of the main compartment floor provides access to the lower forward compartment; one hatch in the aft end of the main compartment floor provides access to the lower aft compartment; another hatch in the aft end of the main compartment provides access to the tail compartment.

WINDSHIELD WIPERS

Hydraulically operated windshield wipers clear the windows directly in front of the pilot and copilot. The wipers are operated by the airplane hydraulic system (figure 1-35). A control knob (11, figure 1-11) is provided to turn the windshield wipers on by rotating the knob counterclockwise, and to regulate the speed of the wipers.

CAUTION

To prevent damage to windshields and difficulty in parking the windshield wipers on dry glass, they should be operated only when the windshields are wet. Should the wipers fail to park when turned off, the control knob should be turned slightly toward the open position until the wipers move to the parked position.

HEATED SUIT PROVISIONS **17260** ▶ **2859**

A control box is installed at each crew station to control heated clothing. Each box includes a rheostat, a heated suit outlet, and a 24 volt DC electrical outlet. (See figure 1-33 for circuit protection of heated suit equipment.) The rheostat is marked OFF--LOW--HIGH and controls the output of the heated suit outlet only. When the rheostat is moved from the OFF to the LOW position and the suit heater cord is plugged in, power is supplied to the heated suit. Then the rheostat may be varied between the LOW and HIGH positions to control the temperature of the heated suit.

NOTE

> Heated suit cords must be disconnected when engines are being started to lessen the electrical load.

DATA CASE

An airplane data case is mounted on the right side of the control cabin behind the engineer's instrument panel.

AIRPLANE LOAD ADJUSTER

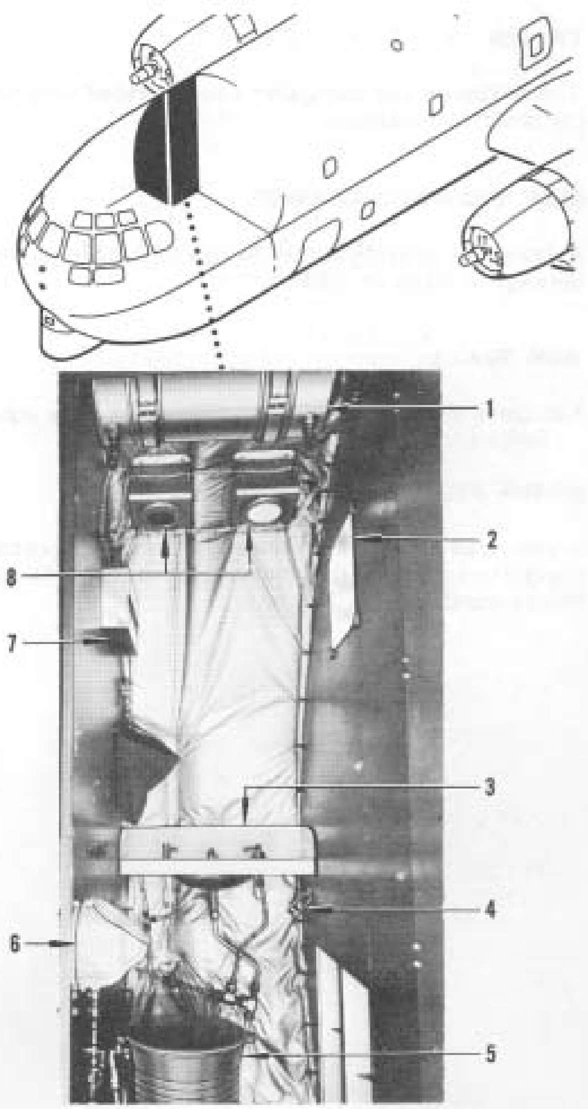
The load adjuster, used for computing the center of gravity under various loading conditions, is located at the forward end of the pilot's auxiliary panel.

BLACKOUT AND SUN CURTAINS

All the windows in the main compartment and the lower forward and aft compartments including the hatches, are equipped with curtains for protection against sun light. The curtains are attached by snapping them to clips on the window frame. The pilots' sliding windows are equipped with curtains that can be manually rolled up. These curtains, when rolled up are held in place with straps; when unrolled, they are snapped in place. Snap-on type curtains are also provided at the navigator's window and the window behind the engineer's station. A special curtain is provided for celestial shots. This curtain is rolled up and held in place by straps when not in use. Two night flying curtains, one on each side of the fuselage, isolate the pilot, copilot, and engineer from the lighted navigation station when the curtain is properly installed. The night flying curtains are folded against the cabin wall and held in place by straps. On airplanes **2826** ▶ in the tanker configuration, a green plexiglass shield is provided for the boom operator's window to lower glare from clouds and receiver airplanes.

LADDERS

There are three fixed ladders in the fuselage. One connects the lower nose compartment with the control cabin; another connects the lower forward compartment with the main compartment; the third connects the main compartment with the lower aft compartment. When the airplane is in the tanker configuration, there is also a curved refueling ladder. This ladder is used when servicing the A/R tanks and is stowed in the aft main compartment just forward of the boom operator's station. The ladder hooks onto the fuselage above the left wing and provides access to the A/R servicing ports.



1 WATER TANK
2 MIRROR
3 WASH BASIN
4 TOILET TISSUE DISPENSER
5 TOILET
6 URINAL
7 TOWEL DISPENSER
8 DOME LIGHTS

CREW LAVATORY

Figure 4-84

RELIEF EQUIPMENT

A crew lavatory is installed in the aft right corner of the control cabin. The lavatory includes a urinal, toilet, washwater tank, wash basin, towel disposal container, mirror, and towel and soap dispensers. At the aft end of the main compartment a curtained toilet compartment, equipped with toilet and urinal, can be installed. This toilet compartment is readily removable and can be stowed on the right side of the lower aft compartment, aft of the A/R tanks.

TABLES

The engineer and navigator are provided with tables for their convenience.

MAP STOWAGE DRAWER

A drawer is provided in the navigator's table to permit stowage of maps and charts.

ASH TRAYS

Ash trays are conveniently located at each crew station.

BOOM STOWING MIRROR

A rear view mirror is provided in the boom operator's compartment forward of the instrument panel to assist him in stowing the A/R boom.

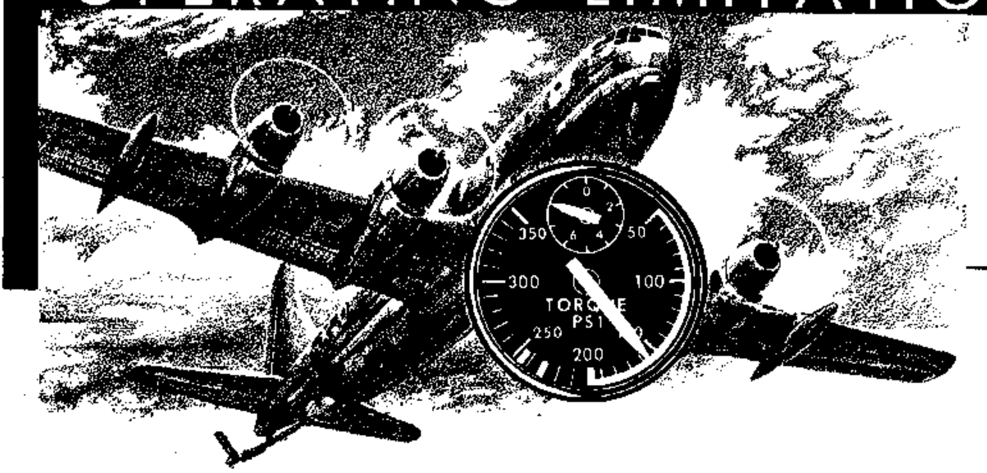
ACCESSORY EQUIPMENT

The following accessory equipment is provided in a kit with each airplane for servicing and ground use: pitot head covers, air intake plugs, mooring eyes, wing jacking pads, turbo nozzle box clearance gages, nose gear ground lock, main gear external down locks, tow bar adapter, engine covers, engine cowl heating shields, engine accessory section heating adapter, turbo cooling cap clearance gage, fuel tank quantity gage, engine oil tank quantity gage, boom lock pin, boom nozzle cover, 1/2 inch hex socket insulated wrench, mooring and jacking point, jacking cone fitting, and a tail strut base.

NAVIGATOR'S STOWAGE CABINET

A navigator's stowage cabinet is located directly above the navigator's table. This cabinet is used for stowing the airplane G file and other miscellaneous equipment.

OPERATING LIMITATIONS



SECTION V

TABLE OF CONTENTS

CONTENTS

This Section covers the operating limitations of the airplane which must be observed during normal operation. Special attention should be given to the instrument markings (figure 5-1) since these limitations are not necessarily repeated under their respective sections. The instrument markings are used to indicate to the pilot, at a glance, that flight operation is being accomplished in a safe, desirable, or unsafe region. The instrument marking system consists of four colors and intermediate blank spaces. Red, if used as a minimum limit marking, indicates a dangerous condition exists if operated below this marking. If used as a maximum range marking, red prohibits operation above this marking. Green indicates the region for continuous operation when used without a blue marking. When used in conjunction with blue markings, green indicates the region where auto-rich operation is required. Blue indicates the region where auto-lean operation is permitted. Yellow indicates caution or that danger may exist in this region under certain conditions. Instrument markings are further explained by the use of notes in figure 5-1. All instruments that indicate operating limits are shown in figure 5-1. Care should be taken not to exceed these limits as damage can result to both equipment and to the airplane.

MINIMUM CREW REQUIREMENTS

The minimum crew requirements for this airplane are a pilot, copilot and engineer. Additional crew members as required will be added at the discretion of the Commanding Officer.

MANIFOLD PRESSURE

🟦	14 IN. HG.	MINIMUM IN FLIGHT
🟦	14 IN. HG TO 50.5 IN. HG . . .	AUTO LEAN PERMITTED
🟩	50.5 IN. HG TO 60 IN. HG . . .	AUTO RICH REQUIRED
🟥	60 IN. HG.	TAKEOFF (WET OR DRY)

CYLINDER HEAD TEMPERATURE

🟦	65 °C TO 243 °C.	AUTO LEAN PERMITTED
🟩	243 °C TO 265 °C	AUTO RICH REQUIRED
🟥	265 °C.	MAXIMUM

NOTE: The maximum at 70% meto power or less is 243 °C.

FUEL GRADE 115/145

TORQUEMETER

PILOT'S TACHOMETER

ENGINEER'S TACHOMETER

🟦	50 PSI.	MINIMUM FOR FLIGHT
🟦	50 PSI TO 198 PSI . . .	AUTO LEAN PERMITTED
🟩	198 PSI	MAXIMUM CONTINUOUS AUTO LEAN OR AUTO RICH (operation above this pressure limited to 30 minutes in auto rich)
🟥	* 230 PSI.	MAXIMUM DRY
🟥	247 PSI.	MAXIMUM WET

* 247 psi maximum dry power for takeoff can be obtained when CAT is minus 24 °C or below.

🟦	1300 TO 1400 RPM.	ALLOWABLE FOR CRUISING (SEE NOTE)
🟦	1401 RPM TO 2550 RPM . . .	AUTO LEAN PERMITTED (MARKED ON PILOTS' TACHOMETERS ONLY)
🟩	2550 RPM (METO).	MAXIMUM CONTINUOUS AUTO LEAN OR AUTO RICH (operation above this rpm limited to 30 minutes in auto rich)
🟥	2700 RPM.	MAXIMUM

NOTE: Operation below 1400 rpm not recommended because of propeller inefficiency

INSTRUMENT MARKINGS

Figure 5-1 (Sheet 1 of 6)

FUEL PRESSURE

🟥	24 PSI	MINIMUM FOR FLIGHT
🟩	24 PSI TO 26 PSI	CONTINUOUS OPERATION
🟥	30 PSI	MAXIMUM ALLOWABLE (engine operating)

OIL TEMPERATURE

🟥	40°C	MINIMUM FOR FLIGHT
🟩	40°C TO 85°C	CONTINUOUS OPERATION
🟥	100°C	MAXIMUM

OIL PRESSURE

🟥	25 PSI	MINIMUM IDLE
🟥	50 PSI	MINIMUM FOR FLIGHT OPERATION ABOVE 1200 RPM ON THE GROUND
	75 PSI	MINIMUM FOR TAKEOFF
🟩	75 PSI TO 110 PSI	CONTINUOUS OPERATION
🟥	110 PSI	MAXIMUM

NOTE: An indication of 25 psi is the minimum oil pressure during idle engine rpm.

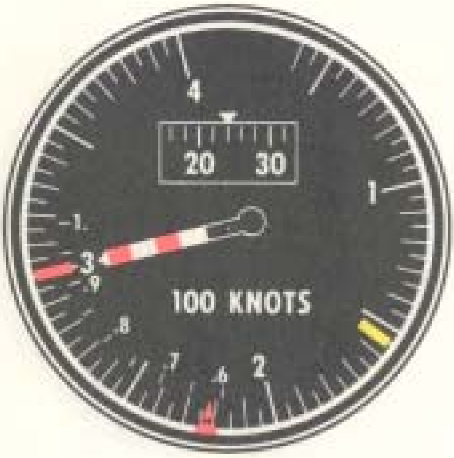
75 psi is required during takeoff to minimize bearing wear.

CARBURETOR AIR TEMPERATURE

🟨	-10° TO 7°C	DANGER OF ICING
🟦	7° TO 38°C	CONTINUOUS OPERATION (AUTO RICH OR AUTO LEAN) (Desired Operation is +20°C)
🟥	38°C	MAXIMUM OPERATION (Auto Lean)
🟩	38°C TO 50°C	MAXIMUM CONTINUOUS OPERATION WITH CARBURETOR PREHEAT
🟥	50°C	MAXIMUM DANGER OF DETONATION

NOTE: 38° to 50°C AUTO RICH, permitted during extended climbs or when operating conditions demand. Other engine operating limits must be observed. Manifold pressure must not be increased except to compensate for CAT corrections up to 50°C as required to maintain power as shown in the Appendix Power Schedule Charts to recover TPSI loss when operating in the green range.

Figure 5-1 (Sheet 2 of 6)



MAXIMUM ALLOWABLE AIR SPEED

🟨 155 KNOTS. . FULL FLAPS (LANDING GEAR 200 KNOTS)
🟥 300 KNOTS. . . . . MAXIMUM AIRSPEED

This instrument setting is such that the red pointer will move to indicate a limiting structural airspeed of 302 KNOTS or the airspeed representing the limiting Mach Number of 0.62, whichever is less.

COWL FLAP INDICATOR

🟥 0.75 INCHES. . . . . MINIMUM OPENING FOR FLIGHT
🟥 3.0 INCHES . . . . . MAXIMUM OPENING FOR FLIGHT

(SEE FIGURE 7-5 FOR OTHER COWL FLAP LIMITS)

PROPELLER DE-ICING LOADMETER

🟥 0.6 PER CYCLE. MINIMUM
🟩 0.6 TO 1.0 PER CYCLE. . . . . NORMAL
🟥 1.0 PER CYCLE. . . . . MAXIMUM

FREQUENCY METER

🟥 380 CYCLES PER SECOND. . . . . MINIMUM
🟩 380 TO 420 CYCLES PER SECOND . . . . . NORMAL
🟥 420 CYCLES PER SECOND. . . . . MAXIMUM

PROPELLER DE-ICING AMMETER PLUS 534

🟥 130 AMPS PER CYCLE. . . . . MINIMUM
🟩 130 TO 215 AMPS PER CYCLE . . . . . . NORMAL
🟥 215 AMPS PER CYCLE. . . . . MAXIMUM

INSTRUMENT MARKINGS (CONT)

Figure 5-1 (Sheet 3 of 6)

▼A/R FUEL PRESS

🟥 50 PSI . . . . MAXIMUM A/R FUEL PRESSURE

CABIN AIR FLOW

🟩 1 IN. HG TO 3 IN. HG. NORMAL

NOTE: At certain power settings and cabin pressurization requirements an indication of cabin airflow somewhat above the green (NORMAL) range may be expected.

ANTI-ICING TEMPERATURE

🟥 190°C. . . . . MAXIMUM DUCT TEMPERATURE
🟥 227°C. . . . . MAXIMUM HEATER TEMPERATURE

BODY HEATER TEMPERATURE

🟩 –20°C TO 182°C. . . . . NORMAL
🟥 182°C . . . . MAXIMUM

Figure 5-1 (Sheet 4 of 6)

▼ BOOM HYDRAULIC SYSTEM PRESSURE

🟥 2500 PSI . . . . MINIMUM
🟩 2700 TO 2950 PSI . . . . NORMAL
🟥 3080 PSI . . . . MAXIMUM

EMERGENCY BRAKE HYDRAULIC PRESSURE

🟨 520 PSI. . . . ONE BRAKE APPLICATION REMAINING
🟥 1825 PSI . . . . MAXIMUM

SERVICE BRAKE HYDRAULIC PRESSURE

🟨 520 PSI. . . . ONE BRAKE APPLICATION REMAINING
🟩 1500 PSI TO 1650 PSI . . . . NORMAL
🟥 1825 PSI . . . . MAXIMUM

▼ ENGINE-DRIVEN AIR REFUELING HYDRAULIC PUMP PRESSURE

🟩 1000 TO 3080 PSI . . . . NORMAL
🟥 3080 PSI . . . . MAXIMUM

NOTE: An indication of 50 to 500 psi during cruise conditions is normal

MAIN HYDRAULIC PRESSURE

🟩 1500 PSI TO 1650 PSI . . . . NORMAL
🟥 1825 PSI . . . . MAXIMUM

INSTRUMENT MARKINGS (CONT)

Figure 5-1 (Sheet 5 of 6)

▼ BOOM SIGNAL COIL TEST VOLTMETER

🟥	OPEN	BOOM SIGNAL COIL CIRCUIT OPEN
🟩	GOOD	BOOM SIGNAL COIL CIRCUIT GOOD
🟥	SHORTED	BOOM SIGNAL COIL CIRCUIT SHORTED

▼ BOOM AZIMUTH

🟩	17° L – 17° R	NORMAL ENVELOPE (Automatic Operation)
🟥	17° L AND 17° R	MAXIMUM

▼ BOOM TELESCOPE

🟥	6 FT	MINIMUM
🟩	6 FT – 18 FT	NORMAL ENVELOPE (Automatic Operation)
🟥	18 FT	MAXIMUM

▼AIR REFUELING HYDRAULIC OIL TEMPERATURE

🟥	100° C	MAXIMUM

NOTE: Reduce refueling flow or shut-down as necessary to stay below this limit.

▼ BOOM ELEVATION

🟩	25° 30' – 45° DOWN	NORMAL ENVELOPE (Automatic Operation)
🟥	45° DOWN	MAXIMUM

Figure 5-1 (Sheet 6 of 6)

ENGINE LIMITATIONS

Whenever engine overspeeding occurs, the following information should be noted in the appropriate section of Form 781 and reported to the ground crew; the maximum rpm which was obtained during flight, duration in minutes of the overspeed condition and the reason for overspeed if known. If engine rpm was between 3100 rpm and 3300 rpm, an inspection of the engine is necessary before further flight. If the engine exceeded 3300 rpm an engine change is necessary. When manifold pressure above the recommended valve specified for takeoff, climb or cruise occurs it will be considered an overboost and the following will be used to determine the necessary action:

1. From one to five inches Hg for periods up to five seconds, no action required.
2. From one to ten inches Hg for periods of five to fifteen seconds; inspection as outlined in applicable maintenance handbook is required.
3. Ten inches Hg or more for any period of time requires removal of the engine.
4. Overboost of any magnitude for periods in excess of fifteen seconds requires removal of the engine.

MILITARY POWER

Military power for reciprocating engine airplanes - Same as maximum (takeoff) power wet or dry except that it is limited to 30 minutes duration instead of five minutes. An airplane engine can actually be run continuously under overload conditions of power and speed for much longer periods than those permitted by the ratings. However, the period of reliable operation is thereby reduced to an impractically short time. By imposing a time limit on maximum and military power ratings, the cumulative effect of the overloads is distributed evenly over the period between overhauls and the useful life of the engine accordingly lengthened. When use of military power is absolutely required for longer than 30 minutes, a notation must be made in Form 781.

TURBO LIMITATIONS

The maximum allowable continuous turbine wheel speed (20,000 rpm) is reached at the engine power settings shown in figure 5-2. Operation above these limits should be used as required but held to an absolute minimum.

ALTITUDE (FEET)	BHP
23,500	2650
25,000	2450
26,000	2350
27,000	2250
28,000	2160
29,000	2070
30,000	1985

CONDITIONS: 32°C CAT 155 knots IAS

TURBO LIMITATIONS

Figure 5-2

ALTERNATE FUEL GRADE OPERATING LIMITS

The R-4360-59B engine requires a fuel grade of 115/145 to develop maximum power ratings without exceeding detonation margins. The alternate fuel for R-4360-59B engines is 100/130 grade. If this lower grade fuel is used for continuous operation the power ratings must be reduced by mechanically limiting manifold pressure to achieve the same safety margin as shown in figure 5-3. Under emergency conditions when using 100/130 grade fuel the above limitations do not apply and the engines can be operated using the same limitations as for the 115/145 grade fuel.

PROP LIMITATIONS

1. Ground Operation - Avoid continuous operation between 1250 to 1650 rpm and 2200 to 2650 rpm except for passing through these ranges. Avoid operation above 2600 rpm under static conditions. Do not use reverse thrust for ground maneuvering. Engine cooling is at a minimum during reverse thrust.

NOTE

> While the 34G60 prop has no flight restrictions, it has been noted at some rpm settings rough operation may be encountered. In order to minimize engine bearing damage, these rpm settings should be avoided. Increase rpm as required to achieve smooth operation.

CONDITION	RPM	BHP	TPSI	APPROX IN. MP	MAX CHT	DESIRED CHT	MAX CAT	DESIRED CAT	MIXTURE POSITION
MAXIMUM (WET)	2700	3250	230	56.5	265°C	–	38°C	–	AR
MAXIMUM (DRY)	2700	3000	214	56.0	265°C	–	38°C	–	AR
METO	2550	2500	187	48.1	265°C	240° – 265°C	38°C	7°–38°C	AR
MAX AUTO LEAN	2300	1900	158	39.0	243°C	225° – 243°C	38°C	7°–38°C	AL

FOR MIL-F-5572, GRADE 100/130 FUEL

CONTINUOUS OPERATION WITH ALTERNATE FUEL

Figure 5-3

BRAKE LIMITATIONS

The landing gear brakes on this airplane are intended for emergency use when stopping or for manipulating the airplane on the ground. Under normal conditions there is little necessity for use of brakes to control the airplane when taxiing since it can usually be controlled by proper use of the engines. Repeated applications of brakes without allowing sufficient time for cooling between applications can cause increased temperatures to dangerous degrees, which will result in complete breakdown of the brake structure, failure of brake drum and wheel structure, blowing of tires and in extreme cases, the complete wheel and brake installations are destroyed by fire. This also applies to excessively short stops from high rates of speed and dragging brakes for any appreciable distance while taxiing at slow speeds. Because of the heat transfer characteristics of this brake, peak temperatures on the outer surfaces of the brakes and wheel assemblies may not be reached until 15 or 20 minutes after use. This can result in nacelle fires or tire explosions in flight after the gear has been retracted. For this reason the brakes should be given sufficient time to cool before gear retraction any time overheat conditions are known or suspected.

AIRSPEED LIMITATIONS

NOTE

> The following limitations supplement those shown in figure 5-1.

Landing Gear - Do not exceed 200 knots IAS with landing gear extended because retracting mechanism and wheel well doors will be overstressed at higher speeds.

Flaps - Do not begin to lower flaps above 190 knots IAS. Do not exceed 190 knots IAS with up to 55 percent flaps. Do not exceed 155 knots IAS with flaps 55 percent to 100 percent. Exceeding any of these conditions can result in damage to flaps and flap operating mechanisms

Landing Light - Do not exceed 200 knots IAS when extending landing lights because extension mechanism will be overstressed at higher speeds

Sheltered Air Door - Do not exceed 210 knots IAS when opening, closing, or operating in the sheltered position. Operating mechanism will be overstressed at higher speeds.

A/R Boom - Do not exceed 260 knots IAS with boom unlatched because of possible damage to the boom or the boom supports

FLIGHT RESTRICTIONS

1. All acrobatics are strictly prohibited
2. Operate cowl flaps as shown in figure 7-5
3. Do not drop external fuel tanks when less than one-half full with flaps extended except in an emergency. See EXTERNAL TANK JETTISONING, Section III.

WARNING

> It is recommended that whenever possible the external tanks be free of usable fuel when landing. Landings with usable fuel in these tanks without lower surface overstress is possible only when control of the landing sinking speed is maintained below the average values shown in figure 5-4.

CENTER OF GRAVITY LIMITATIONS

1. Forward CG limit is 18.5 percent of MAC
2. Rearward CG limit is 30.5 percent of MAC

When the airplane is operated within these limits, all control characteristics during taxiing, takeoff, flight and landing are normal.

NOTE

> The operating limitations noted in the existing weight and balance technical manual (T.O. 1-1B-40) and attendant computer (C/KC-97A thru G) are not applicable for gross weights under 105,000 pounds.

The following applies to all airplanes incorporating TCTO 561

1. The forward CG limit for takeoff and landing of the airplane has been established at 15 percent MAC at airplane gross weights below 105,000 pounds.

2. The forward CG limit for airplane operation remains at 18.5 percent MAC for all airplane operation above 105,000 pounds gross weight.

3. The rear CG limit for all flight conditions remain unchanged.

4. When landing at 15 to 18.5 percent MAC flaps are limited to 55 percent throughout the approach to touchdown. Reduce airspeed to cross threshold at 150 percent power-off stall speed. Minimum power must be maintained at 15 inches Hg on final and throughout the flare where a gradual reduction of power is made to contact the ground with main gear first in a slightly nose up attitude.

HIGH GROSS WEIGHT STRUCTURAL AND PERFORMANCE LIMITATIONS

Every airplane has structural and flight limitations which vary according to its type and size. These limitations must be established when the airplane is designed in order to obtain maximum utility by a satisfactory combination of structural strength, weight, and flight characteristics. Gross weight is an important factor in determining the structural and performance limitations of an airplane. Added gross weight results in a decreased structural margin of safety and climb rate, longer takeoff and landing rolls, and greater control forces. If established weight limits are exceeded, the airplane strength and performance may be inadequate. In the military design specifications, certain criteria have been established to define the maximum overload and maximum normal takeoff weights for any type airplane. The least weight determined by these criteria is usually adopted for normal operating purposes. Under these specifications the overload and normal takeoff weights for this airplane is determined by structural criteria because the performance limitations occur at higher weights. The permance limitations discussed here do not account for all variations in operating conditions. The operating takeoff performance and field length limits based on equivalent performance weights are discussed in the Appendix to the Flight Manual.

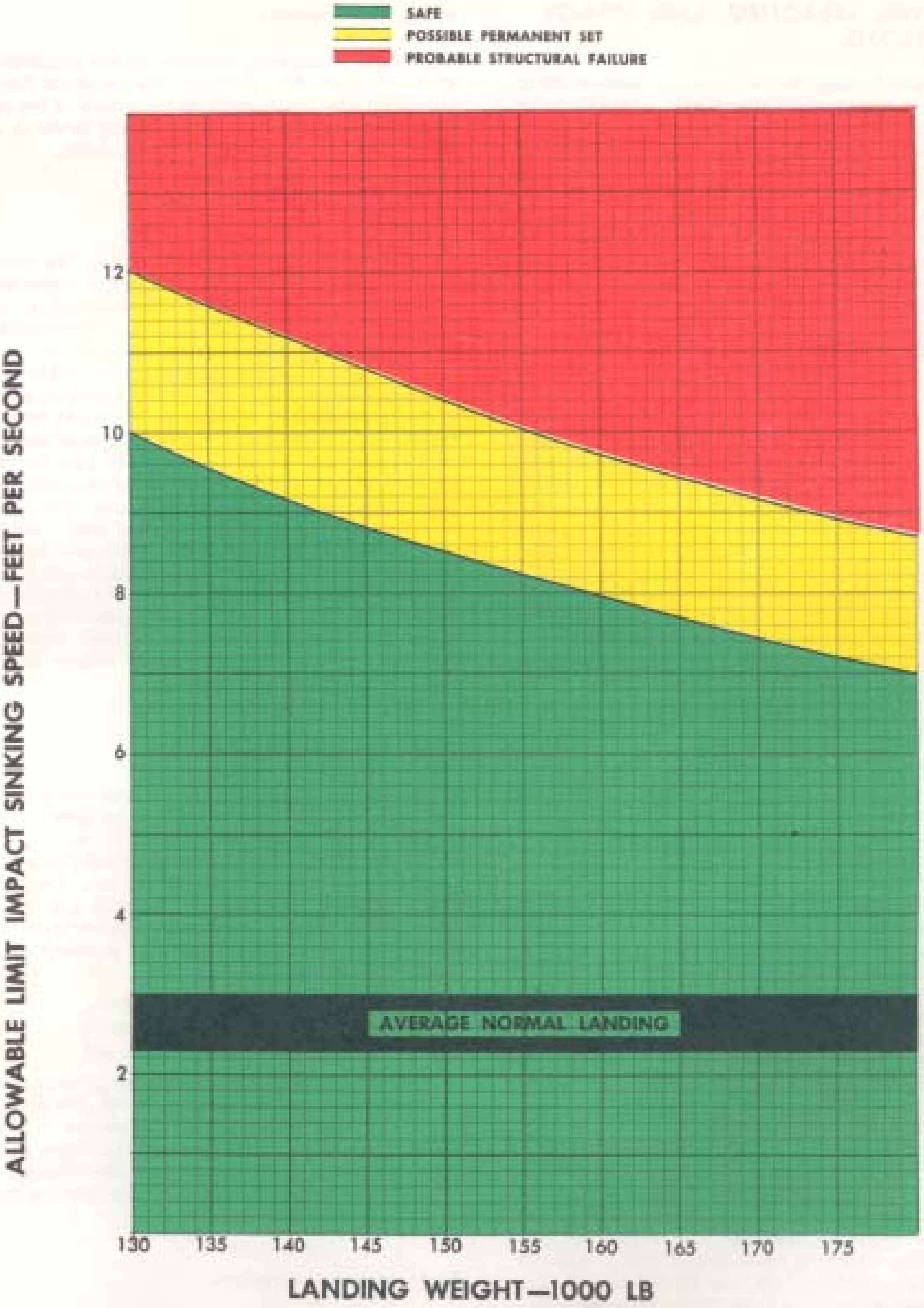
HIGH GROSS WEIGHT LANDING SINKING SPEEDS

The airplane structure is designed for normal landing with a payload up to 38,100 pounds and gross weights up to 130,000 pounds with external fuel tanks empty. At these weights the airplane is designed for a 10 fps limit contact sinking speed with 0.67g wing air lift (a condition which occurs frequently).

CAUTION

> Taxi or takeoff gross weights which exceed 175,000 pounds, or the 2.0g line, whichever is least, are not recommended because of possible structural damage to the landing gear.

It is possible to land at any gross weight without structural damage; however, maximum permissible sinking speeds reduce as gross weights increase, as shown in figure 5-4. More precision will be necessary in maintaining allowable sinking speeds at high gross weights than at low gross weights but the chart shows that a much harder than average normal landing is necessary at any weight to cause structural damage.



HIGH GROSS WEIGHT LANDING CHART

Figure 5-4

WING FUEL LOADING AND USAGE RESTRICTIONS

It is important to distribute the wing fuel weight in a spanwise manner so that satisfactory allowable wing limit load factors will be maintained. This spanwise fuel-weight distribution can be governed by fuel loading and the usage from the wing tanks and external fuel tanks. If the recommended fuel loading and usage procedure is not followed, the allowable limit load factor can be seriously reduced even though the gross weight is within recommended limits. The fuel loading and usage restrictions are shown in figure 5-5.

WEIGHT LIMITATIONS CHART

There are four weight limitations charts shown in figures 5-6 through 5-9. Figure 5-6 illustrates the weight carrying capabilities of the airplane with full external fuel tanks. Figure 5-7 through 5-9 illustrate these capabilities with the external fuel tanks installed but empty. Figures 5-7 through 5-9 may also be used when external fuel tanks are not installed and the gross weight is corrected for the weight of the tanks. The charts are generally used to determine whether the airplane is in recommended or restricted gross weight range with respect to the amount of fuel carried in the fuel tanks versus the payload. Various components of the charts are explained in the following paragraphs.

Gross Weight

Gross weight is indicated by diagonal lines on the weight limitations charts. These diagonal lines not explained in the chart notes are reference lines only.

Operating Weight

The operating weight of 90,000 pounds shown near the top of the chart is an approximate value for the tanker configuration. It includes the basic weight of the airplane as shown in Chart C of the Manual of Weight and Balance Data, T.O. 1-1B-40 plus the standard crew and oil capacity. Since individual airplanes vary in operating weight, it will be necessary to adjust the charts for a specific airplane. This correction is especially significant for the cargo configuration where the operating weight is approximately 83,000 pounds.

Payload

The payload capacity is shown on the vertical axes of the charts. This includes the weight of center wing tank fuel, air refueling fuselage fuel, cargo and airplane operating weight in excess of 90,000 pounds. If the operating weight is less than 90,000 pounds, the allowable payload is increased by the difference between 90,000 pounds and the true operating weight. (See the example Problem.)

Wing Fuel Capacity

The wing fuel capacity is shown on the horizontal axes of the charts. This includes the weight of fuel in the four main wing tanks and also the weight of the external fuel tanks regardless of whether the latter is used to operate the airplane or for air refueling.

Load Factor

The airplane structure is limited in the amount of weight it can carry without danger of permanent set at reasonable load factors. Load factor is the ratio of the force acting on the airplane to the weight of the airplane and may be expressed by the term g. All airplanes at rest on the ground or in straight and level flight are sustaining a one g load which is equivalent to one load factor. The force to resist this load is supplied on the ground by the landing gear and in flight by the wing and tail lift. Increased load factors are produced from acceleration and occur during turns, pull-ups, gusts, landings and taxi. The allowable limit load factor is the load factor above which permanent set can possible occur. The load factor lines in figures 5-6 through 5-9 are allowable limit load factors. The allowable ultimate load factor is one and one-half times the limit load factor and is the load factor at which the structure may fail. These allowable load factors vary with gross weight and distribution of payload and fuel.

Airplane Flight Load Factor

Three of the lines on the weight limitations charts indicate airplane allowable limit load factors for various combinations of fuel and payload. With a 2.5 load factor, the airplane will support 153,000 pounds gross weight without danger of permanent set. Combinations of fuel and payloads which increase gross weights above 153,000 pounds should be flown with caution, especially when making turns or pullouts, or flying through turbulent air.

CAUTION

It is not recommended that the airplane be flown at any gross weight exceeding 175,000 pounds, or in excess of the 2.0g line whichever is least, because of possible structural failure in the event that 2.0g is exceeded or the airplane is subjected to severe maneuver, turbulence, taxi, or landing loads.

Performance Limitations

Performance limitations are shown and explained on the weight limitations charts (figure 5-6 through 5-9.)

	Fuselage Loading for 90,000 Pounds Operating Weight Empty (SEE NOTE 2)	Airplane Gross Weight (SEE NOTE 1)	Fuel Loading Sequence	Fuel Usage Sequence (SEE NOTE 1)
RECOMMENDED LOADING ALLOWABLE LIMIT LOAD FACTOR IS 2.5 OR GREATER	Up to 23,600 Pounds	Up to 153,000 Pounds	1- FILL MAIN TANKS Fuel in tanks 1 and 4 must be equal to or greater than fuel in tanks 2 and 3 2- FILL EXTERNAL WING TANKS 3- FILL CENTER WING TANKS	1- USE CENTER WING TANK (SEE NOTE 4) 2- USE EXTERNAL WING TANK (SEE NOTE 4) 3- USE MAIN WING TANK Fuel in tanks 1 and 4 must always be equal to or greater than fuel in tanks 2 and 3
	Up to 38,100 Pounds	Up to 133,000 Pounds (SEE NOTE 3)		
	23,600 Pounds to 38,100 Pounds	133,000 Pounds to 153,000 Pounds (SEE NOTE 3)	1- FILL MAIN TANKS Not over 1200 pounds (200 gallons) each in tanks 2 and 3 unless tanks 1 and 4 are full 2- FILL EXTERNAL WING TANKS 3- FILL CENTER WING TANK	1- USE CENTER WING TANK (SEE NOTE 4) 2- USE EXTERNAL WING TANK (SEE NOTE 4) 3- For weight limitations with optimum flight limit load factors, as shown in figures 5-6 and 5-7, use fuel in tanks 2 and 3 until 1200 pounds (200 gallons) remain in each; then use fuel in tanks 1 and 4. For alternate weight limitations, as shown in figures 5-8 and 5-9, fuel in tanks 1 and 4 may be equal or greater than fuel in tanks 2 and 3.
ALLOWABLE LIMIT LOAD FACTOR IS LESS THAN 2.5	Over 38,100 Pounds	ALL GROSS WEIGHTS		

QUANTITY of aerial refueling fuel to be loaded	Distribution and Loading Sequence
Up to 38,100 Pounds	Fill fuselage aerial refueling tanks.
Over 38,100 Pounds	External wing tanks must be filled if fuselage tanks are to exceed 38,100 pounds. Fill center wing tank.

NOTES: (Use notes as indicated by above chart)

❶ For landing gross weights refer to figure 5-4.

❷ Fuselage load includes weight of center wing tank fuel and refueling tank fuel or cargo. Fuselage loading must be corrected for operating weight empty.

❸ With fuel in external fuel tanks increase gross weight to include weight of fuel and weight of tanks.

❹ Except when loaded with air refueling fuel.

FUEL LOADING AND USAGE RESTRICTIONS

Figure 5-5

Envelope ABC represents design payload and fuel limit with external fuel tanks full.

GROSS WEIGHT CONDITIONS

Structural Limits

189,000 LB	Allowable flight limit load factor is 2.0 g (with payload equal to or less than 67,600 LB).
175,000 LB	Allowable landing gear limit load factor is 2.0 g.
169,000 LB	Allowable flight limit load factor is 2.25 g (with payload equal to or less than 53,400 LB).
153,000 LB	Allowable flight limit load factor is 2.50 g (with payload equal to or less than 42,300 LB).
130,000 LB	Allowable limit landing sinking speed is 10 fps.

Takeoff Performance

187,000 LB	8000 feet takeoff ground run, sea level, standard day, (3500 bhp per engine).
163,500 LB	In 10,000 feet distance takeoff, climb to 50 feet, and accelerate to a speed which allows a 100 fpm climb rate with one engine inoperative, propeller feathered, gear up, flaps set for takeoff, sea level, hot day, (3380 bhp per engine).

Flight Performance

196,000 LB	100 fpm climb rate, sea level, standard day, one engine inoperative, propeller feathered, gear up, flaps up, maximum power (3250 bhp per engine).
179,000 LB	500 fpm climb rate, sea level, standard day, all engines operating, gear up, flaps up, meto power.
160,000 LB	Long range cruise capability at pressure altitude of 5000 feet, 70 per cent of meto power.

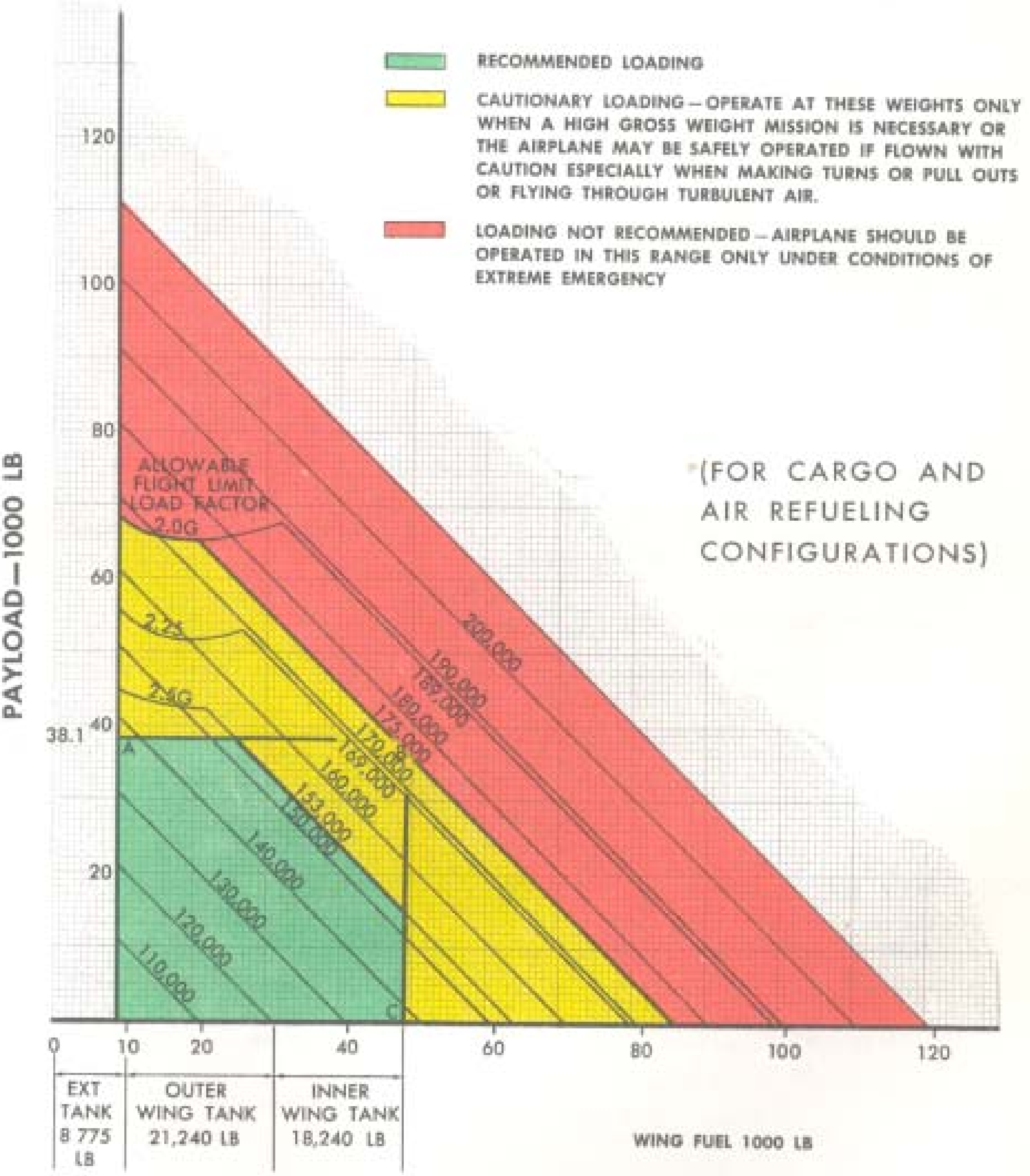
PAYLOAD CONDITIONS

38,100 LB	Design fuselage payload (includes wing center tank fuel).
46,900 LB	Design payload (includes wing center and external tank fuel).
51,800 LB	Payload (includes center wing tank fuel) minimum allowable flight limit load factor is 2.25 g.
60,600 LB	Payload (includes center wing and external tank fuel) minimum allowable flight limit load factor is 2.25 g.
65,000 LB	Payload (includes center wing tank fuel) minimum allowable flight limit load factor is 2.0 g.
73,800 LB	Payload (includes center wing and external tank fuel) minimum allowable flight limit load factor is 2.0 g.

OPTIMUM FLIGHT LIMIT LOAD FACTORS—WEIGHT LIMITATIONS WITH EXTERNAL FUEL TANKS FULL

Figure 5-6 (Sheet 1 of 2)

OPERATING WEIGHT 90,000 LB



🟩 RECOMMENDED LOADING

🟨 CAUTIONARY LOADING – OPERATE AT THESE WEIGHTS ONLY WHEN A HIGH GROSS WEIGHT MISSION IS NECESSARY OR THE AIRPLANE MAY BE SAFELY OPERATED IF FLOWN WITH CAUTION ESPECIALLY WHEN MAKING TURNS OR PULL OUTS OR FLYING THROUGH TURBULENT AIR.

🟥 LOADING NOT RECOMMENDED – AIRPLANE SHOULD BE OPERATED IN THIS RANGE ONLY UNDER CONDITIONS OF EXTREME EMERGENCY

(FOR CARGO AND AIR REFUELING CONFIGURATIONS)

Figure 5-6 (Sheet 2 of 2)

Envelope NOP represents design payload and fuel limit with external fuel tanks empty.

GROSS WEIGHT CONDITIONS

Structural Limits

182,000 LB	Allowable flight limit load factor is 2.0 g (with payload equal to or less than 52,500 LB).
175,000 LB	Allowable landing gear limit load factor is 2.0 g.
169,000 LB	Allowable flight limit load factor is 2.25 g (with payload equal to or less than 43,000 LB).
153,000 LB	Allowable flight limit load factor is 2.50 g (with payload equal to or less than 39,600 LB).
130,000 LB	Allowable limit landing sinking speed is 10 fps.

Takeoff Performance

187,000 LB	8000 feet takeoff ground run sea level, standard day, (3500 bhp per engine).
164,000 LB	In 10,000 feet distance takeoff, climb to 50 feet and accelerate to a speed which allows 100 fpm climb rate with one engine inoperative, propeller feathered, gear up, flaps set for takeoff; sea level, hot day, 3380 bhp per engine.

Flight Performance

199,000 LB	100 fpm climb rate, sea level, standard day, one engine inoperative, propeller feathered, gear up, flaps up, maximum power, (3250 bhp per engine).
181,000 LB	500 fpm climb rate, sea level, hot day, all engines operating, gear up, flaps up, meto power.
161,500 LB	Long range cruise capability at pressure altitude of 5000 feet 70 per cent of meto power, hot day.

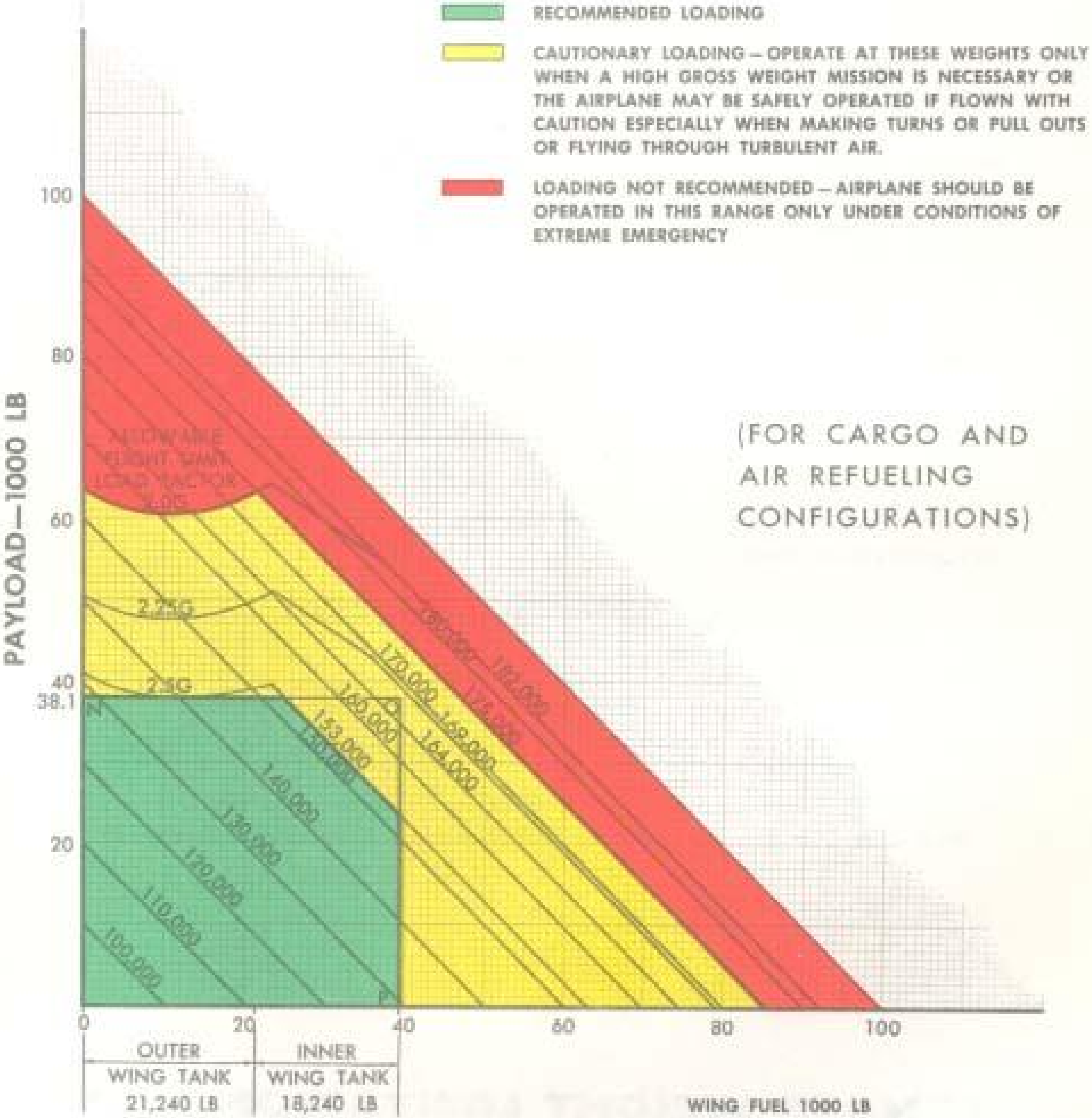
PAYLOAD CONDITIONS

38,100 LB	Design fuselage payload (includes center wing tank fuel)
47,800 LB	Fuselage payload (includes center wing tank fuel) minimum allowable flight limit load factor is 2.25 g.
60,500 LB	Fuselage payload (includes center wing tank fuel) minimum allowable flight limit load factor is 2.0 g.

OPTIMUM FLIGHT LIMIT LOAD FACTORS—WEIGHT LIMITATIONS WITH EXTERNAL FUEL TANKS EMPTY OR NOT INSTALLED

Figure 5-7 (Sheet 1 of 2)

OPERATING WEIGHT EMPTY 90,000 LB



🟩 RECOMMENDED LOADING

🟨 CAUTIONARY LOADING—OPERATE AT THESE WEIGHTS ONLY WHEN A HIGH GROSS WEIGHT MISSION IS NECESSARY OR THE AIRPLANE MAY BE SAFELY OPERATED IF FLOWN WITH CAUTION ESPECIALLY WHEN MAKING TURNS OR PULL OUTS OR FLYING THROUGH TURBULENT AIR.

🟥 LOADING NOT RECOMMENDED—AIRPLANE SHOULD BE OPERATED IN THIS RANGE ONLY UNDER CONDITIONS OF EXTREME EMERGENCY

(FOR CARGO AND AIR REFUELING CONFIGURATIONS)

Figure 5-7 (Sheet 2 of 2)

Envelope ABC represents design payload and fuel limit with external tanks full.

GROSS WEIGHT CONDITIONS

Structural Limits

189,000 LB	Allowable flight limit load factor is 2.0 g (with payload equal to or less than 50,750 LB).
175,000 LB	Allowable landing gear limit load factor is 2.0 g.
169,000 LB	Allowable flight limit load factor is 2.25 g (with payload equal to or less than 40,500 LB).
153,000 LB	Allowable flight limit load factor is 2.50 g (with payload equal to or less than 37,000 LB).
130,000 LB	Allowable limit landing sinking speed is 10 fps.

PAYLOAD CONDITIONS

35,100 LB	Design fuselage payload when operating weight empty equals 93,000 LB (includes center wing tank fuel).
46,900 LB	Design payload (includes outer wing and external tank fuel).
40,500 LB	Payload (includes center wing tank fuel) minimum allowable limit load factor is 2.25 g.
49,300 LB	Payload (includes center wing and external tank fuel) minimum allowable flight limit load factor is 2.25 g.
50,750 LB	Payload (includes center wing tank fuel) minimum allowable flight limit load factor is 2.0 g.
59,500 LB	Payload (includes center wing and external tank fuel) minimum allowable flight limit load factor is 2.0 g.

ALTERNATE WEIGHT LIMITATIONS WITH EXTERNAL FUEL TANKS FULL AND EQUAL FUEL IN WING TANKS

Figure 5-8 (Sheet 1 of 2)

OPERATING WEIGHT EMPTY 93,000 LB

🟩 RECOMMENDED LOADING

🟨 CAUTIONARY LOADING – OPERATE AT THESE WEIGHTS ONLY WHEN A HIGH GROSS WEIGHT MISSION IS NECESSARY OR THE AIRPLANE MAY BE SAFELY OPERATED IF FLOWN WITH CAUTION ESPECIALLY WHEN MAKING TURNS OR PULL OUTS OR FLYING THROUGH TURBULENT AIR.

🟥 LOADING NOT RECOMMENDED – AIRPLANE SHOULD BE OPERATED IN THIS RANGE ONLY UNDER CONDITIONS OF EXTREME EMERGENCY

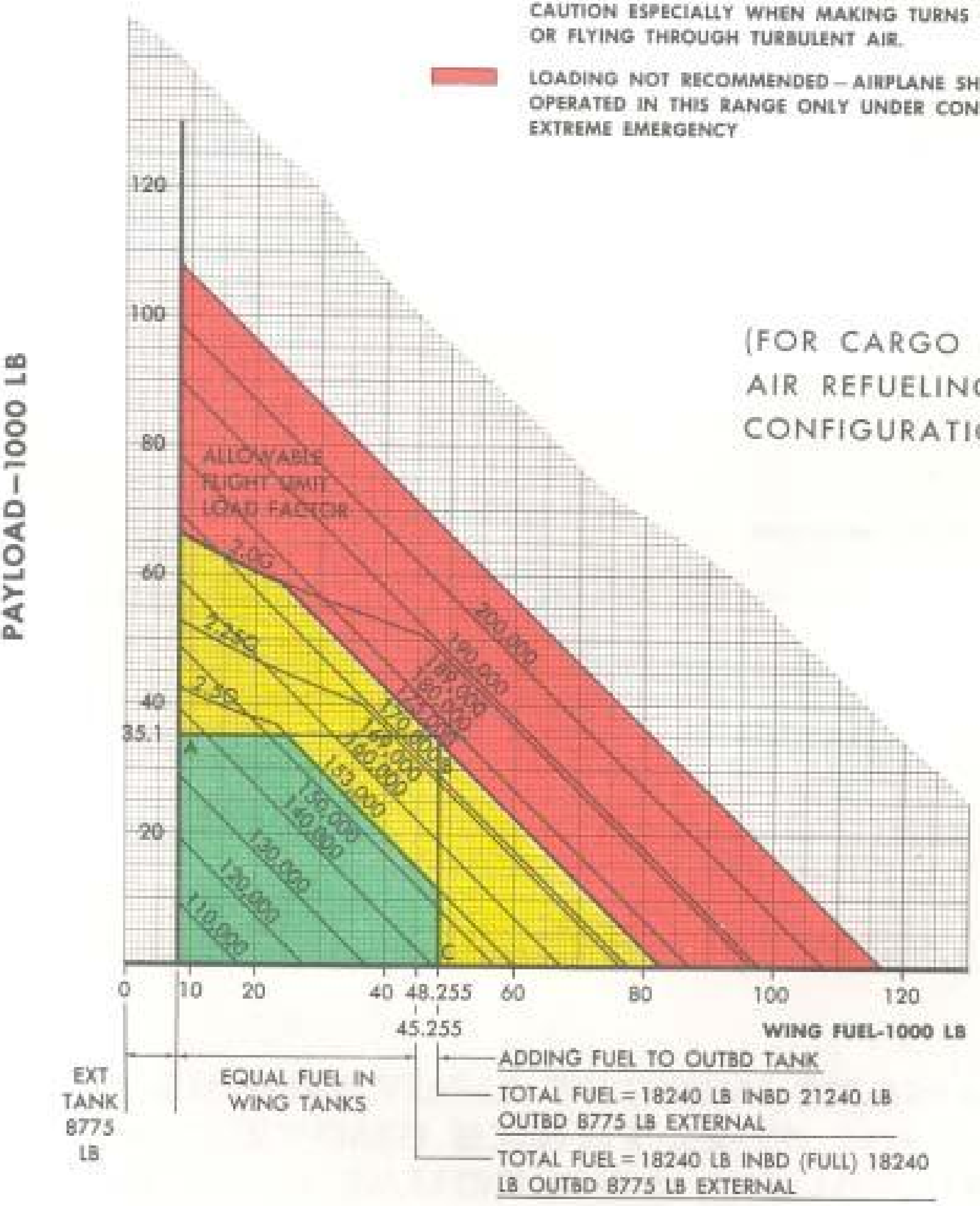

(FOR CARGO AND AIR REFUELING CONFIGURATIONS)

Figure 5-8 (Sheet 2 of 2)

Envelope DEF represents design payload and fuel limit with external tanks empty.

GROSS WEIGHT CONDITIONS

Structural Limits

177,000 LB	Allowable flight limit load factor is 2.0 g (with payload equal to or less than 47,500 LB).
175,000 LB	Allowable landing gear load limit factor is 2.0 g.
160,400 LB	Allowable flight limit load factor is 2.25 g (with payload equal to or less than 31,000 LB).
147,000 LB	Allowable flight limit load factor is 2.25 g (with payload equal to or less than 17,200 LB).

PAYLOAD CONDITIONS

35,100 LB	Design fuselage payload when operating weight empty equals 93,000 LB (includes center wing tank fuel).
17,200 LB	Payload (includes center wing tank fuel) minimum allowable flight limit load factor is 2.5 g.
31,000 LB	Payload (includes center wing tank fuel) minimum allowable flight limit load factor is 2.25 g.
47,500 LB	Payload (includes center wing tank fuel) minimum allowable flight limit load factor is 2.0 g.

ALTERNATE WEIGHT LIMITATIONS WITH EXTERNAL FUEL TANKS EMPTY OR NOT INSTALLED AND EQUAL FUEL IN WING TANKS

Figure 5-9 (Sheet 1 of 2)

OPERATING WEIGHT EMPTY 93,000 LB

🟩 RECOMMENDED LOADING

🟨 CAUTIONARY LOADING — OPERATE AT THESE WEIGHTS ONLY WHEN A HIGH GROSS WEIGHT MISSION IS NECESSARY OR THE AIRPLANE MAY BE SAFELY OPERATED IF FLOWN WITH CAUTION ESPECIALLY WHEN MAKING TURNS OR PULL OUTS OR FLYING THROUGH TURBULENT AIR.

🟥 LOADING NOT RECOMMENDED — AIRPLANE SHOULD BE OPERATED IN THIS RANGE ONLY UNDER CONDITIONS OF EXTREME EMERGENCY

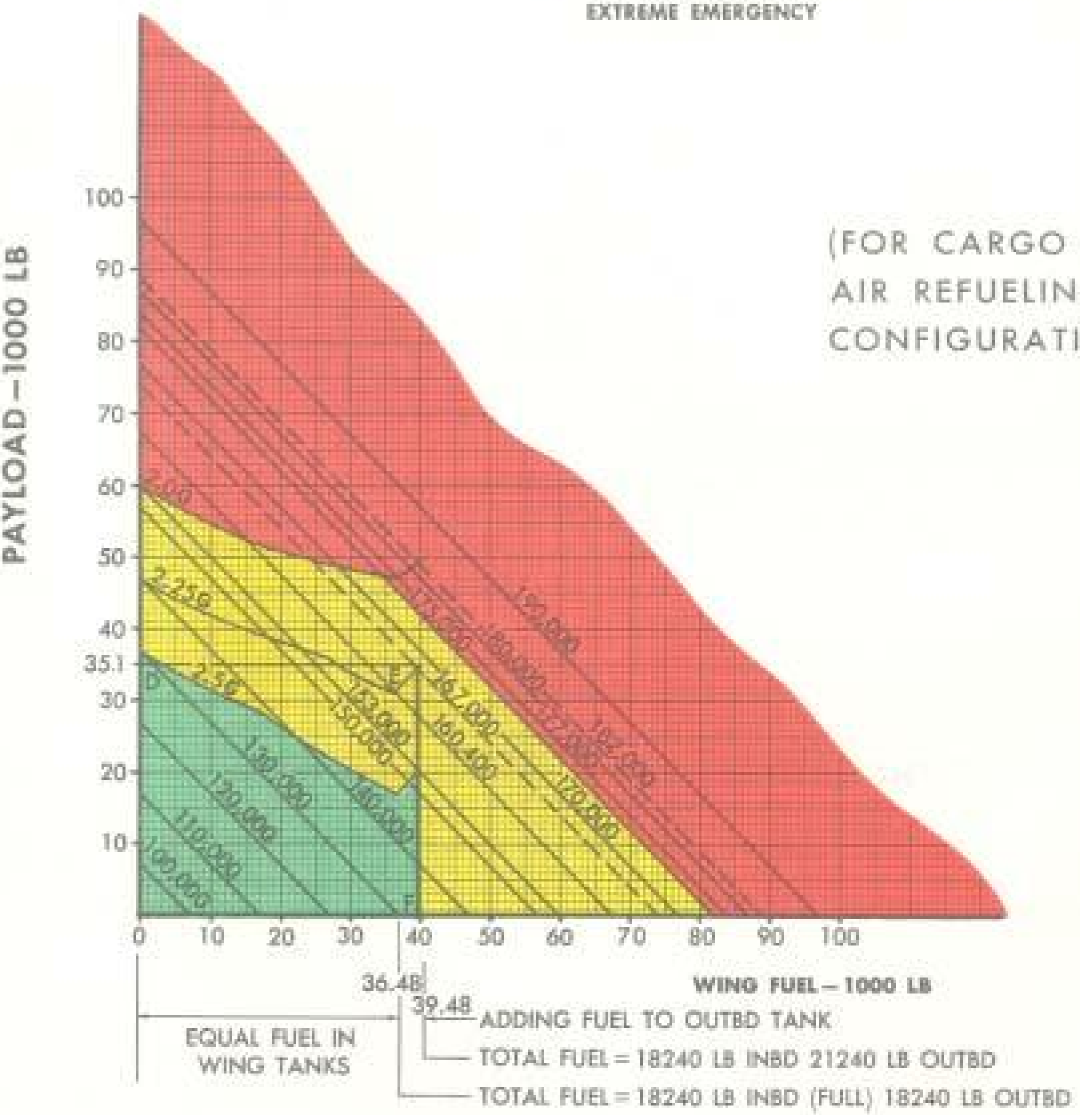


Figure 5-9 (Sheet 2 of 2)

EXAMPLE I USING THE CHARTS

TANKER CONFIGURATION WITH FULL EXTERNAL TANKS

To demonstrate a problem where the operating weight of the airplane is greater than that shown on the charts, assume an operating weight of 94,000 pounds, 53,000 pounds of air refueling fuel, and 26,000 pounds of airplane fuel. According to the fuel loading and usage table, the flight fuel should be distributed in the following manner: Tanks 1 and 4 contain 10,620 pounds each; and the remaining 4760 pounds equally distributed between tanks 2 and 3. The air refueling fuel should be distributed as follows: 39,150 pounds in the fuselage tanks, 8775 pounds in the external tanks and the remaining 5075 pounds in the center wing tank. Reference is now made to figure 5-6. The payload correction for the operating weight is 94,000 - 90,000 pounds or 4000 pounds. The effective payload is the sum of the payload correction for operating weight, the deck tank fuel and the center wing tank fuel (4000 + 39,150 + 5075) or 48,225 pounds. Proceed along the vertical axis of the chart to 48,225 pounds. On the horizontal axis of the chart, locate the wing fuel load of 8775 pounds plus 26,000 pounds or 34,775 and project the line vertically to intersect the horizontal projection of the 48,225 pound line. A gross weight of 173,000 pounds is interpolated from the diagonal lines. It is noted that the weight condition is better than the 2.0g allowable flight and landing limit load factor line and falls within a cautionary loading range. Therefore, the airplane should be flown with caution especially when making turns or pullouts or flying through turbulent air. During the flight prior to fuel transfer the allowable limit flight load factor will increase slightly as fuel is used from the inboard tanks, but will remain in the cautionary range. After air refueling fuel is transferred, the allowable limit load factor will be greater than 2.5g.

EXAMPLE II USING THE CHARTS

CARGO VERSION WITH EXTERNAL TANKS

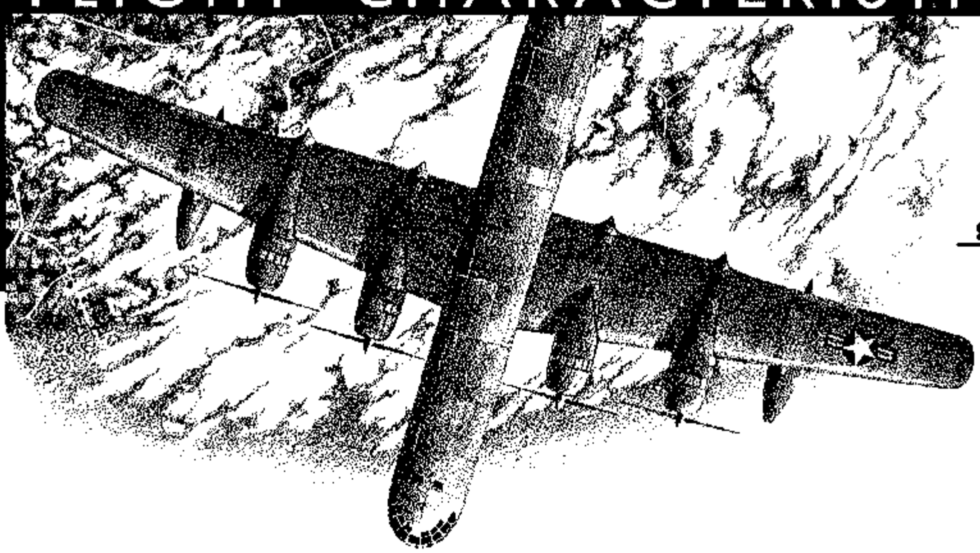
To demonstrate a problem where the operating weight is less than that shown on the weight limitations charts assume an operating weight of 84,000 pounds for the airplane, 47,500 pounds of fuel and 40,000 pounds of cargo. When external tanks are full figure 5-6 is applicable. The payload correction for the lower operating weight is 6000 pounds (90,000 - 84,000 pounds). Locate the effective payload of 34,000 pounds (40,000 - 6000 pounds) on the vertical axis and the wing fuel load of 47,500 pounds on the horizontal axis. Project the payload and wing fuel ordinates along their horizontal and vertical paths respectively to their intersection and interpolate a gross weight of 171,500 pounds. Note that if the correction for the operating weight had been neglected the apparent gross weight would have been 177,500 pounds and the load condition would appear to be in the red or prohibitive portion of figure 5-6. The fuel usage chart recommends that the fuel in the external tanks be used first. To determine the load condition after the external tanks have been emptied proceed to figure 5-7. The correction for operating weight is 6000 pounds. Proceed along the 34,000 pound payload line to intersect the 39,400 wing fuel line and find a gross weight of 157,400 pounds. Note that the airplane load factor at this stage is about 2.3 and that as soon as the inboard main wing tanks have been half emptied the airplane will be in a recommended loading range. Thus, except for the first portion of the flight the mission will be in a recommended loading range.

EXAMPLE III USING THE CHARTS

CARGO VERSION WITHOUT EXTERNAL TANKS

To demonstrate a problem where the operating weight of the airplane is less than that shown on the charts consider an operating weight of 83,000 pounds, 45,000 pounds cargo and 24,000 fuel. Refer to figure 5-7. The payload correction for the operating weight empty is 90,000 - 83,000 or 7000 pounds. Locate the effective payload ordinate of 38,000 pounds on the vertical axis and project horizontally to intersect the vertical projection of the 24,000 pound fuel ordinate where a gross weight of 151,000 pounds is interpolated. This places the mission in a recommended loading range.

FLIGHT CHARACTERISTICS



SECTION VI

TABLE OF CONTENTS

CHARACTERISTICS

The flight characteristics are excellent for a heavy airplane. Maneuvering and control of the airplane does not require undue force by the pilot. The airplane is very stable and trims out very easily. Up to four units of opposite aileron trim may be required for some off-center fuel loadings, which may be rolled in easily during takeoff and climb-out. Only small changes in trim are required for normal operation to maintain the desired airplane attitude. Rudder control is excellent with the rudder boost switch ON. Response to power changes is immediate and very positive. The addition of external fuel tanks does not appreciably affect the airplane feel.

STALLS

The stall characteristics of the airplane are good. Recovery from stalls should present no problem to the average pilot providing the recommended recovery procedures are followed and the proper cautions are observed. The stalling speed increases with the angle of bank as shown in the stall speed chart, figure 6-1. Therefore, care must be exercised in banking the airplane at low airspeeds or with a nose-high attitude. The extended landing gear has no appreciable effect on the stalling speeds.

NOTE

During stalls, at a medium gross weight, the airplane can be expected to lose at least 750 feet of altitude before being returned to level flight, if the proper recovery procedures are begun immediately after the complete stall has been reached.

STALL WARNING

Warning of the impending power-on or power-off stall comes in the form of a comparatively mild buffeting of the horizontal stabilizer and elevator and occasional light buffeting of the ailerons. Severity of the buffeting increases as the complete stall is approached. With flaps up the warning begins approximately 20 knots above the stall. With flaps down buffeting begins approximately 10 knots above stall speed. The buffeting range is reduced as angle of bank is increased. Accelerated stalls give the same warnings as the normal stall, but impose much heavier strains on the airplane and at higher gross weights may result in structural damage.

NOTE

Should stall warning occur during flight, act immediately to avoid completely stalling the airplane. If in level flight increase the airspeed; in a turn, decrease the angle of bank.

IN THE STALL

At the full and complete stall, if a rapid roll occurs, the control wheel might momentarily move hard over, placing the ailerons in their maximum travel position, and remain there until flying speed is regained. A reversal of elevator force may take place during a complete stall, but the force tending to keep the control column back is usually comparatively light and should present no problem to the pilot in pushing the control column forward to recover from the stall. However, with deliberate attempt by the pilot to obtain a very high angle of attack, and under an abnormal combination of conditions, such as a rearward CG position, power on the engines, and wing flaps up, it might be possible to encounter a somewhat high elevator force reversal, which would require considerable force by the pilot to push the control column forward during stall recovery. A combination of these conditions, which might induce a high elevator force, is considered to be far out of the normal operating range. The boom in the stowed or unstowed position does not affect the stall characteristics. However, stalls should be avoided with the boom unstowed due to the danger of it snapping up into the fuselage. Normally no abrupt rolling action either precedes or accompanies a power-off or low power-on stall. However, as in the case of most four-engine airplanes, stalls encountered with unsymmetrical or high power on the engines will result in an abrupt roll either just before or at the stall.

WARNING

Never use power and a nose-high approach to reduce the landing speed, except when required in emergency ditching procedure or crash landing. Under this condition sufficient power should be used to maintain a safe airspeed above the stall warning speed.

The ailerons are effective up to the point of stall. Use of the ailerons in the stall will not aggravate the stall as is experienced in some types of airplanes. With boost on, rudder control is effective through the stall range even with one engine out, since the minimum directional control speed is below the stall speeds except at weights below approximately 100,000 pounds. With boost off, rudder control is similar to that of large airplanes with conventional or unboosted controls.

STALL RECOVERY

When the airplane is stalled, recovery should always be made by nosing the airplane down sufficiently to regain flying speed with minimum loss of altitude. In general, recovery from stalls at safe altitudes with low cruise powers should be made by leaving the power unchanged or by closing the throttles if serious difficulty is encountered. If the airplane is stalled with a large amount of power on, the power should be chopped immediately to prevent roll and an excessive loss of altitude during recovery. A stall with unbalanced power could cause a rapid roll; under this condition the power should be chopped immediately. If power is required for recovery, use symmetrical power. Only at lower altitudes when recovery with a safe altitude margin is questionable, should power be applied during recovery. Avoid excess airspeeds, abrupt pullouts and rough handling of controls during recovery; any or all may result in an accelerated secondary stall.

PRACTICE STALLS

For both power-off and power-on stalls, set props at 2000 rpm. For power-on stalls set throttles at 30 inches MP; power-off stalls, 20 inches MP. Monitor CHT closely during extended stall practice since low airspeeds and turbulent airflow will hinder proper engine cooling. Practice all stalls with and without rudder boost operating. Conduct all stall practice at least 5000 feet above terrain altitude. In order to prevent unnecessary loading of the airplane structure, stalls should not be practiced with usable fuel in the external fuel tanks. To further reduce excessive structural stresses which may be imposed during recovery from a complete stall, it is recommended that the airplane not be stalled completely when practicing stalls. It is necessary only to note the stall warning feel and the airspeeds at which they occur for each configuration.

WARNING

Stall characteristics are greatly affected by CG position and gross weight. Do not practice stalls when the CG is near the aft limit or when the gross weight is over 120,000 pounds.

To become completely familiar with the stalling characteristics of the airplane practice stalls may be made with the wing flaps up, wing flaps full or partially down, landing gear up, landing gear down, power-on, power-off, or any combination of the above configurations. When making power-on stalls avoid abrupt pull outs. To minimize rolling tendencies avoid excessively nose high attitudes during the approach to the stall. Since the rolling tendency is most pronounced in a turn, it is recommended that all stall practice be conducted straight ahead. Stalls may be practiced up to the buffeting point under engine inoperative conditions if the principle of maintaining trim by reduction of power on the operating engines is observed. Approaches to the stall with unsymmetrical power may result in abrupt rolling tendencies, so care should be exercised in this practice maneuver.

INDICATED AIRSPEED-KNOTS

ACTUAL GROSS WEIGHT - POUNDS	WING FLAPS UP			WING FLAPS 33 1/3%			WING FLAPS 55%			WING FLAPS 100%		
	ANGLE OF BANK											
	0°	30°	45°	0°	30°	45°	0°	30°	45°	0°	30°	45°
180,000	134	144	160	123	133	148	115	123	136	105	113	125
160,000	126	136	150	117	125	139	108	116	128	99	106	117
140,000	118	127	141	109	117	130	101	108	120	93	99	110
120,000	110	117	130	101	109	121	93	101	111	86	92	102
100,000	100	108	119	92	101	110	85	92	102	78	84	93
80,000	89	96	106	83	89	98	76	82	91	69	75	83

Stalling speed not affected by landing gear position

Power on stalling speeds are approx. 10 knots lower

POWER-OFF STALLING SPEEDS

Figure 6-1

SPINS

Spins are one of the prohibited maneuvers and must never be done intentionally. However, in case a spin is entered accidentally, if any power is on, it should be chopped immediately. Do not attempt to raise landing gear and wing flaps if they are down when the spin is entered. Use normal recovery procedure to stop rotation and regain level flight. Avoid abrupt pull-outs and the possibility of a secondary stall.

FLIGHT CONTROLS

The flight controls enable the airplane to be controlled without undue effort by the pilot under any reasonable load, flap and power combination. No unusual reactions of any controls will be experienced except for possible light elevator reversal during power-on stalls. The rudder is effective with or without rudder boost on. However, with rudder boost off considerably higher rudder pedal forces will be required. Wing flap position changes have little effect on the trim requirements of the airplane, since the left hand elevator tab is used to provide automatic trimming during changes in flap position. Trim requirements on all controls are slight during normal operation of the airplane. To properly trim, set up the flight attitude, power and airspeed desired, relieve all elevator pressure first, then rudder pressure and finally aileron pressure. Minimize the use of aileron trim, use it only when elevator and rudder trim are not completely effective.

CAUTION

Use of excessive trim during let-downs or approaches is dangerous, since power changes result in high control forces until the airplane is retrimmed.

LEVEL FLIGHT CHARACTERISTICS

SLOW FLYING

No control abnormalities will be discovered during low speed flight. Maintain a close watch on engine CHT due to poor cooling air flow and be alert for possible engine malfunction, since engine failure during low speed flight will result in a dangerous condition. Turns at low speeds are critical and controls should be well coordinated at all times.

CRUISING FLIGHT

No control or other flight peculiarities are evident during cruising flight. Avoid abrupt control movements at all times. Lowering the landing gear will increase the airplane drag and should be accompanied by a symmetrical increase in power to counteract this effect. Slight nose up trim will also be required. Wing flap position will have little effect on trim, but will greatly increase the airplane drag when between the 55 percent and 100 percent down positions. Oil cooler flap, intercooler flap and cowl flap position affect airplane performance, resulting in a loss of airspeed when open. Cowl flap drag is very apparent and unsymmetrical cowl flap operation will require changes in airplane trim. Cowl flap opening in flight is limited to a maximum of three inches due to excessive buffeting at larger openings. Lowering the A/R boom will slow the airplane down about 5 knots and cause a slight nose heaviness. Some trim and additional power will be required to return the airplane to the boom stowed flight condition.

DIVING

Diving is prohibited. If the airplane inadvertently enters a dive, extreme caution should be used during recovery when at or near the limiting airspeed. Avoid abrupt pull-outs at any time.

FLIGHT WITH EXTERNAL LOADS

Flight characteristics noted above will not be changed when the external fuel tanks are installed. However, abrupt maneuvers or practice stalls should not be accomplished with full external fuel tanks.

BUFFETING

Buffeting from various causes can result in considerable control difficulty accompanied by severe airplane vibration. Some of the causes of buffeting which may occur during normal flight are:

1. Damage to wing leading edge including loose or missing leading edge gap seals
2. Parts of cowling loose, damaged or missing
3. Excessive cowl flap openings, or missing cowl flaps
4. Windmilling prop
5. Objects lodged against wing leading edge
6. Body damage or hatches open in the region of the wing upper surface

If buffeting is experienced on takeoff the cowl flap setting should be checked immediately, since leaving the cowl flaps open more than three inches will materially reduce takeoff performance and control effectiveness upon retraction of wing flaps. If upon retraction of wing flaps the buffeting increases, advisability of abandoning the airplane should be considered since the damage is probably not limited to the wing leading edge, cowling area, or both.

NOTE

> If severe tail buffeting is experienced on takeoff, do not hesitate to maintain maximum or emergency power. High power settings have not been known to increase the severity of tail buffeting, and the vibration is not of the frequency or magnitude to cause immediate failure of any primary structure essential to continued flight.

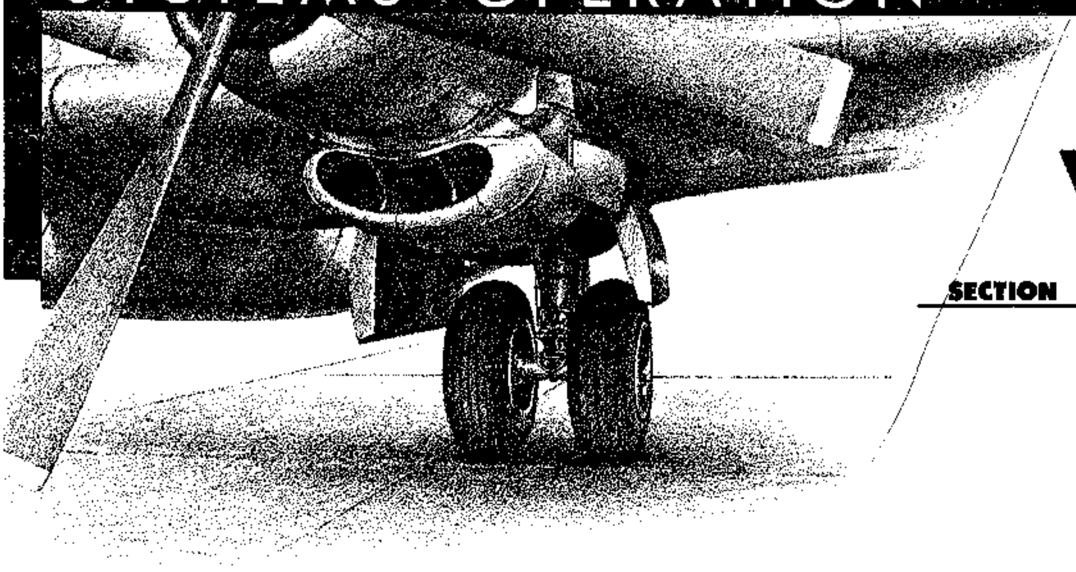
In the cruise configuration, buffeting from these causes is not usually confined to the wing alone. The empennage is usually affected in proportion to the severity of the turbulence, due to the airflow into the region of the horizontal tail surfaces. Tail buffeting can occur from disturbances as far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

1. Maintaining a speed between 155 to 175 knots, will usually result in a minimum buffeting effect with flaps up since decreasing speed will lower the tail further into the turbulence and increasing the speed will increase the degree of turbulence. However, each situation is different. Try all speeds within the speed range in combination with 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 airplane should be held to a minimum by utilization of even full rudder. Rudder boost should be on.
2. Lowering the wing flaps increases the downwash and raises the tail. In many cases this will result in a very effective reduction in buffeting. Usually 10 percent to 20 percent of wing flaps is sufficient to eliminate all but extremely severe buffeting but more may be required. In some cases, this may even reduce the turbulent drag and improve performance. With sufficient flap extension to eliminate buffeting, elevator control effectiveness will usually return to normal. In a particular case, if buffeting is not reduced with flap extension, the flaps should be retracted to minimize performance losses. In very severe cases and where the extent of damage is not known, it is advisable before landing is attempted to check control of the landing configuration to be sure that both elevator and aileron control are adequate.

WARNING

> If the buffeting increases when the flaps are lowered and retraction to the previous flap setting does not improve the condition, an immediate decision should be made regarding the advisability of abandoning the airplane since the damage is probably not limited to the wing leading edge or the engine cowling.

SYSTEMS OPERATION



SECTION VII

TABLE OF CONTENTS

ENGINE

OPERATING CONSIDERATIONS

Engine Ratings

Engine ratings, or the restrictions placed on engine operation, must be one of the primary concerns of the pilot and engineer. It is possible to operate the engine under conditions which exceed the limits set by the ratings. Failure to observe cylinder head or oil temperature limits, or operation without proper regard to oil and fuel pressures or to fuel-air ratio, will create a situation that can only lead to lowered reliability and possible engine failure. The basic engine operating problem consists of combining engine rpm and cylinder pressure in order to obtain power. The way in which these two factors are combined, together with the maintenance of suitable conditions of cooling, lubrication, and mixture strength, determines the efficiency of operation and the length of time between engine overhauls.

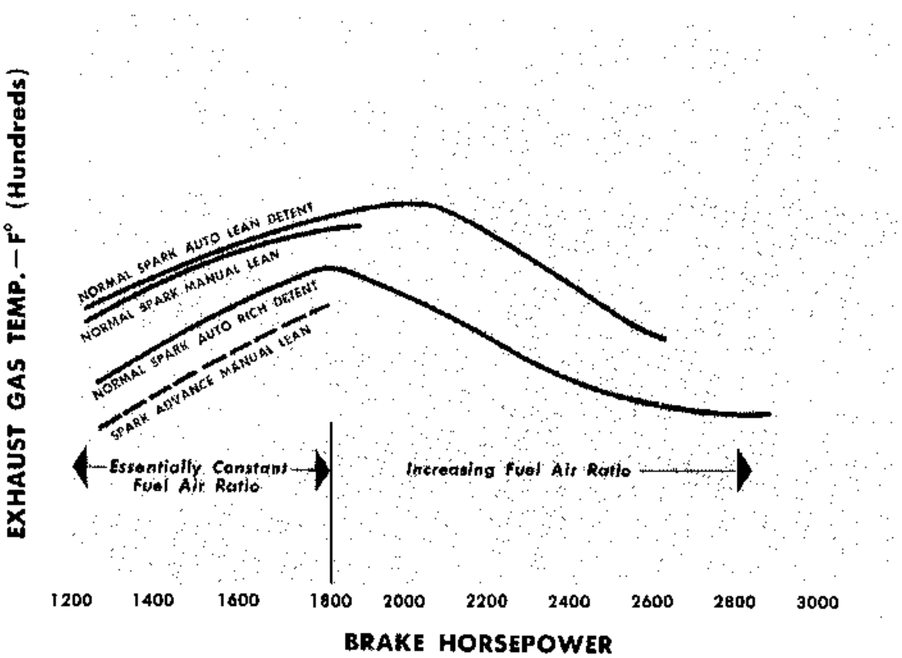
Performance Data and Charts

The performance data and charts have been developed primarily to obtain long range operation using optimum engine performance. The operating limits shown are those above which an unacceptable rate of engine failures would be experienced. More conservative operation will increase power plant life. Experience indicates that engine operating temperature is one of the prime factors. Examination of figure 7-1 will show the relationship between brake horsepower and exhaust gas temperature as influenced by mixture ratio and spark timing. Exhaust gas temperature is closely related to CHT since it is a direct measure of the conditions in the cylinder. High EGT will result in excessive valve, exhaust system and turbosupercharger operating temperatures.

Engine Cooling

In figure 7-1 the drop off in temperature at low powers is due to the lower energy (heat) being developed per unit of time than at higher powers. The high power drop off is due to the cooling effect of the excess fuel added by the power enrichment valves of the carburetor. It will be noted that operation with the mixture control in auto lean detent, with normal spark, results in the hottest condition under all power ranges. Auto rich operation with the normal spark timing results in an EGT 22°C to 52°C lower than auto lean. Manual leaning with normal spark provides a slightly cooler operation than auto lean. As shown, the lowest exhaust temperatures are obtained with the combination of spark advance and manual leaning which will also result in cooler cylinders accompanied by less airplane drag as the cooling requirements of the engine are reduced. Figure 7-1 indicates that for lowered engine cooling requirements, engine operation throughout its power range should be as follows:

1. Below 1820 bhp -spark advance with manual leaning.



EXHAUST GAS TEMPERATURE VS BRAKE HORSEPOWER

Figure 7-1

2. Between 1820 and 1900 bhp - (For maximum range) normal spark with manual leaning
   (For improved engine durability) normal spark with auto rich
3. Above 1900 bhp - (For maximum range) normal spark with auto lean
   (For improved engine durability) normal spark with auto rich

The decision of the limits and type of operation to be employed should be made in advance to fill the requirements of the mission and provide the greatest overall economy of airplane operation.

FUEL ENRICHMENT SYSTEM

On airplanes on which TCTO 595 has been incorporated, the fuel enrichment system provides partial and temporary relief to the hot weather engine cooling problem. Its use is restricted to operations above 1820 BHP where normal auto rich settings do not provide sufficient engine cooling. It is not recommended for use during takeoff because a substantial power loss will be encountered. The system was designed to increase the fuel flow approximately 200 pounds per hour per engine or 10 percent more than the maximum auto rich setting at METO power. This fuel flow rate downstream of the carburetor is constant. When the system is operated in conjunction with manual leaning from auto rich, only a portion of the added fuel should go toward engine cooling. In the past, manual leaning in the rich range at high power has been prohibited due to narrow detonation margins and due to flow transmitters being erroneous. With the fuel enrichment system it is possible and necessary to manual lean in the range of increased fuel flow at high power. This is accomplished by recording the auto rich fuel flow indication for each engine before increasing the fuel flow using the fuel enrichment system. Engage fuel enrichment system, then fuel flow from 0 to 10% richer than auto rich can be established as required for engine cooling. Under conditions where only a minimum additional fuel flow is required it is best to reduce fuel flow before engaging fuel enrichment system to minimize the possibility of after burning in the exhaust stacks.

Proper use of the fuel enrichment system with manual leaning from auto rich is determined by the cowl flap setting. Use of fuel enrichment to reduce CFG settings below approximately 2 inches will not appreciably reduce drag enough to justify the additional fuel consumption. Cowl flap schedules are given in the Appendix. The proper use of fuel enrichment should result in cowl flap requirements from 0 to 0.5 inch higher than this schedule.

When fuel enrichment is employed, power will decrease from the best power point as the mixture is enriched. The excess unburned fuel slows flame speed and extracts heat from the cylinder, consequently, operating temperatures are reduced thus widening detonation margin. It is possible to regain power loss by increasing MP up to 53 in. as required. CAT. must be observed. In hot weather at high altitude, the ability to regain all the power loss may be limited by the turbo exhaust back pressure switch or by CAT. limits. In this situation, maximum effective intercooler flap, 3 in. cowl flap, fuel enrichment to maintain 265° CHT and MP limited by 55° CAT. 45 in. EBP, or 53 in. MP will result in the highest critical altitude.

Climb

The largest benefit from the use of the fuel enrichment system will occur during climb for the following reasons:

1. Large cooling changes are possible at high power settings by varying fuel mixture or CFG
2. Small climb performance changes make large changes in time to climb
3. Improved cooling makes a deviation from the optimum climb speed schedule unnecessary in hot weather

It has been demonstrated that use of the fuel enrichment system will reduce the total fuel required for climb even though fuel is used at a higher rate, since climb time is reduced more than fuel rate is increased. Further, the improved performance makes it possible to lift a greater payload to refueling altitudes. The reduction of engine high power operating time during climb is expected to materially improve engine life. For these reasons it is recommended that the fuel enrichment system be used during climbs in which CFG of over 2 inches is required for engine cooling.

Cruise

The use of fuel enrichment for cruise is not recommended. Comparable cooling with greater fuel economy can be achieved below 1820 BHP by use of fully leaned spark advance mixture settings. If a mission demands cruise power above 1820 BHP and engine cooling cannot be obtained with less than 2 in. CFG, a small amount of fuel enrichment to reduce cowl flap requirements may be profitably employed.

No particular emergency procedures are required for the fuel enrichment system. A break in the bypass line in the nacelle would be similar to an oil dilution or primer line failure. High fuel flow, possibly rough engine operation and fuel pressure drop would indicate a failure. The procedure in Section III to isolate fuel line failures will apply.

Inadvertent solenoid control valve actuation during takeoff or cruise flight should not create a power failure or unsafe engine operating condition. The situation can be recognized by increased fuel flow with associated power loss. To restore the power loss, place the fuel enrichment switch of the affected engine ON, then lean to normal auto rich fuel flow.

A failure of the enrichment system while using 10 percent additional fuel would be the most serious type of possible trouble. While using fuel enrichment the engineer should be alert to the possibility of sudden leaning resulting in increased CHT. While no immediate engine failure is likely to occur, corrective action to reduce power and increase CFG to obtain maximum allowable CHT values should be accomplished promptly.

Should a short circuit in the fuel enrichment system cause the circuit breaker to actuate causing leaning of all four engines, it is still likely that the system will be operable for three engines. After resetting circuit breaker, the fuel enrichment switches should be tried one at a time until the fault is isolated. Normal system use of the other three switches can be expected.

STARTING

Causes of Hydraulic Lock

An engine which has not been shut down properly will retain an excess of oil in the crankcase due to failure of the scavenge pumps to remove all the oil satisfactorily. When the engine is not running, this oil may collect in the lower cylinders. Similarly, over-priming will cause excess fuel to flow into the combustion chambers of the lower cylinders. With liquid in the combustion chamber, the compression ratio will be raised causing extremely high pressure in the cylinder when the engine is turned over. In extreme cases, the piston may actually bottom against the incompressible liquid. In either case it is possible that the cylinder head, piston or connecting rod may be damaged.

Procedure to Clear and Lubricate Engine

To clear fluid from the cylinders and the lower induction system, and to provide sufficient lubrication of the engine and reduction gear bearings, turn the engine over continuously with the starter for 20 blades. Hydraulic lock should show during the first 2 revolutions (eight blades) of the engine as each cylinder is then exposed to a compression stroke. At any sign of hesitation or stoppage, disengage the starter, turn off the fuel boost pump and investigate. Only eight blades continuous cranking is required for engine starts made within 1 hour of the last shutdown as the engine is still well lubricated.

CAUTION

If during cranking of the engine there is evidence of hydraulic lock, release the start switch immediately and investigate.

Procedure for Starting

The priming system feeds fuel into the induction system below the carburetor to provide a rich mixture for the initial firing charge, however the ignition must be on before priming. As the engine is being turned over by the starter, more air is introduced, leaning out the mixture until spark ignition occurs. The amount of priming to be used during this phase depends upon carburetor air temperature, oil temperature and cylinder head temperature. Provision is made for engine start during cold weather by preheating the primer fuel. The starting procedure totals about 8 minutes to start all four engines. Prior to use of hot fuel prime, accomplish all steps up to Start Engines in accordance with Normal Procedure or Alert Procedure as applicable. Hot fuel prime may then be utilized as follows:

CAUTION

> Reference to figure 7-2 will show that the constant loads (interphone, lights, oleo relays, flight instruments, and engine instruments) essential inverter and hot fuel prime will result in a 600 ampere load. The APU has an overload limit of 620 amperes not to exceed 5 minutes in duration

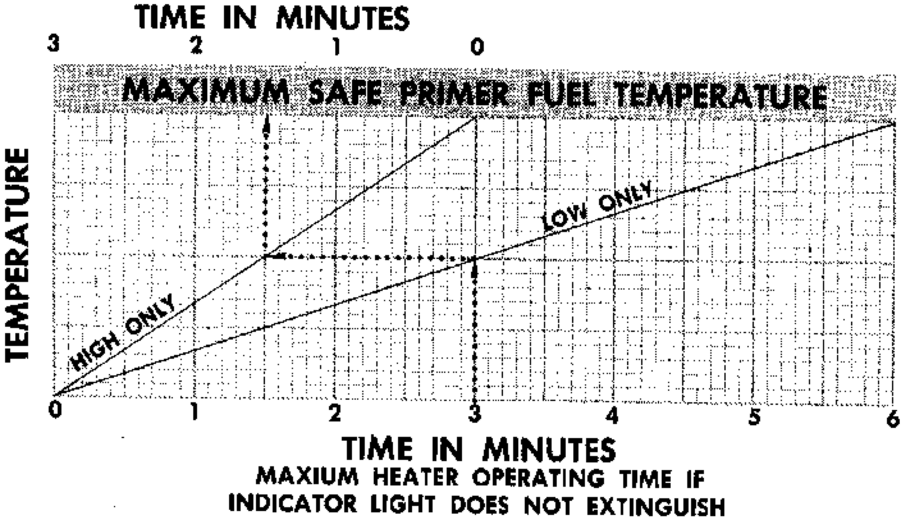
1. No. 3 Hot Fuel Prime Switch - HIGH
2. No. 4 Hot Fuel Prime Switch - LOW
3. No. 3 Hot Fuel Prime Switch - OFF (when indicator light is extinguished)

CAUTION

> If the hot fuel prime indicator light does not extinguish, do not exceed 3 minutes operation on HIGH only or 6 minutes operation on LOW only. See figure 7-2 for maximum operation time on high after initial operation on low (less than 6 minutes on low). Either system malfunction or extremely low fuel temperature may cause the hot fuel prime indicator light to remain illuminated.

4. Essential Inverter Switch - OFF
5. No. 2 Hot Fuel Prime Switch - LOW
6. No. 3 Engine-Started (Refer to Normal Procedure)
7. Essential Inverter Switch - ESS INV (after No. 3 engine is running)
8. No. 4 and No. 2 Hot Fuel Prime Switches - HIGH
9. No. 1 Hot Fuel Prime Switch - LOW
10. No. 4 Hot Fuel Prime Switch - OFF (when indicator light is extinguished)
11. No. 4 Engine-Started (Refer to Normal Procedure)
12. No. 1 Hot Fuel Prime Switch - HIGH
13. No. 2 Hot Fuel Prime Switch - OFF (when indicator light is extinguished)
14. No. 2 Engine - Started (Refer to Normal Procedure)
15. No. 1 Hot Fuel Prime Switch - OFF (when indicator light is extinguished)
16. No. 1 Engine - Started (Refer to Normal Procedure)

An eight minute procedure may be used to start all engines with a minimum of delay as shown in figure 7-2. The temperature is maintained automatically until the switch is placed in the OFF position.



MAXIUM HEATER OPERATING TIME IF INDICATOR LIGHT DOES NOT EXTINGUISH

EXAMPLE

GIVEN:
Heater has been operated on LOW for 3 minutes

FIND:
Time heater can be operated on HIGH

SOLUTION:
Enter bottom of chart at 3 minutes proceeding vertically to LOW ONLY line. Proceed horizontally to HIGH ONLY line and then vertically to read time from "0" point = 1 1/2 minutes

HOT PRIME ENGINE STARTING TIME AND LOAD REQUIREMENTS

Figure 7-2 (Sheet 1 of 2)

CONDITION

BASED ON APPROX - 20°F OAT

1. HOT PRIME SYSTEM REQUIRES 3 MINUTES IN HIGH OR 6 MINUTES IN LOW TO HEAT FUEL TO 220°F
2. ENGINE SHOULD START AT APPROX 7 BLADES AFTER IGNITION ON
3. ENGINE REQUIRES APPROX ONE MINUTE WARM-UP

ENGINE STARTING SEQUENCE

- 🟥 NO. 3 HEATER
- 🟦 NO. 4 HEATER
- 🟥 NO. 2 HEATER
- 🟦 NO. 1 HEATER

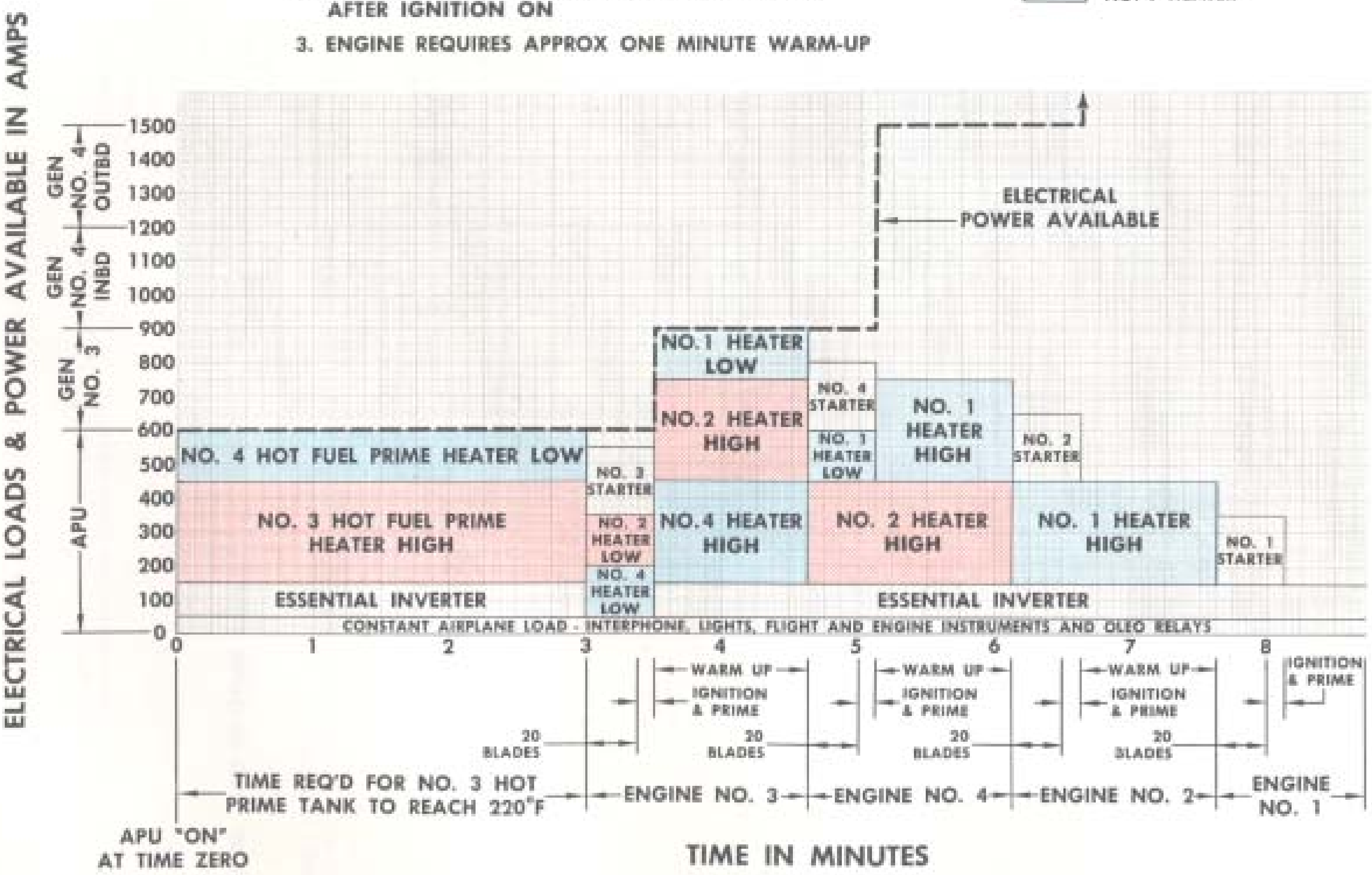


Figure 7-2 (Sheet 2 of 2)

If the engine does not fire in a reasonable time (5 to 10 seconds), discontinue priming but continue cranking, since the mixture in the cylinders was probably too rich for starting. As the engine is further cranked without prime, the excess of air will provide the proper mixture using the fuel already in the manifold, and the engine should start. When the engine catches, use prime as required to bring engine rpm up to 1000 rpm. Slowly ease the mixture control out of FUEL CUTOFF to the AUTO RICH position and discontinue priming when rpm begins to fall off. It may be 2 to 5 seconds before the rpm begins to fall off, especially if the engine is hot, because of vapor lock. Too early or too rapid movement out of the FUEL CUTOFF position may drown out the engine due to a surge of fuel. If the engine tends to become overloaded, it may often be saved by momentarily returning the mixture control to FUEL CUTOFF. Do not attempt to assist the start by pumping the throttle. Flooding of the engine, torching and after-burning may result. When starting a hot engine, after the preliminary crank through has been completed, begin cranking with the ignition switch on, without prime, since there may already be a suitable starting mixture available in the manifold. If the engine does not start, it is probably because the mixture is too lean. Apply prime for 2 seconds while cranking. This will richen the mixture and with further cranking will most likely give a good start. If the engine fails to start after using the above procedures it is probably because the mixture is too rich. Therefore discontinue priming. If engine does not start after cranking 5 to 10 blades repeat the above procedure.

Throttle Position after Starting

Smooth operation after starting depends upon the throttle position. On this engine the carburetor furnishes fuel for idling entirely as a result of the position of the idle valve which is directly linked to the throttle. Air flow has no appreciable effect on the quantity of fuel discharged. If the throttle is opened too wide, the mixture will be too lean, resulting in backfiring. With the throttle retarded too much, the mixture will be too rich for continued running.

WARM UP AND GROUND TEST

Warm Up

The engines should be operated on the ground only as necessary for warm-up, preflight check, and taxiing. Operate in AUTO RICH during warm-up. Operating time should be held to a minimum. Use of auto lean will not accelerate the warm-up. At warm-up speed there is practically no difference in the mixture supplied to the engine whether the mixture control is in the AUTO LEAN or AUTO RICH position, since metering in this power range is governed by the throttle position. Do not fully close the cowl flaps to accelerate the warm-up, regardless of OAT or the cylinder head temperature indication because heat from the exhaust system can cause damage to the ignition leads. Provisions are made for reducing engine warm-up time by the addition of an oil diverter segregator below the engine oil tank. The diverter segregator valve directs oil circulation through the oil tank hopper until the temperature reaches 125°F (52°C). The engines must not be operated within the critical rpm range of the propellers, except to pass through this range. If an excessive amount of dust is present, sheltered air should be used whenever possible to aid in filtering dust particles from the inlet air. At first indication of spark plug fouling, as evidenced by erratic torque indication, magneto drop, backfiring, or ignition analyzer patterns, clean spark plugs as outlined in DEFOULING PROCEDURE ON THE GROUND in this Section.

Preflight Engine Check

The PREFLIGHT ENGINE CHECK outlined in Section II is for the purpose of answering the following questions before a takeoff is attempted:

1. Is the engine in proper mechanical condition?
2. Is the oil system functioning properly?
3. Is the ignition system functioning properly?
4. Is the fuel system delivering fuel to the engine in the required amounts at the desired pressure?
5. Is the propeller system functioning properly?
6. Are engine instruments reliable?

Close adherence to the preflight engine check procedure will answer all the above questions.

TAKEOFF

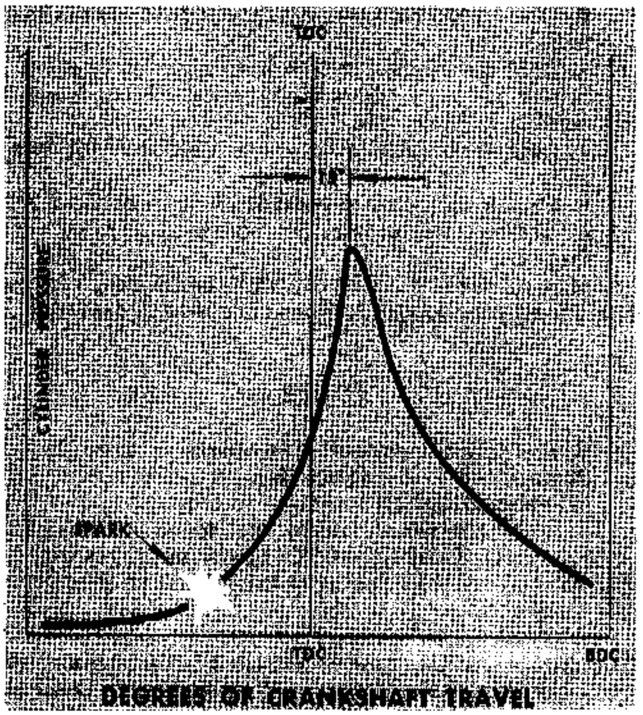
Due to the high energy output of the engine at maximum power, cooling is critical and engine wear is at a maximum. Every effort must be made to observe engine temperature limits at the start of takeoff. Full power should be used to insure a safe takeoff with ample climb airspeed and height above obstacles before the first power reduction. However, maximum power should not be extended unnecessarily because of the above mentioned effects.

CLIMB

Climb performance for meto power is shown in the Appendix.

CRUISING FLIGHT

During normal flight operations, the engine should be operated at power settings obtained from the data in the Appendix. Proper selection of power settings will result in long range operation of the engines. This is obtained by using the manual leaning procedures outlined in NORMAL SPARK CRUISE CONTROL PROCEDURE and SPARK ADVANCE FUEL CONTROL PROCEDURE in this Section. However, these procedures cannot be used above specified brake horsepowers, as internal damage to the engine from overheating or detonation may result. Adherence to specified operating limits of cylinder head temperature and carburetor air temperature is necessary if suitable performance is to be obtained. The engineer should be alert to notice any indication of spark plug fouling, as evidenced by erratic torque pressure indication or ignition analyzer pattern, and take immediate corrective action.



CYLINDER PRESSURE VARIATION

Figure 7-3

Factors Which Influence Engine Operation

IGNITION TIMING. The amount of power derived from combustion of the fuel-air mixture in a cylinder depends upon many factors, among which is the ignition timing. To obtain the best power from any given charge, the spark must be timed so that the peak pressure in the cylinder occurs approximately 15° past top dead center (figure 7-3). If this pressure is reached before the 15° point, too much of the useful work has acted to oppose the rise of the piston to TDC. If the peak pressure is reached after this point the piston has retreated too far into the cylinder, increasing the volume and reducing the peak pressure obtained. In both cases, power has been lost.

FLAME SPEED. The pressure in a cylinder does not rise instantaneously after ignition, but is a function of the speed of burning of the mixture, or flame speed. Flame speed in turn is dependent upon many factors; manifold pressure, mixture ratio, carburetor air temperature and cylinder head temperature. In addition rpm effects the position of the peak pressure point, since with a constant flame speed a higher rpm will allow less time for burning between the ignition point and 15° after TDC.

SPARK ADVANCE. Spark advance is an attempt to change the point of ignition and to arrange the factors which effect flame speed so that ignition takes place and the mixture burns at the required rate to give peak cylinder pressure at 15° after TDC. In order to obtain the proper flame speed to maintain the relationship of peak pressure to crankshaft (or piston) travel, the engineer must be aware of the effect of the various charge conditions on the rate of combustion.

MANIFOLD PRESSURE. The greater the manifold pressure the more closely packed will be the particles of fuel and air. This closeness will allow much more rapid burning than would occur at lower manifold pressures. In fact, at the higher manifold pressures, the burning may take place so rapidly and the consequent heat rise may be so great that detonation may occur. In order to reduce this possibility, a retarded spark is called for under this condition. With low manifold pressures the fuel-air particles are spaced further apart and the flame speed is lower. Consequently this requires an advanced spark so that the mixture has had time to burn before the piston has reached 15° after TDC.

CARBURETOR AIR TEMPERATURE. The temperature of the mixture effects the flame speed. The higher the mixture temperature, the less is the heat which must be added to each fuel molecule before burning takes place, and the higher the flame speed. In this case the spark must be retarded to give proper burning time and to prevent detonation. A cold charge, on the other hand, will give a slower flame speed and require an advanced spark.

CYLINDER HEAD TEMPERATURE (NORMAL SPARK). The cylinder head temperature affects the charge temperature. The hotter the cylinder the higher the temperature of the charge will be raised before combustion. Therefore, with high cylinder head temperature the spark should be retarded and with low cylinder head temperature the spark should be advanced to obtain proper combustion time. For practical purposes the actual spark time is the result of a compromise of all the above factors. The high rpm and rich mixtures used for high power call for advanced spark. However, the accompanying high manifold pressures and cylinder head temperatures require a retarded spark. The NORMAL POSITION is the setting used in this condition.

CYLINDER HEAD TEMPERATURE (ADVANCED SPARK). In comparison with high power requirements, at normal auto-lean cruise operation the lower MP and CHT require an advanced spark. However, the lower rpm and leaner mixtures require a retarded spark with the net result that the NORMAL POSITION for the spark is adequate. For cruise with a mixture leaner than auto-lean the MP, CHT and rpm requirements mentioned above do not change. The leaner mixture with its slower burning time requires an advanced spark to obtain peak cylinder pressure at the proper time. Therefore, the SPARK ADVANCE position has been provided for this condition.

Normal Spark Cruise Control

As illustrated in figure 7-1, high exhaust gas temperatures result from the combination of lean mixtures and normal spark. Use of this procedure should be avoided except for those missions where extreme range (cruise economy) is more important than engine life. Where possible low power with spark advance or high power auto rich operation is preferred.

The procedure for entering normal spark (manual leaning) cruise control is similar to the advance spark procedure except that the shift to SPARK ADVANCE is not made, and 109% of base TPSI is used rather than 111%. Since the explanatory notes given under MANUAL MIXTURE ADJUSTMENT WITH ADVANCED SPARK in this Section apply directly to this procedure, refer to figure 7-4 for this supplementary procedure information.

1. Set all engines at the desired cruise power with the mixture control lever at AUTO RICH
   a. Allow air speed to stabilize
   b. Adjust cowl flaps to set approximately 230° C CHT
   c. Adjust intercooler flaps to set approximately 20° C CAT
   d. Adjust TBS for cabin air flow and part throttle as required
   e. Check MP reading within 2 inches Hg of those specified by the power schedule charts in the Appendix, corrected for CAT. If desired torque cannot be obtained within 2 inches MP of the schedule, record the resulting torque as the base setting for use during the procedure. A low power engine should be monitored carefully

2. On one engine at a time establish 109% of the desired TPSI (172 if a final 158 is desired) with the throttle and note cooling within limits. To set 109% of other values, add 14 TPSI to the base figure

3. Establish best power mixture by slowly leaning the mixture from AUTO RICH one inch of mixture control lever movement (one knob width) while carefully observing TPSI

Case I - Normal carburetor
   If TPSI remains constant, AUTO RICH is best power.
   a. Proceed with Step 4

Case II - Rich carburetor
   If TPSI rises, AUTO RICH is richer than best power.
   a. Set mixture control lever at point of highest TPSI
   b. Retard throttle to re-establish 109% of base torque
   c. Proceed with Step 4

Case III - Lean carburetor
   If TPSI drops rapidly, AUTO RICH is leaner than best power.
   a. Hold the primer switch in to apply prime
   b. Without delay adjust the mixture control lever to point of highest TPSI
   c. Retard throttle to re-establish 109% of base torque
   d. Return the mixture control lever to AUTO RICH
   e. Release the primer switch and proceed with Step 4

4. Manually lean the mixture with the mixture control lever until base torque has been accurately established

NOTE

If sluggish torquemeter response is noted in Steps 2 and 4 (due to low temperature causing oil congealing) all attempts to employ manual mixture control should be abandoned. Return to AUTO RICH or AUTO LEAN setting until warmer air has restored torquemeter sensitivity.

The mixture setting now established is the engine best economy mixture. Cruising at this mixture position may be accomplished by adjusting power and cooling as noted in Step 7 below. If operation at this point is desired, 1 inch MP should be subtracted from the spark advance values given in the Appendix power schedule curves to obtain correct MP limits. For greater overall airplane cruise performance due to a decrease in cooling drag during strategic missions, continue the procedure with Steps 5 and 6 below. In this case, note the position of the mixture control lever as established in Step 5 as a reference position to aid in rough operation adjustment as described below.

5. Increase manifold pressure one inch Hg

PURPOSE

Use of a cruise control procedure which combines spark advance with manual mixture adjustment (manual leaning) provides a means of increasing airplane range.

Range is increased because of improved engine specific fuel consumption available, and reduced cowl flap settings required.

The lowered exhaust gas temperatures that result from this type of operation also favor longer valve, exhaust system, and turbo supercharger life.

EXPLANATION OF MANUAL LEANING PROCESS

To satisfactorily use the following cruise control procedure for the purposes intended it is essential that the process be understood and the limitations known.

Operation of the engine considerably below the standard AUTO LEAN carburetor setting is necessary to obtain much gain from manual mixture adjustment. It is necessary to lean out sufficiently to provide an excess of air over that necessary to burn all the fuel present in the fuel air mixture. This excess air makes lower specific fuel consumption and lower cowl flap setting possible.

EFFECT OF SPARK ADVANCE WITH LEAN MIXTURES

The lean mixture strength (excess air flow) requires more burning time in the cylinder. To accomodate this longer burning time and maintain proper occurrence of peak cylinder pressure with respect to piston travel, the spark must occur earlier in the cycle.

Since slow burning lean mixtures and advanced spark increase the possibility of detonation, a maximum power for use during advanced spark operation has been established at 1820 bhp (2200 rpm).

SPECIAL ATTENTION TO PROCEDURE

To avoid engine damage due to detonation or excessive cylinder head temperature as a result of improper manual mixture-spark advance adjustment it is necessary that the procedures specified be followed accurately. Observation of the special precautions listed in the following procedure is essential. Close attention to engine operating conditions and limits while using the procedure is required.

The following procedure has been developed to achieve the most simple and accurate manual mixture adjustment and is to be used in setting up all advanced spark cruise operation. This manual leaning procedure is based on using best power mixture strength rather than AUTO LEAN as a starting reference point. Torque pressure is the primary reference used below limiting values of manifold pressure.

OPERATING PROCEDURE

SPECIAL PRECAUTIONS REQUIRED WITH SPARK ADVANCE

To prevent engine damage due to detonation and/or pre-ignition observe the following:

1 Use the SPARK ADVANCE position only with grade 115/145 fuel
2 Use the SPARK ADVANCE position only at or below 1820 bhp (2200 rpm)
3 Use the SPARK ADVANCE position only with the manual mixture adjustment procedure below
4 Do not clean spark plugs during advanced spark operation. Return to NORMAL POSITION prior to cleaning fouled plugs
5 Do not adjust the mixture control lever while making minor power changes after cruise mixture has been established with advance spark
6 Do not exceed 243° C CHT, or 38° C CAT
7 Do not switch back to NORMAL POSITION without first moving the mixture control to AUTO LEAN (Move mixture control lever just prior to moving spark advance selector switch)

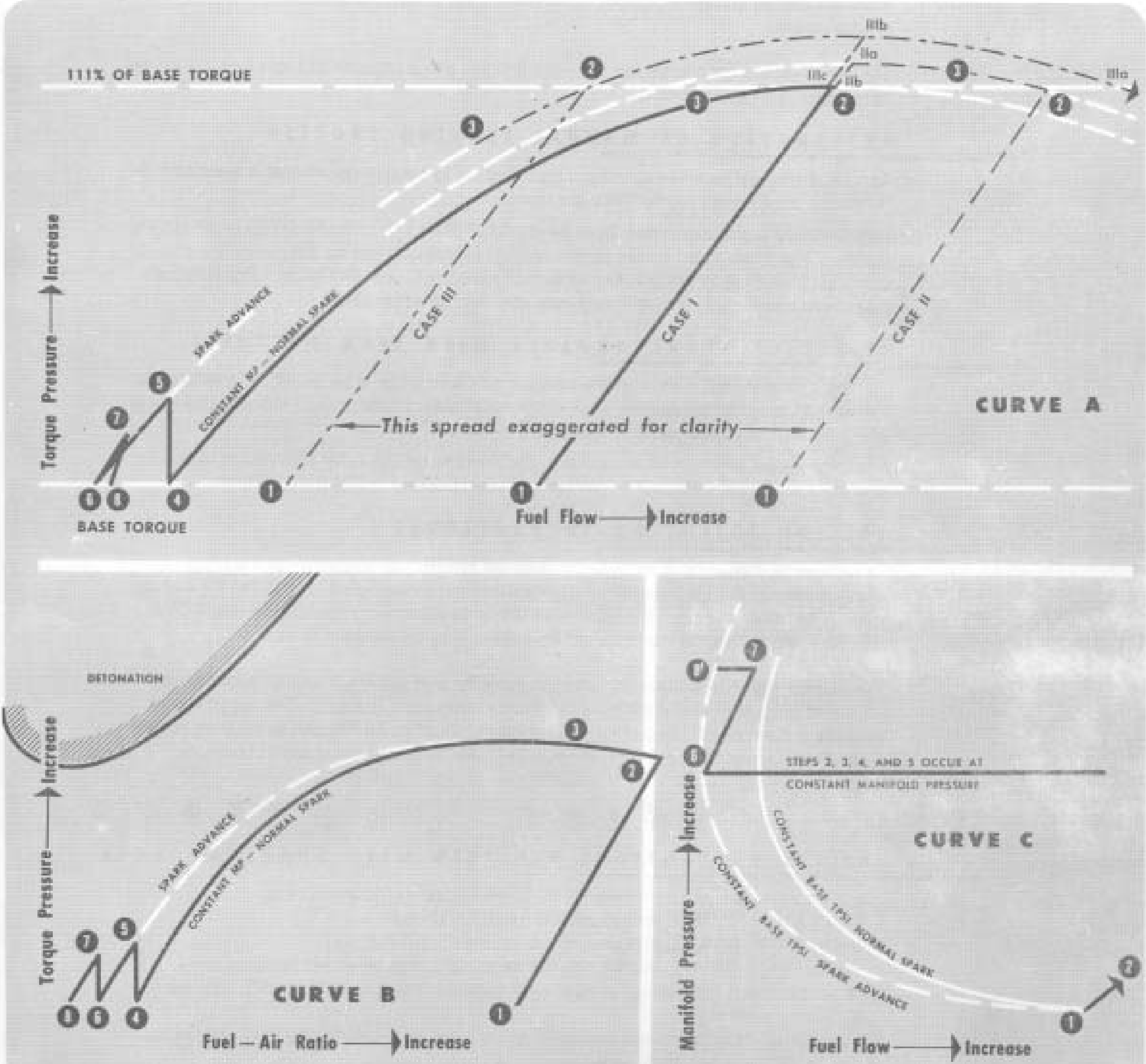
CAUTION

Avoid a combination of high CHT and high CAT with AUTO LEAN mixture and advanced spark, as detonation may occur at these conditions.

SPARK ADVANCE FUEL CONTROL

Figure 7-4 (Sheet 1 of 5)

ADVANCED SPARK MANUAL MIXTURE ADJUSTMENT PROCEDURE



NOTE: *Circled numbers (❽) refer to step procedure, (IIa) refer to carburetor metering check*

The above curves illustrate the following spark advance procedure. Curve A gives the best over all picture plotted against working coordinates. However due to the number of variables involved, curves B and C are included for additional clarity. It will be noted on curve C that point 8 being leaner than point 6 (best economy) results in a slight fuel flow increase causing the cross over on curve A. However fuel-air ratio is still decreasing as shown on curve B. Over all cruise economy is provided by reduced cooling which allows a power reduction following Step 9 resulting in minimum total fuel flow for cruise.

SPARK ADVANCE FUEL CONTROL (CONT)

Figure 7-4 (Sheet 2 of 5)

PROCEDURE FOR MANUAL MIXTURE ADJUSTMENT WITH ADVANCED SPARK

STEP PROCEDURE	EXPLANATORY NOTES
❶ Set all engines at the desired cruise power with the mixture control lever at AUTO RICH.	❶ At this point all preliminary settings are made prior to following the actual leaning procedure.
a. Allow air speed to stabilize	
b. Adjust cowl flaps to set approximately 230° C CHT c. Adjust intercooler flaps to set approximately 20° C CAT	(b)(c) Although cooling limits of 243° C CHT and 38° C CAT are allowed for spark advance operation, it is desirable to use reduced limits during the following procedure steps if cooling limitation will permit. Better cooling establishes a greater margin between critical points of the procedure and the engine detonation limit
d. Adjust the turbo boost selector for cabin air flow and part throttle as required	(d) Since the following steps specify that power advance be accomplished by use of the throttle on one engine at a time, sufficient part throttle should be established to allow a 4 inch mp rise. This will usually be obtained by setting the turbo boost selector lever for desired cabin air flow at altitude, or by retarding throttle at the end of meto power climb
e. Check manifold pressure readings within 1½ inch hg of those specified in the power schedule charts in the Appendix corrected for CAT. If desired power cannot be obtained within 1½ inches mp of the schedule, record the resulting TPSI as the base setting for use during the procedure	(e) If an engine is low in power, spark plug fouling should be checked with the ignition analyzer and if necessary, cleared in accordance with the spark plug defouling procedure in this Section. Abnormally rich or lean carburetors may also cause low engine power, therefore check fuel flow. If desired torque cannot be obtained it is necessary to limit the base torque to observe mp not over 1½ inch hg above the schedule since increasing mp further may cause detonation

The following steps should be accomplished on one engine at a time until desired cruise mixture is established in Step 8

❷ Set 111% base torque with the throttle and note cooling is within limits.	❷ Base torque on low power engines was established in Step 1 and will be 158 TPSI or less depending upon mp limits. To obtain 111% add 17 TPSI to the established base (111% of 158 is 175).
❸ Establish best power mixture by slowly moving the mixture control lever from AUTO RICH one inch of lever movement (one knob width) while carefully observing TPSI.	❸ This observation of TPSI should be made while leaning one knob width. One knob width is equivalent to 50 pounds per hour fuel flow. If leaned too far, TPSI will always drop, giving an erroneous indication of carburetor metering. Fuel flow should be noted before and after leaning as a check on the amount of mixture control lever travel required.

CASE I. Normal Carburetor If TPSI remains constant AUTO RICH is best power.

a. Proceed with Step 4 below

CASE II. Rich Carburetor If TPSI rises then AUTO RICH is richer than best power.

a. Adjust mixture control lever to point of highest TPSI
b. Retard throttle to re-establish 111% of base torque
c. Proceed with Step 4 below

CASE III. Lean Carburetor If TPSI drops rapidly AUTO RICH is leaner than best power.

a. Hold the primer switch in to apply prime
b. Immediately adjust mixture control lever to point of highest TPSI
c. Retard throttle to re-establish 111% of base torque
d. Return the mixture control lever to AUTO RICH
e. Release the primer switch and proceed with Step 4 below

Figure 7-4 (Sheet 3 of 5)

PROCEDURE FOR MANUAL ADJUSTMENT WITH ADVANCED SPARK (Cont)

STEP PROCEDURE	**EXPLANATORY NOTES**
④ Lean the mixture fairly rapidly to within ± 3 TPSI of base TPSI.	④ This Step should be accomplished rapidly to avoid a large cooling change, to speed up the procedure, and to avoid operation at high power and hot mixture which reduces detonation margin.
⑤ Move the spark advance selector switch to SPARK ADVANCE.	⑤ Spark shift should be verified on the ignition analyzer. If not available a 3 to 4 TPSI rise also indicates the advance has been accomplished. If spark fails to advance return to AUTO RICH and use the normal spark leaning procedure outlined in this Section.
⑥ As soon as spark shift has been verified, continue leaning to the exact value of base TPSI. NOTE If sluggish torque-meter response is noted in Steps 5 and 6 (due to low temperature causing oil congealing) all attempts to employ manual mixture control should be abandoned. Return to AUTO RICH or AUTO LEAN setting until warmer air has restored torque meter sensitivity.	⑥ This Step should be performed immediately since the greatest danger of detonation exists at this point. However, the mixture adjustment to the final TPSI setting must be done with accuracy and precision since the measure of leaning is based on the difference between initial torque established in Step 2 or 3 and Step 6. If too much time is used in Step 5 and 6, the cooling change will result in decreased procedure accuracy. Precision and experience will improve the results of this procedure.

The mixture setting now established is the engine best economy mixture; cruising at this mixture position may be accomplished by adjusting power and cooling as noted in Step 9 below. If operation at this point is desired, 1 inch mp should be subtracted from the spark advance values given in the Appendix power schedule curves to obtain correct mp limits.

For greater overall airplane cruise performance due to reduced cooling during strategic missions, continue with Steps 7 and 8 below. In this case, note the position of the mixture control lever as established in Step 6 as a reference position to aid in subsequent adjustment as required below.

⑦ Increase manifold pressure 1 inch hg. with the throttle.	⑦ Accomplish this Step smoothly and accurately, since end mixture is dependent on the measured rise.
⑧ Lean the mixture further with the mixture control lever until base TPSI has been accurately restored.	⑧ The accuracy of the end mixture depends upon accurate reading of the base TPSI. See Step 6 above.

Maximum range cruise mixture setting has now been established on one engine. Repeat Steps 2 through 8 for the remaining engines.

⑨ Final cruise settings.	⑨
a. Adjust cowl flaps so that the CHT will not exceed 243°C b. Adjust intercooler flaps to give 20° to 38° C CAT	(a)(b) If difficulty cooling any engine is noted and mixture control lever position and fuel flow indicate a rich mixture, return to NORMAL POSITION and repeat Steps 2 through 8. If satisfactory cooling still cannot be obtained return to normal spark and automatic mixture setting
c. Adjust turbo boost selector lever for cabin air flow as desired and set throttles to avoid excessive part throttle operation	
d. Check the manifold pressure spread on all engines to agree within 2 inches hg	(d) Observe a poorly performing engine carefully and return to normal spark and AUTO RICH if necessary to avoid difficulty

SPARK ADVANCE FUEL CONTROL (CONT)

Figure 7-4 (Sheet 4 of 5)

CRUISE OPERATION WITH SPARK ADVANCE

POWER ADJUSTMENT

Once the manual mixture adjustment is established, minor power adjustments may be made with the throttle (1 inch mp maximum) and larger adjustments by changing rpm (100 rpm maximum) within the range of 1900 to 2100 rpm. No change in mixture adjustment should be made for these changes as the carburetor will act to maintain constant fuel air ratio in this region. For minor changes between 2100 and 2200 rpm, repeat the above procedure (Steps 2 to 8).

In making power adjustments, some deviation from the recommended schedule is permissible. Specific fuel consumption is increased at lower TPSI values; however, **158** TPSI should not be exceeded when using spark advance. Manifold pressure increases should be limited to **1.5** inches hg above the values given in the Appendix, when Steps 7 and 8 of the procedure have been accomplished, to correct for power shortages that cannot be accounted for by the difference in CAT or fuel flow. If the procedure has been stopped at Step 6, manifold pressure increases should be limited to **0.5** inches hg above Appendix values. Where such power shortage is the result of faulty ignition or other such malfunction, increasing manifold pressure further may result in operation detrimental to the engine.

ROUGH OPERATION

Occasionally poor engine maintanance or leaning in excess of the above procedure may precipitate minor roughness or backfire due to too lean a mixture. The flight engineer should be alert for early indications of trouble and if necessary enrich the mixture toward, but not beyond, the best economy point established in Step 6 and readjust throttle to maintain cruise power.

PLUG FOULING TENDENCIES

Prolonged operation at lean mixtures is conducive to spark plug fouling. Frequent ignition analyzer checks and early use of the defouling procedure will prevent fouling from becoming excessive.

TO RETURN TO NORMAL SPARK

Any return from advanced to normal spark must be made in the following manner:

1. Place the mixture control lever at AUTO LEAN	1. In order to easily accomplish the return to normal spark operation and avoid prolonged operation in adverse engine operating conditions, it is necessary to accomplish this procedure without hesitation between steps.
2. Position the spark advance switch to NORMAL POSITION	2. Spark shift should be verified on the ignition analyzer. If analyzer is not available, a slow 2 to 4 TPSI drop will also indicate the spark shift. If the spark fails to return to normal position, re-position the switch to SPARK ADVANCE. Continue the flight using the approved manual mixture adjustment with advanced spark, starting with the mixture control lever reference position established in Step 6 above. Continue with the final steps as desired. Do not exceed the spark advance power limit.
3. Adjust power and mixture as desired	3. If desired by the flight engineer the throttle may be retarded prior to Step 1 of this procedure. However since power adjustment is required following return to normal spark it is not considered essential to retard throttles initially, provided high power auto lean mixture operation is not prolonged.

Figure 7-4 (Sheet 5 of 5)

6. Lean the mixture further until base TPSI has been accurately restored

NOTE

Maximum range cruise mixture setting has now been established on one engine. Repeat Steps 2 through 6 for the remaining engines.

7. Final cruise settings:
   a. Adjust cowl flaps to set 243°C CHT

NOTE

If difficulty in cooling any engine is noted and mixture control lever position and fuel flow indicate a rich mixture repeat Steps 2 through 6. If satisfactory cooling still cannot be obtained return to automatic mixture setting.

b. Adjust intercooler to give 20° to 38°C CAT
c. Adjust turbo boost selector lever for cabin air flow as desired and set throttles for minimum part throttle operation
d. Check the manifold pressures on all engines to agree within 2 inches Hg

NOTE

Occasionally poor engine maintenance or leaning in excess of the above procedure may precipitate minor roughness or backfire due to too lean a mixture. The flight engineer should be alert for early indications of trouble and if necessary enrich the mixture toward, but not beyond, the best economy point established in Step 4 and readjust throttle to maintain cruise power.

Power Adjustment

Once the normal mixture adjustment is established, minor power adjustments may be made with the throttle (1 inch MP maximum) and larger adjustments by changeing rpm (100 rpm maximum) within the range of 1900 to 2100 rpm. No change in mixture adjustment should be made for these minor power changes as the carburetor will act to maintain constant fuel air ratio in this region. For minor power changes between 2100 and 2300 rpm, repeat the above procedure (Steps 1 to 6).

Plug Fouling Tendencies

To minimize spark plug fouling, return to AUTO RICH for 2 minutes each hour at cruise powers. Flight engineers should be alert for erratic torque as the first indication of spark plug fouling. Use the spark plug defouling procedure described in this Section as often as necessary.

Engine Cooling

PRIMARY MEANS. The primary source of engine cooling is the flow of ram air around the cylinders. This airflow is regulated by positioning of the cowl flaps. Maximum operating limits of the cowl flaps and cylinder head temperature for all flight conditions are given in figure 7-5.

SECONDARY MEANS. A secondary means of cooling the engine is provided by the mixture of fuel and air supplied to the engine. A chemically correct mixture of fuel and air is a mixture in which both of the components of combustion, gasoline and oxygen in this case, are completely consumed in the chemical reaction, or burning of the gasoline. Such a reaction would result in very hot exhaust gases in the combustion chamber. This is undesirable for good cooling, because of the large amount of heat that must be removed through the cylinder walls. Therefore, during high powers the fuel air mixture is supplied to the cylinders with an excess of fuel beyond the ideal mixture for best power settings. This causes maximum consumption of the oxygen in the cylinders, with the excess fuel absorbing some of the heat of combustion, resulting in lower cylinder temperatures. During auto lean cruising the chemically correct mixture is being burned, resulting in the high temperatures shown in figure 7-1. Under these conditions cruise cooling requirements will be at their peak. When operating the engine at best economy, an excess of air beyond the ideal mixture is supplied to the cylinders. This causes maximum combustion of the fuel, with the excess air absorbing part of the heat of combustion. By lowering the combustion chamber temperatures, the external cooling air required is reduced, which permits less cowl flap opening, resulting in less drag. By lowering the carburetor air temperature, the fuel air mixture enters the cylinders at a lower temperature. The cooler mixture provides additional cooling in the combustion chamber through its ability to absorb more heat. Proper adjustment of the carburetor air temperature and cylinder head temperature will enable satisfactory engine operation with a minimum of drag from the cowl flaps and intercooler flaps.

DESCENT

Flying conditions permitting, adjust throttle and propeller to maintain cruising speed during descent. It is important, however, to cushion the high inertia loads on the master rod bearings which occur at conditions of high rpm and low manifold pressure. It is well to remember that each 100 rpm requires at least one inch manifold pressure if the RPM is greater than 2000 RPM. For example, 23 in. Hg at 2300 rpm. Operation at high rpm and low manifold pressures should be kept to a minimum.

CONDITION	COWL FLAP SETTING
Ground	Full open. Do not exceed 243° C cylinder head temperature. Engine shutdown limitation 180°C.
Takeoff	1.5 inch gap for OAT up to 20°C 2.0 inch gap for OAT 20°C to 32°C 2.2 inch gap for OAT above 32°C Do not exceed 3.0 inch gap
Flight	0.75 inch minimum gap, gear and wing flaps up 1.0 inch minimum gap, gear and wing flaps down 3.0 inch maximum gap to avoid excessive vibration and buffeting
Engine Shut-down	Engine shut-down limitation below 200°C
Auto Rich	Above 1855 BHP do not exceed 265° C cylinder head temperature Below 1855 BHP do not exceed 243° C cylinder head temperature
Auto Lean	Cruise. Do not exceed 243° C cylinder head temperature

NOTE: To avoid exceeding 265°C cylinder head temperature during takeoff, reduce cylinder head temperature to a minimum prior to takeoff. The initial temperature for start of takeoff should be 190°C or less, if possible. Cylinder A-2 is usually hottest for ground operation. Either A-2 or B-2 may be hottest for flight operations.

COWL FLAP OPERATION

Figure 7-5

STOPPING

The ratio of the scavenging pumps intake to oil pressure pump output is a maximum at approximately 1000 rpm. Running at 1000 to 1200 rpm after CHT stabilizes below 200°C for 1 minute before shutdown will reduce the number of instances of hydraulicking during the subsequent start, since the amount of oil remaining in the engine will be at a minimum.

SPARK PLUG FOULING

Types of Fouling

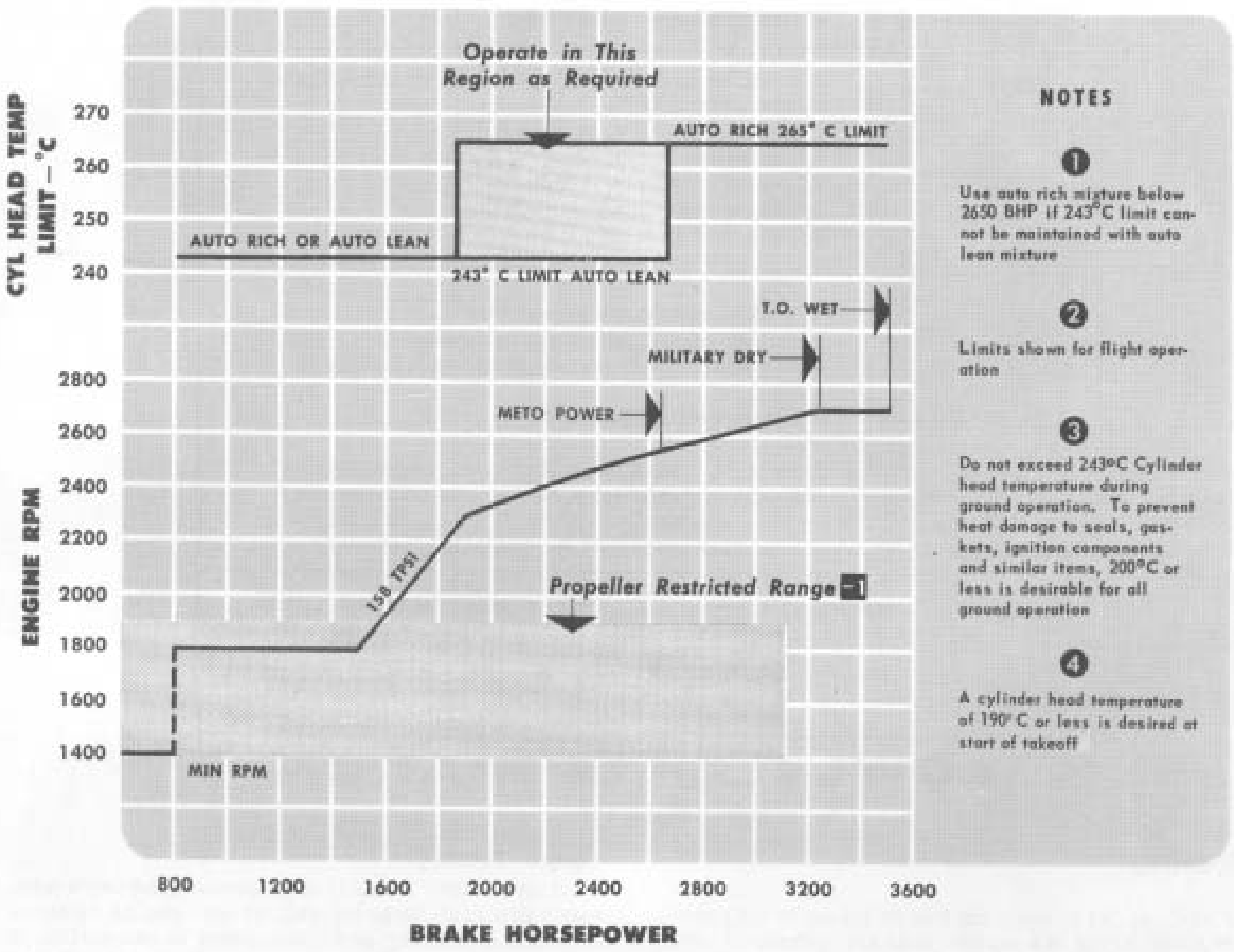
There are several types of spark plug fouling, some of which come from lack of preventative procedures, others from lack of care in maintenance or preflight operation, and still others that come from plug fouling, some of which come from lack of preventative procedures, others from lack of care in maintenance or preflight operation, and still others that come from operating time and the need for plug replacement. Carbon fouling and lead fouling are the most prevalent and are covered in this discussion. Lead fouling may be residual from a previous flight. Carbon fouling is usually due to prolonged ground running at idle, particularly when the idle mixture is richer than the best power; excess carbon from the rich mixture and engine oil in combustion tend to build up as fouling deposits. The symptoms of such fouling usually include excessive mag drop at the power check at field barometric manifold pressure.

Carbon Fouling

Carbon fouling from fuel is associated with mixtures too rich to burn well or so lean as to cause intermittent firing and consequent accumulation of oil and carbon on the misfiring plugs. A rich mixture is evidenced by soot or black smoke coming from the exhaust and by an increase in the rpm when the mixture is manually leaned to best power at idle throttle setting. When the turbulence and heat are as low as they are in idling, this soot settles out on the inside surfaces of the combustion chamber as well as in the exhaust system. At higher rpm and/or power settings the soot is swept out or does not condense out of the charge in the combustion chamber even though it shows up as black smoke in the exhaust during takeoff. During idling there is a tendency for oil to be sucked into the combustion chamber, mix with the soot and form on the spark plugs shorting out the gap. The oil also burns poorly in an already rich mixture and adds carbon.

Lead Fouling

The fuel contains tetraethyl lead which includes scavenger agents. These agents combine with the lead during combustion, forming lead compounds which have low boiling (condensing) temperatures and should not settle out in the engine. During idling, however, the temperature may not be high enough to prevent some of these products. As a result, spark plugs may foul from these lead deposits.



NOTES

❶ Use auto rich mixture below 2650 BHP if 243°C limit cannot be maintained with auto lean mixture

❷ Limits shown for flight operation

❸ Do not exceed 243°C Cylinder head temperature during ground operation. To prevent heat damage to seals, gaskets, ignition components and similar items, 200°C or less is desirable for all ground operation

❹ A cylinder head temperature of 190°C or less is desired at start of takeoff

CYLINDER HEAD TEMPERATURE LIMITS

Figure 7-6

Indication of fouling

Mag checks and power checks will give indications of malfunctions in the ignition system. Fouling, however, is concerned with the combustion end of the spark plug and standard checks will not always point immediately to the source of trouble. Regular monitoring of the spark plugs with the ignition analyzer while operating under power settings conducive to fouling provides a valuable means of determining the degree of fouling affecting spark plug operation.

CONTROLLED SPARK PLUG DEFOULING AND ANTI-FOULING PROCEDURES

These procedures are to aid in reducing spark plug fouling due to oil or excessively rich idle mixtures. Importance of maintaining correct idle mixture setting and proper assembly of idle mixture linkage cannot be overemphasized as the most important factor to be considered in providing protection against carbonaceous spark plug fouling.

Anti-Fouling Procedures for Ground Operation

Changes in altitude and climatic conditions will alter the idle mixture strength. When an airplane is at its home station and the idle mixture is noted out of adjustment, an airplane form entry will be made. However, when an airplane is operating away from its home station, no form entry should be made as the mixture strength may be correct when the airplane returns.

During all ground idle and taxi between minimum and 1200 rpm the mixture will be manually leaned to produce a mixture 25 rpm leaner than best power. After each 10 minutes of ground operation, following completion of power and ignition system checks, slowly advance the throttles to field barometric pressure. Hold this power for one minute, but do not exceed maximum CHT for ground operation. Retard throttle to idle rpm range and manually lean to produce a mixture 25 rpm leaner than best power.

Immediately prior to takeoff, slowly increase manifold pressure to field barometric. This will increase spark plug core tip temperature and decrease marginal spark plug performance during takeoff.

Defouling Procedures on the Ground

When unacceptable spark plug performance is experienced, engine speed will be reduced to 800 - 1000 rpm. Operate engine at this rpm for two minutes with a mixture slightly leaner than best power. Best power is obtained by slowly manually leaning the mixture until maximum rpm is obtained. Further lean mixture until 25 rpm decrease from best power is noted. This will result in mixture slightly leaner than best power. Cylinder head temperature must be between 175°C and 200°C to obtain optimum results. If necessary, adjust cowl flaps to maintain this temperature. This leaning procedure will increase the oxygen-to-fuel ratio within the cylinder to support chemical oxidation removal of carbonaceous material from the spark plug core tip. After two minutes at this power setting, return the mixture control to AUTO RICH and check engine performance. If engine performance check is not satisfactory, repeat the spark plug defouling procedure. In event second attempt to clear the spark plugs fails to produce desired results, replace only those plugs found defective by engine analysis procedures utilizing the ignition analyzer as a basic tool.

NOTE

Too much emphasis cannot be placed on slow movement of the manual mixture control required to obtain best power mixture. Slowly may be defined as rate of movement which would require 12 to 15 seconds to move the manual mixture control from AUTO RICH to best power.

Fouling Prevention During Cruise Operation

After each hour of operating below 1300 BHP, retard spark if in spark advance and move mixture control to AUTO RICH. Advance power slowly to set 1800 BHP, move throttles slowly (5 seconds per one inch manifold pressure). Hold 1800 BHP for two minutes. Return to cruise setting. Prior to final landing, engines will be operated at 1800 BHP for five minutes. Move mixture to AUTO RICH and set rpm and manifold pressure for 1800 BHP according to applicable power schedule in the Appendix and hold for five minutes. Set up power for letdown and hold a minimum of 150°C cylinder head temperature.

NOTE

Cylinder head temperature will be kept above 150°C during letdown procedure and during landing approach.

CARBURETOR ICING

Carburetor Icing on the Ground

If a cold soaked carburetor gives evidence of an overly rich or overly lean mixture during engine ground runup the trouble is probably ice in the carburetor chambers. Apply external ground heat directly to the carburetor for at least 20 minutes and then drain the carburetor chambers of water.

CAUTION

Do not takeoff until the carburetor is metering properly and the chambers have been drained.

Carburetor Icing in Flight

INDICATIONS OF CARBURETOR ICING. Under conditions of high atmospheric humidity, carburetor icing can occur with carburetor air temperature between -10°C and 7°C. If icing does occur it will be indicated by one or more of the following:

1. Change in fuel flow and change in torquemeter pressure

NOTE

This is indicative of icing of the carburetor metering elements and, when experienced at all, is usually encountered on takeoff. This usually results in a very rich mixture.

2. Falling off of manifold and torquemeter pressures while maintaining constant throttle, turbo boost, and rpm
3. Jamming of the throttle in some cases

ELIMINATION OF CARBURETOR ICE. If carburetor icing occurs proceed as follows:

1. Mixture - Adjust (to obtain a normal auto rich fuel flow)

NOTE

- Usually the mixture is enriched, in which case, lean manually. During takeoff or climb, lean the mixture to obtain predicted TPSI; this will result in a mixture approximating the AUTO RICH mixture. During cruise, lean the mixture through maximum TPSI until a drop of approximately 8 TPSI is obtained; this will result in a mixture approximating the auto lean mixture. The resulting mixtures may be cross checked with the fuel flow meter, if it is operating.
- If the mixture becomes lean the AUTO RICH position may be sufficient, or prime may be required to keep fuel flow up.

If turbo boost is not operating, bring in the turbos as soon as the power level (meto or less) or the situation permits.

2. Intercoolers - Close
3. If Necessary:
   a. Turbo Boost - Increase
   b. Throttle - Retard (to maintain manifold pressure within limits)
4. As Ice Is Removed:
   a. Engine Instruments - Monitor (carefully)
   b. Engine Controls - Adjust

Prevention of Carburetor Icing

If icing is anticipated on takeoff use sheltered air. In flight icing may be prevented with the turbo boost on by maintaining a carburetor air temperature of 15°C. If the icing conditions are extreme the carburetor air temperatures may, if desired, be maintained between 35°C and 38°C. The amount of heat available in the following steps is directly proportional to the amount of turbo boost applied:

1. Intercooler Flap - Close
2. Turbo Boost - Increase (as desired)
3. Carburetor Air Switches - SHELT
4. Power - Re-establish

NOTE

If a drop in manifold pressure is experienced while operating on sheltered air, with filters installed, open intercooler flaps 2 inches. This will provide an alternate air intake.

TURBOSUPERCHARGER SYSTEM

NORMAL OPERATING PROCEDURES

Preflight Check

Refer to Section II.

Manual to Automatic Control

ALL TURBOS. To place the turbos in automatic control:

1. Turbo Boost Selector Lever - 0
2. Turbo Boost Manual Override Switches - OPEN (guards down)
3. Turbo Boost Switches - AUTO (one at a time)

   Monitor manifold pressure and cabin air flow closely to guard against inadvertent overboost

4. Intercoolers - Open 2 Inches

   Open intercoolers before advancing the turbo boost selector lever to anticipate carburetor air temperature rise when turbo boost is added

5. Turbo Boost Selector Lever - Advance (carefully)

CAUTION

Do not exceed CAT limits when using turbo boost. When setting up turbo boost, always advance the turbo boost lever carefully until a definite rise in manifold pressure or cabin air flow is noted. No rise means malfunction. If malfunction occurs, return the turbo boost switch for the affected engine to MAN. Investigate when safe altitude is reached by using the TURBOSUPERCHARGER EMERGENCY OPERATION in Section III.

6. Carburetor Air Temperature - Control with intercooler flap

ONE OR MORE TURBOS. For each turbo to be returned from manual to automatic control while other turbos are in automatic, accomplish the following:

1. Turbo Calibrating Knob - Full CCW
2. Turbo Manual Override Switch - OPEN (guard down)
3. Throttle (affected engine) - Retard
4. Turbo Boost Switch - AUTO
5. Throttle (affected engine) - Increase slowly to align with others
6. Turbo Calibrating Knob - Turn CW to desired MP

DURING NORMAL CLIMB. When setting up power following the first power reduction, use throttle only. Leave the turbo boost switches at MAN until wide open throttle has been reached and a definite drop in manifold pressure due to altitude gain has been noted. Then switch to automatic control using the procedure given under MANUAL TO AUTOMATIC CONTROL, in this Section.

NOTE

At certain power settings and cabin pressurization requirements, an indication of cabin air flow somewhat above the green (normal) range may be expected.

TURBO BOOST IMMEDIATELY AFTER TAKEOFF. Under conditions which require turbo boost immediately after takeoff, such as for carburetor pre-heat or cabin air flow, proceed as follows: Decrease the manifold pressure a noticeable amount with the throttles. Using the procedure given under MANUAL TO AUTOMATIC CONTROL in this Section, restore the manifold pressure. Proper restoration of manifold pressure will indicate a normally functioning turbo automatic control system. Adjust part throttle or preheat as desired.

Automatic to Manual Control

To switch all turbos from automatic to manual control during normal operation:

1. Turbo Boost Selector Lever - Retard to 0
2. Turbo Manual Override Switches - Check OPEN (guards down)
3. Turbo Boost Switches - MAN (one at a time)

   Monitor the manifold pressure to guard against inadvertent overboost
4. Manual Override Switches - Hold OPEN for 10 seconds, then OFF (override switch guards up)

Cruise

Set up cruise power using part throttle and turbo, using no more part throttle than required to maintain cabin air flow within the green (normal) range.

NOTE

The use of spark advance and manually adjusted mixture settings during cruise operation will materially reduce exhaust gas temperature and extend exhaust system and turbosupercharger life. If spark advance is not available, the use of AUTO RICH mixtures for cruise will also extend turbosupercharger and exhaust system life.

Descent

Throttle engines as required for descent and advance turbo boost selector lever to keep the cabin air flow indicator within green range. If full turbo boost is inadequate for cabin requirements with symmetrical power, advance power on inboard engines and reduce outboard engine power to obtain desired air flow.

Turbosupercharger Manual Control

The manual control system may be used for extended periods of time if the automatic control system is inoperative and the pilot decides that conditions are such that manual operation is necessary. Make manual adjustments of turbo boost for one engine at a time as follows:

1. To Increase Turbo Boost:

   a. Manifold Pressure (on the desired engine) - Reduce (by means of the throttle)

   b. Turbo Manual Override Switch (corresponding) - Nudge to the CLOSE position and release

   c. Throttle - Advance (slowly to desired position)

   Be alert for possible overboost

   d. Above Steps - Repeat (until within about 2 inches Hg of the desired manifold pressure)

   e. Final Manifold Pressure Adjustment - Use Throttle

2. To Decrease Turbo Boost:

   a. Decrease Turbo Manual Override Switch - Nudge to the OPEN position and release

   Repeat until within about 2 inches Hg of the desired manifold pressure

   b. Final Manifold Pressure Adjustment - Use throttle

NOTE

The wastegate motors are fast acting, therefore care must be exercised when using the turbo manual override switches. Sensitivity of the manual system varies. When the turbo manual override switches are used with the wastegate near the full open position, large changes in wastegate position will produce small manifold pressure changes. Near the closed wastegate position small changes in the gate position cause large changes in manifold pressure and care must be taken not to cause an overboost.

Use the throttle to make minor adjustments of manifold pressure and the turbo manual override switches to make the large adjustments such as those resulting from large changes in altitude, airspeed, or power requirements. The turbo governor does not function with the turbo boost switch in MAN, therefore it is possible to overspeed the turbine wheel. This is particularly true above 23,500 feet where maximum allowable continuous turbine wheel speed (20,000 rpm) is reached at the engine power settings shown below.

ALTITUDE (feet)	BHP
23,500	2650
25,000	2450
26,000	2350
27,000	2250
28,000	2160
29,000	2070
30,000	1985

CONDITIONS

32°C CAT, 155 knots IAS

NOTE

A carburetor air temperature and/or cabin air flow higher than the rest may be indicative of an overspeeding turbine if the intercooler and power settings are symmetrical for all engines.

EMERGENCY OPERATION

See Section III.

PROPELLER SYSTEM

OPERATION DESCRIPTION

Operating Mechanism

The operating mechanism of the propeller used on this airplane is a mechanical-hydraulic system in which hydraulic forces acting upon a piston are transformed into mechanical twisting forces acting upon the blades. Piston movement causes rotation of a cam and bevel gear. This bevel gear, meshing with bevel gear segments attached to the butt ends of the blades, turns the blades. The oil forces which act upon the piston are controlled by a fly weight governor which moves on oil pilot valve thus directing oil under pressure against either side of the piston as the operating condition requires. The propeller contains a pitch lock mechanism which by means of centrifugally actuated valves prevents overspeeding above 3000-3100 rpm by locking the oil in the outboard side of the piston when this speed is reached. The propeller governor control system incorporates an electric stepmotor head which is used to change the governor spring tension opposing the fly weight force which results in rpm change. Stepmotor head operation is controlled manually by the propeller governor selector switches. Each toggle switch energizes a dc motor and determines the direction of its stepmotor to increase or decrease rpm. The dc motor turns a commutator switch which energizes the stepmotor head. This toggle switch adjustment of the governors overrides all other functions, permitting use of the governor selector switches at any time.

Synchronizer

The synchronizer is used to automatically correct for governor setting tolerances which may cause engine speeds to vary slightly. For synchronization either one of two engines may be selected as a master for the other engines to follow. Once the master engine and its speed have been selected (governor set) with the propeller auto control switch and the master lever, the other engines act as slaves and synchronize their speeds to it. The master engine drives a small electric generator through its tachometer drive. The frequency of this generator varies with the speed of the engine. Its output drives one of two synchronous motors in each of the slave differential motors. The other synchronous motor is driven by its slave engine. Between each synchronous motor set is a differential drive. If the slave engine is turning at a different speed than the master, the differential drive rotates in a direction depending on over or under speed. Each differential drive is geared to a commutator switch for its slave engine. When the switch is rotated, the stepmotor on the slave engine is energized to reset the governor. When the slave engine's speed is the same as the master, the differential drive equalizes and relative motion stops.

SYNCHRONIZER CONTROL

The master propeller synchronizer lever is used for ease of operation; it merely allows all four propellers to be controlled simultaneously. The master lever is independent of the toggle switch system but both use the same stepmotor heads at the governors. The master lever changes all engine speeds in the following manner. When the lever is moved, a rotary contact touches a brush of a follow up arm. This connection starts a dc motor turning in the direction the master lever has been moved. The follow up arm rotates with the dc motor until its brush moves off the rotary contact. The dc motor operates a commutator switch which supplies pulsating dc voltage to each stepmotor head. The stepmotor heads turn revolution for revolution with each turn of the commutator switch, thus changing all governor settings simultaneously. Every time the master lever is advanced to takeoff position, all governors are set to their positive high rpm stops. This action is called calibrating. At calibrate and during movement of the master lever, synchronizing is momentarily cut out.

Safety Device

A safety device is incorporated between the commutator switch and differential motor of each slave engine to prevent master engine failure from dragging down slave engine speed. This feature allows the master engine to control the speed of the slaves only within the range of approximately ± 3% of cruise rpm. It consists of a stop gear incorporating a notch which restricts the differential motor from turning either way more than the 3% rpm range by means of a peg through the notch. A locking claw holds the stop gear in position. When the peg has moved to the limit of the notch (3% rpm), it can go no further until the locking claw is released. When this is released the stop gear (and notch) is recentered by spring action. Another 3% correction can then be made by the differential motor, and so on. The locking claw is actuated by the resynchronizer switch which also breaks the circuit from the tachometer generators to the differential motors. The resynchronizer switch must be held momentarily to allow the stop gear to recenter; too rapid action may cause the claw to catch the stop gear at some point other than the center position. Selector switch operation of the individual propellers while the propellers are in automatic operation will be followed by an approximate 3% rpm spring-back towards master engine rpm when the switch is released. No synchronizer action will be experienced with the propeller auto control switch in the **OFF** position.

Reducing RPM

In the event that it is not desired to draw maximum power from an engine for any reason, it is also possible, once the governors are set to high rpm by the master propeller synchronizer lever, to readjust one or more of them downwards by means of its governor selector switch. After takeoff has been accomplished, movement of the master propeller synchronizer lever to reduce rpm will produce equal movement in all governors so that if the governors were within the synchronizing range at the full high rpm position, they will remain within the range and automatic synchronizing will result. If any governor had been reduced from its high rpm position at takeoff, its rpm would be reduced by a proportional amount (less 3 per cent spring-back) so that it will be set for a lower rpm than the rest of the system.

PROPELLER OPERATION

For ground operation and checks see Section II.

Normal Operation

TAKEOFF. Move the propeller synchronizer lever to full INCREASE RPM and adjust the engine controls to maximum power.

CLIMB. For the climbing operation immediately following takeoff, set the engine and the propeller controls to the climb power specified in the Appendix.

ECONOMICAL CRUISING. Once the engine rpm has been adjusted, it will be held constant by the propeller governor. Changes in the attitude and altitude of the airplane, as well as changes in the engine manifold pressure, can be made without altering the rpm. Loss of electrical power will prevent rpm adjustment. However, the propeller will maintain the preset rpm (within pitch change limits) by acting as a simple constant speed propeller regardless of attitude, manifold pressure, airspeed or density changes.

POWER-ON DESCENT. Power-on descent operation in which the power absorption limits of the propeller are not exceeded is fully taken care of by the governor; that is, as the air speed increases in the descent, the governor will move the propeller blades to a higher pitch in order to hold the rpm at the desired value. Set the synchronizer lever to obtain the correct rpm for the power selected. Maintain at least one inch manifold pressure per 100 RPM.

POWER-OFF DESCENT. Used for emergency descents only, see section III.

APPROACH AND LANDING. Set the propeller synchronizer lever to give approach rpm.

REVERSING WHILE LANDING. Make a normal landing with the engine and propeller controls in their usual positions. After the airplane has touched down, open the throttle lock plate and move the desired throttle levers into the reversing position at the rear of their quadrants. When the propellers have reversed, the throttle levers may be adjusted within the reverse portion of the quadrant to set the amount of reverse thrust desired.

CAUTION

If a propeller oil quantity light is illuminated do not attempt to reverse the corresponding propeller as the oil quantity may be insufficient to accomplish propeller reversal.

UNREVERSING WHILE LANDING. To return to forward thrust, advance the throttle levers past the detent. While unreversing, it is important not to apply too much power because ground speed may increase as the propellers go into positive pitch. Propeller unreversing is cut off at approximately six degrees above the low blade angle setting and the governor assumes control at this time. Thus, with the throttle open too wide, the ground speed will be increased. If a propeller should fail to unreverse, shut-down the engine immediately. Do not disturb propeller controls until the malfunction can be determined.

STOPPING ENGINES. Move the synchronizer lever to full INCREASE RPM, follow the procedure outlined in Section II to shut-down the engines.

FEATHERING. For feathering procedure see Section III. In connection with the feathering and unfeathering operations of the propeller, the following points are important.

INADVERTENT FEATHERING. If the feathering switch should be closed inadvertently, the feathering action can be stopped, and the propeller returned to governor control by pulling out the feathering button. If the accidental operation of the feathering switch has resulted in complete feathering, the propeller should be unfeathered in the normal manner. (See Section III.)

AFTER FEATHERING. Propeller oil pressure is not required to hold the blades in the full feathered position. Proper setting of the high pitch (or feathered) stop can be checked by noting any tendency for the propeller to rotate. Once the blades have been feathered and rotation stopped, torque producing aerodynamic forces are in equilibrium and the propeller will not windmill. The feathering button should release after 18 ± 2 seconds; if, for any reason, the feathering button fails to release after this time, it should be pulled out to the neutral position manually.

INADVERTENT ENGAGEMENT OF PITCH LOCK
If a propeller is inadvertently locked due to a momentary overspeed, the lock may be disengaged by decreasing the rpm to 1500-1700 using the governor selector switch. The rpm may then be increased to the desired setting.

Emergency Operating Procedure

See Section III.

PROPELLER OPERATION DURING FLIGHT

PILOTS

1. Prop Integral Control Unit - Visually check for leaks
2. If Prop Oil Quantity Light On (after three minutes) - Feather propeller

Feather the prop if engine is not required.
If engine operation is required, monitor RPM for erratic governor operation. If it is impossible to stop erratic governor operation by use of oil replenishment, a serious oil leak is indicated and the prop must be feathered immediately to prevent runaway.

ENGINEER

1. Prop Oil Refill Switches - Check OFF
2. Prop Oil Quantity Warning Lights - Check not illuminated
3. If Prop Oil Quantity Warning Light Illuminates - Notify pilot
4. Prop Oil Refill Switch - ON
5. Prop Oil Refill Switch - OFF

   When the prop oil quantity warning light goes out turn prop oil refill switch off. If the prop oil quantity light does not go out after three minutes of replenishing, notify pilot since insufficient prop oil quantity with impending difficulties, is indicated. Prop oil replenishment may be repeated as often as necessary provided that the prop oil quantity low warning light is extinguished within three minutes.

6. If Prop Oil Replenished During Flight - Enter in form 781-2

   Number of times and duration of replenishing

NOTE

If engine oil is used for replenishing propeller oil, congealing with resultant poor control may occur after the propeller has been at rest in cold temperatures.

IGNITION ANALYZER

ANALYZER OPERATION PRINCIPLES

It is necessary to discuss the operation of a typical airplane engine ignition installation to show the manner in which ignition faults are revealed by the ignition analyzer. At the instant the magneto breaker contacts open, the permanent magnet rotor is in position to effect a complete reversal of the magnetic field which was built up around the magneto coil. This reversal was prevented from taking place previously, by the presence of the current in the primary winding of the magneto coil. The opening of the magneto breaker breaks the flow of current and the rapid flux reversal induces a high voltage in the secondary coil. It is this secondary high voltage that fires the spark plugs. At the time the breaker points are open and the spark discharge is taking place across the plugs, the ignition analyzer makes an analysis of the ignition system. The discharge of high tension current across the gaps of the system sets in motion an oscillatory circuit. The circuit constants, the condition of the spark plugs, and cylinder pressures are all factors which determine the characteristics of this oscillatory circuit. In order that the oscillatory characteristics may be studied, a method of measurement of these oscillations must be determined. Ignition analyzer calibration is accomplished by checking the voltage appearing across the magneto breaker points during the open period. Visual evaluation of the primary voltage characteristics is made by observation of the primary wave forms as they appear on the cathode-ray tube screen. In the ignition system, all malfunctions are accompanied by some significant change in one or more of the electrical components constituting the oscillatory circuit. In this way various ignition malfunctions can be found by studying the oscillations. Figure 7-8 shows various patterns for normal and malfunctioning ignition systems.

ANALYZER OPERATION PROCEDURE

The following procedure is used to operate the ignition analyzer system.

1. With the engines running at operating temperature, the d-c bus energized, and the secondary inverter operating to supply a-c power, place the system power switch on the ignition analyzer switch panel to the ON position
2. Place the analyzer power switch on the ignition analyzer to ON. The power indicator light should illuminate
3. Allow approximately one minute for the analyzer tubes to warm up. A bright dot should appear on the analyzer screen. Allow this dot to stabilize at one position on the screen, then adjust the position switches until the dot is in the center of the screen
4. If dot does not appear, operate the horizontal and vertical position switches on the analyzer until the dot appears

NOTE

> To prevent burning a spot on the analyzer screen, the bright dot should not be held in one position on the screen for more than two 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. Set the analyzer magneto selector switch, on the analyzer, to the LEFT 1 position

NOTE

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

PATTERN SEQUENCE	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CYLINDERS FIRED BY L, AND R, MAGNETOS	D1	B2	D3	B4	D5	B6	D7	B1	D2	B3	D4	B5	D6	B7
CYLINDERS FIRED BY L, AND R, MAGNETOS	A5	C6	A7	C1	A2	C3	A4	C5	A6	C7	A1	C2	A3	C4

L magnetos fire the left side spark plugs of cylinders **R** magnetos fire the right side spark plugs of cylinders

Pattern sequence chart for use with P & W R-4360-59B engines equipped with a low tension ignition system

ANALYZER PATTERN SEQUENCE

Figure 7-7

6. Rotate the engine and magneto selector switch to the engine and magneto position desired
7. Check for abnormalities in the fourteen patterns on the screen with the switch in the R and L positions. Cylinders which show abnormal patterns are determined by counting off from the first pattern and referring to the placard on the front of the analyzer switch panel
8. Use the 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 the screen for comparison
9. To check magneto synchronization of both sides of cylinder ignition, place the magneto selector switch to each of the RL positions. The patterns for any one cylinder viewed on the screen will be superimposed if magnetos are synchronized.

ANALYZER VOLTAGE CONTROL OPERATION

Use the voltage control switch on a ground check to determine condition of spark plugs before noticeable failure occurs. Operation of the voltage control switch is as follows:
1. Place the relay-resistor switch on the switch panel to the ON position for the engine to be tested

NOTE

Guards for these switches should be down during flight to prevent possible cutting out of cylinders with inadvertent use of the voltage control and resultant damage to the engine by fire or backfiring within the manifold section.

2. Pull out and rotate the voltage control switch from OFF in the decrease direction, while viewing the pattern on the analyzer screen. Misfiring, and finally, complete stoppage of plug firing should occur

NOTE

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

3. The value of the dial readings where misfiring and complete stoppage of firing occur, should be noted. A low dial reading indicates ignition system in good condition

Analyzer Patterns

The procedure to be followed when operating the ignition analyzer is the same regardless of the purpose of the check or the suspected malfunction. Ignition system troubles are determined by proper identification of the patterns viewed on the analyzer screen. If any malfunction exists in the ignition of any one cylinder being fired it can be noted by a deviation from the standard pattern form. By noting the position of this deviation on the complete wave form, the particular cylinder where malfunction occurs can be determined. See figure 7-7. Single detailed patterns of normal firing and common ignition troubles are shown in figure 7-8, as a guide to pattern interpretation. The detailed patterns have been coded with numbers I through XV together with explanatory test following each detail. The exact size and shape of the patterns may vary from those viewed on the analyzer screen, due to engine and ignition system characteristics, and the analyzer control settings. These detailed patterns approximate those on the analyzer screen when the controls are adjusted to show the pattern for only one cylinder. A malfunction of the analyzer does not appear to the operator as an ignition malfunction, but rather, the lack of interpretable patterns. If all patterns exhibit the same type of ignition malfunction, the difficulty lies in the magneto. If only one or two patterns indicate a particular ignition defect, the difficulty lies either in the spark plug itself or at some point between the spark plug and the magneto. The patterns shown are for fine wire plugs and differ slightly from those for massive electrode plugs which have less vertical activity and more horizontal activity at the hash (point where firing occurs).

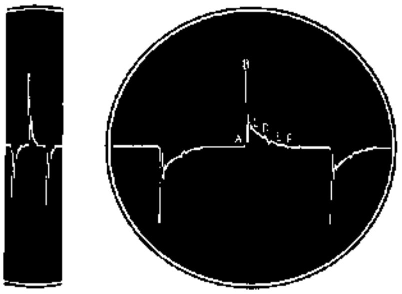
CAUTION

If both plugs of any cylinder show shorted secondary patterns consideration should be given to shut the engine down unless it is needed to sustain flight. Often both plugs showing shorted secondary patterns are the result of piston or valve failure which may be followed by engine failure.

NOTE

Analyzer patterns appear alternately above and below the horizontal line.

NORMAL



DETAIL I

The shape of this normal wave form is the result of each component of the ignition system functioning normally, thereby causing ignition and resultant combustion within the cylinder.

1. Breaker point opening at A
2. Initial rise of voltage at B
3. Voltage ripple reflecting spark plug firing at C
4. Pulse occurring as spark plug firing at D
5. Gradual decay of voltage at E
6. Breaker point closing at F

WHEN ALL WAVE FORMS HAVE A NORMAL SHAPE, THE IGNITION SYSTEM DOES NOT REQUIRE SPECIAL MAINTENANCE OR REPAIR.

DETAIL II

SHORTED PRIMARY BEFORE DISTRIBUTION

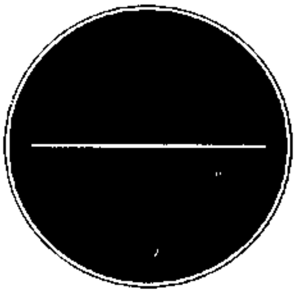
A shorted primary wave form is the result of abnormally low resistance of the primary circuit short circuiting the magneto coil. This wave form will also be produced when the ignition switch controlling the circuit under analysis is in the OFF position.

1. This condition produces a straight horizontal line on the analyzer screen.

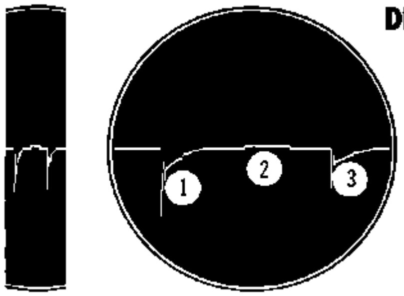
PROBABLE CAUSE.

1. Breaker points do not open
2. Shorted breaker points
3. Shorted primary points
4. Shorted distributor rotor
5. Shorted wire in magneto
6. Shorted harness wire
7. Shorted switch and booster lead
8. Shorted radio filter
9. Shorted ignition switch
10. Booster relay points stuck closed
11. Primary lead to analyzer disconnected
12. Vertical gain control setting of analyzer out of adjustment

NOTE: This will effect all ignition circuits being analyzed.



SHORTED PRIMARY AFTER DISTRIBUTION



DETAIL III

The shorted primary wave form as shown is the result of abnormally low resistance of the primary circuit between the distributor block and the transformer coil primary to ground.

1. Small bar shape of the wave form at stage 2
2. Smaller than normal wave form which follows the shorted primary wave form at stage 3

PROBABLE CAUSE.

1. Shorted primary wire in magneto
2. Shorted primary wire in ring manifold
3. Shorted primary wire in bank manifold

NOTE: Stage 1 is normal.

DETAIL IV

OPEN PRIMARY

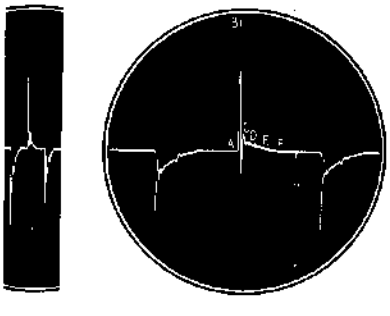
The wave form will occur when there is an open circuit in one of the transformer primary coil circuits. A single wave form will be affected when the trouble is after the distributor block. All wave forms for one circuit will be affected when the trouble is before the distributor block.

1. Extremely high amplitude at B
2. Low frequency oscillation B to D
3. Wave form has less width than normal

One wave form affected: (as illustrated)

PROBABLE CAUSE.

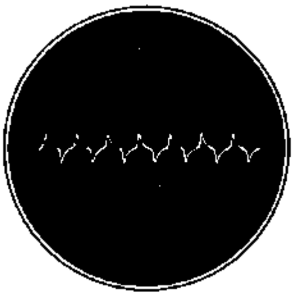
1. Wire terminal broken off back of distributor block
2. Wire broken in ring manifold
3. Open circuit in bank manifold
4. Open in primary winding of transformer coil



IGNITION ANALYZER PATTERN

Figure 7-8 (Sheet 1 of 4)

OPEN BREAKER CIRCUIT



This wave form results when primary current does not flow through breaker circuit.

1. All wave forms are affected
2. Absence of any indication of breaker point opening or closing
3. Symmetrical shape of wave forms
4. Low amplitude wave forms

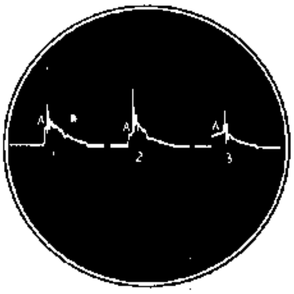
PROBABLE CAUSE.

1. Breaker points not closing

DETAIL V

DETAIL VI

BREAKER POINT ARCING
(3 Stages)



These wave forms are caused as a result of current flow across open breaker points in the form of an arc. The severity of this condition is proportional to the width of that portion of the wave form A preceding the initial high peak.

Stage 1 – Normal Breaker Arcing.

1. Slight arc at A. This condition intermittent

Stage 2 – Excessive Breaker Arcing.

1. Increased duration of arc at A
2. Spark plug firing, however, ignition is occurring late
3. Breaker points operating very hot
4. All wave forms affected

Stage 3 – Severe Breaker Arcing.

1. Increased duration of arc at A
2. Spark plug not firing
3. Breaker points burning severely
4. All wave forms affected

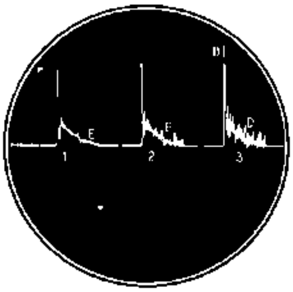
PROBABLE CAUSE.

1. Defective primary condenser
2. Primary condenser disconnected
3. Oil or foreign particles between breaker contacts

NOTE: Stage 1 is a tolerable condition.
Stage 2 and 3 require IMMEDIATE CORRECTION.

DETAIL VII

DISTRIBUTER ROTOR BRUSH ARCING
(3 Stages)



These wave forms are caused by the distributor rotor carbon brushes making intermittent contact with the distributor plate segments.

Stage 1 – Slight Brush Arcing.

1. Slight jagged variations in wave form preceding breaker closing at E

Stage 2 – Moderate Brush Arcing.

1. Increased amplitude of variations at E

Stage 3 – Severe Brush Arcing.

1. Variations in initial voltage rise B may or may not be present
2. Increased amplitude of variations at D and E

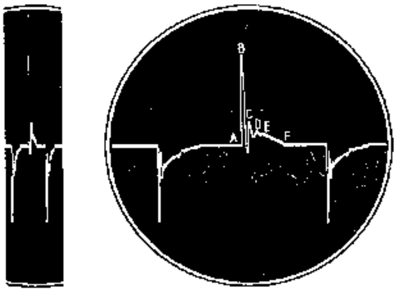
PROBABLE CAUSE.

1. Improper operation of magneto rotor and/or magneto plate

NOTE: Stages 1 and 2 are tolerable conditions and do not necessitate special maintenance.
Stage 3 requires IMMEDIATE maintenance to prevent ignition failure.

Figure 7-8 (Sheet 2 of 4)

OPEN SECONDARY



DETAIL VIII

An open secondary wave form is produced when the resistance of the high tension circuit is so great that there is no path for secondary current to flow.

1. High amplitude of voltage at B
2. Low frequency oscillation between B and C
3. Absence of pulse at D

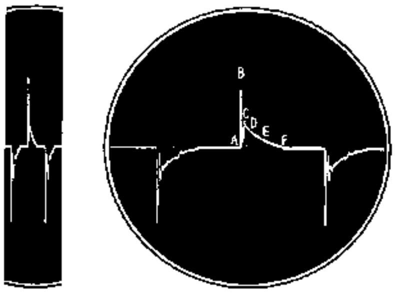
This wave form is similar but should not be confused with an open primary.

PROBABLE CAUSE.

1. Spark plug lead disconnected or not making contact at spark plug. Cigarette spring missing or broken
2. Spark plug lead disconnected or not making contact at transformer coil
3. Open secondary circuit within transformer coil
4. Spark plug gap too wide
5. Magneto timing incorrect. Low energy output to spark plug

DETAIL IX

SHORTED SECONDARY



A shorted secondary wave form is produced when the resistance of the high tension circuit is abnormally low. This allows a high value of secondary current to flow at a relatively smooth rate.

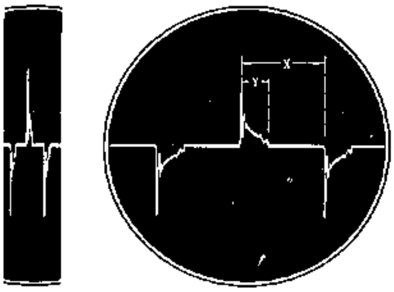
1. Smooth voltage decay from C to F
2. Absence of ripple at C
3. Absence of pulse at D
4. Lower amplitude at B

PROBABLE CAUSE.

1. Spark plug shorted
2. Shorted high tension lead
3. Shorted secondary winding in transformer coil
4. Cylinder condition

DETAIL X

BREAKER POINT OPENING INSUFFICIENT



Insufficient breaker opening is the result of improper adjustment of the ignition breaker (insufficient lift of the cam follower).

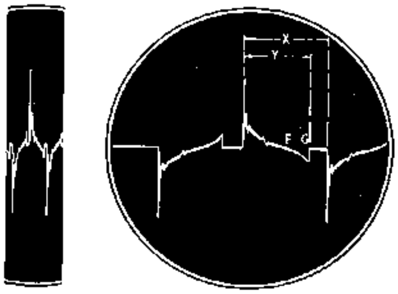
1. Abnormally short breaker open period Y
2. All wave forms affected
3. One complete wave form X

PROBABLE CAUSE.

1. Internal timing of magneto incorrect
2. Cam follower wear

DETAIL XI

BREAKER POINT OPENING EXCESSIVE



The excessive breaker point opening wave form is the result of excessive lift of the cam follower on the cam lobes.

1. Triangular tail on wave form, F to G
2. Y dimension (points open period) is much greater than normal
3. All wave forms affected
4. One complete wave form X

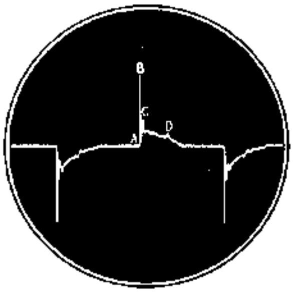
PROBABLE CAUSE.

1. Internal timing of magneto incorrect
2. Extreme breaker contact erosion

IGNITION ANALYZER PATTERN (CONT)

Figure 7-8 (Sheet 3 of 4)

LOW VOLTAGE FIRING



DETAIL XII

This wave form is produced by an ignition system that requires an abnormally small amount of energy to fire the spark plug or plugs. Misfiring will occur and the wave form will show a cease firing condition at a lower than normal reading on the ignition voltage control.

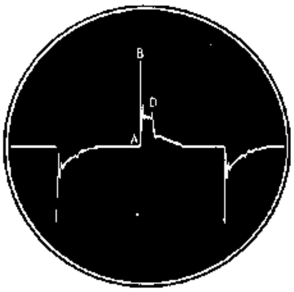
1. Lower than normal amplitude of wave form at B, C, and D
2. Longer period of plug firing indicated by length of A to D

PROBABLE CAUSE.

1. Narrow spark plug gap
2. Spark plug lead disconnected and arcing to ground across small gap
3. Cylinder condition

DETAIL XIII

HIGH VOLTAGE FIRING



This wave form is produced by an ignition system that requires an abnormally large amount of energy to fire the spark plug or plugs. Misfiring will occur and the wave form will show an open circuit condition at a higher than normal reading on the ignition voltage control.

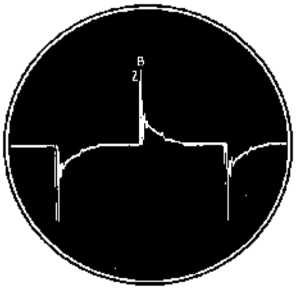
1. High amplitude of wave form at B and D
2. Shorter time of plug firing indicated by pattern width A to D

PROBABLE CAUSE.

1. Wide spark plug gap
2. Spark plug lead disconnected from plug but firing to ground across large gap
3. Contact spring missing from spark plug lead

DETAIL XIV

CAM FOLLOWER BOUNCE



This wave form is the result of a momentary opening of the breaker points which occurs just prior to the breaker open period.

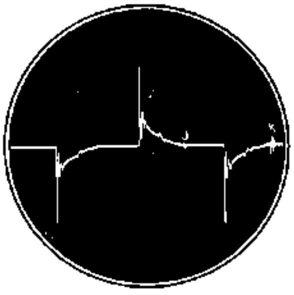
1. Premature pulse occurring at Z
2. Normal initial voltage rise at B
3. One or more wave forms may be affected

PROBABLE CAUSE.

1. Weak cam follower spring

DETAIL XV

BREAKER POINT BOUNCE



This wave form is caused by the untimely opening of the breaker points following their normal closing.

1. Slight voltage pulses at J
2. Increased amplitude of pulses at K

PROBABLE CAUSE.

1. Low main spring tension

1. Intermittent voltage pulses J at high rpm may be considered normal. Does not affect engine operation
2. Continuous voltage pulses K usually indicate a need for replacing breaker assembly

CAUTION: Do not confuse pick-up from other magnetos with this trouble.

Figure 7-8 (Sheet 4 of 4)

FUEL SYSTEM

USE OF FUEL BOOST PUMPS

For fuel loading and usage sequence and restrictions see Section V. Normally for TE operation, one boost pump per tank will be on NORMAL. Follow fuel usage sequence as outlined in Section V if restrictions apply, otherwise balance uneven fuel quantities in the wing tanks to provide the optimum weight distribution. Select the tank required or the tank with the greatest amount of fuel and turn one boost pump switch to EMERGENCY and one boost pump switch to NORMAL with the fuel selector switches in the TME position. Note engine fuel pressure increase with other wing tank boost pumps switches positioned one on NORMAL per tank. When the fuel quantities are as required or equal, resume TE operation. If sufficient fuel pressure is not maintained due to altitude, move one fuel boost pump switch per fuel tank to EMERGENCY to maintain fuel pressure.

NOTE

Takeoffs and climbs are made usually with the fuel selector valve switches positioned TE.

CAUTION

- When changing the fuel selector switches or boost pump switches, watch the fuel pressure. A restoration of fuel pressure, after a drop, may result in engine overspeeding due to power variation. The overspeeding occurs so rapidly that it is necessary to have a hand on the throttles ready for immediate power reduction whenever making a boost pump or selector switch change. At cruising altitude, set boost pump speeds before accomplishing selector switch change. Always have at least one boost pump switch on NORMAL when using the manifold system.

- To prevent possible boost pump damage, do not allow a boost pump to operate in an empty tank.

- When a fuel selector switch is changed, watch for proper synchronization of the selector switch and selector valve. This is indicated by the warning light illuminating during the change and going out as synchronization is accomplished. If the valve does not move when the switch is moved in one direction (CW or CCW), move the switch to the desired position by turning it in the opposite direction since there are independent power leads to the CW and CCW circuits. Reduce throttle prior to cycling through OFF position.

- When moving fuel selector switch to any position other than TE, only move one fuel selector switch to desired position leaving other three fuel selector switches at TE for ten minutes. If no indications of fuel contamination occur, then place other three fuel selectors to desired position.

- Engineer will coordinate with pilot before initiating any fuel management procedures or inflight contamination checks. When operating at other than TE configuration, the Engineer's A/R panel fuel quantity gages and transfer valve switches will be checked periodically, with Engineer's A/R master switch ON.

CONTAMINATION CHECK PRIOR TO TAKEOFF

WARNING

During contamination check, if selected engine CHT rises, the exhaust becomes black, or engine begins to run rough, immediately turn fuel selector valve switch to TE and boost pump switches to NORMAL. Do not open any fuel valve connecting source of contamination to airplane system tanks or engines until system is purged.

The following procedure will be followed on all flights where 115/145 grade fuel for the KC-97 engine consumption is carried in the center wing and/or external tanks:

1. When 115/145 grade fuel is carried in the center wing tank only, the contamination check will be performed in the following manner:
    a. Check No. 2 manual shutoff valve CLOSED and No. 1 manual shutoff valve OPEN
    b. Center wing tank boost pump on NORMAL
    c. Center wing tank shutoff valve OPEN
    d. No. 1 and No. 4 engine selector valves TME
    e. Leave in this configuration while engine run-up is being accomplished. Monitor No. 1 and No. 4 engines closely for any indication of contaminated fuel
    f. No. 1 manual shutoff valve CLOSED
2. When 115/145 grade fuel is carried in the external tanks only, the contamination check will be performed in the following manner:

    a. Check transfer valves CLOSED

    b. One boost pump in external tank on NORMAL

    c. No. 1 and No. 2 manual fuel-shutoff valves OPEN

    d. No. 1 and No. 4 engine fuel selector valves TME

e. Leave in this configuration while engine run-up is being accomplished. Monitor No. 1 and No. 4 engines closely for any indication of contaminated fuel.

f. No. 1 and No. 2 manual fuel-shutoff valves CLOSED

g. External fuel tank boost pump switches OFF

3. When 115/145 grade fuel is carried in the center wing and the external tanks, the contamination check will be made as follows:

   a. Check transfer valves CLOSED

   b. One boost pump in each external tank on NORMAL

   c. No. 1 and No. 2 manual fuel-shutoff valves OPEN

   d. No. 1 and No. 4 engine fuel selector valves TME

   e. Leave in this configuration while No. 1 engine is being run up. The following steps will be accomplished before running up No. 4 engine:

      (1) External tank boost pumps OFF

      (2) CWT boost pump on NORMAL

      (3) CWT shutoff valve OPEN

      (4) Leave in this configuration until run up is complete

FUEL BALANCING PROCEDURES

1. No. 1 and No. 4 Fuel Selector Valve Switches - TME
2. No. 1 or No. 4 Fuel Boost Pump Switch - EMERGENCY (for five minutes)
3. Other desired Fuel Selector Valve Switches - TME
4. Fuel Boost Pump Switches - As required

INFLIGHT USE OF AUXILIARY TANK FUEL FOR AIRPLANE

NOTE

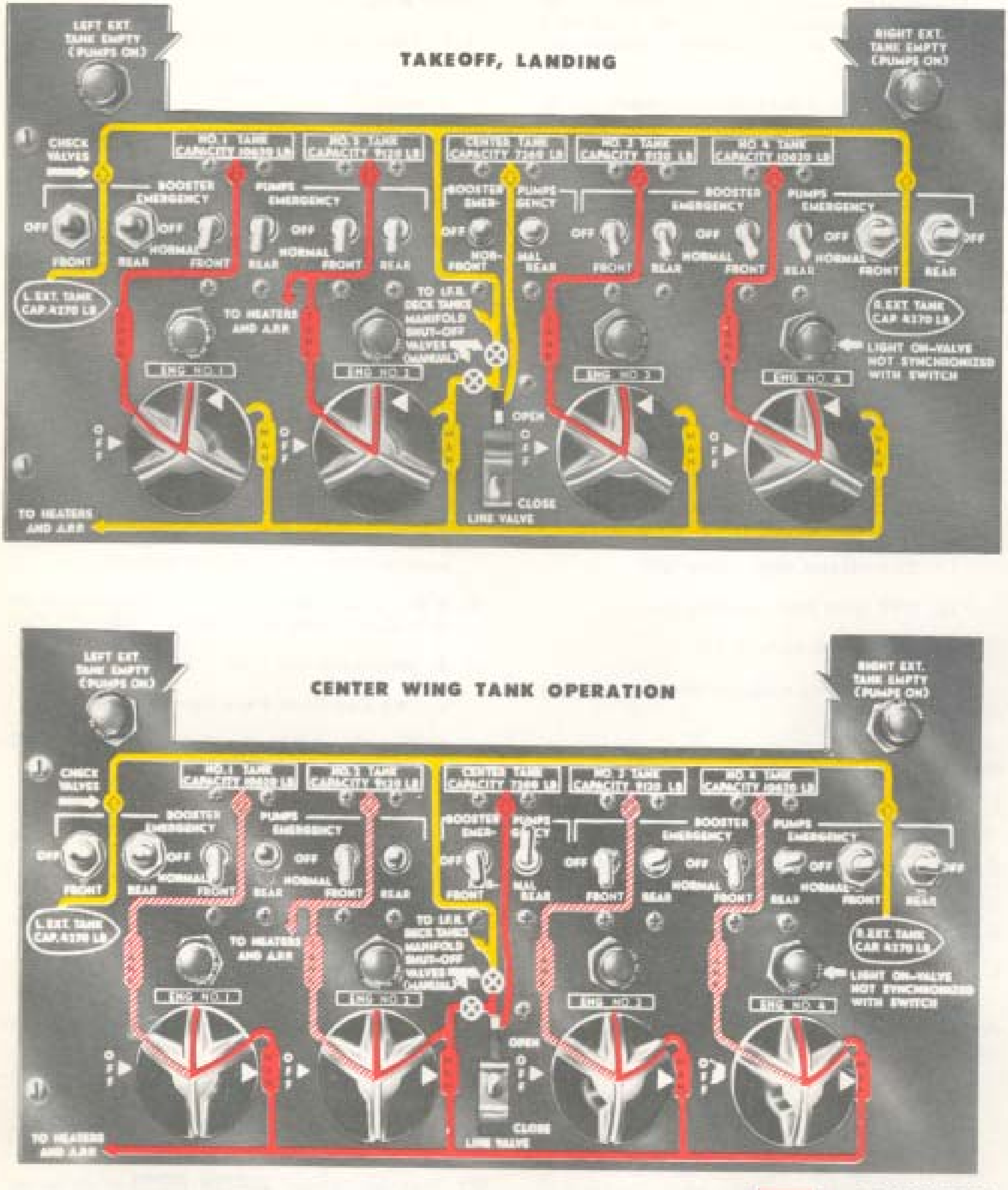
Engineer will coordinate with the pilot prior to beginning fuel management from the auxiliary fuel tanks. At any time other than tank to engine configuration, the pump operator's panel will be checked periodically with pump operator's A/R master switch on.

Center Wing Tank

1. Fuel Selector Switches - TE
2. Fuel Boost Pump Switches - One per tank on NORMAL
3. ▼3. A/R Transfer Valve Switches - Checked CLOSED
4. No. 3 Manual Fuel Shutoff Valve - ✈1C10 KGT507▶ - Visually checked CLOSED
5. ▼5. A/R Transfer Valves **17260** ▶ **22664** or Secondary Valves **22665** ▶ and External Tank Manifold Shutoff Valve **22665** ▶ - Visually checked CLOSED
6. No. 2 Manual Fuel-Shutoff Valve - Visually checked CLOSED.
7. CWT Fuel Boost Pump Switch - NORMAL
8. CWT Line Valve Switch - OPEN
9. No. 1 Manual Fuel-Shutoff Valve - Have OPENED
10. Fuel Selector Switch on One Engine - TME
11. CWT Fuel Boost Pump Switch - EMERGENCY (for 5 minutes to check for contaminated fuel)
12. If after 5 minutes all engine instruments indicate normal, move desired Fuel Selector Switches - TME
13. To Discontinue Use From CWT:
    a. CWT Fuel Boost Pump Switch - NORMAL
    b. No. 1 Manual Fuel-shutoff Valve - Have CLOSED
    c. CWT Line Valve Switch - CLOSED
    d. CWT Fuel Boost Pump Switch - OFF
14. Fuel Management - As required

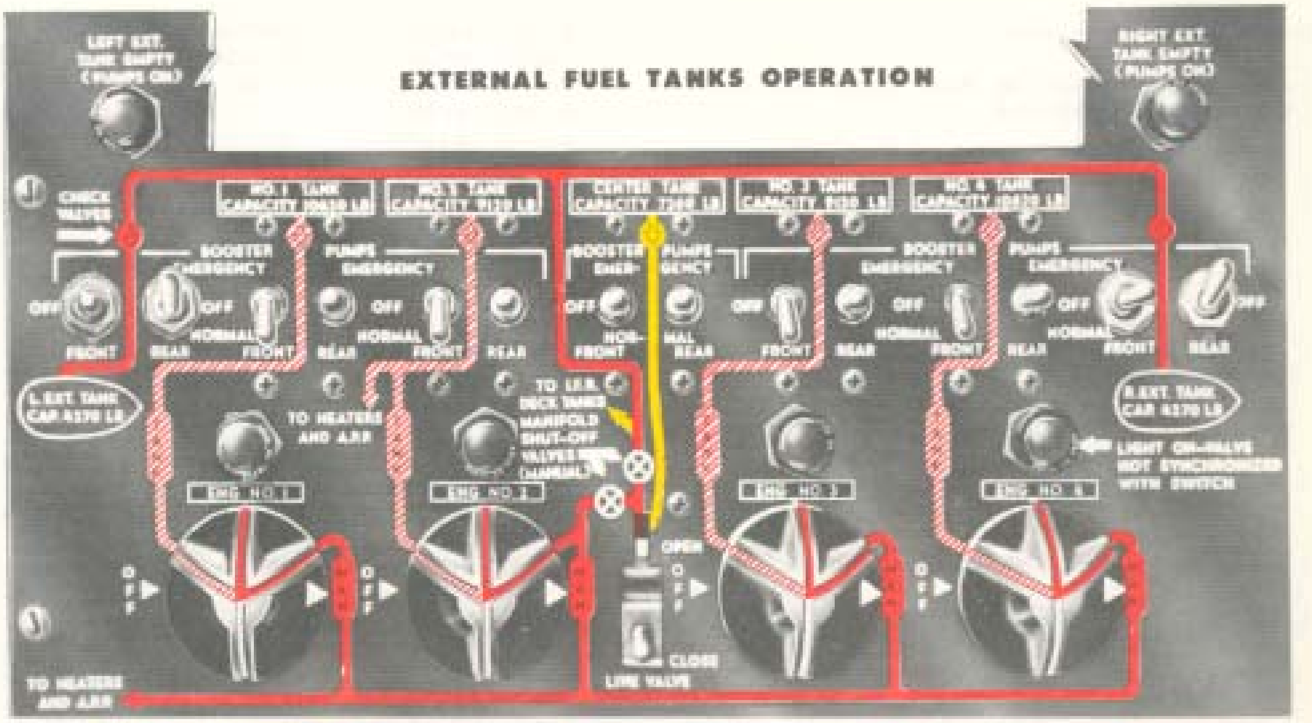
External Fuel Tanks

1. Fuel Selector Switches - TE
2. Fuel Boost Pump Switches - One per tank on NORMAL
3. ▼3. A/R Transfer Valve Switches - Checked CLOSED
4. No. 3 Manual Fuel Shutoff Valve - ✈1C10 KGT507▶ - Visually checked closed
5. ▼5. Transfer Valves **17260** ▶ **22664** or Secondary Valves **22665** ▶ and External Tank Manifold Shutoff Valve **22665** ▶ - Visually checked closed.



FUEL SYSTEM MANAGEMENT

Figure 7-9 (Sheet 1 of 2)



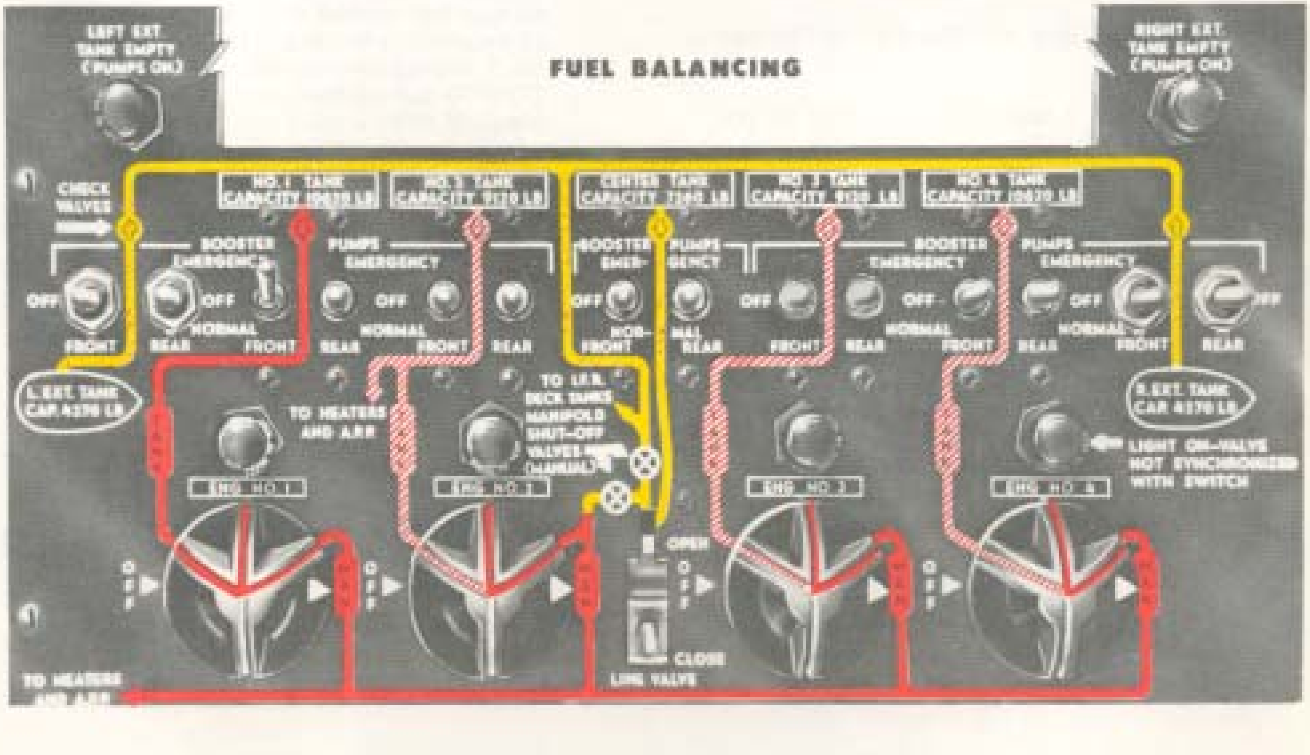


Figure 7-9 (Sheet 2 of 2)

External Fuel Tanks (Cont)

6. External Fuel Tank Fuel Boost Pump Switches - One per tank on NORMAL

NOTE

The external fuel tank low fuel flow warning lights are connected to fuel flow indicating check valves and will indicate an empty tank if the fuel flow drops below 6 gallons per minute. An indication of fuel flow may be obtained by turning the boost pumps on EMERGENCY for a moment, one tank at a time, and watching the fuel pressure gages closely for a momentary rise.

7. No. 1 and No. 2 Manual Fuel-shutoff Valves - Have OPENED
8. Fuel Selector Switch on One Engine - TME
9. External Fuel Tank Fuel Boost Pump Switches - One per External Fuel Tank on EMERGENCY (Operate from one tank at a time for 5 minutes to check for contaminated fuel.)
10. If after 10 minutes all engine instruments indicate normal, move desired Fuel Selector Switches - TME
11. External Fuel Tank Fuel Boost Pump Switches - One per External Tank on EMERGENCY
12. Discontinue use From External Fuel Tanks
    a. External Fuel Tank Fuel Boost Pump Switches - NORMAL
    b. No. 1 and No. 2 Manual Fuel-shutoff Valves - Have CLOSED
    c. External Fuel Tank Fuel Boost Pump Switches - OFF
13. Fuel Management - As Required

EXTERNAL FUEL TANK FUEL VALVE CHECK

1. If JP fuel is carried in the external fuel tanks and the center wing tank, the No. 1 manual fuel-shutoff valve will be CLOSED and safetied and the No. 2 manual fuel-shutoff valve will be CLOSED until required to be opened for fuel transfer
2. If 115/145 fuel is carried in the external fuel tanks and the center wing tank, check transfer valves CLOSED and No. 1 and No. 2 manual fuel-shutoff valves CLOSED until required to be opened for fuel transfer
3. If JP fuel is carried in external fuel tanks and 115/145 fuel is carried in center wing tank, No. 1 manual fuel-shutoff valve will be CLOSED until required to be opened for fuel transfer and No. 2 manual fuel-shutoff valve will be CLOSED and safetied

CAUTION

If JP fuel is carried in center wing tank, then 115/145 will not be used out of external fuel tanks for engine operation.

a. If JP fuel is carried in the external fuel tanks and the center wing tank, the No. 1 manual fuel-shutoff valve will be CLOSED and safetied and No. 2 manual fuel-shutoff valve will be CLOSED until required to be opened for fuel transfer and external fuel tank manifold shutoff valve will be CLOSED

b. If 115/145 fuel is carried in the external fuel tanks and the center wing tank, visually check transfer/secondary valves closed, both No. 1 and No. 2 manual fuel-shutoff valves will be CLOSED until required to be opened for fuel transfer and external fuel tank manifold shutoff valve will be CLOSED

c. If JP fuel is carried in external fuel tanks and 115/145 is carried in center wing tank, No. 1 manual fuel-shutoff valve will be CLOSED until required to be opened for fuel transfer, No. 2 manual fuel-shutoff valve will be CLOSED and safetied, and external fuel tank manifold shutoff valve will be CLOSED

FUEL TRANSFER (RANGE EXTENSION)

7C19 KC1507

NOTE

This procedure is for use with fuel system modification incorporating a range extension No. 3 manual fuel-shutoff valve and transfer line from the A/R manifold to the airplane manifold

WARNING

This procedure will only be used if the air refueling tanks and boom have been flushed and air refueling tanks serviced with airplane fuel.

Contamination Check TCTO KG1507

This procedure will not transfer any fuel to the wing tanks but is only a test for contamination. Accomplish during ground operation and in flight. When fuel is to be used from both forward and aft A/R system tanks, each tank will be checked separately for contamination.

CAUTION

Follow steps carefully in order given.

1. Fuel Selector Valve Switches - TE (E)
2. Main Fuel Tank Fuel Boost Pump Switches - One per tank on NORMAL (E)
3. SPR Secondary Valve Test Switch - Checked Closed (E)
4. No. 3 Manual Fuel-shutoff Valve - Manually OPEN (BO)
5. No. 6 A/R Hydraulic Valves - Manually CLOSED (BO)
6. No. 1 and No. 2 Manual Fuel-shutoff Valves - Check CLOSED (BO)
7. A/R Fuel Pump Selector Valve Handle - As required (BO)
8. One Inboard Fuel Selector Valve Switch - TME (E)
9. Selected Tank Fuel Boost Pump Switches - NORMAL (E)
10. Isodaulic Handle - Advance (E)

    Advance isodraulic handle until a definite rise in fuel pressure is noted on selected engine.

    CAUTION

    Limit A/R fuel pressure gage reading to 30 psi.

11. Monitor All Panel Instruments (especially selected engine) - 10 Minutes (P, E)

    WARNING

    If selected engine CHT rises, the exhaust becomes black or engine begins to run rough, immediately return isodraulic handle to OFF, fuel selector valve switch to TE and boost pump switches to NORMAL. If contamination is evident do not open any other fuel valves connecting the airplane manifold to airplane system tanks or engines until system is purged.

If after 10 minutes of operation all instruments are normal:

12. Isodraulic Handle - OFF (E)
13. Selected Fuel Selector Valve Switch - TE (E)
14. No. 6 A/R Hydraulic Valves - Manually OPEN (BO)
15. No. 3 Manual Fuel-Shutoff Valve - Manually CLOSED (BO)

Transfer from A/R Tanks to Airplane Tanks TCTO KG1507

NOTE

An interphone extension cord will be necessary to enable the boom operator or scanner to monitor interphone and operate the single point refueling panel and valves in the lower aft compartment.

1. SPR Panel
    a. Master Switch - OFF to Prevent Arcing When Connecting Plug
    b. Electrical Plug - Connect
    c. Master Switch - ON

       Press power on light, check illuminated

    d. Circuit Breakers - Set
    e. Secondary Valve Switches for Tanks Selected For Transfer - OPEN

       Check valve open light illuminated

2. Fuel Selector Valve Switches - TE
3. Main Fuel Tank Boost Pump Switches - One per tank on NORMAL
4. No. 3 Manual Fuel-Shutoff Valve - Manually OPEN
5. No. 6 Air Refueling Hydraulic Valves - Manually CLOSED
6. No. 1 and No. 2 Manual Fuel-Shutoff Valves - Manually CLOSED
7. A/R FUEL Pump Selector Valve Handle - As required

    NOTE

    Airplane cg will be affected by selection of air refueling pump.

8. Isodraulic Handle - Advance

CAUTION

- Limit air refueling pressure gage reading to 30 psi.
- Do not fill any tank above the following levels:

  Tanks 1 and 4 - 9700 lb

  Tanks 2 and 3 - 8200 lb

  Center wing tank - 6200 lb

Transfer termination:

9. Isodraulic Handle - Retard
10. Secondary Valve Switches - CLOSED When Above Noted Quantity or Less is Reached in Each Tank, Valve Closed Light Illuminated

    The engineer will monitor the fuel quantity gages and instruct the boom operator to close the secondary valves when the above noted quantity, or less, if desired, is reached.

    NOTE

    Before the last secondary valve switch is closed, retard the air refueling pump control handle to OFF to avoid possible pressure surge.

11. No. 6 A/R Hydraulic Valves - Manually OPEN
12. No. 3 Manual Fuel-Shutoff Valve - Manually CLOSE
13. SPR Panel
    a. Secondary Valve Switches - All CLOSE
    b. Master Switch - OFF
    c. Electrical Plug - Disconnect and stow (BO)
14. Fuel Management - As required

GRAVITY TRANSFER FROM A/R DECK TANKS TO AIRPLANE MANIFOLD

WARNING

- Use of this procedure is an exception and should be used only with extreme caution.
- This procedure should never be attempted when the air refueling tanks contain less than 1000 gallons each, or this fuel is contaminated with fuel other than grades 115/145 or 100/130. Each air refueling tank must contain at least 1000 gallons of fuel or the engines will not be adequately supplied with fuel.

1. Fuel Boost Pump Switch in Each Main Fuel Tank (at least one) - NORMAL
2. All Fuel Selector Switches - TE
3. If Fuel From the CWT is Being Used:
    a. CWT Boost Pump Switches - OFF
    b. CWT Line Valve Switch - CLOSED
4. External Fuel Tank Fuel Boost Pump Switches - Check OFF
5. Fuel Selector Switch for One Inboard Engine - TME
6. No. 3 Manual Fuel-Shutoff Valve - CLOSED
7. No. 1 Manual Fuel-Shutoff Valve - Have Opened
8. No. 2 Manual Fuel-Shutoff Valve - Have Opened
9. Engineer's A/R Master Switch - ON
10. A/R Transfer Valve Switches - OPEN
11. FWD and AFT Transfer Valve Circuit Breakers (on the engineer's A/R panel) - Pull
12. Transfer Valves **17260** ▶ **22664**, or Secondary Valves and External Tank Manifold Shutoff Valve **22665** ▶ - Checked OPEN

13. CWT Secondary Valve - Closed (visually checked closed)

14. Fuel Boost Pump Switches for the Selected Inboard Tank - OFF

15. Fuel Selector Switch for the Selected Inboard Engine - ME

16. Monitor All Engine Instruments Carefully for 10 Minutes, Especially Those for the Selected Inboard Engine

WARNING

If, on the selected inboard engine, the CHT begins to rise (and the other CHT's do not), the exhaust becomes black or the engine begins to run rough, immediately return the engine fuel selector switch to the TE position and turn the fuel boost pump switches to the NORMAL position. The above are indications of contaminated fuel.

17. If, After 10 Minutes Operation, All Engine Instruments Indicate Normally:

    a. Desired Fuel Selector Switches - ME

    b. Affected Main Fuel Tank Fuel Boost Pump Switches - OFF

18. All Engine and A/R Panel Instruments - Monitor Carefully During Operation

NOTE

- Fuel low pressure warning light flicker and engine torque fluctuations can be expected particularly on the outboard engines and especially above 10,000 feet altitude. To minimize fuel low pressure warning light flicker and engine torque fluctuations, maintain level flight throughout this procedure and limit any climbs, glides and banks to shallow attitudes.

- In the event of excessive fuel low pressure warning light flicker and/or engine torque fluctuations, terminate this procedure,

- Monitor the A/R fuel quantity gages and control fuel distribution to prevent undesirable cg conditions.

19. Termination of Procedure:

    Selector valves will be turned TE one at a time

    a. Main Wing Tank Fuel Boost Pump Switches - One on NORMAL

    b. Fuel Selector Switches - TE (or as required)

    c. Follow a and b for each following engine

    d. A/R Transfer Valve Circuit Breakers (on engineer's A/R Panel) - IN

    e. A/R Transfer Valve Switches - CLOSED

    f. No. 1 Manual Fuel-Shutoff Valve - Have Closed

    g. No. 2 Manual Fuel-Shutoff Valve - Have Closed

    h. Transfer Valves 17260 ▶ 22664 ,,or Secondary Valve and External Fuel Tank Manifold Shutoff Valve 22665 ▶ - Checked CLOSED

20. Fuel Management - As Required

FUEL TRANSFER TO A/R TANKS

NOTE

Engineer will coordinate with the pilot on all fuel transfer operations.

WARNING

When carrying fuel other than uncontaminated grade 115/145 or 100/130 in the CWT, the No. 1 manual fuel-shutoff valve must be safety wired in the closed position. When carrying fuel other than uncontaminated grade 115/145 or 100/130 in the external fuel tanks but not in the CWT, the No. 2 manual fuel-shutoff valve must be safety wired in the closed position. This is to prevent contamination of the airplane fuel system. When it is desired to use these fuel tanks for the airplane system, all contaminated fuel must be drained and flushed out before refilling with grade 115/145 or 100/130 fuel. Simultaneous transfer from external fuel-tanks which contain JP-4 fuel and main airplane fuel tanks to the A/R tanks will cause fuel contamination if any engine fuel valve selector is on TME as the external fuel tank booster pump is set at a higher pressure than the main tank booster pump.

CWT to A/R Tanks

1. A/R Transfer Valve Switches - Check CLOSED
2. No. 3 Manual Fuel Shutoff Valve - CLOSED 1CTO KG1507
3. Transfer Valves, or Secondary Valves and External Fuel Tank Manifold Shutoff Valve - Have Visually Checked Closed and Not Safety Wired
4. No. 1 Manual Fuel-Shutoff Valve - Have Checked Closed
5. No. 2 Manual Fuel-Shutoff Valve - Have Opened
6. Engineer's A/R Master Switch - ON
7. CWT Fuel Boost Pump Switches - EMERGENCY (or as desired)
8. CWT Line Valve Switch - OPEN
9. A/R Transfer Valve Switches - OPEN (as desired)
10. Termination of Procedure:
    a. A/R Transfer Valve Switches - CLOSED
    b. CWT Fuel Boost Pump Switches - OFF
    c. CWT Line Valve Switch - CLOSED
    d. No. 2 Manual Fuel-Shutoff Valve - Have Closed
    e. Transfer Valves 17260 ▶ 22664, or Secondary Valves and External Fuel Tank Manifold Shutoff Valve 22665 ▶ - Have Visually Checked Closed
    f. Engineer's A/R Master Switch - OFF (if desired)

External Fuel Tanks to A/R Tanks

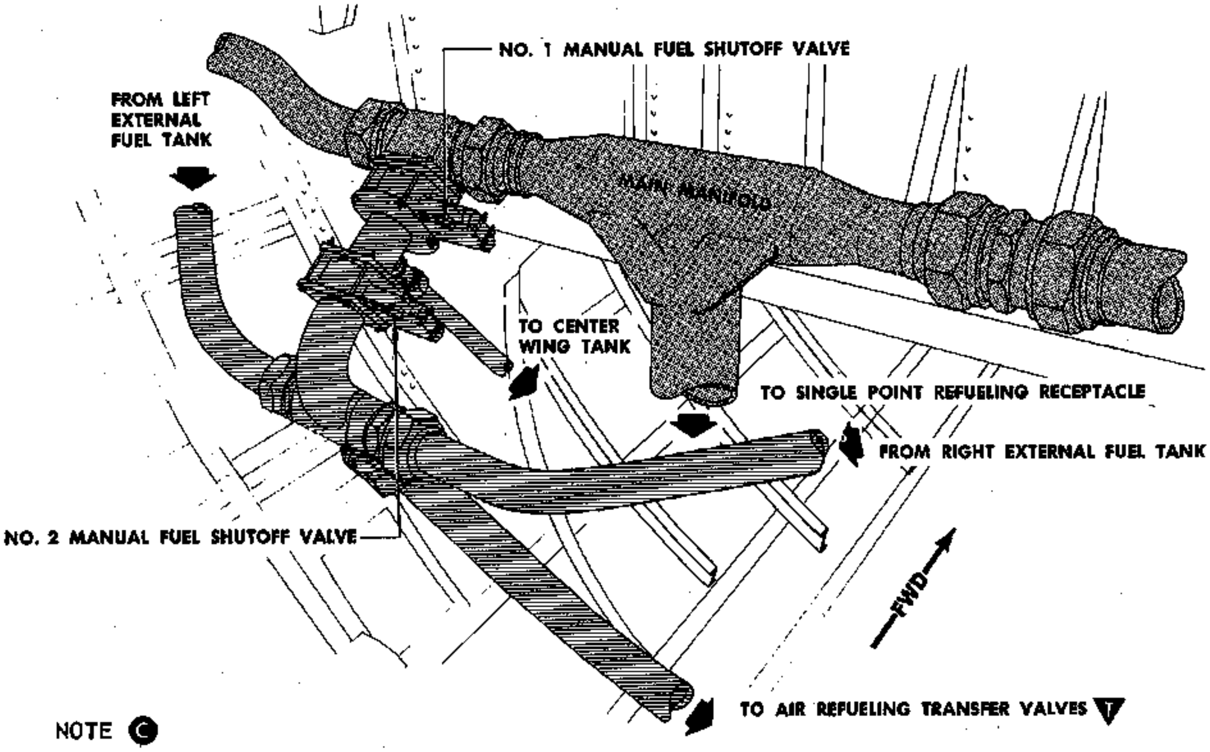
1. A/R transfer Valve Switches - Check CLOSED
2. No. 3 Manual Fuel-Shutoff Valve - CLOSED 1CTO KG1507
3. Transfer Valves 17260 ▶ 22664, or Secondary Valves and External Fuel Tank Manifold Transfer Valve 22665 ▶ - Have Visually Checked Closed and Not Safety Wired
4. No. 1 Manual Fuel-Shutoff Valve - Have Checked Closed
5. No. 2 Manual Fuel-Shutoff Valve - Have Checked Closed
6. Engineer's A/R Master Switch - ON
7. External Fuel Tank Fuel Boost Pump Switches - EMERGENCY (or as desired)
8. A/R Transfer Valve Switches - OPEN (as desired)
9. Termination of Procedure:
    a. A/R Transfer Valve Switches - CLOSED
    b. External Fuel Tank Fuel Boost Pump Switches - OFF
    c. Transfer Valves 17260 ▶ 22664, or Secondary Valves and External Tank Manifold Shutoff Valve 22665 ▶ - Have Visually Checked Closed
    d. Engineer's A/R Master Switch - OFF (if desired)

Main Fuel Tanks to A/R Tanks

WARNING

If the CWT and/or the external Fuel tanks contain fuel other than grades 115/145 or 100/130 the following sequence of operation should be rigidly adhered to:

1. A/R Transfer Valve Switches - Check CLOSED
2. No. 3 Manual Fuel-Shutoff Valve - CLOSED 1CTO KG1507
3. Transfer Valves 17260 ▶ 22664, or Secondary Valves and External Fuel Tank Manifold Shutoff Valve 22665 ▶ - Have Visually Checked Closed and Not Safety Wired
4. No. 1 Manual Fuel-Shutoff Valve - Have Checked Closed
5. No. 2 Manual Fuel-Shutoff Valve - Have Opened
6. Engineer's A/R Master Switch - ON
7. External Fuel Tank Fuel Boost Pump Switches - Check OFF
8. CWT Fuel Boost Pump Switches - Check OFF
9. CWT Line Valve Switch - Check CLOSED
10. CWT Line Valve - Have Visually Checked CLOSED
11. CWT SPR Secondary Valve - Have Visually Checked Closed (always mandatory for this procedure)
12. Desired Main Fuel Tank Fuel Selector Switches - TME

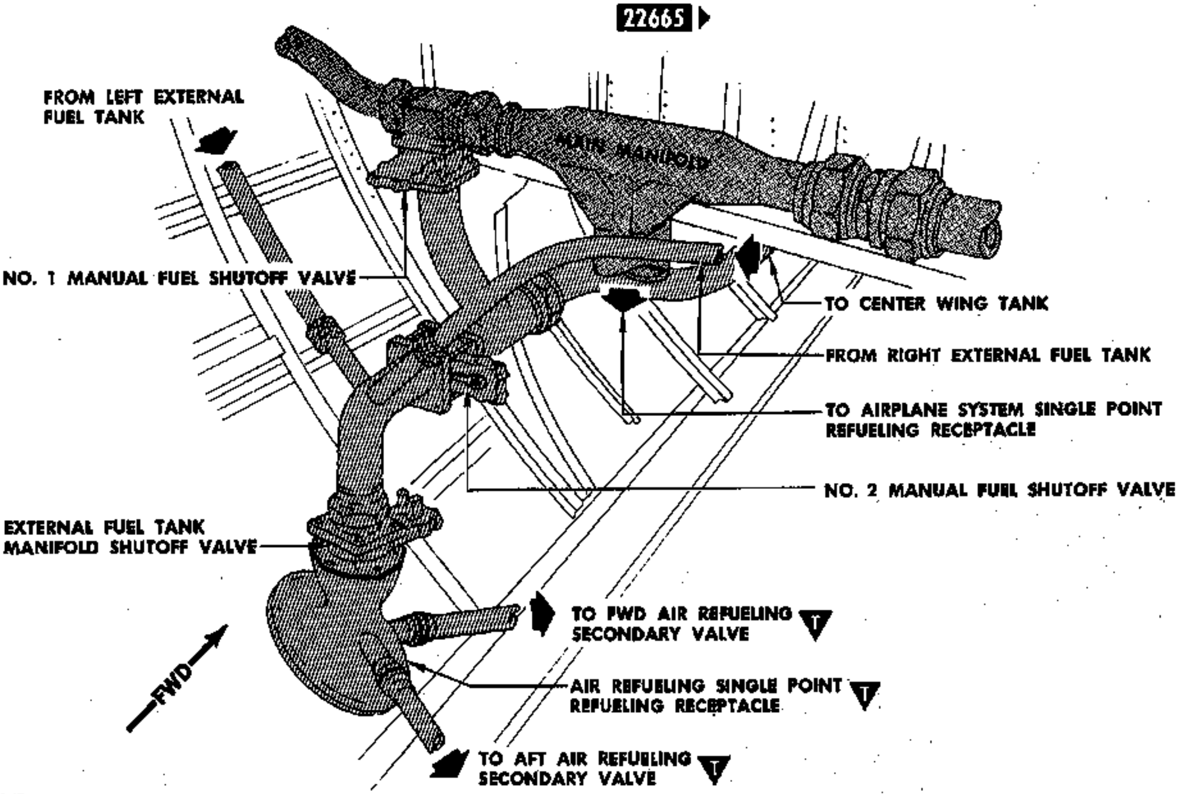


NOTE Ⓒ

Manual fuel-shutoff valves should be open at all times

17260 ▶ **22664**

22665 ▶



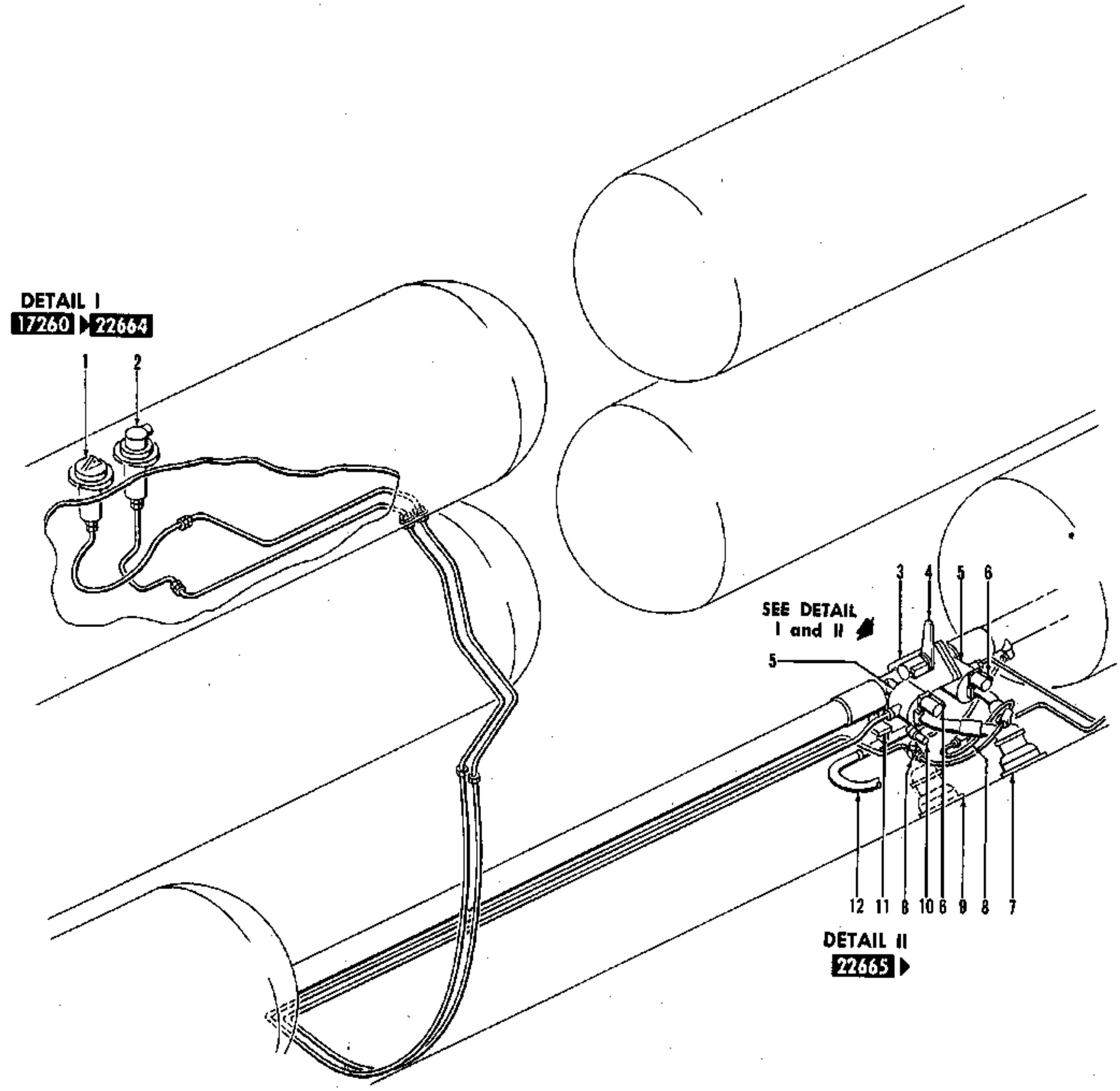
▩ AIRPLANE MAIN FUEL MANIFOLD

▨ AUXILIARY AND/OR AIR REFUELING LINES

VIEWS IN LOWER AFT COMPARTMENT

FUEL SYSTEMS INTERCONNECTION

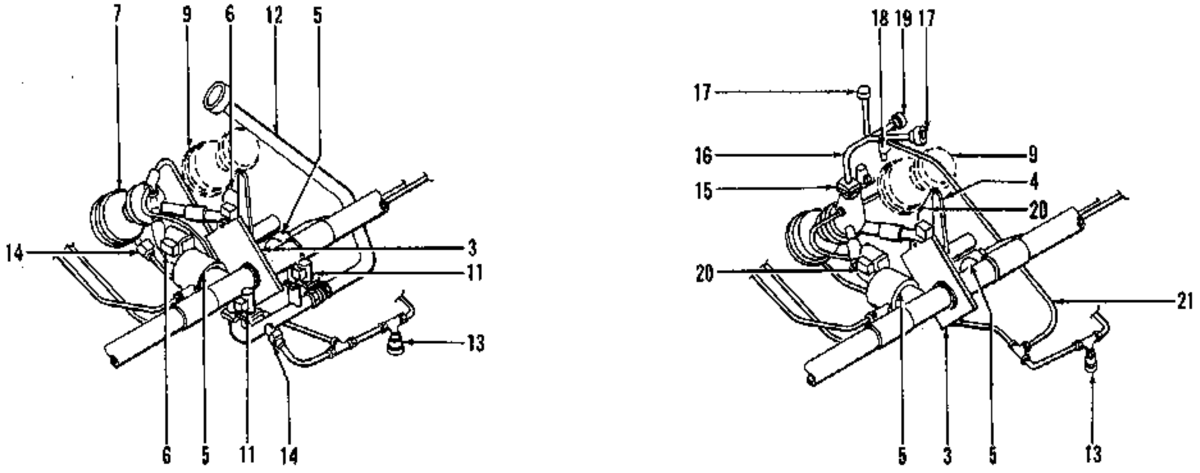
Figure 7-10 (Sheet 1 of 3)



1 PRIMARY FUEL LEVEL FLOAT VALVE
2 SECONDARY FUEL LEVEL FLOAT SWITCH
3 FUEL LEVELING VALVE
4 LEVELING VALVE MANUAL CONTROL ARM
5 PRIMARY SHUTOFF VALVE
6 SECONDARY SHUTOFF VALVE
7 AIR REFUELING SINGLE POINT REFUELING PORT
8 SECONDARY FLOAT SWITCH TEST VALVE
9 MAIN FUEL SYSTEM SINGLE POINT REFUELING PORT
10 THERMAL RELIEF VALVE
11 TRANSFER VALVE 17260 ▶ 22664
12 LINE TO MAIN FUEL SYSTEM MANIFOLD AND TO EXTERNAL WING TANKS 17260 ▶ 22664
13 FILLER PORTS AND TRANSFER LINE OVERBOARD DRAIN
14 DRAIN LINE SHUTOFF VALVE
15 EXTERNAL TANK SHUTOFF VALVE 22665 ▶
16 TRANSFER LINE
17 EXTERNAL WING TANK LINE
18 THERMAL RELIEF VALVE 22665 ▶
19 LINE TO AIRPLANE FUEL SYSTEM MANIFOLD 22665 ▶
20 SECONDARY TRANSFER VALVE 22665 ▶
21 THERMAL RELIEF LINE

FUEL SYSTEMS INTERCONNECTION (CONT)

Figure 7-10 (Sheet 2 of 3)



DETAIL I

17260 ▶ 22664

DETAIL II

22665 ▶

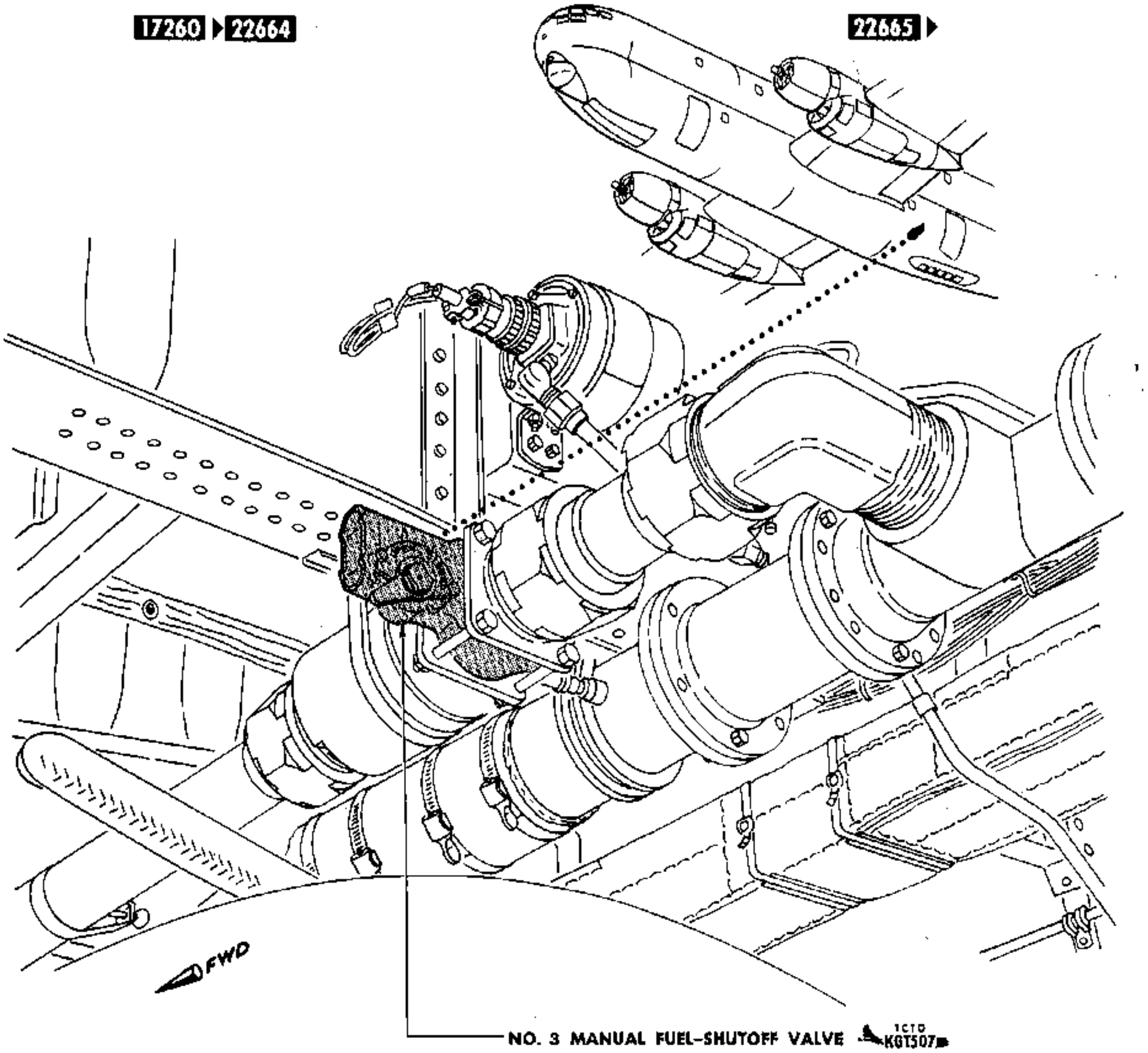


Figure 7-10 (Sheet 3 of 3)

13. Fuel Boost Pump Switches (in each desired main fuel tank):

    a. One - NORMAL

    b. One - EMERGENCY

CAUTION

If a fuel boost pump circuit breaker trips, move the corresponding fuel boost pump switch to NORMAL before resetting circuit breaker. Do not hold the circuit breaker in. Do not return this boost pump switch to the EMERGENCY position during this operation. This will prevent overheating the fuel boost pump.

14. No. 1 Manual Fuel Shutoff Valve - Have Opened

15. A/R Transfer Valve Switches - OPEN (as desired)

WARNING

- This transfer operation can cause the fuel low pressure warning lights to illuminate due to insufficient engine driven fuel pump inlet pressure. If this occurs, terminate transfer of fuel from the main fuel tanks to the A/R tanks; or if transfer of fuel from the main fuel tanks to the A/R tanks is still necessary, have the No. 1 manual fuel-shutoff valve moved toward the closed position until the fuel low pressure warning lights go out and engine torque fluctuation ceases. Partially closing the No. 1 manual fuel-shutoff valve will reduce the rate of fuel transfer from the main fuel tanks the A/R tanks.

- When transferring fuel from the main fuel tanks to the A/R tanks, care must be taken to retain sufficient fuel in the main fuel tanks for a safe landing.

16. Termination of Procedure:

    a. A/R Transfer Valve Switches - CLOSED

    b. No. 1 Manual Fuel-Shutoff Valve - Have Closed (always mandatory for this procedure)

    c. No. 2 Manual Fuel-Shutoff Valve - Have Closed

    d. Transfer Valve 17260 ▶ 22664, or Secondary Valves and External Tank Manifold Shutoff Valve 22665 - Have Visually Checked Closed

    e. Main Wing Fuel Boost Pump Switches - NORMAL (or as required)

    f. Engineer's A/R Master Switch - OFF (if desired)

17. Fuel Management - As Required

DEFUELING AND RECOVERY

Ground Fuel Transfer

The A/R tanks can be defueled on the ground through the boom directly into the receiver receptacle or filler ports of an airplane or into a fuel truck. A ground fuel transfer hose and desired fittings are necessary to connect the boom to an airplane. Power for the operation is obtained from hydraulic and electric supply carts, or the airplane engines if carts are not available.

NOTE

When airplane power is used for transfer, both outboard engines are operated at 1000 rpm for electrical and hydraulic power. The number of engines operated depends upon the rate of transfer desired. Inboard engines are operated for hydraulic power to assure proper braking. On airplanes 22737 ▶ the inboard engines also supply hydraulic pressure to the motor-pump combination for pressurizing the boom hydraulic system.

1. Position tanker in the same relative position used in aerial contact in front of receiver airplane, and close enough to connect ground fuel transfer hose

WARNING

Before and during fuel transfer operations all units should be statically grounded and all fire precautions complied with in order to reduce the fire hazard to a minimum. Portable fire extinguishers should be readied if a fire truck is not available.

2. Connect external power sources, or if not available, start airplane engines

3. Place the boom operator's and engineer's A/R master switches in the ON position, the main inverter switch in the ESS INV position, the secondary inverter switch to SEC INV position, and the telescope-at-disconnect switch in the MANUAL position

4. Lower the boom to within reach of the ground and extend approximately 12 feet

CAUTION

If available, an adjustable padded dolly should follow movement of the boom whenever it is raised or lowered during ground operation in case malfunction of the hoist system should occur.

5. Connect fuel transfer hose to boom and receiver airplane, air refueling receptacle or filler ports

NOTE

A force greater than 100 pounds is necessary to fully bottom nozzle against spring loaded sliding valve in receptacle. It may be necessary to actuate receptacle signal switch manually in order to engage toggle arms.

CAUTION

Care must be taken with dummy receptacle and spare nozzle to prevent scratches and nicks that will result in fuel leakage.

6. Advance signal system to MADE condition, and commence fuel flow by slowly moving the fuel pump control handle in INCREASE direction

CAUTION

Although a flow of 600 gpm is possible when transferring fuel into a receiver airplane through the air refueling receptacle, when using a nozzle to transfer fuel into airplane filler ports or a fuel truck, it is necessary to use a much lower rate of flow to avoid damage to hose.

NOTE

If it is desired to operate one A/R pump, operate the aft pump to prevent a tail-heavy condition. After approximately two thirds of the aft tank capacity has been removed, open the leveling valve and continue defueling until tanks are empty.

7. When tanks are empty, move fuel pump control handle fully to DECREASE, return air refueling signal system to normal and remove ground fuel transfer hose. Retract and stow the boom, place the boom operator's and engineer's air refueling switches in the OFF position

8. If external power supply was used, switch main inverter switch to the OFF position, secondary inverter switch to OFF position, and disconnect external power. If airplane power was used, shut-down engines if not required to supply power to receiver airplane

Recovery

On the ground airplanes with KC10 K521 are capable of supplying dc power to a receiver airplane. The feature is intended primarily for use with B-47 airplanes when other external power sources are not available. The airplane should be positioned in front of the receiver airplane in the same relative position as used in aerial contact.

1. Check external power reset switch on forward power panel positioned to RESET

2. Connect power cable to dc external power receptacles on both airplanes.

CAUTION

To supply starting current to receiver airplane both adjacent dc external power receptacles must be used.

3. Start engines

4. Position external power relay switch to EXT PWR

NOTE

Use only essential electrical services during period receiver airplane is starting engines.

After receiver airplane engines have started, switch external power relay switch to RESET and remove power cable.

WARNING

When using this procedure in conjunction with fuel transfer, extreme care must be taken to avoid the possibility of fire, as arcing may occur should the power cable be connected or disconnected without first insuring that electrical power has been removed from the DC external power receptacle.

OIL SYSTEM

OIL TRANSFER OPERATION

To replenish the engine oil tanks while in flight, the oil tank selector switch is set to the desired tank to be refilled and the oil transfer pump switch is held in the ON position until the desired quantity is reached. Turn the tank selector switch to the next tank to be filled and repeat the procedure. Return the tank selector switch to OFF when the oil transfer operation is completed.

NOTE

- The oil transfer pump transfers oil at a rate of 6 gallons per minute. Do not operate the pump longer than 8 minutes without a cooling period.
- When a pronounced oil pressure drop or fluctuation occurs anytime during engine operation, one gallon of oil will be transferred into the engine oil tank immediately. This will aid in improving oil scavenging and decrease aeration.

When oil dilution is to be performed for more than 7 minutes, make certain that the engine oil tanks are not filled to more than 24 US gallons.

NOTE

During level flight, replenish the tank when the engine oil quantity gage indicates 15 gallons.

CAUTION

- Above altitudes of 15,000 feet do not fill the engine oil tanks above 24 gallons. This will prevent the tanks from overfilling during descent as a result of increased scavenging at low altitudes. If tank level is maintained at 24 gallons or less, no expansion or scavenging problems will be experienced.
- Due to the nose down attitude, in descent the engine may swallow quantities of oil up to 20 gallons which will return to the tank when the airplane is in level flight again. If the tank is replenished while this oil is in the engine, it is possible to force large quantities of oil out of the vent and collapse the turbosupercharger oil tank when oil is returned to the engine oil tank. Therefore, during or immediately following a descent, when the tank level is 10 gallons, replenish to a maximum of 20 gallons.

ELECTRICAL SYSTEM

DIRECT CURRENT POWER SYSTEM

Average DC electrical loads and the number of generators required to meet these loads for various operating conditions are shown in figure 7-12. Major d-c electrical loads are listed in figure 7-11. This table can be used as a guide to determine how many units can be operated in case of partial failure of the d-c power generation system.

Direct Current Power System Battery

The battery can be charged at any time, whether on the ground or in flight, by placing the battery switch in the BAT CHG. position. The switch should be left on BAT CHG. during flight to assure a fully charged battery in an emergency. The life and capacity of a fully charged battery is greater than that of an undercharged battery. Charging current flows from the power distribution circuit through the reverse current relay to the battery. However, any flow of current from the battery to the power distribution circuit would be interrupted by opening of the reverse current relay thus preventing the battery from supplying any power to the normal distribution system. To determine battery voltage, place the battery switch in the OFF position, before placing the DC voltage selector switch in the BAT position. This is necessary because whenever the battery switch is in the BAT CHG. position the reading will show bus voltage. For further information see ELECTRICAL SYSTEM, Section I.

ALTERNATING CURRENT POWER SYSTEM

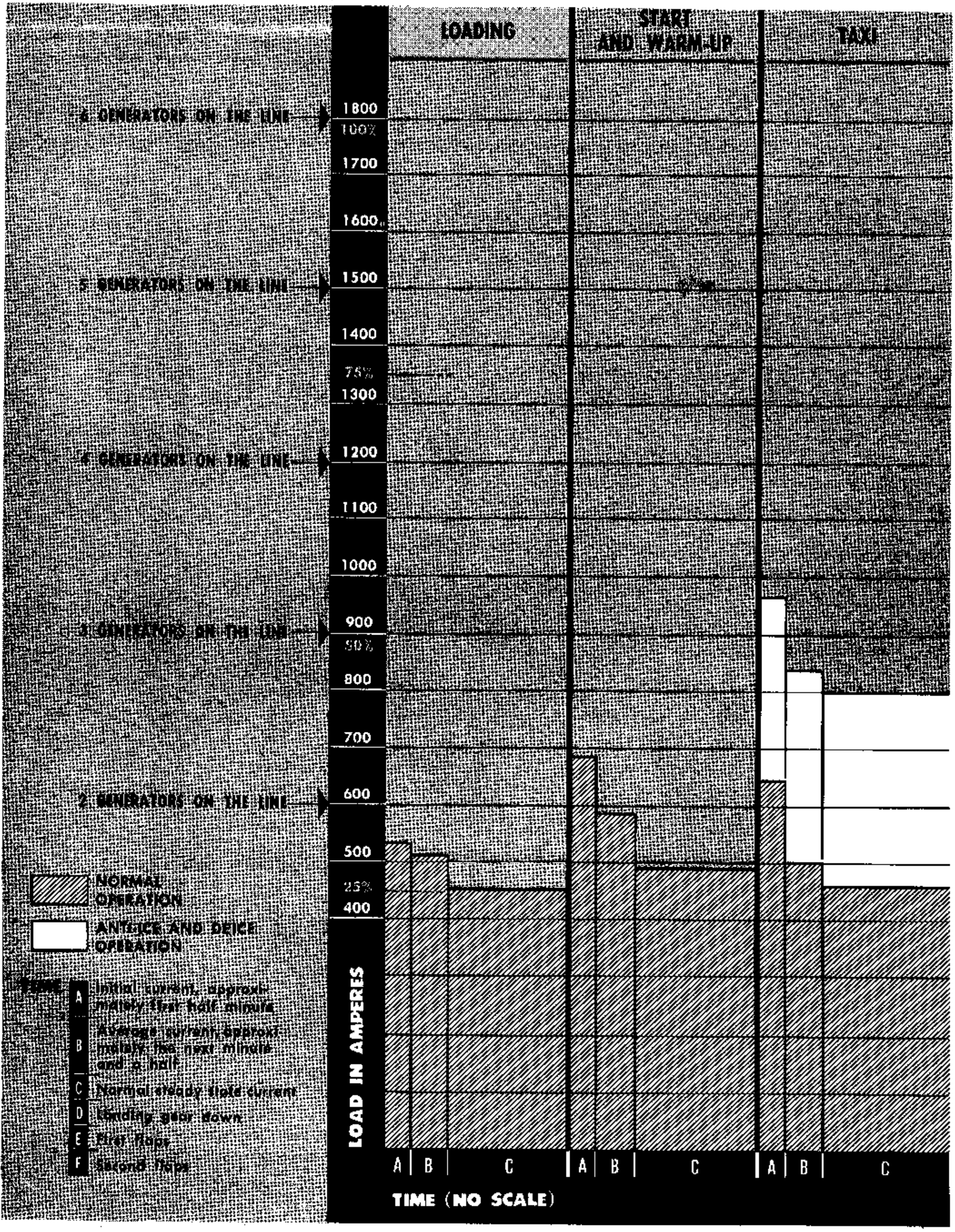
The output from each alternator passes through the voltage regulator. The voltage regulators are used to excite the alternator fields and to maintain constant alternator output voltage. If an unregulated high voltage from the alternator occurs, the probable cause is a defect

EQUIPMENT	NO. UNITS	AMPS PER UNIT	START TAXI	TAKE OFF CLIMB	CRUISE	LANDING
Anti-Icing						
Empennage Ground Blowers	1 Combustion	7				
	1 Ventilating	20	27			27
Propeller Deice	4	279	279	279	279	279
Electrical Power						
Autopilot Inverter	1 1 Spare	42	42	42	42	42
DC Generator Field	6	7	42	42	42	42
Main Inverters	2 1 Spare					
Essential	1		107	107	150	150
Secondary	1		68	92	147	94
Engine Controls						
Prop Feathering and Reversing	4	137				
Carb. Air Actuator	4	17			68	
Carb. Preheat Actuator	4	2.5			10	
Cowl Flap Motors	4	17	69	69	69	69
Prop Throttle Lock	1	24				24
Starter Motors	4	200	205			
Flight Controls						
Wing Flap Motor	1	160 Extend 170 Retract	165	175		165
Fuel and Oil						
ADI Pumps	2	15		30		
Fuel Boost Pumps	8	10 Normal 25 Emergency		83	42	
Fuel Valves	12	0.55	11	11	11	11
Hot Fuel Prime Heaters TCTO 595	4	300 HIGH, 150 LOW	300			
Oil Transfer Pump	1	140 Normal 160 Surge			141	
Heating and Ventilating						
Cabin Fans	2	6	12	12	12	12
Ground Blowers	2	42	85			85
Suit Heaters **17260** ▶ **2859**	5	16				
Landing Gear						
Main Gear Motors	2	235 Extend 260 Retract		412		470
Nose Gear Motor	1	129 Extend 92 Retract		92		129
Lighting						
Control Lamps	79	0.2 to 0.8	20	10	10	10
Dome Lights	16	0.8	13	13	13	13
Landing Lights	2	22	48			48
Taxi Lights	2	5	11			11
Wheel Well Lights	3	2	10			10
Radio						
Auxiliary Liaison Receiver	1	10	10	10	10	
Command	1	20	20	20	20	
Interphone	1	15	15	15	15	15
Liaison	1	59	22	22	59	22
UHF Command	1	17	17	17	17	17
Visual-Omni Range	1	15			15	15
▼ **Air Refueling**						
Ruddevator Anti-ice **17260** ▶ **3249** Without TCTO K509	2	236			472	
Fuel Boost Pumps (Center Wing and Ext Fuel Tanks)	6	32.5			199	

(Loads less than 1% of three generator capacity are not included in this chart)

ELECTRICAL LOADS

Figure 7-11



DC ELECTRICAL LOADS

Figure 7-12 (Sheet 1 of 2)

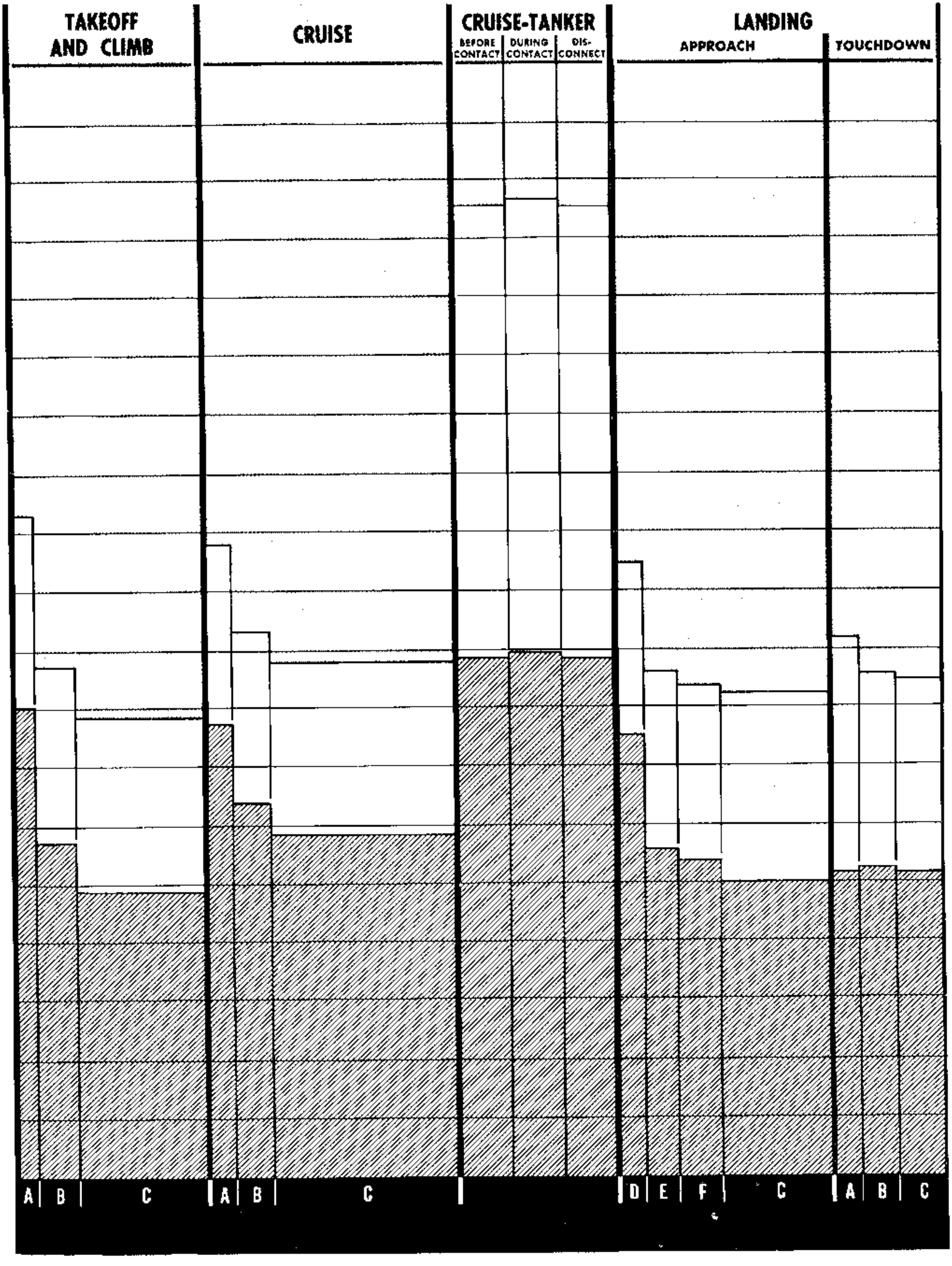
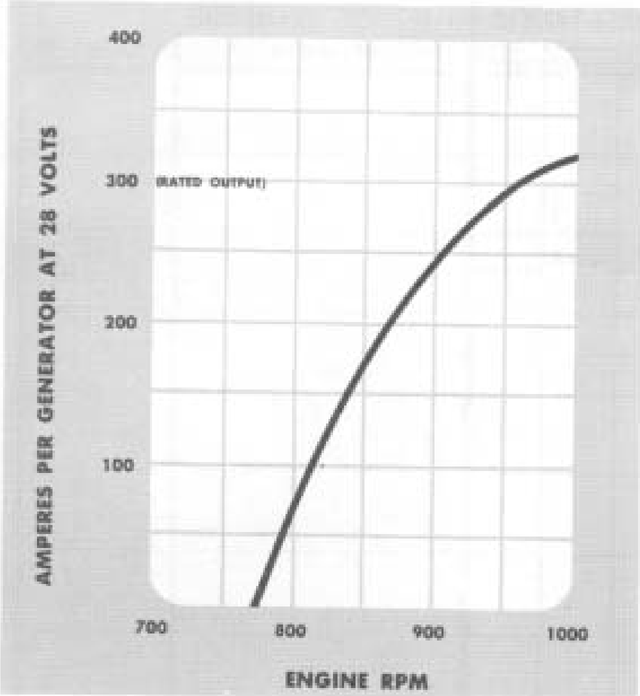


Figure 7-12 (Sheet 2 of 2)



GENERATOR OUTPUT VS ENGINE SPEED

Figure 7-13

shorting out the carbon pile of the voltage regulator. The defect can be in the regulator or in the exciter leads to the regulator.

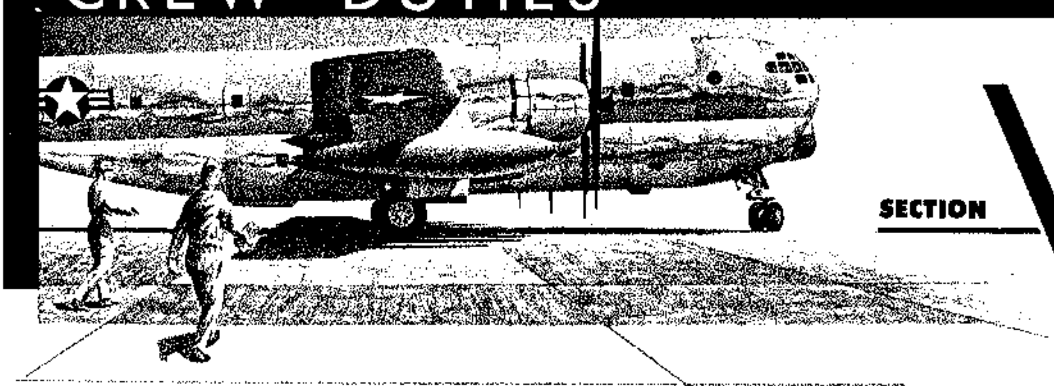
CAUTION

- If this condition exists, the wires to the voltage regulator are to be disconnected. Extreme caution should be exercised while disconnecting the wires, as these wires are "hot." Failure to pull the wires to the voltage regulator could result in possible fire or damage to equipment connected to the alternator bus. Turning off the alternator switch will not stop the overvoltage.
- Wait one minute after turning an alternator off before switching it back on. Always switch the alternators off when engine is stopped.

USE OF LANDING WHEEL BRAKES

Incorrect operation of brakes results in undue wear of the brake mechanisms and tires, adding to the maintenance difficulties and increasing the risk of accident due to brake and tire failures. It is necessary that the airplane brakes be treated with respect, but while use of the brakes should not be avoided, braking should be kept to a minimum and used gently whenever possible. When landing this airplane, brakes should normally be applied when the speed has been reduced to 60 mph (52 knots), however, fullest use should be made of remaining runway to avoid harsh usage of brake. It should always be born in mind that brakes can only stop the wheel from turning, but stopping the airplane is dependent on the friction of the tires on the runway. To further understand this it is easier to think in terms of coefficient of friction which is equal to the frictional force divided by the load on the wheel. Tests indicate that optimum braking occurs with approximately a 15 to 20 percent rolling skid; i.e. the wheel continues to rotate but has approximately 15 to 20 percent slippage on the surface so that the rotational speed is 80 to 85 percent of the speed which the wheel would have if it were free to roll. As the amount of skid increases beyond this amount, the coefficient of friction decreases rapidly so that with a 75 percent skid, the friction is approximately 60 percent of the optimum and, with a full skid, becomes even lower. There are two reasons for this loss in braking effectiveness with skidding. First, the immediate action is scuffing the rubber, tearing off little pieces which act almost like rollers under the tire. Second, the heat generated starts to melt the rubber and the molten rubber acts as a lubricant. NACA figures have shown that for an incipient skid with an approximate load of 10,000 lb per wheel, the coefficient of friction on dry concrete is as high as 0.8, whereas the coefficient is approximately 0.5 or less with a 75 percent skid. Therefore, if one wheel is locked during application of brakes there is a very definite tendency for the airplane to turn away from that wheel and continued or increased brake pressure will offer no corrective action. Since the coefficient of friction goes down when the wheel begins to skid, it is apparent that a wheel, once locked, will never free itself until brake pressure is reduced enough so that the effect of the wheel brakes is less than the friction of the runway. Continuous braking from the point of touchdown will cause excessive wear and extreme heating of the brakes. For short landing rolls, a single, smooth application of the brakes with constantly increasing pedal pressure is most desirable. This procedure applies equally well for operation on emergency braking systems. It is recommended that a minimum of 15 minutes elapse between landings where the landing gear remains extended in the slip stream, and a minimum of 30 minutes between landings where the landing gear has been retracted to allow sufficient time for cooling between brake applications. Additional time should be allowed for cooling if brakes are used for steering, cross-wind taxiing operation, or a series of landings are performed. After the brakes have been used excessively for an emergency stop and are in the heated condition, the airplane should not be taxiied into a crowded parking area or the parking brakes set. Peak temperatures occur in the wheel and brake assembly from 5 to 15 minutes after a maximum braking operation. To prevent brake fire and possible wheel assembly explosion, the specified procedures for cooling brakes should be followed. The brakes should not be dragged when taxiing, and should be used as little as possible for turning the airplane on the ground.

CREW DUTIES



SECTION VIII

TABLE OF CONTENTS

INSTRUCTIONS

The KC-97 is a team work airplane, and the pilot is the commander of the team. The success of the mission and the safety of the crew and airplane depend upon how well the team is organized and the manner in which it is led. The crew is made up of specialists -- each one vitally important to the safety and effectiveness of the entire crew. The pilot's, copilot's, and flight engineer's preflight duties are covered in NORMAL PROCEDURES, Section II. Additional duties and responsibilities of these crew members and duties for other crew members are assigned in the following text.

PERSONAL EQUIPMENT REQUIREMENTS

Personal equipment plays an important part in the safety and comfort of the crew during a flight. It is the responsibility of the pilot prior to each flight, when signing for personal equipment to insure that each crew member and extra crew member has the necessary personal equipment as prescribed by current directives to safely accomplish the mission. At the mission briefing that is attended by all crew members, either the operations officer or the pilot will specify the equipment needed on the specified flight for which the crew has been briefed. Before boarding the airplane, the pilot will perform a formal crew inspection to determine that each individual is wearing identification tags and proper flying clothing.

TIME SCHEDULE

It is very important that all crew members know crew inspection time, when to complete their preflights, final crew briefing time, etc. The pilot, assisted by the copilot, should require all crew members to meet these schedules; nothing makes a crew more slovenly than stragglers. Insist on promptness.

PILOT

MISSION PREPARATION

1. Attend general briefing. Attend specialized briefing in communications, air refueling, and weather.

2. Coordinate with other crew members on routes, charts, and completion of various forms.

   a. Coordinate with navigator on routes and necessary map preparation. Pilot's maps will have applicable route drawn in, ADIZ's, danger areas, highest terrain, etc

   b. Coordinate with navigator and extract necessary reporting points and entries to and from control areas

   c. Obtain the following data from navigator for entry in Form 175: total distance, average true airspeed, and time enroute

MISSION PREPARATION (Cont)

- d. Determine predicted fuel reserve from engineer's completed flight plan
- e. Review and sign Form 365F

RENDEZVOUS AND AIR REFUELING FLIGHT PLANNING

1. Coordinate with navigator for completeness of air refueling flimsy.

2. Ascertain that manuals and directives pertaining to air refueling are available to the crew.

3. Review and coordinate with the navigator on the briefed refueling area to include:

- a. Air refueling frequencies
- b. Air refueling control times
- c. Air refueling timing
- d. Orbit and rendezvous points
- e. Refueling track and altitude
- f. Air refueling completion point

FINAL WEATHER BRIEFING

1. Prior to submitting Form 175 and attachments, coordinate with navigator on:

- a. Forecast enroute and destination weather conditions
- b. Terrain and adverse local area weather which may affect departure procedures
- c. Select suitable alternate and determine time enroute (if required)
- d. Revise time enroute as necessary, utilizing current forecast winds
- e. Review applicable NOTAMS

INSPECTIONS

The pilots will accomplish the duties listed below in addition to those detailed in Section II:

1. CREW INSPECTION - On arrival at airplane
2. PREFLIGHT INSPECTION - Coordinated with other crew members
3. FINAL CREW BRIEFING - Prior to entering the airplane for the mission
4. STATION CHECKLISTS - According to phase of ground operation or flight
5. AIR REFUELING - Utilizing the checklists in this Section
6. POSTFLIGHT INSPECTION - On completion of mission

PILOTS' AIR REFUELING PROCEDURES

PREPARATION FOR CONTACT

The following procedure will normally be initiated when over the orbit point.

①Set Altimeter - Set (29.92 or as briefed) (P, CP, N)

2. Establish Radio Contact - Established (or as briefed) (P)

- a. Obtain:
  - (1) Formating airspeed
  - (2) Receiver ETA to rendezvous point
- b. Give:
  - (1) Altimeter setting if other than 29.92 is used

③Clear Navigator to UHF - Cleared (P, N)

④Clear Boom Operator to Pod - Cleared (P, BO)

Clear boom operator to the pod when the receiver is at 12 NM range.

⑤Set Refueling Power - Set (P, E)

Direct engineer to establish the power setting necessary to obtain the desired formating speed when the receiver is at 12 NM range.

6. Descend 500 feet - Descending (P)

Initiate a 500 foot descent when receiver is at 12 NM range.

7. Rudder Boost Off - OFF (P)

OBSERVATION POSITION

The following procedure will normally be initiated when the boom operator reports that the receiver is at 1/2

NM - in anticipation of the receiver assuming the observation position

1. Set Navigation Lights - Set (STEADY and DIM) (CP)

   Set steady and dim during darkness or low visibility conditions

2. Lower Anti-Collision Light Off - OFF (CP) 1C10 591

③ Notify Engineer of Copilot's Power - Notified (P, CP, E)

   Pilot will advise engineer that it is "copilot's power." Engineer will acknowledge and advise copilot of maximum allowable manifold pressure to be used for the established rpm setting. Copilot's responsibility for power changes will be terminated when the POST REFUELING checklist is called for

④ Clear Crew to UHF - Cleared (All)

   Pilot directs all crew members to position interphone selector switch to COMM UHF

POST REFUELING

This checklist will be initiated after the refueling track has been cleared.

① Crew on Interphone - On interphone (All)

   Pilot directs all crew members to return to interphone

② Set Cruise Power - Set (P, E)

   Direct engineer to set cruise power after boom operator reports, "Boom stowed"

③ Reset Altimeter - Reset (P, CP, N)

   Obtain and set current altimeter setting

4. Lower Anti-Collision Light On - ON (CP) 1C10 591

COPILOT

The copilot will aid the pilot in any way as directed to accomplish the assigned mission. He must be thoroughly familiar with emergency procedures as they pertain to the airplane and to his duties as copilot.

NAVIGATOR

The navigator will aid the pilot and engineer in all matters pertaining to flight planning and other assigned duties. He will be responsible for the navigation of the airplane using all means available to successfully accomplish the mission. He must be thoroughly familiar with designated emergency procedures as they pertain to the airplane and to his duties as navigator. The navigator's procedures are included in this Section in the form of amplified and condensed checklists.

MISSION PLANNING

General Planning

The general mission planning should be accomplished with the cooperation of the other crew members. The complete mission flight planning will include:

1. Weather - Obtained

   Obtain necessary metro data for route and refueling area to include:

   a. Cloud coverage and haze

   b. Climb winds and winds aloft

   c. Temperatures

   d. Location of jet streams and unusual weather phenomena

   e. Pressure pattern information

   f. Terminal forecast

2. Maps for Mission - Selected

   Select maps and charts of suitable scale and projection as indicated by the requirements of the mission. Additional maps will be procured to provide coverage for emergency changes in flight plan. All pertinent air space restrictions and ADIZ boundaries within 50 NM of the flight planned route will be shown, including altitude and time of restriction. The current Flight Information Publication will be consulted for information on danger, warning, and ADIZ's

3. Routes - Plotted

   Complete route plotted on the charts. When using Lambert Conformal Charts, the route will be divided into segments with the length of each leg short enough to prevent large departure of the rhumb line from the straight line on the chart

   a. Dog legs will be included to aid in accomplishing control times when required

   b. Alternate and emergency airfields along the flight planned route will be clearly marked on the chart by enclosing the airfield in a circle

   c. Reporting Points and Control Areas. The navigator will coordinate with the pilots on necessary reporting points and entries to and from control areas

Rendezvous and Air Refueling Flight Planning

1. Air Refueling Flimsy - Checked complete

The air refueling flimsy received at briefing will be checked for the following information. Any items not included in the flimsy will be determined and recorded prior to takeoff.

a. Receiver Initial Point. The point at which all rendezvous equipment will be in full operation and the initial attempt to contact the receiver will be made

b. Rendezvous identification code settings

c. Tanker orbit point

d. Control time at rendezvous point, if applicable

e. Type of rendezvous

f. Rendezvous point

g. Refueling altitude

h. Refueling course

i. True airspeed - start, end, and average during refueling

j. Estimated time to refuel

k. Refueling completion point, if applicable

m. Secondary and tertiary rendezvous points, if applicable

n. Items "a" through "k" for the secondary and tertiary rendezvous points, if applicable

Radar Navigation Planning

1. Charts - Prepared

Prepare navigation data and chart for the route. Select current charts of suitable scale. Consider the availability of radar targets along the route for selection of proper scale chart.

a. Navigation will be from point to point; points should be close enough together to insure rhumb lines do not deviate greatly from the charted route

b. Points for precision fixing and wind determination will be selected

c. Areas for control time solution and performance, if required, will be selected

Celestial Navigation Planning

1. Charts - Selected and plotted

The JN-series chart is recommended, when available.

2. Celestial Precomputations - Accomplished

Precomputations will be accomplished at the discretion of the navigator and will be optional. If the navigator elects to accomplish ground precomputations, use the following steps:

a. Star selection for three-star fixes will be made to obtain 120 degree cuts as closely as possible (Three-star fixes are recommended as the primary method of celestial navigation)

b. Four minutes is the recommended time interval between scheduled observations in a three-star fix; however, this may be varied according to the speed and skill of the individual

c. For an LOP obtained from a single visible body (sun, moon, etc.) a series of three observations is recommended

d. Computations will be on prescribed precomputation form.

Grid Navigation Planning

1. Charts - Selected or prepared

Select a chart of the appropriate area which incorporates a printed grid overlay or construct a grid on an appropriate chart.

2. Convergence Values - Plotted

Label each geographic meridian along the route with its convergence value to the nearest degree from the convergency graph at the bottom of the chart. This will not be necessary on any chart with a convergency factor equal to 1.0.

Airborne Radar Approach Planning

1. Planning - Accomplished

Complete general planning for a radar approach will be accomplished by members of the crew using all available aids (such as: published instrument patterns, instrument let-down books, Flight Information Publications, and scope photos) for base of intended landing and at least one alternate. Obtain detailed map of base and surrounding area.

2. Data - Secured

   The following information will be recorded and/or secured for inflight use:

   a. Detailed map of base and surrounding area, with approach pattern plotted

   b. Clearly marked scope photographs of approach, if available

   c. Field elevation

   d. Type of lighting and obstructions

   e. Availability and location of navigational aids

   f. Altitudes for each phase of approach

   g. Terminal weather

3. Patterns - Studied

   The following will be studied:

   a. Instrument let-down and GCA patterns

   b. Terrain and prominent radar returns on or near the base

Metro Flight Plan

1. Metro Flight Plan - Completed

   a. A complete metro flight plan will be completed utilizing airspeeds provided by the flight engineer prior to flight

   b. A complete line entry will be made for the alternate landing base. This alternate landing base will be as noted on the Form 175

BEFORE INTERIOR INSPECTION

Check navigation kit and mission folder prior to reporting to airplane. Ascertain that all necessary plotting equipment, computers, watches, etc., are available. Check for necessary forms, flimsies, and logs. Upon arrival at the airplane stow personal equipment. When the pilot directs, fall in for crew inspection as shown in figure 2-1. Form 781 will be read by the pilot and discrepancies pertaining to each crew position will be discussed with the crew member concerned. The navigator will give the following emergency procedures report at the pilot's request: "My ditching and crash landing position is ________. On bail-out, I am the first crew member (after the passengers or extra crew members if applicable) to exit." When directed by the pilot, the navigator will step forward and face the crew, give time hack, and state reliability. If accurate hack is not available at this time, a refined time hack will be given at FINAL CREW BRIEFING. When dismissed from crew inspection, the preflight inspection will be started.

INTERIOR INSPECTION — POWER OFF

1. Driftmeter

   a. Switches - OFF

   b. Gyro Caging Knob - CAGE

2. Radio Altimeter Gain Knob - Full CCW

3. Search Radar Function Switch - OFF

4. Radar Pressurizing Switch - OFF

5. Radio Compass Function Switch - OFF

6. IFF Master Switch - OFF **17260** ▶ **2900**, **3340** ▶

7. Radar Beacon Off--Stdby--Operate Switch - OFF **3232** ▶ plus ✈ 1C10 K211

8. APN-12 Power Switch - OFF

9. APN-76 Power Switch - OFF

10. Loran - OFF

⑪ Report to Pilot - Report "Ready for power" (N, P)

   Report to pilot when items 1 through 10 have been completed so that power may be applied to airplane

12. Oxygen Equipment - Check and stow

   See Section IV for oxygen equipment check procedure

13. Safety Belt and Shoulder Harness - Adjust and check for security

   Check inertia reel lock for security of locked position

14. Almanac and Volumes I, II, III H.O. 249 - Check current

15. Indicator Hoods - Check for availability and condition

16. Pyrotechnic Pistol, Mount, and Flares - Check

   Check condition of pistol, mount pressure seal, and flares. Check quantity of flares

⑰ APU - Started (P, N, E)

   If external power is not to be used, navigator will start the APU when pilot rings alarm bell. See Section IV for STARTING PROCEDURE

INTERIOR INSPECTION — POWER ON

①AC Power Clearance - Received from engineer (N, E)

Check inverters as follows: Essential, Secondary, and Autopilot Inverters - ON, 115 ± 5V, 400 ± 20 cycles

CAUTION

Coordinate with engineer prior to turning any inverter on or off.

2. Table, Dome, and Panel Lights - Check and set as required

   Check entrance light and dome light behind engineer's panel. Check all panel lights and push-to-test lights. Lights that are rheostat controlled should be checked for full range operation of the rheostat.

3. Interphone Check
   - a. INTER Interphone Mixer Switch - ON (up)
   - b. Interphone Selector Switch - INTER
   - c. Loudspeaker Switch - ON
   - d. Headset, Lip Microphone, and Loudspeaker - Check

4. Radar Pressurizing Switch - MOMENTARY ON to 40 in. Hg, then NORMAL ON

   Leave pressure at this value until completion of search radar power-on preflight to check for leakage in the radar pressurizing system.

   NOTE

   Operational preflight of the APN-12, APN-76, and APN-69 need only be accomplished for missions scheduled for air refueling.

5. APN-76 Control Panel
   - a. Receiver Switch - STAND BY
   - b. Transmitter Switch (if applicable) - OFF (center)
   - c. Gain Knob - Full CCW (if applicable)
   - d. Pulse Selector Switch - SINGLE
   - e. Power Switch - ON

6. APN-12
   - a. Indicator Panel
     - (1) Intensity Knob - Full CCW
     - (2) Range Selector Switch - 10
     - (3) Delay Knob - Maximum (if applicable)
     - (4) Antenna Switching Motor - OFF (if applicable)
     - (5) Antenna Cables - Check proper coupling

       SX-47A - Left antenna, SX-48A - Right antenna
   - b. Suppressor Cable - Disconnect
   - c. Control Panel
     - (1) Receiver Switch - STAND BY
     - (2) Transmitter Switch - OFF (center)
     - (3) Pulse Selector Switch - SINGLE
     - (4) Gain Knob - Full CCW
     - (5) Power Switch - ON

7. Search Radar
   - a. Range Switch - Climatic (100 in cold weather)
   - b. Scan Switch - Climatic (FULL in cold weather)

     Steps "a" and "b" should be performed when turning on the search radar at freezing temperatures to permit initial rotation of the antenna at its slowest speed and prevent overloading the antenna drive motor and gear train
   - c. Navigator's Scope Intensity Knob - Full CCW
   - d. Gain Knob - Full CCW
   - e. Antenna Heater Switch - OUT
   - f. Function Switch - STANDBY

     Placing the switch in STANDBY starts the required warmup period. After three minutes, the radar circuits are ready for operation

8. Radar Beacon **3232** ▶PLUS
   - a. Suppressor Cable - Disconnect

     Disconnecting the suppressor cable at the APN-69 R/T unit permits the APN-69 signal to be displayed on the search radar scope during the power-on preflight; if desired, the cable may be disconnected at the APS-42 synchronizer unit instead
   - b. Power Selector Switch - EMERG
   - c. Off--Stdby--Operate Switch - STDBY

     The radar beacon requires a three-minute warmup period before it is ready for operation

9. APN-12 and APN-76
   a. All Channel Selector Switches - Set Channel 8
   b. Receiver Switches - ON
   c. Transmitter Switches - HIGH or LOW
   d. APN-12 Indicator Panel
      (1) Intensity and Focus Knobs - Set as desired
      (2) Vertical and Horizontal Center Adjustments - Center trace

      NOTE

      Do not adjust antenna sweep duration controls.

      (3) Antenna Switching Motor (if applicable) - ON
   e. Gain Knobs - CW as desired
   f. Operational Check
      (1) APN-76 Receiver Switch - STAND BY, ON

      Alternately position the APN-76 receiver switch from STAND BY to ON, checking for APN-76 signal to appear superimposed on APN-12 transmitter pulse on indicator scope

      (2) APN-76 Pulse Selector Switch (if applicable) - PAIRED, SINGLE

      Alternately position the APN-76 pulse selector switch from SINGLE to PAIRED, checking APN-76 signal to appear above APN-12 transmitter pulse on indicator

      (3) Channel Selector Switches - Check all required channels

      Check the following channel pairs: 7-7, 6-6, 5-5, 4-4. The APN-76 receiver and the APN-12 transmitter should always be set to the same channel; simiilarly, the APN-76 transmitter and the APN-12 receiver should be set to the same channel

      (4) Briefed Channels - Check

      Check the briefed channels for the mission last, and do not reposition the channel selector switches after the check has been completed. This will insure the briefed channels for the mission are set should a channeling motor malfunction occur

   g. APN-76 Receiver Switch - STAND BY
   h. APN-76 Transmitter Switch (if applicable) - OFF (center)
   i. APN-76 Power Switch - OFF
   j. APN-12 Gain Knob - Full CCW
   k. Delay Marker Accuracy - Check

   Set range selector switch to 50. Rotate delay control crank until delay marker is under 10-20-30-40 NM etched range marker. Check delay dial below scope for 10-20-30-40 NM reading. Set range selector switch to 200. Rotate delay control crank until delay marker is under 40-80-120-160 NM etched range marker. If range selector switch is turned to a delay position, the delay dial will light and be easy to read.

NOTE

If delay dial does not agree with range markers, use the difference to correct all ranges taken using TD.

   m. APN-12 Intensity Knob - Full CCW
   n. APN-12 Antenna Switching Motor (if applicable) - OFF
   p. APN-12 Receiver Switch - STAND BY
   q. APN-12 Transmitter Switch - OFF (center)
   r. APN-12 Power Switch - OFF
   s. APN-76 Suppressor Cable - Connect

10. Search Radar
   a. Control Panel
      (1) Delay Knob - 175
      (2) Antenna Stab Switch - OUT
      (3) STC Switch - OUT
      (4) Tune Switch - AFC
      (5) A-J Switch - OUT
      (6) Tilt Meter - Up indication

      Check tiltmeter for up deflection, indicating completion of warmup period

INTERIOR INSPECTION — POWER ON (Cont)

(7) Range Switch - 10 (or 100, Climatic)

When turning on the search radar at low ambient temperatures, allow the antenna to rotate in FULL scan, with the range switch set to 100 for five minutes (ten minutes, at ambient temperatures below -20°C), before turning the range switch to 10

(8) Function Switch - SEARCH

CAUTION

If the function switch is turned beyond the STANDBY position with range switch at 100, damage to the electronic components may result causing the search radar to be completely inoperative

b. Intensity, Focus, Lights - Adjust as desired

c. Control Panel

(1) Scan Switch - FULL

(2) Gain Knob - CW for optimum reception

(3) Tuning Controls - Readjust

Make fine adjustments on tilt, gain, focus, and intensity to obtain best picture on scope

(4) A--J Switch - FTC, IAGC, OUT

When A--J switch is in FTC position, ground clutter should decrease and make targets more defined. Use of IAGC position should further reduce ground clutter and make targets still more defined

(5) Tune Switch - MANUAL, AFC

Turn approximately 3/4 turn clockwise and adjust for picture manually. After return to AFC, check that picture returns

(6) Antenna Stab Switch - STAB, OUT

Check that picture does not fade on one side. If this occurs, stabilization mechanism is out

(7) OBS--MAP Switch - OBS, MAP

OBS utilizes a pencil beam which gives good definition of obstacles at same altitude. Adjust tilt to zero and check scope for target returns

NOTE

OBS position is better for weather penetration.

(8) STC Switch - STC, OUT

On STC, ground clutter at center of scope is cut down and only sharp targets are visible

d. Radar Beacon Off--Stdby--Operate Switch - OPERATE, Green light on, aural signal checked **3232** ▶ plus ✈ 1C10 K211 ◀

Position the code selector switches to obtain the briefed code. Place APN-69 MONITOR interphone mixer switch ON (up) to check aural signal. After aural check is complete place APN-69 MONITOR switch OFF

To avoid overloading the transmitter (which may blow a fuse), do not insert more than six code elements - including the first (stationary) element

The green transmitter-on light on the APN-69 control panel indicates when the beacon is ready for automatic operation. A clicking noise can also be heard in the headset or over the loudspeaker when a signal is transmitted provided the aural monitor volume knob is turned full CW

e. Function Switch - BEACON, Identify radar beacon code

Check scope for code set in radar beacon. First pulse of the beacon code is at the center of the scope

f. Tune Switch - MANUAL AFC

Manually tune for radar beacon signal

g. Radar Beacon Off--Stdby--Operate Switch - OFF **3232** ▶ plus ✈ 1C10 K211 ◀

h. Function Switch - WEATHER, SEARCH

Check scope for weather targets and ground returns

i. Delay Control, Range Markers, Range Lights - Check

Check 5 and 10 range positions for correct number of 2 NM range markers and red 2 on top of scope. Check 30 and TD positions for correct number of 5 NM range markers and red 5 or TD on top of scope. Check 100 and 200 range positions for correct number of 25 NM range markers and red 25 on top of scope. Check delay marker to coincide with fixed range markers on various ranges (25, 50, 75, 100)

j. Range Switch - 10

k. Auxiliary Indicator - Check and OFF

Adjust focus and intensity controls for sharp picture. Check for proper range marks and targets

m. Gain Knob - Full CCW

n. Tilt Switch - Full UP

p. Scan Switch - STOP, trace near 180 degrees

NOTE

Stop the antenna on or near the 180 degree point to prevent damage to the search radar crystal from nearby radar equipment when power is off

q. Scope Intensity Knob - Full CCW

r. Function Switch - OFF

11. Radar Beacon

a. Power Selector Switch - NORM

b. Suppressor Cable - Connect

⑫ Secondary Inverter - OFF (N, E)

13. N-1 Compass

a. Synchronizer Knob - Center annunciator pointer

b. Heading Pointer - Check 180 degree ambiguity

c. Radio Magnetic Indicators and Copilot's Direction Indicator - Check against master direction indicator

d. Synchronizer Knob - CW, Annunciator pointer right, dot CCW

Rotate synchronizer knob until master indicator heading pointer moves 3 to 5 degrees right. Annunciator pointer should move right of center and the white dot should rotate counterclockwise. Master indicator heading pointer should correct to original heading at the rate of 3 degrees per minute

e. Synchronizer Knob - CCW, Annunciator pointer left, dot CW

Rotate synchronizer knob until master indicator heading pointer moves 3 to 5 degrees left. Annunciator pointer should move left of center and the white dot should rotate clockwise. Master indicator heading pointer should correct to the original heading at the rate of 3 degrees per minute

f. Latitude Correction Knob - S. Latitude, Dot CCW, annunciator pointer centered

Rotate latitude correction knob until pointer indicates S latitude. White dot should rotate counterclockwise. If annunciator pointer is not centered at all times during unslaved operation, compass is malfunctioning

g. Latitude Correction Knob - Stop dot rotation, approximately zero latitude

Adjust latitude correction knob until dot movement stops. If latitude correction pointer is on any value other than zero, apply difference to local latitude when used as a direction indicator

h. Latitude Correction Knob - N. Latitude, dot CW

Rotate latitude correction knob until pointer indicates N latitude. White dot should rotate clockwise.

i. Latitude Correction Pointer - OFF

14. Loran - ON

15. Radio Altimeter - ON, Check, OFF

See Section IV for detailed instructions.

16. APN-9 Loran (if installed)

a. Gain Knob - CW until grass appears

b. Function Switch - 1, Check for two traces

c. Function Switch - 2, Check for two traces

d. Function Switch - 3, Check for one trace

e. PRR Switch - H

f. Function Switch - 4, Check for three 5000 MS markers and four 1000 MS markers

Check for four 1000 MS markers between each 5000 MS markers

g. Coarse and Fine Delay Knobs - Full CW, delay marker off right end of trace

h. Coarse Delay Knob - Full CCW, delay marker 11,000 to 11,500 MS

i. PRR Switch - L, Four 5000 MS markers, four 1000 MS markers, delay marker between 13,500 to 14,000 MS

j. Coarse Delay Knob - Full CW, delay marker off right end of trace

k. Function Switch - 5, Check for two traces, count nine 100 MS markers and four 10 MS markers

Count nine 100 MS markers between 1000 MS markers and four 10 MS markers between 50 MS markers

m. Crosshair - Check, 3-7 spaces from left end lower trace

INTERIOR INSPECTION — POWER ON (Conf)

n. Station Rate Switch - ZERO, Count 8 spaces from crosshair on left to station rate marker on right

p. L--R Switch - Right, Station rate marker jumps 2 spaces left

q. Station Rate Switch - 1, Count 7 spaces from crosshair on left to station rate marker on right

r. L--R Switch - Right, station rate marker jumps 2 spaces left

s. Station Rate Switch - Check stations 2 through 7

Repeat steps "p" and "q" for all stations. Station rate number plus number of spaces should always equal eight

t. Fine Delay Knob - Full CW through CCW, top trace moves 700 to 1400 MS

Use crosshair for reference

u. Function Switch - 6, Check for two traces

v. Function Switch - 1

w. Gain Knob - Full CCW to OFF

17. APN-70 Loran (if installed)

a. Brilliance and Focus Adjustments - Adjust if required

Adjust until 2 traces appear. Each trace has one pedestal about 5/16 in. tall

b. Function Switch - 2, Check for two traces

c. Function Switch - 3, Check for one trace

d. Function Switch - 4, Check for two traces

Check for 1/4 in. vertical separation of traces. No adjustment but note in Form 781 if faulty

e. Function Switch - 5

f. W-Delay Crank - Superimpose marker pips, counter should read 1000, 5000, 11,000 ± 2

Superimpose marker pips by using W-delay crank and count two zeros on last two digits of W-counter

g. HF-Delay Switch - Y

h. Function Switch - Repeat steps "b" through "e"

i. Y-Delay Crank - Superimpose marker pips, counter should read 1000, 5000, 11,000 ± 2

j. Function Switch - 2

k. Drop-out Check - Complete as required

NOTE

If loran stations are available along the flight planned route, the drop-out check of these stations will be performed as outlined in steps (1) through (4)

(1) Y-Delay Crank - Check drop-out 13,025

Pull the Y-delay crank to its outer detent position and turn crank clockwise until the lower trace disappears. This is the H-7 drop-out point. Any deviation from the value will be applied to all readings on the Y-rate side. Acceptable deviations can be ± 10 from the tabulated value

(2) R-Rate Switch - H-6 through L-0

Repeat step (1) on applicable stations from H-6 through L-0 using drop-out values tabulated below

TRACE DROP-OUT POINT FOR APN-70

DELAY READING ± 10 MICROSECONDS		
Station Rate	Basic Rate	
	H	L
7	13025	18025
6	13075	18075
5	13125	18125
4	13175	18175
3	13225	18225
2	13275	18275
1	13325	18325
0	13375	18375

(3) HF-Delay Switch - W

(4) R-Rate Switch - H-7 through L-0

Repeat drop-out check for W-delay side

m. Function Switch - 1

n. Master-XZ Gain and Power Switch - OFF

18. Driftmeter

a. Driftmeter Switch - ON

b. Gyro Switch - ON

c. Starting Button - Depress and hold momentarily (if applicable)

19. Periscopic Sextant and Mount

a. Desiccant - Check

b. Halftime Dial - Check for accuracy

See Section IV for detailed instructions.

c. Altitude Averager - Check for accuracy

See Section IV for detailed instructions.

d. Bubble - Form and adjust

Check that bubble can be adjusted in size.

e. Navigator's Sighting Stool - Lock in position

f. Sextant - Insert

Insert sextant with arrows on tube and mount aligned, then turn clockwise until plunger locks sextant in retracted position. Open port and push sextant up until it locks in operating position

g. Electrical Cable - Connect to sextant and mount

h. Illumination - Check

Check for illumination of bubble, azimuth ring scale, altitude counter, azimuth counters, averager indices, and watch clip. Illumination of the bubble and azimuth ring scale is further controlled by a rheostat on the left side of the sextant. Check rheostat for proper operation. Other lights are not adjustable. If lights do not operate, check circuit breaker and bulbs.

i. Sextant Alignment - Check

See Section IV for detailed instructions.

j. Bearing for Driftmeter Alignment - Obtain and record

See Section IV for detailed instructions.

k. Illumination Switch - OFF

m. Averager Actuator - Depress and release

n. Sextant Mount - Drain

Remove plug from sextant mount and allow excess moisture to drain out. Replace plug.

p. Sextant Port - Retract sextant and close

q. Sextant and Cable - Remove and stow

Place sextant in case and strap down securely prior to takeoff to prevent damage to the sextant.

r. Navigator's Sighting Stool - Stow

Stow sighting stool in lavatory or tie down securely in main compartment.

20. Driftmeter

a. Rheostat Knob - Adjust brilliance of grid as desired

b. Focus - Adjust

c. Line-of-Sight Handle - Full trail position

d. Azimuth Drive Knob - Check ________ degrees alignment

Perform alignment check on predetermined point selected with periscopic sextant check. Reposition driftmeter azimuth pointer or record correction to be applied during flight. See Section IV for detailed instructions

e. Line-of-Sight Handle - ZERO detent

f. Azimuth Drive Knob - Turn azimuth scale to 180 degrees

g. Gyro Caging Knob - UNCAGE, Check, CAGE

Check for precession of gyro

h. Gyro Switch - OFF

i. Driftmeter Switch - OFF

21. Auxiliary Liaison Receiver

a. AUX-REC Interphone Mixer Switch - ON (up)

b. Time Hack - Obtain

See Section IV for operating instructions for appropriate receiver. If radio operator is on board, receiver will have been tuned to appropriate frequency and left on

c. Power Switch - OFF

d. Navigator's Clock - Wind and set

INTERIOR INSPECTION — POWER ON (Cont)

㉒ Essential and Autopilot Inverter Switches - OFF (N, E)

Insure that no other crew members are using inverters before turning the inverters off

23. Radar Pressurizing System - Check and bleed

Check for 40 ± 1 in. Hg per 30 min and bleed system to approximately 30 in. Hg.

24. Table, Dome, and Panel Lights - OFF

EXTERIOR INSPECTION

1. Driftmeter Cover - Clean and secure or remove

The driftmeter cover may be removed for flight at the navigator's discretion if there is evidence that visibility may be restricted through the cover

2. Radome - Condition

Check fasteners and coating.

3. Radome Drain - Open, drain, close

Open drain and check for presence of water or hydraulic fluid. This may be accomplished by a ground crew member at the navigator's direction

FINAL CREW BRIEFING

The crew will fall in for final crew briefing at the established time. Navigator will give preflight report as follows when requested by the pilot: "Navigator's preflight complete." The navigator will brief the crew on any applicable changes to the mission. When requested by the pilot, he will step forward and face the crew to give a time hack to include a count down for the last five seconds. If time hack given at crew inspection was accurate, the time hack will be omitted at this time.

BEFORE TAKEOFF

1. Life Vest and Parachute - Don (if applicable)

Life vests will be worn for takeoff as directed by the pilot

2. Headset - On

③ Altimeter - Set and cross checked (N, P, CP)

Check all three pointers on the altimeter to assure proper settings. Pilot will announce station pressure over interphone, after which crew members will set station pressure and verbally compare readings over interphone

④ Alarm Bell, Oxygen, and Interphone Check - Report "Navigator's regulator normal, alarm bell loud and clear" (N, CP)

The response will be made over the interphone using the CALL position

5. VHF COMM and UHF COMM Interphone Mixer Switches - ON (up)

Position the interphone mixer switches to permit the navigator to monitor the flight clearance

⑥ N-1 Compass - Synchronize and check against the B-16 (N, CP)

7. Radio Altimeter Gain Knob - ON

8. Search Radar Function Switch - STANDBY

9. IFF Master Switch - NORM **17260** ▶ **2900**, **3340** ▶

10. Mode 2 and Mode 3 Switches - Set as briefed **17260** ▶ **2900**, **3340** ▶

11. SIF - Set (if applicable)

⑫ Taxi Report - Report "Navigator ready for taxi" (N, P)

⑬ A/R Pressure Check - Completed (N, BO) (radio operator not on board)

The navigator (radio operator not on board) will be stationed at the air refueling hydraulic panel on interphone. If leak is discovered or the hydraulic fluid level drops below normal, report this condition to boom operator immediately

14. Search Radar
    - a. Tilt Switch - Check for deflection and adjust
    - b. Scope Intensity Knob - Adjust
    - c. Function Switch - SEARCH
    - d. Scan Switch - FULL
    - e. Gain Knob - Adjust
    - f. Tilt Switch - Adjust as required
    - g. Antenna Stab Switch - STAB (as required)

⑮ Flight Clearance - Monitor, record, and acknowledge (N, CP)

Navigator will acknowledge receipt of ATC clearance after copilot's "read back" to tower is confirmed

16. Initial Heading - Give to pilot

17. Safety Belt and Shoulder Harness - Fasten and lock

⑱ Takeoff Report - Report "Navigator ready for takeoff" (N, P)

⑲ Takeoff Time - Hack and record (N, P)

Navigator will initiate calls on interphone to effect the scheduled takeoff time

AFTER TAKEOFF AND CLIMB

1. Driftmeter - ON
2. Station Keeping - If required

   Locate and identify reference airplane using beacon function as necessary. Adjust heading and airspeed as required to maintain briefed position
3. Departure - Monitor instructions and airplane position

   Monitor departure instructions to determine the route of departure to be flown. Maintain airplane position making maximum utilization of search radar

CRUISE

1. Level-off Time and Position - Record
2. Altimeter - Set 29.92
3. Deviation - Check
4. Position Reports - Prepare as required
5. Flight Progress - Inform crew

   Keep crew informed of beginning and end of various phases of flight and of any inflight deviations from planned route

SECONDARY CLIMB

1. Climb Information - Record
2. Level-off Time and Position - Record

PREPARATION FOR CONTACT

1. Rendezvous Equipment - ON as required
   - a. Radar Beacon **3232** ▶ plus 1C10 K211
     - (1) Code Selector Switches - Check briefed settings
     - ② Power Supply - Alternator ON, NO. 2 BUS (N, E)

       If alternator power is not available, APN-69 may be operated on the essential inverter by placing the power selector switch to EMERG position. In the EMERG position, power is cut-off from radio altimeter, loran, and glide path receiver
     - (3) Off--Stdby--Operate Switch - OPERATE, Light on

       After a three-minute warmup period, the green transmitter light should come on, indicating radar beacon is ready for automatic operation. Returning switch to STDBY for identification purposes does not require the three-minute delay when returning to OPERATE
     - (4) APN-69 MONITOR Interphone Mixer Switch - ON (up), Check signal, OFF (down)
   - b. APN-12
     - (1) Power Switch - ON

       Turn set on as outlined in preflight checklist except turn transmitter switch to HIGH
     - (2) Range Switch - 200
     - (3) Gain Knob - As required
   - c. Search Radar Function Switch - BEACON as desired

     Monitor search and beacon functions as desired to determine position of nearby airplanes or to assist in rendezvous
2. Radio Contact - Accomplished by pilot
   - a. Interphone Selector Switch - COMM UHF
   - b. UHF COMM and INTER Interphone Mixer Switches - ON (up), all others OFF (down)
   - c. Headset - On
   - d. Radio Communications - Assume control

     Navigator will assume responsibility for UHF communications when directed by pilot
3. Rendezvous (APN-69) **3232** ▶ plus 1C10 K211
   - a. APN-69 Signal - Receive and identify code (by receiver)

     Navigator will switch to STDBY and back to OPERATE at request of receiver to aid in identification
   - b. Initial Radar Contact - Record time and range, notify crew

PREPARATION FOR CONTACT (Cont)

c. Adjusted Descent Range - Compute or obtain from receiver

Use DESCENT RANGE chart in Appendix I or use the following formula:

$$\text{DESCENT RANGE} = \frac{\text{Differential Alt.}}{\text{Recvr's Descent Rate}} \text{ X Rate-of-Closure}$$

Have receiver notify tanker when descent range is reached

d. Orbit Departure Time - Compute, record, and make good

Compute time required to depart orbit point to arrive at rendezvous point at rendezvous time. Control orbit pattern to depart orbit as required

e. 12 Nautical Mile Range - Advise pilot

NOTE

Using the APN-69 is the primary method of effecting an air refueling rendezvous. However, the APN-12 should be used as a cross reference whenever possible

4. Rendezvous (APN-12)

a. Receiver APN-76 Signal - Identify

As soon as signal appears on APN-12 scope, request receiver to place APN-76 on STAND BY to identify signal. Signal on APN-12 should disappear and reappear when receiver turns APN-76 back on. Repeat procedure until receiver is definitely identified. Inform receiver that positive identification has been established

NOTE

If APN-76 signal cannot be received and radio contact has been established, advise receiver to change channel settings and change APN-12 channel accordingly to attempt to establish electronic contact

b. Initial Radar Contact - Record time and range, notify crew

c. Receiver Ranges - Relay to receiver and crew

See Section IV for detailed instructions

d. Receiver Heading - Correct to effect rendezvous

Course corrections may be transmitted at any time regardless of range

e. Adjusted Descent Range - Compute and relay or obtain from receiver

Use DESCENT RANGE chart in Appendix I

f. Orbit Departure Time - Compute, record, and make good

Compute time required to depart orbit point to arrive at rendezvous point at rendezvous time. Control orbit pattern to depart orbit as required

g. 12 Nautical Mile Range - Advise pilot

h. Receiver - Direct to observation position

CONTACT AND REFUELING

1. Rendezvous - Record time and position

2. Initial Contact - Record time, MH, TAS, and ALT

3. Final Disconnect - Record time, MH, TAS, and ALT

4. Receiver Identification - Record

POST REFUELING

1. Refueling Report - Relay to receiver

Transmit position and fuel off-load to receiver

2. Interphone Selector Switch - INTER

GRID NAVIGATION

Grid Entry Procedure

① Disengage Autopilot - Disengaged (N, P)

② Follow Direction Indicator - Followed (N, P)

Use the pilot's direction indicator to maintain heading while setting the N-1

3. N-1 Compass

a. Latitude Correction Knob - CW and set

Set latitude correction pointer on geographic latitude

b. Synchronizer Knob - Engage and set

Convert true heading of airplane to grid heading and set on master direction indicator

c. Heading Check - Complete

Determine the heading of the airplane by celestial means

d. Master Direction Indicator - Correct

④ Engage Autopilot - Engaged (N, P)

⑤ Steer Desired Grid Heading - Steered (N, P)

Turn the airplane until the desired grid heading is read on the N-1 compass. Unless there is a predetermined precession rate, the desired and initial headings are the same

⑥ Set Direction Indicator - Set (N, P)

After airplane is established on desired heading, the pilot will set the desired heading on the pilot's direction indicator

Grid Enroute Procedure

1. Heading Check - Accomplish

Check grid heading by celestial means at intervals not to exceed 30 minutes, recording necessary information in the gyro log or graph. For the primary gyro, record "Grid Heading minus Desired Heading." Navigator must continuously monitor heading pointer to assure pilot is holding proper heading. Correct precession rate can only be determined if the heading is correctly flown. For the secondary gyro, record "Grid Heading minus Gyro Reading "

NOTE

If the N-1 compass reads within 4 degrees of the celestial grid heading, the heading check will be recorded and precession rate determined on both the N-1 and the direction indicator, and steps 2, 3, and 4 that follow may be disregarded. It is not necessary to reset secondary gyro

② Disengage Autopilot - Disengaged (N, P)

3. Heading Pointer - Reset

Reset the N-1 heading pointer to the celestial grid heading

④ Engage Autopilot - Engaged (N, P)

5. Latitude Correction Pointer - Reset (if applicable)

Reset the latitude correction pointer to the midlatitude in two degree increments as the airplane changes latitude

6. N-1 Compass Precession Rate - Determine

Determine the airplane heading change due to N-1 precession, average grid heading flown, new desired heading, and new initial heading

7. Airplane Heading - Correct

Turn airplane to new initial heading

8. Heading Check - Complete (if applicable)

Heading check should be taken as soon as possible after any turn in excess of 20 degrees to determine any N-1 compass precession during the turn. Should celestial grid heading differ from the N-1 reading by more than 4 degrees, steps 2, 3, and 4 must be repeated

9. Airplane Position - Determine

NOTE

Should the N-1 compass become inoperative, the direction indicator will be used as the primary steering reference

Grid Exit Procedure

① Disengage Autopilot - Disengaged (N, P)

2. N-1 Compass

   a. Latitude Correction Pointer - OFF

   b. Synchronizer Knob - Engage and synchronize

   Set the heading pointer to indicate the approximate magnetic heading of the airplane. The annunciator pointer should be approximately centered

   ⓒ Cross Check B-16 Compass - Cross checked (N, CP)

   Cross check the B-16 compass reading with the N-1 compass reading

③ Engage Autopilot - Engaged (N, P)

DESCENT

1. UHF COMM, VHF COMM, and INTER Interphone Mixer Switches - ON (up)

2. Descent - Monitor instructions and airplane position

Monitor descent instructions to determine the route of descent to be flown, maintain airplane position, and make maximum utilization of search radar

③ Altimeter - Set and cross checked (N, P, CP)

Verbally compare readings over interphone

4. Radio Altimeter Gain Knob - ON

5. Periscopic Sextant and Sighting Stool - Stow

Stow sighting stool in lavatory or tie down securely in main compartment

DESCENT (Cont)

6. Headset - On

7. Electrical Equipment - OFF (if not required)

8. Search Radar

   Vary range switch to keep target in outer one-half of scope

   a. Tilt, Gain, Intensity - Adjust as required

      Readjust tuning controls during approach as range and altitude are varied. Take any offset of sweep pivot into consideration when noting bearings

   b. Antenna Stab Switch - STAB (as desired)

   c. OBS--MAP Switch - For best reception

9. Initial Points - Make good

   The navigator will direct or monitor the airplane to the VOR station, LF range, or other published reference points to be used for initiating the instrument let-down, arriving over the point on the desired heading for initial descent

10. Let-down - Initiate or monitor

    Upon reaching the selected reference point, a standard instrument let-down will be initiated

11. Published Let-down Pattern - Direct or monitor airplane

    The navigator will direct or monitor the airplane through the published instrument let-down pattern for that particular base, advising the pilot of the proper times for adjusting heading, altitude, or airspeed. The bearing of the cursor and the fixed range markers will be used to determine when to start turns and/or descents

BEFORE LANDING

①Nose Gear - Visually checked down (N, E)

Report to engineer when nose gear is visually checked down.

2. Safety Belt and Shoulder Harness - Fasten

3. Traffic Pattern - Direct airplane or monitor as required

   Upon reaching the level-off altitude specified for the instrument let-down, the navigator will direct or monitor the airplane around the normal GCA pattern for the active runway, advising the pilot of the proper times for adjusting altitudes and/or airspeeds. The airplane should be 1200 feet above the terrain at 130 knots IAS upon reaching the glide path. The bearing of the azimuth marker and the fixed range markers will be used to determine when to start turns and/or descents

4. Airplane Position - Align or monitor alignment with runway on final approach

   Upon completing the turn on final, the navigator will position or monitor the airplane to approach the runway on the runway heading plus or minus drift

5. Heading - Correct or monitor as required

   During remainder of approach, correct or monitor airplane heading as required to keep airplane aligned with runway, while maintaining runway heading plus or minus drift

6. Final Descent - Initiate or monitor at 4 nautical miles

   When airplane reaches four miles from end of runway, instruct or monitor the pilot to initiate a 600 foot-per-minute descent while maintaining desired heading

7. Rate-of-Descent - Check at 2 nautical miles

   The rate-of-descent will be checked when the airplane reaches two miles. The airplane should be 600 feet above the terrain. If not, adjust rate-of-descent accordingly

8. Go-around - Direct airplane or monitor position as required

   If a practice approach is being made, it will be discontinued at published GCA minimum altitude for PPI approaches and a go-around initiated, maintaining the last heading, if feasible to evaluate approach. Navigator will direct airplane during go-around or monitor position as required. If a landing is to be made from the approach, navigator will continue corrections as required and be prepared to direct airplane if a go-around becomes necessary

AFTER LANDING

1. Search Radar

   a. Scan Switch - OFF, trace at 180 degrees

   b. Tilt Switch - Full UP

   c. Antenna Stab Switch - OUT

   ⓓ Scope Intensity Knobs - Full CCW (N, CP)

   e. Gain Knob - Full CCW

- f. Delay Knob - Full CW
- g. A--J Switch - OFF
- h. Range Switch - 10
- i. Tune Switch - AFC
- j. Function Switch - OFF

2. Radar Pressurizing Switch - OFF

3. Radar Pressurizing Bleeder Valve Knob - Depress and bleed to 30 in. Hg.

4. All Electrical Equipment - OFF

   Insure that the following equipment is turned off: loran, APN-12 rendezvous radar, APN-76 rendezvous radar, radar beacon **3232**▶ plus TCTO K211●, radio compass, radio altimeter, IFF **17260**▶ **2900**, **3340**▶ , and driftmeter

⑤ Report to Engineer - Report "Electrical equipment OFF" (N, E)

POST FLIGHT

1. Area - Police
2. Form 781 - Complete
3. Reports, Maps, and Logs - Complete
4. Personal and Professional Equipment - Check and assemble for unloading

NAVIGATOR'S ALERT PROCEDURES

Due to the alert concept, there is a need for a plan to enable the crew to safely launch the airplane in the most expeditious method. For overall alert concept, refer to ALERT PROCEDURES in Section II.

PREFLIGHT

Accomplish INTERIOR and EXTERIOR INSPECTIONS as set forth in the normal procedures, prior to airplane being placed on alert status.

COCKING

Upon completion of the INTERIOR and EXTERIOR INSPECTIONS, the navigator's cocking duties have been accomplished.

SCRAMBLE

Before Starting and Starting Engines

1. EWO Folder - Place on airplane (if applicable)

② Ground Heating Equipment and Covers - Remove (as briefed) (All)

3. No. 3 and No. 4 Engine Dust Plugs and Right Rear Chock - Remove and stow

   Remove and stow in lower aft compartment (if applicable)

4. No. 3 and No. 4 Engine - Stand fire guard
5. Fire Bottle - Remove to right wing tip
6. Right Forward Chock - Remove and stow

   Remove and stow in lower aft compartment (if applicable)

7. Enter Airplane - Aft entry door
8. EWO Folder - Obtain and Review

Before Takeoff

Accomplish normal BEFORE TAKEOFF procedure

DAILY PREFLIGHT

1. Time Hack - Obtain and set clocks
2. Almanac - Check current
3. Sextant Mount - Drain
4. Personal and Professional Equipment -- Check for availability and stowage

   Check for presence of all navigation equipment, sextant, and personal equipment

UNCOCKING

No items are required for the navigator.

TAXI BACK

Accomplish normal AFTER LANDING procedure.

FLIGHT ENGINEER

The flight engineer will perform his portion of the preflight inspection prior to flight and determine that the condition of the airplane is satisfactory for the mission. He must be thoroughly familiar with emergency procedures as they pertain to the airplane and his duties as flight engineer. The flight engineer's procedures for airplane operation are covered in Section II. His A/R procedures are included in this Section.

FLIGHT ENGINEER'S AIR REFUELING PROCEDURE

The following A/R pump operating duties are handled by the engineer and are in addition to his normal flight duties. The checks and procedures are presented as an aid to successful operation of the A/R pump system before and during refueling flights.

FUEL DUMP CHECK — POWER OFF

The FUEL DUMP CHECK - POWER OFF is coordinated with the boom operator.

1. Line Valve Circuit Breaker - PULLED

② Fuel Dump Switches - DUMP (E, BO)

③ Fuel Dump Switches - NORMAL (E, BO)

When boom operator completes his check, return fuel dump switches to NORMAL

4. Line Valve Circuit Breaker - Reset

⑤ Fuel Dump Switches - DUMP (E, BO)

Actuate fuel dump switches for boom operator's check of line valve

⑥ Fuel Dump Switches - NORMAL (E, BO)

WARNING

Line valve must be CLOSED after actuating the fuel dump switch to prevent gravity flow of fuel from the forward A/R tanks, through the bypass valve, to the aft A/R tanks. This fuel movement can cause a dangerous shift in the center of gravity of the airplane.

ISODRAULIC SYNCHRONIZATION CHECK

Check synchronization of isodraulic master control unit at flight engineer's position.

1. Isodraulic Handle - OFF
2. Synchronization Valve (on master control unit) - OPEN
3. Isodraulic Handle - NO. 5 Position
4. Synchronization Valve - CLOSE
5. Isodraulic Handle - Retard until cushion is felt

   This step insures that the slave unit is bottomed

6. Synchronization Valve - OPEN
7. Isodraulic Handle - Halfway Between OFF and NO. 1
8. Synchronization Valve - CLOSE

   A cushion should still be felt when the isodraulic handle is moved toward the OFF position

A/R PRESSURE CHECK

The A/R PRESSURE CHECK is coordinated with the boom operator during engine run-up, whenever fuel transfer is anticipated during flight.

1. A/R Master Switch - Checked ON
2. Hydraulic Pressure - Checked

   Engineer's A/R hydraulic pressure should indicate between 50 and 500 psi

NOTE

- When boom operator places his hydraulic switch to AUTO or ON on airplanes **17260** ▶ **22736**, the engineer's hydraulic pressure should indicate approximately 3080 psi until the boom operator's hydraulic pressure reaches approximately 2950 psi. The engineer's hydraulic pressure should then drop to a value between 50 to 500 psi.
- When boom operator places his hydraulic pressure switch to AUTO or ON on airplanes **22737** ▶, the engineer's hydraulic pressure will remain between 50 to 500 psi.

3. Line Valve Switch - AUTO
4. Lights - Checked

   Visually check contact lights, emergency fuel-shutoff light, and line valve light for operation

5. No. 1 and No. 4 Engine RPM - Advance as required

   Avoid operation in rpm restricted range - except to pass through

⑥ Isodraulic Handle - Advance 40 psi (E, BO)

Upon request from boom operator advance isodraulic handle until 40 psi can be maintained in refueling lines

CAUTION

A/R fuel pumps should not be operated over one minute duration with zero flow in refueling line. Energy used to drive fuel pumps is converted to heat and dissipated into the fuel which cools the pumps. Under no circumstances shall the A-1 pumps be operated with less than 600 pounds of fuel in each tank system.

7. Isodraulic Handle - Retard

Retard isodraulic handle to OFF after boom operator resets signal system to "ready for contact "

8. No. 1 and No. 4 Engine RPM - 1000 rpm

⑨ A/R Fuel Pressures - Compared (E, BO)

Compare fuel pressure reading with boom operator

⑩ Line Valve Switch - CLOSED (E, BO)

After boom operator has completed the pressure check, move line valve switch to the CLOSED position

11. A/R Panel - Stowed

PREPARATION FOR CONTACT

1. Airplane Fuel Configuration - TE (or as required)

Establish TE fuel configuration except when inboard wing tank fuel restriction applies because of payload

2. Marker Beacon Circuit Breaker - PULLED

3. A/R Panel - In position

  a. Master Switch - ON
  b. All Circuit Breakers - Set
  c. Indicator Lights - Test
  d. Fuel Quantity - Checked
  e. Totalizer - Zero
  f. A/R Fuel Pressure - Zero
  g. Hydraulic Oil Supply Valve Switches - OPEN
  h. Isodraulic Handle - OFF
  i. Fuel Leveling Valve Switch - CLOSED (or as required)

④ Transfer Valves - Visually checked CLOSED (E, BO or RO)

⑤ Manual Fuel-Shutoff Valves - Visually checked CLOSED (or as required) (E, BO or RO)

Recheck fuel transfer configuration required for contact and refueling. Have boom operator or radio operator visually check the position of each manual fuel-shutoff valve and report the position to the engineer

6. Mixtures - Check AUTO RICH (locked)

⑦ Refueling Power - Set (when directed by pilot) (E, P)

8. Fuel Enrichment Switches - As required ✈ TCTO 595 ➡

9. Line Valve Switch - AUTO

NOTE

Line valve switch must be in the CLOSED position except when wet transfer is anticipated.

⑩ Report to Pilot - Report "Preparation for contact checklist complete, copilot's power" (E, P)

Acknowledge when pilot advises "Copilot's power" and advise of maximum allowable manifold pressure to be used for established rpm setting

11. Radios - Monitor (as required)

Switch to VHF (or UHF) upon direction of pilot; monitor interphone

CONTACT AND REFUELING PROCEDURES

During contact and refueling, the engineer will advance the isodraulic handle when contact has been established and the contact-made light illuminates. Advance as required to obtain desired fuel pressure and/or flow.

CAUTION

To prevent damage to the A/R system, do not exceed 5400 pounds per minute MAXIMUM fuel flow during A/R operations.

CONTACT AND REFUELING PROCEDURES (Cont)

NOTE

> When operating with only one A/R fuel pump, do not advance the isodraulic handle beyond the NO. 5 position. Advancing this handle further will result in excessive hydraulic oil pressure and temperature, with no increase in fuel flow. If disconnect occurs, reset the isodraulic handle to OFF before contact is re-established

Maintain A/R fuel pressure as required. To hold the pressure in the tanker below the maximum recommended psi for the receiver involved, while still maintaining the highest practical rate of transfer, the following procedure will generally be necessary. Start fuel transfer by advancing the isodraulic handle toward maximum recommended refueling pressure and as the pressure approaches the limiting psi, move the isodraulic handle toward OFF.

NOTE

> The pressure disconnect settings:
>
> B-52 — 68 ± 2 psi
> B-47 — 55 ± 2 psi
> B-45 — 78 ± 2 psi
> F-84 — 78 ± 2 psi
> F-100 —
> F-101 — 80 psi
> B-57 — 80 psi

Depending on the receiver type, fuel pressure in the receiver manifold will be approximately 10 psi higher than the fuel pressure indicated on the boom operator's and engineer's A/R fuel pressure gage. A pressure disconnect may result if allowances are not made for this condition. Be on the alert at all times for sudden increases in pressure resulting from incorrect operation or malfunction and retard isodraulic handle immediately in such events. Disconnects may be made automatically when receiver fuel tanks are full. Disconnects may be initiated by the receiver if less than a full load is required or a malfunction is suspected. If a pre-arranged quantity of fuel is to be transferred, the boom operator may initiate a disconnect or stop the flow of fuel with his A/R emergency fuel-shutoff button at any time. In the event the boom operator stops the fuel flow with his A/R emergency fuel-shutoff button, the flight engineer must retard the isodraulic handle to OFF until the boom operator re-establishes flow with the A/R emergency fuel-shutoff reset button, then the isodraulic handle may be advanced as required. The A/R emergency fuel-shutoff light will illuminate on the flight engineer's A/R panel when the A/R emergency fuel-shutoff button has been actuated. The flight engineer will periodically check his A/R indicators and lights.

When the amount of fuel transferred nears the predetermined amount of fuel off-load, the flight engineer will begin retarding the isodraulic handle and will retard it to OFF when proper fuel quantity has been transferred.

During practice dry contacts, the engineer will periodically monitor the aft A/R fuel quantity gage for an indication of reverse flow from the receiver to the tanker.

POST REFUELING

1. Isodraulic Handle - OFF

   When the predetermined amount of fuel has been transferred, the flight engineer will inform navigator of amount

2. Line Valve Switch - CLOSED
3. Fuel Leveling Valve Switch - CLOSED
4. Transfer Valve Switches - CLOSED
5. Fuel Enrichment Switches - OFF ✈ 1C10 595
6. Cruise Power - Set (when directed by pilot) (E, P)
7. A/R Fuel Valves - Correct position (E, BO)
8. Marker Beacon Circuit Breaker - Reset
9. Report to Pilot - Report "Panel stowed, valves checked" (E, P)

RADIO OPERATOR

The radio operator must be proficient in the utilization of all radio equipment installed in the airplane and, in addition, be current in the use of CW and voice procedures. He must be thoroughly familiar with emergency procedures as they pertain to his duties as radio operator. He will assist the boom operator in scanning duties at the right scanning position for ground and in-flight operation of the airplane when not required to perform communications duties.

MISSION PLANNING

1. Communications Requirements - Complete

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

2. Applicable Pilot's Manuals - Current and complete

   Check applicable pilot's manuals (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 (125 USAF-1, 131 and 135)

BEFORE INTERIOR INSPECTION

Prior to departing for the airplane, check all required equipment and communications kit available and complete. Fall in for crew inspection when the pilot directs. Pilot reads Form 781 to the crew, citing discrepancies that pertain to each crew position. The radio operator will give the following emergency procedures report at the pilot's request: "My ditching and crash landing position is______. On bail-out, I follow the navigator."

INTERIOR INSPECTION — POWER OFF

The following action will be required in complying with the response portion of the preflight inspection checklists.

Condition - A visual check only is required
Security - A physical check is required
Check - An operational check is required

1. Personal Equipment - Stow

   Stow personal equipment, not necessary for flight, in the main compartment

2. Mask and Portable Oxygen Bottle - Check and stow

   Copilot's portable oxygen bottle will be primary oxygen supply for the radio operator. Charge the portable bottle equivalent to the airplane oxygen system pressure. Connect mask to bottle and check for leaks and free flow of oxygen. Stow bottle in proper position or remove and stow at scanning position in aft compartment for use as duties require

3. Required Publications - Stow

   Stow applicable pilot's manuals, mission data, and communications publications in control cabin

EXTERIOR INSPECTION

1. Nose Wheel Well Interphone Call Box and Connections - Security

2. Antennas - Condition or security (as applicable)

   Inspect all antennas for security of mounts, cleanliness, no grease spots or exhaust carbon on stub masts, no cracks on base, ground wire secure on stub types

3. Static Dischargers - Condition

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

INTERIOR INSPECTION — POWER ON

Lower Forward Compartment

1. Interphone Call Box

   a. Call Box and Connections - Security

   b. NORMAL and CALL Operation - Check

2. IFF - Security

3. Radio Compass - Security

4. Marker Beacon - Security

5. UHF/DF - Security TCTO 321

6. TACAN - Security TCTO 572

Lower Aft Compartment

1. Interphone Call Boxes **22665** ▶ **3213**

   a. Call Boxes and Connections - Security

   b. NORMAL and CALL Operation - Check

      On airplanes **22665** ▶ **3213**, an additional call box is near the air refueling hydraulic panel

Main Compartment

1. Omni - Security

   Insure circuit breakers are set

2. Aldis Lamp - Check and stow

   Check operation of aldis lamp and condition of cord and plug. Check filters for proper colors and condition

3. All Interphone Call Boxes

   a. Call Box and Connections - Security

   b. NORMAL and CALL Operation - Check

Control Cabin

1. Aldis Lamp - Check and stow

   Check operation of aldis lamp and condition of cord and plug. Check filters for proper colors and condition

Control Cabin (Cont)

2. "G" File - Check (if applicable)

   Check radio publications in file for availability and currency

3. Interphone Dynamotors (DY-76, DY-77) - Security

4. Glide Slope Receiver - Security

5. VHF Radio

   a. Transmitter and Receiver - Security

   b. Channelization - Set as required

      Check for proper crystals and thumb wheel settings

   c. J-68/ARC-3 - Security

6. UHF Radio

   a. R/T Unit - Security

   b. Master Control Panel - Security

   c. Channelization - Set as required

7. Radio Operator's Interphone - Check

8. UHF Tone - Check

9. UHF Local/Remote Switch - REMOTE

10. Aux. Liaison Receiver

    a. Receiver - Security

    b. Function Switches - Check

       Turn on equipment (power switch to MVC). Check dial lights, crystal filter switch, beat frequency knob, C.W. OSC switch, and antenna alignment knob

    c. Reception - Check all bands

    d. Time Signal - Tune

       Leave receiver on for navigator's time hack

11. Liaison Radio (ARC-21 or ARC-65)

    a. R/T Unit - Security

    b. Antenna Coupler - Security

    c. Channelization - Check

       Channelization should be checked for mission requirement

    d. Operation - Check

       When operational checks are permitted, they will be in accordance with current directives

12. Copilot's Interphone - Check

NOTE

Essential inverter must be on for the following checks

13. Radio Compass

    a. Dial Lights, Modulation Switch, and Filter Switches - Check

    b. Alignment - Check

       Check alignment at low end of the high band

    c. Function Switch - ANT, Check all bands

       Utilize ANT position to check reception on all bands

    d. Function Switch - LOOP, Check nulls

       Switch to LOOP position and check operation of the left-right switch by rotating the switch in both directions and checking both nulls. Adjust volume for an approximate 8 to 10 degree null width

    e. Function Switch - COMP, Check ADF

       Switch to COMP position and check the No. 1 needle for proper homing. Leave tuned to local navigational station

14. Glide Slope Receiver - Check

    Tune localizer frequency on the Omni receiver. Check the glide path alarm pointer (red flag) and horizontal bar for movement

NOTE

The first indication of an operating receiver is the disappearance of the glide path alarm pointer (red flag). When sufficient signal is not received the pointer will not disappear.

15. Omni

    a. Instrument Select Switch - VOR-ILS TCTO 572

    b. Local Station - Tune

    c. RMI No. 2 Needle - Check for homing

    d. TO/FROM Flags - Check

       Set the reading indicated by the pointer of the No. 2 needle into the course set window. Check the vertical bar on the pilot's course indicator for centering and the TO/FROM window for a TO indication. Set the reciprocal reading indicated by the No. 2 needle into the course set window. Check the vertical bar on the pilot's course indicator for centering and the TO/FROM window for FROM indication. Leave tuned to local navigational station.

16. TACAN 1C10 572

    a. Instrument Select Switch - TACAN

    b. Local Station - Tune

    c. RMI No. 1 Needle - Check for homing

    d. Range Indicator - Check

    e. Pilot's Course Indicator - Check

    f. Navigator's RMI No. 2 Needle - Check for homing

    g. Instrument Select Switch - VOR-ILS

    Tune in the station by selecting the proper channel on the TACAN control panel. Check the No. 1 needle on the pilot's TACAN/VOR RMI for proper homing. Place the function selector switch to T/R and check the range indicator. Place the instrument select switch to TACAN and check the vertical needle on the pilot's course indicator and the No. 2 needle on the navigator's RMI for proper homing. Return the instrument select switch to VOR-ILS

17. VHF Radio

    a. Operation - Check

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

    NOTE

    No transmissions will be made on emergency (distress) frequency channels except for emergency purposes.

    b. DF Tone - Check

    Check for audible tone when tone button is depressed

18. UHF Radio - Check operation

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

    NOTE

    No transmission will be made on emergency (distress) frequency channels except for emergency purposes

19. UHF/DF 1C10 321

    a. Pilot's UHF Operation Switch - ADF

    b. Channel Selector Switch - Select desired channel

    If a signal is not heard, request a short count from control tower

    c. RMI - Check UHF/DF pointer

    Check the UHF/DF pointer for the proper bearing of the signal source

    d. Pilot's UHF Operation Switch - T/R + GUARD

20. ARR-36 Auxiliary Liaison Receiver 1C10 KG206

    a. Channel Selector Switch - As desired

    b. Control Switch - ON

    Wait for warmup. If control switch returns to OFF, select another channel

    c. Function Switches - Check

    Check noise control knob, volume knob, operation selector switch, and CW tuning knob for proper operation

21. All Radios (except VHF and UHF) - OFF

    Leave VHF and UHF radios on and tuned to local tower frequency

22. MF Transmitter ART-13 (B)

    a. Transmitter - Security

    b. Dynamotor - Security

    Check reset buttons and fuses

    c. Channelization - Check

    Channelization should be checked for mission requirement frequencies as outlined by current directives

    d. Operation - Check

    When operational checks are permitted, they will be in accordance with current directives

FINAL CREW BRIEFING

The crew will fall in for final crew briefing at the established time. When requested by the pilot, the radio operator will report: "Radio operator's preflight complete." When dismissed from final crew briefing, remove the right down lock and give it to the boom operator prior to boarding the airplane.

STARTING ENGINES

1. Interphone - Monitor

2. Engine Start - Scan

   Report any abnormal operation

BEFORE TAXI

① Alarm Bell, Oxygen, and Interphone Check - Report "Radio operator's mask plugged into walk-around bottle, alarm bell loud and clear" (RO, CP)

Report after the navigator, using the interphone CALL function.

② Contamination Check - Accomplish (RO or BO, E)

Position fuel valves as directed by the engineer

3. Aft Entry Door - Close and lock (RO or BO)

④ Crew Report - Report "Radio operator ready to taxi" (RO, P)

Report after the navigator

TAXI

1. Gear and Tires - Visually check

   Report any abnormal conditions

2. Turns - Clear

ENGINE RUN-UP

① A/R Pressure Check - Accomplish when directed (RO, BO)

The radio operator will be stationed at the air refueling hydraulic panel on interphone. If any fuel and/or hydraulic leak is discovered, or the hydraulic fluid level drops below normal, report this condition immediately

2. Engines - Scan

   Report any abnormal operation

3. Parachute Harness - ON

BEFORE TAKEOFF

① Wing Flap Movement - Report (RO, BO)

Check wing flaps and report to the boom operator.

2. Safety Belt - Fasten

   Assume the right scanning position.

③ Takeoff Report - Report "Radio operator ready for takeoff" (RO, P)

Report after the navigator

④ Cowl Flaps - Scan and report (RO, BO)

Scan cowl flaps and report to BO "Cowl flaps set"

TAKEOFF, CLIMB, AND CRUISE

1. Engines - Scan

   Report any abnormal operation

② Landing Gear Movement - Report (RO, BO)

③ Wing Flap Movement - Report (RO, BO)

4. Turns - Clear

⑤ Engine Reports - Complete (RO or BO, E)

When HF communications are not required for the mission, assist the boom operator in scanning duties during cruise. Visually check engines and report at briefed times to the engineer, "All engines OK (or state discrepancies)"

INFLIGHT PROCEDURES

During flight, perform all duties as briefed to complete the mission. Perform inflight maintenance, if possible, to maintain communications. Utilize the inflight checklist as a guide depending on the mission briefing requirements and operating limitations.

1. Radio Log - Initiate and maintain

   Log will contain pertinent information concerning the flight

2. Radios - Monitor as briefed

   Monitor assigned frequencies at required times

3. HF Reports - As briefed

   When HF reporting is directed at briefing, procedures to be used will be as outlined in current directives and publications. Strict radio communications security will be adhered to when HF communications procedures are not covered at briefing, or radio silence is directed

4. Time Hacks - As required

5. Emergency Communications - Transmit as pilot directs

   When circumstances require emergency transmission, the pilot will authorize the type message required. Format and procedures will be as outlined in current publications and directives

PREPARATION FOR CONTACT

1. Communications Duties - As required

   When required, use HF/MF back-up procedures for communications with the receiver and back-up rendezvous procedures (MF Homing) when primary rendezvous equipment fails

2. HF Back-up Frequency - Monitor

   Monitor HF back-up frequency during rendezvous

3. Observation Position

   a. HF Transmitter - OFF

      Check HF transmitter OFF at radio position, unless transmitter is required for communications during air refueling

   b. Off Watch - Logged

      Make appropriate entry in log, when leaving position. Pilots should assume HF radio watch during air refueling

   c. Scanning Position - On interphone

      Scan engines and receiver. Report any abnormal conditions

   (d) Valves and Hydraulic Panel - Check as directed (RO, E, BO)

      Check or position fuel valves as directed by engineer. Check hydraulic panel as directed by boom operator

POST REFUELING

1. Receiver Position - Scan

   Advise pilot of receiver's position after disconnect

2. Radio Equipment - On as required

   Restore power to radio operator's equipment as required

3. On Watch - Logged

   Make appropriate entries in log as required

4. Communications Duties - As required

   Transmit required reports as directed by the pilot or as briefed

DESCENT

1. Radio Equipment - OFF

   Turn equipment OFF at radio position when not required for approach or landing communications

2. Off Watch - Logged

   Sign off watch if not required to operate radio for approach or landing, complete log and forms

3. Scanning Position - On interphone

BEFORE LANDING

(1.) Landing Gear Movement - Report (RO, BO)

   Report "Main gear down" to boom operator

(2.) Wing Flap Movement - Report (RO, BO)

   Report wing flap movement and settings to boom operator

3. Safety Belt - Fasten

AFTER LANDING

1. Cowl Flaps - Scan

   Report any abnormal condition

2. Gear and Tires - Check

   Visually check gear and tires and report if abnormal situation exists

POSTFLIGHT

1. Portable Oxygen Bottle - Stow (copilot's position)

   If portable oxygen bottle has been placed at scanner's position for convenience, stow in proper position

2. Classified Material - Account for

   Insure all classified material is accounted for and given to crew member that signed for material

3. Personal Equipment - Off load

4. Form 781 - Complete

RADIO OPERATOR'S ALERT PROCEDURES

For overall alert concept, refer to ALERT PROCEDURES in Section II

PREFLIGHT

Accomplish EXTERIOR and INTERIOR INSPECTIONS as set forth in the normal procedures

COCKING

No items are required for the radio operator

SCRAMBLE

The SCRAMBLE procedure is to be utilized to get the airplane safely airborne. It is imperative that the radio operator be familiar with the procedures outlined in this checklist and follow same. This checklist will be used from arrival at the airplane after an alert signal is sounded until after takeoff. Ground heating equipment, ducting, wing and empennage covers will be removed as briefed by the pilot. After boarding the airplane, utilize normal procedures beginning with STARTING ENGINES.

Before Starting Engines

① Remove Ground Heating Equipment and Covers - Remove (as briefed) (All)

② Remove and Stow Tail Jack - Remove and stow (RO, BO)

Assist boom operator in removing and stowing tail jack

③ Remove Ground Power Unit - Remove (if applicable) (RO, GC)

Assist ground crew in removing the ground power unit

4. Enter Airplane - Aft entry door (stow chocks)

   Stow chocks received from navigator and boom operator

Starting Engines

Refer to normal STARTING ENGINES procedure

Before Taxi

Refer to normal BEFORE TAXI procedure

Taxi

Refer to normal TAXI procedure

Before Takeoff

Refer to normal BEFORE TAKEOFF procedure

Takeoff, Climb, and Cruise

Refer to normal TAKEOFF, CLIMB, and CRUISE procedure

DAILY PREFLIGHT

While the airplane is in the alert status, accomplish a daily preflight using this checklist. When checking the radios, only a check on the operational frequencies is required.

1. Radio Compass

   a. Function Switch - LOOP, Check nulls

      Switch to LOOP and check operation of the left-right switch by rotating the switch in both directions and checking both nulls. Adjust volume for an approximate 8 to 10 degree null width

   b. Function Switch - COMP, Check ADF

      Switch to COMP and check the No. 1 needle for proper homing. Leave tuned to local navigation station

2. Omni

   a. Local Station - Tune

   b. RMI No. 2 Needle - Check for homing

   c. TO/FROM Flag - Check

   Set the reading indicated by the pointer of the No. 2 needle into the course set window. Check the vertical bar on the pilot's course indicator for centering and the TO/FROM window for a TO indication. Set the reciprocal reading indicated by the No. 2 needle into the course set window. Check the vertical bar on the pilot's course indicator for centering and the TO/FROM window for FROM indication. Leave tuned to local navigation station

3. VHF Radio

   a. Operation - Check

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

   NOTE

   No transmissions will be made on emergency (distress) frequency channels except for emergency purposes

   b. DF Tone - Check

   Check for audible tone when tone button is depressed

4. UHF Radio - Check operation

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

   NOTE

   No transmissions will be made on emergency (distress) frequency channels except for emergency purposes

UNCOCKING

No items are required for the radio operator

TAXI BACK

Accomplish normal AFTER LANDING procedure

JUMPMASTER

The pilot will assign one crew member to act as the jumpmaster. Normally this will be the boom operator. The jumpmaster will be responsible for the proper execution of the bail-out procedure and will be on interphone during the bail-out alert. Prior to bailing out, the jumpmaster will notify the pilot that all other occupants have departed and that he is leaving the airplane.

BOOM OPERATOR

The duties of the boom operator require that he maintain proficiency in:

1. The skillful operation of assigned air refueling equipment.
2. Cargo and passenger loading and provide assistance in preparation of Form 365F.
3. Inflight maintenance of assigned air refueling equipment.
4. The knowledge and performance of emergency procedures as they pertain to his duties as boom operator.

The following checks and procedures are presented as an aid to successful operation of the air refueling system for all flights. When an air refueling fuel transfer is anticipated, all checks and procedures must be accomplished as outlined. If the mission does not include air refueling the A/R LIGHT CHECK, FUEL PRESSURE CHECK, and all A/R inflight checklists may be omitted.

Because of the physical location of the air refueling equipment, it requires assistance from other personnel to properly accomplish the preflight. The following personnel will assist the boom operator in accomplishing FUEL DUMP CHECK, A/R LIGHT CHECK, and A/R PRESSURE CHECK: copilot, ground crew, and radio operator. In case of a five-man crew, the navigator will assume the duties of the radio operator as outlined.

The following action will be required in complying with the response portion of the checklists:

Condition — A visual check only is required.
Security — A physical check is required.
Checked — An operational check is required.

MISSION PLANNING

The mission planning will be accomplished and coordinated with the other crew members:

1. Fuel Loading, Basic Weight, Moment and/or Index, Cargo and/or Passenger Data - Assist in obtaining
2. Form 365F - Assist in accomplishing
3. Briefings - Attend

   The boom operator will obtain the following information, if applicable: Personal equipment time, station time, tanker tail number, tanker call sign,

MISSION PLANNING (Cont)

receiver call sign, receiver type, rendezvous time, refueling time, number of scheduled wet and dry contacts, and fuel off load

4. A/R Procedures - Review (if applicable)

   If the mission includes air refueling, the boom operator will review air refueling procedures as follows: A/R OPERATIONS in Section IV, all sub-paragraphs under BOOM OPERATOR in this Section, and other applicable directives

BEFORE INTERIOR INSPECTION

① Safety Check (BO, E)

   a. Fuel Valves - Condition

      (1) No. 3 Manual Fuel-Shutoff Valve - CLOSED and safetied ◣tcto K61507■

      Check safetied with heavy gage safety wire

      (2) Leveling Valve - CLOSED

      (3) Secondary Valves **22665** ► or Transfer Valves **17260** ► **22664** – CLOSED

      (4) External Tank Manifold Shutoff Valve - CLOSED **22665** ►

      (5) No. 1 and No. 2 Manual Fuel-Shutoff Valves - CLOSED

      (6) Center Wing Secondary Valve - CLOSED

   b. No. 1 Engine Heater Cavity - Climatic

      Visually check that the heater outlet plug is installed and the engine preheat switch is in the OFF position

   c. Left Main Landing Gear Chocks and Down Lock - In place

   d. Right Main Landing Gear Chocks and Down Lock - In place

   e. No. 4 Engine Heater Cavity - Climatic

      Visually check that the heater outlet plug is installed and the engine preheat switch is in the OFF position

   f. APU CO_2 Discharge Indicator Disc - Intact

      Visually check that the indicator disc, located on the fuselage adjacent to the APU exhaust, is intact

   g. Nose Gear Down Lock - In place

2. Equipment - Stow

   Stow professional and personal equipment aboard the airplane. Stow spare parachutes near primary bail-out exit

3. Crew Inspection - Complete

   Crew inspection is conducted as outlined in CREW INSPECTION, Section II

4. Oxygen Equipment - Checked

   Detailed oxygen check is outlined in OXYGEN EQUIPMENT CHECK, Section IV. Check one oxygen outlet at boom operator's station

INTERIOR INSPECTION

Fuel Dump Check — Power Off

The fuel dump check will be made in conjunction with the flight engineer's fuel dump check. Ground crew will be stationed on a maintenance stand positioned at the aft end of the boom to check emergency fuel dump operation. Copilot will man the boom system emergency hand pump to pressurize fuel dump system and extend the boom

1. Boom Emergency Hand Pump Selector Valve Knob - TELESCOPE

2. Boom Hydraulic System Depressurization Valve - OPEN, CLOSE

③ Fuel Dump Switch - DUMP (BO, E)

④ Boom System Emergency Hand Pump - Actuate (BO, CP)

   Have copilot actuate boom system emergency hand pump slowly to pressurize emergency fuel dump system

⑤ Fuel Dump Actuating Lever - Center (BO, GC)

⑥ Boom Hydraulic System Depressurization Valve - OPEN, CLOSE (BO, GC, CP)

   On signal from ground crew (when fuel dump actuating lever cams over to the poppet valve) open boom hydraulic system depressurization valve and direct copilot to stop actuating emergency hand pump, close boom hydraulic system depressurization valve

⑦ Fuel Dump Switch - NORMAL (BO, E)

⑧ Boom System Emergency Hand Pump - Actuate (BO, CP)

   Have copilot actuate boom system emergency hand pump to return fuel dump actuating lever to normal

⑨ Fuel Dump Actuating Lever - Normal (BO, GC)

Ground crew will signal when fuel dump actuating lever has returned to normal

10. Boom Hydraulic System Depressurization Valve - OPEN, CLOSE

11. Boom Telescoping Lever - RETRACT

Position boom telescoping lever to RETRACT to relieve A/R emergency hydraulic system pressure

⑫ Fuel Dump Switch - DUMP (BO, E)

13. Line Valve - OPEN

⑭ Fuel Dump Switch - NORMAL (BO, E)

15. Line Valve - CLOSE

WARNING

A/R line valve will not close automatically with power off. Line valve must be closed manually after actuating the fuel dump switch to prevent gravity flow of fuel from the forward air refueling tanks, through the bypass valve, to the aft air refueling tanks. This fuel movement can cause a dangerous shift in center of gravity of the airplane

16. A/R Master Switch - ON

Electrical power for the airplane will be applied before continuing this check

⑰ Boom - 5 feet (BO, CP)

Position boom emergency hand pump selector valve knob to HOIST, hoist lever to UP, telescope lever to EXTEND, and have copilot actuate emergency hand pump

18. Boom Hydraulic System Depressurization Valve - OPEN, CLOSE

⑲ Copilot - Release (BO, CP)

20. Signal Coil - Checked

Check that boom signal coil test voltmeter indicates "GOOD"

21. A/R Master Switch - OFF

EXTERIOR INSPECTION

① Engineer's Power-On Check - Complete (BO, CP, GC, E)

Boom operator will be positioned under the left wing to assist flight engineer in checking wing flaps and waste gates

2. Boom Nozzle Assembly - Condition

3. Surge Boot Inflation - Checked

Check inflation for 50 + 5 or -2 psi. Check valve cap properly recessed

4. Fuel Dump Actuator - Condition

Check pins under guard

5. Ruddevators - Condition

CAUTION

A loose fastener in the vicinity of the ruddevators may jam the ruddevators during flight

6. Boom Fairing - Condition

7. Boom Chock Assembly - Condition

8. Boom Pin - Removed

9. Flex Hose Area - Condition

Check for evidence of leaks

10. Boom Operator's Window - Condition

Check for cleanliness

INTERIOR INSPECTION CONTINUED

Lower Aft and Stowage Compartments Inspection

1. Fuel and Hydraulic Equipment - Condition

Check for evidence of fuel and/or hydraulic leaks and scupper drains closed, as inspection progresses

2. A/R Cannon Plugs - Condition

Check A/R cannon plugs as inspection progresses

3. Fuel Bypass Valve - Condition

Lower Aft and Stowage Compartment Inspection (Cont)

4. Line Valve - Condition

5. Aft Power Panel - Condition

   Check circuit breakers set

6. Fuel Flow Transmitter - Condition

7. Fuel Bypass Control Valve - Condition

8. A/R Densitometer - Condition

9. A/R Hydraulic Reservoir - Condition and Security

   Check for proper fluid level and cap security

10. Bleed Valve - NORMAL and safetied

11. Isodraulic Compensator - Condition

    Check indicator bolt for proper extension (3/8 to 7/8 in.)

12. High and Low Pressure Accumulators - Checked **17260** ▶ **22736**

    Check preload pressure, high 500 ± 25 psi, low 50 ± 5 psi

13. Return Line Accumulator - Checked TCTO K553

    Check preload pressure, 125 ± 5 psi

14. Emergency Hydraulic Bypass Valve - CLOSED and safetied **17260** ▶ **22736**

15. No. 6 Solenoid Valves - Condition and safetied

    Check handles pointing toward cannon plugs and safetied

16. Pressure Control Valve - Condition **17260** ▶ **22736**

17. A/R Fuel Pump Selector Valve Handle - NORMAL and safetied

18. Fuel Pressure Switches - Condition

A/R Light Check

When the ground crew has completed assisting the flight engineer in the ENGINEER'S POWER-ON CHECK, the ground crew will remain on the ground interphone to assist the boom operator in the A/R LIGHT CHECK. This check will be accomplished as outlined in the following procedure, depending upon the type of receiver director lights installed

For airplanes with TCTO K526:

1. A/R Master Switch - ON

2. Lighting System Selector Switch - STA. 350

3. Red STA. 350 and 750 - Rheostats full CW

④ Director Light Test Switch - ELEVATION (BO, GC)

   Position switch to UP, DOWN, and NORMAL. GC reports, "Up green, down green, and both center green."

⑤ Director Light Test Switch - TELESCOPE (BO, GC)

   Position switch to FORWARD, AFT, and NORMAL. GC reports, "Forward green, aft green, and both center green."

⑥ Manual Director Light Switches - Actuate (BO, GC)

   Position switches to DOWN and FORWARD then UP and AFT. GC reports, "Red down, red forward, red up, red aft."

7. Red STA. 350 and 750 Rheostats - OFF

⑧ STA. 350 Background Light Rheostats - Full CW (BO, GC)

   Position four background light rheostats to full intensity. GC reports, "All letters, four white strips on right side of airplane, five colored panels on left side of airplane."

9. STA. 350 Background Light Rheostats - OFF

NOTE

If ground interphone cord is of sufficient length, station 750 receiver director lights and other A/R lights will be checked using interphone and ground crew will report condition of lights and color of rendezvous light lens. If ground interphone cannot be used, ground crew will check station 750 lights and the additional lights and report back on ground interphone giving the condition of the lights and color of rendezvous light lens.

10. Lighting System Selector Switch - STA. 750

NOTE

If ground interphone cannot be used, ground crew will signal boom operator from the ground through the boom operator's window when ready to check station 750 receiver director lights

⑪ Director Light Test Switch - ELEVATION (BO, GC)

Position switch to UP, DOWN, and NORMAL. GC reports or checks, "Up, down, red and green lights."

⑫ Director Light Test Switch - TELESCOPE (BO, GC)

Position switch to FORWARD, AFT, and NORMAL. GC reports or checks, "Forward, aft, red and green lights."

⑬ A/R Light Switches - ON (BO, GC)

Position all exterior light switches ON except receiver director lights and have GC report or check lights

14. A/R Light Switches - As required

NOTE

To expedite preflight during darkness, the underwing and underbody lights may be left on.

15. A/R Master Switch - OFF

For airplanes without 1C10 K526:

① A/R Light Switches - ON (BO, GC)

Position all exterior light switches ON, except receiver director lights, and have GC report or check lights

2. A/R Light Switches - As required

③ Receiver Director Lights - TEST (BO, GC)

Actuate ground test switch on aft power panel and have GC check station 750 receiver director lights

NOTE

On airplanes not incorporating 1C10 K526, station 750 receiver director lights may be checked following the EXTERIOR INSPECTION.

Boom Operator's Compartment Inspection

1. Miscellaneous Equipment Panel - Condition

Check for stowage of crash axe, first aid kit, and fire extinguisher. Check fire extinguisher for proper service

2. Fire Extinguisher - Condition

Check fire extinguisher on right side of airplane for proper service (if installed)

3. Boom - Retract

Retract boom using boom system emergency hand pump

4. A/R Cannon Plugs - Condition

Check A/R cannon plugs as inspection progresses

5. Fuel and Hydraulic Equipment - Condition

Check for evidence of fuel and/or hydraulic leaks, and scupper drains closed, as inspection progresses

6. Quick Disconnects - Condition

Check quick disconnects on hydraulic lines for mounting as inspection progresses

CAUTION

If the quick disconnect return line is not connected when the boom hydraulic system is pressurized, the return lines will be pressurized causing damage.

7. Fuel Pressure Transmitter - Condition

8. Main Refueling Line - Condition

9. A/R Accumulators - Condition

Check for preload pressure (1500 ± 100 psi)

10. Boom System Hydraulic Reservoir - Condition and security **22737** ▶

Check for proper fluid level and cap security.

11. No. 7 Solenoid Valve - Condition **22737** ▶

Check handle pointing toward cannon plug and safetied

Boom Operator's Compartment Inspection (Cont)

12. Spare Bulbs - Condition
13. Signal Amplifiers - Condition
14. Hydraulic Pressure Switches - Condition
15. Boom Operator's Panel - Condition

    Check all circuit breakers SET. Check panel lights for operation

16. Hydraulic Pressure Transmitter - Condition 2894 ▶
17. Hoist and Telescope Metering Valves - Condition
18. Ruddevator Control Stick - Checked

    Check for freedom of movement

19. Fire Extinguisher - Condition

    Check for proper service

20. Azimuth Transmitter - Condition
21. No. 1, 2, 4, and 5 Solenoid Valves - Condition

    Check handles pointing toward cannon plugs and safetied

Tail Compartment Inspection

1. Hydraulic Equipment - Condition

   Check for evidence of hydraulic leaks as inspection progresses

2. No. 3 Solenoid Valve - Condition

   Check handle pointing toward cannon plug and safetied

3. Hoist and Cable Tension Motors - Condition
4. Rudder Boost - Condition

   Check for evidence of hydraulic fluid on bottom side of horizontal stabilizer

5. Control Cables and Pulleys - Condition
6. Cabin Vacuum Relief Valve - Checked

   Check for freedom of movement and closed position

7. Tail Compartment Access Door - Condition and close

EXTERIOR INSPECTION CONTINUED

Top of Wing Inspection

1. Engine and Turbo Oil Quantity - Checked and filler caps secure
2. Fuel Caps - Security
3. ADI Caps - Security
4. Engine Cowling and Cowl Flaps - Condition
5. Wing - Condition
6. Emergency Exit Hatches - Condition

INTERIOR INSPECTION CONTINUED

Miscellaneous Duties

① Cargo and Loose Equipment - Security (BO, GC)

② Extra Hydraulic Fluid - Quantity (BO, GC)

A minimum of eight gallons will be aboard for all flights

③ Hydraulic Reservoirs, Accumulators, and Surge Boot - Serviced (BO, GC)

Check that surge boot, reservoirs, and accumulators are serviced within limits

4. Form 781 - Enter discrepancies (if applicable)

FINAL CREW BRIEFING

The crew will fall in for final crew briefing at the established time. When requested by the pilot, the boom operator will report: "Boom operator's preflight complete." When dismissed from final crew briefing and as the down locks are being removed, check the manual defueling valve for CLOSED position. Boom operator will then proceed to forward entry door and display boom lock pin and down locks to the pilot prior to his entering the airplane

STARTING ENGINES

1. Interphone - Monitor
2. Starting Engines - Scan

   Report any abnormal condition

BEFORE TAXI

① Alarm Bell, Oxygen, and Interphone Check - Report "Boom operator's regulator normal, alarm bell loud and clear" (BO, CP)

Give report after pilot rings the alarm bell and announces, "Alarm bell, oxygen, and interphone check."

② Contamination Check - Coordinate (BO, E)

3. Entry Doors - Checked

Visually check closed and locked

④ Taxi Report - Report "Boom operator ready to taxi" (BO, P)

Report after pilot announces over interphone, "Crew report ready to taxi."

TAXI

1. Gear and Tires - Condition
2. Scan - As required

A/R PRESSURE CHECK

The following check of the air refueling system, if required, will be made with the flight engineer and boom operator at their respective stations. The navigator (or radio operator, if aboard) will be at the air refueling hydraulic panel on interphone. Crew member at the air refueling panel will report any fuel or hydraulic leaks and/or hydraulic fluid level drop in reservoir

1. A/R Master Switch - ON
2. Hydraulic Pressure Switch - AUTO or ON

Check boom hydraulic low pressure warning light out at 2500 psi and hydraulic pressure approximately 2950 psi

3. Vent-Type Relief Valves - Checked **17260** ▶ **22700**
4. Telescope-at-Disconnect Switch - MANUAL
5. Elevation Limit Cutout Switch- INACTIVE
6. Signal System Manual Override Switch - OVERRIDE
7. Boom - 15 feet
8. Signal System Manual Contact Switch - Actuate

⑨ Fuel Pressure - Approximately 40 psi (BO, E)

Request flight engineer to pressurize boom to approximately 40 psi fuel pressure

10. Signal System Manual Override Switch - NORMAL

Check ready light illuminated

11. Boom - Retract

Retract boom until A/R fuel pressure gage indicates approximately 50 psi. If fuel pressure drops off, continue to retract boom to maintain fuel pressure. Hold this pressure for a minimum of two minutes, not to exceed four minutes. Boom operator will check the boom operator's compartment for fuel and/or hydraulic leaks. Crew member at hydraulic panel will check area for leaks and hydraulic reservoir for proper fluid level. There is no allowable fuel leakage inside the airplane. (Allowable fuel leakage from the boom, outside of the airplane, is outlined in the maintenance handbook.)

CAUTION

The boom operator must remain in the boom compartment area while the boom is pressurized so that he can advise the pilot of any fuel leakage

NOTE

In the event of a ruptured flex hose, or fuel leak, during ground operation, the boom operator will inform the pilot and engineer. Engineer will close line valve. Pilot will call tower and request fire fighting equipment and direct engineer to cut engines and master switches.

12. Signal System - MADE

Check A/R fuel pressure gage for slow drop in pressure indicating the line valve is open and fuel bypass valve is closed. The fuel pressure drop is due to fuel flowing through the densitometer

13. A/R Emergency Fuel-Shutoff Button - Actuate

Check A/R fuel pressure gage for fast drop in pressure indicating fuel bypass valve open. When fuel pressure drops to approximately 10 psi, reset A/R emergency fuel-shutoff button

14. A/R Emergency Fuel-Shutoff Reset Button - Depress

Fuel pressure should stabilize at approximately 10 psi

15. Signal System - DISCONNECT

Fuel pressure should drop to approximately zero

16. Boom - Retract

Retract boom and check for approximately zero fuel pressure indication

A/R PRESSURE CHECK (Cont)

17. Switches - As required

⑱ Inform Crew - "Pressure check complete " (All)

ENGINE RUN-UP

① Run-up Report - Report "Airplane clear in rear, boom operator ready for run-up" (BO, P)

Report after pilot announces over interphone, "Run-up report "

2. Hatches and Doors - Close and lock

③ Manual Fuel-Shutoff Valves - Positioned (BO, E)

BEFORE TAKEOFF

1. Passenger's Safety Belts - Fastened

2. Wing Flap Movement - Report

③ Hatches and Doors - Report "Hatches and doors closed and locked" (BO, P)

Report after pilot announces over interphone, "Close windows, hatches, and doors "

4. A/R Hydraulic System - Retraction accumulators pressurized

5. A/R Master Switch and Boom Hydraulic Pressure Switch - OFF

After the A/R system pressure check, the A/R master switch and hydraulic pressure switch will be turned OFF and remain OFF until the BOOM INFLIGHT CHECK

CAUTION

The A/R master switch and hydraulic pressure switch are placed OFF to prevent damage to the A/R pumps and gear boxes due to pressure surges at high engine RPM during takeoff and climb. The retraction accumulators will supply pressure to the fuel dump actuator for fuel dumping when the A/R master switch and the hydraulic pressure switch are OFF. The retraction accumulators are isolated by a one-way check valve.

⑥ Takeoff Report - Report "Cowl flaps set, boom operator ready for takeoff." (BO, P)

Report after pilot announces over interphone, "Takeoff report."

WARNING

The boom operator's station will not be occupied during takeoff or landing.

NOTE

The boom operator will occupy the left auxiliary crew seat for takeoff and landing and have safety belt fastened.

TAKEOFF, CLIMB, AND CRUISE

1. Engines - Scan

Report any abnormal condition

2. Landing Gear Movement - Report

3. Wing Flap Movement - Report

Report flap movement when flaps start up and when fully retracted

4. Turns - Clear as required

⑤ Walk-around Inspection Report - Report "Walk-around inspection complete" (BO, E)

Check boom operator's station area, main compartment, and lower compartments for fuel fumes and hydraulic leaks. Check A/R hydraulic reservoir fluid level. Inform engineer, "Walk-around complete "

⑥ Engine and Compartment Report - Report "All engines and compartments check OK" (BO, E)

A visual inspection of the engines will be made and reported to the flight engineer every hour. A walk-around inspection will be made in conjunction with the engine report requirements. Boom operator reports, "All engines and compartments check OK (or state discrepancies)"

BOOM INFLIGHT CHECK

If the mission requires inflight fuel transfer, the boom operator will make an inflight check of A/R equipment as soon as practical after takeoff when the engines are at cruise rpm.

CAUTION

Do not make inflight check of A/R equipment during climb as pressure surges at high engine RPM can damage A/R pumps and gear boxes.

① Boom Inflight Check - Accomplish (BO, P)

2. A/R Master Switch - ON

Check that all circuit breakers on boom operator's panel are set

3. Boom Hydraulic Pressure Switch - AUTO or ON

4. Telescope-at-Disconnect Switch - MANUAL

5. Limit Cutout Switches - ACTIVE

⑥ Boom - Lower (BO, P)

7. Boom - 10 feet

8. Boom Trail Position - Checked

9. Boom Envelope - Checked

Check azimuth limits 17 degrees left and right, telescope limits 6 and 18 feet, and elevation limits 25 degrees upper limit and 45 degrees lower limit.

NOTE

- Lower limit should be checked only once each flight to prevent overspeeding and reduce wear of the hoist motor.
- When checking limits, limit switch must always be approached from within the air refueling envelope.

10. Boom - 10 feet

11. Signal System - MADE

12. Telescope-at-Disconnect Switch - AUTO

⑬ Inform Crew - "Auto retraction" (All)

14. Disconnect Switch - Actuate

15. Boom - Stow and latch

CAUTION

Due to airflow around the tail of the airplane, ruddevator control forces become much lighter as the boom approaches the horizontal position. This leads to a tendency to over-control. Care must be exercised when raising the boom to the stowed position to prevent damage to the boom and the empennage of the airplane.

16. Ruddevator Control Stick - LOCK

17. Boom Operator's Panel Switches - As required

18. A/R Hydraulic System - Depressurized

19. Rendezvous Light Switch - ON **3196** ▶ plus TCTO K231 ▶

⑳ Inform Crew - "Boom inflight check complete" (All)

PREPARATION FOR CONTACT

Boom operator will proceed to the boom operator's station in time to complete the PREPARATION FOR CONTACT procedure prior to receiver reaching 1/2 mile.

NOTE

Normal operation of the air refueling equipment will include use of all automatic provisions. Manual operation shall be confined to training and special conditions at the discretion of the boom operator.

① Manual Fuel-Shutoff and Transfer Valves - Condition (BO, E)

2. Command Radio - Monitor

3. Signal System Manual Override Switch - NORMAL

4. A/R Master Switch - ON

NOTE

Allow three minutes for signal amplifier to warmup before operating A/R system.

5. Boom Hydraulic Pressure switch - AUTO or ON

6. Telescope-at-Disconnect Switch - AUTO

NOTE

Telescope-at-disconnect switch will be in MANUAL for all contacts made with fighter type receivers.

7. Circuit Breakers - Set

8. Limit Cutout Switches - ACTIVE

9. Indicator Lights - Test

10. Receiver Director Lights

Turn receiver director light controls to full intensity for daylight air refueling and dim for night air refueling. Intensity variations subject to request of receiver pilot.

NOTE

During air refueling, the boom operator will position the receiver director light selector switch to STA. 350 for B-52 airplanes and to STA. 750 for all other receivers.

a. STA. 750 Receiver Director Lights

(1) Lighting System Selector Switch - STA. 750

(2) All Receiver Director Light Rheostats - CW as required

PREPARATION FOR CONTACT (Cont)

b. STA. 350 Receiver Director Lights ✈$^{1C10}_{K526}$▶

(1) Lighting System Selector Switch - STA. 350

(2) All Receiver Director Light Rheostats - CW as required

(3) All STA. 350 Background Lights Rheostats - CW as required

⑪ Receiver at 1/2 Mile - Inform pilot (BO, P)

12. Rendezvous Light Switch - OFF **3196** ▶ plus ✈$^{1C10}_{K231}$▶

⑬ Receiver in Observation Position - Inform pilot (BO, P)

Boom operator reports, "Receiver in observation position, standing by to lower boom."

⑭ Boom - Lower (BO, P)

15. Boom - 10 feet

⑯ Inform Crew - "Boom operator ready for contact" (All)

CONTACT AND A/R PROCEDURES

When the pilot clears the boom operator to use the command radio, the boom operator will establish radio contact with the receiver. Communications during contact and refueling operations should be held to an absolute minimum except when it is deemed necessary to use voice procedures to establish contact. A/R VISUAL SIGNALS and ORAL COMMUNICATIONS are outlined in Section IV.

NOTE

- It is the boom operator's responsibility to insure that the boom is clear of the receiver during precontact and disconnect.
- During night contacts, maintain the boom in a position that will prevent the boom nozzle lights from blinding the receiver pilot.

If necessary, talk receiver pilot into correct position, or utilize receiver director light manual switches. If the receiver director light manual switches are used, the boom operator will actuate the switches after the receiver is within the observation position. A steady red light will indicate a large correction and a flashing red light will indicate a small correction in the direction indicated by the red director lights.

The boom operator should follow the receiver movements with the ruddevator control stick. A slight stick pressure should be maintained in the direction of receiver movement. The greater the displacement from normal, the more pressure is required - except for up elevation when only slight up pressure is required

CAUTION

- Do not apply too much up pressure on ruddevator control stick as a disconnect could cause damage to boom and fuselage.
- Nozzle binding can occur while in contact with a receiver. This condition will depend on the relative position of the tanker and receiver and the receiver's stability while in the air refueling envelope. Nozzle binding occurs at many positions depending on degree of azimuth and/or elevation and rate-of-closure. The boom operator must be constantly aware of the receiver's position and be prepared to initiate a disconnect or break-away before the receiver gets into a position where nozzle binding could occur.

Inform the receiver pilot of the corrective action to stay within the refueling envelope. It is important to preface commands to receiver by first giving direction for receiver to move, then estimated distance to move to reach normal contact position. This will prevent misunderstanding and minimize communications. It is necessary for the boom operator to have a clear understanding of the actual boom envelope. The boom position indicators and receiver position should be monitored closely.

POST REFUELING

1. Boom - Stow and latch

Check boom stowed and latched by placing hoist lever to the DOWN position momentarily

2. Ruddevator Control Stick - LOCK

3. Switches - As required

4. A/R Hydraulic System - Depressurized

⑤ Inform Pilot - "Boom stowed" (BO, P)

⑥ Fuel Valve Check - Accomplish (BO, E)

Report position of manual fuel-shutoff valves, leveling valve, transfer valves, and, on airplanes **22665** ▶, the external tank manifold shutoff valve to flight engineer

7. Form 781 - Enter A/R information

DESCENT

1. Boom - Stowed and latched

   When pilot calls for DESCENT checklist, boom operator will check boom stowed and latched by placing hoist lever to the DOWN position momentarily

2. Passengers and Cargo - Condition

BEFORE LANDING

1. Landing Gear - Report down
2. Wing Flap Movement - Report
3. Safety Belt - Fastened

AFTER LANDING

1. Wing Flap Movement - Report
2. Gear and Tires - Condition
3. Scan - As required

POSTFLIGHT

1. Down Locks - Check installed
2. Exterior Inspection - Complete

   Boom operator will make a visual walk-around inspection of boom checking for evidence of fuel and/or hydraulic leaks and structural damage

3. Form 781 - Complete

BOOM OPERATOR'S ALERT PROCEDURES

For overall alert concept, refer to ALERT PROCEDURES in Section II.

PREFLIGHT

Accomplish the normal INTERIOR INSPECTION, EXTERIOR INSPECTION, A/R PRESSURE CHECK and ENGINE RUN-UP procedures, prior to airplane being placed on alert status.

COCKING

Upon completion of the ENGINE RUN-UP procedure, the boom operator's cocking duties have been accomplished.

SCRAMBLE

The SCRAMBLE checklist is to be utilized to get the airplane safely airborne. It is imperative that boom operators be familiar with the procedure outlined in this checklist and follow same. This checklist will be used from arrival at the airplane after an alert signal is sounded until after takeoff. After becoming airborne, utilize normal procedures starting with the TAKEOFF, CLIMB, and CRUISE checklist.

Before Starting and Starting Engines

1. Down Locks - Remove

② Ground Heating Equipment and Covers - Remove (as briefed) (All)

   Each crew member and ground crew will remove ground heating equipment, ducting, wing and empennage covers as briefed by pilot or as per local directives

③ Tail Jack Assembly - Remove and stow (BO, RO or P)

4. No. 1 and No. 2 Engine Dust Plugs and Left Rear Chock - Remove and stow

   Remove and stow in lower aft compartment (if applicable)

5. No. 1 and No. 2 Engines - Stand fire guard

6. Fire Bottle - Remove to left wing tip

7. Left Forward Chock - Remove and stow

   Remove and stow in lower aft compartment (if applicable)

8. Enter Airplane - Aft entry door

⑨ Taxi Report - Report "Boom operator ready to taxi." (BO, P)

Taxi

1. Gear and Tires - Condition
2. Scan - As required

Before Takeoff

(1) Hatches and Doors - Report "Hatches and doors closed and locked" (BO, P)

Report after pilot announces over interphone, "Close windows, hatches, and doors"

2. A/R Hydraulic System - Retraction accumulators pressurized
3. A/R Master Switch and Boom Hydraulic Pressure Switch - OFF
4. Wing Flap Movement - Report

(5) Takeoff Report - Report "Cowl flaps set, boom operator ready for takeoff" (BO, P)

Report after pilot announces over interphone, "Takeoff report"

After Takeoff

Refer to normal AFTER TAKEOFF procedure

DAILY PREFLIGHT

While the airplane is on alert status, make the following checks each day:

1. Boom - Condition

   Check for evidence of fuel or hydraulic leaks

2. Airplane Interior - Condition

   Check for evidence of fuel or hydraulic leaks and for stowage of equipment

UNCOCKING

No items are required for the boom operator

TAXI BACK

1. Wing Flap Movement - Report
2. Gear and Tires - Condition
3. Scan - As required
4. A/R Hydraulic System - Depressurized
5. Switches - As required
6. Down Locks - Check installed

RULES TO BE ENFORCED

SMOKING

1. No smoking during ground operation, takeoffs, or landings
2. No smoking during air refueling
3. No smoking at any time when fuel fumes are detected
4. No smoking while oxygen equipment is near the face or for 15 minutes after oxygen use has been discontinued
5. Smoking in main compartments
   a. No smoking will be permitted in the main compartment during unpressurized flight or when fuel is carried in the air refueling tanks
   b. Smoking may be permitted in the main compartment during pressurized flight, and when no fuel is carried in the air refueling tanks

CAUTION

Never attempt to throw lighted materials from the airplane.

PARACHUTES

1. All personnel aboard will wear a parachute or parachute harness at all times from takeoff to landing, except when removal for the accomplishment of certain duties is required
2. One additional parachute or 10 percent of the required number of parachutes (whichever is greater) when more than four persons are making the flight. However, this number will not exceed 10 spare parachutes in any case

PROPELLERS

WARNING

- Personnel will not walk through the propeller arc area at any time.
- Personnel will not leave or enter the airplane during ground operation when the propellers are turning, unless personally ordered to do so by the pilot, and then only by the aft entry door.

USE OF OXYGEN AND PRESSURIZATION

1. Oxygen masks will be carried by crew members on all flights, regardless of altitude or duration of mission.

2. The copilot will initiate complete crew checks at appropriate time intervals when cabin altitudes are as shown in the table below:

Below 10,000 ft.	- every hour
10,000 to 20,000 ft.	- every 15 minutes
20,0000 to 25,000 ft.	- every 10 minutes
25,000 ft. and above	- every 5 minutes

NOTE

Above 25,000 feet crew members will make continuous visual checks of personnel in their compartment to augment the above checks by the copilot.

3. The following general rules will apply:

Cabin Altitude	Pressure Altitude	Oxygen Equipment
10,000 feet and above		Helmet worn, mask on face, regulator on NORMAL OXYGEN
Below 10,000 feet	28,000 feet and below	Mask and helmet near crew member
Below 10,000 feet	Above 28,000 but below 35,000 feet	Helmet worn, mask attached to helmet and regulator, but need not be worn
Above 10,000 feet	Above 35,000 feet	Helmet and mask worn, regulator on NORMAL OXYGEN or altitude setting

INTERPHONE

1. All crew members will wear headsets during the following conditions:

   a. All ground operations (including engine starts) except when removal is required to accomplish certain duties

   b. During rendezvous and air refueling

   c. During flight under weather conditions

   d. Formation flying

   e. During all takeoffs and landings

2. Interphone calls will be made by identifying the crew position being called and the crew position from which the call is originated. All crew members will advise the pilot when leaving or returning to their respective crew positions. Interphone conversation will be held to the absolute minimum during the conditions listed under paragraph 1 above. Crew members will monitor interphone at all times except as follows:

   a. When crew duties necessitate leaving interphone

   b. At least one pilot will monitor interphone during climb, cruise, and descent

3. An aft compartment crew member will stay on interphone at all times in flight and give immediate reports on all airplanes sighted

SAFETY BELTS

All crew members will have safety belts fastened at all times, except when performing specified duties which preclude the use of safety belts. Shoulder harnesses will be fastened on all takeoffs and landings.

CONTROLS AND SWITCHES

All crew members will visually check switches and controls before actuation.

KC-97G
PILOTS' AIR REFUELING CONDENSED CHECKLIST

PREPARATION FOR CONTACT

When over orbit point:

① Set Altimeter - Set (29.92 or as briefed) (P, CP, N)
2. Establish Radio Contact - Established (or as briefed) (P)
   a. Obtain:
      (1) Formating airspeed
      (2) Receiver ETA to rendezvous point
   b. Give:
      (1) Altimeter setting if other than 29.92 is used
③ Clear Navigator to UHF - Cleared (P, N)
④ Clear Boom Operator to Pod - Cleared (P, BO)
⑤ Set Refueling Power - Set (P, E)
6. Descend 500 feet - Descending (P)
7. Rudder Boost Off - OFF (P)

OBSERVATION POSITION

1. Set Navigation Lights - Set (STEADY and DIM) (CP)
2. Lower Anti-Collision Light Off - OFF (CP) TCTO 591
③ Notify Engineer of Copilot's Power - Notified (P, CP, E)
④ Clear Crew to UHF - Cleared (All)

POST REFUELING

① Crew on Interphone - On interphone (All)
② Set Cruise Power - Set (P, E)
③ Reset Altimeter - Reset (P, CP, N)
4. Lower Anti-Collision Light On - ON (CP) TCTO 591

T.O. 1C-97(K)G-1
15 OCTOBER 1959

1

CUT ON DOTTED LINE

KC-97G
NAVIGATOR'S
CONDENSED CHECKLIST

INTERIOR INSPECTION — POWER OFF

1. Driftmeter
   a. Switches - OFF
   b. Gyro Caging Knob - CAGE
2. Radio Altimeter Gain Knob - Full CCW
3. Search Radar Function Switch - OFF
4. Radar Pressurizing Switch - OFF
5. Radio Compass Function Switch - OFF
6. IFF Master Switch - OFF **17260** ▶ **2900**, **3340** ▶
7. Radar Beacon Off--Stdby--Operate Switch - OFF **3232** ▶
   plus ✈ TCTO K211 ◀
8. APN-12 Power Switch - OFF
9. APN-76 Power Switch - OFF
10. Loran - OFF
⑪ Report to Pilot - Report "Ready for power" (N, P)
12. Oxygen Equipment - Check & stow
13. Safety Belt & Shoulder Harness - Adjust & check for security
14. Almanac & Volumes I, II, III H.O. 249 - Check current
15. Indicator Hoods - Check
16. Pyrotechnic Pistol, Mount, & Flares - Check
⑰ APU - Started (P, N, E)

INTERIOR INSPECTION — POWER ON

① AC Power Clearance - Received from engineer (N, E)
2. Table, Dome, & Panel Lights - Check & set as required
3. Interphone Check
   a. INTER Interphone Mixer Switch - ON (up)
   b. Interphone Selector Switch - INTER
   c. Loudspeaker Switch - ON
   d. Headset, Lip Microphone, & Loudspeaker - Check
4. Radar Pressurizing Switch - MOMENTARY ON to 40 in. Hg, then NORMAL ON
5. APN-76 Control Panel
   a. Receiver Switch - STAND BY

(Cont)

T.O. 1C-97(K)G-1
15 OCTOBER 1959

1

CUT ON DOTTED LINE

INTERIOR INSPECTION — POWER ON (Cont)

b. Transmitter Switch (if applicable) - OFF (center)
c. Gain Knob - Full CCW (if applicable)
d. Pulse Selector Switch - SINGLE
e. Power Switch - ON
6. APN-12
a. Indicator Panel
(1) Intensity Knob - Full CCW
(2) Range Selector Switch - 10
(3) Delay Knob - Maximum (if applicable)
(4) Antenna Switching Motor - OFF (if applicable)
(5) Antenna Cables - Check proper coupling
b. Suppressor Cable - Disconnect
c. Control Panel
(1) Receiver Switch - STAND BY
(2) Transmitter Switch - OFF (center)
(3) Pulse Selector Switch - SINGLE
(4) Gain Knob - Full CCW
(5) Power Switch - ON
7. Search Radar
a. Range Switch - Climatic (100 in cold weather)
b. Scan Switch - Climatic (FULL in cold weather)
c. Navigator's Scope Intensity Knob - Full CCW
d. Gain Knob - Full CCW
e. Antenna Heater Switch - OUT
f. Function Switch - STANDBY
8. Radar Beacon **3232** ▶ plus ✈ 1C10 K211
a. Suppressor Cable - Disconnect
b. Power Selector Switch - EMERG
c. Off--Stdby--Operate Switch - STDBY
9. APN-12 and APN-76
a. All Channel Selector Switches - Set Channel 8
b. Receiver Switches - ON
c. Transmitter Switches - HIGH or LOW
d. APN-12 Indicator Panel
(1) Intensity & Focus Knobs - Set as desired
(2) Vertical & Horizontal Center Adjustments - Center trace
(3) Antenna Switching Motor (if applicable) - ON
e. Gain Knobs - CW as desired

(Cont)

INTERIOR INSPECTION — POWER ON (Cont)

- f. Operational Check
  - (1) APN-76 Receiver Switch - STAND BY, ON
  - (2) APN-76 Pulse Selector Switch (if applicable) - PAIRED, SINGLE
  - (3) Channel Selector Switches - Check all required channels
  - (4) Briefed Channels - Check
- g. APN-76 Receiver Switch - STAND BY
- h. APN-76 Transmitter Switch (if applicable) - OFF (center)
- i. APN-76 Power Switch - OFF
- j. APN-12 Gain Knob - Full CCW
- k. Delay Marker Accuracy - Check
- m. APN-12 Intensity Knob - Full CCW
- n. APN-12 Antenna Switching Motor (if applicable) - OFF
- p. APN-12 Receiver Switch - STAND BY
- q. APN-12 Transmitter Switch - OFF (center)
- r. APN-12 Power Switch - OFF
- s. APN-76 Suppressor Cable - Connect

10. Search Radar
- a. Control Panel
  - (1) Delay Knob - 175
  - (2) Antenna Stab Switch - OUT
  - (3) STC Switch - OUT
  - (4) Tune Switch - AFC
  - (5) A--J Switch - OUT
  - (6) Tilt Meter - Up indication
  - (7) Range Switch - 10 (or 100, Climatic)
  - (8) Function Switch - SEARCH
- b. Intensity, Focus, Lights - Adjust as desired
- c. Control Panel
  - (1) Scan Switch - FULL
  - (2) Gain Knob - CW for optimum reception
  - (3) Tuning Controls - Readjust
  - (4) A--J Switch - FTC, IAGC, OUT
  - (5) Tune Switch - MANUAL, AFC
  - (6) Antenna Stab Switch - STAB, OUT
  - (7) OBS--MAP Switch - OBS, MAP
  - (8) STC Switch - STC, OUT
- d. Radar Beacon Off--Stdby--Operate Switch - OPERATE, Green light on, aural signal checked **3232** ▶ plus ✈ TCTO K211 ◀

(Cont)

T.O. 1C-97(K)G-1
15 October 1959

3

CUT ON DOTTED LINE

INTERIOR INSPECTION — POWER ON (Cont)

e. Function Switch - BEACON, Identify radar beacon code
f. Tune Switch - MANUAL, AFC
g. Radar Beacon Off--Stdby--Operate Switch - OFF **3232** ▶ plus ✈ 1570 K211
h. Function Switch - WEATHER, SEARCH
i. Delay Control, Range Markers, Range Lights - Check
j. Range Switch - 10
k. Auxiliary Indicator - Check & OFF
m. Gain Knob - Full CCW
n. Tilt Switch - Full UP
p. Scan Switch - STOP, trace near 180 degrees
q. Scope Intensity Knob - Full CCW
r. Function Switch - OFF

11. Radar Beacon
    a. Power Selector Switch - NORM
    b. Suppressor Cable - Connect

⑫ Secondary Inverter - OFF (N, E)

13. N-1 Compass
    a. Synchronizer Knob - Center annunciator pointer
    b. Heading Pointer - Check 180 degree ambiguity
    c. RMI's & Copilot's Direction Indicator - Check against master direction indicator
    d. Synchronizer Knob - CW, Annunciator pointer right, dot CCW
    e. Synchronizer Knob - CCW, Annunciator pointer left, dot CW
    f. Latitude Correction Knob - S. Lat, dot CCW, annunciator pointer centered
    g. Latitude Correction Knob - Stop dot rotation, approximately zero latitude.
    h. Latitude Correction Knob - N. Lat, dot CW
    i. Latitude Correction Pointer - OFF
14. Loran - ON
15. Radio Altimeter - ON, Check, OFF
16. APN-9 Loran (if installed)
    a. Gain Knob - CW until grass appears
    b. Function Switch - 1, Check for 2 traces
    c. Function Switch - 2, Check for 2 traces
    d. Function Switch - 3, Check for 1 trace
    e. PRR Switch - H
    f. Function Switch - 4, Check for three 5000 MS markers & four 1000 MS markers

(Cont)

INTERIOR INSPECTION — POWER ON (Cont)

g. Coarse & Fine Delay Knobs - Full CW, delay marker off right end of trace
h. Coarse Delay Knob - Full CCW, delay marker 11,000 to 11,500 MS
i. PRR Switch - L, Four 5000 MS markers, four 1000 MS markers, delay marker between 13,500 to 14,000 MS
j. Coarse Delay Knob - Full CW, delay marker off right end of trace
k. Function Switch - 5, Check for 2 traces, count nine 100 MS markers & four 10 MS markers
m. Crosshair - Check, 3-7 spaces from left end lower trace
n. Station Rate Switch - ZERO, Count 8 Spaces from crosshair on left to station rate marker on right
p. L--R Switch - Right, station rate marker jumps 2 spaces left
q. Station Rate Switch - 1, Count 7 spaces from crosshair on left to station rate marker on right
r. L--R Switch - Right, station rate marker jumps 2 spaces left
s. Station Rate Switch - Check stations 2 through 7
t. Fine Delay Knob - Full CW through CCW, top trace moves 700 to 1400 MS
u. Function Switch - 6, Check for 2 traces
v. Function Switch -1
w. Gain Knob - Full CCW to OFF

17. APN-70 Loran (if installed)
   a. Brill & Focus Adjustments - Adjust if required
   b. Function Switch - 2, Check for 2 traces
   c. Function Switch - 3, Check for 1 trace
   d. Function Switch - 4, Check for 2 traces
   e. Function Switch - 5
   f. W-Delay Crank - Superimpose marker pips, counter should read 1000, 5000, 11,000 ± 2
   g. HF-Delay Switch - Y
   h. Function Switch - Repeat steps "b" through "e"
   i. Y-Delay Crank - Superimpose marker pips, counter should read 1000, 5000, 11,000 ± 2
   j. Function Switch - 2

(Cont)

CUT ON DOTTED LINE

INTERIOR INSPECTION — POWER ON (Cont)

k. Drop-out Check - Complete as required
  (1) Y-Delay Crank - Check drop-out 13,025
  (2) R-Rate Switch - H-6 through L-0

TRACE DROP-OUT POINT FOR APN-70

DELAY READING ± 10 MICROSECONDS								
BASIC	STATION RATE							
RATE	7	6	5	4	3	2	1	0
H	13025	13075	13125	13175	13225	13275	13325	13375
L	18025	18075	18125	18175	18225	18275	18325	18375

  (3) HF-Delay Switch - W
  (4) R-Rate Switch - H-7 through L-0
m. Function Switch - 1
n. Master-XZ Gain & Power Switch - OFF

18. Driftmeter
  a. Driftmeter Switch - ON
  b. Gyro Switch - ON
  c. Starting Button - Depress & hold momentarily (if applicable)
19. Periscopic Sextant & Mount
  a. Desiccant - Check
  b. Halftime Dial - Check for accuracy
  c. Altitude Averager - Check for accuracy
  d. Bubble - Form & adjust
  e. Navigator's Sighting Stool - Lock in position
  f. Sextant - Insert
  g. Electrical Cable - Connect to sextant & mount
  h. Illumination - Check
  i. Sextant Alignment - Check
  j. Bearing for Driftmeter Alignment - Obtain & record
  k. Illumination Switch - OFF
  m. Averager Actuator - Depress & release
  n. Sextant Mount - Drain
  p. Sextant Port - Retract sextant & close
  q. Sextant and Cable - Remove & stow
  r. Navigator's Sighting Stool - Stow

(Cont)

INTERIOR INSPECTION — POWER ON (Cont)

20. Driftmeter
    a. Rheostat Knob - Adjust brilliance of grid as desired
    b. Focus - Adjust
    c. Line-of-Sight Handle - Full trail position
    d. Azimuth Drive Knob - Check ______ degrees alignment
    e. Line-of-Sight Handle - ZERO detent
    f. Azimuth Drive Knob - Turn azimuth scale to 180 degrees
    g. Gyro Caging Knob - UNCAGE, check, CAGE
    h. Gyro Switch - OFF
    i. Driftmeter Switch - OFF
21. Auxiliary Liaison Receiver
    a. AUX-REC Interphone Mixer Switch - ON (up)
    b. Time Hack - Obtain
    c. Power Switch - OFF
    d. Navigator's Clock - Wind & set
㉒. Essential & Autopilot Inverter Switches - OFF (N, E)
23. Radar Pressurizing System - Check & bleed
24. Table, Dome, & Panel Lights - OFF

EXTERIOR INSPECTION

1. Driftmeter Cover - Clean & secure or remove
2. Radome - Condition
3. Radome Drain - Open, drain, close

BEFORE TAKEOFF

1. Life Vest & Parachute - Don (if applicable)
2. Headset - On
③. Altimeter - Set & cross checked (N, P, CP)
④. Alarm Bell, Oxygen, & Interphone Check - Report "Navigator's regulator normal, alarm bell loud and clear" (N, CP)
5. VHF COMM & UHF COMM Interphone Mixer Switches - ON (up)
⑥. N-1 Compass - Synchronize & check against B-16 (N, CP)
7. Radio Altimeter Gain Knob - ON
8. Search Radar Function Switch - STANDBY
9. IFF Master Switch - NORM 17260 ▶ 2900, 3340 ▶

(Cont)

T.O. 1C-97(K)G-1
15 October 1959

7

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

BEFORE TAKEOFF (Cont)

10. Mode 2 and Mode 3 Switches - Set as briefed 17260 ▶ 2900, 3340 ▶
11. SIF - Set (if applicable)
⑫ Taxi Report - Report "Navigator ready for taxi" (N, P)
⑬ A/R Pressure Check - Completed (N, BO) (radio operator not on board)
14. Search Radar
    a. Tilt Switch - Check for deflection & adjust
    b. Scope Intensity Knob - Adjust
    c. Function Switch - SEARCH
    d. Scan Switch - FULL
    e. Gain Knob - Adjust
    f. Tilt Switch - Adjust as required
    g. Antenna Stab Switch - STAB (as required)
⑮ Flight Clearance - Monitor, record, & acknowledge (N, CP)
16. Initial Heading - Give to pilot
17. Safety Belt & Shoulder Harness - Fasten & lock
⑱ Takeoff Report - Report "Navigator ready for takeoff" (N, P)
⑲ Takeoff Time - Hack & record (N, P)

AFTER TAKEOFF AND CLIMB

1. Driftmeter - ON
2. Station Keeping - If required
3. Departure - Monitor instructions & airplane position

CRUISE

1. Level-off Time and Position - Record
2. Altimeter - Set 29.92
3. Deviation - Check
4. Position Reports - Prepare as required
5. Flight Progress - Inform crew

SECONDARY CLIMB

1. Climb Information - Record
2. Level-off Time & Position - Record

PREPARATION FOR CONTACT

1. Rendezvous Equipment - ON as required
   a. Radar Beacon **3232**▶ plus ✈ ICTO K211
      (1) Code Selector Switches - Check briefed settings
      (2) Power Supply - Alternator ON, NO. 2 BUS (N, E)
      (3) Off--Stdby--Operate Switch - OPERATE, light on
      (4) APN-69 MONITOR Interphone Mixer Switch - ON (up), check signal, OFF (down)
   b. APN-12
      (1) Power Switch - ON
      (2) Range Switch - 200
      (3) Gain Knob - As required
   c. Search Radar Function Switch - BEACON as desired
2. Radio Contact - Accomplished by pilot
   a. Interphone Selector Switch - COMM UHF
   b. UHF COMM & INTER Interphone Mixer Switches - ON (up) all others OFF (down)
   c. Headset - On
   d. Radio Communications - Assume control
3. Rendezvous (APN-69) **3232**▶ plus ✈ ICTO K211
   a. APN-69 Signal - Receive & identify code (by receiver)
   b. Initial Radar Contact - Record time & range, notify crew
   c. Adjusted Descent Range - Compute or obtain from receiver
   d. Orbit Departure Time - Compute, record, & make good
   e. 12 NM Range - Advise pilot
4. Rendezvous (APN-12)
   a. Receiver APN-76 Signal - Identify
   b. Initial Radar Contact - Record time & range, notify crew
   c. Receiver Ranges - Relay to receiver & crew
   d. Receiver Heading - Correct to effect rendezvous
   e. Adjusted Descent Range - Compute & relay or obtain from receiver
   f. Orbit Departure Time - Compute, record, & make good
   g. 12 NM Range - Advise pilot
   h. Receiver - Direct to observation position

T.O. 1C-97(K)G-1
15 October 1959

9

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

CONTACT AND REFUELING

1. Rendezvous - Record time & position
2. Initial Contact - Record time, MH, TAS, & ALT
3. Final Disconnect - Record time, MH, TAS, & ALT
4. Receiver Identification - Record

POST REFUELING

1. Refueling Report - Relay to receiver
2. Interphone Selector Switch - INTER

GRID NAVIGATION

Grid Entry Procedure

① Disengage Autopilot - Disengaged (N, P)
② Follow Direction Indicator - Followed (N, P)
3. N-1 Compass
   a. Latitude Correction Knob - CW & set
   b. Synchronizer Knob - Engage & set
   c. Heading Check - Complete
   d. Master Direction Indicator - Correct
④ Engage Autopilot - Engaged (N, P)
⑤ Steer Desired Grid Heading - Steered (N, P)
⑥ Set Direction Indicator - Set (N, P)

Grid Enroute Procedure

1. Heading Check - Accomplish
② Disengage Autopilot - Disengaged (N, P)
3. Heading Pointer - Reset
④ Engage Autopilot - Engaged (N, P)
5. Latitude Correction Pointer - Reset (if applicable)
6. N-1 Compass Precession Rate - Determine
7. Airplane Heading - Correct
8. Heading Check - Complete (if applicable)
9. Airplane Position - Determine

GRID NAVIGATION (Cont)

Grid Exit Procedure

① Disengage Autopilot - Disengaged (N, P)
2. N-1 Compass
   a. Latitude Correction Pointer - OFF
   b. Synchronizer Knob - Engage & synchronize
   ⓒ Cross Check B-16 Compass - Cross checked (N, CP)
③ Engage Autopilot - Engaged (N, P)

DESCENT

1. UHF COMM, VHF COMM, & INTER Interphone Mixer Switches - ON (up)
2. Descent - Monitor instructions & airplane position
③ Altimeter - Set & cross checked (N, P, CP)
4. Radio Altimeter Gain Knob - ON
5. Periscopic Sextant & Sighting Stool - Stow
6. Headset - On
7. Electrical Equipment - OFF (if not required)
8. Search Radar
   a. Tilt, Gain, Intensity - Adjust as required
   b. Antenna Stab Switch - STAB (as desired)
   c. OBS--MAP Switch - For best reception
9. Initial Points - Make good
10. Let-down - Initiate or monitor
11. Published Let-down Pattern - Direct or monitor airplane

BEFORE LANDING

① Nose Gear - Visually checked down (N, E)
2. Safety Belt & Shoulder Harness - Fasten
3. Traffic Pattern - Direct airplane or monitor as required
4. Airplane Position - Align or monitor alignment with runway on final approach
5. Heading - Correct or monitor as required
6. Final Descent - Initiate or monitor at 4 NM
7. Rate-of-Descent - Check at 2 NM
8. Go-around - Direct airplane or monitor position as required

T.O. 1C-97(K)G-1
15 October 1959

11

CUT ON DOTTED LINE

AFTER LANDING

1. Search Radar
   - a. Scan Switch - OFF, trace at 180 degrees
   - b. Tilt Switch - Full UP
   - c. Antenna Stab Switch - OUT
   - d. Scope Intensity Knobs - Full CCW (N, CP)
   - e. Gain Knob - Full CCW
   - f. Delay Knob - Full CW
   - g. A--J Switch - OFF
   - h. Range Switch - 10
   - i. Tune Switch - AFC
   - j. Function Switch - OFF
2. Radar Pressurizing Switch - OFF
3. Radar Pressurizing Bleeder Valve Knob - Depress & bleed to 30 in. Hg.
4. All Electrical Equipment - OFF
5. Report to Engineer - "Report electrical equipment OFF" (N, E)

POST FLIGHT

1. Area - Police
2. Form 781 - Complete
3. Reports, Maps, & Logs - Complete
4. Personal & Professional Equipment - Check & assemble for unloading

KC-97G
NAVIGATOR'S ALERT PROCEDURES CONDENSED CHECKLIST

PREFLIGHT

Accomplish normal INTERIOR and EXTERIOR INSPECTIONS.

COCKING

Upon completion of the INTERIOR and EXTERIOR INSPECTIONS the navigator's cocking duties have been accomplished.

SCRAMBLE

Before Starting and Starting Engines

1. EWO Folder - Place on airplane (if applicable)
② Ground Heating Equipment & Covers - Remove (as briefed) (All)
3. No. 3 & No. 4 Engine Dust Plugs & Right Rear Chock - Remove & stow
4. No. 3 & No. 4 Engine - Stand fire guard
5. Fire Bottle - Remove to right wing tip
6. Right Forward Chock - Remove & stow
7. Enter Airplane - Aft entry door
8. EWO Folder - Obtain & review

Before Takeoff

Accomplish normal BEFORE TAKEOFF procedure.

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

DAILY PREFLIGHT

1. Time Hack - Obtain & set clocks
2. Almanac - Check current
3. Sextant Mount - Drain
4. Personal & Professional Equipment - Check for availability & stowage

UNCOCKING

No items are required for the navigator.

TAXI BACK

Accomplish normal AFTER LANDING procedure.

T.O. 1C-97(K)G-1
15 October 1959

2

KC-97G
FLIGHT ENGINEER'S AIR REFUELING CONDENSED CHECKLIST

FUEL DUMP CHECK — POWER OFF

1. Line Valve Circuit Breaker - PULLED
② Fuel Dump Switches - DUMP (E, BO)
③ Fuel Dump Switches - NORMAL (E, BO)
4. Line Valve Circuit Breaker - Reset
⑤ Fuel Dump Switches - DUMP (E, BO)
⑥ Fuel Dump Switches - NORMAL (E, BO)

ISODRAULIC SYNCHRONIZATION CHECK

1. Isodraulic Handle - OFF
2. Synchronization Valve - OPEN
3. Isodraulic Handle - NO. 5 Position
4. Synchronization Valve - CLOSE
5. Isodraulic Handle - Retard until cushion is felt
6. Synchronization Valve - OPEN
7. Isodraulic Handle - Halfway between OFF and NO. 1
8. Synchronization Valve - CLOSE

A/R PRESSURE CHECK

1. A/R Master Switch - Checked ON
2. Hydraulic Pressure - Checked
3. Line Valve Switch - AUTO
4. Lights - Checked
5. No. 1 & No. 4 Engine RPM - Advance as required
⑥ Isodraulic Handle - Advance 40 psi (E, BO)
7. Isodraulic Handle - Retard
8. No. 1 & No. 4 Engine RPM - 1000 rpm
⑨ A/R Fuel Pressures - Compared (E, BO)
⑩ Line Valve Switch - CLOSED (E, BO)
11. A/R Panel - Stowed

T.O. 1C-97(K)G-1
15 OCTOBER 1959

1

CUT ON DOTTED LINE

PREPARATION FOR CONTACT

1. Airplane Fuel Configuration - TE (or as required)
2. Marker Beacon Circuit Breaker - PULLED
3. A/R Panel - In position
   a. Master Switch - ON
   b. All Circuit Breakers - Set
   c. Indicator Lights - Test
   d. Fuel Quantity - Checked
   e. Totalizer - Zero
   f. A/R Fuel Pressure - Zero
   g. Hydraulic Oil Supply Valve Switches - OPEN
   h. Isodraulic Handle - OFF
   i. Fuel Leveling Valve Switch - CLOSED (or as required)

④ Transfer Valves - Visually checked CLOSED (E, BO or RO)
⑤ Manual Fuel-Shutoff Valves - Visually checked CLOSED (or as required) (E, BO or RO)
6. Mixtures - Check AUTO RICH (locked)
⑦ Refueling Power - Set (when directed by pilot) (E, P)
8. Fuel Enrichment Switches - As required ✈ 1C10 595
9. Line Valve Switch - AUTO
⑩ Report to Pilot - Report "Preparation for contact checklist complete, copilot's power" (E, P)
11. Radios - Monitor (as required)

POST REFUELING

1. Isodraulic Handle - OFF
2. Line Valve Switch - CLOSED
3. Fuel Leveling Valve Switch - CLOSED
4. Transfer Valve Switches - CLOSED
5. Fuel Enrichment Switches - OFF ✈ 1C10 595
⑥ Cruise Power - Set (when directed by pilot) (E, P)
⑦ A/R Fuel Valves - Correct position (E, BO)
8. Marker Beacon Circuit Breaker - Reset
⑨ Report to Pilot - Report "Panel stowed, valves checked" (E, P)

KC-97G
BOOM OPERATOR'S CONDENSED CHECKLIST

MISSION PLANNING CARD

PE TIME__________ STATION TIME__________

TANKER TAIL NUMBER__________ TANKER CALL SIGN__________

RECEIVER CALL SIGN__________

RECVR TYPE__________ RDZ. TIME__________

REFUELING TIME__________ CONTACTS: WET______ DRY______

OFFLOAD__________

RECEIVER CALL SIGN__________

RECVR TYPE__________ RDZ. TIME__________

REFUELING TIME__________ CONTACTS: WET______ DRY______

OFFLOAD__________

ADDITIONAL INFORMATION__________

____

____

T.O. 1C-97(K)G-1
15 OCTOBER 1959

1

CUT ON DOTTED LINE

BEFORE INTERIOR INSPECTION

① Safety Check (BO, E)
  a. Fuel Valves - Condition
    (1) No. 3 Manual Fuel-Shutoff Valve - CLOSED & safetied KGT507
    (2) Leveling Valve - CLOSED
    (3) Secondary Valves **22665** ▶ or Transfer Valves **17260** ▶ **22664** - CLOSED
    (4) External Tank Manifold Shutoff Valve - CLOSED **22665** ▶
    (5) No. 1 & No. 2 Manual - Fuel Shutoff Valves - CLOSED
    (6) Center Wing Secondary Valve - CLOSED
  b. No. 1 Engine Heater Cavity - Climatic
  c. Left Main Gear Chocks and Down Lock - In place
  d. Right Main Gear Chocks and Down Lock - In place
  e. No. 4 Engine Heater Cavity - Climatic
  f. APU CO_2 Discharge Indicator Disc - Intact
  g. Nose Gear Down Lock - In place
2. Equipment - Stow
3. Crew Inspection - Complete
4. Oxygen Equipment - Checked

INTERIOR INSPECTION

Fuel Dump Check — Power Off

1. Boom Emergency Hand Pump Selector Valve Knob - TELESCOPE
2. Boom Hydraulic System Depressurization Valve - OPEN, CLOSE
③ Fuel Dump Switch - DUMP (BO, E)
④ Boom System Emergency Hand Pump - Actuate (BO, CP)
⑤ Fuel Dump Actuating Lever - Center (BO, GC)
⑥ Boom Hydraulic System Depressurization Valve - OPEN, CLOSE (BO, GC, CP)
⑦ Fuel Dump Switch - NORMAL (BO, E)
⑧ Boom System Emergency Hand Pump - Actuate (BO, CP)
⑨ Fuel Dump Actuating Lever - Normal (BO, GC)

(Cont)

INTERIOR INSPECTION (Cont)

Fuel Dump Check — Power Off (Cont)

10. Boom Hydraulic System Depressurization Valve - OPEN, CLOSE
11. Boom Telescoping Lever - RETRACT
⑫ Fuel Dump Switch - DUMP (BO, E)
13. Line Valve - OPEN
⑭ Fuel Dump Switch - NORMAL (BO, E)
15. Line Valve - CLOSE
16. A/R Master Switch - ON
⑰ Boom - 5 Feet (BO, CP)
18. Boom Hydraulic System Depressurization Valve - OPEN, CLOSE
⑲ Copilot - Release (BO, CP)
20. Signal Coil - Checked
21. A/R Master Switch - OFF

EXTERIOR INSPECTION

① Engineer's Power-On Check - Complete (BO, CP, GC, E)
2. Boom Nozzle Assembly - Condition
3. Surge Boot Inflation - Checked
4. Fuel Dump Actuator - Condition
5. Ruddevators - Condition
6. Boom Fairing - Condition
7. Boom Chock Assembly - Condition
8. Boom Pin - Removed
9. Flex Hose Area - Condition
10. Boom Operator's Window - Condition

INTERIOR INSPECTION CONTINUED

Lower Aft and Stowage Compartments Inspection

1. Fuel & Hydraulic Equipment - Condition
2. A/R Cannon Plugs - Condition
3. Fuel Bypass Valve - Condition
4. Line Valve - Condition

(Cont)

T.O. 1C-97(K)G-1
15 October 1959

3

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

Lower Aft and Stowage Compartments Inspection (Cont)

5. Aft Power Panel - Condition
6. Fuel Flow Transmitter - Condition
7. Fuel Bypass Control Valve - Condition
8. A/R Densitometer - Condition
9. A/R Hydraulic Reservoir - Condition & security
10. Bleed Valve - NORMAL & safetied
11. Isodraulic Compensator - Condition
12. High & Low Pressure Accumulators - Checked 17260 ▶ 22736
13. Return Line Accumulator - Checked TCTO K553
14. Emergency Hydraulic Bypass Valve - CLOSED & safetied 17260 ▶ 22736
15. No. 6 Solenoid Valves - Condition & safetied
16. Pressure Control Valve - Condition 17260 ▶ 22736
17. A/R Fuel Pump Selector Valve Handle - NORMAL & safetied
18. Fuel Pressure Switches - Condition

A/R Light Check Airplanes with TCTO K526

1. A/R Master Switch - ON
2. Lighting System Selector Switch - STA. 350
3. Red STA. 350 and 750 Rheostats - Full CW
④ Director Light Test Switch - ELEVATION (BO, GC)
⑤ Director Light Test Switch - TELESCOPE (BO, GC)
⑥ Manual Director Light Switches - Actuate (BO, GC)
7. Red STA. 350 and 750 Rheostats - OFF
⑧ STA. 350 Background Light Rheostats - Full CW (BO, GC)
9. STA. 350 Background Light Rheostats - OFF
10. Lighting System Selector Switch - STA. 750
⑪ Director Light Test Switch - ELEVATION (BO, GC)
⑫ Director Light Test Switch - TELESCOPE (BO, GC)
⑬ A/R Light Switches - ON (BO, GC)
14. A/R Light Switches - As required
15. A/R Master Switch - OFF

For airplanes without TCTO K526

① A/R Light Switches - ON (BO, GC)
2. A/R Light Switches - As required
③ Receiver Director Lights - TEST (BO, GC)

INTERIOR INSPECTION CONTINUED

Boom Operator's Compartment Inspection

1. Miscellaneous Equipment Panel - Condition
2. Fire Extinguisher - Condition
3. Boom - Retract
4. A/R Cannon Plugs - Condition
5. Fuel & Hydraulic Equipment - Condition
6. Quick Disconnects - Condition
7. Fuel Pressure Transmitter - Condition
8. Main Refueling Line - Condition
9. A/R Accumulators - Condition
10. Boom System Hydraulic Reservoir - Condition & security 22737 ▶
11. No. 7 Solenoid Valve - Condition 22737 ▶
12. Spare Bulbs - Condition
13. Signal Amplifiers - Condition
14. Hydraulic Pressure Switches - Condition
15. Boom Operator's Panel - Condition
16. Hydraulic Pressure Transmitter - Condition 2894 ▶
17. Hoist & Telescope Metering Valves - Condition
18. Ruddevator Control Stick - Checked
19. Fire Extinguisher - Condition
20. Azimuth Transmitter - Condition
21. No. 1, 2, 4, and 5 Solenoid Valves - Condition

Tail Compartment Inspection

1. Hydraulic Equipment - Condition
2. No. 3 Solenoid Valve - Condition
3. Hoist & Cable Tension Motors - Condition
4. Rudder Boost - Condition
5. Control Cables & Pulleys - Condition
6. Cabin Vacuum Relief Valve - Checked
7. Tail Compartment Access Door - Condition & close

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

EXTERIOR INSPECTION CONTINUED

Top of Wing Inspection

1. Engine & Turbo Oil Quantity - Checked & filler caps secure
2. Fuel Caps - Security
3. ADI Caps - Security
4. Engine Cowling & Cowl Flaps - Condition
5. Wing - Condition
6. Emergency Exit Hatches - Condition

INTERIOR INSPECTION CONTINUED

Miscellaneous Duties

① Cargo & Loose Equipment - Security (BO, GC)
② Extra Hydraulic Fluid - Quantity (BO, GC)
③ Hydraulic Reservoirs, Accumulators & Surge Boot - Serviced (BO, GC)
4. Form 781 - Enter discrepancies (if applicable)

STARTING ENGINES

1. Interphone - Monitor
2. Starting Engines - Scan

BEFORE TAXI

① Alarm Bell, Oxygen & Interphone Check - Report "Boom operator's regulator normal, alarm bell loud and clear" (BO, CP)
② Contamination Check - Coordinate (BO, E)
3. Entry Doors - Checked
④ Taxi Report - Report "Boom operator ready to taxi" (BO, P)

TAXI

1. Gear & Tires - Condition
2. Scan - As required

A/R PRESSURE CHECK

1. A/R Master Switch - ON
2. Boom Hydraulic Pressure Switch - AUTO or ON
3. Vent-Type Relief Valves - Checked 17260 ▶ 22700
4. Telescope-at-Disconnect Switch - MANUAL
5. Elevation Limit Cutout Switch - INACTIVE
6. Signal System Manual Override Switch - OVERRIDE
7. Boom - 15 Feet
8. Signal System Manual Contact Switch - Actuate

⑨ Fuel Pressure - Approx. 40 psi (BO, E)

10. Signal System Manual Override Switch - NORMAL
11. Boom - Retract
12. Signal System - MADE
13. A/R Emergency Fuel-Shutoff Button - Actuate
14. A/R Emergency Fuel-Shutoff Reset Button - Depress
15. Signal System - DISCONNECT
16. Boom - Retract
17. Switches - As required

⑱ Inform Crew - "Pressure check complete" (All)

ENGINE RUN-UP

① Run-up Report - Report "Airplane clear in rear, boom operator ready for run-up" (BO, P)

2. Hatches & Doors - Close & lock

③ Manual Fuel-Shutoff Valves - Positioned (BO, E)

BEFORE TAKEOFF

1. Passenger's Safety Belts - Fastened
2. Wing Flap Movement - Report

③ Hatches and Doors - Report "Hatches and doors closed and locked" (BO, P)

4. A/R Hydraulic System - Retraction accumulators pressurized
5. A/R Master Switch & Boom Hydraulic Pressure Switch - OFF

⑥ Takeoff Report - Report "Cowl flaps set, boom operator ready for takeoff" (BO, P)

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

TAKEOFF, CLIMB, AND CRUISE

1. Engines - Scan
2. Landing Gear Movement - Report
3. Wing Flap Movement - Report
4. Turns - Clear as required

⑤ Initial Walk-around Inspection Report - Report "Walk-around inspection complete" (BO, E)
⑥ Engine & Compartment Report - Report "All engines and compartments check OK" (BO, E)

BOOM INFLIGHT CHECK

① Boom Inflight Check - Accomplish (BO, P)
2. A/R Master Switch - ON
3. Boom Hydraulic Pressure Switch - AUTO or ON
4. Telescope-at-Disconnect Switch - MANUAL
5. Limit Cutout Switches - ACTIVE

⑥ Boom - Lower (BO, P)
7. Boom - 10 Feet
8. Boom Trail Position - Checked
9. Boom Envelope - Checked
10. Boom - 10 Feet
11. Signal System - MADE
12. Telescope-at-Disconnect Switch - AUTO

⑬ Inform Crew - "Auto retraction" (All)
14. Disconnect Switch - Actuate
15. Boom - Stow & latch
16. Ruddevator Control Stick - LOCK
17. BO Panel Switches - As required
18. A/R Hydraulic System - Depressurized
19. Rendezvous Light Switch - ON 3196 ▶ plus ✈ ICTO K231 ▶

⑳ Inform Crew - "Boom inflight check complete" (All)

PREPARATION FOR CONTACT

① Manual Fuel-Shutoff & Transfer Valves - Condition (BO, E)
2. Command Radio - Monitor
3. Signal System Manual Override Switch - NORMAL
4. A/R Master Switch - ON
5. Boom Hydraulic Pressure Switch - AUTO or ON
6. Telescope-at-Disconnect Switch - AUTO

(Cont)

PREPARATION FOR CONTACT (Cont)

7. Circuit Breakers - Set
8. Limit Cutout Switches - ACTIVE
9. Indicator Lights - Test
10. Receiver Director Lights
    a. STA. 750 Receiver Director Lights
        (1) Lighting System Selector Switch - STA. 750
        (2) All Receiver Director Light Rheostats - CW as required
    b. STA. 350 Receiver Director Lights TCTO K526
        (1) Lighting System Selector Switch - STA. 350
        (2) All Receiver Director Light Rheostats - CW as required
        (3) All STA. 350 Background Lights Rheostats - CW as required

⑪ Receiver at 1/2 Mile - Inform pilot (BO, P)
12. Rendezvous Light Switch - OFF **3196** ▶ plus TCTO K231
⑬ Receiver in Observation Position - Inform pilot (BO, P)
⑭ Boom - Lower (BO, P)
15. Boom - 10 Feet
⑯ Inform Crew - "Boom operator ready for contact" (All)

A/R VISUAL SIGNALS

Signals For Normal Operation

1. Boom Extended 10 Feet, Up and Down, Trail - Ready for contact
2. Boom Retracted, Up and Down, Stowed - Malfunction, fixed shortly
3. Boom Extended 10 Feet, Side to Side, Trail - Receiver check your system
4. Boom Retracted, Side to Side, Stowed - Completely inoperative
5. Boom Retracted, Side to Side, Trail - Prescribed fuel transferred

T.O. 1C-97(K)G-1
15 October 1959

9

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

A/R VISUAL SIGNALS (Cont)

Signals For Manual Operation

1. BO Notify Receiver "Tanker Manual Operation" - Trail boom fully extended
   Receiver Acknowledge:
   a. B-47 Flash both landing lights
   b. B-52 Flash A/R overwing lights (Night) or Aldis Lamp/ Flashlight (Day)
   c. B-57 Flashing flashlight
   d. B-58 Flashing flashlight
2. Receiver Notify BO "Manual boom latching"
   a. B-47 Flashes both landing lights
   b. B-52 Flashes A/R overwing lights (Night) or Aldis lamp/ flashlight (Day)
   c. B-57 Flashing flashlight
   d. B-58 Flashing flashlight
   e. BO - Acknowledge, Fully extended boom (One up and down)
3. Breakaway - Actuate ground test switch. Notify pilot on interphone
4. Disconnect - Pull receiver director lights circuit breakers

POST REFUELING

1. Boom - Stow & latch
2. Ruddevator Control Stick - LOCK
3. Switches - As required
4. A/R Hydraulic System - Depressurized
5. Inform Pilot - "Boom stowed" (BO, P)
6. Fuel Valve Check - Accomplish (BO, E)
7. Form 781 - Enter A/R information

DESCENT

1. Boom - Stowed & latched
2. Passengers & Cargo - Condition

BEFORE LANDING

1. Landing Gear - Report down
2. Wing Flap Movement - Report
3. Safety Belt - Fastened

AFTER LANDING

1. Wing Flap Movement - Report
2. Gear & Tires - Condition
3. Scan - As required

POSTFLIGHT

1. Down Locks - Check installed
2. Exterior Inspection - Complete
3. Form 781 - Complete

T.O. 1C-97(K)G-1
15 October 1959

11

CUT ON DOTTED LINE

KC-97G
BOOM OPERATOR'S
ALERT PROCEDURES
CONDENSED CHECKLIST

PREFLIGHT

Accomplish the normal INTERIOR INSPECTION, EXTERIOR INSPECTION, A/R PRESSURE CHECK, and ENGINE RUN-UP procedures, prior to airplane being placed on alert status.

COCKING

Upon completion of the ENGINE RUN-UP procedure, the boom operator's cocking duties have been accomplished.

SCRAMBLE

Before Starting and Starting Engines

1. Down Locks - Remove
② Ground Heating Equipment & Covers - Remove (as briefed) (All)
③ Tail Jack Assembly - Remove & stow (BO, RO or P)
4. No. 1 & No. 2 Engine Dust Plugs & Left Rear Chock - Remove & stow
5. No. 1 & No. 2 Engine - Stand fire guard
6. Fire Bottle - Remove to left wing tip
7. Left Forward Chock - Remove & stow
8. Enter Airplane - Aft entry door
⑨ Taxi Report - Report "Boom operator ready to taxi" (BO, P).

Taxi

1. Gear & Tires - Condition
2. Scan - As required

CUT ON DOTTED LINE

CUT FROM OTHER SIDE

SCRAMBLE (Cont)

Before Takeoff

① Hatches & Doors - Report "Hatches and doors closed and locked" (BO, P)
2. A/R Hydraulic System - Retraction accumulators pressurized
3. A/R Master Switch & Boom Hydraulic Pressure Switch - OFF
4. Wing Flap Movement - Report
⑤ Takeoff Report "Cowl flaps set, boom operator ready for takeoff" (BO, P)

After Takeoff

Refer to normal AFTER TAKEOFF procedure.

DAILY PREFLIGHT

1. Boom - Condition
2. Airplane Interior - Condition

UNCOCKING

No items are required for the boom operator.

TAXI BACK

1. Wing Flap Movement - Report
2. Gear & Tires - Condition
3. Scan - As required
4. A/R Hydraulic System - Depressurized
5. Switches - As required
6. Down Locks - Check installed

KC-97G
CREW CHIEF'S
ALERT PROCEDURES
CONDENSED CHECKLIST

COCKING

1. Chocks - Install (each main landing gear)
2. All Down Locks - Install
3. Tail Jack - Install
4. Ground Power Unit & Fire Extinguishers - Position
5. Grounding Wires - Install
6. Interphone Cord - Position for scramble engine start

SCRAMBLE

① Ground Heating Equipment & Covers - Remove (as briefed) (All)

② Ground Power Unit - Remove to left wing tip (if applicable) (GC, P or RO)

3. Grounding Wires - Remove
4. Ground Interphone - Stand by for engine start
5. Interphone Cord - Remove after engines are started (when dismissed by pilot)
6. Visually Signal Pilot - When clear to taxi

T.O. 1C-97(K)G-1
15 OCTOBER 1959

1

CUT ON DOTTED LINE

COLOR CODING

TUBING CODE KC-97 SERIES AIRPLANES 1207 ▸

🟨 🟩 AIR PRES. MIN. 25 PSI

🟦 🟩 AIR PRES. MAX. 25 PSI

⬛ 🟩 STATIC PRES. AIR SPEED

🟦 🟨 🟦 HYD. PRES. OIL

🟦 🟩 ⬛ CABIN AIRFLOW IND.-LOW

⬛ 🟦 🟩 CABIN AIR FLOW IND.-HIGH

🟦 ⬛ 🟦 WATER (WASTE & LAVATORY)

🟨 🟥 🟨 HEATER PRES. DIFF.-COLD AIR

🟦 🟥 HEATER PRES. DIFF.-HOT AIR

🟩 🟨 🟩 OXYGEN (FILLER)

🟩 🟥 🟩 GASOLINE COMBUSTION HTR.

⬛ PITOT PRES. AIR SPEED

🟨 OIL (LUB)

🟩 OXYGEN (DISTRIBUTION)

🟥 FUEL (GASOLINE)

🟫 FIRE EXTING.

🟫 🟥 EXHAUST LINE COMBUSTION HTR.

⬜ 🟦 MANIFOLD PRESSURE

🟥 ⬛ VENTS & DRAINS

⬜ 🟩 🟥 CO DETECTOR SYSTEM

🟥 ⬜ 🟥 WATER INJECTION SYS.

🟨 🟦 🟨 TORQUEMETER

T.O. 1C-97(K)G-1
15 October 1959

CUT ON DOTTED LINE

CONTROL CABLE CODE

APPLICABLE TO ALL C/KC-97 SERIES AIRPLANES

COLOR CODE	LETTER CODE	CONTROL & FUNCTION
⬜⬛	AA	AILERON — R. AILERON UP L. AILERON DOWN
⬜	AB AS	AILERON AIL. SERVO — L. AILERON UP R. AILERON DOWN
⬜	ATA	AILERON TRIM TAB — R. TAB DOWN L. TAB UP
⬜⬛	ATB	AILERON TRIM TAB — R. TAP UP L. TAB DOWN
🟩⬛	RA RSA	RUDDER RUDDER SERVO — RUDDER LEFT
🟩	RB RSB	RUDDER RUDDER SERVO — RUDDER RIGHT
🟩⬛	RTA	RUDDER TRIM — TRIM LEFT
🟩	RTB	RUDDER TRIM — TRIM RIGHT
🟨⬛	EA ESA	ELEVATOR ELEV. SERVO — ELEV. DOWN
🟨	EB ESB	ELEVATOR ELEV. SERVO — ELEV. UP
🟨	ETA	ELEVATOR TRIM TAB — TAB UP
🟨⬛	ETB	ELEVATOR TRIM TAB — TAB DOWN
🟫🟨	ETFA	ELEVATOR TAB-FLAP OPERATED — TAB UP
🟫🟨⬛	ETFB	ELEVATOR TAB-FLAP OPERATED — TAB DOWN
🟥	SLA	SURFACE LOCK — LOCK
🟥⬛	SLB	SURFACE LOCK — UNLOCK
🟥⬜	SED	SERVO EMERGENCY DISCONNECT
🟦	NWSA	NOSE WHEEL
🟦⬛	NWSB	NOSE WHEEL
🟫⬛	M1A M2A M3A M4A	MIXTURE — FUEL CUT OFF
🟫	M1B M2B M3B M4B	MIXTURE — RICH
⬛⬛	T1A T2A T3A T4A	THROTTLE — CLOSE
⬛🟥	T1B T2B T3B T4B	THROTTLE — OPEN

T.O. 1C-97(K)G-1
15 October 1959

ALL WEATHER OPERATION

SECTION IX

TABLE OF CONTENTS

INTRODUCTION

This Section contains only those procedures which are in addition to the normal operating instructions in Section II regarding night, instrument flight, turbulent air flight, as well as cold weather, hot weather and desert operation. Cold weather operation should only be attempted in those airplanes which have been winterized.

INSTRUMENT FLIGHT PROCEDURES

INSTRUCTIONS

The airplane is stable and easy to handle under all conditions of instruments flight. The following are recommended techniques for the airplane under instrument flight conditions from takeoff to approach and landing that differ from or are in addition to VFR procedures. Some items are repeated for emphasis.

BEFORE ENTERING THE AIRPLANE

Have all snow and ice removed from airplane.

INSTRUMENT TAKEOFF TECHNIQUE

The instrument takeoff and initial climb procedure should be as much as possible like night takeoff procedure. Leave airplane firmly on nose wheel until within 10 knots below unstick speed, then smoothly and firmly lift nose until the miniature airplane on attitude indicator is approximately two bar widths above horizon. Allow airplane to leave runway and establish and maintain initial climb in this attitude. Retract gear as soon as airplane is definitely airborne as indicated by an increase in altitude on altimeter and vertical velocity indicator.

CLIMB

Retrim for best climbing airspeed. Turns should be limited to a maximum bank of 30 degrees. If icing conditions are expected, turn on anti-icing equipment before entering icing conditions.

DURING INSTRUMENT CRUISING FLIGHT

Readjust miniature airplane on attitude indicator. During turns, cross check attitude indicator with airspeed and altimeter for proper pitch reference; limit banks to 30 degrees. The airplane will handle normally throughout its speed range during instrument flight. Limit maneuvers to gentle turns, climbs and descents for maximum ease of control. Use the autopilot whenever possible, to relieve pilot fatigue.

DESCENT

Descents can be made straight ahead up to the limiting airspeed; limit maximum banks to 30 degrees.

NOTE

> At IAS over 220 knots, it is recommended that banks be limited to 15 degrees to provide a safe margin above buffeting range.

Normally descents should be made with the airplane clean, however, the airplane is completely controllable in a maximum rate descent with gear and flaps extended.

CAUTION

> Descents with gear or wing flaps extended under icing conditions should not be made when avoidable.

HOLDING

Holding procedures for the airplane when in a clean configuration normally present no problem concerning fuel consumption, regardless of altitude. The holding pattern may be flown throughout the cruising speed range; however, 155 knots IAS is a recommended speed to fly. The power required for holding will depend on the airplane weight, engine operating limits, etc.

INSTRUMENT APPROACHES

Instrument approaches are easily performed and the flight characteristics during range let-down, ILS, and Ground Controlled Approaches are satisfactory.

RADIO RANGE APPROACH — 4 ENGINES

1. Complete the DESCENT checklist prior to reaching the high cone.

2. Start the BEFORE LANDING checklist after passing the high cone. Maintain 148 knots IAS.

3. After completing procedure turn inbound to low cone, slow airplane to 130 knots IAS.

4. Make final flap setting when visual contact with runway is established.

RADIO RANGE APPROACH — LESS THAN 4 ENGINES

1. Complete the DESCENT checklist prior to reaching the high cone.

2. Start the BEFORE LANDING checklist (except for landing gear) after passing the high cone. 2550 rpm or 2700 if required. Flaps as required to maintain 148 knots IAS.

3. After completing procedure turn inbound to low cone, slow airplane to 130 knots IAS. If operating conditions are critical, gear may be held up at pilot's discretion.

4. Make final flap setting when visual contact with the runway is established.

GROUND CONTROLLED APPROACH — 4 ENGINES

1. Complete the DESCENT checklist prior to reaching designated radio fix.

2. Start the BEFORE LANDING checklist after passing radio fix.

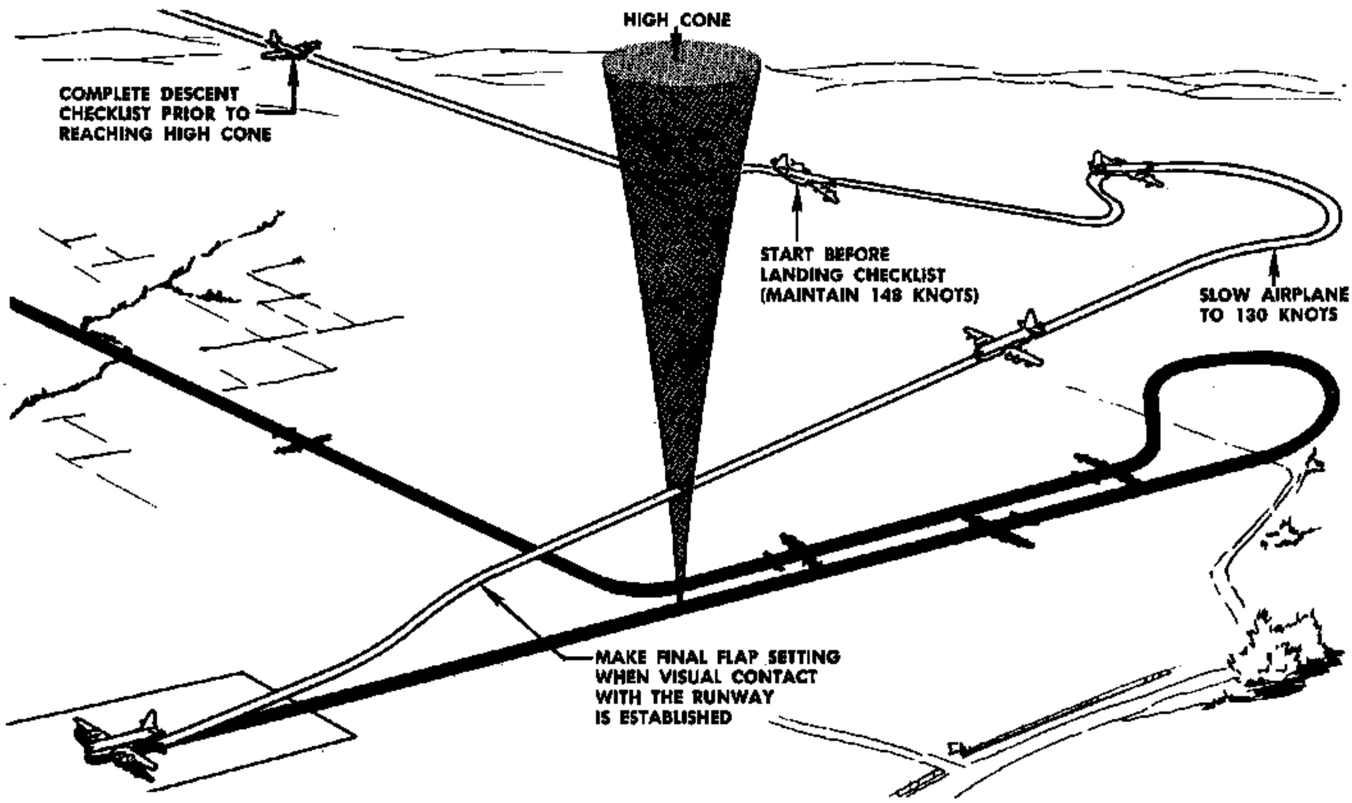
3. After turning final approach, slow airplane to 130 knots IAS. Maintain rate of descent as required by GCA controller.

4. Make final flap setting when visual contact with the runway is established.

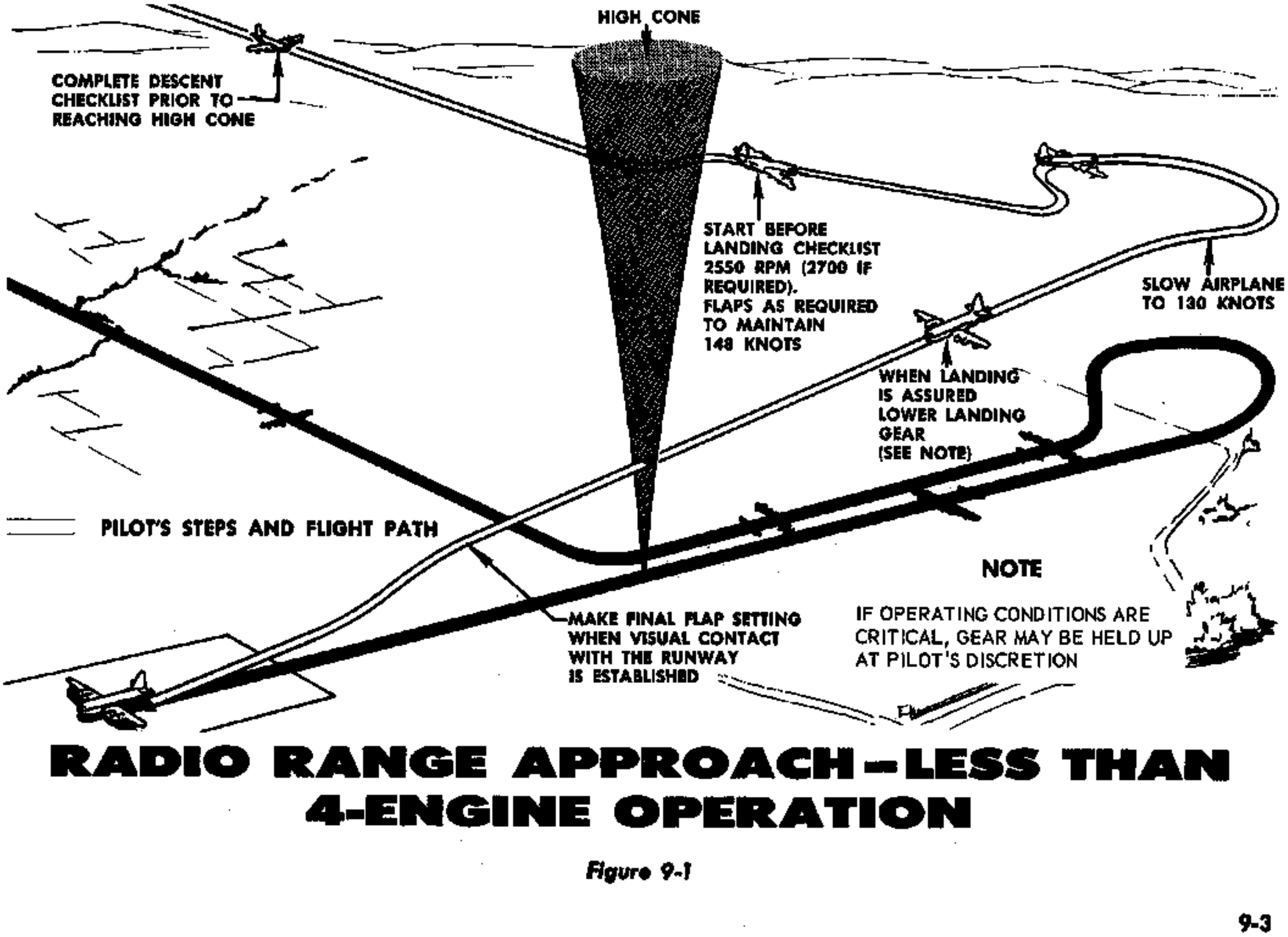
GROUND CONTROLLED APPROACH — LESS THAN 4 ENGINES

1. Complete the DESCENT checklist prior to reaching the designated radio fix.

2. Start the BEFORE LANDING checklist (except for gear) after passing the radio fix. 2550 rpm or 2700 if required. Flaps as required to maintain 148 knots IAS.



RADIO RANGE APPROACH—4-ENGINE OPERATION

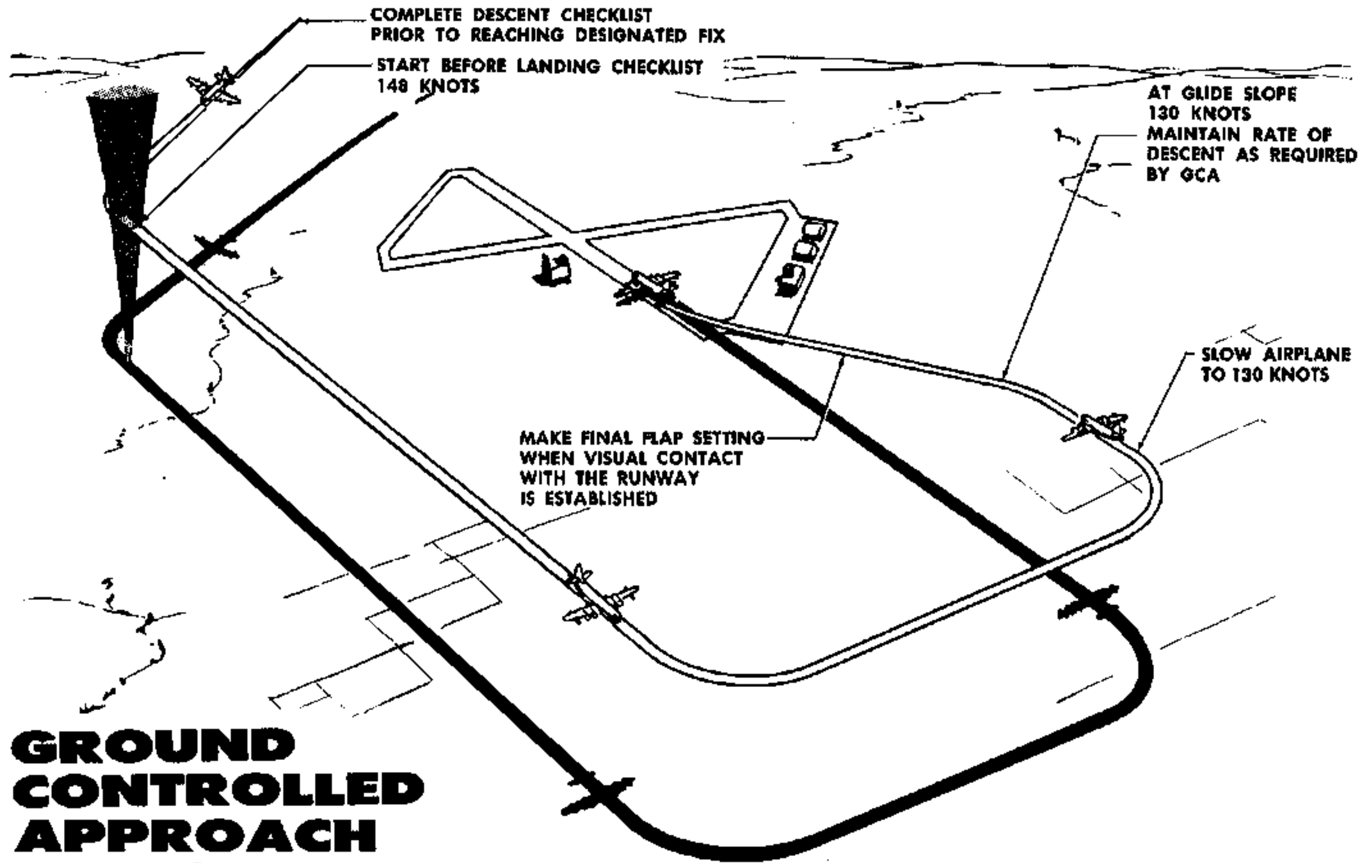


NOTE

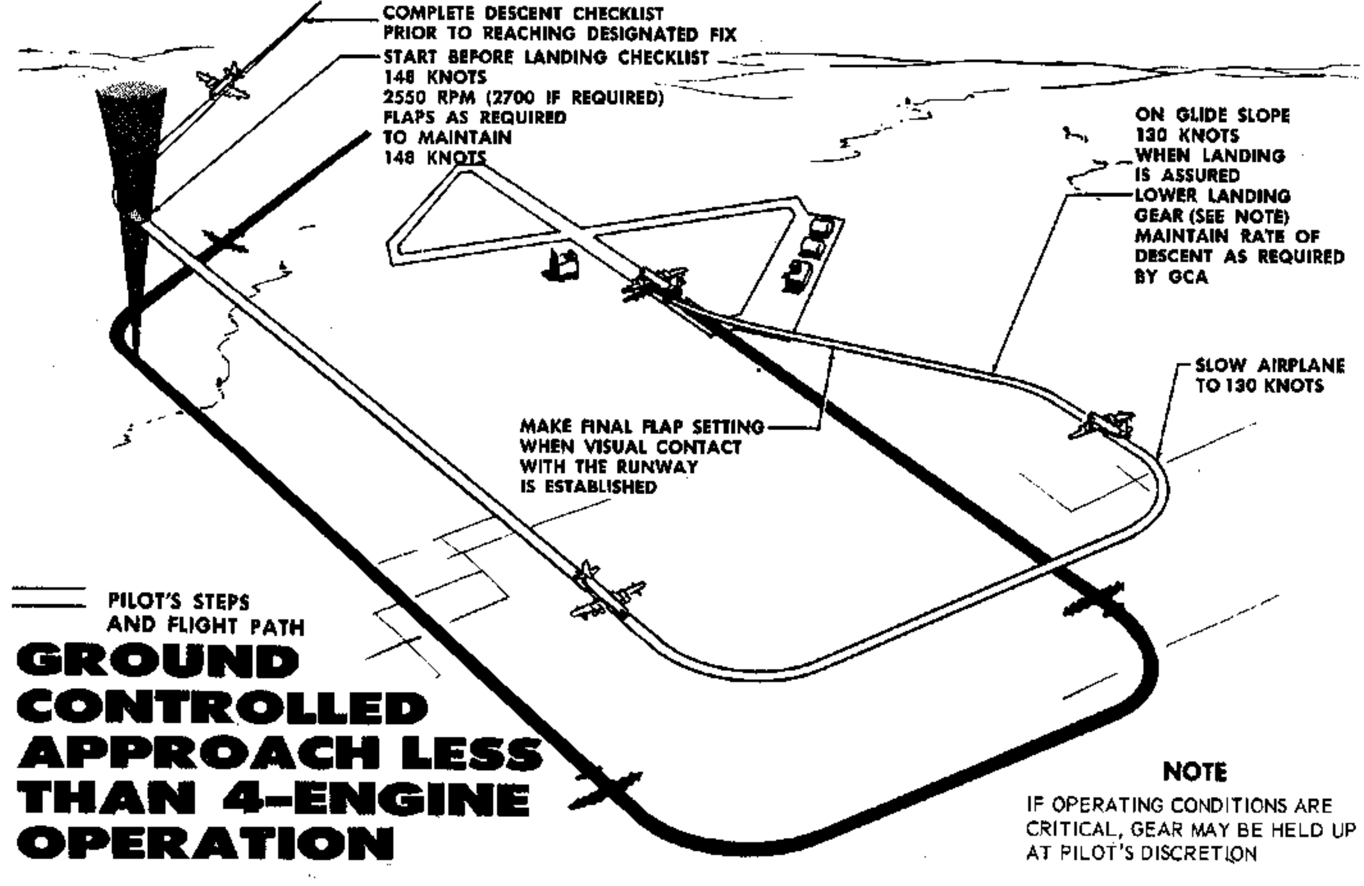
IF OPERATING CONDITIONS ARE CRITICAL, GEAR MAY BE HELD UP AT PILOT'S DISCRETION

RADIO RANGE APPROACH—LESS THAN 4-ENGINE OPERATION

Figure 9-1



GROUND CONTROLLED APPROACH 4-ENGINE OPERATION

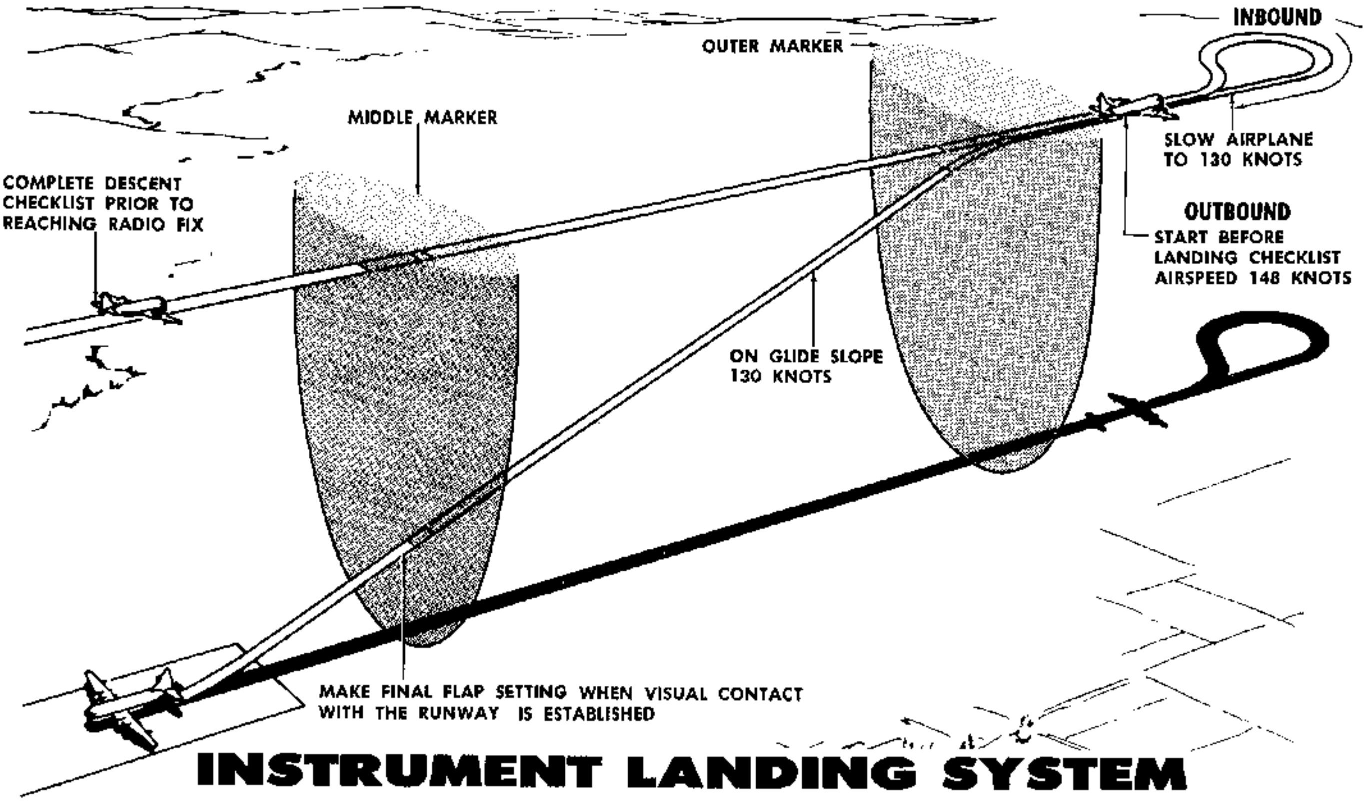


GROUND CONTROLLED APPROACH LESS THAN 4-ENGINE OPERATION

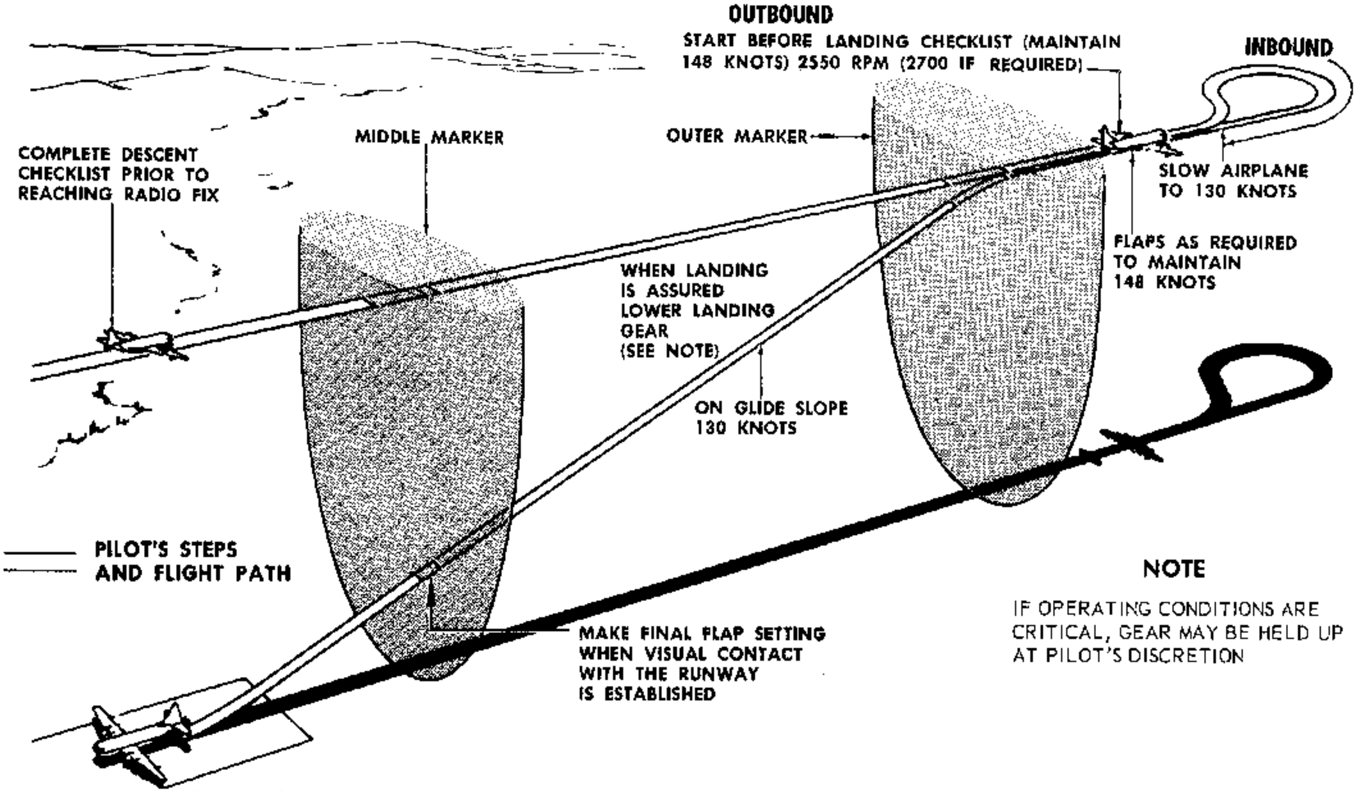
NOTE

IF OPERATING CONDITIONS ARE CRITICAL, GEAR MAY BE HELD UP AT PILOT'S DISCRETION

Figure 9-2



INSTRUMENT LANDING SYSTEM
4-ENGINE OPERATION



NOTE

IF OPERATING CONDITIONS ARE CRITICAL, GEAR MAY BE HELD UP AT PILOT'S DISCRETION

INSTRUMENT LANDING SYSTEM
LESS THAN 4-ENGINE OPERATION

Figure 9-3

3. After turning final approach, slow airplane to 130 knots IAS. If operating conditions are critical, gear may be held up at pilot's discretion. Maintain rate of descent as required by GCA controller.

4. Make final flap setting when visual contact with the runway is established.

ILS — 4 ENGINES

1. Complete the DESCENT checklist prior to reaching the radio fix.

2. Start the BEFORE LANDING checklist after passing the outer marker outbound. Maintain airspeed 148 knots IAS.

3. After completing procedure turn inbound, slow airplane to 130 knots IAS.

4. Make final flap setting when visual contact with the contact with the runway is established.

ILS — LESS THAN 4 ENGINES

1. Complete the DESCENT checklist prior to reaching the radio fix.

2. Start the BEFORE LANDING checklist (except for gear) after passing the outer marker outbound. 2550 rpm or 2700 if required. Flaps as required to maintain 148 knots IAS.

3. After completing procedure turn inbound, slow airplane to 130 knots IAS. If operating conditions are critical, gear may be held up at pilots' discretion.

4. Make final flap setting when visual contact with the runway is established.

LANDING

When the use of reverse thrust is planned with water, snow, or loose dirt on the runway, care should be exercised to prevent loss of visibility, especially in a light wind. Also care should be taken that one or more engines do not stop during use of reverse thrust.

ICE AND RAIN

TAKEOFF WITH ICE AND SNOW ON WINGS

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 speeds and characteristics to an extremely dangerous degree. Loss of an engine shortly after takeoff 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.

ICING DURING FLIGHT

Rime and clear icing can be expected at any and all attitudes. Ice will normally adhere to the windshield, leading edge of wings, empennage and props. Control while on instruments becomes very sluggish when heavy icing accumulates on the airplane. Normally, airspeed cannot be regained with power as long as heavy ice formations remain on the airplane. Therefore, it is necessary to lose altitude to regain airspeed lost. If the above condition exists, be sure and use additional speed during approach and low altitude flight because of the added weight and change in air flow over the wings. If severe icing is suspected, proceed as follows:

1. If at all possible, avoid areas of heavy or extended icing.

2. Have all items of anti-icing and deicing equipment operating prior to entering icing area.

SURFACE ANTI-ICING SYSTEM

The wings and the empennage each have their own anti-icing system. If icing is anticipated turn on the entire system to give normal anti-icing. During critical icing conditions when sufficient heat is not available, the outboard wings, dorsal fin and horizontal stabilizer only may be deiced by placing the limited anti-ice switches in the desired positions. For cases of extreme emergency anti-ice switches allow by-passing of the automatic heat control and emergency cycling of the heaters as required. Under all conditions it is advisable to monitor the heater duct temperatures closely.

CARBURETOR ANTI-ICING

See CARBURETOR ICE ELIMINATION, Section VII.

PROP DEICING

When prop icing conditions are suspected, place the prop deice switch in the ON position to energize the circuit. Prop deicing will be indicated by the prop deicing indicators and by the loadmeter flicking as the timer selects each prop. Should it become apparent that one or more props are not properly deicing check the circuit breakers.

WINDOW HEATING AND DEFROSTING

The center row of windows at the forward end of the control cabin, with the exception of the last window on each side, is deiced by electric window heat. To obtain window deicing place the alternator switches in the ON position. Power may then be selected from either alternator for the Nesa bus. Start with the window heat selector switch in the LOW position to allow more gradual and even heating of the glass.

RAIN DURING LANDING

The following information provides the vision limits that can be expected in various reported precipitation conditions, providing that wipers have been properly maintained:

1. If mist or light rain is reported vision will not be significantly impaired during landing.

2. If moderate rain is reported the wipers will be needed during landing to improve vision.

3. If heavy rain is reported, vision will be fair through wiper area.

4. If very heavy rain is reported, the wipers will provide little or no clearance.

FLIGHT IN TURBULENCE AND THUNDERSTORMS

Experience has shown that the greatest amount of severe turbulence occurs at approximately 16,000 feet, while the least amount of turbulence of a given strength occurs at 6,000 feet and below. Flight through a thunderstorm should be avoided if possible. However, since circumstances may force you at some time to enter a zone of severe turbulence, you should be familiar with the recommended techniques for flying the airplane under such conditions. When flight in turbulence is anticipated it is imperative that the airplane be prepared prior to entering the turbulent area. A penetration speed must be established so that the airplane will neither reach limit load factors nor enter the stalling speed range. Power settings and pitch attitudes are the keys to proper flight techniques in maintaining this penetration speed once the turbulent zone is entered. If a constant power setting and pitch attitude is maintained throughout the storm, a more nearly constant airspeed will result regardless of any false readings on the airspeed indicator. A safe, comfortable penetration speed for the airplane is 60 knots IAS above power-off stalling speed for the weight and configuration being flown. (See figure 6-1 and figure 9-4.) Specific instructions for preparing to enter the storm and for flying in it are given in the following paragraphs.

APPROACHING THE STORM

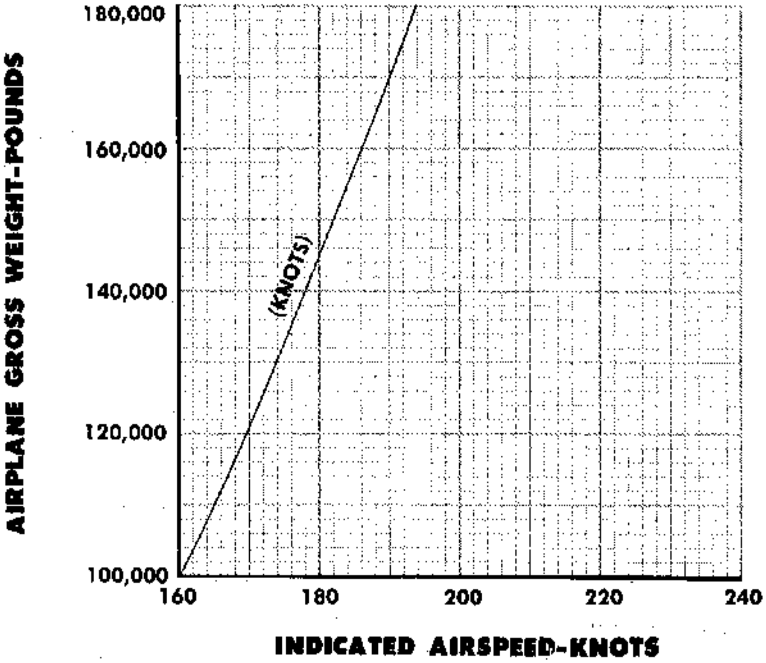
It is imperative that you prepare the airplane prior to entering a zone of turbulent air. If the storm cannot be seen, its proximity can be detected by radio crash static. The airplane's radar should be used to avoid the storms or to pick the best point of penetration. The radar echo shows the location of the moisture content of the storm. The greatest amount of turbulence is associated with these precipitation areas. The brighter the echo the heavier the precipitation, (possible hail) and the greater the turbulence. The echoes should be avoided if at all possible. If a penetration must be made, the shortest course through the weakest echo should be chosen. Prepare the airplane as follows:

1. Disengage autopilot, trim airplane.

2. Mixture levers AUTO RICH.

3. Master propeller synchronizer lever 2400 rpm for gyroscopic stability.

4. Pitot heater and surface anti-icing switches ON.



TURBULENT AIR PENETRATION SPEEDS

Figure 9-4

5. Carburetor heat - as required.

6. Throttles adjusted as necessary to obtain penetration speed.

7. Check gyro instruments for proper settings.

8. Safety belt tightened (Check with crew members).

9. Turn off any radio equipment rendered useless by static.

10. Turn cockpit lights full bright to minimize effect of lightning.

CAUTION

Do not lower gear and wing flaps as they merely decrease the aerodynamic efficiency of the airplane.

IN THE STORM

Emphasis is placed on the following:

1. Maintain power setting and pitch attitude (established before entering the storm) throughout the storm. Hold these constant and your airspeed will be constant regardless of the airspeed indicator.

2. Devote all attention to flying the airplane.

3. Expect turbulence, precipitation, and lightning and do not allow them to cause undue concern.

4. Maintain attitude. Concentrate principally on holding a level attitude by reference to the attitude indicator.

5. Do not chase the airspeed indicator, since doing so will result in extreme airplane attitudes. If a sudden gust should be encountered while airplane is in a nose high attitude, a stall might easily result. A heavy rain, by partial blocking of the pitot tube pressure head, may decrease the indicated airspeed reading by as much as 60 knots.

6. Use as little elevator control as possible to maintain your attitude in order to minimize the stress imposed on the airplane.

7. The altimeter is unreliable in thunderstorm flying because of differential barometric pressures within the turbulent area. A gain or loss of several thousand feet may be expected. Make allowance for this error in determining minimum safe altitude. Static electricity may appear on the prop hubs and blades and around the cockpit windows in the form of a flickering blue light. This will cause severe static on HF and LF radio equipment. It is recommended that all radios except the VHF be turned off to prevent a discharge through the set.

NIGHT FLYING

It is important when making a night takeoff and immediately afterwards, to hold the airplane at the proper attitude and to let the airspeed build up steadily without any loss of altitude at any time. Takeoff normally and allow the airspeed to increase in a shallow climb to 140 knots IAS. Hold 140 knots by increasing the climb rate until a safe altitude is reached. Level off slightly at a safe altitude until the airspeed increases to climb speed for the gross weight and then continue to climb at this speed. On the approach for landing whether visual or instrument approach, the copilot will monitor the altimeter and vertical velocity indicators; he will advise the pilot flying the airplane whenever the angle of bank exceeds 30 degrees, airspeed falls below computed traffic pattern or final approach speeds, and when the airplane appears to be dangerously low to the ground or other obstructions (visual and altimeter cross-check). Leave about 15 inches MP on the engines for flareout and touchdown.

COLD WEATHER PROCEDURES

Successful cold weather operations depend upon the adherence by flight crews and maintenance crews to established procedures. A very important consideration for flight crews is the use of cold weather preflight, inflight and post flight procedures. Maintenance crews must winterize the airplane before it can be operated successfully under conditions of extreme cold. This winterization program includes tightening of fittings in the fuel cell access doors, and the flexible fittings in the hydraulic lines and fuel lines of the air refueling system. These maintenance procedures should be accomplished prior to departure from warmer climates for the most satisfactory results. Cold weather operation requires careful planning of ground activities before takeoff. The central oil tank should be serviced during preflight rather than post flight to reduce the oil tank pre-heat requirement. Arrange pre-heating periods so that all airplane equipment will be inspected, warmed, ready and operating at the time of starting engines. While pre-heating is being accomplished, ice and snow should be removed, inspections and operational checks made, electronic equipment warmed up and other necessary activities conducted. Ground inspections and operational checks must be thorough since cold weather may cause hidden difficulties such as ice and snow accumulation in control mechanisms; fuel, oil and hydraulic hose brittleness with accompanying lowered resistance to pressure shocks; and plexiglas brittleness.

PREFLIGHT

ENGINE PREHEAT INSTRUCTIONS

To preheat the engines using the APU, proceed as follows:

1. Obtain preheat equipment from the storage space in the rear of the airplane. Check against following list:

a. Two 9-inch hoses for each wing (total, four).
b. Four 6-inch hoses for each wing (total, eight).
c. Air flow divider (octopus), one for each wing.
d. Ram-air duct hose connection, one for each wing.
e. Oil ventilator access adapter.
f. Nacelle covers or plugs for each engine.

2. Open No. 1 and No. 4 engine nacelles and remove heater outlet cap.

3. Insert ram-air plug adapter in leading edge of each wing and attach 9-inch hose to plug. Attach other end of hose to blower outlet.

4. Attach second 9-inch hose to heater outlet. Attach other end of this hose to large opening of octopus.

5. Attach four 6-inch hoses to smaller openings of each octopus.

6. Install nose plugs or nacelle covers on engines.

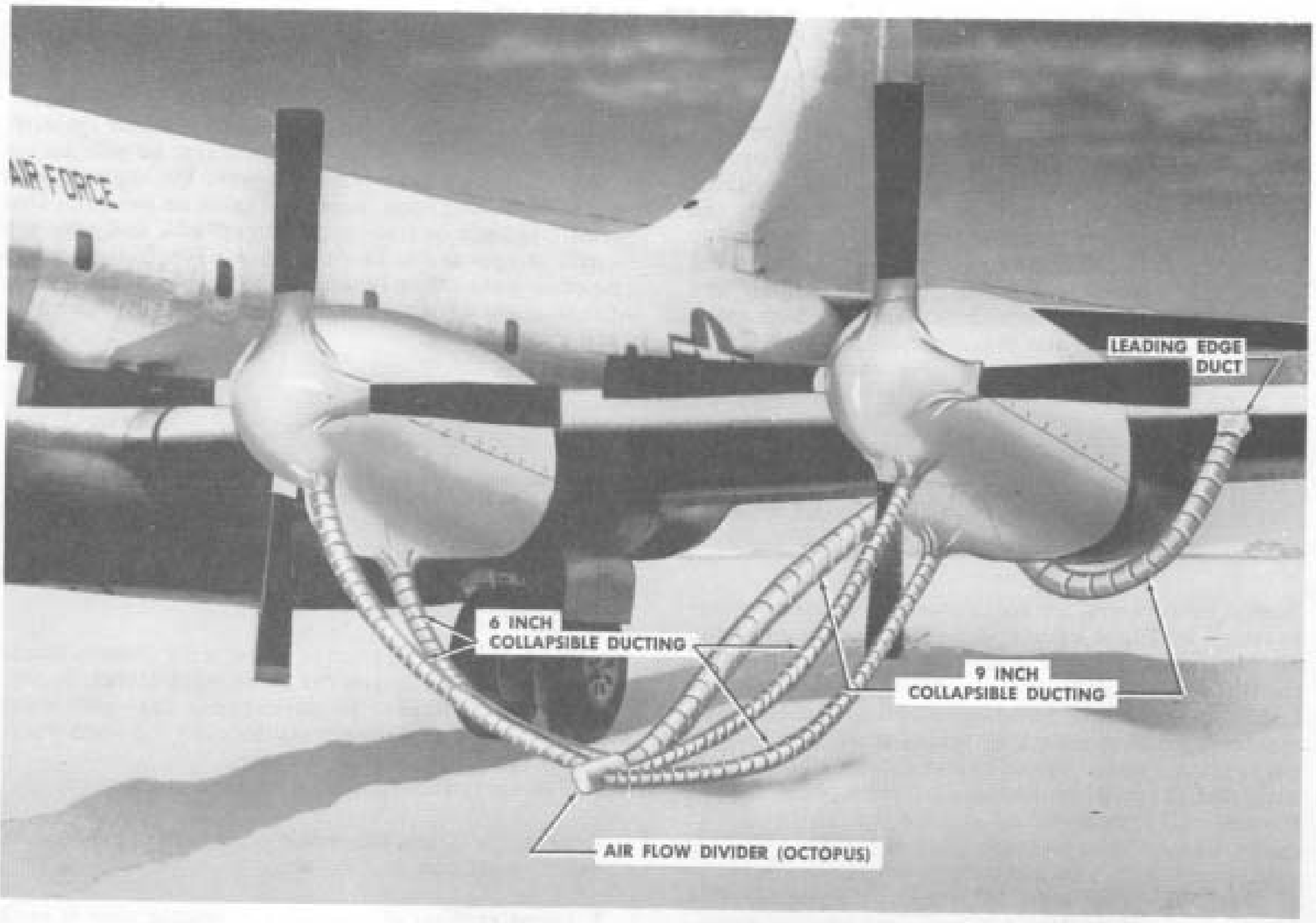
7. Install adapter in oil ventilator access door. Attach one 6-inch hose from octopus to this adapter, and tee with straps.

8. Attach one 6-inch hose from octopus to nacelle cover or plug. (See figure 9-5.)

NOTE

> The above instructions are typical for all four engines. If only one engine on each side is to be heated, attach two 6-inch hoses to nacelle plug and two 6-inch adapters to oil vent for faster heating.

9. Operate APU in accordance with procedures given in AUXILIARY POWER UNIT (APU), Section IV.



COLLAPSIBLE DUCTING ARRANGEMENT

Figure 9-5

10. Turn the engine preheat switch ON at the nacelle.

NOTE

Anti-icing heater outlet valves close when engine preheat switch in turned ON.

11. Place the inverter switch on the engineer's instrument panel at ESSENTIAL.

12. Place the anti-ice master switch on the engineer's instrument panel at ON.

13. Place the limited anti-ice switch on the engineer's instrument panel at ON.

14. Place wing anti-icing heater fuel valve switches on the engineer's instrument panel at ON as required for LH wing and RH wing No. 1, 2, and 3 heaters.

15. Operate APU in accordance with AUXILIARY POWER UNIT (APU), Section IV.

CAUTION

After completing preheat operation, engine preheat switch must be returned to the OFF position.

Preheat Shut-Down Procedures

1. Wing anti-icing heater switches OFF

2. Limited anti-ice switch OFF.

3. Anti-ice master switch OFF.

4. Engine preheat switch OFF.

   Nacelle blower operation for approximately 2 minutes after fuel shutoff is required to purge and cool wing anti-icing heaters.

5. Disassemble hoses and adapters and stow.

6. Replace heater outlet cap.

7. Close heater cavity doors.

8. Leave APU on the line for immediate engine start if required.

BEFORE ENTERING THE AIRPLANE

The following procedures will be adhered to during cold weather operations:

1. At temperatures below freezing the engines and cabin must be pre-heated if the airplane is not in a heated hangar.

2. Ensure that adequate heat has been applied to the central oil tank, the oil transfer lines in the lower forward compartment and the oil transfer valve. If this step is not taken, the congealed oil will not transfer.

3. Check that the engines have been pre-heated until a cylinder head temperature of at least 0°C is obtained.

CAUTION

Insure sufficient heat has been applied to melt all accumulated snow or ice around the engine to prevent later melting and freezing on the landing gear and leading edge of the wing.

4. A unit which is malfunctioning, frequently can be made operational by the application of external heat. This is true of wheel brakes, air refueling boom sliding seal, flap actuators, selector valves, etc.

5. Check the main tires for flat spots. If airplane has been parked more than 48 hours in temperatures of -40°C (-40°F) or below, particularly with a full load, the tires must be heated and rotated. Heat should be left on the tires for at least 15 minutes after rotation to eliminate the flat spots.

6. Check that sheltered air inlet filters have been removed.

7. Use external power.

8. Check that ice, snow, and frost have been removed from wings, control surfaces, and control surface hinges. 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 speeds and characteristics to an extremely dangerous degree. Loss of an engine shortly after takeoff 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.

9. Check fuel vents, limit switches and actuating arms that fold for accumulation of snow and ice.

CAUTION

When directing heat to the induction system from ground heaters, limit to a maximum of 20 minutes to prevent damage to the butterfly valves.

ON ENTERING THE AIRPLANE

Have the APU and battery warmed sufficiently to enable the APU to be started and to maintain smooth operation. Start cabin heating system to defrost windows and to warm flight instruments, radios, and other equipment within the airplane. If the cabin heating system does not supply adequate heat at extremely low temperatures, heat from external heaters can be introduced into the forward and aft compartment through entrance doors.

NOTE

Do not utilize Nesa heat to defrost windshield unless normal defrosting system is inadequate.

BEFORE STARTING ENGINES

The following procedures will be adhered to before starting in cold weather:

1. Have all ground heating equipment removed. Have oil immersion heaters removed if used. Hold the time interval between removal of ground heating equipment and engine start to a minimum.

2. Turn off cabin heaters and all other unnecessary equipment.

WARNING

The cabin heaters must be turned off because the amount of electrical power required to start the engines will reduce the voltage to the ground blower and thereby reduce the volume of air for a combustible mixture. This overly rich mixture will result in burning gasoline being vented overboard beneath the fuselage, causing a critical fire hazard.

STARTING ENGINES

Open cowl flaps and start engines in the normal manner as described in Section II provided adequate external heat has been applied. If adequate external heat has not been applied, the cowl flaps, sheltered air doors, and intercooler flaps must not be moved until after the engines are started and the cylinder head temperature has reached 150°C. In addition to the normal procedure for starting engines, those airplanes incorporating 1C10 572 have a hot fuel prime system to aid in cold weather starting. Hot fuel prime may be used between 20°F and 0°F at the pilots' discretion; below 0°F, hot fuel prime should be used. Use the following procedure for cold weather starting.

1. If hot fuel prime is used; start engines in accordance with PROCEDURE FOR STARTING, Section VII and figure 7-2.

Cold weather starting, not using hot fuel prime; after 15 blades, position boost pump switch to EMERGENCY and prime; after 20 blades turn on ignition and apply ignition boost.

CAUTION

Do not prime engine before engaging starter. To prevent hydraulic lock, avoid every possibility of liquid fuel collecting in the intake pipes or cylinders.

NOTE

- All normal starts will be made on prime. See SYSTEMS OPERATION, Section VII for starting procedures.
- Twenty blades are required for any start made after 1 hour shut-down period. Eight blades will insure detection of hydraulic lock and are sufficient for engine starts made within 1 hour of last shut-down.

2. If there is no oil pressure after 30 seconds running, or if the oil pressure drops after a few minutes of ground operation, shut-down the engine and have the ground crew check for blown lines or coolers and recheck for congealed oil or ice in the Y drain or oil tank sump drain. If oil pressure is registered but is consistently low, or if fluctuating oil pressure is experienced, have instrument pressure transmitter line checked for congealed oil or air lock.

3. If oil pressure becomes too high for a prolonged period (200 psi or above for more than 30 seconds) the oil may be diluted slightly by actuating the dilution switch intermittently to bring down the oil pressure. If 30 seconds of this intermittent dilution fails to reduce the excessive pressure, discontinue the use of the dilution switch; the oil pressure will drop as the oil warms.

4. With an extremely cold engine the initial warm-up may have to begin at a lower speed if backfiring occurs at 1000 rpm.

ENGINE GROUND OPERATION

At extremely low temperatures, it may become necessary to close the cowl flaps to minimum flight opening in order to raise the cylinder head temperature enough to obtain smooth engine operation for engine check. Ground operation with cowl flap openings of less than 1 inch may cause the ignition harness to bake, therefore extended operation under these conditions should be avoided. Turn on cabin heat. Accomplish as much of the ground check as is possible with the wheels blocked to prevent slipping on a slick surface. To eliminate congealing of oil lines in the oil transfer system accomplish the following:

1. Test oil transfer system for proper operation by transferring 1 gallon to each nacelle tank. If system is inoperable (cannot transfer) and heat to central tank and transfer line has been applied, it is an indication the transfer lines in the wing are congealed.

2. To warm the oil transfer lines, manually close turbo waste gates, open preheat valves, and advance throttles to 2000 rpm. Maintain cabin airflow of at least 2 in. Hg. The resultant CAT rise should be approximately 40°C in 3 to 4 minutes. This will aid in decongealing the oil because the oil transfer lines are lagged to the cabin air bleed ducts. This will also aid in developing desirable CHT for takeoff.

3. Re-test oil transfer system. Repeat Step 2 as required.

4. For extreme cold weather operation exercise the props before the propeller automatic control check given in Section II:

a. Propeller auto control switch to No. 1 MASTER.

b. Using the master propeller synchronizer lever, exercise props between 1100 rpm and 1850 rpm slowly, 5 to 7 times, allowing 1 minute between cycles.

WARNING

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

TAXI

CAUTION

The nose wheel steering is not dependable on icy strips and runways. Use throttles primarily for directional control. This also applies for take-offs and landings.

Cold weather taxiing presents two problems. Soft snow and congealed wheel bearing lubricants will retard the taxi roll causing a higher power requirement than for normal taxiing operation. Once the wheel bearing lubricant has warmed, the problem is reversed; rolling action is no longer retarded and it becomes a problem of braking the roll on a slippery surface. The taxiing roll may best be slowed by intermittent use of the brakes. Never ride the brakes on a slick surface. When the brakes are ineffective use reverse thrust to slow or stop the airplane.

CAUTION

- Use of reverse thrust causes uneven and inefficient cooling of the engine, even in cold weather, and continued use for ground operations will result in serious overheating of parts of the engine. This overheating is not readily detectable on the engine instruments.
- Avoid contacting snow, ice or slush with the props and exercise caution when operating in areas where ice, slush or snow may be blown into props as extensive damage to props, engines, and engine mounts may result.

BEFORE TAKEOFF

The following procedure should be accomplished in addition to the normal instructions in Section II:

1. If an instrument takeoff is anticipated, check all flight instruments for proper operation. In cold weather, make sure all instruments have warmed-up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

2. Operate wing flaps through at least one complete cycle.

TAKEOFF

The following procedure will always be adhered to during cold weather takeoffs:

1. For extreme cold weather operations set cowl flap opening at 1.5 inches while holding brakes. Allow the cylinder head temperature to rise to a desired 190° to 212°C temperature before takeoff.

2. During periods of high humidity and carburetor air temperature below +7°C use sheltered air.

CAUTION

Turbos will not be used for takeoff because this will damage the power plant.

3. Maintain carburetor air temperature at +15°C, if possible, to aid fuel vaporization.

4. At sub-zero temperatures, maximum power output will be obtained at a reduced manifold pressure due to the increase in air density. The torque meters may be utilized to determine when maximum power is being delivered.

5. Operate the cabin heating system to assure proper functioning of the instruments.

6. The pilots should be cognizant of the fact that the attitude indicators are unreliable at cabin temperatures below -45°F (-43°C) and that all flight instruments must be cross-checked.

AFTER TAKEOFF — CLIMB

The following procedures are in addition to the normal instructions in Section II:

1. After the first power reduction is made after takeoff adjust the carburetor preheat as necessary to maintain the proper carburetor air temperature.

2. Check surface anti-icing systems in operation if precipitation is encountered.

3. If gross weight and climb conditions permit, operate landing gear through one complete cycle to remove accumulated slush and snow.

CLIMB

Climb with cowl flaps closed to minimum opening, or as needed to keep cylinder head temperature below maximum limit for AUTO RICH operation. Whenever visible moisture conditions exist, the following procedures will eliminate the possibilities of carburetor icing:

1. Keep intercooler flaps closed at all times below carburetor air temperature of +15°C.

2. Use the turbo system to avoid operation with a carburetor air temperature between-10°C and +7°C.

3. Maintain a minimum of 2 in. Hg cabin air flow throughout the flight to warm the oil transfer lines.

CRUISE

Erratic engine operation and inefficient performance at extremely low temperatures may sometimes be encountered due to a poor fuel vaporization, a low carburetor air temperature or low cylinder head temperature encountered at low power settings. If this develops, check to be certain that the carburetor air temperature is within the proper operating limits. If the carburetor air temperature is at the low limit, raise it to the high limit. If difficulty persists, increase mixture strength by use of the mixture lever to obtain smooth engine operation or change power setting to increase cylinder head temperature.

ALTIMETRY ERROR CORRECTIONS

Altimeter errors obtained during flight in the arctic areas will usually be taken care of by the 1000 or 2000 foot terrain clearance requirements. In the arctic regions where low lapse rates cause dangerous computer errors a higher terrain clearance requirement should be established. There low lapse rate errors could also be taken care of during planning or during flight if the computer is modified to allow adjustment for the mean lapse rate for the route.

ICING OR CONGEALING OIL

Extreme cold or icing conditions may result in icing of the oil cooler or congealing of the oil in the oil cooler core with resultant oil temperature rise. With oil cooler flap switches in AUTO the oil cooler flaps will automatically be opened farther, causing increased ice accumulation and higher oil temperature. If this situation occurs as indicated by wide open oil cooler flaps and high oil temperature, close the oil cooler flaps manually. The oil temperature will rise above the red line, but 1 to 3 minutes at this high temperature will relieve the icing or congealing condition. Normal operation with the oil cooler flap switches in AUTO may then be resumed. To reduce the possibility of oil congealing in the transfer lines, some oil should be transferred to each engine oil tank at ten to fifteen minute intervals. Make a complete cycle of the oil tank selector switch positions. Stop at each position and hold the oil transfer pump switch to ON for ten seconds.

DESCENT

Temperature inversions are common in winter in arctic regions. Thus, the air may be 15° to 30°C (27° to 45°F) colder on the ground than at altitude. Therefore, care must be taken to avoid rapid cooling when letting down. Landing gear and partial flaps may be extended to reduce airspeed if icing conditions are not present.

APPROACH

In addition to the normal approach procedure the following should be observed during cold weather operations:

1. Use sheltered air as necessary.

2. Close the cowl flaps to minimum opening. At extremely low temperatures, it would be wise to effect a long, low approach for landing using engine power. This will aid in keeping cylinder head temperatures above critically low values.

LANDING

In addition to the landing instructions in Section II, the following procedures should be followed during cold weather operation:

CAUTION

Avoid contacting snow with props as extensive damage to props, engines, and engine mounts may result.

1. On runways covered with loose snow of undetermined depth, accomplish landings using only 50 to 75 percent flaps to prevent possible damage to the flap trailing edges.

2. Manually open oil cooler doors immediately after landing to permit oil to cool while taxiing. This will permit oil dilution on arrival at the ramp.

3. Use reverse thrust on inboard engines only to decelerate on snow or ice, and use brakes only if necessary after landing roll speed has been reduced.

CAUTION

During reverse thrust operation at slow speeds, loose snow may be blown ahead of the airplane with resultant loss of visibility.

ENGINE SHUT-DOWN

The following oil dilution procedure will be adhered to immediately before stopping engines in cold weather in addition to the normal instructions in Section II. Oil dilution is required if the expected minimum temperature is at or below -1°C (30°F).

1. Service the nacelle oil tank from the central oil system. The amount of oil to be contained in the tank prior to dilution is found by taking oil tank capacity, and subtracting the amount of fuel to be added by dilution. The amount of fuel added by dilution is one US gallon for each minute of dilution. On airplanes incorporating TCTO K522 the oil tank capacity is 32.5 US gallons, on airplanes not incorporating TCTO K522 the oil tank capacity is 35 US gallons.

Example:

1. Dilution time required for -12.2°C (10°F) minimum temperature is three minutes from figure 9-6, for airplanes incorporating TCTO K522. So, if one US gallon of fuel is added to the oil system for each minute of oil dilution, the amount of fuel added is three US gallons. Then 32.5 gallons tank capacity less three gallons fuel to be added gives 29.5 gallons, the level to which the nacelle oil tanks are to be serviced prior to dilution.

2. Idle engines at 1000 rpm with cowl flaps and oil cooler flaps open until cylinder head temperature has been reduced below 150°C and oil temperature has decreased to a minimum, preferably below 50°C.

NOTE

If the oil temperature exceeds 50°C, 15 seconds or 1/4 minute of additional dilution time will be added for each one minute of normal dilution required by the table in figure 9-6, but not to exceed 60 seconds (one minute) of additional dilution.

3. Dilute oil at 1000 rpm:

(a) Turn fuel boost pump switches off.

(b) Turn desired oil dilution engine selector switches on.

(c) Hold master dilution switch on for the dilution time corresponding to the lowest OAT expected.

NOTE

If oil temperature rises above 50°C (122°F) or if oil pressure drops below 15 psi during dilution, record amount of time of dilution accomplished and shut engine down and allow it to cool before continuing.

WITH TCTO K522

Time – Minutes		1	2	3	4	5	6	7	8	9
OAT	°F	30	20	10	0	-10	-20	-30	-40	-50
	°C	-1	-7	-12	-18	-23	-29	-34	-40	-46

NOTE: Oil temperature should be a minimum of 50°C before oil dilution is started.

WITHOUT TCTO K522

Time – Minutes		1	2	2.5	3.5	4.5	5.5
OAT	°F	10	-5	-20	-35	-50	-65
	°C	-12	-21	-29	-37	-46	-54

NOTE: Oil temperature should be a minimum of 50°C before oil dilution is started.

OIL DILUTION TIME

Figure 9-6

4. At end of the dilution period:

(a) Move mixture levers to fuel cut-off.

(b) Hold master dilution switch on until the props stop rotating.

NOTE

Enter time period of dilution in Form 781.

5. If preheat is to be applied to engine and accessories as contained in this Section, dilution time as calculated from figure 9-6 will be reduced by one-half.

CAUTION

When preheat is required, it should be used only for the period necessary to raise the temperatures within the nacelle to 0°C (32°F).

NOTE

In event preheat is not available and dilution was in accordance with above preheat instructions, it will be necessary to restart engines and dilute half again to equal normal schedule.

6. Leave cowl flaps approximately two inches open.

REDILUTION PROCEDURES

After Flight

If flight is in excess of one hour, the normal dilution values for time and temperature will be utilized to dilute the engines. The oil dilution period after flight of less than one hour duration will be half the normal dilution values for time at the lowest expected OAT.

CAUTION

Extreme care must be exercised to avoid over-dilution.

After Ground Operation

1. The redilution of the engines after ground operation will be in accordance with the method outlined below: The number of minutes of redilution is equal to the number of minutes of engine operation divided by 120, times the number of minutes of normal dilution (required by figure 9-6) for the lowest expected OAT.

2. The Formula is:

$$\frac{\text{Min Eng Oper}}{120} \text{ X Min Dil at OAT = Redilution Time.}$$

3. EXAMPLE: After 30 minutes ground operation at expected OAT of 0°F, redilution time is calculated as follows:

$$\frac{\text{30 Min Oper}}{120} \text{ X 4 Min (Req for -18°C (0°F) = 1 Minute of Redilution Time.}$$

POST FLIGHT CHECK

The following items are in addition to the normal instructions in Section II:

1. After diluting oil, have a small amount of oil drained from the Y drains and oil tank sump drains. This will eliminate stagnant, undiluted oil from these low points and reduce the possibility of clogged drains.

2. Have a small amount of fuel drained from fuel drains and strainers to eliminate any moisture which may have collected.

3. In temperatures below -20°F (-29°C), have the battery removed after flight if airplane is to remain outside 24 hours or longer so that when reinstalled, the battery will be able to deliver full capacity immediately.

4. Have central oil tank and system drained if subzero temperature is expected, where practical.

CAUTION

In addition to established requirements for reporting any system defects, unusual and excessive operations, the flight crew will also make entries in Form 781 to indicate when any limits in the Flight Manual have been exceeded.

DESERT AND HOT WEATHER PROCEDURES

PREFLIGHT

BEFORE ENTERING THE AIRPLANE

In addition to the normal instructions in Section II check the following for hot weather operations:

1. Check that all filters are installed and are clean of dust, corrosion, and mold.

2. Check oleos and surface control hinge points free of dust and sand. Check inflation of oleos and tires frequently. Changes in air pressure caused by wide changes in temperature result in improper inflation. Over-inflation is most often encountered.

3. Check for leaks in hydraulic system since heat and moisture cause valve packings to swell.

4. Check airplane position in relation to other airplanes. Sand blown by operating engines of one airplane can add hours to the maintenance problems of other airplanes.

ON ENTERING THE AIRPLANE

After entering the airplane, complete the following:

1. When external power is connected or when the APU is operating, turn the air conditioning master switch ON and the cabin air selector switches to NORMAL to operate the ground blowers for air circulation.

2. Open windows, hatches, bulkhead doors, and entrance door to ventilate the airplane.

3. Check equipment for evidence of corrosion.

4. Position carburetor air switches to SHELT if dusty.

BEFORE STARTING ENGINES

If the APU is used for starting engines, turn the air conditioning master switch OFF to prevent electrical power drain until at least one engine has been started.

STARTING ENGINES

Do not overprime engines since fuel vaporization will be rapid in high temperatures.

ENGINE GROUND OPERATION

In all hot weather and desert operations it is imperative that engine operation and ground tests be conducted in a minimum length of time to prevent high cylinder head temperatures that will exceed the maximum temperature allowable for start of takeoff run. Be certain airplane is clear of other airplanes during ground operations. Use a platform or hard stand to check engines whenever or wherever possible.

TAXI

When taxiing, keep adequate distance between airplanes to prevent prop blown sand from causing damage to following airplanes. Use the brakes as little as possible since it will be difficult to cool them in hot weather operation.

TAKEOFF

Hot weather operations require the pilot to be more cautious of stalling speeds and temperature limitations. Emphasis is placed on the following:

1. Takeoffs during hot periods of the day require longer runs. Efficiency up to 10 percent is lost to heat at this time.

2. Takeoffs with sheltered air may require longer runs because of the power loss resulting from the use of sheltered air.

NOTE

For more complete information on sheltered air power loss, see POWER AVAILABLE FOR TAKEOFF in the Appendix.

3. Close observance of stalling speeds is necessary.

4. Close observance of cylinder head temperatures is necessary.

AFTER TAKEOFF — CLIMB

Retract wing flaps with caution watching for settling tendencies of the airplane due to loss of lift.

CLIMB

Climb at not less than specified climbing speed. Lower climb speeds cause high cylinder head temperature. Return carburetor air switches to RAM when airplane is above dust layer. See Section V for airspeed limitations during operation of sheltered air doors.

DESCENT

Before entering dust layer, position carburetor air switches to SHELT. See Section V for airspeed limitations during operation of sheltered air doors.

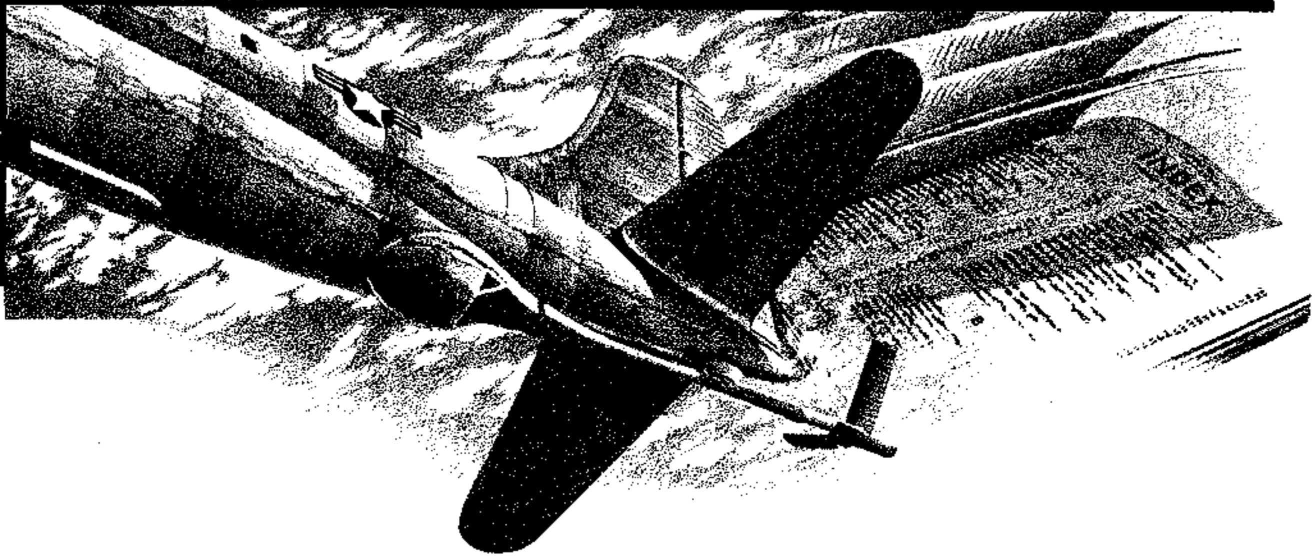
LANDING

Landing ground rolls are longer than those in normal temperatures. Ground speed increases with the same indicated airspeed due to thinner air.

POSTFLIGHT CHECK

Cover all ducts and air intakes as soon as possible to prevent the entrance of blowing sand. Leave windows, hatches and doors open for ventilation in a hot weather region only if blowing sand is not excessive. Close sheltered air doors.

INDEX



✱ DENOTES ILLUSTRATION

Window Defrosting Control Knob

A single knob (9, figure 1-11), on the pilot's auxiliary panel, controls the window defrosting valves. The knob has CABIN HEAT and WINDOW DEFROSTING positions. When the knob is turned to the WINDOW DEFROSTING position, heated air from the cabin heating and pressurizing air ducts is directed through defrosting ducts to the six upper, four lower, and two rear-center windows in the control cabin. When the knob is in the CABIN HEAT position, heated air is directed to the cabin heat outlet ducts.

Window Heat Selector Switch

This switch (2, figure 1-21) on the engineer's auxiliary overhead panel, has OFF--IFR (Air Refueling) EMER--HIGH--NORMAL--LOW positions. When in the HIGH, NORMAL or LOW position, variable frequency ac power from the Nesa bus in the alternator relay shield (figure 1-35) is directed to the control cabin electrically heated windows (figure 4-6) and power from bus No. 2 in the alternator relay shield is directed to the boom operator's window heat selector switch. On ▼ airplanes, when in the IFR (Air Refueling) EMER position, power from the Nesa bus is directed to the boom operator's window heat selector switch as well as to the control cabin windows. The IFR (Air Refueling) EMER position should not be used on Ⓒ airplanes. As the switch is turned from LOW to HIGH, increasing voltages are applied to the control cabin windows. When the switch is in the IFR (Air Refueling) EMER position, a normal voltage is applied to the control cabin windows. Windows 4L and 4R do not receive power when the switch is in either the HIGH or IFR (Air Refueling) EMER positions. The temperature of the Nesa windows will cycle between 38°C and 43°C in all positions. The LOW, NORMAL, and HIGH positions of the selector switch control the voltage to the window heaters and regulate the rate of heating.

Boom Operator's Window Anti-Ice Switch ▼

This switch (14, figure 4-72), on the boom operator's panel, has LOW--OFF--NORMAL positions. The LOW position is used to warm the boom operator's center window slowly and the NORMAL position is used for all other conditions requiring window heating. The circuit protection for this circuit is on the boom operator's panel (next to the switch).

WINDOW ANTI-ICING SYSTEM NORMAL OPERATION

For normal operation in flight, turn window heat selector switch to NORMAL only after a 20 minute warmup of the windows with the window heat selector switch in the LOW position. Before turning the window heat switch OFF, operate window heating with the switch in the LOW position for 5 minutes. Windows 3L and 3R must be closed before any control cabin windows can be heated. For ground operation, use LOW heat only. These steps are necessary to prevent damage to the window glass.

CAUTION

Nesa windows should be operated at as low a temperature as possible without impairing deicing or affecting safety. Excessive temperature reduces service life and contributes to cracking and layer separation.

WINDOW ANTI-ICING SYSTEM EMERGENCY OPERATION

When the control cabin windows are not being deiced sufficiently with the engineer's window heat selector switch in the NORMAL position, turn the selector switch to HIGH. Windows No. 4L and 4R do not receive current for anti-icing when the window heat selector switch is in the HIGH position. To operate the control cabin system with a window failure, shut the system off and disconnect inoperative windows at the upper and lower power leads of each window. Then, if either control window, No. 1 or No. 2L are still operating, start the system again. However, if both control windows are inoperative, leave the system off.

If power to the boom operator's Nesa window fails, ▼, turn the engineer's window heat selector switch to IFR (Air Refueling) EMER.

NOTE

▼ When the engineer's selector switch is in IFR (Air Refueling) EMER position, windows 4L and 4R do not receive power, and the remaining control cabin windows receive normal voltage only. The boom operator's window will receive low voltage only.

PITOT HEAD ANTI-ICING SYSTEM

Ice formation on the pitot heads is prevented or removed electrically by 28 v dc heating elements in each of the two pitot heads.

Pitot Heat Switches

Airplanes **F** **G** **1243**▶ **3141** less those incorporating 1C10 292 have two ON--OFF switches (36, figure 1-12) on the overhead panel to operate the pitot heaters. The left switch controls the pitot heater in the pilot's airspeed indicating system, and the right switch controls the pitot heater in the copilot's airspeed indicating system. Power is supplied from the 28 volt DC bus and circuit protection is through the switches, which are circuit breaker type. On airplanes **G** **3142**▶ plus those incorporating 1C10 292, the pilot's pitot heater switch has EMER--OFF--NORM positions. When in the EMER position, power is supplied from the battery bus. Circuit protection is provided for this switch by circuit breakers on the forward power panel (figure 1-35).

PITOT HEAD ANTI-ICING SYSTEM OPERATION

In flight, turn the pitot heaters on by turning pitot heat switches to ON (or NORM, as applicable). To prevent burning out the heater element, ground operation of the pitot heaters should be limited to brief maintenance checks; extreme cold weather ground operation; and takeoffs during rain, snow, and instrument conditions.

RUDDEVATOR ANTI-ICING SYSTEM ▼V F G 1243 ▶ 3249 less ✈ ECTO K509 ▶

The ruddevators on the air refueling boom are electrically anti-iced. Rubber boots containing heating elements are on the leading edges of the ruddevators. Anti-icing is controlled by a switch on the engineer's air refueling panel. The anti-icing control circuit is protected by a circuit breaker on the engineer's air refueling panel (figure 4-76) and the anti-ice heating elements are protected by fuses on the main power panel (figure 1-35).

Ruddevator Anti-Ice Switch ▼V F G 1243 ▶ 3249 less ✈ ECTO K509 ▶

This switch (1, figure 4-76) has ON--OFF positions and is guarded to the OFF position. When in the ON position, 28 volt dc power is supplied continuously to the ruddevator anti-ice heating elements. An oleo actuated switch keeps the system de-energized when the airplane is on the ground.

Ruddevator Anti-Ice Test Switches ▼V F G 1243 ▶ 3249 less ✈ ECTO K509 ▶

Two switches (on the ADC relay shield, in the ceiling of the lower aft compartment) are for ground maintenance tests of the ruddevator anti-icing system. The switches receive power through circuit breakers on the aft power panel.

CAUTION

To prevent damage to the rubber boots and heating elements, do not operate the ruddevator anti-ice test switches for more than 40 seconds.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

WARNING

- Due to high voltages within electronic equipment, do not attempt inflight maintenance of electronic equipment beyond checking circuit breakers and fuses. Locations of all electronic equipment circuit breakers can be determined from figure 1-35 and figure 4-40.
- ▼V Do not operate unnecessary electrical or electronic equipment during air refueling.

NOTE

No transmission will be made on emergency (distress) frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

All electronic equipment used for communications, navigation, and identification is listed in figure 4-7. The communication radios are connected through a radio junction box to the interphone so that individual selection of the receivers and transmitters can be made at each crew member's interphone control panel. A master d-c radio and radar power circuit breaker is on the forward power panel (figure 1-35). Circuit protection for radio a-c circuits is on the a-c power panel (figure 1-35).

NOTE

Radio equipment used for two-way communications have separate transmitters and receivers. When a radio is used, the receiver operates continuously except for the periods when the transmitter is used. Since the receiver is cut-out during transmission, it is not possible to transmit and receive simultaneously on the selected radio. Similarly, if other receivers use the same antenna, these receivers are cut-out during transmission also.

INTERPHONE (AN/AIC-8) F 1243 ▶ 1371
(AN/AIC-10) F G 1372 ▶

Airplanes F 1243 ▶ 1371 have AN/AIC-8 interphone equipment and airplanes F G 1372 ▶ have AN/AIC-10 interphone equipment. The AIC-8 and AIC-10 have different control panels and related equipment; however, the function of the controls and the operating procedures for each interphone is the same. The interphone ties all communication facilities together on a common channel. The particular control panel or panels at each station determine the facilities available for talking and listening. Regular crew stations have control panels with switching arrangements that permit speech communication between crew members, transmission and reception on the liaison, MF command, UHF, and VHF radios, and reception of the signals from the navigation equipment. There are six stations which have auxiliary interphone installations. The auxiliary interphone panels are only connected to the interphone and call circuits so that the user is limited to talking or listening to other crew members. The auxiliary interphone panels are located in the nose wheel well, at the rear wing spar, APU, overwing emergency exit hatches, left scanner's station, boom operator's compartment (or aft cargo door Ⓒ), the A/R hydraulic panel on airplanes G 22665 ▶, and the right scanner's station on airplanes G 17260 ▶ 22664. Control power is 28 volt DC with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

Interphone Controls

F 1243 ▶ 1371

NORMAL--SINGLE REC SWITCH. This switch (12, figure 4-8), on the AN/AIC-8 interphone control panel, allows only one receiving channel to be heard when in the SINGLE REC position. When more than one interphone mixer switch is in the ON position, the signals take priority in the following order: VHF COMM, LIAISON, HF COMM, INTER, UHF, ADF 1, ADF 2, MARKER and VHF NAV. The switch should normally be in the NORMAL position.

F G 1372 ▶

NORMAL--AUXILIARY LISTEN SWITCH. Each AN/AIC-10 interphone control panel has a NORMAL--AUX LISTEN switch (6, figure 4-8) that is safetied to NORMAL. In the NORMAL position, all the facilities on the control panel operate in the normal manner. There is a small amplifier for each control panel. If the amplifier at the user's station fails, the AUX LISTEN operation is an emergency measure for listening. Switching to AUX LISTEN bypasses the amplifier, makes the volume control ineffective, and makes it possible to listen but not talk. Operation in this function is with reduced signal strength (no amplification) with a subsequent reduction in volume. There is a definite switching priority of the mixing switches and the selector switch during individual control panel operation in AUX LISTEN. The left mixer switch has first priority. While this switch is in the ON (up) position no other circuit is connected, regardless of the position of the other switches. Placing the left switch OFF (down) passes priority to the switch immediately to the right. Priority continues to pass to the right in this manner as each switch is shut off. All switches to the left of the switch controlling the function the user wants to listen to must be down. Placing all mixing switches down enables the selector switch to control the selection of equipment.

F 1243 ▶ 1371

INTERPHONE SELECTOR SWITCH. A rotary selector switch (7, figure 4-8) on the AN/AIC-8 interphone control panel is for the selection of one facility for talking and listening. Switch markings are CALL--INTER--HF COMM--LIAISON--VHF COMM. On airplanes incorporating 1C10 K527, the HF COMM position is marked UHF COMM. Rotating the selector to the spring-loaded CALL position enables the user to interrupt all other interphone activity to talk to the crew (regardless of the arrangement of switches on the control panels at the various stations). When using the CALL function, the selector must be held in the CALL position to talk and released to INTER to listen. INTER position allows communication between all crew stations. The HF COMM position is for receiving on the BC-454 receiver and transmitting either voice or code on the MF command radio (ART-13 transmitter on the radio rack). On airplanes incorporating 1C10 527, the UHF COMM position is used to transmit and receive on the UHF radio. The LIAISON position selects reception of the BC-348 receiver and permits transmission on MF command radio (ART-13 transmitter at the radio operator's station). On airplanes incorporating 1C10 527, the LIAISON position selects reception on the BC-454 receiver and transmission on the MF command transmitter on the radio rack when the command mike switch (14, figure 4-12) is on HF COMM. The VHF COMM position allows the operator to receive on the VHF radio and transmit when his respective mike switch is depressed.

F G 1372 ▶

INTERPHONE SELECTOR SWITCH. A rotary selector switch (7, figure 4-8) on the AN/AIC-10 interphone control panel is for the selection of one facility for talking and listening. Switch markings are CALL--INTER--COMM UHF--LIA--COMM VHF--COMM MF. Rotating the selector to the spring loaded CALL position enables the user to interrupt all other interphone activity to talk to the crew (regardless of the arrangement of switches on the control panels at the various stations). When using the CALL function, the selector must be held in the CALL position to talk and released to INTER to listen. The user can talk without pressing the mike switch when utilizing the headset with boom-type mike attached. However, when the hand mike is used, the mike switch must be used when the switch is on the CALL position to contact all stations. INTER position allows communication between all crew stations. COMM UHF position allows the operator to receive on the UHF radio and transmit when his respective mike switch is pressed. LIA position allows crew members to receive liaison radio signals and to transmit when his respective mike switch is depressed. COMM VHF allows the operator to receive on the VHF radio and transmit when his respective mike switch is pressed. COMM MF allows voice transmission or code transmission and reception on the MF command radio. The copilot and navigator are provided with a key for code transmission. When using the COMM MF position on the interphone selector switch, the operator should ascertain that his mixer switch is not in the LIA position.

F 1243 ▶ 1371

INTERPHONE MIXER SWITCHES. These switches (1, 2, 3, 4, 5, 9, 10, 11 and 13, figure 4-8) are all on the AN/AIC-8 interphone control panel. The switches are marked ADF 1--ADF 2--HF COMM--MARKER--VHF NAV--UHF--INTER--LIAISON--VHF COMM. When the NORMAL--SINGLE REC switch (12, figure 4-8) is on NORMAL, the ON position of any of the above mentioned mixer switch mixes the audio signal

TYPE AND DESIGNATION	USE	PRIMARY OPERATOR	RANGE	CONTROL LOCATION	REMARKS
INTERPHONE (AN/AIC-8) F 1243 ▶ 1371 (AN/AIC-10) F G 1372 ▶	Intercrew Communication and use with other radio equipment	All crew members	Intraplane only except when used in conjunction with other equipment	All crew stations. Call boxes located at various positions in airplane	
VHF RADIO (AN/ARC-3)	Short range, two-way voice and code communication	Pilot	Up to 135 NAM at 10,000 feet, characterized by line-of-sight conditions	Control stand	Remote tuning on 8 channels
UHF RADIO (AN/ARC-27)	Short range, two-way voice and code communication	Pilot	Line-of-sight. Range varies with altitude in respect to receiving station	Pilots' panel on control stand. On airplanes F G 1243 ▶ 3177 less TCTO 600, master control at navigator's station Airplanes G 3178 ▶ less TCTO 600 have master control on radio rack	1750 frequencies can be selected manually
UHF DIRECTION FINDER (AN/ARA-25) G 3178 ▶ PLUS TCTO 321	Receives signals for directional bearing and homing, both air to air and air to ground	Pilot	Line-of-sight. Range depends upon power of transmitting stations and conditions	ADF position on UHF radio control panel on control stand	Used with UHF radio set AN/ARC-27
LIAISON RADIO (AN/ARC-8) F **TRANSMITTER (T-47/ART-13)** **RECEIVER (BC-348)**	Long range, two-way voice and code communications	Radio Operator	Range depends upon transmitting frequency and conditions. Up to several thousand miles	Radio Operator's Station	
LIAISON RADIO (AN/ARC-21) G AIRPLANES WITHOUT TCTO 1-1-666	Long range, two-way voice and code communications	Copilot	Range depends upon transmitting frequency and conditions. Up to several thousand miles	Control stand	20 preset channels. CW & MCW keying provided for copilot. Key on copilot's auxiliary panel.
LIAISON RADIO (AN/ARC-65) G AIRPLANES WITH TCTO 1-1-666	Long range, two-way voice and code communications	Copilot	Range depends on mode selected, operating frequency, and conditions. Up to several thousand miles	Control stand	20 preset channels. CW & MCW keying provided for copilot. Key on copilot's auxiliary panel. Either amplitude modulation (AM) or single sideband (SSB) operation
MF COMMAND RADIO F **TRANSMITTER (T-47/ART-13)** **RECEIVER (BC-454)**	Long range two-way voice and code transmission	Pilot	Range depends upon transmitting frequency and conditions. Up to several thousand miles	Control stand	

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

Figure 4-7 (Sheet 1 of 3)

TYPE AND DESIGNATION	USE	PRIMARY OPERATOR	RANGE	CONTROL LOCATION	REMARKS
MF COMMAND RADIO (AUX LIAISON) TRANSMITTER (AN/ART-13) G	Long range voice and code communication	Navigator	Range depends upon transmitting frequency and conditions. Up to several thousand miles	Navigator's station	Used as an auxiliary liaison and special transmitter for rendezvous
LIAISON RECEIVER (BC-348) G 17260 ▶ 3278 LESS TCTO KG206 **LIAISON RECEIVER (AN/ARR-36) G 3279 ▶** PLUS TCTO KG206		Navigator (BC-348) Pilot (ARR-36)	Reception depends upon power of transmitting station and conditions	Main radio rack (BC-348) overhead panel (ARR-36)	For additional monitoring requirements
RADIO COMPASS (AN/ARN-6)	Receives signals for directional bearings, homing and radio range flying	Pilot and Navigator	Depends upon power of transmitting station and conditions	Control stand and navigator's station	Control may be transferred between pilot and navigator
MARKER BEACON (AN/ARN-12)	Receives location marker signals on radio navigation beams	Automatic		Beacon light is on pilot's course indicator on pilots' instrument panel	
GLIDE PATH RECEIVER (AN/ARN-18)	Indicates glide angle for instrument approach	Pilot	Short range, line-of-sight	Control stand (Omni control panel)	Indication on course indicator on pilots' instrument panel
VHF NAVIGATION RADIO (OMNI) (AN/ARN-14)	VHF radio-navigation aids	Pilot	Line-of-sight	Control stand (Omni control panel and instrument select switch)	Navigation information displayed on pilot's course indicator and RMI's
UHF NAVIGATION RADIO (TACAN) (AN/ARN-21) TCTO 572	Provides continuous bearing and distance data to ground beacon	Pilot	195 NAM within line-of-sight	Control stand (Tacan control panel and instrument select switch)	Bearing displayed on RMI's and on pilot's course indicator. Range data displayed on range indicator on pilot's instrument panel. Requires N-1 compass data.
DINGHY TRANSMITTERS (AN/CRT-3A)	Emergency transmitter to send signals when forced down	Any crew member	Range depends upon transmitting frequency, location, etc. Up to several thousand miles maximum under ideal conditions at 8364KC. 200-300 miles optimum on 500 KC	Stowed forward of life raft supports in main compartment	
RADIO ALTIMETER (SCR-718C)	Indicates distance from airplane to surface	Navigator	0-40,000 feet	Navigator's Station	
LORAN (AN/APN-9) F	Indicates mapping fixes	Navigator	Up to 1400 NAM depending upon conditions and time of day	Navigator's Station	
LORAN (AN/APN-70) G	Provide accurate fixes for navigation	Navigator	Up to 1400 NAM depending upon conditions and time of day	Navigator's station	

Figure 4-7 (Sheet 2 of 3)

TYPE AND DESIGNATION	USE	PRIMARY OPERATOR	RANGE	CONTROL LOCATION	REMARKS
IFF (AN/APX-6) WITHOUT TCTO 590 **(AN/APX-25)** WITH TCTO 590	Airplane Recognition (Identification Friend or Foe)	Radio Operator F Navigator G 17260 ▶ 2900 G 3340 ▶ Pilot G 2901 ▶ 3339	Line-of-sight	Navigator's Station F Navigator's station G 17260 ▶ 2900 G 3340 ▶ pilot's station G 2901 ▶ 3339	
SEARCH RADAR (AN/APS-42)	Search and navigation radar	Navigator	200 miles maximum	Navigator's Station	For obstacle detection and navigation
T **RADAR BEACON (AN/APN-69)**	Sends signals to other airplane for rendezvous	Navigator	Up to 205 NAM	Navigator's Station	Sends signals when triggered by search radar of approaching airplane. Signals are displayed on search radar of approaching airplane
T **RENDEZVOUS RADAR (AN/APN-12)**	Rendezvous radar transmitter-receiver	Navigator	Up to 350 NAM	Navigator's Station	Sends signals to and receives signals from AN/APN-76 transponder in other airplane or ground station
T **RENDEZVOUS RADAR (AN/APN-76)**	Rendezvous radar transponder	Navigator	Up to 350 NAM	Navigator's Station	Sends signals to approaching airplane when triggered by signals from AN/APN-12 radar in approaching airplane
RADAR PRESSURIZING EQUIPMENT	Pressurizes radar sets to provide satisfactory operation at high altitudes	Navigator		Navigator's Station	
STATIC DISCHARGERS (AN/ASA-3)	Discharges static electricity to air			Wing tips and tail surfaces, boom ruddevators and boom nozzle hood	

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT (CONT)

Figure 4-7 (Sheet 3 of 3)

from the respective receiver separately or simultaneously with the output from the interphone selector switch. This allows the crew member to monitor incoming signals from the various equipment without changing the interphone selector switch position. The MARKER mixer switch on the navigator's panel is also used to monitor the APN-69 radar beacon tone. On airplanes incorporating TCTO 572, the VHF NAV mixer switch (11, figure 4-8) has been changed to VHF TACAN NAV (13, figure 4-8) to permit reception of the identity code transmitted by the selected TACAN station. However, the reception of VOR (Omni) or TACAN signals is also dependent upon the position of the instrument select switch (18, figure 4-23). When the NORMAL--SINGLE REC switch is on SINGLE REC and more than one mixer switch is ON, the mixer switch with the highest priority will pass a signal. For mixer switch priority, see NORMAL--SINGLE REC SWITCH this Section.

F G 1372 ▶

INTERPHONE MIXER SWITCHES. Five mixer switches (1, 2, 3, 4 and 5, figure 4-8) are on the AN/AIC-10 interphone control panel. These switches have INTER--UHF COMM--LIA--ADF--VHF COMM positions. When the NORMAL--AUX LISTEN switch is in the NORMAL position, the ON position of each toggle switch mixes the signal from the respective equipment separately or simultaneously with the facility selected by the interphone selector switch. This allows the crew member to monitor incoming signals from the various equipment without changing the selector switch position. The ON position of the INTER mixer switch allows monitoring on the interphone. The ON position of the UHF COMM mixer switch allows monitoring of signals from the UHF radio receiver. The ON position of the LIA mixer switch allows signals from the liaison receiver to be monitored. The ON position of the ADF mixer switch allows monitoring of signals from the radio compass receiver. The ON position of the VHF COMM mixer switch allows audio signals from the VHF radio receiver to be monitored. In addition, five other mixer switches are on the interphone mixer switch panel. (See figure 4-8.) The additional mixer switches are marked: APN-69 MONITOR--AUX REC--MARKER--APN-76 MONITOR--VHF NAV--TACAN. These switches allow monitoring of signals from their respective receiver. The APN-69 MONITOR mixer switch is used only at the navigator's station. The TACAN mixer switch is used only at the pilot's stations and only on airplanes incorporating ✈ 1010 572 ▶. The APN-76 MONITOR mixer switch on airplanes **G 3142** ▶ is only on the navigator's panel.

F 1243 ▶ **1371**

INTERPHONE VOLUME KNOB. This knob (8, figure 4-8) on the AN/AIC-8 interphone control panel controls the volume of all signals heard in the headset except for transmission on CALL.

F G 1372 ▶

INTERPHONE VOLUME KNOB. A volume knob (8, figure 4-8) on the AN/AIC-10 interphone control panel and auxiliary interphone control panel allows regulation of volume level received at that station. The volume knob is ineffective when the NORMAL--AUX LISTEN switch is in the AUX LISTEN position. The counterclockwise limit of the knob gives minimum volume operation. The maximum volume before peak clipping, is obtained with the knob at approximately the mid-position. Advancing the knob beyond this point results in clipping the speech peaks and increasing the average power of a speech signal when needed to overcome noise at a listener's station. (Peak clipping excludes sharp sound pressures from the ear of a listener during high average output; however, the greater power makes more noticeable the electrical background noise in the system.) Normally the volume control should be set to midposition except on the auxiliary interphone control panel which normally should be set to maximum clockwise position. The volume levels of the various equipment connected to the interphone should then be set for comfortable listening using the individual equipment volume controls.

F G 1372 ▶

LOUDSPEAKER SWITCH. Loudspeakers at each of the major crew stations are turned on and off by an ON--OFF switch (17, figure 4-8) on the base of the speaker. With the switch ON, the speakers maintain the volume level set by the volume knob on the interphone control panel regardless of the airplane altitude. With the switch OFF, no sound will be heard through the loudspeakers, unless a signal is originated using the CALL function.

F 1243 ▶ **1371**

INTERPHONE AND MICROPHONE JACKS. These jacks (15 and 16, figure 4-8) are on the AN/AIC-8 interphone call boxes. They connect headsets and microphones to the interphone.

AUXILIARY INTERPHONE CALL BUTTON. The function of the CALL button (14, figure 4-8) on the auxiliary interphone panels is the same as the CALL function of the selector switch on the interphone control panels at each crew station. This is an emergency provision that enables a crew member to talk to the rest of the crew on the interphone regardless of the switch arrangements on the control panels at the various stations. Pressing the CALL button interrupts all other interphone activity and permits the user to talk without using the press-to-talk switch.

CONTROL WHEEL MIKE SWITCH. This switch (20, figure 4-8) is on the pilots' control wheels. When the switch is depressed, the respective crew member's mike is connected to the facility selected by the interphone selector switch. The switch allows the crew member to listen and talk over the interphone or the selected radio without removing his hands from the control wheel to operate switches on the control panel.

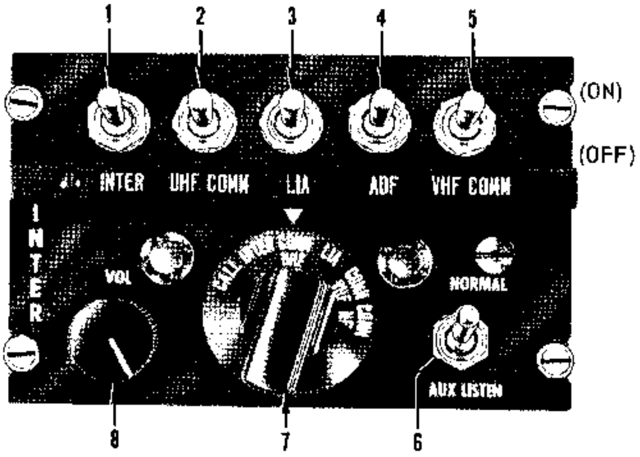
FOOT MIKE SWITCHES. On airplanes **F G 1243** ▶ **3177** there are three foot-operated mike switches (7, figure 4-9) on the floor at the navigator's, engineer's, and radio operator's stations for their use. On airplanes **G 3178** ▶, there are two foot mike switches at the navigator's station. When the foot switch is depressed, transmission is possible only through the equipment indicated by the interphone selector switch on the individual's interphone control panel.

RADIO RANGE FILTER SWITCH. This five-position rotary filter switch (21, figure 4-8) is on the radio range filter control panel. The switch has VOICE--RANGE--BOTH positions for ADF-1 use. RANGE position allows radio compass range signals to be heard at their full volume level and the voice signals reduced to a lower level. The VOICE position allows the voice signals to be heard at their full intensity while the range signals are reduced. The BOTH position disconnects the filter and allows both radio range and voice signals to be heard at equal intensity. The switch also has these positions for ADF-2, however, the switch is inoperative for ADF-2 RANGE or ADF-2 VOICE positions.

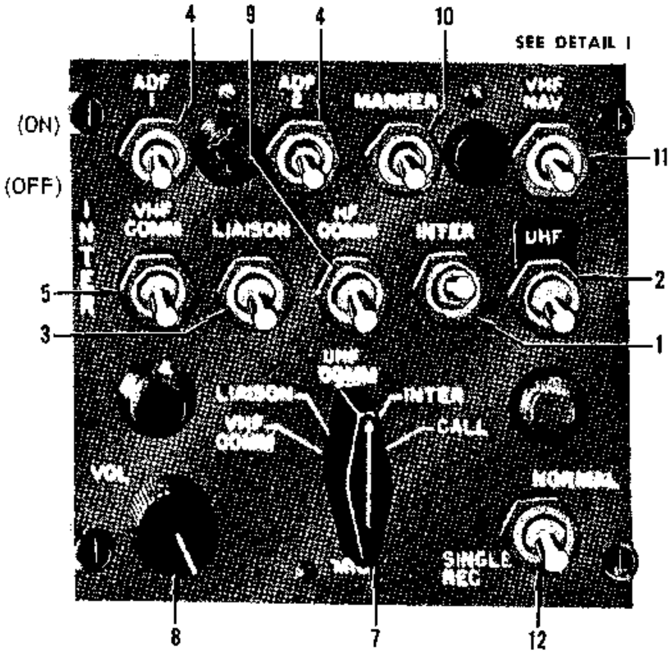
Normal Operation of the Interphone

INTERCOMMUNICATIONS. Communication between crew members may be accomplished as follows:

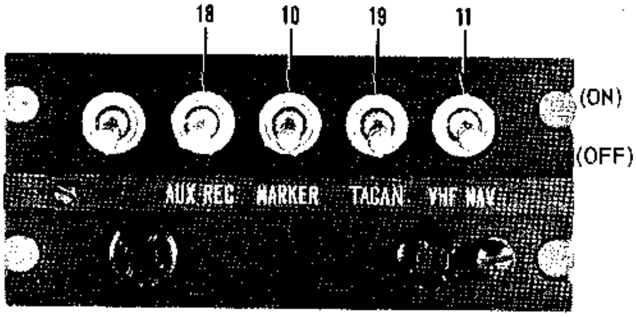
1. Place the NORMAL--SINGLE REC switch (or NORMAL--AUX LISTEN switch, if applicable) on the in-



AN/AIC-10 INTERPHONE CONTROL PANEL F G 1372 ▶

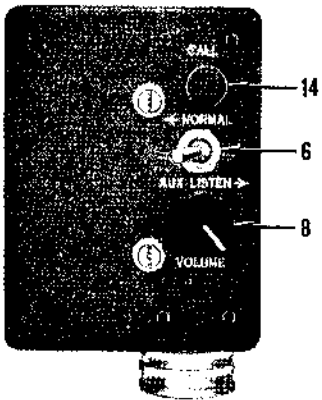


AN/AIC-8 INTERPHONE CONTROL PANEL
F 1243 ▶ 1371

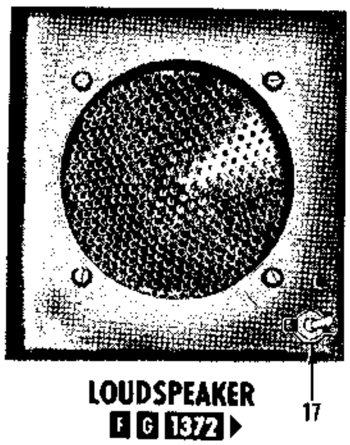


AN/AIC-10 INTERPHONE MIXER SWITCH PANEL
(TYPICAL) F G 1372 ▶

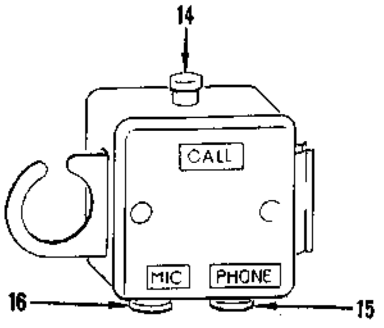
DETAIL I



AN/AIC-10 AUXILIARY
INTERPHONE CONTROL PANEL
F G 1372 ▶



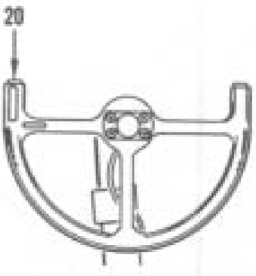
LOUDSPEAKER
F G 1372 ▶



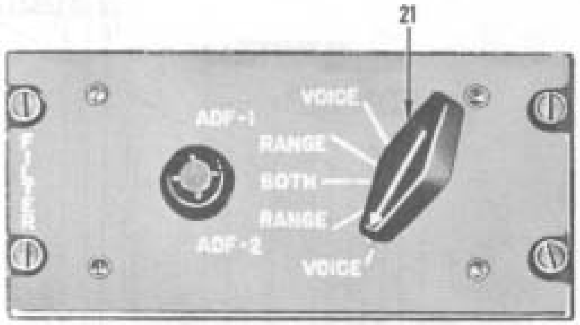
AN/AIC-8 INTERPHONE
CALL BOX
F 1243 ▶ 1371

INTERPHONE CONTROL PANELS

Figure 4-8 (Sheet 1 of 2)



CONTROL WHEEL (PILOT'S SHOWN)



RADIO RANGE FILTER CONTROL PANEL

1 INTERPHONE MIXER SWITCH (2 PLACES)
2 UHF RADIO MIXER SWITCH (2 PLACES)
3 LIAISON RADIO MIXER SWITCH (2 PLACES)
4 RADIO COMPASS (ADF) MIXER SWITCH (3 PLACES)
5 VHF RADIO MIXER SWITCH (2 PLACES)
6 NORMAL--AUXILIARY LISTEN SWITCH (2 PLACES)
7 INTERPHONE SELECTOR SWITCH (2 PLACES)
8 INTERPHONE VOLUME KNOB (3 PLACES)
9 MF COMMAND (HF COMMAND) RADIO MIXER SWITCH
❶ 10 MARKER BEACON MIXER SWITCH (2 PLACES)
11 VHF NAVIGATION RADIO (OMNI) MIXER SWITCH (2 PLACES) AIRPLANES WITHOUT TCTO 572
12 NORMAL--SINGLE REC SWITCH
13 VHF NAVIGATION RADIO (OMNI)/UHF NAVIGATION RADIO (TACAN) MIXER SWITCH AIRPLANES WITH TCTO 572
14 AUXILIARY INTERPHONE CALL BUTTON (2 PLACES)
15 INTERPHONE HEADSET JACK
16 MICROPHONE JACK

17 LOUDSPEAKER SWITCH
18 "AUXILIARY" LIAISON RADIO RECEIVER MIXER SWITCH
19 UHF NAVIGATION RADIO (TACAN) MIXER SWITCH AIRPLANES WITH TCTO 572
20 CONTROL WHEEL MIKE SWITCH
21 RADIO RANGE FILTER SWITCH

NOTE

❶ The MARKER BEACON mixer switch on navigator's AN/AIC-8 interphone control panel is also the APN-69 MONITOR mixer switch.

Figure 4-8 (Sheet 2 of 2)

terphone control panel in NORMAL and move the interphone selector switch to INTER position. On the pilots' panels, move all mixer switches to OFF (down). The interphone is now set up for normal communication between crew members

2. The pilot or copilot may communicate with other stations by depressing his control wheel mike switch. The navigator and flight engineer may use the foot switch to permit use of their mike. Volume of signals received may be regulated by the volume knob

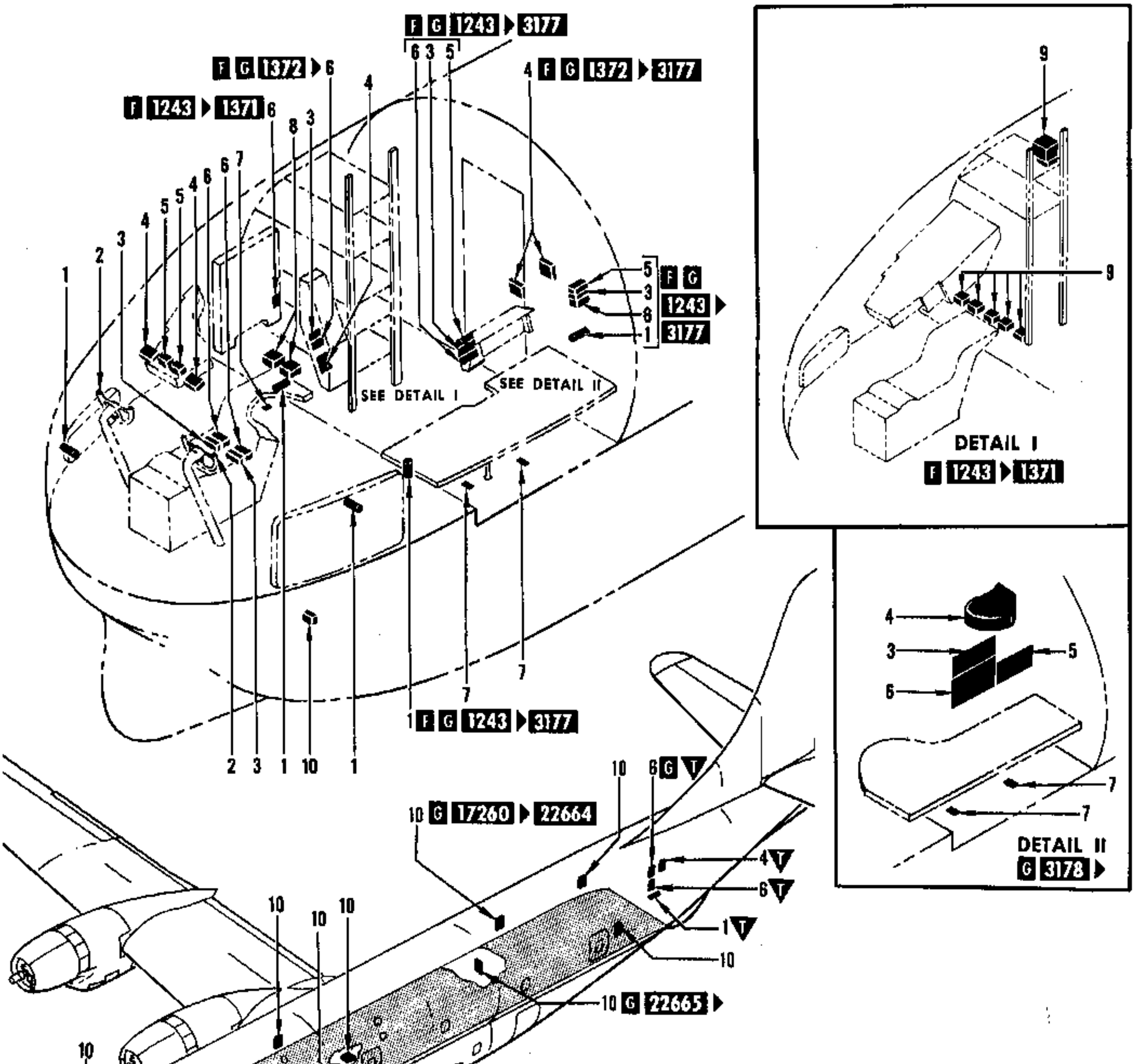
3. Call all crew members from the pilot's or copilot's station by depressing the control wheel mike switch on the pilots' control wheel or by placing the pilots' interphone selector switch to CALL. Call by other crew members may be made by positioning their interphone selector switch to CALL. Call from stations with auxiliary interphone panels may be made by pressing the auxiliary interphone call button on that panel. While any switch is on CALL, the signals from all auxiliary equipment are disconnected from the interphone

NOTE

The microphones used with this equipment are gradient microphones. Satisfactory results will therefore be obtained only when the talker's lips are very close to or touching the moisture barrier of the microphone.

INTERPHONE/RADIO COMMUNICATION. Operation of the radio facilities in conjunction with the interphone may be accomplished as follows:

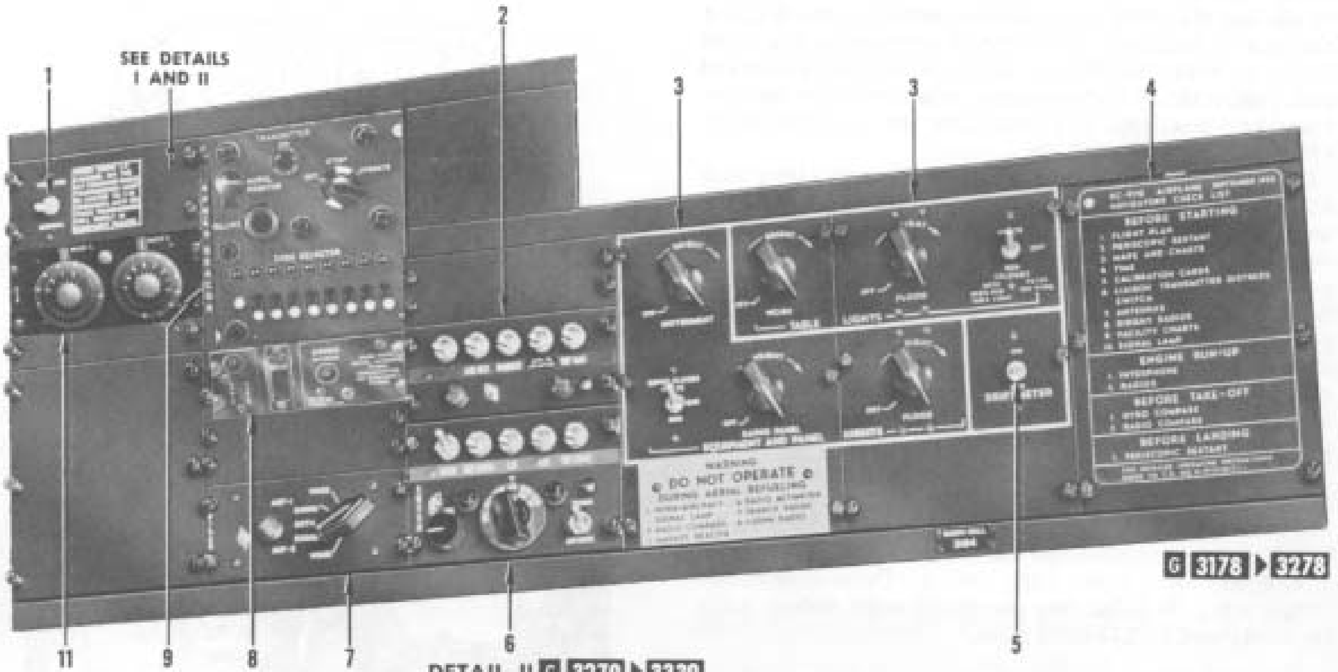
1. The command radios as well as intercommunication between crew members may be heard by placing the proper mixer switch marked UHF COMM or VHF COMM to ON. The pilot and copilot may transmit over a command radio by positioning the interphone selector switch to the desired command radio and using their mike switch on the control wheel. When transmitting, the crew member will hear a sidetone in his headphones. The sidetone enables the user to regulate his speech by hearing his own voice in the headset. Each



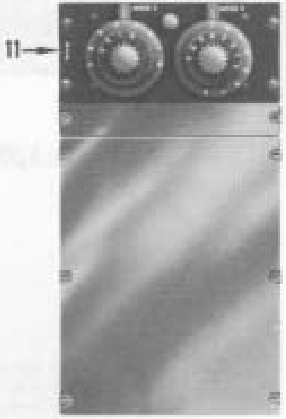
1 HEADSET-MIKE JACK (6 PLACES)
2 CONTROL WHEEL MIKE SWITCH (2 PLACES)
3 INTERPHONE MIXER SWITCH PANEL (6 PLACES) F G 1372 ▶
4 LOUDSPEAKER (6 PLACES) F G 1372 ▶
5 RADIO RANGE FILTER CONTROL PANEL (5 PLACES)
6 INTERPHONE CONTROL PANEL (9 PLACES)
7 FOOT MIKE SWITCH (5 PLACES)
8 DYNAMOTOR F G 1372 ▶
9 INTERPHONE AMPLIFIER (2 PLACES) F 1243 ▶ 1371
10 INTERPHONE CALL BOX F 1243 ▶ 1371 OR
AUXILIARY INTERPHONE CONTROL PANEL F G 1372 ▶
(8 PLACES)

INTERPHONE EQUIPMENT LOCATIONS

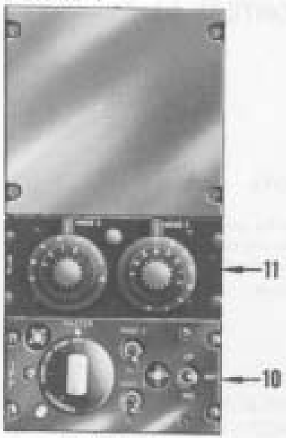
Figure 4-9



DETAIL II G 3279 ▶ 3339



DETAIL I



G 3340 ▶

1 AUXILIARY LIAISON NORMAL/MONITOR SWITCH G 3178 ▶ 3278
2 INTERPHONE MIXER SWITCH PANEL (SEE FIGURE 4-8)
3 LIGHT SWITCHES (2 PLACES)
4 NAVIGATOR'S CHECKLIST
5 DRIFTMETER SWITCH
6 INTERPHONE CONTROL PANEL (SEE FIGURE 4-8)
7 RADIO RANGE FILTER CONTROL PANEL (SEE FIGURE 4-8)
8 RADAR BEACON POWER CONTROL PANEL AN/APN-69 (SEE FIGURE 4-34)
9 RADAR BEACON CONTROL PANEL AN/APN-69 (SEE FIGURE 4-34)
10 IFF CONTROL PANEL (SEE FIGURE 4-30) G 3340 ▶
11 SIF CODER CONTROL PANEL (3 PLACES) (SEE FIGURE 4-32) TCTO 590

NAVIGATOR'S INTERPHONE AND LIGHT PANELS

G 3178 ▶

Figure 4-10

crew member may receive command conversation by placing his interphone selector switch to the desired command position. The crew members may also listen to other facilities while receiving command radio (selected by the interphone selector in the desired command position) by positioning the desired mixer switch in the ON position

2. Radio compass signals may be heard along with other communication facilities by placing the mixer switch marked ADF in the ON position. The pilot may select reception of both range and voice signals by positioning the radio range filter switch to BOTH. When positioned to ADF-1 VOICE or ADF-1 RANGE, reception of the selected signal will be more predominant. The crew member may also listen to other facilities while listening to radio compass (selected by the ADF mixer switch) by placing the desired mixer switches in the ON position

3. Liaison radio reception may be heard separately by positioning the interphone selector switch to LIA. All crew members may transmit over a liaison radio by placing their respective interphone selector switches to LIA and using their mike switch. On airplanes incorporating ✈ TC10 K527, the command mike switch must be positioned to LIAISON also.

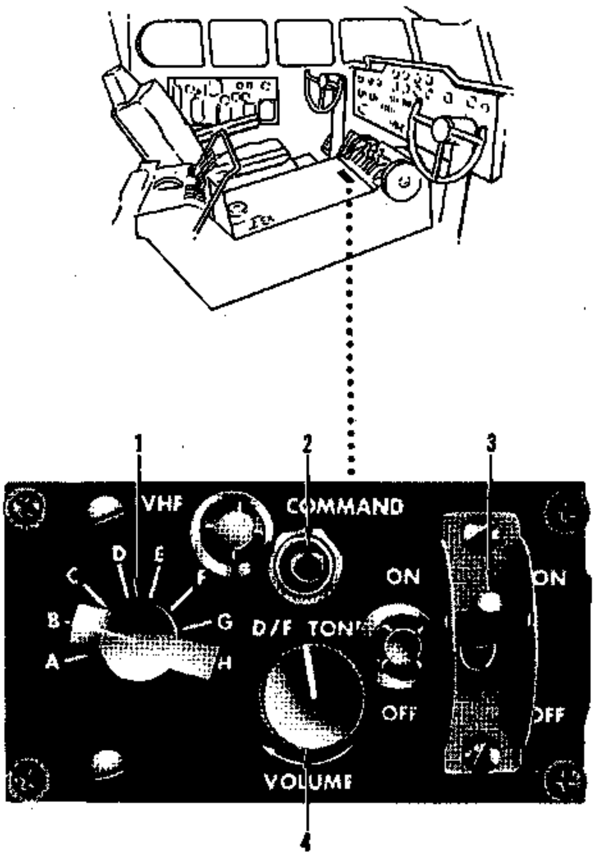
Emergency Operation of the Interphone

To contact all stations in an emergency:

1. The pilot or copilot will position his interphone selector switch to CALL
2. Other crew members place their interphone selector switch to CALL
3. A crew member at a station with an auxiliary interphone panel presses his call button

In the event of amplifier failure at any crew station, as evidenced by intercommunication silence or unintelligible signals from all facilities, proceed as follows:

1. Place NORMAL--SINGLE REC switch in SINGLE REC position (or the NORMAL--AUXILIARY LISTEN switch in AUX LISTEN, if applicable)
2. Place all mixer switches in OFF position and turn interphone selector switch to the desired listening facility
3. If the desired listening facility cannot be selected by the interphone selector switch: turn ON appropriate mixer switch. If more than one mixer switch is ON, the facility heard will be the switch which is in the ON position that has the highest priority. Refer to NORMAL--SINGLE REC SWITCH (or NORMAL--AUXILIARY LISTEN SWITCH) in this Section for priority of switches



VHF RADIO CONTROL PANEL

NOTE

The command mike switch (14, figure 4-12) also controls the VHF radio on airplanes without ✈ TC10 K527.

1 CHANNEL SELECTOR SWITCH
2 D/F TONE BUTTON
3 VHF POWER SWITCH
4 VHF VOLUME KNOB

VHF RADIO CONTROLS

Figure 4-11

VHF RADIO (AN/ARC-3)

The VHF radio is for air to air or air to ground voice or modulated code communications. Range of the equipment is characterized by line-of-sight and by atmospheric conditions. The set operates in a frequency range of 100 to 156 megacycles. Eight crystal controlled channels are provided and may be selected at a control panel (figure 4-11) on the control stand. Channelization crystal changes are possible and only limited to the availability of crystals in the sets frequency range. The radio is turned on and off with the power switch on the control panel. Since the radio is connected to the interphone, the interphone selector switch and mixer switch must be in the appropriate COMM VHF position to transmit or receive. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-35). Additional circuit protection for the set is provided by fuses on the VHF power junction box (J-68/ARC-3) on top of the main radio rack.

VHF Radio Controls

VHF POWER SWITCH. The VHF radio is turned on and off by positioning the power switch (3, figure 4-11) on the VHF radio control panel, to the desired position.

CHANNEL SELECTOR SWITCH. A channel selector switch (1, figure 4-11) on the VHF radio control panel is for selection of one of the eight lettered channels available. The switch has positions marked A through H.

D/F TONE BUTTON. In addition to supplying a tone for direction-finding purposes, this button (2, figure 4-11) on the VHF radio control panel may be used as a key when MCW operation is desired. Maximum keying speed is limited to approximately 15 words per minute.

VHF VOLUME KNOB. A volume knob (4, figure 4-11) on the VHF radio control panel is to adjust the sound level through the interphone.

Normal Operation of the VHF Radio

The VHF radio can be operated from any crew station that has an interphone control panel; however, the channelization and power are controlled at the pilots' station only. Operation of the set is as follows:

1. Place the power switch ON
2. Ascertain that selector switch on interphone control panel is on COMM VHF
3. Allow 30 to 45 seconds for set to reach normal operating temperature
4. Test set for sidetone by pressing the microphone switch
5. Release microphone switch. Place channel selector switch on any desired channel. The receiver will continuously monitor selected channel
6. Adjust sound level with the VHF volume knob. Clockwise rotation increases volume. Counterclockwise rotation decreases volume
7. To turn the set off, position the power switch to OFF

NOTE

To select proper VHF crystals when crystal charts are not available, the following procedure will be used:

1. Transmitter - To find the proper transmitter crystal for a particular channel, divide the desired operating frequency by 18.
2. Receiver - The proper receiver crystal for a particular channel will be determined in the following manner:

$$FC = \frac{FO - 12}{H}$$

FC = Crystal Frequency
FO = Operating Frequency Desired
H = Harmonic

The correct value of (H) is given in the following table:

Operating Frequency (MCS)	Receiver Harmonic (H)
100 - 108	11
108 - 116	12
116 - 124	13
124 - 132	14
132 - 140	15
140 - 148	16
148 - 156	17
156 -	18

The receiver thumb wheel setting for each channel must be set on the desired operating frequency.

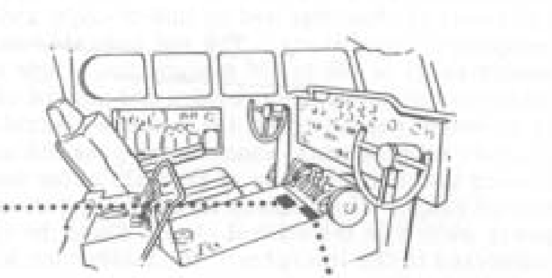
Emergency Operation of the VHF Radio

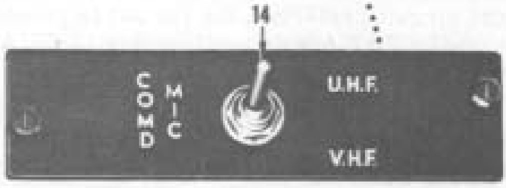
If an obstruction has caused the defective operation of a desired channel, place the channel selector switch to a different frequency and return immediately to the desired channel. This will often correct the difficulty. A crystal failure on one frequency will not affect all frequencies.

$F_{O}(-12) = H - \boxed{FC} -$

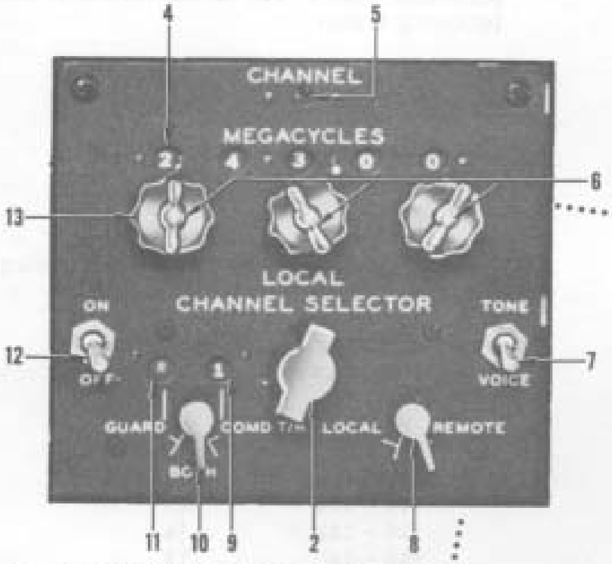
$FO = (H\ FC) + 12$

UHF RADIO (REMOTE) CONTROL PANEL
AIRPLANES WITHOUT TCTO 600

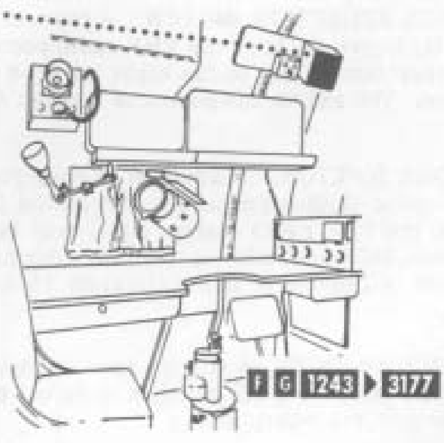


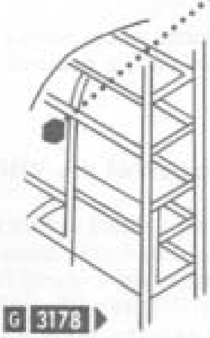


F 1243 ▶ 1371 WITHOUT TCTO K527



UHF RADIO MASTER CONTROL PANEL
AIRPLANES WITHOUT TCTO 600

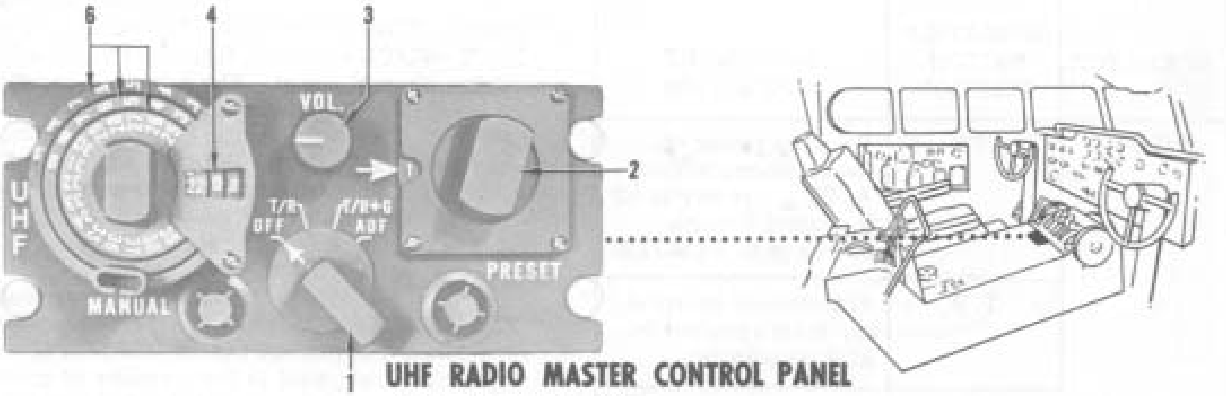




1 PILOTS' UHF OPERATION SWITCH (2 PLACES)
2 CHANNEL SELECTOR SWITCH (3 PLACES)
3 VOLUME KNOB (2 PLACES)
4 FREQUENCY WINDOW (2 PLACES)
5 CHANNEL WINDOW
6 FREQUENCY SELECTOR KNOBS (2 PLACES)
7 TONE--VOICE SWITCH
8 CONTROL TRANSFER SWITCH
9 CHANNEL SELECTOR WINDOW
10 MASTER UHF OPERATION SWITCH
11 GUARD RECEIVER MODE WINDOW
12 UHF POWER SWITCH
13 FREQUENCY SELECTOR KNOB LOCK SCREW
14 COMMAND MIKE SWITCH LESS TCTO K527

UHF RADIO CONTROLS

Figure 4-12 (Sheet 1 of 2)



UHF RADIO MASTER CONTROL PANEL

AIRPLANES WITH TCTO 600

Figure 4-12 (Sheet 2 of 2)

UHF RADIO (AN/ARC-27)

The UHF radio is for short range two-way voice communication on frequencies between 225.0 to 399.9 megacycles. Since the radio operates in the ultra-high frequency (UHF) spectrum, the range for transmission and reception is limited to line-of-slight distances. There are three types of panels to control operation of the radio. Airplanes without TCTO 600 have two separate panels, a remote control panel for the pilots and a master control panel at the navigator's station (airplanes F G 1243 ▶ 1371) or on the main radio rack (airplanes G 3178 ▶). (See figure 4-12, sheet 1.) The radio can be operated from either one of the two panels but not from both panels simultaneously. The position of the control transfer switch on the master control panel determines which panel has control. Airplanes incorporating TCTO 600 have one master control panel on the control stand at the pilots' station. (See figure 4-12, sheet 2.) The master control panel (all airplanes) has facilities for manual selection of any one of the 1750 available frequencies. Each panel has a channel selector switch which permits rapid selection of a common frequency. One of the preset channels is for the guard frequency and each of the remaining 18 preset channels (20 channels on airplanes with TCTO 600) can have any frequency within the operating capability of the set. Refer to CHANGING PRESET FREQUENCIES in this Section. The master control panel on airplanes without TCTO 600 has a provision for transmitting a continuous tone for direction finding by other stations. On airplanes F G 1372 ▶ plus those incorporating TCTO 527, the radio is connected to the interphone for both talking and listening when the interphone selector switch (7, figure 4-8) is on COMM UHF (or UHF COMM, as applicable). To connect the radio to the interphone on airplanes G 1243 ▶ 1371 less those incorporating TCTO 527, the interphone selector switch is positioned to VHF COMM and the command mike switch (14, figure 4-12) placed on UHF. Reception of the UHF receiver is also heard when the UHF radio mixer switch (2, figure 4-8) is ON (up). On airplanes G 3178 ▶ plus those incorporating TCTO 321, the UHF radio is a component of the direction finder (UHF/DF) AN/ARA-25. Refer to DIRECTION FINDER in this Section. Control power for the radio is 28 volt DC with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

UHF Radio Controls

UHF OPERATION SWITCH. Each UHF radio control panel has a UHF operation selector switch (1 and 10, figure 4-12) for selecting different transmitting and receiving operations. The switch on the control panel at the pilots' station has four positions and, on airplanes without TCTO 600, the switch on the master control panel has three positions. See figure 4-13 for an explanation of the switch positions.

FREQUENCY SELECTOR KNOBS. The UHF radio master control panel has three knobs (6, figure 4-12) for manually selecting one of the 1750 different operating frequencies. The knobs are effective when the channel selector switch (2, figure 4-12) on the master control panel is on "M." The knobs are positioned so that the numbers of the desired frequency appear in the frequency window (4, figure 4-12). On airplanes without TCTO 600, the frequency selector knobs are also used to change the preset frequencies. Refer to CHANGING PRESET FREQUENCIES in this Section.

CHANNEL SELECTOR SWITCH. The channel selector switch (2, figure 4-12) on each type of UHF radio control panel is different. On airplanes without TCTO 600, the switch has channel positions numbered from 1 to 18 for selection of one of the preset frequencies. The switch on the remote control panel (pilots' station) has a "G" position to select the guard frequency for both transmission and reception. The selector switch on the master control panel has an "M" position to permit manual selection of a frequency (without affecting a preset frequency) with the frequency selector knobs (6, figure 4-12). The position of the control transfer switch (8, figure 4-12) determines which of the two channel selector switches is operative. Refer to CONTROL TRANSFER SWITCH in this Section. The channel selector switch on airplanes incorporating TCTO 600 has numbered positions from 1 to 20 for 20 preset channels plus the "G" and "M" positions described above.

OPERATOR	OPERATION SWITCH POSITION	EQUIPMENT OPERATION
PILOT	OFF	Primary power off (on airplanes without TCTO 600, power is off if control transfer switch is in REMOTE)
	T/R	Transmitter on standby, main receiver on. ADF on standby
	T/R + G REC	Transmitter on standby, main receiver on, guard receiver on. ADF on standby
	On airplanes G 3178 ▶ plus TCTO 321	
	ADF	ADF (AN/ARA-25) antenna connected, ADF operation ready

On airplanes without TCTO 600

NAVIGATOR	GUARD	Transmitter on guard channel in standby. Main receiver on guard channel. Guard receiver off
	COMD T/R	Transmitter on standby. Main receiver on. Guard receiver in standby
	BOTH	Transmitter on standby. Main receiver on, guard receiver on

OPERATION SWITCH POSITIONS

Figure 4-13

UHF VOLUME KNOB. A volume knob (3, figure 4-12) on the control panel at the pilots' station adjusts the audio signal level from the receiver to the interphone.

Airplanes without TCTO 600

UHF POWER SWITCH. The power switch (12, figure 4-12) on the UHF radio master control panel has two positions: ON and OFF. Placing the switch ON supplies power to operate the radio from the master control panel. Turning the switch OFF de-energizes the radio if the control transfer switch (8, figure 4-12) is on LOCAL. With the control transfer switch on REMOTE, placing the power switch OFF de-energizes some controls at the master control panel. Refer to CONTROL TRANSFER SWITCH in this Section.

Airplanes without TCTO 600

TONE--VOICE SWITCH. There is a two-position TONE--VOICE switch (7, figure 4-12) on the UHF radio master control panel. The switch is operative when the control transfer switch (8, figure 4-12) is on LOCAL. The switch must be on VOICE to transmit voice communications. With the switch on TONE, the transmitter sends a continuous tone so that other stations can determine the bearing of the airplane with their direction finding equipment.

Airplanes without TCTO 600

CONTROL TRANSFER SWITCH. A two-position switch (8, figure 4-12), marked LOCAL--REMOTE, on the UHF master control panel is for transfer of control of the radio. When the switch is on LOCAL, all of the switches on the master control panel are operative and all of the switches on the pilots' panel are inoperative. Placing the switch on REMOTE transfers control of the radio by making the pilots' panel operative and some of the controls on the master control panel inoperative. Regardless of which panel has control, any crew member can transmit and receive on the selected frequency when his interphone selector switch (7, figure 4-8) is on COMM UHF.

COMMAND MIKE SWITCH. On airplanes not incorporating TCTO K527, the command mike switch (13, figure 4-11) on the control stand has two positions: UHF and VHF. The switch is used to connect either the UHF radio or the VHF radio to the interphone. Transmission and reception on the selected radio is then controlled by using the VHF COMM position of the interphone selector switch. The selected radio is also heard when the VHF COMM interphone mixer switch is ON. On airplanes with TCTO K527, the switch is marked LIAISON--HF COMM. For these airplanes, the switch connects either the liaison radio (ART-13 & BC-348 at the radio operator's station) or the MF command radio (ART-13 & BC-454 on the radio rack) to the interphone. Operation on either the liaison or MF command radio is made with the interphone selector switch on LIAISON.

UHF Radio Indicators

Airplanes without TCTO 600

FREQUENCY WINDOWS. There are five frequency windows (4, figure 4-12) on the UHF radio master control panel. The numbers in the windows indicate the selected frequency of the transmitter and main receiver.

Airplanes without TCTO 600

CHANNEL WINDOW. A window (5, figure 4-12) on the UHF master control panel indicates the channel to which the transmitter and receiver are tuned. The number appearing in the window is the number of the preset channel selected on the panel which has control.

Airplanes without TCTO 600

GUARD RECEIVER MODE WINDOW. A window (11, figure 4-12) on the UHF radio master control panel indicates the operation of the guard receiver. When the navigator's UHF operation switch is placed in the GUARD position, the symbol T/R will appear in the window. This indicates that both the transmitter and main receiver will transmit and receive only on the frequency of the guard channel. When the switch is placed in the BOTH position, the letter R appears in the window. This indicates that the guard receiver is on and will receive signals transmitted on the guard frequency while the main receiver-transmitter is operating on any other frequency. When the switch is placed in the COMD T/R position, the word OFF appears in the window. This indicates that the guard receiver is off but the main transmitter and receiver are on and will operate on the frequency selected by the channel selector switch.

Airplanes without TCTO 600

CHANNEL SELECTOR WINDOW. A window (9, figure 4-12) on the UHF radio master control panel indicates the channel selection of the channel selector switch. Also when the navigator's UHF operation switch is in the GUARD position, the word OFF appears in the window indicating that the main transmitter and receiver will not be operating on a channel selected by the channel selector switch on the master control panel.

Normal Operation of the UHF Radio

Transmission and reception on the UHF radio is possible from any crew station that has an interphone control panel; however, the channelization and power are controlled only at either the pilots' or navigator's position, depending upon the position of the control transfer switch and the type of control panel installed.

Airplanes without TCTO 600

Operation of the radio from the master control panel (transfer switch in the LOCAL position) is as follows:

1. Place the UHF power switch (12, figure 4-12) to the ON position

CAUTION

> Allow at least one minute for the set to warmup before operating to preclude damage to the equipment. Warmup time should be extended when voltage input is below normal.

2. Place the interphone controls to the desired position for UHF radio operation
3. Select mode of operation with the master UHF operation switch. See figure 4-13 for possible modes
4. Select desired channel with channel selector switch on master control panel. Preset frequency will appear in frequency windows (4, figure 4-12). Channel number selected will also appear in window next to channel selector and at the top center of the panel
5. If some frequency other than those preset is desired, select M with channel selector switch. Turn frequency selector knobs until desired frequency appears in the frequency windows
6. In normal operation, the tone--voice switch is in VOICE. In TONE position, the radio set transmits a continuous tone

Pilot operation of the UHF radio is as follows:

1. On airplanes without TCTO 600, place control transfer switch on REMOTE
2. Select mode of operation desired with pilots' UHF operation switch (1, figure 4-12)
3. Select preset channel with the channel selector switch on the UHF control panel at the pilots' station. This switch has a "G" position which sets transmitter and main receiver to guard frequency. On airplanes with TCTO 600, the channel selector switch has an "M" position to make the frequency selector knobs operative.
4. Adjust volume to desired level

NOTE

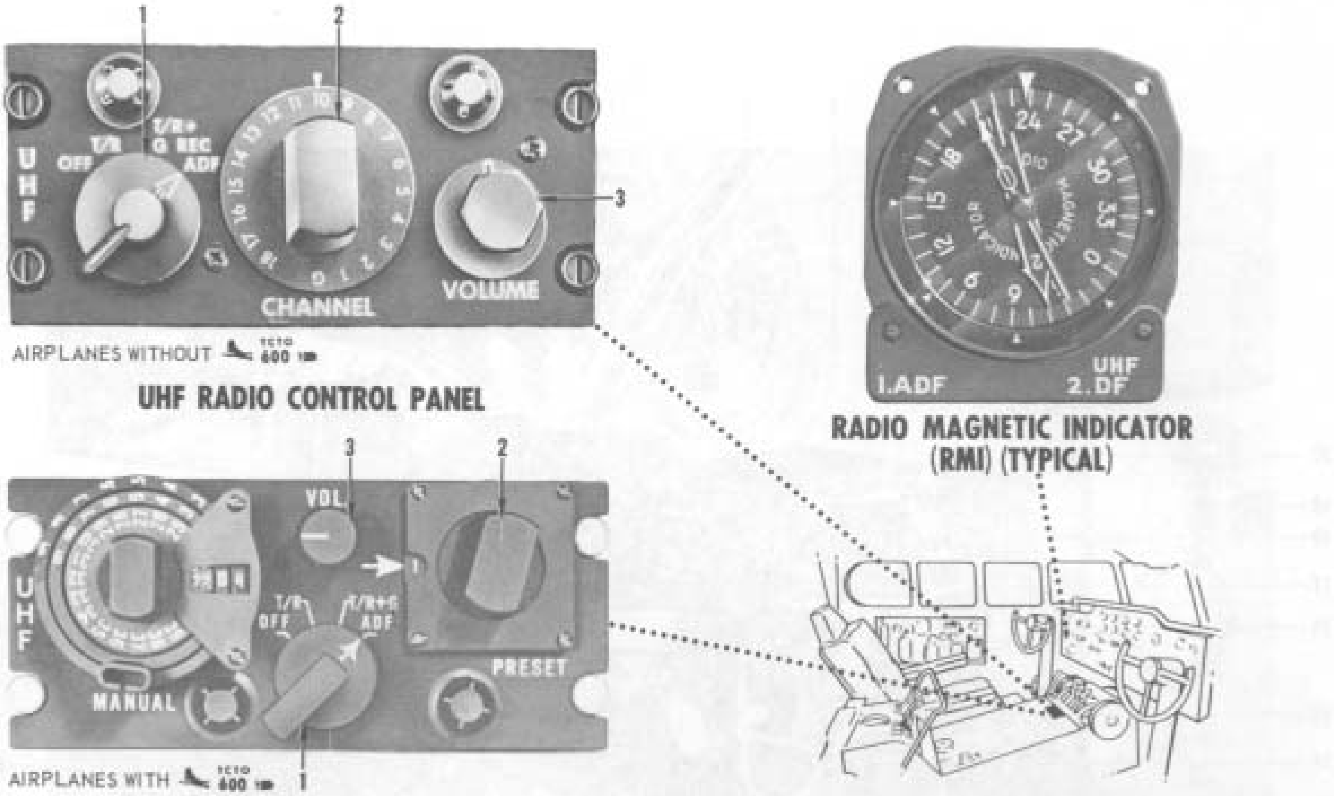
> Tone modulation is not available from UHF control panel on the control stand or on airplanes with TCTO 600.

5. If the radio is to be turned off, turn pilots' UHF operation switch to OFF. On airplanes without TCTO 600, it is necessary to turn UHF power switch to OFF if the control transfer switch is in the LOCAL position.

CHANGING PRESET FREQUENCIES. On airplanes incorporating TCTO 600, the frequency of a preset channel can only be changed by removing the control panel at the pilots' station. Normally, this will not be done in flight due to the ease by which any frequency can be manually selected with the frequency selector knobs (6, figure 4-12). On airplanes without TCTO 600, the frequency of a preset channel can be changed at the master control panel. To change a frequency: (1) Set the channel selector switch (2, figure 4-12), on the panel that has control, to the number of the channel being changed; (2) Loosen the frequency selector knob lock screws (13, figure 4-12); (3) Rotate the frequency selector knobs (6, figure 4-12) until the numbers of the desired frequency appear in the frequency windows (4, figure 4-12); (4) Tighten the frequency selector knob lock screws; and (5) Enter the frequency on the frequency chart.

Emergency Operation of the UHF Radio

If an obstruction has caused the defective operation of a desired channel, place the channel selector switch to a different channel and return immediately to the desired channel. This will often correct the difficulty. A crystal failure on one frequency will not affect all frequencies. Try operation at a different frequency. In case the channel selector switch becomes inoperative, turn the channel selector switch on the master control panel to "M" and adjust the knobs to the desired frequency.



* 1 PILOTS' UHF OPERATION SWITCH (2 PLACES)
2 CHANNEL SELECTOR SWITCH (2 PLACES)
3 VOLUME KNOB (2 PLACES)

* THIS SWITCH MUST BE IN ADF POSITION IN ORDER TO ALLOW DIRECTION FINDER TO FUNCTION

UHF DIRECTION FINDER CONTROLS

G 3178 ▶ PLUS TCTO 321

Figure 4-14

DIRECTION FINDER (AN/ARA-25)

G 3178 ▶ plus TCTO 321

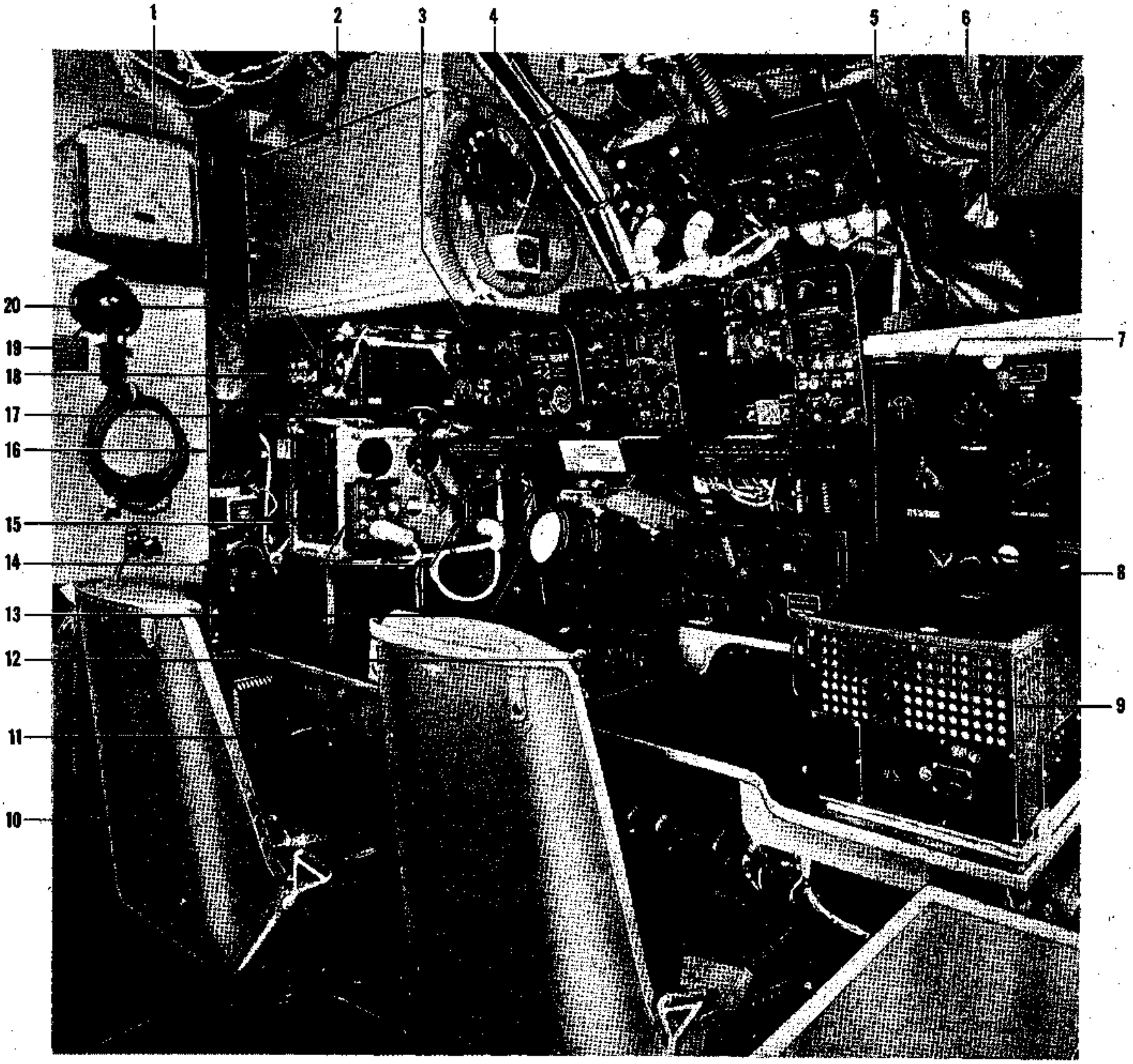
The direction finder indicates the relative bearing of radio signals in the frequency range of 225 to 400 megacycles. The signals are received by the UHF command radio set (AN/ARC-27), using the direction finder antenna. The direction finder is controlled from the UHF radio control panel when the pilot's UHF operation switch (1, figure 4-14) is positioned to ADF. Bearing of the received signal is indicated by the No. 1 pointer of the pilots' UHF D/F radio magnetic indicator (RMI) (15, figure 1-9) on airplanes not incorporating TCTO 572. On airplanes with TCTO 572 the bearing indication is displayed on the No. 2 pointer of RMI's marked 1. ADF--2. UHF DF. Control power is 28 volt DC with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

Normal Operation of the Direction Finder

G 3178 ▶ plus TCTO 321

The direction finder (AN/ARA-25) is made operative by the following procedure:

1. Rotate pilots' UHF operation switch to ADF as shown in figure 4-14. (On airplanes without TCTO 600, the control transfer switch on the UHF radio master control panel must be in REMOTE)
2. Select the desired frequency with the channel selector switch
3. Allow 3 minutes warmup period if the pilots' UHF operation switch was in OFF
4. If the direction finder is being used for homing, fly the airplane to keep the UHF D/F pointer of the radio magnetic indicator under the reference index at the top of the instrument
5. If the direction finder is being used for direction finding, observe the direction of signal source (relative bearing of source) as indicated on the azimuth scale under the arrow of the UHF D/F pointer of the radio magnetic indicator
6. Turn off the equipment by placing the UHF operation switch in OFF. This turns off the AN/ARA-25 direction finder and the UHF radio. Standby operation of the direction finder is achieved by placing the UHF operation switch in T/R or T/R + G REC

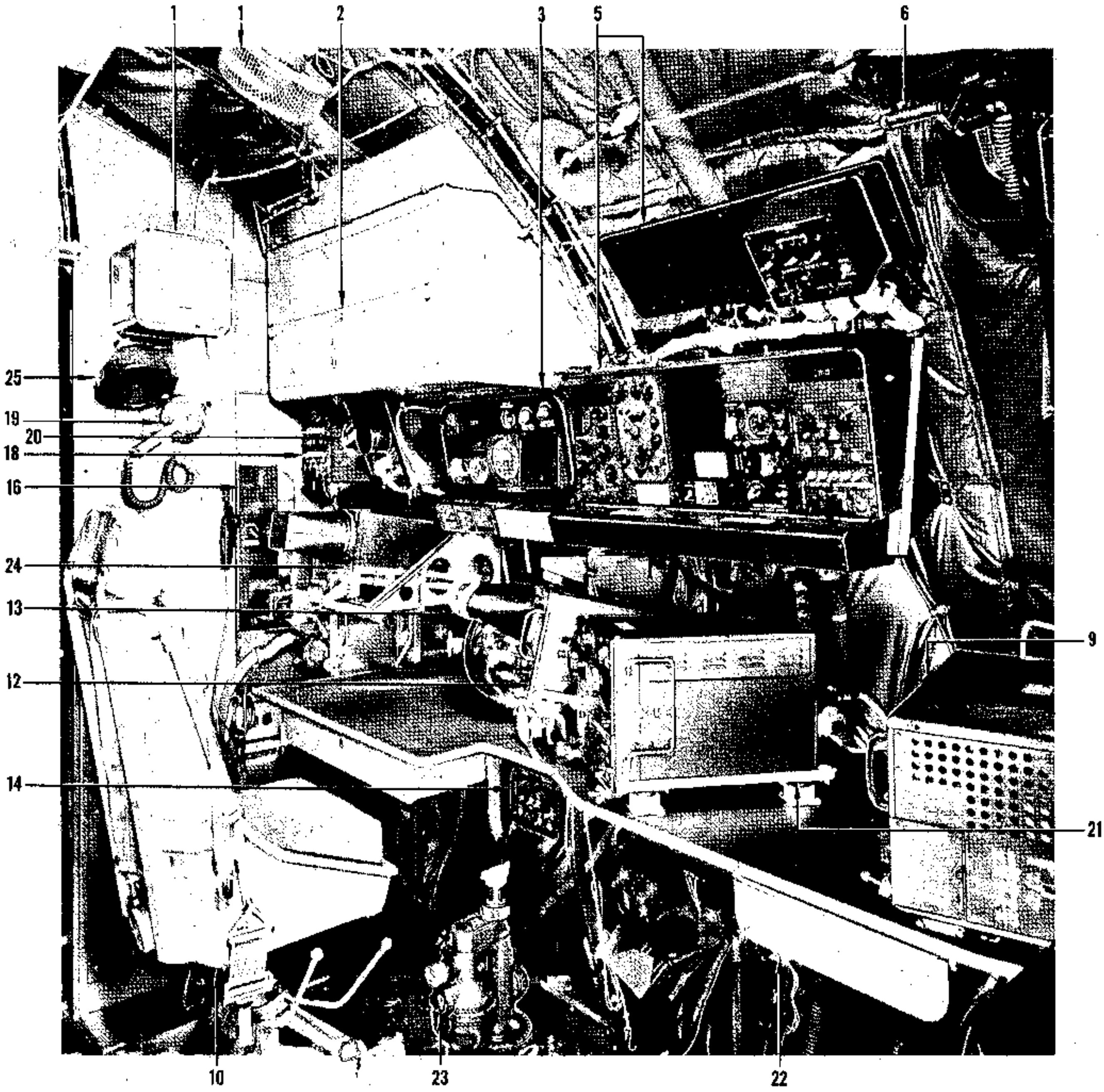


1 VENTILATING FAN (3 PLACES)
2 NAVIGATOR'S STOWAGE CABINET (2 PLACES)
3 NAVIGATOR'S INSTRUMENT PANEL (FIGURE 4-50) (2 PLACES)
4 RADIO OPERATOR'S OXYGEN REGULATOR
5 RADIO AND RADAR CONTROL PANELS (FIGURE 4-17) (2 PLACES)
6 PYROTECHNIC PISTOL MOUNT (2 PLACES)
7 LIAISON RADIO ANTENNA LOADING UNIT (FIGURE 4-18)
8 BC-348 LIAISON RECEIVER (FIGURE 4-18)

NAVIGATOR'S AND RADIO OPERATOR'S STATION

F

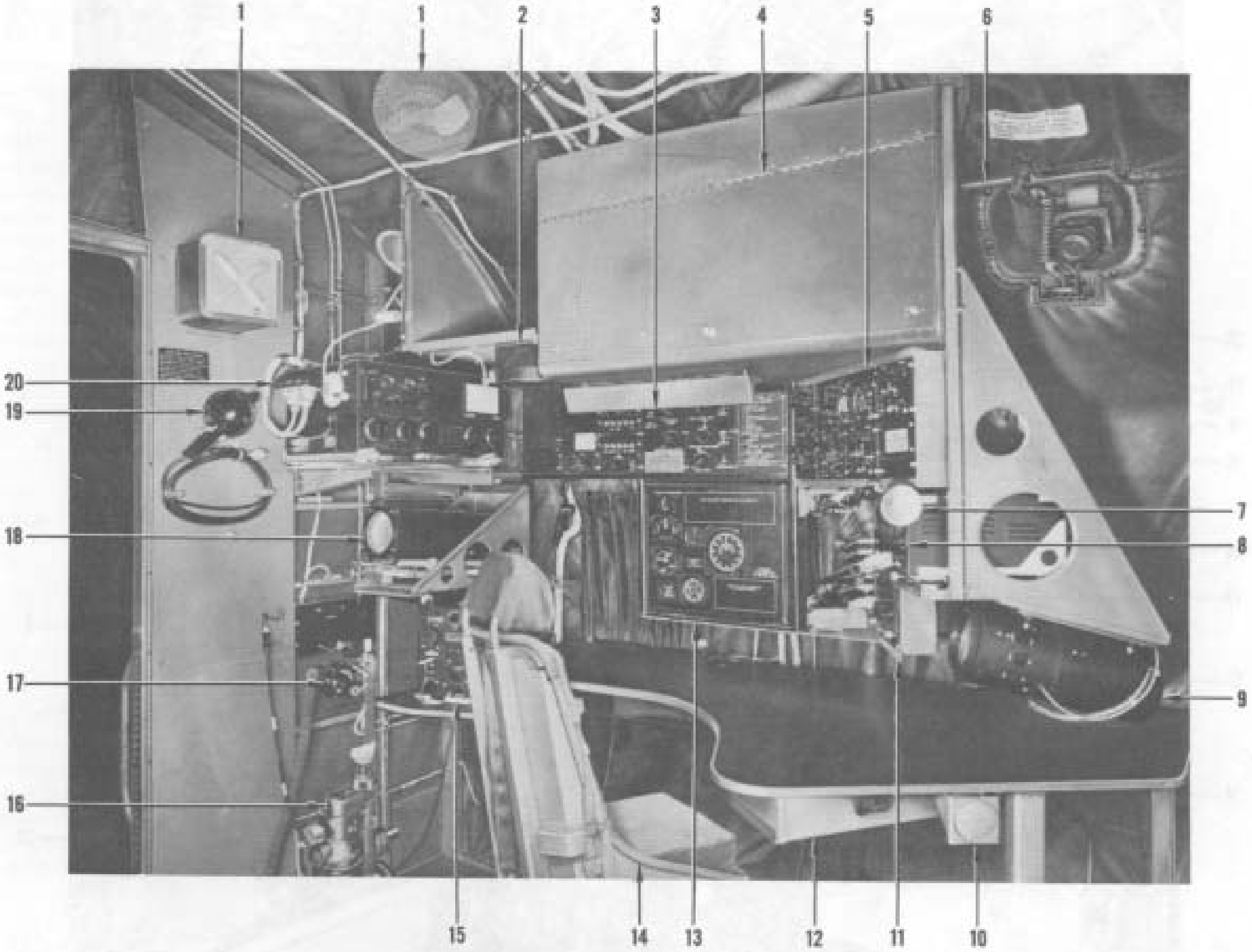
Figure 4-15 (Sheet 1 of 2)



9 MF TRANSMITTER (AN/ART-13) (FIGURE 4-18) (2 PLACES)
10 NAVIGATOR'S SEAT (2 PLACES)
11 RADIO OPERATOR'S SEAT
▼T 12 APN-12 RENDEZVOUS RADAR INDICATOR (FIGURE 4-35) (2 PLACES)
13 SEARCH RADAR INDICATOR (FIGURE 4–33) (2 PLACES)
▼T 14 APN-12 RENDEZVOUS RADAR CONTROL PANEL(S) (FIGURE 4-35) (2 PLACES)
15 LORAN RECEIVER AND INDICATOR (FIGURE 4-28)
16 NAVIGATOR'S AUXILIARY PANEL (2 PLACES)
17 TABLE LIGHT
18 NAVIGATOR'S INTERPHONE PANEL (FIGURE 4-8) (2 PLACES)
19 SIGNAL LAMP (2 PLACES)
20 RADIO ALTIMETER (FIGURE 4-26) (2 PLACES)
21 LORAN CONTROL UNIT (FIGURE 4-27)
22 NAVIGATOR'S TABLE DRAWER
23 DRIFTMETER (FIGURE 4-53 OR 4-55)
24 LORAN INDICATOR (FIGURE 4-29)
25 LOUDSPEAKER F G 1372 ▶

G 17260 ▶ 3177

Figure 4-15 (Sheet 2 of 2)



1 VENTILATING FAN (2 PLACES)
2 LOUDSPEAKER
3 NAVIGATOR'S INTERPHONE AND LIGHT PANEL (FIGURE 4-10)
4 NAVIGATOR'S STOWAGE CABINET
5 RADIO AND RADAR PANELS (FIGURE 4-17)
6 PYROTECHNIC PISTOL DOOR HANDLE
7 NAVIGATOR'S TABLE LAMP
8 RADIO ALTIMETER (FIGURE 4-26)
9 SEARCH RADAR INDICATOR (FIGURE 4-33)
10 ASH TRAY
▼11 RENDEZVOUS RADAR INDICATOR (FIGURE 4-35)
12 NAVIGATOR'S TABLE DRAWER
13 NAVIGATOR'S INSTRUMENT PANEL (FIGURE 4-50)
14 NAVIGATOR'S SEAT
15 LORAN CONTROL UNIT (FIGURE 4-29)
16 DRIFTMETER (FIGURE 4-55)
17 OXYGEN REGULATOR
18 LORAN INDICATOR (FIGURE 4-29)
19 SIGNAL LAMP
20 MF COMMAND TRANSMITTER (FIGURE 4-20)

NAVIGATOR'S STATION

Figure 4-16

LIAISON RADIO (AN/ARC-8) F

The liaison radio consists of an AN/ART-13 transmitter and a BC-348 receiver. (See figure 4-18.) These units, on the table at the radio operator's station, are described separately under MF TRANSMITTER (AN/ART-13) and LIAISON RECEIVER (BC-348) in this Section. Code transmissions on the liaison radio are possible when the key transfer switch is positioned to LIAISON. Operation of the liaison radio is also controlled by the command mike switch on airplanes F 1243 ▶ 1371 incorporating 1C10 527.

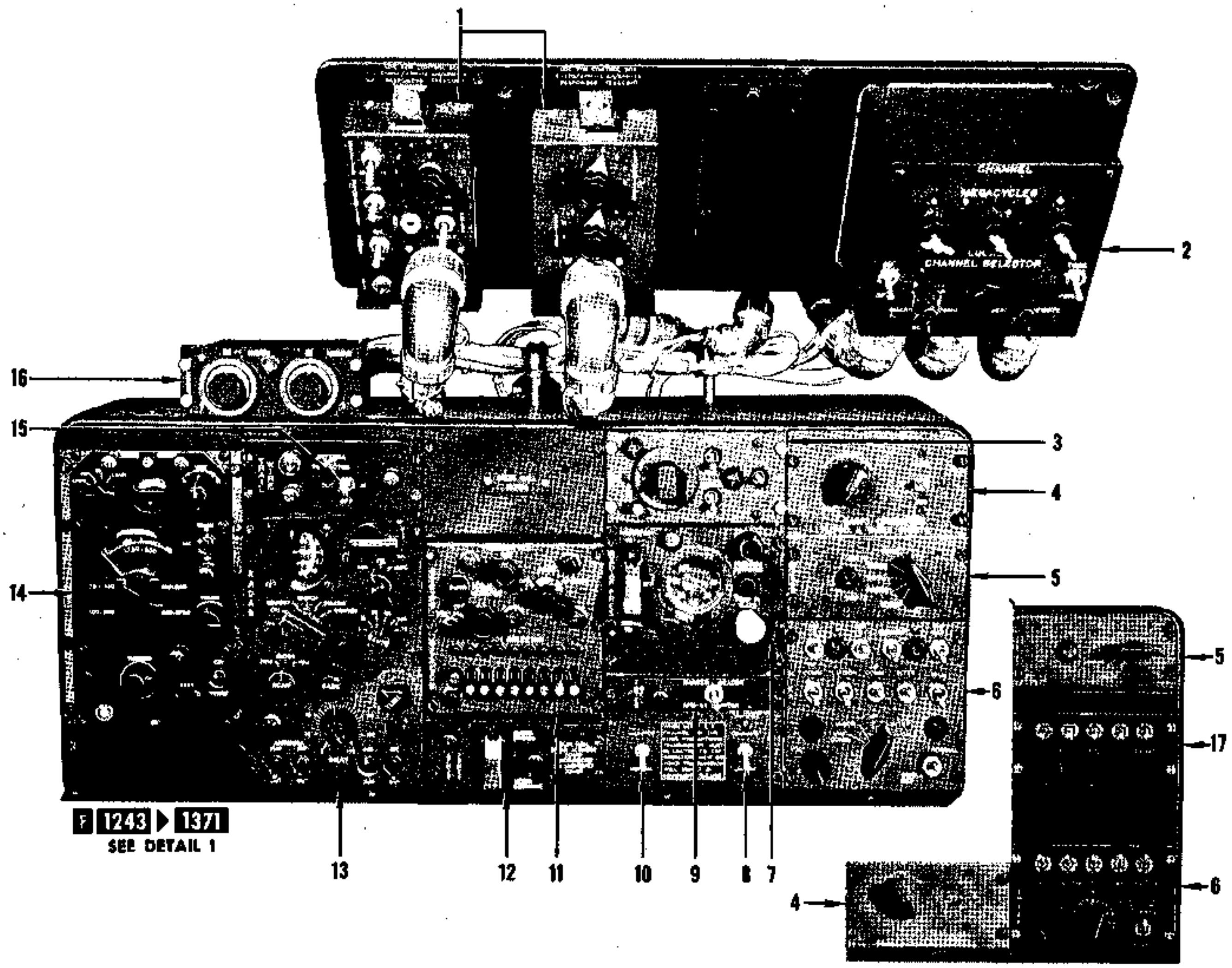
MF (HF) TRANSMITTER (AN/ART-13)

Two liaison transmitters (figures 4-18 and 4-20) can be used for transmitting voice, modulated continuous wave telegraphy (MCW), or continuous wave telegraphy (CW). Transmitting frequencies are in the range of 2000 to 18,000 kilocycles and either 200 to 1500 kc or 300 to 500 kc depending upon the type of oscillator installed. If a crystal control unit (CDA-T) is installed, the low frequency range is 300 to 500 kc and the selection of frequencies in this range is limited to those frequencies for which crystals are provided. When using a variable frequency oscillator (VFO), the low frequency range is 200 to 1500 kc and transmission is possible on frequencies other than crystal frequencies. (With a VFO, the frequency is derived with respect to a crystal check frequency and the master oscillator is not crystal stabilized.) The transmitter may operate either with crystal frequency control or VFO frequency control. For VFO operation, ten frequencies in the high frequency range can be preset to correspond with the ten numbered positions of the channel selector switch. During crystal operation, on transmitters having a CDA-T unit installed, there are provisions for presetting 24 frequencies. The 24 available frequencies consist of 10 frequencies in the high frequency range for each position of the A--B switch and 4 frequencies in the low frequency range (using the low frequency channel selector). A channel selector switch is used to select one of the preset frequencies or one channel that permits manual selection of any desired frequency. The transmitter automatically tunes (auto-tune) to a selected preset channel, but a manually selected frequency must be manually tuned. Dials A and B are used to select the frequency for each preset channel or to obtain a frequency manually. Dial A is the coarse frequency control and dial B is the fine frequency control. Dial B has a movable vernier, which is set to zero for the crystal check point and the operating frequency is obtained by moving the dial with respect to the vernier. While obtaining a crystal check point during crystal operation in the high frequency range, dials A and B must be tuned to the crystal frequency. The lowest crystal frequency given on the calibration chart on the transmitter determines the settings of the dials for this tuning. When transmitting on frequencies between 200 to 600 kilocycles (liaison radio only), the antenna tuning and loading circuits in the transmitter are not used and the antenna loading unit is automatically connected to the transmitter. On F airplanes the transmitter on the main radio rack is remotely controlled with the control panel (33, figure 1-16) on the control stand. Any crew member can make a voice transmission by pressing a microphone switch when the transmitter is selected with the interphone selector switch (or by plugging a mike into the microphone jack). On airplanes F 1243 ▶ 1371 plus those incorporating 1C10 K527, the interphone selector must be placed on LIAISON and the command mike switch correctly positioned to make a transmission. Code transmissions are made by using the key at the copilot's station, or, on F airplanes, at the radio operator's station or by connecting a key to the key jack on the transmitter. See KEY TRANSFER SWITCH in this Section. Control power is 28 volt DC with circuit protection located on the dynamotor unit (DY-17/ART-13) and on the radio junction box circuit breaker panel (figure 1-35).

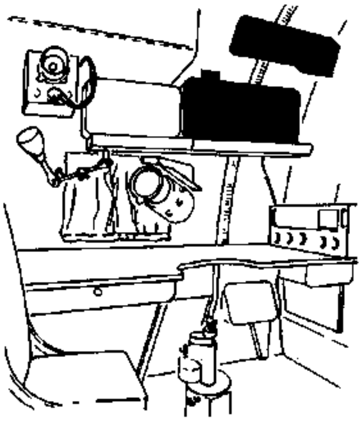
MF Transmitter Controls

EMISSION SWITCH. The emission switch (7, figure 4-18) is used to turn the equipment on and off and to select the desired mode of transmission. The switch positions are: OFF--VOICE--CW--MCW. The position of the local--remote switch determines which switch is operative. Refer to LOCAL--REMOTE SWITCH in this Section.

CHANNEL SELECTOR SWITCH. The channel selector switch (26, figure 4-18) permits selection of any one of ten preset, high frequency channels and one low frequency channel. If a CDA-T unit is installed, selection of the preset channel for the low frequency range is also controlled by the low frequency channel selector (11, figure 4-18). In addition, a position marked MANUAL is provided where the frequency control knobs can be rotated freely without disturbing the preset positions. The switch sets the auto-tune system into operation when a preset channel is selected so that the channel automatically tunes. The selector switch that is effective depends on the position of the local--remote switch. Refer to LOCAL--REMOTE SWITCH in this Section.



DETAIL I F 1372 ▶



▼1 APN-76 RENDEZVOUS RADAR CONTROL PANELS (4 PLACES) (SEE FIGURE 4-37)
2 UHF RADIO MASTER CONTROL PANEL (2 PLACES) (SEE FIGURE 4-12) WITHOUT TCTO 600
3 IFF CONTROL PANEL (2 PLACES) (SEE FIGURE 4-32) F G 1243 ▶ 2900, G 3340 ▶
4 RADIO OPERATOR'S FLOOD AND TABLE LIGHTS CONTROL PANEL (3 PLACES) F G 1243 ▶ 3177
5 RADIO RANGE FILTER CONTROL PANEL (2 PLACES) (SEE FIGURE 4-8) F
6 RADIO OPERATOR'S INTERPHONE PANEL (3 PLACES) (SEE FIGURE 4-8) F G 1243 ▶ 3177
7 RADAR PRESSURIZING CONTROL PANEL (3 PLACES) (SEE FIGURE 4-38)
8 KEY TRANSFER SWITCH F
9 MARKER BEACON--APN-69 MONITOR INTERPHONE SWITCH (SEE FIGURE 4-34) F 1243 ▶ 1371
10 LIAISON NORMAL/MONITOR SWITCH (2 PLACES) F G 1243 ▶ 3278
▼11 RADAR BEACON CONTROL PANEL (2 PLACES) (SEE FIGURE 4-34)
▼12 RADAR BEACON POWER CONTROL PANEL (2 PLACES) (SEE FIGURE 4-34)
13 SEARCH RADAR CONTROL PANEL (3 PLACES) (SEE FIGURE 4-33)
14 RADIO COMPASS CONTROL PANEL (3 PLACES) (SEE FIGURE 4-22)
15 LORAN TRAILING WIRE ANTENNA CONTROL SWITCH F
16 SIF CODER CONTROL PANEL (2 PLACES) (SEE FIGURE 4-32) TCTO 590
17 INTERPHONE MIXER SWITCH PANEL (SEE FIGURE 4-8)
▼18 APN-12 RENDEZVOUS RADAR CONTROL PANEL (SEE FIGURE 4-35)

RADIO AND RADAR CONTROL PANELS

Figure 4-17 (Sheet 1 of 2)

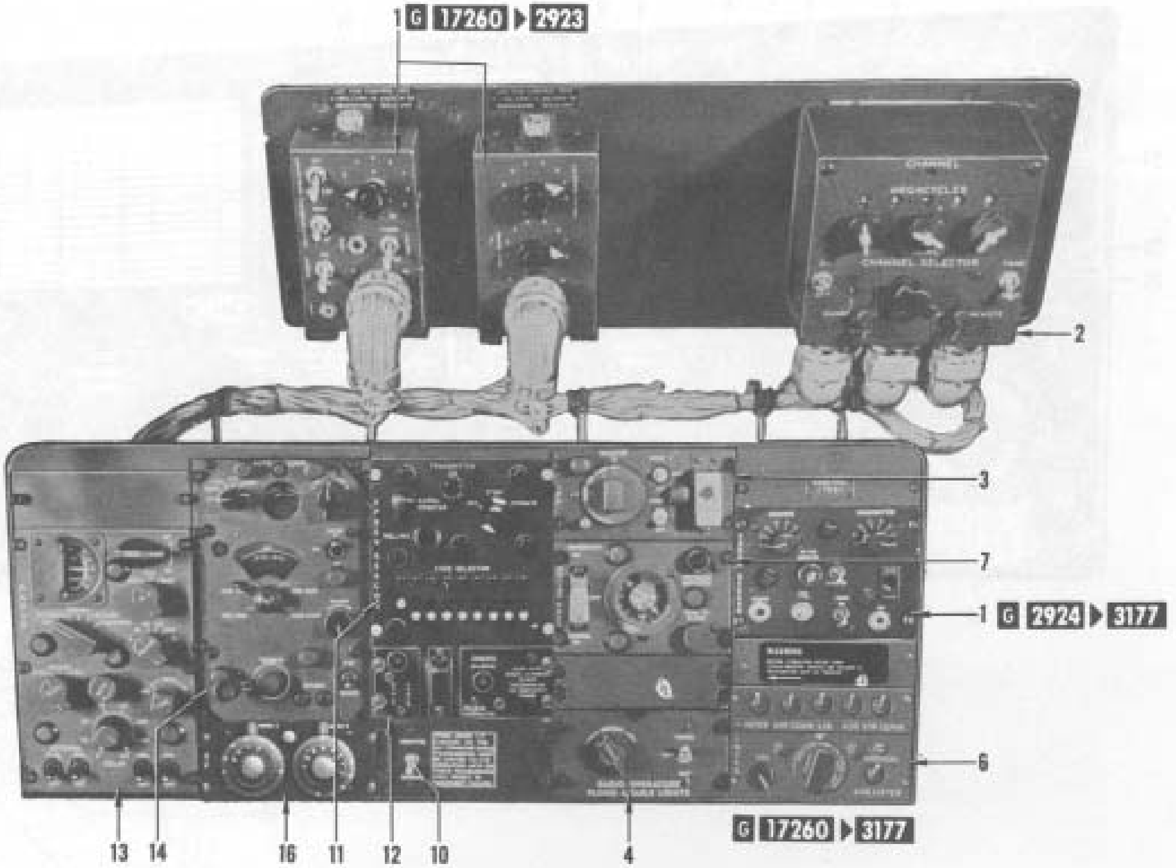
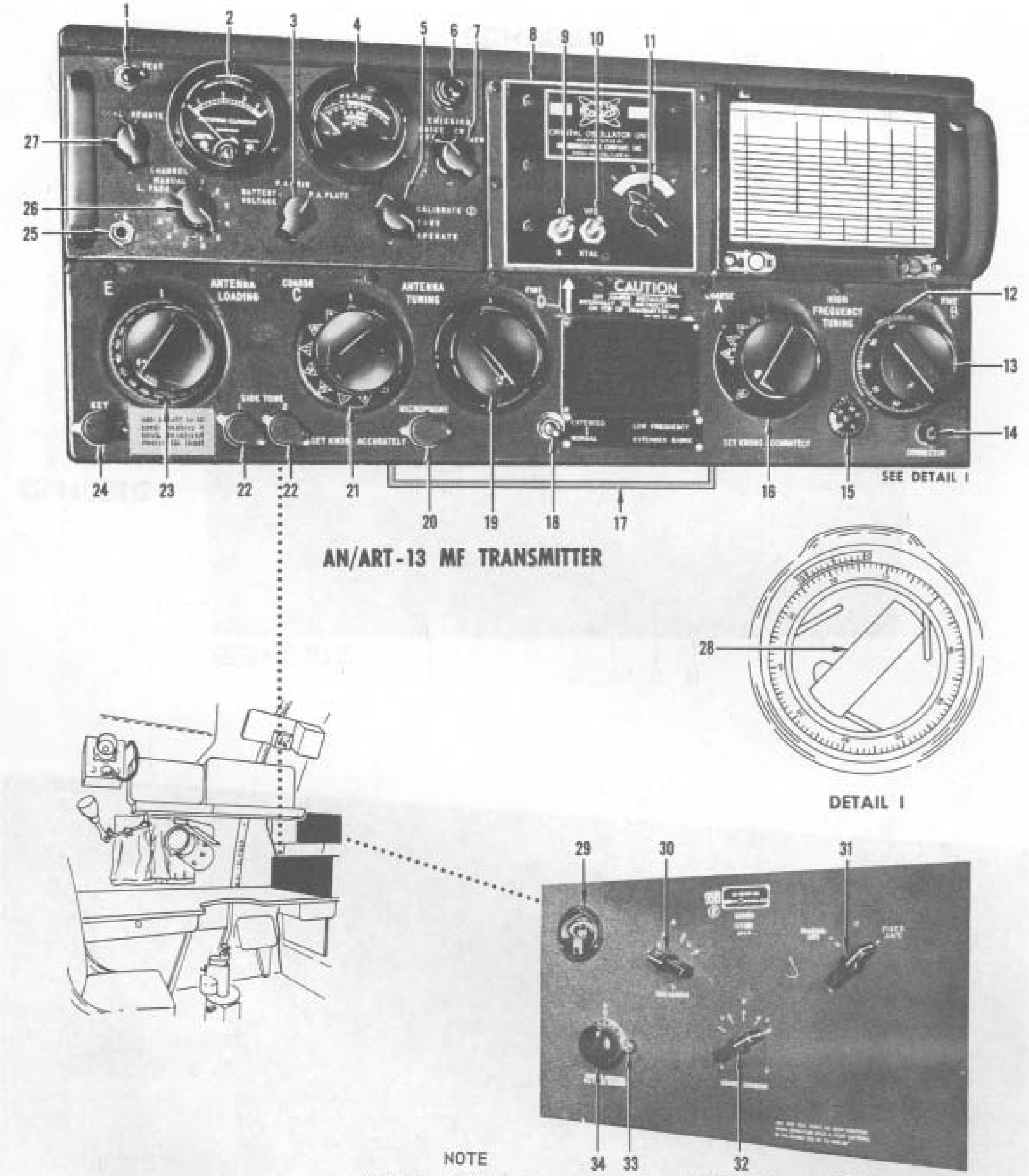


Figure 4-17 (Sheet 2 of 2)

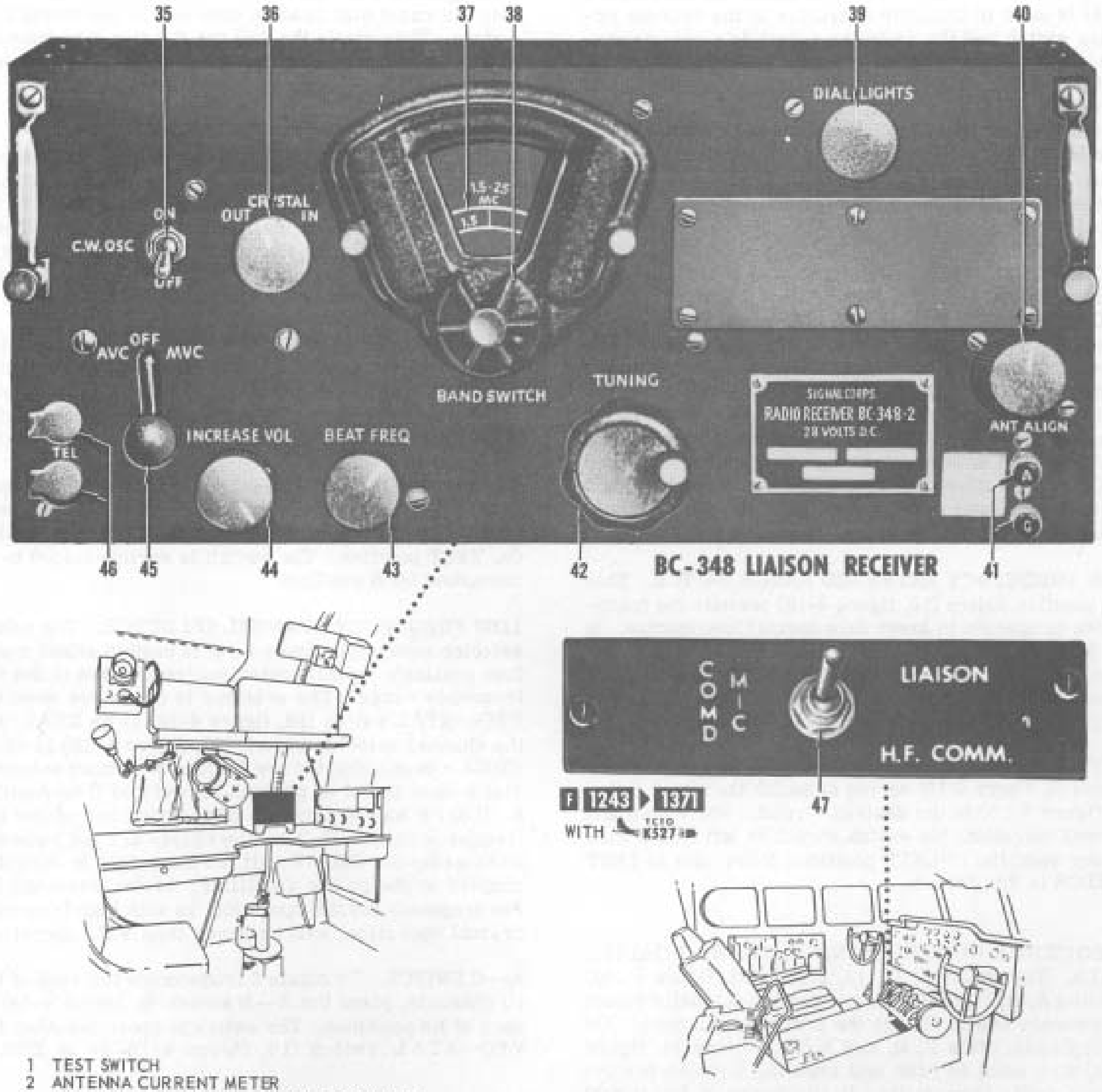


NOTE

Antenna loading unit is used for transmissions on frequencies between 200 and 600 kilocycles.

LIAISON RADIO (AN/ARC-8) CONTROLS F

Figure 4-18 (Sheet 1 of 2)



1 TEST SWITCH
2 ANTENNA CURRENT METER
3 BATTERY--P.A.GRID--P.A. PLATE SWITCH
4 TUNING METER
5 CTO (CALIBRATE-TUNE-OPERATE) SWITCH
6 PILOT LIGHT
7 EMISSION SWITCH
8 CDA-T OSCILLATOR
9 A-B SWITCH
10 VFO--XTAL(VARIABLE FREQUENCY OSCILLATOR-CRYSTAL) SWITCH
11 LOW FREQUENCY CHANNEL SELECTOR
12 DIAL B VERNIER
13 DIAL B (HIGH FREQUENCY FINE TUNING)
14 CORRECTOR KNOB
15 DIAL B REVOLUTION COUNTER
16 DIAL A (HIGH FREQUENCY COARSE TUNING)
17 CALIBRATION TABLES STOWAGE
18 LOW FREQUENCY EXTENDED RANGE SWITCH
19 DIAL D (ANTENNA TUNING FINE ADJUSTMENT)
20 MICROPHONE JACK
21 DIAL C (ANTENNA TUNING COARSE ADJUSTMENT)
22 SIDETONE JACK (2 PLACES)
23 DIAL E (ANTENNA LOADING ADJUSTMENT)
24 KEY JACK
25 T.S. (THROTTLE SWITCH) JACK
26 CHANNEL SELECTOR SWITCH
27 LOCAL--REMOTE SWITCH
28 LOCKING BAR
29 RF (RADIO FREQUENCY) AMMETER
30 DIAL Q (ANTENNA LOADING FINE ADJUSTMENT)
31 ANTENNA SELECTOR SWITCH
32 DIAL P (ANTENNA LOADING COARSE ADJUSTMENT)
33 DIAL R LOCK
34 DIAL R (ANTENNA TUNING ADJUSTMENT)
35 C.W. OSC SWITCH
36 CRYSTAL FILTER SWITCH
37 TUNING DIAL
38 BAND SWITCH
39 DIAL LIGHT RHEOSTAT
40 ANTENNA ALIGNMENT KNOB
41 ANTENNA AND GROUND-BINDING POSTS
42 TUNING CRANK
43 BEAT FREQUENCY KNOB
44 VOLUME KNOB
45 POWER SWITCH
46 TEL. JACKS
47 COMMAND MIKE SWITCH

Figure 4-18 (Sheet 2 of 2)

LOCAL--REMOTE SWITCH. This switch (27, figure 4-18) is used to transfer operation of the channel selector switch and the emission switch to a remote station. The red pilot light (6, figure 4-18) indicates the position of the local--remote switch. When the set is energized and the switch is on LOCAL, the light on the transmitter is lit at all times except when the autotune is cycling. The light on the transmitter goes out when the switch is placed to REMOTE and on f airplanes the light on the panel at the pilot's station will go on.

CTO SWITCH. This switch (5, figure 4-18) has three positions: CALIBRATE, TUNE, and OPERATE. When on CALIBRATE, the variable frequency oscillator is turned on to permit calibration. (In this position, the power amplifier is not energized so that set does not transmit during tuning.) In the TUNE position, the equipment is operated at reduced power to prevent damage to the P.A. tube during preliminary tuning and loading of the antenna circuits. The switch is placed on OPERATE after final tuning has been completed and the equipment operates at full power. The switch should be left in OPERATE except during tuning.

LOW FREQUENCY EXTENDED RANGE SWITCH. This two position switch (18, figure 4-18) permits the transmitter to operate in lower than normal frequencies. In the NORMAL position, the equipment operates at the usual frequencies. In the EXTENDED position, the transmitter is capable of operating in the frequency range of 1670 to 2000 kilocycles.

BATTERY--P.A.GRID--P.A.PLATE SWITCH. This switch (3, figure 4-18) serves to switch the tuning meter (4, figure 4-18) to the desired circuit. For tuning and normal operation, the switch should be left on the P.A. (power amplifier) PLATE position. Refer also to TEST SWITCH in this Section.

FREQUENCY CONTROL AND ANTENNA LOADING DIALS. The dials (13, 16, 19, 21, and 23, figure 4-18), labelled A, B, C, D, and E, are used to manually select a frequency and to change the preset frequencies. On f airplanes, dials P, Q, and R (32, 30, and 34, figure 4-18) are used to tune and load the antenna for the liaison radio transmitter in the range of 200 to 600 kilocycles. High frequency tuning dials A and B, the corrector knob, vernier scale, and revolution counter provide a means of calibrating and tuning the variable frequency oscillator to the desired operating frequency. Dials C and D are the coarse and fine antenna tuning controls respectively. Dials C and D, are used in conjunction with dial E to properly tune the antenna. The antenna is loaded after calibration and initial tuning have been completed. The dials turn freely when the channel selector switch (26, figure 4-18) is set on MANUAL. When the channel selector is on any other position, the dials are positioned by loosening the locking bar (28, figure 4-18) in the center of each knob and then rotating them to the settings obtained from the calibration tables. After the dials are adjusted, the locking bars are tightened. To lock the dials, first note the exact dial reading obtained in the tuning procedure. Then rotate the dial one quarter turn counterclockwise and return to (but not past) the exact desired setting. Hold the dial on the setting and tighten the locking bar.

CORRECTOR KNOB. The corrector knob (14, figure 4-18) provides an accurate zero line on the vernier scale which serves as an index or indicator mark for the fine tuning of the B dial. The corrector knob moves the vernier scale clockwise or counterclockwise as required to establish the correct setting as noted in the calibration tables for each frequency to be tuned.

T.S. (THROTTLE SWITCH) JACK. This jack (25, figure 4-18) is a provision for a microphone switch - used with "hot" mike installations. (The T.S., throttle switch, terminology is a carry-over from other types of airplanes having microphone switches on the throttle.)

TEST SWITCH. The antenna current meter (2, figure 4-18) and the tuning meter (4, figure 4-18) are operative when the test switch (1, figure 4-18) is held to the TEST position. The switch is spring-loaded to an unmarked OFF position.

LOW FREQUENCY CHANNEL SELECTOR. The rotary selector switch (11, figure 4-18) is used to select one of four available crystal controlled frequencies in the low frequency range. The selector is operative when the VFO--XTAL switch (10, figure 4-18) is on XTAL, and the channel selector switch (26, figure 4-18) is on L. FREQ. When using the low frequency channel selector, dial A must be set on position 13, and dial C on position 8. (Dial B has no function when using any of the low frequency units.) Calibration charts are not required when using the CDA-T unit, as its output is directly coupled to the power amplifier. Meter readings for low frequency crystal operation, as with high frequency crystal operation, will be lower than VFO operation.

A--B SWITCH. To obtain 2 frequencies for each of the 10 channels, place the A--B switch (9, figure 4-18) to each of its positions. The switch is operative when the VFO--XTAL switch (10, figure 4-18) is on XTAL.

Tuning Procedures for MF Transmitter (AN/ART-13)

For VFO operation:

1. Check all dials locked. Place LOCAL--REMOTE switch to LOCAL. Place emission switch to VOICE. VFO--XTAL switch to VFO. Low frequency extended range switch to NORMAL
2. Select desired channel; wait for complete cycling of auto-tune system before using set. (Red pilot light will illuminate indicating cycle is complete)
3. Unlock all dials
4. Set dial C on 1
5. Find the desired frequency in the calibration tables, set dials A and B to the settings of the nearest crystal check point marked in heavy black type

6. Check the liaison normal/monitor switch on the navigator's radio and radar panel in the NORMAL position
7. Place CTO switch to CALIBRATE. Rotate dial B back and forth until zero beat (aural-null signal) is obtained
8. Place CTO switch to TUNE
9. Turn corrector knob to position vernier scale index to the crystal check point setting for dial B
10. Set dial B to the reading obtained for the desired operating frequency in the calibration tables, utilizing the vernier scale index as zero reference. Recheck dial A for proper operating frequency setting. Lock dials A and B
11. Place emission switch to CW
12. Place battery--P.A. grid--P.A. plate switch to P.A. PLATE
13. Set dials C, D and E to the values obtained from the 60 foot antenna calibration tables
14. If dial C is on position 7 or below:
    a. Hold test switch closed and rotate dial E for minimum dip on P.A. Plate meter
    b. Place CTO switch to OPERATE
    c. If the plate current meter reading is above the area marked CW, move dial D a few divisions lower and re-adjust dial E for minimum plate current. If the plate current meter reading is below the area marked CW, move dial D a few divisions higher and re-adjust dial E for minimum plate current
15. If dial C is on position 8 or above:
    a. Hold test switch closed and rotate dial D for minimum dip on P.A. Plate meter
    b. Place CTO switch to OPERATE
    c. If the plate current meter reading is above the area marked CW, move dial E a few divisions lower and re-adjust dial D for minimum plate current. If the plate current meter reading is below the area marked CW, move dial E a few divisions higher and re-adjust dial D for minimum plate current

NOTE

> If a minimum dip is not obtained on P.A. Plate meter by rotating the specified dial, set control C to the next higher position and rotate dial D or E as required.

16. Lock dials C, D and E
17. Place emission switch to VOICE. The equipment is now ready for operation

For crystal operation, the tuning procedure for crystal operation is essentially the same as for VFO OPERATION outlined above. Meter readings will be lower.

Liaison Normal/Monitor Switch

On airplanes **F** **G** **1243** ▶ **3177**, the liaison normal/monitor switch (10, figure 4-17) is on the navigator's radio and radar control console. On airplanes **G** **3178** ▶ **3278**, the switch (1, figure 4-10) is on the navigator's interphone and light panel. The switch is used with the MF command (auxiliary liaison) transmitter and the BC-348 liaison receiver. The switch must be in the NORMAL position to calibrate the transmitter. While the switch is on NORMAL, the sidetone can be heard when the transmitter is operated. Positioning the switch on MONITOR cuts out the sidetone and the signals from the transmitter are heard through the receiver. Using the MONITOR position enables the operator to tune and zero beat the BC-348 receiver to the exact frequency of the transmitter, or to tune and zero beat the transmitter to an exact preselected and preset frequency on the receiver.

LIAISON RECEIVER (BC-348)
F and **G** **17260** ▶ **3278** less TCTO K0206

The BC-348 receiver operates over a frequency range from 200 to 500 KC and 1.5 to 18.0 megacycles. All controls are on the front panel of the receiver, where they may be easily operated by airplane personnel. (See figures 4-18 and 4-21.) Antenna, ground, and headphone connections are made through a connector plug on the back of the receiver. The receiver is capable of voice, tone and CW reception. Manual or automatic volume control may be selected by a switch on the front panel of the receiver. The receiver is not intended for remote control and no provision has been made for this operation. The receiver is on the radio operator's table on **F** airplanes and on the main radio rack on **G** airplanes. Control power is 28 volt DC with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

BC-348 Liaison Receiver Controls
F and **G** **17260** ▶ **3278** less TCTO K0206

POWER SWITCH. A power switch (45, figure 4-18) with AVC--OFF--MVC positions is on the BC-348 liaison receiver control panel. Placing the switch to AVC (automatic volume control) or MVC (manual volume control) selects a method of regulating the volume and turns on the power to energize the equipment. With the switch in the OFF position, no power is supplied to the receiver.

BAND SWITCH. A band switch (38, figure 4-18) on the BC-348 control panel allows the operator to change the frequency band.

TUNING CRANK. Reception is accomplished by tuning the receiver to the desired signal by use of the tuning crank (42, figure 4-18) on the BC-348 control panel. The frequency to which the receiver is tuned is indicated at all times on the dial scale.

VOLUME KNOB. The volume level of the audio signal is controlled by the volume knob (44, figure 4-18). When the receiver is operated with manual volume control, the sensitivity of the receiver is controlled. When automatic volume control is desired, the level of the audio signal fed into the output tube is controlled.

C.W. OSC SWITCH. This switch (35, figure 4-18) on the BC-348 liaison receiver control panel has ON--OFF positions. The CW oscillator is turned ON for CW, or OFF for voice reception.

DIAL LIGHT RHEOSTAT. This knob (39, figure 4-18) on the BC-348 liaison receiver control panel adjusts the brilliancy of dial illumination. The dial lamps may be adjusted for any desired degree of illumination or turned off completely.

BEAT FREQUENCY KNOB. This knob (43, figure 4-18) adjusts the frequency of the CW oscillator and allows the operator to adjust the tone of the received signal to the pitch he considers the most suitable.

CRYSTAL FILTER SWITCH. This control (36, figure 4-18) on the BC-348 liaison receiver control panel, inserts a crystal filter into the circuit when turned to the IN position. This filter increases the selectivity of the receiver, enabling reception through heavy interference.

TEL. JACKS. Dual output is provided through two open circuit phone jacks (46, figure 4-18). These jacks are connected to the output circuit of the receiver and permit headphone reception by the operator.

ANTENNA AND GROUND BINDING POSTS. The antenna is connected to the binding post marked A, while the ground lead is connected to the binding post marked G, (41, figure 4-18) on the BC-348 liaison receiver control panel.

ANTENNA ALIGNMENT KNOB. This knob (40, figure 4-18) on the BC-348 liaison receiver control panel is provided to allow the operator to align the antenna for best signal reception.

BC-348 Liaison Receiver Indicators
F and G 17260 ▶ 3278 less ✈ 1C10 K0206

TUNING DIAL. This dial (37, figure 4-18) on the BC-348 liaison receiver control panel is adjusted by the band switch and tuning knob. The frequency set in with these knobs appears in the dial window.

Normal Operation of the BC-348 Liaison Receiver F and G 17260 ▶ 3278 less ✈ 1C10 K0206

The BC-348 liaison receiver is put into operation as follows:

1. Place LIAISON interphone mixer switch F 1243 ▶ 1371 or AUX REC interphone mixer switch F G 1372 ▶ to ON (up)
2. Set power switch (45, figure 4-18) to MVC. Allow set approximately 30 seconds to warmup.
3. Adjust volume knob (44, figure 4-18) until a slight background noise is heard
4. Set band switch (38, figure 4-18) to the frequency band in which signals can be heard
5. Rotate the tuning crank (42, figure 4-18) with reference to the tuning dial (37, figure 4-18), tune in the desired signal

NOTE

All tuning should be done with the power switch set on MVC and with the volume knob advanced only enough to give the desired signal strength. In the absence of a signal, the setting of the volume can be judged by the loudness of the background noise. On MVC with the volume set at maximum, very strong carrier waves will block the receiver and intelligible signals cannot be received.

6. Set power switch to AVC. The desired signal should still be heard
7. With the beat frequency knob (43, figure 4-18) at zero position (arrow on knob pointing up), place the C.W. OSC switch ON position. An audible beat note should be heard which should vary in pitch when the beat frequency adjustment is changed
8. With the C.W. OSC switch in the ON position, place the crystal filter switch (36, figure 4-18) to IN. Noise should be greatly reduced and the signal can be tuned out by a much smaller movement of the tuning crank than when the crystal filter switch is in the OUT position
9. Turn the dial light rheostat (39, figure 4-18) and observe if control of illumination is secured with both dial lights functioning
10. When the receiver is not being used, turn the power switch to OFF

Modulated Signal Reception of the BC-348 Liaison Receiver F and G 17260 ▶ 3278 less ✈ 1C10 K0206

For the reception of modulated signals in the frequency bands covered by this receiver, proceed as follows:

1. Turn the power switch to MVC
2. Place the C.W. OSC switch to the OFF position
3. Position the crystal filter switch to OUT

NOTE

Tuning should be done with the power switch in the MVC position and with the volume knob advanced only as far as required for a comfortable output level.

4. Allow set to warmup (approximately 30 seconds) before adjusting volume knob until the background noise can be heard
5. Turn tuning crank until frequency of the desired signal is reached and signal is heard in the headphones. Turn tuning crank slowly back and forth until the position at which the signal is received is the strongest found
6. If automatic volume control is desired, position power switch to AVC and readjust volume knob for the desired output
7. In the event interference is encountered, position crystal filter switch to IN

CW Reception of the BC-348 Liaison Receiver F and G 17260 ▶ 3278 less TCTO KB286

For reception of the CW signals, proceed as follows:

1. Turn power switch to MVC
2. Place C.W. OSC switch to the ON position
3. Position beat frequency knob to the zero beat position (arrow on knob pointing up)
4. Proceed as instructed for the reception of modulated signals and when the signal is tuned in, adjust beat frequency knob to the position producing the most satisfactory tone
5. Automatic volume control may be used by switching the power switch to AVC

LIAISON RADIO G

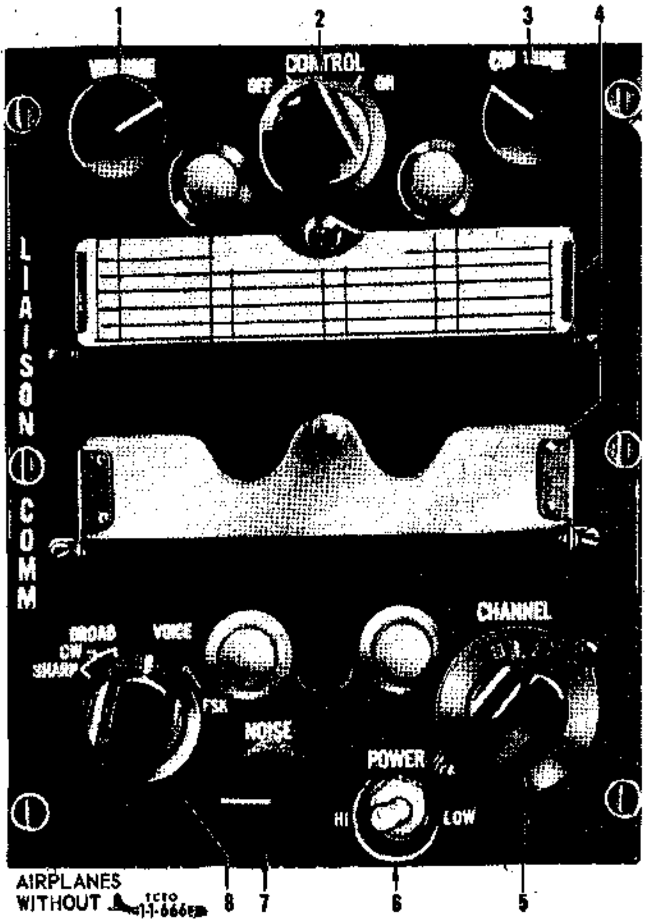
(AN/ARC-21 on airplanes without TCTO 1-1-666)
(AN/ARC-65 on airplanes with TCTO 1-1-666)

The liaison radio operates over a range of frequencies from 2 to 24 megacycles giving a total of 44,000 usable frequencies. The control panel for the liaison radio (shown in figure 4-19) is on the control stand. The set permits long range two-way voice and code communication from airplane to airplane or from airplane to ground. The radio is turned on and off by a control switch on the liaison radio control panel. Twenty channels may be preset on the control panel and individually selected with the channel selector switch. A time delay of up to 15 seconds is incorporated in the set to delay operation while the set is tuning after a channel change. Therefore, the crew member operating the set should not expect immediate communication after changing channels. The receiver immediately tunes to the selected channel; however, initial tuning of the transmitter is delayed until a mike switch is used. In addition to voice communications, the liaison radio has facilities for communication by continuous wave telegraphy (CW). The set also has provisions for operating a teletypewriter although this equipment is not provided. The radio is connected to the interphone; therefore, to transmit and receive on the liaison radio the interphone selector switch and mixer switch must be placed in the appropriate LIA position. Control power is 28 volt dc and operating power is 115 volt ac with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

On airplanes incorporating TCTO 1-1-666, the AN/ARC-21 is replaced by an AN/ARC-65 liaison radio which has the additional capability of single sideband (SSB) transmission and reception. Both sets use the same control panels and all but one of the controls (the operation selector switch) have the same function.

NOTE

> The single sideband (SSB) capability gives improved reception and increased range. The major difference between single sideband and conventional radio transmissions is the form of the transmitted wave. Conventional radio signals consist of a carrier wave, an upper sideband, and a lower sideband. A carrier wave

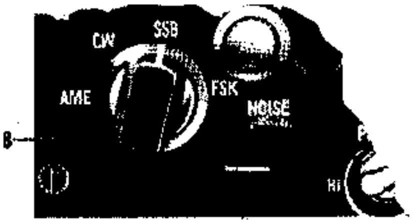


AIRPLANES WITHOUT TCTO 1-1-666

SEE DETAIL 1

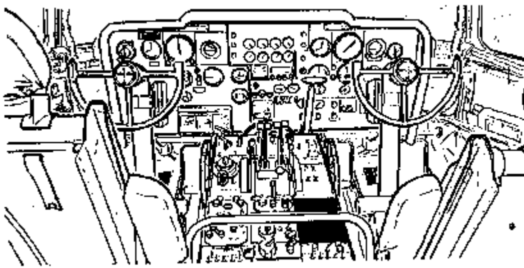
AN/ARC-21

1 VOLUME KNOB
2 CONTROL SWITCH
3 CW TUNING KNOB
4 PRESETTING DRUM COVERS
5 CHANNEL SELECTOR SWITCH
6 HI-LOW POWER SWITCH
7 NOISE CONTROL KNOB
8 OPERATION SELECTOR SWITCH (2 PLACES)



DETAIL 1
AIRPLANES WITH TCTO 1-1-666

AN/ARC-65



LIAISON RADIO CONTROLS G

Figure 4-19

is the unmodulated output of the transmitter. In itself, the carrier conveys no information. It is only when the carrier is modulated (varied by speech through the microphone) that it is possible to transmit a message. Modulation of the carrier sets up new frequencies both above and below the frequency of the carrier. The new frequencies, called side frequencies, make up narrow bands known as sidebands. These sidebands carry all the information. The band higher than the carrier frequency is called the upper sideband and the band lower than the carrier frequency is the lower sideband. For single sideband transmission, the carrier wave is suppressed and signals travel on one sideband. By suppressing the carrier all the power is used to transmit information - resulting in greater range. Likewise, suppression of the carrier makes the set less susceptible to interference from static or jamming. Facilities using amplitude modulated (AM) radios cannot receive single sideband transmissions satisfactorily and single sideband reception of AM broadcasts has distorted pitch. To maintain compatibility with existing facilities, there is a separate unit in the receiver for AM reception and a carrier wave may be transmitted with the upper sideband to transmit "equivalent" (AME).

Liaison Radio Controls

CONTROL SWITCH (LIAISON RADIO). A two-position ON--OFF rotary switch (2, figure 4-19) on the liaison radio control panel, is used to turn the equipment on and off. The control switch is also a protective device that returns the switch to OFF when there are faults in the equipment.

VOLUME KNOB. A volume knob (1, figure 4-19) on the liaison radio control panel provides a means for adjusting the volume from the liaison radio to the interphone system during voice operation and signal sensitivity during CW operation.

CHANNEL SELECTOR SWITCH. A channel selector switch (5, figure 4-19) on the liaison radio control panel has channel positions numbered from 1 to 20 providing selection of any of the preset frequencies.

HI--LOW POWER SWITCH. A two-position switch (6, figure 4-19), marked POWER, is on the liaison radio control panel. The switch has HI--LOW positions and provides a means of selecting the power output in a 10 to 1 proportion. The HI position will normally be used when maximum range transmissions are desired. The LOW position is used when shorter range transmissions are desired.

NOISE CONTROL KNOB. A knob (7, figure 4-19), marked NOISE, is on the liaison radio control panel. The knob allows adjustment of the background noise level of the receiver during voice operation. The knob should be adjusted for best reception of voice signals.

PRESETTING DRUMS. Two presetting drums in the liaison radio control panel provide means for manually presetting the frequency of each channel as selected by the channel selector switch. Each drum is protected by hinged covers (4, figure 4-19). A special tool for the presetting operation is stowed inside the top drum cover. A card mounted on the face of the top drum cover is used to record frequency values of each channel as the presetting operation is accomplished.

CW TUNING KNOB. A CW tuning knob (3, figure 4-19) on the liaison radio control panel is used to adjust the CW beat frequency when receiving CW signals.

OPERATION SELECTOR SWITCH (LIAISON RADIO). A rotary-type selector switch (8, figure 4-19) on the liaison radio control panel has CW SHARP--CW BROAD--VOICE--FSK positions and is used to select the type of liaison radio operation desired. CW SHARP position provides CW operation with a narrow band width to increase intelligibility of signals. CW BROAD provides CW operation with 7-kilocycle band width for general operation. VOICE position allows voice transmission and reception of the liaison radio. FSK position is provided for teletypewriter operation, although this equipment is not provided. On airplanes incorporating [illegible], the switch has AME--CW--SSB--FSK positions for use in single sideband operation. With the switch on SSB, the set transmits and receives single sideband type radio waves. Placing the switch on AME (equivalent AM), permits communication with standard AM radios.

Normal Operation of the Liaison Radio

FREQUENCY PRESETTING. Frequencies can be preset on the control panel (with the equipment turned off). Normally, all presetting operations will be performed before flight; however, if presetting during flight is necessary, the operation can be accomplished as follows:

1. Loosen two screws holding drum covers in position and open covers
2. Remove presetting tool from clip inside top drum cover
3. Place channel selector so that the number of the channel to be preset appears on the left side of the frequency drum. Disregard the channel number that appears in the selector window

4. Using the presetting tool, move the four buttons, one at a time, to a position under the respective numbers. This is done by sliding the socket end of the tool over the buttons and moving them along the drum to coincide with the desired numbers
5. Move the top drum left button to coincide with the figure representing thousands of kilocycles
6. Move the top drum right button to coincide with the figure representing hundreds of kilocycles
7. Move the bottom drum left button to coincide with the figure representing tens of kilocycles
8. Move the bottom drum right button to coincide with the figure representing units and halves of kilocycles
9. Record the frequency (just set) adjacent to the applicable channel number on the card mounted on the top drum cover
10. Turn the channel selector switch to the next channel number to be preset and repeat Steps 4 through 9. Preset remaining channels in the same manner
11. Close drum covers and tighten holding screws

NOTE

If the drum cover doors on the control panel are not securely closed, a door interlock switch will remain open and prevent operation of the liaison radio.

G

VOICE COMMUNICATION. The liaison radio control panel has controls necessary for all types of liaison radio operation. Liaison radio voice communication can be accomplished by the following procedure:
1. Place interphone selector switch in LIA to receive and transmit liaison radio signals
2. Place liaison radio control switch to ON

NOTE

- A 40-second period is required after turning on equipment before the radio is ready for operation. The first 30 seconds allow for tube warmup and the remaining 10 seconds allow for automatic tuning.
- If automatic tuning is not accomplished in the normal 40-second period, the control switch will go to OFF and must be returned to ON position.
- At extremely low operating temperatures (approximately -55° C) the liaison radio control switch may return to OFF in 40 seconds. If this happens, select another channel and return control switch to ON. Repeat this procedure until the control switch stays on, then allow the equipment to warmup for 15 minutes. During the warmup period, do not change channel or transmit. After the warmup, proceed with normal operation.
- The AN/ARC-65 liaison radio requires a warm-up time of approximately 10 to 15 minutes to give optimum performance.

3. Turn the channel selector switch to the channel of the desired frequency and rock the knob slightly to feel the switch click into its seat. The channel in use will be shown by the middle figure in the selector window
4. Rotate the operation selector switch to VOICE, SSB, or AME (as applicable)
5. Place power switch in HI or LOW depending on desired range of transmissions

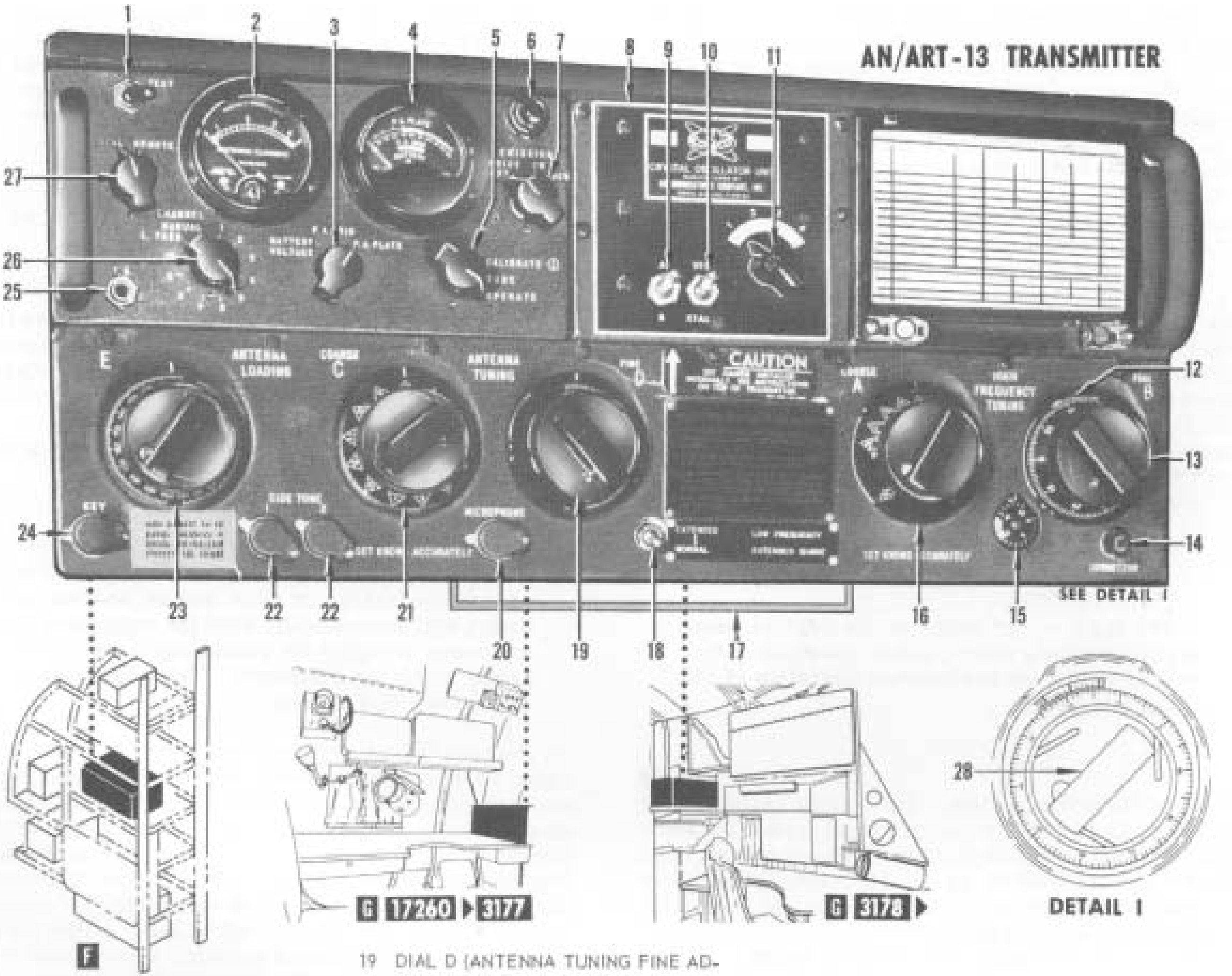
NOTE

Should the air pressure within the equipment be reduced by leakage or other means, an aneroid switch will automatically shift the equipment to low power to reduce the possibility of electrical arcing within the equipment. There is no indication when this occurs.

6. Depress the microphone switch until the side-tone signal is heard in the headphones, then release the microphone switch. The presence of the side-tone signals, while talking, will indicate the transmitter tune-up is completed and signals are being transmitted. This step will not have to be repeated unless the operating channel is changed. Adjust the volume for proper audio level and the noise control for a slight background noise in absence of signals. A side-tone will be heard in the headset when talking if the transmitter is on the air
7. Turn the equipment off by rotating the liaison radio control switch on the panel to OFF

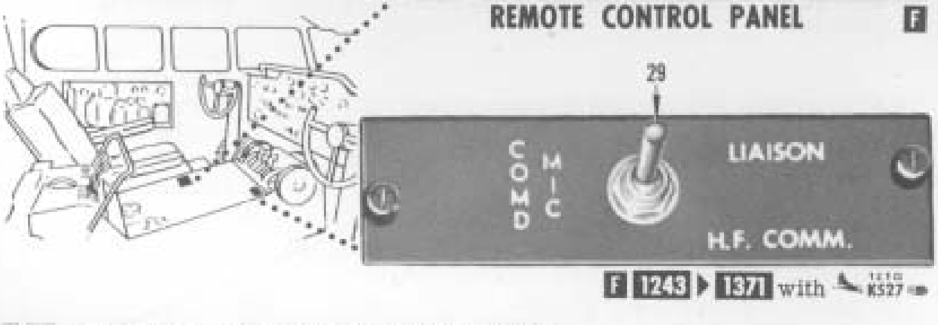
Emergency Operation of the Liaison Radio G

When a frequency selection cycle is not completed in the normal time interval, causing the liaison radio control knob to return to OFF position, a second try preferably on another channel is recommended. If tuning is normal, return to the initially selected channel. Malfunction within the equipment is indicated by the liaison radio control knob moving to OFF position. If damage to the equipment is less important than getting the message through, transmission or reception can be resumed by holding the knob in ON position. If no sidetone is heard when attempting to transmit, the transmitter is not on the air.



1 TEST SWITCH
2 ANTENNA CURRENT METER
3 BATTERY–P.A. GRID–P.A. PLATE SWITCH
4 TUNING METER
5 CTO (CALIBRATE–TUNE–OPERATE) SWITCH
6 PILOT LIGHT
7 EMISSION SWITCH
8 CDA–T OSCILLATOR
9 A–B SWITCH
10 VFO-XTAL (VARIABLE FREQUENCY OSCILLATOR–CRYSTAL) SWITCH
11 LOW FREQUENCY CHANNEL SELECTOR
12 DIAL B VERNIER
13 DIAL B (HIGH FREQUENCY FINE TUNING)
14 CORRECTOR KNOB
15 DIAL B REVOLUTION COUNTER
16 DIAL A (HIGH FREQUENCY COARSE TUNING)
17 CALIBRATION TABLES STOWAGE
18 LOW FREQUENCY EXTENDED RANGE SWITCH
19 DIAL D (ANTENNA TUNING FINE ADJUSTMENT)
20 MICROPHONE JACK
21 DIAL C (ANTENNA TUNING COARSE ADJUSTMENT)
22 SIDETONE JACK (2 PLACES)
23 DIAL E (ANTENNA LOADING ADJUSTMENT)
24 KEY JACK
25 T.S. (THROTTLE SWITCH) JACK
26 CHANNEL SELECTOR SWITCH
27 LOCAL–REMOTE SWITCH
28 LOCKING BAR
29 COMMAND MIKE SWITCH

REMOTE CONTROL PANEL F



F 1243 ▶ 1371 with TCTO K527

MF (HF) COMMAND TRANSMITTER CONTROLS LESS TCTO K572

Figure 4-20

MF COMMAND (HF COMMAND) RADIO

On F airplanes the MF command radio consists of the AN/ART-13 transmitter on the radio rack and a BC-454 receiver. Each of these units are controlled from panels on the control stand. For a description of each component, refer to MF TRANSMITTER (AN/ART-13) and LIAISON RECEIVER (BC-454) in this Section. Code transmissions are possible on the MF command radio when the key transfer switch is positioned to COMMAND. Operation of the MF command radio is also controlled by the command mike switch on airplanes incorporating 1C10 K527. On G airplanes, the MF command radio consists of the AN/ART-13 transmitter (figure 4-20) on the radio operator's table (airplanes G 17260 ▶ 3177) or at the navigator's station (airplanes G 3178 ▶); and, a liaison receiver. The liaison receiver is the BC-348 receiver on the main radio rack on airplanes G 17260 ▶ 3278 less those incorporating 1C10 KG206 or the ARR-36 receiver on the overhead panel on airplanes G 3279 ▶ plus those incorporating 1C10 KG206. (See figure 4-21.) For a description of each component refer to MF TRANSMITTER (AN/ART-13), LIAISON RECEIVER (BC-348), and LIAISON RECEIVER (AN/ARR-36) in this Section.

LIAISON RECEIVER (BC-454) F

The MF command radio has a BC-454 receiver. This receiver operates over a frequency range from 3.0 to 6.0 megacycles (3000 to 6000 kilocycles). The controls for the receiver, on the control stand, are used to turn on the set, select the frequency, and select the type of signal to be received (CW or MCW). The reception of the receiver is heard on the interphone when the HF COMM interphone mixer switch is ON. The set uses 28 volt d-c power and has circuit protection on radio junction box circuit breaker panel (figure 1-35).

Liaison Receiver (BC-454) Controls

F

POWER SWITCH. This switch (11, figure 4-21) on the BC-454 control panel has CW--OFF--MCW positions. Moving the switch out of the OFF position to either CW or MCW turns on the receiver. When CW is selected, the reception will be code signals which are being transmitted by interrupting an unmodulated continuous wave (CW). To receive voice transmissions as well as modulated continuous wave code signals, the switch is placed on MCW.

F

TUNING CRANK. The frequency of the receiver is selected by positioning the tuning dial (3, figure 4-21) with the tuning crank (8, figure 4-21).

F

VOLUME KNOB. The volume level of the sound from the BC-454 receiver into the interphone is adjusted with the volume knob (10, figure 4-21).

Liaison Receiver (BC-454) Normal Operation F

For reception on the liaison radio (BC-454) receiver:

1. Place the power switch to either CW or MCW
2. Turn tuning crank to the desired frequency

CAUTION

Do not attempt to rotate the dial beyond the boundary calibration marks.

3. Place the HF COMM interphone mixer switch ON
4. Adjust volume

Liaison Receiver (BC-454) Emergency Operation F

If the liaison radio (BC-454) receiver becomes inoperative, it may be necessary to replace a fuse in the receiver on the main radio rack to restore operation.

WARNING

Place the BC-454 receiver power switch OFF before attempting to change a fuse. The dynamotor on the receiver generates a high voltage.

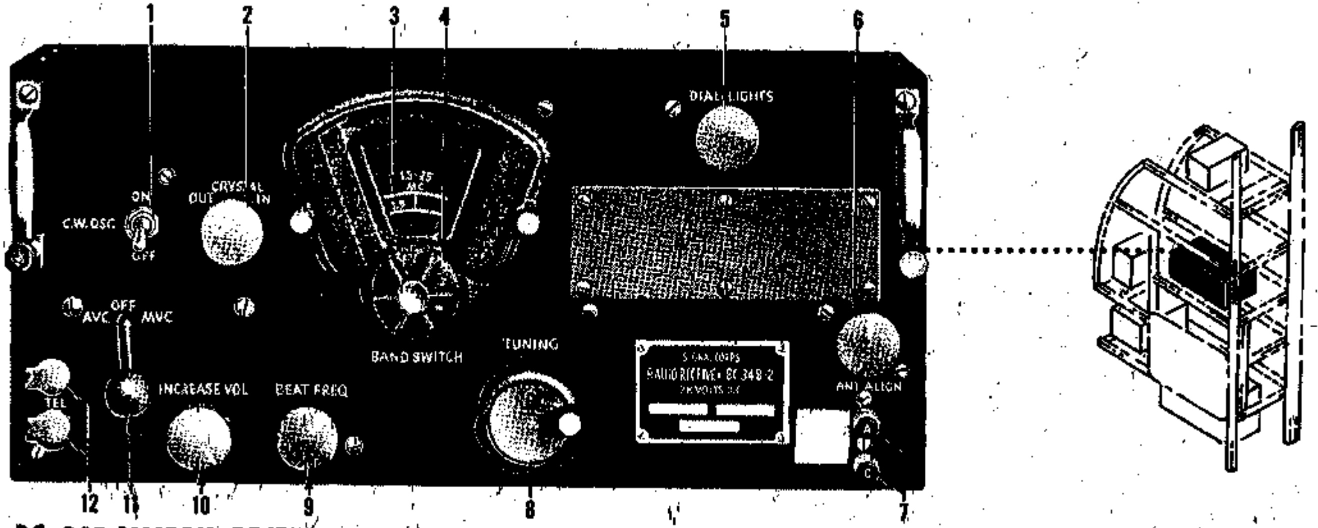
LIAISON RECEIVER (AN/ARR-36) G 3279 ▶ plus 1C10 KG206

The AN/ARR-36 is a radio receiver that provides CW, voice, and frequency shift reception in the frequency range from 2 to 23.9 megacycles in 500-cycle steps giving a total of 44,000 usable frequencies. Any 20 of the 44,000 possible frequencies can be set up, in any order, for selection by the operator through the use of a channel selector switch on the control panel. The ARR-36 liaison receiver control panel (45, figure 1-12) is on the overhead panel. Control power is 28 volt DC with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

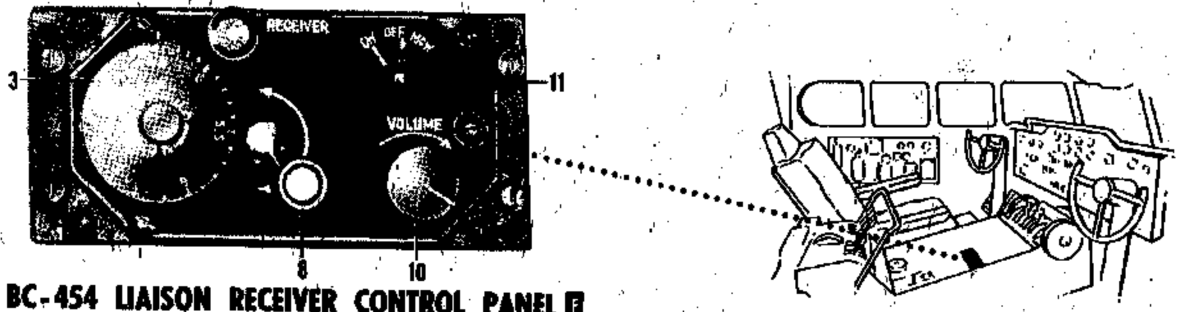
AN/ARR-36 Liaison Receiver Controls

G 3279 ▶ plus 1C10 KG206

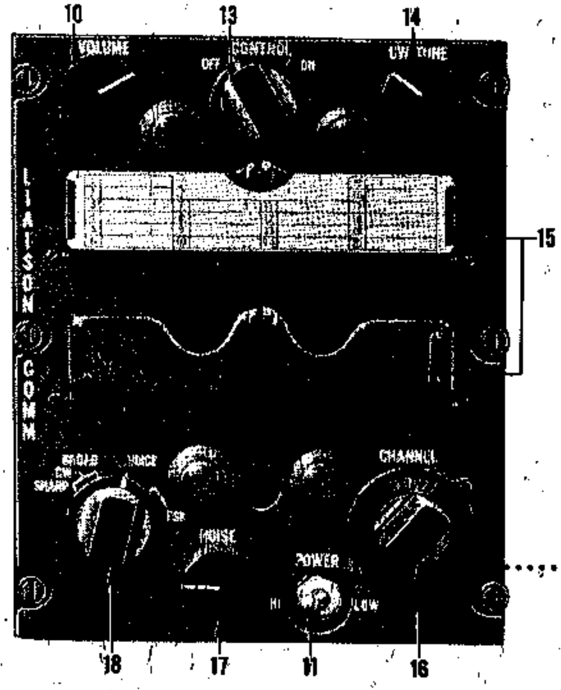
OPERATION SELECTOR SWITCH. A rotary-type selector switch (18, figure 4-21) on the ARR-36 liaison receiver control panel has CW SHARP--CW BROAD--VOICE--FSK positions. This switch is used to select a type of reception on the ARR-36 liaison receiver. The CW SHARP position provides CW reception on a narrow band width to increase intelligibility of signals. CW BROAD has a 7-kilocycle band for general CW reception. VOICE is for voice reception. The FSK position is a provision for a teletypewriter and is not used.



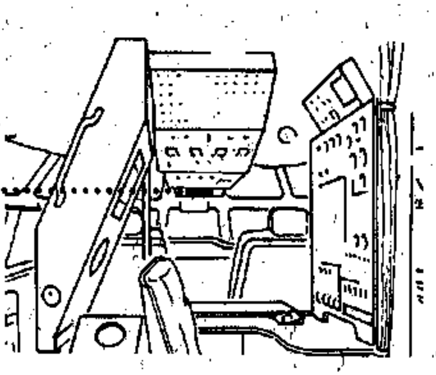
BC-348 LIAISON RECEIVER CONTROL PANEL G 17260 ▶ 3278 LESS TCTO K0206



BC-454 LIAISON RECEIVER CONTROL PANEL F



1 C.W. OSC SWITCH
2 CRYSTAL FILTER SWITCH
3 TUNING DIAL
4 BAND SWITCH
5 DIAL LIGHT RHEOSTAT
6 ANTENNA ALIGNMENT KNOB
7 ANTENNA AND GROUND BINDING POSTS
8 TUNING CRANK (2 PLACES)
9 BEAT FREQUENCY KNOB
10 VOLUME KNOB (3 PLACES)
11 POWER SWITCH (3 PLACES)
12 TEL. JACKS
13 CONTROL SWITCH
14 CW TUNING KNOB
15 PRESETTING DRUM COVERS
16 CHANNEL SELECTOR SWITCH
17 NOISE CONTROL KNOB
18 OPERATION SELECTOR SWITCH



ARR-36 LIAISON RECEIVER CONTROL PANEL
G 3279 ▶ PLUS TCTO K0206

AUXILIARY LIAISON RECEIVER CONTROLS

Figure 4-21

G 3279 ▶ plus TCTO K02061

CONTROL SWITCH. This switch (13, figure 4-21) with OFF--ON positions serve to turn the receiver on or off. The control switch is also a protective device that returns the switch to OFF when there are faults in the equipment.

G 3279 ▶ plus TCTO K02061

VOLUME KNOB. This knob (10, figure 4-21) on the ARR-36 liaison receiver control panel, controls the loudness of received signals to the interphone.

G 3279 ▶ plus TCTO K02061

CW TUNING KNOB. The CW tuning knob (14, figure 4-21) on the ARR-36 liaison receiver control panel is used to adjust the tuning when receiving CW signals.

G 3279 ▶ plus TCTO K02061

CHANNEL SELECTOR SWITCH. This switch (16, figure 4-21) on the ARR-36 liaison receiver control panel is used for selecting any one of the 20 preset frequencies.

G 3279 ▶ plus TCTO K02061

PRESETTING DRUM COVERS. These covers (15, figure 4-21) are on the ARR-36 liaison receiver control panel. The covers are held closed by thumb screws, which enclose the drums on which the desired frequencies are preset. A matte-surfaced plastic sheet for recording the preset channel is mounted on the top cover.

G 3279 ▶ plus TCTO K02061

POWER SWITCH. This switch (11, figure 4-21) on the ARR-36 liaison receiver control panel is not operative.

G 3279 ▶ plus TCTO K02061

NOISE CONTROL KNOB. This knob (17, figure 4-21) is on the ARR-36 liaison receiver control panel. The control is operative only when the operation selector switch is in the VOICE or FSK positions. This is a limited-range sensitivity or squelch control for adjusting the noise threshold when receiving voice or frequency shift keying signals.

Normal Operation of the AN/ARR-36 Liaison Receiver

G 3279 ▶ plus TCTO K02061

The AN/ARR-36 liaison receiver is put into standby operation when airplane is airborne as follows:

1. Set channel selector switch to the desired channel.
2. Turn control knob to ON. If control returns to OFF in approximately 40 seconds, select another channel. Repeat this procedure until control remains ON. Do not change channel for 15 minutes. After this warm-up period, proceed with normal operating procedures
3. Turn operation selector switch to the desired type of operation
4. Adjust the noise control knob to the point where characteristic noise is not objectionable when no signals are being received. Reducing the noise too much may prevent hearing signals.

To receive voice signals using the AN/ARR-36 liaison receiver, proceed as follows:

1. Place AUX REC interphone mixer switch ON (up)
2. Set operation selector switch to VOICE
3. While receiving voice signals, adjust the volume for satisfactory loudness of signals in the headphones
4. When no signals are being received, adjust the noise control until the receiver background noise is not objectionable. Reducing the level below this point may result in the loss of weak signals.

NOTE

The CW tuning knob is inoperative during VOICE or FSK operation.

To receive CW signals using the AN/ARR-36 liaison receiver, proceed as follows:

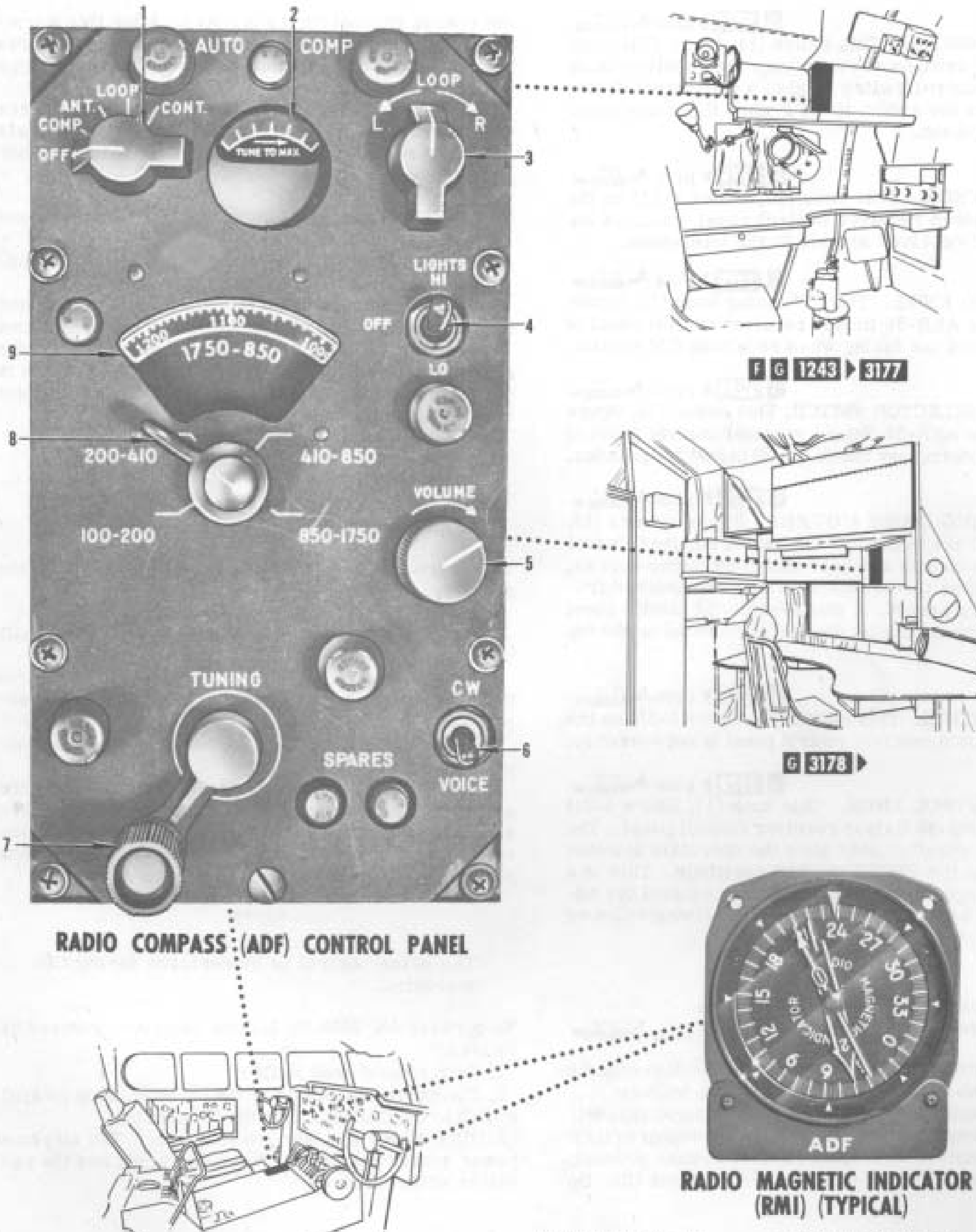
1. Place AUX REC interphone mixer switch ON (up)
2. Set the operation selector switch to the CW-BROAD position
3. While receiving CW signals, adjust the volume knob for satisfactory loudness of signals in the headphones
4. Adjust the CW tuning knob for an easily readable pitch of the received signals
5. If an unusually high noise level from interference or jamming makes reception difficult, switch the operation selector switch to CW SHARP. This may require readjustment of the CW tuning knob for desirable signal pitch

NOTE

The noise control is inoperative during CW operation.

To turn off AN/ARR-36 liaison receiver, proceed as follows:

1. Turn control knob to OFF
2. For emergency shutoff of the receiver, turn control switch to ON then OFF if in the ON position
3. Turn off the airplane power source. The airplane power source can then be turned on again and the receiver will remain off



RADIO COMPASS (ADF) CONTROL PANEL

RADIO MAGNETIC INDICATOR (RMI) (TYPICAL)

1 FUNCTION SWITCH
2 TUNING METER
3 LOOP SWITCH
4 LIGHT SWITCH
5 VOLUME KNOB
6 MODULATION SWITCH
7 TUNING CRANK
8 BAND SWITCH
9 FREQUENCY DIAL

RADIO COMPASS (ADF) CONTROLS AND INDICATORS

Figure 4-22

RADIO COMPASS (AN/ARN-6)

The low frequency radio compass is a navigational aid for the pilot and navigator. The radio compass may be used for automatic direction finding or as a homing device on any signal transmitted at a frequency from 100 to 1750 kilocycles. This set is also used as a receiver for low frequency range reception. Indicators for the set are on the pilots' instrument panel and the navigator's instrument panel. Control panels for the set are on the control stand for the pilot, and on the radio and radar control panels at the navigator's station, for use by the navigator. Operating power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

NOTE

The radio compass should not be used as a navigational aid until the loop has been compensated.

Radio Compass Controls

FUNCTION SWITCH. A function switch (1, figure 4-22) on the pilots' and navigator's radio compass panels is used to turn the radio compass equipment on and off, select the mode of operation, and transfer control of the radio compass to the pilots' or navigator's panel as desired. The switch positions are labelled OFF--COMP--ANT--LOOP--CONT and function as follows (the first four effective only from the radio compass panel having control): OFF turns off the radio compass equipment. COMP provides homing and automatic direction finding (ADF) operation. ANT connects the sense antenna to provide for receiver operation only. LOOP is used for aural-null direction finding and receiver operation. CONT is spring-loaded for momentary operation to transfer control from one radio compass panel to the other each time either switch is actuated.

NOTE

Control is indicated to be at the pilots' radio compass panel when one of the three operation positions of the pilots' function switch is in use and his frequency dial and tuning meter are illuminated when the indicator light switch is on HI or LO. Another indication of control will be a deflection of the tuning meter pointer away from its clockwise stop when the equipment has warmed up approximately 15 seconds. The indication of control at the navigator's panel is the same as the pilot's.

LOOP SWITCH. A rotary loop switch (3, figure 4-22) on the pilots' and navigator's radio compass panels provides manual control of rotation of the radio compass loop antenna. Turning the switch toward L or R rotates the loop counterclockwise or clockwise, respectively, provided the radio compass function switch is in LOOP position. The radio compass loop switch is spring-loaded to the center (off) position. The rate of loop rotation is proportional to the knob displacement from the center position and varies from approximately 5 degrees per second minimum to approximately 40 degrees per second maximum.

TUNING CRANK. A tuning crank (7, figure 4-22) on the pilots' and navigator's radio compass panels selects the desired station, the frequency of which is indicated on the calibrated dial.

LIGHT SWITCH. An indicator light control switch (4, figure 4-22) on the radio compass panel has HI--OFF--LO positions. HI and LO positions vary the indicator light intensity. OFF position turns off the lights.

BAND SWITCH. A band switch (8, figure 4-22) on the pilots' and navigator's radio compass panels selects any one of four receiver operating bands of frequencies. The switch positions are 100 to 200, 200 to 410, 410 to 850, and 850 to 1750 kilocycles. When a band is selected, the dial calibration is selected accordingly.

VOLUME KNOB. A volume knob (5, figure 4-22) on the pilots' and navigator's radio compass panels is provided as a means for adjustment of the audio level to the interphone.

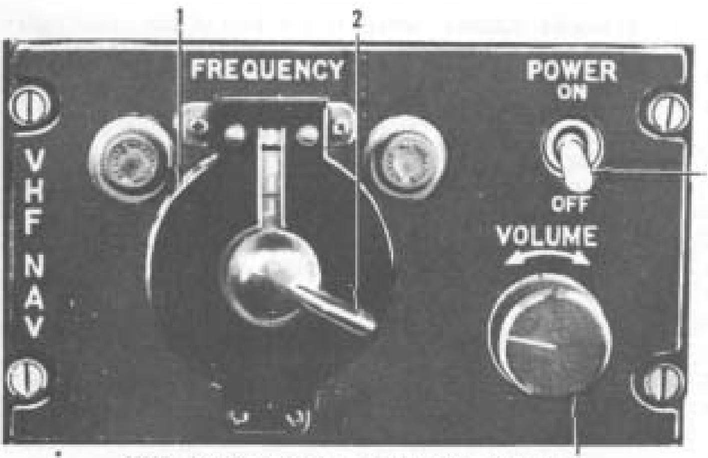
MODULATION SWITCH. A switch (6, figure 4-22) with CW--VOICE positions on the pilot's and navigator's radio compass panels is for selection of either code or voice reception.

Radio Compass Indicators

TUNING METER. A tuning meter (2, figure 4-22) is provided on the radio compass panels to indicate maximum signal strength during the process of tuning in a station.

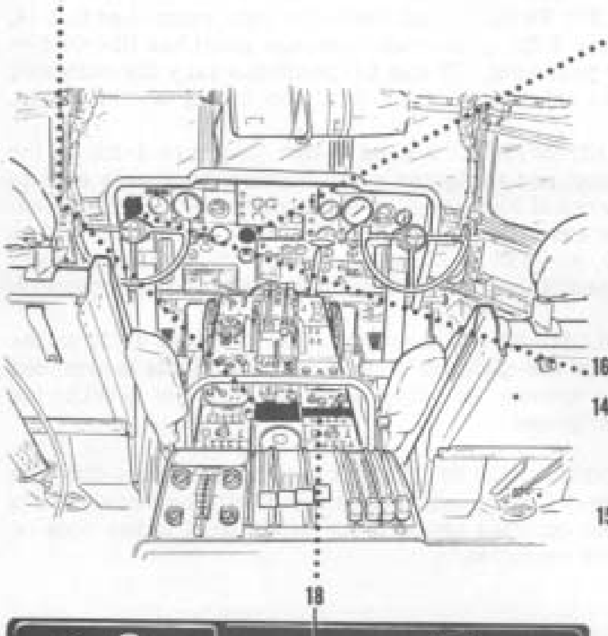
FREQUENCY DIAL. A dial scale (9, figure 4-22) on the pilots' panel shows the frequency to which the radio compass is tuned.

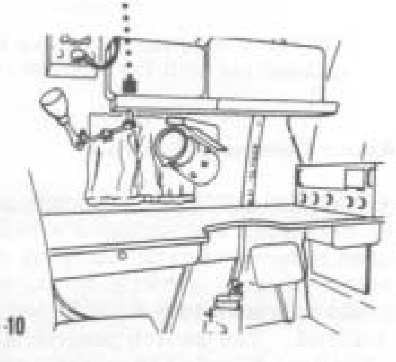
RADIO MAGNETIC INDICATOR (RMI). The ADF needle on the pilot's and navigator's RMI's indicates the direction of a tuned station relative to the airplane's heading. Refer to RADIO MAGNETIC INDICATOR under VHF NAVIGATION RADIO (OMNI) INDICATORS in this Section.

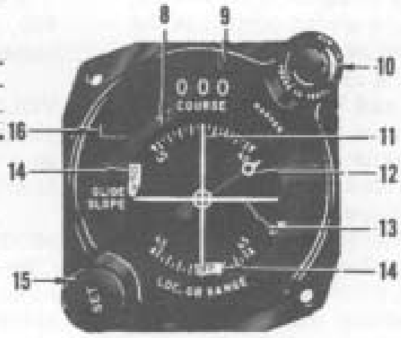


VHF NAVIGATION CONTROL PANEL

RADIO MAGNETIC INDICATOR (RMI) (TYPICAL)







PILOT'S COURSE INDICATOR

NOTE

On some airplanes, the navigator's RMI indicates bearing to omni station only when instrument select switch is on VOR-ILS.

AIRPLANES INCORPORATING TCTO 572

NAVIGATION INSTRUMENT SELECTOR PANELS

AIRPLANES NOT INCORPORATING TCTO 572

1 FREQUENCY SELECTOR KNOB (WHOLE MEGACYCLE)
2 FREQUENCY SELECTOR KNOB (TENTH MEGACYCLE)
3 POWER SWITCH
4 VOLUME KNOB
5 TACAN NEEDLE
6 OMNI NEEDLE
7 ROTATING COMPASS CARD
8 HEADING POINTER SCALE
9 COURSE SET WINDOW
10 MARKER BEACON LIGHT
11 LOCALIZER OR RANGE NEEDLE
12 RELATIVE HEADING POINTER
13 GLIDE SLOPE NEEDLE
14 FLAG ALARM (2 PLACES)
15 COURSE SET KNOB
16 TO/FROM WINDOW
17 OBD--VOR SELECTOR SWITCH
18 INSTRUMENT SELECT SWITCH

VHF NAVIGATION RADIO (OMNI) CONTROLS AND INDICATORS

Figure 4-23

2 FO

Normal Operation of Radio Compass

NOTE

Operation on the COMP function of the radio compass while the airplane ground wire is connected may result in erroneous bearing indications.

The radio compass is made operative by the following procedure:

1. Place the function switch to ANT

CAUTION

Aural and sensing function may be affected by the simultaneous operation of the rendezvous radar sets (AN/APN-12 and APN-76).

NOTE

If ANT position of the function switch does not turn on the radio compass equipment, move function switch momentarily to CONT and return to ANT.

2. Place the appropriate interphone controls to the desired positions for reception of the radio compass receiver. See INTERPHONE SYSTEM, this Section
3. Select desired frequency band and use tuning crank to tune station and obtain maximum swing of tuning meter
4. Place function switch in desired (type of operation) position
5. Turn off equipment by placing function switch in OFF

Emergency Operation of Radio Compass

In the event of failure of the radio magnetic indicator or indicator circuits which prevent a compass reading, bearings may be taken from the azimuth scale at the bottom of the loop assembly in the lower nose compartment. These readings, however, will only indicate direction to the station as measured from the airplane heading.

MARKER BEACON (AN/ARN-12)

A marker beacon receiver is used as a navigational and landing aid. When flying over a beacon, an identifying signal may be heard through the interphone system and is shown visually by an amber marker beacon light (10, figure 4-23). The beacon light is on the pilot's course indicator on the pilot's instrument panel. Control power is 28 volt DC with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

Marker Beacon Controls And Operation

No controls are available for the marker beacon receiver. The receiver is automatically operated by DC power and will operate continuously as long as power is available from the DC power distribution system.

VHF NAVIGATION RADIO (OMNI) (AN/ARN-14)

The VHF navigation radio (omni) equipment provides navigation information and comprises a portion of the instrument landing system (ILS). A course indicator on the pilots' instrument panel provides visual course and heading indication with respect to the localizer beam or a selected VOR radial. If a localizer or omnirange signal is being received, a small warning flag in the bottom of the indicator will disappear from view to provide positive indication of station reception. Radio magnetic indicators on the pilots' instrument panel, one each for the pilot and copilot, and one for the navigator, indicate bearing to the omni station. The VHF-NAV interphone mixer switch (11, figure 4-8) must be ON (up) to hear the station identity code on the interphone. A switch (18 or 17, figure 4-23) must be positioned to VOR to provide signals to the pilot's course indicator, the radio magnetic indicators and the interphone. Control power is 28 volt DC with circuit protection on the aft radio rack junction box (figure 1-35).

OMNI And Localizer Controls

FREQUENCY SELECTOR KNOBS. Two rotary selector knobs (1 and 2, figure 4-23) on the VHF NAV control panel provide control of localizer and omni range frequency selection. The knobs may be turned either clockwise or counterclockwise. Frequencies between 108.0 and 135.9 megacycles provide 280 channels for selection. Tuning a localizer frequency automatically causes the proper glide slope channel to be selected simultaneously to provide ILS cross-pointer information.

POWER SWITCH. The omni receiver is turned on and off by a two-position power switch (3, figure 4-23) on the VHF NAV control panel.

VOLUME KNOB. A volume knob (4, figure 4-23) on the VHF NAV control panel is used to adjust the audio level from the omni receiver to the interphone.

COURSE SET KNOB. A course set knob (15, figure 4-23) on the pilot's course indicator is used to set the magnetic bearing of a desired course in the three upper tab windows (course set window).

OBD-VOR SELECTOR SWITCH. Airplanes not incorporating TCTO 572. This switch (17, figure 4-23) on the navigation instrument selector panel is on the control stand. The switch which is operative only in the VOR position at this time, allows signals to be fed to the pilot's course indicator (1, figure 1-9) and the radio magnetic indicators (figure 4-23). Information will be furnished for the OBD position when available. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

INSTRUMENT SELECT SWITCH. Airplanes incorporating TCTO 572. Input signals to the radio magnetic indicators and pilot's course indicator are selected by the instrument select switch (18, figure 4-23). When the switch is in the VOR-ILS position, signals from the VHF navigation radio are applied to the indicators. In the TACAN position, the indicator input is from the UHF navigation radio. The indicator light is illuminated to show which system is operating the course indicator. The other switch position marking is left dark to aid in determining which radio system is operating the instruments.

VHF Navigation Radio (OMNI) Indicators

PILOT'S COURSE INDICATOR. The pilot's course indicator on airplanes not incorporating TCTO 572, give a composite display of VHF navigation or approach information (Omni or ILS). On airplanes incorporating TCTO 572, the course indicators display either VHF (Omni or ILS) or UHF (TACAN) navigation information dependent upon the position of the instrument select switch. The indicator (figure 4-23) is on the pilot's flight instrument panel. The course set knob (15, figure 4-23), marked SET, permits the pilot to set up a magnetic course to reach a VOR, TVOR, or TACAN omni directional range station. In addition, radials from stations to the right or left of course can be selected for navigational reference. The selected course appears in the course set window (9, figure 4-23). The LOC or RANGE needle (11, figure 4-23) indicates the lateral position of the airplane relative to the selected station radial or ILS localizer beam. The displacement of the vertical bar from center indicates the direction of turn to position the airplane on the selected course. The GLIDE SLOPE needle (13, figure 4-23), operative only when the set is on an ILS frequency, shows the vertical position of the airplane on the glide path. Both needles operate in the same manner, maintaining a center position when "on course" and deviating from center when "off course". The relative heading pointer (12, figure 4-23) is an N-1 compass repeater that is oriented by the course set knob to show the heading of the airplane relative to the selected radial. When the relative heading pointer is centered, the heading of the airplane is the same as the course shown in the course set window. If the pointer is deflected to the left or right, the airplane heading is to the left or right the number of degrees indicated on the pointer scale. Deviation of the heading pointer from the vertical index indicates the crab angle of the airplane when the vertical bar is centered. The TO/FROM indicator (16, figure 4-23) indicates FROM when the airplane is on or near the selected radial and TO when the airplane is on or near the reciprocal radial. (Radials are established as outbound magnetic bearings from the station.) The TO/FROM indicator is blank during ILS operation or upon loss of signal. There are flag alarms (14, figure 4-23) for the LOC or RANGE and GLIDE SLOPE needles. The OFF flag is visible when the respective pointer is unreliable because of a weak signal or the equipment is de-energized. The flag moves out of sight when the pointer is reliable. Each course indicator has a marker beacon light (10, figure 4-23). The light is operated by the marker beacon receiver. During ILS operation, the LOC or RANGE needle operates independent of the heading set in the course set window.

NOTE

> The heading pointer of the course indicator receives heading reference information from the N-1 compass system and will perform only the above functions when the N-1 compass system is operating in the magnetic slaved operational mode. When the N-1 system is in directional indicator operational mode the heading pointer will give only heading referenced to a preselected gyro datum and will be of no use for localizer and omni range operations unless synchronized with magnetic compass data.

RADIO MAGNETIC INDICATOR (RMI). The radio magnetic indicators give a composite display of airplane heading, radio compass or direction finder (ADF) station bearing, omni range station bearing, tacan station bearing on airplanes incorporating TCTO 572 ▶, and bearing to UHF radio stations (UHF/DF) on airplanes **G** **3178** ▶ plus those incorporating TCTO 321 ▶. The indicator receives heading reference information from the N-1 compass which rotates the circular compass card so that the heading of the airplane will always be under the reference index at the top of the instrument. The No. 2 pointer is the azimuth indicator for the omni receiver and indicates the bearing to the omni range from the airplane as measured from magnetic North whether N-1 compass system is in magnetic slaved operational mode or directional indicator mode. The No. 2 needle receives synchro excitation voltage only through the N-1 compass; however, in the event of failure of power to the N-1, a relay is energized which provides an alternate source of excitation voltage. In effect, this makes the No. 2 needle completely independent of the N-1. When the omni radio is operating properly and the C-1 amplifier is receiving power, the No. 2 needle always indicates magnetic bearing to the station regardless of the mode of operation of the N-1 compass or if the N-1 compass is inoperative. The directional information to the omni radio is obtained from a phase difference between two rotating antennas in the ground installation. It is oriented to magnetic North for convenience only. The only function of the N-1 compass, as it affects the No. 2 needle, is to keep the airplane heading at the top of the rotating compass card; that is, the needle points physically in the direction of the station as well as to the number on the card which is the magnetic bearing to the station.

Normal Operation of VHF Navigation Radio (OMNI)

The VHF navigation radio (omni) is made operative by placing the power switch in the ON position and inoperative by placing the power switch in OFF position.

Emergency Operation of VHF Navigation Radio (OMNI)

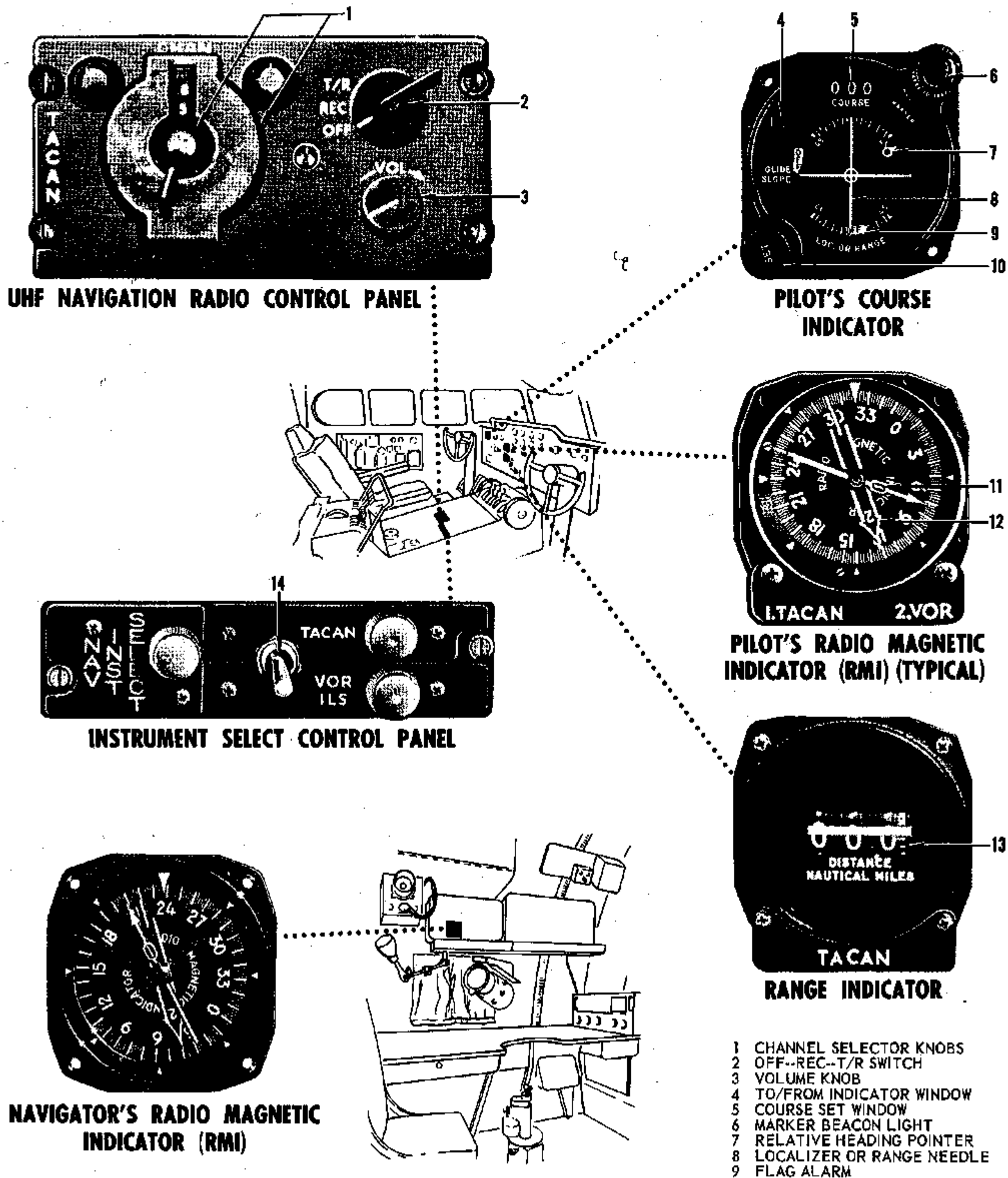
In event of failure of the C-1 signal power amplifier, the pilots' and navigator's radio magnetic indicators will become inoperative. When such a failure occurs, directional indication from the rotating compass card and the No. 1 and 2 needles for the radio magnetic indicator will not be available. Under these conditions, bearing information from the omni receiver may be obtained from the pilot's course indicator by rotating the course set knob until the vertical bar is centered. Magnetic bearing to or from the omni-station can then be determined by observing the to/from indicator and the counter reading.

GLIDE PATH RECEIVER (AN/ARN-18)

A glide path receiver is a portion of the instrument landing system (ILS). The pilot's course indicator on the pilots' instrument panel provides visual glide slope indication along with the localizer indication. Control of glide path equipment is automatic through normal operation of VHF navigation radio (omni) equipment. See figure 4-39 for antenna location. Control power is 28 volt dc, operating power is 115 volt ac with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

Glide Path Receiver Indicator

A glide slope horizontal needle (13, figure 4-23) in the pilot's course indicator provides indication of airplane position relative to the glide slope beam. The horizontal needle will be centered on the indicator if the airplane is flying on the beam during an approach. A warning flag on the left side of the indicator moves out of sight when a glide slope signal is being received.



1	CHANNEL SELECTOR KNOBS
2	OFF--REC--T/R SWITCH
3	VOLUME KNOB
4	TO/FROM INDICATOR WINDOW
5	COURSE SET WINDOW
6	MARKER BEACON LIGHT
7	RELATIVE HEADING POINTER
8	LOCALIZER OR RANGE NEEDLE
9	FLAG ALARM
10	COURSE SET KNOB
11	RMI NO. 1 POINTER
12	RMI NO. 2 POINTER
13	RANGE INDICATOR WINDOW
14	INSTRUMENT SELECT SWITCH

NOTE: On some airplanes, the navigator's RMI No. 2 needle indicates bearing to TACAN station when instrument select switch is on TACAN.

UHF NAVIGATION RADIO (TACAN) CONTROLS AND INDICATORS WITH TCTO 572

Figure 4-24

1025-1150 mcs range; associated ground to air freqs are in 962-1024 mcs & 1151-1213 mc range - chan-spaced at 1 mc apart. AUTH - AFM 51-37. TACAN FREQ.

Normal Operation of Glide Path Receiver

The glide path receiver is turned on and off and tuned remotely through normal use of the VHF navigation radio (omni) equipment. The power switch (3, figure 4-23) for the VHF navigation radio starts and stops operation of the glide path equipment. When the omni and localizer frequency selector knobs (1 and 2, figure 4-23) are set to a designated ILS localizer frequency, the glide path equipment is automatically tuned to the proper channel. Glide path equipment is in a standby condition when VHF omni-range frequencies are used.

NOTE

Power to the glide path receiver is turned off when the radar beacon power selector switch (8, figure 4-34) is on EMERG.

Emergency Operation of Glide Path Receiver

Emergency operation does not differ from normal operating procedure.

UHF NAVIGATION RADIO (TACAN) (AN/ARN-21) TCTO 572

Airplanes incorporating TCTO 572 have a UHF navigation radio that operates in conjunction with surface navigation beacons. The radio and a surface beacon together comprise a radio navigation system, called TACAN, that enables the airplane to obtain continuous indications of distance and bearing to a selected station. The radio has five components: receiver-transmitter, antenna, control panel, range indicator, and azimuth indicators (pilot's course indicators and radio magnetic indicators) (figure 4-24). Operating controls for the radio are on the control panel on the control stand. The panel has two channel selector knobs, a tone level control for the station identity code (marked VOL), and the OFF--REC--T/R switch for energizing the equipment. There are one hundred twenty six channels available. The ground stations continuously transmit radio pulses. These pulses are detected by the receiver and translated into bearing information. TACAN supplies bearing data to the pilot's course indicator and radio magnetic indicators. For distance information the TACAN transmitter radiates pulses known as distance interrogation pulses. These signals are detected by the ground station and cause the ground station transmitter to respond with "distance reply" pulses. The receiver detects the distance reply pulses, measures the time difference between the interrogation pulse and the reception of the reply pulse, and converts this time difference into a nautical miles meter reading. Distance information is shown on the range indicator (figure 4-24). TACAN information is connected to the pilot's course indicator and radio magnetic indicators when the instrument select switch (14, figure 4-24) is in TACAN position. The TACAN mixer switch (13 and 19, figure 4-8) on the interphone mixer switch panel must be ON (up) to hear the station identity code on the interphone. This navigation system requires heading data from the N-1 compass. Both 28 volt DC and 115 volt AC power are used in the operation and control of the set with circuit protection through circuit breakers on the radio junction box circuit breaker panel (figure 1-35).

WARNING

On airplanes having both VHF and UHF navigation radios, turn off the UHF navigation radio (TACAN) when making a VOR or ILS approach. There is an automatic change-over to TACAN in the event of power failure to the VHF navigation radio (omni). This change-over may occur without being noticed by the pilot since there is no distinctive indication of such a failure.

UHF Navigation Radio (TACAN) Controls TCTO 572

TCTO 572

OFF--REC--T/R SWITCH. Placing the OFF--REC--T/R switch (2, figure 4-24) in the OFF position, turns off all power to the set. When the switch is in REC (receive) position, the set supplies only bearing information. Bearings are displayed on the pilot's radio magnetic indicator and on some airplanes on the navigator's RMI. Bearing data is also supplied to the pilot's course indicator to give position indications with respect to the selected radial. When the switch is placed in the T/R (transmit-receive) position, the equipment is in full operation with both bearing and distance information displayed. The distance to the station is displayed by the range indicator on the pilot's instrument panel.

TCTO 572

CHANNEL SELECTOR KNOBS. The two channel selector knobs (1, figure 4-24) select one of 126 operating channels. The small knob determines the unit digit of the channel number and the large knob determines the tens and/or hundreds digit. The selected channel number is displayed in the window above the small knob.

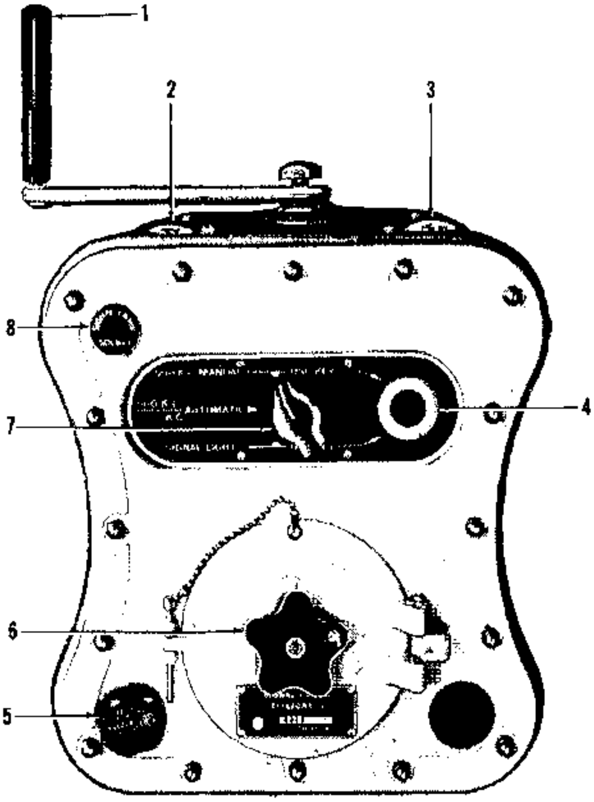
TCTO 572

VOLUME KNOB. The knob (3, figure 4-24) controls the volume of the three-letter Morse code beacon identification signal.

TCTO 572

INSTRUMENT SELECT SWITCH. Input signals to the radio magnetic indicators and pilot's course indicator are selected by the instrument select switch (14, figure 4-24). When the switch is in the VOR-ILS position, signals from the VHF navigation radio are applied to the indicators. In the TACAN position, the indicator input is from the UHF navigation radio. The indicator light is illuminated to show which system is operating the course indicator. The other switch position marking is left dark to aid in determining which radio system is operating the instruments.

COURSE SET KNOB. A course set knob (10, figure 4-24) on the pilot's course indicator is used to set the magnetic bearing of a desired course in three-digit display windows.



DINGHY TRANSMITTER

1 HAND CRANK
2 RADIO OUTPUT LIGHT
3 SPEED INDICATOR LIGHT
4 KEY
5 GROUND LEAD
6 ANTENNA REEL
7 SELECTOR SWITCH
8 SIGNAL LAMP SOCKET

DINGHY TRANSMITTER CONTROLS

Figure 4-25

UHF Navigation Radio (TACAN) Indicators TCTO 572

RANGE INDICATOR. The range indicator on the pilots' instrument panel displays the slant range in nautical air miles to the selected ground beacon station. When the equipment is searching for a satisfactory range signal, the indicator drum counters (13, figure 4-24) are partially covered by a red bar and the counters move too rapidly for a reading to be obtained. When the equipment has locked on to a reliable range signal, the red bar disappears and the counters move slowly as determined by airplane flight. Maximum reading of the range indicator will be 195 nautical air miles.

PILOT'S COURSE INDICATOR. The pilots' course indicator, (figure 4-24) provides a composite display of the UHF navigation radio bearing information when the instrument select switch is in TACAN position. Deviation from the selected course to the ground beacon is shown by the vertical pointer. The selected course to the beacon is shown in the three-digit course set window. The course is selected by turning the SET knob. When the vertical pointer signals are not reliable, a vertical pointer flag alarm labelled OFF appears. A heading pointer shows relationship of the airplane heading to the selected bearing. With the vertical pointer centered, the heading pointer indication is the crab angle of the airplane. An amber indicator light illuminates when the marker beacon receiver operates. A to/from flag indicates whether the course selected is to or from the TACAN beacon station.

NOTE

> The pilot's course indicator and the radio magnetic indicators operate in conjunction with either the VHF navigation radio (omni) or the UHF navigation radio (TACAN), depending on the position of the instrument select switch. The switch must be in TACAN position for the UHF navigation radio to operate the indicators.

RADIO MAGNETIC INDICATOR (RMI). Bearing information of the UHF navigation radio is displayed on the radio magnetic indicators or RMI's (figure 4-24) one on the pilots' instrument panel and one RMI on the navigator's instrument panel. On the pilots' instrument panel, the radio magnetic indicators which have the marking 1. TACAN show UHF navigation radio bearing with the No. 1 pointer. On some airplanes the navigator's radio magnetic indicator shows UHF navigation radio bearing on the No. 2 pointer when the instrument select switch is in the TACAN position. The pointers rotate continuously when the equipment is not locked on a reliable beacon bearing signal.

AZIMUTH INDICATOR. This indicator is next to the forward power panel in the lower forward compartment. It displays the relative bearing to the TACAN beacon station. Since this information is presented on the radio magnetic indicators, the azimuth indicator is not normally used in flight.

Normal Operation of UHF Navigation Radio (TACAN) TCTO 572

To obtain bearing information from the UHF navigation radio, move the OFF--REC--T/R switch to the REC position and select the channel of the appropriate ground beacon station. To identify the beacon station, move the TACAN interphone mixer switch to the ON position and listen for the code signal. Adjust the volume of the signal. Place the instrument select switch in the TACAN position. When the radio magnetic indicator TACAN pointers stop rotating, the search cycle of the equipment is completed and the pointers indicate the bearing of the beacon. The pilot's course indicator may be used to indicate deviation of the airplane from the selected course by turning the course set knob. To obtain range information in addition to bearing information, move the OFF--REC--T/R switch to T/R and read the range to the beacon in nautical air miles on the range indicator after the red bar disappears. To turn the equipment off, move the OFF--REC--T/R switch to the OFF position.

Emergency Operation of UHF Navigation Radio (TACAN)

1C10 572

In event of failure of the C-1 signal power amplifier, the pilots' and navigator's radio magnetic indicators will be inoperative. When such a failure occurs, directional indication from the rotating compass card and the No. 1 and No. 2 needles for the radio magnetic indicators will not be available. Under these conditions, bearing information may be obtained from the pilot's course indicator by turning the course set knob until the vertical pointer is centered. Magnetic bearing to or from the beacon can then be read in the course marker window. The to/from flag will indicate whether the bearing is to or from the beacon. Partial failure of the equipment may not impair other functions. If the warning flag is not visible, the indication can be considered reliable.

DINGHY TRANSMITTER (AN/CRT-3A)

Two manually operated dinghy transmitters (6, figure 3-1) are provided for emergency transmission of automatic or manual modulated code or light signals.

Dinghy Transmitter Controls

HAND CRANK. Power is generated by turning a hand crank, (1, figure 4-25) at the top of the transmitter.

KEY. The key (4, figure 4-25) on the transmitter is utilized to manually key the transmitter or signal light, when the selector switch is in MANUAL or SIGNAL LIGHT positions respectively.

GROUND LEAD. This lead (5, figure 4-25) on the bottom of the transmitter serves as a ground for the set and can be placed in water or buried in soil.

ANTENNA REEL. The antenna reel (6, figure 4-25) on the transmitter is provided to reel or unreel the desired antenna length.

SELECTOR SWITCH. The selector switch (7, figure 4-25) has AUTOMATIC--MANUAL positions. The switch should be on AUTOMATIC for at least 5 minutes of each of the International Distress Listening periods to enable D/F stations to make an accurate fix of the sets location. The switch should be placed on MANUAL occasionally (2 or 3 times hourly) and the call letters of the distressed airplane keyed to permit D/F stations or search craft homing on 500 kc signal to distinguish between your signals and those of any other set sending out signals on the same frequency.

SIGNAL LAMP SOCKET. This socket (8, figure 4-25) is provided to allow signal lamp to be plugged in. The light is used at night to enable search craft to sight exact location of distress party using it.

Dinghy Transmitter Indicators

RADIO OUTPUT LIGHT. This light (2, figure 4-25) on the transmitter should glow after approximately one minute of operation, indicating that transmission is taking place.

SPEED INDICATOR LIGHT. A speed indicator light (3, figure 4-25) on the transmitter, indicates by illumination when the proper cranking speed has been reached.

Automatic Radio Transmission of the Dinghy Transmittter

To start the transmitter, proceed as follows:

1. Set the selector pointer to 500 K.C.-8364 K.C. AUTOMATIC
2. To start transmission, rotate the crank in a clockwise direction at approximately 80 to 100 revolutions per minute. When sufficient speed has been attained, the lamp marked SPEED INDICATOR KEEP LIGHTED on the top of the transmitter will light. Faster crank speeds are ineffective since the transmitter contains automatic voltage regulation, and undesirable since they speed up the transmitter code characters
3. Continue cranking. Allow at least 20 seconds for the filaments of the vacuum tubes to heat, after which time the radio output light should flash on and off with the keying of the transmitted signal. There are no further adjustments
4. In the 500 K.C.-8364 K.C.-AUTOMATIC selector switch position, the transmitter automatically sends a signal consisting of six groups of SOS followed by a sustained dash of about 20 seconds duration. This occurs first on 500 kilocycles and then on 8364 kilocycles, automatically switching from one frequency to the other about every 40 or 50 seconds

To stop the transmitter, stop cranking.

General Instructions for Transmission:

1. Most shore stations and even some ship and airplane stations maintain continuous watch, therefore, if no timepiece is available the exact time for transmission is not of great concern
2. Transmit for at least 5 minutes at a time to enable stations to determine bearings after the signal is heard
3. Transmit at least once every half hour during the day. Many short transmissions, close together, are better than one continuous transmission for hours followed by a long period of silence. An airplane using the radio transmissions as a guide for the rescue needs frequency signals so it can keep on the correct course
4. Transmit both at night and during the day to take advantage of the changes in range. Always transmit several times in the periods near dawn and near dusk
5. Radio stations engaged in the rescue operation may be far from the life raft and from each other. They must communicate with each other and with rescue agencies close by before the rescue can be accomplished. The operator, therefore, must not use all of his strength the first day .
6. Transmit continuously if a ship or airplane is heard or sighted. At night, use both radio transmission and the signal lamp as circumstances warrant
7. Share the work of cranking. Interchange hands to ease the effort. If possible, let others crank the transmitter while one man holds it between his legs

Manual Radio Transmission

To start the transmitter for manual transmission, proceed as follows:

1. Set the selector switch pointer to the 500 KC MANUAL position
2. To start transmission, rotate the crank in a clockwise direction at approximately 80 to 100 revolutions per minute. When sufficient speed has been attained, the lamp marked SPEED INDICATOR KEEP LIGHTED located on the top of the transmitter will light. Faster crank speeds are ineffective, since the transmitter contains automatic voltage regulation. Continue cranking for about 20 seconds to allow the filaments to heat
3. To transmit a signal, the push button marked KEY must be pressed. This button is manipulated most conveniently by the operator with one of the first two fingers of the left hand. If another person is present, he might telegraph with his right hand while the other cranks. The indicator lamp marked RADIO OUTPUT should light when the key is depressed. This light provides a means for visually monitoring the message transmitted. The International Morse Code is printed on the top of the transmitter.

To stop the transmitter, proceed as follows:

1. To stop transmission for a few moments only, release the key button; continue cranking
2. To stop operation completely, merely stop cranking

General Instructions for Manual Transmission:

1. Send slowly, about five words per minute at most. It is difficult to send readable code with this transmitter
2. Monitor the transmission by reading the radio output light as a blinker
3. At intervals transmit a sustained dash to enable planes which may be homing on the transmission to get a bearing
4. Use manual keying only when you have a particular message to send
5. Never use manual keying alone; switch to AUTOMATIC for five minute intervals occasionally. Transmission on 8364 kilocycles, available on automatic keying only, gives the greatest range

OPERATION OF SIGNAL LAMP. A signal lamp may be used for visual signaling at night if an airplane is heard. This does not require the antenna.

1. Obtain the signal lamp from the accessory bag. Plug the cord attached to the signal lamp into the signal lamp socket at the upper left corner of the transmitter panel
2. Strap the transmitter between the legs
3. Set the selector switch knob at the SIGNAL LIGHT position
4. Strap the signal lamp on top of the head with the straps under the chin. The lamp is nondirectional, and its light may be seen from any direction
5. Depress the push-button key
6. Crank the transmitter at a speed where maximum brilliancy of the signal light is obtained

NOTE

If the lamp bulb does not light or if it burns out during use, unscrew the dome of the signal lamp, replace the bulb with the spare bulb supplied in the space clip next to the socket, and then replace the dome.

7. To telegraph with the signal light, manipulate the push-button key

NOTE

No radio transmission occurs when the signal lamp is used.

RADIO ALTIMETER (SCR-718C)

The radio altimeter is used in airplanes for determining height above terrain. The nominal range of the equipment is 0 to 50,000 feet, although the altimeter is only accurate to 40,000 feet. The set operates on a frequency from 400 to 2400 cps. The indicator and all controls are on the face of the set. The altimeter (figure 4-22) is at the navigator's station. Operating power is 115 volt ac with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

WARNING

Radio and radar waves can penetrate the surface of snow and ice fields, therefore when radio and radar equipment are used for measuring terrain clearance they may indicate greater terrain clearance than actually exists. An apparent terrain clearance several hundred feet greater than actual clearance has been recorded.

NOTE

When two or more airplanes using radio altimeters are flying in close proximity (formation, A/R rendezvous, etc.), the signals from the radio altimeter on one airplane can cause interference with the radio altimeter in the other airplane(s). The interference makes the altitude indications unusable.

Radio Altimeter Controls

SCALE SWITCH. This switch (1, figure 4-26) on the face of the radio altimeter has TIMES TEN--TIMES ONE positions. In the TIMES TEN position, the lobe on the indicator travels one revolution for 50,000 feet. In the TIMES ONE position, the lobe travels one revolution for each 5000 feet.

TIMES TEN ZERO ADJUSTMENT KNOB. This knob (2, figure 4-26) on the radio altimeter adjusts the zero lobe to zero when the scale switch is positioned to TIMES TEN.

TIMES ONE ZERO ADJUSTMENT KNOB. This knob (4, figure 4-26) on the radio altimeter adjusts the zero lobe to zero when the scale switch is positioned to TIMES ONE.

CIRCLE SIZE KNOB. The circle size knob (5, figure 4-26) on the radio altimeter adjusts the physical size of the circular trace on both the TIMES ONE and TIMES TEN positions. Normally, the adjustment is made only on the TIMES ONE position, to place the trace under the etched circle on the face of the scope. On the TIMES TEN position, the trace will then fall approximately 1/4 inch inside the etched circle, but the reference lobe can still be easily read.

REC GAIN KNOB. This knob (6, figure 4-26) on the radio altimeter has ON--OFF positions. The knob serves a double purpose. In the extreme counterclockwise position, the set is OFF and no power is applied. When the knob is turned clockwise from the extreme counterclockwise position to the ON position, power to all components of the radio altimeter will be applied. Further rotation of the knob adjusts the lobe height.

Radio Altimeter Indicators

INDICATOR FACE. The indicator face (3, figure 4-26) on the radio altimeter has a scale which ranges from 0 to 5, allowing altitude to be read up to 50,000 feet.

PILOT LIGHT. A pilot light (7, figure 4-26) on the radio altimeter will light when the components of the set are energized.

Normal Operation of Radio Altimeter

To start the set, proceed as follows:

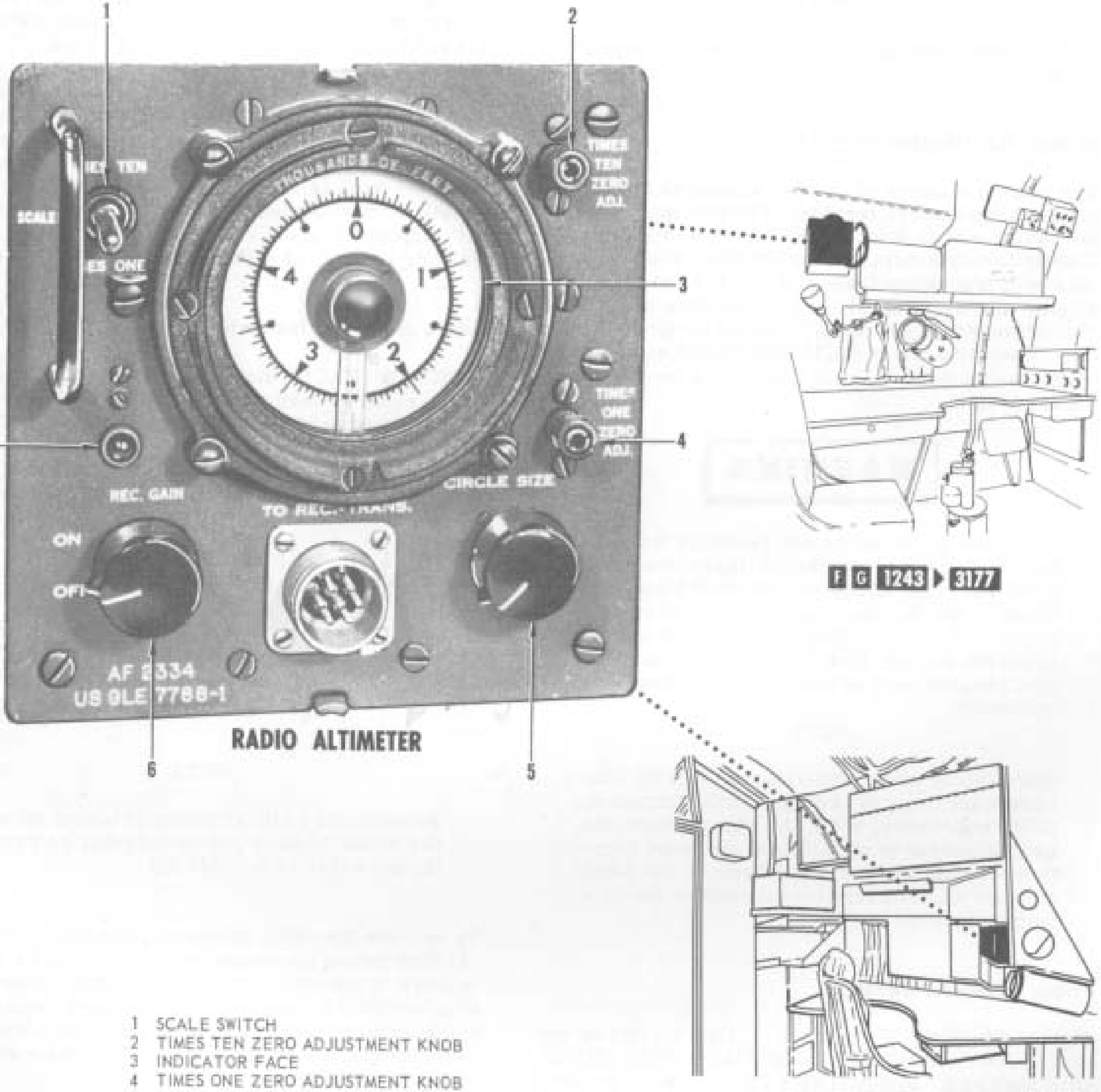
1. Turn the rec. gain knob clockwise, about one-half turn from the OFF position to the ON position
2. Check the pilot light on, indicating equipment is energized

NOTE

Power to the radio altimeter is turned off when the radar beacon power selector switch (8, figure 4-34) is on EMERG.

To operate the radio altimeter, proceed as follows:

1. After turning the equipment on, allow about 3 minutes or more, if possible, for the tubes to reach their operating conditions; then turn rec. gain knob until a trace in the form of a green circle with one or more pulses on it appears on the indicator face. Set scale switch in TIMES ONE position
2. Adjust the circle size knob so that the circle trace is barely visible as a luminous ring at the outer edge of the black calibrated scale
3. Adjust the rec. gain knob so that a pulse approximately 1/4 inch high appears on the circle trace near 0 on the calibrated scale
4. With the scale switch in the TIMES TEN position, check that the circle trace is about 1/4-inch inside the black calibrated scale
5. Adjust the times ten zero adjustment knob until the reference pulse is at zero
    a. After warmup, wait until the voltage to the equipment is normal (between 110 and 120 volts). If this cannot be read on a voltmeter, it may be estimated by judging the speed of the airplane engines, which should be greater than idling but less than takeoff speed



1 SCALE SWITCH
2 TIMES TEN ZERO ADJUSTMENT KNOB
3 INDICATOR FACE
4 TIMES ONE ZERO ADJUSTMENT KNOB
5 CIRCLE SIZE KNOB
6 REC. GAIN KNOB
7 PILOT LIGHT

RADIO ALTIMETER CONTROLS

Figure 4-26

b. Set the scale switch to the TIMES ONE position

c. Adjust the times one zero adj. knob so that the reading point of the reference pulse is set to zero on the indicator scale. This should be done just as the wheels of the airplane are about to leave the ground

d. As the airplane climbs, the reflected pulse will move away from zero and decrease in amplitude

e. At an altitude of several hundred feet, turn up the rec. gain control so that the reflected pulse (a new pulse appearing near zero) is 1/4-inch high

f. The reference pulse is due to leakage in the transmitter-receiver unit and between the transmitter and receiver antenna systems (cables and antennas); it may not be exactly at zero on the indicator scale. Record its exact position for later use. When reading altitude, adjust the rec. gain control so that the reflected pulse is 1/4-inch high, disregarding any slight shift of the reference pulse to the left

g. For zero adjustment during flight, adjust the rec. gain control so that the reference pulse is 1/4-inch high. Then use the times one zero adj. knob if necessary to set the pulse to the reading recorded in "f" above. This may be necessary to compensate for the effects of temperature and humidity changes; changes in barometric pressure have negligible effect on the zero setting. After making this adjustment, set the rec. gain control so that the reflected pulse is 1/4-inch high before reading altitude. Do not add or subtract the reading of the reference pulse

To read altitude, proceed as follows:

1. The black circular scale on the indicator is provided with a 0 to 5000 foot altitude calibration. Calibration marks are provided for every 50 feet of altitude and are sufficiently widely spaced so that readings can be estimated to the nearest 25 feet. To read the position of any pulse, determine the point along the scale where the counterclockwise edge of the pulse intersects the luminous green circle, making sure that the rec. gain control is set so that the pulse to be read is 1/4-inch high. Following takeoff, the reflection pulse travels clockwise around the scale as airplane height above terrain increases. Until the airplane reaches 5000 feet, read height merely by noting the positions of the pulse

2. When the airplane reaches 5000 feet, the reflected pulse will have progressed completely around the scale and returned to 0. As height above terrain increases further, up to 10,000 feet, the reflected pulse will travel clockwise on a second encirclement of the scale and 5000 feet must be added to the indication of the pulses

3. When the airplane reaches 10,000 feet, the reflected pulse will have completed a second encirclement of the scale, and one further clockwise encirclement will take place for each additional 5000 feet of altitude attained. Similarly, a counterclockwise encirclement will take place for each drop of 5000 feet sustained. To obtain actual height above terrain at any time, add 5000 feet to the indication of the pulses for every previous clockwise encirclement and subtract 5000 feet from the indication of the pulses for every previous counterclockwise encirclement of the scale by the reflected pulse. However, it generally is more practicable to estimate the approximate height above terrain (by use of an aneroid altimeter such as a Kollsman and knowledge of approximate terrain height above sea level) and then to determine the exact height above terrain by adding to the reading of the indicator pulses an appropriate multiple of 5000 feet, such as that the total closely checks the estimated height. For instance, if the estimated height above terrain is 25,000 feet and the indication of the pulses is 1275 feet, then the exact height is 25,000 plus 1275 feet, that is 26,275 feet

4. When using this set remember that the large times one circle (5000 foot scale) is merely an expanded vernier on the small times ten circle (50,000 foot scale). On the small circle it is possible to read to within approximately 500 feet and the scale switch should generally be left in the TIMES TEN position, especially at high altitudes. When greater accuracy is required, the large circle reading must be taken into consideration as follows: With the scale switch in the TIMES TEN position, read the reflected pulse position on the small circle to the next lower 5000 foot mark (indicated by dots and arrowheads on the indicator scale). Note this reading and switch to the TIMES ONE position; add the new reading to the one obtained previously. The large circle can, with practice, be read within 25 feet

5. This set is not designed for use as an extremely low altitude altimeter. As the height of the airplane above the ground decreases to less than 1000 feet, reduce the gain as required to prevent the reflected pulse from becoming too broad and more than 1/4-inch high. While doing this, at about 500 feet the reference pulse will begin to be affected by the reduced gain and will begin to decrease in amplitude. By careful adjustment of the rec. gain control, it will be possible to see the reflected pulse move in to zero, the reference or zero pulse having completely disappeared by the time the airplane lands

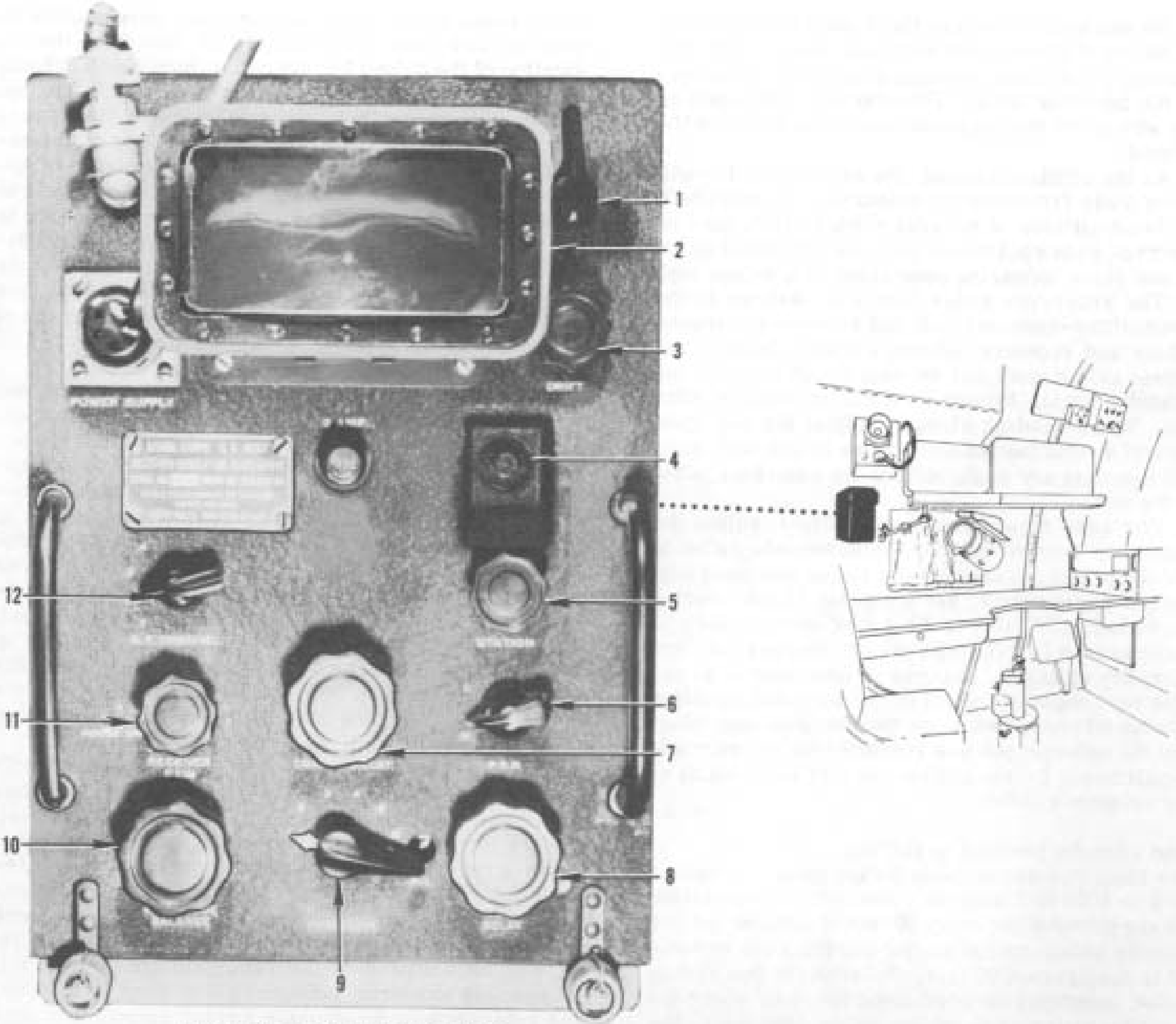
When using the radio altimeter, the following precautions should be observed:

1. Effect of Terrain. Flying over rough terrain will produce fluctuating indications, and flying over water will produce relatively steady indications

2. Blind Spots. At altitudes of 5000 feet and all multiples thereof, the reflected pulse will occupy the same position as the reference pulse. The pulses will appear to merge and cause a blind spot, that is, a region about 250 feet wide in which the position of the reflected pulse cannot be determined accurately

3. Accuracy. When the radio set is operating properly, the deviation of its indication from exact height above terrain is less than 50 feet. When improper operation causes the error to become greater than stated above, such improper operation is almost always shown by the indicator circle becoming oval in shape

4. Receiver Gain. Turning the rec. gain knob up



AN/APN-9 LORAN RECEIVER

1 L--R (LEFT-RIGHT) SWITCH
2 LENS
3 DRIFT CONTROL
4 PILOT LIGHT
5 STATION RATE SWITCH
6 PRR SWITCH
7 COARSE DELAY KNOB
8 FINE DELAY KNOB
9 FUNCTION SWITCH
10 AMPLITUDE BALANCE CONTROL
11 POWER SWITCH AND GAIN KNOB
12 CHANNEL SELECTOR SWITCH

NOTE

The loran receiver has additional controls (not shown) that are adjusted with a screwdriver.

LORAN (AN/APN-9) CONTROLS

F

Figure 4-27

higher than is necessary for a satisfactory image will result in a blurred or fuzzy trace

5. Dives, Climbs, and Banks. Sharp banks, dives and turns may flatten out the reflected pulse, or the pulse may disappear completely during the bank or dive
6. Observable Defects:
    a. A circle trace which is not truly circular will cause inaccurate readings
    b. A circle trace that is off center will cause inaccurate readings
    c. Shifting of the reference pulse will cause inaccurate readings unless compensated for as stated in Step 4, NORMAL OPERATION OF THE RADIO ALTIMETER, this Section
7. Excessive Altitude. Use of the radio set at heights above sea level greater than 40,000 feet may result in impaired operation, although the accuracy of its indication will not be diminished. Use at heights above sea level greater than 45,000 feet may result in permanent damage. This damage would be caused if the reduction in air pressure were sufficient to allow voltage breakdown between closely-spaced circuits carrying high potential difference

CAUTION

Before disconnecting any unit or cable of the equipment, and before removing the fuse, be sure the altimeter is turned off.

To turn the radio altimeter off, proceed as follows:

1. Turn the rec. gain knob fully counterclockwise to the OFF position

LORAN (AN/APN-9) F

The loran radio receiving set is used by the operator to receive and interpret loran signals. The set serves as a navigational aid and assists the operator in determining geographic location of airplane position. A scope and controls for the set are on the front of the receiver. The receiver (15, figure 4-16) is at the navigator's station. Operating power is 115 volt ac and control power is 28 volt dc. Circuit breakers for the set are on the radio junction box circuit breaker panel (figure 1-35).

Trailing Wire Antenna F

1. The trailing wire antenna will be extended only when necessary to accomplish a mission
2. Utilization of the trailing wire antenna will be noted in Form 781 upon completion of flight

WARNING

Do not extend antenna in turbulent air over populated areas unless such operation is deemed necessary. Do not extend antenna during air refueling.

NOTE

On airplanes incorporating 1C10 K228, use of the loran (AN/APN-9) is possible during refueling operations (when the trailing antenna must be retracted) by using the two position switch (COMMAND ANTENNA - TRAILING ANTENNA) on the loran receiver. When this switch is in the COMMAND ANTENNA position, the loran utilizes the MF command radio antenna.

APN-9 Loran Controls F

F

LEFT--RIGHT SWITCH. This switch (1, figure 4-27) on the loran receiver is used in shifting pulses to the left or right as may be necessary to frame them on the pedestals.

F

DRIFT CONTROL. The knob (3, figure 4-27), marked DRIFT, on the loran receiver is used to correct movements of signals until they are stationary.

F

STATION RATE SWITCH. This knob (5, figure 4-27) on the loran receiver and the PRR switch are used together to select proper pulse repetition rate and station.

F

FINE DELAY KNOB. This knob (8, figure 4-27) on the loran receiver is used to align the signals vertically.

F

COARSE DELAY KNOB. This knob (7, figure 4-27) on the loran receiver when turned counterclockwise, causes the signal to jump to the right in the event signals are not aligned after using the fine delay knob.

F

FUNCTION SWITCH. This switch (9, figure 4-27) on the receiver has five-positions. The knob controls the receiver-indicator circuits for the operations necessary in taking a loran reading.

F

AMPLITUDE BALANCE CONTROL. This knob (10, figure 4-27) on the loran receiver, adjusts the signal amplitude of the separate traces when a double sweep is used.

F

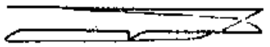
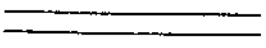
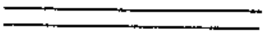
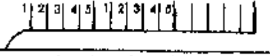
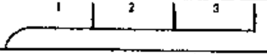
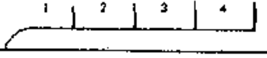
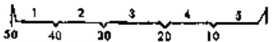
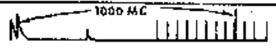
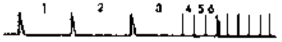
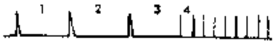
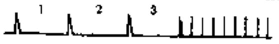
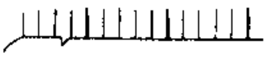
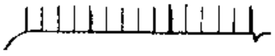
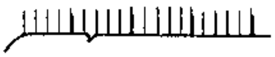
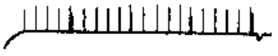
POWER SWITCH AND GAIN KNOB. This knob (11, figure 4-27) on the loran receiver has POWER OFF--RECEIVER GAIN positions. In the POWER OFF position, the receiver is inoperative. Turning the knob clockwise until it clicks, turns on power. Further clockwise rotation increases the gain of the receiver.

F

CHANNEL SELECTOR SWITCH. This switch (12, figure 4-27) on the loran receiver selects one of six pre-tuned channels.

F

LENS. The lens (2, figure 4-27) on the loran receiver enlarges the image of the cathode-ray indicator screen.

Funct.	Stn.	PRR	Scope Pattern	Remarks	Adj.	Crse.	Fine
5	0	L or H		Adjust for distinct picture	Focus		
5	0	L or H		Adjust to operator's desire	Brill		
1	0	L or H		Adjust alternately for length & position	Sl. Swp. H Cent & Ampl.		
2	0	L or H		Adjust alternately for length & position	Fa. Swp. H Cent & Ampl.		
2	0	L or H		Adjust to center vertically	Vert. Center		
5	0	L or H		Adjust 1000MS mkrs ⅛"-¼" above 100MS Mkrs	Marker Ampl.		
5	0	L or H		Adjust until cross-hair barely touches 10 MS markers on upper trace	Cross Hair		
4	0	H		5 (1000 Spaces) between (5000 Mkrs)	C		
4	0	H		3 (5000 MS Markers)	D		
4	0	L		4 (5000 MS Markers)	E		
5	0	H	Bottom Trace 	4 (10 MS Mkrs) between (50 MS Mkrs)	A		
5	0	H	Top Trace 	9 (100 MS Mkrs) between (1000 MS Mkrs)	B		
5	0	H	Cross Hair 	Count 8 spaces from cross-hair on left to first stn rate on right (BTM trace)	B		
5	1	H	Cross Hair 	Count 7 spaces from cross-hair to STN rate marker	B		
5	2	H		Count 6	2		
5	3	H	Cross Hair 	Count 5	2		
5	4	H		Count 4	4		
5	5	H		Count 3	4		
5	6	H	Cross Hair 	Count 2	F 6		
5	7	H	Cross Hair 	Count 1	F 6		
5	4	H	Move L-R switch to right, stn. rate marker should jump two spaces left		B R-L		
4	0	H		Marker reads between 11,000 & 11,500	5th hole Right Side	C.C.W.	C.W.
4	0	H		Marker just off screen recheck previous step	2nd hole Right Side	C.W.	C.W.
4	0	L		Marker reads between 13,500 & 14,000	4th hole Right Side	C.C.W.	C.W.
4	0	L		Marker just off screen Recheck previous step	3rd hole Right Side	C.W.	C.W.
5	0	H	Rotate fine delay C.W. to C.C.W. and count hundreds; read no less than 700 nor more than 1500		1st hole Right Side	Set on 5000	C.W. & C.C.W.

APN-9 LORAN CALIBRATION CHART

F

Figure 4-28

Normal Operation of the APN-9 Loran

1. Turn on the power by turning the power switch and gain knob clockwise until the pilot light above the station rate switch lights up. Allow a few minutes for equipment to warm up. Two traces appear on the scope, with a blip on the lower trace.

NOTE

> Power to the loran equipment is turned off when the radar beacon power selector switch (8, figure 4-34) is on EMERG.

2. Set the amplitude balance and fine delay controls to their respective center positions
3. Set the channel selector, PRR, and station rate switches at the proper positions to receive the desired station pair
4. Set the function switch to position 1
5. Rotate the gain knob clockwise until the signals appear on the scope
6. Move both signals to the lower trace with the left--right switch. Signals may first appear on the top trace, or on the bottom trace; or one signal may appear on each trace. Position both signals on the lower trace, with the left signal set at the extreme left end of the trace
7. Adjust the coarse delay until the variable delay marker is under the righthand signals

NOTE

> Amplitude balance control will not effect signals when function switch is at position 1.

8. Turn the function switch to position 2
9. Adjust the gain and amplitude balance until the signals are of the same height and of the correct amplitude
10. Use the left--right switch to move the signals toward the left side of the trace until they open out. If the signals tend to drift, stop trace movement with the drift control
11. Align the signals vertically with the fine delay knob. If they do not line up when the fine delay has reached the limit of its clockwise rotation, slowly turn the coarse delay knob counterclockwise until the signal on the lower trace jumps one step to the right. You can now line up the signals by turning the fine delay knob counterclockwise. As the signals are moved from the right side of the scope to the left side, the fine delay, amplitude balance, gain, and drift controls become increasingly sensitive. This happens because the left side of the scope is a gradual expansion of only a small part of the right side
12. Turn the function switch to position 3. Position 3 superimposes the master and slave signals for final matching. You may need to adjust the fine delay and amplitude balance slightly.

LORAN (AN/APN-70) G

The loran radio receiving set is used by the operator to receive and interpret loran signals. The set serves as a navigational aid and operates over the standard high-frequency band from 1700 to 2000 kc, and on the low-frequency bands of 170 to 190 kc and 90 to 110 kc. Controls for the set are on the front of the receiver. The loran control unit and loran indicator (15 and 18, figure 4-16) are at the navigator's station. Operating power is 115 volt ac and control power is 28 volt dc. Circuit breakers for the set are on the radio junction box circuit breaker panel (figure 1-35).

APN-70 Loran Controls G

G

W-DELAY AND Y-DELAY CRANKS. These cranks (7 and 17, figure 4-29) are on the loran control unit. Each crank, when turned, operates the delay revolution counter. The cranks have two speeds, the one in use being determined by position of the crank shaft. The shaft is movable in a plane perpendicular to the front panel of the receiver, and when pushed in will turn its counter at the rate of one thousand units per revolution of the crank. One revolution will cause a change of one hundred units in the reading when the crank shaft is pulled out.

G

R-RATE SWITCH. This switch (2, figure 4-29) on the loran control unit serves as a pulse repetition rate selector.

G

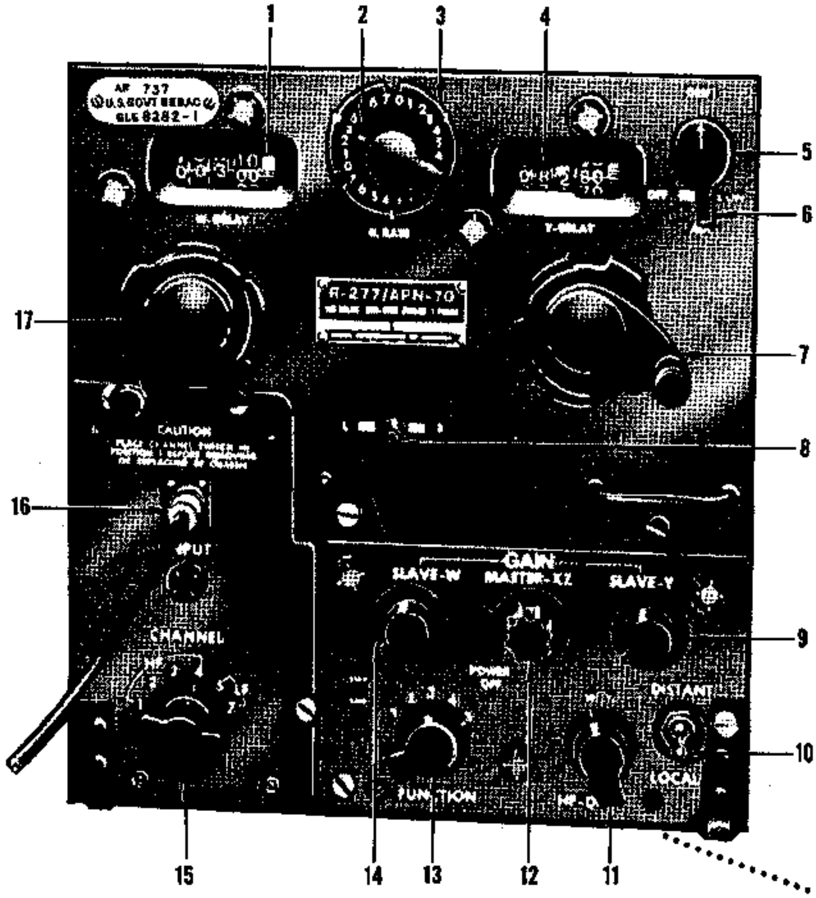
DRIFT CONTROLS. The loran set has a manual drift adjustment and an automatic drift adjustment. The drift control (5, figure 4-29) on the loran control unit, may be used as a manual drift adjustment for synchronizing the receiving equipment with the transmitter. For most operating conditions, an ADC (Automatic Drift Control) system is preferable to manual operation. The ADC switch (6, figure 4-29), with ON--OFF positions, is on the lower portion of the drift control, and operates independently.

G

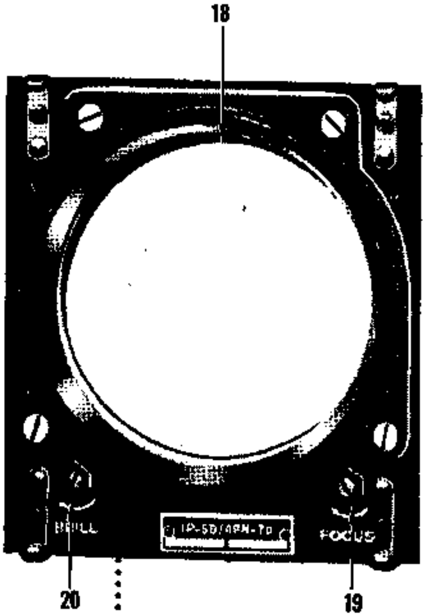
L--R SWITCH. This switch (8, figure 4-29) on the loran control unit, moves the received signals to the left or to the right in order that they may be properly positioned to obtain readings.

G

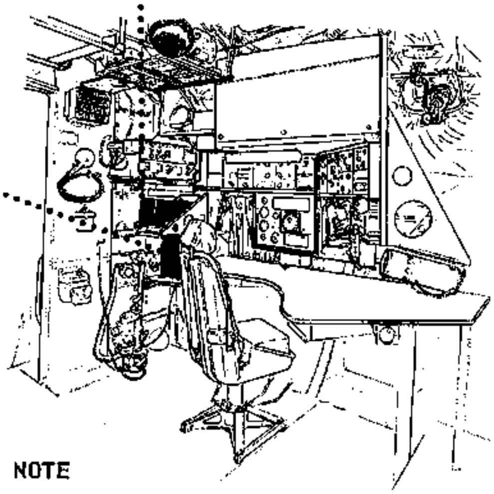
MASTER-XZ GAIN AND POWER SWITCH. This switch (12, figure 4-29) on the loran control unit serves a double purpose. The switch applies power to the set when switch action is felt as the gain control is turned in a clockwise direction from its extreme counterclockwise position. Power is disconnected when the control is returned the extreme counterclockwise position. The master-xz gain control sets the level of the master pulse, or pulses, as viewed on the indicator screen.



LORAN CONTROL UNIT



LORAN INDICATOR



1 W-DELAY REVOLUTION COUNTER
2 R-RATE SWITCH
3 R-RATE INDICATOR
4 Y-DELAY REVOLUTION COUNTER
5 DRIFT CONTROL
6 AUTOMATIC DRIFT CONTROL (ADC) SWITCH
7 Y-DELAY CRANK
8 L--R SWITCH
9 SLAVE-Y GAIN CONTROL
10 LOCAL--DISTANT SWITCH
11 HF-DELAY SWITCH
12 MASTER-XZ GAIN AND POWER SWITCH
13 FUNCTION SWITCH
14 SLAVE-W GAIN CONTROL
15 CHANNEL SWITCH
16 ANTENNA CONNECTION
17 W-DELAY CRANK
18 LORAN SCOPE
19 FOCUS ADJUSTMENT
20 BRILLIANCE ADJUSTMENT

NOTE

There are additional adjustments (not shown) on the side of the control unit and the indicator for tuning the Loran. These adjustments are positioned with a screw driver. The adjustments are:

Control Unit

PED. DUR. (Pedestal Duration)
SLOW SW. HOR. CENT. (Slow Sweep Horizontal Center)
MED. TO FAST SW. HOR. CENT. (Medium to Fast Sweep Horizontal Center)
SLOW SW. AMPL. (Slow Sweep Amplitude)
FAST SW. AMPL. (Fast Sweep Amplitude)
MED. SW. AMPL. (Medium Sweep Amplitude)

Indicator

ASTIGMATISM
VERT CENTER (Vertical Center)

APN-70 LORAN CONTROLS G

Figure 4-29

G

SLAVE-Y AND SLAVE-W GAIN CONTROLS. These controls (9 and 14, figure 4-29) are on the loran control unit. They operate in a manner determined by the channel switch and the HF-delay switch to set the level of the slave pulses.

G

FUNCTION SWITCH. This switch (13, figure 4-29) on the loran control unit determines the presentation on the loran scope. (See figure 4-30.)

G

LOCAL--DISTANT SWITCH. This switch (10, figure 4-29) with LOCAL--DISTANT positions is on the loran control unit. The purpose of the switch is to adjust the signal of the antenna coupler. When a signal is being received from a distance, the switch is used in the DISTANT position to permit maximum signal input to the antenna coupler. When the switch is placed in the LOCAL position, it reduces the input to prevent overloading.

G

HF-DELAY SWITCH. This switch (11, figure 4-29) on the loran control unit sets the level of the slave pulses. The switch also determines the variable delay circuits in use in the HF positions of the channel switch.

G

CHANNEL SWITCH. The channel switch (15, figure 4-29) is on the loran control unit. The switch along with the R-rate switch selects desired station.

G

FOCUS ADJUSTMENT. This knob (19, figure 4-29) on the loran indicator is used to focus signals on the loran scope.

G

BRILLIANCE ADJUSTMENT. The brill knob (20, figure 4-29) on the loran indicator is used to adjust brilliance of the signal displayed on the loran scope.

APN-70 Loran Indicators G

G

W-DELAY AND Y-DELAY REVOLUTION COUNTERS. These counters (1 and 4, figure 4-29) are on the loran control unit. The counters indicate a direct reading of delay time in microseconds.

G

R-RATE INDICATOR. This indicator (3, figure 4-29) on the loran control unit indicates channel selected by use of channel and R-rate switches.

G

LORAN SCOPE. The scope (18, figure 4-29) on the loran indicator displays the signals to be interpreted by crew members.

Normal Operation of the APN-70 Loran G

To start the loran set, proceed as follows:

1. Apply power to the set by turning the master-xz gain and power switch in a clockwise direction from the extreme counterclockwise position. When the power switch operates, the panel will be illuminated. Determine that the blower starts when the loran is turned on. The set requires cooling air to prevent overheating some equipment components.

NOTE

> Power to the loran equipment is turned off when the radar beacon power selector switch (8, figure 4-34) is on EMERG.

2. Allow the equipment to warm up for about one minute. As soon as the presentation on the loran scope becomes stable, the equipment is ready for use

For HF (High Frequency) reception, proceed as follows:

1. After the set has been turned on and allowed a short warmup period, set the three gain controls at the center of their rotation, the local--distant switch to DISTANT, and the drift control to its center position

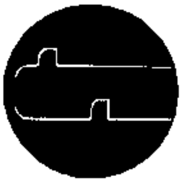
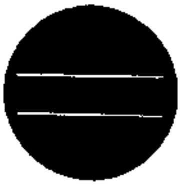
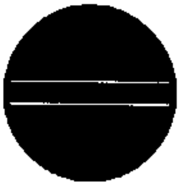
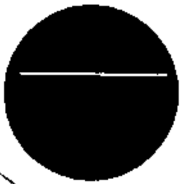
NOTE

> The local--distant switch is normally used in the DISTANT position, which affords greater sensitivity than the LOCAL position. The latter is used in the presence of high interfering signals, when flying in the vicinity of a loran transmitter, or when a better signal to noise or interference ratio is obtained in that position.

2. Turn the ADC switch to the OFF position
3. Refer to the loran charts for the approximate geographical location of the airplane and determine at which position the channel and R-rate switches are to be set
4. Set the channel and R-rate switches as determined from the chart
5. Set the function switch to position 1. Two traces should appear on the screen of the loran scope, with a pedestal on each trace. See figure 4-30.
6. Set the HF-delay switch to W, and adjust the master-XZ and slave-W gain controls for signals twice the amplitude of the pedestals

NOTE

> When signals are very weak, it may be advisable to preset the delay controls to the expected reading. If only one station's signal appears, place it on one of the pedestals, using the L--R switch, and locate the other station's signal by placing the function switch in position 2 and investigating either the upper or the lower trace, as the case may be. This practice may aid in the identification of ground or sky waves, since corresponding pulses should appear nearly in alignment if the estimate is close. If either the master or the slave station is double-pulsed, the appearance of the signals should make it possible to distinguish one from the other. Also, a weak signal is sometimes easier to detect if it is drifting across the trace. Therefore, if trouble is encountered in locating a weak signal, try holding the L--R switch to one side or the other while looking for the pulse.

STEP	SWITCH	SWITCH POSITION	SCOPE	REMARKS	ADJUSTMENTS
1	Master XZ – Gain & Power W–Delay Crank Y–Delay Crank Channel Function R–Rate HF–Delay	CW to ON 11,000 11,000 1 1 HO W		Adjust until 2 traces appear. Adjust for clear and distinct traces. M. trace has a pedestal about 5/16" tall. Center traces vertically and horizontally. Adjust traces until ends are 1/4" from edge of scope	BRILL FOCUS ASTIGMATISM VERT CENTER SLOW SW HOR CENTER SLOW SW AMPL
2	Function	2		Two traces appear about 1 1/4" apart Center them and adjust ends for 1/4" from edge of screen	MED TO FAST SW HOR CENTER MED SW AMPL
3	Function	3		Adjust for right edge of trace 1/4" from edge of scope.	FAST SW AMPL
4	Function	4		Traces separated by 1/4" vertically	No adjustment. Note in Form 781 if faulty
5	Function	5		Use W–delay crank to superimpose pips. Count 2 zeros on last two digits of W–counter. Crank above or below 11,000 to separate traces.	W–DELAY CRANK
6	Function R–Rate	2 H–7, H–6, etc. See table		Adjust W–delay at fine speed until lower trace disappears	W–DELAY CRANK
7	HF–Delay R–Rate	Y Same as step 6		Adjust Y–delay at fine speed until lower trace disappears	Y–DELAY CRANK

TRACE MUST DISAPPEAR AT FOLLOWING SETTINGS (±10 microseconds)

BASIC RATE	STATION RATE							
	7	6	5	4	3	2	1	0
H	13025	13075	13125	13175	13225	13275	13325	13375
L	18025	18075	18125	18175	18225	18275	18325	18375
S	23025	23075	23125	23175	23225	23275	23325	23375

APN-70 LORAN CALIBRATION CHART

G

Figure 4-30 (Sheet 1 of 2)

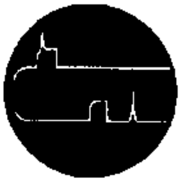
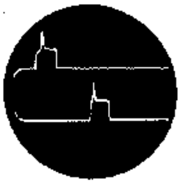
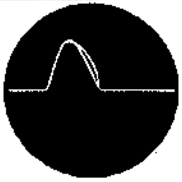
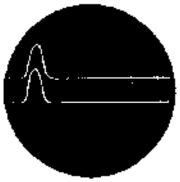
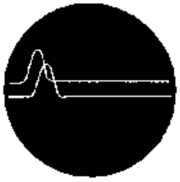
STEP	SWITCH	SWITCH POSITION	SCOPE	REMARKS	ADJUSTMENTS
8	Function R–Rate HF–Delay	5 H7 W		Markers must be superimposed and appear as one trace for W–delay values of: 00500 02000 05000 08500 11500	W–DELAY CRANK
9	HF–Delay	Y		Markers must be superimposed and appear as one trace for Y–delay values of: 00600 02100 05100 09000 11000	Y–DELAY CRANK
10	Local–Distant R–Rate Function HF–Delay	DISTANT As desired 1 W		Use Loran chart station information to determine usable readings to obtain pips. Adjust W–delay near expected reading. Adjust for signals twice the height of pedestals. Use L--R switch to position upper pip to the left of lower pip. If no signal appears on lower trace, hold L--R switch until signal also appears on lower trace, then place upper pip on leading edge of upper pedestal	W–DELAY CRANK MASTER XZ–GAIN & POWER SWITCH SLAVE–W GAIN CONTROL L--R SWITCH
11	ADC Drift Control	As required As required		Use drift controls to hold signals steady. Position pip on lower pedestal leading edge with W–delay crank	L--R SWITCH DRIFT CONTROL ADC SWITCH W–DELAY CRANK
12	Function	2		Align lower expanded signal with upper signal	W–DELAY CRANK
13	Function	3		Adjust both signals for same height. Superimpose leading edges of signals. Switch to function 4 if signals fluctuate too much	MASTER XZ–GAIN & POWER SWITCH SLAVE–W GAIN CONTROL W–DELAY CRANK
14	Function	4		Navigation along a Loran LOP, on-course indication. W–Delay reading gives Loran LOP	W–DELAY CRANK
15	Function	4		Navigation along a Loran LOP, off-course indication	
16	HF-Delay	Y		Check other stations in same manner using Y–Delay	Y-DELAY CRANK

Figure 4-30 (Sheet 2 of 2)

NOTE

If the delay setting is past either end of its range for a given position of the R-rate switch, no pedestal will appear on the lower trace in FUNCTION 1, and there will be no lower trace in positions 2, 3, and 4 of the function switch. If the pedestal is not visible, turn the W-delay crank until the entire pedestal appears on the lower trace.

7. Adjust the drift control to hold the pulses stationary on the scope, and use the L--R switch to position one of the pulses on the leading edge of the upper pedestal. Turn the ADC switch to the ON position

NOTE

The ADC (Automatic Drift Control) circuits hold the repetition rate of the loran receiving set synchronized to that of the transmitting group when a signal is properly positioned on the leading edge of either pedestal. This prevents the received pulses from drifting across the screen of the loran scope and obviates continual adjustment of the drift control. The ADC switch should be left in the ON position once the drift control has been set, except when excessive noise causes bothersome pulse jitter.

8. Rotate the drift control in both directions to check the ADC action, and return the control to its original position. If the ADC circuits are functioning normally, rotation of the drift control will not cause the signal to drift from the edge of the pedestal
9. If the ADC action is satisfactory, proceed with Step 10; if not, place the local--distant switch to the LOCAL position and observe the signals and ADC action there. Leave the switch in the position which gives the better operating characteristics
10. Use the W-delay crank in the high-speed position (shaft pushed in) to position the leading edge of the slave pedestal (on the lower trace) under the slave pulse

NOTE

To determine the Indicated Time Difference, the master received pulse must be situated on the leading (left) edge of the master (top) pedestal. When it is in that position, there will be one pulse on each trace; the master pulse on the top trace and the slave pulse on the bottom trace. If the slave pulse should be situated on the master pedestal there will be two pulses on the upper trace and none on the lower. If this should occur, use the L--R switch to situate the master pulse at the leading edge of the master (top) pedestal.

11. Turn to FUNCTION 2
12. Use the W-delay crank in the slow-speed position (shaft pulled out), to vertically align the expanded pulses
13. Turn to FUNCTION 3
14. Adjust the master-XZ and slave-W gain controls so that the two pulses are of the same height as nearly as possible
15. Superimpose the two pulses by use of the W-delay crank. Align the pulses, the leading edges especially, as closely as possible

NOTE

Matching by superimposition is often difficult when either signal is weak compared to the noise level. The operator must mentally average the fluctuating signals and align the averages. This is often most easily and accurately done in FUNCTION 4.

16. The Indicated Time Difference may now be read on the W-delay counter
17. Using the Indicated Time Difference established on the W-delay counter, locate the position of the airplane on one loran line-of-position
18. Select another pair of loran transmitting stations which have a service area including the approximate location of the airplane
19. Set the channel and R-rate switches to the values obtained from the chart
20. Turn the ADC switch to the OFF position
21. Set the HF-delay switch to the Y position
22. Repeat Steps 7 through 20 to obtain the second Indicated Time Difference. Use the Y-delay crank and slave-Y gain control whenever the W-delay crank and slave-W gain control are mentioned
23. The intersection of the two loran lines-of-position determines the location of the airplane. Allowance should be made for the distance the airplane has traveled between the two readings

For LF (Low Frequency) reception, proceed as follows:
1. Place channel switch in position 5 or 7

NOTE

Due to the recovery time of the pedestal generator circuits, the width of a slave pedestal on FUNCTION 1 at channel positions 5 and 7 (the channels with which dual presentation is used) becomes progressively narrower as the corresponding delay crank is rotated in the counterclockwise direction from the point where the counter reading is approximately 02600. At a counter reading of about 02000 the pedestal width is approximately three-fourths the normal value and, as rotation of the delay crank is continued, becomes narrower still until, at a reading of about 01800, the pedestal disappears. The length of the corresponding slave trace in function positions 3 and 5 is dependent upon the width of the pedestal, and those traces will become increasingly shorter in the same ratio as the pedestal becomes progressively narrower. The other function positions (3 and 5) are not affected. Since loran readings below 02000 are not used with triad reception, the accuracy of the counter reading is not affected. Also, since the pulse match is always made near the left edge of the screen, the decrease in slave-trace length on function positions 2 and 4 has no effect on operation.

2. After the loran has been turned on and allowed to warm up for approximately one minute, set the gain controls to the center of their rotation, the local--distant switch to DISTANT, and the drift control to its center position

3. Turn the ADC switch to the OFF position

NOTE

The local--distant switch is normally used in the DISTANT position, which affords greater sensitivity than the LOCAL position. The latter is used in the presence of high interfering signals, when flying in the vicinity of a loran transmitter, or when a better signal to noise or interference ratio is obtained in that position.

4. Refer to the loran charts and determine the settings of the channel and R-rate switches from the approximate geographical location of the airplane

5. Set the channel and R-rate switches to the positions determined from the charts

6. Set the function switch to position 1. Two traces and four pedestals (two on each trace) should be present on the loran scope

NOTE

If a delay setting is past either end of the range for a given setting of the R-rate switch, no slave delay pedestal for that delay control will be seen in FUNCTION 1, and the trace corresponding to that pedestal will not appear in positions 2, 3, or 4 of the function switch. If only one pedestal should appear on the upper trace, turn the Y-delay crank until the entire second pedestal is visible. If only one pedestal should appear on the lower trace, use the W-delay crank to bring the second pedestal within range. (The HF-delay switch is inoperative in the LF settings of the channel switch and may be left in either position.)

7. Use the gain controls to adjust the amplitude of the received pulse to approximately twice that of the pedestals, and adjust the drift control to hold the signals stationary on the indicator screen

NOTE

- The master-XZ gain control determines the amplitude of the signals occurring in the interval between the beginning of either trace and the end of the first pedestal. The slave-W gain control sets the signal level on the remainder of the upper trace, while the slave-Y gain control sets the signal level on the remainder of the lower trace.
- When signals are very weak, it may be advisable to preset the delay controls to the expected reading. If only one station's signal appears, place it on one of the pedestals, using the L--R switch, and locate the other station's signal by placing the function switch in position 2 and investigating either the upper or the lower trace, as the case may be. This practice may aid in the identification of ground or sky waves, since corresponding pulses should appear nearly in alignment if the estimate is close. If either the master or the slave station is double-pulsed, the appearance of the signals should make it possible to distinguish one from the other. Also, a weak signal is sometimes easier to detect if it is drifting across the trace. Therefore, if trouble is encountered in locating a weak signal, try holding the L--R switch to one side or the other while looking for the pulse.

8. Position a pulse on the leading edge of any of the pedestals by use of the L--R switch, and turn the ADC switch to the ON position

NOTE

The ADC (Automatic Drift Control) circuits hold the repetition rate of the loran set synchronized to that of the transmitting group when a signal is properly situated on the leading edge of a pedestal. This prevents the received pulses from drifting across the screen of the loran scope and obviates continual adjustment of the drift control. The ADC switch should be left in the ON position once the drift control has been set, except when excessive noise causes bothersome pulse jitter.

9. Rotate the drift control in both directions to check the ADC action, and return the control to its original position. If the ADC circuits are functioning normally, rotation of the switch will not cause the signal to drift from the pedestal

10. If the ADC action is satisfactory, proceed with Step 11; if not, operate the local--distant switch to the DISTANT position and observe the signals and ADC action there. Leave the switch in the position which gives the better operating characteristics

11. Use the L--R switch to position the master station pulse X, followed by the ghost pulse X, on the leading (left) edge of the master (first) pedestal on the upper trace. This will automatically position the Z master pulse on the leading edge of the master (first) pedestal on the lower trace. If the X pulse and its ghost should appear on the lower trace, hold the L--R switch to either side until the pulse-ghost combination drifts off the lower trace and reappears on the upper. Then, properly position them

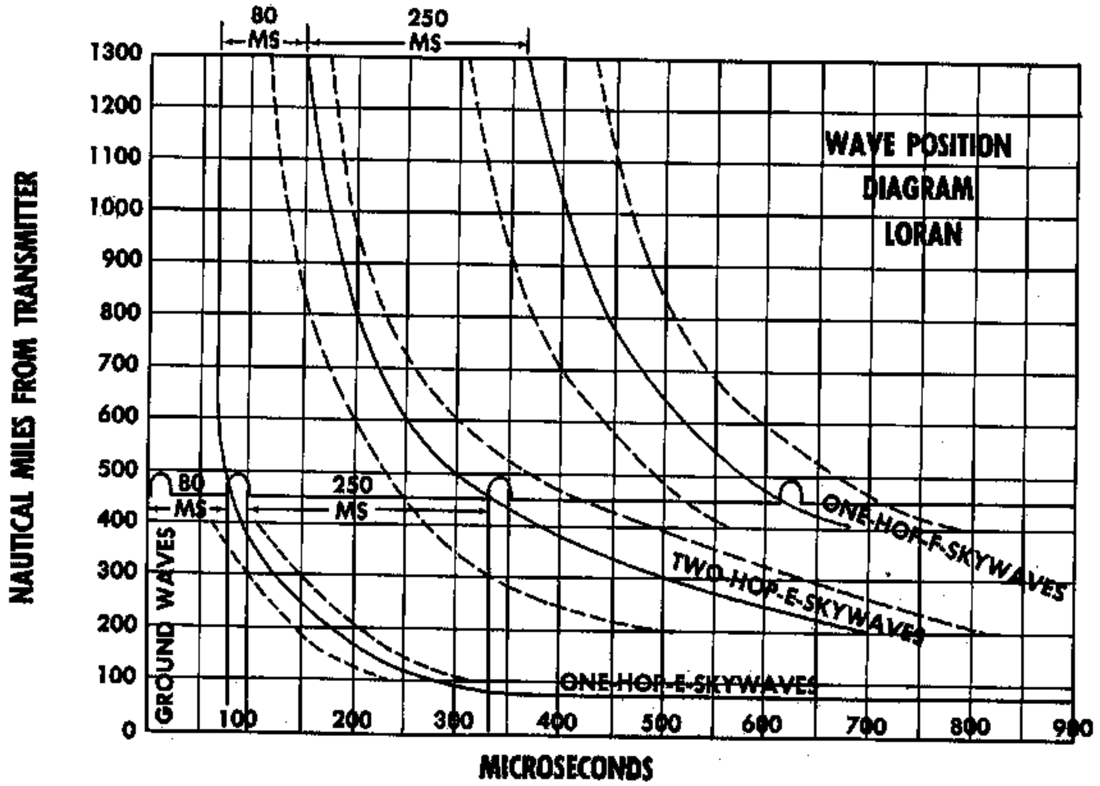
NOTE

If the received pulses should drift at any time during the remainder of the procedure, use the drift control to stop the signal motion and the L--R switch to reposition the pulses.

12. Use the W-delay crank in its high-speed position to move the leading edge of the slave (second) pedestal on the lower trace beneath the slave pulse

NOTE

To obtain special correction used to correct a ground wave and one-hop-E sky wave match, enter the diagram with the distance from the transmitter that the sky wave is coming from. The correction will be found by going across the diagram horizontally to the right from the ground wave line to the one-hop-E sky wave. If the one-hop-E sky wave is coming from the slave station the correction is subtracted from the reading. If it is coming from the master station the correction is added to the reading.



LORAN WAVE POSITION DIAGRAM

Figure 4-31

NOTE

When the shaft of a delay crank is pushed in, the crank is in its high-speed position. When pulled out as far as it will go, it is in the slow-speed position.

13. Use the Y-delay crank in its high-speed position to situate the leading edge of the slave pedestal on the upper trace beneath the slave pulse
14. Turn the function switch to position 2
15. Use the W-delay crank in the slow-speed position to vertically align the expanded pulses on the two upper traces
16. Use the Y-delay crank in the slow-speed position to vertically align the expanded pulses on the two lower traces
17. Turn the function switch to position 3
18. Use the W-delay crank to superimpose the two pulses on the upper trace. Use the slave-W gain control to make the amplitude of the two pulses exactly the same. Align the pulses, especially the leading edges, as closely as possible
19. Use the Y-delay crank to superimpose the two pulses on the lower trace. Use the slave-Y gain control to make the amplitude of the two pulses exactly equal. Align the pulses, especially the leading edges, as closely as possible.

NOTE

Matching by superimposition is very difficult when either signal is weak compared to the noise level. The operator must mentally average the fluctuating signals and match the averages. This is often most easily and accurately done with the function switch turned to position 4.

20. Use the Indicated Time Difference readings to find the two loran lines-of-position on the chart. The intersection of the two lines-of-position determines the location of the airplane at the time the readings were taken

To turn off the loran set, proceed as follows:
1. Turn the master-xz gain and power switch in a counterclockwise direction until the switch operates and the panel lights go out

Emergency Operation of the APN-70 Loran G

IF ONE DELAY CHANNEL DEFECTIVE. In normal operation, the two readings required to determine the location of the airplane are made by separate delay channels. If one of the delay channels should become defective, both readings may be obtained from the channel which is functioning properly.

For reception of HF signals:
1. Place the HF-delay switch to the position which still functions properly and take the first reading using the normal procedure
2. Set the channel switch and R-rate switch to receive the second transmitting system
3. Use the same HF-delay setting and the same delay crank to obtain the second reading. Since the two readings are not made simultaneously, allowance must be made for the time elapsed between the two

For reception of LF signals:
1. Take the first reading using the L--R switch to position the master pulse on leading (left) edge of the upper trace master pedestal if the W-delay channel is the one functioning normally, or on the leading edge of the lower trace master pedestal if the Y-delay channel is the good one. (If sky wave, or combined ground and sky wave reception is used, trains of pulses will be present and the normal precautions must be observed)
2. Return the function switch to position 1.
3. Hold the L--R switch to the right. The received signals will move to the right of the screen and will disappear at the right edge of the trace. The signals will reappear at the left edge of the other trace and drift toward the master pedestal. The first pulse to reappear in this manner will be the other slave pulse, and the second pulse is the other master pulse. Position the second master pulse at the leading edge of the master pedestal used to obtain the first reading
4. Using the good delay channel, take the second reading
5. Determine the location of the airplane, making allowance for the time elapsed between the two readings

IF THE ANTENNA COUPLER UNIT IS DEFECTIVE: The antenna for the loran receiver is also used by the MF command transmitter on airplanes **G** **17260** ▶ **3177** less those incorporating TCTO KG211 or the liaison radio and the liaison receiver on airplanes **G** **3178** ▶ less those incorporating TCTO KG513. It may be possible to operate on one or more of the HF channels by utilizing the antenna coupler outputs provided for these other radios. Channel 1 is the closest to the band of frequencies which the antenna coupler is designed to pass. Channels 3, 2, and 4 are progressively farther from this band.
1. If the antenna coupler is accessible, remove the plug from the LORAN jack and connect it to the COMM or AUX jack. When using either the COMM or AUX jack, the radio equipment normally connected to the jack must be turned on to energize some circuits in the coupler. If the antenna coupler is not accessible, it may be possible to disconnect the antenna from the MF command or a liaison radio (as applicable) and reconnect it to the jack, marked INPUT, on the loran control unit

NOTE

> The local--distant switch will be inoperative when using an antenna connection that is different from the normal connection.

2. If the reception of the other radio equipment, having the same antenna as the loran, is affected by a defective antenna coupler, it will be necessary to bypass the coupler. If the antenna lead-in is accessible, connect the antenna directly to the jack, marked INPUT, on the loran control unit. Also, it may be possible to use any other antenna in the same way.

IF THE SCOPE PRESENTATION IS UNUSABLE: Determine whether or not the condition is external to the set by:
1. Disconnecting the antenna connector from the jack, marked INPUT, on the loran control unit. If the interference persists, the loran receiver is defective; if not, the disturbance is coming in on the input. (If the antenna coupler is accessible, try the same test with its antenna connection)
2. Try other positions of the channel switch. (This should be done even if the defect is found to be in the loran receiver. One channel may be defective and the others all right)
3. Reception may be possible in spite of interference by proper use of the gain and drift controls. (Manual drift control will probably be preferable to automatic control under such conditions)

Emergency Adjustments of the APN-70 Loran **G**

IF SWEEP LENGTH IS DEFECTIVE IN FUNCTION 1: Adjust the traces to a length of approximately four inches with the SLOW SW. AMPL. control

IF SWEEP LENGTH IS DEFECTIVE IN FUNCTIONS 2, 3, 4, or 5:

1. Turn the function switch to the 2 or 4 position and adjust the MED. SW. AMPL. control for a trace length of approximately four inches
2. Turn the function switch to the 3 or 5 position and adjust the FAST SW. AMPL. control to obtain a trace of approximately four inches

IF THE HORIZONTAL CENTERING IS DEFECTIVE IN FUNCTION 1:
Use the SLOW SW. HOR. CENT. control to position the traces

IF THE HORIZONTAL CENTERING IS DEFECTIVE IN FUNCTIONS 2, 3, 4, or 5:
Use the MED. TO FAST SW. HOR. CENT. control to position the traces. The one adjustment covers the four positions

IF THE PEDESTAL DURATION (WIDTH OF THE PEDESTAL) REQUIRES EMERGENCY ADJUSTMENT:

1. Turn the function switch to position 5
2. Superimpose the fixed and movable marker pips by use of the proper delay crank. (The adjustment may be made with either single or dual presentation. If dual presentation is used, it is only necessary to superimpose one set of marker pips)
3. Set the PED. DUR. adjustment at the point where exactly four superimposed marker pips are visible on the indicator scope. (The positive pips are the ones extending above the trace)

IF THE VERTICAL CENTERING IS DEFECTIVE: Use the VERT. CENTER control to position the traces. Make the adjustment with the function switch on position 1. The single adjustment covers all positions of the function switch

IF THE TRACE DEFINITION IS POOR AND THE FOCUS ADJUSTMENT DOES NOT CORRECT THIS CONDITION:

1. Turn the channel switch to position 7. (Use channel switch position 1 for loran control units having R-277A or R-277B on the nameplate at the center of the panel)
2. Turn the function switch to position 1
3. Turn the slave-W and the slave-Y gain controls full CCW
4. Turn the master-XZ gain and power switch to its minimum gain position (CCW), but do not turn off the set
5. Use the FOCUS and ASTIGMATISM adjustments to obtain the best overall definition of the traces
6. Rotate the function switch through the rest of its positions, noting the trace definition in each position
7. Repeat step 5

IFF (AN/APX-25) (Airplanes incorporating ✈ TCTO 590 ■)

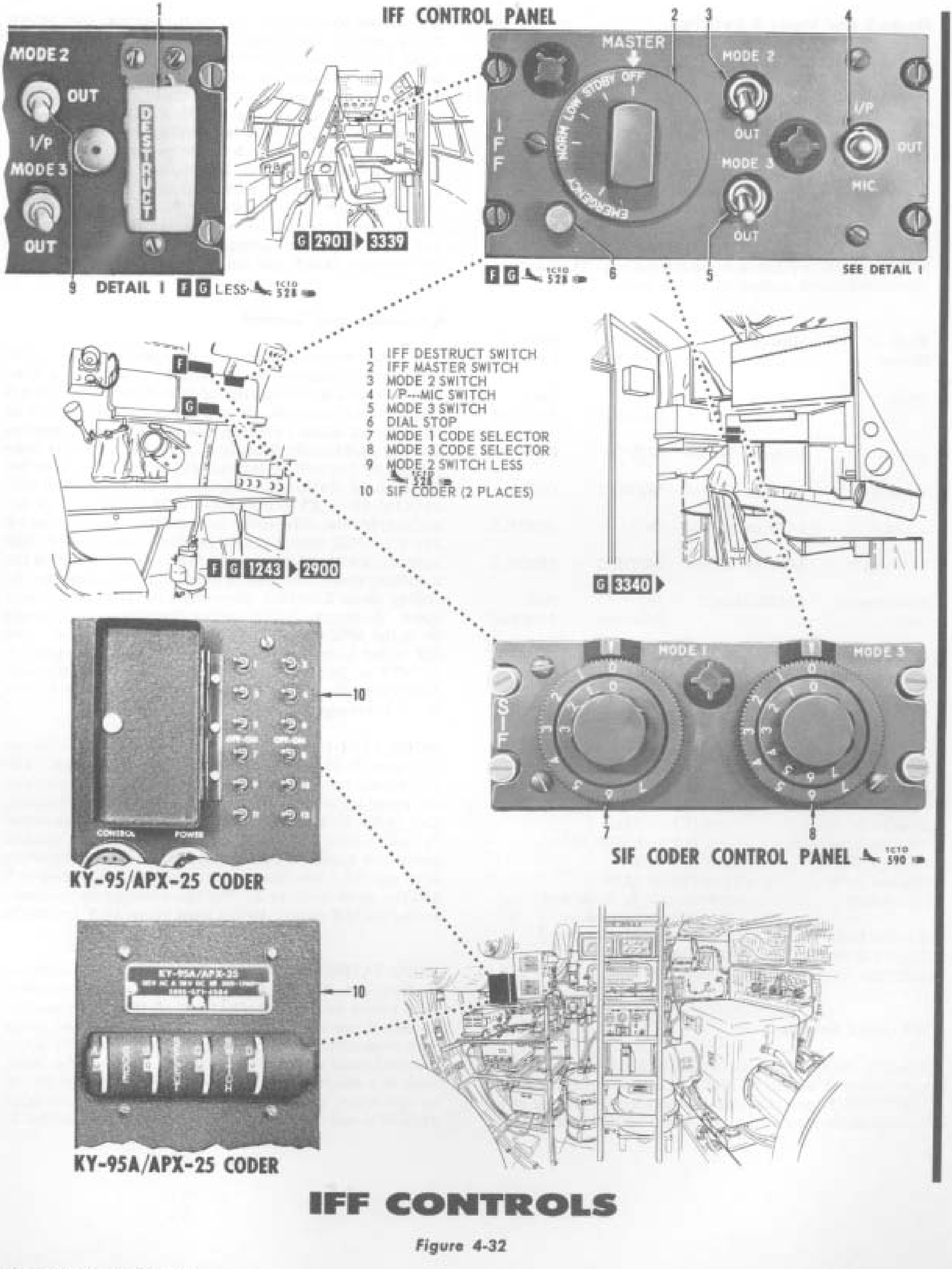
Airplanes can be detected at great ranges by means of radar echoes, but radar echoes do not identify the targets (as friend or foe). The IFF transponder (receiver-transmitter) is a signalling device for radar echo identification. The receiver turns on the transmitter momentarily each time it picks up coded challenges from suitably equipped surface or airborne radar. The reply from the transmitter accompanies the display of the associated echo on the indicators of the challenging radar, thereby identifying the echo.

The three functions of the IFF are: (1) to automatically identify the airplane whenever it is challenged by friendly radar, (2) to identify a specific friendly airplane within a group and (3) to serve as a means of indicating a distress condition.

Transponder operation may be in an emergency code or a combination of three normal codes - called "modes." The normal codes may be changed by use of the SIF coder control panel. Transponder operation is controlled by the IFF control panel. The IFF control panel (figure 4-32) has three switches for selection of modes: IFF Master (MODE 1), MODE 2 and MODE 3, and one switch for an "identification of position" feature: I/P-MIC switch. Checkout of the IFF on the ground requires special equipment; therefore, the set is normally tested in flight. The transponder requires 28 volt dc control power and 115 volt ac operating power. Circuit protection is through circuit breakers or fuses on the radio junction box circuit breaker panel. (Sheet 2, figure 1-35.)

IFF Master Switch

A master switch (2, figure 4-32) on the IFF control panel has EMERGENCY--NORM--LOW--STDBY--OFF positions. Any of the five positions may be selected by rotating the master switch clockwise. When the switch is in the OFF position, no electrical power is supplied to the set. In the STDBY position, the set is turned on, and the tubes will heat in approximately 45 seconds, making the set ready for operation; however, the receiver is not sensitized and no replies can be transmitted. In the LOW position, the set operates at reduced sensitivity and replies will be transmitted only upon receipt of strong interrogation signals, ordinarily from nearby interrogator--responders. In the NORM position, the transponder receiver is given full sensitivity and the transponder operates with maximum performance. In the EMERGENCY position, the set is fully sensitized, and the distinctive emergency reply is transmitted upon receipt of any mode of interrogation, regardless of the settings of the mode switches (3 and 5, figure 4-32) on the IFF control panel. To move the switch to EMERGENCY, depress the dial stop (6, figure 4-32) and rotate the switch.



IFF CONTROL PANEL

F G TCTO 528

DETAIL I F G LESS TCTO 528

1 IFF DESTRUCT SWITCH
2 IFF MASTER SWITCH
3 MODE 2 SWITCH
4 I/P—MIC SWITCH
5 MODE 3 SWITCH
6 DIAL STOP
7 MODE 1 CODE SELECTOR
8 MODE 3 CODE SELECTOR
9 MODE 2 SWITCH LESS TCTO 528
10 SIF CODER (2 PLACES)

SIF CODER CONTROL PANEL TCTO 590

KY-95/APX-25 CODER

KY-95A/APX-25 CODER

IFF CONTROLS

Figure 4-32

Mode 2 and Mode 3 Switches

The mode switches (3 and 5, figure 4-32) marked MODE 2--OUT and MODE 3--OUT, are on the IFF control panel. Placing a switch in a mode position causes the transponder to reply in the selected mode when challenged by friendly radar. The OUT function prevents the transponder from replying in the respective mode. For example, with the MODE 3 switch in the MODE 3 position, the transponder replies to MODE 3 interrogations; and when the MODE 3 switch is in the OUT position, the transponder does not reply to MODE 3 challenges. The IFF must be on LOW or NORM for the switches to be operative. The various combinations of modes available are:

Mode or Modes	Master Switch	Mode 2 Switch	Mode 3 Switch
None	OFF or STDBY	Not Affected	Not Affected
1 only	LOW or NORM	OUT	OUT
1 and 2	LOW or NORM	MODE 2	OUT
1 and 3	LOW or NORM	OUT	MODE 3
1, 2 and 3	LOW or NORM	MODE 2	MODE 2
Emergency only	EMERGENCY	Not Affected	Not Affected

The following code words will be used when referring to IFF operations:

Code	Meaning
Parrot	IFF Mark X
Squawk	Turn IFF on NORM (Mode 1)
Squawk 2	Turn IFF to Mode 2
Squawk 3	Turn IFF to Mode 3
Squawk Emergency	Turn IFF to EMERGENCY
Squawk Flash	Turn IFF to I/P
Squawk Low	Turn IFF to LOW
Squawking	Showing IFF in Mode and Position Indicated
Parrot Lazy	Turn IFF to STDBY
Parrot Bent	IFF inoperative
Strangle Parrot	Turn off IFF

I/P--MIC Switch

The I/P--MIC switch (4, figure 4-32) is a three position switch, I/P--OUT--MIC. When the switch is in the "OUT" (OFF) position, the equipment operates as controlled by the mode switches. In the "I/P" (identification of position) position, the equipment responds, (for MARK X IFF only), to each mode 2 interrogation with a normal mode 2 reply, while the switch is held in "I/P" position, and for 30 seconds after release. The I/P response with SIF is a double mode 1 pulse train reply to mode 1 interrogations when Coder KY-95/APX-25 is installed. If Coder KY-95A/APX-25 is installed, mode 1 and mode 3 responses will be made to these respective interrogations. In "MIC" position, I/P replies are transmitted while the UHF radio is keyed (microphone switch closed) and for 30 seconds after the microphone switch is released, provided the command radio is operating, and the interphone control panel associated with the microphone switch has the UHF radio selected.

SIF Coder and Control

The coder equipment gives the transponder a "selective identification feature" known as SIF. The SIF is a system of signals consisting of coded mode 1, 2 and 3 transponder replies. It is possible to select one of 32 different mode 1 replies, one of 400 mode 2 replies and one of 64 mode 3 replies. The SIF coder is controlled by the SIF coder control panel located at the navigator's station; see figure 4-32. Either the KY-95/APX-25 or KY-95A/APX-25 SIF coder may be installed; for the differences in operating characteristics see I/P--MIC switch in this Section. The mode 2 code selector switches are on the SIF coder located on the auxiliary radio rack; see figure 4-32. The switches for coding mode 2 are not normally adjusted by the flight crew. A switch, S-103, on the transponder unit must be in the MOD position to permit SIF operation. The SIF coder is operative when the IFF master switch is on LOW or NORM and a mode (or modes) is selected. Electrical power for the SIF coder is obtained from the IFF transponder.

MODE 1 CODE SELECTOR. The Mode 1 code selector (7, figure 4-32) consists of two concentric knobs. The outer knob has eight positions (0 thru 7 inclusive) and the inner knob has four positions (0 thru 3 inclusive). One of the 32 Mode 1 codes available can be selected by positioning the knobs with respect to the pointer above the knob. For a numerical code designation such as "52," the outer knob would be positioned to 5 and the inner knob at 2. For the selector to be operative, the IFF master switch must be on LOW or NORM.

MODE 3 CODE SELECTOR. The mode 3 code selector (8, figure 4-32) consists of two concentric knobs. Both knobs have eight positions (0 thru 7 inclusive). To select one of the 64 mode 3 codes, position the knobs with respect to the pointer above the knob. For a numerical code designation such as "45" set the outer knob to 4 and the inner knob to 5. For the selector to be operative, the IFF master switch must be on LOW or NORM and the Mode 3 switch must be on MODE 3.

IFF (AN/APX-6) (Airplanes not incorporating ✈ TCTO 590 ▶)

On airplanes incorporating ✈ TCTO 528 ▶, this set operates in the same manner as the IFF (AN/APX-25) without the SIF provisions.

On airplanes not incorporating ✈ TCTO 528 ▶, this set operates in the same manner as the IFF (AN/APX-25) without SIF provisions and with the following differences:

a. The mode 2 switch has MODE 2--OUT--I/P positions (9, figure 4-32). For operation, refer to MODE 2 and MODE 3 SWITCHES and I/P--MIC switch in this Section.

b. The IFF control panel has a destruct switch (1, figure 4-32). This switch is a two position ON--OFF switch protected against accidental operation by a guard, which is normally wired down.

NOTE

> The IFF destruct switch, if installed, is operative even though the IFF master switch is in the OFF position.

SEARCH RADAR (AN/APS-42)

The AN/APS-42 is an airborne navigation and search radar. The set has four main uses: to detect obstacles which could cause a collision, for spotting weather disturbances, for navigation, and for mapping terrain. The set provides a visual indication of the position of cities, landmarks, shorelines, islands, ships, other airplanes, and cloud formations. The position of such targets is indicated visually in range and azimuth in relation to the heading of the airplane. Coded radar beacon indications can also be received and are presented in the conventional spaced code groups. A control panel (figure 4-33) on the radio and radar control consoles, is used to operate the set. Indications from the set are fed to a scope (figure 4-33) at the navigator's station and to a second scope at the pilots' station. Control power is 28 volt DC, operating power is 115 volt AC with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

NOTE

> When two or more airplanes with search radar sets in operation are flying in close proximity (formation, A/R rendezvous, etc.), the signals from one search radar set can cause interference with the search radar set in the other airplane(s). The interference makes the scope presentation unreliable.

Search Radar Controls

ANTENNA HEATER SWITCH. This switch (9, figure 4-33), with HTR and OUT positions, is on the search radar control panel. The switch energizes a resistance heater on airplanes **F** **G** **1243** ▶ **2859** , when the switch is in the HTR position. When ambient temperature is of the order of -10°C (+14°F) or less, the antenna heaters should be energized. On airplanes **G** **2860** ▶, no heaters are installed in the antennas, and radar functions are de-energized in these airplanes, when the switch is positioned to HTR.

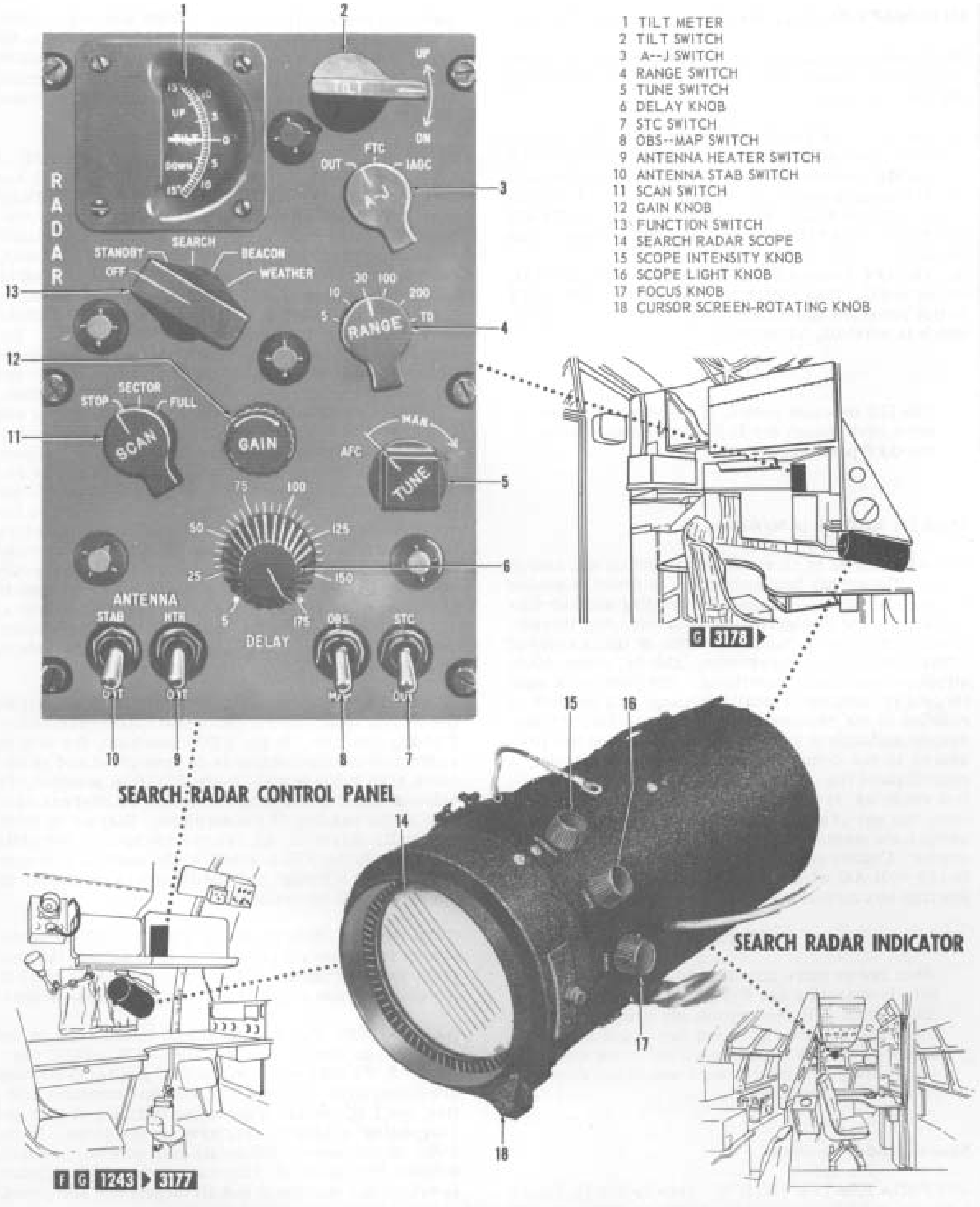
FUNCTION SWITCH. This switch (13, figure 4-33) is on the search radar control panel. The switch has OFF--STANDBY--SEARCH--BEACON--WEATHER positions. In the STANDBY position, there is no transmission or reception of the radar set. In the SEARCH position, objects such as airplanes, surface vessels, rivers, land, landmarks, and the like, are indicated up to a distance of approximately 200 nautical miles. In the BEACON position, signals from beacon stations only are displayed on the search radar indicators. The beacon presentations in range and azimuth provide navigational information to determine the course and location of the airplane. In the WEATHER position, the search radar indicators show cloud formations and storm fronts indicative of the surrounding weather conditions. Signal strength from cloud formations, indicated in relative brightness on the scope, is dependent upon the moisture content or density of the cloud formation. Indications as interpreted by the observer from light or thin formations are therefore less apparent than those from more dense or heavy formations. In the TD (target discrimination) position, any 30-mile sector of range may be expanded to full size on the scopes of the search radar indicators. This feature permits the observer to obtain greater detail of terrain or objects. OFF position aids in securing the set.

SCAN SWITCH. A scan switch (11, figure 4-33) on the search radar control panel has STOP--SECTOR--FULL positions. In the STOP position, the search radar antenna mechanism is de-energized and no antenna scan takes place. In the SECTOR position, the antenna scans a 120 degree sector, 60 degrees each side of the heading of the airplane. Display is automatically offset on all ranges except the 200-mile position. In the FULL position, the antenna will scan 360 degrees although only 240 degrees of display on the scope will be available.

GAIN KNOB. This knob (12, figure 4-33) is on the search radar control panel. The knob adjusts the gain of the receiver portion of the set to control the level of the video signals supplied to the search radar scopes.

A--J SWITCH. The A--J switch (3, figure 4-33) on the search radar control panel has OUT--FTC--IAGC positions. In the OUT position, the FTC and IAGC circuits are inoperative. In the FTC (fast time constant) position, the FTC circuit is operative reducing clutter and sharpening up targets displayed on the scope. In the IAGC (instantaneous automatic gain control) position, both the FTC and IAGC circuits are operative. Clutter is practically eliminated and all targets are sharpened.

ANTENNA STAB SWITCH. This switch (10, figure 4-33) on the search radar control panel has STAB--



1 TILT METER
2 TILT SWITCH
3 A--J SWITCH
4 RANGE SWITCH
5 TUNE SWITCH
6 DELAY KNOB
7 STC SWITCH
8 OBS--MAP SWITCH
9 ANTENNA HEATER SWITCH
10 ANTENNA STAB SWITCH
11 SCAN SWITCH
12 GAIN KNOB
13 FUNCTION SWITCH
14 SEARCH RADAR SCOPE
15 SCOPE INTENSITY KNOB
16 SCOPE LIGHT KNOB
17 FOCUS KNOB
18 CURSOR SCREEN-ROTATING KNOB

SEARCH RADAR CONTROL PANEL

SEARCH RADAR INDICATOR

SEARCH RADAR CONTROLS AND INDICATORS

Figure 4-33

OUT positions. In the STAB position, the antenna stabilization mechanism performs compensating motion in both the pitch and roll axes. In the OUT position, the antenna stabilizing mechanism does not function, and the search radar antenna remains in its fixed upright position relative to the airplane.

OBS--MAP SWITCH. This switch (8, figure 4-33) on the search radar control panel has OBS--MAP positions. In the OBS (obstacle) position, the search radar antenna radiates a normal pencil beam. In the MAP (mapping) position, the antenna radiates an equal-energy-return beam (cosecant-squared beam). The BEACON position of the function switch provides automatic change to MAP.

TILT SWITCH. This switch (2, figure 4-33) with UP--DOWN positions is on the search radar control panel. The UP and DOWN positions are momentary, whereas the switch is spring-loaded to the center position. In the center or rest position, the tilt mechanism of the search radar is inoperative. In the UP position, the antenna is tilted upward continuously, elevating the beam. In the DOWN position the antenna is tilted downward continuously, depressing the beam.

NOTE

> The limits of elevation and depression are reached by holding the tilt switch in the UP and DOWN positions respectively. Releasing the tilt switch causes the antenna to remain in the elevated or depressed position arrived at when the tilt switch was released. The degree of elevation or depression is indicated by the tilt meter. The limits of elevation or depression are set by physical stops and a friction clutch that functions automatically and independently of the tilt switch.

RANGE SWITCH. This switch (4, figure 4-33) on the search radar control panel has five range positions and a TD position. The switch may select any of the first five range positions which vary from 5 to 200 nautical miles. By selecting TD (target discrimination), a 30-mile range sector is presented on the search radar scopes. This 30-mile range sector is manually and continuously variable to start at any desired point between 5 and 175 miles in range.

DELAY KNOB. The delay knob (6, figure 4-33) is on the search radar control panel. This control, which is calibrated in nautical miles, provides manual adjustment in range of a marker spot which appears in presentation with first five settings of range switch. The control also provides manual adjustment of start of 30-mile range sector when the range switch is in the TD position.

TUNE SWITCH. This switch (5, figure 4-33) on the search radar control panel has AFC--MAN positions. With the control in the AFC position (full counterclockwise), AFC circuits are operative. In the MAN position, the manual tuning equipment is put into operation to control the tuning of the local oscillators.

STC SWITCH. This switch (7, figure 4-33) on the search radar control panel is a two-position OUT--STC control. In the OUT position, STC (sensitivity time control) circuits are inoperative with receiver gain functioning normally. In the STC position, STC circuits are operative to reduce the intensity of nearby targets and clutter. Effect is noted in the first three to four miles of range with a 10-mile maximum adjustment.

SCOPE INTENSITY KNOB. The scope intensity knob (15, figure 4-33) on the search radar indicator is used to adjust the intensity of the display on the search radar scope.

SCOPE LIGHT KNOB. This knob (16, figure 4-33) on the search radar indicator varies the brightness of the illuminating lights for observing cursor marks and the azimuth scale. The knob also varies the brightness of the range marker and TD lights on the upper rim of the search radar scope.

FOCUS KNOB. This knob (17, figure 4-33) on the search radar indicator is used for focusing or sharpening the display on the search radar scope.

CURSOR SCREEN-ROTATING KNOB. This knob (18, figure 4-33) on the search radar indicator is used to rotate the cursor lines to the desired azimuth positions.

Search Radar Indicators

SEARCH RADAR SCOPE. The search radar scope (14, figure 4-33) on the search radar indicator displays the signals to be interpreted by the operator.

Normal Operation of Search Radar

The search radar set is put into normal operation when the airplane is airborne as follows:

1. Place the antenna heater switch to OUT
2. Turn the function switch from OFF to STANDBY. Wait until the normal operating delay of approximately three minutes is over. When the needle on the tilt meter can be moved from the zero degree calibration by operating the tilt switch, this time delay is complete

CAUTION

- When starting the search radar set at low ambient temperature, either in flight or on the ground, the procedure should be varied to prevent possible damage to the equipment. Before turning the function switch from OFF to STANDBY, first place the range switch to 100 and the scan switch to FULL. Then place the function switch to STANDBY and wait five minutes (ten minutes at ambient temperature below -20 degrees C) before operating any other controls of the radar set. This permits initial rotation of the antenna at its slowest speed and prevents overloading the antenna drive motor and gear train. When the antenna system is operating normally after the specified time period, turn the range switch to 10 and the function switch to either SEARCH, BEACON, or WEATHER position, depending on the type of operation desired.
- Turning the function switch to any other position beyond STANDBY, with the range switch on 100 or beyond, before the radar set has reached full operating temperature can cause severe damage to electronic circuits and may render the set completely inoperative.

NOTE

There is no sweep on the search radar scopes during the time delay period.

3. Adjust the scope intensity knob on the search radar indicators so that the sweep line appears plainly on the scope
4. Adjust the focus knob on the indicators so that the sweep line appears sharp and clear. Alternately readjust the focus knob and the scope intensity knob until a clear, sharp, sweep line is obtained
5. Rotate the scope intensity knob slowly counterclockwise until the sweep line is just visible on the screen. The set should now operate in any desired function

Search operation is accomplished by the following procedure:

1. Set the function switch to the SEARCH position
2. Place the scan switch in the FULL position. The type of scanning performed will be shown on the search radar scopes with the sweep trace rotating a full 360 degrees around their centers. With the antenna scanning, the range marks appear as circles centered about the beginning of the sweep. From these circles, target ranges are determined
3. Observation of specific objects in the direction of the airplane heading is slightly improved by utilizing sector scan. General coverage of the area is obtained with the full scan condition
4. Rotate the gain control clockwise thus causing moving object and fixed echoes to appear on the indicator screen. Adjust the gain control for the best display, that is, for clearest viewing and highest degree of definition. For optimum adjustment after the proper setting of the gain control, reduce the intensity so that the sweep trace is just barely visible
5. Utilize the A--J switch to obtain better definition of targets. Heavy masses of objects or sea return that may obscure lesser objects will be materially reduced by setting the A--J switch to FTC position. Further sharpening of the display may be obtained by utilizing the IAGC position. Utilize the position that gives the clearest indication and readjust the gain control if

necessary. The A--J switch should not be used, however, unless necessary to obtain proper definition, since its use reduces the over-all sensitivity of the video circuits and makes small objects, such as approaching airplanes more difficult to detect on the longer ranges

6. Place the STC switch on the STC position. This will reduce the intensity of nearby objects, ground clutter, and sea return. The STC circuits are effective up to 10 miles of range. Utilize the STC switch position (STC or OUT) that gives the clearest indications

7. Place the antenna stab switch in the STAB position. This activates the roll-and pitch-stabilization mechanism and circuits, maintaining the antenna in its normal position relative to the horizon regardless of the roll or pitch of the airplane

8. Observe the two antenna beam pattern conditions from the displays by placing the OBS--MAP switch alternately in the OBS and MAP positions. When the airplane is airborne, terrain objects will be more apparent on lesser ranges when the OBS--MAP switch is in the MAP position. The mapping beam which has an equal-energy-return pattern, is utilized to its best advantage when the antenna is set at zero tilt and the stabilizer is in operation. The OBS position utilizes the pencil beam which is generally used to observe objects at the longer ranges or at the same approximate altitude as the airplane. When observation of a particular object is desired, the antenna tilt switch may be used for the desired elevation or depression angle necessary for the best indicator presentations

9. Operate the tilt switch in the UP and DOWN positions and note the tilt action and degree of tilt of the search radar antenna as indicated by the tilt meter. Optimum detection and indication with the mapping beam is generally obtained when the antenna tilt is set at zero. The normal tilt setting of the antenna when the OBS (pencil) beam is used, is zero degrees. This condition is normal for observing obstacles or objects in the same approximate altitude as the airplane, and the longer range ground targets. Such objects may include mountain ranges and peaks, clouds, or other airplanes. It should be noted that under these conditions, nearby terrain objects are less clear on the indicator than when using the map beam. Other degrees of antenna tilt may be used at the discretion of the operator. These conditions generally involve the observation of particular objects which require elevation or depression of the antenna for best indication. Other conditions may be those which require simultaneous observation of airborne objects requiring a compromise setting of the antenna tilt angle

10. Adjust the light control on the indicator for satisfactory illumination of range-marker lights and cursor

11. Set the range switch to the desired range. Different range settings may require slight readjustment of the antenna tilt for the desired beam coverage. When the range switch is in the TD position, the 30-mile range sector, manually variable by means of the delay control, is displayed on the search radar scope. This range sector affords the operator a magnified presentation of objects on the longer ranges

12. Turn the tune switch to MAN and check whether sharper tuning may be obtained manually than with AFC

13. Rotate the cursor screen by means of the knurled knob to find the exact azimuth bearing of targets

The beacon function is employed to find navigational and homing information from radar beacons at ranges up to 200 nautical miles. During beacon operation, the equipment is responsive only to X-band radar signals, and does not display normal radar targets. Since the beacon indications are in terms of range and azimuth, the navigator may employ this information for plotting a course. If homing is desired the pilot will head the airplane so that the beacon signal appears in the zero-degree heading on the indicator. Other courses may also be conveniently plotted from two or more beacon signals. During beacon operation, the mapping beam is automatically selected.

Beacon operation is accomplished as follows:

1. Set the function switch to BEACON
2. Set the range switch to the desired range where beacons are expected. A picture of all the beacon stations within the range of the equipment may be secured by utilizing the 200-mile maximum range. The lesser range positions may be used when looking for beacon stations of known locations. When homing on a beacon, the range settings should be correspondingly reduced to provide optimum indications as the airplane approaches the beacon location. For reading distant beacons, the range switch may be placed in the TD position, thus providing an amplified view within a 30-mile

range sector. Intermittent rather than continuous operation on beacon is recommended to avoid overloading the beacon transmitter

3. Utilize antenna stabilization by placing the antenna stab switch in the STAB position
4. Adjust the brightness of the indicator edge lights and range-marker lamps by means of the scope light knob for best viewing conditions of indicator presentations and the azimuth scale
5. Adjust the scan switch to the position giving the type of scanning desired, SECTOR or FULL. If the beacon station is being used for homing, or is within a sector of 120 degrees ahead of the airplane, sector scan may be preferred
6. Adjust the gain control for the best presentation of beacon signals
7. Adjust the tilt switch for best signal response
8. The range may be determined from the range marker rings. All ranges of beacon stations are referenced from the indicator origin to the first line of arc of the beacon signal

The weather function provides indication of surrounding weather conditions from cloud and storm-front formations. Locations of formations are presented on the indicator screen in terms of range and azimuth in the same manner as that for the search function. Indication presentations also show the relative character and size of cloud and storm-front formations, thus providing the pilot with useful information for determining this course. Weather operation is accomplished as follows:

1. Place the function switch in the WEATHER position
2. Place the range switch in the proper position to cover the range within which information is desired. When making the initial survey of the area, it may be preferable to make observations in the maximum 200-mile range, and then to select the lesser range or the 30-mile TD sector to observe particular formations
3. Adjust the scan switch to the position giving the type of scanning desired, SECTOR or FULL. If storm avoidance is of primary concern, place the scan switch in the SECTOR position
4. Place the OBS--MAP switch in OBS position. The obstacle or pencil beam provides best presentation of cloud and storm-front formations, since it eliminates ground targets and clutter.
5. Adjust antenna tilt to the zero tilt position with the tilt switch. Vary the antenna slightly with the tilt switch for the most clearly defined presentation. On OBS operation, ground indications may be practically eliminated by means of the tilt adjustment providing the best analysis of weather conditions
6. Heavy clouds and storm fronts having higher moisture content produce stronger and more intense indications than lighter clouds and lighter formations. An experienced operator has no great difficulty in interpreting presentations
7. Amplified presentations, as provided by the 30-mile TD range sector, provide a more complete analysis of the formations. TD operation of the equipment for weather is the same as in the search function

To place the equipment in standby, turn the function switch to the STANDBY position.

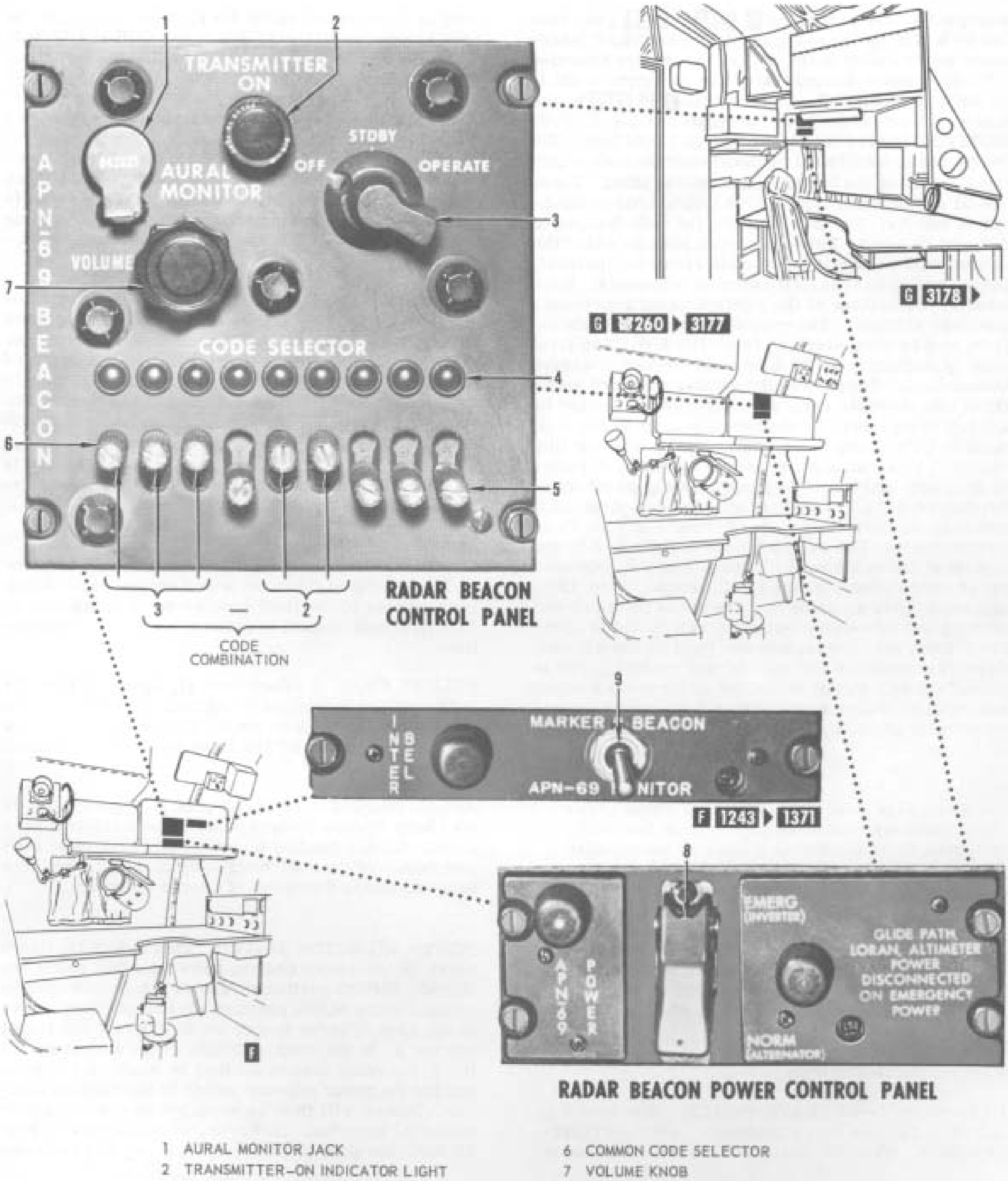
Securing the Search Radar

The search radar set is turned off by the following procedure:

1. Range switch to 10
2. Gain knob full CCW
3. Scan switch stopped with trace at 180 degrees
4. Intensity knobs fully CCW
5. Antenna stab switch in OUT position
6. Function switch in the OFF position to completely de-energize the equipment

RADAR BEACON (AN/APN-69)

The radar beacon is used primarily as a navigational aid for air refueling rendezvous. Two control panels (11 and 12, figure 4-17) are used to operate the set. After the equipment is energized and the desired code has been selected, the beacon operates automatically. During flight, coded reply signals are transmitted whenever the beacon responds to interrogation pulses from any suitably equipped radar. The beacon's response is indicated by a distinctive display on the scope of the interrogating radar. From this display, the operator of the interrogating radar may identify the beacon-equipped airplane and determine its range and bearing. The response of the beacon is also indicated by a tone on the



1 AURAL MONITOR JACK
2 TRANSMITTER--ON INDICATOR LIGHT
3 OFF--STDBY--OPERATE SWITCH
4 CODE SELECTOR INDICATORS
5 CODE SELECTOR SWITCHES
6 COMMON CODE SELECTOR
7 VOLUME KNOB
8 POWER SELECTOR SWITCH
9 MARKER BEACON--APN-69 MONITOR INTERPHONE SWITCH

RADAR BEACON CONTROLS

Figure 4-34

interphone. On airplanes F 1243▶ 1371 , the tone can be heard by the navigator if the MARKER interphone mixer switch is ON (up) and the marker beacon--APN-69 monitor interphone switch (8, figure 4-15) is on APN-69 MONITOR. On airplanes F G 1372▶, the tone can be heard by the navigator if the APN-69 MONITOR interphone mixer switch is ON (up). The reply code is established by positioning the code selector switches at the bottom of the control panel. There are 52 usable codes available. A typical code is selected as follows: For this example, the code designated 3-2 will be used. Three dash two indicates that the beacon will transmit three code elements (pulses), pause, and then transmit two code elements. Each knob on the bottom of the control panel represents one code element. The code elements are numbered from one to nine starting from the left. The first knob is stationary so the first code element is always transmitted. Therefore, the second and third knobs (first two movable code selector switches) must be ON (up) to give three successive pulses, the fourth knob must be OFF (down) to give the correct pause, the fifth and sixth knobs must be up to give the final two pulses of the code, and the remaining knobs must be down. See figure 4-34. (The correct pause is obtained if one code element is removed from a series - one switch down.) The selected code is indicated by the indicator lights above the knobs. For the code used in the above example, the first, second, third, fifth, and sixth lights would be lit. The set is turned on and off with the off--stdby--operate switch and is operative when the transmitter-on light is illuminated. Operating power is 115 volt AC and control power is 28 volt DC with circuit protection on the radio junction box circuit breaker panel (figure 1-35) and the alternator relay shield (figure 1-35).

NOTE

> The radar beacon may trigger itself occasionally which will be indicated on the interphone by an intermittent click on buzz. When the beacon is triggered by a radar set whose antenna is scanning, a buzz will be heard in the headset at the scanning frequency of the radar antenna. This scanning frequency will be quite low, sometimes as low as four scans per minute. If the radar is not scanning but is directed on the beacon, a tone of approximately 300 cycles per second will be heard.

Radar Beacon Controls

OFF--STDBY--OPERATE SWITCH. This switch (3, figure 4-34) has three positions: OFF--STDBY--OPERATE. When the switch is OFF, the beacon equipment is de-energized except for the panel lights and the code selector indicators. Refer to CODE SELECTOR INDICATORS in this Section. Placing the switch on STDBY energizes all circuits, except the high-voltage circuits, after a 30-second delay. Switching to OPERATE makes the beacon completely energized and ready for automatic operation after a 3-minute delay. If the switch has been on STDBY for at least three minutes, the beacon will be completely operative as soon as the switch is placed on OPERATE. When it is desired to discontinue operation temporarily, turning the switch to STDBY keeps the beacon ready for immediate use.

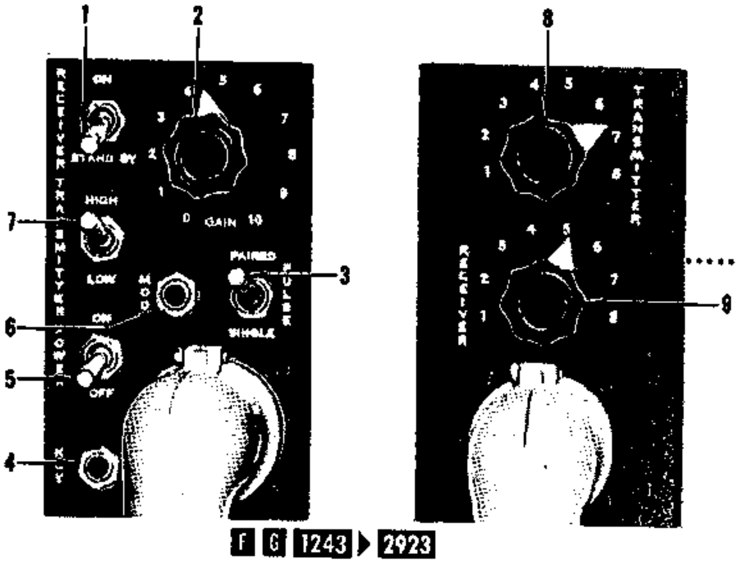
CODE SELECTOR SWITCHES. Eight code selector switches (5, figure 4-34) on the radar beacon control panel are used to establish the desired code response of the beacon system. The switches are operated by pulling the associated spring-loaded knobs outward and then lifting upward to the ON position or downward to the OFF position. Transmission of a code element occurs only when the corresponding switch knob is in the up position. When the switch knob is down, the corresponding code element is absent from the transmitted code.

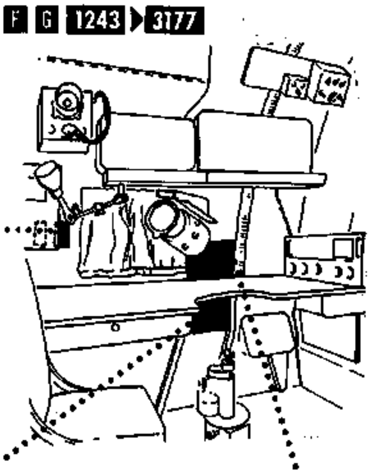
COMMON CODE SELECTOR. A common code selector (6, figure 4-34) on the radar beacon control panel, which corresponds to the first code element is stationary. This first code element is common to all code combinations.

VOLUME KNOB. A volume knob (7, figure 4-34) on the radar beacon control panel adjusts the volume of the beacon tone into the interphone. The volume of the tone is also controlled by the interphone volume knob.

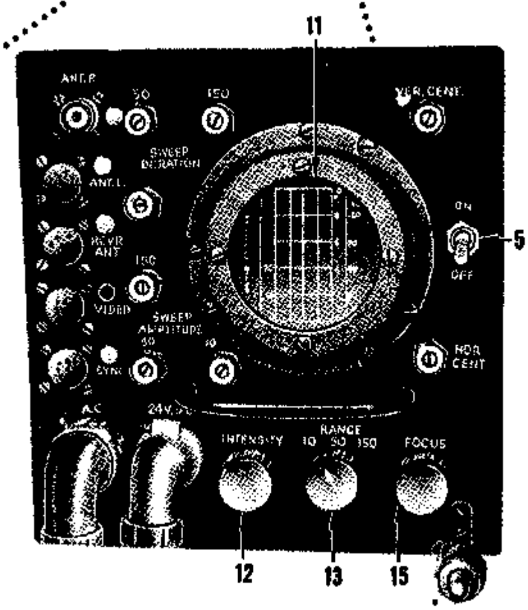
AURAL MONITOR JACK. A jack (1, figure 4-34) on the radar beacon control panel is used for test purposes. When a headset is connected to the jack, random noise (or periodic triggering of the system) may be heard and is indicative of beacon operation.

POWER SELECTOR SWITCH. This switch (8, figure 4-34) on the radar beacon power control panel has NORM--EMERG positions. The switch is protected by a guard in the NORM position. In this position, power to the APN-69 radar beacon set is from the alternator bus No. 2. In the event of failure of the alternator bus No. 2, the radar beacon set may be made operative by placing the power selector switch to the EMERG position. Power will then be supplied by the airplane's essential inverter. However, when the switch is in EMERG, the glide slope receiver, loran, and the radio

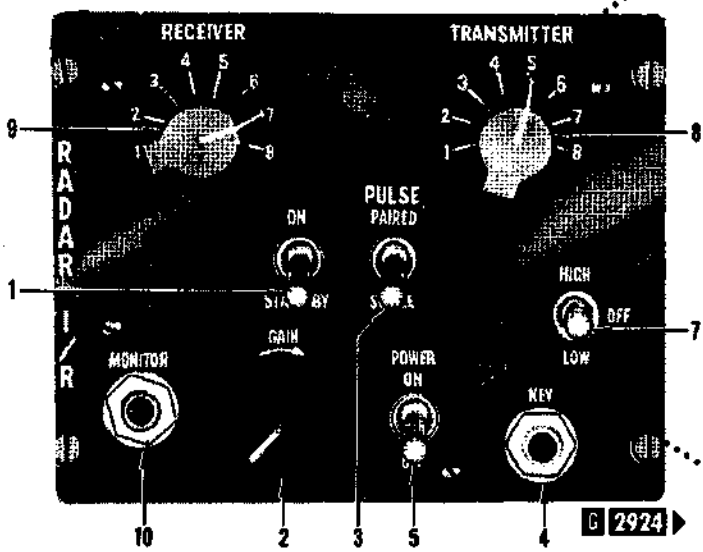




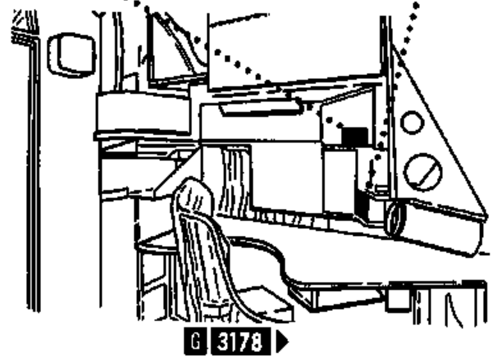
RENDEZVOUS RADAR CONTROL PANELS



RENDEZVOUS RADAR INDICATOR PANEL



1 RECEIVER SWITCH (2 PLACES)
2 GAIN KNOB (2 PLACES)
3 PULSE SELECTOR SWITCH (2 PLACES)
4 KEY JACK (2 PLACES)
5 POWER SWITCH (2 PLACES)
6 MODULATOR JACK
7 TRANSMITTER SWITCH (2 PLACES)
8 TRANSMITTER CHANNEL SELECTOR SWITCH (2 PLACES)
9 RECEIVER CHANNEL SELECTOR SWITCH (2 PLACES)
10 MONITOR JACK
11 RENDEZVOUS RADAR INDICATOR
12 INTENSITY KNOB
13 RANGE SELECTOR SWITCH
14 DELAY KNOB
15 FOCUS KNOB



RENDEZVOUS RADAR (AN/APN-12) CONTROLS

Figure 4-35

altimeter will be disconnected. When the switch is in the NORM position, circuit protection is from the alternator relay shield (figure 1-35). When the EMERG position is selected, circuit protection is from the AC power panel (figure 1-35). When the switch is in either position, operating power is 115 volt AC.

F 1243 ▶ 1371

MARKER BEACON--APN-69 MONITOR INTERPHONE SWITCH. This switch (9, figure 4-34), on the radio and radar control panel, selects the signal to be heard when the MARKER interphone mixer switch (4, figure 4-8) on the navigator's interphone panel is ON. With the switch on MARKER BEACON, the identity code transmitted by a beacon will be heard when the airplane passes over the beacon. Placing the switch on APN-69 MONITOR permits the navigator to hear the tone which indicates that the radar beacon is transmitting.

Radar Beacon Indicators

TRANSMITTER-ON INDICATOR LIGHT. A green indicator light (2, figure 4-34), marked TRANSMITTER ON, is on the radar beacon control panel. When the master power switch is turned to OPERATE, and a three minute warmup period has elapsed, the green press-to-test TRANSMITTER ON indicator light illuminates indicating that the radar beacon is ready for automatic operation.

CODE SELECTOR INDICATORS. Nine code selector indicators (4, figure 4-34) are on the bottom of the radar beacon control panel. The navigator's radio panel lights control controls the brilliance of the indicators. Each code selector switch (5, figure 4-34) controls its respective indicator. The indicators, when illuminated, indicate the presence of a code element inserted in the beacon response.

Normal Operation of the Radar Beacon

The radar beacon equipment is made operative and inoperative by the following procedure:

1. Place the off--stdby--operate switch to STDBY
2. Allow approximately 3 minutes for warmup and place off--stdby--operate switch to OPERATE. After the warmup period, the transmitter-on light is energized and the system is ready for automatic operation and will reply to interrogating pulses of the proper characteristics
3. Set the code selector switches to the desired reply code. As an example of a 3-2 code, the first (which is the stationary one and is common to all code combinations), second, third, fifth, and sixth switch knobs would be placed in the up position. All other switch knobs would be in the down position. This would be a five-element code. Do not insert more than six code elements, including the first stationary element, at one time
4. If it is desirable to monitor the beacon system operation, the navigator may do so by use of the interphone mixer switch
5. If it is desired to discontinue operation temporarily, turn off--stdby--operate switch to STDBY. In this manner, the equipment is kept ready for immediate use
6. To make inoperative, reset code selector switches to down position and turn off--stdby--operate switch to OFF

NOTE

> A suppressor cable connecting the AN/APN-69 radar beacon and AN/APS-42 search radar synchronizer unit prevents blanking of the search radar indicators by temporarily inactivating the AN/APN-69 radar beacon.

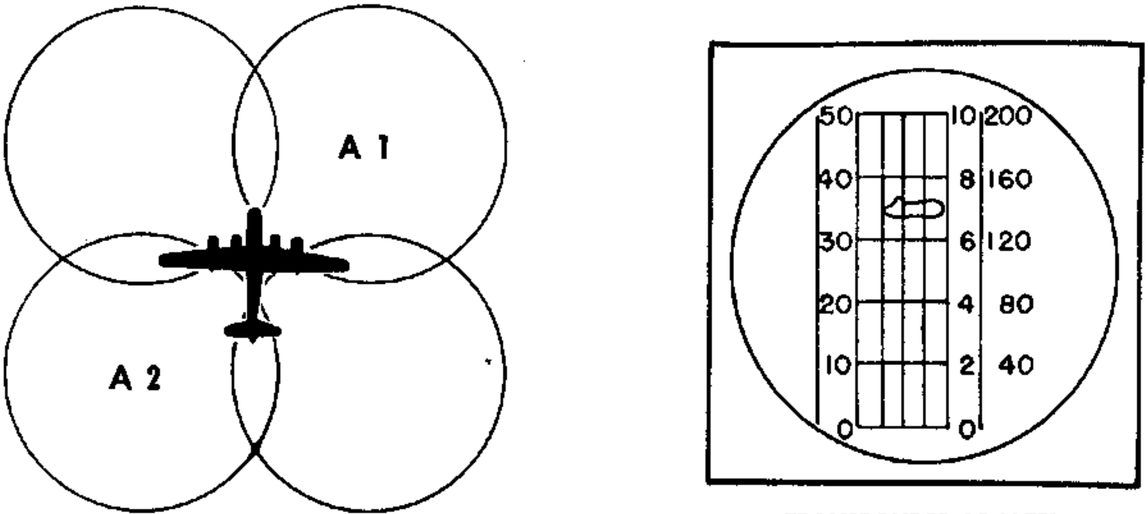
RENDEZVOUS RADAR (AN/APN-12)

The AN/APN-12 rendezvous radar is used for recognition and navigation by interrogation of ground beacons or transponders (AN/APN-76). The return signal is displayed on the rendezvous radar indicator (figure 4-35), indicating range and quadrantal location of the transponder with respect to the AN/APN-12. The AN/APN-12 receiving antennas give the receiving pattern illustrated in figure 4-36. The signals received by the AN/APN-12 receiving antennas are displayed on an indicator with an L-type scan. The center vertical trace indicates range, with zero range at the bottom (except when operating on 10D and 50D) and increasing up the scope. Range is read from the bottom of the scope to the bottom of the received signal using the etched lines on the face of the scope as range markers. Signals will appear as horizontal indications unbalanced to the left, unbalanced to the right or centered across the vertical trace. By comparison of left and right signal amplitude, quadrantal position of the receiver airplane may be determined. If the signal is centered on the vertical trace, the receiver airplane is in one of four possible positions; dead ahead, dead astern, or directly abeam of either wing. When the signal is unbalanced to the right, the receiver airplane is located in quadrants A_1 or A_2. In this situation, with the receiver airplane approaching the tanker airplane, the receiver should be directed to correct to the right in order to balance the received signal across the vertical trace of the scope. When the signal becomes balanced, the receiver should be directed to turn to the heading or reciprocal heading of the tanker airplane, whichever is applicable. Conversely, when the signal is unbalanced to the left the receiver should be directed to correct to the left until the received signal is balanced or centered across the vertical trace. Control power is 28 volt DC, operating power is 115 volt AC, with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

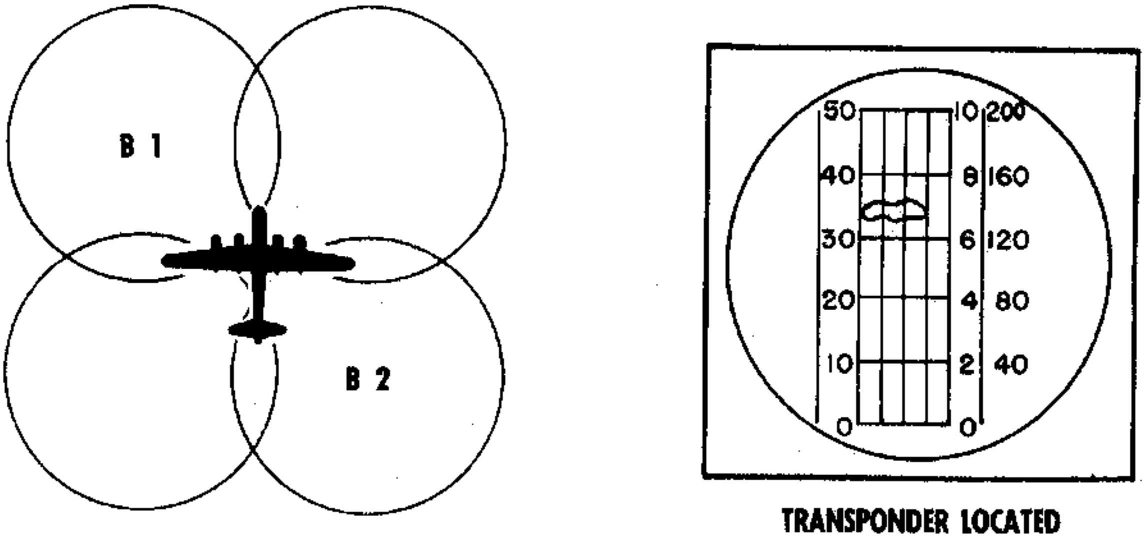
AN/APN-12 Rendezvous Radar Controls

POWER SWITCH. The switch (5, figure 4-35) on the AN/APN-12 rendezvous radar control and indicator panels has ON--OFF positions. The switch is used to turn the set on and off.

TRANSMITTER SWITCH. This three-position toggle switch (7, figure 4-35) on the control panels has HIGH--OFF--LOW positions. The switch is used to select high or low operating ranges when in the desired position. When the switch is in the center or OFF position, no transmission is possible.



TRANSPONDER LOCATED
IN ONE OF QUADRANTS
LABELED A



TRANSPONDER LOCATED
IN ONE OF QUADRANTS
LABELED B

RECEIVING PATTERNS (AN/APN-12) SCOPE

Figure 4-36

RECEIVER SWITCH. This switch (1, figure 4-35) on the control panels has ON and STANDBY positions. ON position energizes the receiver. When in STANDBY, the receiver tubes are kept hot and the receiver is in readiness for instant operation.

PULSE SELECTOR SWITCH. This switch (3, figure 4-35) on the control panels has PAIRED and SINGLE positions. The switch is used to provide paired pulse or single pulse operation.

GAIN KNOB. The gain control (2, figure 4-35) on the control panels is a knob controlled potentiometer. The control is used for the purpose of controlling receiver gain.

TRANSMITTER CHANNEL SELECTOR SWITCH. This switch (8, figure 4-35) on the control panels is used to select any of the eight preset frequencies. Each channel position is labeled on the panels to inform the operator on which channel the transmitter is operating.

RECEIVER CHANNEL SELECTOR SWITCH. This switch (9, figure 4-35) on the control panels is used for selecting any one of the eight preset frequencies of the receiver. Each channel position is labeled.

G 2924 ▶

KEY JACK. This jack, (4, figure 4-35) on the control panels allows a keying device to be plugged into the panel and automatically switches the beacon transmitter on and off in accordance with a predetermined code.

MODULATOR JACK. This jack (6, figure 4-35) on the panels permits audible monitoring of the transmitter triggering circuits. The jack is also used when the radar set is being operated as a beacon without the use of the indicator, by plugging a headphone into the jack and listening to a popping noise.

AN/APN-12 Rendezvous Radar Indicator

RENDEZVOUS RADAR INDICATOR. This indicator (10, figure 4-35) is on the rendezvous radar indicator panel. The indicator provides a visual representation of distance and direction, with respect to the line of flight and a ground beacon station.

Normal Operation of AN/APN-12 Rendezvous Radar

To start the AN/APN-12 set, proceed as follows:
1. Place the transmitter switch on the control panels in the OFF (mid) position
2. Place the power switch on the control panels in the ON position
3. When operating as an interrogator-responser, place the on--off switch, on the rendezvous radar indicator panel in the ON position. (This step applies only to those indicator panels which have an on--off switch - some panels do not have this switch.)

NOTE

Allow one minute for warmup before attempting to operate the equipment.

To stop the AN/APN-12 set, proceed as follows:
1. Turn gain and intensity knobs full counterclockwise
2. Place the power switches in the OFF position

To operate the AN/APN-12 set as an interrogator-responser, proceed as follows:
1. Remove the top cover of Receiver-Transmitter RT-316/APN, by loosening the four slide fasteners
2. Using a screwdriver, rotate the BEACON--IR switch, located in the top of Receiver-Transmitter RT-316/APN, to the IR position
3. Replace the top cover of Receiver-Transmitter RT-216/APN
4. Start the equipment
5. Place the pulse selector switch in the SINGLE position
6. After approximately one minute, place the transmitter switch in the HIGH position
7. Adjust the focus and intensity controls, on rendezvous radar indicator panel until a clear, well-defined trace is obtained on the display screen
8. Place the receiver switch in the ON position
9. Adjust the gain control until grass appears in the trace on the display screen on the rendezvous radar indicator. The appearance of grass indicates proper operation of the receiver, and the rectangular-shaped pulse at the base line indicates proper operation of the transmitter
10. Check operation of the receiver for each position of the receiver channel selector switch
11. Place the receiver and transmitter channel selector switches on the assigned channels
12. When the airplane is within the range of a ground transponder beacon, a signal should appear on the rendezvous radar indicator, showing the distance from the beacon and whether or not the airplane is on course. (See figure 4-36) If the signal on the right of the center line is larger, the beacon is to the right of the airplane and the pilot should be directed to the right until the right- and left-hand signals are equal

NOTE

Range is read to the bottom edge of the receiver signal pulse.

13. As the airplane approaches the beacon, the received signal gradually approaches the zero line on the indicator. At the time the airplane is directly over the beacon, the received signal collapses

To operate the AN/APN-12 set as beacon (transponder), proceed as follows:
1. Perform operations 1 through 10 as mentioned for interrogator-responser operation.
2. Remove the top cover of receiver-transmitter RT-316/APN, by loosening the four slide fasteners
3. Using a screwdriver, rotate the BEACON--IR switch, located on the top of receiver-transmitter RT-316/APN, to the BEACON position

4. Replace the top cover of receiver-transmitter RT-316/APN
5. Place the receiver and transmitter channel selector switches on the assigned channels
6. Set the gain knob to maximum (10) position. If the flashing of the base line on the rendezvous radar indicator exceeds an average of once per second, reduce the setting of the receiver gain knob until this condition exists. When the radar set is being operated as a beacon without the indicator, it will be necessary to listen to the popping noise with headphones plugged into the MOD jack. When the beacon is interrogated by weak signals, it may be necessary to set the receiver gain control higher than herein described. Reliable beacon operation can be obtained with random noise triggering rates considerable in excess of once per second; however, the gain knob setting should be held at a minimum which will give satisfactory operation with the weakest signals expected. Lower settings of the gain knob will eliminate random noise triggering, but will also limit operation of the beacon to strong signals

NOTE

Since receiver sensitivity may vary from one channel to another, it will probably be necessary to reset the gain control in accordance with above instructions when the receiver is switched to another channel.

7. Place the pulse selector switch in either the SINGLE or PAIRED position as desired
8. The MOD jack, also permits audible monitoring of the transmitter triggering circuits. It is thus possible for the operator to determine when his beacon is being interrogated by listening for the steady tone in the headphones

Operation of the AN/APN-12 set for communication:
1. Insert a plug which is attached to a key, into the key jack
2. Operate AN/APN-12 as interrogator-responsor
3. The associated ground equipment can be keyed for a reply and the keyed response observed on the rendezvous radar indicator

NOTE

A suppressor cable connecting the AN/APN-76 and AN/APN-12 rendezvous radar units, prevents the AN/APN-76 set from firing when the AN/APN-12 set interrogates.

RENDEZVOUS RADAR (AN/APN-76)

This radar set is an airborne radar beacon. When properly interrogated, the beacon responds automatically to airplanes equipped with rendezvous radar AN/APN-12 or an equivalent interrogator-responser radar unit operating within the frequency range of 160 to 240 megacycles. The airplane equipped with the interrogator-responser unit can thereby home on the beacon signal to aid in a rendezvous. The control panel(s) for the set (figure 4-37) are at the navigator's station. Control power is 28 volts DC, operating power is 115 volts AC with circuit breakers on the radio junction box circuit breaker panel (figure 1-35).

AN/APN-76 Rendezvous Radar Indicator

AC POWER INDICATOR LIGHT. This light (12, figure 4-37) on the rendezvous radar control panel will illuminate when ac power is available for the equipment.

AN/APN-76 Rendezvous Radar Controls

TRANSMITTER SWITCH. This three-position switch (8, figure 4-37) on the rendezvous radar control panel (AN/APN-76) provides a means of using high or low transmitter power or placing the transmitter on standby. In the HIGH or LOW position it energizes the keying relay, permitting the transmitter modulator circuit to operate. In the center position, the OFF position, the transmitter is on standby.

POWER SWITCH. This switch (6, figure 4-37) with ON--OFF positions is on the rendezvous radar control panels (AN/APN-76). The switch when positioned to ON controls the a-c and d-c voltage to the receiver transmitter.

PULSE SELECTOR SWITCH. **G** **3213** ▶ PLUS ✈ ICIO KG502 ▶. This switch (3, figure 4-37) has PAIRED--SINGLE positions and is on the rendezvous radar control panel (AN/APN-76). The switch allows the operator to transmit either single or paired pulses from the set.

RECEIVER SWITCH. This switch (1, figure 4-37) on the rendezvous radar control panels (AN/APN-76) has ON--STANDBY positions. Movement of the switch places the receiver in either a standby or operating condition.

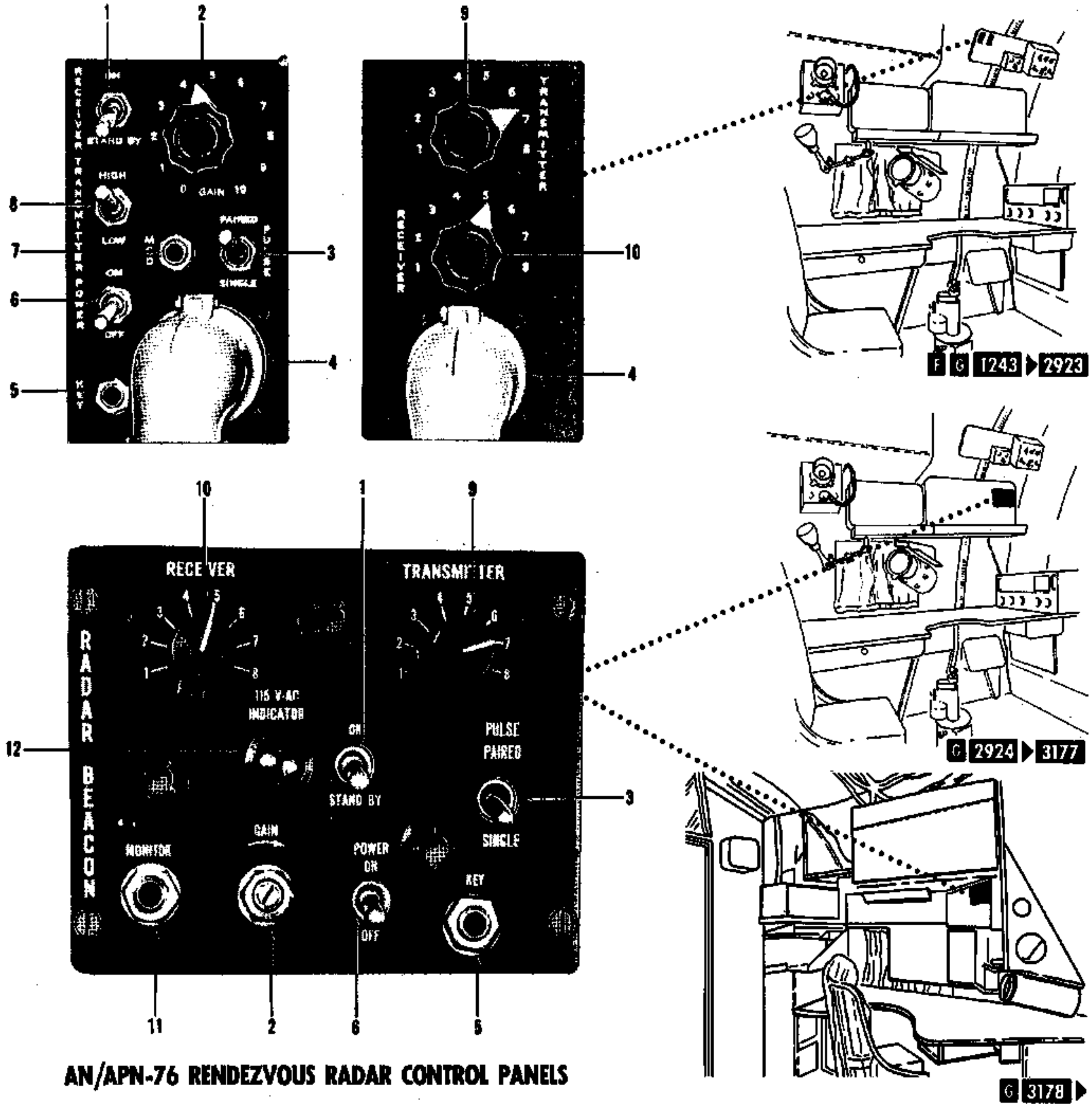
GAIN KNOB. The gain knob (2, figure 4-37) on the rendezvous radar control panel (AN/APN-76) varies the sensitivity of the receiver.

TRANSMITTER CHANNEL SELECTOR SWITCH. This switch (9, figure 4-37) on the rendezvous radar control panel (AN/APN-76) permits selection of any one of eight preset transmitter frequencies.

RECEIVER CHANNEL SELECTOR SWITCH. This switch (10, figure 4-37) on the rendezvous radar control panel (AN/APN-76) permits selection of any one of eight preset receiver frequencies.

Normal Operation of AN/APN-76 Rendezvous Radar

The radar set is made operative and inoperative by the following procedure:
1. Place the power switch to ON
2. Allow approximately 3 minutes for warmup and place the receiver switch to ON
3. To make inoperative, place the power switch to OFF and the receiver switch to STANDBY

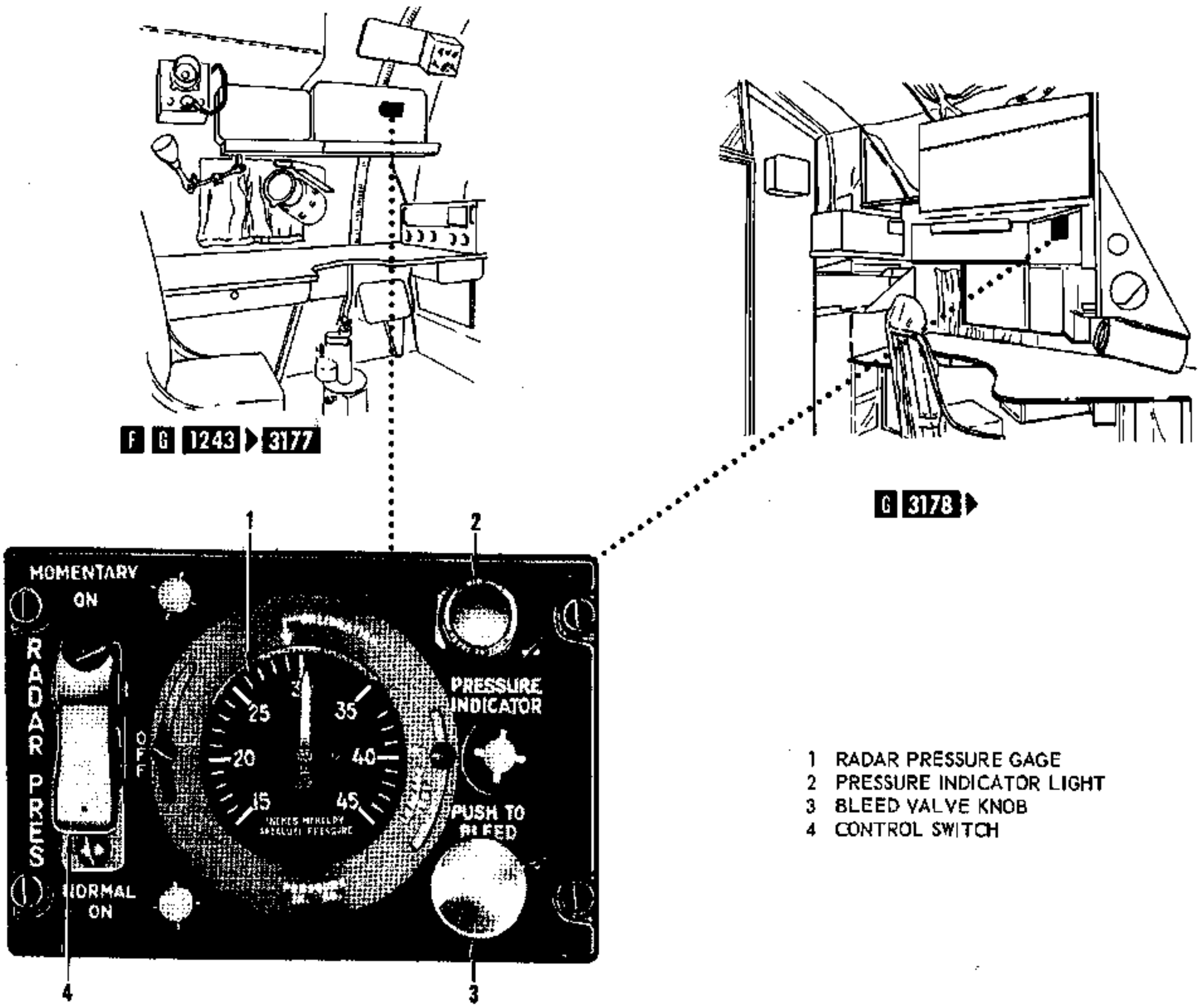


AN/APN-76 RENDEZVOUS RADAR CONTROL PANELS

1 RECEIVER SWITCH (2 PLACES)
2 GAIN KNOB (2 PLACES)
3 PULSE SELECTOR SWITCH (2 PLACES) G 3213 ▶ PLUS TCTO K6502
4 RECEPTACLE (2 PLACES)
5 KEY JACK (2 PLACES)
6 POWER SWITCH (2 PLACES)
7 MODULATOR JACK
8 TRANSMITTER SWITCH
9 TRANSMITTER CHANNEL SELECTOR SWITCH (2 PLACES)
10 RECEIVER CHANNEL SELECTOR SWITCH (2 PLACES)
11 MONITOR JACK
12 AC POWER INDICATOR LIGHT

RENDEZVOUS RADAR (AN/APN-76) CONTROLS

Figure 4-37



1 RADAR PRESSURE GAGE
2 PRESSURE INDICATOR LIGHT
3 BLEED VALVE KNOB
4 CONTROL SWITCH

RADAR PRESSURIZING CONTROL PANEL

RADAR PRESSURIZING CONTROLS

Figure 4-38

RADAR PRESSURIZING SYSTEM

Pressurizing equipment supplies pressurized air to the search radar set (AN/APS-42) for satisfactory operation at high altitudes. The equipment is controlled by a switch on the radar pressurizing control panel (7, figure 4-17) on the navigator's radio and radar control panels. Pressure is maintained at the proper level by a pressure operated switch within the system. Control power is 28 volt dc with circuit protection on the radio junction box circuit breaker panel (figure 1-35).

Radar Pressurizing System Controls

CONTROL SWITCH. This switch (4, figure 4-38) on the radar pressurizing control panel has MOMENTARY ON--OFF--NORMAL ON positions. The switch, guarded to the NORMAL ON position, controls operation of the connected air system. With the switch in the NORMAL ON position, intermittent operation of connected equipment is automatic with results indicated on the control panel. Switch positions MOMENTARY ON and OFF are used for testing and emergency.

BLEED VALVE KNOB. A knob (3, figure 4-38) on the radar pressurizing control panel is marked PUSH TO BLEED. When the knob is pushed in, it mechanically actuates a valve to discharge system compressed air into the cabin. The bleed valve knob is spring-loaded to the extended (bleed valve closed) position.

Radar Pressurizing System Indicators

PRESSURE INDICATOR LIGHT. A green indicator light (2, figure 4-38) on the radar pressurizing control panel, when illuminated, indicates that the compressor is operating.

RADAR PRESSURE GAGE. A radar pressure gage (1, figure 4-38) on the radar pressurizing control panel indicates system air pressure in inches of mercury. A mask assembly with red and green range markings, leakage test, and calibration marks is fitted over the face of the indicator. The leakage test and calibration marks are used only for ground and flight test of the system after maintenance work has been accomplished.

Radar Pressurizing System Normal Operation

The radar pressurizing system must be turned on whenever the search radar set is to be operated and left on throughout the operation of the set. At all other times, radar pressurizing should be off. Operation of the system is as follows:

1. Place the radar pressurizing control switch to NORMAL ON; pressure indicator light should come on and remain on until pressure builds up within the green operating range on the radar pressure gage. When pressure stabilizes within the green operating range, the search radar set may be turned on
2. After the search radar set has been turned OFF, place the radar pressurizing control switch to OFF

Radar Pressurizing System Emergency Operation

FAILURE OF AUTOMATIC PRESSURE REGULATION. In the event the pressure regulator switch malfunctions or fails and continued operation of the search radar set is essential, radar pressurizing may be maintained by manual control.

1. Place the radar pressurizing control switch in OFF
2. Bring pressure within green operating range on the radar pressure gage either by holding the pressurizing control switch in MOMENTARY ON, or by pushing and holding in the pressure bleed valve knob
3. Whenever the pressure drops to the low limit of the green operating range, hold the radar pressurizing control switch in MOMENTARY ON until the pressure builds up to the high limit. Repeat this procedure as necessary to maintain the pressure within the limits of the green operating range

NOTE

In an extreme emergency only, when pressure cannot be maintained in the green operating range but can be kept within the upper and lower limits of the red (marginal) range on the radar pressure gage, the search radar set may be kept in operation by manual tuning of the units.

INABILITY TO MAINTAIN PRESSURE. If failure of the compressor, broken lines, or similar difficulty, makes it impossible to maintain proper pressure either by automatic or manual means, proceed as follows:

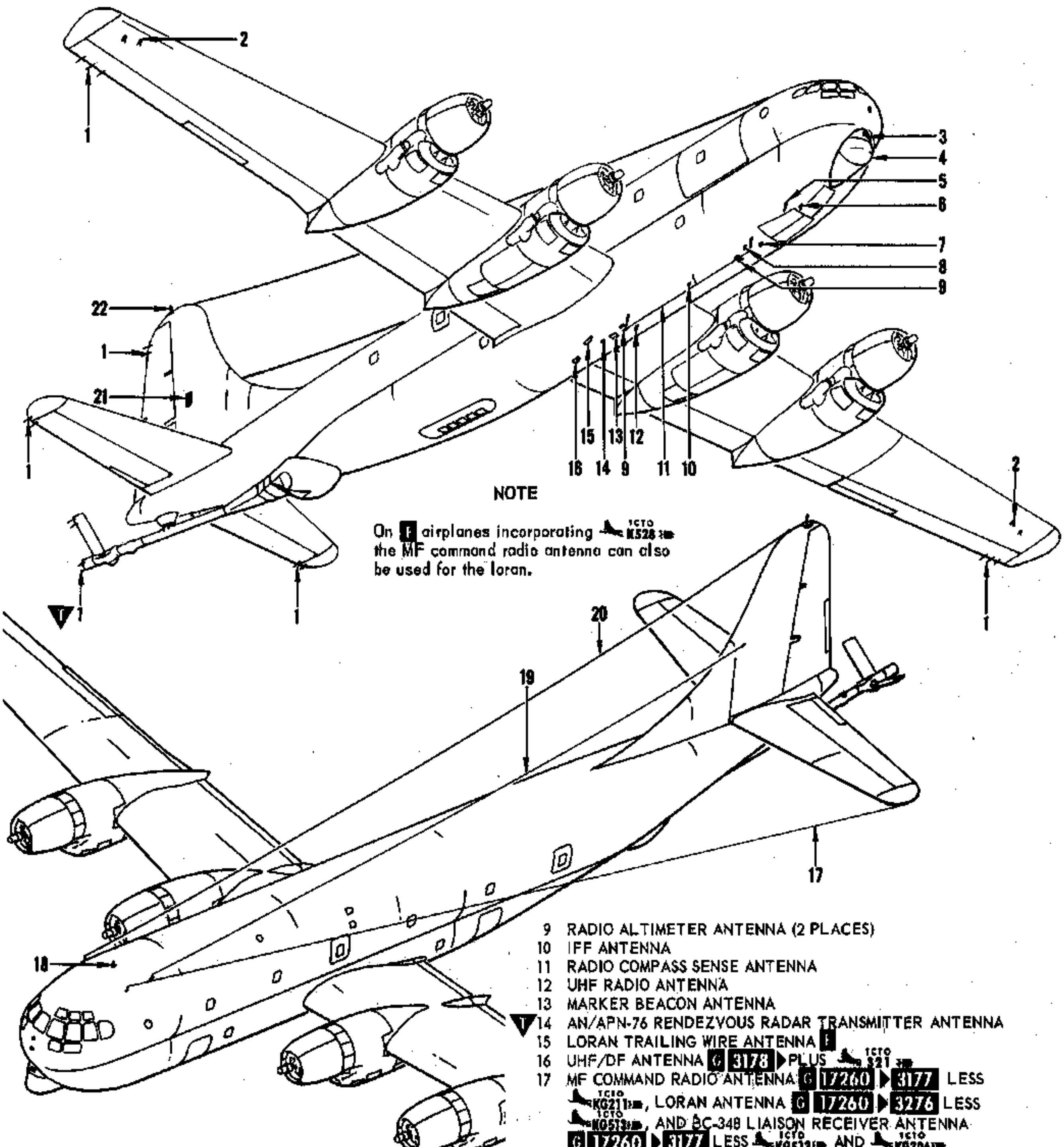
1. Place the radar pressurizing control switch in OFF
2. Turn off the search radar set

CAUTION

Continued operation of the search radar set after failure of the radar pressurizing system is likely to result in damage to the search radar components.

STATIC DISCHARGERS

Static dischargers are provided to discharge static electricity from the airplane to the air. The dischargers are tufts of braid located on the wing tips, empennage and ruddevators.



NOTE

On F airplanes incorporating TCTO K528 the MF command radio antenna can also be used for the loran.

1 STATIC DISCHARGERS (6 PLACES)
▼2 AN/APN-12 RENDEZVOUS RADAR RECEIVER ANTENNAS (2 PLACES)
3 GLIDE SLOPE ANTENNA
4 SEARCH RADAR ANTENNA
5 VHF RADIO ANTENNA
▼6 AN/APN-12 RENDEZVOUS RADAR TRANSMITTING ANTENNA
7 RADIO COMPASS LOOP ANTENNA
8 UHF NAVIGATION RADIO (TACAN) ANTENNA TCTO 572
9 RADIO ALTIMETER ANTENNA (2 PLACES)
10 IFF ANTENNA
11 RADIO COMPASS SENSE ANTENNA
12 UHF RADIO ANTENNA
13 MARKER BEACON ANTENNA
▼14 AN/APN-76 RENDEZVOUS RADAR TRANSMITTER ANTENNA
15 LORAN TRAILING WIRE ANTENNA F
16 UHF/DF ANTENNA G 3178 ▶ PLUS TCTO 321
17 MF COMMAND RADIO ANTENNA G 17260 ▶ 3177 LESS TCTO KG211, LORAN ANTENNA G 17260 ▶ 3276 LESS TCTO KG513, AND BC-348 LIAISON RECEIVER ANTENNA G 17260 ▶ 3177 LESS TCTO KG513 AND TCTO KG206
▼18 RADAR BEACON ANTENNA
19 ARC-8 LIAISON RADIO ANTENNA F, ARC-21 OR ARC-65 LIAISON RADIO ANTENNA G, LORAN G 3277 ▶ PLUS TCTO KG513, BC-348 LIAISON RECEIVER ANTENNA G 3178 ▶ 3278 LESS TCTO KG206 PLUS TCTO KG513, AND ARR-36 LIAISON RECEIVER ANTENNA G 3279 ▶ PLUS TCTO KG513
20 MF COMMAND RADIO ANTENNA F AND G 3178 ▶ PLUS TCTO KG211
21 VHF NAVIGATION RADIO (OMNI) ANTENNA
▼22 AN/APN-76 RENDEZVOUS RADAR RECEIVER ANTENNA

ANTENNA LOCATIONS

Figure 4-39

EQUIPMENT	SYSTEM	AMP	TYPE	LOCATION
AN/APS-42 Search Radar				
Radar nav	DC	5	Circuit breaker	Radio rack
Radar nav	AC	15	G 17260 ▶ 22700 Fuse	Radio rack
		15	F & G 22701 ▶ Circuit breaker	Radio rack
Radar press	DC	5	Circuit breaker	Radio rack
Radar feed	AC	25	F G 1243 ▶ 22700 Fuse	AC power panel
		25	G 22701 ▶ Circuit breaker	AC power panel
801	AC	5	Fuse	Synch, unit, left front
802	AC	3	Fuse	Synch, unit, right front
401	AC	10	Fuse	RT unit, top
(NOTE: Fuse 401 is inactive on later sets)				
402	AC	8	Fuse	RT unit, middle
403	AC	3	Fuse	RT unit, bottom
AN/APN–12 Rendezvous Radar				
Intgtr	DC	5	Circuit breaker	Radio rack
Intgtr	AC	3	G 17260 ▶ 22700 Fuse	Radio rack
		5	F & G 22701 ▶ Circuit breaker	Radio rack
Radar feed	AC	25	F G 1243 ▶ 22700 Fuse	AC power panel
		25	G 22701 ▶ Circuit breaker	AC power panel
AN/APN–76 Rendezvous Radar				
Respndr	DC	5	Circuit breaker	Radio rack
Respndr	AC	3	G 17260 ▶ 22700 Fuse	Radio rack
		5	F & G 22701 ▶ Circuit breaker	Radio rack
Radar feed	AC	25	F G 1243 ▶ 22700 Fuse	AC power panel
		25	G 22701 ▶ Circuit breaker	AC power panel
AN/APN–69 Radar Beacon				
Rdz beacon	DC	5	Circuit Breaker	Radio rack
Rdz beacon	AC	10	G 17260 ▶ 22700 Fuse	Radio rack
		10	F & G 22701 ▶ Circuit breaker	Radio rack
Radar beacon APN-69	AC	15	G 17260 ▶ 22700 Fuse	Alternator relay shield
		15	F & G 22701 ▶ Circuit breaker	Alternator relay shield
Radio feed	AC	15	F G 1243 ▶ 22700 Fuse	AC power panel
		15	G 22701 ▶ Circuit breaker	AC power panel
Radar feed	AC	25	F G 1243 ▶ 22700 Fuse	AC power panel
		25	G 22701 ▶ Circuit breaker	AC power panel
501	DC	1	Fuse	Front RT unit
502	AC	4	Fuse	Front RT unit
503	AC	3	Fuse	Front RT unit
504	AC	3	Fuse	Front RT unit
Radio Altimeter				
Altimeter	AC	3	G 17260 ▶ 22700 Fuse	Radio rack
		5	F & G 22701 ▶ Circuit breaker	Radio rack
Radio feed	AC	15	F G 1243 ▶ 22700 Fuse	AC power panel
		15	G 22701 ▶ Circuit breaker	AC power panel
Line ampl	AC	1 1/2	Fuse	RT unit
B–3 Driftmeter F G 1243 ▶ 22628 Less TCTO K235				
Driftmeter	AC	1	F G 1243 ▶ 22628 Fuse	AC power panel
B–6A Driftmeter G 22629 ▶ Plus TCTO K235				
Driftmeter A	AC	2	G 22629 ▶ 3141 plus TCTO K235 Fuse	AC power panel
		2	G 3142 ▶ Fuse	Autopilot power panel
Driftmeter C	AC	2	G 22629 ▶ 3141 plus TCTO K235 Fuse	AC power panel
		2	G 3142 ▶ Fuse	Autopilot power panel

NAVIGATION EQUIPMENT CIRCUIT BREAKERS AND FUSES

Figure 4-40 (Sheet 1 of 2)

EQUIPMENT	SYSTEM	AMP	TYPE	LOCATION
AN/APN-9 Loran F				
Loran	DC	5	Circuit breaker	Radio rack
Radio feed	AC	15	Fuse	AC power panel
Loran	AC		Fuse	Radio rack
AN/APN-70 Loran G				
Loran	DC	5	G 17260 ▶ 22700 Circuit breaker	Radio rack
Rec ant	DC	5	G 22701 ▶ Circuit breaker	Radio rack
Loran	AC	5	G 17260 ▶ 22700 Fuse	Radio rack
		5	G 22701 ▶ Circuit breaker	Radio rack
Radio feed	AC	15	G 17260 ▶ 22700 Fuse	AC power panel
		15	G 22701 ▶ Circuit breaker	AC power panel
Periscopic Sextant G 2860 ▶ Plus tcto 133	DC	5	Circuit breaker	Overhead circuit breaker panel
AN/ARN-14 VHF Navigation Radio (OMNI)				
OMNI Rec		10	Circuit breaker	Aft radio rack (tail cone)
OMNI test		5	Circuit breaker	Aft radio rack (tail cone)
Emp-gnd blower & VOR	DC	35	Circuit breaker	Aft power panel
OBD–VOR nav without tcto 572	DC	5	Circuit breaker	Radio rack
VOR–ILS nav with tcto 572	DC	5	Circuit breaker	Radio rack
AN/ARN-21 UHF Navigation Radio (TACAN) tcto 572				
Tacan	AC	5	G 22701 ▶ Circuit breaker	Radio rack
		5	F G 1243 ▶ 22700 Fuse	Radio rack
Tacan	DC	5	Circuit breaker	Radio rack
VOR–ILS nav	DC	5	Circuit breaker	Radio rack
AN/ARN-6 Radio Compass				
No. 1 compass	DC	5	Circuit breaker	Radio rack
Outside Air Temperature Gage, Temp cabin, OAT and heaters	DC	5	Circuit breaker	Overhead circuit breaker panel
N-1 compass				
Autopilot repeat	AC	3	F G 1243 ▶ 22700 Fuse	AC power panel
		5	G 22701 ▶ Circuit breaker	AC power panel
Autopilot A	AC	5	F G 1243 ▶ 22700 Fuse	AC power panel
		5	G 22701 ▶ 3177 Circuit breaker	AC power panel
		5	G 3178 ▶ Circuit breaker	Autopilot power panel
Autopilot C	AC	5	F G 1243 ▶ 22700 Fuse	AC power panel
		5	G 22701 ▶ 3177 Circuit breaker	AC power panel
		5	G 3178 ▶ Circuit breaker	Autopilot power panel
Autopilot	DC	10	Circuit breaker	Overhead circuit breaker panel
Autopilot inv	DC	5	Circuit breaker	Overhead circuit breaker panel
Panel Lights				
Panel lights	DC	5	Circuit breaker	Radio rack
Nav Table and Instrument Lights Control Cabin				
Left red–white	DC	15	Circuit breaker	Overhead circuit breaker panel

Figure 4-40 (Sheet 2 of 2)

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Taxi	2	On fuselage nose and nose landing gear	Overhead panel	Overhead panel (Same as switch)
Passing Light (Red)	1	On fuselage nose	Overhead panel	Overhead panel (Same as switch)
Landing	2	Under each outboard wing aft of rear spar	Control stand	Overhead panel and Main C/B panel
Navigation	6	Wing tips, tail cone, top and bottom of fuselage	*Two switches on overhead panel	Overhead panel
Formation	9	Three on the upper surface of each wing, three on top of fuselage	Overhead panel	Overhead panel
Wing Illumination	2	One on each side of fuselage	Overhead panel	Overhead panel (Same as switch)
Anti-Collision TCTO 591	8	Top and bottom of fuselage, opposite wing leading edge	Overhead panel	Overhead panel (lights) AC power panel (motors)
▼ **Boom Marking**	4	In boom nozzle hood	Two switches on boom operator's panel	Boom operator's panel
▼ **Boom Nozzle**	2	In boom nozzle hood	Two switch type rheostats on boom operator's panel	Boom operator's panel
▼ **Boom Chock**	1	Beside boom stowing chock	Boom operator's panel	Boom operator's panel (Same as switch)
▼ **Receiver Director Sta. 350** ▼ **Receiver Director Sta. 750** TCTO K526	10 18	Fuselage underside	Boom operator's panel	Boom operator's panel
▼ **Inboard Nacelle Underwing**	4	Fuselage underside	Boom operator's panel	Boom operator's panel
▼ **Outboard Nacelle Underwing**	2	Fuselage underside	Boom operator's panel	Boom operator's panel
▼ **Underbody**	1	Fuselage underside	Boom operator's panel	Boom operator's panel
Wheel Well	3	One in each wheel well	Overhead panel	Overhead panel (Same as switch)
▼ **Rendezvous Beacon** G 3196 ▶ PLUS TCTO K231	2	Tail cone	Boom operator's panel	Boom operator's panel

NOTE: *Lights on wing and tail can be set for STEADY or FLASH; lights on fuselage remain on STEADY at all times lights are on.

EXTERIOR LIGHTING

Figure 4-41

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Pilots' . . .				
Pilots' Instrument Panel (Right Side White)	3	Top of panel under crash pad hood	**Switch type rheostat on copilot's auxiliary panel	Overhead panel
Pilots' Instrument Panel (Right Side Red)	4	Top of panel under crash pad hood	Switch type rheostat on copilot's auxiliary panel	Overhead panel
Pilots' Instrument Panel (Left Side White)	3	Top of panel under crash pad hood	**Switch type rheostat on pilot's auxiliary panel	Overhead panel
Pilots' Instrument Panel (Left Side Red)	4	Top of panel under crash pad hood	Switch type rheostat on pilot's auxiliary panel	Overhead panel
Pilots' Instrument Panel (Center White)	4	Top of panel under crash pad hood	**Switch type rheostat on overhead panel	Overhead panel
● **Pilot's Instrument Panel (Center Red)**	5	Top of panel under crash pad hood	Switch type rheostat on overhead panel	Overhead panel
Pilots' Control Column (Red)	2	Top forward side of control column	Same rheostat used for pilots' instrument panel left side red lights	Overhead panel
Copilot's Control Column (Red)	2	Top forward side of control column	Same rheostat used for pilots' instrument panel right side red lights	Overhead panel
Copilot's Auxiliary Panel (Red)	3	In tube at top of auxiliary panel	Switch type rheostat on copilot's auxiliary panel	Overhead panel
Pilot's Auxiliary Panel (Red)	3	In tube at top of auxiliary panel	Switch type rheostat on pilot's auxiliary panel	Overhead panel
Pilot's Dome (White)	1	Overhead	**Switch on pilot's auxiliary panel	Overhead panel
Copilot's Dome (White)	1	Overhead	**Switch on copilot's auxiliary panel	Overhead panel
● **Pilot's Map. (Red or White)**	1	Left side of overhead panel	Switch type rheostat on side of overhead panel	Overhead panel
● **Copilot's Map. (Red or White)**	1	Right side of overhead panel	Switch type rheostat on side of overhead panel	Overhead panel
● **B-16 Compass Panel (Red)**	1	Right side of pilots' instrument panel	Switch type rheostat on overhead panel	Overhead panel
Overhead Panel (White)	5	Vertical step portion of the panel sections	**Switch type rheostat on overhead panel	Overhead panel
● **Overhead Panel (Red)**	7	Vertical step portion of the panel sections	Switch type rheostat on overhead panel	Radio junction box
● **Pilot's and Copilot's Interphone Filter**	2	On filters	Same rheostat on overhead panel as for red overhead panel lights	Overhead panel
Pilot's and Copilot's Electronic Control Panel	F 21 G 22	On control panels for interphone, radio compass, VHF radio, liaison, UHF radio, and VHF navigation radio	Same rheostat on overhead panel as for control stand lights	Radio junction box
	G 2901▶ 6	On control panels for IFF and auxiliary liaison receiver	Same rheostat used for red overhead panel lights	Overhead panel

INTERIOR LIGHTING

Figure 4-42 (Sheet 1 of 5)

Navigator's . . .

Navigator's Table Flood G 3178 ▶	6 red 3 white	Over navigator's table, under Instrument mount	RED--OFF--WHITE switch and switch type rheostat on navigator's interphone and light panel	Overhead panel
Navigator's Table Work	1 white	Over navigator's table	Switch type rheostat on navigator's instrument panel and interphone and light panel	Overhead panel
Navigator's Instrument F G 1243 ▶ 3177	4 red 3 white	In shield above and below instrument panel	***RED--OFF--WHITE switch and switch type rheostat on navigator's instrument panel and auxiliary panel	Overhead panel
Navigator's Instrument Panel Flood G 3178 ▶	2 red 1 white	In shield above instrument panel	RED--OFF--WHITE switch and switch type rheostat on navigator's interphone and light panel	Overhead panel
Navigator's Instrument G 3178 ▶	14	In individual instruments	Switch type rheostat on navigator's interphone and light panel	Overhead panel
Navigator's Radio Panel F G 1243 ▶ 3177	3 red 2 white	In light shield below panel	***RED--WHITE switch and switch type rheostat on navigator's radio panel	Overhead panel
Navigator's Electronic Panel F G 1243 ▶ 3177	21 to 27	On control panels for interphone, radio compass, and IFF	Switch type rheostat on navigator's instrument	Radio junction box
Navigator's Radio Panel G 3178 ▶		In individual electronic equipment	Switch typre rheostat on navigator's interphone and light panel	Radio junction box
Navigator's Auxiliary G 3178 ▶	2 white	On aft end of instrument panel flood shield over oxygen regulator	Instrument panel flood switch type rheostat on navigator's interphone and light panel	Overhead panel

INTERIOR LIGHTING (CONT)

Figure 4-42 (Sheet 2 of 5)

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Engineer's . . .				
Engineer's Table (White)	2	Over the engineer's table; under engineer's instrument panel	F Switch and switch type rheostat on engineer's instrument panel G Switch and switch type rheostat on engineer's auxiliary overhead panel	Overhead panel
Engineer's Table (Red)	3	Over the engineer's table; under engineer's instrument panel	F Switch and switch type rheostat on engineer's instrument panel G Switch and switch type rheostat on engineer's auxiliary overhead panel	Overhead panel
Engineer's Instrument Spot (Red or White)	1	On support post at engineer's station and ceiling	F Switch type rheostat on engineer's instrument panel G Switch and switch type rheostat on engineer's auxiliary overhead panel	Overhead panel
Engineer's Instrument Flood (Red)	1	At ceiling near center of fuselage	F 1375 ▶ Switch type rheostat on engineer's instrument panel G Switch and switch type rheostat on engineer's auxiliary overhead panel	Overhead panel
● **Engineer's Dome (Red and White)**	1 each	Overhead at engineer's station	F 1243 ▶ 1371 Switch type rheostat on overhead panel F 1372 ▶ switch and switch type rheostat on engineer's instrument panel G 17260 ▶Switch and switch type rheostat on engineer's auxiliary panel	Overhead panel
● **Overhead Panel Spot (Red or White)**	2	On right and left side of control stand	Switch and switch type rheostat on engineer's auxiliary overhead panel	Overhead panel
▼ **Engineer's A/R Panel Lights (Red and White)**	1 each	Above engineer's auxiliary panel	F Rheostat and color switch on engineer's A/R panel G Rheostat and color switch on engineer's auxiliary overhead panel	Overhead panel
● **Engineer's Interphone Control Panel**	4	On interphone control panel	F Same switch and switch type rheostat on engineer's instrument panel as for engineer's instrument panel spot lights G Same switch and switch type rheostat on engineer's auxiliary overhead panel as for engineer's instrument panel spot lights	Overhead panel

Figure 4-42 (Sheet 3 of 5)

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Boom Operator's . . .				
▼ **Boom Operator's Dome Lights (Same as Main Compartment Dome Lights)**				
▼ **Boom Operator's Spotlights (Red or White)**	2	Right and left of boom operator's station	Color switch on boom operator's panel	Boom operator's panel
▼ **Boom Operator's Panel Lights (White)**	4	Forward edges of boom operator's panel	Switch type rheostat and color switch on boom operator's panel	Boom operator's panel
▼ **Boom Operator's Panel Lights (Red)**	7	Forward and aft edges of boom operator's panel	Switch type rheostat and color switch on boom operator's panel	Boom operator's panel
▼ **Boom Operator's Oxygen Panel Floodlights (Red)** F G 1279 ▶ 22806	2	Right and left side of boom operator compartment	Switch type rheostat on boom operator's panel	Boom operator's panel
▼ **Boom Operator's Oxygen Panel Floodlights (Red)** G 3106 ▶	1	Left side of boom operator's compartment	Switch type rheostat on boom operator's panel	Boom operator's panel
Compartment . . .				
▲ **Main Compartment Fluorescent** F G 1243 ▶ 3267	14	Overhead	*Adjacent to each right side light for five forward lights; adjacent to each left side light for two aft lights	AC power panel
▲ **Lower Compartments Fluorescent** F G 1243 ▶ 3267	6	Overhead, 2 in lower forward and 4 in lower aft compartments	Adjacent to lights	AC power panel
Main Compartment Dome Lights	9	Overhead	One rheostat switch on right side of fuselage for each three lights; also one switch near control cabin door, one switch on right side of fuselage aft section and one switch on boom operator's panel each controlling all nine lights	Main circuit breaker panel
Lower Forward Compartment Dome	2	Overhead	Overhead in lower forward compartment adjacent to hatch	Forward power panel
Lower Aft Compartment Dome	3	Overhead	Overhead in aft compartment	Main circuit breaker panel

INTERIOR LIGHTING (CONT)

Figure 4-42 (Sheet 4 of 5)

LIGHTS	QUANTITY	LOCATION	SWITCH LOCATION	CIRCUIT BREAKER
Compartment . . . (Cont)				
Stowage Compartment Dome	1	Overhead	Overhead in stowage compartment	Main circuit breaker panel
Tail Compartment Dome	2	Overhead	Forward side of pressure bulkhead on LH side above tail compartment access door	Main circuit breaker panel
Lower Nose Compartment	2	Overhead	Switch adjacent to light aft of hatch	Forward power panel
Spot Extension	2	One at auxiliary power unit and one in lower nose compartment	Switch on light	Forward power panel
Control Cabin Miscellaneous . . .				
Entrance	1 white	Overhead in control cabin	One at top of ladder in lower forward compartment and one in control cabin adjacent to the entrance light	Forward power panel
Aft Cabin Dome	2 red 1 white	Overhead in control cabin	***ON--OFF switch on navigator's auxiliary panel or support bracket for auxiliary liaison transmitter at control cabin bulkhead	Overhead panel
Dais Step	2 red	One under navigator's table and one near bottom of back side of engineer's panel	On overhead panel	Overhead panel
Toilet Compartment Dome	1 red 1 white	Overhead in toilet compartment	***In toilet compartment	Overhead panel

NOTE

* The master light switch at the aft side of control cabin door must be ON to operate these lights

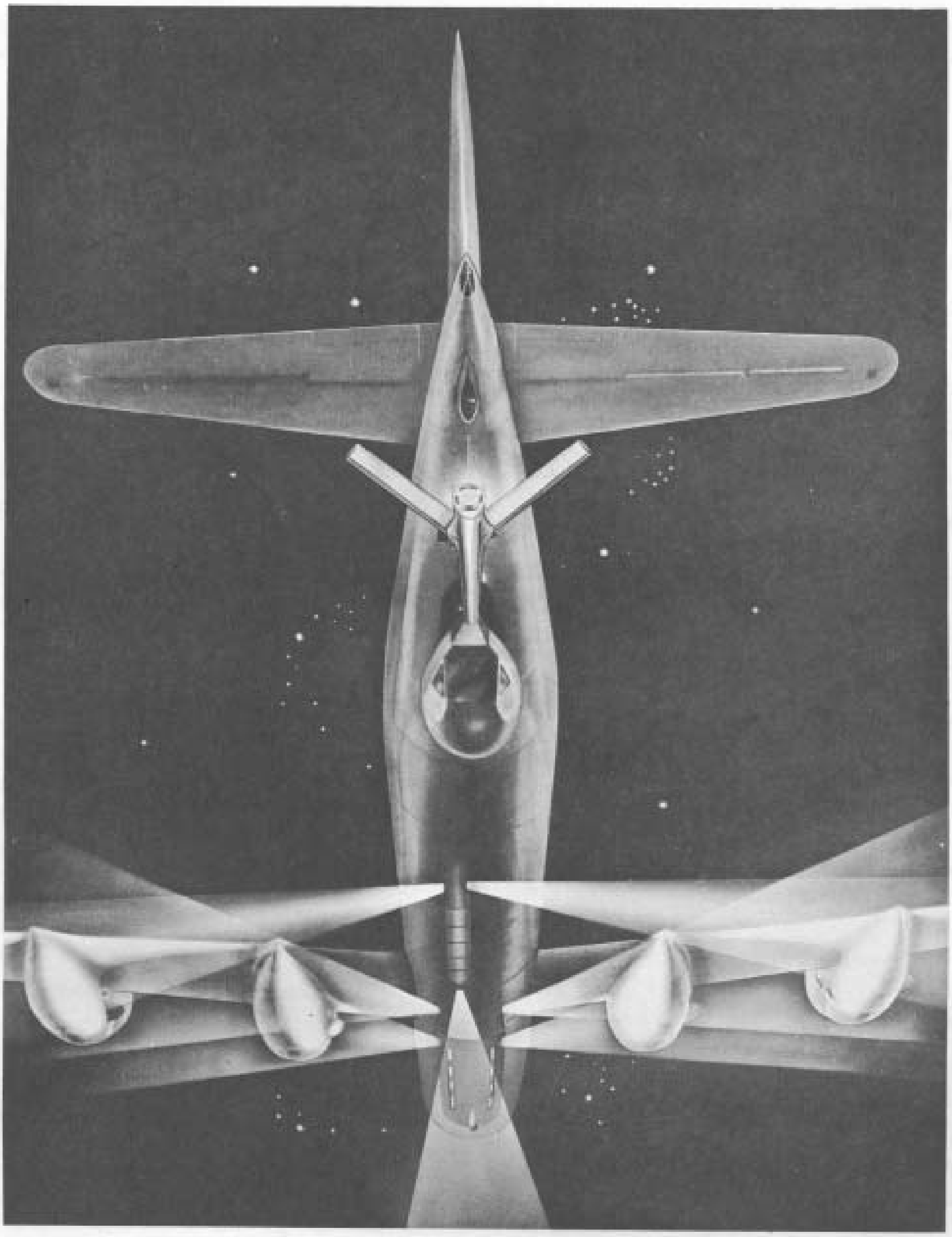
** Lights will illuminate to full intensity regardless of rheostat position when a master control cab lights switch on the overhead panel is positioned to WHITE BRIGHT

*** White lights will illuminate only when the master control cab aft light switch on the overhead panel is positioned to AFT WHITE

● On airplanes G 2930 ▶plus those incorporating TCTO 239 these lights can be operated from battery power when the gyro instrument emergency power switch is in the BATTERY position

▲ Fluorescent lights are inoperative when the airplane is in the tanker configuration

Figure 4-42 (Sheet 5 of 5)



Lighted Area as Seen From Receiver Airplane

A/R FLOODLIGHTS ILLUMINATION ▽

Figure 4-43

LIGHTING EQUIPMENT

EXTERIOR LIGHTS

The exterior lights all operate on DC power. See figure 4-41 for a listing of the lights, their locations and their switch and circuit breaker locations. A special group of exterior lights is provided for underbody illumination during night A/R missions. Figure 4-43 shows tanker A/R floodlighting as seen from a receiver airplane. On airplanes with TCTO 591 incorporated, two sets of anti-collision lights, one set on top and one set on bottom, are mounted on the fuselage opposite the wing leading edge. These lights are used as anti-collision and rendezvous lights.

NOTE

TCTO 591

- The anti-collision lights should be turned OFF during flights through conditions of reduced visibility where the pilot could experience vertigo as a result of the rotating reflections of the lights against the clouds. In addition, the lights would be ineffective as anti-collision lights during these conditions since they could not be observed by pilots of other airplanes.

TCTO 591

- To prevent blistering or melting the fairing due to excessive heat from the anti-collision lights, do not operate these lights for more than 5 minutes while the airplane is on the ground.

TCTO 591

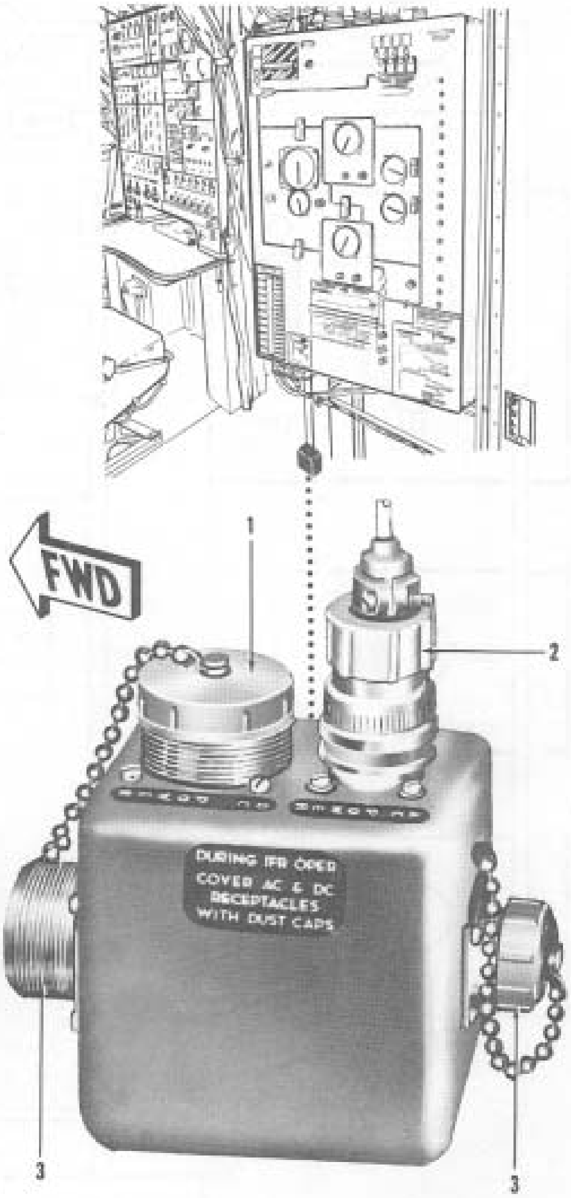
- The anti-collision lights operate on DC power. The motors driving the rotating light assembly operate on AC power from the secondary inverter. Therefore the secondary inverter switch must be in SEC INV during operation of the anti-collision lights on the ground or in flight.

INTERIOR LIGHTS

See figure 4-42 for a listing of interior lights, their locations and their switch and circuit breaker locations. A box of spare lamps is mounted on the aft left side of the control cabin bulkhead. Only the fluorescent lights operate on AC power. (See figure 4-44.)

NOTE

Airplanes G 3268 ▶ do not have fluorescent lights, and on all other airplanes, the fluorescent lights are inoperative when the airplane is in the tanker configuration.

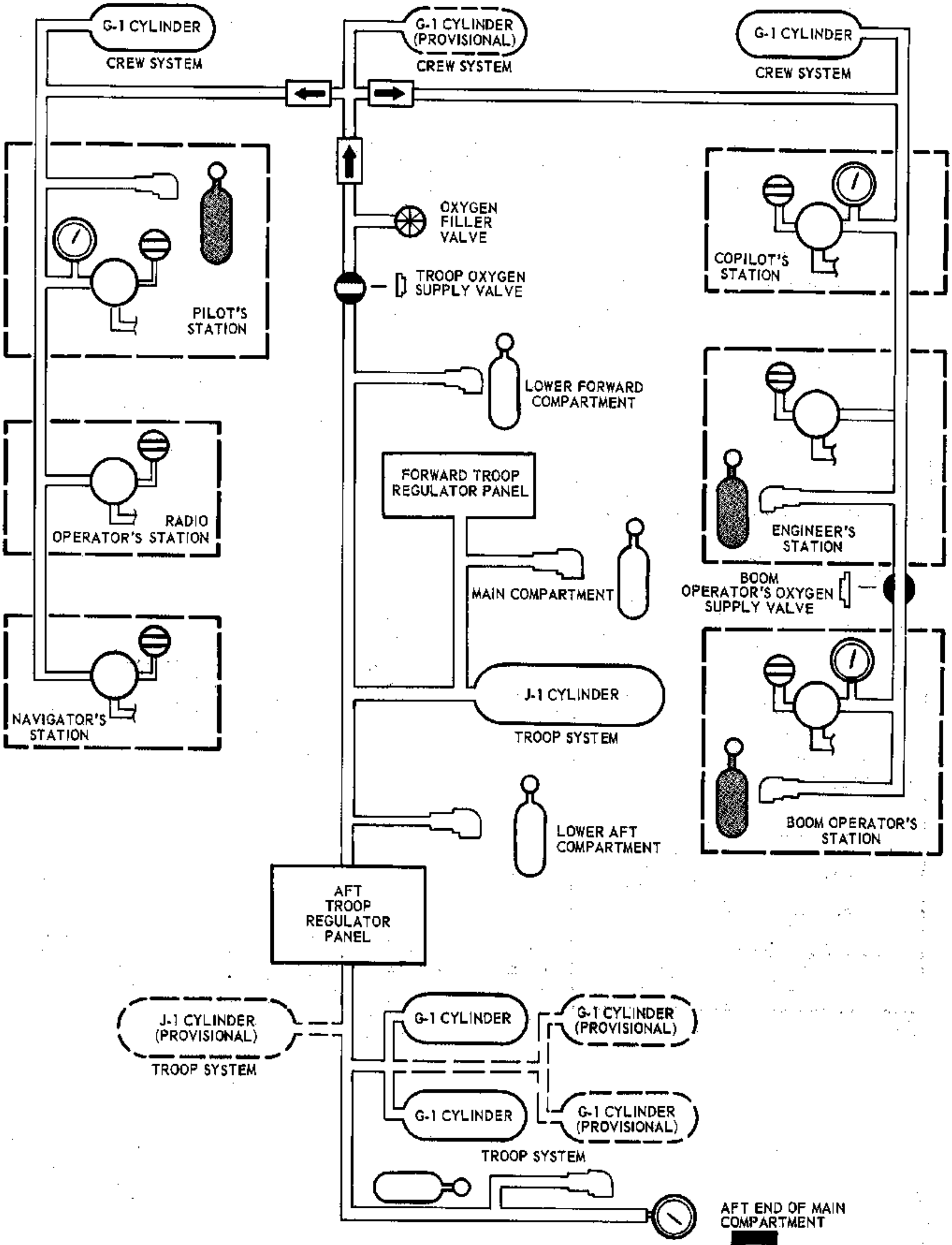


NOTE:
To transfer power from the engineer's A/R panel to the fluorescent light box, unscrew the two cannon plugs on the bottom of the engineer's A/R panel and attach them to the two receptacles on top of the fluorescent light box. This transfer should be made with power off.

1 DC POWER RECEPTACLE
2 AC POWER RECEPTACLE
3 DUMMY RECEPTACLE (2 PLACES)

FLUORESCENT LIGHT BOX

Figure 4-44



OXYGEN SYSTEM

Figure 4-45 (Sheet 1 of 2)

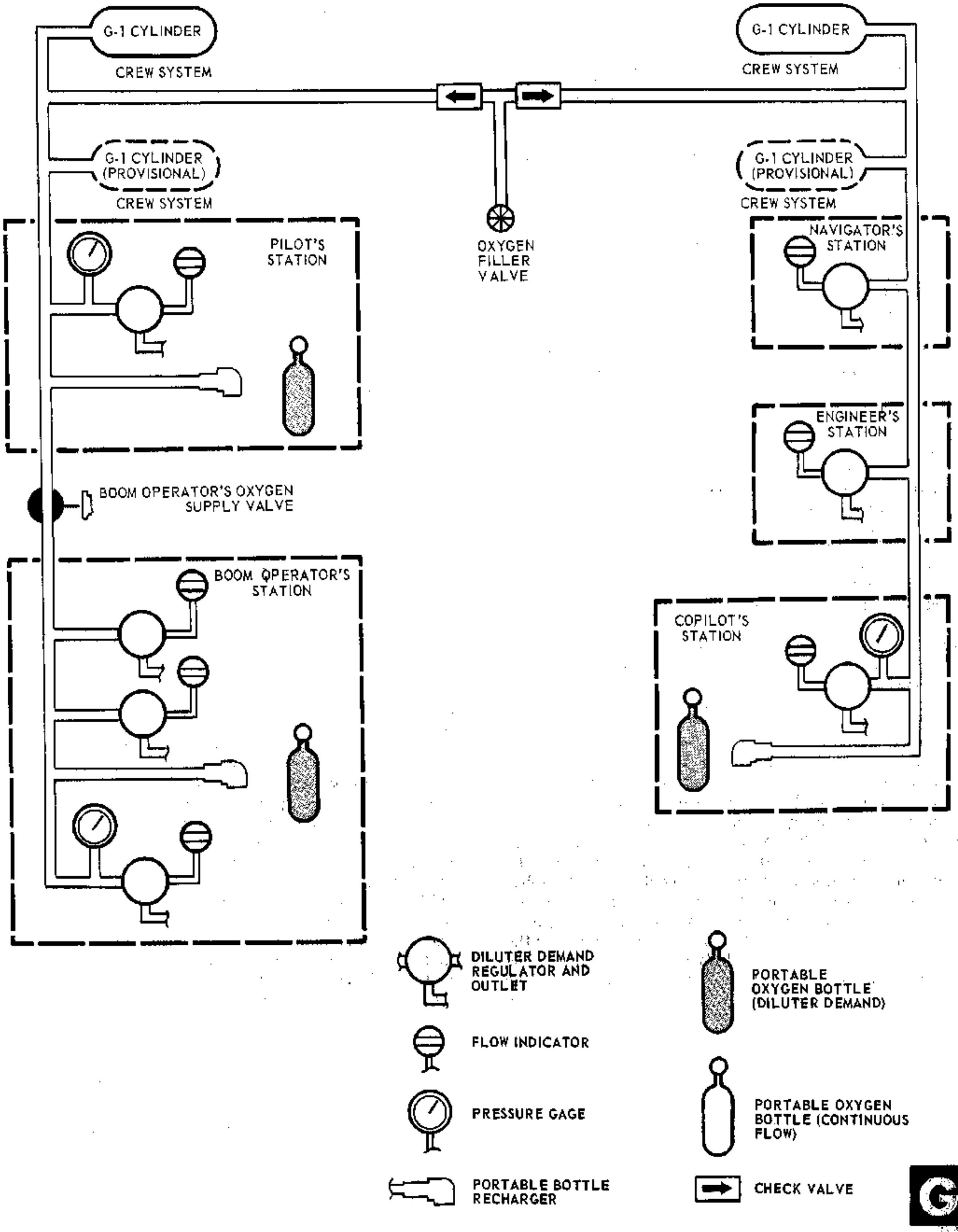


Figure 4-45 (Sheet 2 of 2)

OXYGEN SYSTEM

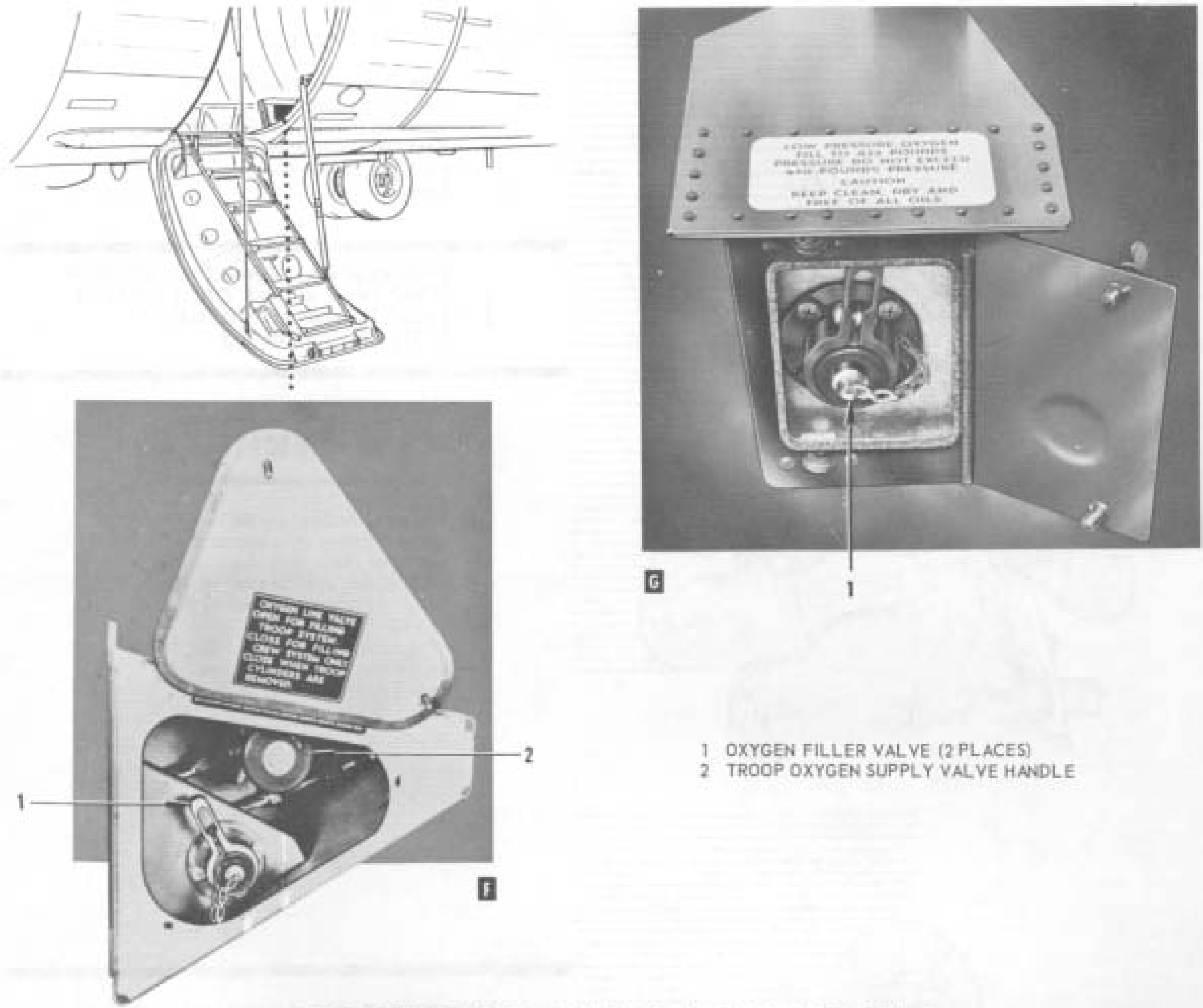
The 400-psi gaseous oxygen system consists of the following components; an oxygen filler valve (1, figure 4-46) located in the lower forward compartment just aft of the forward entry door, oxygen supply cylinders, oxygen regulators, oxygen pressure gages and oxygen flow indicators. A pressure of 450 psi should not be exceeded when filling the oxygen system to 425 psi. Before takeoff a minimum of 400 psi system pressure is required.

F

The oxygen system on F airplanes consists of two complete systems, a crew oxygen system and a troop oxygen system, separated by the troop oxygen supply valve. (See figure 4-45.) The oxygen filler valve is used to service both systems. The crew oxygen system is divided into two separate systems by the use of two check valves, one mounted on each of the two G-1 cylinders which normally supply crew oxygen. The check valves allow the oxygen of one cylinder to be used by the pilot, navigator and radio operator and the oxygen of the other cylinder to be used by the copilot, engineer, and (when the boom operator's oxygen supply valve in the boom operator's line is open) to the boom operator. These two G-1 cylinders of the crew systems are located in the lower nose compartment. Provision is also made for the installation of an additional G-1 cylinder near the top and to the rear of the control cabin if additional oxygen is needed for the crew systems. A check valve is not used with this cylinder. However, another check valve is mounted in the oxygen filler line between this cylinder and the oxygen filler valve, which allows this cylinder to be filled and permits its oxygen to be used in both of the crew systems. This check valve in the crew filler line allows the crew systems to utilize the oxygen of the troop system (when the troop oxygen supply valve is open), but automatically prevents the oxygen of the crew systems from going back into the troop system at any time. A pressure gage, a blinker type flow indicator, and a diluter-demand regulator are located at crew stations as shown in figure 4-45. Six portable oxygen bottles are provided as shown in figure 3-1. In the control cabin one portable bottle and recharger assembly are on the pilot's auxiliary panel and one portable bottle and recharger assembly are forward of the engineer's instrument panel. In the main compartment one bottle is on the ceiling near the forward bulkhead and one on the right side near the tail. Two more portable bottles are located in the lower compartments; one on the left hand side of the lower forward compartment, another on the left hand side of the lower aft compartment. Passengers, troops, or litter patients are supplied by one Type J-1 and two Type G-1 oxygen cylinders. Space provision has been allowed for an additional Type J-1 and two additional Type G-1 oxygen cylinders as required for any special mission. A pressure indicator for the troop oxygen system is located on the right aft wall of the main compartment. A continuous flow portable oxygen unit and recharger facilities are provided at the forward and aft ends of the main compartment, in the lower forward compartment and in the lower aft compartment. Continuous flow regulators provide outlets for each troop and litter station as well as the toilet compartment. Continuous flow oxygen mask containers are installed throughout the main, lower forward and lower aft compartments. The passenger regulators are automatic and supply the proper amount of oxygen required with altitude. Only continuous flow oxygen masks will be used. The approximate oxygen duration in man hours are shown in figure 4-48.

G

The oxygen system on G airplanes consists of two completely independent systems. One system supplies the navigator, engineer, and copilot. The other system supplies the pilot, and on tanker configuration airplanes, the boom operator, boom instructor, and boom trainee. The pilot can be isolated in his system by a line shutoff valve. On airplanes G 17260 ▶ 3177, no oxygen outlet is provided for the radio operator, therefore he must utilize a walk-around bottle, provided at the pilot's and copilot's stations, in the event use of oxygen becomes necessary. Two G-1 cylinders, one for each system, are located in the lower nose compartment. Provision is also made for the installation of two additional G-1 cylinders near the top of the lower nose compartment if the additional oxygen is needed for the crew systems. These cylinders, when installed, are also filled from the oxygen filler valve. On cargo airplanes, a blinker type flow indicator and a diluter-demand regulator are provided for at each crew station. In addition to the aforementioned equipment, the pilot and copilot have an oxygen pressure gage provided for at their stations. On tanker airplanes, a blinker type flow indicator and a diluter-demand regulator exist at all crew stations including the boom operator and two assistants. The pilot, copilot, and boom operator have an oxygen pressure gage at their stations in addition to the normal equipment on these airplanes. Portable oxygen bottles are provided as shown in figure 3-1. In the control cabin, one portable bottle and recharger assembly are on the pilot's auxiliary panel, and one portable bottle and recharger assembly are forward of the engineer's instrument panel. On T airplanes, a third portable bottle and recharger assembly is located forward of the boom operator's panel. Approximate oxygen duration in manhours is shown in figure 4-48.



1 OXYGEN FILLER VALVE (2 PLACES)
2 TROOP OXYGEN SUPPLY VALVE HANDLE

OXYGEN FILLER VALVE

Figure 4-46

OXYGEN EQUIPMENT

Regulator Diluter Lever

A NORMAL OXYGEN--100 % OXYGEN lever is located on each oxygen regulator. With the lever in the NORMAL OXYGEN position, the regulator automatically supplies the proper mixture of oxygen and air to the user up to a cabin altitude of 34,000 feet. Above 34,000 feet cabin altitude 100% pure oxygen is supplied to the user. With the lever in the 100% OXYGEN position, the air intake port is closed and pure oxygen is supplied to the user for emergency use. The diluter lever is left in the NORMAL position except when treating for hypoxia, shock, noxious fumes or for denitrogenation.

Regulator Emergency Valve Knob

An emergency valve knob (16, figure 1-11) is provided on the regulator and is always safety-wired closed. This valve, when opened, supplies a continuous flow of 100% oxygen to the mask for emergency use.

NOTE

This illustration shows the procedure for connecting the oxygen hose and does not necessarily reflect the type of head gear, oxygen mask and oxygen mask straps to be used.

1 WRAP MASK MALE CONNECTOR TIE-DOWN STRAP TWICE AROUND CHEST STRAP AS CLOSE TO SNAP AS POSSIBLE, AND FASTEN TO CONNECTOR

WARNING

- Failure to double loop the connector tie-down strap around the parachute chest strap may permit the tie-down strap to slip into and open the chest strap snap during egress.
- Do not wrap the tie-down strap around the chest strap snap.

2 CONNECT HOSE, LISTEN FOR CLICK AND CHECK THAT SEALING GASKET IS ONLY HALF EXPOSED

OXYGEN HOSE CONNECTION

Figure 4-47 (Sheet 1 of 2)

3 ATTACH ALLIGATOR CLIP TO THE END OF THE MASK MALE CONNECTOR STRAP

WARNING

Do not attach alligator clip to the parachute harness as this may prevent quick separation during egress. The force required to pull the clip loose from the parachute harness is considerably greater than from the tie-down strap.

4 PUT ON OXYGEN MASK AND CHECK OXYGEN FLOW INDICATOR
ATTACH BAILOUT BOTTLE HOSE TO MALE CONNECTOR (IF CARRIED)

Figure 4-47 (Sheet 2 of 2)

Troop Oxygen Supply Valve Handle F

Rotating this valve handle (2, figure 4-46) in the counterclockwise direction opens the valve and allows simultaneous recharging of the complete oxygen system, and also permits the crew to draw oxygen from the troop system. This valve is normally closed to prevent oxygen flow from the troop section to the crew sections of the oxygen system. The troop oxygen supply valve handle is located next to the oxygen system filler valve in the lower forward compartment just aft of the forward entry door.

Boom Operator's Oxygen Supply Valve

F

On F airplanes this handle operated valve is above the control cabin door and is in the oxygen line of the system which supplies the copilot. When opened, this valve allows the boom operator to use oxygen from the copilot's oxygen system. When the valve is closed, no oxygen will flow to the boom station.

G

On G airplanes this handle operated valve is above the control cabin door and is in the oxygen line of the system which supplies the pilot. When opened, this valve allows the boom operator, boom instructor, and boom trainee to use oxygen from the pilot's oxygen system. When the valve is closed, no oxygen will flow to these boom stations.

Oxygen Pressure Gages

Oxygen pressure gages (13, figure 1-11) are provided at the pilot's and copilot's station on all airplanes, and also at the boom operator's station on Tanker airplanes. The gages indicate system pressure in psi.

Oxygen Flow Indicators

A blinker-type oxygen flow indicator (12, figure 1-11) is provided near each crew member's oxygen regulator unit. Opening and closing of luminescent segments as the crew member breathes indicates normal flow of oxygen.

OXYGEN SYSTEM NORMAL OPERATION

Oxygen Equipment Check

NOTE

> The following procedure applies to each member unless otherwise noted.

1. Oxygen Pressure - 400 psi (minimum) (P, CP, BO)
2. Oxygen Hose - Blow gently into end of hose

If there is a resistance to blowing, the regulator is satisfactory, little or no resistance indicates a faulty demand diaphragm, diluter air valve or leaking mask to regulator hose.

WARNING

> When performing the oxygen equipment check at low ambient temperatures, caution must be observed when blowing into the end of the oxygen hose. At temperatures near or below freezing the cold metal connector on the end of the oxygen tubing may stick to the operator's lips causing injury.

3. Mask - Don and connect mask hose to regulator
4. Diluter Lever - NORMAL, check for free flow of oxygen
5. Diluter Lever - 100% OXYGEN, check for free flow of oxygen
6. Diluter Lever - NORMAL
7. Emergency Valve - Closed and safetied
8. Mask - Remove and stowed
9. Oxygen Bottle - Serviced (if applicable) (BO)

In Flight

The regulator diluter lever on each crew member's pressure regulator should be in the NORMAL OXYGEN position except when operating under emergency conditions. On F airplanes, when the passengers use oxygen, a proper flow is automatically provided to the mask when the mask bayonet is attached to the oxygen outlet coupling. The coupling will automatically close when the mask bayonet is removed.

Heavy Figures Indicate Diluter Lever 100%
Light Figures Indicate Diluter Lever NORMAL

Oxygen Duration
-MAN HOURS

Crew

Cylinders: 1 Type G-1

CABIN ALTITUDE—FEET	GAGE PRESSURE—PSI 400	350	300	250	200	150	100	BELOW 100
30,000	**4.2** 4.5	**3.6** 3.9	**3.0** 3.3	**2.4** 2.7	**1.8** 1.8	**1.2** 1.2	**0.6** 0.6	**EMERGENCY** **Descend to Altitude Not Requiring Oxygen**
25,000	**3.3** 4.2	**3.0** 3.6	**2.4** 3.0	**1.8** 2.4	**1.5** 1.8	**0.9** 1.2	**0.6** 0.6	
20,000	**2.4** 4.8	**2.1** 3.9	**1.8** 3.3	**1.5** 2.7	**1.2** 2.1	**0.6** 1.2	**0.3** 0.6	
15,000	**2.1** 5.7	**1.8** 4.8	**1.5** 4.2	**1.2** 3.3	**0.9** 2.4	**0.6** 1.5	**0.3** 0.9	
10,000	**1.5** 7.5	**1.5** 6.6	**1.2** 5.4	**0.9** 4.2	**0.6** 3.3	**0.3** 2.1	**0.3** 1.2	

Oxygen Duration
-MAN HOURS

Passenger

Cylinders: 1 Type J-1
2 Type G-1

CABIN ALTITUDE—FEET	GAGE PRESSURE—PSI 400	350	300	250	200	150	100	BELOW 100
30,000	60	52	43	34	26	17	9	**EMERGENCY** **Descend to Altitude Not Requiring Oxygen**
25,000	66	56	47	38	28	19	9	
20,000	72	62	52	41	31	21	10	
15,000	80	69	57	46	34	23	11	
10,000	90	77	64	51	39	26	13	

NOTE

- To find the oxygen duration for a crew of three using oxygen from one type G-1 cylinder, divide oxygen man hours in upper chart by three.
- As an airplane ascends to high altitudes, where the temperature is normally quite low, the oxygen cylinders become chilled. As the cylinders grow colder, the oxygen gage pressure is reduced, sometimes rather rapidly. With a 100°F decrease in temperature in the cylinders the gage pressure can be expected to drop 20 percent. This rapid fall in pressure is occasionally a cause of unnecessary alarm. All the oxygen is still there, and as the airplane descends to warmer altitudes, the pressure will tend to rise again, so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the airplane is in level flight, or while it is descending, is not ordinarily due to falling temperature, of course. When this happens, leakage or loss of oxygen must be suspected.

OXYGEN DURATION

Figure 4-48

OXYGEN SYSTEM EMERGENCY OPERATION

With symtoms of hypoxia, or if smoke or fumes should enter the cabin, set the regulator diluter lever to 100% OXYGEN. If the regulator becomes inoperative, open the emergency valve by turning the red emergency knob counterclockwise.

WARNING

When the regulator diluter lever is placed in the 100% OXYGEN position or the emergency valve control knob is turned on, inform the pilot immediately because these actions will substantially reduce the duration of oxygen.

If the oxygen regulator becomes completely inoperative, disconnect the mask from the oxygen system and connect to a portable bottle.

WARNING

If the regulator becomes completely inoperative, the pilot should be informed immediately so that he can descend to an altitude not requiring oxygen.

AUTOPILOT

The airplane is equipped with a type F-1 electrically operated autopilot. The autopilot, when engaged, provides a system of automatic control which holds the airplane on any selected magnetic heading and returns it to this heading when momentary displacements occur, and simultaneously keeps the airplane stabilized in pitch and bank. While under autopilot control, the airplane can be made to climb, dive, and execute coordinated turns. Power for operation of the autopilot is provided by the autopilot inverter system. The autopilot inverter must be operating before the autopilot can be used. The DC control circuit is protected by a circuit breaker on the overhead circuit breaker panel (figure 1-35). Circuit protection is provided for the operating power circuits on the AC power panel (figure 1-35).

AUTOPILOT EQUIPMENT

N-1 Compass System

The N-1 compass system provides directional signals for autopilot control. The autopilot may be used during either slaved magnetic operation or directional indicator operation. See N-1 COMPASS SYSTEM OPERATION in this Section.

Copilot's Turn and Slip Indicator

The copilot's turn and slip indicator (18, figure 1-9), which is calibrated for two minute turns and functions as a rate control gyro unit, is located on the right side of the pilots' instrument panel, and automatically transmits a rate of turn signal to the rudder servo to stabilize the airplane in yaw. The unit serves as a conventional turn and slip indicator when the autopilot inverter is operating, even though the autopilot is not energized.

Copilot's Attitude Indicator

The copilot attitude indicator (14, figure 1-9), which functions as a vertical gyro control unit, is located on the right side of the pilots' instrument panel, and automatically transmits signals to the aileron and elevator servos, returning the airplane to the proper attitude in pitch or roll whenever displacement occurs with reference to the vertical seeking gyro. A caging knob located on the lower right corner of the unit is used to erect the axis of the gyros in the vertical gyro control unit and the remote gyro flux gage compass to the vertical axis of the airplane. When the autopilot is energized, but not engaged, the vertical gyro control unit serves as a conventional attitude indicator. The master direction indicator, copilot's attitude indicator, and copilot's turn and slip indicator operate continuously when the autopilot inverter is operating, even though the autopilot master switch is not in the ON position.

Autopilot Master Switch

An ON--OFF switch (47, figure 1-16) is located on the control stand. When the switch is in the ON position, power is supplied to the autopilot servo motors. When the switch is in the OFF position, the autopilot servos are de-energized.

Autopilot Clutch Switch

A push button switch (46, figure 1-16), located on the control stand, is used to engage the autopilot. When the switch is pushed in, four electrically operated clutches, one in each of the servos and one in the master direction indicator, are engaged. This connects the autopilot to the airplane control surfaces and permits signals from the master direction indicator to control the heading of the airplane.

Autopilot Release Switches

A push button type switch (5, figure 1-7 and 2, figure 1-8), located on each pilot's control wheel, is used to disengage the autopilot. When this switch is depressed, the autopilot clutch switch pops out, releasing the clutches and fully disengaging all automatic control.

Autopilot Emergency Disconnect Handle

An autopilot emergency disconnect handle (1, figure 1-16), located on the control stand, is used to manually disengage the servos from the control system of the airplane in event of electrical failure or other emergencies. When the handle is pulled, the servo pulleys are released and will turn freely when control surfaces are operated manually.

Autopilot Turn and Pitch Controller

An autopilot turn and pitch controller (figure 4-49) is provided on the control stand for maneuvering the airplane when the autopilot is engaged.

PITCH WHEEL. A knurled pitch wheel (2, figure 4-49) is located on the right side of the controller and UP--DOWN markings are provided above the wheel. When this wheel is rotated toward UP, the airplane will climb. When the wheel is rotated toward DOWN the airplane will dive. A climb or dive attitude up to 40 degrees is possible.

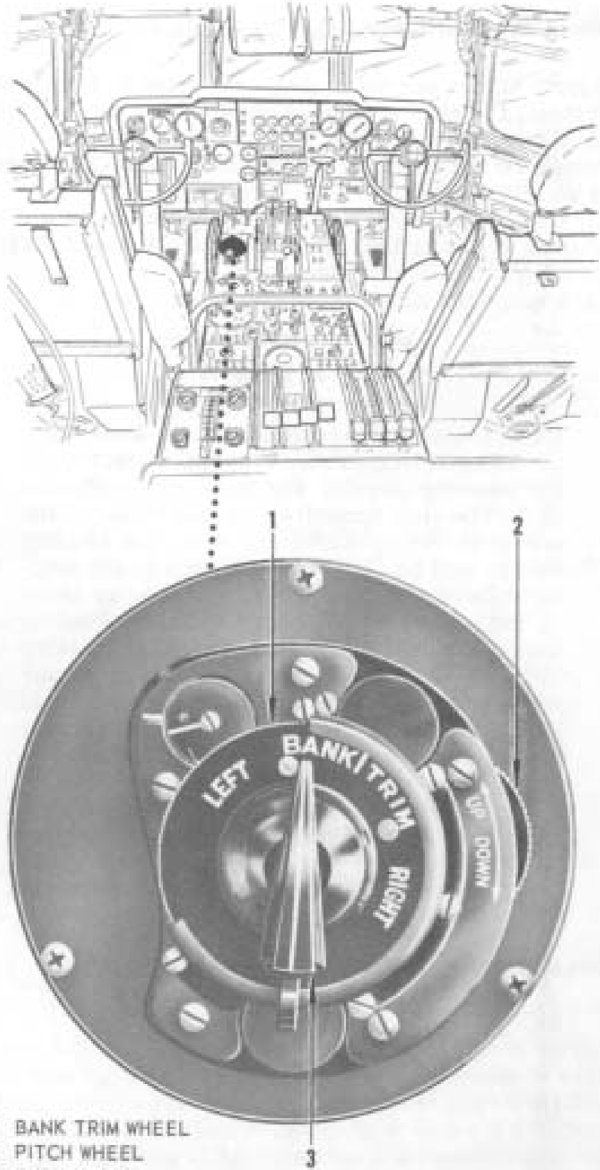
BANK TRIM WHEEL. A knurled bank trim wheel (1, figure 4-49), marked LEFT--RIGHT is located on the left forward quarter of the controller. When this wheel is rotated in the RIGHT direction, the airplane will bank to the right. When the wheel is rotated in the LEFT direction, the airplane will bank to the left. Banks up to 10 degrees are possible. Do not use the bank trim wheel for making minor corrections to level wings or a change in heading will result.

TURN KNOB. A turn knob (3, figure 4-49), located on the top of the controller, is provided with a central detent position. When the knob is rotated to the right from this central detent position, the airplane will make a right turn. When the knob is rotated to the left from the detent position, the airplane will make a left turn. As long as the knob is out of the detent position, the airplane will continue to make a coordinated turn. When the knob is returned to the detent position, the airplane will resume level flight.

AUTOPILOT NORMAL OPERATION

In order to prevent the autopilot from inadvertently engaging during critical flight conditions, the following precautions must be observed.

1. Do not place the autopilot master switch in the ON position until a safe altitude has been reached
▼2. The autopilot master switch must be in the OFF position during all refueling contacts
3. The autopilot master switch must be in the OFF position prior to landing



AUTOPILOT TURN AND PITCH CONTROLLER

Figure 4-49

WARNING ▼

Do not use autopilot during A/R operations. Inadequate or erratic autopilot functioning while in contact with a receiver airplane can result in structural damage to one or both airplanes.

Slave Magnetic Autopilot Operation

During slaved magnetic operation of the N-1 compass system, the airplane, when on autopilot control, will fly a magnetic heading. Operation of the autopilot during slaved magnetic operation of the N-1 compass is as follows:

1. Check that the N-1 compass system is on slaved magnetic operation. See N-1 COMPASS SYSTEM OPERATION in this Section
2. Engage the autopilot as described below

CAUTION

Do not operate the synchronizer knob when on autopilot control. If synchronization of the heading pointer has been accomplished in a direction opposite that indicated by the arrow on the synchronizer knob, the heading pointer will be 180° off from the correct magnetic heading. This can be checked by comparing the master direction indicator heading with the magnetic compass. Synchronizing 180° off from the correct heading is an unstable condition which, if left alone, will correct itself at a rate of approximately 3° per minute. During this time the airplane will alter course at the same rate and assume the new heading as described above. The heading pointer should not be repositioned during or immediately after turns as the system will remain in synchronization during and at the completion of the turn.

Direction Indicator Autopilot Operation

During directional indicator operation of the N-1 compass system, the airplane, when on autopilot control, will fly a gyro heading and approximate a great circle route (under a no wind condition). Directional indicator autopilot operation is especially useful in regions where the horizontal component of the earth's magnetic field is so weak or distorted as to be unreliable. Directional indicator autopilot operation is as follows:

1. Check that the N-1 compass system is on directional indicator operation. See N-1 COMPASS SYSTEM OPERATION in this Section
2. Set the desired reference heading on the indicator
3. Engage the autopilot as described below

NOTE

During directional indicator operation the heading on the master direction indicator is not referenced to the geographical coordinate system. If a constant gyro heading is maintained the airplane will fly a great circle route. Once the gyro heading is set, the synchronizer knob should not be adjusted at any time the autopilot is engaged.

Engaging The Autopilot

1. Check copilot's attitude indicator erected and uncaged
2. Check clutch switch out. Check autopilot inverter switch at AUTOPILOT INV
3. Turn autopilot master switch ON. Allow 1 minute for amplifier warm-up
4. Center the turn control and pitch controller
5. Trim airplane to fly hands off
6. Engage autopilot by pushing clutch switch in

CAUTION

Pilot must keep safety belt fastened when engaging autopilot to prevent being thrown from the seat in the event of autopilot malfunction. Maintain straight and level flight when engaging the autopilot and turn the autopilot off in the event of any uncontrolled action of the airplane.

Turns And Banks

Rotate the turn knob until the desired rate of turn is obtained. The bank attitude of the airplane may be changed by rotating the bank-trim wheel. Do not adjust bank trim during turns.

Climbs Or Dives

Rotate the pitch wheel to obtain the desired climb or dive rate.

Disengaging The Autopilot

The autopilot is disengaged by pressing either of the autopilot release switches, or by pulling out the autopilot clutch switch. The autopilot may also be disengaged by caging the copilot's attitude indicator. To prevent a disengage transient oscillation, check and adjust pitch control to center before disengagement.

AUTOPILOT EMERGENCY OPERATION

If the autopilot cannot be disengaged by pressing the autopilot release switches, or by pulling out the clutch switch, or by caging the copilot's attitude indicator, pull the autopilot emergency disconnect handle. The handle will pull out approximately eight inches. If the above steps fail, turn autopilot master switch and autopilot inverter switch OFF.

NOTE

If the autopilot emergency disconnect handle has been pulled, the autopilot cannot be re-engaged while in flight.

Autopilot Inverter Failure

If the normal autopilot inverter fails, the spare inverter is automatically energized by the inverter changeover relay. If the changeover relay fails, as indicated by continued illumination of the red warning light, place the autopilot inverter switch in the SPARE INV position. If both autopilot inverters fail, the autopilot, copilot's turn and slip indicator and attitude indicator, the master direction indicator, and on airplanes **G** **22629** ▶ plus those incorporating TCTO K235, the driftmeter will cease to function. The red warning light indicating autopilot inverter failure will remain illuminated regardless of the position of the autopilot inverter switch. If the autopilot is engaged, pull the autopilot emergency disconnect handle. On airplanes **G** **3250** ▶, when operating on autopilot, the clutch switch will automatically disengage in the event of autopilot inverter failure.

NAVIGATIONAL EQUIPMENT AND SYSTEMS

NAVIGATOR'S INSTRUMENT

On airplanes **F** **G** **1243** ▶ **3177**, the navigator's instrument panel (figure 4-50) has a master direction indicator (N-1 Compass System), a radio magnetic indicator, a true airspeed indicator, an outside air temperature gage, an altimeter, a clock, two rheostats for operation of the navigator's flood and panel lights, and a direction indicator. The direction indicator only appears on airplanes **F** **G** **1243** ▶ **2859**. On airplanes **G** **3178** ▶, the same instruments appear on the navigator's instrument panel; however, the light rheostats as well as the direction indicator have been deleted. The light rheostats are on the navigator's light panel. The navigator's oxygen flow indicator which appears on the navigator's auxiliary panel (16, figure 4-15) on airplanes **F** **G** **1243** ▶ **3177**, now appears on this navigator's instrument panel.

N-1 COMPASS SYSTEM

The basic component of the N-1 compass system is a gyro that can be controlled by two methods. The two methods are: (1) Magnetic-slaved operation whereby the gyro is used to stabilize magnetic heading indications and (2) Directional gyro operation using a manually selected correction to compensate for apparent gyro drift. (An uncorrected gyro appears to drift due to the rotation of the earth.) When operated as a directional gyro, corrected for latitude, the compass indicates the heading of the airplane relative to any arbitrary reference selected by the operator. Using this method of operation removes the influence of the earth's magnetism so that the compass functions in any locality. This is especially useful where the earth's magnetic field is too weak or distorted for magnetic-slaved operation. When operated as a magnetic slaved compass and the heading pointer is properly synchronized, the heading indication is the airplane's magnetic heading. This method of operation may be used in any locality except in high latitudes or in areas where severe magnetic distortion occurs. The controls for the system are on the master direction indicator (figure 4-51). The system is energized whenever there is 28 volt DC and 115 volt AC power on the airplane and the autopilot inverter in ON. The N-1 compass system furnishes heading data to the autopilot, navigator's master direction indicator (figure 4-51), copilot's directional indicator (13, figure 1-9), and the radio magnetic indicators (RMI) at the pilot's, copilot's, and navigator's stations (15, figure 1-9 and 8, figure 4-50). Circuit protection is on the overhead circuit breaker panel (figure 1-35), marked FLIGHT INSTRUMENT, AUTO PILOT and the AC power panel (figure 1-35) marked DIRECTIONAL GYRO.

WARNING

The synchronizer knob should not be adjusted at any time the autopilot is engaged, since the autopilot reacts very rapidly to the signals received from the N-1 compass and an uncontrolled action of the airplane may result.

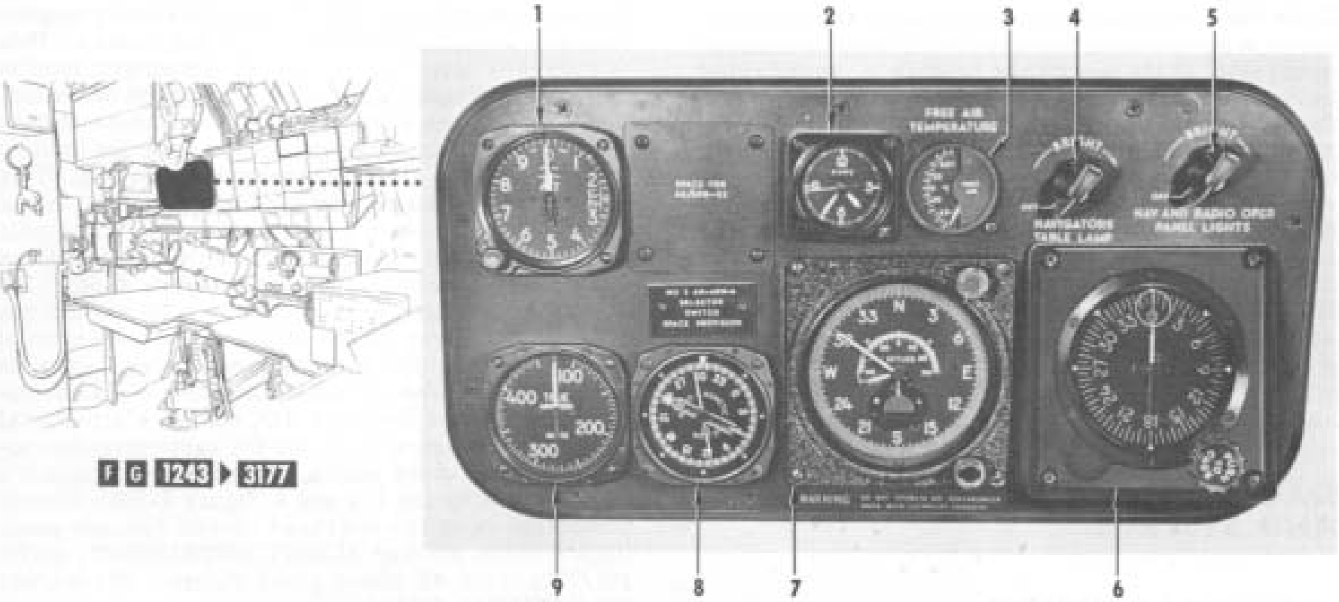
NOTE

The copilot's direction indicator displays the same heading as the master direction indicator within two degrees and the radio magnetic indicator headings are within 2-1/2 degrees of the master direction indicator.

Master Direction Indicator Controls

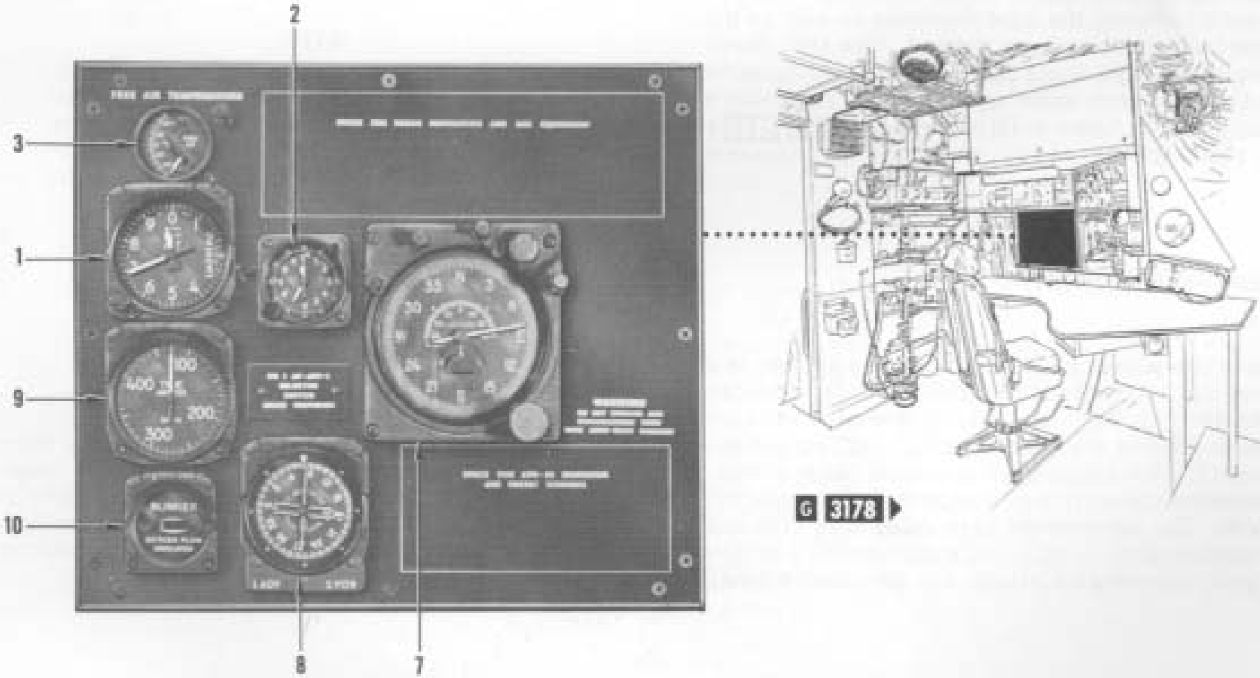
HEADING POINTER

The heading pointer (2, figure 4-51) indicates the correct magnetic heading while the compass is in magnetic-slaved operation (providing the pointer is properly synchronized), or deviations from a preselected heading during directional gyro operation. Heading indications are accurate within ± 1/2 degree.



F G 1243 ▶ 3177

1 ALTIMETER (2 PLACES)
2 CLOCK (2 PLACES)
3 OUTSIDE AIR TEMPERATURE GAGE (2 PLACES)
4 NAVIGATOR'S TABLE LAMP RHEOSTAT
5 NAVIGATOR'S PANEL LIGHT RHEOSTAT
6 DIRECTION INDICATOR F G 1243 ▶ 2859
7 MASTER DIRECTION INDICATOR (N-1 COMPASS SYSTEM) (2 PLACES)
8 RADIO MAGNETIC INDICATOR (RMI) (2 PLACES)
9 TRUE AIRSPEED INDICATOR (2 PLACES)
10 OXYGEN FLOW INDICATOR



G 3178 ▶

NAVIGATOR'S INSTRUMENT PANEL

Figure 4-50

LATITUDE CORRECTION CONTROL KNOB

The function of this knob (1, figure 4-51) is to switch from magnetic-slaved operation to directional-gyro operation or vice versa, and to adjust the latitude correction setting. Refer to LATITUDE CORRECTION POINTER.

LATITUDE CORRECTION POINTER

The latitude correction control knob (1, figure 4-51) positions the latitude correction pointer (6, figure 4-51) with respect to the latitude scale at the center of the master indicator dial face. The scale has an OFF position and is marked in 2 degree increments clockwise from 90 degrees N through 0 degrees to 90 degrees S. When the pointer is in the OFF position, the compass operates as a magnetic slaved compass. Moving the pointer to the latitude scale switches the compass to the directional gyro mode of operation and corrections are applied to the gyro to maintain accurate headings for the latitude selected. The indicated latitude should be ± 1 degree from the airplane's position and should be changed to mid-latitude for each 2 degrees change in latitude.

SYNCHRONIZER KNOB

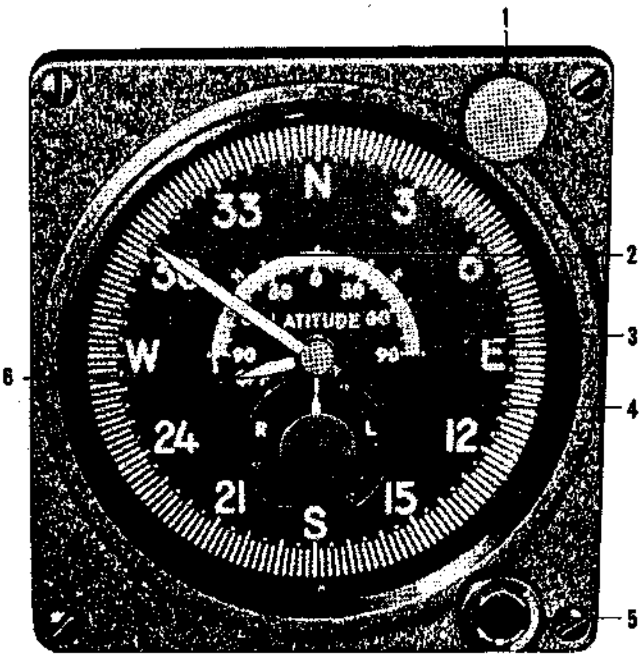
During directional-gyro operation, the synchronizer knob (5, figure 4-51) is used to set the heading pointer to any desired position (usually repositioned for grid navigation reference). During magnetic-slaved operation, the compass maintains synchronization automatically; however, when the compass is first energized or changed from DG to MAG operation, the annunciator may indicate that the heading pointer is not synchronized with the earth's magnetic field. The knob may be turned in the direction indicated by the annunciator to bring the compass into synchronization more rapidly.

NOTE

Rotation of this knob in flight affects all systems using N-1 compass heading information and will cause the airplane to turn when the autopilot is engaged.

ANNUNCIATOR (N-1 Compass)

The annunciator, operative only during magnetic-slaved operation, consists of a dial and pointer (4, figure 4-51). The pointer indicates the direction in which to rotate the synchronizer knob to align the heading pointer with the earth's magnetic field. When the pointer is centered the compass is synchronized. A 30 degree deflection of the pointer from center indicates that the heading pointer has an error of approximately 3 to 5 degrees.



1 LATITUDE CORRECTION CONTROL KNOB
2 HEADING POINTER
3 CORRECTION INDICATOR PORT
4 ANNUNCIATOR POINTER
5 SYNCHRONIZER KNOB
6 LATITUDE CORRECTION POINTER

MASTER DIRECTION INDICATOR

Figure 4-51

CORRECTION INDICATOR PORT

The intermittent appearance of the small white dot behind the correction indicator port (3, figure 4-51) indicates that the compass system is being corrected. During directional gyro operation, the white dot rotates CW in North latitudes and CCW in South latitudes; and, the setting of the lattitude correction pointer governs the rate of correction. The corrections applied during magnetic-slaved operation keeps the gyro "slaved." In this mode of operation, the white dot rotates CW when the annunciator is in the R area and CCW when in the L area.

N-1 Compass System Operation

The N-1 compass system is energized whenever the autopilot inverter is operating. The system should be allowed to warm-up for 10 minutes after being energized so that the gyros may stabilize.

SLAVED MAGNETIC OPERATION

The N-1 compass system is put into slaved magnetic operation as follows:

1. Check that the autopilot inverter is operating
2. Allow 10 minutes for the system to warm-up and the gyros to stabilize.
3. Rotate the latitude correction control knob on the master direction indicator so that the latitude correction pointer is at the OFF position. This slaves the indicator to the remote compass transmitter
4. Synchronize the heading pointer by rotating the synchronizer knob in the direction indicated by the annunciator pointer

NOTE

> It is merely necessary to rotate the synchronizer knob until the annunciator pointer is approximately centered, then allow 1 or 2 minutes for the system to drive into synchronization.

5. Check the indication of the heading pointer against the copilot's magnetic compass to avoid an ambiguous heading

CAUTION

> If synchronization is accomplished in a direction opposite that indicated by the arrow on the synchronizer knob, the heading pointer will be 180° off the correct magnetic heading. This is an unstable condition which will correct itself if left alone, at an approximate rate of 3° per minute. If the airplane is on autopilot control, it will change its heading at approximately 3° per minute and assume the new heading. See AUTOPILOT NORMAL OPERATION in this Section. Do not synchronize the heading pointer during or immediately after turns, or whenever the autopilot is engaged.

6. Check the correction indicator (white dot) occasionally. Rotation of the dot indicates the system is operating properly

DIRECTION INDICATOR OPERATION

Direction indicator operation is to be used when the earth's magnetic field is too weak or distorted to be reliable, Such as in regions near the earth's magnetic poles. Direction indicator operation is initiated as follows:

1. Rotate the latitude correction control knob clockwise until the latitude correction pointer indicates the latitude of the airplane position. This isolates the remote compass transmitter from the system and switches to direction indicator operation
2. As the airplane changes position, the latitude correction pointer should be reset progressively to the new latitude

NOTE

> Setting the mid-latitude every 2° will generally be sufficient for proper operation.

3. The reference heading may be set as desired by engaging and rotating the synchronizing knob

CAUTION

> Do not reposition the heading pointer at any time the autopilot is engaged, as erroneous headings may result. Set the desired reference heading on the indicator before engaging the autopilot.

4. Observe the correction indicator (white dot) occasionally, for proper operation. The dot will rotate clockwise in north latitudes and counterclockwise in south latitudes

PERISCOPIC SEXTANT AND G 2860 ▶ PLUS ✈ MOUNT

A periscopic sextant is stowed on the lower forward side of the engineer's instrument panel support, just aft of the copilot's seat. Access to the periscopic sextant is from the crew passageway outboard of the engineer's panel. When being used, the sextant is mounted on a support on the ceiling of the control cabin. The periscopic sextant mount is between the overhead windows in the control cabin. A receptacle on the mount is provided to furnish power to the sextant. Control power is 28 volt DC with circuit protection on the overhead circuit breaker panel (figure 1-36).

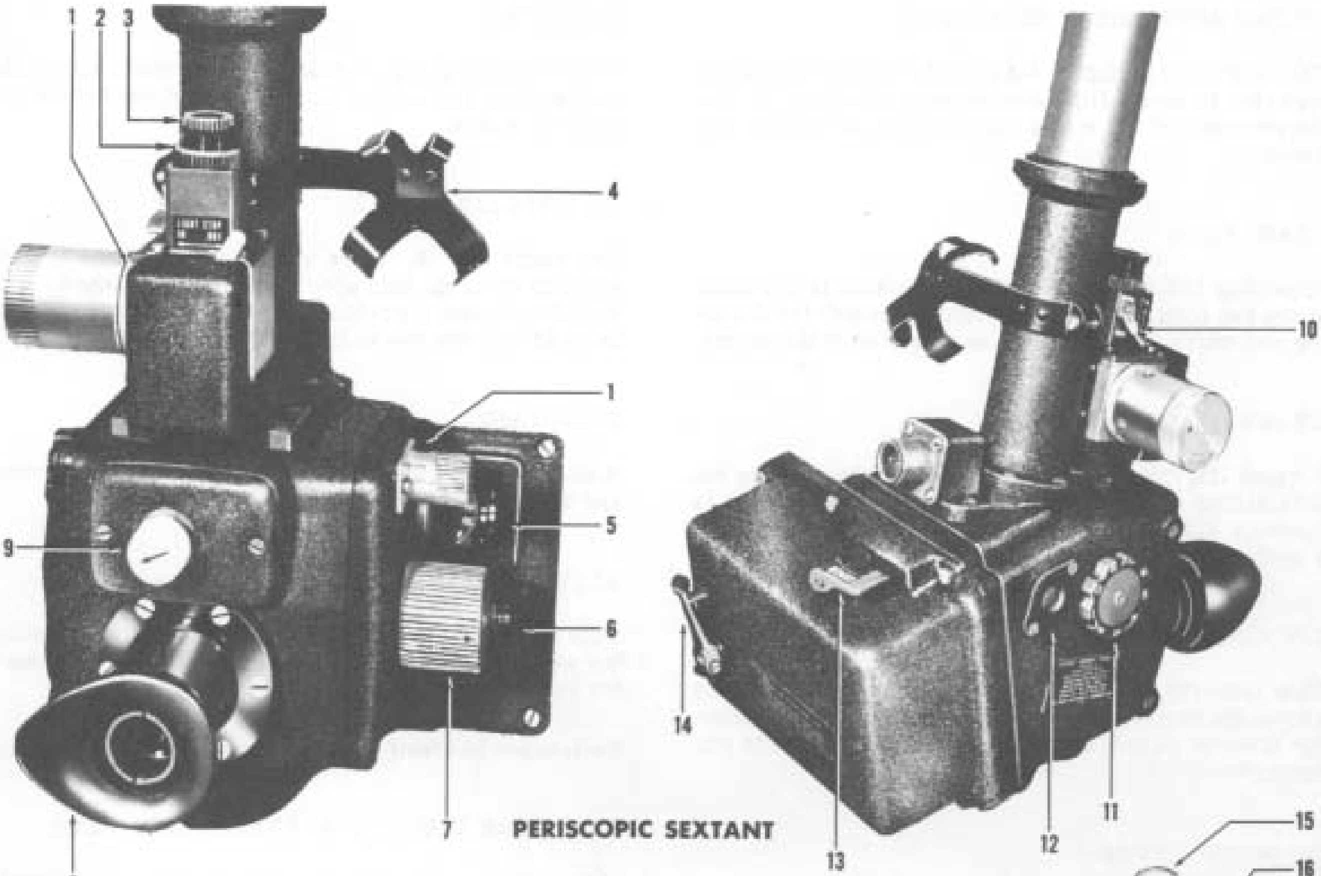
Periscopic Sextant And Mount Controls

ILLUMINATION SWITCH

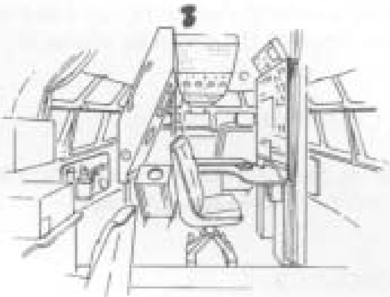
This on-off toggle switch (21, figure 4-52) on the mount controls illumination. The illumination of the bubble and the azimuth scale of the mount is adjustable by rheostat. No adjustment is provided to control the illumination of the mount counter, sextant counter, averager indices or the navigator's watch.

EYEPIECE

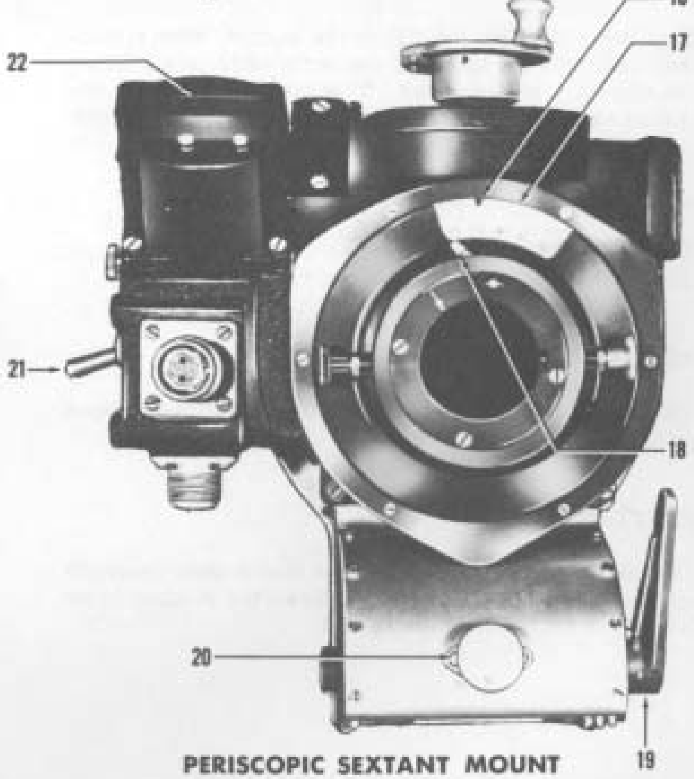
The eyepiece (6, figure 4-52) on the sextant is adjustable from -2 to +2 diopters for focusing.



PERISCOPIC SEXTANT



1 LAMP (2 PLACES)
2 PROJECTION LENS LOCKING RING
3 PROJECTION LENS ADJUSTMENT RING
4 WATCH CLIP
5 HALFTIME DIAL AND AVERAGER INDICATOR
6 ALTITUDE COUNTER
7 ALTITUDE KNOB
8 EYEPIECE
9 RHEOSTAT
10 DIFFUSER LEVER
11 FILTER ADJUSTMENT SELECTOR
12 DESICCANT
13 ACTUATION LEVER
14 AVERAGER WINDING LEVER
15 CRANK
16 LUBBER LINE
17 AZIMUTH SCALE
18 LOCKING LEVER
19 SHUTTER LEVER
20 DRAIN PLUG
21 ILLUMINATION SWITCH
22 AZIMUTH COUNTER



PERISCOPIC SEXTANT MOUNT

PERISCOPIC SEXTANT AND PERISCOPIC SEXTANT MOUNT CONTROLS

G 2860 ▶PLUS

Figure 4-52

FILTER ADJUSTMENT SELECTOR

This selector (11, figure 4-52) on the sextant allows the operator to select filters of various densities, so that the intensity of the sun's light may be adequately reduced.

DRAIN PLUG

This plug (20, figure 4-52) on the mount is provided at the two point in the shutter retraction well for draining any water which might have collected in the mount.

CRANK

A crank (15, figure 4-52) on the mount is provided to set indications on the azimuth counter. As the crank is turned, a slight hesitation can be felt at each 10° mark - a useful feature when a setting is to be made.

LOCKING LEVER

This lever (18, figure 4-52) on the mount, when unlocked allows the sextant and mount to be rotated freely. When the lever is locked, the sextant should not rotate in any direction.

DIFFUSER LEVER

This lever (10, figure 4-52) on the sextant, when operated, obstructs the image of the scale when true heading readings are not required. This however does not detract from the effective illumination of the bubble.

AVERAGER WINDING LEVER

This lever (14, figure 4-52) is on the sextant and allows the operator to wind the averager.

ACTUATION LEVER

This lever (13, figure 4-52) on the sextant is provided to start and stop the averager.

SHUTTER LEVER

This lever (19, figure 4-52) on the mount when operated opens the mount shutter and allows the sextant to be further inserted into the mount.

RHEOSTAT

This rheostat (9, figure 4-52) on the sextant, allows the operator to control the illumination of the bubble and azimuth scale.

WATCH CLIP

The watch clip (4, figure 4-52) on the sextant is provided to securely hold special navigator watches. It is mounted in such a position as to allow the watch face to be read with the eye in line with the eyepiece position.

DESICCANT

A desiccant (12, figure 4-52) is located on the sextant and aids in preventing moisture.

ALTITUDE KNOB

This knob (7, figure 4-52) on the sextant aids in finding the average altitude angle when the opeartor recenters the averager indices using the knob.

Periscopic Sextant And Mount Indicators

HALF TIME DIAL AND AVERAGER INDICATOR

This indicator (5, figure 4-52) is on the periscopic sextant. This is a time dial graduated in seconds indicating the half time of an observation, which indication may be added directly to the time of start to give the mean time of the average altitude.

ALTITUDE COUNTER

This counter (6, figure 4-52) on the sextant allows the operator to read the average altitude.

AZIMUTH COUNTER

This counter (22, figure 4-52) is on the mount. This counter indicates the position of the azimuth scale with respect to the lubbers line.

LUBBERS LINE

A lubbers line (16, figure 4-52) on the mount which may be aligned with the airplanes longitudinal axis to establish a lubbers line, provides indication of azimuth on the scale.

AZIMUTH SCALE

An independently rotatable azimuth scale (17, figure 4-52) is on periscopic sextant mount. This scale indicates azimuth heading.

Operation Of The Periscopic Sextant

The procedures described below are detailed instructions on the various operational techniques for the Periscopic Sextant. Personnel not completely familiar with the equipment should study them carefully.

Six procedures are discussed
1. Inserting the sextant
2. Forming and adjusting the bubble
3. Time dial check
4. Altitude average check
5. Alignment of sextant and mount in the airplane
6. Removal of the sextant from the mount

INSERTING THE SEXTANT IN THE MOUNT

1. With the line of sight locking lever on mount unlocked, insert the sextant as far as possible with arrows on tube and mount aligned
2. Hold the sextant firmly to prevent dropping and rotate the lower ring of mount counterclockwise (looking up, toward mount) until it hits a stop
3. Pull out knob marked, To Insert, Remove--Pull
4. Rotate lower ring on mount further allowing knob to seat itself. Be sure the sextant cannot rotate in either direction with the line of sight locking lever locked

NOTE

The provision of stops in the retracted position of the sextant is intended only to prevent its being dropped during insertion or removal. It is not advisable to leave the sextant in the retracted position for any extended period, particularly during rough weather. When the sextant is removed from the mount, it should be returned to the carrying case and secured.

5. Open the mount shutter with lever
6. Insert sextant further until knob marked To Retract Sextant-Pull snaps into place
7. Make connections between the mount and the sextant with the electrical cable

WARNING

In the case of pressurized airplane, do not open the shutter of mount until after the sextant has been inserted to its retracted position.

FORMING AND ADJUSTING THE SIZE OF THE BUBBLE.

Focusing Sextant
With switch on the mount in the ON position, adjust the intensity of illumination with rheostat by looking through the eyepiece and rotating the rheostat knob. Focus on the reticle image, by turning eyepiece and the bubble will be in focus.

To Form A Bubble In The Field Of View:
1. Set increase bubble knob to minimum position
2. Tilt sextant to the right
3. Slowly rotate the knob
4. A bubble will be formed at the notch, visible on the right hand side of the field of view
5. Rotate knob slowly back and forth until proper size bubble is obtained
6. Move sextant to vertical position, i.e. when the bubble is in the center of the field of view
7. Slowly rotate knob to maximum increase position

Bubble Already Formed And Of The Desired Size:
1. Under this condition, there is nothing to do except to put the bubble in focus by turning the eyepiece
2. Check to be sure the increase bubble knob is in maximum increase position

Bubble In Field Of View Is Too Large:
1. With sextant in the vertical position, rotate increase bubble knob to maximum position
2. Tilt sextant to the right and center the bubble in the notch
3. Slowly rotate the knob to reduce the size of the bubble

4. If the travel of the knob is reached without reducing bubble to the desired size, repeat cycle
5. When desired bubble size is obtained, move sextant to vertical (bubble located near intersection of reticle)
6. Slowly rotate knob to maximum increase position

Bubble In The Field Of View Is Too Small:
1. Knob is rotated to minimum increase position with sextant vertical
2. Tilt sextant to right and center the bubble in the notch
3. Slowly rotate the knob, to increase size of bubble
4. If the travel of the knob is reached without increasing bubble to the desired size, repeat cycle
5. When desired bubble size is obtained, return sextant to vertical and slowly rotate knob to maximum increase position. Suggested size of bubble is about 1-1/2 to 2 degrees (the sun appears to subtend about one degree)

NOTE

> Little or nothing will happen to bubble size unless it is resting in the notch when the knob is turned. Tilting the sextant will permit the fluid level in the air chamber to uncover the transfer port allowing air to be drawn into the bubble chamber for bubble formation. In the vertical position the fluid level in the air chamber will be above the transfer port and fluid instead of air will be drawn into the bubble chamber. Except when adjusting the bubble, the increase bubble knob is to be kept at full increase at all times. The knob encloses a compensation system for changes and variations in temperature and pressure. When the knob is set at maximum position, the compensation system has its full range. When the sextant is not in use, location or size of the bubble is not important.

TIME DIAL CHECK

Fully depress the averager rewind lever and release slowly. Averager will operate for three seconds, then stop automatically. Time dial should indicate zero. Depress and release the averager actuating button, noting time to nearest second when sextant starts. Note time when shutter clicks closed. The time dial should read 59 when shutter clicks since shutter closes two seconds before averager stops. Double dial reading since it indicates half time and compare to watch reading. The readings should agree within plus or minus two seconds.

ALTITUDE AVERAGER CHECK

To check the accuracy of the altitude averager, proceed with the following steps:
1. Depress and release the averager rewind lever

CAUTION

> This should wind the averager, zero the time dial and raise the shutter. Do not change altitude setting during three-second interval immediately after releasing the averager rewind lever.

2. Turn the altitude knob until exactly 13°00' is set in the altitude counter
3. Start the sextant by depressing and releasing the averager actuating button
4. Stop sextant when time reads exactly 15
5. Reset altitude counter to exactly 12°00' and restart sextant
6. Stop sextant when time dial reads 30
7. Reset altitude counter to exactly 8°00' and restart sextant
8. Stop sextant when time dial reads 45
9. Reset altitude counter to exactly 7°00' and restart sextant. When time cycle for averager is complete, the averager stops automatically
10. Rotate altitude knob until red blocks on altitude counter are aligned. Altitude counter should read 10°00' plus or minus 2 minutes

Alignment Of Sextant And Mount With Airplane

ADJUSTMENT OF AZIMUTH COUNTER AND SCALE ON MOUNT

1. Set 000.0 degrees in the azimuth counter
2. With the sextant in the operating position, the diffuser lever in out position, the line of sight locking lever open, sight forward. Focus on the reticle image by

turning eyepiece. Sighting through the sextant eyepiece and ignoring all other objects, the azimuth scale as read against the lubbers line should agree to within 0.1 degree with the setting on the azimuth counter to assure proper alignment of the mount. Recheck to see that the aximuth counter reading has not been changed inadvertently

OPTICAL ADJUSTMENT OF PROJECTION LENS ASSEMBLY

1. With sextant in the operating position in the mount the diffuser lever must be in the out position and the true heading scale will be visible in the lower part of the field of view
2. Rotate sextant until lubbers line and vertical reticle line are coincident or nearly coincident. Ignore all other objects in the field of view
3. Lock line of sight locking lever
4. Check for parallax between lubbers line and vertical reticle line keeping bubble near center of reticle pattern

NOTE

> Parallax, as it applies here, is the apparent movement of the image of the lubbers line (or azimuth scale), relative to the vertical line of the reticle, or vice versa, as the operator's head is moved from side to side. Parallax is to be avoided.

5. If satisfied that no parallax exists, the sextant and mount are to be considered as optically adjusted but not aligned. If no satisfied, proceed as follows:
   a. Loosen the projection lens locking ring and rotate the projection lens so that it moves either up or down. The lubbers line will appear to move in an elliptical path, making a complete cycle for each revolution of the lens
   b. Rotate the lens as many times as necessary to position the lubbers line at one of the uppermost positions in its elliptical path, and at the same time produce a sharp image of the lubbers line plus a distinct lack of parallax as described in the above note
   c. With the locking ring loosened, be sure the lubbers line is at the uppermost position of its travel in an elliptical path as the projection lens is rotated back and forth. Disregard the relative position of the vertical line of the reticle and lubbers line. Lock the projection lens locking ring without further movement of the projection lens

ALIGNMENT OF SEXTANT AND MOUNT

1. The relative bearing of the vertical stabilizer is 180°00' and affords the easiest point on which to check sextant alignment with the longitudinal axis of the airplane

NOTE

> Relative bearing is defined as the angle between the airplane's longitudinal axis and the line-of-sight to the object (Vertical stabilizer).

2. Small errors may be introduced by parallax when sighting on a nearby object such as the vertical stabilizer. (The average of several settings may be used, if desired, to improve accuracy when using a nearby object)
3. Crank the azimuth counter to read exactly 000.0 degree
4. With the sextant inserted in the mount, the line-of-sight locking lever unlocked and the bubble centered in the field, sight on the vertical stabilizer and lock the line-of-sight locking lever. Sighting on the stabilizer may involve both adjusting the altitude control knob and rotating the sextant in aximuth. Select a suitable filter so that both stabilizer and azimuth scale can be seen simultaneously

NOTE

> If lighting conditions do not permit simultaneous viewing of both stabilizer and scale, it may be necessary to change the filter adjustments to use a darker filter to see the scale.

If more light is required against the azimuth scale than is provided by the sextant, use of a flashlight or C-4 type cockpit light is recommended. If scale is blurred, the eyepiece of the sextant should be focused. During darkness it may be necessary to use an aldis lamp to illuminate the vertical stabilizer

5. When sighting as described above, the vertical line of the reticle, stabilizer and 180° on the azimuth scale should coincide
6. If an error greater than 1/4 degree exists between the stabilizer and 180 degrees on the azimuth scale as viewed through the eyepiece, it may be corrected by rotating the projection lens which is mounted on top of the bubble cell. This may be done in the following manner:
   a. Loosen the projection lens locking ring.
   b. Sight through the eyepiece and rotate the projection lens in either direction until the 180 degree

mark of the azimuth scale is brought to coincide with the vertical line of the reticle and the stabilizer

NOTE

Rotation of the projection lens will cause the image of the azimuth scale and the lubbers line to appear to move in an elliptical path, giving two settings (high and low) where coincidence will occur. The higher of the settings should be selected.

c. Secure the projection lens with the lock ring
d. The projection lens has a range of approximately 2 to 3 degrees which should be sufficient to allow proper alignment. If unable to properly align, record the difference. This difference will have to be applied in the same direction to any heading read during flight. If this condition occurs on only one sextant, the sextant may require overhaul. If this condition occurs with several sextants in the same mount, it is indicative of the lubbers line of the mount not being in alignment with the longitudinal axis of the airplane

Removal Of Sextant From The Mount

1. Turn switch to the OFF position, and disconnect the electrical cable
2. Holding the sextant securely with one hand, pull out knot marked. To Retract Sextant--Pull and lower the sextant to the retracted position
3. Close the mount shutter
4. Holding the sextant securely with one hand, pull out knob marked, To Insert, Remove--Pull and rotate the lower ring on the mount counterclockwise until arrows on tube and mount are aligned
5. Sextant will then be free to be lowered until completely removed
6. Turn it to the carrying case and secure as shown

CAUTION

Before replacing sextants in the carrying case always press actuating lever or button, allowing the averager to run down and always rotate bubble knob to maximum increase position.

DRIFTMETERS

An electrically driven gyro-stabilized driftmeter (figure 4-53 or figure 4-55) is installed at the navigator's station. The driftmeter provides an accurate means of determining angle and degree of deviation from a predetermined course of flight. It also furnishes data from which ground speed and wind velocity can be determined. On airplanes F G 1243 ▶ 22628 less those with ✈ TCTO K235 incorporated, the B-3 driftmeter is used. On airplanes G 22629 ▶ plus those with ✈ TCTO K235 incorporated, the B-6A driftmeter replaces the type B-3. On airplanes F G 1243 ▶ 3177 , the driftmeter gyromotor is turned on and off by an ON--OFF switch on the navigator's auxiliary panel (17, figure 4-15) at the navigator's station. On airplanes G 3178 ▶ , the gyromotor driftmeter switch (5, figure 4-10) is located on the navigator's interphone and light panels. The motor is protected by a fuse on the AC power panel (figure 1-35).

B-3 Driftmeter F G 1243 ▶ 22628 less ✈ TCTO K235

RHEOSTAT KNOB

A rheostat knob and pointer (2, figure 4-53) on the top of the upper gyro housing, is used to turn the three-volt lamp on and off and to control its brightness.

GYRO SWITCH

A switch (3, figure 4-53) for starting and stopping the gyro is mounted on the side of the lower gyro housing.

GYRO CAGING KNOB

The caging knob (4, figure 4-53) located at the bottom of the lower gyro housing operates a mechanism which holds the gyro in a vertical position when it is not in use, or when it is tipped too far from the vertical during maneuvers.

SLOW-MOTION KNOB

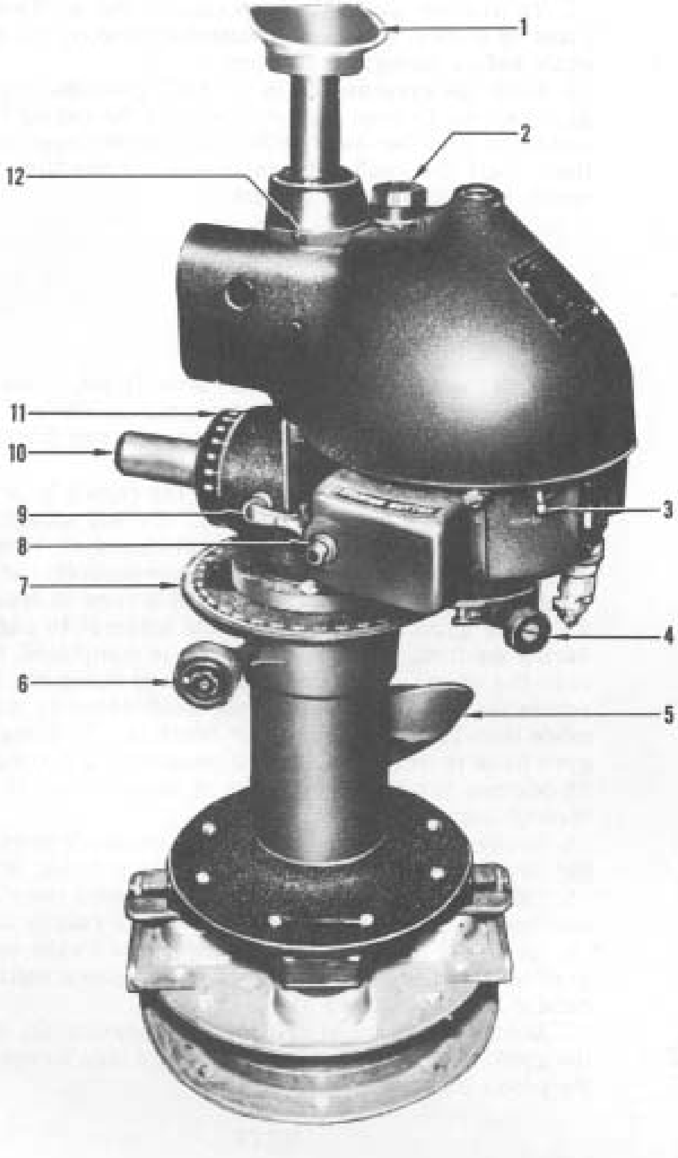
The slow-motion knob (6, figure 4-53) mounted on the stationary housing just beneath the azimuth scale, provides a means of fine adjustment of rotation of the instrument. It operates by means of a worm-gear mechanism which may be disengaged for free rotation of the driftmeter.

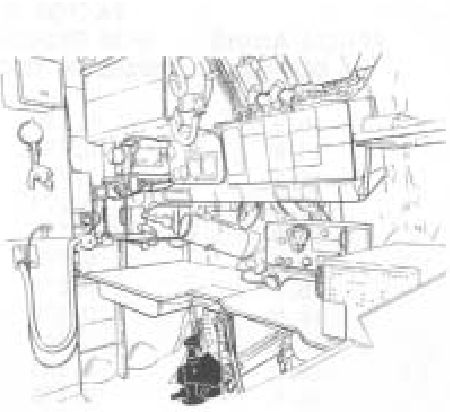
EYEPIECE ADJUSTING RING

Mounted on top of the gyro optics case and holding whichever of the alternate eyepiece assemblies is in use is the eyepiece adjusting ring (12, figure 4-53). Turn as required for clarity of focus.

SHADE GLASS LEVER

The lever (9, figure 4-53) mounted on the filter housing controls a shade glass. By operation of the lever, the





DRIFTMETER B-3

1 EYEPIECE
2 RHEOSTAT KNOB
3 GYRO SWITCH
4 GYRO CAGING KNOB
5 HIGH ALTITUDE EYEPIECE
6 SLOW-MOTION KNOB
7 AZIMUTH SCALE
8 PUSH-BUTTON SWITCH
9 SHADE GLASS LEVER
10 LINE OF SIGHT HANDLE
11 LINE OF SIGHT DIAL
12 EYEPIECE ADJUSTMENT RING

DRIFTMETER B-3 F G 1243 ▶ 22628 less ✈ 1C10 K235

Figure 4-53

shade glass may be interposed in the optical system to reduce the intensity of light when the ground image is too bright.

PUSH-BUTTON SWITCH

When pressed, the push button switch (8, figure 4-53) on the transformer housing momentarily provides power to start the gyro.

LINE OF SIGHT HANDLE

This handle (10, figure 4-53) on the driftmeter turns a prism at the bottom of the driftmeter tube and directs the operator's line-of-sight away from the vertical.

LINE OF SIGHT DIAL

This dial (11, figure 4-53) on the driftmeter is graduated in 1-degree increments over a range of from 16 degrees forward to 87 degrees rearward of the vertical.

AZIMUTH SCALE

An azimuth scale (7, figure 4-53) graduated in 1-degree increments through 360 degrees, is on the driftmeter. This scale remains fixed when the instrument is rotated.

RETICLE ANGLE IN DEGREES	FACTOR K (FOR GROUND SPEED IN KNOTS)
16.9	0.176
16.8	0.175
16.7	0.174
16.6	0.173
16.5	0.172
16.4	0.171
16.3	0.170
16.2	0.169
16.1	0.167
16.0	0.166
15.9	0.165
15.8	0.164
15.7	0.163
15.6	0.162
15.5	0.161
15.4	0.160
15.3	0.159
15.2	0.158
15.1	0.157
15.0	0.156
14.9	0.155
14.8	0.154
14.7	0.153
14.6	0.152
14.5	0.151
14.4	0.150
14.3	0.148
14.2	0.147
14.1	0.146
14.0	0.145
13.9	0.144

FORMULA:

1. Factor for 0 = 1.184 X 1/2 TAN RETICLE ANGLE
2. $\frac{\text{ABSOLUTE ALT}}{\text{Time in sec's}} = \frac{\text{GS in Knots}}{\text{Factor K}}$

K FACTORS FOR GROUND SPEED BY TIMING ZERO ANGLE METHOD

(B-3 DRIFTMETER) **F** **G** **1243** ▶ **22628** less TCTO K235 ▶

Figure 4-54

Operation Instructions Of The B-3 Driftmeter

BEFORE TAKEOFF

1. See that the window in the objective end of the instrument and the top lens of the eyepiece are clean. For cleaning purposes, use a clean cotton or linen cloth. To remove sand or grit, brush the surfaces lightly with a small, clean paint brush, or a loose fold of cloth. Do not attempt to clean any other glass surfaces in the instrument
2. To prevent possible breakage of the driftmeter glass by stones, set the instrument at zero on the drift scale before takeoff (or landing)
3. Keep the gyro switch in the OFF position and the gyro caged. To cage the gyro, pull out the caging knob and move it as far as possible toward the caged position. Pull the knob out gently--heavy handling will strain the caging mechanism

IN FLIGHT

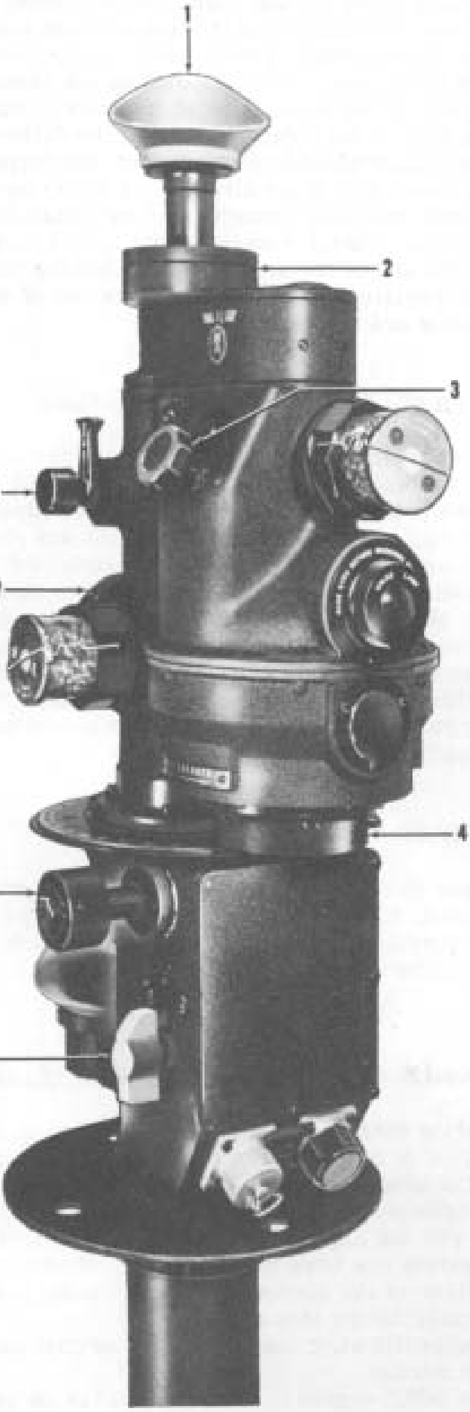
1. With the airplane in normal level flight, close the switch on the junction box to start the inverter
2. Switch on the gyro, and allow it to run for from 3 to 5 minutes before uncaging
3. Uncage the gyro by pulling out the caging knob and moving it to the uncaged position. Do not uncage the gyro when the gyro motor is stationary or running slowly, since the gyro and reticle moving freely in the housing may become damaged. If a turn is started while the gyro is uncaged, do not attempt to cage it during the turn. Wait until the turn is completed, then cage the gyro. To prevent damage to the gyro, it is advisable to cage it before the driftmeter is tipped more than 15 degrees from the vertical. To bring the gyro back to vertical if it has been tipped more than 15 degrees in a flight maneuver, it is necessary to run through cage-uncage cycle
4. Always cage the gyro before switching off power to the instrument and keep it caged when it is not in use
5. When sighting through the eyepiece, turn the rheostat knob to adjust the illumination of the reticle lines
6. By means of the ocular housing holder on the upper gyro housing, adjust the focus of the eyepiece until the reticle lines are sharp and clear
7. Upon completion of driftmeter observations, cage the gyro. Turn the gyro switch off, and then switch off the power supply

NOTE

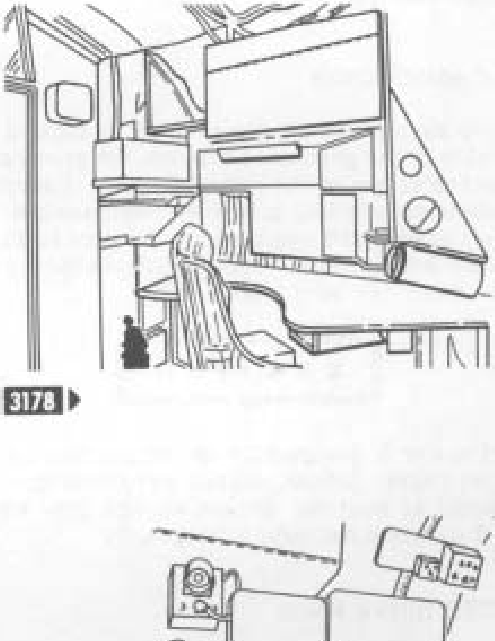
A chart indicating K factors for ground speed timing of zero angle method for the B-3 driftmeter is shown in figure 4-54.

B-6A Driftmeter **G** **22629** ▶ plus TCTO K235 ▶

Operation of the driftmeter is dependent upon seven controls: the rotary switch located on the box side of the stationary pedestal case; the reticle light switch on the upper gyro case; the gyro caging knob on the underside of the lower gyro case; the azimuth drive knob on the box side of the pedestal case; the rotating handle protruding from the side of the line-of-sight case; a filter selector knob and handle mounted on the line-of-sight case, and an eyepiece adjusting ring assembled under the eyepiece of the optics case. Purpose and operation of these seven controls is as follows:



1 EYEPIECE
2 EYEPIECE ADJUSTING RING
3 RETICLE LIGHT SWITCH
4 GYRO CAGING KNOB
5 ROTARY SWITCH
6 AZIMUTH DRIVE KNOB
7 LINE-OF-SIGHT HANDLE
8 FILTER SELECTOR KNOB AND HANDLE



G 3178 ▶

G 22629 ▶ 3177 PLUS TCTO K235

DRIFTMETER B-6A G 22629 ▶ PLUS TCTO K235

Figure 4-55

ROTARY SWITCH

The rotary switch, (5, figure 4-55) located on the stationary pedestal case, activates the gyro and erection system. A switch plate mounted under the knob establishes the central position as OFF, the left position of the pointer knob as ON, 28 volt DC and the right position as ON, 115 volt AC. A detent stop secured to the underside of the selector knob limits the switch operation to the applicable and corresponding power source. To put driftmeter in operation, turn switch to applicable ON position and allow a ten minute warm-up period prior to uncaging gyro.

RETICLE LIGHT SWITCH

The reticle light switch (3, figure 4-55) located on the pedestal case operates a rheostat to control the brightness of the reticle field. Switch knob turns left to dim and right to brighten reticle lights. A switch plate under the knob identifies the DIM and BRIGHT positions with corresponding arrows. Adjust lighting as observation conditions require.

GYRO CAGING KNOB

The gyro caging knob (4, figure 4-55) is located on the under side of the gyro case between the gyro case and the electrical box of the pedestal case. Except when the driftmeter is in use, gyro must remain caged. When gyro is caged, gyro caging knob is turned full right. Turn knob left to uncage. Uncage gyro ten minutes after rotary switch has been turned on.

CAUTION

Driftmeter is designed for use during reasonably level flight. Do not uncage gyro during taxi, takeoff or landing. Do not uncage gyro when roll or pitch exceeds 35 degrees.

AZIMUTH DRIVE KNOB

The azimuth drive knob (6, figure 4-55) is located on the side of the pedestal case and is mounted on a worm gear shaft. When the worm gear is normally engaged, the entire mobile section of the driftmeter is held stationary. Turning the azimuth drive knob revolves the worm gear, permitting fine adjustment after the general line of sight is obtained. Pull out the azimuth drive knob and move shaft through keyway to disengage the gear. This permits the rotating section to swing free in the pedestal case and rotate until the desired line-of-sight is obtained. Replace knob in original position to engage gears and obtain final fine adjustment by turning knob.

LINE-OF-SIGHT HANDLE

The handle assembly (7, figure 4-55) which protrudes from the line-of-sight case mounts a calibrated dial and contains a detent arrangement where a spring mounted ball assembly attached to the line-of-sight case registers at three points. These points are located at 0, 50 and 70.9 degrees. When the dial on the handle registers zero at the lubber line at the base of the handle, the prisms in the objective head of the driftmeter reflect an image which is straight down and perpendicular to the center line of the airplane. A pulley assembly in the handle assembly connects with extension rods which operate the prisms mounted in the main bracket at the objective end of the driftmeter. When the dial on the handle registers 35 degrees, the cables of the pulley assembly are of equal lengths.

FILTER SELECTOR KNOB AND HANDLE

Mounted on the line-of-sight case are the handle and knob assembly (8, figure 4-55) which permit selection between polarized and clear filters and adjustment to the amount of polarization required for any given flight condition. The clear glass and polarized filters are mounted perpendicular to each other in the line-of-sight case. Movement of the handle alternates the use of clear or polarized filter. Imprints on the handle identify the two positions as SHADE GLASS. With the polarized filter in position, movement of the knob, turning a worm gear, controls the amount of polarization desired at a specified time.

EYEPIECE ADJUSTING RING

Mounted on the top of the gyro optics case and holding whichever of the alternate eyepiece assemblies is in use is the eyepiece adjusting ring (2, figure 4-55). Turn as required for clarity of focus.

B-3 And B-6A Driftmeter Alignment Check

To obtain maximum accurate utilization of the driftmeter, it is necessary to check for proper alignment with the longitudinal axis of the airplane. This may be accomplished by cross checking the driftmeter alignment with the alignment of the periscopic sextant after the sextant has been properly aligned on the vertical stabilizer of the airplane. The following steps apply in accomplishing this alignment.

1. Correctly align the periscopic sextant as outlined in this Section
2. Set 000.0 degree in azimuth counter of periscopic sextant
3. Sight on object approximately 045 degrees left of the nose, at least 400 feet from the airplane using the periscopic sextant. Record the bearing and subtract from 360 degrees

NOTE

The object should be at least 400 feet from the airplane to minimize the error to less than one degree. Using this distance will compensate for the offset distance of the driftmeter location from the sextant mount.

T.O. 1C-97(K)G-1DW

SAFETY OF FLIGHT SUPPLEMENT

O'Neil

FLIGHT MANUAL

USAF SERIES

KC-97G

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-97(K)G-1 AND REPLACES FORMAL SAFETY OF FLIGHT SUPPLEMENT T.O. 1C-97(K)G-1DM WITH CHANGES TO THE TEXT. Reference to this supplement will be made on the title page of the basic publication by personnel responsible for maintaining the publication in current status.

NOTE COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AF PERSONNEL CLEARED FOR OPERATION OF SUBJECT AIRCRAFT.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

NOTICE: Reproduction for non-military use of the information or illustrations contained in this publication is not permitted without specific approval of the issuing service (BuAer or USAF).

8 OCTOBER 1959

1. PURPOSE.

To provide new and more comprehensive oil dilution and re-dilution instructions for those aircraft equipped with the oil diverter segregator system (T.O. 1C-97(K)-522), and to emphasize the importance of proper oil dilution for optimum safety and engine reliability.

2. GENERAL.

a. Existing instructions regarding oil dilution and re-dilution after flight or ground runs are inadequate.

b. A revised oil dilution and re-dilution schedule appears in figure 1. (See page 2 of this supplement for figure 1.) This schedule is based on controlled climatic laboratory tests and the importance of strict adherence to the oil dilution, re-dilution, and preheat instructions contained herein cannot be overemphasized.

3. INSTRUCTIONS. (refer to basic Flight Manual)

SECTION II

ENGINE SHUT-DOWN

ENGINEER

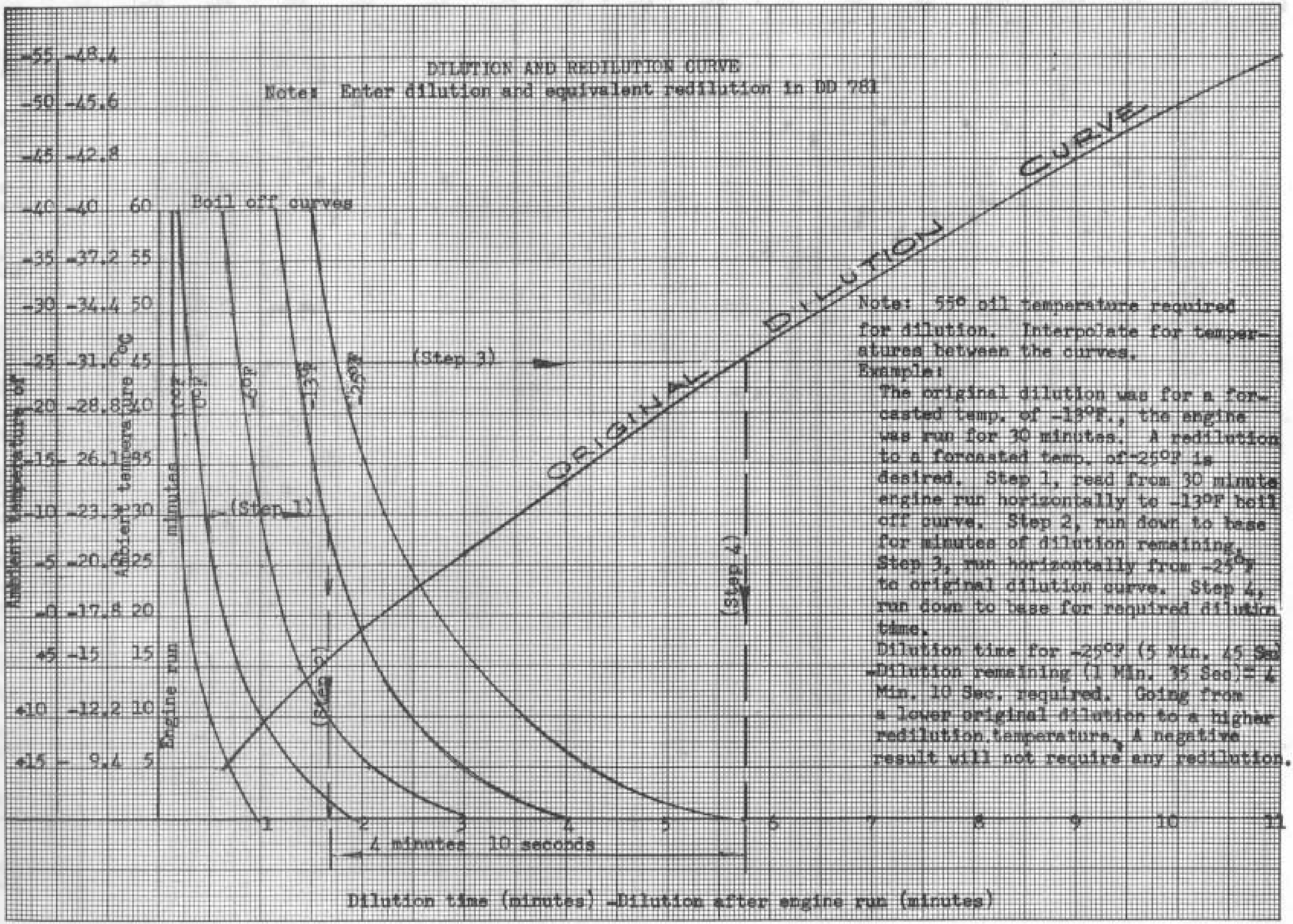
OIL DILUTION . . . . COMPLETED COLD WEATHER

See Section IX to accomplish oil dilution for the purpose of aiding next engine start when expected OAT is 15°F, (-9°C) or below. ENTER time period of dilution in DD Form 781.

SECTION IX

COLD WEATHER PROCEDURES -

BEFORE ENTERING AIRCRAFT



DILUTION AND REDILUTION CURVE

Note: Enter dilution and equivalent redilution in DD 781

Note: 55° oil temperature required for dilution. Interpolate for temperatures between the curves.

Example:

The original dilution was for a forcasted temp. of -13°F., the engine was run for 30 minutes. A redilution to a forcasted temp. of -25°F is desired. Step 1, read from 30 minute engine run horizontally to -13°F boil off curve. Step 2, run down to base for minutes of dilution remaining. Step 3, run horizontally from -25°F to original dilution curve. Step 4, run down to base for required dilution time.

Dilution time for -25°F (5 Min. 45 Sec) -Dilution remaining (1 Min. 35 Sec) = 4 Min. 10 Sec. required. Going from a lower original dilution to a higher redilution temperature, A negative result will not require any redilution.

Figure 1

3. Check that engines have been preheated until a cylinder head temperature of -15°C to 0°C is obtained.

CAUTION

Insure that sufficient heat has been applied to melt all accumulated snow or ice around the engine to prevent later melting and freezing on the landing gear and leading edge of the wing.

WARM-UP AND GROUND TESTS

WARNING

The oil cooler may not be fully diluted due to the action of the 60°C vernatherm which bypasses the oil coolers at desired dilution oil temperatures of 50°C. It may have partially congealed oil in the cores at extreme low OAT. After engine start the oil cooler doors should be kept closed by manual control until normal oil temperatures exist. (Refer to systems icing, section IX for instructions for icing or congealing of oil systems.)

TAXIING INSTRUCTIONS

CAUTION

Insure that all engines have reached 40°C oil temperature before increasing power to initiate taxi roll. This is to assure that adequate oil flow and lubrication exists prior to increasing engine rpm.

BEFORE TAKE-OFF

3. To insure diverter action of the oil diverter segregator valve, a minimum oil temperature of 60°C on all engines is required.

STOPPING ENGINES

The following oil dilution procedures will be used prior to stopping engines in cold weather in addition to normal procedures in section II. Oil dilution is required if the expected minimum temperature is to be at or below 15°F (-9°C).

1. Service nacelle oil tank from the central oil system. The amount of oil to be contained in the tank prior to dilution is found by taking oil tank capacity, 32.5 US gallons and subtracting the amount of fuel to be added by dilution. This amount is one US gallon for each minute of dilution.

Example:

Dilution time required for (-6°F) expected minimum temperature is three minutes from figure 1. So, if one US gallon of fuel is added to the oil system for each minute of oil dilution, the amount of fuel added is three US gallons. Then 32.5 gallons tank capacity less three gallons fuel to be added gives 29.5 gallons, the level to which the nacelle oil tanks are to be serviced prior to dilution.

2. Idle engines at 1000 rpm with cowl flaps and oil cooler flaps open until cylinder head temperature has been reduced below 150°C and oil temperature has decreased to a minimum, preferably 50°C.

3. Dilute oil at 1000 rpm:

a. Turn fuel boost pump switches off.

b. Turn desired oil dilution engine selector switches on.

c. Hold master dilution switch on for the dilution time corresponding to the lowest OAT expected.

NOTE

If oil temperature rises above 55°C or if oil pressure drops below 15 PSI during dilution, record amount of time of dilution accomplished and shut engine down and allow it to cool before continuing.

4. At end of dilution period:

a. Move mixture controls to fuel cut-off.

b. Hold master dilution switch on until the propellers stop rotating.

NOTE

ENTER TIME PERIOD OF DILUTION AND/OR EQUIVALENT RE-DILUTION IN DD 781.

5. Leave cowl flaps approximately two inches open.

6. Preheat:

a. If the expected minimum temperature is to be at or below 0°F (-18°C), aircraft on alert status will be diluted to the schedule value shown in figure 1 for 0°F (-18°C) and preheat will be applied continuously in the engine and accessory section.

NOTE

In applying preheat it should be used to keep the CHT at from -15°C to 0°C.

b. If the expected minimum temperature is from 15°F (-9°C) to -25°F (-31°C) aircraft not on alert status will be diluted to the expected minimum temperature as shown in the schedule, figure 1, and preheat will be used in the accessory section as required before engine start.

c. If expected minimum temperatures are to be at or below -25°F (-32°C), aircraft not on alert will be diluted to the schedule, figure 1, for 0°F (-18°C) OAT, and use preheat as required in the engine and accessory section before engine start.

d. Dilution schedules are presented for temperatures down to -55°F; however, dilution below -25°F (-32°C) should only be accomplished for emergency operation when preheat is not available.

7. Re-dilution:

a. After ground operation:

1. Engine operation for periods of five minutes or less re-dilution is not required.

2. Engine ground operation in excess of five minutes will require re-dilution in accordance with the appropriate schedule in figure 1.

NOTE

Under both normal and alert conditions only two re-dilutions will be accomplished, prior to next flight. This is to prevent over dilution and insure maximum safety and engine reliability.

END

O'NEILL

T.O. 1C-97(K)G-1EF

SAFETY OF FLIGHT SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

KC-97G

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-97(K)G-1. Reference to this supplement will be made on the title page of the basic publication by personnel responsible for maintaining the publication in current status.

NOTE COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AF PERSONNEL CLEARED FOR OPERATION OF SUBJECT AIRCRAFT.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

25 MARCH 1960

1. PURPOSE.

To furnish emergency procedures for turbo supercharger turbine wheel bearing failure.

2. INSTRUCTIONS.

SECTION III

TURBO SUPERCHARGER EMERGENCY OPERATION

Turbine Wheel Bearing Failure.

The most probable cause of turbine wheel bearing failure is faulty lubrication. The most positive indication of bearing failure and pending turbo failure is a drop in manifold pressure. If the manifold pressure drop occurs when operating with turbo boost on automatic, cause of manifold pressure drop may be determined as follows:

1. Turbo Override Switch - OFF (Guard up)
2. Turbo Switch - MAN

If manifold pressure remains constant, except for normal decrease in climb with wastegate in fixed position, malfunction is in the automatic circuits.

If manifold pressure continues to drop:

3. Turbo Override Switches - OPEN (Guard down)
4. At Pilot's Discretion - Shut down engine

Engine shutdown is recommended if power requirement is not critical.

TURBOSUPERCHARGER EMERGENCY OPERATION

Engine Overboost

1. IMMEDIATELY AND SIMULTANEOUSLY:
   a. THROTTLE (AFFECTED TURBO) - RETARD
   b. TURBO OVERRIDE SWITCH (FOR AFFECTED TURBO) - OPEN (GUARD DOWN)
   c. TURBO SWITCH (AFFECTED TURBO) - MAN
2. Turbo Amplifier Fuse - Have checked
   a. If Blown - Replace
   b. Amplifier (If Fuse Not Blown) - Replace
3. Amplifier - Warm up
4. Turbo to Automatic Control - Return
5. Malfunction Still Indicated:
   a. Perform Step 1 again.
6. Manual Control - Use (at Pilot's discretion)

Turbo Lubrication Failure

1. Advise the Pilot - Turbo oil leakage
2. At the Pilot's Discretion Either (For The Affected Engine):
   a. Wastegate - Open
   b. Prop - Feather

Turbo Wheel Bearing Failure

1. Turbo Override Switch - OFF (Guard up)
2. Turbo Switch - MAN

If manifold pressure continues to drop:

3. Turbo Override Switches - OPEN (Guard down)
4. At Pilot's Discretion - Shut down engine

CUT ON DOTTED LINE

END

T.O. 1C-97(K)G-1EE
O'NEILL

SAFETY OF FLIGHT SUPPLEMENT

FLIGHT MANUAL

USAF SERIES
KC-97G
AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-97(K)G-1. Reference to this supplement will be made on the title page of the basic publication by personnel responsible for maintaining the publication in current status.

NOTE COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AF PERSONNEL CLEARED FOR OPERATION OF SUBJECT AIRCRAFT.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

NOTICE: Reproduction for non-military use of the information or illustrations contained in this publication is not permitted without specific approval of the issuing service (BuAer or USAF).

11 MARCH 1960

1. PURPOSE.

To provide for IFF check when aircraft is to operate within a radar advisory area.

2. GENERAL.

a. To insure safety of flight, all aircraft operating within a radar advisory area on a VFR, DVFR, or VFR on top clearance, are required by Air Route Traffic Control to have a functional IFF. In the event the IFF is inoperative, an aircraft may proceed through a radar advisory area only if ARTC has granted approval.

b. When a radar facility is available, the IFF should be checked for normal operation twice during each flight. The first check must be performed after take-off and prior to entering radar advisory areas. The second check should be within one hour prior to landing.

c. The check consists of ascertaining that the IFF transmitter is functioning normally and being properly received by the ground interrogator.

3. INSTRUCTIONS.

Section II

a. In the After Take-off Check List, include:

IFF -- Checked

If positive operation of the normal mode of IFF has not been established during departure with an air traffic control facility, a check should be made with such a facility as soon after take-off as flight conditions will permit. This check must be made prior to entering a radar advisory area. If IFF is inoperative, consult the appropriate navigation publications.

b. In the Descent Check List, include:

IFF -- Checked

This check should be performed within one hour prior to the estimated time of landing.

END

Air Force OC, 16 Mar 60-15700

T.O. 1C-97(K)G-1ED
O'NEILL

SAFETY OF FLIGHT SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

KC-97G

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-97(K)G-1 AND REPLACES SAFETY OF FLIGHT SUPPLEMENT T.O. 1C-97(K)G-1EC, DATED 14 DECEMBER 1959, WITH CHANGES TO THE TEXT. Reference to this supplement will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

NOTE COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AF PERSONNEL CLEARED FOR OPERATION OF SUBJECT AIRCRAFT.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

8 MARCH 1960

1. PURPOSE.

To avoid propeller blade failure on KC-97 aircraft with R-4360-59 and R-4360-65 engines, that fail to have proper damping action.

2. GENERAL.

Recent propeller blade cracks at 12 inches from the tip have been attributed to the lack of 3.5 engine order damping. Test analysis have shown the measured mechanically induced vibratory stresses were excessive between 2100 RPM and 2350 RPM on the blades that failed.

3. INSTRUCTIONS.

SECTION II, NORMAL PROCEDURES

ENGINE GROUND OPERATION

CAUTION

Head aircraft directly into the wind for all ground runs. Running engines on the ground with a 90 degree crosswind of 10 knots or over, increases normal propeller stresses by two or three times and causes engine overheat.

Air Force OC, 9 Mar 60-14700

SECTION V, OPERATING LIMITATIONS

PILOT'S AND ENGINEER'S TACHOMETERS

Figure 5-1

Inflight operation between 2100 RPM and 2350 RPM is prohibited except while passing through this range.

PROPELLER LIMITATIONS

1. Ground operation between 1250 to 1650 RPM and 2100 to 2650 RPM is prohibited except for passing through these ranges and performing authorized checks. Avoid operation above 2650 RPM under static conditions. Do not use reverse thrust for ground maneuvering.

END