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NAVAIR 01-75GAE-1

NATOPS Flight Manual

NAVY MODELS EC-130G/Q AIRCRAFT

THIS MANUAL SUPERSEDES NAVAIR 01-75GAE-1 DATED 1 MARCH 1969, CHANGED 1 MAY 1973, WHICH SHOULD BE DESTROYED

ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS AND UNDER THE DIRECTION OF THE COMMANDER, NAVAL AIR SYSTEMS COMMAND

1 October 1975

LIST OF EFFECTIVE PAGES

Date of issue for original pages is:

Original (0) . . . . 1 Oct 75

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 911 CONSISTING OF THE FOLLOWING:

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INTERIM CHANGE SUMMARY

The following Interim Changes have been canceled or previously incorporated in this manual:

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
1–8	

The following Interim Changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER	REMARKS/PURPOSE
9	Flaps (Hydraulic System)

Interim Changes Outstanding - To be maintained by the custodian of this manual:

INTERIM CHANGE NUMBER	ORIGINATOR/DATE (or DATE/TIME GROUP)	PAGES AFFECTED	REMARKS/PURPOSE

RECORD OF APPLICABLE TECHNICAL DIRECTIVES.

Technical Directive No.	Date	Title	Changes/Revision/ Supplement Date
AFC-94	9 November 1967	Landing Gear - Installation of NLG Drag Strut Actuator (ECP GV-206)	1 March 1969
AFC-99	29 January 1968	Avionics - Installation of Diversity HF Antenna (ECP GV-211-1)	1 March 1969
AFC-104	26 June 1968	Landing Gear - Installation of MLG Emergency Extension Wrench (ECP GV-225)	1 March 1969
AFC-109	11 November 1968	Electrical - Installation of Isolated DC Bus Warning Light (ECP GV-234)	27 August 1969
AFC-112	27 August 1968	Hydraulic - Installation of Check Valve in the Emergency Brake Return Line (ECP GV-235)	1 March 1969
AFC-122	27 January 1972	Avionics - Integration of TACSATCOM Equipment in EC-130Q Aircraft (ECP GV-254)	27 October 1971
AFC-124	13 January 1969	Avionics - EC-130Q Interface Update (ECP GV-253)	1 March 1969
AFC-126	7 October 1969	Avionics - Installation of Servo Repeater for the AN/ASN-41 Computer (ECP GV-249)	27 August 1969
AFC-133	15 January 1970	Revision to AIMS Systems Circuitry (ECP GV-238)	27 August 1969
AFC-134	6 March 1970	Addition of Check Valves to Brake Anti-Skid Return Lines (ECP GV-257)	27 August 1969
AFC-139	10 November 1971	Incorporation of Improved Center Wing	4 May 1971
AFC-155	Pending	Main Landing Gear - Modification of MLG Track Support Beam (ECP GV-281)	26 May 1972
AFC 160	September 1972	Conversion of TACAMO III to a high-power TACAMO IVB	1 March 1975
AVC 1329	September 1972	Incorporation of a high-power VLF subsystem into Communication System AN/USC-13(V)	1 March 1975

NEW NEW NEW

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

1 October 1975

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft accident rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative, but rather to aid the Commanding Officer in increasing his unit's combat potential without reducing his command prestige or responsibility.

2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual procedure is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing, progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end, Commanding Officers of aviation units are authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAVINST 3510.9 series, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.

3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and may be carried in Naval Aircraft for use therein. It is forbidden to make copies of this entire publication or major portions thereof without specific authority of the Chief of Naval Operations.

W.D. Houser

W.D. HOUSER
Vice Admiral, USN
Deputy Chief of Naval Operations
(Air Warfare)

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FOREWORD

SCOPE

The NATOPS Flight Manual is issued by the authority of the Chief of Naval Operations and under the direction of Commander, Naval Air Systems Command in conjunction with the Naval Air Training and Operating Procedures Standardization (NATOPS) Program. This manual contains information on all aircraft systems, performance data, and operating procedures required for safe and effective operations. However, it is not a substitute for sound judgement. Compound emergencies, available facilities, adverse weather or terrain, or considerations affecting the lives and property of others may require modification of the procedures contained herein. Read this manual from cover to cover. It's your responsibility to have a complete knowledge of its contents.

APPLICABLE PUBLICATIONS

The following applicable publications complement this manual:

NAVAIR 01-75GAE-1M (Supplement)
NAVAIR 01-75GAE-1C (Emergency Card Checklist)
NAVAIR 01-75GAE-1.1C (Normal Card Checklist)
NAVAIR 01-75GAE-1.2C (ACS Card Checklist)
NAVAIR 01-75GAE-1F (Functional Checkflight Checklist)
NAVAIR 01-75GAE-1S (Scroll Checklist)

HOW TO GET COPIES

Each flight crewmember is entitled to personal copies of the NATOPS Flight Manual and appropriate applicable publications.

Automatic Distribution

To receive future changes and revisions to this manual or any other NAVAIR aeronautical publication automatically, a unit must be established on an automatic distribution list maintained by the Naval Air Technical Services Facility (NATSF). To become established on the list or to change existing NAVAIR publication requirements, a unit must submit NAVAIR Form 5605/3, Parts I through IV to NATSF, 700 Robbins Ave., Philadelphia, Pa. 19111, listing this manual and all other NAVAIR publications required. For additional instructions refer to NAVAIRINST 5605.4 series and Introduction to Navy Stocklist of Publications and Forms NAVSUP Publication 2002 (S/N 0535-LP-004-0001).

Additional Copies

Additional copies of this manual and changes thereto may be procured by submitting DD Form 1348 to NAVPUBFORMCEN Philadelphia in accordance with Introduction to Navy Stocklist of Publications and Forms NAVSUP Publication 2002.

UPDATING THE MANUAL

To ensure that the manual contains the latest procedures and information, NATOPS review conferences are held in accordance with OPNAVINST 3510.9 series.

CHANGE RECOMMENDATIONS

Recommended changes to this manual or other NATOPS publications may be submitted by anyone in accordance with OPNAVINST 3510.9 series.

Routine change recommendations are submitted directly to the Model Manger on OPNAV Form 3500-22 shown on the next page. The address of the Model Manager of this aircraft is:

Commanding Officer
Fleet Air Reconnaissance Squadron Four
Naval Air Station
Patuxent River, Maryland 20670

Change recommendations of an URGENT nature (safety of flight, etc.,) should be submitted directly to the NATOPS Advisory Group Member in the chain of command by priority message.

NATOPS/TACTICAL CHANGE RECOMMENDATION
OPNAV FORM 3500/22 (5-69) 0107-722-2002 DATE

TO BE FILLED IN BY ORIGINATOR AND FORWARDED TO MODEL MANAGER

FROM (originator)	Unit
TO (Model Manager)	Unit

Complete Name of Manual/Checklist	Revision Date	Change Date	Section/Chapter	Page	Paragraph

Recommendation (be specific)

☐ CHECK IF CONTINUED ON BACK

Justification

Signature	Rank	Title

Address of Unit or Command

TO BE FILLED IN BY MODEL MANAGER *(Return to Originator)*

FROM	DATE
TO	

REFERENCE
(a) Your Change Recommendation Dated ____________

☐ Your change recommendation dated ________ is acknowledged. It will be held for action of the review conference planned for ____________ to be held at ____________

☐ Your change recommendation is reclassified URGENT and forwarded for approval to ____________ ____________ by my DTG ____________

/S/ ____________ MODEL MANAGER, ____________ AIRCRAFT

YOUR RESPONSIBILITY

NATOPS Flight Manuals are kept current through an active manual change program. Any corrections, additions, or constructive suggestions for improvement of its content should be submitted by routine or urgent change recommendation, as appropriate, at once.

NATOPS FLIGHT MANUAL INTERIM CHANGES

Flight Manual Interim Changes are changes or corrections to the NATOPS Flight Manuals promulgated by CNO or NAVAIRSYSCOM. Interim Changes are issued either as printed pages, or as a naval message. The Interim Change Summary page is provided as a record of all interim changes. Upon receipt of a change or revision, the custodian of the manual should check the updated Interim Change Summary to ascertain that all outstanding interim changes have been either incorporated or canceled; those not incorporated shall be recorded as outstanding in the section provided.

CHANGE SYMBOLS

Revised text is indicated by a black vertical line in either margin of the page, adjacent to the affected text, like the one printed next to this paragraph. The change symbol identifies the addition of either new infomation, a changed procedure, the correction of an error, or a rephrasing of the previous material.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to "WARNINGS", "CAUTIONS", and "NOTES" found through the manual.

WARNING

An operating procedure, practice, or condition, etc., which may result in injury or death if not carefully observed or followed.

CAUTION

An operating procedure, practice, or condition, etc., which may result in damage to equipment if not carefully observed or followed.

Note

An operating procedure, practice, or condition, etc., which is essential to emphasize.

WORDING

The concept of word usage and intended meaning which has been adhered to in preparing this Manual is as follows:

"Shall" has been used only when application of a procedure is mandatory.

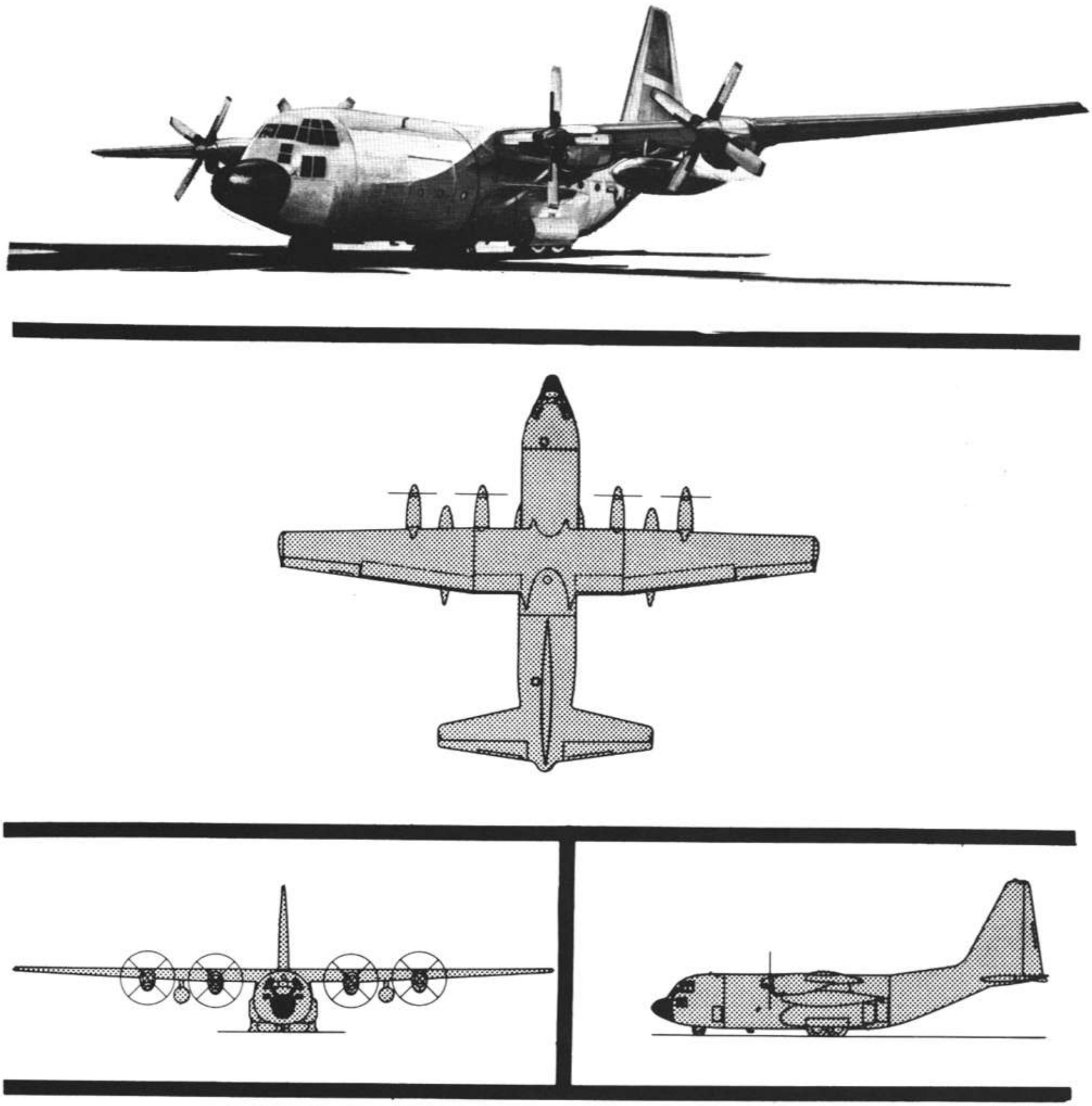
"Should" has been used only when application of a procedure is recommended.

"May" and "need not" have been used only when application of a procedure is optional.

"Will" has been used only to indicate futurity, never to indicate any degree of requirement for application of a procedure.

the aircraft

EC-130 G/Q



EC-130-1-0-339

SECTION I

AIRCRAFT

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PART 1

GENERAL DESCRIPTION

THE AIRCRAFT.

The Lockheed EC-130G and EC-130Q aircraft are mission-dedicated aircraft containing Communication System AN/USC-13(V). The aircraft is a high-wing, all-metal, long-range, land-based monoplane. Communication System AN/USC-13(V) is a message-handling terminal that can receive and transmit encrypted and unencrypted voice, keyed cw, and tty messages. Details of Communication System AN/USC-13(V) are contained in NAVAIR 01-75GAE-1M and NAVAIR 16-45-1848.

PROPULSION.

Power is supplied by four Allison T56-A-423 turboprop, constant-speed engines. There are provisions for externally mounted ATO units to provide additional thrust for take-off.

AIRCRAFT DIMENSIONS.

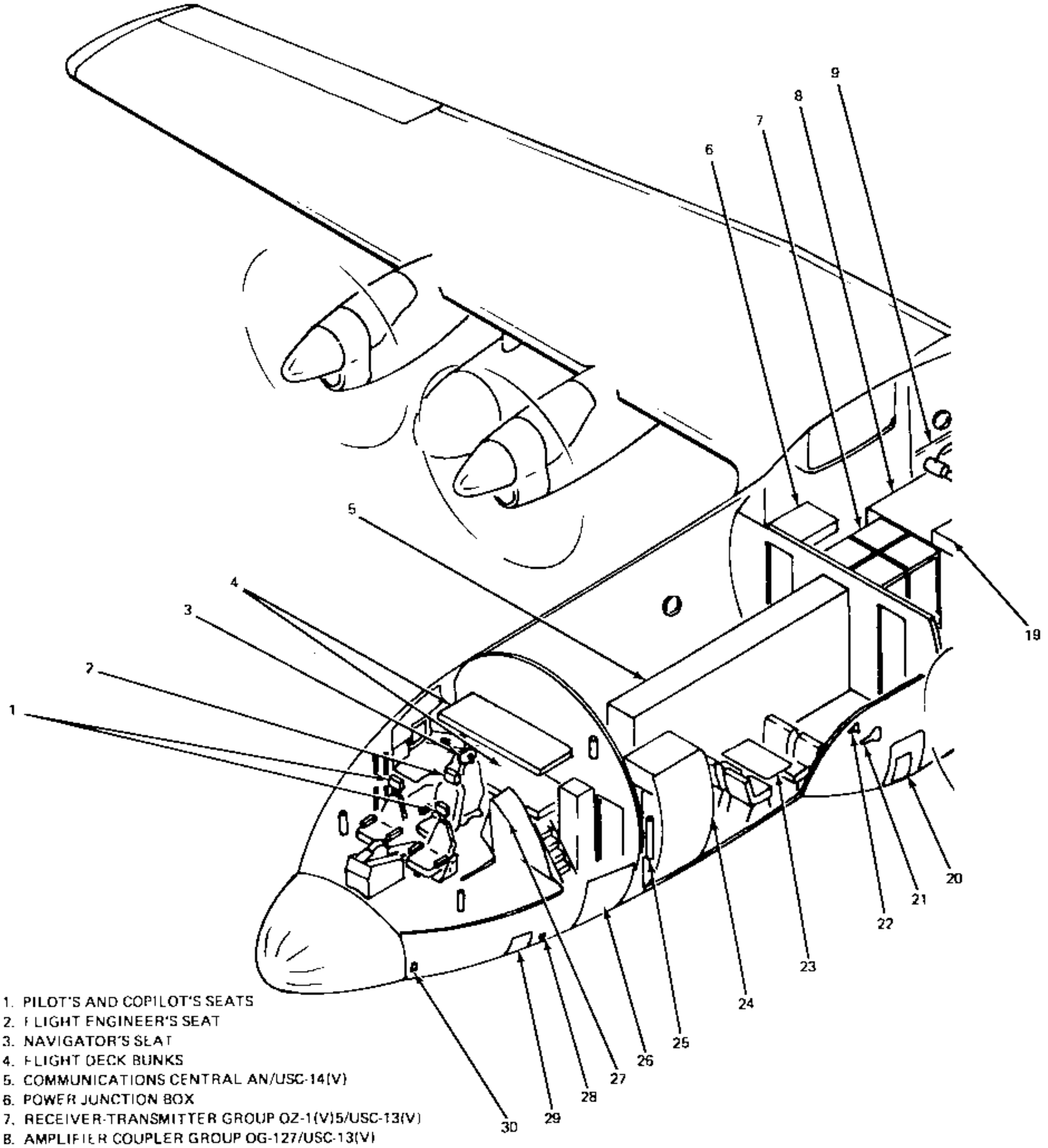
The principal dimensions of the aircraft are:

Wing Span	132 feet 7 inches
Length	99 feet 4 inches
Height	38 feet 6 inches
Stabilizer Span	52 feet 8 inches
Special Equipment Compartment:	
Length	41 feet
Width (Minimum)	10 feet 3 inches
Height (Minimum)	9 feet

CREW STATIONS.

Crew stations on the flight deck are provided for a pilot, copilot, navigator, and flight engineer. The pilot and copilot are seated on the left and right sides, respectively, of the control pedestal in the forward section of the flight station. The navigator is seated behind the copilot on the right side of the flight station, facing outboard. The flight engineer is seated in the center of the flight station, behind the pilot and copilot. See figures 1-2 through 1-11 for crewmembers stations and control panels.

general arrangement diagram



1. PILOT'S AND COPILOT'S SEATS
2. FLIGHT ENGINEER'S SEAT
3. NAVIGATOR'S SEAT
4. FLIGHT DECK BUNKS
5. COMMUNICATIONS CENTRAL AN/USC-14(V)
6. POWER JUNCTION BOX
7. RECEIVER-TRANSMITTER GROUP OZ-1(V)5/USC-13(V)
8. AMPLIFIER COUPLER GROUP OG-127/USC-13(V)
9. AFT BUNKS (2 ON STARBOARD SIDE AND 2 ON PORT SIDE)
10. PARATROOP DOOR (STARBOARD SHOWN, PORT SIDE OPPOSITE)
11. ANTENNA AS-2888/USC-13(V) (LONG WIRE ANTENNA)
12. LAVATORY
13. ANTENNA AS-2889/USC-13(V) (SHORT WIRE ANTENNA)

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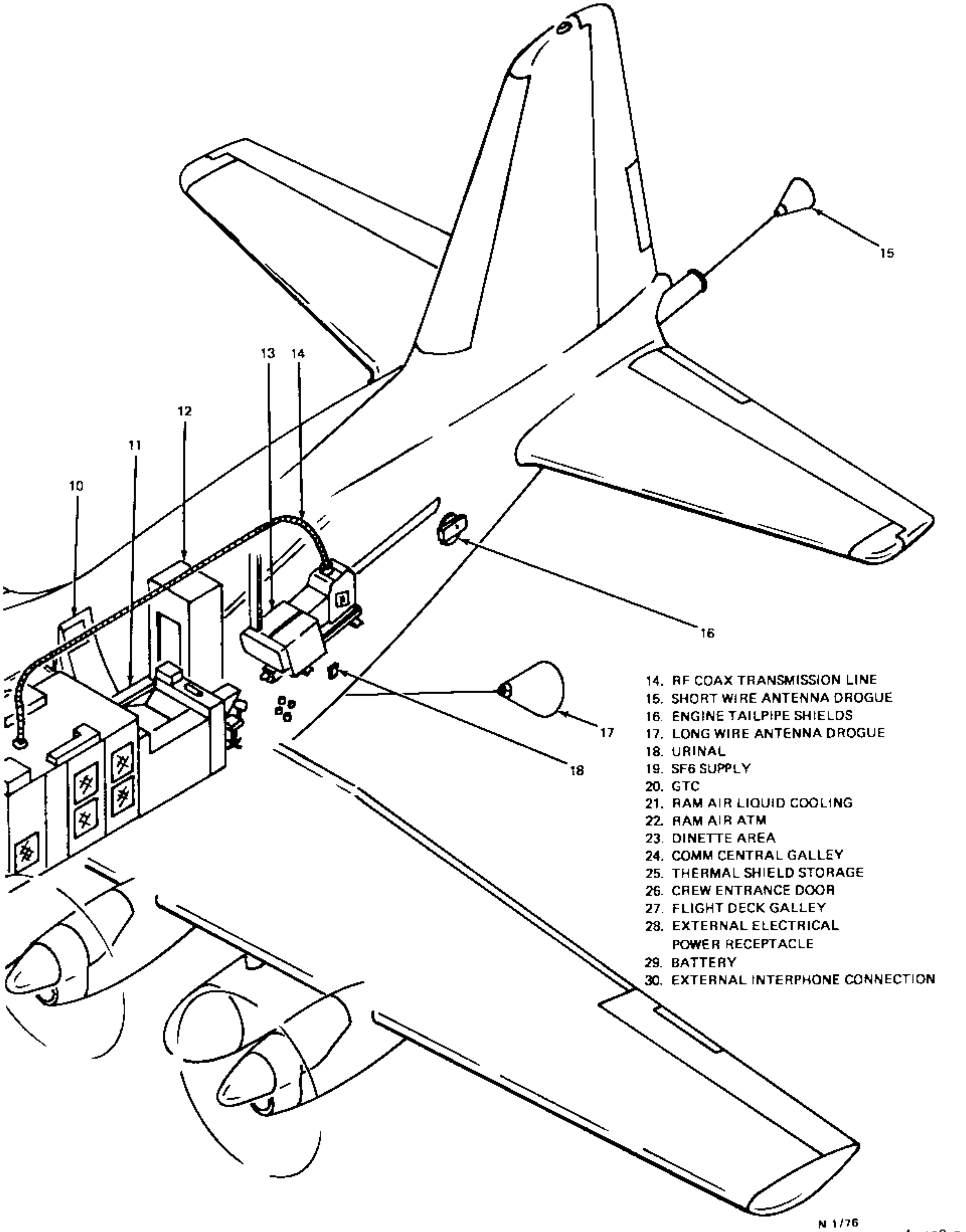
Figure 1-1 (Sheet 1 of 2)



14. RF COAX TRANSMISSION LINE
15. SHORT WIRE ANTENNA DROGUE
16. ENGINE TAILPIPE SHIELDS
17. LONG WIRE ANTENNA DROGUE
18. URINAL
19. SF6 SUPPLY
20. GTC
21. RAM AIR LIQUID COOLING
22. RAM AIR ATM
23. DINETTE AREA
24. COMM CENTRAL GALLEY
25. THERMAL SHIELD STORAGE
26. CREW ENTRANCE DOOR
27. FLIGHT DECK GALLEY
28. EXTERNAL ELECTRICAL POWER RECEPTACLE
29. BATTERY
30. EXTERNAL INTERPHONE CONNECTION

Figure 1-1 (Sheet 2 of 2)

flight station forward

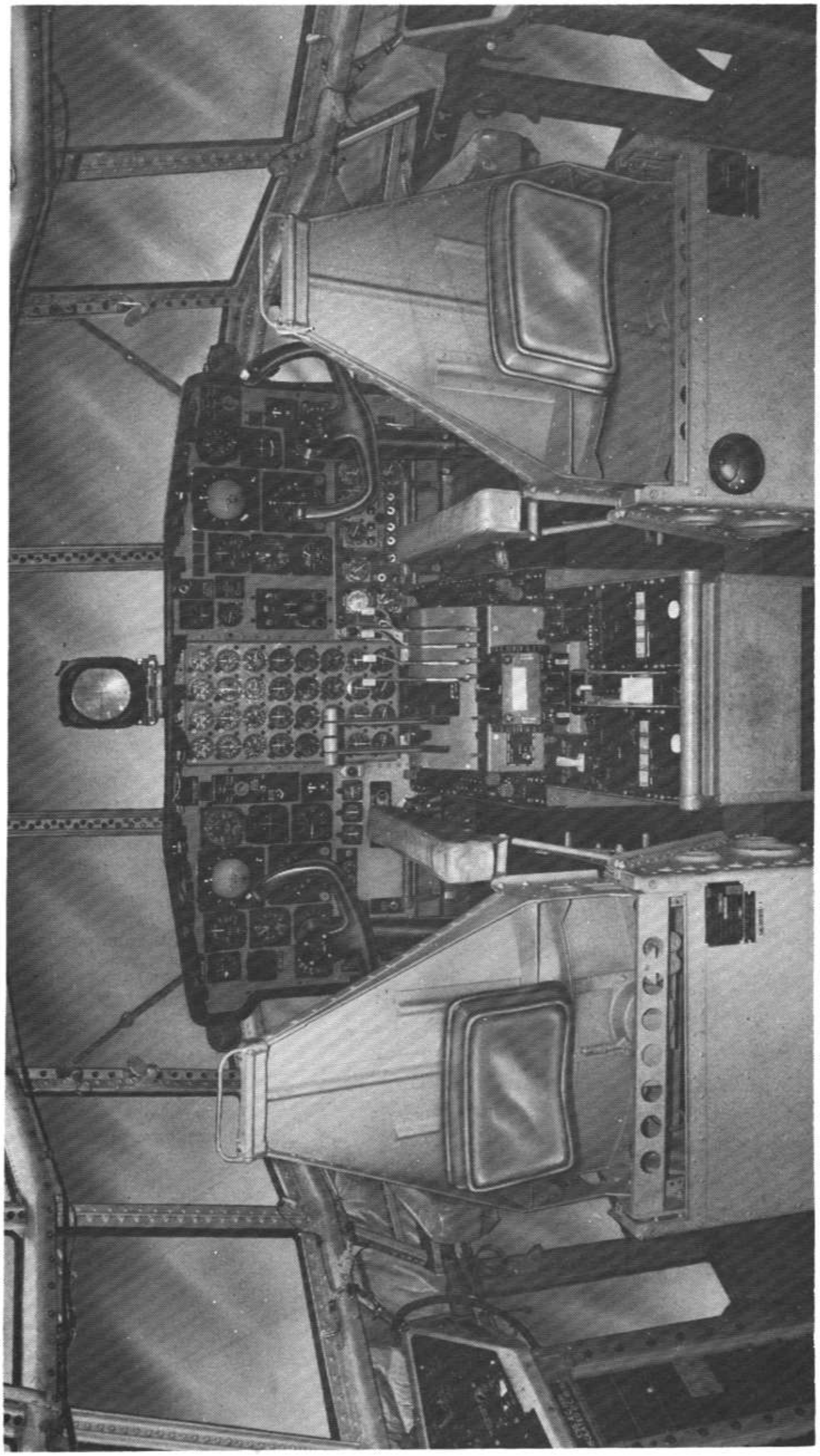


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Figure 1-2.

pilot's station

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Figure 1-3.

copilot's station

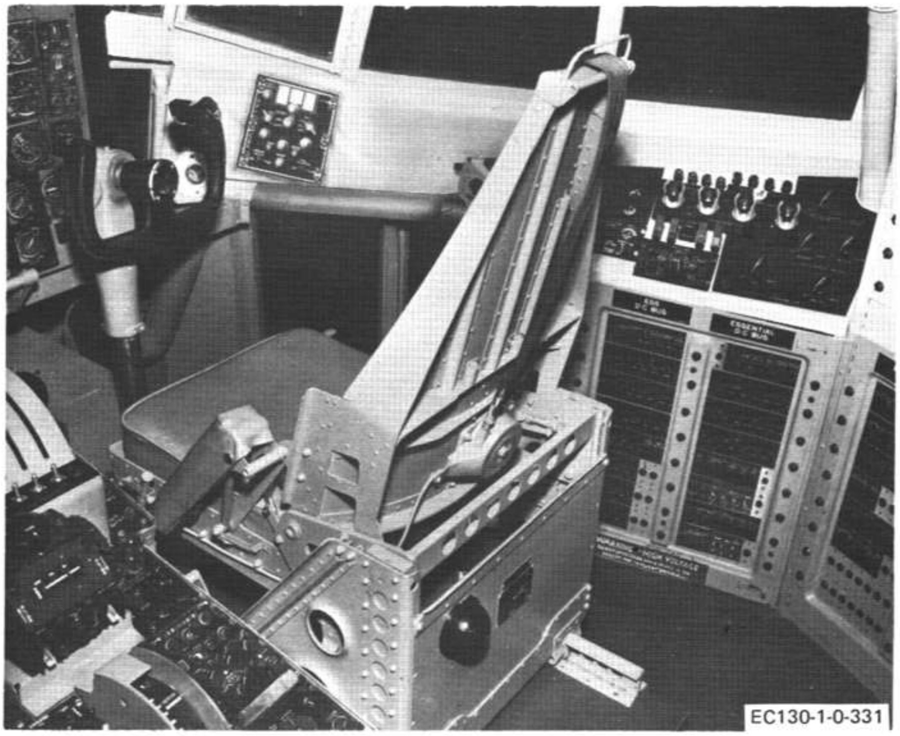
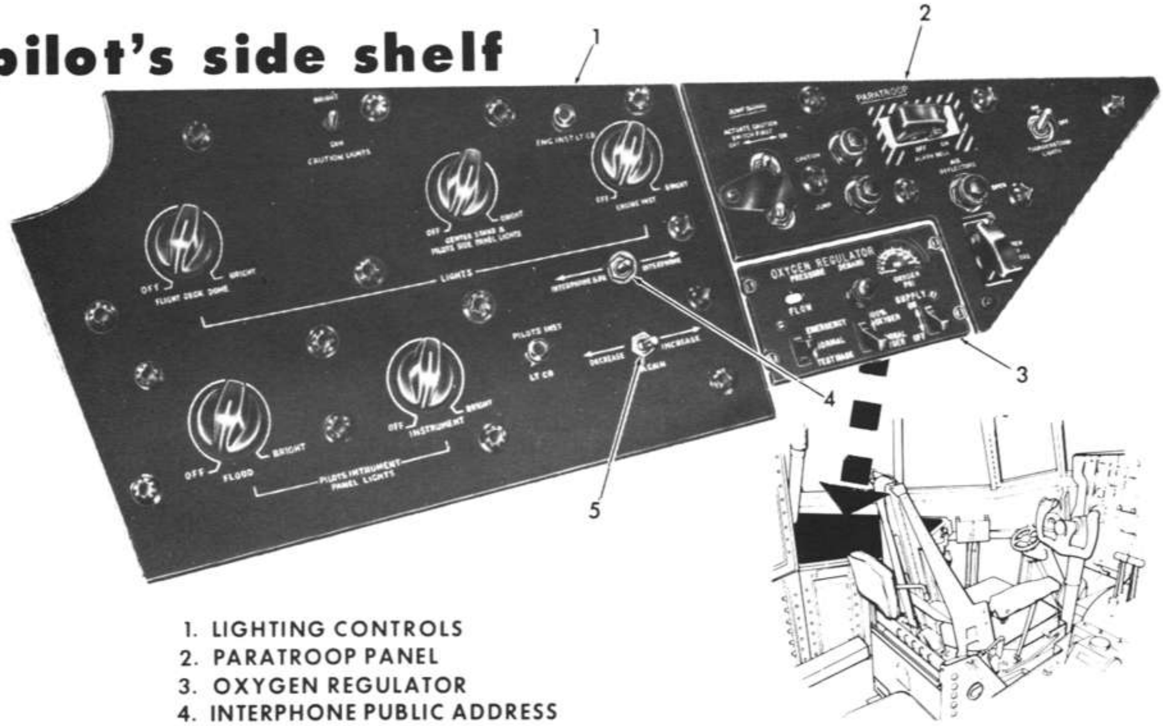


Figure 1-4.

pilot's side shelf



1. LIGHTING CONTROLS
2. PARATROOP PANEL
3. OXYGEN REGULATOR
4. INTERPHONE PUBLIC ADDRESS SELECTOR SWITCH
5. PILOT'S PA GAIN CONTROL SWITCH

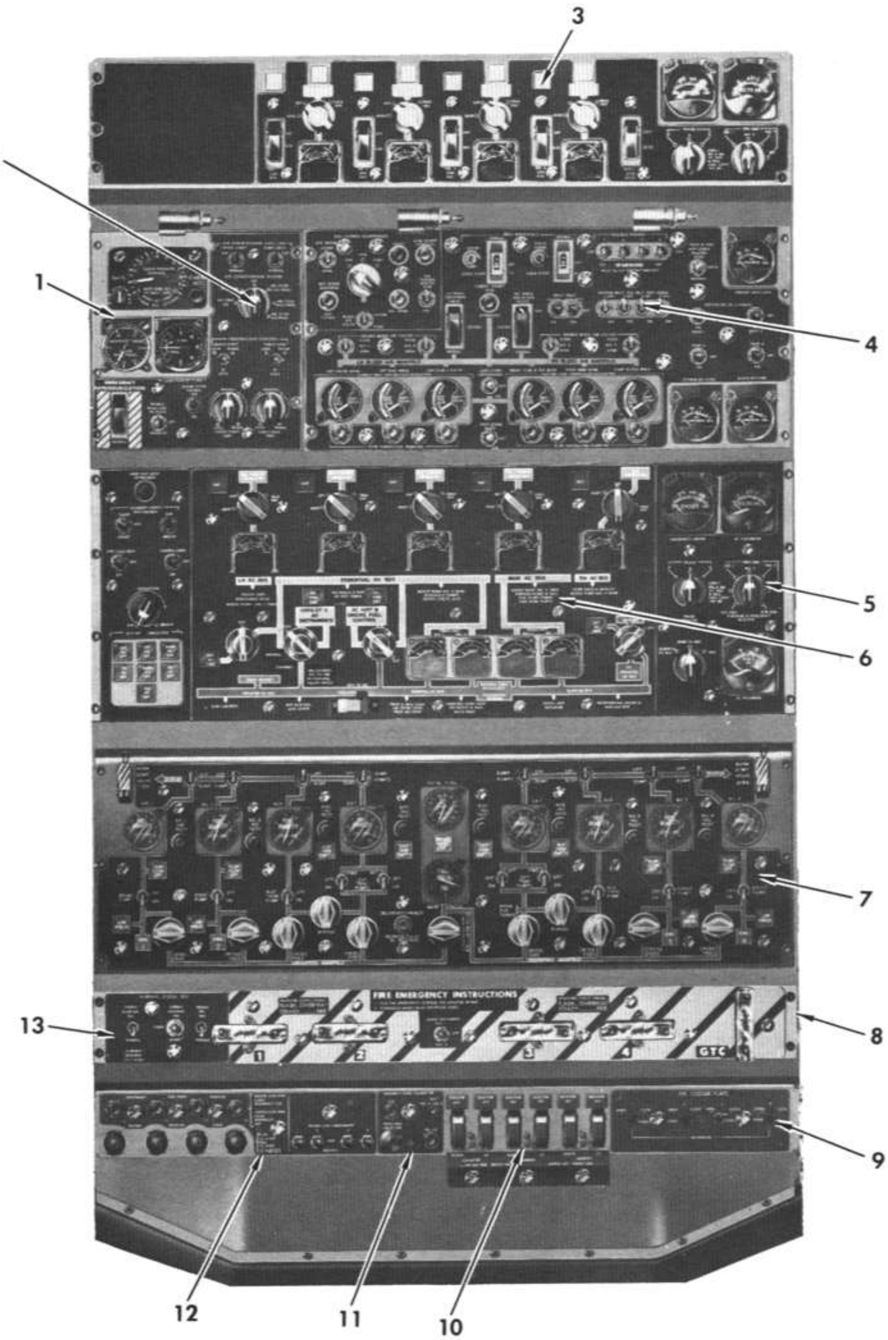
Figure 1-5.

copilot's side shelf

1. PARATROOP PANEL
2. PROPELLER CONTROLS
3. LIGHTING CONTROLS
4. OXYGEN REGULATOR PANEL

Figure 1-6.

overhead control panel



1. AIR CONDITIONING AND PRESSURIZATION CONTROL PANEL
2. GTC CONTROL PANEL
3. 90 KVA GENERATOR CONTROL PANEL
4. ANTI-ICING SYSTEMS CONTROL PANEL
5. OVERHEAD ELECTRICAL CONTROL PANEL
6. 50 KVA GENERATOR CONTROL PANEL
7. FUEL CONTROL PANEL
8. FIRE EMERGENCY CONTROL PANEL
9. OIL COOLER FLAP CONTROL PANEL
10. CONTROL BOOST SWITCH PANEL
11. ICE DETECTION PANEL
12. ENGINE STARTING CONTROL PANEL
13. WARNING SYSTEM TEST PANEL

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Figure 1-7

main instrument panel

1. PILOT'S INSTRUMENT PANEL
2. AN/APN-59 INDICATOR
3. ENGINE INSTRUMENT PANEL
4. COPILOT'S INSTRUMENT PANEL

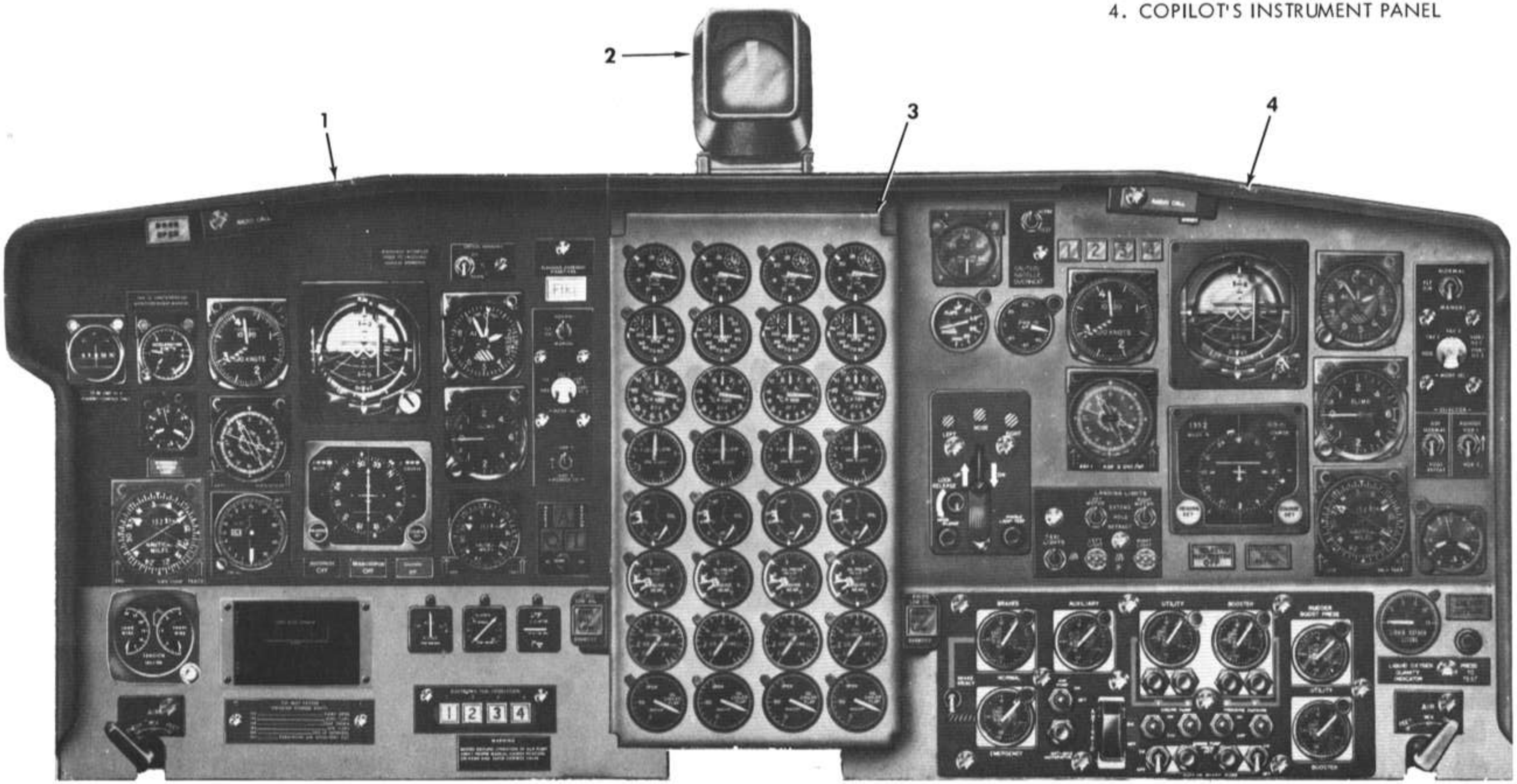

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Figure 1-8

navigator's station

typical

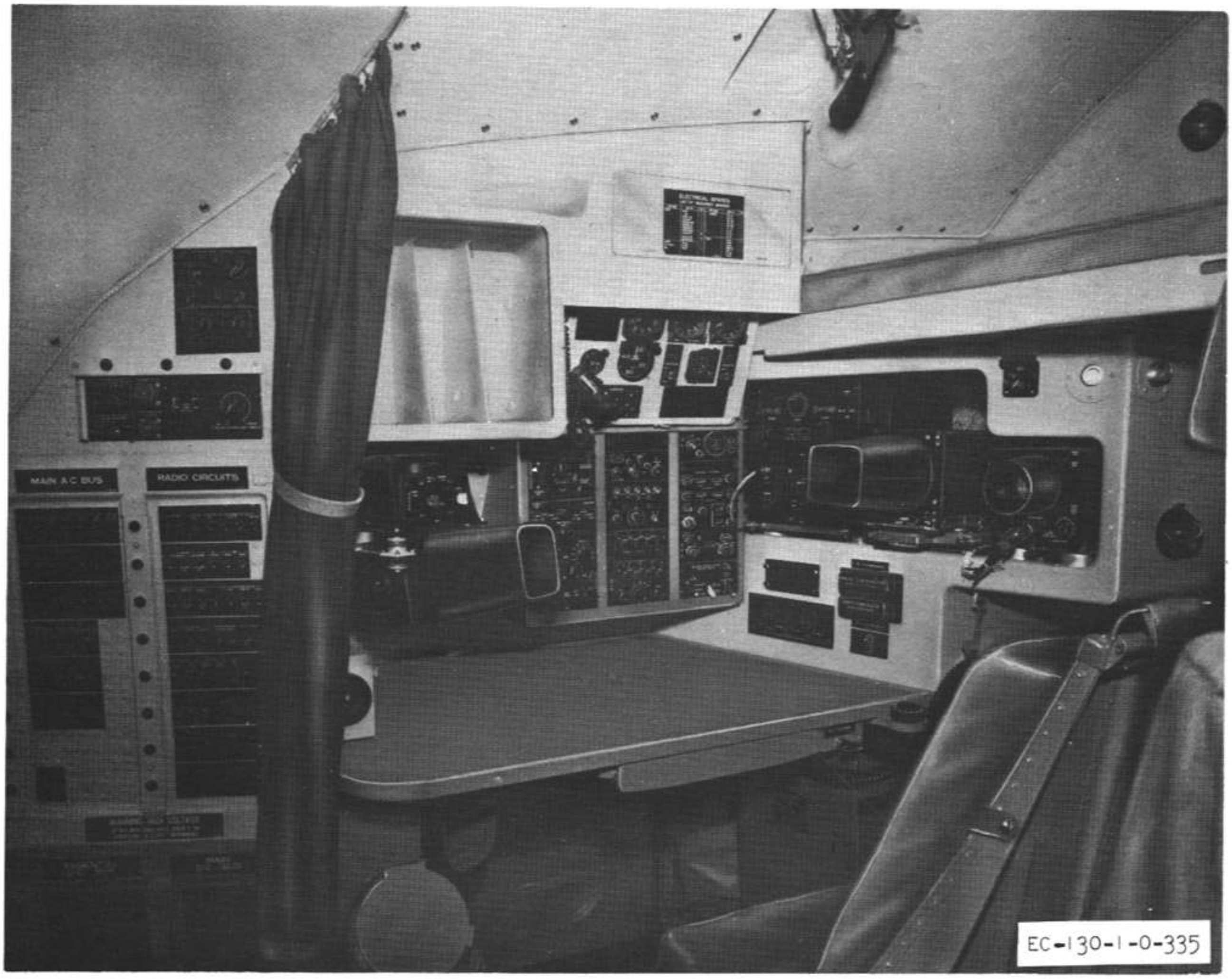
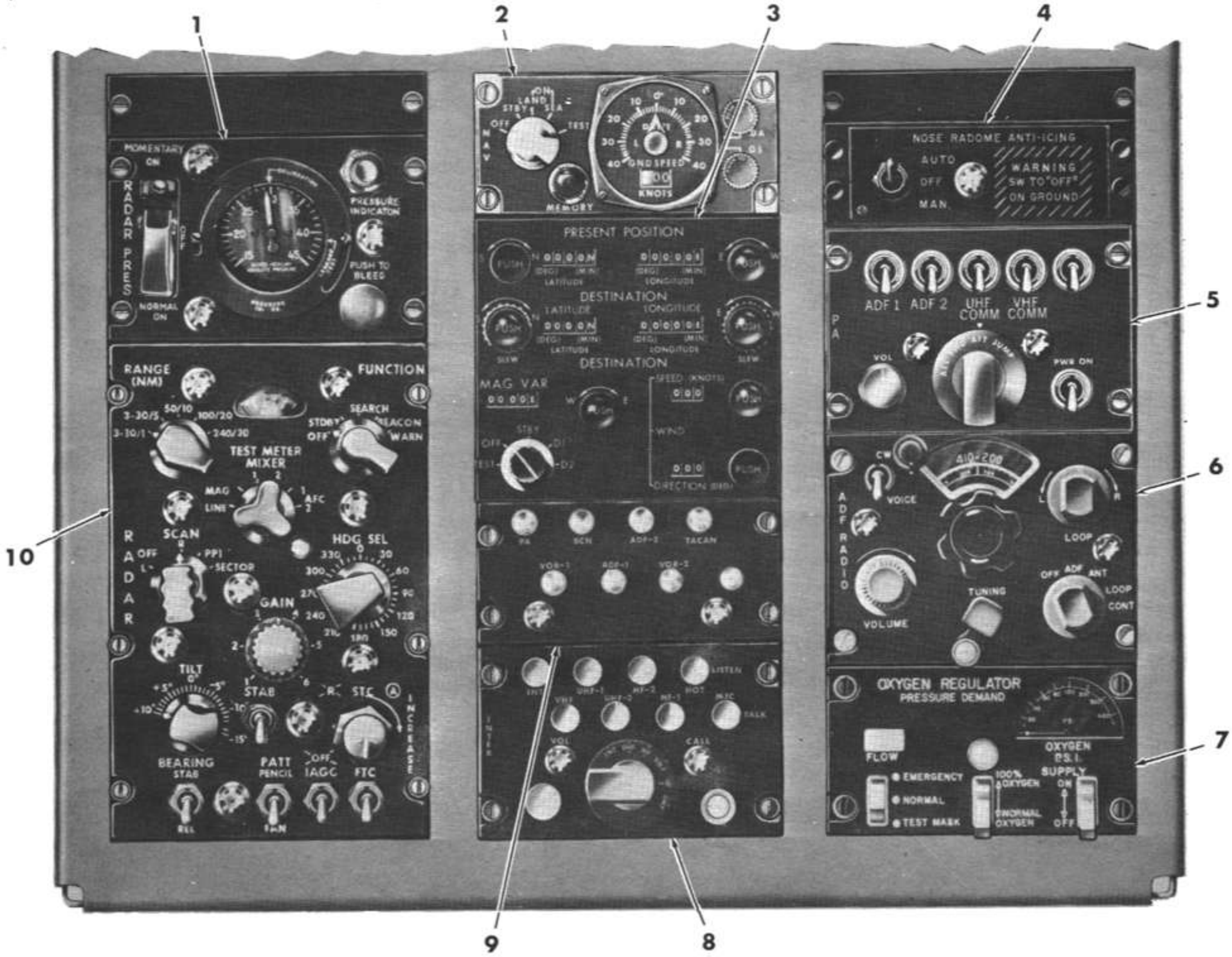


Figure 1-9.

navigator's control panel (EC-130G aircraft)



1. RADAR PRESSURIZATION CONTROL PANEL
2. DOPPLER RADAR NAVIGATION CONTROL PANEL
3. DOPPLER NAVIGATION COMPUTER CONTROL PANEL
4. NOSE RADOME ANTI-ICING CONTROL PANEL
5. PUBLIC ADDRESS SYSTEM MAIN CONTROL PANEL
6. RADIO COMPASS CONTROL PANEL (ADF-1)
7. OXYGEN REGULATOR
8. INTERCOMMUNICATION SYSTEM CONTROL PANEL
9. INTERCOMMUNICATION SYSTEM SWITCH PANEL
10. SEARCH RADAR CONTROL PANEL

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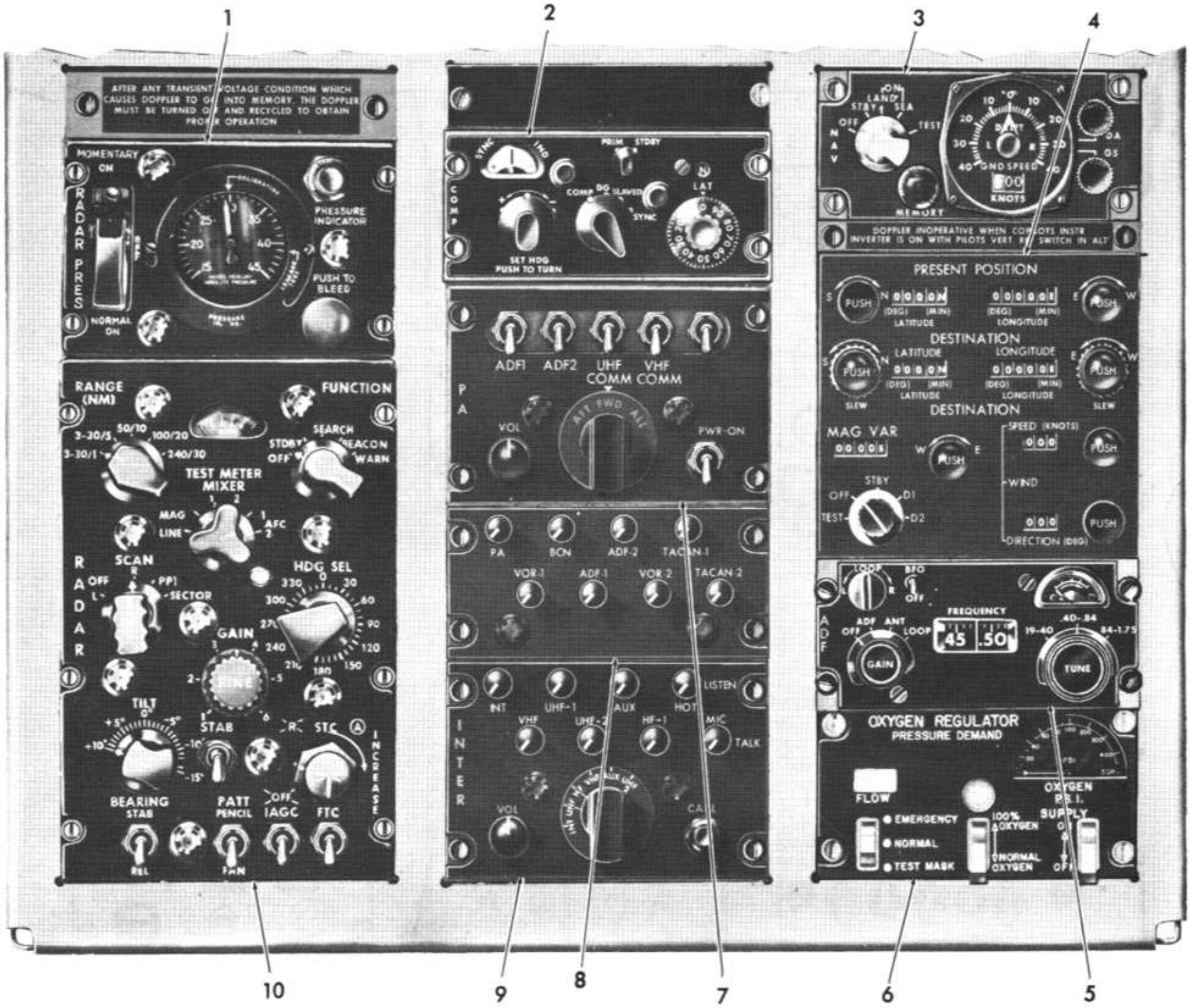
Figure 1-10. (Sheet 1 of 3)

(EC-130Q aircraft BuNo 156170—156177)



1. RADAR PRESSURIZATION CONTROL PANEL
2. ATTITUDE HEADING REFERENCE SYSTEM CONTROL PANEL
3. DOPPLER RADAR NAVIGATION CONTROL PANEL
4. NAVIGATION COMPUTER CONTROL PANEL
5. AUTOMATIC DIRECTION FINDER CONTROL PANEL **(ADF-2)**
6. OXYGEN REGULATOR
7. PUBLIC ADDRESS SYSTEM MAIN CONTROL PANEL
8. INTERCOMMUNICATION SYSTEM SWITCH PANEL
9. INTERCOMMUNICATION SYSTEM CONTROL PANEL
10. SEARCH RADAR CONTROL PANEL

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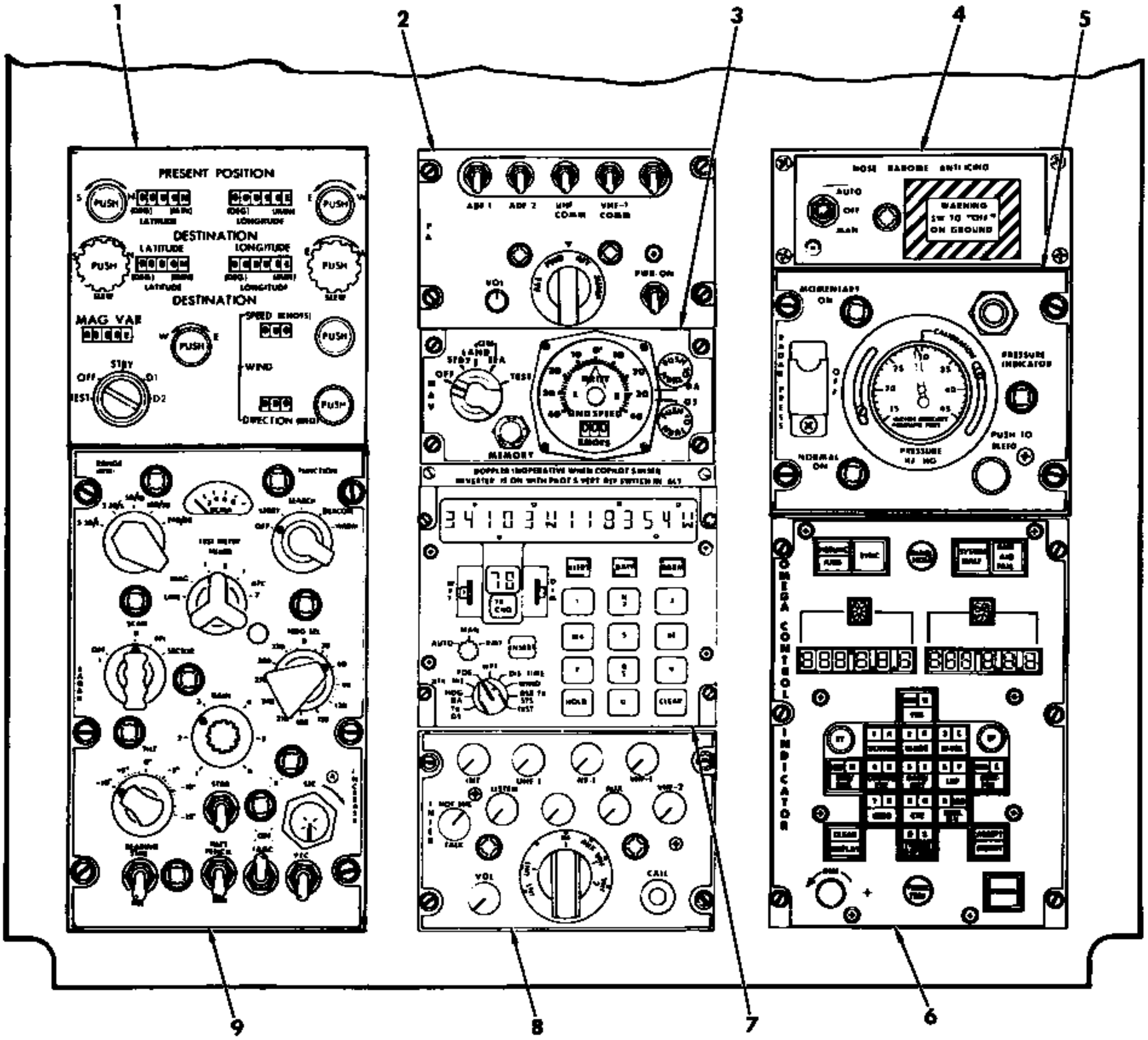
Figure 1-10. (Sheet 2 of 3)

(EC-130Q aircraft BuNo 159348 and 159469)



1. NAVIGATION COMPUTER CONTROL PANEL
2. PUBLIC ADDRESS SYSTEM MAIN CONTROL PANEL
3. DOPPLER RADAR NAVIGATION CONTROL PANEL
4. NOSE RADOME ANTI-ICING CONTROL PANEL
5. RADAR PRESSURIZATION CONTROL PANEL
6. OMEGA CONTROL INDICATOR PANEL
7. INERTIAL NAVIGATION SYSTEM CONTROL DISPLAY PANEL
8. INTERCOMMUNICATION SYSTEM CONTROL
9. SEARCH RADAR CONTROL PANEL

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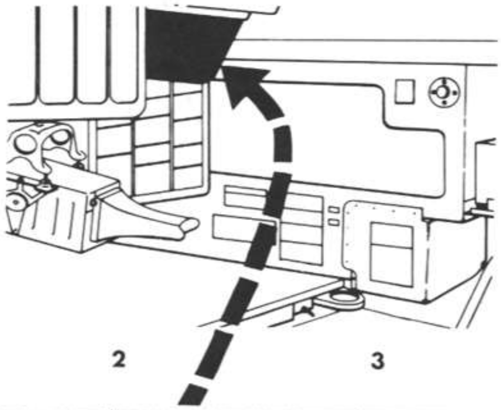
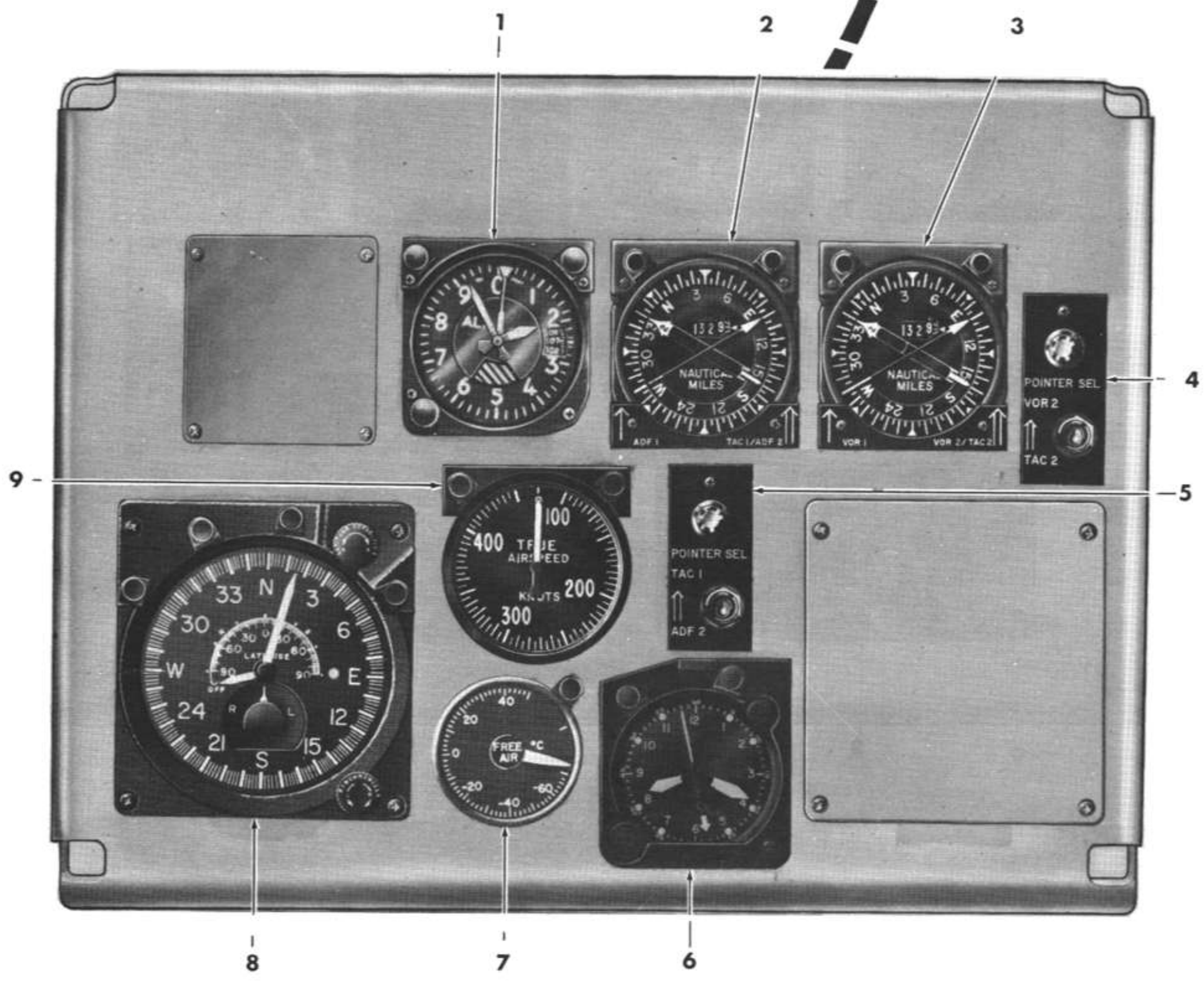
Figure 1-10. (Sheet 3 of 3)

navigator's instrument panel (EC-130G aircraft)





1. ALTIMETER
2. ID-1103 BEARING-DISTANCE-HEADING INDICATOR (ADF NO. 1, TACAN NO. 1, ADF NO. 2)
3. ID-1103 BEARING-DISTANCE-HEADING INDICATOR (VOR NO. 1, VOR NO. 2, TACAN NO. 2)
4. SELECTOR SWITCH, NO. 2 POINTER (VOR 2, TACAN 2)
5. SELECTOR SWITCH, NO. 2 POINTER (TACAN 1, ADF 2)
6. CLOCK
7. FREE AIR TEMPERATURE INDICATOR
8. N-1 COMPASS MASTER INDICATOR
9. TRUE AIRSPEED INDICATOR

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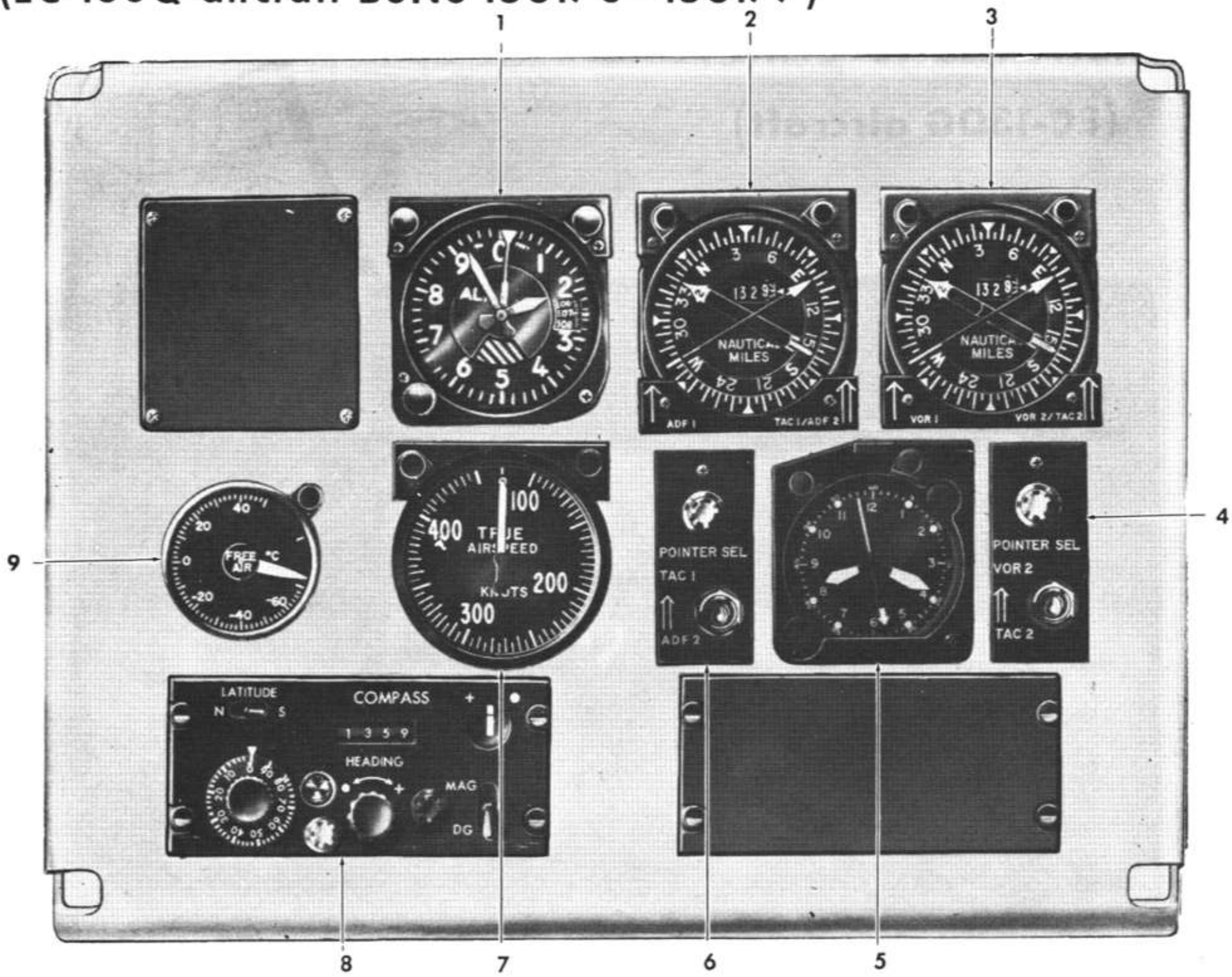
Figure 1-11. (Sheet 1 of 3)

(EC-130Q aircraft BuNo 156170—156177)



1. ALTIMETER
2. ID-1103 BDHI (ADF 1, TAC 1/ADF 2)
3. ID-1103 BDHI (VOR 1, VOR 2/TAC 2)
4. SELECTOR SWITCH NO. 2 POINTER (VOR 2, TAC 2)
5. CLOCK
6. SELECTOR SWITCH NO. 1 POINTER (TAC 1, ADF 2)
7. TRUE AIRSPEED INDICATOR
8. C-12 COMPASS CONTROLLER
9. FREE AIR TEMPERATURE INDICATOR

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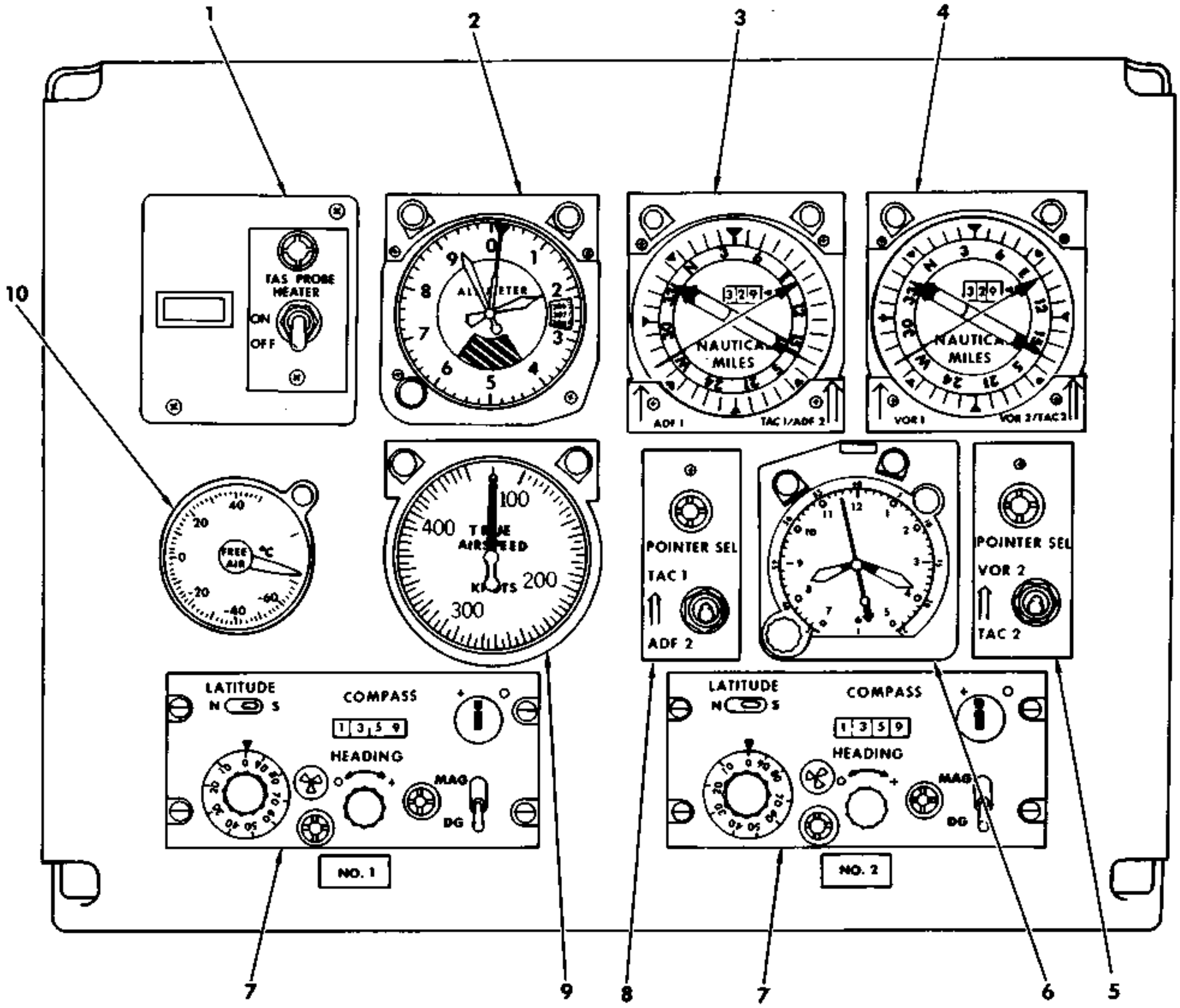
Figure 1-11. (Sheet 2 of 3)

(EC-130Q aircraft BuNo 159348 and 159469)



1. TAS PROBE HEATER SWITCH
2. ALTIMETER
3. ID-1103 BDHI (ADF 1, TAC 1/ADF 2)
4. ID-1103 BDHI (VOR 1, VOR 2, TAC 2)
5. SELECTOR SWITCH NO. 2 POINTER (VOR 2, TAC 2)
6. CLOCK
7. C-12 COMPASS CONTROLLER
8. SELECTOR SWITCH NO. 1 POINTER (TAC 1, ADF 2)
9. TRUE AIRSPEED INDICATOR
10. FREE AIR TEMPERATURE INDICATOR

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Figure 1-11. (Sheet 3 of 3)

PART 2

SYSTEMS AND EQUIPMENT

ENGINES.

The aircraft is powered by four T56-A-423 engines. (See figure 1-12.) The static, standard-day, sea level, take-off rating of the engine at 100 percent rpm (13,820) is 4,910 equivalent propeller SHP: 4,591 propeller SHP plus 319 ESHP resulting from jet thrust. In the EC-130G and EC-130Q installations, the engine is restricted to 4,510 equivalent propeller SHP; 4,200 propeller SHP (19,600 inch-pounds torque) plus 310 ESHP resulting from jet thrust.

POWER SECTION.

The power section of the engine has a single-entry, 14-stage, axial-flow compressor: a set of six combustion chambers of the through-flow type; and a 4-stage turbine. Mounted on the power section are an accessories drive assembly and components of the engine fuel, ignition, and control systems. Acceleration bleed valves are installed at the 5th and 10th compressor stages. A manifold at the diffuser bleeds air from the compressor for aircraft pneumatic systems. Anti-icing systems prevent accumulation of ice in the engine inlet air duct and the oil cooler scoop. Inlet air enters the compressor and is progressively compressed through the 14 stages of the compressor. The compressed air (at approximately 125 psi, 600° F) flows through a diffuser into the combustion section. Fuel flows into the combustion chambers and burns, increasing the temperature and thereby the energy of the gases. The gases pass through the turbine, causing it to rotate and drive the compressor, propeller, and accessories. The gases, after expanding through the turbine, flow out a tailpipe.

TORQUE SHAFT ASSEMBLY.

The torque shaft assembly consists of two concentric shafts and torquemeter components. The inner shaft transmits power from the power section to the reduction gear. The outer shaft serves as a reference so the torsional deflection of the loaded inner shaft can be detected by the magnetic pickups of the torque indicating system.

REDUCTION GEAR ASSEMBLY.

The reduction gear assembly contains a reduction gear train, a propeller brake, an engine negative torque control system, and a safety coupling. Mounted on the accessory drive pads are the engine starter, ac generators, a hydraulic pump, an oil pump, and a tachometer generator. The reduction gear has an independent dry-sump oil system supplied from the engine oil tank. The reduction gear train is in two stages, providing an over-all reduction of 13.54 to 1 between engine speed (13,820 rpm) and propeller shaft speed (1,021 rpm). The propeller brake, engine negative torque control system, and safety coupling are described in the following paragraphs.

Propeller Brake.

The cone-type propeller brake acts on the first stage of reduction gearing. During engine operation, it is held disengaged by gearbox oil pressure when rpm exceeds 23 percent, and is engaged below this speed. As engine speed is reduced and oil pressure drops, the braking surfaces are brought into contact by spring force to help slow the propeller to a stop. Helical splines are provided between the starter shaft and the starter gear on the outer brake member causing the brake to disengage when starting torque is applied during starting. The brake also engages to stop reverse rotation of the propeller.

Safety Coupling.

The safety coupling is provided to decouple the power section from the reduction gear if negative torque applied to the reduction gear exceeds approximately 6,000 inch-pounds, a value much higher than that required to operate the NTS system. Because of its higher setting, the safety coupling backs up the NTS system to reduce drag until the propeller can be feathered. The safety coupling connects the engine torque shaft to the pinion of the first stage of reduction gears. It consists of three members. An outer member is attached to the torque shaft; an inner member is attached to the pinion; and an

(T56-A-423-engine)

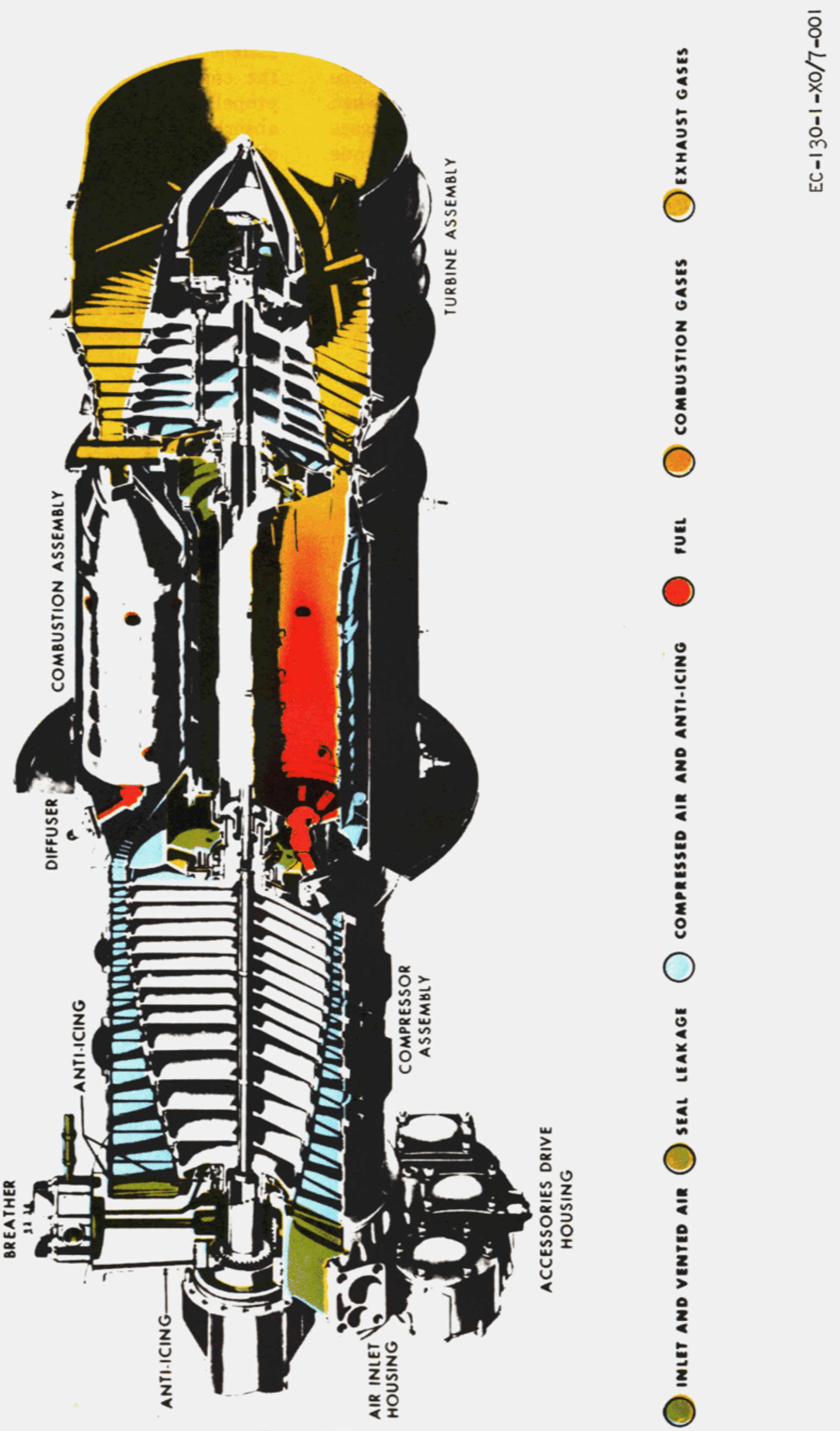


Figure 1-12.

intermediate member is engaged to the outer member by straight teeth and to the inner member by helical teeth. Reaction of the helical teeth tends to force the intermediate member aft out of engagement when negative torque is applied; and the members disengage if approximately 6,000 inch-pounds negative torque is reached. While disengaged, the two members are forced together by springs so that the teeth ratchet. The teeth can thus be damaged; therefore, the engine should not be continued in operation after a decoupling. Before restarting the engine, the coupling must be replaced.

NTS (Negative Torque Signal) System.

The NTS (negative torque signal) system provides a mechanical signal to limit negative torque. Negative torque is encountered when the propeller attempts to drive the engine. If not relieved, this condition creates a great amount of drag, causing the aircraft to yaw. The NTS system consists of an actuating mechanism housed partly within the reduction gear assembly and partly in a signal assembly in the propeller valve housing. It operates when negative torque applied to the reduction gear exceeds a predetermined value of -1260 (±600) inch-pounds. A ring gear is then moved forward against springs as a result of a torque reaction generated through helical splines. In moving forward, the ring gear pushes a plunger through the nose of the gearbox. The plunger pushes against a cam in the signal assembly to actuate control linkage connected to the propeller valve housing. When a negative torque signal is transmitted to the propeller, the propeller increases blade angle to relieve the condition, except when the throttles are below the FLIGHT IDLE position. When the throttles are below FLIGHT IDLE, a cam moves the actuator away from the NTS plunger and renders the system inoperative. This is necessary to prevent a propeller from receiving a possible negative torque signal at high landing speeds when the throttles are moved toward reverse. If the negative torque is sufficiently reduced, the signal mechanism returns to normal.

Note

> The NTS does not commit the propeller to feather.

ENGINE FUEL AND CONTROL SYSTEM.

The turboprop engine consists of the same components as the turbojet engine except that a propeller and a reduction gear are added. A turboprop engine turbine extracts more energy from the gas stream than a turbojet engine. This is necessary to drive not only the compressor and the accessories but also the propeller. Since most of the gas stream energy is absorbed by the turbine, the jet action, while still effective, is reduced considerably. A reduction gear is used because the turning speed of the power unit is too high for use with a propeller. In flight the engine operates at a constant speed which is maintained by the governing action of the propeller. Power changes are made by changing fuel flow and propeller blade angle rather than engine speed. An increase in fuel flow causes an increase in turbine inlet temperature and a corresponding increase in energy available at the turbine. The turbine absorbs more energy and transmits it to the propeller in the form of torque. The propeller, in order to maintain governing speed, increases blade angle to absorb the increased torque. Turbine inlet temperature is a very important factor in the control of the engine. It is directly related to fuel flow and consequently to power produced. It is also limited because of the strength and durability of the combustion and turbine section materials. The control system schedules fuel flow to produce specific turbine inlet temperatures and to limit those temperatures so that the temperature tolerances of combustion and turbine section materials are not exceeded. The fuel system (figure 1-29) consists of fuel filters, a fuel pump, a hydromechanical fuel control in series with an electronic temperature datum control system, and six fuel nozzles. Operating with the fuel system is the ignition system, the starting fuel enrichment system, the bleed air system, and the propeller. Changes in power settings are effected by the throttle which is connected to the fuel control and the propeller through a mechanical coordinator. During ground operation, changes in throttle position mechanically affect both the fuel flow and the propeller blade angle. In flight, changes in throttle position mechanically affect fuel flow and the propeller governor regulates blade angle, maintaining constant engine speed. The hydromechanical fuel control, which is part of the basic fuel system, senses engine inlet air temperature and pressure, rpm, and throttle position and varies fuel flow accordingly. The electronic temperature datum (TD) control system senses turbine inlet temperature and throttle position and makes any necessary changes in the fuel flow from the fuel control before it reaches the fuel nozzles. The TD system compensates for minor variables not sensed by the hydromechanical fuel control and for mechanical tolerances within the fuel control itself. By means of switches the TD system can be turned off or locked and the engine will operate on the basic hydromechanical system alone. With the TD system in AUTO, temperature protection is provided through the entire throttle range, and automatic temperature scheduling is provided when the throttle is in the range of 65 to 90 degrees. When the TD system is in NULL, the automatic functions of temperature limiting and temperature scheduling must be accomplished manually by adjustment of the throttle.

Basic Hydromechanical Fuel System.

The basic hydromechanical fuel system consists of a throttle, a coordinator, a low-pressure fuel filter, a high-pressure fuel filter, a dual-element fuel pump, a hydromechanical fuel control, and six fuel nozzles.

Throttle, Coordinator, and Propeller Control Linkage.

The coordinator is a mechanical discriminating device which coordinates the throttle, the propeller, the fuel control, and the electronic temperature datum (TD) system. Movements of the throttle are transmitted to the coordinator and, in turn, to the fuel control and the propeller by a series of levers and rods. A potentiometer in the coordinator provides signals to the TD system. Propeller blade angle is scheduled by throttle position from MAXIMUM REVERSE to FLIGHT IDLE. For throttle settings between FLIGHT IDLE and TAKE-OFF, the propeller is governing. Throttle movement in this range serves primarily to change fuel flow and also to change propeller hydraulic pitch stop (beta follow-up) settings.

Fuel Control and Fuel Nozzles.

Fuel flows from the fuel pump to the hydromechanical fuel control. The control is sensitive to throttle position, air temperature and pressure at the engine inlet, and engine speed. The engine speed function of the fuel control maintains engine speed in the taxi range and limits engine speed in the flight range if the propeller governor fails. Governor action is controlled by flyweights that respond to engine rpm. The control will start to reduce fuel to the engine at approximately 103.5 percent rpm. The fuel flow schedule maintained by the fuel control provides satisfactory operation of the engine throughout its entire range. Fuel metered by the control is equal to engine requirements plus an additional 20 percent, which is for the use of the temperature datum valve, a part of the TD system. With the TD system off, the excess fuel provided by the fuel control is constantly bypassed by the temperature datum valve back to the fuel pump and fuel metering is accomplished by the fuel control alone. The required fuel flow passes on through the temperature datum valve to the fuel nozzles and into the combustion liners, where it is burned.

Electronic Temperature Datum Control System.

The temperature datum control together with the coordinator potentiometer, temperature adjustment network, a turbine inlet temperature measurement system, and the temperature datum valve make up the electronic temperature datum system. The system compensates for variations in fuel heat value and density, engines, and control system characteristics. The temperature datum control is furnished actual turbine inlet temperature signals from a set of thermocouples and desired turbine inlet temperature signals by the throttle through the coordinator potentiometer and the temperature adjustment network. The control compares the actual and the desired turbine inlet temperature signals. In the temperature controlling range (65° - 90°), if there is a difference, the temperature datum control signals the temperature datum valve to increase or decrease fuel flow to bring the temperature back on shcedule. In the temperature limiting range (0° -65°) the temperature datum control acts only when the limiting temperature is exceeded at which time it signals the temperature datum valve to decrease fuel flow. The temperature datum valve is located between the fuel control and the fuel nozzles. It is a motor-operated, bypass valve which responds to signals received from the temperature datum control. In throttle positions between 0 and 65 degrees the valve remains in a 20 percent bypass or null position and the engine operates on the fuel flow scheduled by the fuel control. The valve remains in the null position unless it is signaled by the temperature datum control to limit turbine inlet temperature. The valve then reduces the fuel flow (up to 50 percent during starting, 20 percent above 94 percent rpm) to the nozzles by returning the excess to the fuel pump. When the turbine inlet temperature lowers to the desired level, the temperature datum control signals the valve to return to the null position. In throttle positions between 0° and 65° the control system is in the temperature limiting range. In throttle positions between 65° and 90° the temperature datum valve acts to control turbine inlet temperature to preselected schedule corresponding to throttle position; this is the temperature controlling range. In this range the valve may be signaled by the temperature datum control to allow more (higher temperature desired) or allow less (lower temperature

engine fuel flow

engine starting (parallel operation)

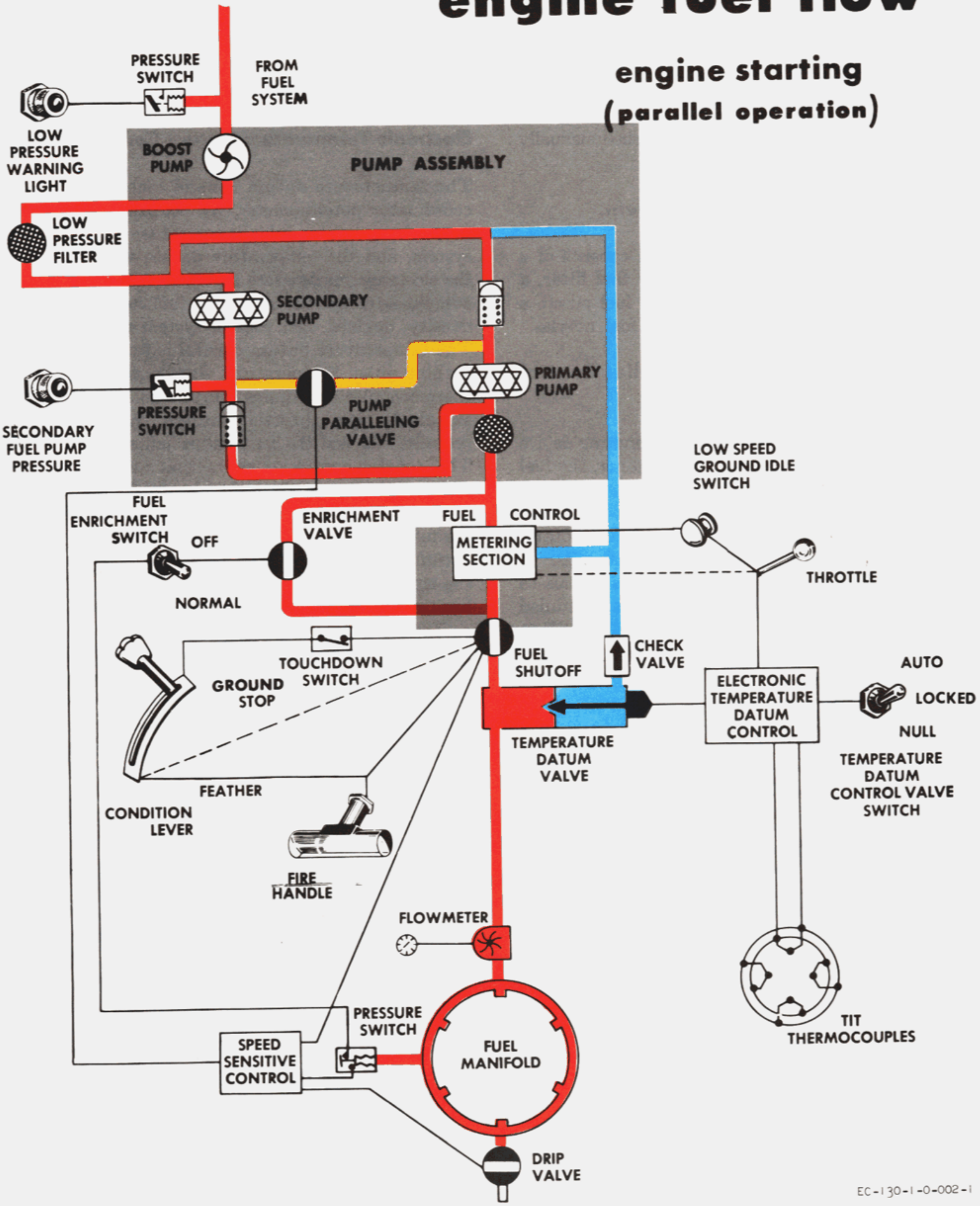


Figure 1-13. (Sheet 1 of 2)

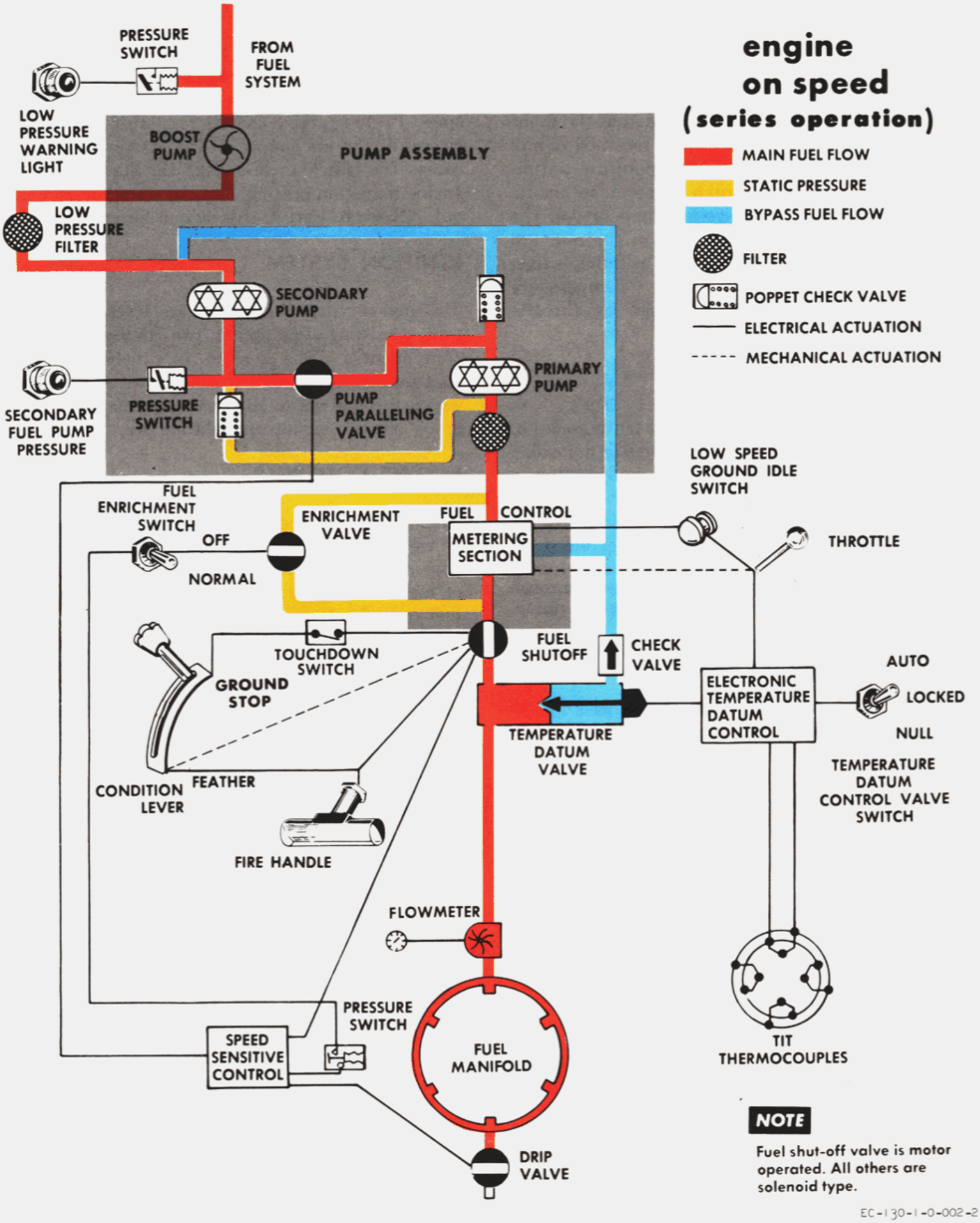


Figure 1-13. (Sheet 2 of 2)

desired) of the fuel to flow to the fuel nozzles. Any specific fuel flow trim correction applied in the 65 degree - 90 degree throttle range can be locked into the temperature datum valve while above 65 degrees and will be maintained in the 0 - 65 degree range by the use of the TD control switch located at the flight station. Also, the TD system can be returned to null at any time by the use of the temperature datum control switch. When the switch is in null, automatic temperature limiting circuits are inoperative, the temperature datum valve remains in the null (20 percent bypass) position, and all fuel metering is then accomplished by the fuel control. Temperature limiting then must be accomplished by throttle adjustment.

Acceleration Bleed Air Valves.

The bleed air valves on the fifth and tenth stages of the compressor are provided for compressor unloading during starting and while the engine is operating in the low-speed ground idle range. These bleed valves remain open only when engine speed is below 94 percent rpm. The fifth and tenth stage bleed air valves are automatic in operation and are actuated **closed by 14th stage compressor air pressure through an engine-driven speed sensitive valve assembly.**

Starting Fuel Enrichment System.

The enrichment system consists of a bypass line in which is mounted a solenoid valve controlled by the speed-sensitive control and a pressure switch. The valve is opened by the speed-sensitive control through the ignition relay when engine speed reaches 16 percent rpm during starting. While open, it allows pump discharge fuel to flow around the metering section of the fuel control to add to the metered flow from the fuel control. After fuel pressure in the manifold reaches approximately 50 psi (gage), the manifold pressure switch opens to de-energize the valve, which then closes.

STARTING SYSTEM.

An air turbine starter unit drives the engine for ground starts. This starter unit consists of an air-driven turbine section, a clutch, and a reduction gear section that is splined to the reduction gear section of the engine. Air for driving the starter can be supplied by the gas turbine compressor, by an operating engine, or by an external air source. The air is routed through the bleed air system and the engine bleed air valves. When the respective bleed air valve is opened, air is supplied to the starter regulator valve. The starter regulator valve opens when its solenoid is energized, and it allows airflow into the starter turbine section. A centrifugal cutout switch, mounted on the output side of the clutch housing, opens at starter cutout speed to de-energize the air regulator valve. This closes off the air supply to the starter turbine and causes the clutch to disengage the starter from the engine reduction gearing, and the starter button pops out. (Refer to Part 4, this section for starter limits.)

IGNITION SYSTEM.

The ignition system is a high-voltage, condenser-discharge type, consisting of an exciter, two igniters, and control components. The system is controlled by the speed-sensitive control through the ignition relay which turns it on at 16 percent engine rpm and off at 65 percent engine rpm during starting.

ENGINE CONTROLS.

Engine control in the flight range of operation is based on regulation of engine speed by propeller constant-speed governing and control of torque through regulation of fuel flow. Note that the throttle acts only as a fuel control. It exercises no direct control over the propeller, which is controlled entirely by the propeller regulator to regulate engine speed and to limit the low blade angle. The throttle does select the rate of fuel flow. The fuel control regulates the rate of increase and decrease of fuel metering for acceleration and deceleration.

Throttles.

The throttles (figure 1-16) are quadrant-mounted on the flight control pedestal. Throttle movement controls engine operation by positioning propeller controls and by positioning controls to select the rate of engine fuel flow. Throttle movements are transmitted through mechanical linkage to an engine-mounted coordinator. The coordinator transmits the movements through mechanical linkage to the propeller and to the engine fuel control, and it also actuates switches and a potentiometer which affect electronic temperature datum control system operation. Each throttle has two distinct ranges of movement, taxi and flight, which are separated by a stop (figure 1-14). Both ranges are used for ground operation, but the taxi range must not be used in flight. In the taxi range, the throttle position selects a propeller blade angle and a corresponding rate of fuel flow. In the flight (governing) range, throttle position selects a rate of

throttle quadrant

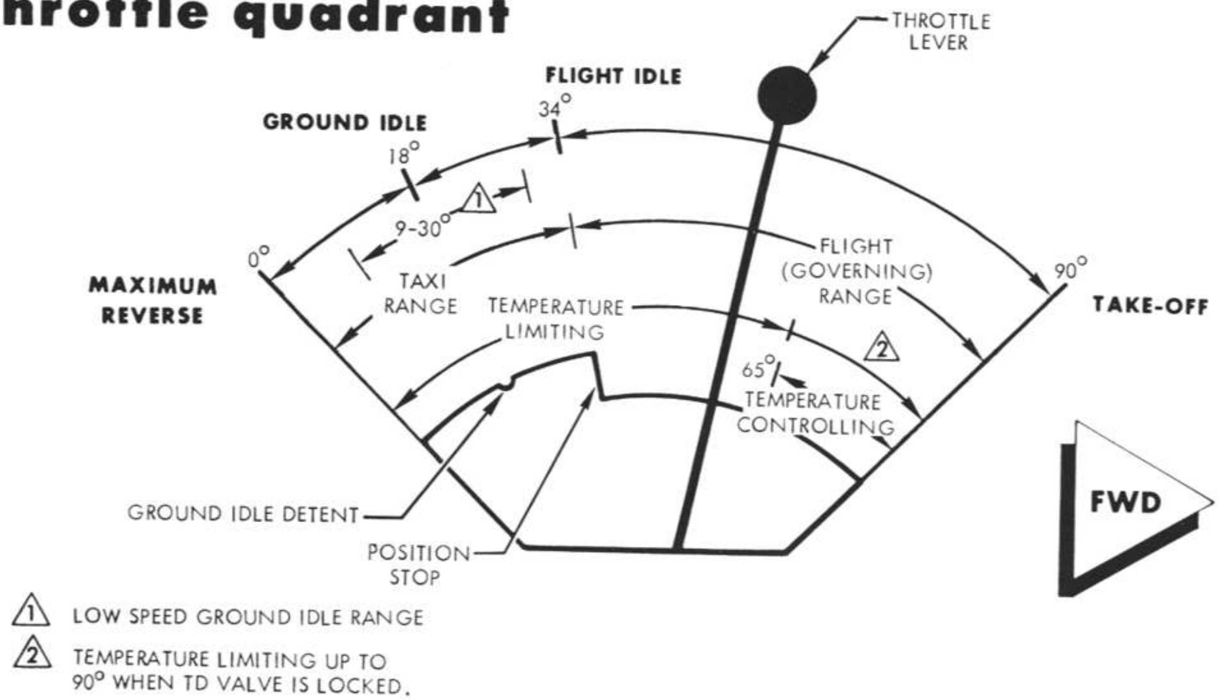


Figure 1-14.

low speed ground idle panel

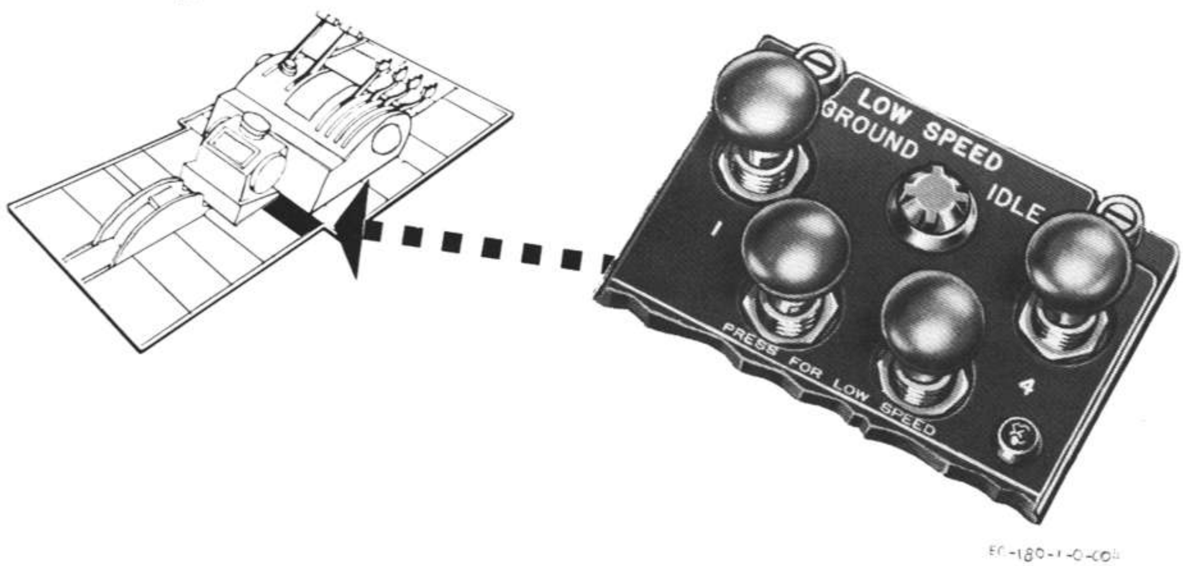


Figure 1-15.

fuel flow to produce a scheduled turbine inlet temperature; and the propeller governor controls propeller blade angle. The throttles have the following four placarded positions:

MAXIMUM REVERSE — Statically, gives maximum reverse thrust equal to approximately 30 percent of static take-off power and at 100 KIAS gives reverse thrust equal to 60 percent of static take-off power.

GROUND IDLE - (Approximately 18 degrees travel) is a detent position. This is the ground starting position at which blade angle is set for minimum thrust.

FLIGHT IDLE - (34 degrees travel) is the transition point between the taxi and flight (governing) ranges. A step in the quadrant limits aft travel of the throttle at this position until the throttle is lifted.

TAKE-OFF - (90 degrees travel) is the maximum power position.

The throttle quadrant is also divided into two unmarked ranges with respect to control of the electronic temperature datum control system. The crossover point is at 65 degrees throttle travel, at which point the switches in the coordinator are actuated. Below this point, the electronic temperature datum control system can limit turbine inlet temperature. Above this point, it is controlling turbine inlet temperature.

Low-Speed Ground Idle Controls.

Four low-speed ground idle control buttons (figure 1-15) located on the control pedestal may be pushed in to reduce fuel flow from the fuel control, thus causing engine rpm to decrease to approximately 72 percent at any time the throttles are in the range between 9 degrees and 30 degrees. Moving the throttles out of this range will automatically disengage the low-speed ground idle buttons. Power is supplied from the 28-volt essential dc bus through the low-speed ground idle circuit breakers on the copilot's side circuit breaker panel.

Throttle Friction Knob.

A friction knob (figure 1-16) on the throttle quadrant adjusts the amount of friction applied to the throttles to prevent creeping or accidental movement.

Condition Levers (Placarded ENGINE CONDITION)

Four pedestal-mounted condition levers (figure 1-16) are primarily controls for engine starting and stopping and propeller feathering and unfeathering.

They actuate both mechanical linkages and switches which provide electrical control. Each lever has four placarded positions:

RUN is a detent position. At this position, the lever closes a switch which places engine fuel and ignition systems under control of the speed-sensitive control. For engines No. 2 and No. 3, the ice detection system is energized.

AIR START is a position attained by holding the lever forward against spring tension. In this position, the lever closes the same switch closed by placing the lever at RUN, and in addition closes a switch which causes the propeller auxiliary pump to operate, thus providing pressure to unfeather the propeller.

GROUND STOP is a detent position. In this position, the lever actuates a switch which causes the electrical fuel shutoff valve on the engine fuel control to close only if the aircraft is on the ground, when landing gear touchdown switches are closed. On EC-130G aircraft, the switch also closes the nacelle preheat control circuit, making this system operable.

FEATHER is a detent position. When the lever is pulled toward this position, mechanical linkages transmit the motion to the engine-mounted coordinator and from the coordinator to the propeller and to the shutoff valve on the engine fuel control. Switches are also actuated by the lever as it is pulled aft. The results of moving the lever to FEATHER are the following:

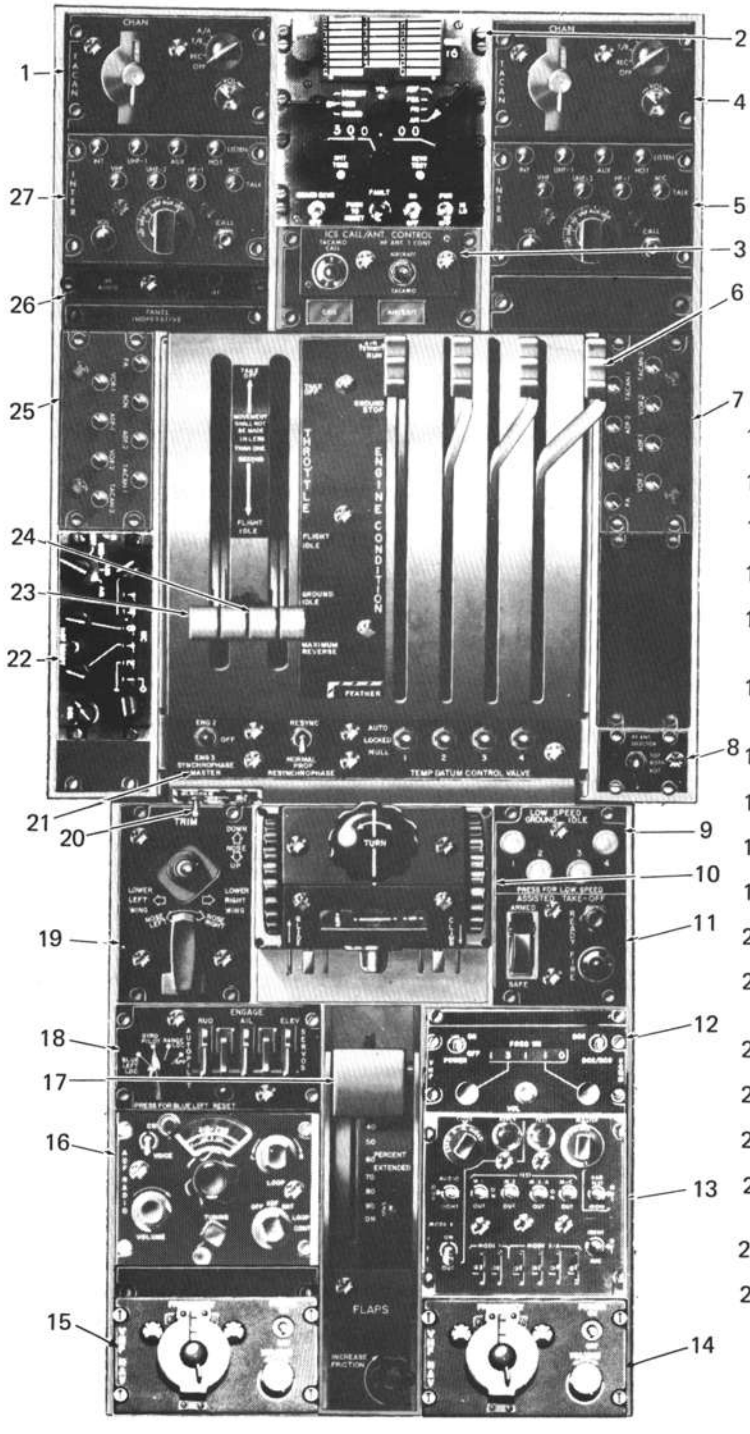
The propeller receives a feather signal that electrically energizes the feather valve solenoid. The feather valve is also positioned to the feather position mechanically.

The fuel shutoff valve on the engine fuel control is closed both mechanically and electrically.

The propeller auxiliary pump is turned on, providing pressure to feather the propeller.

The nacelle preheat system remains operable only when the aircraft is on the ground.

flight control pedestal
(EC-130G aircraft)



1. NO. 1 TACAN CONTROL PANEL
2. UHF COMMAND RADIO CONTROL PANEL
3. ICS CALL/ANT CONTROL PANEL
4. NO. 2 TACAN CONTROL PANEL
5. COPILOT'S INTERCOMMUNICATION CONTROL PANEL
6. CONDITION LEVERS
7. COPILOT'S INTERCOMMUNICATION SWITCH PANEL
8. IFF ANTENNA SELECTOR PANEL
9. LOW SPEED GROUND IDLE PANEL
10. AUTOPILOT CONTROLLER
11. ASSISTED TAKE-OFF CONTROL PANEL
12. VHF COMMAND RADIO CONTROL PANEL
13. IFF TRANSPONDER CONTROL PANEL
14. NO. 2 LOCALIZER AND VOR RECEIVER CONTROL PANELS
15. NO. 1 LOCALIZER AND VOR RECEIVER CONTROL PANEL
16. ADF CONTROL PANEL
17. FLAP LEVER
18. AUTOPILOT CONTROL PANEL
19. TRIM TAB CONTROL PANEL
20. ELEVATOR TAB POWER SWITCH
21. PROPELLER SYNCHROPHASER CONTROL PANEL
22. HF LIAISON RADIO CONTROL PANEL
23. THROTTLES
24. THROTTLE FRICTION KNOB
25. PILOT'S INTERCOMMUNICATION SWITCH PANEL
26. IFF AUDIO PANEL
27. PILOT'S INTERCOMMUNICATION CONTROL PANEL

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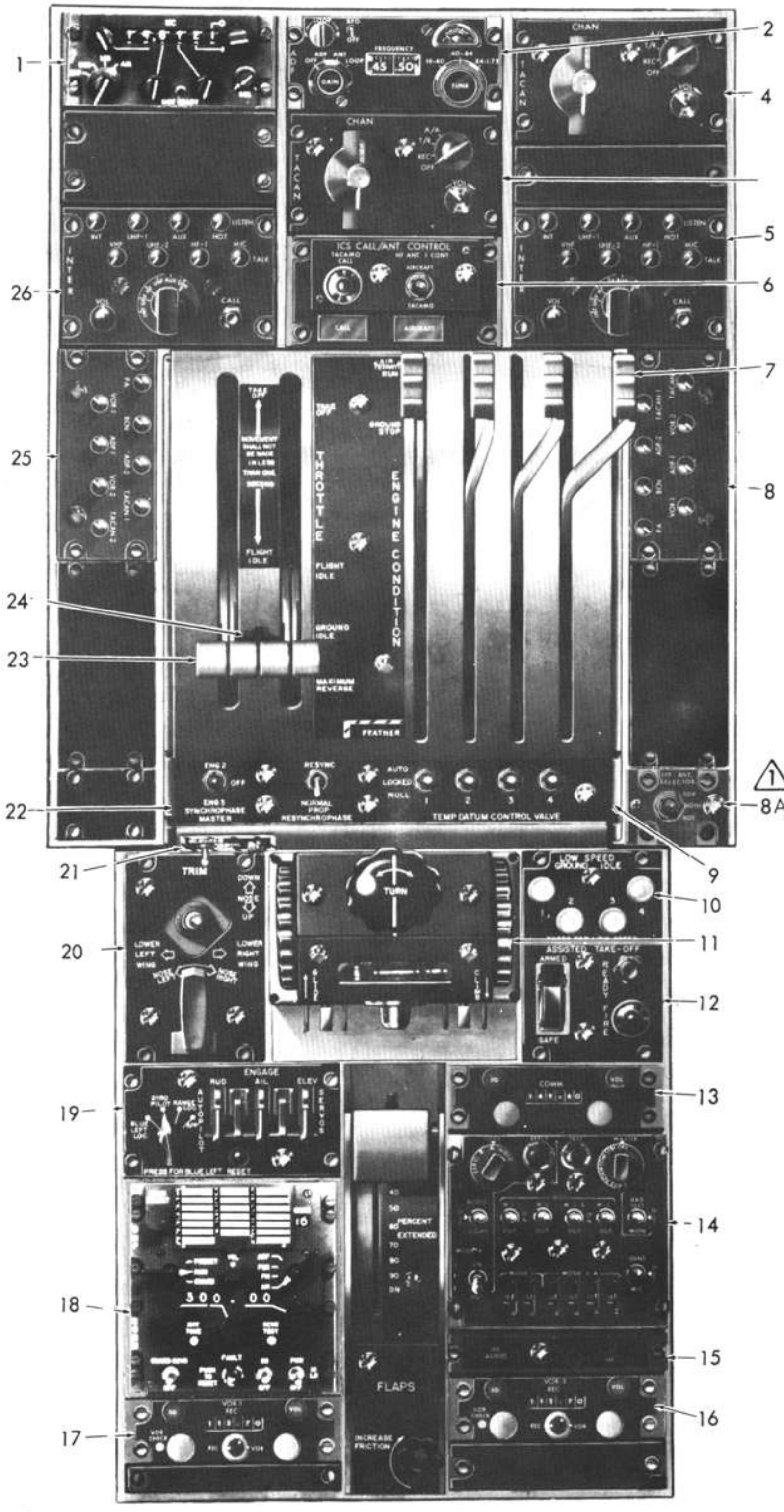
Figure 1-16. (Sheet 1 of 3)

(EC-130Q aircraft BuNo 156170—156177)



1. LIAISON RADIO CONTROL
1. HF LIAISON RADIO CONTROL PANEL
2. NO. 1 ADF CONTROL PANEL
3. NO. 1 TACAN CONTROL PANEL
4. NO. 2 TACAN CONTROL PANEL
5. COPILOT'S INTERCOMMUNICATION CONTROL PANEL
6. ICS CALL/ANT CONTROL PANEL
7. CONDITION LEVERS
8. COPILOT'S INTERCOMMUNICATION SWITCH PANEL

8A. IFF ANTENNA SELECTOR PANEL

9. TEMPERATURE DATUM CONTROL VALVE SWITCH PANEL
10. LOW SPEED GROUND IDLE PANEL
11. AUTOPILOT CONTROLLER
12. ASSISTED TAKE-OFF CONTROL PANEL
13. VHF COMMAND RADIO CONTROL PANEL
14. △1 IFF TRANSPONDER CONTROL PANEL
15. IFF AUDIO CONTROL PANEL
16. NO. 2 LOCALIZER AND VOR RECEIVER CONTROL PANEL
17. NO. 1 LOCALIZER AND VOR RECEIVER CONTROL PANEL
18. NO. 1 UHF COMMAND RADIO CONTROL PANEL
19. AUTOPILOT CONTROL PANEL
20. TRIM TAB CONTROL PANEL
21. ELEVATOR TAB POWER SWITCH
22. PROPELLER SYNCHROPHASER CONTROL PANEL
23. THROTTLES
24. THROTTLE FRICTION KNOB
25. PILOT'S INTERCOMMUNICATION SWITCH PANEL
26. PILOT'S INTERCOMMUNICATION CONTROL PANEL

△1 AIRCRAFT MODIFIED BY C-130 AFC NO. 133.

Figure 1-16. (Sheet 2 of 3)

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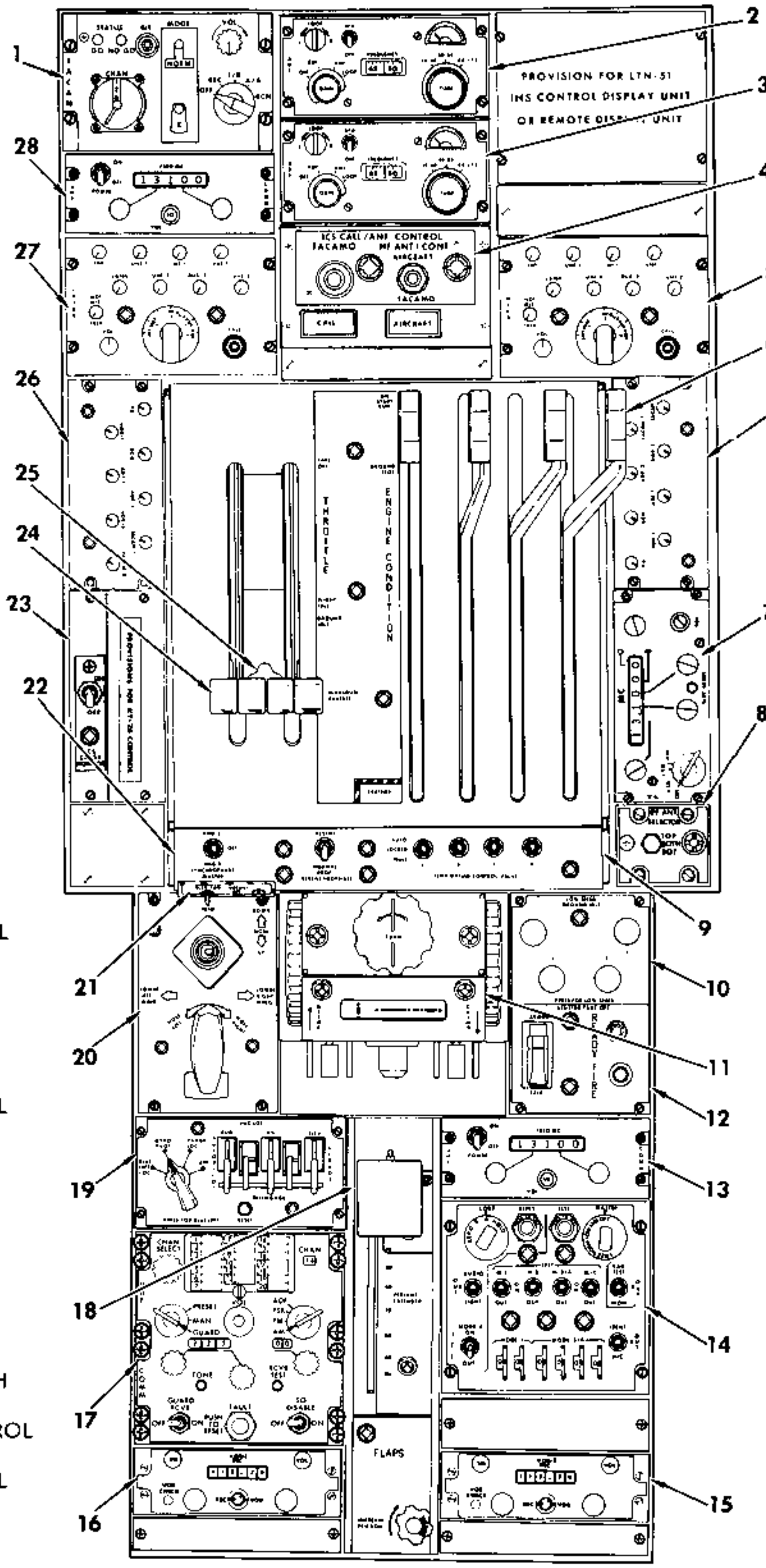
EC-130-1-1-143-2

(EC-130Q aircraft BUNO 159348 and 159469)



1. NO. 1 TACAN CONTROL PANEL
2. NO. 1 ADF CONTROL PANEL
3. NO. 2 ADF CONTROL PANEL
4. ICS CALL/ANT CONTROL PANEL
5. COPILOT'S INTERCOMMUNICATION CONTROL PANEL
6. CONDITION LEVER
7. COPILOT'S INTERCOMMUNICATION SWITCH PANEL

7A. HF LIAISON RADIO CONTROL PANEL

8. IFF ANTENNA SELECTOR PANEL
9. TEMPERATURE DATUM CONTROL VALVE SWITCH PANEL
10. LOW SPEED GROUND IDLE PANEL
11. AUTOPILOT CONTROLLER
12. ASSISTED TAKE-OFF CONTROL PANEL
13. NO. 2 VHF COMMAND RADIO CONTROL PANEL
14. IFF TRANSPONDER CONTROL PANEL
15. NO. 2 LOCALIZER AND VOR RECEIVER CONTROL PANEL
16. NO. 1 LOCALIZER AND VOR RECEIVER CONTROL PANEL
17. NO. 1 UHF COMMAND RADIO CONTROL PANEL
18. FLAP LEVER
19. AUTOPILOT CONTROL PANEL
20. TRIM TAB CONTROL PANEL
21. ELEVATOR TAB POWER SWITCH
22. PROPELLER SYNCHROPHASER CONTROL PANEL
23. ICS CROSS MONITOR SWITCH
24. THROTTLES
25. THROTTLE FRICTION KNOB
26. PILOT'S INTERCOMMUNICATION SWITCH PANEL
27. PILOT'S INTERCOMMUNICATION CONTROL PANEL
28. NO. 1 VHF COMMAND RADIO CONTROL PANEL

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Figure 1-16. (Sheet 3 of 3)

Temp Datum (TD) Control Valve Switches.

Four temperature datum control valve switches (figure 1-17) are mounted on a control panel at the aft end of the flight control pedestal. Each switch has AUTO, LOCKED, and NULL positions. The switch positions are used as follows:

The AUTO position permits normal operation of the electronic temperature datum control system by applying single-phase, ac power to the amplifier from the ac instrument and engine fuel control bus through an engine fuel and temperature control circuit breaker on the pilot's lower circuit breaker panel.

The LOCKED position may be set when the throttles are in temperature-controlling range, to provide a fixed percentage correction on the metered fuel flow throughout the engine operating range and will permit the fuel control to compensate for changes in ambient temperatures in order to maintain a symmetrical shaft horsepower at flight idle. If the TD control valve switch is then positioned at LOCKED, the TD valve is locked at whatever position it is in at the time. The TD valves remain locked and the fuel correction lights remain out through all throttle movements, unless an overtemperature condition is sensed by the amplifier. When the switch is in the LOCKED position, the TD valve for an engine is unlocked and moves toward a "take" position if turbine inlet temperature for the engine exceeds normal temperature limiting.

If a valve is unlocked by its control system to correct an overtemperature condition, the fuel correction light for that engine illuminates to indicate that the valve is unlocked.

Note

> The switches lock a fuel correction only when they are positioned at LOCKED while the throttle is in temperature controlling range and the fuel correction light is out. If the switches have not been placed in the LOCKED position and the throttles are moved out of the temperature controlling range, the TD valves return to the NULL position.

The NULL position removes ac power from the control system amplifier; and the TD valve, receiving no control signals, returns to its null position so that it does not correct the fuel flow according to turbine inlet temperature. The TD valve brake is released by 28-volt dc power supplied from the essential dc bus through the engine fuel control circuit breakers located on the copilot's side circuit breaker panel.

The NULL position of these switches is used to deactivate the electronic temperature datum control systems when erratic fuel scheduling is suspected or when the engines are not operating.

Electronic Fuel Correction Lights.

The electronic fuel correction amber lights (figure 1-18) are located on the pilot's instrument panel. The lights are on while the throttles are in temperature-limiting range (below 65 degrees) and go out when the throttles are advanced to the temperature-controlling range (above 65 degrees).

Starting Control System.

The starting control system automatically controls fuel flow and ignition, during ground and air starts. Electric power for the control circuits is supplied from the essential dc bus through engine start control circuit breakers and the ignition control circuit breakers on the copilot's side circuit breaker panel. Provisions are made for using the battery to energize these circuits when all the air output of the gas turbine compressor is required to drive the starter. The automatic control of the starting control system has a speed-sensitive control and a speed-sensitive valve, which are engine-driven. The speed-sensitive control performs the following functions:

On acceleration to 16 percent rpm - the fuel shutoff valve in the engine fuel control is opened, the ignition relay is energized completing circuits to the ignition exciter, the engine fuel pump paralleling valve closes, the fuel enrichment valve opens, and the manifold drip valve closes.

On acceleration to 65 percent rpm - ignition system is deenergized, fuel pump paralleling valve is opened to return pumps to series operation, manifold drip valve is deenergized (it is then held closed by pressure). At 94 percent rpm - electronic temperature datum control system is switched from start limiting to normal limiting, and the speed-sensitive valve opens to allow 14th stage bleed air to force the 5th and 10th stage acceleration bleed valves closed. The TD valve take capability changes from 50 percent to 20 percent.

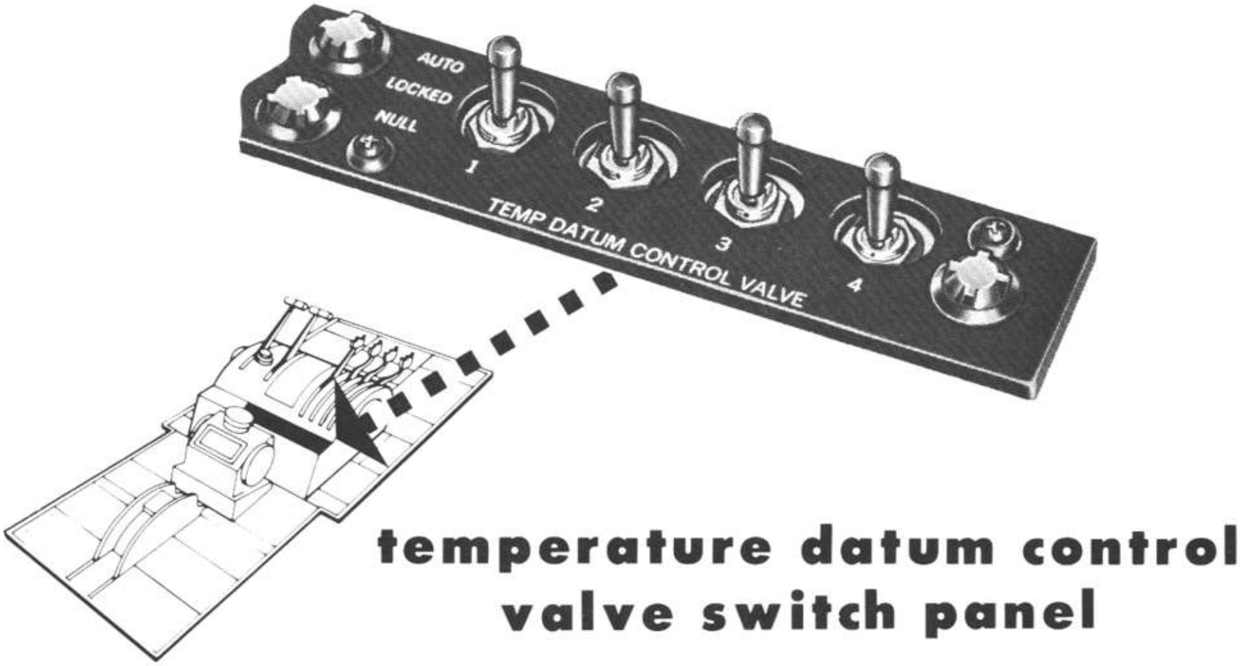

Figure 1-17.

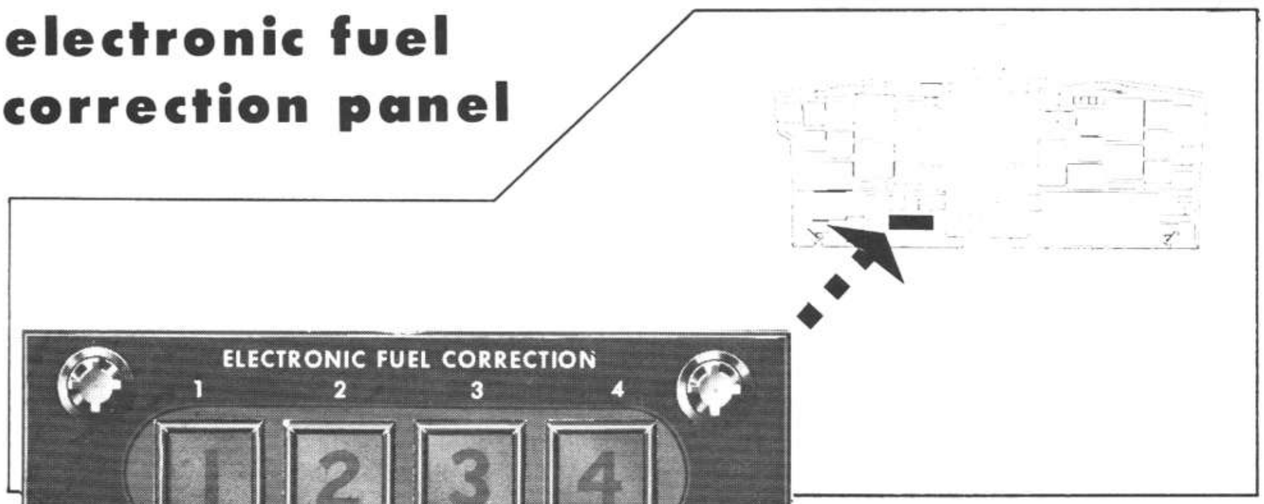

Figure 1-18.

NORMAL ENGINE STARTING SEQUENCE.

During a normal start, the following actions take place automatically (provided Section III checklist procedures have been followed) as listed. An examination of the sequence will be helpful in understanding the overall operation of any start.

% ENGINE RPM (approximate)	ACTION	CONTROLLED BY
0 - 94%	Temperature Datum Control Normally Limits TIT to 830°C During Start.	Speed-Sensitive Control
0 - 94%	5th and 10th Stage Compressor Bleeds Open	Speed-Sensitive Valve
	Electronic Fuel Correction Light On	Throttle and Electronic Fuel Correction Switch
16%	Fuel Shutoff Opened	Speed-Sensitive Control
16%	Fuel Enrichment On	Speed-Sensitive Control and Fuel Enrichment Switch
16%	Fuel Pumps in Parallel Operation	Speed-Sensitive Control
16% and UP	Drip Valve Closed	Speed-Sensitive Control and Fuel Pressure
16%	Ignition On	Speed-Sensitive Control
50 PSIG Fuel Manifold Pressure	Fuel Enrichment Off	Manifold Pressure Switch
56 to 75.5%	Starter Disengaged	Starter Cutout Switch
65%	Fuel Pumps in Series Operation	Speed-Sensitive Control
65%	Ignition Off	Speed-Sensitive Control
94%	5th and 10th Stage Compressor Bleeds Closed	Speed-Sensitive Valve
94%	TIT Limited to 1083°C by Temperature Datum Control	Speed-Sensitive Control
94%	TD Valve Take Capability Changes from 50 Percent to 20 Percent.	Speed-Sensitive Control

Engine Ground Start Switches.

The engine ground start switches (figure 1-19) are located on the engine starting panel on the overhead control panel. Each switch is used to open the starter air regulator valve to permit operation of the starter. The switch button is pushed in manually and held until the regulator valve opens, then a solenoid holds the button in. A red light in the button glows as long as the button is held in. When the engine accelerates to starter cutout speed, speed switches in the starter are actuated to cause the regulator valve to close and the switch button to be released, causing the light to be extinguished. The button can be pulled manually at any time to discontinue starter operation. If the switch is not released when starter cutout speed is indicated by the engine tachometer, it should be pulled out before engine speed reaches the starter limit speed indicated in Section I, Part 4. On EC-130Q aircraft, each engine starting circuit is electrically interlocked with the corresponding engine oil fire shutoff valve control circuit. This renders the starting circuit inoperative unless the fire control handle is pushed in and the oil fire shutoff valve circuit breaker is engaged.

Engine Fuel Enrichment Switches.

The engine fuel enrichment switches (figure 1-19) are located on the engine starting panel. They are toggle switches with NORMAL and OFF positions. In NORMAL, each switch allows the engine fuel enrichment valve to be controlled by the speed-sensitive control and manifold pressure switch during starting. The OFF position is provided to permit deactivating the fuel enrichment system for the respective engine.

During the engine starting cycle the fuel enrichment system furnishes unmetered fuel to the temperature datum valve to supplement normal flow through the fuel control. This enriching starts at 16 percent rpm and lasts only until fuel manifold pressure reaches approximately 50 psig.

Engine Bleed Air Valve Switches (EC-130G and EC-130Q BuNo 156170 through 156177).

The engine bleed air valve switches are located on the anti-icing systems control panel on the overhead panel. They are toggle switches with OPEN and CLOSED positions. Each switch controls a motor-driven bleed air valve in the aft section of the engine nacelle, just forward of the wing beam. When the valve is opened, it allows bleed air to flow from the bleed air system manifold to the starter valve, the nacelle preheat valve, and the inlet air scoop anti-icing valve; or, if the engine is running, it allows air to flow from the bleed air manifold of the engine to the bleed air system. The valve is closed when necessary to prevent air flow from the engine to the bleed air system or from the bleed air system to the nacelle ducts. A check valve is provided to prevent back flow into the engine diffuser. The bleed air valves receive 28-volt dc power from the essential dc bus through the bleed air fire shutoff valve circuit breakers on the copilot's side circuit breaker panel.

Engine Bleed Air Valve Switches (EC-130Q BuNo 159348 and 159469).

The engine bleed air valve switches, located on the anti-icing and de-icing control panel, are three position (OFF, ON, OVRD) toggle switches. Each switch controls a pressure-actuated, dual solenoid-controlled pressure regulator. When the bleed air switch is in OFF the regulator shuts off all airflow to or from the engine. When the switch is in the ON position the regulator regulates air flow from the engine to the crosswing manifold to approximately 50 psi and prevents air flow into the engine nacelle if the manifold pressure is above approximately 50 psi. Low manifold pressure will allow air flow into an engine nacelle. When the switch is in OVRD (override) the regulator is fully open and permits air flow in either direction. It is necessary to use the OVRD position during engine starting, nacelle preheating (if installed), and for engine inlet air scoop anti-icing with the engine not running. A check valve is provided to prevent backflow into the engine diffuser. The bleed air regulators receive 28-volt dc power from the essential dc bus through the bleed air fire shutoff valves circuit breakers on the copilot's side circuit breaker panel. The regulators go to the closed position when de-energized.

engine starting panel

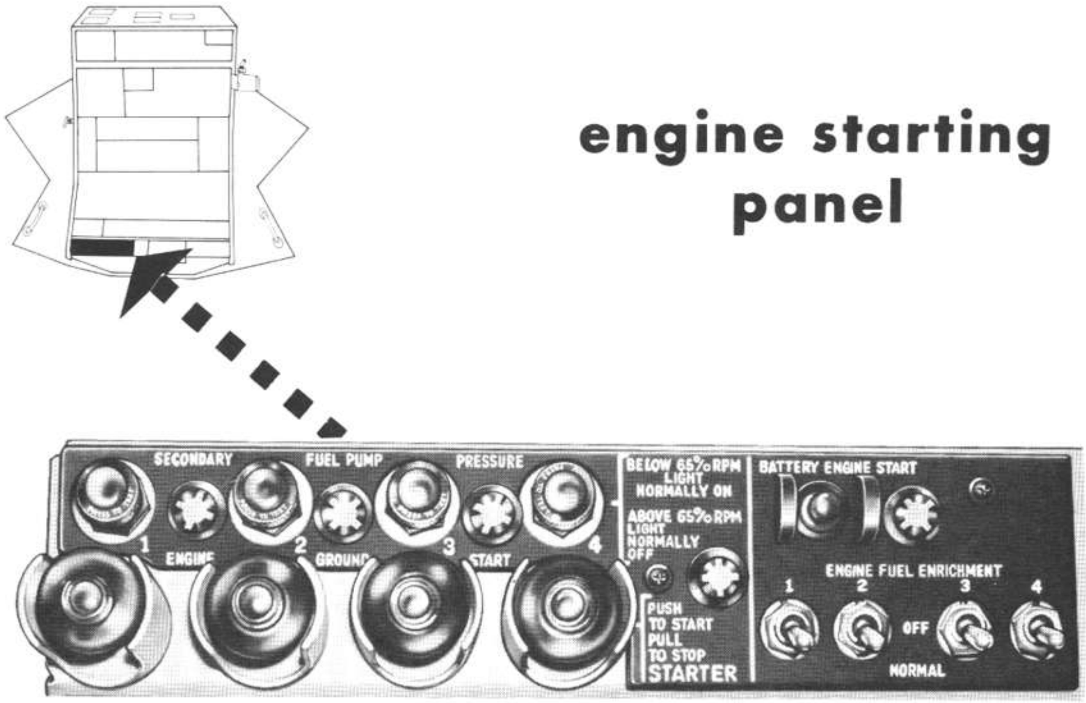

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Figure 1-19.

Feather Valve and NTS Test Switch and Lights.

The feather valve and negative torque signal check system (figure 1-26) consists of a feather valve and NTS check switch, four indicator lights, (one for each engine), four NTS check relays (one for each engine), a feather valve switch, and an NTS switch in each propeller control assembly. When the feather valve and NTS check switch is in the VALVE position, it completes the light circuits from the essential dc bus through the lights and contacts of each NTS check relay to the feather valve switch in each propeller control assembly. If the feather valve is mechanically positioned for feathering the propeller, it completes a circuit to ground for the corresponding indicator light. The light will come on to indicate that the feather valve is in position to feather the propeller. When the feather valve and NTS check switch is in the NTS position, it completes two circuits. One circuit is completed from the essential dc bus through each indicator light to a set of contacts in each NTS check relay. The other circuit is completed from the essential dc bus through the coil of each NTS check relay to the NTS check switch in the propeller control assembly. When a negative torque condition exists, the engine NTS plunger actuates a linkage which closes the NTS switch. The NTS switch completes a circuit to ground for the NTS check relay coil and energizes the relay. The relay actuates to provide a ground path for the light circuit and the relay coil. The relay will remain energized, and the indicator light will glow as long as the feather valve and NTS check switch is in the NTS position.

ENGINE INSTRUMENTS.

Torquemeters.

Each of the four torquemeters (figure 1-20) indicates torque in inch-pounds, and can indicate either positive or negative torque. The indicated torque is detected at the extension shaft between the engine power section and reduction gear assembly. The torquemeters receive 115-volt, single-phase ac power from the ac instrument and engine fuel control bus through the engine torquemeter circuit breakers on the pilot's lower circuit breaker panel.

Tachometers.

Each of the four tachometers (figure 1-20) indicates engine speed in percent of normal engine rpm. Normal rpm (100 percent) equals 13,820 engine rpm. A vernier dial on each indicator makes it possible to read to the nearest percent. The tachometer system has a separate engine-driven tachometer generator mounted on each engine that is not dependent upon the aircraft electrical system for operation.

Turbine Inlet Temperature Indicators.

Each of the turbine inlet temperature indicators (figure 1-20) indicates temperature sensed by thermocouples in the engine turbine inlet casing. Each indicator registers temperature in degrees Centigrade and contains a vernier scale graduated in degrees. Single-phase, 115-volt ac power for the indicator systems is supplied from the ac instrument and engine fuel control bus through the turbine inlet temperature circuit breakers on the pilot's lower circuit breaker panel.

Fuel Flow Gages.

Each of the four fuel flow gages (figure 1-20) indicates flow in pounds per hour. Flow is measured at the point where it enters the manifold on the engine. Single-phase, 115-volt, ac power is supplied to the indicator systems from the ac instrument and engine fuel control bus through the fuel flow circuit breaker on the pilot's lower circuit breaker panel. A single fuel flow power supply unit, which powers all fuel flow transmitters, receives 28-volt, dc power from the essential dc bus through the fuel flow circuit breaker on the copilot's lower circuit breaker panel.

Note

For additional information on fuel indicators and pressure warning lights see FUEL SYSTEM INDICATORS in this section.

Secondary Fuel Pump Pressure Lights.

Four secondary fuel pump pressure lights (figure 1-19) are located on the engine starting panel. Each light is controlled by a pressure switch on the engine fuel pump and filter assembly. The light is normally illuminated while the two gear pumps in the assembly are operating in parallel during engine starting (prior to 65 percent rpm). The light also illuminates at any other time if the pump paralleling valve is not open or if the primary gear pump fails. If the light does not illuminate during starting, it may indicate either the pump paralleling valve has not closed or the secondary pump has failed. The four lights receive 28-volt dc power from the essential dc bus through the fuel management sec. pump ind. lights circuit breaker on the copilot's side circuit breaker panel.

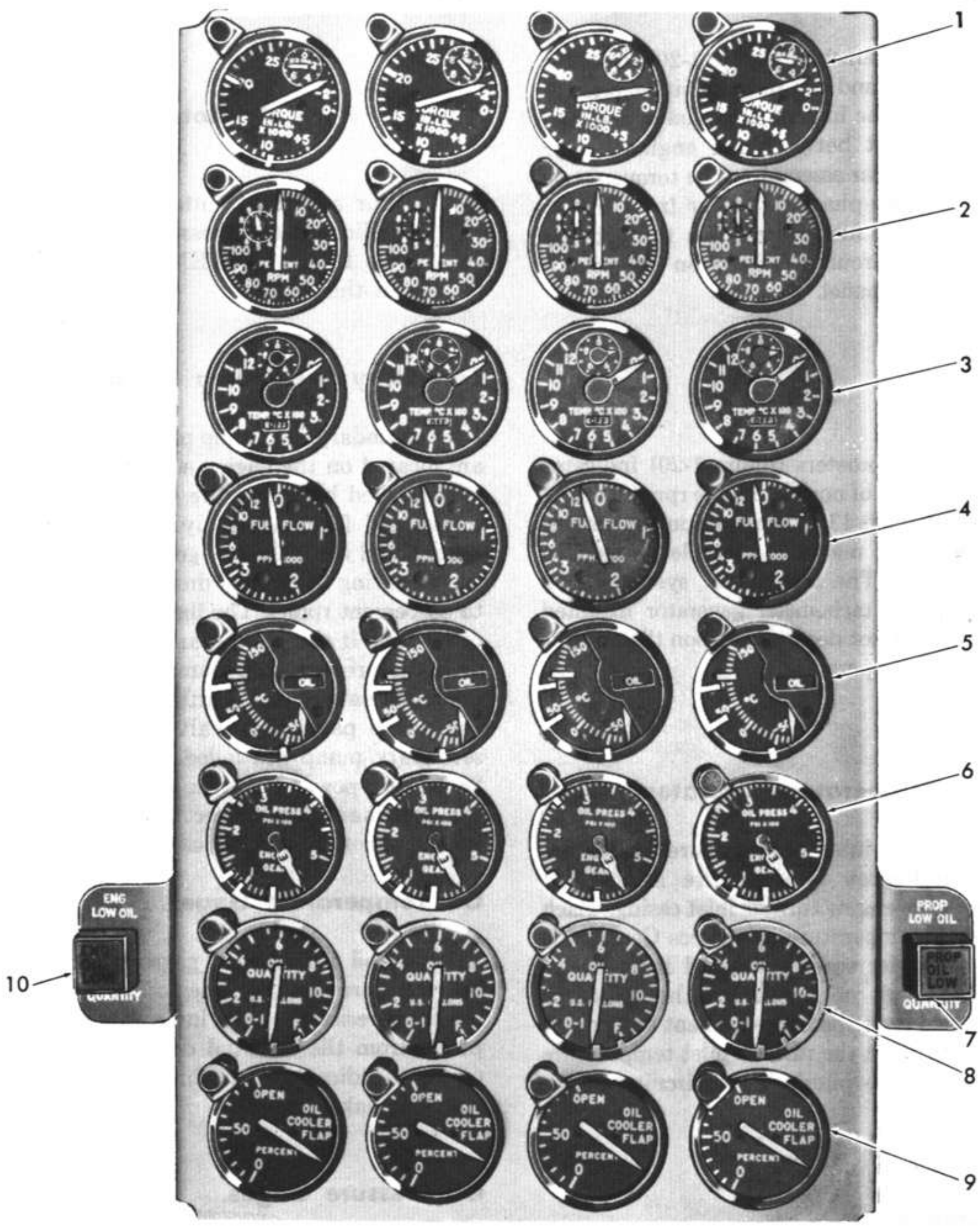
Oil Temperature Gages.

The four oil temperature gages (figure 1-20) indicate oil temperature in the oil inlet lines. The electrical-resistance type indicators receive 28-volt dc power from the essential dc bus through the engine oil temp. indicator circuit breaker on the copilot's side circuit breaker panel.

Oil Pressure Gages.

Four dual oil pressure gages (figure 1-20) registers oil pressure for both the engine power sections and reduction gears. The rear needle marked G on each indicator shows reduction gear oil pressure; and the front needle marked E indicates power section oil pressure. The oil pressure gages receive 26-volt ac power from the instrument transformers through the gear box ind oil pressure and ind engine oil pressure fuses on the pilot's lower circuit breaker panel.

engine instrument panel



1. TORQUEMETER
2. TACHOMETER
3. TURBINE INLET TEMPERATURE INDICATOR
4. FUEL FLOW GAGE
5. OIL TEMPERATURE GAGE
6. OIL PRESSURE GAGE
7. PROP LOW OIL QUANTITY MASTER WARNING LIGHT
8. OIL QUANTITY GAGE
9. OIL COOLER FLAP POSITION INDICATOR
10. ENGINE LOW OIL QUANTITY WARNING LIGHT

Figure 1-20.

FIRE AND OVERHEAT DETECTION SYSTEMS.

FIRE DETECTION AND WARNING SYSTEMS.

A fire detection and visual warning system is provided for each engine and the gas turbine compressor. Each engine system consists of a continuous loop detector, amplifier, and indicator lights located in the flight station. The gas turbine compressor system is the same. Each system is sensitive to high temperature and, when detected, the amplifier unit initiates a signal to the indicator lights. These lights give a steady red glow when activated. A test system is provided to test operation of each detector and system. The test switch is located on the warning system test panel and when actuated will illuminate all fire warning lights simultaneously. The test switch and the warning lights are powered by the essential dc bus through the fire detector circuit breaker on the copilot's side circuit breaker panel.

Visual warning of the detection of a fire is supplemental to an audible warning. Detection of a fire is transmitted simultaneously to the appropriate indicator lights (see above) and to a speaker located aft of the overhead control panel. The result is a steady red glow from the indicator lights and a loud blaring noise from the speaker. Momentary selection of the SILENCE position of a three-position (TEST, NORM, SILENCE) spring-loaded, toggle switch, located on the warning system test panel (figure 1-22), will silence the speaker. The indicator lights will continue to glow until the fire is extinguished. The TEST and SILENCE positions of the switch are both test positions. Holding the switch to TEST while visually monitoring the master fire warning light, No. 1 fire handle light, and audibly monitoring the speaker, provides a check of the continuity of the audible fire warning system. A blaring sound from the speaker should be accompanied by a steady red glow at the master fire warning light panel, and the No. 1 fire handle light. When the switch is released, it should return to NORM. Holding the switch to SILENCE while simultaneously holding the engine fire test switch to TEST and repeating both monitoring operations, provides a check on the current operational status of a holding relay in the system. If the speaker remains silent and the master fire warning light and all fire handle lights glow, the relay is functioning as desired. If the speaker continues to sound, the relay is defective. Releasing the switch from the SILENCE position should cause it to return to NORM. Electrical power for the system is furnished from the essential dc bus through an audio warning circuit breaker located on the copilot's side circuit breaker panel.

Fire Detection Systems Indicator Lights.

Two lamps in each of the fire handles provide fire indication. The red lamps in a handle glow whenever fire is detected in the corresponding nacelle. The lamps glow steadily to distinguish the indication from the flashing overheat warning indication.

Master Fire Warning Panel.

The master fire warning panel (figure 1-21) is located on the pilot's instrument panel. The panel contains a warning light and a panel light. If fire is detected by any one of the detection systems, the panel and warning light will glow steadily. The steady light distinguishes the signal from an overheat warning indication, which is a flashing of the same lights. When the master panel indicates fire, the lamps in one of the fire handles will illuminate also to indicate the location of the fire. The master fire warning light receives 28-volt, dc power from the essential dc bus through the master fire warning circuit breaker on the copilot's side circuit breaker panel.

NACELLE OVERHEAT WARNING SYSTEMS.

A nacelle overheat warning system is provided for each nacelle. Each system consists of thermal-switch detector units, mounted in the nacelle area forward of the fire wall. Four numbered nacelle overheat warning lights and a placard light are located on the copilot's instrument panel. A test switch is provided for testing all four warning systems and the test panel placard light simultaneously. The purpose of each system is to warn of an overheat condition in the area around the engine compressor section. Overheat in this area can result from the nacelle preheat valve being opened, or a rupture occurring in the bleed air system ducts. The overheat condition could also result from fire. The overheat condition can be detected by any one of the six detectors, which are connected in parallel to a loop. The fenwal setting at which the detector lights will give an overheat warning is

master fire warning light panel

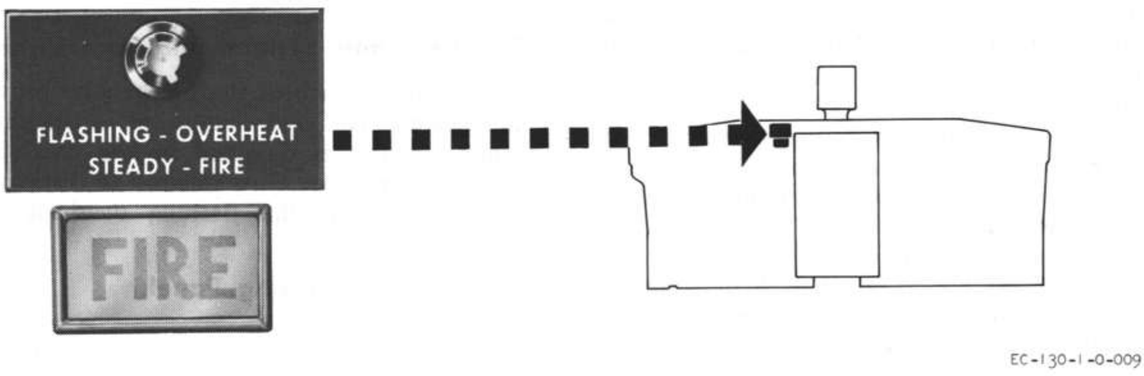


Figure 1-21.

warning system test panel

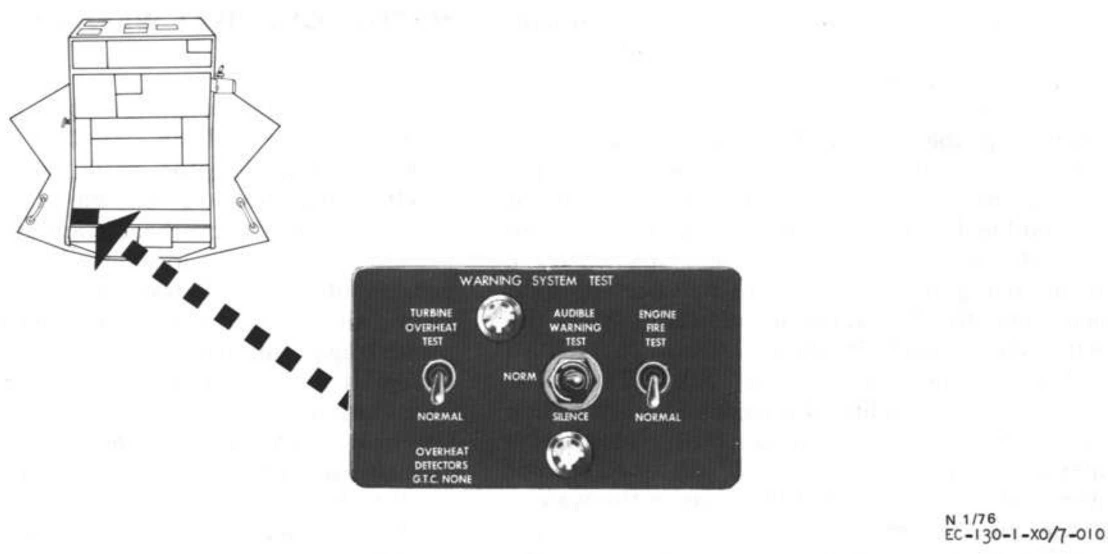


Figure 1-22.

approximately 149°C (300°F). Twenty-eight volt, dc power for the detector units is supplied from the essential dc bus through overheat detectors nacelle circuit breakers on the copilot's side circuit breaker panel.

Nacelle Overheat Test Switch.

A test switch is located on the nacelle overheat warning panel (figure 1-23) next to the lights. Operation of the test switch closes all four nacelle overheat warning circuits simultaneously, causing all four warning lights and the placard light to glow as long as the switch is held in TEST. Failure of a light to come on indicates a break in continuity in the warning circuit.

Note

> The test switch will only check circuit continuity and that the switch is functioning properly. Even though all indicator lights illuminate, this does not indicate the detectors are properly set or even operating.

ENGINE TURBINE OVERHEAT WARNING SYSTEMS.

An overheat warning system is provided for each engine hot section. Each system consists of four thermal-switch detector units mounted in the "hot section" of the nacelle aft of the fire wall, a flasher, and indicator lights. These components are interconnected so that an overheat condition sensed by any one of the detectors causes the lights to flash. The detectors are connected in parallel to a loop; and if part of the detectors are inoperable, the remaining detectors can still close the circuit to turn on the lights. A test switch permits testing all four systems at the same time. The fenwal setting at which the detector lights will give an overheat warning is approximately 371° C (700° F). Twenty-eight-volt, dc power for energizing the system is supplied from the essential dc bus through overheat detectors tailpipe circuit breakers on the copilot's side circuit breaker panel.

Indicator Lights.

Two lamps in each of the engine fire handles (figure 1-25) are flashed to indicate an engine overheat condition. The lamps are red.

Master Fire Warning Panel.

The master fire warning panel (figure 1-21) is located on the pilot's instrument panel. The panel lights are flashed whenever any one of the engine turbine overheat warning systems senses an overheat condition. When the lights flash, the lights in the fire handle flash also, and those lights indicate in which engine the overheat condition has been sensed. The master panel contains a master light and a panel light, both of which flash to indicate engine turbine overheat.

Turbine Overheat Detector Test Switch.

The overheat detectors test switch (figure 1-22) is located on the warning system test panel on the overhead control panel. The switch has NORMAL and TEST positions. When positioned at TEST, it closes all four of the overheat warning system circuits in the same manner as if they were closed by detectors sensing an overheat condition. If the indicator lights all come on and flash when the switch is operated, circuit continuity and flasher operation are satisfactory.

Note

> The test switch will only check circuit continuity and that the test switch is functioning properly. Even though all indicator lights illuminate and flash, this does not indicate that the detectors are properly set, or even operating.

FIRE EXTINGUISHING SYSTEM.

A two-shot bromochloromethane (CB) fire extinguishing system (figure 1-24) is connected through a series of directional flow valves to each of four engine nacelles and to the gas turbine compressor compartment. (Dibromodifluoromethane (DB) may be used when CB is not available.) Each bottle contains approximately 19 pounds of agent. One bottle is discharged each time the system is actuated. A check valve prevents the agent from entering a bottle which has previously been discharged. Each bottle is charged to approximately 600 psi, with nitrogen acting as a propellant for the CB. Individual pressure gages on each bottle show charged pressure.

nacelle overheat warning panel

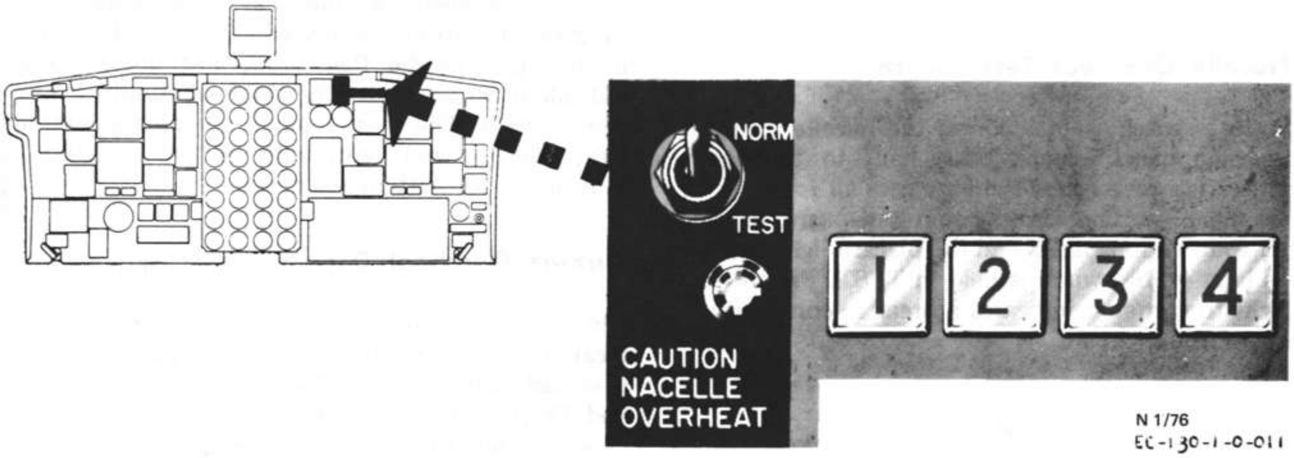


Figure 1-23.

FIRE EXTINGUISHING SYSTEM CONTROLS.

The fire extinguishing system controls are located on the fire control panel (figure 1-25) forward of the overhead electrical control panel. The fire extinguishing system control circuits use dc power supplied from the battery bus through the fire ext circuit breaker on the pilot's side circuit breaker panel.

AGENT DISCHARGE SWITCH. A three-position (NO. 1, OFF, No. 2) toggle switch located on the fire emergency control panel (figure 1-25) controls the discharge of the bottles. The agent discharge switch is spring-loaded to the OFF position. This circuit is not effective however until one fire handle is pulled. The fire handle circuit powers the correct sequence of solenoid directional control valves in the system to direct flow of agent to the selected engine when one of the bottles is fired. The control valves move in the same order as the handles are pulled. If two fire handles are pulled, the agent will be routed to the engine for the last handle pulled. In order to route agent to the engine for the first handle pulled, the first handle must be pushed in and pulled again.

FIRE HANDLES. The five plastic fire handles (figure 1-25) are mounted on the fire emergency control panel. They operate emergency shutdown switches for the gas turbine compressor and the four engines. When a fire handle is pulled out, it closes dc circuits to operate valves which isolate the engine as follows:

The shutoff valve on the engine fuel control is closed.

The engine oil shutoff valve is closed.

The firewall fuel shutoff valve is closed.

The firewall hydraulic shutoff valves are closed.

The engine bleed air is shut off.

fire control panel

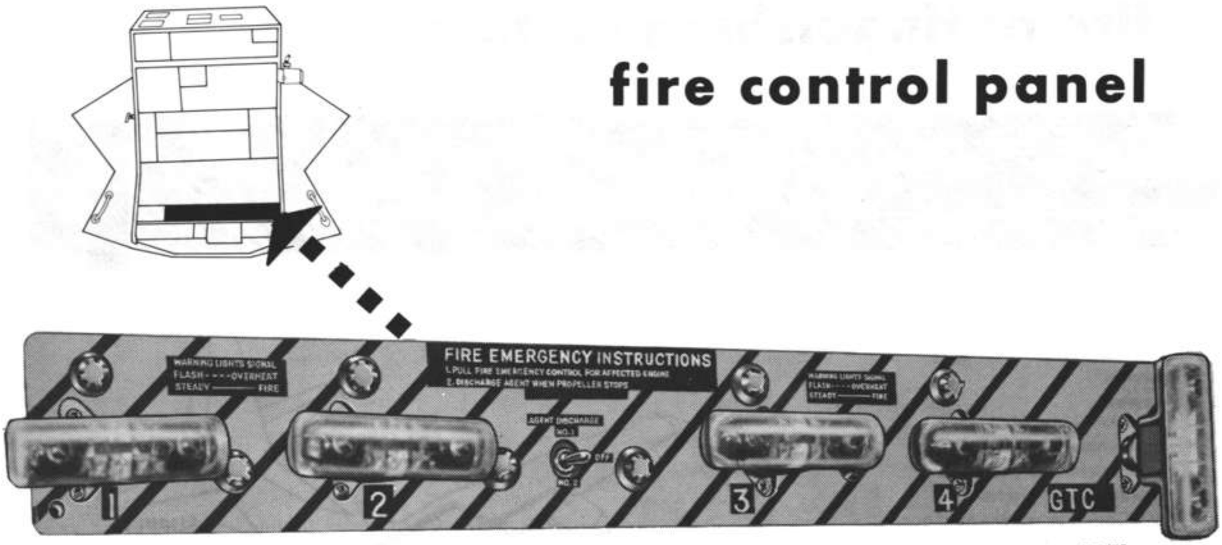


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Figure 1-25.

Engine starting control circuits are deenergized.

The propeller is feathered.

Positions the fire extinguisher system control valves.

Arms the extinguishing agent discharge switch.

When the GTC fire handle is pulled, the GTC is isolated as follows:

The GTC fuel shutoff valve is closed.

The GTC oil shutoff valve is closed.

The GTC bleed air valve is closed.

Positions the fire extinguisher system control valve.

Arms the extinguisher agent discharge switch.

The GTC door switch is disarmed.

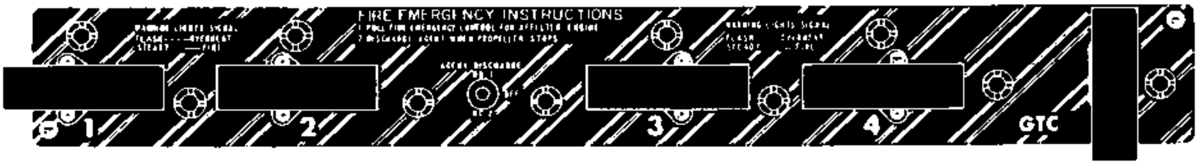
PROPELLERS.

Each engine is equipped with a Hamilton Standard, four-blade, electro-hydromatic, full feathering, reversible-pitch propeller. The propeller operates as a controllable-pitch propeller for throttle settings below FLIGHT IDLE and as a constant-speed propeller for throttle settings of FLIGHT IDLE or above. The major components of the propeller system are the propeller assembly, the synchrophasing system, the control system, and the anti-icing and deicing systems. The oil capacity of the pressurized sump is 6.5 quarts. The capacity of the complete system fully serviced including the pressurized sump is 26 quarts.

PROPELLER BLADES.

The propeller blades are of solid aluminum alloy with shanks which are partially hollow for weight reduction. The blade incorporates a fairing made of plastic foam (Lockfoam) covered with a nylon reinforced rubber material to direct the airflow into the engine. The blade gear segments, thrust bearings, oil seal, and deicing rings are located on the mounting end of the blades.

fire extinguishing system



NOTE

Electrically operated valves are solenoid operated, shown in the normal de-energized position. After discharging agent, open valves are held open as long as the fire handle is out providing another fire handle is not pulled.

CYLINDER DETONATOR

2-WAY CHECK VALVE

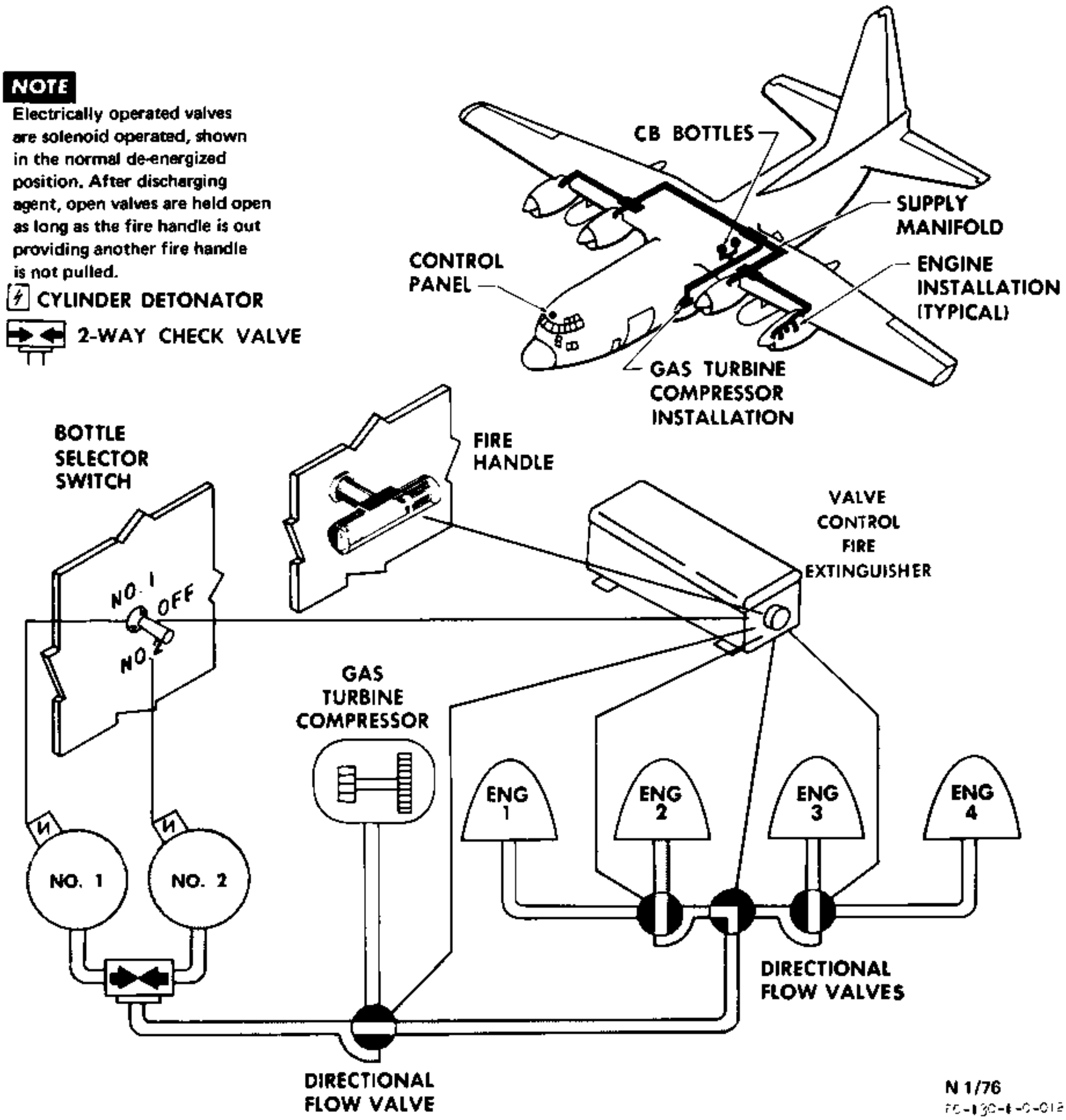


Figure 1-24.

BARREL ASSEMBLY.

The principal functions of the barrel assembly are to retain the blades within the propeller assembly, to provide the means of attaching the propeller to the engine shaft, and to transmit engine torque to the blades. The barrel assembly is made in two sections which are bolted together to retain the propeller blades. The rear half of the assembly has an extension which is machined to fit over the splined engine shaft.

PITCH LOCK ASSEMBLY.

The pitch lock regulator assembly is located within the barrel assembly. Components of the pitch lock mechanism are a stationary pitch lock ratchet which is splined to the barrel, and a rotating pitch lock ratchet which is splined to the rotating cam within the dome assembly. The pitch lock mechanism prevents the blades from decreasing pitch if over-speeding of approximately 103 percent rpm occurs or if hydraulic pressure is lost. The stationary and rotating pitch lock ratchet rings are held disengaged by propeller oil pressure under control of the pitch lock regulator; they are spring-loaded to engage when this pressure is lost. However, when the ratchet rings are engaged, the propeller can still increase pitch to allow feathering. When an overspeed condition is sensed by the flyweights within the pitch lock regulator assembly, oil pressure is removed to allow the pitch lock ratchets to engage and prevent a decrease in blade angle. To release the pitch lock, the overspeed must be corrected to restore oil pressure, and the blade angle must increase a few degrees to disengage the ratchets. In order that pitch lock action will not interfere with normal reversing of the propeller, the pitch lock ratchet rings are mechanically held apart by cam action throughout a blade angle range of a few degrees above the low pitch stop to full reverse. However, a propeller which has once locked pitch cannot be reversed, as its blade angle cannot be reduced. In case of inadvertent pitch lock, see PROPELLER FAILURES in Section V.

DOME ASSEMBLY.

The dome assembly is mounted on the forward section of the barrel assembly. It contains the pitch changing mechanism and the low-pitch stop assembly. The pitch changing mechanism converts hydraulic pressure into mechanical torque. Its main parts are a piston assembly, a stationary cam, a rotating cam, and the dome shell. The piston is a double-walled assembly which fits over the two cams and inside the dome shell. The piston is held in place by rollers which ride in the cam tracks of both cams. The rear of the rotating cam is connected to the propeller blades by beveled gears. As hydraulic pressure is applied to the piston, causing it to move, the rollers riding in the cam tracks turn the rotating cam, changing the blade angle. The low-pitch stop is located in the dome and mechanically stops the piston from decreasing blade angle below approximately 23 degrees in flight. The low-pitch stop is retracted to allow lower blade angles during ground operation.

CONTROL ASSEMBLY.

The propeller control assembly is mounted in the aft extension of the propeller barrel but does not rotate. It contains the oil reservoir, pumps, valves, and control components which supply the pitch changing mechanism with hydraulic pressure of the proper magnitude and direction to vary the propeller blade angle as required for the selected operating condition. The main components contained within the valve housing assembly section of the control assembly are the fly-weight speed sensing pilot valve, feather valve, feather solenoid valve, and feather actuating valve. The pump housing assembly contains a scavenge, main, standby, and an electric-driven, double-element, auxiliary pump. The flow of fluid from these pumps is controlled by the valves in the valve housing assembly to accomplish the desired propeller operation. All mechanical and electrical connections necessary for propeller operation are made through the control assembly. The mechanical connections are linkages from the engine control system and the NTS (negative torque signal) system. The electrical connections are for oil level indication, pulse generator coil, auxiliary pump motor, synchrophasing system, NTS and feather switches, anti-icing and deicing systems, and the electric feathering system.

SPINNER ASSEMBLY.

The spinner assembly improves the aerodynamic characteristics of the propeller assembly. It encloses the dome, barrel, and control assemblies. It consists of a front section, rear section, and a non-rotating afterbody assembly. Cooling air is admitted through an air inlet at the front of the spinner and passes over the dome assembly, barrel assembly, and control assembly fins and exhausts through vents in the engine nacelle.

ANTI-ICING AND DEICING ASSEMBLY.

The anti-icing and deicing assembly (figure 1-84) is made up of resistance-type heating elements which are incorporated on the leading edge and fairing of each blade and the entire spinner assembly for anti-icing and deicing. Continuous anti-icing heaters cover the front portion of the spinner assembly and the entire afterbody assembly. Cyclic deicing heaters cover the remainder of the spinner front section, the spinner rear rotating section, the spinner plateaus, and the blade leading edge and fairing. Power from the airplane electrical system is transmitted through the brush housing assembly, mounted on the stationary control assembly, through the rotating sliprings on the contact ring holder assembly, mounted on the aft end of the barrel, to the anti-icing and deicing elements. Power to the blade heaters is transmitted through four brush housings mounted on the contact ring holder assembly to the blade sliprings.

PROPELLER LOW OIL WARNING LIGHTS.

A propeller low oil warning light for each propeller is located on the copilot's side shelf (figure 1-26); a prop low oil quantity light, which acts as a master warning light, is located on the engine instrument panel (figure 1-20). The propeller low oil warning system is controlled by a float-actuated switch in each propeller control assembly. When the oil quantity for any propeller drops approximately 2 quarts below normal, the float-actuated switch closes and illuminates the propeller low oil warning light for that engine and the prop low oil quantity light. If another propeller experiences a low oil quantity, the only indication will be from the propeller low oil warning light for that engine. The low oil warning lights receive 28-volt, dc power from the essential dc bus through the prop low oil level circuit breaker on the copilot's side circuit breaker panel.

PROPELLER SPEED CONTROL SYSTEM.

The speed of the propeller is controlled by the propeller governing system within the Flight Range of the throttle lever so as to maintain a constant rpm. Within the Ground Range, the propeller blade angle is a function of throttle lever position. The propeller does not govern the rpm within the Ground Range.

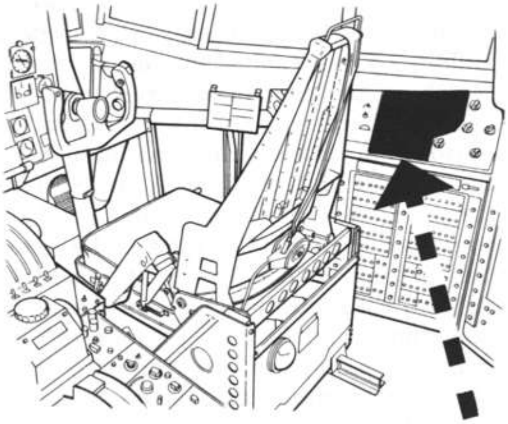
Propeller Governing System.

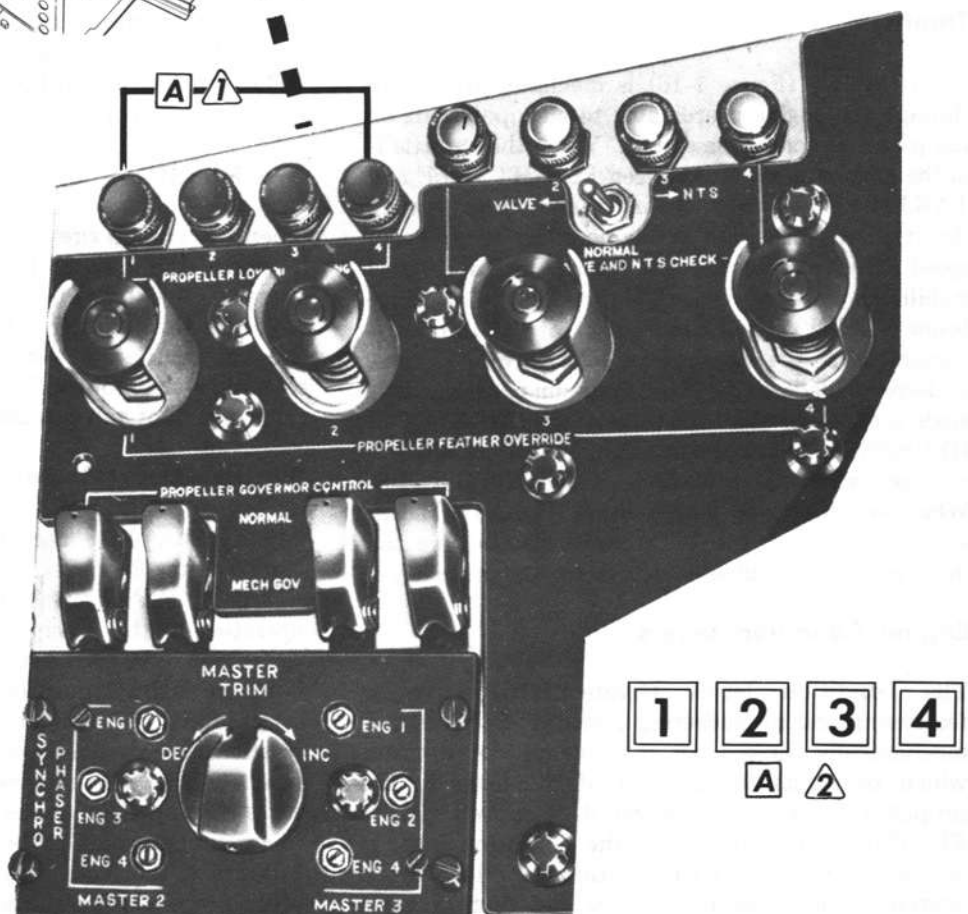
The principal function of the propeller governing system is to maintain a constant engine operating rpm. Propeller governing is accomplished by the action of the flyweight speed-sensing pilot valve. This valve is controlled by the mechanical action of the flyweights opposing the force of the speeder spring. When the propeller is in an on-speed condition, the pilot valve meters sufficient fluid to the increase pitch or forward side of the dome assembly piston to overcome the centrifugal twisting moment and maintain the required blade angle. When an overspeed condition occurs, the flyweight force overcomes the speeder spring force, and the pilot valve moves to increase the flow to the increase pitch side of the piston to increase blade angle and cause the propeller to slow down. If the propeller slows below governed speed, the force of the speeder spring overcomes the force exerted by the flyweights, and the pilot valve meters fluid to the aft side of the dome assembly piston to decrease blade angle and allow the propeller to increase speed. The low-pitch stop prevent the propellers from decreasing blade angle below approximately 23 degrees while the throttles are in the flight range.

ELECTRONIC PROPELLER GOVERNING.

The synchrophaser electronic unit provides circuits for the following governing functions: speed stabilization (derivative), throttle anticipation, and synchrophasing. The propeller mechanical governor will hold a constant speed in the flight range, but throttle changes will cause the governor to overspeed or underspeed while trying to compensate for the change in power. A stabilization circuit stabilizes the mechanical governor during these changes when the propeller govern or control switch is in the NORMAL position by sending a signal to the speed bias servo control motor to change the speeder spring compression. The throttle anticipation circuit stabilizes the propeller speed during rapid movement of the throttle when the propeller governor control switch is in the NORMAL position. Throttle movement rotates the anticipation potentiometer in the propeller control assembly sending a signal to the anticipation circuit which sends an amplified signal to the speed bias servo control motor to change the speeder spring compression. The synchrophasing system acts to keep all the propellers turning at the same speed, and it maintains a constant rotational position relationship between the blades to decrease vibration and to lower the noise level. The system uses either No. 2 or No. 3 engine as the master engine, and it relates the blade position of the other three engines to the master. The blade position of a slave engine is changed by moving the pilot valve to increase or decrease the speed of that engine. The synchrophasing circuit determines blade position by

copilot's side shelf
propeller controls





Note

⚠1 EC-130G EC-130Q BuNo 156170–156177

⚠2 EC-130Q BuNo 159348 and 159469

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Figure 1-26.

comparing an electrical pulse generated by each slave propeller to a modified pulse from the master propeller. If the blades are in the correct position, the resultant voltage of the slave and master pulse will be zero. Any deviation in blade position will produce a positive or negative voltage from the two compared pulses. This voltage drives the speed bias servo control motor to change the speeder spring compression, correcting the blade position. If propeller operation is erratic, see PROPELLER FAILURES in Section V.

PROPELLER CONTROLS.

Propeller controls include the throttles, condition levers, fire handles, synchrophaser master switch, prop resynchrophase switch, synchrophaser trim controls, propeller governor control switches, fuel governor check switches, feather override buttons, and feather valve and NTS CHECK SWITCH.

Throttles.

Each throttle (figure 1-16) is mechanically linked through the engine coordinator to an input shaft on the propeller control assembly. When the throttle is in the governing range, between FLIGHT IDLE and TAKE-OFF positions, the input shaft rotates with throttle movement, but it has no effect on propeller speed except normal throttle anticipation and speed stabilization action. When the throttle is in the range below FLIGHT IDLE, movement of the throttle is transmitted to the speed-sensing pilot valve to increase or decrease blade angle. The maximum negative blade angle is obtained when the throttle is at MAXIMUM REVERSE. Approximate minimum thrust angle is obtained when the throttle is at GROUND IDLE. When the throttle is moved below FLIGHT IDLE, a cam locks out the NTS system and a switch interrupts synchrophaser signals to the propeller.

Engine Condition Levers.

The condition levers (figure 1-16) serve as feathering and unfeathering controls. Each lever is mechanically linked to the engine coordinator, which transmits the motion of the lever to the propeller linkage only when it is moved to the FEATHER position. When the condition lever is moved to the FEATHER position the pilot valve is ported to increase pitch, and the feather valve moves to the feather position. The condition lever also actuates a switch in the control pedestal, completing a circuit to the holding coil of a propeller feather override button on the copilot's side shelf. The propeller feather override button pulls in and completes circuits to energize a feather solenoid and the auxiliary pump motor. The feather actuating valve and feather solenoid valve route fluid to position the feather valve and pilot valve for propeller feathering. When the feather valve reaches the position to feather the propeller, the feather valve and NTS check light illuminates if the cockpit switch is in the VALVE position. When the propeller blades reach feather angle, a pressure buildup occurs and actuates a pressure cutout switch in the control assembly, which opens the holding circuit for the propeller feather override button. For unfeathering, condition lever is held in the AIR START position. A switch is actuated to turn on the auxiliary pump, and the pump continues to operate as long as the lever is held in this position. When the condition lever is in the AIR START position and the auxiliary pump is operating, fluid is routed to the aft side of the dome assembly piston through the propeller governor to move the blades toward low pitch angle. When the condition lever is in GROUND STOP or RUN positions it has no effect on the propeller control.

Fire Handles.

When the engine fire handle (figure 1-25) is pulled it closes the circuit to stop the engine and to energize the propeller feather override button, which in turn energizes the auxiliary pump motor and the feathering solenoid valve. The feathering solenoid valve routes fluid to position the feather valve and pilot valve to feather the propeller.

Synchrophase Master Switch.

The synchrophase master switch (figure 1-27) is located on the flight control pedestal. This three-position (ENG 2, OFF, ENG 3) toggle switch controls the operation of the synchrophasing system and selects the engine to be used as the master. When the switch is in the ENG 2 position, the number 2 engine is selected as the master and the other propeller rotational speeds and blade phase angles are referenced to this engine. When the switch is in the OFF position, there is no synchrophasing and the propellers operate in normal governing. When the switch is in the ENG 3 position, the No. 3 engine is the master and the other propellers are referenced to this engine.

Prop Resynchrophase Switch.

The prop resynchrophase switch (figure 1-27) is a two-position (NORMAL, RESYNC) toggle switch located on the flight control pedestal. The switch is spring-loaded to the NORMAL position. When the switch is placed in the RESYNC position, the speed bias servo motors of the slave propellers are repositioned to the midpoint of their travel range, and the speed of the propellers remains the same until the switch is released to the NORMAL position. Each time the switch is placed in RESYNC and released, the speed of the slave propellers can change approximately 2 percent to a maximum of approximately ±5 percent from the optimum 100 percent. When the switch is held in the RESYNC position for 1 to 2 seconds and then released to NORMAL, it takes the synchrophasing system as long as 1 minute to make each incremental change in phase angle.

Synchrophaser Trim Controls.

The synchrophaser master trim knob is located on the copilot's side shelf (figure 1-26). It positions a potentiometer for altering the speed of the master engine. Full travel of the master trim knob will change the speed of the master engine plus or minus one percent. The six screwdriver adjustments located around the master trim knob are for maintenance adjustment only.

Propeller Governor Control Switches.

The four propeller governor control switches are two-position (NORMAL, MECH GOV) guarded toggle switches located on the copilot's side shelf (figure 1-26).When the switches are in the NORMAL position the throttle anticipation and speed stabilization (derivative) circuits are operative, and if the synchrophaser master switch is positioned to either master engine, the blade rotational position of the slave engines is related to the master by the synchrophasing system. Placing a switch in the MECH GOV position disconnects the electrical speed control to that propeller, and the speed of the propeller is controlled by basic mechanical governing.

Fuel Governing Check Switches.

The four fuel governing check switches located on the aft end of the overhead control panel are for maintenance purposes only. The switches are safetied and should not be used in flight.

Feather Override Buttons.

Four feather override buttons are located on the copilot's side shelf (figure 1-26). They provide a means for manually stopping the auxiliary pump at completion of the feather cycle. When the condition lever is moved to FEATHER or the fire handle is pulled, a circuit is completed to a holding coil of the propeller feather override button. The propeller feather override button pulls in and completes circuits to energize the auxiliary pump and feather solenoid. Normally, a pressure switch at the propeller opens the holding solenoid circuit when the blades reach feather and the button pops out. If the button fails to pop out after the feather cycle is completed, the button should be pulled out manually to turn off the auxiliary pump. The holding coil of the override button receives 28-volt, dc power from the essential dc bus through the feather & air start or emer feather circuit breakers on the copilot's side circuit breaker panel.

OIL SYSTEMS.

Independent oil systems, one for each engine, supply lubrication to the engine gearboxes and power sections. An oil tank is located in each nacelle above the engine and has a 12-gallon oil capacity and a 7.5 gallon expansion space. The oil feeds from the tank into the gearbox and power section of the engine, where it is picked up by scavenge pumps and driven through a heat exchanger and oil cooler back into the oil tank. Hot oil passing through the heat exchanger heats the engine fuel and prevents ice from forming in the fuel filter. Air flowing through an oil cooler duct and over the coils of the oil cooler absorbs excess heat from the oil. A thermostatic element, located in the oil tank return line, controls the oil temperature by regulating the amount of air flowing through the oil cooler duct. Four motor-operated valves provide an emergency means of shutting off oil flow to the engines when the fire handles are pulled. The valves receive 28-volt dc power from the essential dc bus through the oil fire shutoff valves circuit breakers on the copilot's side circuit breaker panel. On EC-130Q aircraft each valve control circuit is electrically interlocked with the corresponding engine starting circuit, so that the engine can be started only when the fire handle has been pushed in and the valve circuit breaker has been closed. Oil used in this aircraft must conform to the specification and grade listed in the servicing diagram in Part 3 of this section.

synchronization control switch panel

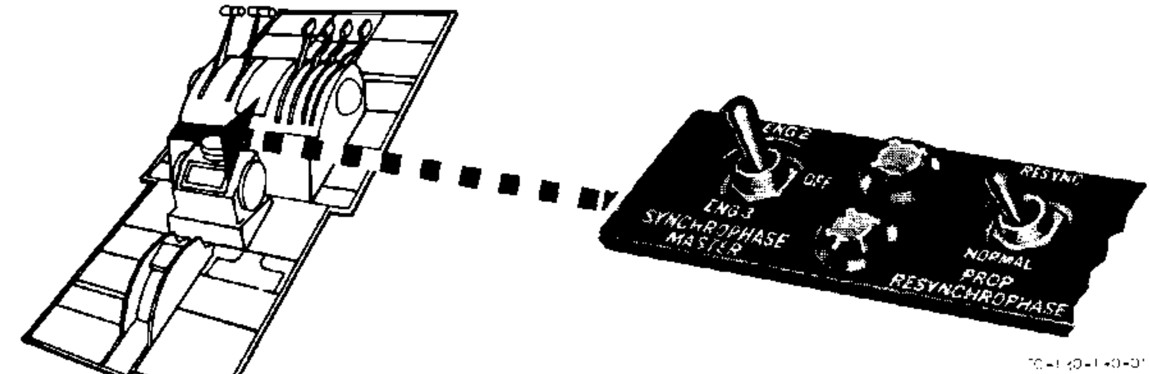

Figure 1-27.

OIL SYSTEM CONTROLS.

Oil Cooler Flap Switches.

Airflow through the oil cooler is governed by a controllable oil cooler flap which restricts the opening of the oil cooler air exit duct. Four four-position (AUTOMATIC, OPEN, CLOSE, FIXED) toggle switches are located on the oil cooler flaps switch panel (figure 1-28) of the flight control overhead panel. These switches control the electrical circuits of the oil cooler flap actuators. When any of the four switches is in AUTOMATIC position, the position of the oil cooler flap is regulated by a thermostatic unit to cool the oil to approximately 80° C (176° F). In the OPEN or CLOSE POSITIONS (spring-loaded), the thermostat is excluded from the circuit, and the actuator is directly energized to open or close the oil cooler flap. When the switch is moved to the FIXED position, the flap actuator is deenergized and the flap will remain in the position it was in prior to moving the switch. Moving the switch to the AUTOMATIC position, provides for all normal operations. OPEN, CLOSE, and FIXED positions are used to control the oil cooler flap actuator manually if the thermostatic control unit fails. The oil cooler flap actuators are energized through the oil cooler flap switches by 28-volt, dc power from the essential dc bus through the oil cooler flaps circuit breaker on the copilot's side circuit breaker panel.

Fire Emergency Control Handles.

Motor-operated shutoff valves, energized by 28-volt dc power and controlled by the fire handles on the fire panel, are installed in the engine oil systems to shut off the flow of oil at the bottom of the tank during an emergency. See FIRE EXTINGUISHING SYSTEM in this section for other functions of fire handles.

OIL SYSTEM INDICATORS.

The oil system indicators are located on the engine instrument panel. Each engine has individual indicators on this panel.

Oil Quantity Gages.

Four oil quantity gages (figure 1-20), one for each engine oil system, are located on the engine instrument panel. Each instrument is calibrated from 0 (empty) to F (full) in increments of 2 quarts and numbered

oil cooler flaps switch panel

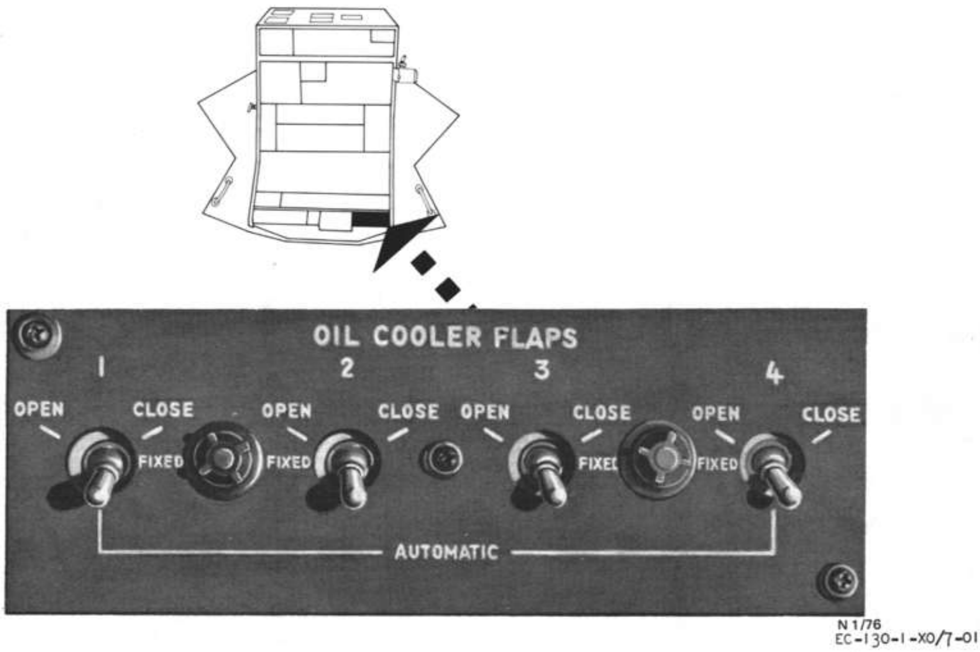

Figure 1-28.

in gallons. The indicators are energized by 28-volt, dc power from the essential dc bus through the oil quantity indicator circuit breaker on the copilot's side circuit breaker panel.

Oil Cooler Flap Position Indicators.

Four oil cooler flap position indicators (figure 1-20), one for each engine oil system, are located on the engine instrument panel. The indicators are electrically connected to position transmitters that are geared to the oil cooler flap actuators. The indicator dials, calibrated from 0 to OPEN in increments of 10 percent, indicate the percent of opening of cooler flap doors. The indicators are energized by 28-volt, dc power from the essential dc bus through the oil cooler flaps circuit breaker on the copilot's side circuit breaker panel.

Low Oil Quantity Warning Lights.

A low oil quantity warning light (figure 1-20) is located on the engine instrument panel, left of the oil quantity indicators. The light is electrically connected to each oil quantity indicator transmitter, and glows when an oil tank quantity level drops to approximately 4.0 gallons. The light will be energized only on the first engine to have a low oil quantity. The warning light is energized by 28-volt, dc power from the essential dc bus through the engine oil quantity light circuit breaker on the copilot's side circuit breaker panel.

FUEL SYSTEM.

The fuel system is a modified manifold-flow type, incorporating a fuel crossfeed system, a single point refueling and defueling system, and a fuel dump system. The system provides fuel supply for the four engines and the gas turbine compressor. It is adaptable to a number of flow arrangements (figure 1-29). Fuel specifications and grades are listed in the servicing diagram, Part 3 of this section. Nominal values for fully serviced and total usable capacities of the fuel tanks are shown in figure 1-30. For system management, see Section III. Aircraft limitations resulting from use of emergency fuels are discussed in Part 4 of this section.

fuel

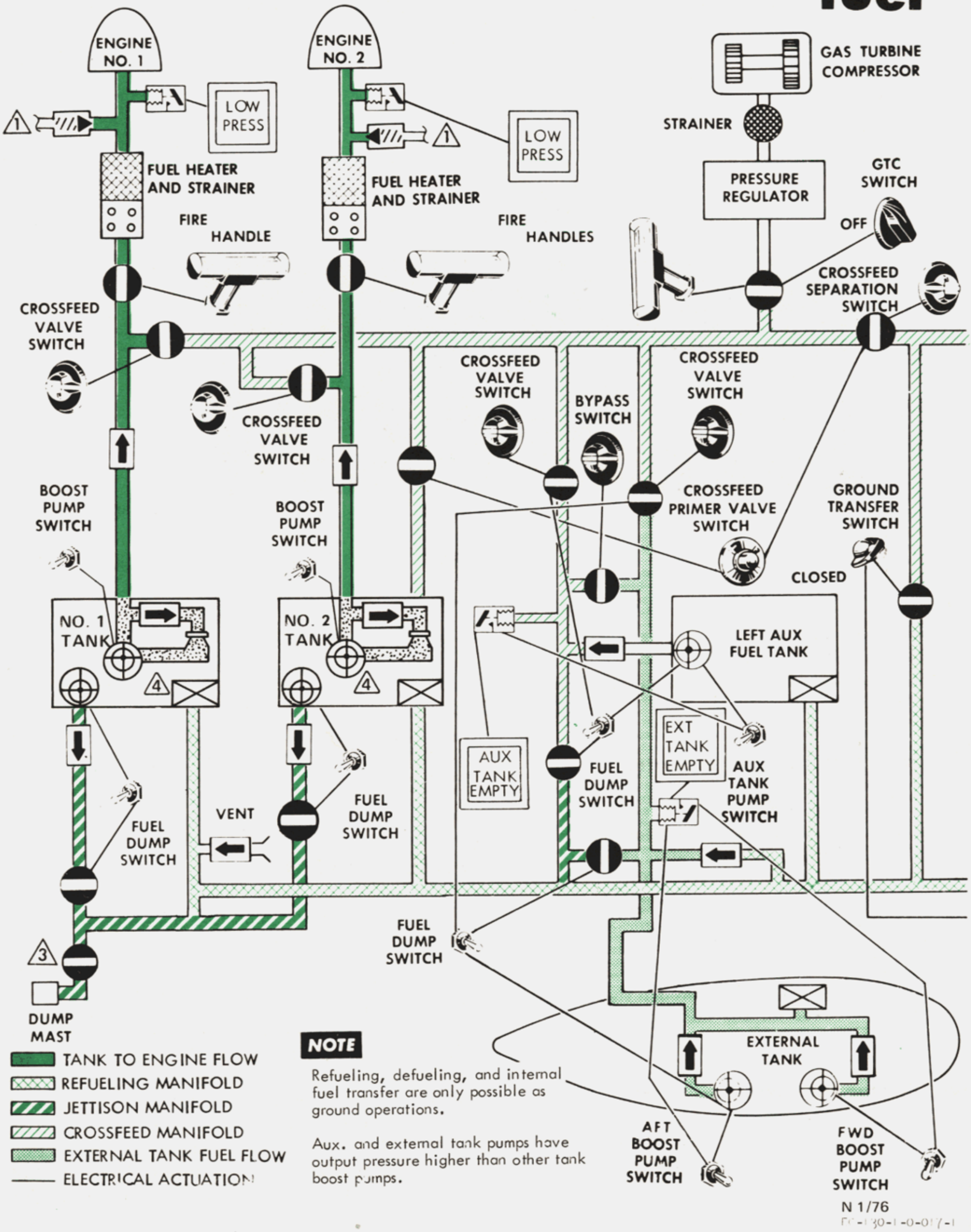

Figure 1-29. (Sheet 1 of 2)

system

NOTE

1. OVERBOARD DRAIN LINE.
2. SURGE SUPRESSOR.
3. VALVES ACTUATED BY TOUCH-DOWN SWITCH (CLOSED ON GROUND, OPEN IN FLIGHT)
4. EC-130G AIRCRAFT AND EC-130Q AIRCRAFT BUNO 156170 THROUGH 156177 ARE EQUIPPED WITH A SINGLE EJECTOR SYSTEM. EC-130Q AIRCRAFT BUNO 159348 AND 159469 ARE EQUIPPED WITH A TWO EJECTOR WATER REMOVAL SYSTEM.

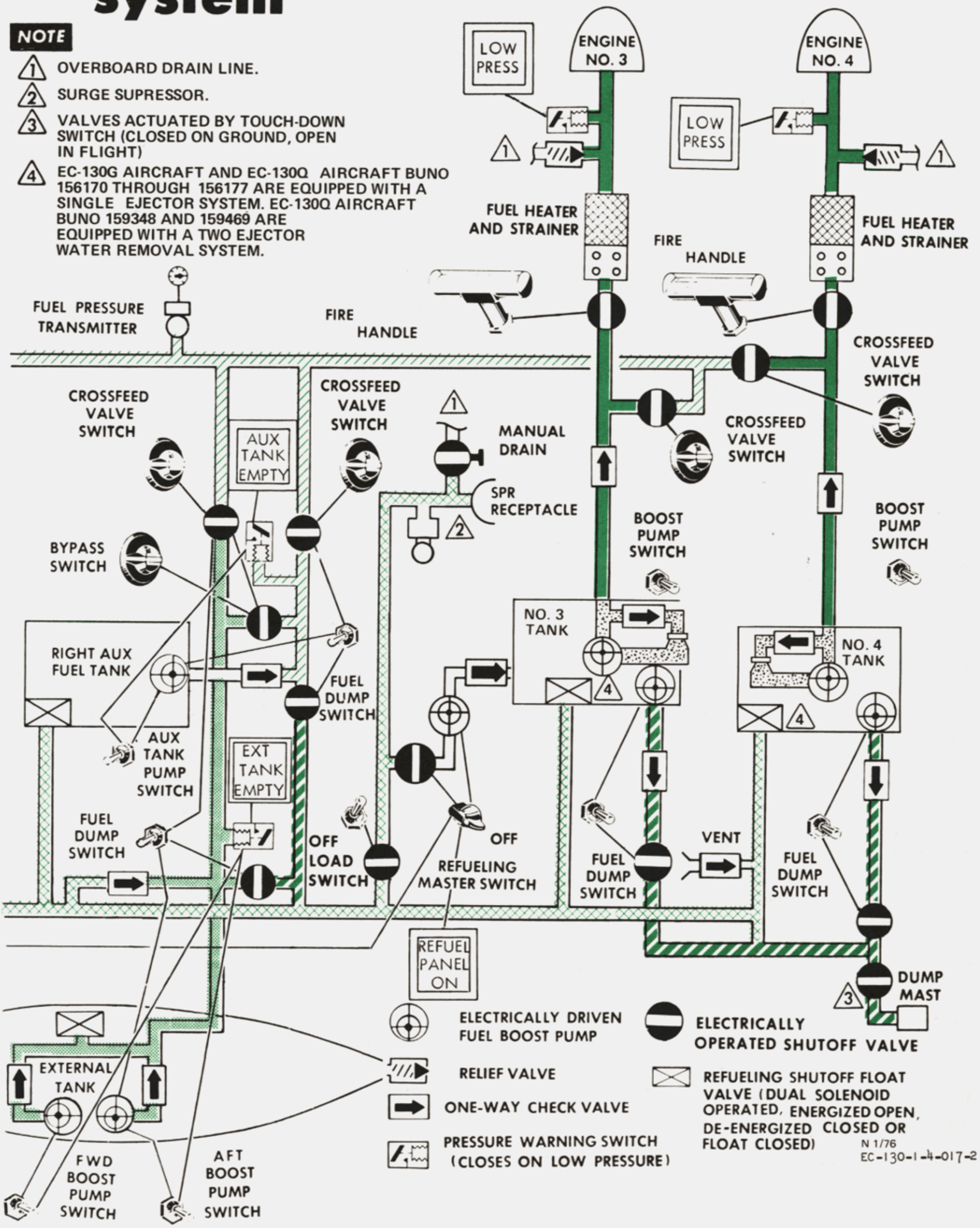

Figure 1-29. (Sheet 2 of 2)

FUEL FLOW.

Each engine may be supplied fuel either directly from the main respective fuel tank or through the crossfeed manifold system from any tank. Fuel for the GTC is supplied through the crossfeed manifold system also, and may come from any tank.

REFUELING AND DEFUELING.

Wing and external fuel tanks may be refueled or defueled from a single point ground refueling and defueling receptacle located in the right aft landing gear fairing. Fuel is routed from the single point receptacle through the refueling manifold. Each tank has a separate supply line from the manifold and each supply line has a float type shutoff valve. Refueling is controlled at the single point refueling control panel, located above the refueling receptacle. As an alternate method, main and external tanks may be fueled separately through a filler opening in the top of each tank. (See SINGLE POINT REFUELING AND DEFUELING SYSTEM in this section.)

INTERNAL TANKS.

Six fuel tanks are located within the wing. The No. 1, 2, 3, and 4 tanks are integral and use sealed wing structure for tank walls. A left and right auxiliary fuel tank, each composed of three bladder-type cells interconnected to form a single assembly, are located within the wing center section. Each of the six tanks has a three-phase, ac-powered boost pump to assure fuel flow to the engines. On EC-130G and EC-130Q aircraft BuNo 156170 through 156177, fuel level around the boost pump is maintained through use of a jet-pump-ejector located in the inboard forward corner of each main tank. On EC-130Q aircraft BuNo 159348 and 159469, the water removal system maintains the fuel level around the boost pump. An additional pump is located in each main tank for fuel dumping.

Water Removal System (EC-130Q BuNo 159348 and 159469).

The water removal system provides continual water removal from the tank low points during boost pump operation. The system consists of two ejectors, a check valve, a strainer, and associated plumbing in each tank. The ejectors are connected by plumbing to the boost pump discharge line and a part of the boost pump fuel flow is routed through each ejector housing and discharged through its nozzle. This fuel flow through the ejectors causes a differential pressure and additional fuel is drawn from between the lower wing panel risers and is ejected into the surge box. Any time the fuel boost pump is operating, the fuel will be continually stirred, preventing water from settling in the bottom of the tank.

EXTERNAL TANKS.

Two all-metal external fuel tanks are mounted under the wings on pylons between the inboard and outboard engines. The tanks are partially compartmented for center-of-gravity control. All fuel flows into the center compartment through check valves. A surge box in the tank center compartment contains a forward and an aft boost pump, providing dual reliability and an increased fuel dumping rate if both pumps are operated during fuel dumping. Both pumps have overriding output pressures which, under normal operation, assure depletion of fuel from the external tanks before the main tanks are affected.

VENT SYSTEM.

All of the fuel tanks are vented to the atmosphere to equalize pressure at all times. Tanks No. 2 and No. 3 and the left and right auxiliary have a wrap-around vent system. The wrap-around system permits venting for the above tanks even though the aircraft is not in a wing-level attitude. Vent air leaving the tank passes through a drainbox on its way overboard. On EC-130G and EC-130Q aircraft BuNo 156170 through 156177, any fuel entering the vent lines because of a change of attitude of the aircraft collects in the drainbox and is returned to the tank continuously by a jet eductor pump operated by fuel flow taken from the booster pump discharge line. On EC-130Q aircraft BuNo 159348 and 159469, the vent tank in the main tank is emptied by the water removal system. The extreme outboard tanks, No. 1 and No. 4 are vented by a float-controlled vent valve to prevent fuel loss overboard on the ground when the aircraft is not in a wing-level attitude and in flight when the wings deflect upward. Unless the auxiliary tank boost pumps are operated during taxi and flight operation when the tanks are filled to capacity, it is possible to get considerable fuel venting from the auxiliary tank vent masts. Boost pump pressure is

fuel quantity data table-JP-4 and JP-5

TANK	FULLY SERVICED SINGLE POINT REFUELING			* USABLE FUEL		
	GALS	POUNDS		GALS	POUNDS	
		JP-4	JP-5		JP-4	JP-5
TANK NO 1	1350	8775	9180	1340	8710	9112
TANK NO 2	1240	8060	8432	1230	7995	8364
LEFT AUXILIARY	910	5915	6188	910	5915	6188
RIGHT AUXILIARY	910	5915	6188	910	5915	6188
TANK NO 3	1240	8060	8432	1230	7995	8364
TANK NO 4	1350	8775	9180	1340	8710	9112
LEFT EXTERNAL	1400	9100	9520	1360	8840	9248
RIGHT EXTERNAL	1400	9100	9520	1360	8840	9248
TOTAL	9800	63700	66640	9680	62920	65824

All values presented in table are nominal.

NOTE: THE FUEL QUANTITY GAGES MAY HAVE AN ERROR VARYING LINEARLY FROM 2 PERCENT WITH AN EMPTY TANK TO 6 PERCENT WITH A FULL TANK.

* Usable fuel quantity is based on 4° nose up attitude for the wing tanks in coordinated or balanced flight.

CAUTION

It should be noted that JP-5 fuel weight is 6.8 pounds per gallon at standard day even though the aircraft can be fueled to a much greater fuel weight, using JP-5. The aircraft is still structurally limited to those weight values per tank shown in the " fuel quantity data table" under column for JP-4 fuel weight.

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Figure 1-30.

necessary for the vent eductor water removal system to operate. The external tanks are vented through the spaces at the top of the bulkheads separating the tank compartments, and through the fuel vent line. The vent line runs from the forward compartment of the tank through the pylon and up into the wing trailing edge, where it vents to the atmosphere. Fuel will not fill the vent line because the tank is separated by compartments, and the line is at the top of the tank and runs upward to the wing.

FUEL STRAINER AND HEATER UNIT.

A combination fuel strainer and heater is located in the right side of each nacelle. Heat is transferred from engine oil to the fuel in the heater unit, and the temperature is thermostatically controlled.

CROSSFEED PRIMER SYSTEM.

A press-to-actuate crossfeed fuel primer valve switch is located on the fuel control panel (figure 1-31). This switch, when depressed moves the motor-operated crossfeeed fuel primer valve to the open position and opens the motor-drive crossfeed separation valve. This allows fuel to flow through the manifold into the No. 2 fuel tank to remove any trapped air. Normally fuel from the No. 4 tank is used to prime the manifold. This requires that the No. 4 tank crossfeed valve be open and No. 4 tank boost pump be on. Releasing the switch actuates the primer valve to the closed position and closes the crossfeed separation valve. The crossfeed fuel primer valve receives 28-volt dc power from the essential dc bus through the engine crossfeed valves prime circuit breaker on the co-pilot's side circuit breaker panel.

FUEL DUMPING SYSTEM.

A fuel dump system (figure 1-31) is provided to enable all fuel, except 1,560 pounds in each of the main tanks and approximately 65 pounds in the external tanks to be dumped overboard. Eight two position (OFF, DUMP) toggle switches are located on the fuel control panel. The switches are safety-wired to the OFF position. The dumping rate for one tank at a time is approximately 520 pounds per minute. The dumping rate for all tanks together is approximately 3,690 pounds per minute. If the external tanks forward boost pumps are switched on manually, the rate increases to approximately 3,900 pounds per minute. Actuation of any switch will initiate the dumping overboard of the fuel in its respective tank. All tanks feed into a common dumping manifold with outlets at both wing tips. Check valves at each tank dump outlet prevent any reverse flow. The No. 1, No. 2, No. 3, and No. 4 tanks have individual integral pumps specifically for dumping. The left auxiliary tank and right auxiliary tank use the same pump for dumping and normal boost pumping. The aft boost pump in the external tanks is used for normal dumping, and the foward boost pump can be switched on manually to increase the dumping rate. All pumps are powered by three-phase, 115/200-volt, 400 Hz ac. Actuation of a dump switch will open the 28-volt, dc motor-operated jettison valve and simultaneously turn on the pump for the selected tank. The crossfeed valve will close when the dump switch for an auxiliary or external tank is placed in the DUMP position. The 28-volt, dc motor-operated dump valves are all powered from the essential dc bus through the copilot's side circuit breaker panel. The No. 1, No. 2, No. 3 and No. 4 dump pumps are powered from the main ac bus through the copilot's upper circuit breaker panel. The boost/dump pumps for the left and right auxiliary tanks are powered from the main ac bus through the auxiliary tank circuit breakers on the copilot's upper circuit breaker panel. The boost/dump pumps for the left and right external tanks receive power through the external tank pump aft circuit breakers on the copilot's upper circuit breaker panel and the external tank pump forward circuit breakers on the pilot's upper circuit breaker panel.

Dump Mast Shutoff Valves.

A fuel dump shutoff valve is located in the line going to each of the two dump masts. The re-fueling manifold and dump lines are connected together to permit rapid offloading of fuel through the SPR receptacle using the dump pumps. The dump mast shut-off valves prevent fuel from coming out the dump mast during ground de-fueling operation. The valves are actuated by the touchdown switch to close on the ground and open in flight. Electrical power is supplied from the essential dc bus through the fuel dump valves shutoff circuit breaker on the copilot's side circuit breaker panel.

FUEL SYSTEM CONTROLS.

All controls for inflight management of the fuel system are located on the fuel control panel (figure 1-31).

fuel control panel

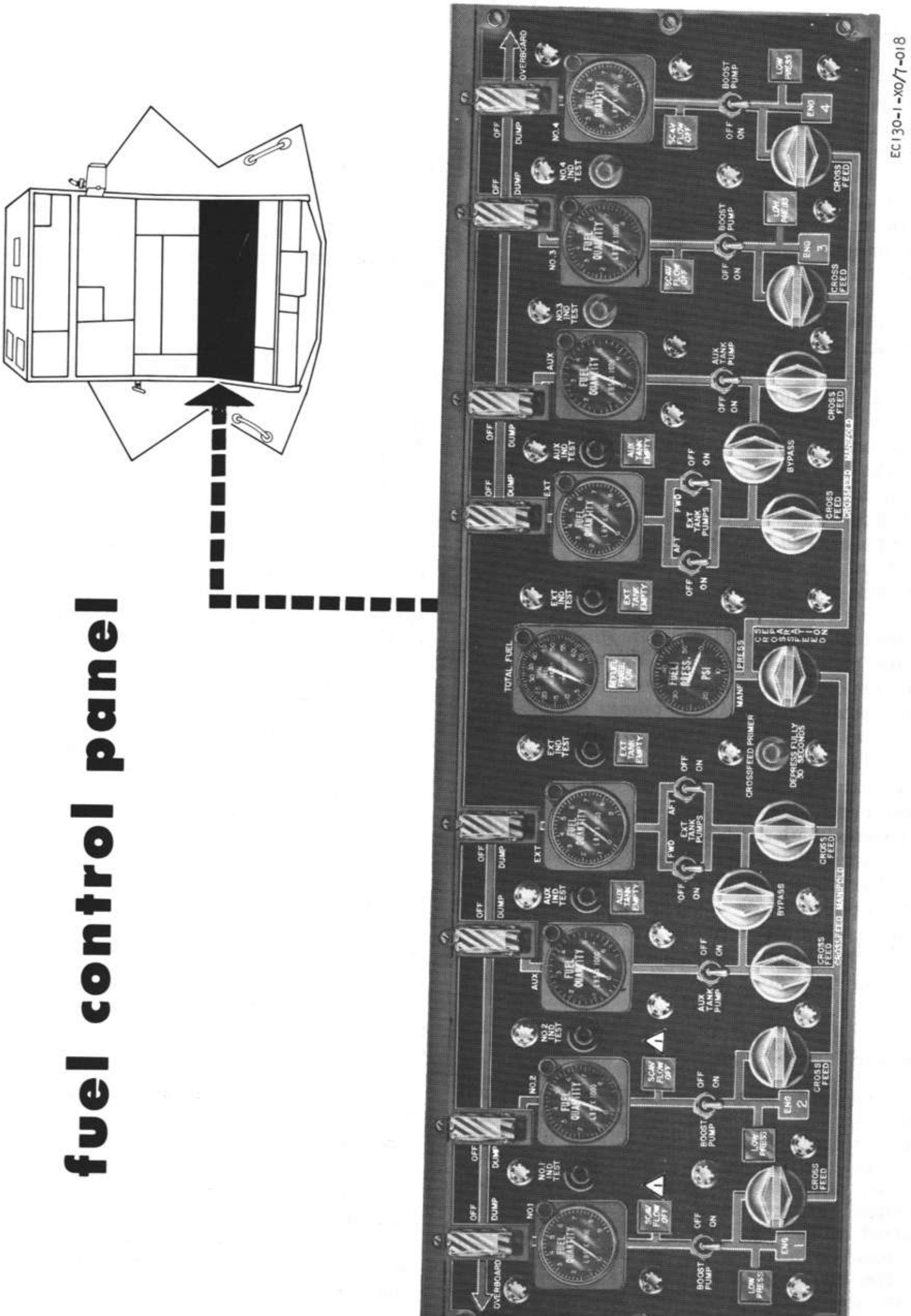


Figure 1-31.

Boost Pump Switches.

Ten boost pump switches are located on the fuel control panel. The No. 1, 2, 3, and 4 fuel tank boost pump switches control the internal boost pumps for their respective tanks. The left and right auxiliary fuel tank pump switches control the pump in each of the auxiliary tanks. The two pump switches for each external tank control the forward and aft boost pumps in the external tanks. All of the boost pumps are powered by three-phase, 115/200-volt, 400 Hz ac. The No. 1 tank pumps are supplied power from the left ac bus through the fuel boost pump tank No. 1 circuit breaker on the pilot's upper circuit breaker panel. The No. 2 tank pumps are supplied power from the essential ac bus through the fuel boost pump tank 2 circuit breaker on the pilot's side circuit breaker panel. The No. 3 tank pumps are supplied power from the main ac bus through the fuel boost pump tank 3 circuit breaker on the copilot's upper circuit breaker panel. The No. 4 tank pumps are supplied power from the right ac bus through the fuel boost pump tank No. 4 circuit breaker on the pilot's upper circuit breaker panel. The left and right auxiliary fuel tank boost pumps are supplied power from the main ac bus through the auxiliary tank circuit breakers on the copilot's upper circuit breaker panel. The aft boost pumps for the right and left external tanks receive power from the main ac bus through the external tank pump aft circuit breakers on the copilot's upper circuit breaker panel. The forward boost pump for the right external tank receives power from the right ac bus through the external tank pump forward circuit breaker on the pilot's upper circuit breaker panel. The forward boost pump for the left external tank receives power from the left ac bus through the external tank pump forward circuit breaker on the pilot's upper circuit breaker panel.

Crossfeed Valve Switches.

Eight crossfeed valve switches (figure 1-31) are located on the fuel control panel. These two-position rotary switches route 28-volt dc power from the essential dc bus through the engine crossfeed valves circuit breakers on the copilot's side circuit breaker panel to the motor-operated crossfeed valves. When the switches are placed in the crossfeed position (switch markings aligned with the fuel control panel markings), the valve motors are energized to open the valves. When the switches are placed in the off position (switch markings at right angles to the panel markings), the valve motors are energized to close the valves. In case of power failure, the valves hold the last energized position.

Bypass Valve Switches.

Two bypass valve switches (figure 1-31) are located on the fuel control panel to permit an alternate path for fuel from the left and right auxiliary and external fuel tanks if crossfeed valves fail to open. These two-position rotary switches route 28-volt dc power from the essential dc bus through the engine crossfeed valves 1 & 4 circuit breaker (left valve) and 2 & 3 circuit breaker (right valve) on the copilot's side circuit breaker panel to motor-operated bypass valves. The left bypass valve receives power from the essential dc bus through the 1 & 4 engine crossfeed valves circuit breaker, and the right bypass valve receives power from the essential dc bus through the 2 & 3 engine cross-feed valves circuit breaker on the copilot's side circuit breaker panel. When switches are placed in bypass position (switch markings aligned with fuel control panel markings), valve motors are energized to open the valves and allow external tank fuel to be crossfed or jettisoned through the auxiliary tank crossfeed or jettison valves, and vice versa. The bypass valves may be used to jettison main tank fuel in the event of main tank dump valve failure. When switches are placed in the off position (switch markings at right angles to panel markings), valve motors are energized to close the valves. In case of power failure, the valves hold the last energized position.

Crossfeed Separation Valve Switch.

The crossfeed separation switch (figure 1-31) is located on the fuel control panel. The motor operated crossfeed separation valve is provided in the crossfeed manifold system to permit additional control on fuel routing. The crossfeed separation valve provides for directing fuel from tanks located in the left section of the wing to engines No. 1 and No. 2 while engines No. 3 and No. 4 operate on fuel from the tanks located in the right section of the wing. This procedure insures a more even fuel consumption when operating from the auxiliary or external tanks through the crossfeed manifold. Since there may be a slight variation in boost pump pressure, and if both pumps were supplying the manifold, the pump operating at the highest pressure would feed the manifold if not prevented by the separation valve. When the crossfeed separation switch is placed in the open (vertical) position, the crossfeed separation valve is electrically actuated by 28-volt, dc power from the essential dc bus through the engine crossfeed valves prime circuit breaker located on the copilot's side circuit breaker panel.

Fire Handles.

Five fire handles, one for each engine and one for the gas turbine compressor, are mounted on the fire control panel (figure 1-25). These handles route 28-volt, dc power to the motor-operated, engine fire wall fuel shutoff valves and to the motor-operated, gas turbine compressor fuel supply shutoff valve. In case of power failure, valves hold the last energized position. Circuit protection is provided by the engine fire shutoff valve circuit breakers on the copilot's side circuit breaker panel and the GTC control circuit breaker on the pilot's side circuit breaker panel. Other functions of the handles are described under FIRE EXTINGUISHING SYSTEM in this section.

FUEL SYSTEM INDICATORS.

Quantity gages and warning lights are located on the fuel control panel to give the crew a continuous, visual indication of the status of the fuel system. For additional information on the fuel indicators, see ENGINE INSTRUMENTS in this section.

Total Fuel Quantity Indicator.

A total fuel quantity indicator (figure 1-31) is located in the center of the fuel control panel. The indicator is electrically connected to each of the fuel tank quantity gages, through a ratio assembly and power unit, and continuously shows the total fuel quantity (in pounds) in the fuel tanks, when the single point refueling master switch is in the OFF position. When the master switch is in any position other than OFF, the total fuel quantity indicator is de-engerized. The total fuel quantity indicator receives single-phase, 115-volt ac power from the ac instrument and engine fuel control bus through fuel quantity totalizer circuit breaker on the pilot's lower circuit breaker panel.

Fuel Quantity Indicators and Test Switches.

Eight fuel quantity indicators (figure 1-31) are located on the fuel control panel. Each tank indicator is connected to capacitance probes in one of the respective fuel tanks, and gives a continuous visual indication of the pounds of fuel contained in that tank. Single-phase, 115-volt ac power to operate the quantity indicators is taken from the ac instrument and engine fuel control bus. Circuit protection is provided by the fuel quantity circuit breakers on the pilot's lower circuit breaker panel. Quantity indicator test switches (figure 1-31) are provided to test the quantity indicating system. When depressed, these press-to-test switches provide a ground and all indicator pointers move toward zero. Failure of any pointer to move toward (but not necessarily to) zero indicates a malfunction in that quantity indicator. If a power failure is encountered the indicators will remain at the last indication before power failure. If a power failure is encountered on one indicator, the individual indicator will remain at the last indication before power failure and the total fuel quantity indicator will subtract the amount of fuel indicated on the inoperative indicator.

Auxiliary Fuel Tank Magnetic Sight Gage (Aircraft

An auxiliary fuel tank magnetic sight gage is located on the underside of the wing center section for each auxiliary fuel tank. The magnetic sight gage consists of three components: a mounting base and outer tube, a float, and a gage stick. The mounting base is attached to the lower surface of the auxiliary fuel tank with the outer tube secured to the mounting base. The float rides on the outside of the tube and has magnets in its inner diameter. The gage stick is contained within the outer tube, has magnets on its upper end, markings to indicate fuel quantity, and latches on the lower end into the mounting base. The gage stick markings indicate fuel quantity in pounds and is marked in 500 pounds increments from 5 to 59.

Auxiliary and External Tank Empty Lights.

Two aux tank empty lights and two ext tank empty lights are located on the fuel control panel in the flight station. If the boost pump switch associated with a given auxiliary or external tank is positioned at ON and the crossfeed separation valve is closed, the associated tank empty light will be illuminated whenever output flow pressure is below approximately 23 psi. Illumination of the light indicates either depleted tank quantity or an inoperative boost pump or (in the case of the external tanks, only) failure of the fuel level control valve. The press-to-test lights receive 28-volt dc power from the essential dc bus through the dump valves circuit breakers on the copilot's side circuit breaker panel.

Refueling Panel on Light.

The refueling panel on light is located on the fuel control panel (figure 1-31). This press-to-test light will illuminate when the single point refueling master switch is in any position other than OFF. The refueling panel on light receives 28-volt dc power from the main dc bus through the ground transfer valve circuit breaker on the copilot's lower circuit breaker panel.

Fuel Pressure Ground Test Indicator.

A fuel press indicator (figure 1-31) located on the fuel control panel is used to check out the fuel boost pumps. This indicator is electrically connected to a fuel pressure transmitter which measures the pressures in the crossfeed manifold. When the fuel boost pumps are turned on individually, the pressure supplied the crossfeed system by any pump is measured by the transmitter and shown by the indicator. Single-phase, 26-volt, 400-Hz ac to operate the pressure indication system is supplied by the No. 1 instrument power transformer. Circuit protection is provided by the fuel pressure indicator fuse on the pilot's lower circuit breaker panel.

Note

> The markings on this instrument are for preflight reference only. Inflight low-pressure warning is supplied by the pressure warning lights on the fuel control panel. However, boost pump pressure may be checked with this instrument at any time.

Fuel Low-Pressure Warning Lights.

Four fuel low-pressure warning lights (figure 1-31) are located on the fuel control panel. Each light is turned on when fuel supply pressure at the point where fuel enters the engine pump falls below approximately 8.5 psi. When illuminated, a light indicates a possible booster pump failure, valve failure, fuel line failure, or a malfunctioning pressure switch. The lights receive 28-volt dc power from the essential dc bus through the fuel management low-pressure lights circuit breaker on the copilot's side circuit breaker panel.

SINGLE POINT REFUELING AND DEFUELING SYSTEM.

A single point refueling and defueling system enables all normal refueling and defueling operations to be accomplished through a single receptacle located in the aft end of the right wheel well fairing. All tanks, including the external tanks carried below the wings, may be serviced through the system. Controls and indicators for the system are on the refueling control panel (figure 1-32) located immediately above the receptacle.

When refueling, fuel enters the tanks by way of the refueling manifold, and a dual float valve in each tank shuts off the flow when the tank is filled to its single point refueling capacity. Defueling and ground tank-to-tank fuel transfer is accomplished by running the tank boost pumps and the auxiliary and external tank pumps. Defueling flow is through the crossfeed manifold, through the ground transfer valve to the refueling manifold, and out the single point refueling-defueling receptacle.

The fuel dump pumps may be used for defueling. The pumps are controlled from the flight station fuel control panel. Defueling flow, when using the dump pumps, is through the dump line to the refueling manifold and out the single point refueling/defueling receptacle. A surge suppressor is located in the refueling line to prevent damage to the fuel system components. A surge suppressor pressure gage is located on the surge suppressor and may be observed behind the starboard air deflector door.

SINGLE POINT REFUELING AND DEFUELING SYSTEM CONTROLS.

Except for the pump switches, which are located on the fuel control panel and are used to operate the tank pumps during defueling operations, all the single point refueling and defueling controls are on the refueling control panel (figure 1-32) above the fueling receptacle on the right wheel well fairing. These controls comprise a master switch, a selector switch and a fuel quantity gage for each of the eight tanks, a ground transfer switch, and an off-load valve switch.

single point refueling control panel

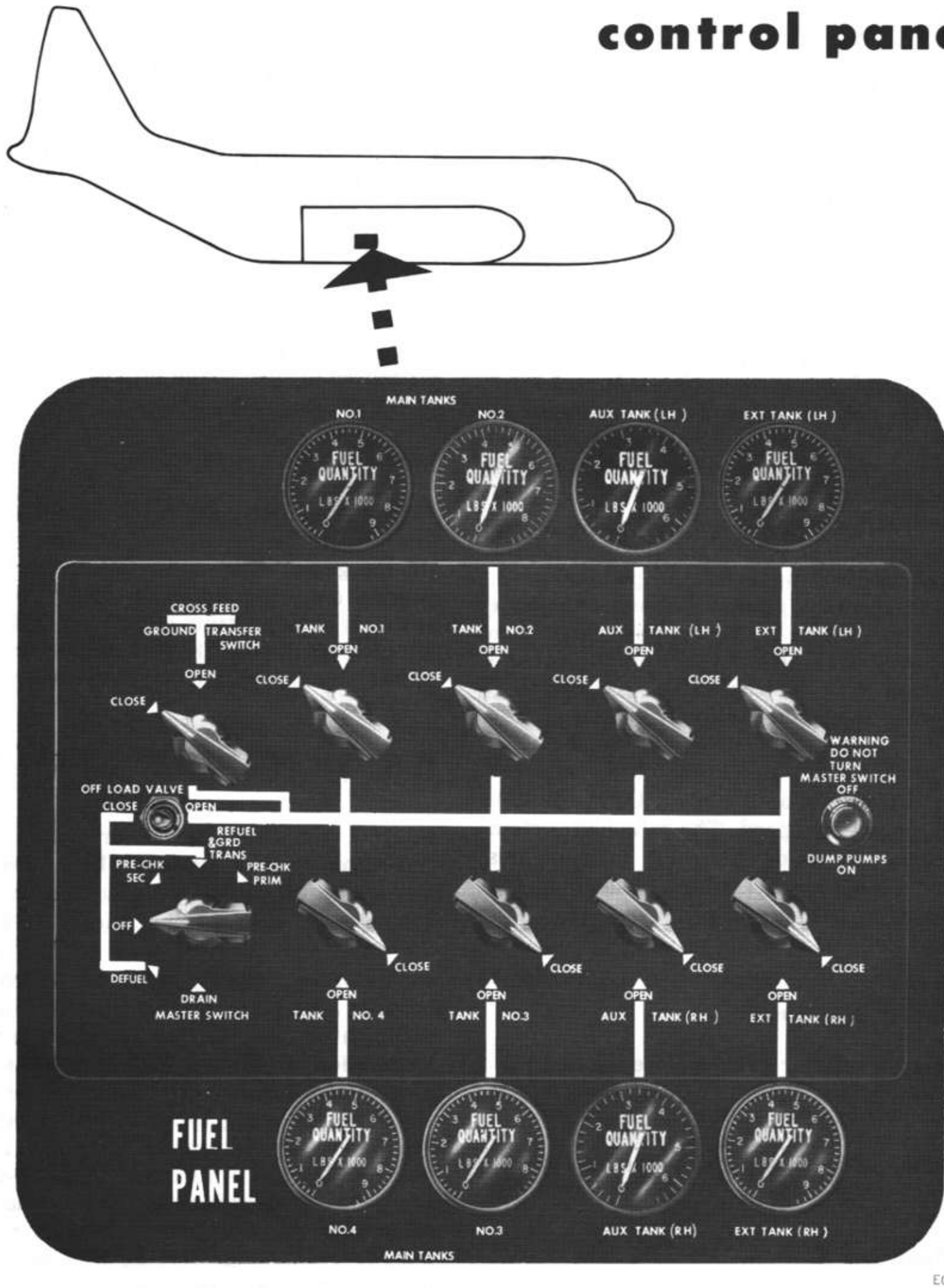


Figure 1-32.

Master Switch.

A master switch for the single point refueling system is located on the refueling control panel (figure 1-32). The switch is a six-position (DRAIN, DEFUEL, OFF, PRE-CHK SEC, REFUEL & GRD TRANS, PRE-CHK PRIM) rotary type by which the system function is selected. Placing the master switch in the REFUEL & GRD TRANS position supplies power to the tank selector switches and the ground transfer switch, permitting selective (OPEN, CLOSE) operation of the tank fill valves and the ground transfer valve. Placing the master switch in the DEFUEL position supplies power to operate the ground transfer valve only. The tank valves cannot be opened when the master switch is in the DEFUEL position. Placing the switch in either the PRE-CHK PRIM position or the PRE-CHK SEC position interrupts power to a solenoid in the tank fill valves, closing the fill valves and simulating a tank-full condition, thus providing a check on the automatic operation of the tank fill valves. In both the PRE-CHK PRIM and the PRE-CHK SEC positions, power is supplied to the ground transfer switch, permitting operation of the ground transfer valve. In the DRAIN position, power is supplied to open the drain valve and to operate the drain pump. Power is also supplied directly to the ground transfer valve, bypassing the ground transfer switch, to close the valve. In the OFF position, power is supplied directly to the ground transfer valve, closing the valve: and to the tank selector switches, rendering the switches inoperative. In all positions except OFF, the fuel quantity gages are energized. The refueling system operates from 28-volt dc from the main dc bus through the refueling panel circuit breakers on the copilot's lower circuit breaker panel.

Tank Selector Switches.

Each of the eight selector switches, one for each tank, is a two-position (OPEN, CLOSE) rotary switch through which power is supplied to the solenoids of the associated tank valve. However, the switches can operate the valves only while the fueling control master switch is set to REFUEL & GRD TRANS.

Ground Transfer Switch.

The ground transfer switch, located on the single point refueling control panel (figure 1-32), is a two-position (OPEN, CLOSE) rotary type used to control the ground transfer valve. The master switch must be in the DEFUEL, PRE-CHK SEC, REFUEL & GRD TRANS, or PRE_CHK PRIM position before the ground transfer valve will operate. When the master switch is in the OFF or DRAIN position, the ground transfer switch is bypassed, and the ground transfer valve is energized to the closed position.

Off-Load Valve Switch.

The off-load valve switch, located on the single point refueling control panel (figure 1-32), is a two-position (CLOSE, OPEN) toggle type used to control the offload valve when the fueling control master switch is in any position except OFF and DRAIN. When the fueling master switch is in the OFF position, the off-load valve switch is bypassed and the off-load valve is energized to the closed position. When the fueling master switch is in the DRAIN position, power is supplied to open the off-load valve in either position of the off-load valve switch.

Fuel Quantity Gages.

Eight fuel quantity gages, one for each fuel tank are installed on the fueling control panel (figure 1-32). All the gages, which indicate tank fuel quantity in pounds, are energized when the fuel control master switch is at any setting other than OFF. The gages are powered through the fuel quantity-totalizer circuit breaker on the pilot's lower circuit breaker.

ELECTRICAL POWER SUPPLY SYSTEM.

Internal electrical power originates at nine ac generators and a battery. Each aircraft engine drives one 50-kva ac generator and one 90-kva ac generator. An air turbine motor (ATM) drives a 20-kva ac generator. (The air turbine motor-driven generator is basically rated at 20-kva. However, because the air turbine motor fan provides sufficient cooling air, the generator is rated in this installation at 30-kva for continuous operation.) The 50-kva generators provide power for aircraft use. The following types of power originate from the 50-kva generators: 28 volts dc; 115/200-volts, 400-Hz, 3-phase primary ac; and 115-volt 400-Hz, single phase, secondary and primary ac. The 50-kva generators are connected through relays to the following ac buses: left ac bus, essential ac bus, main ac bus, and right ac bus. Operation of the relays applies power from any two operating 50-kva generators to the four ac buses. If only one 50-kva generator is operating, the relays connect power to the essential and main ac buses (figure 1-37). Setting the ATM generator switch to the ON position (knob stripe aligned with panel stripe) on the 50-kva generator control panel (figure 1-35) energizes an ATM generator contractor relay that connects the ATM generator to the essential ac bus. The ATM generator powers only the essential ac bus. The ATM generator under-frequency control circuit is deactivated during engine start to prevent the ATM generator from dropping off the line caused by slowing of the ATM during engine start. See ATM in this section for additional information. The 90-kva generators provide power for comm central through relays in a special power distribution box. The comm central load transfers to the No. 1 90 kva generator if the No. 4, No. 3, or No. 1 and 2 50 kva generator(s) are inoperative. Controls for operation of the electrical system are located on panels mounted on the flight deck overhead panel.

EXTERNAL POWER PROVISIONS.

Note

> The 115/200-volt, 3-phase, 400-Hz ac external source should have a capacity of 50-kva; its phase rotation must be A-B-C. The 28-volt dc external source should have a capacity of 600 amperes.

DC and ac external power receptacles are located on the left side of the fuselage aft of the battery compartment (figure 1-1). DC power from an external source is supplied through two current limiters to the main dc bus and controlled by the ground power switch. Any dc electrically operated equipment on the aircraft, except equipment connected to the battery bus, can be supplied from the external dc power source. External ac power is applied through the control panel circuit to the four ac buses, the special mission equipment bus, the dc buses through transformer-rectifier units, and to the battery bus to charge the battery when the dc power switch is in the BATTERY position. Closing an EXTERNAL POWER switch on the 90-kva generator control panel also enables operation of special mission equipment.

Note

> The ATM generator switch must be in the OFF position before external ac power can be fed into the aircraft system.

DC POWER SYSTEM.

Power from the essential ac bus and the main ac bus operates four transformer-rectifier units (two from each ac bus) to provide dc power for the aircraft (figure 1-33). The four transformer-rectifier units, mounted on the electronic control and supply rack, convert the power from the ac buses to 28-volt dc. Both the essential ac bus and the main ac bus may be powered by any of the engine-drive generators (refer to the AC Bus Power Sources chart). The essential ac bus is powered from the air turbine motor generator also, so it may be used as a source of dc power for ground operation. The transformer-rectifier units feed current through reverse current relays to the main dc bus and the essential dc bus.

DC System Busses.

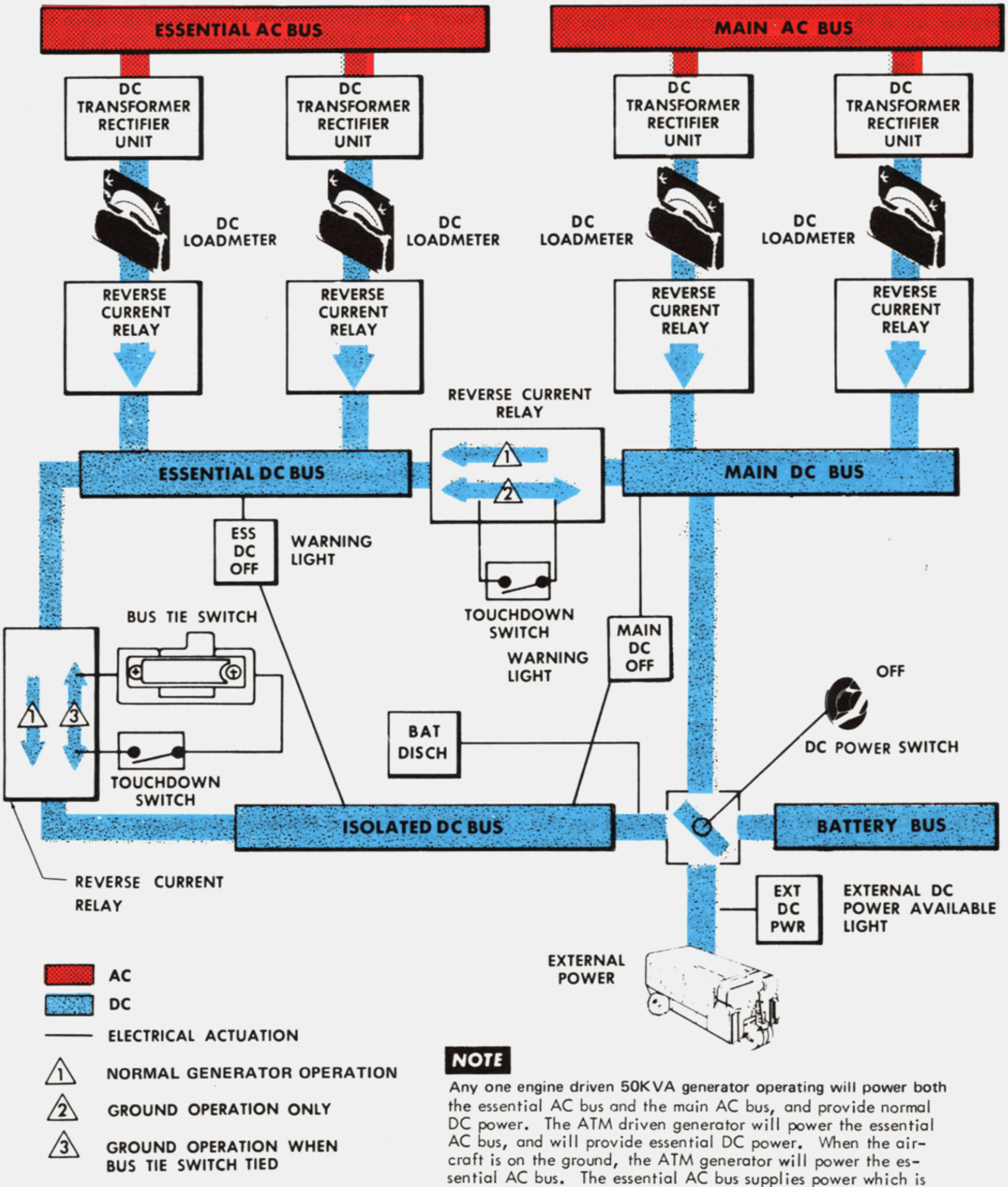
There are four busses in the dc power system: the main bus, the essential bus, the isolated bus, and the battery bus (figure 1-34). The main and essential busses are connected through a reverse-current relay, which in flight allows current to flow from the main bus to the essential bus, but limits current flow in the opposite direction. When the aircraft is on the ground, a touchdown switch is actuated to complete a circuit which overrides the current limiting features of the reverse-current relay and permits current flow in either direction between the main and essential busses. The essential and isolated busses are similarly connected through another reverse-current relay which limits current flow from the isolated bus to the essential bus in flight. When the aircraft is on the ground, the touchdown switch completes a circuit so that manual positioning of the bus tie switch overrides the current limiting features of the reverse-current relay and permits current flow in either direction between the isolated and essential busses.

Note

> The bus tie switch is only effective if the touchdown switch is actuated by the aircraft being on the ground.

The isolated bus is connected to the battery bus by the dc power switch. During ground operation with no engines operating, all of the dc busses may be connected and powered through either the battery, or the essential dc bus, which can utilize air turbine motor ac generator output to the essential ac bus as a power supply. External dc power is fed through the main dc bus and will supply all dc busses, except the battery, when the dc power switch is in the EXT DC PWR position.

dc power supply



NOTE

Any one engine driven 50KVA generator operating will power both the essential AC bus and the main AC bus, and provide normal DC power. The ATM driven generator will power the essential AC bus, and will provide essential DC power. When the aircraft is on the ground, the ATM generator will power the essential AC bus. The essential AC bus supplies power which is rectified for use in the essential DC bus. The essential DC bus can be connected to the main DC bus through the reverse current relay.

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Figure 1-33.

Battery.

A 24-volt, 36-ampere-hour battery is located in a fuselage compartment forward of the crew entrance door. The battery supplies power to the battery bus and to the isolated bus. A reverse current cutout is connected between the isolated bus and the essential and main dc busses. The reverse current cutout normally prevents the battery from powering equipment connected to the essential and main dc busses and permits power from the essential and main dc busses to be used to power equipment connected to the isolated bus, and to charge the battery. During gas turbine compressor starting the battery powers the GTC starter and control circuits through the GTC control circuit breaker on the pilot's side circuit breaker panel.

In EC-130Q aircraft BuNo 159348 and 159469, a 24-volt, 32-ampere hour battery for the INS is located inboard and behind the aircraft battery.

DC System Controls.

The dc electrical system is powered directly by the ac electrical system; therefore, only two dc system controls are necessary to operate the system. They are the bus tie switch and the dc power switch which are both located on the electrical control panel on the overhead control panel in the flight station.

The bus tie switch is a two-position (NORMAL, TIED) guarded toggle switch which functions in conjunction with the touchdown switch. When the aircraft is on the ground the bus tie switch can connect the isolated dc bus and the essential dc bus for current flow in either direction. This allows battery power to feed all dc busses and circuits when the dc power switch is in the BATTERY position.

DC POWER SWITCH. The dc power switch is a three-position, rotary-type switch located on the overhead electrical control panel (figure 1-35). When the switch is in the EXT DC PWR position, the external power relays will close when external power is applied in the correct polarity, to connect the external power receptacle to the main dc bus. When the switch is in the BATTERY position, the battery relay is closed and the battery is connected to the isolated bus. This position of the switch permits power to flow from the main dc bus or the essential dc bus through the reverse current cutout to the isolated bus to charge the battery. When the switch is in the OFF position, the external power relay is opened and the external power receptacle is disconnected from the main dc bus, and the isolated bus.

DC System Indicators.

The dc system indicators are all located on the electrical control panel on the overhead control panel in the flight station and include four loadmeters, three bus off indicators, an external dc power available light, and a voltmeter with a bus selector switch.

LOADMETERS. Four loadmeters, one for each transformer rectifier unit, indicate percent of rated current load flowing from each unit.

Note

The battery discharge light will never glow except for a malfunction, or if the dc power switch is placed in the EXT DC PWR position when no external power is connected and no internal ac generator power is powering the dc system.

BATTERY DISCHARGE LIGHT. When the amber BAT DISCH light, located on the exterior lights navigation panel, is on, it indicates that the battery charge is being depleted by the isolated dc bus loads due to failure of the reverse current relay. The corrective action is to secure power to the battery or shift loads from the isolated bus.

BUS OFF INDICATOR LIGHTS. Two bus off indicator lights, one each for the main dc bus, and the essential dc bus give a visual indication of a power off condition of the busses. Both the main and essential dc bus lights are powered from the isolated dc bus.

VOLTMETER AND BUS SELECTOR SWITCH. The voltmeter is located on the overhead electrical control panel (figure 1-35) and is connected to the main dc bus, essential dc bus, or battery by means of the voltmeter selector switch adjacent to the voltmeter. Selected bus voltage will be indicated on the voltmeter.

dc power distribution (EC-130G aircraft)

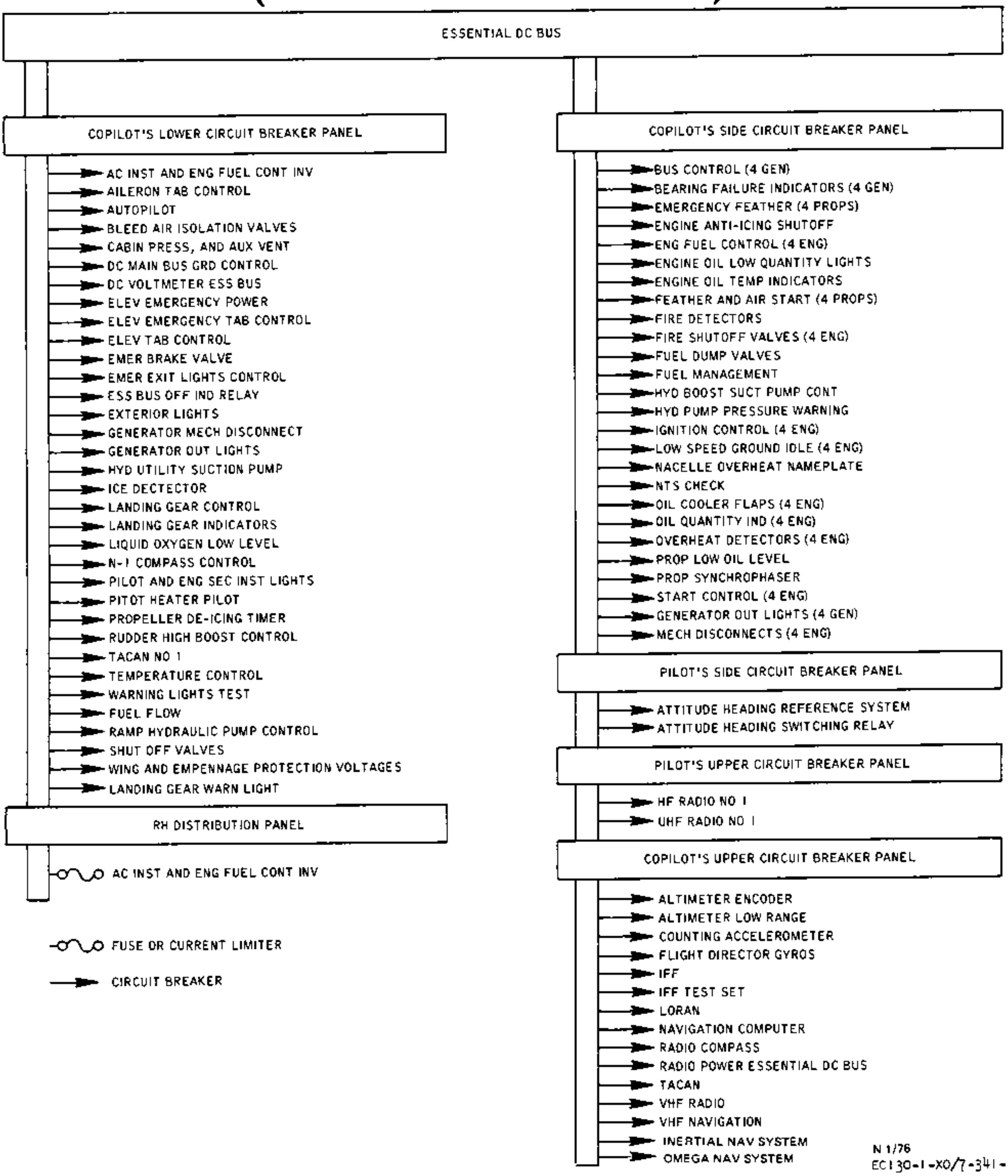


Figure 1-34. (Sheet 1 of 4)

dc power distribution (EC-130G aircraft)

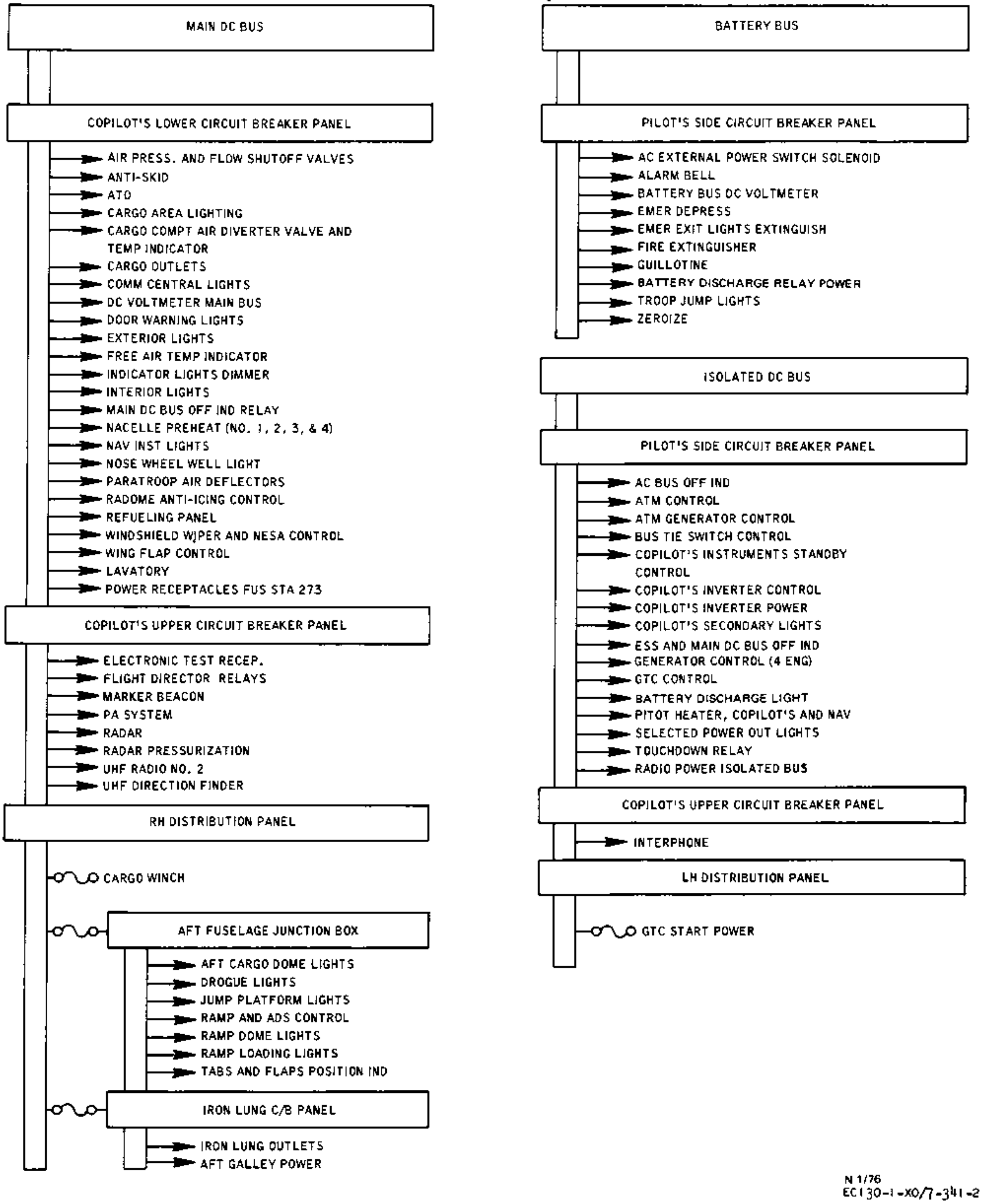


Figure 1-34. (Sheet 2 of 4)

(EC-130Q aircraft)

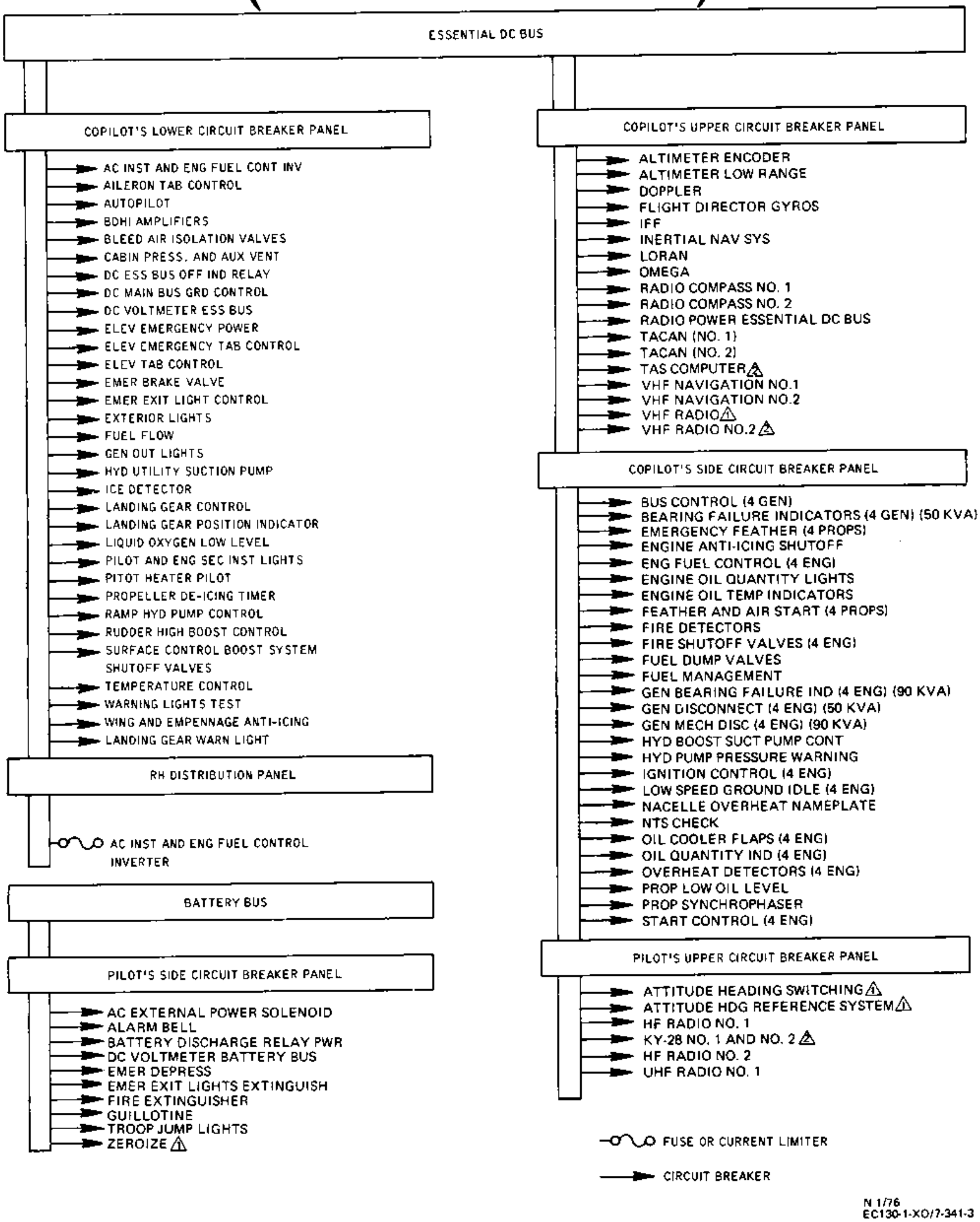
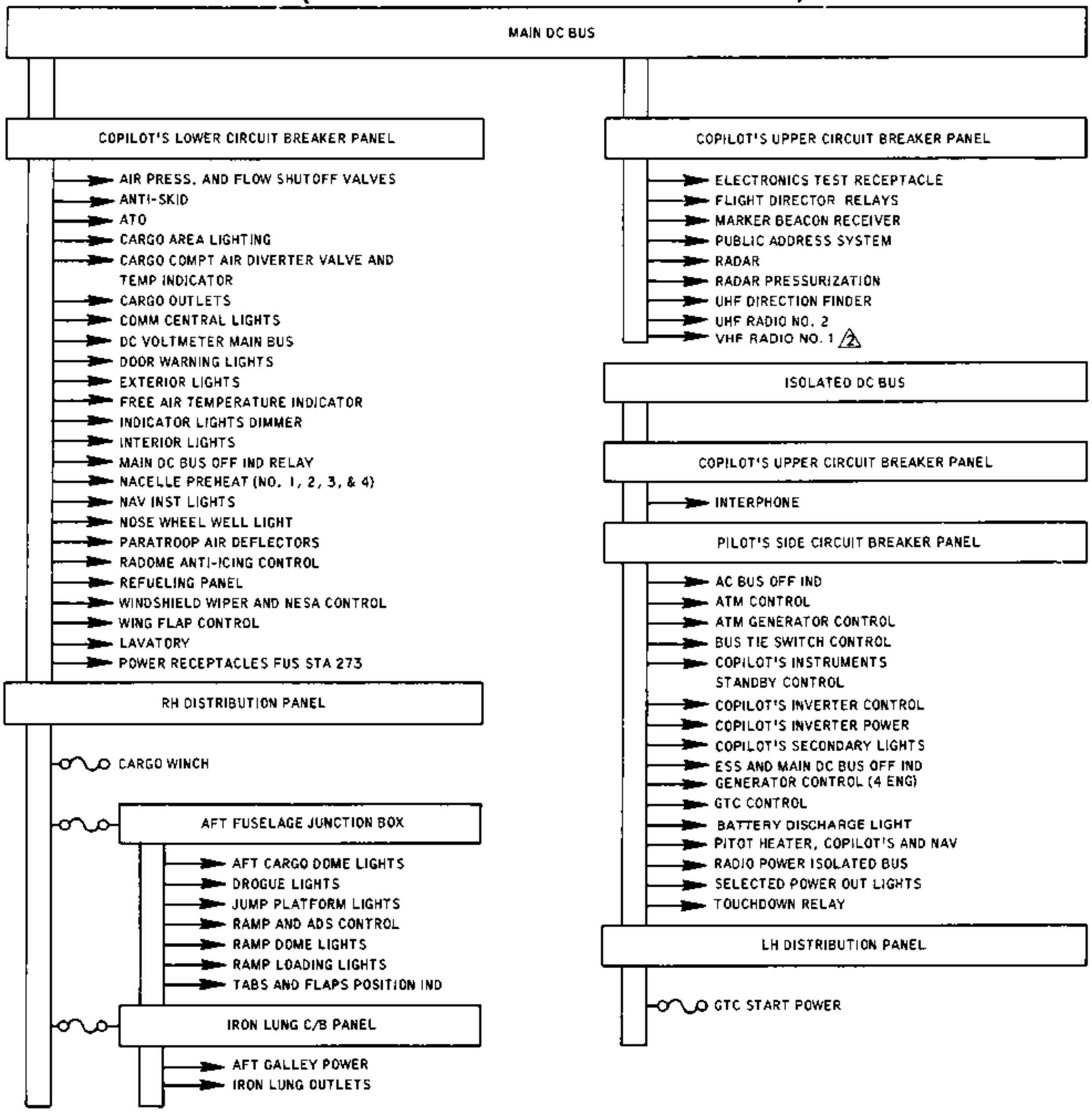


Figure 1-34. (Sheet 3 of 4)

(EC-130Q aircraft)



Note

⚠1 BUNO 156170 THROUGH 156177

⚠2 BUNO 159348 AND 159469

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Figure 1-34. (Sheet 4 of 4)

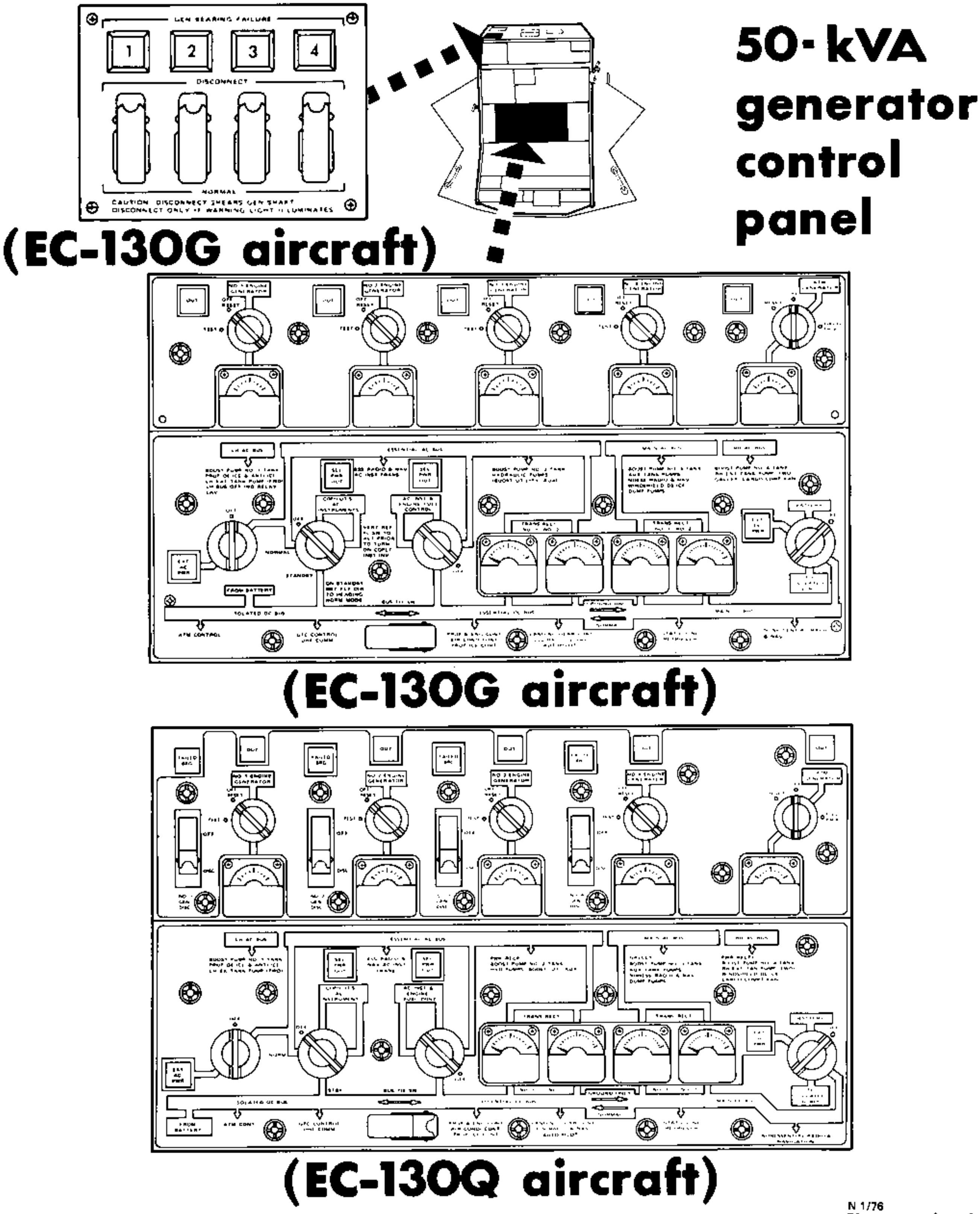
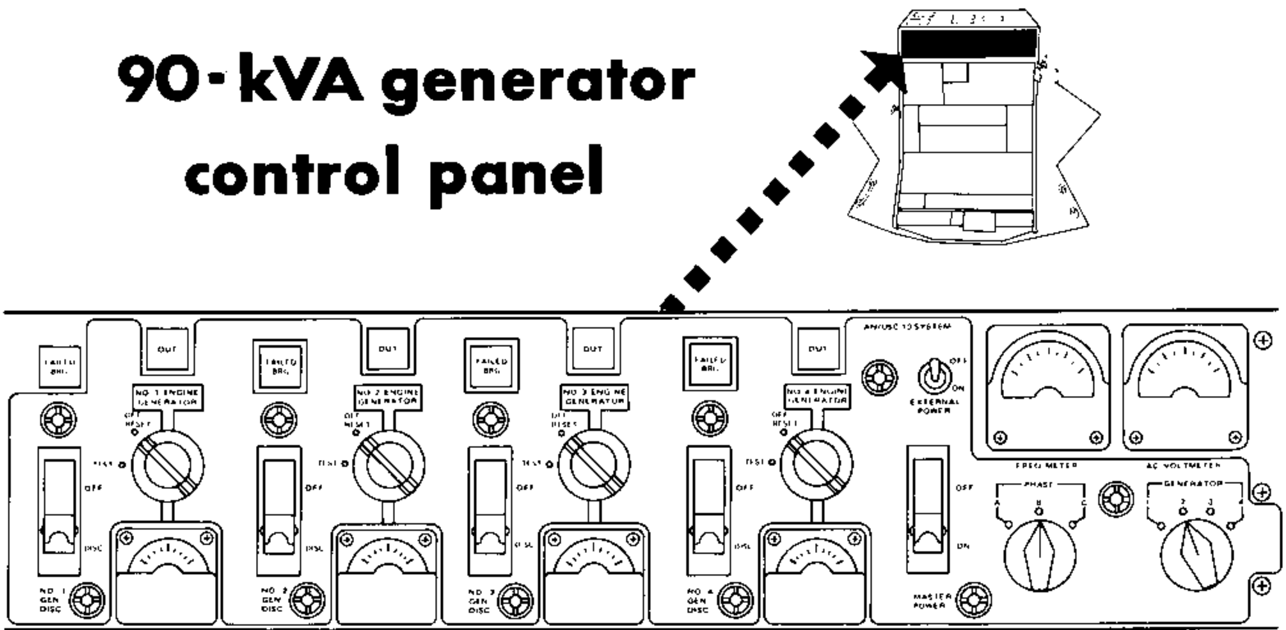


Figure 1-35. (Sheet 1 of 2)

90-kVA generator control panel



(EC-130G and EC-130Q aircraft)

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Figure 1-35. (Sheet 2 of 2)

EXTERNAL DC POWER INDICATOR. The external dc power available light will be illuminated whenever external dc power is connected to the external dc power receptacle in the correct polarity. In the OFF position no power is supplied to the system.

PRIMARY AC SYSTEM.

Primary AC System Controls.

The ac system is controlled by the 50-kva generator control panel and the 90-kva control panel.

Four 3-position rotary switches and one 4-position rotary switch are mounted on the 50-kva generator control panels (figure 1-35, sheet 1), and four 3-position rotary switches are mounted on the 90-kva generator control panel (figure 1-35, sheet 2). Setting a generator switch to ON position (knob stripe aligned with panel stripe) applies power from the selected generator to the applicable ac bus or equipment. Distribution of ac power to ac buses is shown on figures 1-36, 1-37, and 1-38. Setting a 50- or 90-kva generator switch to OFF RESET disables the generator. Setting a 50- or 90-kva generator switch to TEST enables the generator and applies power to the applicable ac voltmeter and frequency meter for measurement; however, power is not applied to the ac buses and equipment. Setting the ATM generator switch to OFF disables the ATM generator. Setting the ATM generator switch to FIELD TRIP removes generator excitation, stopping production of voltage by the ATM generator. When the ATM generator switch is rotated to the spring-loaded RESET position, the generator field circuit closes allowing the ATM generator to build up voltage.

GENERATOR DISCONNECT SWITCHES (EC-130G AIRCRAFT). A gen bearing failure control panel (figure 1-35) that has four guarded, two-position (DISCONNECT, NORMAL) generator disconnect switches and four generator bearing failure lights numbered 1,2,3, and 4, is located on the overhead control panel. When a generator disconnect switch is placed in the DISCONNECT position, the appropriate generator is mechanically disconnected from the accessory drive. Maintenance is required to reconnect the generator. Power to operate the mechanical disconnect solenoid comes from the 28-volt essential dc bus through a generator mech disconnect circuit breaker on the copilot's lower circuit breaker panel.

GENERATOR DISCONNECT SWITCHES (EC-130Q AIRCRAFT). Four guarded and safetied gen disc switches are located on the overhead electrical control panel (figure 1-35). Each switch has two positions (OFF, DISC) and controls the disconnect mechanism to a single generator. When a switch is placed to DISC, the appropriate generator is mechanically disconnected from the accessory drive. Maintenance is required to reconnect the generator. Power to operate the mechanical disconnect solenoid comes from the 28-volt essential dc bus through a gen disconnect circuit breaker located on the copilot's side circuit breaker panel.

GENERATOR DISCONNECT SWITCHES (90-KVA). Five guarded generator disconnect switches are mounted on the 90-kva generator control panel (figure 1-35, sheet 2). NO. 1 GEN DISC, NO. 2 GEN DISC, NO. 3 GEN DISC, and NO. 4 GEN DISC switches control the mechanism to disconnect a specific 90-kva generator. Placing the switch to DISC mechanically disconnects the generator. Ground maintenance is required to replace the generator. Placing the MASTER POWER switch in OFF electrically trips all four generators. Power to operate the mechanical disconnect solenoid, associated with each 90-kva generator, originates at the essential dc bus. Power is applied through a mechanical disconnect circuit breaker mounted on the copilot's side circuit breaker panel.

AC EXTERNAL POWER SWITCH. The external ac power switch is a two-position, rotary switch that is mounted on the 50-kva generator control panel (figure 1-35, sheet 1). Setting the external ac power switch to the ON position (knob stripe aligned with panel stripe) connects external ac power to the four ac buses. Then setting the EXTERNAL POWER switch (figure 1-35, sheet 2) on the 90-kva generator control panel to ON connects external power to the special mission equipment. Setting the external ac power switch to the OFF position disconnects the external ac power from the aircraft ac distribution system.

Note

> An override solenoid in the system is powered from the battery and turns the switch OFF if the ATM generator control switch is ON, if the ac power is not in the correct phase sequence, if any engine generator is on the line, or if the external power plug is not in the receptacle.

EXTERNAL POWER SWITCH. The EXTERNAL POWER switch is a two-position toggle switch mounted on the 90-kva generator control panel (figure 1-35, sheet 2). Setting the EXTERNAL POWER switch to ON applies external ac power to the AN/USC-13 equipment. Setting the EXTERNAL POWER switch to OFF disconnects external ac power from the AN/USC-13 equipment.

GENERATOR AND FREQUENCY SELECTOR SWITCH (50-KVA). A seven-position (ENG GEN NO. 1, ENG GEN NO. 2, ENG GEN NO. 3, ENG GEN NO. 4, ATM GEN, EXT PWR, COPLT INV ØA & ØB AC INST & ENG FUEL CONT INV ØC) rotary switch is located on the 50-kva generator control panel. The switch selects a source of ac power for measurement.

GENERATOR PHASE SELECTOR SWITCH (50-KVA). A three-position phase selector switch, located on the 50-kva generator control panel selects one of the three phases of 50-kva ac generator output to be measured by the ac meters on the panel. Placing the switch in a given position determines which phase is measured by the five ac loadmeters, the ac voltmeter, and the frequency meter on the 50-kva generator control panel. The switch can be used in conjunction with the voltage and frequency selector switch to test a given ac power source.

GENERATOR VOLTAGE AND FREQUENCY SELECTOR SWITCH (90-KVA). A four-position (GENERATORS 1, 2, 3, and 4) rotary switch is mounted on the 90-kva generator control panel (figure 1-35, sheet 2). Positioning of this switch permits measuring of the selected generator voltage and frequency.

ac secondary power system

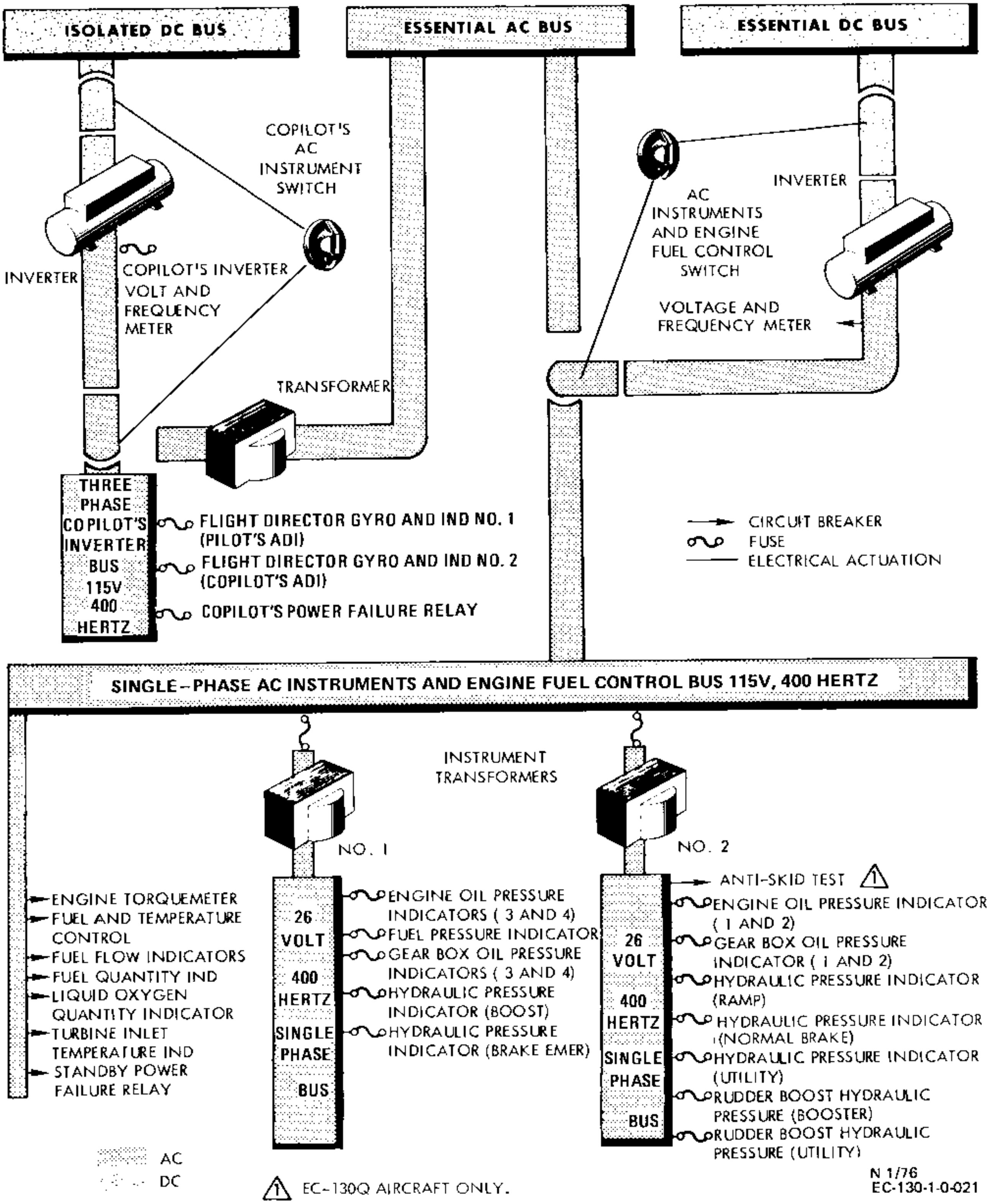

Figure 1-36.

50-kVA ac bus power sources

50-KVA GENERATORS				AC GENERATOR POWER SOURCE			
NO 1	NO 2	NO 3	NO 4	LH AC BUS	ESSENTIAL AC BUS	MAIN AC BUS	RH AC BUS
ON	ON	ON	ON	1	2	3	4
OUT	ON	ON	ON	2	2	3	4
ON	OUT	ON	ON	1	1	3	4
ON	ON	OUT	ON	1	2	4	4
ON	ON	ON	OUT	1	2	3	3
OUT	OUT	ON	ON	4	3	3	4
ON	OUT	OUT	ON	1	1	4	4
ON	ON	OUT	OUT	1	2	2	1
OUT	ON	ON	OUT	2	2	3	3
OUT	ON	OUT	ON	2	2	4	4
ON	OUT	ON	OUT	1	1	3	3
OUT	OUT	OUT	ON		4	4	
OUT	OUT	ON	OUT		3	3	
OUT	ON	OUT	OUT		2	2	
ON	OUT	OUT	OUT		1		
OUT	OUT	OUT	OUT		ATM GEN		

OUT = GENERATOR OUT   ON = GENERATOR ON

EXAMPLE: NO 2 AND NO 3 ENGINE DRIVEN GENERATORS OUT.
LH AC BUS SUPPLIED BY NO 1 GENERATOR.
ESSENTIAL AC BUS SUPPLIED BY NO 1 GENERATOR.
MAIN AC BUS SUPPLIED BY NO 4 GENERATOR.
RH AC BUS SUPPLIED BY NO 4 GENERATOR.

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Figure 1-37. (Sheet 1 of 2)

90-kVA ac bus power sources

90-KVA GENERATORS				AC GENERATOR POWER SOURCE				
				ESS LV PWR ANT AND P/A	POWER AMPLIFIER			COMM CENT
NO 1	NO 2	NO 3	NO 4		HV POWER SUPPLY A	HV POWER SUPPLY B	HV POWER SUPPLY C	*RH BUSS
ON	ON	ON	ON	1	2	3	4	1
OUT	ON	ON	ON	2		3	4	2
ON	OUT	ON	ON	1		3	4	1
ON	ON	OUT	ON	1	2	4		1
ON	ON	ON	OUT	1	2	3		1
OUT	OUT	ON	ON			3	4	3
ON	OUT	OUT	ON	1		4		1
ON	ON	OUT	OUT	1	2			1
OUT	ON	ON	OUT	2		3		2
OUT	ON	OUT	ON	2		4		2
ON	OUT	ON	OUT	1		3		1
OUT	OUT	OUT	ON			4		4
OUT	OUT	ON	OUT			3		3
OUT	ON	OUT	OUT	2				2
ON	OUT	OUT	OUT	1				1

OUT = GENERATOR OUT

ON = GENERATOR ON

EXAMPLE: NO 2 AND NO 3 ENGINE DRIVEN GENERATORS OUT.
ESSENTIAL LOW VOLTAGE POWER TO THE ANTENNAS AND P/A SUPPLIED BY NO 1 GENERATOR.
P/A HIGH VOLTAGE POWER SUPPLY A OFF.
P/A HIGH VOLTAGE POWER SUPPLY B SUPPLIED BY NO 4 GENERATOR.
P/A HIGH VOLTAGE POWER SUPPLY C OFF.

*50-KVA CIRCUIT

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Figure 1-37. (Sheet 2 of 2)

(EC-130Q aircraft)

LH AC BUS

PILOT'S UPPER CIRCUIT BREAKER PANEL

- FUEL PUMP, BOOST TANK NO. 1 (3 PHASE)
- LH EXT TANK PUMP (FWD) (3 PHASE)
- LH AC BUS OUT IND RELAY (3 PHASE)
- SPINNER ANTI-ICING (4 ENG) (PHASE A)
- LAVATORY

UPPER MAIN AC PANEL

- BLADE DE-ICING (4 ENG) (PHASE C)
- SPINNER DE-ICING (4 ENG) (PHASE B)

MAIN AC BUS

COPILOT'S UPPER CIRCUIT BREAKER PANEL

- AUX TANK PUMPS LH, RH (3 PHASE)
- COMM CENTRAL LIGHTS
- DUMP PUMPS (4 TANKS, 3 PHASE)
- EXT TANK PUMP, LH AFT (3 PHASE)
- EXT TANK PUMP, RH AFT (3 PHASE)
- FUEL PUMP, BOOST TANK NO. 3 (3 PHASE)
- HIGH RANGE ALTIMETER
- MAIN AC BUS OFF IND RELAY (3 PHASE)
- MAIN DC BUS, 2 TRANS-RECT (3 PHASE)
- RADAR
- UHF DF △2
- UHF RADIO NO. 2 (3 PHASE)
- VHF COMM NO. 1 △2
- WINDSHIELD ANTI-ICING (3 PHASE)

RH AC BUS

PILOT'S UPPER CIRCUIT BREAKER PANEL

- CARGO COMPT FAN (3 PHASE)
- FUEL PUMP, BOOST, TANK NO. 4 (3 PHASE)
- RH AC BUS OUT IND RELAY (3 PHASE)
- RH EXT TANK PUMP (FWD) (3 PHASE)
- GALLEY POWER

LOWER MAIN AC PANEL

- (fuse) POWER (3 PHASE) F.S. 273

ESSENTIAL AC BUS

COPILOT'S UPPER CIRCUIT BREAKER PANEL

- ALTIMETER ENCODER
- DOPPLER COMPUTER
- DOPPLER RADAR
- ELECTRONIC TEST RECEPTACLE
- EMERGENCY TRANSMITTER HEATER
- FLIGHT DIRECTOR COMPUTERS
- GLIDEPATH
- IFF
- INERTIAL NAV SYSTEM
- LORAN
- LOW RANGE ALTIMETER
- OMEGA
- TACAN NO. 1
- TACAN NO. 2
- TRUE AIRSPEED △2
- VHF RADIO
- VHF NAV NO. 1
- VHF NAV NO. 2
- COMM CENTRAL LIGHTS

PILOT'S SIDE CIRCUIT BREAKER PANEL

- AC INST AND ENGINE FUEL CONT POWER
- COPILOT'S AC INST STANDBY PWR (3 PHASE)
- ESSENTIAL AC BUS OFF IND RELAY (3 PHASE)
- ESSENTIAL AC BUS POWER (3 PHASE)
- ESSENTIAL DC BUS, 2 TRANS-RECT (3 PHASE)
- FEATHER PUMP MOTOR (4 ENG, 3 PHASE)
- FUEL PUMP, BOOST TANK 2 (3 PHASE)
- HYD PUMP, AUX SYSTEM (3 PHASE)
- HYD SUCTION PUMP, UTILITY AND BOOSTER (3 PHASE)
- MISSILE SUPPORT POWER (3 PHASE)
- PROPELLER SYNCHROPHASER (3 PHASE)
- RADIO ESSENTIAL AC
- TRIM TAB, RUD, AIL, AND ELEV

PILOT'S UPPER CIRCUIT BREAKER PANEL

- ATTITUDE HEADING REFERENCE SYSTEM △1
- AUTOPILOT
- C-12 COMPASS △1
- C-12 COMPASS NO. 1 AND NO. 2 △2
- HF RADIO NO. 1 (3 PHASE)
- HF RADIO NO. 2 (3 PHASE)
- UHF RADIO NO. 1 (3 PHASE)

PILOT'S LOWER CIRCUIT BREAKER PANEL

- (fuse) HORIZONTAL SITUATION INDICATORS
- (fuse) VHF COMM NO. 2 △2

UPPER MAIN AC PANEL

- (fuse) PRIMARY INSTRUMENT LIGHTS

(arrow) CIRCUIT BREAKER

(fuse) FUSE OR CURRENT LIMITER

Note

△1 BUNO 156170 THROUGH 156177

△2 BUNO 159348 AND 159469

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Figure 1-38. (Sheet 1 of 2)

ac power distribution (EC-130G aircraft)

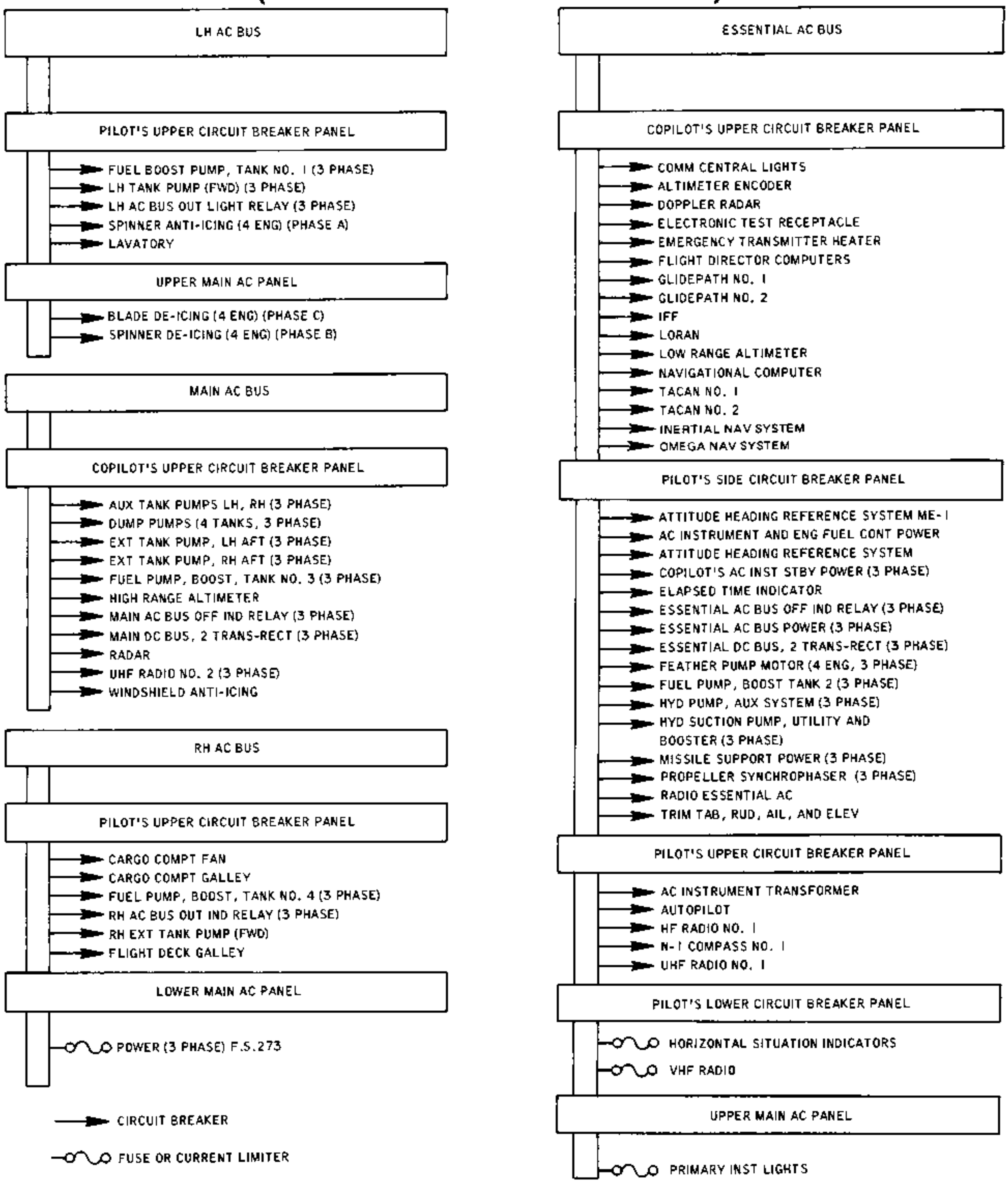

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Figure 1-38. (Sheet 2 of 2)

GENERATOR PHASE SELECTOR SWITCH (90-KVA). A three-position phase selector switch, located on the 90-kva generator control panel (figure 1-35, sheet 2), selects voltage and frequency on one of the three phases of the ac generator output to be measured by the phase meter and ac voltmeter. (The ac generator output is selected by the 90-kva generator voltage and frequency selector switch.) Placing the phase selector switch in a given position determines which phase is measured.

Primary AC System Indicators.

Primary ac system indicators are mounted on the 50-kva and 90-kva generator control panels. They consist of five generator-out indicator lights, five ac loadmeters, four bus off indicators, an ac voltmeter and a frequency meter for test-measuring the sources of ac power, and an ac external power on indicator light.

GENERATOR-OUT INDICATOR LIGHTS. Operation of each 50- and 90-kva generator is monitored by a generator OUT indicator light mounted on the 50- and 90-kva generator control panels (figure 1-35, sheets 1 and 2). A generator out indicator illuminates when the associated generator control switch is in the ON position and one or more of the following conditions exist: engine rpm too low, differential fault in one or more phases, output frequency not within established limits, or an under or over voltage in one or more phases. Illumination of a generator OUT light indicates that the associated generator is removed from service. If the condition is temporary, the generator can be reset by setting the generator control switch to OFF RESET and back to ON.

AC LOADMETERS. Five ac loadmeters are located on the 50-kva generator control panel (figure 1-35, sheet 1). Each ac loadmeter provides a continuous indication of the percent of rated current flow from the respective generator.

BUS OFF INDICATORS. Four warning lights, one for each bus, are located on the overhead electrical control panel and will illuminate any time the average voltage of the 3 phases drops below 90 volts. If the generator voltage drops below 90 volts for 7-9 seconds, the generator will field trip and transfer the bus. Illumination of the bus off light for more than 7-9 seconds indicates failure of the generator transfer relay. The lights receive 28 vdc power from the isolated dc bus through the ac bus off circuit breaker on the pilot's side circuit breaker panel.

AC VOLTMETERS. AC voltmeters are mounted on the 50- and 90-kva generator control panels. The 50-kva generator control panel ac voltmeter measures the output voltage of the generator or inverter selected by the 50-kva generator voltage and frequency selector switch. The 90-kva generator control panel ac voltmeter measures the output voltage of the generator selected by the 90-kva generator voltage and frequency selector switch. Each of the three phases of the applicable generator output power can be measured by selecting the appropriate position of the applicable phase selector switch.

FREQUENCY METERS. Frequency meters are mounted on the 50- and 90-kva generator control panels. Each frequency meter permits measuring of the output power frequency from the generator selected by the applicable 50- or 90-kva voltage and frequency selector switch. Each of the 50- or 90-kva generator output phases can be measured by positioning of the applicable 50- or 90-kva generator phase selector switches.

AC EXTERNAL POWER ON INDICATOR LIGHT. An ac external power on (EXT AC PWR) indicator light is mounted next to the ac external power switch on the overhead electrical control panel (figure 1-35). The light is energized by dc power through small pins in the ac external power receptacle and through the closed contacts of a phase sequence relay on the lower main ac distribution panel when the relay is energized. The phase sequence relay is energized when three-phase external ac power with correct phase sequence and no open phases is connected to the aircraft. Test power is supplied to the power on indicator light by pressing against the lens.

GENERATOR BEARING FAILURE LIGHTS, 50-KVA (EC-130G AIRCRAFT). Four generator bearing failure lights numbered 1, 2, 3, and 4 are located on the overhead control panel (figure 1-35). When a generator bearing fails and causes the rotor to contact the stator, a mechanical failure indicator relay is energized which routes electrical power from the 28-volt essential dc bus through a generator mech disconnect circuit breaker on the copilot's lower circuit breaker panel to the failure lights.

GENERATOR BEARING FAILURE LIGHTS, 50-KVA (EC-130Q AIRCRAFT). Four generator bearing failure lights are located on the overhead electrical control panel (figure 1-35) immediately above the respective generator disconnect switch. These lights are labeled FAILED BRG. When a generator bearing fails and causes the rotor to contact the stator, a mechanical failure indicator relay is energized which routes electrical power from the 28-volt essential dc bus through a gen bearing failure ind circuit breaker located on the copilot's side circuit breaker panel to the failure lights.

GENERATOR BEARING FAILURE LIGHTS (90-KVA). Four generator bearing failure lights are located on the 90-kva generator control panel (figure 1-35, sheet 2) immediately above the respective generator disconnect switch. These lights are labeled FAILED BRG. When a generator bearing fails and causes the rotor to contact the stator, a mechanical failure indicator relay is energized. This routes electrical power from the 28-volt essential dc bus through a generator bearing failure indicator circuit breaker located on the copilot's side circuit breaker panel to the failure light.

SECONDARY AC SYSTEM.

The secondary ac power is comprised of two systems, the copilot's ac instrument system and the ac instrument and engine fuel control system (figure 1-36). Circuit breakers and fuses for distribution of the system are located on the pilot's lower circuit breaker panel.

Copilot's AC Instrument Power System.

A single 250-volt-ampere inverter supplies 115-volt, 400-Hz, three-phase power. The inverter draws dc power from the isolated bus; therefore, it can be operated from the battery during emergency flight conditions of flight. Power can also be supplied from the essential ac bus, through a power transformer, which converts three-phase, 115/200 volt—400-Hz power to three-phase, 115-volt, 400-Hz power to operate the pilot's and copilot's ac instruments.

AC Instruments and Engine Fuel Control System.

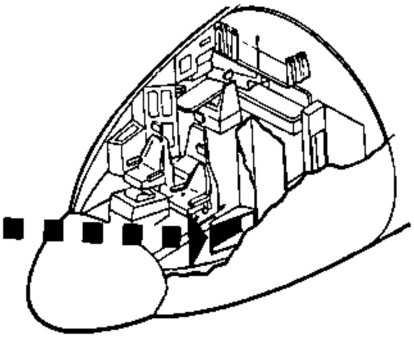
The ac instruments and engine fuel control system is powered by a 115-volt, 400-Hz, single-phase, ac bus. Either a 1500-volt ampere or a 2500-volt ampere single-phase inverter can be used as the source of power for the EC-130G/Q aircraft. The inverter power is controlled through the ac inst & eng fuel cont inverter circuit breaker on the copilot's lower circuit breaker panel from the essential dc bus. Power can also be supplied from phase A of the essential ac bus through the ac inst & eng fuel cont pwr circuit breaker on the pilot's side circuit breaker panel. Two instrument transformers are powered from the 115-volt, 400-Hz, single-phase bus, and provide 26-volt, single-phase, ac power for instrument use.

Secondary AC System Controls.

Controls for the secondary ac power system are located on the overhead electrical control panel in the flight station. The controls consist of four rotary-type switches, two of which act as inverter controls and power source selectors, with the remaining two serving to permit measuring the frequency and voltage of the output power of the inverters.

COPILOT'S AC INSTRUMENT SWITCH. The copilot's ac instrument switch is a three-position (ISOLATED DC BUS, OFF, ESSENTIAL AC BUS) rotary switch. In the ISOLATED DC BUS position power is routed from the isolated dc bus to operate the copilot's instrument inverter for the copilot's instrument power supply system. In the ESSENTIAL AC BUS position the inverter is turned off, and power for the copilot's instrument power system is taken from the essential ac bus through a transformer.

pilot's side circuit breaker panel (EC-130G aircraft)



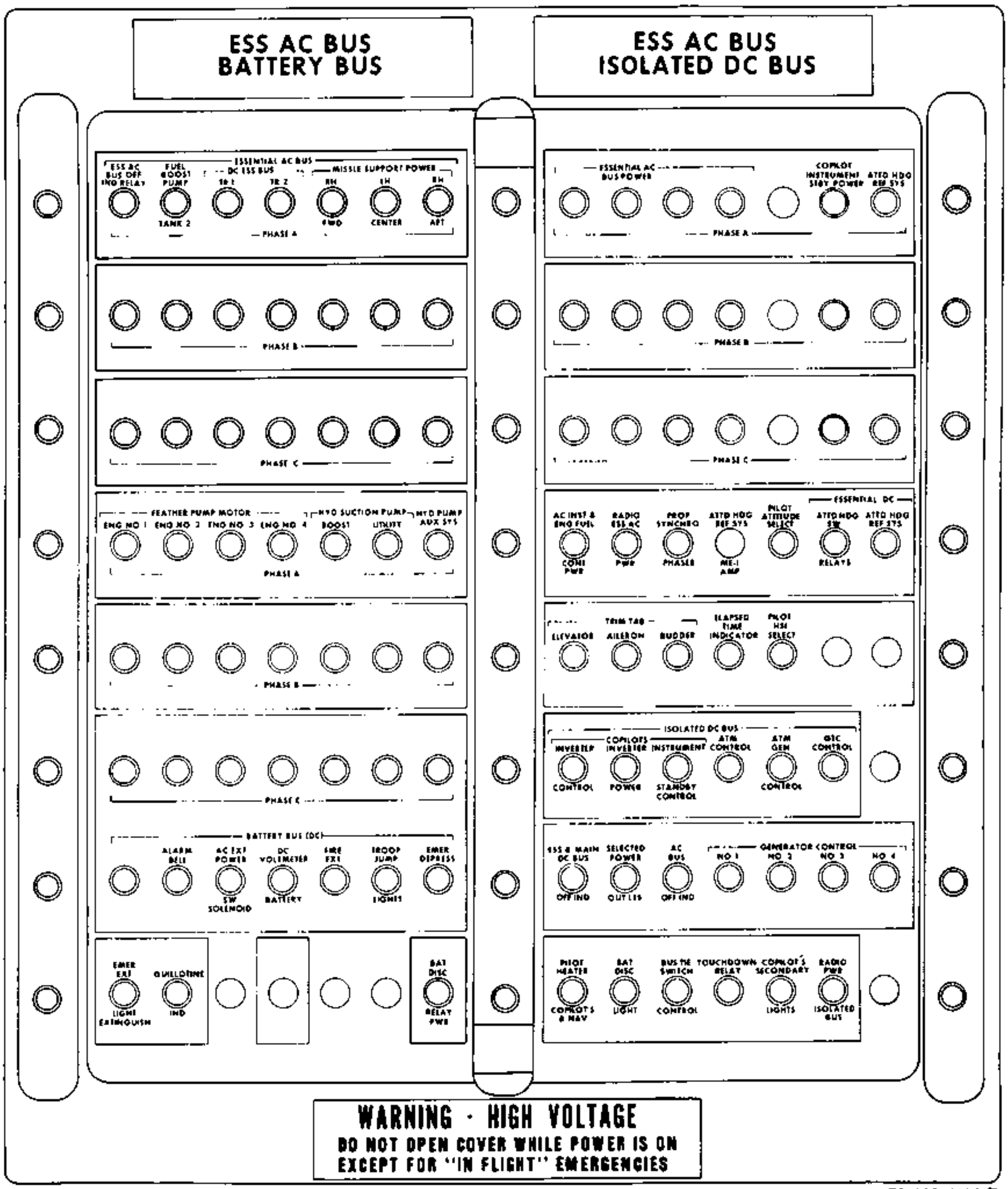


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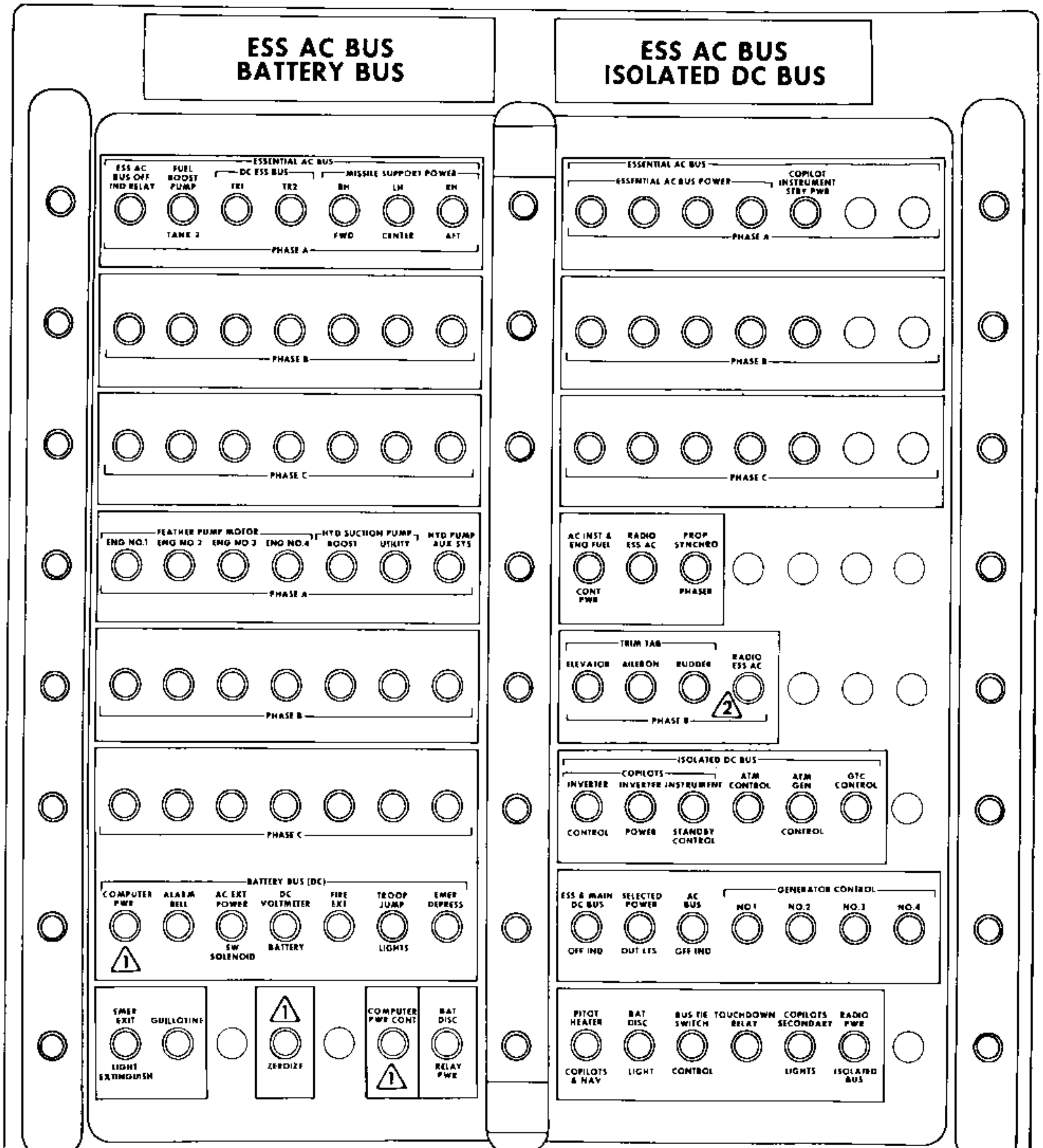
Figure 1-39. (Sheet 1 of 2)

(EC-130Q aircraft)



NOTE

1 BUNO 156170 THROUGH 156177.

WARNING - HIGH VOLTAGE
DO NOT OPEN COVER WHILE POWER IS ON EXCEPT FOR "IN FLIGHT" EMERGENCIES

2 BUNO 159348 AND 159469.

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Figure 1-39. (Sheet 2 of 2)

AC INSTRUMENT AND ENGINE FUEL CONTROL SWITCH. The ac inst & engine fuel control switch is a three-position (ESSENTIAL AC BUS, OFF, ESSENTIAL DC BUS) rotary switch. In the ESSENTIAL AC BUS position power is supplied to the 115-volt, 400-Hz, single-phase bus from phase A of the essential ac bus. In the ESSENTIAL DC BUS position power is supplied to the ac instruments and engine fuel control inverter which will then power the system. If the inverter voltage is insufficient, the power supply is automatically switched from the essential dc bus to the essential ac bus. This occurs when the inverter voltage supplied to the system drops to 25 (±20) volts.

VOLTAGE AND FREQUENCY SELECTOR SWITCH. A voltage and frequency selector switch, located on the overhead control panel (figure 1-35), has seven positions for measuring the output voltage and frequency of the ac power supply sources. Placing the switch in the COPLT INVϕA &ϕB AC INST & ENG FUEL CONT INVϕC position, while simultaneously placing the phase selector switch in either the PHASE A or PHASE B position, provides an indication of the frequency and voltage of the copilot's inverter on the frequency meter and the ac voltmeter respectively. Positioning the phase selector switch to PHASE C, provides an indication of the output frequency and voltage of the ac instrument and engine fuel control inverter. If the switch is at the inverter position and a bus source of power is being used in place of the inverter, the frequency meter and the ac voltmeter will not indicate.

PHASE SELECTOR SWITCH. A three-position phase selector switch, located on the overhead electrical control panel (figure 1-35), permits selection of the appropriate phase of electrical power when measuring the output voltage and frequency of either of the inverters.

Secondary AC System Indicators.

Indicators for the secondary ac power system are an ac voltmeter, a frequency meter and selected power out lights located on the overhead electrical control panel in the flight station.

AC VOLTMETER. An ac voltmeter, mounted on the overhead electrical control panel (figure 1-35), permits measuring the output voltage of that phase of inverter power selected with the phase selector switch. In order for the voltmeter to measure inverter output voltage, the voltage and frequency selector switch must be in the COPLT INV ϕA &ϕB AC INST & FUEL CONT INVϕC position. If the switch is at this position and a bus source of power is being used in place of the inverter, the voltmeter will not indicate.

FREQUENCY METER. A frequency meter mounted on the overhead electrical control panel (figure 1-35) permits measuring the frequency of the output power of that phase of inverter output selected with the phase selector switch. In order for the frequency meter to measure the frequency of the inverter output power, the voltage and frequency selector switch must be in the COPLT INVϕA &ϕB AC INST & FUEL CONT INVϕC position. If the switch is at this position and a bus source of power is being used in place of the inverter, the frequency meter will not indicate.

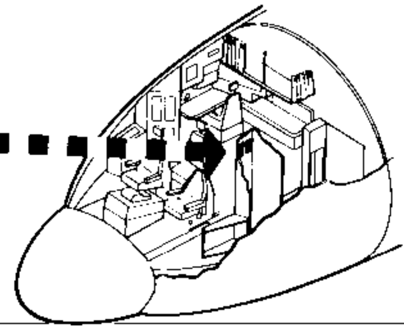
SELECTED POWER OUT LIGHTS. Two selected power out lights (figure 1-35) are located on the electrical control panel. If the copilot's instrument selected power out light comes on, it indicates that no power is being supplied to the copilot's instruments. When the ac inst & engine fuel control switch is in the ESSENTIAL DC BUS position and its sel pwr out light glows, an inverter has failed: however, the 115-volt ac instrument and eingine fuel control bus is then automatically connected to the standby power source (the essential ac bus). A light does not glow when the corresponding selector switch is at OFF.

HYDRAULIC POWER SUPPLY SYSTEMS.

A booster hydraulic system, a utility hydraulic system, and an auxiliary hydraulic system comprise power supply sources for all hydraulic components operation on the aircraft. The booster system furnishes hydraulic power to a portion of the surface control boost system only. The utility system normally operates the landing gear, wing flaps, brakes, nose wheel steering, and a portion of the surface control boost system. The auxiliary system normally operates the ramp system and provides emergency pressure for brake operation. The auxiliary system also provides pressure for emergency extension of the nose landing gear and ground test of the utility system and components. Hydraulic power for the short trailing wire antenna is provided by the auxiliary hydraulic system.

NEW

pilot's upper circuit breaker panel (EC-130G aircraft)



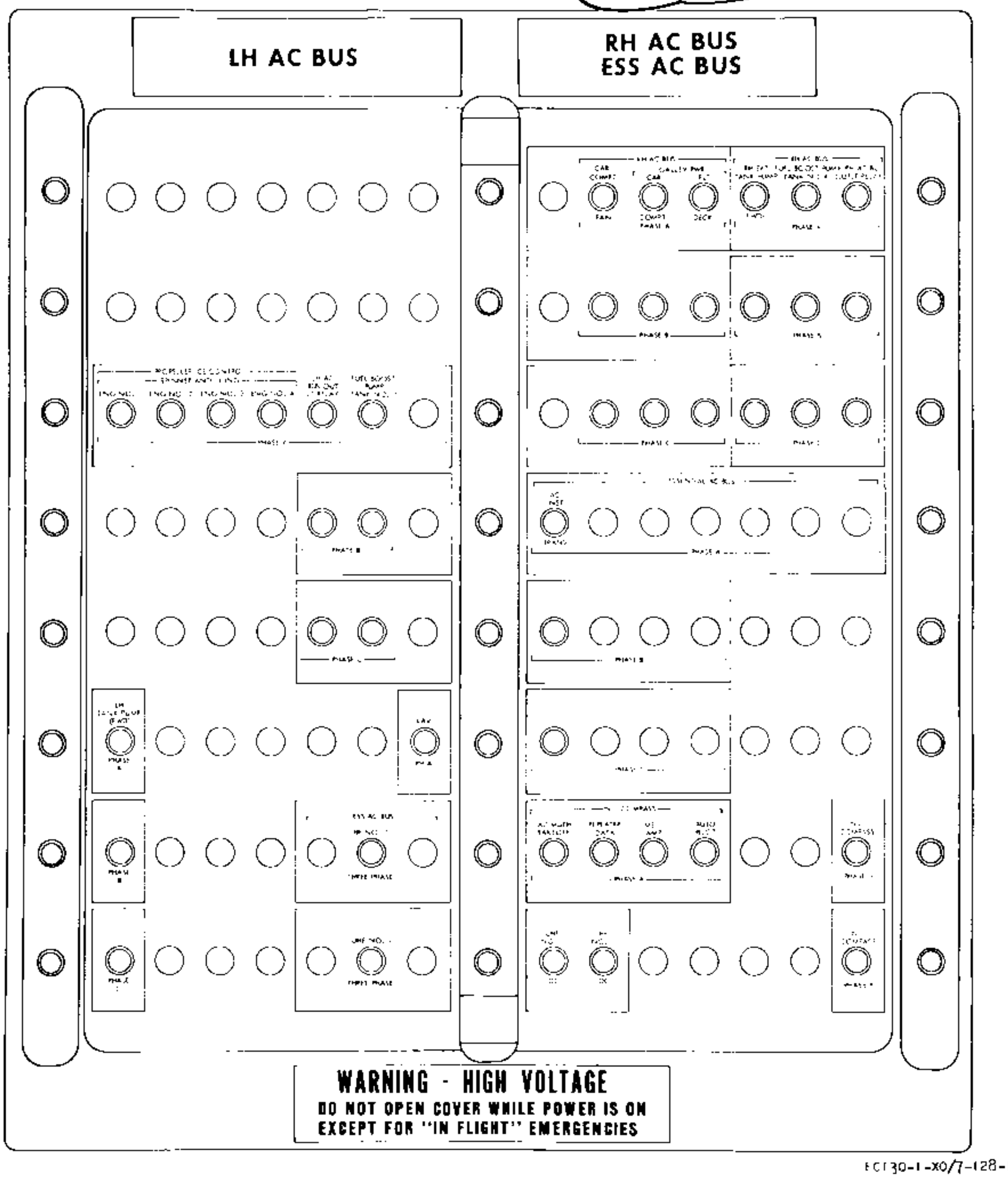
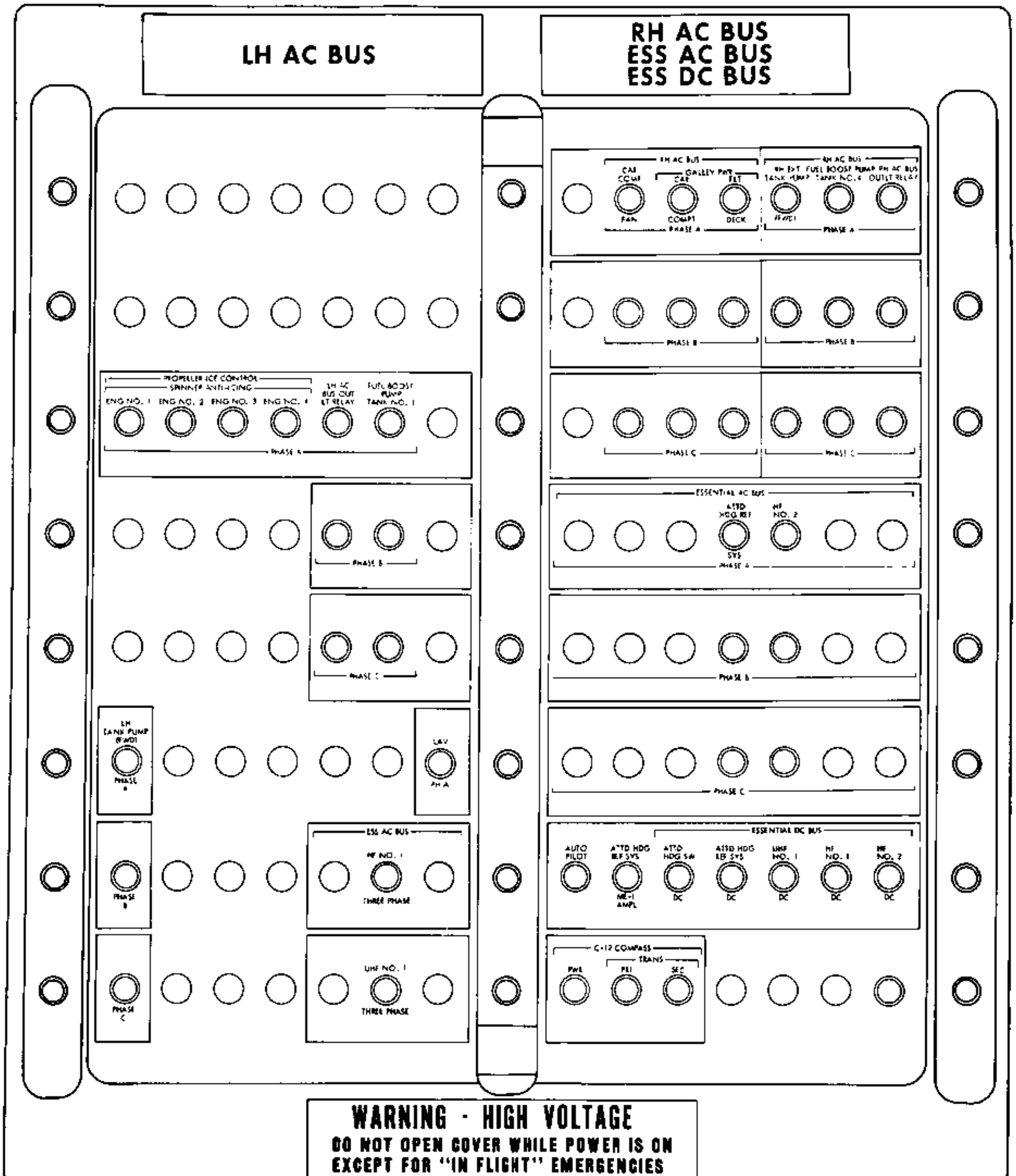


Figure 1-40. (Sheet 1 of 3)

(EC-130Q BuNo 156170 through 156177)



EC130-1-X0/7-128-2
N 1/76

Figure 1-40. (Sheet 2 of 3)

(EC-130Q aircraft) BUNO 159348 and 159469

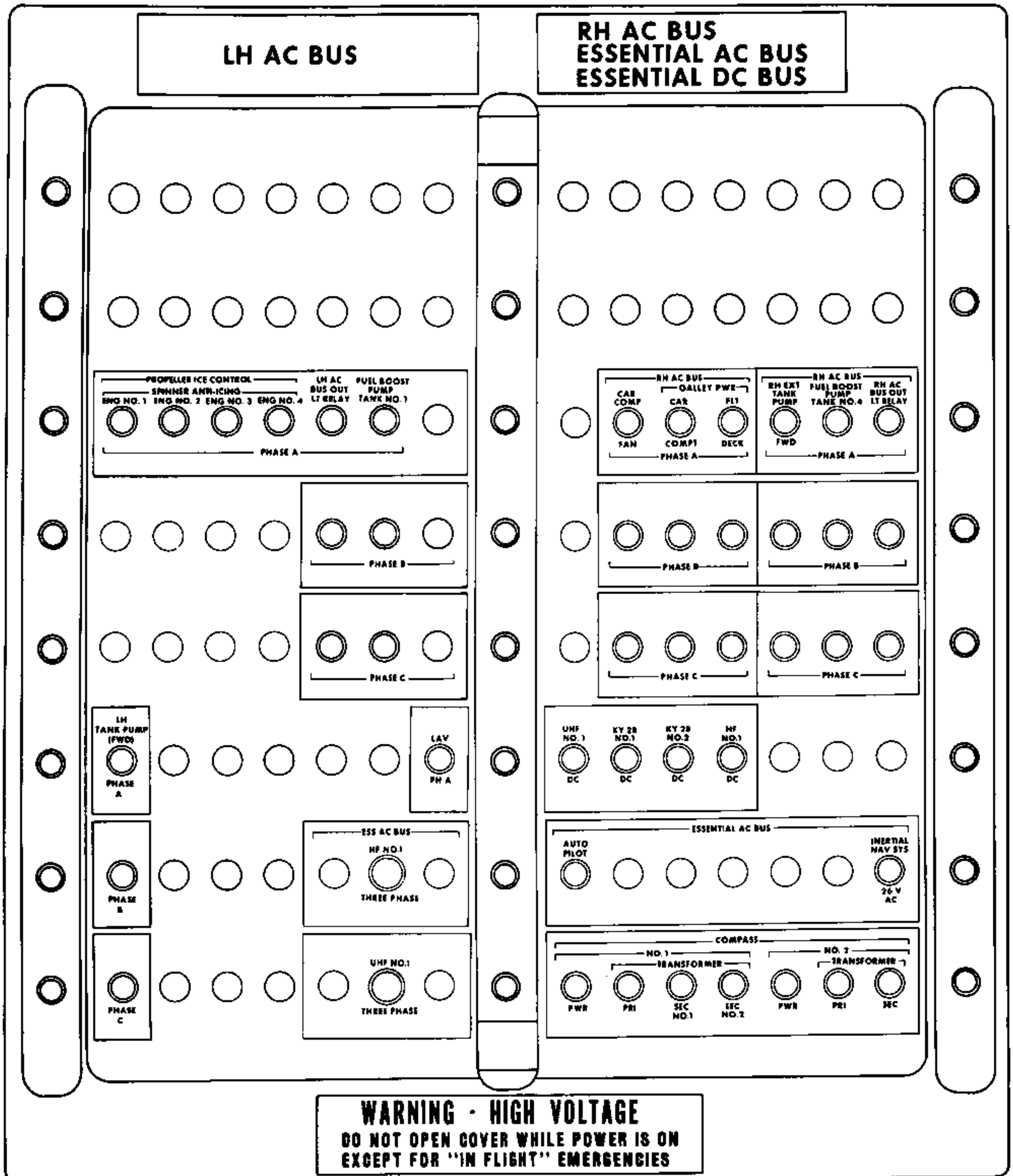


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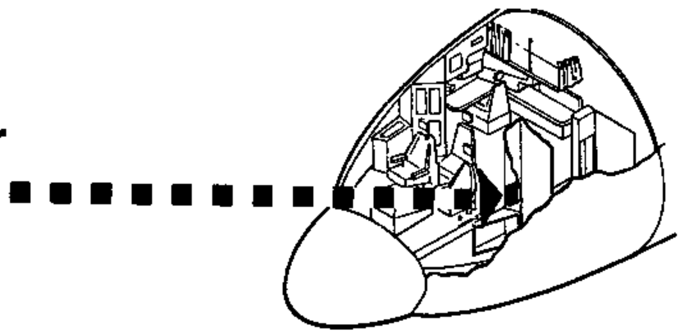
Figure 1-40. (Sheet 3 of 3)

pilot's lower circuit breaker panel (EC-130G aircraft)



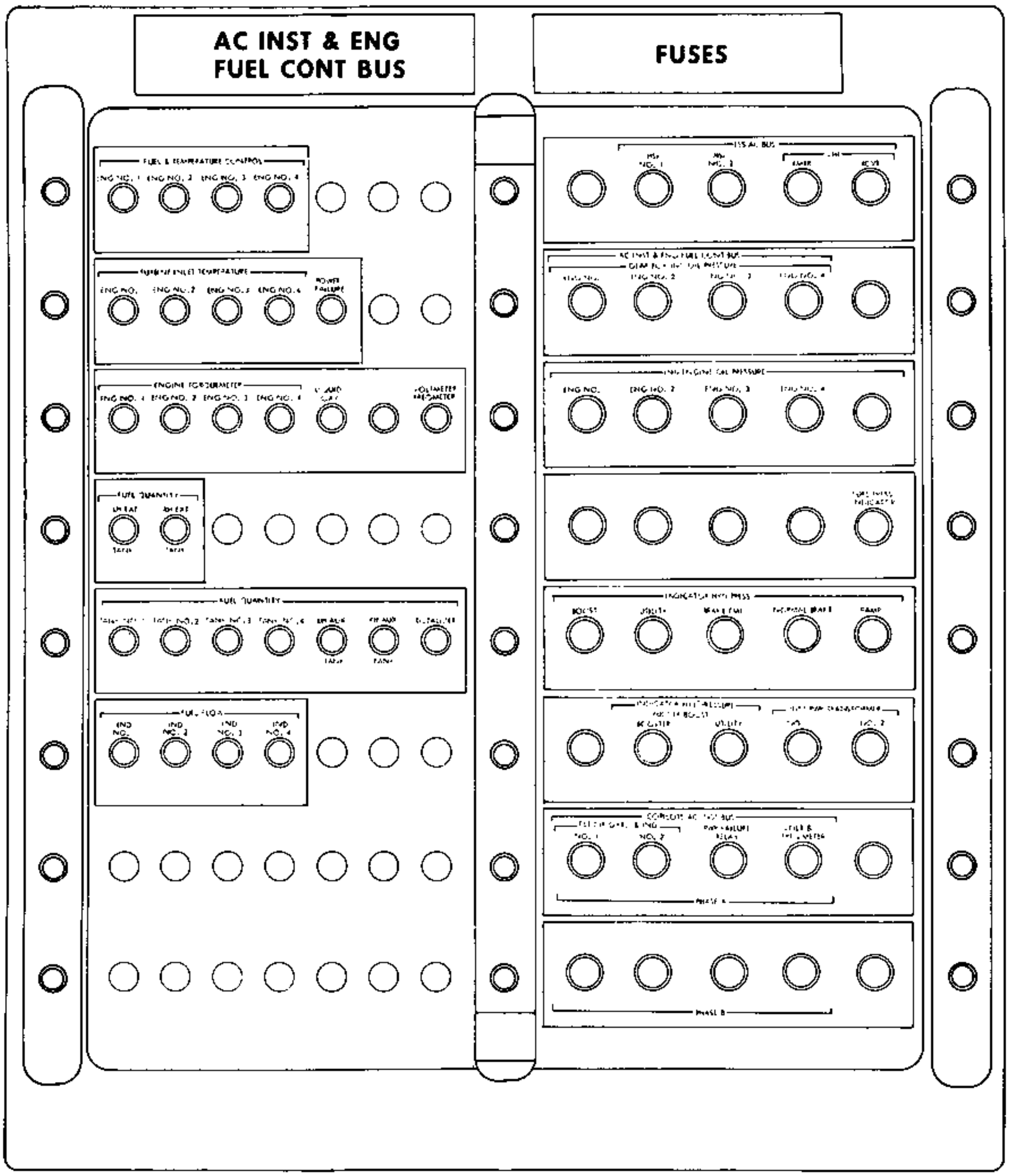


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Figure 1-41. (Sheet 1 of 2)

(EC-130Q aircraft)

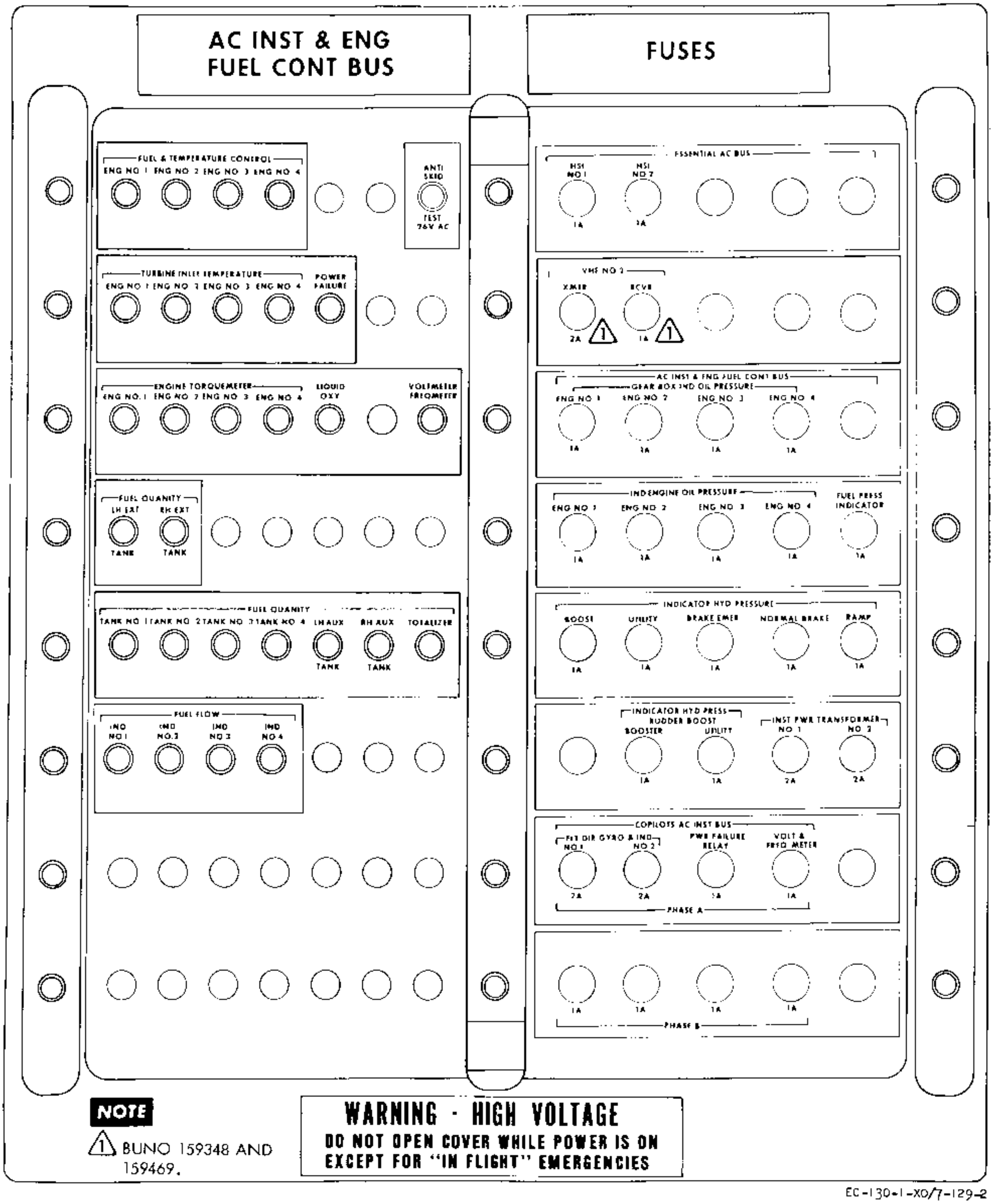
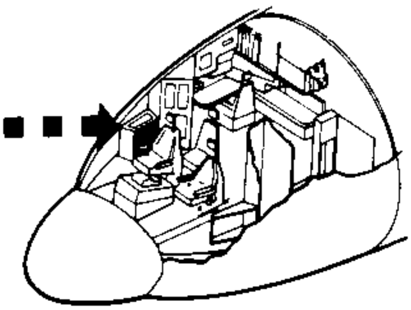
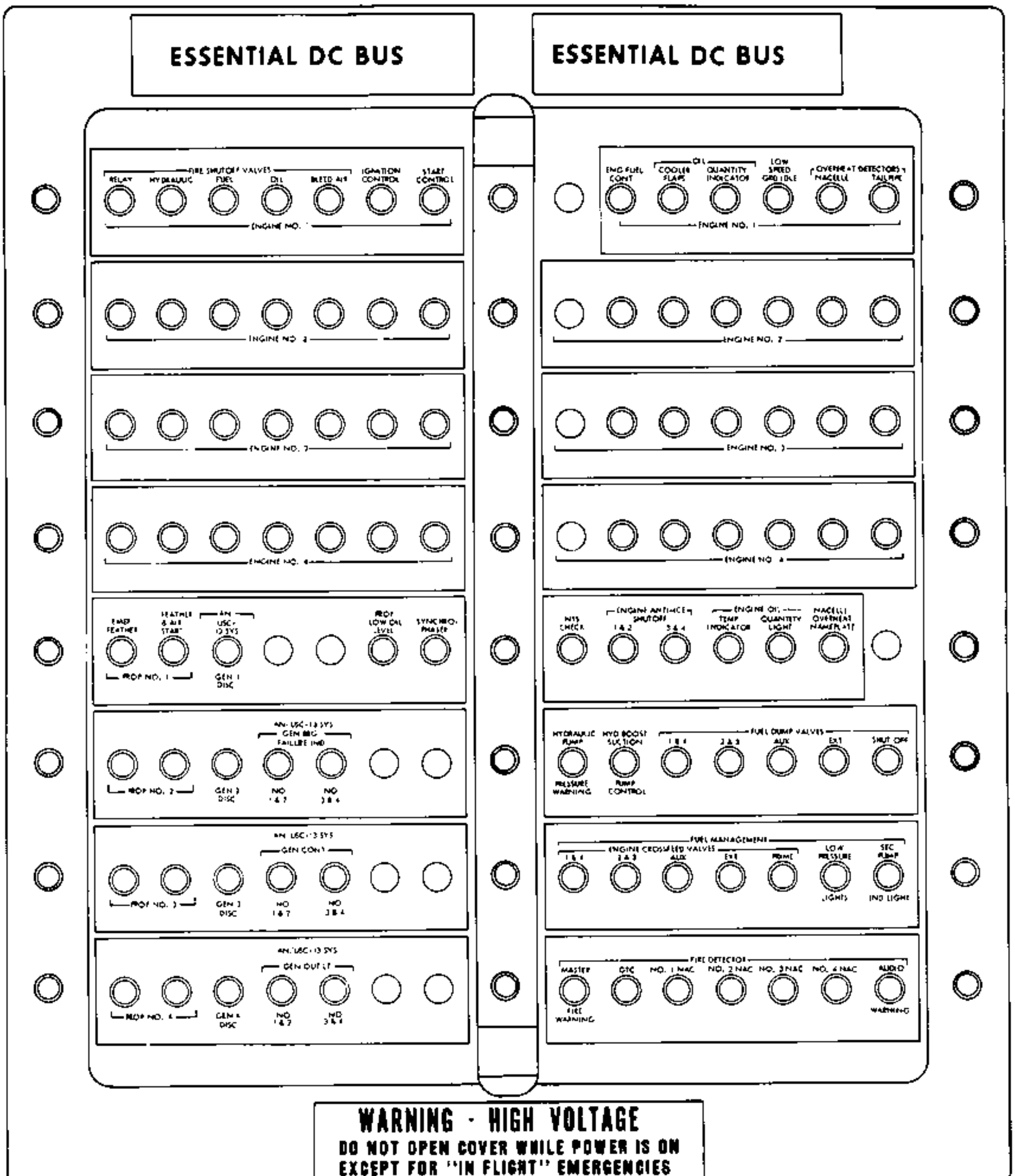


Figure 1-41. (Sheet 2 of 2)

copilot's side circuit breaker panel (EC-130G aircraft)





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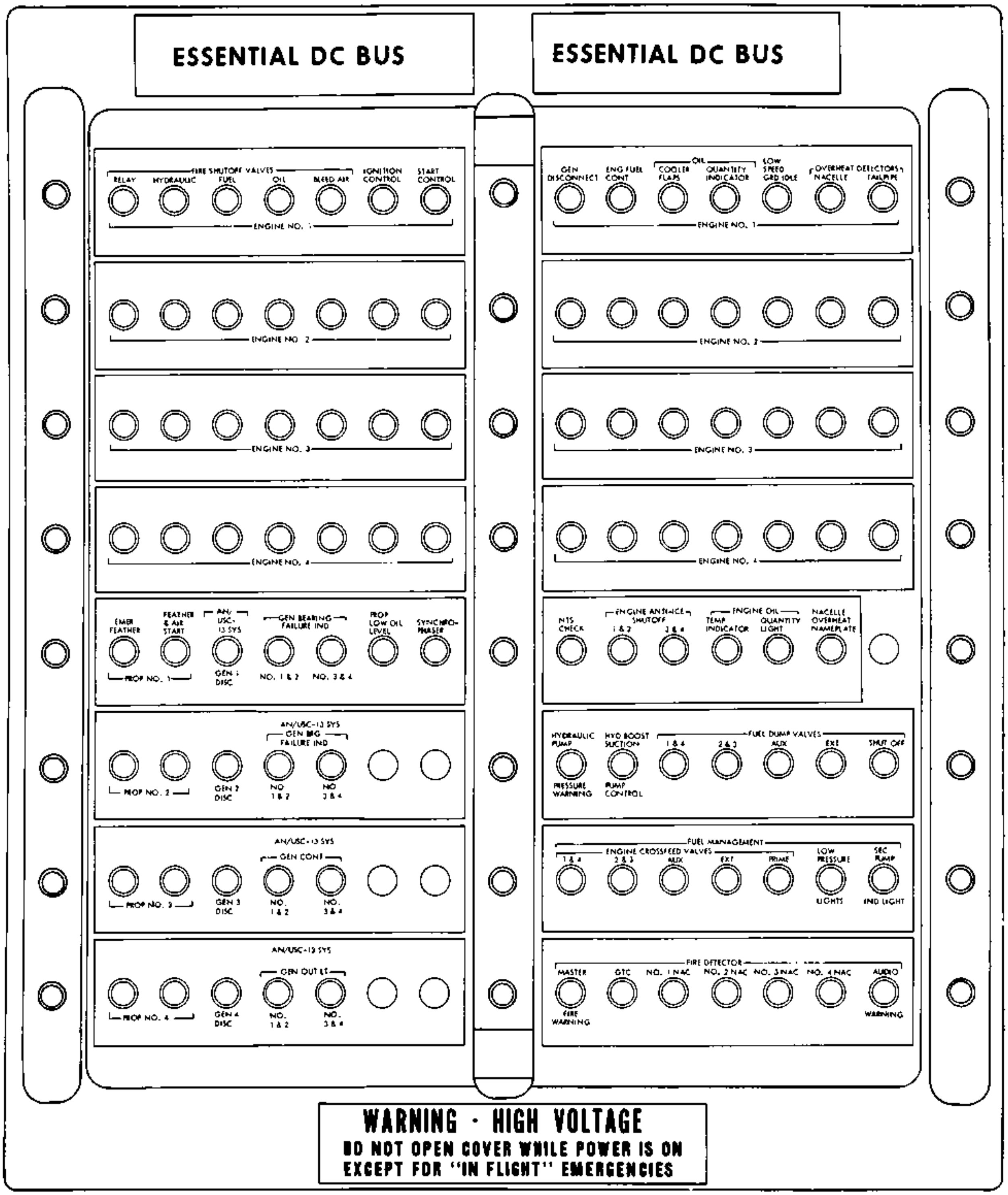
N 1/76

Figure 1-42. (Sheet 1 of 2)

(EC-130Q aircraft)



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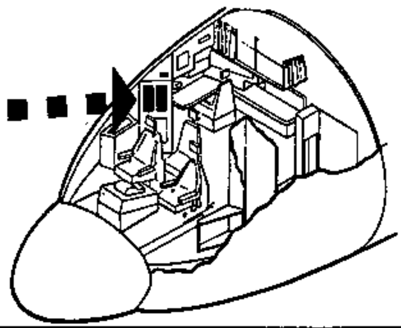
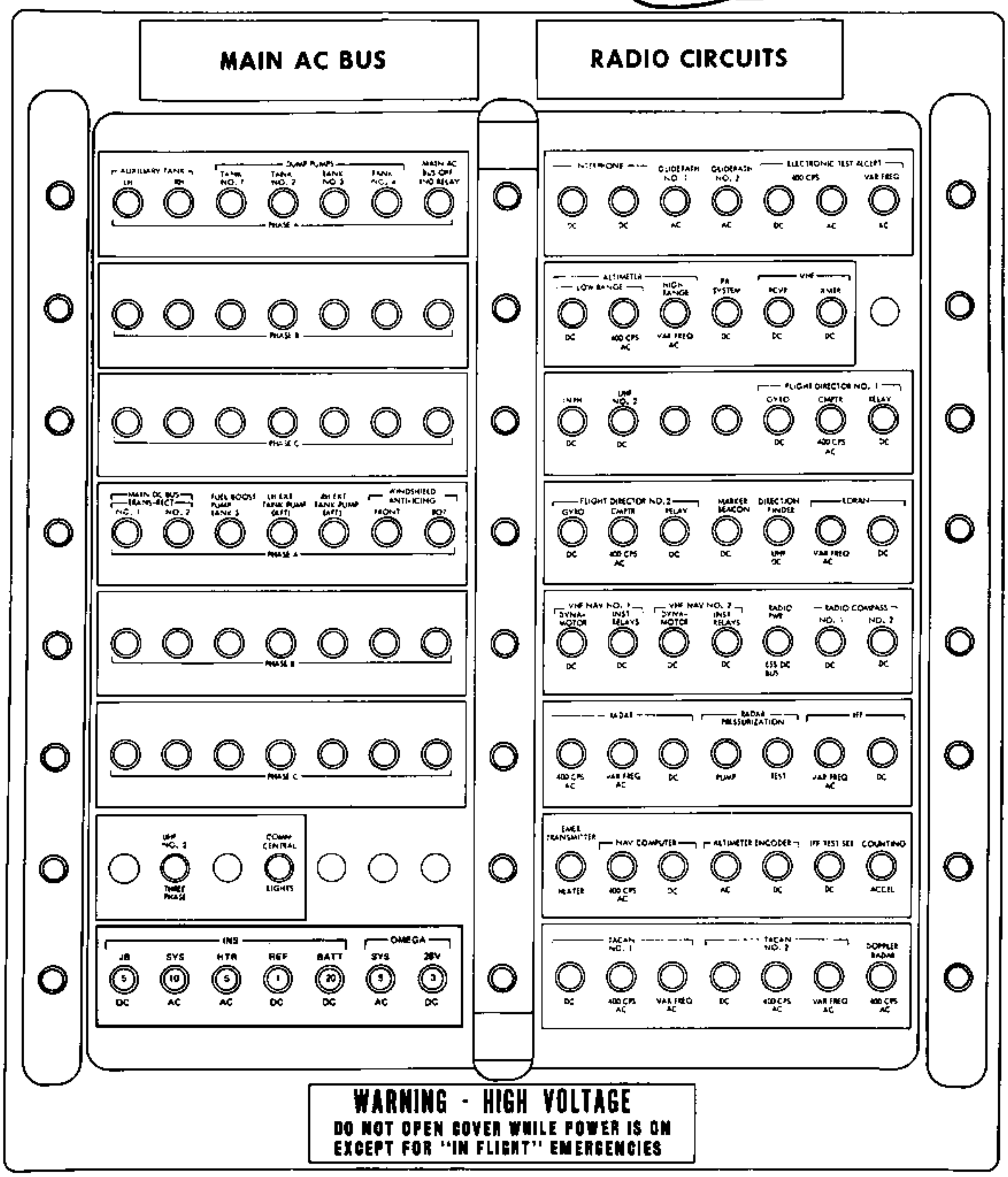
EC130-1-X0/7-130-2

Figure 1-41. (Sheet 2 of 2)

copilot's upper circuit breaker panel (EC-130G aircraft)





EC-130G, EC-130Q BUNO 156170 THROUGH 156177

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Figure 1-43. (Sheet 1 of 3)

(EC-130Q buno156170 through 156177)

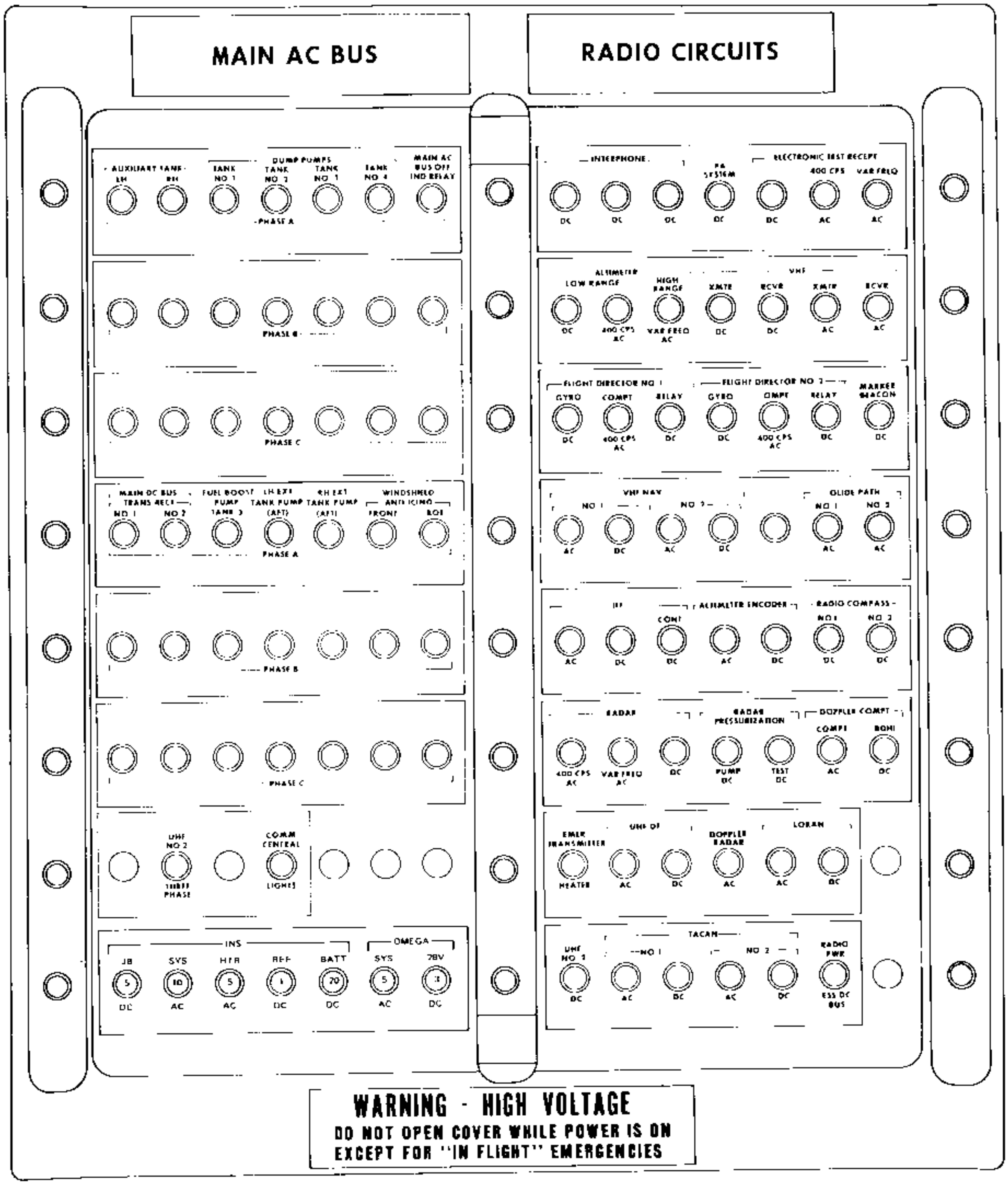

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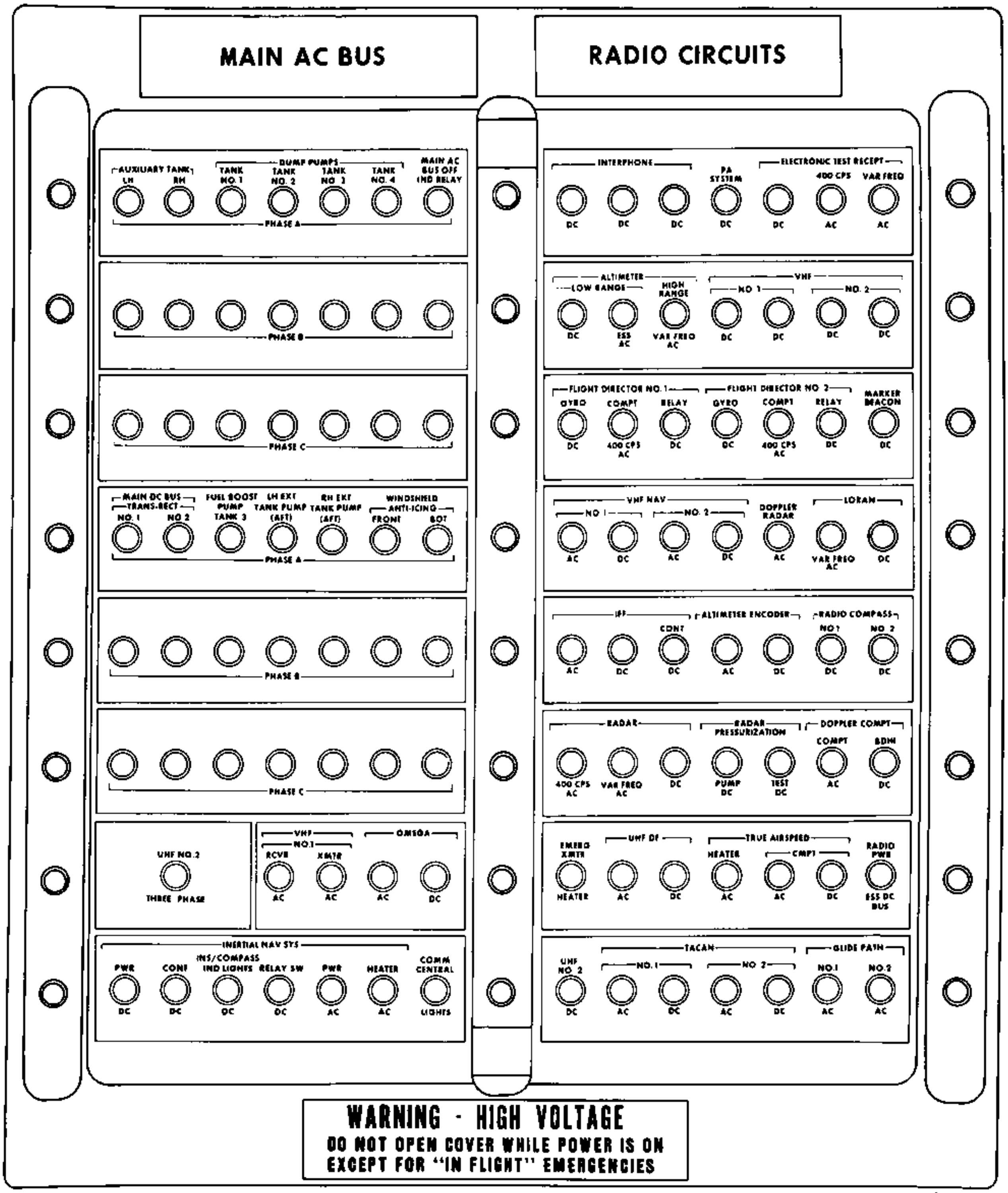
Figure 1-43. (Sheet 2 of 3)

(EC-130Q aircraft) BUNO 159348 and 159469



EC-130-1-X0/7-131-3
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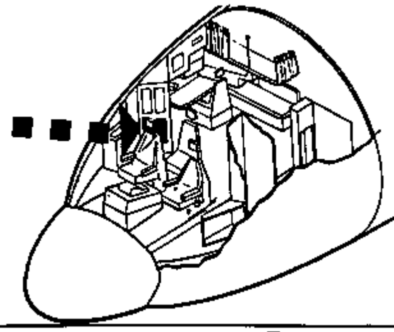
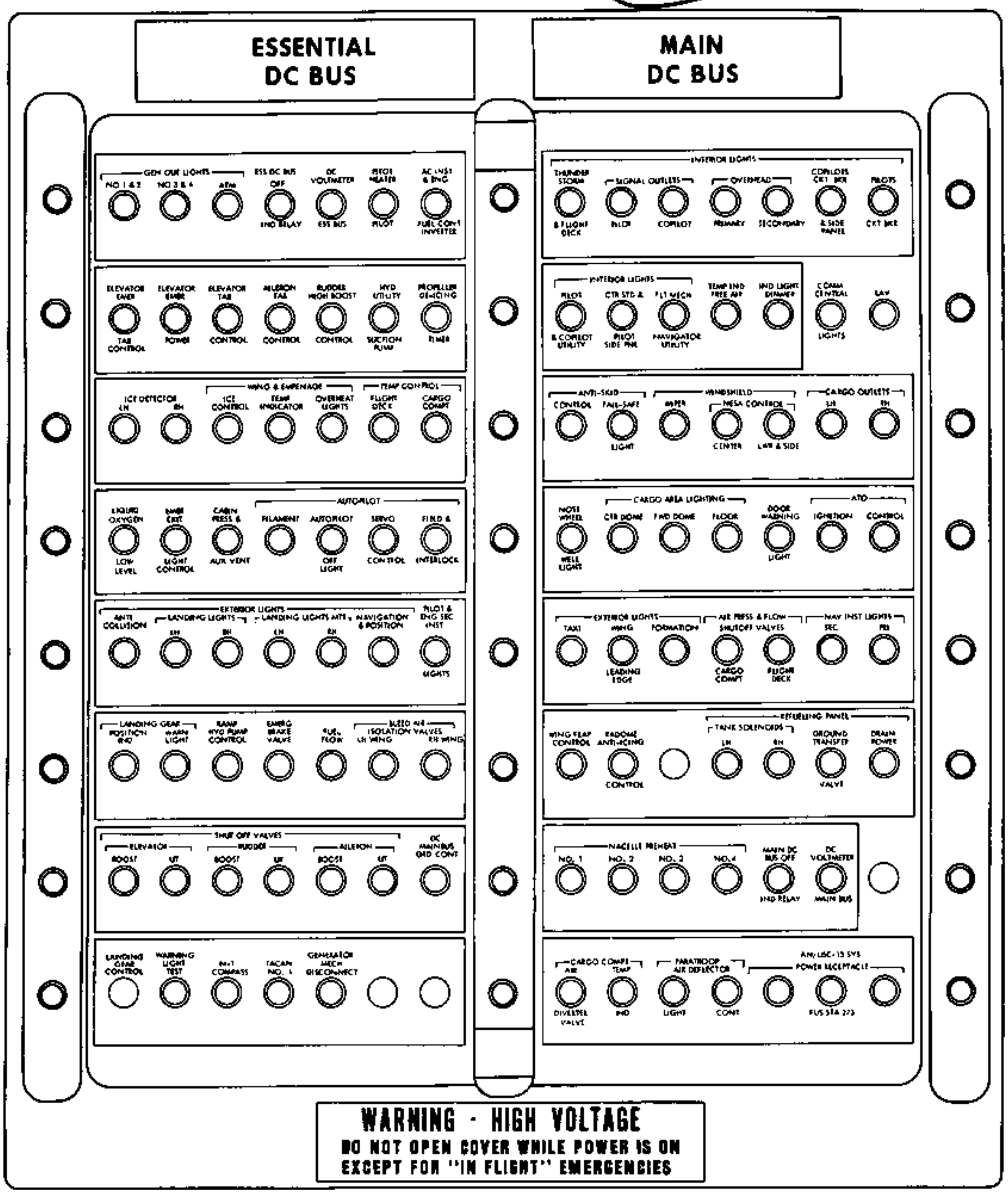
Figure 1-43. (Sheet 3 of 3)

copilot's lower circuit breaker panel (EC-130G aircraft)





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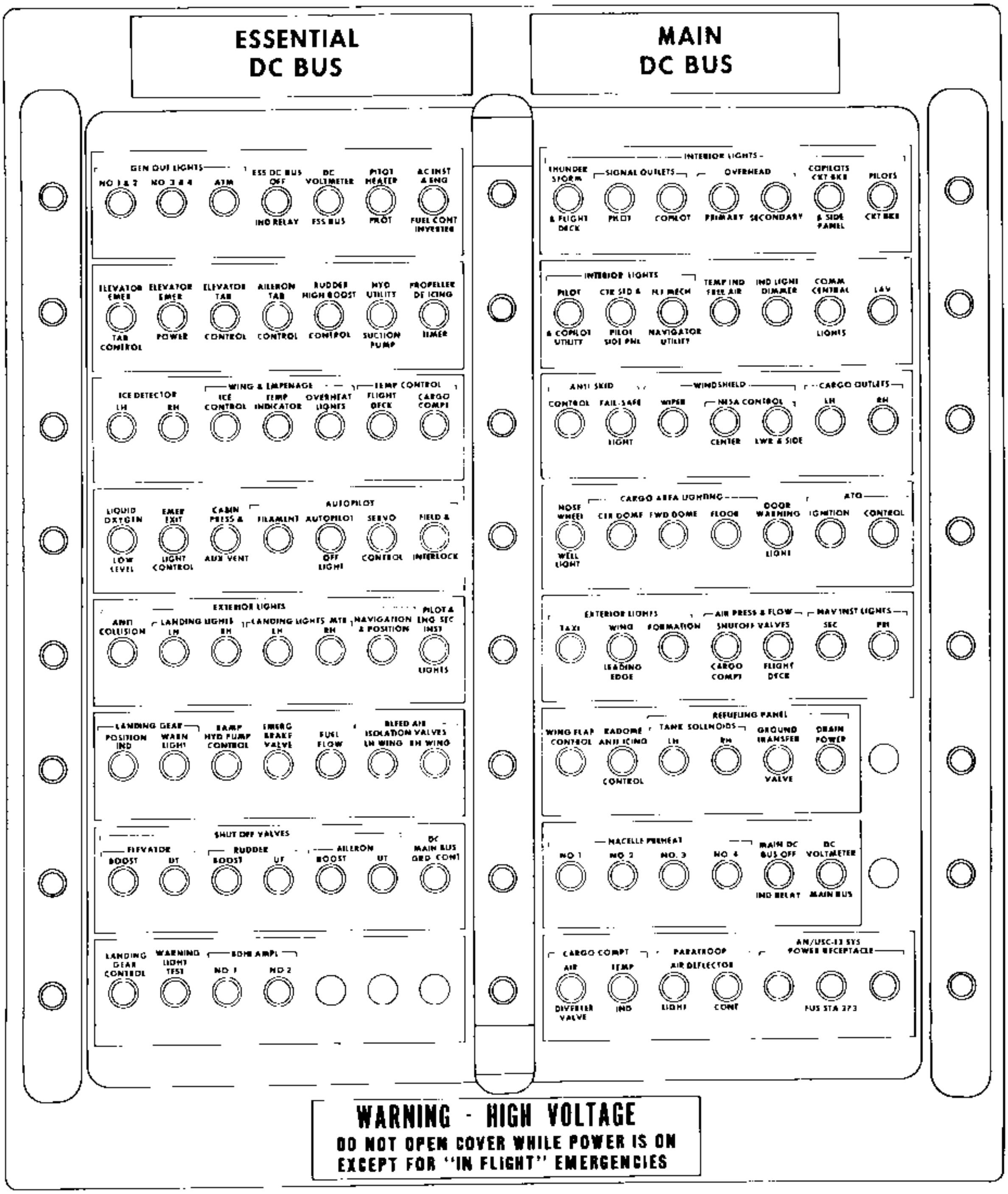
EC-130-1-X0/7-132-1

Figure 1-44. (Sheet 1 of 2)

(EC-130Q aircraft)



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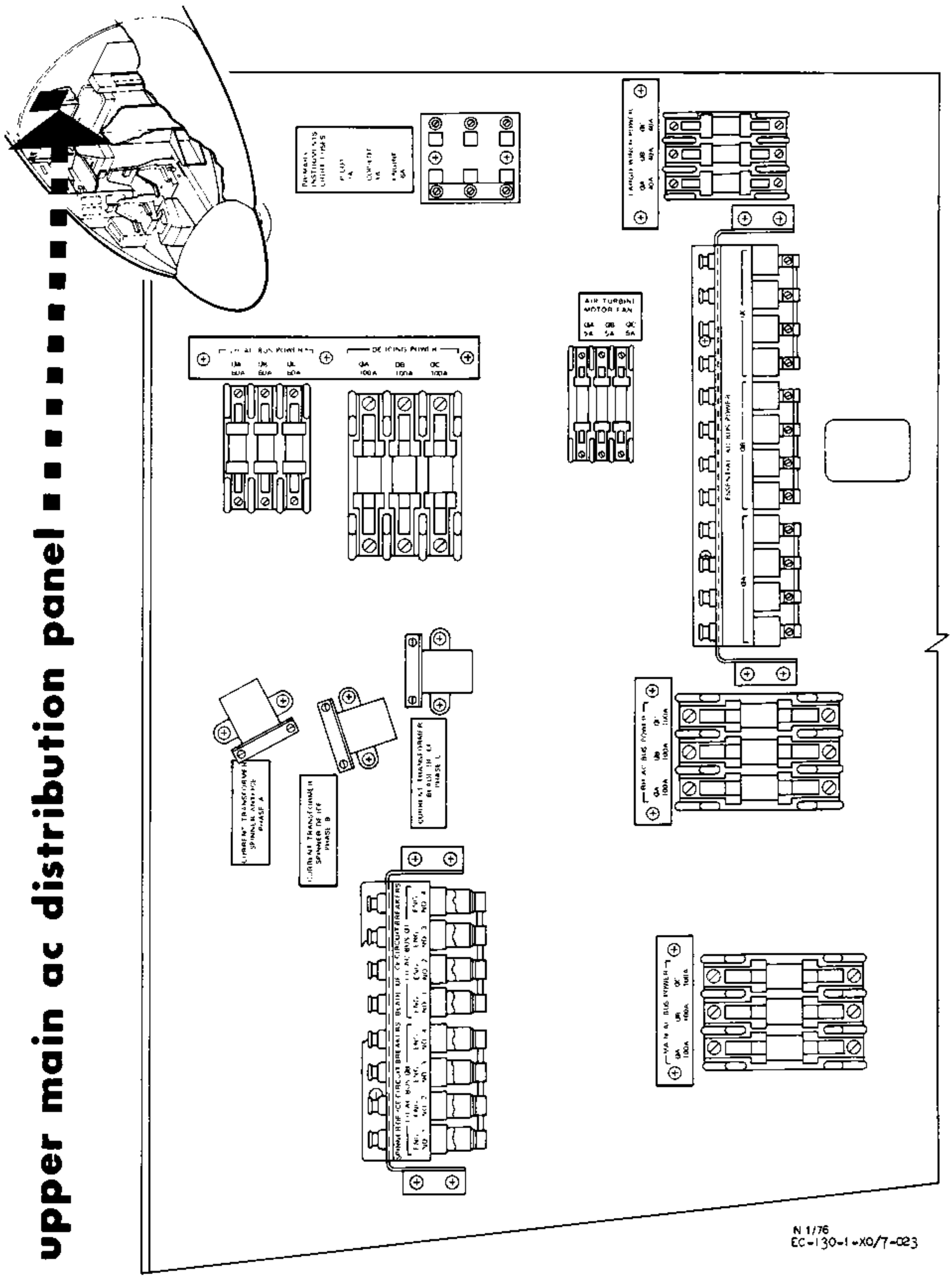
EC-130-1-X0/7-132-2

Figure 1-44. (Sheet 2 of 2)

upper main ac distribution panel



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EC-130-1-X0/7-023

Figure 1-45.

aft fuselage junction box

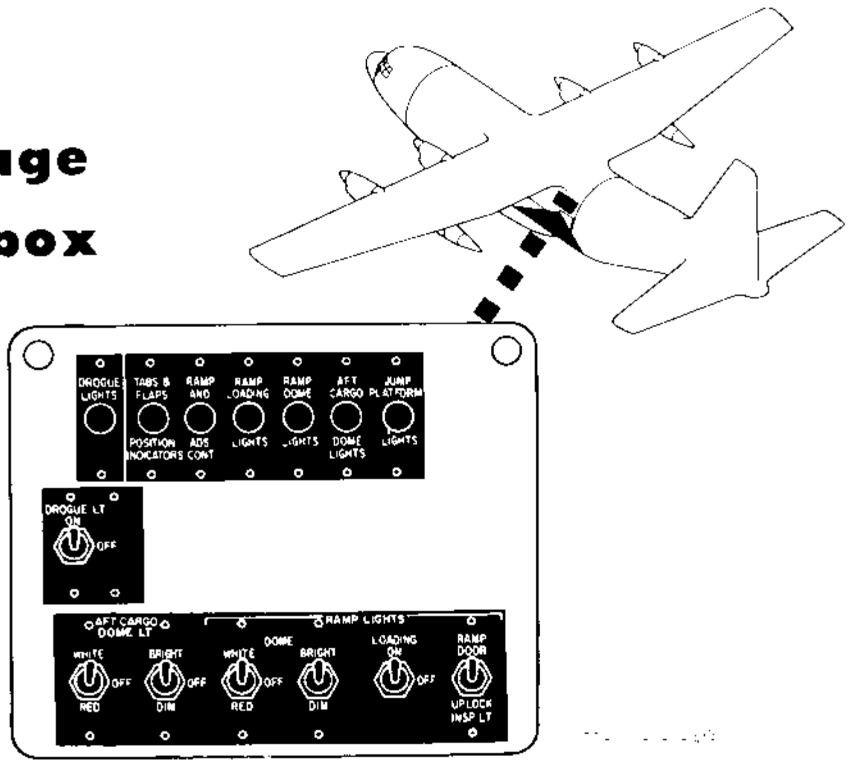


Figure 1-46.

UTILITY HYDRAULIC SYSTEM.

The utility hydraulic system (figure 1-47) operates from the output of the number one and number two engine-driven hydraulic pumps and supplies hydraulic power to the wing flap hydraulic motor, the main landing gear hydraulic motors, the nose landing gear hydraulic system, the main landing gear brakes, nose wheel steering, and to a portion of the aileron, rudder, and elevator control boost system. The engine-drive variable displacement pumps are supplied hydraulic fluid under electric suction boost pump pressure from a 3.2-gallon reservoir mounted on the left side of the special equipment compartment. The engine-driven pumps are provided with internal control mechanisms to vary their output volume with system demand and control pressure to maintain approximately 3,000 psi output pressure. If the pump is not operating, the low pressure warning light will glow. The pressurized output fluid of each pump passes through a filter, an electrically operated shutoff valve, and a one-way check valve before merging as system pressure. The one-way check valve provides individual pump failure warning by preventing system pressure from actuating the pressure warning switch of the failed pump. Fluid supply and output of the engine-driven pumps can be cut off by actuation of the fire handle or engine pump switch for that particular engine. The supply fluid and output is cut off by the closing of electrically actuated shutoff valves. External connections are provided so an external supply of pressure may be used for ground maintenance operation of the system. Ground test valves are incorporated in the system so that system pressure from the auxiliary hydraulic system may be used if desired in ground maintenance operations. On EC-130G aircraft supply and return functions are incorporated in the test valves. On EC-130Q aircraft, a single nine-port ground test valve is used in lieu of the two three-port valves. This valve provides supply, return, and case drain functions. Four filters are used in the system to provide protection from foreign material contamination. A pressure relief valve provides protection against system overpressures. An accumulator is installed in the utility hydraulic system pressure line to provide reserve pressure and a damping effect during demand and pressure fluctuations. A sight level gage mounted on the reservoir gives a visual indication of the reservoir fluid quantity. Provisions for control and monitoring of the utility hydraulic system are all located on the hydraulic control panel (figure 1-50) on the copilot's instrument panel.

Utility Suction Boost Pump Switch.

The utility system suction boost pump switch is a two-position (OFF, ON) toggle switch which furnishes 28-volt dc power from the essential dc bus through the hyd utility suction pump circuit breaker on the copilot's lower circuit breaker panel to operate a relay which controls three-phase ac power from the essential ac bus to the suction boost pump motor through the circuit breakers on the pilot's side circuit breaker panel.

Suction Boost Pump Pressure Warning Light.

The suction boost pump low pressure warning light is an amber warning light controlled by a pressure sensitive switch. The warning light will illuminate if pressure output of the suction boost pump drops below approximately 20 psi. The suction boost pump motor is protected by thermal circuit breakers which open and stop the motor if the current exceeds 11 to 12 amperes. When this occurs, the low-pressure warning light will illuminate. As the circuit breakers cool, the circuits will close to restore power to the pump motor, and the light will go off. The light receives 28-volt dc power from the essential dc bus through the hyd utility suction pump circuit breaker on the copilot's lower circuit breaker panel.

Engine Pump Switch.

Engine Pump OFF-ON switch is a two-position toggle switch which controls two hydraulic shutoff valves. One of these valves shuts off supply flow to the engine-driven pump, and the other shuts off pump output. These are the same valves operated by the fire handle. Since the engine pump continues to turn after both the supply and output valves are closed, normal flow from the pump case drain passes through a check valve back into the suction port of the pump to form a run-around circuit. This feature is provided to prevent damage to the engine-driven pumps that would otherwise result from lack of hydraulic fluid and overheating. The valves receive 28-volt dc power from the essential dc bus through the fire shutoff valves hydraulic circuit breaker on the copilot's side circuit breaker panel.

Engine Pump Pressure Warning Light.

The engine pump pressure amber warning lights are controlled by pressure actuated switches which sense the engine-driven pump output pressures. Whenever either engine pump output pressure drops below approximately 1,000 psi, its light will illuminate. The pressure warning light will also illuminate when the engine pump switch is placed in the OFF position. The lights receive 28-volt dc power from the essential dc bus through the hydraulic pump pressure warning circuit breaker on the copilot's side circuit breaker panel.

Utility Hydraulic Pressure Gage.

The utility system hydraulic pressure gage is controlled by a remote transmitter and indicates utility system pressure. The gage receives 26-volt ac power from the No. 2 instrument transformer through the indicator hyd pressure utility fuse on the pilot's lower circuit breaker panel.

BOOSTER HYDRAULIC SYSTEM.

The booster hydraulic system (figure 1-48) operates from the output of number three and number four engine-drive hydraulic pumps and supplies hydraulic power to a portion of the elevator, rudder, and aileron control boost system. The engine-driven variable displacement pumps are supplied hydraulic fluid under electric suction boost pump pressure from a 2-gallon reservoir mounted on the right side of the special equipment compartment. The engine-drive pumps are provided with internal control mechanisms to vary their output volume with system demand and control pressure to maintain approximately 3,000-psi output pressure. If the pump is not operating, the low pressure warning light will glow. The pressurized output fluid of each pump passes through a filter, an electrically operated shutoff valve, and a one-way check valve before merging as system pressure. The one-way check valve provides individual pump failure warning by preventing system pressure from actuating the pressure warning switch of the failed pump. Fluid supply and output of the engine-driven pumps can be cut off by actuation of the fire handle or engine pump switch for that particular engine. The supply fluid and output is cut off by the closing of electrically actuated shutoff valves. Provisions are included in the system for manual overboard draining of the system fluid. External connections are also provided so an external supply of pressure may be used for ground maintenance operation of the system. Four filters are incorporated in the system to provide protection from foreign material contamination. A pressure relief valve provides protection against system overpressures. An accumulator in the system provides reserve pressure and a damping effect during demand and pressure fluctuations.

A sight level gage mounted on the reservoir gives a visual indication of the reservoir fluid quantity. Provisions for control and monitoring of the booster hydraulic system are all located on the hydraulic control panel (figure 1-50) on the copilot's instrument panel.

Booster Suction Boost Pump Switch.

The booster system suction boost pump switch is a two-position OFF-ON toggle switch which furnishes 28-volt dc power from the essential dc bus through the hyd boost suction pump control circuit breaker on the copilot's side circuit breaker panel, and controls three-phase ac power from the essential ac bus through the circuit breakers on the pilot's side circuit breaker panel to the suction boost pump motor.

Suction Boost Pump Pressure Warning Light.

The suction boost pump low pressure warning light is a yellow warning light controlled by a pressure-sensitive switch. The warning light will glow, if pressure output of the suction boost pump drops below approximately 20 psi. The suction boost pump motor is protected by thermal circuit breakers which open and stop the motor if the current exceeds 11 or 12 amperes. When this occurs, the low pressure warning light will illuminate. As the circuit breakers cool the circuit will close to restore power to the pump motor and the light will go off. The light receives 28-volt dc power from the essential dc bus through the hyd boost suction pump control circuit breaker on the copilot's side circuit breaker panel.

Engine Pump Switch.

Engine Pump OFF-ON switch is a two-position toggle switch which controls two hydraulic shutoff valves. One of these valves shuts off supply flow to the engine-driven pump, and the other shuts off pump output. These are the same valves operated by the fire handle. Since the engine pump continues to turn after both the supply and output valves are closed, normal flow from the pump case drain passes through a check valve back into the suction port of the pump to form a run-around circuit. This feature is provided to prevent damage to the engine-driven pumps that would otherwise result from lack of hydraulic fluid and overheating. The valves receive 28-volt dc power from the essential dc bus through the fire shutoff valves hydraulic circuit breaker on the copilot's side circuit breaker panel.

Engine Pump Pressure Warning Lights.

The engine pump pressure amber warning lights are controlled by pressure actuated switches which sense the engine-driven pump output pressure. Whenever either engine pump output pressure drops below approximately 1,000 psi, its lights will illuminate. The pressure warning light will also illuminate when the engine pump switch is placed in the OFF position. The lights receive 28-volt dc power from the essential dc bus through the hydraulic pump pressure warning circuit breaker on the copilot's side circuit breaker panel.

Booster Hydraulic Pressure Gage.

The booster system hydraulic pressure gage is controlled by a remote transmitter and indicates booster system pressure. The gage receives 26-volt ac power from the No. 1 instrument transformer through the indicator hyd pressure boost fuse on the pilot's lower circuit breaker panel.

AUXILIARY HYDRAULIC SYSTEM.

The auxiliary hydraulic system (figure 1-49) operates from a three-phase, ac, electrically-driven hydraulic pump. It powers the aft cargo door and ramp system, provides emergency pressure for the main landing gear brakes, provides pressure for the short wire antenna drive circuits, and provides pressure for nose gear emergency extension. The auxiliary hydraulic system is mounted in the aft equipment area and may be electrically operated from the ramp control panel (figure 1-68), or from the hydraulic control panel (figure 1-50). A handpump (figure 1-68) in the system provides an optional source of system pressure for ground or inflight operation. A direct measuring pressure gage located near the handpump shows system pressure. A remotely controlled pressure gage located on the hydraulic control panel also indicates system pressure. The electrically driven system pump (supplied hydraulic fluid from a 3.4-gallon reservoir) is a variable-volume output type that will maintain approximately 3,000 psi output pressure. Check valves allow handpump pressure to operate the system when the handpump is operated and the electrical pump is off. A manually operated shutoff valve is provided to furnish overboard drain provisions. A manually operated nose landing gear emergency extension valve connects the system to the nose landing gear system allowing auxiliary system pressure to be transferred to the nose landing gear uplock and to the down actuating cylinder for emergency extension of the nose gear. Two filters provide protection from foreign material contamination within the system. On EC-130G and EC-130Q aircraft BuNo 156170 through 156177, an accumulator is provided in the auxiliary hydraulic system. The accumulator takes part of the starting load off the auxiliary hydraulic pump and, in turn, helps to prevent surge loads on the essential ac bus. A cooler assembly in the system permits continuous pump operation. Two manual shutoff valves control application and return of hydraulic fluid to the short wire antenna reel.

Auxiliary Hydraulic Pump Switches.

The auxiliary hydraulic pump may be controlled by either of two ON-OFF toggle switches, located on the hydraulic control panel and the ramp control panel. When either switch is placed in the ON position, 28-volt dc power is supplied from the essential dc bus through the ramp hyd pump control circuit breaker, located on the copilot's lower circuit breaker panel, to energize the auxiliary hydraulic pump relay. When the relay is energized, 115/200-volt, three-phase, ac power is supplied from the essential ac bus through the hyd pump aux sys circuit breakers, located on the pilot's side circuit breaker panel, to drive the auxiliary hydraulic pump motor. When both switches are placed in the OFF position, the relay is de-energized and power is removed from the auxiliary hydraulic pump motor.

Auxiliary Hydraulic Pressure Gages.

The auxiliary hydraulic system pressure is indicated by the gage located on the hydraulic control panel and the gage located in the special equipment compartment near the handpump. The gage located in the cargo compartment is a direct-reading instrument and shows system pressure at all times, whether from the handpump or from the electric pump. The gage located on the hydraulic control panel is controlled by a remote transmitter; it receives 26-volt ac power from the No. 2 instrument transformer through the ramp indicator hyd pressure fuse located on the pilot's lower circuit breaker panel.

Ground Test Valves.

Ground test valves are provided for pressurizing the utility hydraulic system with auxiliary system pressure without running the engines in order to check equipment operated by the utility system. On EC-130G aircraft two ground test valves provide supply and return functions. On EC-130Q aircraft a single nine-port valve provides supply, return, and case drain functions. These valves are provided for maintenance purposes only and cannot be used for checking systems when airborne since the valve controls are located in the left aft wheel well fairing and must be positioned manually.

utility hydraulic system (EC-130G aircraft)

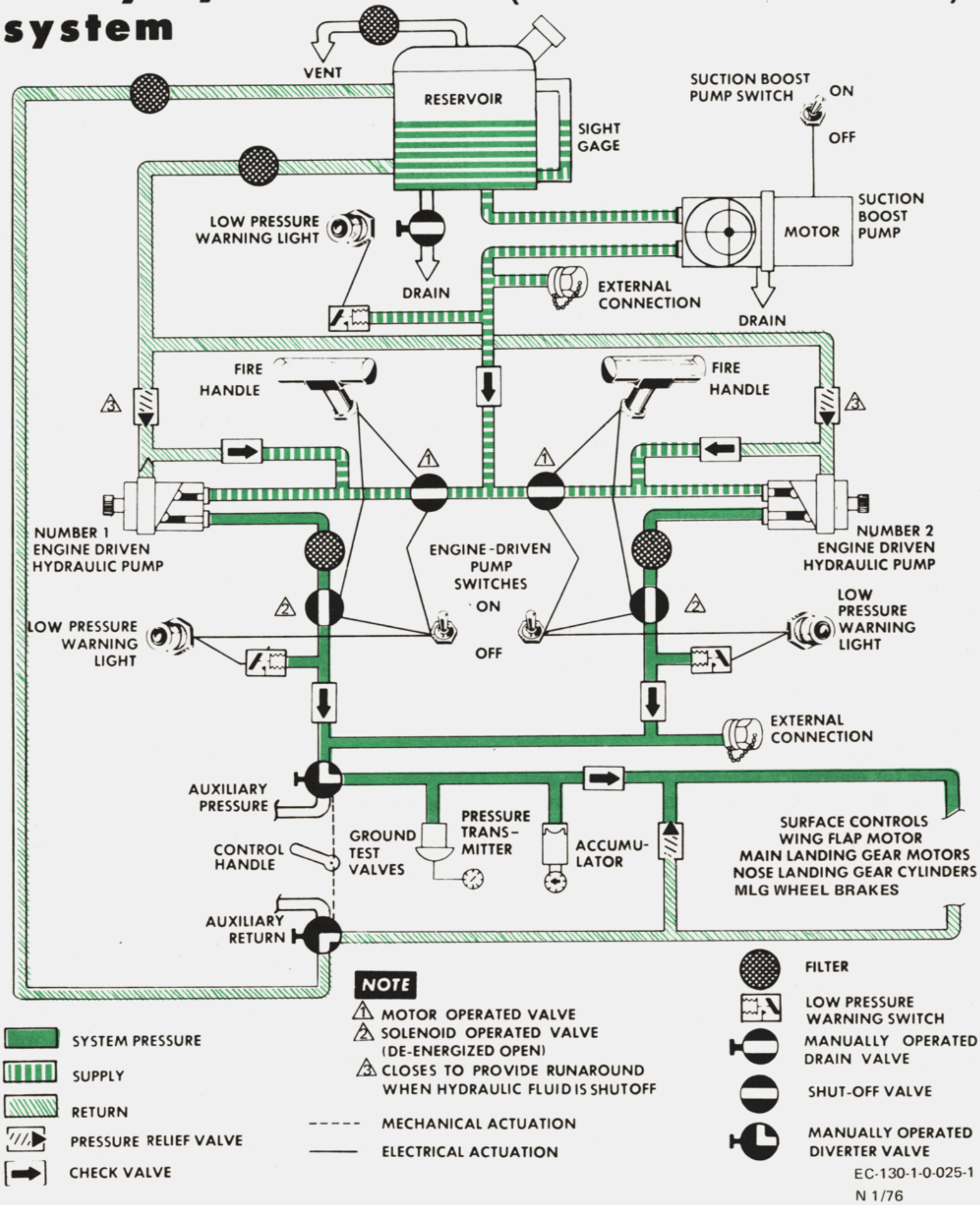


Figure 1-47. (Sheet 1 of 2)

utility hydraulic system (EC-130Q)

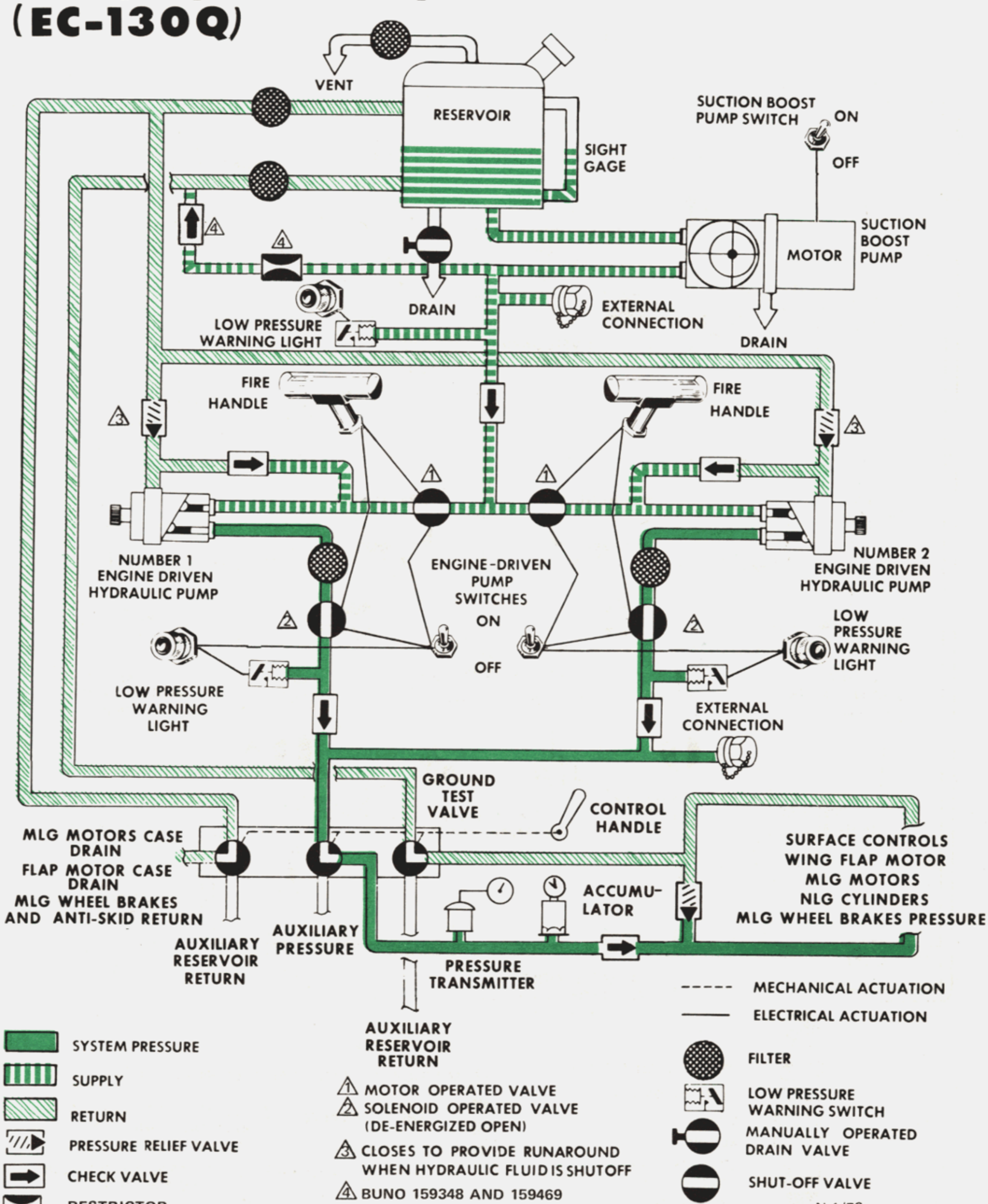


Figure 1-47. (Sheet 2 of 2)

booster hydraulic system

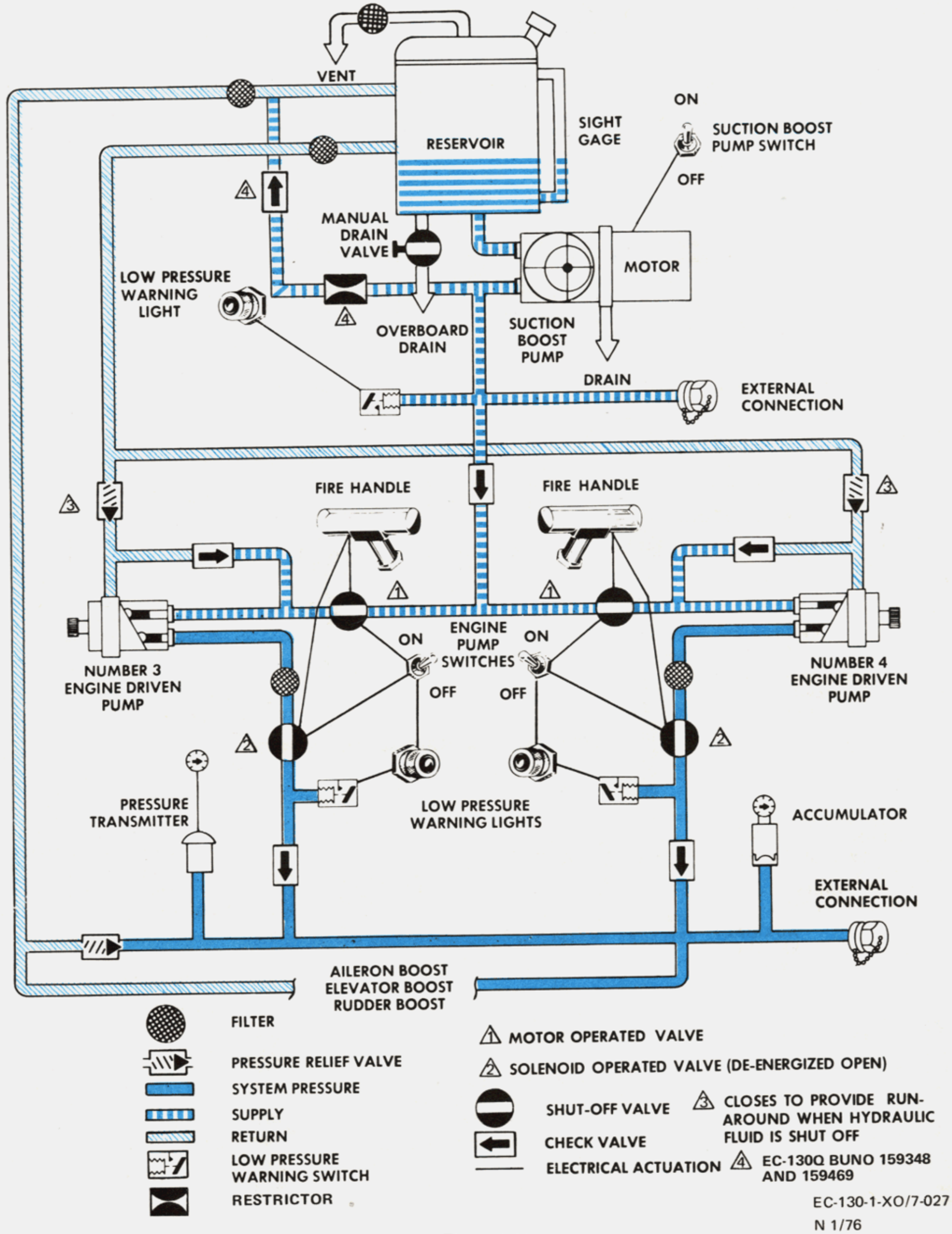


Figure 1-48.

auxiliary hydraulic system

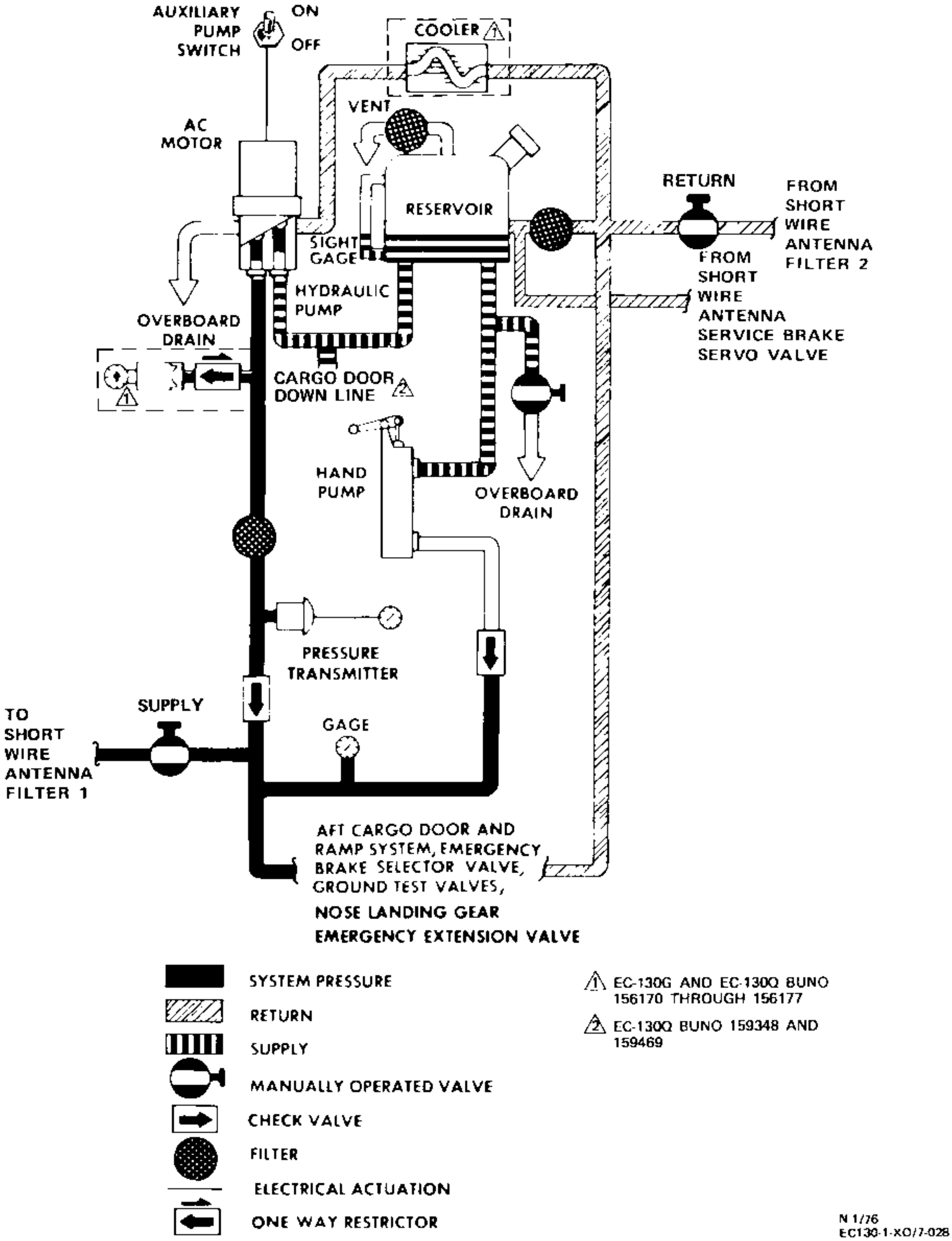


Figure 1-49.

FLIGHT CONTROLS.

The flight controls include the main surface control systems, which are aileron, rudder, and elevator systems, and tab control systems. The main surfaces are controlled by mechanical systems with hydraulic boost. The trim tabs are controlled by electrical control systems. The autopilot, when operating, controls the main surfaces and elevator trim tabs.

MAIN SURFACE CONTROL SYSTEMS.

The main surfaces (ailerons, rudder, and elevators) are controlled by mechanical control systems, consisting of cables, pushrods, bellcranks, and torque tubes. Hydraulically driven booster units provide most of the force required to move the surfaces. The booster units are driven by hydraulic pressure supplied simultaneously by the booster and utility hydraulic system (figure 1-55), each of which serves to power one portion of the booster units. System operation is such that failure or malfunction of any component of either system in any booster unit will allow normal function of the other system powering the same unit. A loss of hydraulic pressure in either hydraulic system results in a corresponding loss in the booster unit, and a proportionate loss of power to operate the unit. The aircraft may be controlled with complete loss of booster unit power by the use of trim tabs and engine power, plus coordinated increased efforts of the pilot and copilot. Solenoid-operated shutoff valves in each surface control system can be actuated by switches on the control boost switch panel (figure 1-53) at the flight station to shut off supply pressure to either portion of the systems. The valves are spring-loaded and will open when de-energized (control boost switches in the ON position). A booster off warning light for each switch is also powered by the solenoid shutoff valve switch and will illuminate when the switch is in the OFF position. An autopilot servomotor is cable-rigged to each booster unit to substitute for manual control during autopilot operation. Electrical power for operation of the booster shutoff valves is supplied from the essential dc bus through the aileron, elevator, and rudder shutoff valves circuit breakers on the copilot's lower circuit breaker panel.

Rudder Booster Assembly.

The rudder booster assembly is a single tandem-type hydraulic actuating cylinder which furnishes most of the force to actuate the rudder. During normal operation, fluid supplied at approximately 3,000 psi pressure is routed by solenoid-controlled, normally deenergized diverter valves through pressure reducer valves in each of the systems; and from there at a pressure of approximately 1,300 psi,to the rudder booster assembly. This system pressure produces desirable characteristics of sensitivity and surface travel for normal inflight operation. Movement of the flap lever from the retracted (UP) position to approximately the 15 percent position or beyond will energize the solenoids of the diverter valves, actuating the valves in such a manner that the pressure reducers are bypassed thereby permitting supply fluid at approximately 3,000 psi pressure to reach the booster assembly. This doubles the available actuating force and gives desirable characteristics of sensitivity and surface travel at low airspeeds such as are encountered in take-off, landing, flying traffic patterns, troop drops, and cargo drops where flaps are used. The diverter valves are powered from the essential dc bus through the rudder high boost circuit breaker located on the copilot's lower circuit breaker panel. The amount of pressure actuating the rudder booster assembly (both the booster and utility portion of the system) is indicated on pressure gages located on the hydraulic panel (figure 1-50) of the copilot's instrument panel. Transmitters for these indicators are located downstream of the diverter valve and therefore will show high or low pressure operation. Relief valves protect the booster unit in case of pressure reducer failures.

Note

Snubber action may be detected on rudder booster assemblies containing Ronson actuators when moving from travel extremes with only one hydraulic system pressurized. This snubbing action is not binding or sticking. With both hydraulic systems pressurized, there should be no perceptible snubbing action when actuating from travel extremes toward center.

NEW NEW NEW NEW NEW

Aileron Booster Assembly.

The aileron booster assembly is a single tandem-type hydraulic actuating cylinder which furnishes most of the force to actuate the ailerons. During normal operation, the booster assembly is furnished fluid through a pressure-reducer at approximately 2,050 psi from both the booster and utility hydraulic systems.

hydraulic control panel

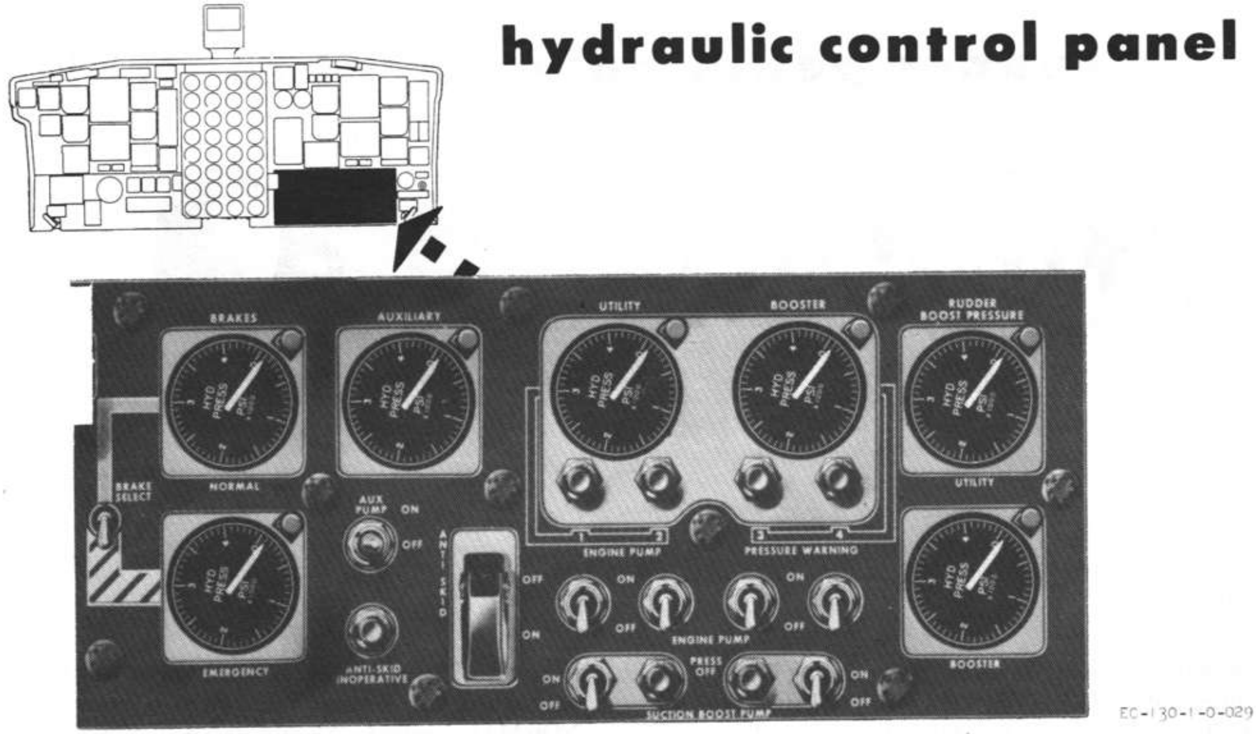


Figure 1-50.

Elevator Booster Assembly.

The elevator booster assembly has dual actuating cylinders connected to the booster assembly output power lever that operates the elevator control surfaces. The actuating cylinders operate simultaneously with 3,000 psi pressure supplied by the booster and utility hydraulic systems, each of which powers one actuating cylinder.

Surface Control Systems Controls.

CONTROL COLUMNS AND WHEELS. Control columns and wheels (figure 1-52) installed at the pilot's and copilot's stations to operate the aileron and elevator surface controls are of the conventional type. Mechanical linkage actuates the hydraulically powered booster unit control valves and servomotors for each of these surface controls. Push rods (elevator) and a chain and cable arrangement (ailerons) connect the control column to bell cranks on torque tubes which are mounted under the flight station beneath the pilot's and copilot's seats. From there, dual sets of steel cables continue the elevator linkage as far as the pressure bulkhead at the extreme rear of the cargo compartment and the aileron linkage to the rear face of the center section wing rear beam web. From these points push rods and bell cranks pick up the motion and transmit it to the booster unit control valves and servo units.

RUDDER PEDALS AND ADJUSTMENT LEVERS. Rudder pedals are of the convential type. Each pair of rudder pedals can be adjusted individually by unlocking the rudder adjustment lever (figure 1-51) and pushing or releasing the spring-loaded pedals to the desired position. The rudder pedals are used to operate the rudder boosters when hydraulic power is available, and to operate the rudder manually when hydraulic power is not available. Toe pressure on the rudder pedals actuates the brake during either normal or emergency braking.

CONTROL BOOST SWITCHES AND WARNING LIGHTS.

The control booster unit shutoff valve actuating switches (figure 1-53) are located on the control boost switch panel on the overhead control panel. There are six guarded two-position toggle switches (ON with cover down, deenergized) which will actuate the shutoff valves to isolate the corresponding booster

rudder pedal adjustment control

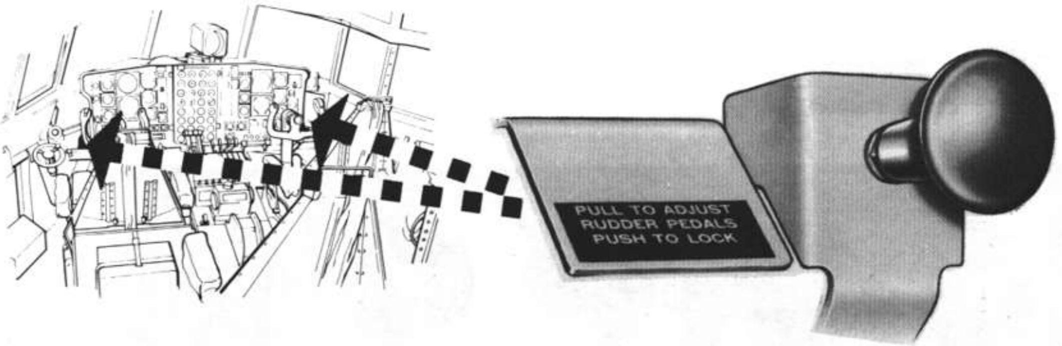


Figure 1-51.

package and energize six hooded warning lights which illuminate BOOSTER OFF when their respecitve switch is placed in the OFF position. The panel switches supply power to the warning lights directly through the copilot's lower circuit breaker panel when in the OFF position and therefore furnish no independent indication directly of boost unit failure or that the shutoff valves are closed. The warning light only indicates that the switch is in the OFF position and dc power is routed to the solenoid shutoff valve. Individual pressure control from both the booster and utility system is available to each boost package. Twenty-eight volt dc power for the lights and valves is supplied from the essential dc bus through the shutoff valves circuit breakers on the copilot's lower circuit breaker panel. (See FLIGHT CONTROL SYSTEMS FAILURE in Section V for emergency procedures.)

TRIM TAB CONTROL SYSTEMS.

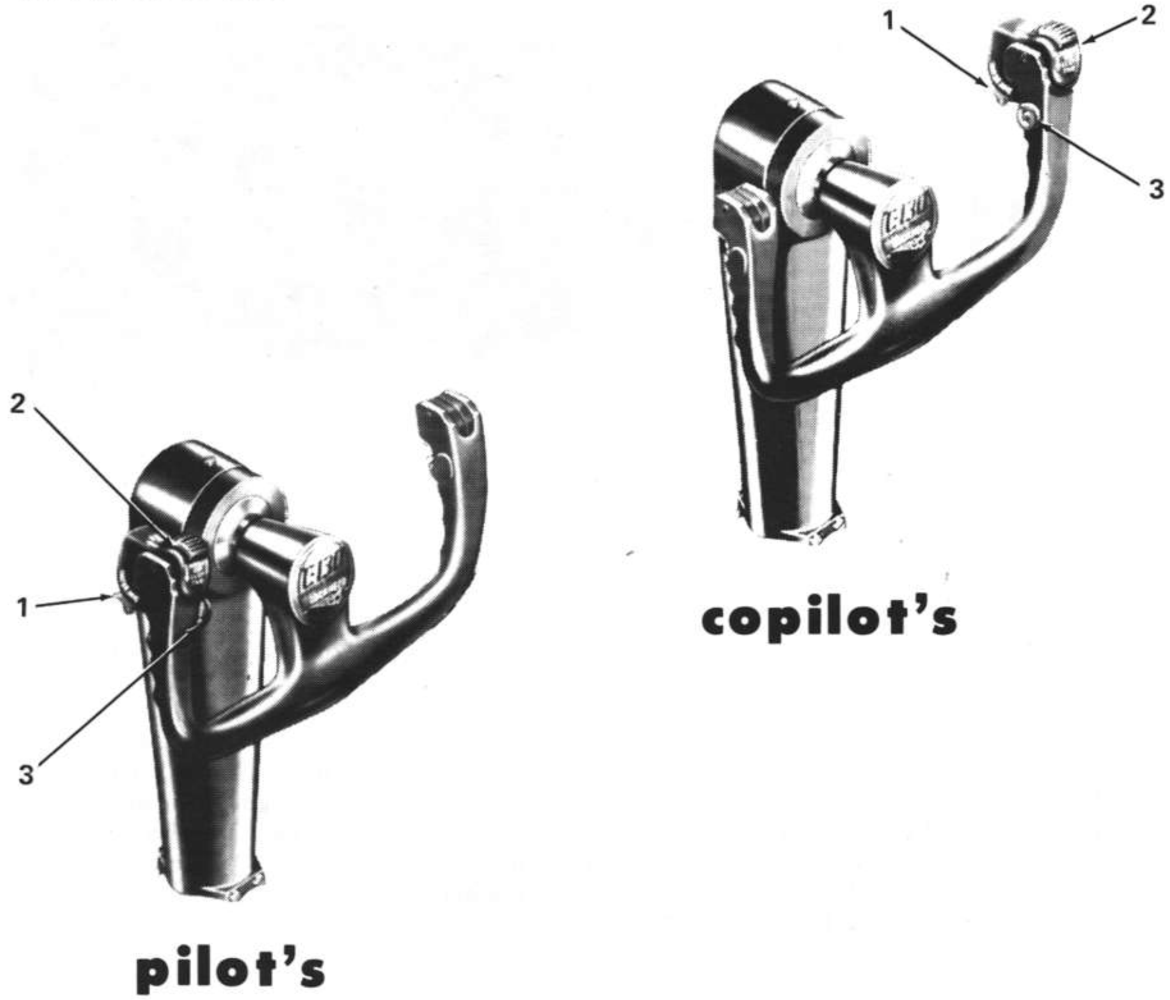
Trim tabs are provided on the control surfaces to aid in trimming the aircraft during flight. Lateral trim is obtained through opeation of a trim tab on the left aileron. A ground adjustable tab is located on the right aileron to compensate for any inherent unbalance about the longitudinal axis of the aircraft. Nose-up and nose-down trim is obtained through operation of the trim tabs on the elevators, one trim tab on each elevator control surface. Minor directional control for yaw conditions is obtained by operation of the rudder trim tab. The elevator trim tab normal system is inoperative for manual control when the autopilot is engaged. The autopilot elevator servo will function only when the elevator tab switch is placed in the NORMAL position. All trim tab actuators are driven by 115-volt, single-phase, ac motors, except during emergency operation when the elevator trim tab actuator is driven by a 28-volt, dc motor.

Trim Tab System Controls.

Trim tab controls consist of switches for control of the tab actuators and a power selector switch to select emergency operation of the elevator tabs.

AILERON AND ELEVATOR TRIM TAB SWITCH. An aileron and elevator trim tab switch is located on the trim tab control panel of the flight control pedestal (figur 1-54). It is a recessed, five-position (NOSE UP, NOSE DOWN, OFF, LOWER LEFT WING, LOWER RIGHT WING) toggle switch, with all switch positions other than the OFF (center) position spring-loaded to return to the center position upon release of the switch. When the switch is held in the LOWER LEFT WING or LOWER RIGHT WING position, the trim tab on the left aileron control surface is actuated by a tab motor to trim the aircraft laterally. When the switch is held in the NOSE UP or NOSE DOWN position, the elevator trim tabs are actuated by a tab motor to raise or lower the nose of the aircraft. When the switch is in the OFF (center) position, the electric motors that actuate the trim tabs are deenergized. The tab motors receive 115-volt ac power from the essential ac bus through the respective trim tab circuit breaker on the pilot's side circuit breaker panel.

control wheels



1. MICROPHONE BUTTON
2. ELEVATOR TAB SWITCH
3. AUTOPILOT RELEASE BUTTON

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Figure 1-52.

control boost switch panel

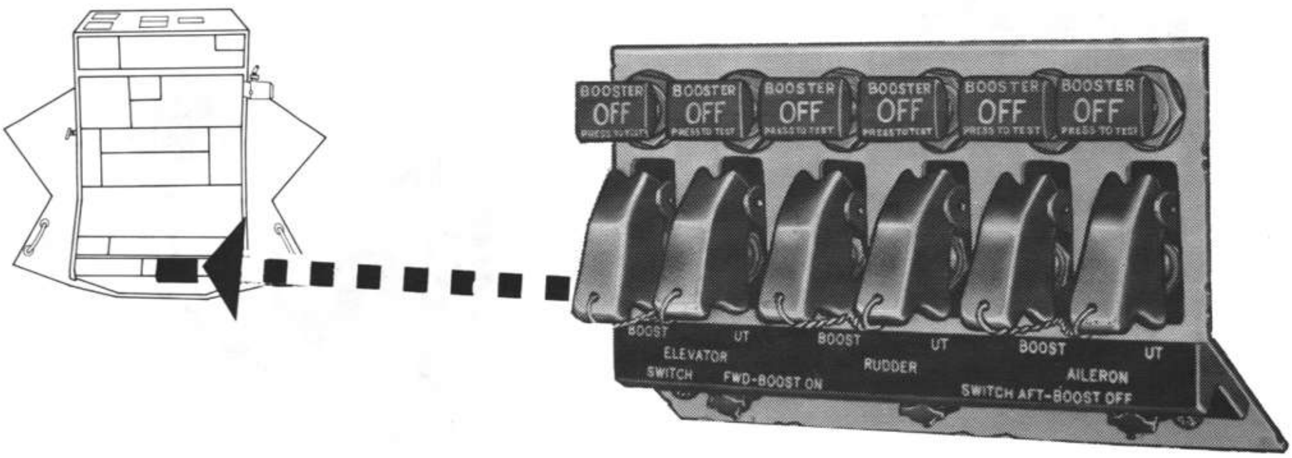


Figure 1-53.

Two control relays in the aileron trim tab power circuit are energized by the trim tab control switch. The relays eliminate the necessity to route the 115-volt, ac power required to operate the aileron trim tab actuator through the trim tab control switch. When the switch is placed in the LOWER LEFT WING position, it will energize the tab down relay which connects 115-volt, ac power to the aileron trim tab actuator and lowers the left wing. When the switch is placed in the LOWER RIGHT WING position, it will energize the tab up relay which connects 115-volt, ac power to the aileron trim tab actuator and lowers the right wing. The relays are actuated by 28-volt, dc power from the essential dc bus through the aileron tab control circuit breaker on the copilot's lower circuit breaker panel.

ELEVATOR TAB SWITCHES. An elev tab switch (figure 1-52) is located on the outboard hand grip of each control wheel. It is a slide-type switch with NOSE UP, NOSE DOWN, and center off positions. These two switches are connnected in parallel with the pedestal-mounted trim tab switch, and any one of the three switches can control the tabs. A runaway tab condition may be corrected by opposite movement of either of the other switches. When any one of the three switches is in NOSE UP or NOSE DOWN position, a pair of dual relays are actuated to apply power to the elevator trim tab actuator. If the elevator tab power selector switch is in NORMAL, 115-volt ac power from the essential ac bus through the elev trim tab circuit breaker is applied to the actuator. Twenty-eight volt, dc power from the essential dc bus through the elev emer power circuit breaker on the copilot's lower circuit breaker panel is applied to the actuator if the power selector switch is in EMERGENCY. The elevator tab switch on the control wheels is inoperative when the elevator tab power selector swith is placed in the EMERGENCY position.

ELEVATOR TAB POWER SELECTOR SWITCH. An elevator tab power selector switch (figure 1-54) is located on the flight control pedestal. It is a three-position (NORMAL, OFF, EMERGENCY) toggle switch used to select the source of electrical power for operation of the elevator trim tabs. When the switch is in the NORMAL position, 115-volt, ac power is supplied from the essential ac bus through the elevator trim tab circuit breaker on the pilot's side circuit breaker panel to a trim tab actuating motor relay for autopilot or manual operation of the elevator trim tabs. In the NORMAL position, the elevator trim tabs can be controlled from either of the control

trim tab system controls and indicators

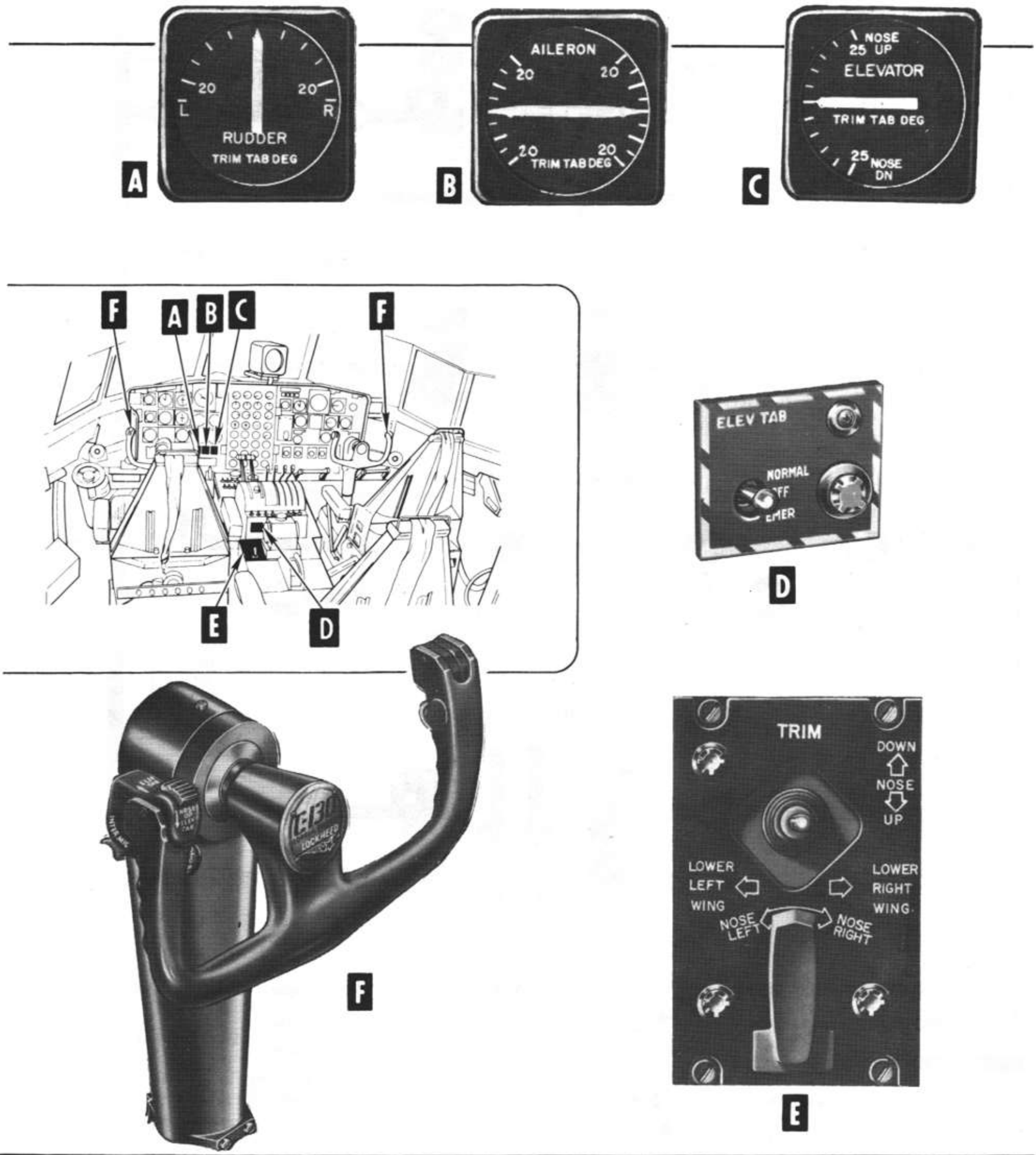
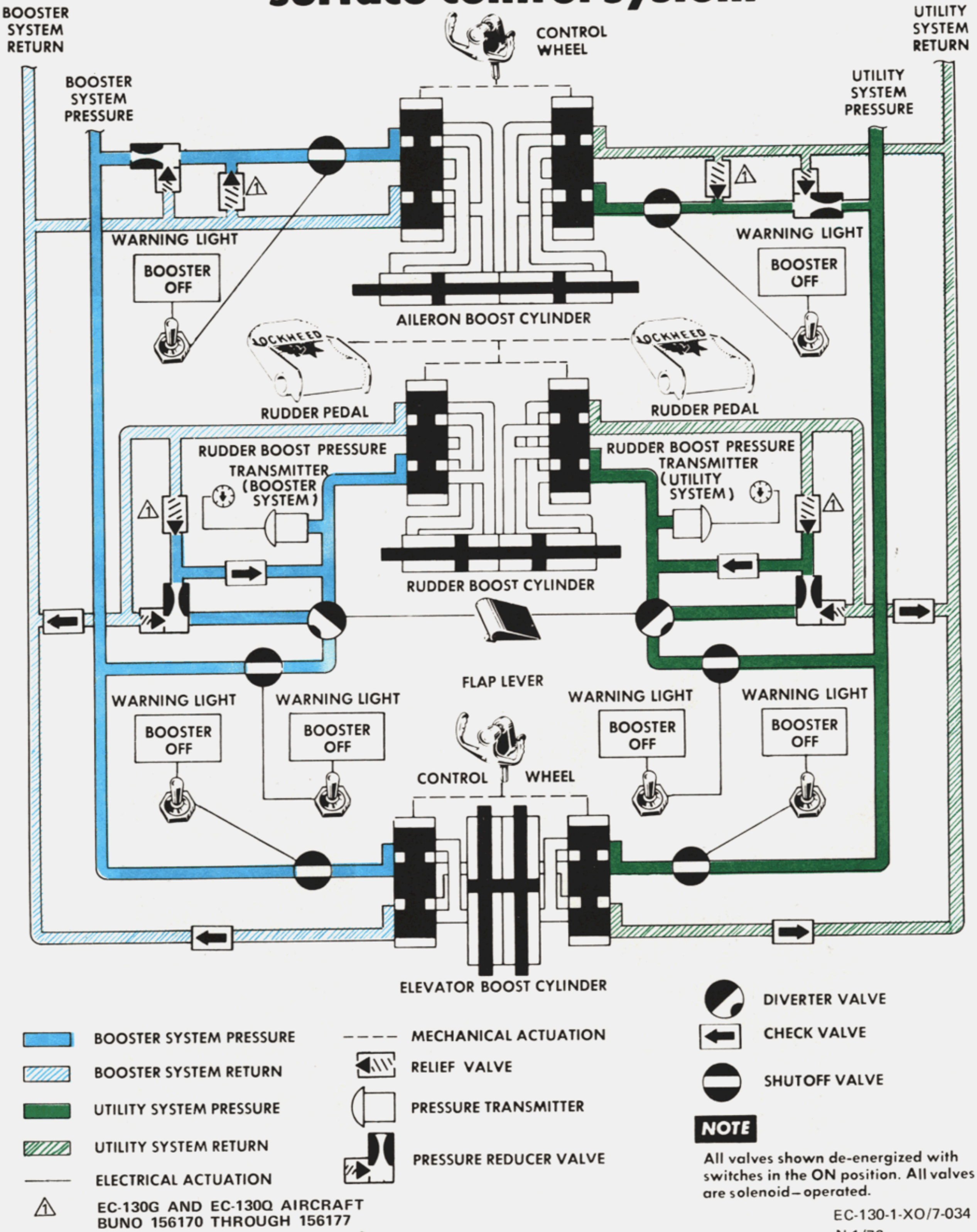


Figure 1-54.

surface control system



NOTE

All valves shown de-energized with switches in the ON position. All valves are solenoid–operated.

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Figure 1-55.

wheels or from the pedestal. When in the EMERGENCY position, the elevator trim tabs can be controlled only from the elevator trim tab switch located on the pedestal. During emergency opeation, 28-volt, dc power is supplied from the essential dc bus through the elevator emer power circuit breaker, located on the copilot's lower circuit breaker panel to a trim tab actuating motor that will drive the elevator trim tabs either up or down when the respective elevator trim tab control relay is energized by actuation of the trim tab control switch on the pedestal. When the elevator tab power selector switch is in the NORMAL position, the elevator trim tab control relays are powered by 28-volt dc, from the essential dc bus through the elevator tab control circuit breaker, located on the copilot's lower circuit breaker panel. When the elevator tab power selector switch is in the EMERGENCY position, the elevator trim tab control relays are powered by 28-volt dc, from the essential dc bus, through the elevator emer tab control circuit breaker located on the copilot's lower circuit breaker panel. When the elevator tab power selector switch is placed in the OFF position, all circuits to the elevator trim tabs are deenergized. (See FLIGHT CONTROL SYSTEMS FAILURE in Section V for emergency operation.)

RUDDER TRIM TAB SWITCH. A rudder trim tab switch is located on the trim tab control panel of the flight control pedestal (figure 1-54). It is a three-position (NOSE LEFT, OFF, NOSE RIGHT) switch that controls operation of the rudder trim tab motor. The NOSE LEFT and NOSE RIGHT positions are spring-loaded to return to the OFF(center) position upon release of the control switch. When the switch is in NOSE LEFT or NOSE RIGHT position, 115-volt ac power from the essential ac bus through the rudder trim tab circuit breaker on the pilot's side circuit breaker panel energizes the rudder trim tab motor to position the rudder trim tab and trim the aircraft.

Tab Position Indicators.

Tab position indicators show the pilot the exact angle formed by any trim tab with its corresponding control surface and the direction in which the trim will act.

RUDDER TRIM TAB POSITION INDICATOR. A rudder trim tab position indicator is located on the pilot's instrument panel (figure 1-54). The indicator is connected to a transmitter mounted on the rudder trim tab actuator housing and indicates to the pilot the degree of rudder trim tab positioning relative to the rudder control surface. This indicator is energized by 28-volt, dc power from the main dc bus through the tabs and flap position ind circuit breaker in the aft fuselage junction box. The indicator dial face is calibrated from 0 to L and 0 to R in increments of 5 degrees of rudder trim tab travel from the neutral 0 marking. The needle on the indicator shows the exact angle between the rudder trim tab and rudder surface and the direction in which the trim will act.

AILERON TRIM TAB POSITION INDICATOR. An aileron trim tab position indicator is located on the pilot's instrument panel (figure 1-54). This indicator is connected to a transmitter mounted on the left aileron trim tab actuator and indicates to the pilot the degree of left aileron trim tab positioning relative to the aileron control surface. This indicator is energized by 28-volt, dc power from the main dc bus through the tabs and flaps position indicators circuit breaker in the aft fuselage junction box. The indicator dial face is calibrated from the neutral position of 0 to 20 up and 0 to 20 down in 5-degree increments of left aileron trim tab travel. The needle on the indicator shows the exact angle between the aileron trim tab and the left aileron surface and the direction in which the trim will act.

ELEVATOR TRIM TAB POSITION INDICATOR. An elevator trim tab position indicator is located on the pilot's instrument panel (figure 1-54). The indicator is connected to a transmitter mounted on the elevator trim tab rotary actuator housing and indicates to the pilot the degree of elevator trim tab positioning relative to the elevator control surface. This indicator is energized by 28-volt dc power from the main dc bus through the tabs and flaps position indicators circuit breaker in the aft fuselage junction box. The indicator dial face is calibrated from the neutral position 0 to 25 up or 25 down, in 5-degree increments of elevator trim tab travel. The needle on the indicator shows the exact angle between the elevator trim tabs and the corresponding elevator surface and the direction in which the trim will act.

Note

Trim tab travel is controlled by limit switches set at 6 degrees nose down and 25 degrees nose up, and by mechanical stops set at 8 degrees nose down and 27 degrees nose up.

FLAP SYSTEM.

The aircraft is equipped with four flaps, consisting of an outboard and an inboard flap in each wing. The flaps are of the Lockheed-Fowler, high-lift type in which the flap motion is a combination of an aft movement to increase wing area and a downward tilting movement to alter the airfoil section to increase lift and drag. The time required for full extension or retraction of the flaps is between 10 to 13 seconds. When 100 percent extended, the flaps form an angle of approximately 35 degrees with the wings. The flaps are operated by a reversible hydraulic motor, a cam-actuated microswitch followup mechanism, torque tubes, gearbox, and drive screw assemblies. Hydraulic pressure is directed through a check valve to the emergency flap brake valve, and wing flap control valve, where pressure is directed to the up or down system. The hydraulic motor operates the torque shaft section extending outboard to the gearbox, which rotates ball bearing drive screws for actuation of the flaps. The flaps may be operated manually with a handcrank. A disk-type, spring-loaded flap brake holds the flaps in the selected position and prevent movement by aerodynamic loads. The brake is released by fluid pressure supplied to the system for operation of the flap drive motor. Emergency flap brakes are splined to the outer ends of the flap drive torque shaft to prevent unequal actuation of the flaps during normal extension and retraction of the flaps. Utility hydraulic system pressure is used for operation of the flap system (figure 1-56).

FLAP SYSTEMS CONTROLS.

Flap system controls are provided for normal operation of the flaps. Provisions exist for manual operation of the flaps if the normal operating system fails to function.

Flap Lever.

A flap lever (figure 1-57) is located on the aft end of the flight control pedestal. It is a manually actuated control lever with the lever range calibrated from UP to DOWN in increments of 10 percent. There is a detent at approximately the 50 percent position but the flaps can be extended to any desired position by placing the lever at the selected percent of flap extension. The lever is attached by cables to a movable cam inside a flap control unit mounted on the center section wing rear beam in the cargo compartment. Movement of this cam closes microswitches which close a 28-volt dc control circuit for the wing flap selector valve. The actuated valve directs a flow of hydraulic fluid to drive the flap motor in the selected direction. A rudder pressure diverter valve, electrically actuated by a switch on the flap control lever mechanism, controls the pressure available for operation of the rudder. Pressure available for rudder operation of flap settings from 0 to 15 percent is approximately 1,300 psi as compared to approximately 3,000 psi for flap settings for 15 to 100 percent. The pressure control system is provided to prevent excessive air loads at high speeds. When the selected position of the flaps is reached, the microswitches open, the selector valve shuts off hydraulic flow, and a spring-loaded hydraulic brake locks the flaps in the selected position. The wing flap selector valve receives 28-volt dc power from the main dc bus through the wing flap control circuit breaker on the copilot's lower circuit breaker panel.

Note

> The landing gear warning horn is interconnected with the flap system. When the flap lever is set at approximately 70 percent or more with the landing gear up, the landing gear warning horn will sound; it cannot be silenced until the landing gear is down and locked or the flap lever is retracted above 70 percent.

Flap Lever Friction Knob.

A flap lever friction knob (figure 1-57) is located on the flap control panel. Turning the knob clockwise mechanically tightens the friction on the flap cables, preventing the flap lever from vibrating out of its set position.

Wing Flap Selector Valve.

A wing flap selector valve (figure 5-5) is mounted on the left hydraulic panel, forward of the left wheel well. It is a solenoid-operated valve, directing the flow of utility hydraulic fluid to either the up or down side of the flap motor for normal raising and lowering of the flaps, depending on the position of the flap lever. Override controls, consisting of two buttons marked RAISE and LOWER, are located on the selector valve for use in case of electrical failure. Pushing the button marked LOWER routes hydraulic fluid to release the flap brakes and to the gearbox drive motor to lower the flaps. Pushing the button marked RAISE routes hydraulic fluid to release the brakes and to the gearbox

flap system

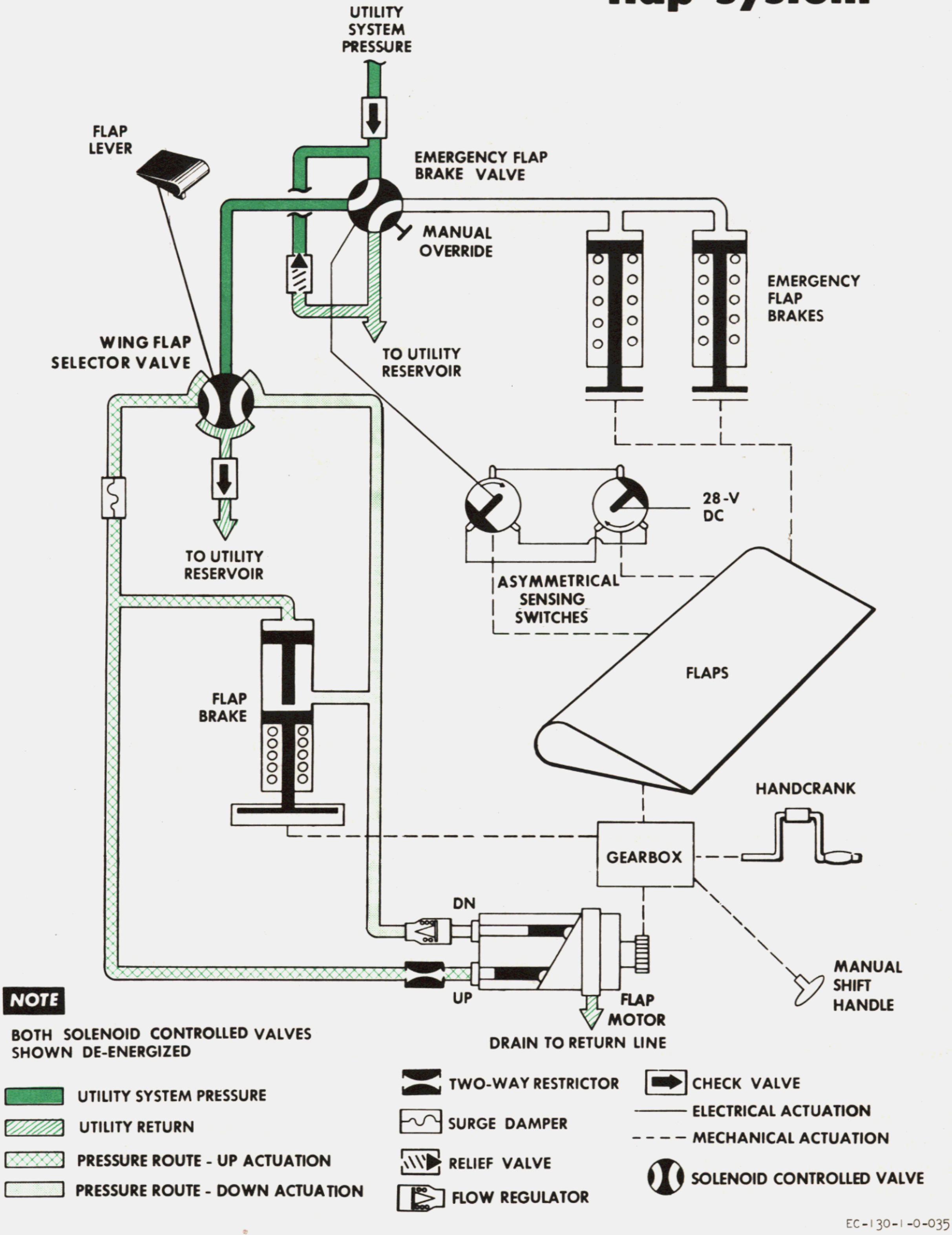


Figure 1-56.

flap control panel

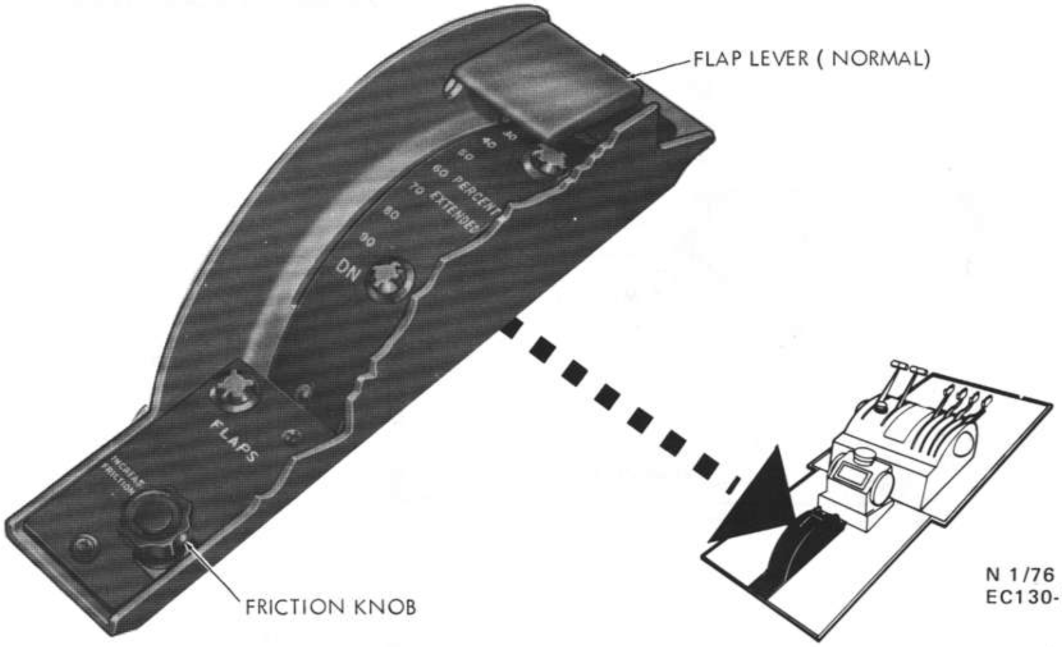


Figure 1-57.

drive motor to raise the flaps. In normal operation, the valve is energized by 28-volt, dc power from the main dc bus through the wing flap control circuit breaker on the copilot's lower circuit breaker panel.

Manual Operation.

An emergency method of operating the flaps mechanically is provided by an extension stub shaft connected through a universal joint to the torque shaft which drives the flap screwjacks. The extension stub shaft and the handcrank are located on the forward wall of the left main landing gear wheel well. (See FLAP SYSTEM FAILURE in Section V for manual operation.)

Emergency Flap Brake Valve.

The emergency flap brake valve is a solenoid-operated hydraulic valve, located on the left hydraulic panel forward of the left wheel well. In its de-energized position, hydraulic pressure passes through it to the flap selector valve. It is equipped with a manual override that unlocks the emergency flap brakes. In the event that a torque tube in the system breaks or a coupling comes apart, the asymmetric sensing switches located at the ends of the torque tubing will sense the resulting out of phase condition. This sensing is immediately translated to the emergency flap brake valve by 28-volt, dc power through the wing flap control valve circuit breaker on the copilot's lower circuit breaker panel to energize the brake valve and lock the flap brakes before further motion of the flaps can occur. The flaps cannot then be raised or lowered by any means until the manual override is moved. The manual override resets the emergency flap brake valve, releasing the emergency flap brakes. (See ASYMMETRICAL FLAP POSITIONING in Section V.)

WARNING

The manual override is for ground use only.

Emergency Flap Brakes.

There are two emergency flap brakes, located one at each of the outboard flap drive gear boxes. The emergency flap brakes are spring loaded released and hydraulically applied by pressure supplied through the emergency flap brake valve. When actuated, the brakes lock the flaps, preventing any further motion of the flaps. The brakes are released by operating the emergency flap brake valve manual override.

Flap Position Indicator.

A flap position indicator is located on the copilot's instrument panel (figure 1-90). The indicator is connected to a transmitter that is mounted on the flap drive control unit located on the aft face of the wing rear beam. The indicator dial is calibrated from UP to DOWN in increments of 10 percent. The indicator system is energized by 28-volt, dc power from the main dc bus through the tabs & flaps position indicators circuit breaker in the aft fuselage junction box.

LANDING GEAR SYSTEM.

The landing gear system includes a dual-wheel, steerable nose gear and two tandem-mounted main landing gears. Normal operation of the system is through the utility hydraulic system. The nose gear retracts forward into the nose section of the fuselage; the main landing gears retract vertically into the left and right wheel well on either side of the fuselage. In the retracted position, all landing gears are enclosed by mechanically operated flush doors. A landing gear position-indicating system gives a visual and audible indication of an unlocked condition of the landing gear. Under normal operation, the time required for the nose and main landing gear to retract or extend is 19 seconds or less.

MAIN LANDING GEAR.

The main landing gear system (figure 1-58) consists of four wheels, two mounted in tandem on each side of the fuselage. Each wheel has a separate strut. The landing gear actuation system is normally supplied hydraulic fluid under pressure by the utility system. Fluid from the utility system flows through a landing gear control valve to each of the two main landing gear motors. Each pair of struts is raised and lowered in vertical tracks by screwjacks driven by torque shafts which are powered by the hydraulic motor through a gearbox. A flow regulator in the up line controls the flow of hydraulic fluid from the motor to return and controls the lowering time of the gear. A flow regulator in the down line controls the raising time of the gear by regulating the flow of return fluid. A controllable restrictor valve is located in the up line between the flow regulator and the hydraulic motor. It is mechanically actuated at a point approximately 1 inch from the fully retracted position by a bracket located in the top of the front strut of each main landing gear. The bracket depresses a plunger, closing the valve opening to a small orifice, thus slowing up approximately the final 0.8 inch of retraction of the main landing gear. The gear box contains a main landing gear spring-loaded brake assembly which holds the gear in the UP position until released by hydraulic pressure or by mechanical means. With the main gear down and the aircraft on the ground, friction washers on the screwjack assemblies serve as down locks. Mechanical linkage between the aft main landing gear struts and the doors causes the doors to open and close as the main landing gears are extended and retracted. Manual release cables attached to emergency engaging handles provide an alternate means of releasing the gear brake mechanisms in case of complete loss of utility hydraulic pressure. One emergency release handle is located on the forward side of each main landing gear wheel well. Six pressure-sealed doors, three on each wheel well bulkhead, are provided to permit access to malfunctioning main landing gear components while in flight. Each door is retained by bolts which can be removed by either of two extension handcranks stowed near the wheel well bulkheads. Glass panels, two on each wheel well bulkhead, permit visual inspection of the main landing gears. A positive down condition may be determined by checking if the ball nut is resting on the lower bumper stop at the shelf bracket.

MANUAL OPERATION PROVISIONS.

Emergency methods of actuating the main landing gear mechanically or manually are provided by means of emergency engaging handles, two extension stub shafts, two handcranks, a main landing gear emergency extension wrench (EC-130Q aircraft and EC-130G aircraft modified by C-130 AFC No. 104), and six easily removed pressure-sealed doors. The two emergency engaging handles, one located on the forward side of each wheel well bulkhead, are connected by cables to their respective gearbox assemblies. Pulling an emergency engaging handle disengages the hydraulic brake mechanism in the gearbox assembly and, simultaneously, shifts the gearbox from power to manual drive. Either handcrank (one is located on each side of the fuselage near the wheel well bulkheads) can then be used to operate the appropriate extension stub shaft. The shaft is connected by mechanical linkage to the gearbox assembly which drives the retraction screwjacks. One extension stub shaft is mounted on the forward wall of each main landing gear wheel well. The emergency extension wrench is provided for manually extending the main landing gear after both the normal and emergency extension systems have failed. Use of the wrench requires removal of the pressure-sealed doors in the wheel well. The upper of the six pressure-sealed doors (there are three on each wheel well bulkhead) provide access to the main landing gear hydraulic gearboxes, permitting manual release of the respective hydraulic brake mechanism in the event of manual release cable jamming or failure. Release of the hydraulic brake mechanism will be accompanied by a shift of the gearbox mechanism from power to hand drive. The lower doors provide access to the respective vertical torque shafts, permitting limited maintenance on some of the components of the torque shaft. The bolts retaining each of the pressure-sealed doors can be removed with a handcrank. Two glass panels are located on each of the right and left wheel well bulkheads. These panels are used for visual inspection to determine whether or not the main landing gear is fully extended. The landing gear down-and-locked indicators remain operative during manual operation.

NOSE LANDING GEAR.

The nose landing gear is a swinging-type gear, extending down and aft, actuated by a hydraulic cylinder, and secured in the up and down positions by locks. The gear is normally supplied with hydraulic fluid under pressure by the utility supply system, or by the auxiliary hydraulic system (for emergency extension only). Hydraulic fluid from either the up or down side of the landing gear uplocks and downlocks and to the nose landing gear actuating cylinder (figure 1-59). Fluid for the nose landing gear steering control valve is supplied from the landing gear control valve in the down position only. A two-way flow regulator restricts the flow of hydraulic fluid to and from the cylinder in order to modulate landing gear actuation. A shuttle valve connects the utility pressure down line to the auxiliary system pressure line, permitting the respective pressure to be used to place the nose gear in the down-and-locked position when the utility system is inoperative. The manual release handle at the flight station provides a mechanical means of unlocking the nose gear uplock. The auxiliary system motor-driven pump, or handpump may be used to unlock the nose gear uplock and must be used to pump the nose landing gear into the down-and-locked position. A removable access panel, which also includes the inspection window, is provided for emergency nose landing gear extension. There are no provisions for emergency retraction of the nose landing gear.

LANDING GEAR LEVER.

A landing gear lever (figure 1-60) is located on the left side of the copilot's instrument panel. It is a two-position (UP, DOWN) lever which directs the gear actuating mechanism to raise or lower the nose and main landing gears. When the lever is moved to UP position, a solenoid-operated selector valve directs pressure from the utility hydraulic system to release the nose gear downlock and the landing gear retracts. When the lever is moved to the DOWN position, the nose landing gear uplock is released, the main landing gear brake locks which hold the gear in the up position, are released, and the landing gear extends. The valve circuit is powered by 28-volt dc from the essential dc bus through the landing gear control circuit breaker on the copilot's lower circuit breaker panel. A mechanical locking device is engaged when the landing gear is moved to the DOWN position, so that the lever stays in the DOWN position until released. During take-off or in flight, the open position of the touchdown switch energizes the landing gear lever release solenoid to reduce the locking device to a simple detent. At other times the lock release finger latch must be pulled down before the landing gear lever can be moved to the UP position.

MAIN LANDING GEAR TOUCHDOWN SWITCH.

A touchdown switch is installed on the lower aft side of each forward main gear strut. The switches are safety devices which either prevent some aircraft system from operating or permit it to operate when the aircraft is on the ground or in flight. The weight of the aircraft on the gear operates these switches. Some systems are wired directly through the touchdown switches and others operate through relays which are controlled by the touchdown switches. Systems that are affected by the touchdown switches and relays are as follows:

1. Touchdown switch

   a. Engine ground stop (inop in flight)

main landing gear system

NOTE

All Valves Are Shown De-energized. After Gear Down Has Been Selected, The Landing Gear Control Valve Will Remain In Down Position Until Gear Up Solenoid Is Energized.

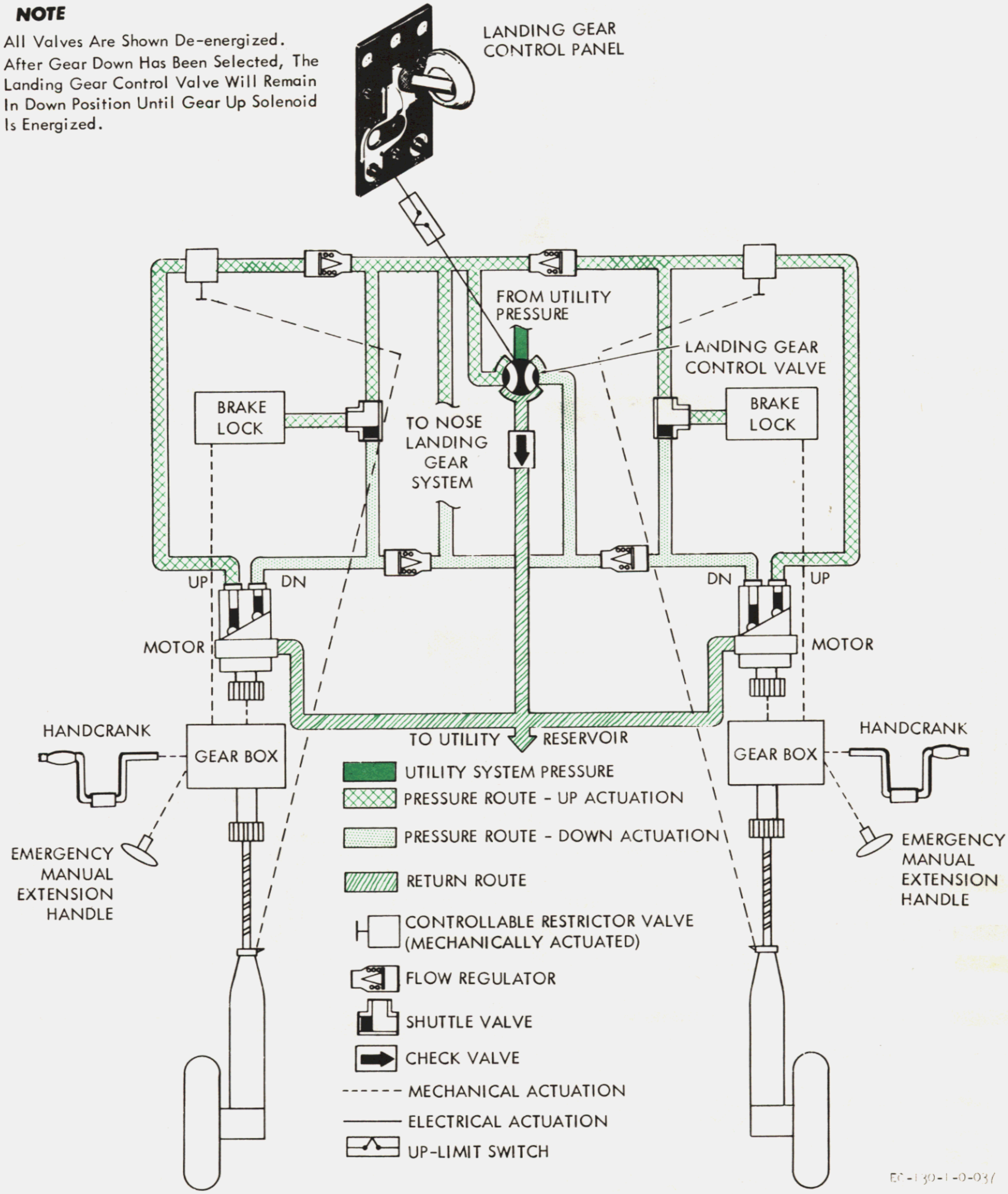


Figure 1-58.

nose landing gear system

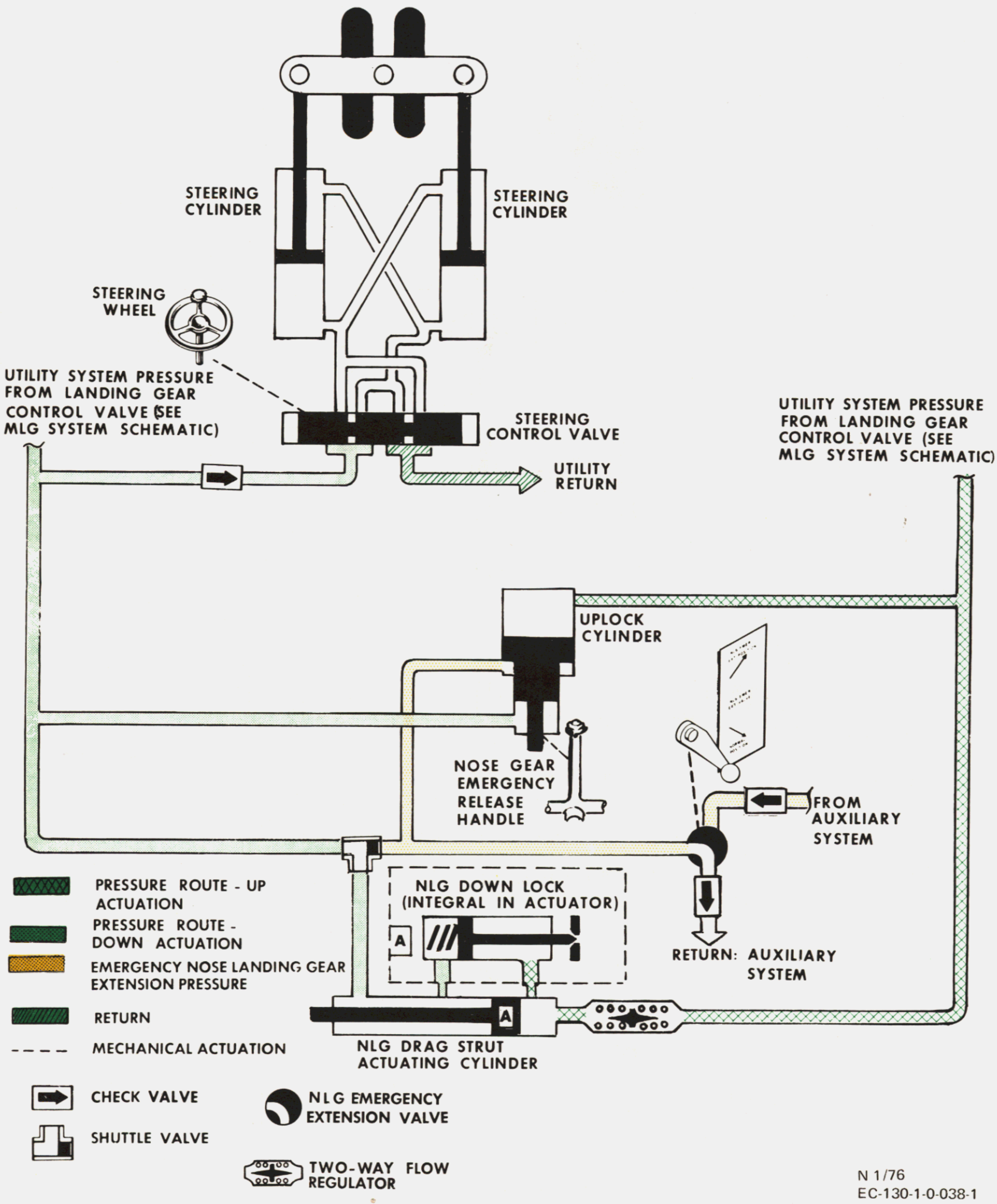


Figure 1-59.

landing gear control panel

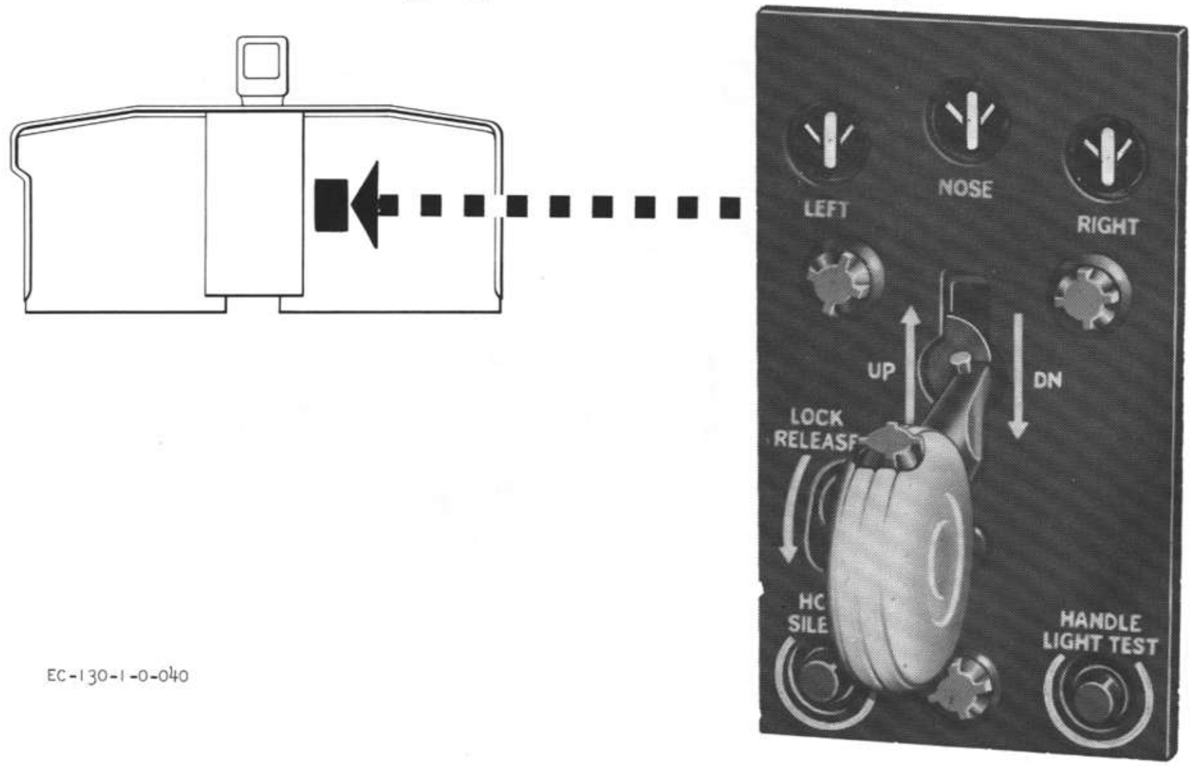


Figure 1-60.

b. Nacelle preheat (inop in flight) (EC-130G aircraft only)

c. Dump mast shutoff valves (closed on ground, open inflight)

2. Touchdown relay

a. Landing gear control handle lock (unlocked in flight)

b. Wheel brakes (anti-skid) (brakes inop in flight)

3. Auxiliary touchdown relay

a. GTC control power and door control (inop in flight)

b. DC bus tie control (inop in flight)

EMERGENCY ENGAGING HANDLE.

A yellow emergency engaging handle is located on the forward wall of each wheel well, just below the extension shaft of the landing gear manual operation stub shaft. The handle operates a cable which disengages the main landing gear hydraulic brake and the drive motor, and simultaneously engages the mechanical linkage which connects the stub shaft to the gearbox, thereby permitting manual raising or lowering of the main landing gear. The yellow handle must be pulled outward and locked before the landing gear can be extended or retracted manually. After each manual extension or retraction of the main landing gear, the handle must be turned one-quarter turn clockwise to unlock, and then be released to the normal position.

Proper positioning of the emergency engaging handle can be verified by rotating the handcrank in both directions. If the handle is in the normal position, the handcrank will rotate freely.

Landing Gear Handcrank.

Two landing gear handcranks are provided for the manual operation of the main landing gear. One handcrank is stored in retaining clips on the forward face of the left wheel well, and the other is stored on the forward access panel of the right wheel well. One end of each crank is made to fit over the

nose landing gear ground lock

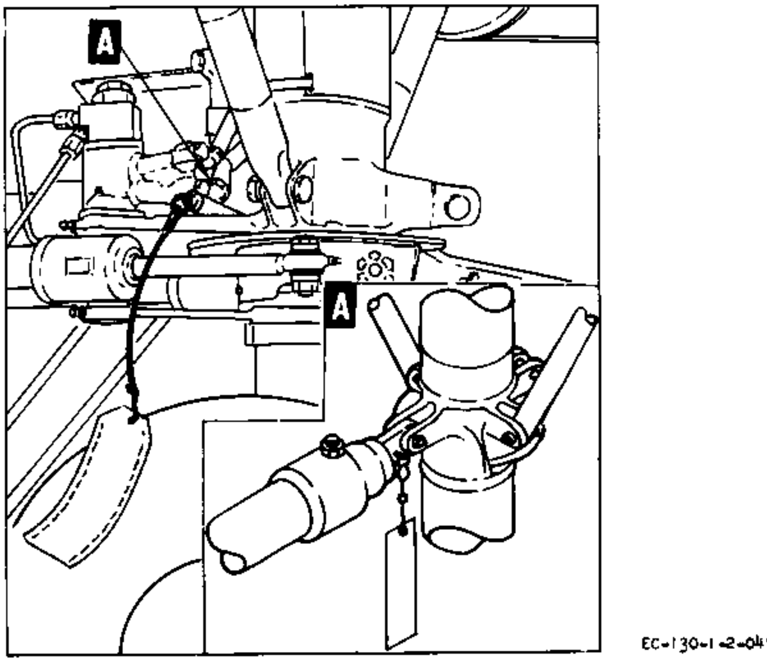


Figure 1-61.

protruding end of the extension stub shaft. An extension stub shaft is located on each wheel well forward wall, just above the emergency engaging handles.

Main Landing Gear Emergency Extension Wrench.

The emergency extension wrench is provided for manual extension of the main landing gear after both the normal and emergency extension systems fail to extend the gear. The wrench has a fixed socket on one end and a ratchet and socket on the other end. The wrench is used to manually rotate the landing gear ballscrews to lower the struts. The wrench is stowed on the forward face of the left wheel well.

Main Landing Gear Ground Lock.

Two main landing gear ground locks are provided for use while performing maintenance on the gear, to prevent accidental retraction of the main landing gears. The locks are installed on the hexagonal ends of the main landing gear screw assemblies, one lock on each side of the aircraft. The locks are stowed in the miscellaneous equipment box aft of the right paratroop door.

Nose Landing Gear Ground Lock.

A nose landing gear ground lock (figure 1-61) is provided to prevent accidental retraction of the nose landing gear while the aircraft is parked. The ground lock consists of a ball-lock pin which is inserted in a hole in the actuator rod-end and prevents release of the internal downlock of the actuator.

Nose Gear Emergency Release Handle.

A nose gear emergency release handle (figure 1-62) is located below the floor of the flight station under a hinged panel between the copilot's seat and the control pedestal. The handle operates a cable system which releases the nose landing gear uplock and allows the nose gear to fall free.

nose gear uplock emergency release handle

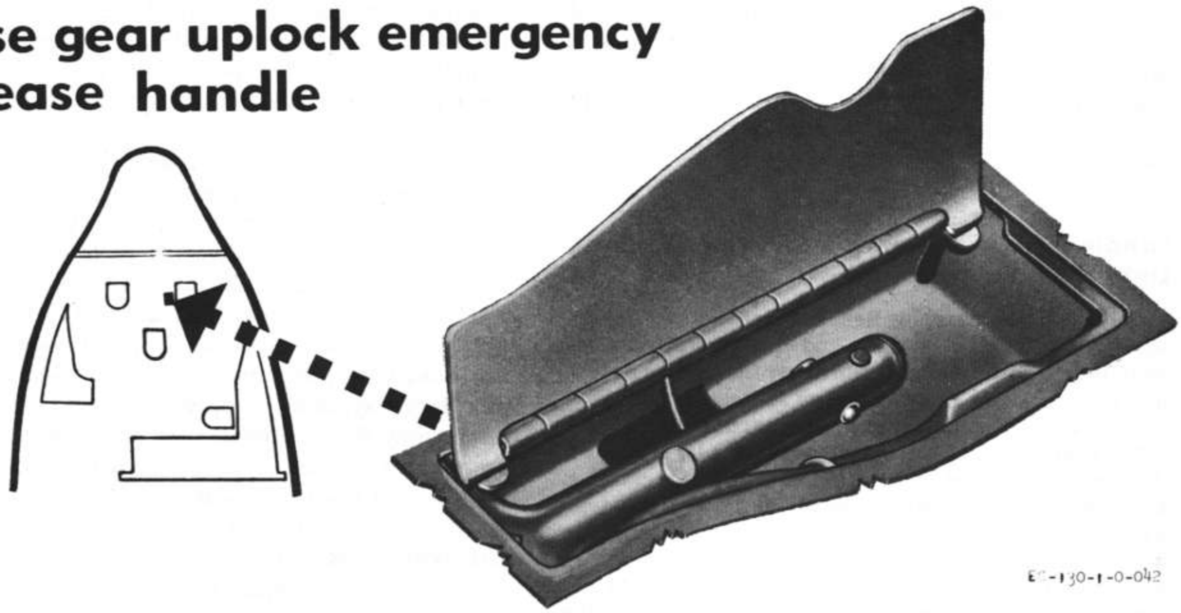


Figure 1-62.

Note

Dropping the nose gear by pulling the emergency release handle may allow air to enter the hydraulic system and may require bleeding before normal operation will be restored. Also, use of this method of lowering the nose landing gear can cause a small amount (approximately 1 quart) of hydraulic fluid to be transferred from the utility supply system to the auxiliary system reservoir, each time the release handle is operated. As a result, practice use of this method of lowering the nose landing gear is not recommended and should be avoided.

LANDING GEAR SYSTEM INDICATORS.

Landing gear warning signals are presented by a horn and a light. Landing gear positions are indicated by three indicators.

Note

The landing gear warning horn and light operate from the same circuit. Failure of either individual landing gear warning circuit will cause the horn to remain in silent and the light to remain out.

Landing Gear Warning Horn and Silence Switch.

The landing gear warning horn is located above and to the left of the pilot's seat. Two things will cause the landing gear warning horn to sound: retarding a throttle to a position 5 degrees forward of the FLIGHT IDLE position with the landing gear not fully extended, and extending the flaps more than approximately 70 percent with the landing gear up. A warning horn silence switch (figure 1-60) is located on the landing gear control panel. It is a press-type switch used to silence the landing gear warning horn when a throttle is retarded. It will not silence the horn when flaps are extended more than 70 percent. When the switch is pressed, the horn-silencing relay is actuated, and the warning horn electrical circuit is broken. Cycling of the landing gears or advancement of an engine throttle will reset the horn-silencing relay, so that the horn can sound again. The landing gear warning horn circuit is energized by 28-volt, dc power from the essential dc bus through the landing gear warn light circuit breaker on the copilot's lower circuit breaker panel.

Landing Gear Warning Light and Warning Light Test Switch.

The landing gear warning light is connected to the landing gear retraction system and the throttle warning switches; it will illuminate whenever the landing gear is not in a locked position, or when an engine throttle is retarded to a position 5 degrees forward of the FLIGHT IDLE position and the landing gear is not fully extended. A warning light test switch (figure 1-60) is located on the landing gear control panel. It is a press-type switch, used to test the continuity of the landing gear warning light electrical circuit. When the switch is pressed, the landing gear warning light bulb in the landing gear lever handle will illuminate. Failure of the bulb to illuminate shows a defective circuit. The landing gear warning light is energized by 28-volt, dc power from the essential dc bus through the landing gear warn light circuit breaker on the copilot's lower circuit breaker panel.

Landing Gear Position Indicators.

A left main gear position indicator, a nose gear position indicator, and a right main gear position indicator (figure 1-60) are located on the landing gear control panel. These indicators give a visual indication of position of the landing gear. When the letters UP appear on the face of an indicator, it means that the gear represented by that indicator is retracted and locked. When the picture of a landing gear wheel appears on the face of an indicator, it means that the landing gear represented by that picture is extended and locked. Diagonal stripes on the face of an indicator mean that the landing gear represented by that indicator is somewhere between the extended and retracted positions or that the indicator is inoperative. The landing gear position indicators are energized by 28-volt, dc power from the essential dc bus through the landing gear position and circuit breaker on the copilot's lower circuit breaker panel.

BRAKE SYSTEM.

On EC-130 aircraft a hydraulically operated tri-metallic, multiple disc brake is installed on each of the four main landing gear wheels. The nose landing gear wheels do not have brakes. The brakes normally operate from utility hydraulic system (figure 1-63) pressure with an alternate supply available through the auxiliary hydraulic system. If electrical power is lost to the brake selector valve, the system which has the higher pressure will supply the pressure to operate the brakes. Fluid flows through a brake pressure selector valve to the right and left brake control valves. When the fluid leaves the brake control valves, it flows through the anti-skid valves and shuttle valves to the brakes. Each of the two halves (left and right) of the brake system contains a brake control valve, a dual anti-skid valve, and two brake shuttle valves. The auxiliary system supply flows through the emergency brake pressure selector valve. When the emergency brake system is actuated, fluid is directed to the brake control valves, then through shuttle valves directly to the brakes, bypassing the anti-skid valves. Utility or auxiliary system pressure is selected by manually positioning a brake pressure switch. Auxiliary system handpump pressure can also be used for brake operation for towing operations when utility or auxiliary hydraulic system pressure is not available. This will give only one brake application, therefore the brake pedals should be depressed firmly and held when braking is required. System pressure will not build up when the brake pedals are pumped on and off while the auxiliary system handpump is being operated.

BRAKE SYSTEM ACCUMULATORS.

Air-charged accumulators are used in both the normal brake and the emergency brake hydraulic systems to increase the supply of hydraulic pressure in case of a pressure failure. The accumulator in the normal brake system, when fully charged with hydraulic fluid, is capable of supplying pressure for about two brake applications. The accumulator in the emergency brake system, having one-half the capacity of the normal brake system accumulator, is capable of supplying pressure for about one additional brake application.

BRAKE ANTI-SKID PROVISIONS.

Skidding due to excess brake application during normal brake operation is controlled by an anti-skid system, which is actuated as skidding commences and releases brake pressure until the skid condition is corrected. The EC-130 aircraft uses a modulating individual wheel control anti-skid system. A skid at any wheel will reduce pressure to that brake only. (See ANTI-SKID SYSTEM in this section.)

brake system

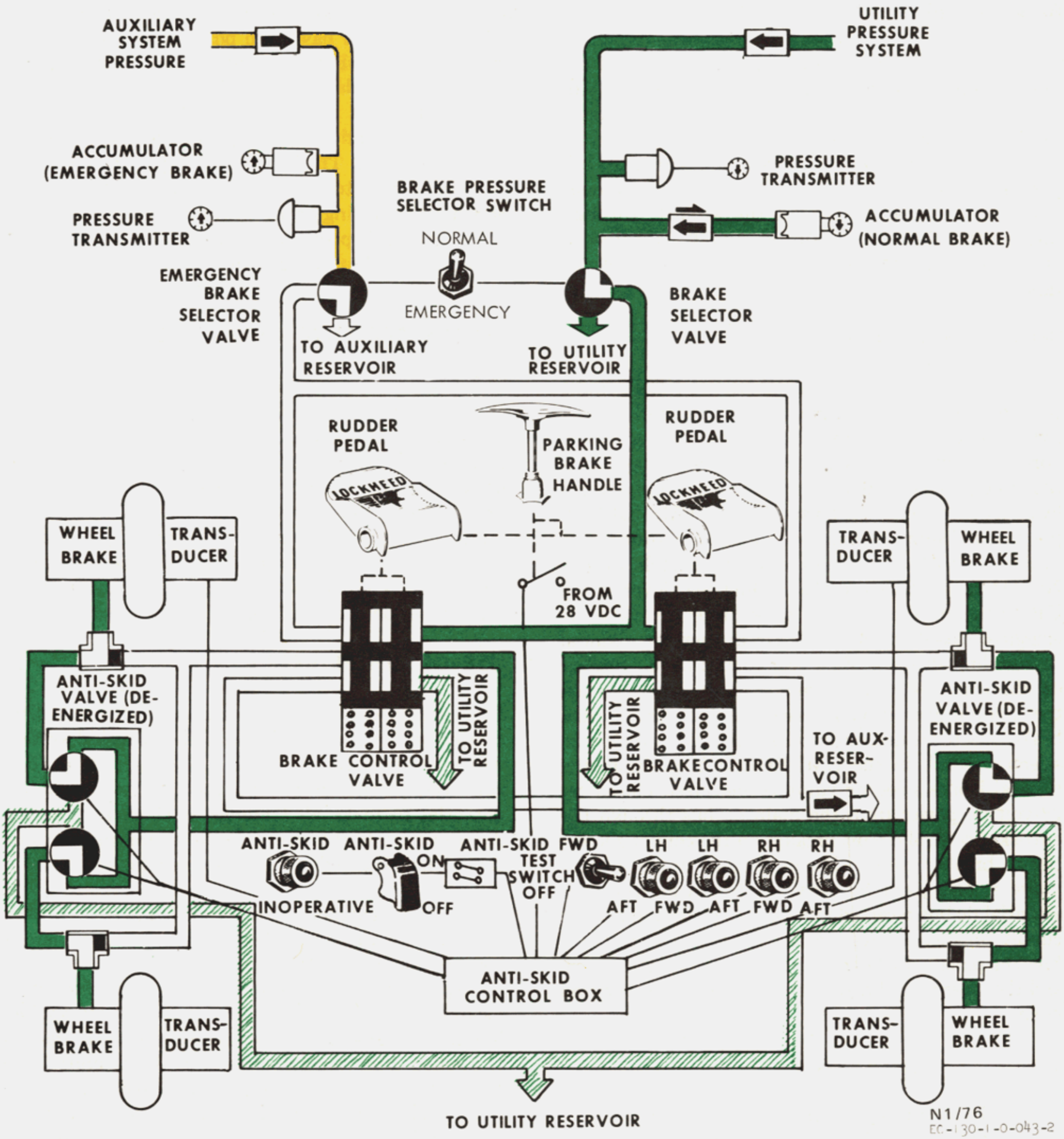


Figure 1-63.

BRAKE SYSTEM CONTROLS.

Mechanical and electrical brake system controls are furnished to operate the brakes by hydraulic power.

Brake Pedals.

Actuation of the brakes is through application of toe pressure on the rudder pedals at either the pilot's or copilot's station. The amount of braking force is proportional to the force applied to the brake pedals. The right pedals actuate the right brakes, and the left pedals actuate the left brakes. This arrangement allows directional control of the aircraft through differential braking. Normal brake pressure is available any time the landing gear handle is in the down position.

Brake Pressure Selector Switch.

A two-position (NORMAL, EMERGENCY) brake selector toggle switch (figure 1-50) located on the hydraulic control panel provides selection of either normal or auxiliary hydraulic pressure for applying the brakes. The NORMAL position will supply utility hydraulic pressure to the brakes, and the EMERGENCY position will supply auxiliary hydraulic pressure to the brakes. With the brake selector switch in the NORMAL position and the landing gear lever in the UP position, the normal brake selector valve is energized closed by 28-volt dc power from the essential dc bus through the landing gear control circuit breaker on the copilot's lower circuit breaker panel. When the landing gear lever is placed to DN, the normal brake selector is deenergized to open. With the brake selector switch in the EMERGENCY position, the normal brake selector valve is energized closed by 28-volt dc power from the main dc bus through the anti-skid control circuit breaker on the copilot's lower circuit breaker panel. The emergency brake selector valve is energized by 28-volt, dc power from the essential dc bus received through the emer brake valve circuit breaker located on the copilot's lower circuit breaker panel. Both the normal brake selector valve and the emergency brake selector valve are deenergized open.

Note

> In case of dc electrical power failure, the deenergized valves admit both utility and auxiliary hydraulic system pressures to the brake system. The shuttle valve is positioned by the system supplying the greater pressure.

Parking Brake Control Handle.

A parking brake control handle (figure 1-64) is located in front of the pilot's seat, to the right of the pilot's right foot rest. The control handle is mounted on a panel support and is attached to a flexible cable. This cable pulls a pawl into position so that it locks the brakes into whatever position they are set by the action of the rudder pedals. The brakes are set for parking by first depressing the toe section of the rudder pedals and then pulling out the parking brake control handle. The brakes are released by again depressing the toe section of the rudder pedals. Setting the parking brake while the anti-skid switch is in the ON position deenergizes the anti-skid system and illuminates the anti-skid inoperative light.

BRAKE PRESSURE INDICATORS.

Two brake pressure indicators (figure 1-50) are located on the hydraulic control panel at the bottom of the copilot's instrument panel. The indicators are connected to pressure transmitters in the pressure lines of the brake control system and register the hydraulic pressure available in the brake sections of both the utility and auxiliary hydraulic systems. The indicators are energized by 26-volt, ac power from the instrument transformers through the brake emer and normal brake fuses on the pilot's lower circuit breaker panel.

USE OF WHEEL BRAKES.

It is absolutely necessary that aircraft brakes be treated with respect. Although the anti-skid system will give consistently shorter landing rolls on dry runways, it should not be used to its maximum potential to make all landings as short as possible. To minimize brake wear, the following precautions should be observed insofar as practicable:

1. Use extreme care when applying brakes immediately after touchdown or at any time there is considerable lift on the wings if the anti-skid system is inoperative. A heavy brake pressure can result in locking the wheels more easily if brakes are applied immediately after touchdown than if the same pressure is applied after the full weight of the aircraft is on the wheels. A wheel once locked in this manner will not unlock when the load is increased, as long as brake pressure is maintained. Brakes, by themselves, can merely stop the wheel from turning. Stopping the aircraft is dependent on the friction of the tires on the runway. There are two reasons for this loss of braking effectiveness in a skid. First, the immediate

parking brake handle

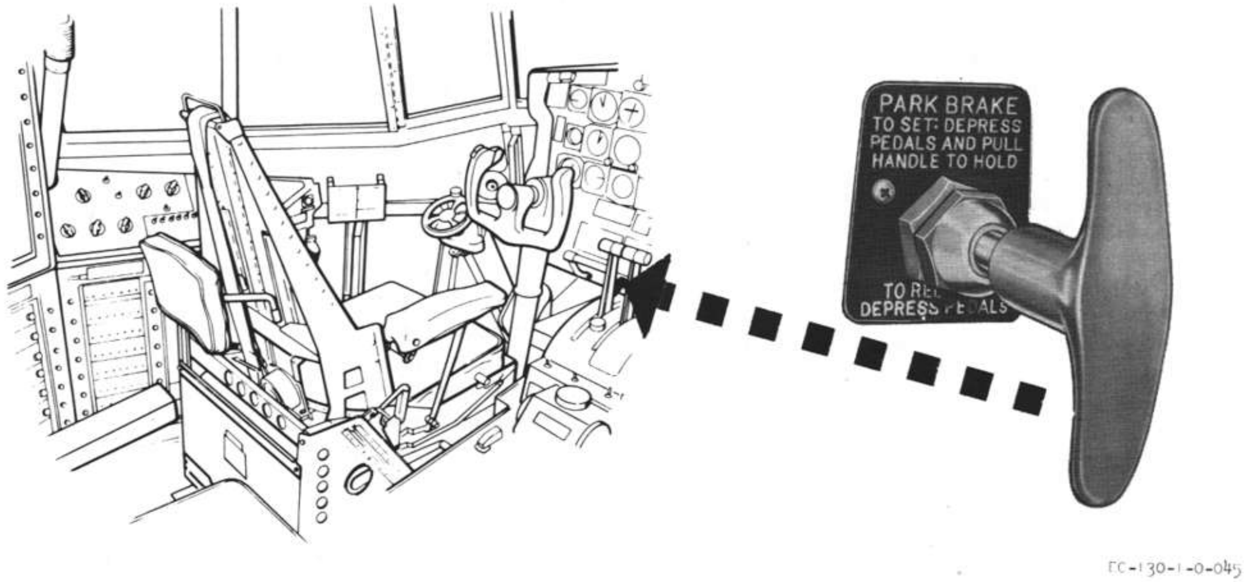


Figure 1-64.

action is to scuff the rubber, tearing off little pieces which act like small rollers under the tire. Second, the heat generated starts to melt the rubber and the molten rubber acts as a lubricant. Therefore, if one pair of wheels is locked during application of brakes, there is a tendency for the aircraft to turn away from the locked wheels, and further application of brake pressure to those wheels will offer no corrective action. Since the coefficient of friction goes down when a wheel begins to skid, it is apparent that a wheel, once locked, will never free itself until brake pressure is reduced.

2. Anti-skid systems are intended to prevent skids at high speeds under light wheel loads. Therefore, brakes may be applied immediately after touchdown, with anti-skid, but this should be done only when definitely necessary. The anti-skid system will function to prevent tire skidding if it is operating properly; however, it is not designed to perform as a completely automatic braking system. Continuous braking from the point of touchdown will result in considerable overworking of the anti-skid system in addition to causing excessive wear and extreme heating of the brakes.

3. If maximum braking is required after touchdown, lower the nose as soon as possible, and apply the brakes. Reverse thrust should be used, whenever possible.

4. For short-field landings, a single, smooth application of the brakes with constantly increasing pedal pressure is most desirable.

5. If maximum braking has been used in landing, it is recommended that the gear be left extended after subsequent take-off for a minimum of 15 minutes before retraction or before another braked landing is attempted. The parking brakes should not be set if the airplane is parked subsequent to such a landing, and the aircraft should be taxied using the minimum amount of brakes necessary for safety.

6. The full landing roll and propeller reversing should be used at all times to minimize the use of brakes.

7. After the brakes have been used excessively, make an inspection of the brakes and tires as brake fires are possible. Do not taxi into crowded parking areas or set the parking brake when the brakes are overheated. Peak temperatures occur in the wheel and tire assembly from 15 to 30 minutes after a maximum braking operation. If maximum brakes are used, record on yellow sheet.

WARNING

Do not approach the main wheel area when extreme temperatures due to excessive braking are suspected. If conditions require personnel to be close to an overheated wheel or tire assembly, the approach should be from fore or aft only.

8. Release the parking brakes as soon as possible after the wheel chocks are in place.

ANTI-SKID SYSTEM.

The anti-skid system consists of four wheel-speed transducers, an electrical control box, and two electro-hydraulic servo brake pressure control valves.

ANTI-SKID SYSTEM OPERATION.

The system prevents skidding of wheels when too much brake pressure is applied during aircraft decelerations. This is done through a brake-releasing system, controlled by signals from wheel-speed transducers.

SKID-DETECTOR OPERATION.

The wheel-speed transducer unit mounted in the axle of each main landing gear wheel applies control to the braking operation through the anti-skid valves when the landing gear wheel begins to approach a skid condition. One dual anti-skid valve is located above the booster hydraulic reservoir on the forward wheel-well wall, and the other is on the left hydraulic panel forward of the utility hydraulic reservoir. Each wheel-speed transducer unit contains a frequency generator which senses wheel rotational speed and wheel speed change. The transducers form part of an electrical circuit which prevents landing with brakes on, and which releases brakes in case of a locked condition. Should the wheel speed decrease rapidly, indicating approach of a skid condition, the control box sends an electric impulse to an anti-skid valve which reduces pressure to the affected brake below the pressure which caused sensing of the skid. As subsequent skids are sensed, they are electronically compared with the amount the hydraulic pressure had to be reduced to eliminate earlier skids detected. This comparison results in a more accurate determination of the minimum reduction in brake pressure required to eliminate the skid. The skid detection and control function is independent on each wheel. The skid control system will not function when the brake system is operating from the auxiliary hydraulic system or when the parking brakes are set.

ANTI-SKID SYSTEM CONTROLS AND INDICATORS.

Anti-Skid Switch.

An anti-skid two-position (OFF, ON) guarded toggle switch (figure 1-50) is located on the hydraulic control panel. It is energized by 28-volt dc power from the main dc bus, through the anti skid control circuit breaker on the copilot's lower circuit breaker panel. When the switch is in the ON position, the anti-skid system is operative and becomes an integral part of the wheel brake system. When the switch is in the OFF position the landing gear brake system operates without anti-skid protection.

NEW

Anti-Skid Inoperative Light.

An anti-skid inoperative light (figure 1-50), located on the hydraulic control panel, glows whenever the anti-skid system is not operating as an integral part of the landing gear brake system. It warns the pilot that skid protection has been lost. This light will also illuminate when the parking brake is set. This system is energized by 28-volt dc power from the main dc bus, through the anti-skid fail-safe light circuit breaker on the copilot's lower circuit breaker panel. A functional test of the light circuit is made by pressing on the light bulb cover. Failure of the light to glow shows a defective circuit.

anti-skid test panel (EC-130Q aircraft)

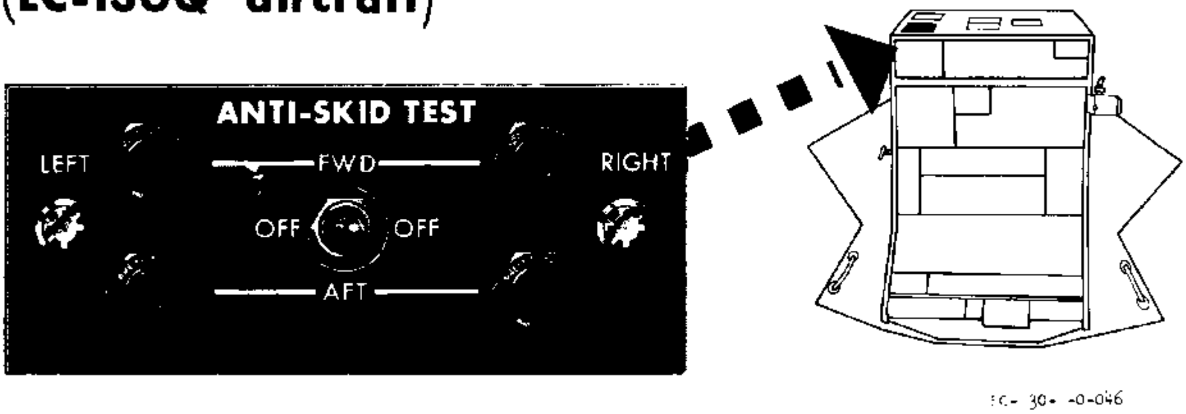


Figure 1-65.

Anti-Skid Test Switch and Indicator Lights.

An anti-skid test panel (figure 1-65) is located on the aft end of the overhead control panel. The test panel contains a three-position (FWD, OFF, and AFT) anti-skid test switch (the FWD and AFT positions are spring-loaded to return to the OFF Position when released) and four green indicator lights identified as LH FWD, RH FWD, LH AFT, and RH AFT. During a ground test, when the test switch is placed in the FWD position, 26-volt, 400-Hz power obtained from the ac instrument and engine fuel control bus through the anti-skid test circuit breaker, located on the pilot's lower circuit breaker panel is applied to the anti-skid control box to simulate high speed wheel rotation. When the switch is released to the OFF position the control box detects that the wheels have abruptly stopped and appear to be in a full skid. The control box immediately generates a dump signal which causes the anti-skid valve to release all brake pressure on the forward wheel brakes. The dump signal causes the FWD lights to illuminate momentarily. Illumination of the lights indicates that the anti-skid control box would have properly responded to an actual skid. When the test switch is placed in the AFT Position and released, the AFT indicator lights should illuminate momentarily. Illumination of the lights indicates that the anti-skid control box would have properly responded to an actual skid. During an inflight test, all four lights should illuminate after the landing gear is lowered. This indicates that a locked wheel signal is being fed through the landing gear touchdown switch to the anti-skid control box. The control box in turn feeds a continuous dump signal to the anti-skid control valves. When the test switch is placed in FWD position the locked wheel signal is removed causing the control box to remove the dump signal and all four lights go out. When the test switch is released to OFF the locked signal is reapplied to the forward anti-skid circuits causing the FWD test lights to illuminate. The aft circuits are momentarily desensitized for test purposes. A similar sequence of events takes place when the anti-skid test switch is placed to the AFT position and released.

Note

False indications may be obtained if wheels are rotating after a touch and go landing.

NOSE WHEEL STEERING SYSTEM.

The aircraft is steered during taxiing by directional control of the nose wheel. The nose wheel is hydraulically actuated and governed by a steering

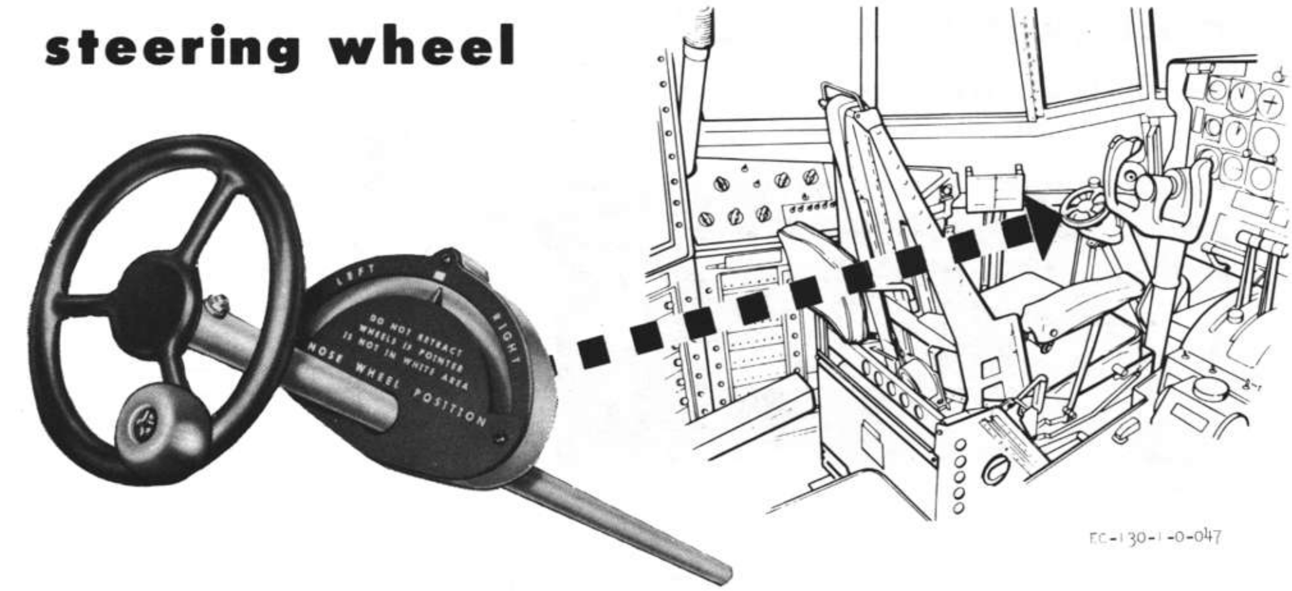


Figure 1-66.

control valve in the utility hydraulic system. The steering control valve is connected by a cable to a manually operated nose steering wheel (figure 1-66) located in the flight station at the left of the pilot's control column. Direction control of the nose wheel is limited by means of mechanical stops to 60 degrees right and left of center. One and one-quarter turns from center position of the nose steering wheel will turn the steering wheel to the full-left or the full-right position. Orifices in the steering cylinders provide snubbing action to dampen oscillations of the nose wheel and to prevent shimmy. Centering cams on the nose gear strut return the nose wheel to a centered position whenever the weight of the aircraft is removed from the nose gear.

AFT CARGO DOOR AND RAMP SYSTEM.

Both the cargo ramp and cargo door are operated with hydraulic pressure supplied by the auxiliary hydraulic system (figure 1-67), or they can be pressurized with a handpump connected to the auxiliary hydraulic system reservoir; however, the cargo ramp is disabled to prevent damage to the long trailing wire exit tube. Control of the system during ground operation is from a ramp control panel located aft of the left paratroop door. Control of the system during flight is from the ramp control panel. Door and ramp control switches on these panels are equipped with guards to prevent accidental opening and equipment damage.

Note

Refer to Section V for emergency operation of the aft cargo door.

AFT CARGO DOOR CONTROL SWITCH.

An aft cargo door control switch is located on the ramp control panel (figure 1-68) aft of the left paratroop door. This three-position (CLOSE, NEUTRAL, OPEN) toggle switch, spring-loaded to the NEUTRAL position, controls the normal ground operation of the aft cargo door. When the switch is held in the OPEN position, the aft cargo door control valve is energized by 28-volt, dc power through the ramp and ADS control circuit breaker on the aft fuselage junction box. The control valve directs hydraulic pressure to the open side of the aft cargo door actuating cylinder to open the aft cargo door. As the door reaches the open position, it engages the aft cargo door uplock assembly which latches mechanically. When the switch is held in the CLOSE position, hydraulic pressure is directed to the aft cargo door uplock cylinder which unlatches the uplock. The control valve then directs pressure to the close side of the aft cargo door actuating cylinder, and the door swings downward to the closed position and locks in place. When the switch is released, the aft cargo door circuit is deenergized and the valves return to a neutral position.

RAMP CONTROL SWITCH.

A ramp control switch is located on the ramp control panel (figure 1-68) aft of the left paratroop door. This three-position (RAISE, NEUTRAL, LOWER) toggle switch, spring-loaded to the NEUTRAL position controls the normal ground operation of the ramp.

When the switch is held in the LOWER position, the ramp control valve is energized by 28-volt, dc power through the ramp and ADS control circuit breaker on the aft fuselage junction box. The control valve directs hydraulic pressure to the up side of the ramp actuating cylinders and to the uplock side of the ramp uplock control valve, until the uplock is unlatched. The hydraulic pressure then is directed to the down side of the ramp actuating cylinders to lower the ramp. When the switch is held in the RAISE position, the ramp control valve directs hydraulic pressure to the up side of the ramp actuating cylinders to raise the ramp. At the same time, pressure is directed into the unlock side of the ramp uplock control valve to unlock the ramp uplock until the ramp is raised into the normal raised position. Pressure then is directed to the lock side of the ramp uplock control valve to lock the ramp in place. When the switch is released, the ramp circuit is deenergized, and the valves return to a neutral position.

RAMP MANUAL CONTROL KNOB.

The ramp manual control knob (figure 1-68) is a rotary selector located above the ramp control panel. It may be set to any of six numbered positions: DOWN - 1 (unlock) and 2 (lower); N (neutral) -3; UP -4 (raise) and 5 (lock); N (neutral) -6. These settings of the knob manually position the system valves which control flow, supplied either from the handpump or the auxiliary hydraulic system electric pump, to and from the ramp actuating and ramp uplock cylinders. When the knob is placed in position 1, hydraulic pressure is directed to the up side of the ramp extension cylinders to raise the ramp off the up locks; then pressure is directed to the unlock side of the ramp uplock cylinder to unlatch the ramp uplocks. When the knob is moved to position 2, pressure is directed to the down side of the ramp actuating cylinders to lower the ramp. Position 3 on the selector knob is a NEUTRAL position. When the knob is moved to position 4, pressure is directed to the up side of the ramp actuating cylinders to raise the ramp. Position 5 directs pressure to the lock side of the ramp uplock cylinders to lock the ramp in the closed position. Position 6 on the selector knob is a NEUTRAL position; the knob should be left in this position when the ramp is not being operated.

AFT CARGO DOOR MANUAL CONTROL VALVE HANDLE.

The aft cargo door manual control valve (figure 1-68) has three positions; OPEN, NEUT (center), and CLOSE. When the handle is set to OPEN, the valve directs hydraulic pressure, either from the handpump or the auxiliary hydraulic system electric pump, to the up side of the door actuating cylinder, thus raising and opening the door. On reaching the fully opened position, the door is secured by a spring-loaded uplock. When the handle is set to CLOSE, hydraulic pressure, either from the handpump or the auxiliary system electric pump, is first directed by the valve to the uplock cylinder to release the uplock engagement of the door, and then is directed to the down side of the door actuating cylinder to lower and close the door. Setting the handle in the NEUT (center) position shuts off hydraulic pressure to the door operating system and leaves the control valve in a position from which it can be actuated by selection at the aft cargo door control switch.

CAUTION

The aft cargo door manual control valve handle and the ramp manual control knob must always be placed at the neutral position when manual operation is not desired, otherwise the door and ramp may open or close when the auxiliary hydraulic pump is switched on.

aft cargo door and ramp hydraulic system

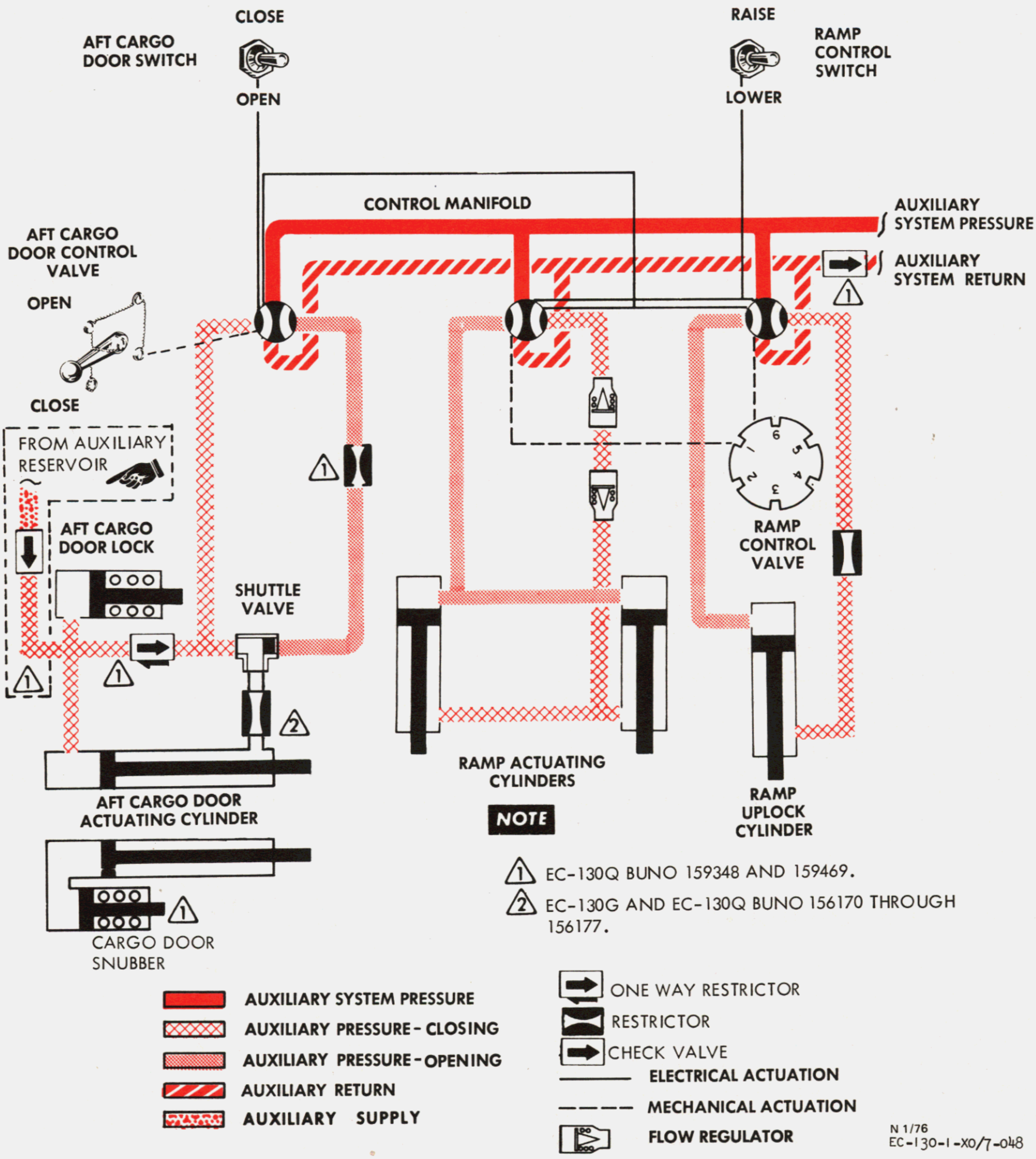
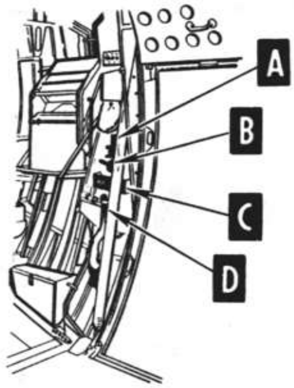
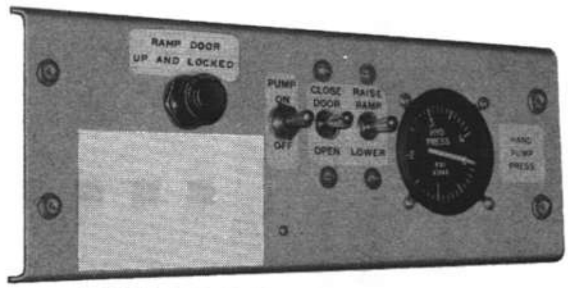


Figure 1-67.

aft cargo door and ramp controls





(COVER AND SWITCH GUARDS REMOVED)

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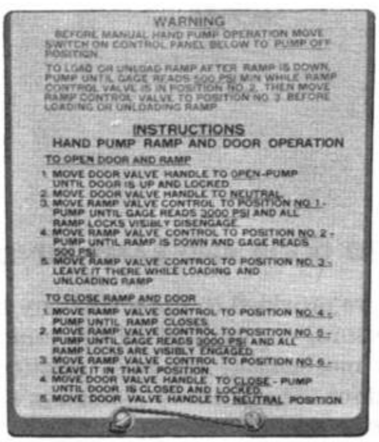

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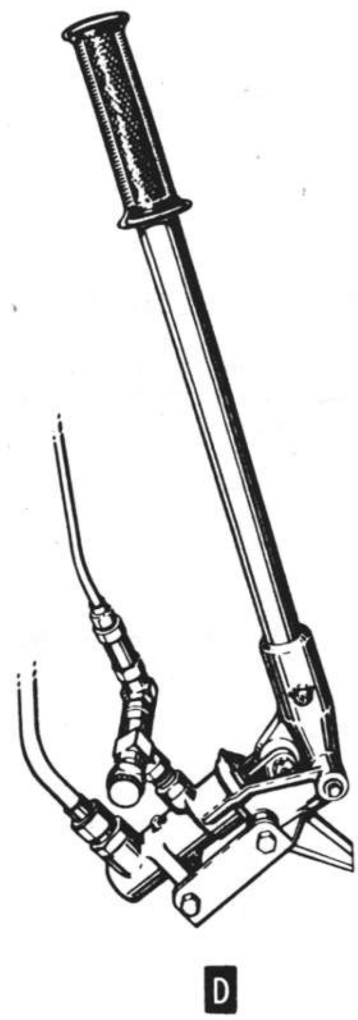

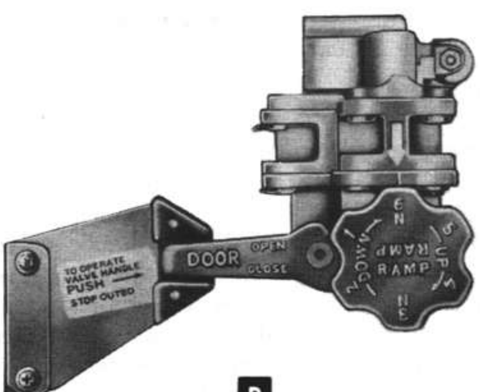

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Figure 1-68.

aft cargo door uplock manual release

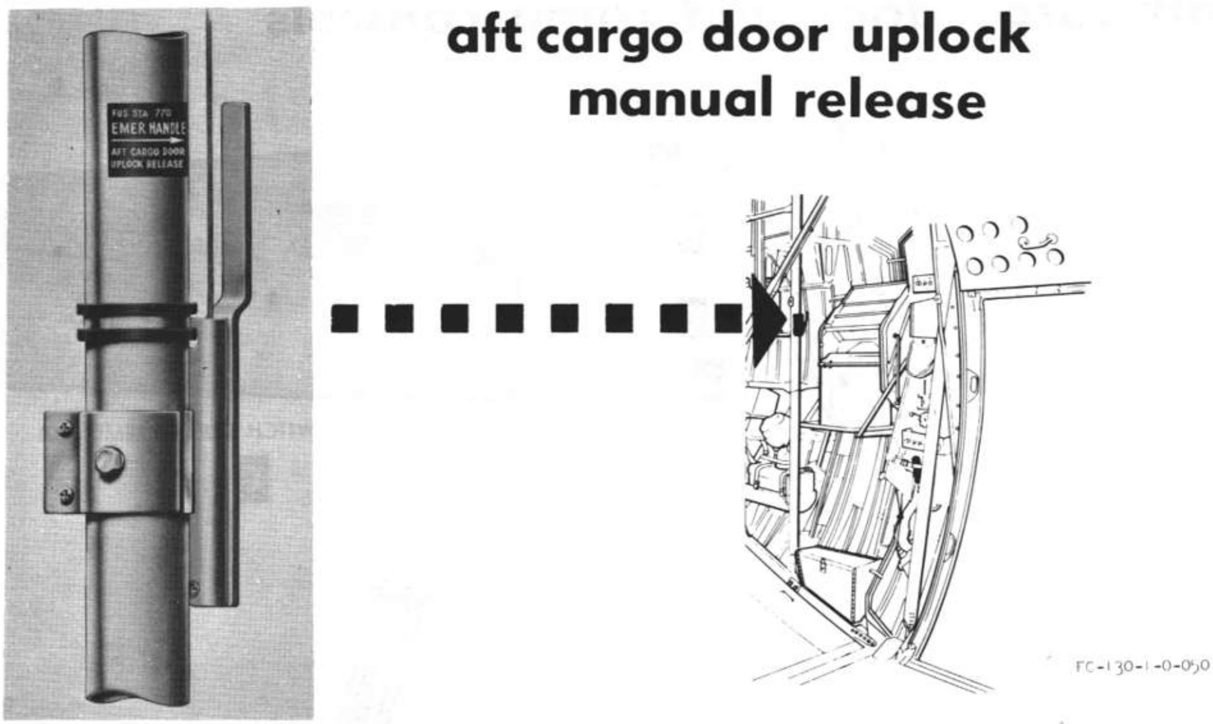


Figure 1-69.

AUXILIARY HYDRAULIC SYSTEM HANDPUMP.

The auxiliary system handpump (figure 1-68), just below the ramp control panel, provides an alternative pressure source to operate the aft cargo door and ramp in an emergency. The handpump can also be used to provide alternative pressure to operate the nose gear for emergency extension.

Aft Cargo Door Uplock Emergency Manual Release Lever.

The aft cargo door uplock manual release (figure 1-69) is a mechanical lever intended for emergency use in the event of failure of the hydraulic system to release the spring-loaded uplock. The lever, connected by a system of cables and pulleys to the door uplock mechanism, is mounted on the outboard side of the tubular strut between the toilet and urinal, aft of the left paratroop door. The lever, normally stowed in the vertical (locked) position, pivots forward and downward when pulled to release the door uplock mechanism. The lever resumes the vertical position when it is released.

AFT CARGO DOOR AND RAMP INDICATORS.

Indicators are provided to show auxiliary hydraulic system pressure, engagement of the cargo door in the uplock mechanism, and open positions of the ramp and door. The pressure indicators are on the ramp control panel and the hydraulic control panel; the door and ramp position indicators are lights on the ramp control panel. The uplock engagement indicator is a mechanically operated metal flag, illuminated by a red inspection light, attached to the aft cargo door uplock mechanism.

Pressure Gages.

The pressure gages, one mounted on the ramp control panel (figure 1-68) and the other on the hydraulic control panel on the copilot's instrument panel, register the pressure of the auxiliary hydraulic system. The gage located on the ramp control panel is direct indicating, while the one on the copilot's instrument panel is electrically operated. The gage on the ramp control panel, although registering the system pressure supplied either by the electric-driven pump or the handpump, is intended primarily for use during handpump operations and is identified as such on the panel.

Aft Cargo Door Uplock Indicator.

The aft cargo door uplock indicator is a black metal flag with a yellow circle. The flag is attached to the uplock mechanism so that when the aft cargo door is open and locked in the up position, the flag will swing down to provide a visual indication. The flag is spring-loaded to return to the masked position whenever the aft cargo door is not locked in the up position. A red inspection light is installed to illuminate the flag indicator. This light is controlled by a two-position (ON,OFF) toggle switch on the aft fuselage junction box and another switch on the forward public address control panel.

AFT CARGO DOOR AND RAMP OPERATION.

CAUTION

The AN/USC-13(V) equipment must be partially disconnected before using normal aft cargo door and cargo ramp operating procedures. Refer to NAVAIR 01-75GAE-2-2 for disconnecting procedures.

Hydraulic pressure for normal aft cargo door and ramp operation is supplied by the auxiliary hydraulic system from an electric-driven pump. It's controlled through a switch on the ramp control panel, or in the event of failure of the normal pressure source, through a handpump connected to the reservoir of the auxiliary hydraulic system. The system control valves can be positioned electrically through switches on the ramp control or manually by means of a control lever and knob (figure 1-68) adjacent to the ramp control panel.

Operation of Aft Cargo Door and Ramp with Electrically-Driven Pump Pressure.

Operation of the aft cargo door and ramp, using pressure from the electric-driven pump in the auxiliary hydraulic system, can be accomplished through the switches on the ramp control panel (figure 1-68).

CAUTION

The ramp manual control knob, above the ramp control panel must be set at the 6N (neutral) position before operating the pump switch on the ramp control panel.

With the pump switch set to ON, the aft cargo door is opened by holding the aft cargo door control switch in the OPEN position until the door is fully opened and retained by the uplock; the ramp then is moved to the desired position by holding the ramp control switch at LOWER.

Note

The ramp can be stopped at any position by releasing the ramp control switch. The cargo door will free-fall back to the closed position if the door control switch is released prior to the moment the door reaches the up-and-locked position.

The ramp is closed by holding the ramp control switch in the RAISE position until the ramp is up and locked.

Note

When being raised, the ramp can be stopped in any position by releasing the ramp control switch.

The door is closed by holding the cargo door switch to the OPEN position and pulling the aft cargo door manual release until the uplock is released.

After the uplock is released, hold the cargo door switch to the CLOSE position until the door is closed and locked.

Manual Operation of Aft Cargo Door And Ramp With Handpump Pressure.

CAUTION

The ramp has been intentionally disabled. No attempt shall be made to operate the ramp or door. The aft cargo door can be used for emergency bailout. Refer to Emergency Procedures, Section V.

After the AN/USC-13(V) equipment has been partially disconnected, the aft cargo door and ramp can be operated manually through the auxiliary hydraulic pressure system by means of the handpump (figure 1-68) located below the ramp control panel. An instruction plate (figure 1-68) for handpump operation of the ramp and cargo door is installed on the side of the fuselage above the ramp control panel.

CAUTION

Before manual handpump operation, check that the pump switch on the ramp control panel is at the OFF position.

To open the aft cargo door and lower the ramp by use of the handpump, proceed as follows:

1. Move the aft cargo door manual control valve handle to OPEN, and operate the handpump until the door is up and locked.

2. Move the aft cargo door manual control valve handle to the NEUT (center) position.

3. Move the ramp manual control knob to the No. 1 (unlock) position; operate the handpump until the handpump pressure gage on the ramp control panel shows 3,000 psi and all the ramp locks are visibly disengaged.

4. Move the ramp manual control knob to the No. 2 (lower) position. Operate the handpump until the ramp is lowered and the handpump pressure gage registers 500 psi.

5. Move the ramp manual control knob to the 3N (neutral) position. Leave the knob in this position while loading and unloading.

CAUTION

Do not use the ramp for loading or unloading when the handpump pressure gage on the ramp control panel shows less than 500 psi. Serious damage may result if the locking action of the ramp cylinders is lost because of insufficient hydraulic pressure.

To close the aft cargo door and raise the ramp by using the handpump, proceed as follows:

6. Check that the pump switch, on the ramp control panel, is at the OFF position.

7. Move the ramp manual control knob to the No. 4 (raise) position, and operate the handpump until the ramp is fully closed.

8. Move the ramp manual control knob to the No. 5 (lock) position. Operate the handpump until the handpump pressure gage registers 3,000 psi and all ramp locks are visibly engaged.

9. Move the ramp manual control knob to 6N (neutral), and leave it in that position.

10. Move the aft cargo door manual control valve handle to OPEN positon. Operate the handpump until the pressure gage reads a minimum of 500 psi, pull the aft cargo door up-lock manual release to the unlock position and move the manual control valve to NEUT. The door will free fall.

11. Move the aft cargo door manual control valve handle to CLOSE, and operate the handpump until the door is locked.

12. Move the aft cargo door manual control valve handle to the NEUT (center) position. The handle does not have a positive stop at the NEUT (center) position, so it should be checked to ensure that it has not been inadvertently moved beyond this setting.

BLEED AIR SYSTEM.

The bleed air system (figure 1-70) consists of high-pressure, stainless steel ducts and air shutoff valves which direct compressed air to pneumatically operated systems of the aircraft. The entire system of ducts serve as a plenum from which air is distributed to other systems. The pneumatic systems served by the bleed air system are as follows:

- Engine starting
- Nacelle preheat (EC-130G aircraft)
- Air conditioning
- Cabin pressurization
- Windshield defogging
- Engine air inlet scoop anti-icing
- Leading edge anti-icing
- Radome anti-icing
- Air turbine motor
- Urinal drain ejector
- Lavatory drain ejector

Compressed air is supplied to the bleed air system from the engines when they are running, or compressed air is supplied from either the gas turbine compressor or from an external pressure source when the aircraft is on the ground and the engines are not running. The normal procedure is to supply air from the gas turbine compressor or from an external source until the first engine is started; then, engine bleed air is used. The main bleed air manifold extends across the leading edge of the wing. Air enters the main manifold through five ports: four from the engines and one from the gas turbine compressor or an external source. Branch ducts connected to the main manifold distribute air for operating the following systems:

- Air conditioning
- Radome anti-icing
- Leading edge anti-icing
- Air turbine motor
- Urinal drain ejector
- Cabin pressurization system
- Lavatory drain ejector

Each engine bleed air manifold is connected to the main manifold just aft of the fire wall by an engine bleed air shutoff valve. Branch ducts connected to the engine manifold forward of the fire wall distribute air for operating the following systems:

- Engine starting
- Nacelle preheat
- Engine air inlet scoop anti-icing

Check valves installed in each engine bleed air manifold, the gas turbine compressor supply duct, and the external pressure supply duct prevent reverse flow when any of these sources of supply are inoperative.

ENGINE BLEED AIR CONTROLS (EC-130Q AIRCRAFT BUNO 156170 THROUGH 156177).

Four engine bleed air valve switches on the anti-icing systems control panel (figure 1-80) control the opening and closing of the engine bleed air valves. The control circuit for each valve is connected through a switch actuated by the fire handle. When the fire handle is pulled, the engine bleed air valve is closed and the normal switch control is rendered inoperative. Twenty-eight volt dc power for operation of each of the motor-driven valves is supplied from the essential dc bus through the bleed air fire shutoff circuit breaker on the copilot's side circuit breaker panel.

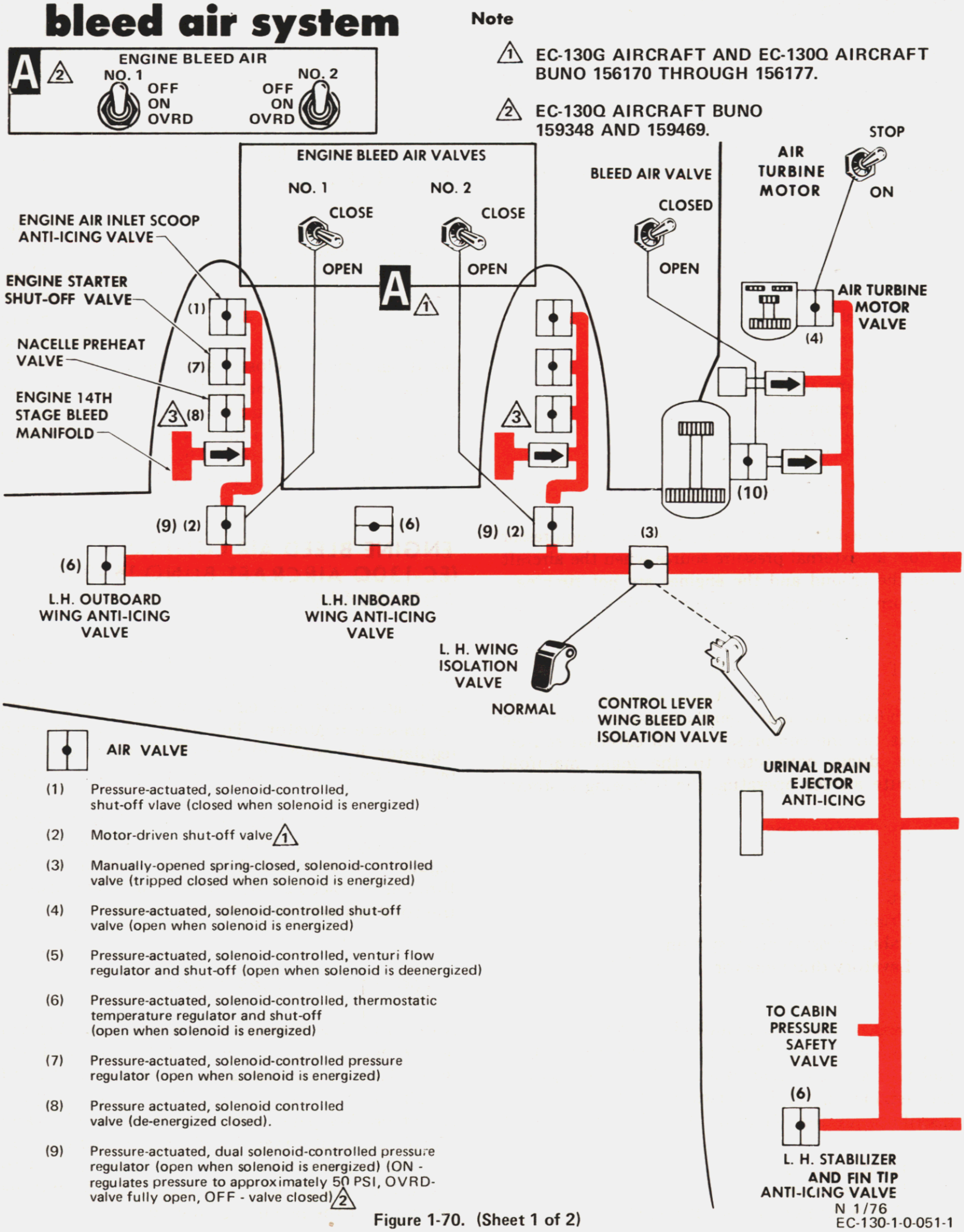
ENGINE BLEED AIR CONTROLS (EC-130Q AIRCRAFT BUNO 159348 AND 159469).

Four engine bleed air switches on the anti-icing systems control panel (figure 1-80) control the opening, closing, and regulation of the engine bleed air pressure regulators. The control circuit for each regulator is connected through a switch actuated by the fire handle. When the fire handle is pulled, the engine bleed air regulator is closed and the normal switch control is rendered inoperative. Twenty-eight volt dc power for operation of each regulator is supplied from the essential dc bus through the bleed air fire shutoff circuit breaker on the copilot's side circuit breaker panel.

BLEED AIR PRESSURE GAGE.

A direct-reading pressure gage (figure 1-72) located on the navigator's console (EC-130G and EC-130Q BuNo 156170 through 156177) or the right hand circuit breaker box above the copilot's upper circuit breaker panel (EC-130Q BuNo 159348 and 159469) indicates main bleed air manifold pressure in pounds per square inch. The gage is used to check the pressure of the bleed air supply and the operation of the pneumatic systems.

bleed air system



(1) Pressure-actuated, solenoid-controlled, shut-off vlave (closed when solenoid is energized)

(2) Motor-driven shut-off valve ⚠1

(3) Manually-opened spring-closed, solenoid-controlled valve (tripped closed when solenoid is energized)

(4) Pressure-actuated, solenoid-controlled shut-off valve (open when solenoid is energized)

(5) Pressure-actuated, solenoid-controlled, venturi flow regulator and shut-off (open when solenoid is deenergized)

(6) Pressure-actuated, solenoid-controlled, thermostatic temperature regulator and shut-off (open when solenoid is energized)

(7) Pressure-actuated, solenoid-controlled pressure regulator (open when solenoid is energized)

(8) Pressure actuated, solenoid controlled valve (de-energized closed).

(9) Pressure-actuated, dual solenoid-controlled pressure regulator (open when solenoid is energized) (ON - regulates pressure to approximately 50 PSI, OVRD- valve fully open, OFF - valve closed) ⚠2

Figure 1-70. (Sheet 1 of 2)

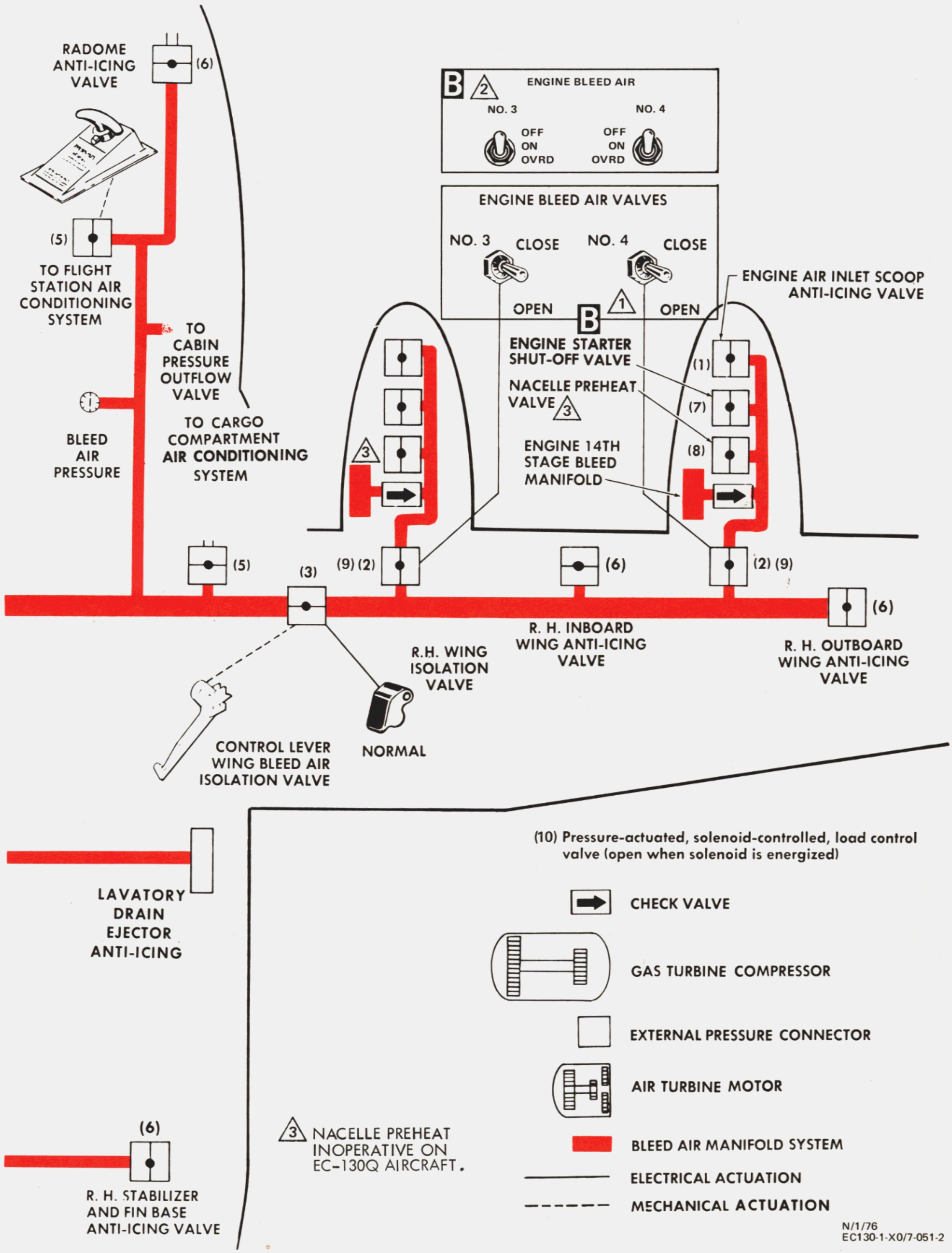


Figure 1-70. (Sheet 2 of 2)

WING BLEED AIR ISOLATION VALVES.

Two wing isolation valves are installed in the bleed air manifold near the inboard section of the wing. These valves are electrically closed by the wing isolation valve switches on the anti-icing system control panel (figure 1-80) and manually opened by two handles mounted in the top of the special equipment compartment (figure 1-71) forward of the left and right wheel well wall. Twenty-eight volt, dc power for operation of the valves is supplied from the essential dc bus through the bleed air isolation valve circuit breakers on the copilot's lower circuit breaker panel.

GROUND CHECKOUT OF THE BLEED AIR SYSTEM.

Note

The engine bleed air switches on EC-130G and EC-130Q aircraft BuNo 156170 through 156177 are labeled OPEN and CLOSE. On EC-130Q aircraft BuNo 159348 and 159469, they are labeled OFF, ON, and OVRD.

The bleed air pressure gage can be used to check the bleed air system. Use the following steps to check out the system with external ac or dc power and with air supplied by the gas turbine compressor:

1. Make sure that the engine bleed air circuit breakers on the copilot's side circuit breaker panel are closed.

2. Place the engine bleed air switches to OPEN/OVRD and turn off all systems that use bleed air.

3. Open the gas turbine compressor bleed air valve.

4. Check the system pressure for a reading of 35 psi minimum. Failure to reach this pressure indicates that some valve in the system has not closed, that a duct is leaking, or that the compressor output is low.

5. Close the gas turbine compressor bleed air valve.

6. As pressure in the system drops, time the drop from 30 to 15 psi. This time should not be less than 12 seconds.

Use the following steps to check out the bleed air system with air supplied by an engine:

7. Place the engine bleed air switches to CLOSE/OFF and turn off all systems which use bleed air.

8. Place the bleed air switch for one operating engine and all engines not operating to OPEN/OVRD.

9. When the system pressure reaches 70 psi or higher, place the bleed air switch of the operating engine to CLOSE/OFF. Pressure should begin to drop almost immediately. If pressure does not drop, the engine bleed air has failed to shut off.

10. Time the pressure drop from 65 to 35 psi. This time should not be less than 15 seconds.

AIR CONDITIONING SYSTEMS.

The aircraft is equipped with two independently operated air conditioning systems (figure 1-73), one for the flight deck and the other for the special equipment compartment. Both are operated by bleed air supplied from the engine compressor, or they may be operated on the ground by air supplied from the gas turbine compressor or by the attachment of an external ground compressor unit. Each system keeps the air at a required temperature and removes excess moisture from it before sending it through a system of ducts into the crew and special equipment compartment. The principal components of each system comprise a venturi-type airflow regulator, an electrical temperature control system, a water separator, a refrigerating unit, auxiliary vent valve and controls, and distribution ducts. The flight deck system includes a windshield defogging system and controls;

wing bleed air isolation valve control lever

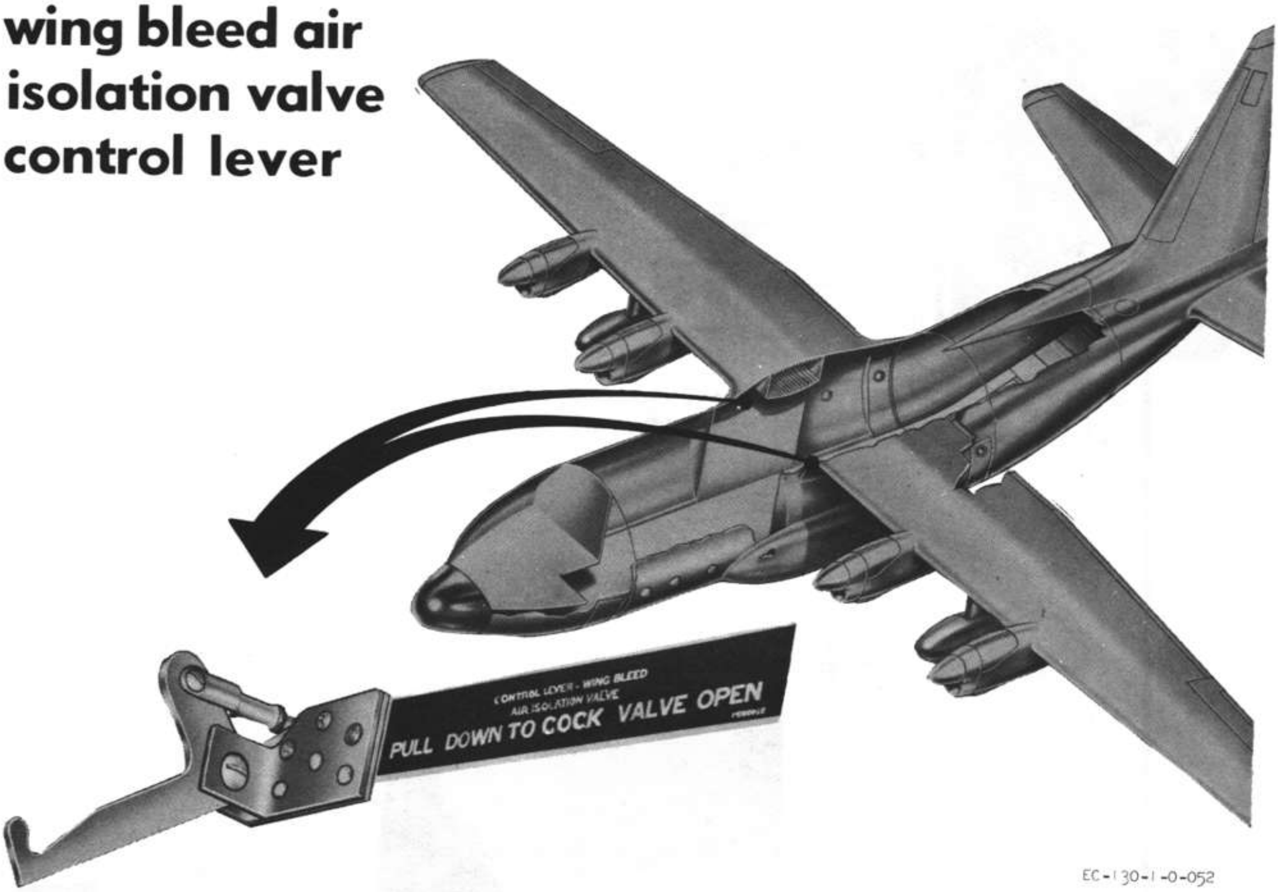
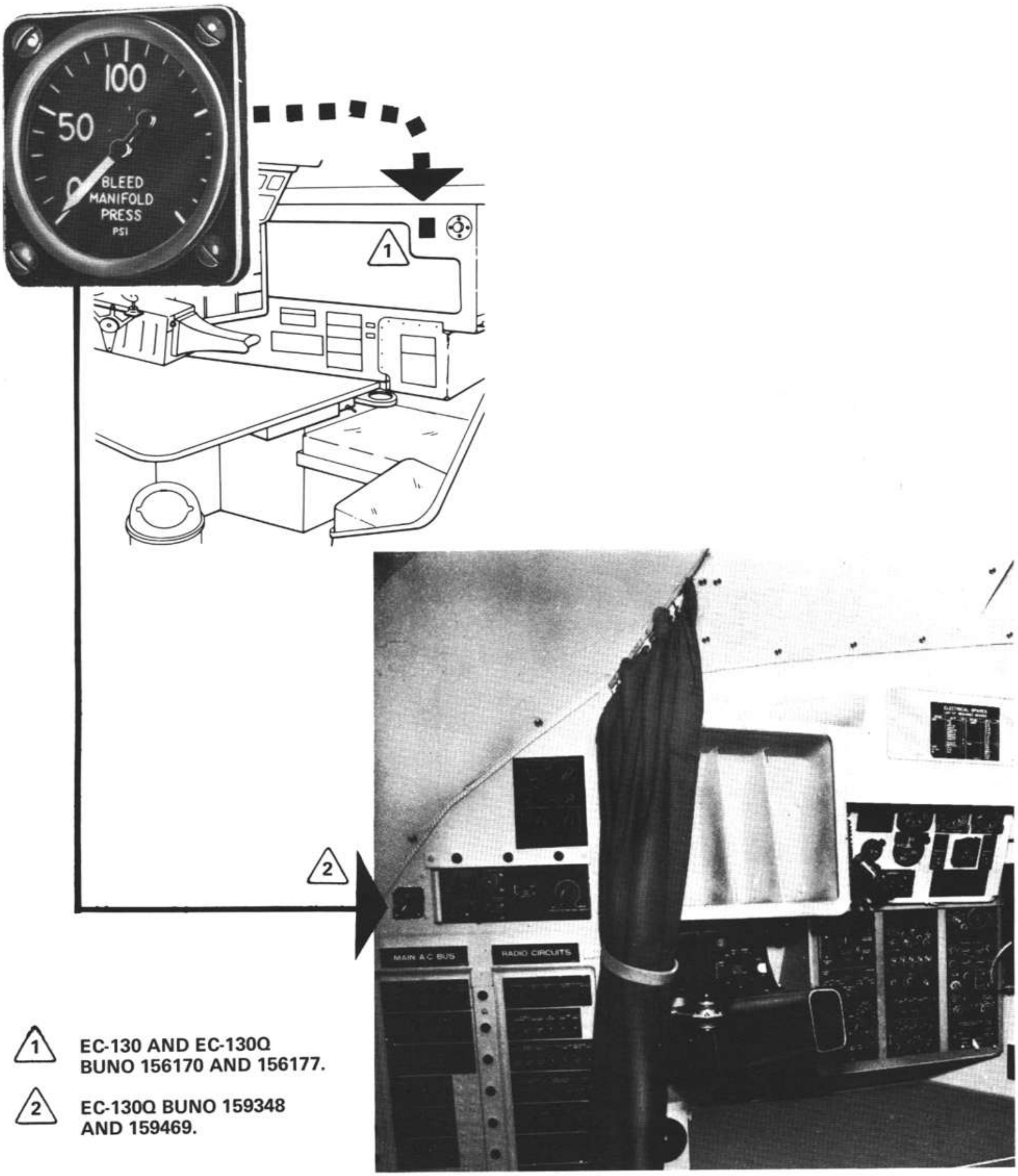


Figure 1-71.

bleed air pressure gage



1. EC-130 AND EC-130Q BUNO 156170 AND 156177.
2. EC-130Q BUNO 159348 AND 159469.

Figure 1-72.

the special equipment compartment system includes an add heat system for the aft compartment. Both systems are similar except for flow capacity; the higher capacity system serves the special equipment compartment, and the lower capacity system is used for the flight deck. Electrical power for the air conditioning system control components is supplied through circuit breakers on the copilot's lower circuit breaker panel. Ground air conditioning can be accomplished by connecting an external unit to the cooling air scoops with airscoop adapters and using the aircraft ducting.

AIRFLOW REGULATION.

The amount of air flowing through each air conditioning system is controlled by the venturi-type airflow regulator in the system. Each regulator is set by the position of the air conditioning master switch, on the air conditioning and pressurization control panel (figure 1-74), for three operating conditions: during flight, on the ground with the gas turbine compressor supplying bleed air, and the shutoff condition when neither air conditioning nor pressurization are required.

The flight deck airflow regulator maintains a constant airflow of 30 pounds per minute when the air conditioning master switch is in either the AIR COND AUTO PRESS, AIR COND MAN. PRESS. or AIR COND NO PRESS position, and 15 pounds per minute when in the AIR COND GTC position. The special equipment compartment airflow regulator maintains a constant airflow of 70 pounds per minute when the air conditioning master switch is in either the AIR COND AUTO PRESS, AIR COND MAN PRESS, or AIR COND NO PRESS position. When the switch is in the AIR COND GTC position, the airflow regulator maintains a minimum pressure upstream of the valve at 27 psi, regardless of flow through the special equipment compartment air conditioning system, to insure air turbine motor operation and to allow airflow through the flight deck air conditioning system. These airflow regulators also act as shutoff valves to stop the bleed airflow through the air conditioning systems. They are pneumatically actuated and electrically controlled through solenoid valves to select the normal airflow, or shutoff condition. Electrical power for control of the airflow regulators is supplied from the essential dc bus through the cabin press and aux vent circuit breaker on the copilot's lower circuit breaker panel.

AIR TEMPERATURE CONTROL.

The dual temperature control valve in each air conditioning system opens or closes two bypass ports to establish flow routes for bleed air entering the system. Conditioned air is the combined flow of bypassed bleed air, heat exchanger cooled air, and air cooled by the turbine unit. The dual temperature control valve is electrically operated by either automatic or manual control. During automatic operation, a desired temperature is selected, and the system positions the valve intermittently until the selected temperature is sensed by a thermostat. Approximately 5 minutes are required for the valve to travel from one extreme position to the other during automatic operation. A high-limit thermostat prevents excessively high output air temperature during automatic operation of the temperature control valve. When the valve is controlled manually, it will travel from full cold to full hot in approximately 4 minutes and from full hot to full cold in approximately 35 seconds. Electrical power for temperature control is supplied from the essential dc bus through the flight deck temp control and cargo compt temp control circuit breaker on the copilot's lower circuit breaker panel.

REFRIGERATION.

Part or all of the bleed air flowing to each air conditioning system flows through the heat exchanger and turbine. The first stage of cooling is provided by heat transfer in the air-to-air heat exchanger. During flight, ambient air under ram pressure passes through the heat exchanger and provides the cooling medium to initially reduce the bleed air temperature. Air which enters the turbine after being partly cooled in the heat exchanger is cooled further by expending its energy to drive the turbine, which is loaded by the cooling air fan. In loading the turbine, the fan also augments the cooling airflow through the heat exchanger. During ground operation, with no ram air provided, the fan will draw air through the heat exchanger whenever the turbine is rotating to assure first-stage cooling of the bleed air. The special equipment compartment air conditioning system incorporates a jet pump in series with the cooling fan to assure augmented cooling airflow over the entire area of the heat exchanger. The temperature of the output air depends on what portion of the total airflow is routed through the heat exchanger and turbine.

air conditioning system

flight station

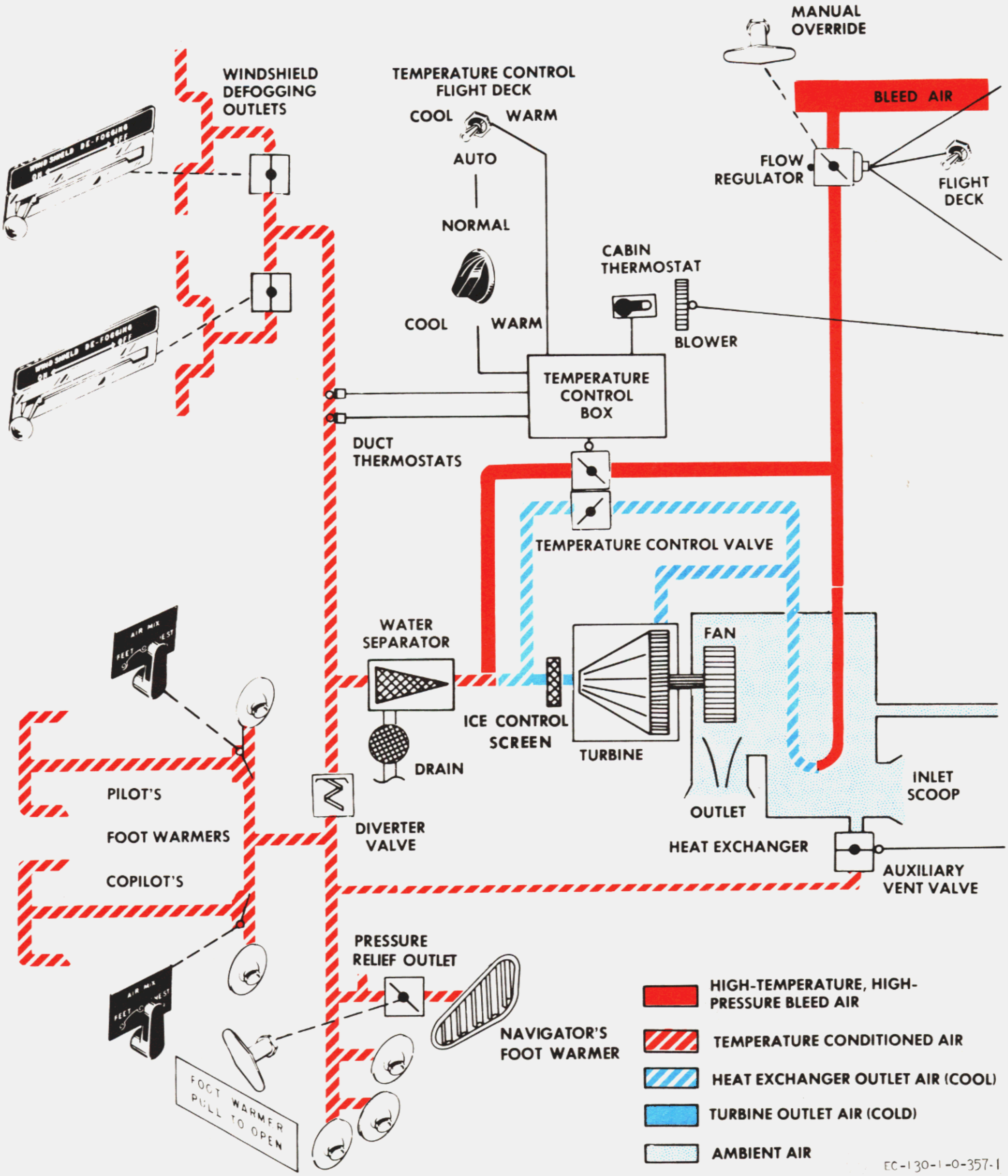


Figure 1-73. (Sheet 1 of 2)

AN USC-13(V) area

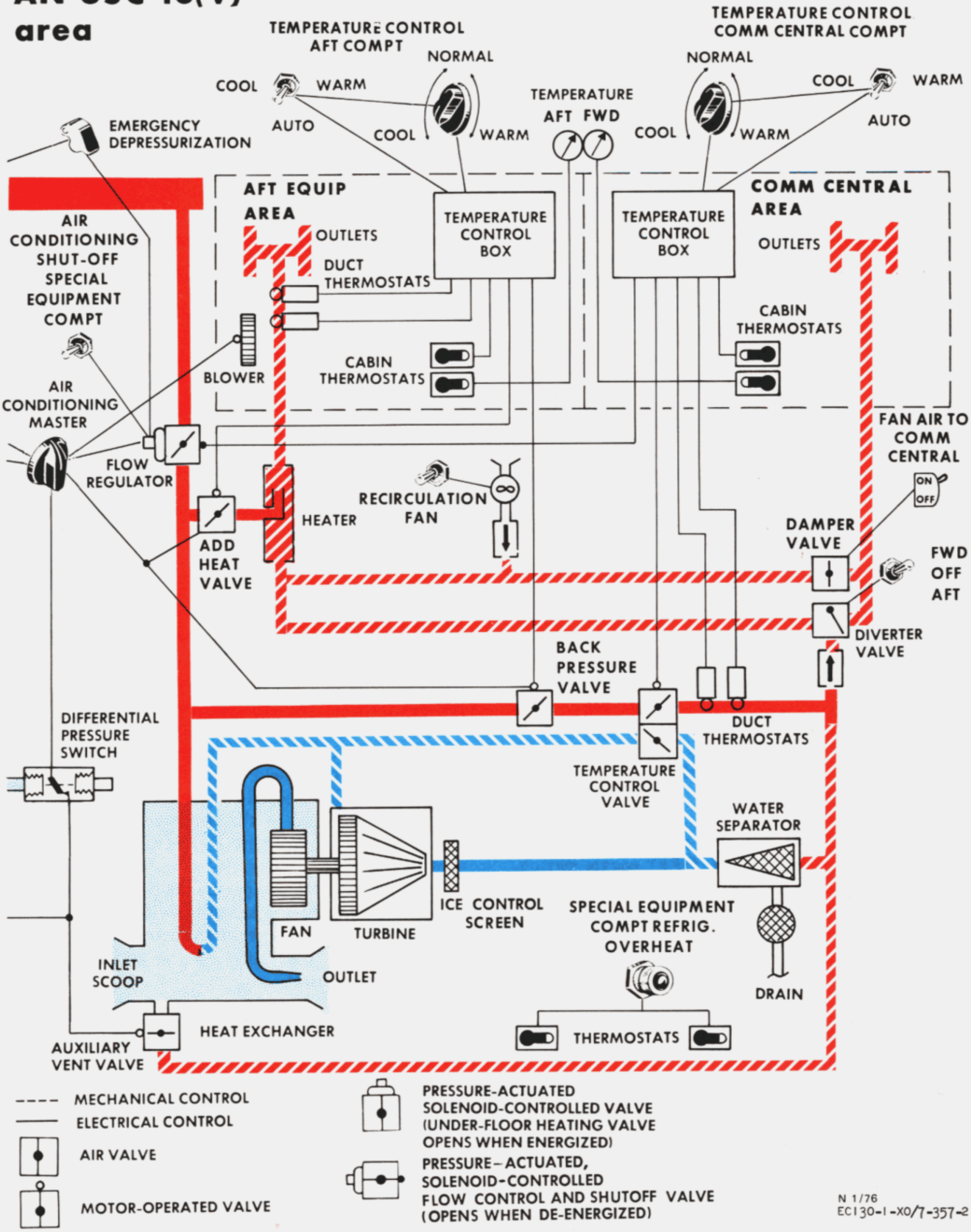


Figure 1-73. (Sheet 2 of 2)

WATER SEPARATION.

Each water separator will remove from 70 to 85 percent of the moisture which condenses when air is, refrigerated. Moisture remaining in the air maintains a comfortable humidity level in the compartments. The water separator contains a cone-shaped bag, and a drain. The bag causes fog in the air to form into water droplets which are swirled and thrown against the shell of the separator;then they collect and run down to the drain. If the bag in the water separator becomes clogged, a pressure-sensitive relief valve at the tip of the bag opens to bypass the airflow. Icing of the separator is prevented by an ice control screen at the turbine outlet, which keeps the turbine outlet air temperature above freezing.

Note

Water separators do not remove all moisture from conditioned air. When cargo (special equipment) compt temp and/or flight deck temp selectors on the air conditioning control panel (figure 1-74) are moved all the way over to cool, a considerable amount of fog may enter compartments from diffusers. Evaporation of fog increases the cooling effect of air, and moisture provides a comfortable humidity level in the compartments. Output of fog normally decreases as selectors are moved toward WARM.

RECIRCULATING FAN SWITCH.

The recirculating fan switch, located on the air conditioning and pressurization control panel (figure 1-74), is a two-position (ON, OFF) toggle switch. When the air conditioning master switch is in any of the AIR COND positions and the aft cargo (special equipment) compartment temp cont switch is in the OFF position, the recirculating fan can be turned on and off with the fan switch.

SPECIAL EQUIPMENT COMPARTMENT TEMPERATURE CONTROL SYSTEM.

A separate special equipment compartment temperature control system has been added and the underfloor heating system has been deleted. The new temperature control system works in conjunction with the basic special equipment compartment temperature control system to provide regulated heat for the aft compartment.

Fan Air To Forward Compartment Lever.

A two position (ON,OFF) (fan air) to (fwd compt) lever is mounted on the forward end of the left wheel well. In the ON position a damper valve in the overhead duct is opened to route air to the COMM central compartment. The OFF position closes the damper valve to shut off the flow to the COMM central compartment.

Special Equipment Compartment Temperature Controls and Indicators.

The special equipment compartment temperature control panel (figure 1-75) is mounted above the copilot's upper circuit breaker panel.

TEMPERATURE CONTROL SWITCH. The special equipment compartment temperature control system is engaged when the temperature control switch is placed to ON and the air conditioning master switch is placed to any of the AIR COND positions. The recirculating fan will operate when the air conditioning master switch is in any of the AIR COND positions regardless whether the fan switch if OFF or ON.

TEMPERATURE SELECTOR SWITCH. The temperature selector switch has two momentary positions (WARM, COOL) and two fixed positions (AUTO, OFF). When the switch is held in the WARM position, hot air from the bleed air manifold is injected into the special equipment compartment distribution ducts through a diffusion type heater. When the switch is held in the COOL position, the temperature in the special equipment compartment is completely controlled by the basic temperature system of the special equipment compartment with the temperature of the air distributed to both the COMM CENTRAL and aft compartments being the same. When the temperature selector switch is placed to AUTO, the temperature in the special equipment compartment is controlled by the position of the temperature rheostat.

TEMPERATURE CONTROL RHEOSTAT. The temperature control rheostat may be adjusted from NORMAL to COOL or WARM. The rheostat works with three thermostats in the special equipment compartment to regulate the air temperature.

DIVERTER VALVE SWITCH. The diverter valve switch is a three position (FWD, OFF and AFT) toggle switch that controls the flow of conditioned air

special equipment compartment temperature control

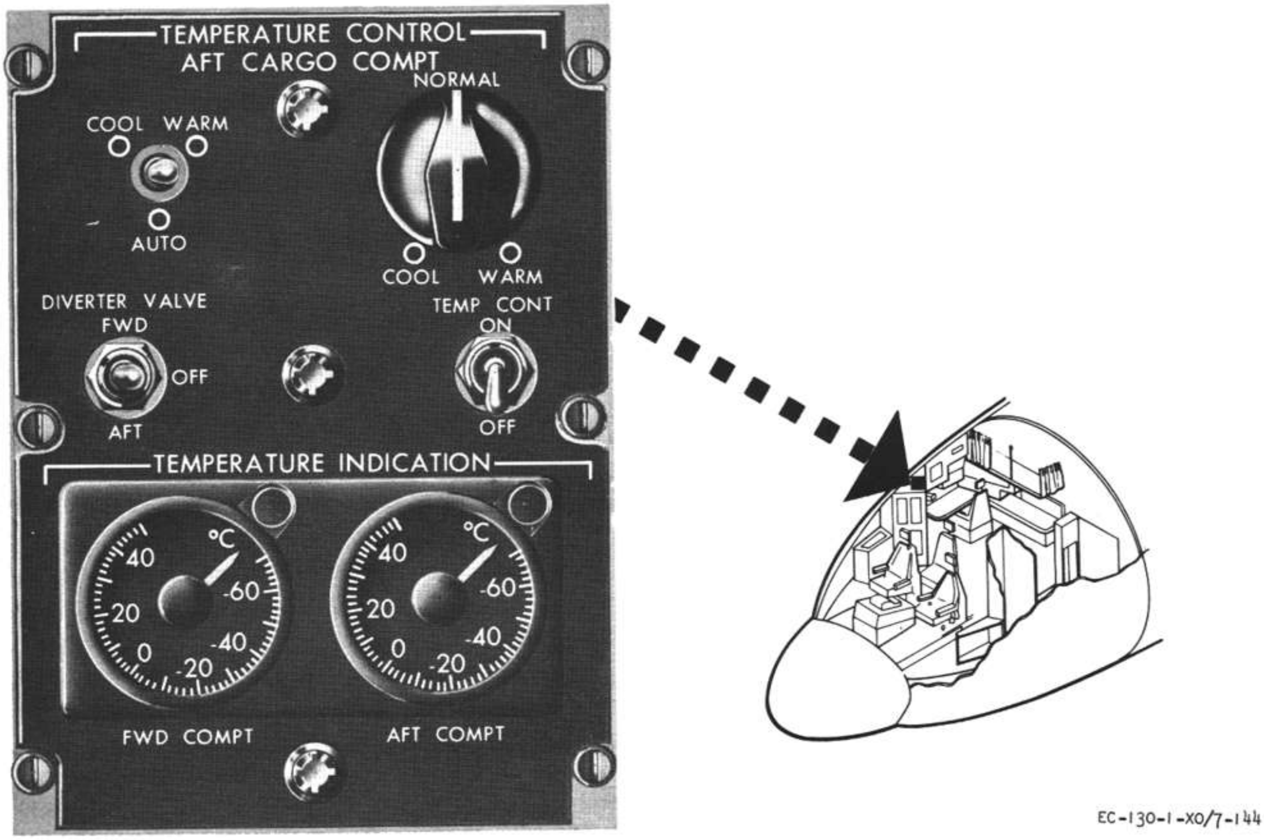


Figure 1-75.

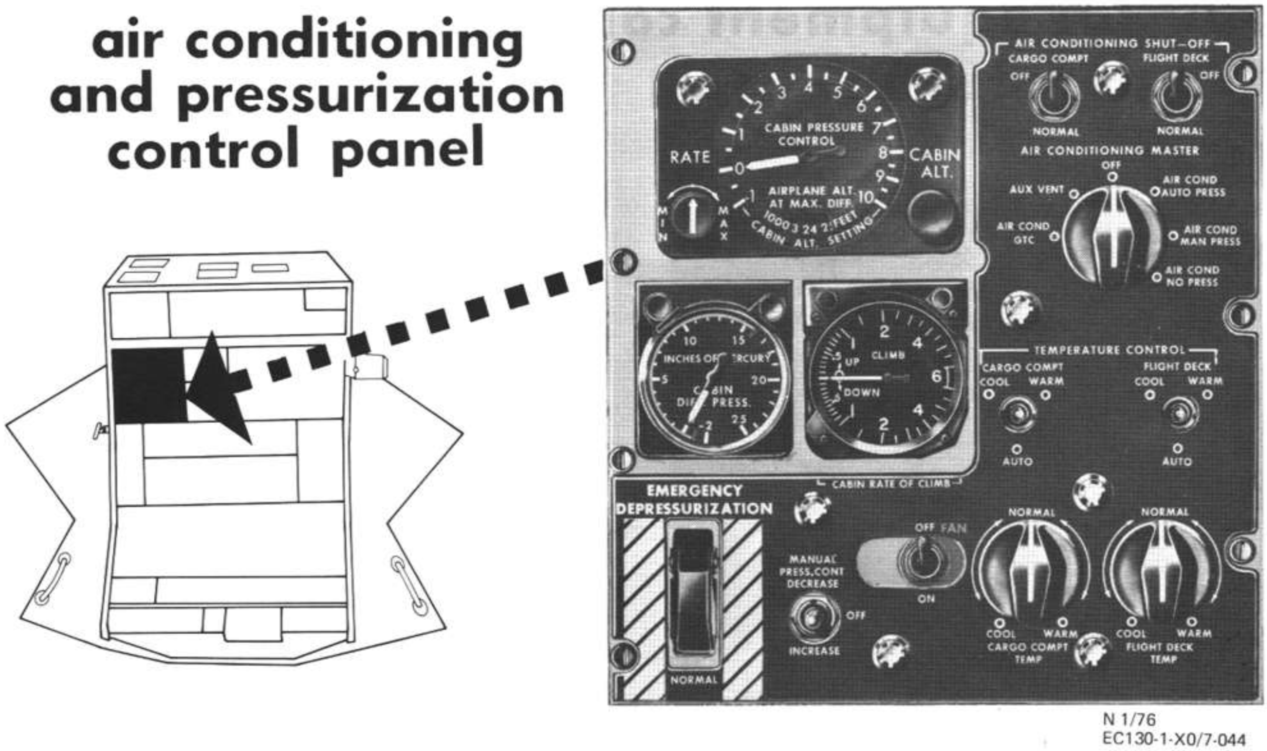


Figure 1-74.

to the COMM central and aft compartment. The FWD and AFT positions of the switch are spring-loaded to the OFF position. Holding the diverter valve switch to either of these momentary positions drives the diverter valve toward the forward or aft position, continuously varying the proportion of air delivered to the compartment. In the OFF position the diverter valve is deenergized and remains in the position to which it has been driven.

TEMPERATURE INDICATORS. Two temperature gages permit monitoring of the temperature in both the COMM central and aft compartments.

SPECIAL EQUIPMENT COOLING SYSTEM.

Fans furnished with comm central area electronic equipment circulate air to cool electronic components. Comm central area air is forced through the amplifier-coupler by blowers. Heated air from the amplifier-coupler group is ducted to a heat exchanger under the comm central area floor, where heat is dissipated through the aircraft skin. After cooling, this air passes through ducts in the cargo ramp and is discharged into the aft equipment area.

AUXILIARY VENTILATION.

The auxiliary ventilation provision in each system consists of a valve connecting the heat exchanger cooling air inlet duct to the conditioned air distribution ducts. When the valve is opened, most of the air entering the cooling air scoop flows directly into the distribution ducts. In flight, the air thus admitted to the aircraft is ambient air under ram pressure. On the ground, adapters can be attached to the cooling air scoops so that air from an external air conditioner can be supplied for ventilation. If the cabin is pressurized, a differential pressure switch prevents the auxiliary vent valves from opening until the differential pressure is reduced to approximately 0.28 psi. The purpose of the switch is to prevent differential pressure from collapsing the air conditioning low-pressure ducts.

AIR CONDITIONING SYSTEMS CONTROLS.

The main controls for the two air conditioning systems are located on the air conditioning and pressurization control panel (figure 1-74). These comprise a six-position rotary master switch, and a temperature control switch and rheostat. Associated controls on the panel include a manual pressurization control switch and a guarded two-position emergency depressurization switch. Other air conditioning controls in the flight deck include air delivery diverter levers on the main instrument panel, windshield defogging outlet valve controls on the pilots' side shelves, and a flight deck refrigeration shutoff valve override handle at the navigator's station. A cargo (special equipment) compartment refrigerator overheat warning light is located on the anti-icing systems control panel (figure 1-80). A manual emergency depressurization handle, which operates a quick-opening door in the center escape hatch, is located directly above the pilot's seat.

Air Conditioning Master Switch.

The air conditioning master switch, located on the air conditioning and pressurization control panel (figure 1-74) is a six-position (AIR COND GTC, AUX VENT, OFF, AIR COND AUTO PRESS, AIR COND MAN PRESS, AIR COND NO PRESS) rotary switch which selects the type of air conditioning and pressurization desired. The control functions of the master switch are as follows:

AIR COND GTC

Flow regulators open and provide reduced airflow:

Auxiliary ventilation valves close.

Outflow valve opens.

Safety valve opens.

Thermostat blowers are turned on.

AUX VENT.

Airflow regulators shut off bleed air flow.

Auxiliary ventilation valves open.

Outflow valve opens.

Safety valve opens.

OFF

Airflow regulators shut off flow of bleed air.

Auxiliary ventilation valves open.

Outflow valve opens.

Safety valve closes.

AIR. COND AUTO PRESS

Airflow regulators provide normal airflow.

Safety valve closes.

Outflow valve is modulated automatically.

Auxiliary ventilation valves close.

Thermostat blowers are turned on.

AIR COND MAN PRESS

Airflow regulators provide normal airflow.

Safety valve closes.

Outflow valve is modulated manually.

Auxiliary ventilation valves close.

Thermostat blowers are turned on.

AIR COND NO PRESS

Airflow regulators provide normal airflow.

Outflow valve opens.

Safety valve opens.

Auxiliary ventilation vlaves close.

Thermostat blowers are turned on.

Flight Deck and Special Equipment Compartment Temperature Controls.

The flight deck and special equipment compartment temperature controls consist of two toggle switches and two rheostats on the air conditioning and pressurization control panel (figure 1-74). One switch and one rheostat are used to control temperature conditions within the flight deck, and the second switch and rheostat control temperature within the special equipment compartment.

The toggle-type temperature control switches are used to select warm, cool, or automatically controlled temperature conditions, but they function only when the air conditioning master switch is set to one of the four AIR COND positions. Each switch may be moved from the center (off) position upward to COOL or WARM or downward to AUTO. With the temperature control switch set to AUTO, the temperature control valve is controlled automatically to maintain the compartment temperature selected on the temperature rheostats. When the switch is moved to the COOL position, the temperature control valve moves toward the extreme cold setting; the switch must be held for approximately 35 seconds for the valve to move from the extreme hot position to the extreme cold setting. With the switch at WARM, the valve turns to the extreme hot setting. Complete movement of the valve from the extreme cold setting to the extreme hot position takes approximately 4 minutes. The switch may be released at any time from either the WARM or COOL positions and is spring-loaded to return to the center (off) position; the temperature control valve will remain at the setting achieved when the switch is released. The system thermostat blowers are activated whenever the air conditioning master switch is at one of the four AIR COND positions.

The two temperature rheostats, located below their respective temperature control switches, are used to select the temperature conditions desired within the flight deck and special equipment compartment during automatic temperature control. The settings of each rheostat cover a temperature range from COOL through NORMAL to WARM. Power for the temperature control system is supplied from the essential dc bus through the flight deck and cargo compt temp control circuit breakers on the copilot's lower circuit breaker panel.

Air Diverter Controls.

A lever at each side of the main instrument panel controls a valve through which the conditioned airflow may be directed,by way of a louver, toward each pilot's chest or through floor-level outlets toward the pilot's feet; a central position for the lever, marked MIX, divides the available airflow between the upper and lower outlets. At the rear of the flight deck, a similar valve arrangement controlled by a handle on the right-hand edge of the navigator's table directs the conditioned airflow through a foot-warming louver below the navigator's table or through three directable louvers disposed about the aft flight deck. The handle is pulled to open the foot-warming louver and admit temperature-conditioned air to the navigator's station, or it is pushed in to close the louver. The three individual louvers in the rear of the flight deck and similar louvers at the pilot's stations may be moved manually to change the direction of the airflow.

Windshield Defogging Levers.

A windshield defogging lever on each pilot's side shelf controls a valve connecting the temperature-conditioned air duct to the windshield defogging outlets on that side of the flight deck. With the lever moved to ON, the valve is opened and the available airflow is directed by a diverter valve to the windshield defogging outlets and away from the flight deck air distribution louvers and outlets.

Air Conditioning Shutoff Switches.

Two shutoff switches, at the top of the air conditioning and pressurization control panel (figure 1-74), override the air conditioning master switch and enable either air conditioning system to be shut down individually. Each switch may be set to either OFF or NORMAL. If the flight deck switch is set to OFF, the airflow regulator for the flight deck air conditioning system halts the flow of bleed air regardless of the setting of the air conditioning system master switch. Similarly, if the cargo (special equipment) compt switch is placed to OFF, the airflow regulator closes off the supply of bleed air to the special equipment compartment air conditioning system. With either switch set to NORMAL, the associated airflow regulator maintains the normal flow of air to the air conditioning system. In an emergency, the flight deck system airflow regulator may be closed, to halt the entry of bleed air, by pulling the OVERRIDE FLT DECK REFRIG SHUTOFF VALVE handle on the floor of the navigator's station.

Flight Deck Refrigeration Shutoff Valve Override.

A manual override, which allows the flight deck system airflow regulator to be controlled manually, is located on the floor below the navigator's table. When the handle is pulled, the flow regulator will close whether the system is pressurized or not. When the handle is pushed in, the regulator will open only if the system is pressurized. During normal operation of the air conditioning system, the handle must remain in the neutral position.

Cargo Compartment (Special Equipment) Refrigerator Overheat Warning Light.

A red press-to-test light (figure 1-80) located on the anti-icing control panel is provided to warn the pilot of an overheat condition in the special equipment compartment refrigerator area. Two overheat detectors are located in the refrigerator area of the wheel well. When an overheat condition of 200° F exists, the warning light will illuminate and the overheat condition must be corrected to extinguish the light. Electrical power for the light is supplied from the essential dc bus through the wing and empennage overheat lights circuit breaker on the copilot's lower circuit breaker panel.

Emergency Depressurization Switch.

The emergency depressurization switch is a guarded, two-position toggle switch on the air conditioning and pressurization control panel (figure 1-74). When the switch is moved from NORMAL to EMERGENCY DEPRESSURIZATION, an electrical circuit closes both air conditioning system flow regulators and opens both the outflow and safety valves to the pressurization system (figure 1-76).

NORMAL OPERATION OF AIR CONDITIONING SYSTEMS.

The air conditioning systems can be operated from bleed air supplied by the gas turbine compressor or by the engines while the aircraft is on the ground, or an external ground compressor unit may be attached. The engines supply the bleed air for operating the air conditioning systems in flight.

Ground Air Conditioning.

Ground air conditioning is accomplished by using either an external unit or the aircraft air conditioning system.

AIR CONDITIONING WITH AN EXTERNAL UNIT.

1. Place a ground air conditioning adapter in the air scoop of the system to be operated.

2. Attach the hose of the ground air conditioning unit to the adapter.

3. Position the air conditioning master switch to OFF.

Note

Air scoop adapters for ground air conditioning are stowed on a rack aft of the right paratroop door.

AIR CONDITIONING WITH AIRCRAFT SYSTEM.

1. Place the engine bleed air valve switches in the CLOSE position.

2. Start the gas turbine compressor.

3. Place the gas turbine compressor bleed air switch in OPEN.

4. Check the bleed air pressure gage.

5. Position the air conditioning shutoff switches to NORMAL.

6. Turn the air conditioning master switch to AIR COND GTC.

CAUTION

If the engine bleed air valve switches are in the OPEN position and the air conditioning master switch is in the AIR COND GTC position, the special equipment compartment airflow regulator will go to the full flow position. In this position, sufficient air may not be available to operate the ATM and the flight deck air conditioning system.

7. Hold the temperature switches in COOL or WARM as desired for 30 seconds; then return to AUTO. This procedure will position the temperature control valve to the approximate desired position more rapidly and minimize the amount of hot bleed air entering the compartment when the temperature rheostats are in COOL.

8. Position temperature rheostats as desired.

9. Turn the air conditioning master switch to OFF before starting an engine.

10. With one or more engines operating, place the air conditioning master switch in AIR COND NO PRESS.

pressurization system

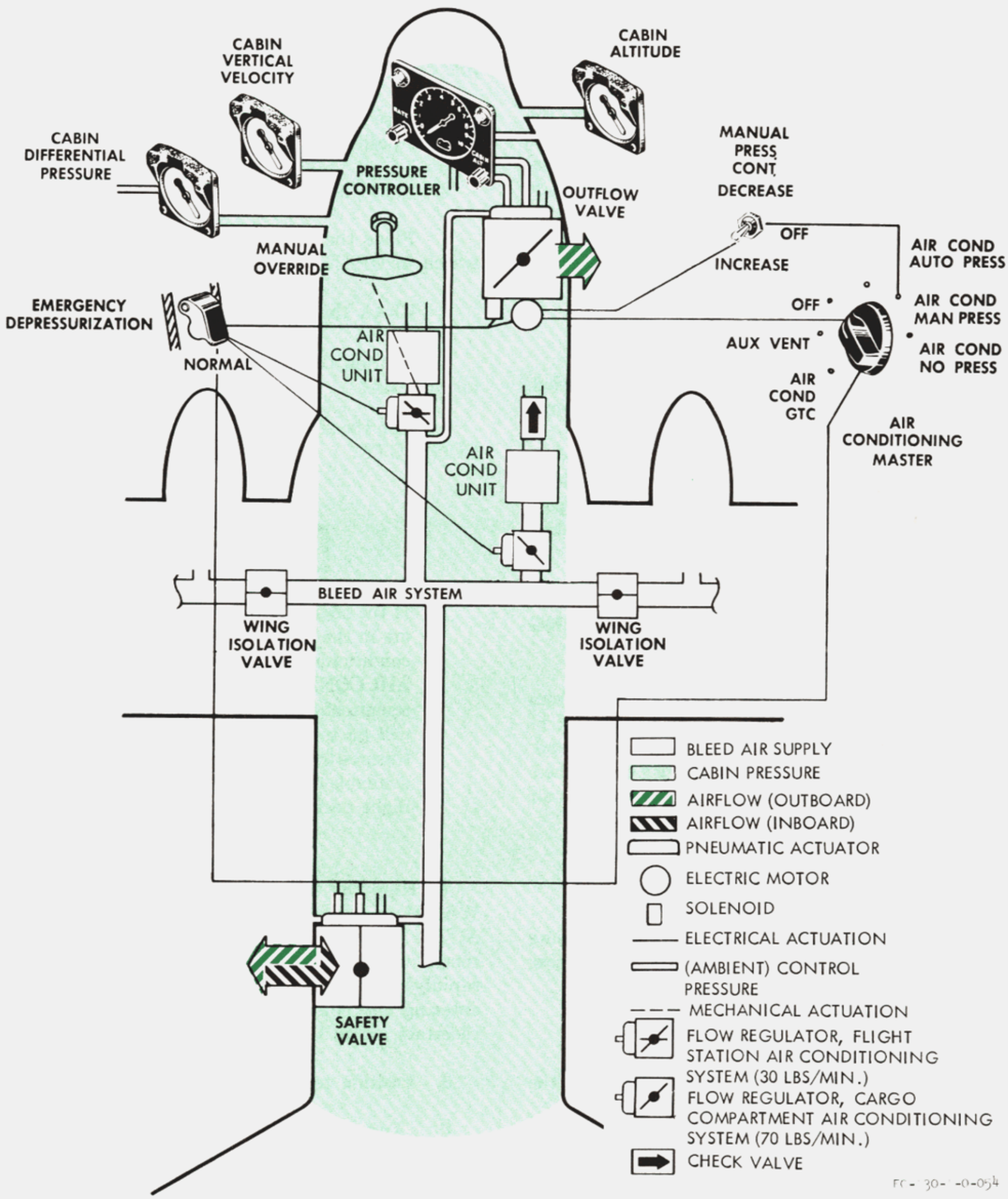


Figure 1-76.

cabin pressurization chart

● **ICAO STANDARD ATMOSPHERE**

SAMPLE PROBLEM

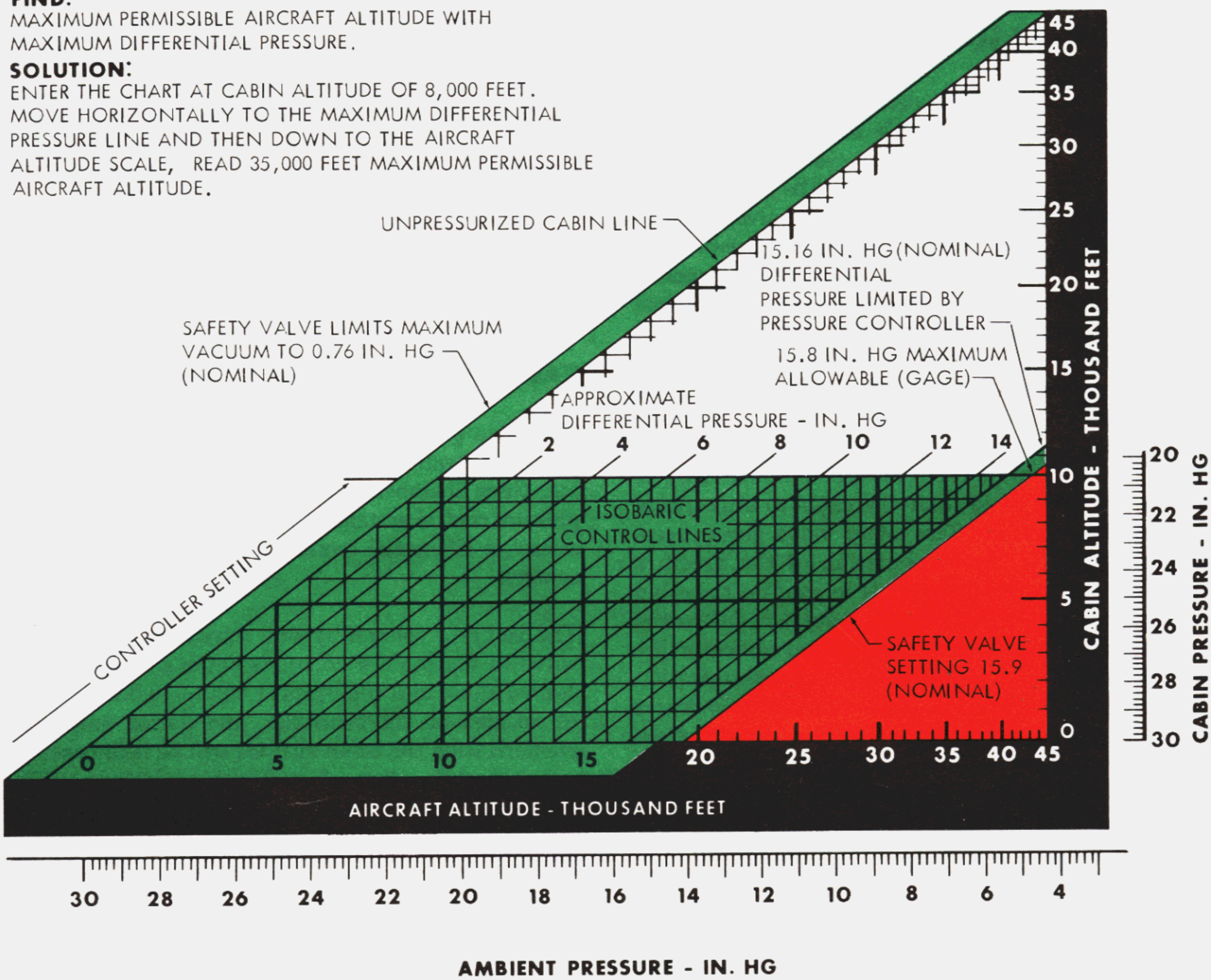
GIVEN:
LONG RANGE MISSION WITH PASSENGERS ON BOARD.
CABIN PRESSURE LIMITED TO 8,000 FEET.

FIND:
MAXIMUM PERMISSIBLE AIRCRAFT ALTITUDE WITH MAXIMUM DIFFERENTIAL PRESSURE.

SOLUTION:
ENTER THE CHART AT CABIN ALTITUDE OF 8,000 FEET. MOVE HORIZONTALLY TO THE MAXIMUM DIFFERENTIAL PRESSURE LINE AND THEN DOWN TO THE AIRCRAFT ALTITUDE SCALE, READ 35,000 FEET MAXIMUM PERMISSIBLE AIRCRAFT ALTITUDE.

NOTE

FOR MAXIMUM DIFFERENTIAL RANGE OF CABIN PRESSURE, READ CABIN ALTITUDE AT JUNCTION OF AIRCRAFT ALTITUDE AND MAXIMUM DIFFERENTIAL PRESSURE LINE. REFER TO SECTION I FOR LIMITS.



ISOBARIC RANGE - READ DIFFERENTIAL PRESSURE AT JUNCTION OF CONTROLLER SETTING (CABIN ALTITUDE) AND AIRCRAFT ALTITUDE LINES.

EXCESSIVE DIFFERENTIAL PRESSURE

Figure 1-77.

Inflight Air Conditioning.

1. Place the air conditioning master switch in AIR COND AUTO PRESS, AIR COND MAN PRESS, or AIR COND NO PRESS, as desired.

2. Position temperature switches to AUTO.

3. Position temperature rheostats as desired.

CABIN PRESSURIZATION SYSTEM.

Pressurization of the flight deck and special equipment compartment for high-altitude flight is achieved by air supplied from the bleed air system and ducted through the air conditioning system. The pressurization system basically consists of an outflow valve, pressure controller, differential pressure gage, cabin rate-of-climb indicator, cabin altimeter, safety valve, and a manually operated emergency depressurization door. The special equipment compartment distribution system also incorporates a check valve to prevent rapid loss of cabin pressure in the event of failure in the recirculating duct system. The outflow valve, which opens to relieve excess pressure, is used with the pressure controller to maintain cabin pressure automatically at a constant level or to limit the cabin-to-atmosphere differential pressure. The safety valve gives excess pressure relief if the combination of the pressure controller and outflow valve fails to regulate the cabin pressure properly. The pressure controller, differential pressure gage, and cabin rate-of-climb indicator are mounted on the air conditioning and pressurization control panel (figure 1-74). Two knobs on the pressure controller permit pre-setting of the cabin rate of climb and cabin pressure. The differential pressure gage indicates the difference between cabin and atmospheric pressure, and the rate-of-climb indicator shows the rate at which the cabin pressure is changing. The aircraft is pressurized when pressure within the flight deck and special equipment compartment exceeds atmospheric pressure. This may be accomplished by automatic control of the pressurization system or by manual operation, depending upon the setting of the air conditioning master switch.

OUTFLOW VALVE.

The outflow valve is located on the right side of the aircraft at the aft end of the flight station. It exhausts cabin air to the atmosphere through a louver in the skin. The valve consists of a butterfly valve, a main actuating diaphragm, a relay valve, an air jet pump, a solenoid dump valve, and an electric actuator. During automatic pressurization, the butterfly valve is pneumatically positioned by differential pressure across the main actuating diaphragm. The relay valve and air jet pump control the differential pressure in accordance with the cabin altitude selected on the pressure controller. The solenoid dump valve opens the butterfly valve for emergency depressurization. Electrical power to energize the dump solenoid is supplied by the battery bus through the emer depress circuit breaker on the pilot's side circuit breaker panel. The electric actuator is controlled by a switch to position the butterfly valve during manual operation of the system. Electrical power for manual operation of outflow valve is supplied from the essential dc bus through the cabin press & aux vent circuit breaker on the copilot's lower circuit breaker panel.

CABIN PRESSURE CONTROLLER.

The cabin pressure controller, on the air conditioning and pressurization control panel (figure 1-74) is divided into three chambers, each providing a separate cabin pressure control system: a constant pressure or isobaric control, a differential control system, and a rate-of-climb control.

The isobaric control system positions the outflow valve to maintain a constant cabin pressure. Any desired cabin altitude, from -1,000 to 10,000 feet, can be selected on the controller, and during automatic pressurization the cabin altitude will be held constant upon reaching the selected cabin altitude. The differential control system positions the outflow valve to vary the cabin pressure altitude when the maximum differential pressure is reached. The cabin altitude will change in order to maintain a constant differential pressure. This system protects the aircraft structure from excessive pressures by overriding the isobaric control system (refer to Part 4, Section I for differential pressure limitations). The rate control system positions the outflow valve to maintain a constant rate of cabin pressure change up to the isobaric altitude selected. Any desired rate of cabin pressure change from MIN (30 to 200 feet per minute) to MAX (1,600 to 2,900 feet per minute), can be selected on the controller. During automatic pressurization, the cabin pressure will change at the selected rate until the cabin pressure altitude reaches the isobaric altitude selected on the controller.

SAFETY VALVE.

The safety valve is located on the aft cargo door. It is electrically controlled and pneumatically opened in a nonpressure condition or for emergency depressurization. The valve is normally closed during any pressurized operation. It will open to relieve cabin pressure if the positive differential pressure reaches 15.9 inches Hg or if the negative differential pressure reaches -0.76 inches Hg. When either depressurization or nonpressure operation is selected, the valve is opened. Electrical power to energize the safety valve solenoid is supplied from the battery bus through the emer depress circuit breaker on the pilot's side circuit breaker panel.

CHECK VALVE.

To prevent rapid loss of cabin pressure in the event of failure in the air recirculating duct system, a check valve is installed in the special equipment compartment air conditioning and pressurization system. The valve basically consists of a hinged flap which normally assumes an open position under pressure of the inward-flowing air, but will close if inward air pressure is lost.

EMERGENCY DEPRESSURIZATION DOOR.

An emergency depressurization door, located in the center emergency escape hatch, is released by pulling the emergency depressurization handle (figure 1-78) on the overhead control panel directly above the pilot. The handle is connected by a cable to the release mechanism of the door which is restrained from consequential loss by two shock cords. After depressurization is accomplished, the door can be replaced and the release mechanism reset manually.

CABIN PRESSURIZATION CONTROLS.

Controls for the cabin pressurization system consist of the air conditioning master switch, a pressure controller, manual pressure control switch, and emergency depressurization switch. All controls are located on the air conditioning and pressurization control panel. A manually operated emergency depressurization system also is provided.

Air Conditioning Master Switch.

The air conditioning master switch on the air conditioning and pressurization control panel (figure 1-74) is used to select the type of operation of the air conditioning and pressurization systems. It controls operation of the outflow and safety valve under conditions of pressurized and nonpressurized operation. For functions of the switch positions, refer to AIR CONDITIONING CONTROLS SYSTEMS in this section.

Electrical power for control circuits of the outflow and safety valves is supplied from the essential dc bus through the cabin press and aux vent circuit breaker on the copilot's lower circuit breaker panel.

Cabin Pressure Controller.

The cabin pressure controller on the air conditioning and pressurization control panel (figure 1-74) includes the cabin differential pressure gage, a rate-of-climb indicator, a cabin altitude selector knob, a rate selector knob, and an altitude selector indicator. The cabin altitude selector knob and the altitude selector indicator are used to pre-set the required cabin altitude. For the chosen altitude, shown by the pointer on the indicator and selected by turning the knob, a window on the indicator dial face indicates the maximum aircraft altitude which can be reached before cabin differential pressurization begins.

CAUTION

Do not force the cabin alt. knob below a setting of -1,000 feet or above 10,000 feet. To do so may damage the pressure controller.

The rate selector knob is used to determine the rate of cabin pressure change until the cabin altitude, as shown by the pointer, is reached. The knob is turned from MIN (30 to 200 feet per minute) clockwise to MAX (1,600 to 2,900 feet per minute).

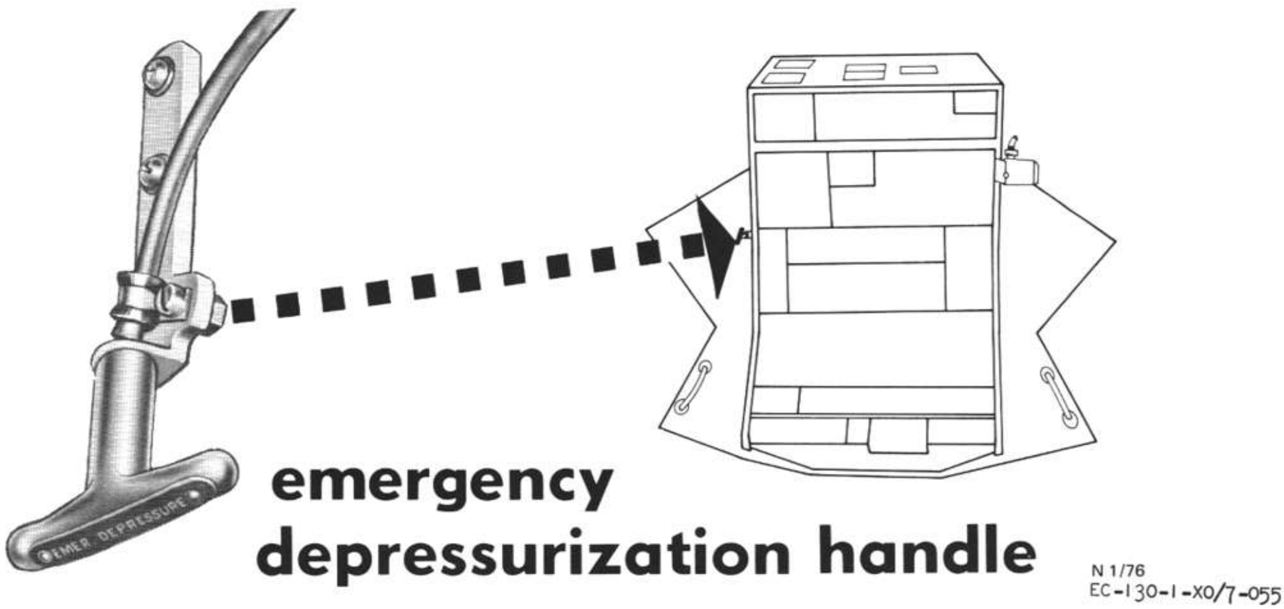


Figure 1-78.

Manual Pressure Control Switch.

The manual pressure control switch is a three-position (INCREASE, OFF, DECREASE) toggle switch, located on the air conditioning and pressurization control panel (figure 1-74). It has a center spring-loaded OFF position and momentary INCREASE and DECREASE positions. The switch controls the electric actuator of the outflow valve when the air conditioning master switch is in the AIR COND MAN PRESS position. When the switch is held in the INCREASE position, the actuator turns the outflow butterfly valve toward its closed position. When the switch is held in the DECREASE position, the actuator turns the butterfly valve toward its open position. When operating the system manually, the cabin vertical velocity indicator will give the first indication of pressurization. Electrical power for manual pressure control is supplied from the essential dc bus through the cab in PRESS & AUX VENT circuit breaker on the copilot's lower circuit breaker panel.

Note

After switching from automatic to manual pressure control, the manual pressure control switch must be held in the DECREASE position for approximately 40 seconds to open the outflow valve fully.

CAUTION

Deliberate operation of the manual pressure control switch in a manner that will drive the outflow valve to the closed position, resulting in the safety valve opening, is prohibited.

Emergency Depressurization Switch.

The emergency depressurization switch is a two-position (NORMAL, EMERGENCY DEPRESSURIZATION) guarded toggle switch. When the switch is positioned to EMERGENCY DEPRESSURIZATION, battery power from the battery bus through the emer depress circuit breaker on the pilot's side circuit breaker panel is used to override the normal control circuit to open the outflow and safety valves and to close both air

cabin altimeter

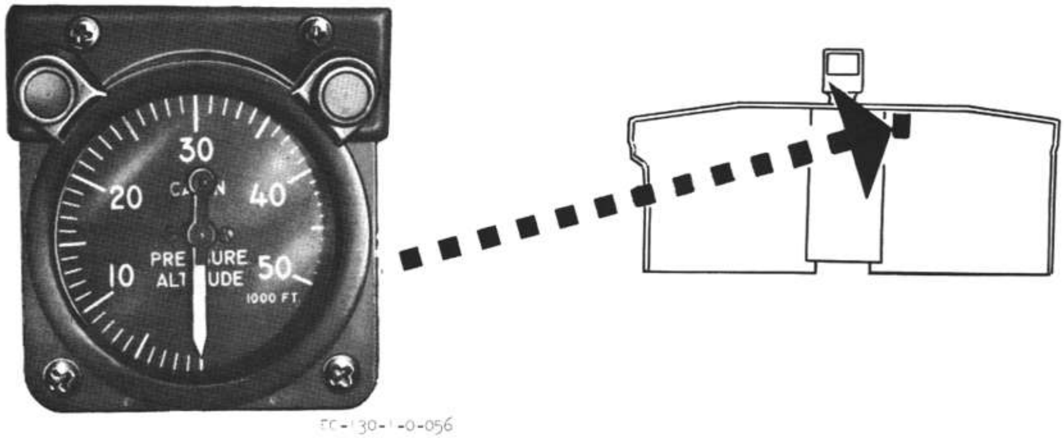


Figure 1-79.

conditioning shutoff valves. However, if the flight deck air conditioner is being operated by the manual override handle, the emergency depressurization switch will not close the flow regulator. It must be closed by use of the manual override.

PRESSURIZATION TEST VALVES.

An isobaric and an atmospheric test valve, labeled "No. 1" and "No. 2" respectively, are located on the left side of the overhead control panel. These valves, wired in the open position, are intended only for ground use.

CABIN PRESSURIZATION SYSTEM INDICATORS.

The cabin pressurization system indicators are a differential pressure gage, a cabin rate-of-climb indicator, and a cabin altimeter.

Differential Pressure Gage.

The differential pressure gage, located on the air conditioning and pressurization control panel (figure 1-74), senses both cabin and atmospheric pressures and indicates the pressure differential in inches of mercury.

CAUTION

The normal differential pressure operating limits specified in Part 4, Section I should never be exceeded.

Cabin Rate-of-Climb Indicator.

The cabin rate-of-climb indicator, which shows the rate of change of cabin altitude in feet per minute, is mounted on the air conditioning and pressurization control panel.

Cabin Altimeter.

The cabin altimeter (figure 1-79) indicates cabin air pressure altitude within the range 0 to 50,000 feet; it is installed on the copilot's instrument panel.

NORMAL OPERATION OF CABIN PRESSURIZATION SYSTEM.

Pressurized Flight-Automatic Pressure Control.

CAUTION

To allow rapid egress in event of an emergency, do not pressurize the aircraft during taxi or take-off operations.

BEFORE TAKE-OFF.

1. Turn the rate knob to MIN.

2. Set the cabin alt. knob to the desired cabin cruise altitude, but never less than field elevation.

3. Set the air conditioning master switch to AIR COND AUTO PRESS.

AFTER TAKE-OFF CLIMB.

1. Set the rate knob to the desired rate.

Adjust the rate setting as required during climb so that the cabin reaches the selected altitude at the same time the aircraft reaches cruise altitude. Thus, the rate of cabin pressure change is held to a minimum. The rate of cabin pressure change is held constant only up to pressure controller differential limit.

Note

> Monitor cabin altitude against aircraft altitude to make sure that cabin altitude stays within the isobaric range (figure 1-77).

CRUISE.

During pressurized flight, monitor the cabin differential pressure and cabin altitude. Do not allow cabin differential pressure to exceed the maximum allowable for the aircraft.

DESCENT.

1. Set the cabin alt. knob for the desired cabin altitude.

2. Set the rate knob to desired rate.

BEFORE LANDING.

Check the cabin differential pressure before landing. If more than 1.5 inches of mercury is indicated, the cabin altitude selector and the rate knob should be adjusted to higher settings to increase the rate of depressurization.

Note

> Cabin differential pressure should be zero for landing. If the differential pressure is less than 0.5 inch of mercury, no discomfort will be experienced if the air conditioning master switch is turned to a nonpressure position.

Pressurized Flight-Manual Pressure Control.

BEFORE TAKE-OFF.

1. Set the air conditioning master switch to AIR COND MAN PRESS.

2. Hold the manual pressure control switch to the INCREASE position until a pressure indication is noted on the cabin rate-of-climb indicator.

AFTER TAKE-OFF CLIMB.

Hold the manual pressure control switch in the INCREASE position until an indication of cabin pressure is observed on the cabin vertical velocity indicator. Exercise caution during manual pressure control in order to prevent excessive rates of cabin pressure change which can cause extreme discomfort to passengers and crew. Operation of the manual pressure control switch by momentarily holding it in the desired position and then releasing it to the OFF position will provide satisfactory control. Monitor the aircraft vertical velocity indicator, cabin vertical velocity indicator, the cabin differential pressure gage,and the cabin altimeter. Establish as closely as possible a constant cabin rate of climb by intermittently positioning the manual pressure control switch momentarily to the INCREASE position. By reaching the normal differential pressure at the desired cabin altitude when the aircraft reaches cruise altitude, the minimum rate of cabin pressure change will be attained.

Note

> Monitor cabin altitude against aircraft altitude to make sure that cabin altitude stays within the isobaric range (see figure 1-77).

CRUISE.

When the aircraft has reached stabilized cruise conditions, adjust the outflow valve with the manual control switch to maintain a constant differential pressure and constant cabin pressure altitude. Monitor the cabin differential pressure gage and the cabin altimeter so as not to exceed the allowable limits.

DESCENT.

As soon as the aircraft starts the descent, position the manual pressure control switch momentarily to the INCREASE position, in order to establish a decrease of cabin pressure altitude. Maintain a comfortable rate of cabin pressure change by intermittently positioning the outflow valve until the desired altitude is reached. Allow cabin differential pressure to decrease by positioning the manual pressure control switch to open the outflow valve.

BEFORE LANDING.

Check the cabin differential pressure prior to landing. If more than 1.5 inches of mercury differential pressure exists, momentarily position the manual pressure control switch to the DECREASE position, to control the rate of cabin depressurization.

Set air conditioning master switch (as required).

Note

> Cabin differential pressure should be zero for landing. If cabin differential pressure does not exceed 0.5 inch of mercury, no discomfort will be experienced if the aircraft is depressurized by turning the air conditioning master switch to a nonpressure position.

Nonpressurized Flight.

BEFORE TAKE-OFF.

1. Set the air conditioning master switch to AIR COND NO PRESS or AUX VENT.

Transition from Nonpressurization to Pressurization During Flight.

1. Turn rate knob to MIN.

2. Set cabin alt. knob to desired cabin altitude.

3. Turn air conditioning master switch to AIR COND AUTO PRESS.

Allow cabin differential pressure to build up to approximately 2 inches of mercury to provide sufficient pressure for the pneumatically actuated controller to stabilize and maintain a selected rate.

4. Turn rate knob to desired rate.

Adjust the rate setting so that the cabin reaches the selected altitude at the same time the aircraft reaches cruise altitude. The rate of cabin pressure change is thus held to a minimum.

Transition From Pressurization To Nonpressurization During Flight.

1. Set rate knob to desired rate.

2. Set cabin alt. knob to aircraft altitude at altitudes below 10,000 feet.

3. When above 10,000 feet, turn the air conditioning master switch to AIR COND MANUAL PRESS, and hold the manual pressure control switch in the DECREASE position.

Cabin altitude will increase at the rate selected until cabin pressure equals atmospheric pressure. The differential pressure is thus reduced at a controlled rate.

4. Turn air conditioning master switch to AIR COND NO PRESS (as soon as differential pressure reaches zero).

ANTI-ICING AND DEICING SYSTEMS.

Anti-icing systems, which can be used to prevent the formation of ice on critical areas of the aircraft, and deicing systems, which will remove ice after it is formed, are installed on the aircraft. Heat for the systems is obtained either by the use of electrical heating elements or by heated air drawn from the compressor of each engine.

Anti-icing systems using heated air from the bleed air system serve the wing and empennage leading edges, the nose radome, and the engine inlet air and oil cooler scoops. Anti-icing of the engine compressor inlet vanes also is accomplished by heated air, but this is suppled directly from the engine compressor and not through the bleed air system.

Anti-icing systems using heat from electrical sources are installed for the windshields, pitot tubes, and the forward section and afterbody of the propeller spinner.

Deicing of the propeller blades and rear section of the propeller spinner also is accomplished electrically.

An ice detection system may be used to achieve automatic operation of the following anti-icing and deicing systems:

Nose radome anti-icing
Engine inlet air scoop anti-icing

Compressor inlet vane anti-icing

Propeller spinner forward section and afterbody and anti-icing

Propeller blade deicing

Propeller spinner middle and rear section deicing

Propeller spinner plateaus deicing

WING AND EMPENNAGE LEADING EDGES ANTI-ICING SYSTEM.

The leading edge anti-icing system (figure 1-81) is divided into six sections, each consisting of a shutoff valve, ejectors, and control components. The shutoff valve controls the flow of air from the bleed air system to the ejectors, where it is ejected through small nozzles into mixing chambers. The hot bleed air at approximately 550° F is mixed with ambient air drawn into the mixing chambers. The resultant mixed air at approximately 350° F flows through passages next to the leading edge skin. Since some of the air leaving the passages is drawn back in for recirculation, a lower percentage of bleed air is required for continuous anti-icing. Each of the six shutoff valves is pneumatically actuated and electrically controlled. Each shutoff valve acts as a shutoff valve to stop anti-icing and to control airflow when anti-icing is required. When a solenoid on the valve is energized, the valve permits flow of bleed air to the leading edge area. The differential pressure assures a flow of air through the leading edge passages. Thermoswitches connected to the control solenoid of the shutoff valve cause the valve to close and shut off the flow of bleed air when the temperature in the leading edge reaches approximately 180° F. When the temperature drops to approximately 158° F, the valve opens and hot bleed air enters the leading edge. An overheat warning system is installed in the leading edge area. When the temperature in the leading edge area reaches approximately 200° F, the overheat warning light for that area is energized.

Wing and Empennage Anti-icing Switches.

The wing and empennage anti-icing switches are two-position (ON, OFF) toggle switches located on the anti-icing system control panel (figure 1-80). When the switches are placed in the ON position, solenoids on the anti-icing shutoff valves are energized and the valves control a flow of bleed air to the leading edge air ejectors. When the switches are in the OFF position, the anti-icing regulators shut off the flow of bleed air to the anti-icing ejectors. If the prop & eng anti-icing master switch is also in the AUTO position, the radome system is turned on automatically when ice is detected by the ice detection system.

Leading Edge Temperature Indicators.

Six leading edge temperature indicators, one for each section of the anti-icing system, are located on the anti-icing system control panel (figure 1-80). Each indicator is connected to a resistance bulb located in the leading edge area. The resistance bulbs are placed so that they sense temperature of the air in the area aft of the leading edge skin, not the hot air passed next to the skin. Electrical power for the indicators is supplied from the essential dc bus through the wing and empennage temp indicator circuit breaker on the copilot's lower circuit breaker panel. Each indicator is marked in ranges as follows:

INOPERATIVE - Approximately 75° F and below.

NORM OPER RANGE - Between approximately 75° F and 200° F.

OVERHEAT - Approximately 200° F and above.

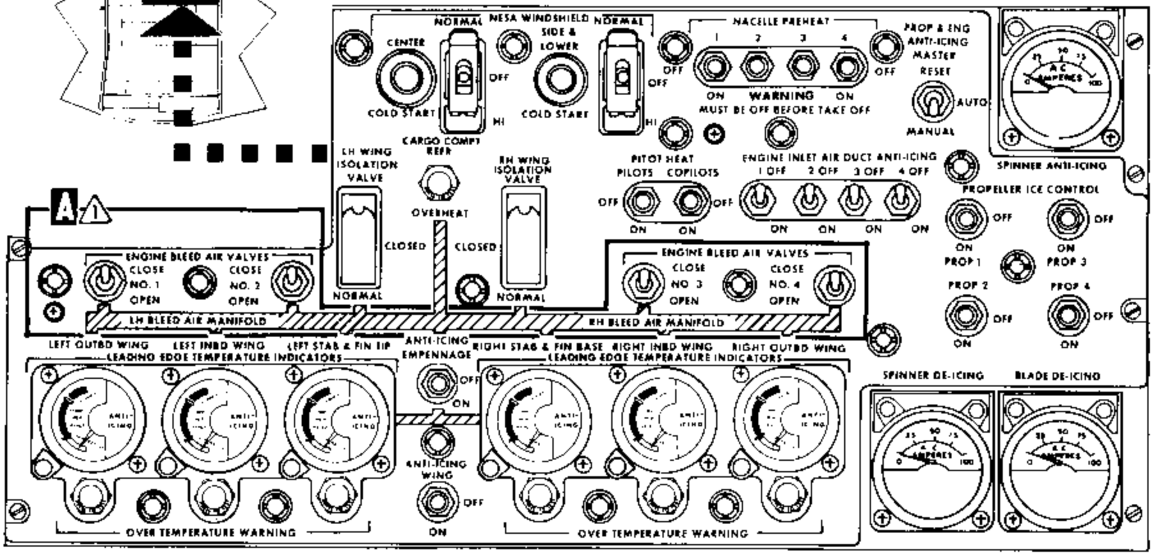
Leading Edge Overtemperature Warning Lights.

Six overtemperature warning lights, one for each section of the leading edge anti-icing system, are located below the temperature indicators on the anti-icing system control panel (figure 1-80). When the temperature in the leading edge reaches approximately 200° F, the warning light for that area illuminates. A seventh warning light, mounted directly above the wing and empennage anti-icing switches on the anti-icing systems control panel (figure 1-80), illuminates to indicate an overheated condition in the cargo compartment air conditioning refrigeration unit. Electrical power for the lights is supplied from the essential dc bus through the wing and empennage overheat lights circuit breaker on the copilot's lower circuit breaker panel.

Normal Operation of Leading Edge Anti-icing System.

The wing and empennage leading edge anti-icing system is turned on or off by the anti-icing switches on the anti-icing systems control panel. Regulation of temperatures within the leading edges is achieved automatically by thermostatic control of the valves, permitting entry of bleed air to the system ejectors. The temperature indicators on the control panel, however, should be monitored while the system is operating, since an emergency condition will exist if

anti-icing systems control panel



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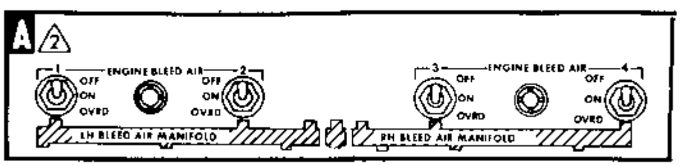


NOTE

1. EC-130G AND EC-130Q BUNO 156170 THROUGH 156177.
2. EC-130Q BUNO 159348 AND 159469.

Figure 1-80.

either the associated indicators or the warning lights show an overheated condition in any section.

CAUTION

> The leading edge anti-icing system must not be used to remove ice from surfaces when the aircraft is on the ground. With no airflow over the surface, the air within the leading edge area quickly rises in temperature, and the excessive heat damages fuel tank sealants, paint, structure, and other equipment. If the system is operated for testing, constant monitoring of the temperature indicators must be maintained, and the system must not remain on more than 30 seconds.

RADOME ANTI-ICING SYSTEM.

The radome anti-icing system (figure 1-82) conducts a mixture of hot bleed air and recirculated return air through passages in the radome structure to heat the radome surface. The flow of bleed air is controlled by a throttling and shutoff valve, which is pneumatically actuated and electrically controlled. When the system is operating, the valve opens to allow hot bleed air at a temperature of approximately 550° F to flow through a nozzle in an ejector. Return air from the radome passages is mixed with the bleed air in the ejector to provide a mixture at a temperature between 150° F and 275° F, which is ejected into the radome passages. A pneumatic thermostat controls the valve so as to regulate anti-icing air temperature and another thermostat prevents air at a temperature higher than 275° F from entering the radome passages.

Pressure of air in the radome passages is held constant by a relief valve on the ejector. A solenoid on the throttling and shutoff valve is energized to permit the valve to open; it is deenergized to cause the valve to close to shut off the airflow. The valve control circuit is interconnected with the ice detection system so that the radome anti-icing can be turned on automatically when the detection system senses icing. Twenty-eight volt, dc electrical power for control of the radome

leading edge anti-icing system

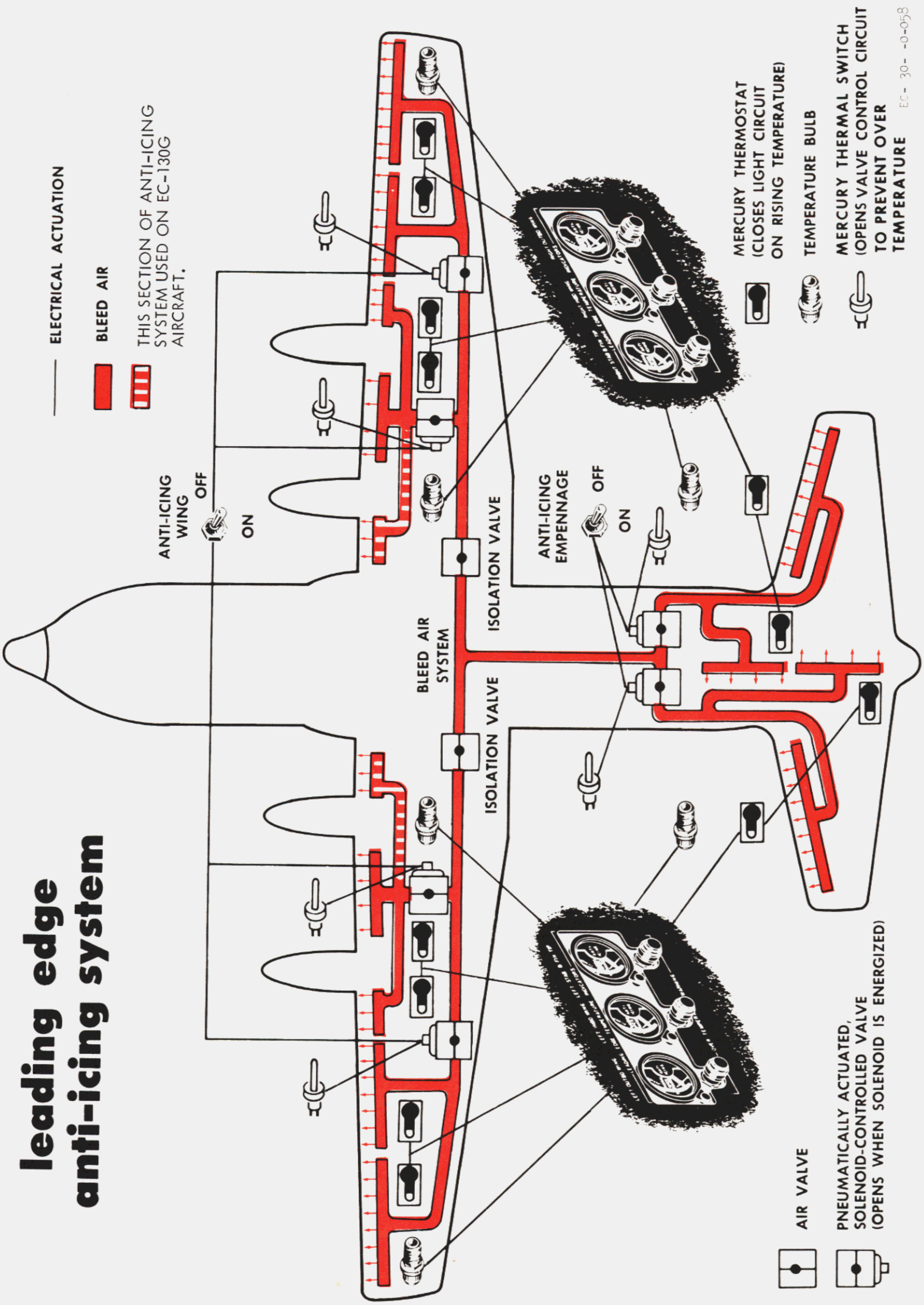


Figure 1-81.

anti-icing system is supplied from the main dc bus through the radome anti-icing control circuit breaker on the copilot's lower circuit breaker panel.

Nose Radome Anti-icing Switch.

The nose radome anti-icing switch (see figure 1-10) is located on the navigator's panel. It is a three-position (AUTO,OFF,MANUAL) toggle switch. When the switch is in the AUTO position, it permits control of the radome anti-icing valve by the ice detection system. If the prop & eng anti-icing master switch is also in the AUTO position, the radome system is turned on automatically when ice is detected by the ice detection system. When the radome anti-icing switch is in the OFF position, the anti-icing valve is closed to shut off all air flow through the radome passages. When the switch is in the MANUAL position, the anti-icing system is on.

Normal Operation of Radome Anti-Icing System.

CAUTION

The radome anti-icing system must not be operated when the aircraft is on the ground. To do so may overheat and damage the radome.

For direct operation of the nose radome anti-icing system, independently of the sensing of ice by the detection system, the nose radome anti-icing switch on the navigator's control panel should be set to MAN. Turning the switch to OFF immediately closes the throttling and shutoff valve, stopping the flow of anti-icing air to the radome.

To permit automatic operation of the nose radome anti-icing system when ice is sensed by the aircraft ice detection system, both the nose radome anti-icing switch on the navigator's instrument panel or control panel, and the propeller and engine anti-icing master switch on the anti-icing systems control panel (figure 1-80), must be set to AUTO. The nose radome, propeller, and engine anti-icing systems are then simultaneously controlled. Placing the propeller and engine anti-icing master switch to the momentary RESET position will turn off all three systems. The ice detection system, however, will remain armed if the the switch then is returned to AUTO. With the switch thus positioned, the detection system will automatically turn on the radome, propeller, and engine anti-icing systems if ice conditions are again detected by the ice detection system.

Normally radome anti-icing should not be used except when ice accumulation interferes with the scope presentation or for a 5 minute period when climbing through the freezing level to remove possible moisture from the radome or from the anti-icing system valves.

ENGINE INLET AIR DUCT ANTI-ICING SYSTEMS.

Two systems (figure 1-83) are provided for engine inlet air duct anti-icing. One system routes bleed air from the bleed air system to passages in the engine inlet air scoop and oil cooler scoop to heat the scoops. The other system routes air from the compressor diffuser section of the engine to passages in the compressor inlet vanes. The scoop anti-icing airflow is shut off by a solenoid valve which is energized closed. The air flows when the valve is deenergized open. The vane anti-icing airflow is controlled by two pressure-actuated valves, which are controlled by a single solenoid valve. When the solenoid valve is energized, the pressure-actuated valves shut off the airflow, and when the solenoid valve is deenergized, the pressure-actuated valves open. Both the scoop and vane anti-icing systems are termed fail-safe, meaning that anti-icing is provided when the system power supply is lost. The electrical control circuits are interconnected with the ice detection system so that the duct anti-icing can be turned on automatically when the detection system senses icing.

Engine Inlet Air Duct Anti-icing Switches.

Four engine inlet air duct anti-icing switches are located on the anti-icing systems control panel (figure 1-80). Each switch has ON and OFF positions. If a switch is in the ON position, the scoop and vane anti-icing systems for that engine are turned on if the prop and engine anti-icing master switch is in MANUAL. If the master switch is in the AUTO position, anti-icing is turned on when the ice detection system detects ice. When an engine inlet air duct anti-icing switch is in the OFF position, both scoop and vane anti-icing valves for that engine close to shut off the anti-icing airflow.

Normal Operation of Engine Inlet Air Duct Anti-icing Systems.

1. To turn the systems on manually, position the prop and engine anti-icing master switch to MANUAL and the engine inlet air duct anti-icing switches to ON.

2. To allow the system to be turned on automatically by the ice detection system, position the prop and engine anti-icing master switch to AUTO and the engine inlet air duct anti-icing switches to ON.

radome anti-icing system

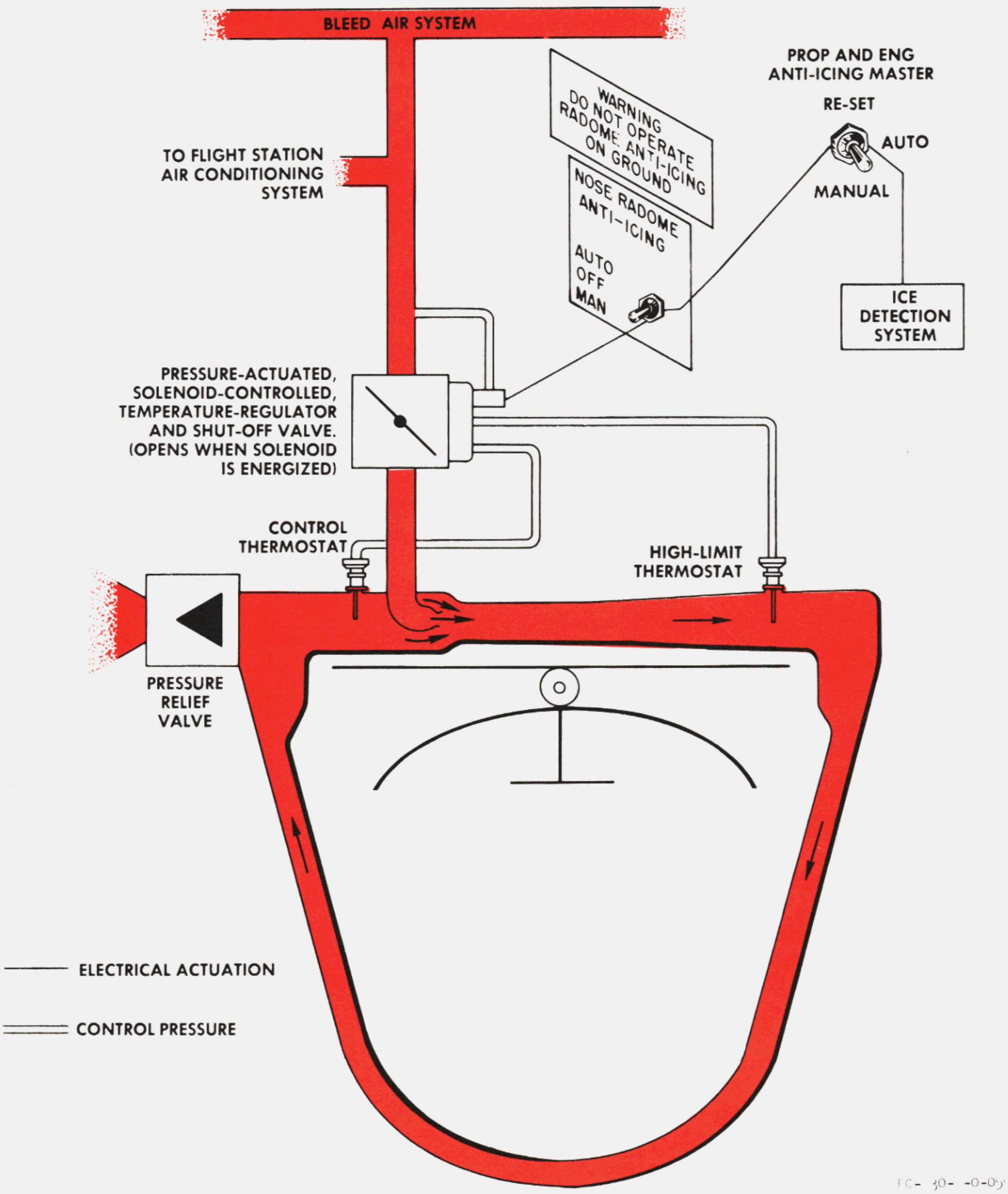
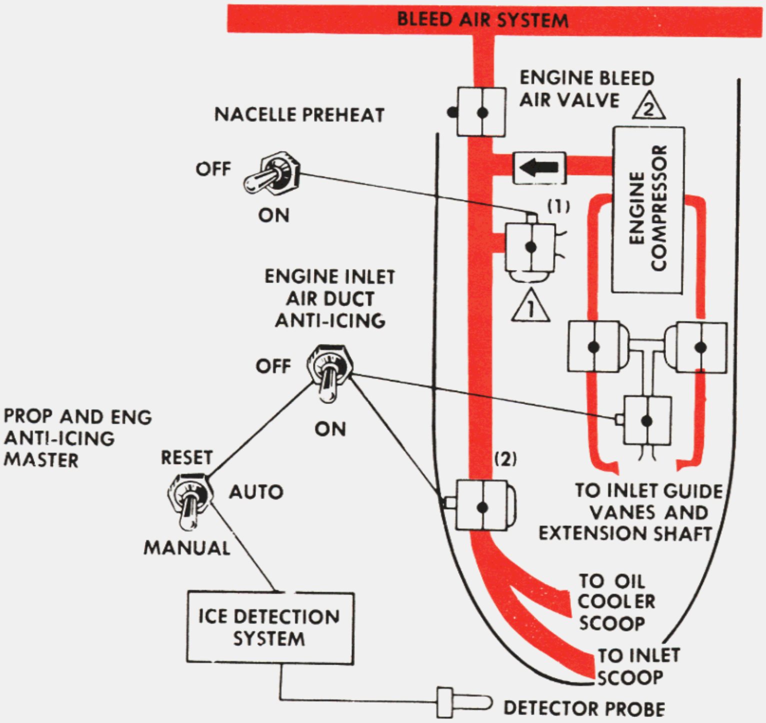
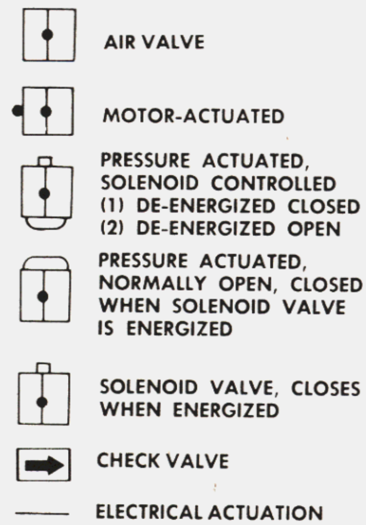


Figure 1-82.

engine anti-icing system





⚠1 NACELLE PREHEAT INOPERATIVE ON EC-130Q AIRCRAFT.

⚠2 MOTOR-DRIVEN SHUTOFF VALVE ON EC-130G AND EC-130Q BUNO 156170 THROUGH 156177. PRESSURE-ACTUATED DUAL SOLENOID-CONTROLLED PRESSURE REGULATOR (OPEN WHEN SOLENOID IS ENERGIZED) ON EC-130Q BUNO 159348 AND 159469.

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Figure 1-83.

3. To shut the systems off while leaving them subject to automatic control, position the prop and engine anti-icing master switch to RESET and release to the AUTO position. Let the engine inlet air duct anti-icing switches remain in the ON position.

4. To shut the systems off, place the engine inlet air duct anti-icing switches in the OFF position.

Note

If an engine is shutdown during flight, the inlet duct anti-icing should be left on if icing conditions exist. However this will not be possible if the fire handle was pulled.

PROPELLER ANTI-ICING AND DEICING SYSTEMS.

The propeller spinner and blades are equipped with heating elements for anti-icing and deicing (figure 1-84).

Propeller Anti-icing System.

The forward section of the spinner and the propeller afterbody are covered by electrical resistance-type heating elements to provide anti-icing. Phase A primary ac power is applied to the heating elements to warm the surface of the spinner and prevent the formation of ice. The AC power is protected by the spinner anti-icing circuit breakers on the pilot's upper circuit breaker panel and is applied by relays which are controlled by DC control circuits. The control circuits are interconnected with the ice detection system so that the propeller anti-icing can be turned on automatically when the detection system senses icing. The propeller anti-icing is a continuous heating type system.

Propeller Deicing System.

The aft portion of the front spinner section, the rear rotating spinner section, the spinner plateaus, and the leading edges and fairing of the propeller blades contain heating elements for deicing the surfaces. The aft portion of the front spinner section, along with the forward part of the rear rotating spinner section and the spinner plateaus, use Phase B primary ac power and are protected by the spinner deicing circuit breaker on the upper main ac panel. The aft portion of the rear rotating spinner section and the leading edges and fairing of the propeller blades use Phase C primary ac power and are protected by the blade deicing circuit breaker on the upper main ac panel. The control circuits for the propeller deicing, like the control circuits for the propeller anti-icing system, are connected to the ice detection system so that they may be turned on automatically. The application of spinner and blade deicing power to the heating elements is controlled by the deicing timer. The timer receives 28-volt, dc power from the essential dc bus through the propeller deicing timer circuit breaker on the copilot's lower circuit breaker panel. The timer applies power to the heating elements of only one propeller at a time; the elements of each propeller are energized 15 seconds and deenergized for 45 seconds during each one-minute cycle. The 115-volt, ac power for the heating elements is supplied from the lh ac bus through the blade and spinner deicing circuit breakers on the upper main ac panel.

Propeller Ice Control Switches.

Four propeller ice control switches are located on the anti-icing systems control panel (figure 1-80). These 2-position (ON, OFF) toggle switches control the propeller anti-icing and deicing systems. When a switch is placed in the ON position and the prop and engine anti-icing master switch is in the MANUAL position, the anti-icing and deicing systems for the corresponding propeller are energized. If a switch is positioned to ON while the prop and engine anti-icing master switch is in the AUTO position, the anti-icing and deicing systems are energized only when the ice detection system detects icing. When a switch is placed in the OFF position, the anti-icing and deicing systems for the corresponding propeller are deenergized.

Anti-icing and Deicing Ammeters.

Three ammeters located on the anti-icing systems control panel indicate the amperage of the various phases of primary ac power drawn for the propeller anti-icing and deicing systems. The spinner anti-icing ammeter indicates the amperage of Phase A power drawn for anti-icing; the spinner deicing ammeter indicates the amperage of Phase B power drawn for deicing; and the blade deicing ammeter indicates the amperage of Phase C power drawn for deicing. (Refer to Part 4, this section for limits.)

Normal Operation of Propeller Anti-icing and Deicing Systems.

1. To turn on the anti-icing and deicing systems manually, place the prop and engine anti-icing master

propeller anti-icing and de-icing system

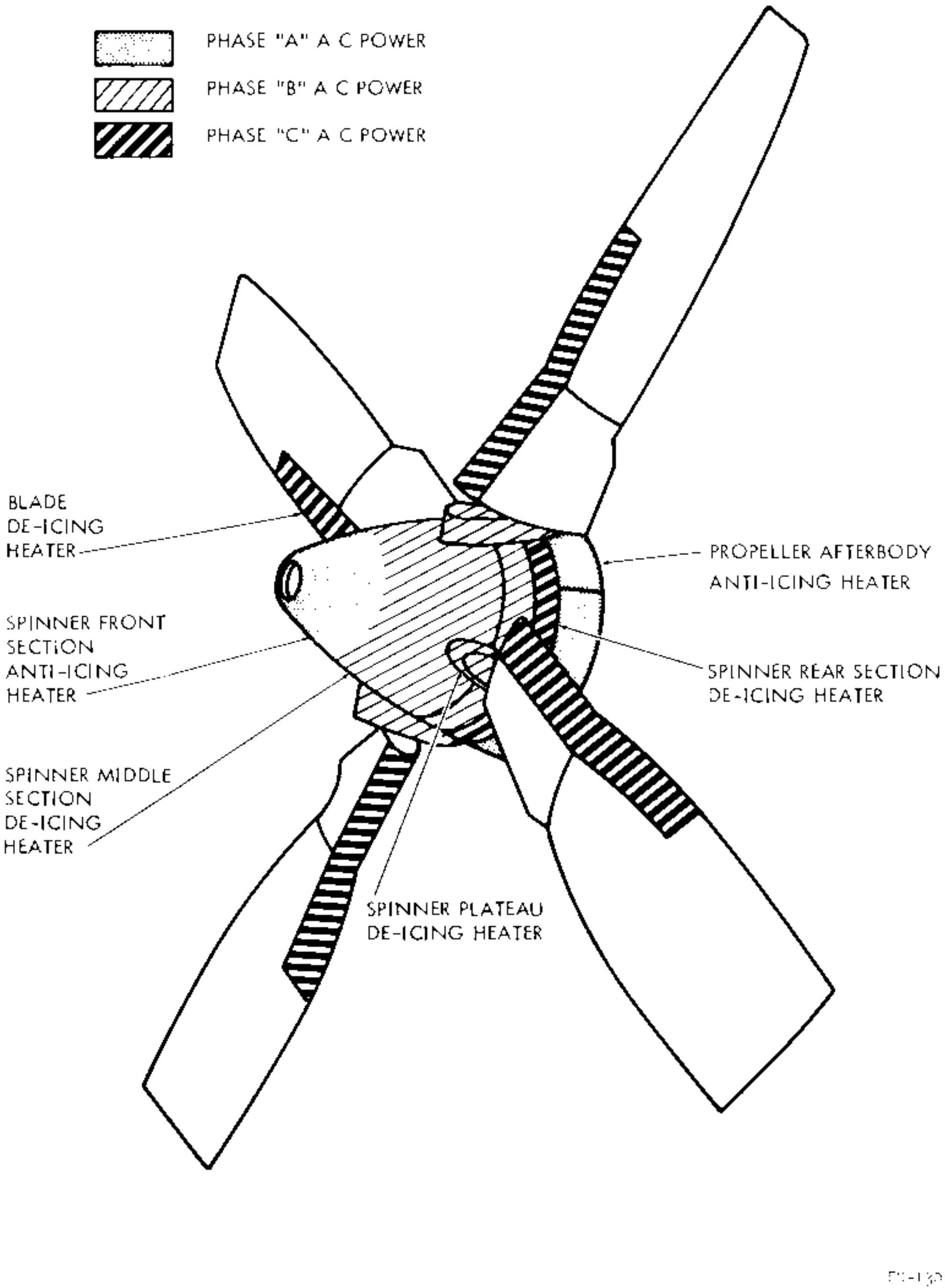


Figure 1-84.

switch in the MANUAL position and the propeller ice control switches in the ON position.

Note

To allow the systems to be turned on automatically by the ice detection system, place the prop and engine anti-icing master switch in the AUTO position and the propeller ice control switches in the ON position.

2. To turn off the system and leave them subject to automatic control by the ice detection system, move the prop and engine anti-icing master switch to the RESET position, and release it to the AUTO position.

3. To turn off the propeller anti-icing and deicing systems, place the propeller ice control switches in the OFF position.

Note

A preflight check of the propeller anti-icing and deicing system may be made with the engines running in accordance with the procedures outlined in Section III.

CAUTION

When the aircraft is on the ground, do not operate the propeller anti-icing or deicing for an engine that is not running. The engine must be running in order to dissipate the heat generated by the heating elements to prevent damage to the elements. Never operate the system for more than two cycles while the aircraft is on the ground. Anti-icing and deicing may be used for a propeller feathered in flight.

WARNING

Before flying into known or suspected icing conditions, turn on the propeller blade deicing system. If a blade deicing ammeter reading falls below 65 amperes for a period of 15 seconds in each one-minute deicing cycle, do not fly into known or suspected icing conditions.

ICE DETECTION SYSTEM.

The ice detection system is used as an automatic control for turning on the radome anti-icing, engine inlet air duct anti-icing, and propeller anti-icing and deicing systems. The detection system consists of a prop and engine anti-icing master switch, two sets of detector units, indicator lights, a test switch, and control relays. Each set of detection units has a detector and an interpreter. Each detector includes a probe; one is mounted in the No. 2 engine inlet air duct, and the other is in the No. 3 engine duct. The detection units are energized by essential dc power applied through the engine starting circuits, and they are operative when the No. 2 or No. 3 engine is running and the prop and engine anti-icing master switch is at AUTO. Electrical protection for the ice detectors is provided by the lh and rh ice detector circuit breakers on the copilot's lower circuit breaker panel. If either probe becomes iced over while the engine in which it is installed is running, and if the prop and engine anti-icing master switch is at AUTO position at that time, the detection units trigger a control relay. This relay turns on the anti-icing and deicing systems if the switches for those systems are at ON or AUTO positions. The relay also turns on an indicator light. The ice detection system does not turn off the anti-icing and deicing systems automatically when icing conditions no longer exist, but the master switch can be held at RESET position to turn them all off simultaneously. Timers in the ice detection system operate after the No. 2 and No. 3 engines are shut down and disarm the detection system. If any of the anti-icing or deicing systems have been left in automatic operation, they are turned off upon disarming of the detection system at engine shutdown.

Propeller and Engine Anti-icing Master Switch.

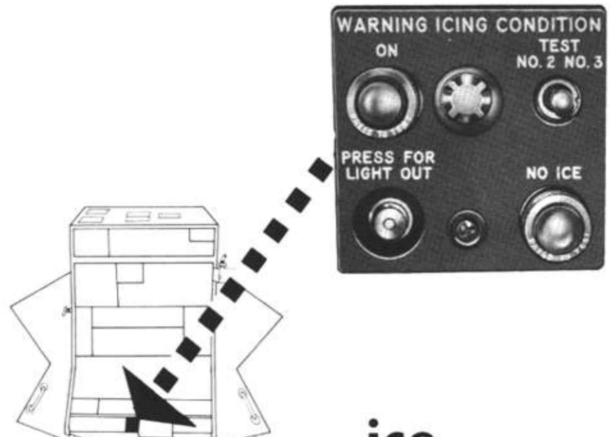
The prop and engine anti-icing master switch is located on the anti-icing systems control panel (figure 1-80). It has three positions - AUTO, MANUAL, and RESET. When at AUTO position, it permits control of the radome anti-icing, engine inlet air duct anti-icing, and propeller anti-icing and deicing systems by the ice detection system. The AUTO position is also used to permit testing of the ice detection system. When at MANUAL position, the switch permits control of the anti-icing and deicing systems by the individual control switches for the systems. The RESET position is a momentary position used to turn off the anti-icing and deicing systems when icing conditions no longer exist. When the switch is positioned at RESET and allowed to return to AUTO, the ice detection system remains armed; therefore, it will automatically turn on the anti-icing and deicing systems again if it senses icing.

Test Switch.

The test switch is located on the ice detection panel (figure 1-85). It has No. 2 and No. 3 momentary positions and a center OFF position. It is used to test operation of the two sets of ice detector interpreter units by simulating detection of icing. If it is held at No. 2 position while the No. 2 engine is running and the prop and engine anti-icing master switch is at AUTO, the ON indicator light on the ice detection panel comes on to indicate that the ice detection system has triggered the control relay which turns on the anti-icing and deicing systems. The No. 3 position of the switch is used in the same manner to test operation of the other set of detector interpreter units. After the test switch is operated to either position, the prop and engine anti-icing master switch must be held at RESET momentarily to unlock the control relay and rearm the detection system.

On-Light and Press-For-Light-Out Switch.

The on-light and the press-for-light-out switch is located on the ice detection panel (figure 1-85). The indicator light is turned on by the ice detection system whenever it detects ice while the prop and engine anti-icing master switch is in the AUTO position. When lighted, it indicates that icing has been detected by probes in the engine inlet air scoops and that anti-icing and deicing systems have been turned on automatically if the individual system switches are at ON or AUTO. It also lights when the test switch is operated and then indicates that the detection units



ice detection panel

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Figure 1-85.

are functioning. The momentary light out switch can be operated to turn the light out. If the prop and engine anti-icing master switch is held in the RESET position to turn off the anti-icing and deicing systems, the light remains off if icing no longer exists.

No-Ice Light.

The no-ice light is on the ice detection panel (figure 1-85). It is turned on when the probes of the detection system are no longer icing and indicates that the anti-icing and deicing systems can be turned off. If the prop and engine anti-icing master switch is held in the RESET position to turn the anti-icing and deicing systems off, the light is also extinguished.

PITOT TUBE ANTI-ICING SYSTEM.

Pitot tube anti-icing is provided by dc electric heating elements on the two tubes. The pilot's pitot tube heaterer uses power from the essential dc bus through the pilot's pitot heat circuit breaker, and the copilot's and navigator's pitot tube heater uses power from the isolated dc bus through the copilot's and navigator's pitot heater circuit breaker. This arrangement permits power to be drawn from the battery to heat the copilot's and navigator's pitot tube when normal dc power sources have failed. The pilot's pitot heater circuit breaker is located on the copilot's lower circuit breaker panel, and the copilot's and navigator's pitot heater circuit breaker is located on the pilot's side circuit breaker panel.

Pitot Heat Switches.

The pilot's and copilot's pitot heater switches are located on the anti-icing systems control panel (figure 1-80). These two-position toggle switches have ON and OFF positions. When a switch is placed in the ON position, the heating element for the corresponding pitot tube is energized. When the switch is in the OFF position, the heating element is deenergized.

WINDSHIELD ANTI-ICING SYSTEM.

The three windshields, the two windows on each side of the windshields, and the two lower windows in front of the pilot are Nesa-type. These panels are heated by applying primary ac power from the main ac bus to a resistance material between the layers of glass. The ac power is applied by automatic dc control systems which cycle to maintain window temperature within specific limits. A center windshield system controls heating of the three center windshields, and a side and lower system controls heating of the side and lower windows. The two systems are identical except for the amount of total ac power provided. Provisions are made for selecting either normal or high rate of heating. When high rate is selected, higher voltage is applied for shorter periods of time so that the Nesa heats more rapidly, but not to a higher temperature. Provisions are also made for controlling the temperature increase manually when the Nesa panels are extremely cold. The control systems do not function automatically when window temperature is below -43° C (-45° F).

Nesa Windshield Switches.

The Nesa windshield switches are on the anti-icing systems control panel (figure 1-80). Each switch has NORMAL, OFF, and HI positions. When the center windshield switch is in the NORMAL position, the three center windshields are heated at the normal rate. If the switch is positioned to HI, the three center windshields have higher voltage applied to the heating material so that they heat more rapidly. Heating of the side and lower windows is controlled in the same manner by the side and lower windshield switch.

Nesa Windshield Coldstart Switches.

The coldstart switches are located on the anti-icing systems control panel (figure 1-80) next to the Nesa windshield control switches. The coldstart switches are push-type momentary switches. The purpose of the switches is to provide manual control of windshield heating to raise the windshield temperature gradually from extremely cold temperature so as to prevent damaging the glass panels. If temperature of the windshield panels is below -43° C (-45° F) the control systems do not function automatically. Pressing the coldstart switches causes the control systems to apply ac power to the windshield panels while the switches are held.

Normal Operation of Windshield Anti-icing System.

CAUTION

Operation of Nesa anti-icing when outside air temperature is above 27° C (81° F) will increase the possibility of delamination within the Nesa panels.

1. Always place the Nesa windshield anti-icing switches in the NORMAL position before take-off to reduce thermal shock and the possibility of cracking the windshield.

CAUTION

Monitor operation of the anti-icing systems by feeling the glass and observing ice formation on the panels. Turn off the system if any of the following conditions are noticed:

Panels feel excessively hot.

Electrical arcing is observed in one of the panels.

One of the panels containing thermistors is not heating. This might cause the other panels in the same system to overheat.

2. If ice is forming on the windshields at a rate higher than it can be removed by operating the

anti-icing system in NORMAL, set the switches to HI until out of the extreme icing conditions. Do not use the HI position when turning on a system initially.

3. When ambient temperatures is below -43° C, place the Nesa windshield anti-icing switches in the NORMAL position. Actuate the cold-start switches, 5 seconds ON and 10 seconds OFF, until the temperature of the windshield is above -43° C.

CAUTION

Do not exceed the operating limits of 5 seconds on, 10 seconds off when operating the coldstart switch. To do so might cause the windshield panels to be damaged.

NACELLE PREHEAT SYSTEM.

Note

The nacelle preheat system on some engines may be inoperative due to the preheat valves not being installed.

The nacelle preheat system allows hot air from the bleed air system to flow into the nacelle to heat the engine and nacelle equipment before starting the engine. A solenoid valve and diffuser in each nacelle controls the airflow. The engine bleed air valve in a nacelle must be open before bleed air can flow to the preheat valve. The preheat valves are controlled by four nacelle preheat switches on the anti-icing systems control panel (figure 1-80). The control circuits for the valves are energized by 28-volt dc power from the main dc bus through the nacelle preheat circuit breakers on the copilot's lower circuit breaker panel only while the corresponding engine condition levers are at GROUND STOP or FEATHER position and the aircraft is on the ground.

NACELLE PREHEAT SWITCHES.

The four nacelle preheat switches, located on the anti-icing systems control panel (figure 1-80), are two-position (ON, OFF) toggle switches. When a switch is placed in the ON position while the aircraft is on the ground and the corresponding engine condition lever is at GROUND STOP or FEATHER, the nacelle preheat valve is energized open and remains open as long as the switch is in the ON position. Placing the nacelle preheat switch in the OFF position deenergizes the valve closed.

Note

Nacelle preheat is operational only when the touchdown switch is closed, that is, when the aircraft is on the ground.

Normal Operation of Nacelle Preheat System.

1. To apply heat to a nacelle, place the nacelle preheat switch for that engine in the ON position and the corresponding engine condition lever in GROUND STOP or FEATHER.

2. To stop nacelle heating, place the nacelle preheat switch for that engine in the OFF position.

CAUTION

Nacelle preheat should be used only when the ambient temperature is below 0°F and only when necessary to remove frost or ice from equipment in the nacelle to facilitate engine starting. The bleed air for nacelle preheating is at approximately 600°F when supplied by an engine or 350°F when supplied by the GTC. Air at this temperature can quickly bake electrical cables and damage electronic components in the nacelle. Closely monitor the nacelle overheat warning light. If it illuminates, place the nacelle preheat switch to the OFF position.

GAS TURBINE COMPRESSOR (GTC).

The GTC (figure 1-86), located forward in the left wheel well, supplies air for ground operation of the air turbine motor, engine starting, nacelle preheat, and the air conditioning system. The unit is composed of a compressor assembly, power turbine assembly, and an accessory assembly. The GTC ignition, and electrical controls are energized by 28-volt, dc power from the isolated dc bus.

Circuit protection is provided by the GTC control circuit breaker on the pilot's side circuit breaker panel.

COMPRESSOR ASSEMBLY.

The GTC uses a two-stage, centrifugal-type compressor. When the compressor is operating at full speed, part of the compressed air is discharged into the power turbine to support combustion, and the remainder is available as pneumatic power.

POWER TURBINE ASSEMBLY.

The power turbine assembly drives the compressor and the GTC accessories. The assembly consists of a turbine section and a combustor. Fuel is injected into the combustion chamber, mixed with air, and burned. The combustion gases are directed against the turbine wheel, which supplies rotary power to drive the compressor and accessory assemblies. After being used to turn the turbine wheel, the combustion gases pass out the exhaust.

ACCESSORY ASSEMBLY.

The accessory assembly of the GTC consists of a starter motor, oil and fuel pumps, an oil cooler fan, and a governor. The accessory group, with the exception of the starter motor, is powered through a reduction gear train directly coupled to the compressor drive shaft. The starter motor is coupled to the reduction gear train through a spring-loaded clutch. The starter clutch is disengaged by centrifugal force when the unit reaches approximately 35 percent of its nominal governed speed.

GTC OIL SYSTEM.

The GTC oil, circulation system provides lubrication for all gears and shaft bearings. Oil from a fuselage-mounted reservoir is delivered by a gear-type pump through an oil filter to the various lubrication points. A relief valve in the system maintains the desired pressure. Oil is removed from the unit by a dual scavenge pump and returned to the reservoir, either through the oil cooler or, if oil temperature is below 27°C (81°F), through the oil cooler bypass valve. An oil drain line is connected to the accessory section to eliminate the possibility of oil accumulation after the gas turbine compressor is stopped. Oil used in this unit must conform to the specification and grade listed in the servicing diagram (figure 1-136).

GTC FUEL SYSTEM.

Fuel for operation of the GTC may be supplied from any fuel tank through the cross-feed manifold. A pressure regulator limits the inlet pressure to the GTC gear-driven fuel pump to approximately 15 psi. A fuel strainer is located in the supply line between the pressure regulator and the combustion chamber. In addition to filtering the fuel, the strainer removes water from the incoming fuel and collects it in a sump. A valve is provided for sump drainage. During the starting cycle, when the oil pressure in the GTC oil system reaches approximately 3 psi, the fuel and ignition circuits are energized through a switch actuated by oil pressure. The fuel supply to the GTC is shut off by moving the GTC control switch to OFF or by pulling the GTC fire handle.

GTC CONTROL SYSTEM.

The operation of the GTC is governor-controlled to maintain a nearly constant speed of approximately 100 percent rpm under varying load conditions. The speed-sensing governor, powered by the accessory gear train, controls the unit by regulating fuel flow into the combustion chamber. An overspeed switch closes the fuel shutoff valve to prevent overspeeding when the GTC reaches approximately 44,500 rpm, 110 percent of Normal Rated Speed.

GTC CONTROLS.

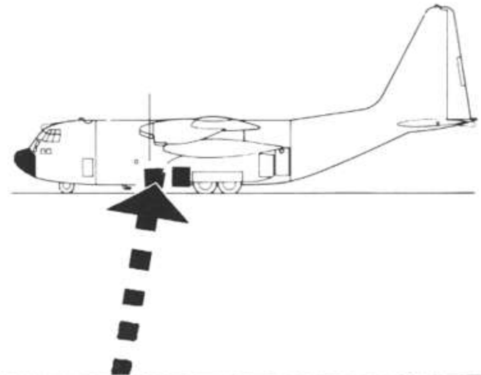
All GTC controls are located on the GTC control panel (figure 1-87), on the overhead control panel. The GTC controls are energized by 28-volt dc power from the isolated dc bus through the GTC control circuit breaker on the pilot's side circuit breaker panel.

GTC Control Switch.

A selector switch for the GTC is located on the GTC control panel (figure 1-87). This three-position (OFF, RUN, START) rotary switch controls the operation of the GTC. Holding the selector switch in the spring-loaded START position energizes the self-holding GTC starter relay. This relay will remain closed until the circuit is broken by the 35-percent speed switch or by moving the selector switch to the OFF position. When the switch is released, it moves to the RUN position. In this position, all GTC circuits are energized to the various automatic controls. These oil-pressure and speed-sensitive switches control their respective circuits to accomplish starting and running of the GTC. In the OFF position, all circuits are deenergized.

gas turbine compressor

1. HOURMETER
2. EXTERNAL PRESSURE CONNECTION
3. GTC COOLING FAN EXHAUST
4. EXHAUST
5. INLET
6. PRIMER BUTTON



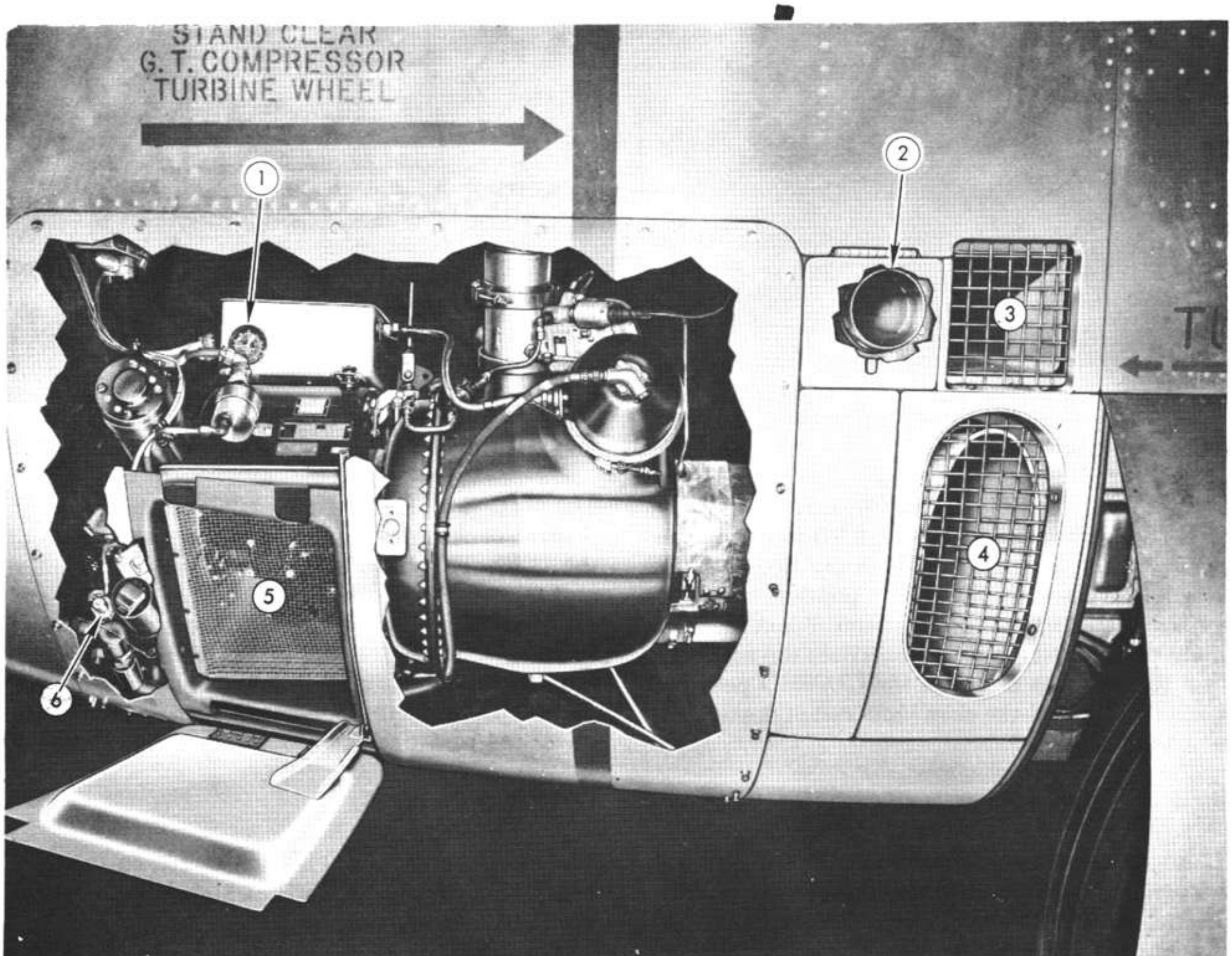


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Figure 1-86.

gas turbine compressor control panel

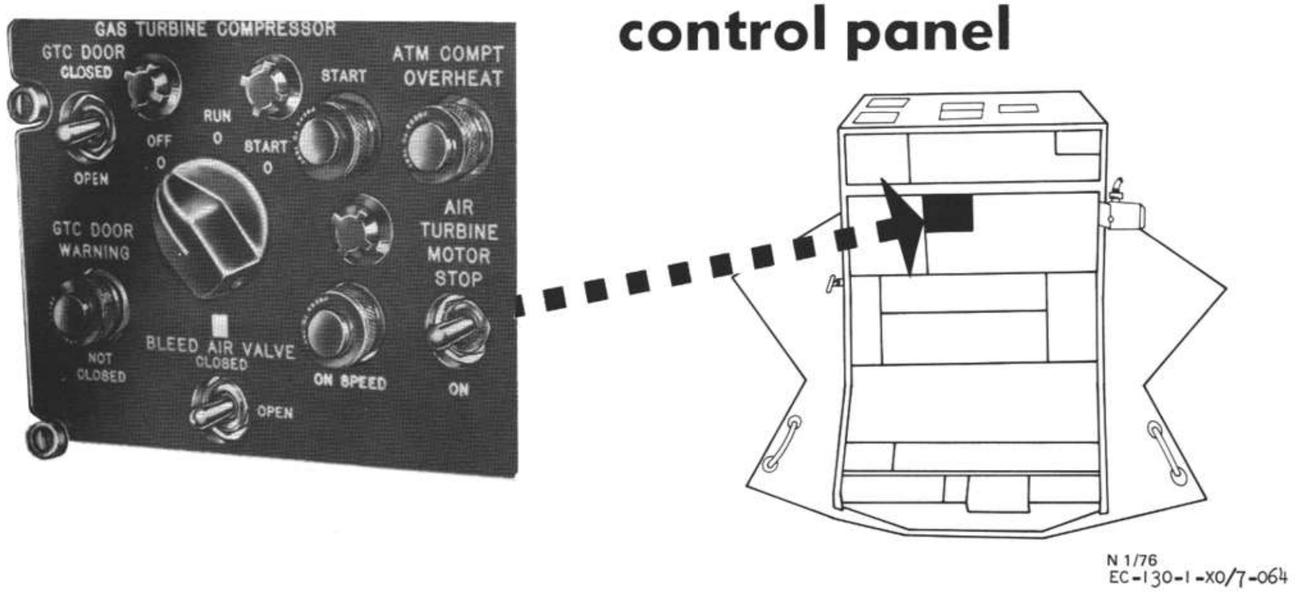


Figure 1-87.

GTC Door Switch.

A two-position (OPEN, CLOSED), toggle switch on the GTC control panel (figure 1-87) controls the opening and closing of the GTC intake door. When the switch is placed in the OPEN position, the GTC door is actuated to the open position. When the door is fully open, a limit switch deenergizes the actuator. When the switch is placed in the CLOSED position, the door closes, and the close limit switch deenergizes the actuator.

Bleed Air Valve Switch.

A bleed air valve switch is located on the GTC control panel (figure 1-87). After the compressor reaches operating speed, this two-position (OPEN, CLOSED) toggle switch controls the normally closed, solenoid-operated bleed air valve. With the valve closed, air is supplied to the power turbine combustion chamber only. With the valve open, air is supplied to both the combustion chamber and the bleed air system of the aircraft. Applying a bleed air load to the compressor before it reaches operating speed is prevented by the 95-percent speed switch, which completes the circuit to the bleed air valve switch only after operating speed is reached.

Fire Handle.

The GTC fire handle (figure 1-25) on the overhead control panel provides for emergency shutdown of the GTC. This handle, when pulled, energizes the motor operated oil shutoff valve closed, and deenergizes power to the GTC door and control switch. When the circuit to the control switch is broken, the motor operated fuel valve is energized closed. The solenoid operated fuel and bleed air valves are also deenergized to the closed position.

GTC INDICATORS.

The indicators for the GTC are located on the GTC control panel (figure 1-87), which is part of the overhead control panel.

Start Light.

A start light is located on the GTC control panel. This press-to-test light glows to indicate that the starter motor is energized and engaged with the GTC drive train. The light stays on until the compressor reaches approximately 14,900 rpm, at which time a centrifugal switch deenergizes the starter and the start light.

ON Speed Light.

An on speed light is located on the GTC control panel. This press-to-test light is energized through the 95-percent speed switch, and it indicates that the compressor has reached or is maintaining operating speed.

GTC Door Warning Light.

A GTC door warning light is located on the GTC control panel (figure 1-87). This press-to-test light illuminates when the GTC intake door is not closed.

GTC OPERATING INSTRUCTIONS.

The GTC can be operated on the ground only. The air intake door and GTC are operated from the GTC control panel on the overhead control panel.

WARNING

During starting and operation of the GTC, personnel must stand clear of compressor air intake and exhaust and plane of rotation of turbine and compressor. Exercise extreme care to prevent foreign material from entering the air intake, as turbine failure may be sufficiently violent to damage equipment and endanger nearby personnel.

Starting the GTC.

Start the GTC as follows:

1. Turn on dc power. If external dc power is available, turn the battery switch to EXT DC PWR position. If external ac power is available, turn the external ac power switch to the EXT AC PWR position and turn the battery switch to BATTERY. If no external power is available, turn the battery switch to the BATTERY position.

2. Open the GTC air intake door by placing the GTC door switch in the OPEN position.

Note

A limit switch prevents starting of the GTC unless the air intake door is fully open.

3. Tie the bus tie switch (if required).

4. Route fuel to the GTC by opening a cross-feed valve.

5. Place the bleed air valve switch in the CLOSED position.

6. Turn the GTC control switch to the spring-loaded START position. The start light should illuminate immediately.

7. Release the control switch. The spring return will move the switch to the RUN position.

CAUTION

As soon as the GTC starter disengages, the starter light will go out. If the light does not go out within 1 minute, move the control switch to OFF, and wait 4 minutes before making another start attempt. The starter duty cycle is 1 minute on, 4 minutes off.

After the GTC control switch is placed in START, power is supplied to the starter, the start light, and to the fuel and ignition circuits, though the fuel and ignition circuits are not yet complete. When the starter brings the GTC up to approximately 5,000 rpm, a switch operated by oil pressure closes to complete the fuel and ignition circuits. After lightoff, the combined power of the starter and combustion gases on the power turbine continues the acceleration of the assembly.

Note

If the GTC does not lightoff, the cause could be a lack of oil in the line to actuate the switch to complete the fuel and ignition circuits. If this is the case, the oil system can be primed manually by pressing the primer button on the check valve in the pump assembly while motoring the compressor. Then attempt another start.

At approximately 14,900 rpm the 35-percent switch opens, deenergizing the starter, the ignition circuit, and the start light. The GTC is now under its own power, and acceleration continues. At 95-percent speed, another centrifugal switch closes and connects power to the bleed air valve switch and the on speed light. When full speed is reached, the governor assumes control and limits rotation to approximately 42,400 rpm. In case of governor failure, the overspeed switch prevents the turbine from "running away" by breaking the circuit to the fuel shutoff valve holding relay, which shuts off the fuel.

CAUTION

If dc power is interrupted while the GTC is operating, the control circuit will be opened, causing the unit to stop.

Loading Operation.

Apply load to the GTC as follows:

1. Insure that the unit is on speed.

2. Place the bleed air valve switch in the OPEN position.

3. Check bleed air pressure.

Stopping the GTC.

Stop the GTC as follows:

1. Place the bleed air valve switch in the CLOSED position.

2. Turn the GTC control switch to the OFF position.

3. Place the GTC intake door switch in the CLOSED position, and check that the GTC door warning light is out.

AIR TURBINE MOTOR (ATM).

The ATM, located in the left wheel well above and aft of the GTC, is a single-stage, axial-flow turbine used to drive a 20-kva, ac generator to supply 115/200-volt, three-phase, ac power. With the aircraft on the ground and at an ambient temperature of 40° C (104° F) or less, the ATM-driven ac generator is rated at 30 kva (1.0 reading on loadmeter). Compressed air for ground operation of the ATM is furnished by the GTC or an external source. Compressed air for inflight operation of the ATM is supplied by bleed air from the engines. The speed of the unit is controlled by a speed-sensing butterfly valve in the turbine inlet which meters the amount of air supplied the turbine and provides automatic shutdown in case of overspeed and must be manually reset in the ATM compartment. A cooling fan for the ac generator, energized by generator output, is included in the unit. A plug assembly for the ATM cooling fan air intake is supplied with the airplane and stowed in the miscellaneous stowage box. The ATM generator can be operated with the fan failed as follows:

During Flight	Full load No time limit
Ground Operation	20 KVA (66% load 0.66) No time limit

ATM CONTROL SWITCH.

The ATM control switch is located on the GTC control panel (figure 1-87). This two-position (ON, STOP) toggle switch controls a shutoff valve in the ATM inlet line. When the switch is moved to the ON position, the shutoff valve is opened, and compressed air is admitted to drive the ATM. The shutoff valve operates from 28-volt, dc power through the ATM control circuit breaker on the pilot's side circuit breaker panel.

ATM COMPARTMENT OVERHEAT WARNING LIGHT.

A red press-to-test light located on the GTC control panel (figure 1-87) is installed to warn the pilot of an overheat condition in the ATM compartment. When an overheat condition of 200° F exists, the warning light will illuminate and the overheat condition must be corrected to extinguish the light. Electrical power for the light is supplied from the essential dc bus through the wing and empennage overheat lights circuit breaker on the copilot's lower circuit breaker panel.

ATM OPERATION.

Operation of the ATM is possible only when the bleed air manifold is pressurized, either from an external pressure source or from bleed air from the GTC or the engines. The unit is started by placing the ATM control switch in the ON position; it is stopped by placing the switch in the STOP position.

INSTRUMENTS.

Only those instruments which are not part of a complete system are covered under this heading. For the description of instruments that are part of a complete system, see the paragraph covering that system. The flight director system is covered in this section.

PITOT-STATIC INSTRUMENTS.

Ram air pressure and atmospheric pressure to operate the vertical velocity indicators, airspeed indicators, and altimeters are supplied by the pitot-static system (figure 1-88). Two pitot tubes furnish the ram pressure for the airspeed indicators, and four static ports furnish static pressure for the airspeed and vertical velocity indicators and altimeters. Two static ports are located forward of the wheel well fairing on each side of the fuselage. The forward ports, one on each side of the aircraft, serve the pilot's instruments; the aft ports, one on each side of the aircraft, serve the copilot's and navigator's instruments.

Vertical Velocity Indicators.

The two vertical velocity indicators, one mounted on the pilot's instrument panel (figure 1-89) and the other mounted on the copilot's instrument panel (figure 1-90), are differential-pressure-measuring instruments that indicate the rate of change in altitude of the aircraft.

Airspeed Indicators.

The three airspeed indicators, one mounted on the pilot's instrument panel (figure 1-89), one on the copilot's instrument panel (figure 1-90), and a true airspeed indicator on the navigator's instrument panel (figure 1-10), are instruments which use differential air pressure to determine airspeed. The banded pointer on the airspeed indicators constantly indicates the structural speed limit at sea level and does not provide an accurate indication of airspeed limitation. The method of obtaining accurate information regarding airspeed limitation versus altitude is contained in Part 4, Section I.

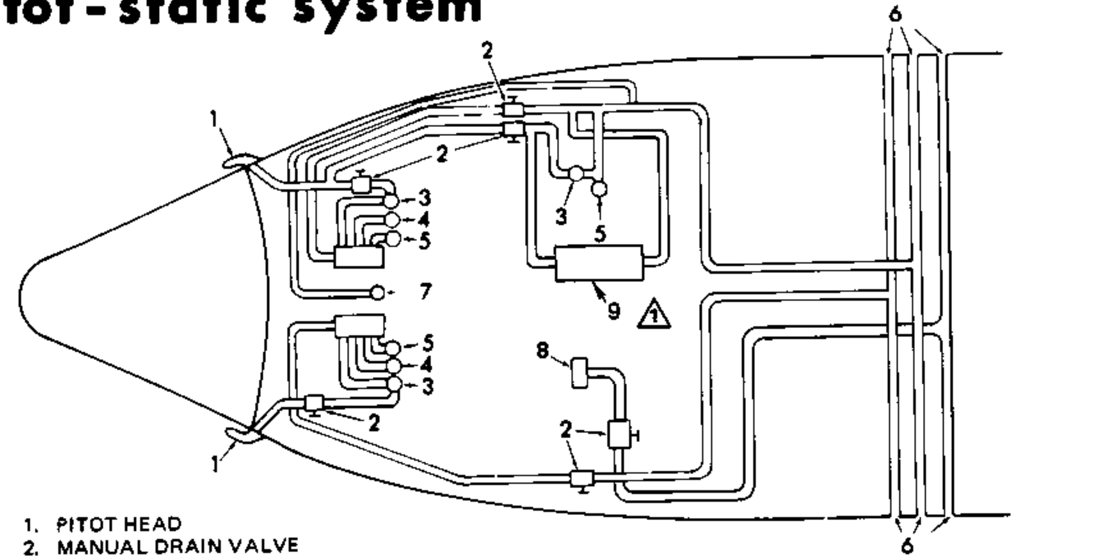
Altimeters.

The three altimeters (one mounted on the pilot's instrument panel; one on the copilot's instrument panel, figure 1-8 & 1-10; and one on the navigator's instrument panel, figure 1-138), are barometric-type instruments measuring variations in pressure by means of aneroid units.

The pilot's altimeter combines a conventional barometric altimeter and an altitude reporting encoder in one self-contained unit. 10,000- and 1000-foot counter indicators and a 100-foot drum indicator provide a direct digital output and readout of altitude in increments of 100 feet, from -1000 to 38,000 feet. The digital output is referenced to 29.92 inches of mercury and is not affected by changes of barometric setting. A pointer repeats the indications of the 100-foot drum, and serves both as a vernier for the drum and as a quick indication of the rate and sense of altitude changes. Two methods may be used to read indicated altitude on the counter-drum-pointer altimeter: (1) read the counter-drum window, without reference to the pointer, as a direct digital readout in thousands and hundreds of feet, or (2) read the thousands of feet on the two counter indicators, without referring to the drum, and then add the 100-foot pointer indication.

The self-contained servo driven encoder provides altitude encoded in 100-foot increments for automatic transmission when the AIMS (IFF) transponder is interrogated on Mode C. In case of

pitot-static system



1. PITOT HEAD
2. MANUAL DRAIN VALVE
3. AIRSPEED INDICATOR
4. VERTICAL VELOCITY INDICATOR
5. ALTIMETER
6. STATIC PORTS
7. DIFFERENTIAL PRESSURE INDICATOR
8. AUTOPILOT MA-4 AMPLIFIER
9. TRUE AIRSPEED COMPUTER

Note

⚠1 EC-130Q BUNO 159348 and 159469

Figure 1-88.

power loss to the encoder servo system, a CODE OFF flag will appear automatically in a window in the upper left portion of the display, indicating that altitude information is no longer being transmitted to the ground. In this condition, the instrument continues to function as a normal barometric altimeter.

The altimeter setting is entered by use of a normally operated barometric set knob in the lower left front of the instrument case. The altimeter setting appears on counters in the window in the lower right of the display and has a range of settings from 28.1 to 31.0 inches of mercury.

An internal vibrator operates continuously whenever aircraft dc power is turned on. The vibrator minimizes internal mechanical friction, enabling the instrument to provide a smoother display during changing altitude conditions. Should vibrator failure occur, the altimeter will continue to function pneumatically, but a less-smooth movement of the instrument display will be evident with changes in altitude. The vibrator receives 28-volt dc power from the essential DC bus through the ENCODER/ALTIMETER CB on the radio CB panel.

Note

If the altimeter's internal vibrator is inoperative due to either internal failure or dc power failure, the 100-foot pointer may momentarily hang up when passing through 0 (12 o'clock position). If the vibrator has failed, the 100-foot pointer hang up can be minimized by tapping the case of the altimeter. Pilots should be especially watchful for this failure when their minimum approach altitude lies within the 800-1000 foot part of this scale (1800-2000 feet, 2800-3000 feet, etc.), and should use any appropriate altitude back-up information available.

MISCELLANEOUS INSTRUMENTS.

Free Air Temperature Indicators.

Two free air temperature indicators, one on the copilot's instrument panel (figure 1-90) and the other on the navigator's instrument panel (figure 1-11), indicate ambient outside air temperature. This temperature must be corrected for compressibility for true air temperature during flight. The indicators are electrically connected to resistance bulbs mounted on each side of the aircraft. The free air temperature indicators receive 28-volt dc power from the main dc bus through the temp ind free air circuit breaker on the copilot's lower circuit breaker panel.

Note

> The navigator's indicator will read slightly higher than the copilot's when the radome anti-icing or radar is on.

Magnetic Compass.

A magnetic compass (figure 1-89) is mounted on the pilot's instrument panel. This is a standard "floating card" type compass that indicates the direction the plane is headed with respect to magnetic north.

Accelerometer.

A Type MA-1 accelerometer is located on the pilot's instrument panel (figure 1-89) and gives instantaneous as well as maximum and minimum readings of the g forces exerted on the aircraft. The gage scale indicates readings of from plus 4 g's to minus 2 g's. The maximum and minimum indication needles will remain at highest readings until the PUSH TO SET button on the gage case is pushed, then they will both return to plus one g and will again register maximum or minimum readings of g forces until again reset. The accelerometer is designed for inflight use only and does not accurately measure g forces during landing. This instrument is to be used in conjunction with the information on structural limitations in Part 4, this section.

Counting Accelerometer (EC-130G Aircraft).

A counting accelerometer system (if installed) is provided to record the number of times preselected "g" loads are exceeded during flight. The system consists of a transducer and indicator. The transducer is located on the centerline of the aircraft approximately at the front wing beam. The indicator is located on the forward left side of the cargo compartment. The indicator contains four counters that record the number of times 2.0, 2.5, 3.0, and 3.5 "g's" are exceeded. The accelerometer circuit is connected through the landing gear touchdown relay to prevent system operation when the aircraft is on the ground. Power for operation of the acclerometer system is supplied from the essential dc bus through the counting accel circuit breaker on the copilot's upper circuit breaker panel.

Clocks.

Three clocks, one on the pilot's instrument panel (figure 1-89), one on the copilot's instrument panel (figure 1-90), and one on the navigator's instrument panel (figure 1-11), are mounted in the aircraft.

COMMUNICATION AND NAVIGATION EQUIPMENT.

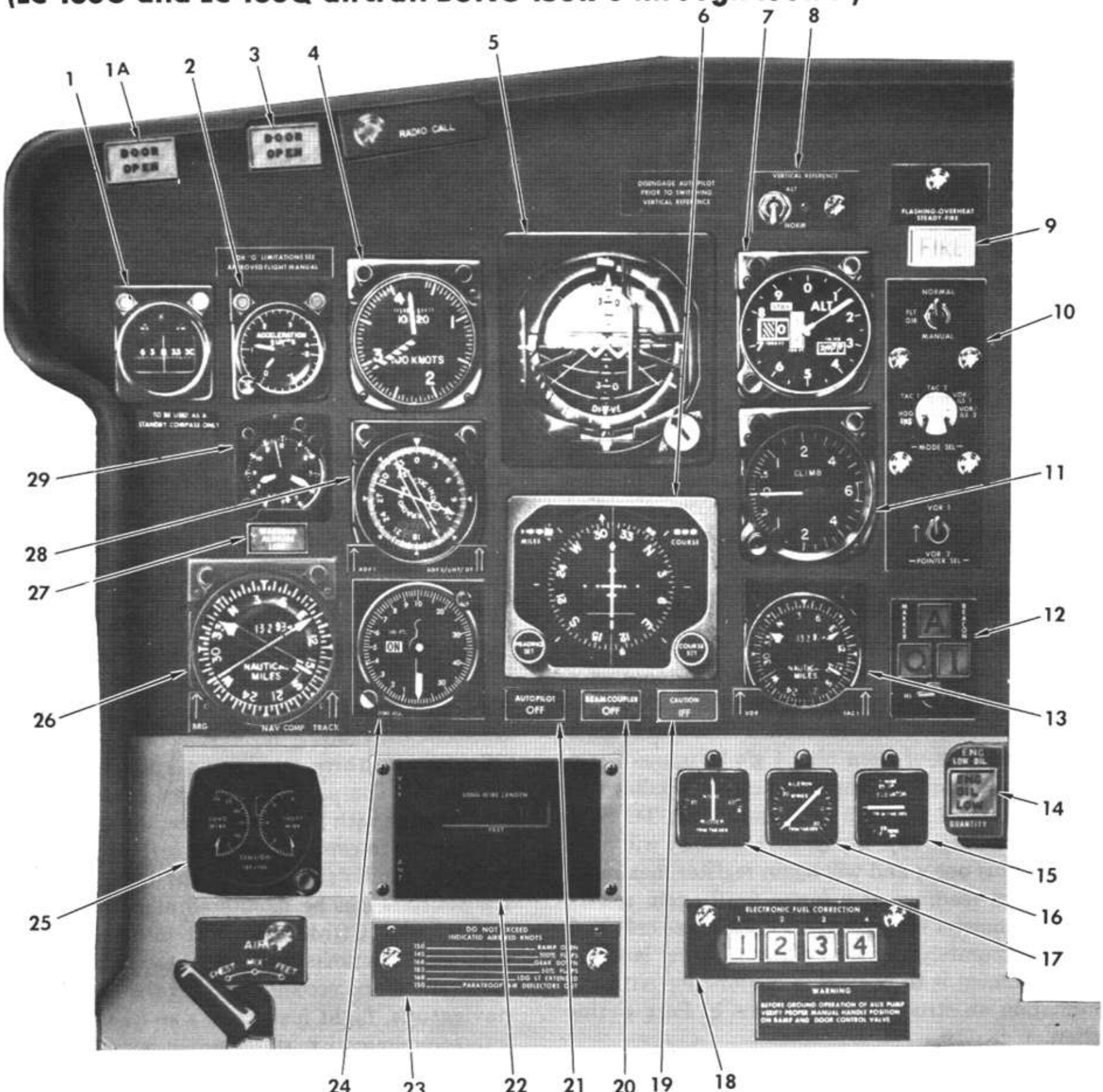
The communication and associated electronic equipment consists of radio and intercommunication equipment to provide aircraft-to-aircraft communication, aircraft-to-ground communication, and intra-aircraft communication; navigation sets for guidance; and radar sets for identification and warning (figure 1-91). For antenna locations, see figure 1-92.

INTERCOMMUNICATION SYSTEM (AN/AIC-18A).

The intercommunication system permits voice communication among flight station intercommunication stations and three auxiliary stations in the special equipment compartment. Voice communication is also possible with the ground crew through an external interphone receptacle at the left aft edge of the radome. Audio signals from the radio receivers and transmitters can be monitored at each of the flight station and COMM Central intercommunication positions. Transmissions through the radio transmitters, however, can be accomplished at the pilot's, copilot's, navigator's, flight instructor's and COMM Central intercommunication stations.

Reception and transmission over the channels available at a particular station are made possible by headset microphones at each intercommunication station. A three-position microphone/interphone switch on both the pilot's and copilot's control wheels permits transmissions from these positions. A press-to-talk button on the connector cords at all other intercommunication stations can be used to talk from these stations. A foot switch at the navigator's and flight mechanics station can be used as an alternate "switch-in" to talk from these stations. In appearance, flight station intercommunications control panels are identical; in capability, the flight engineer intercommunication panels are restricted.

pilot's instrument panel
(EC-130G and EC-130Q aircraft BUNO 156170 through 156177)



1. MAGNETIC COMPASS
1A. DOOR OPEN WARNING LIGHT (EC-130Q AIRCRAFT)
2. ACCELEROMETER
3. DOOR OPEN WARNING LIGHT (EC-130G AIRCRAFT)
4. AIRSPEED INDICATOR
5. ATTITUDE DIRECTOR INDICATOR
6. HORIZONTAL SITUATION INDICATOR
7. ALTIMETER
8. VERTICAL REFERENCE TRANSFER PANEL
9. MASTER FIRE WARNING LIGHT
10. RADIO INSTRUMENTS SELECTOR PANEL
11. VERTICAL VELOCITY INDICATOR
12. MARKER BEACON CONTROL PANEL
13. BDHI (VOR, TAC 1)
14. ENGINE LOW OIL QUANTITY WARNING LIGHT
15. ELEVATOR TAB POSITION INDICATOR
16. AILERON TAB POSITION INDICATOR
17. RUDDER TAB POSITION INDICATOR
18. ELECTRONIC FUEL CORRECTION PANEL
19. IFF OFF LIGHT
20. BEAM COUPLER OFF LIGHT
21. AUTOPILOT OFF LIGHT
22. LONG WIRE ANTENNA LENGTH PANEL
23. AIRSPEED LIMITATIONS PLACARD
24. RADAR ALTIMETER
25. DUAL TENSION INDICATOR
26. NAVIGATIONAL COMPUTER BEARING-RANGE INDICATOR
27. LOW ALTITUDE WARNING LIGHT
28. RADIO MAGNETIC INDICATOR (ADF 1, ADF 2/UHF/DF)
29. CLOCK

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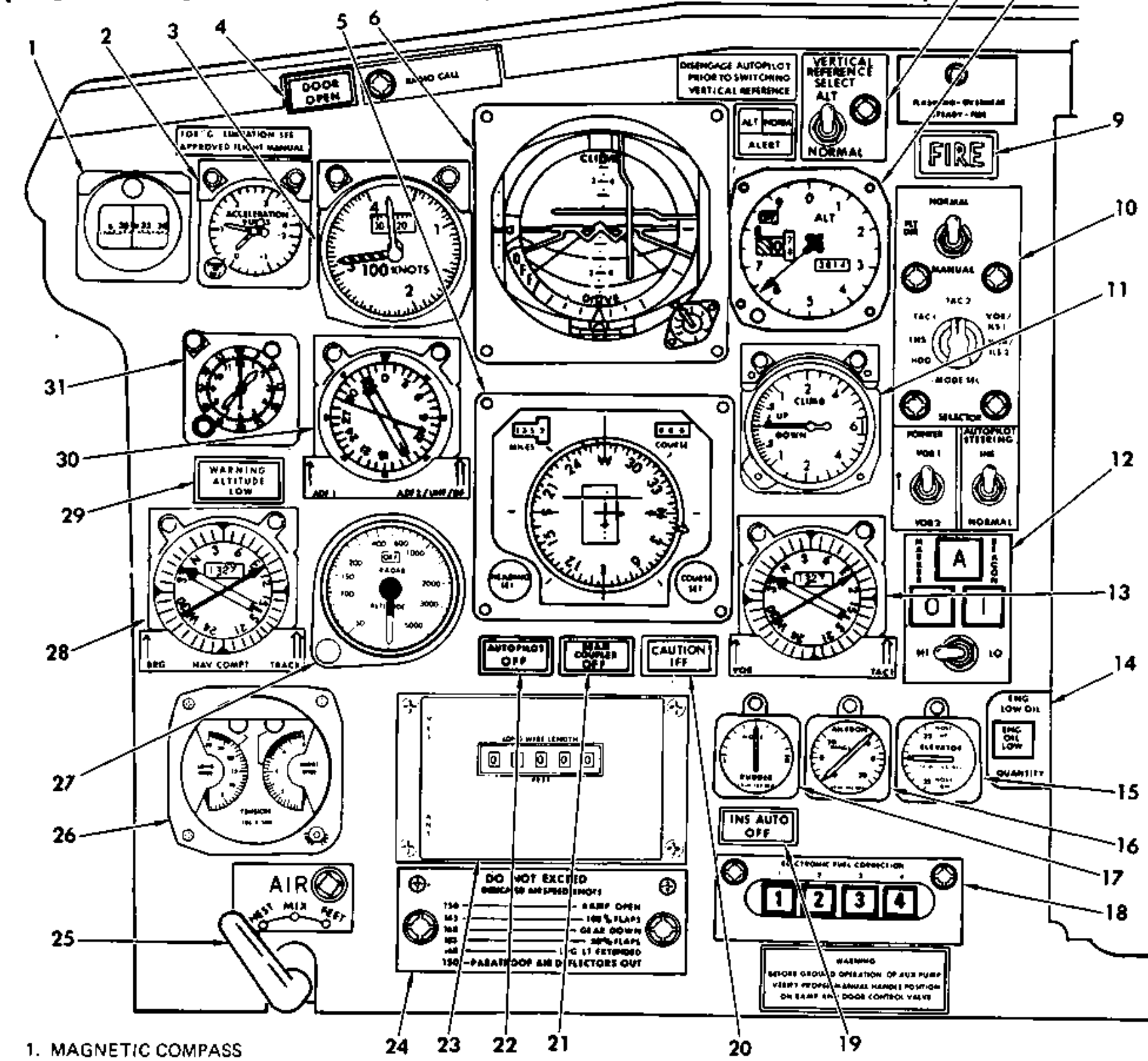
Figure 1-89. (Sheet 1 of 2)

pilot's instrument panel
(EC-130Q aircraft BUNO 159348 and 159469)



1. MAGNETIC COMPASS
2. ACCELEROMETER
3. AIRSPEED INDICATOR
4. DOOR OPEN WARNING LIGHT
5. HORIZONTAL SITUATION INDICATOR
6. ATTITUDE DIRECTOR INDICATOR
7. VERTICAL REFERENCE TRANSFER PANEL
8. ALTIMETER (IFF ENCODER)
9. MASTER FIRE WARNING LIGHT
10. RADIO INSTRUMENTS SELECTOR PANEL
11. VERTICAL VELOCITY INDICATOR
12. MARKER BEACON CONTROL PANEL
13. BDHI (VOR, TAC 1)
14. ENGINE OIL QUANTITY WARNING LIGHT
15. ELEVATOR TAB POSITION INDICATOR
16. AILERON TAB POSITION INDICATOR
17. RUDDER TAB POSITION INDICATOR
18. ELECTRONIC FUEL CORRECTION PANEL
19. INS AUTO OFF LIGHT
20. IFF OFF LIGHT
21. BEAM COUPLER OFF LIGHT
22. AUTOPILOT OFF LIGHT
23. LONG WIRE ANTENNA LENGTH PANEL
24. AIRSPEED LIMITATIONS PANEL
25. AIR DIVERTER HANDLE
26. DUAL TENSION INDICATOR
27. RADAR ALTIMETER
28. NAVIGATIONAL COMPUTER BEARING-RANGE INDICATOR
29. LOW ALTITUDE WARNING LIGHT
30. RADIO MAGNETIC INDICATOR (ADF 1, ADF 2/UHF/DF)
31. CLOCK

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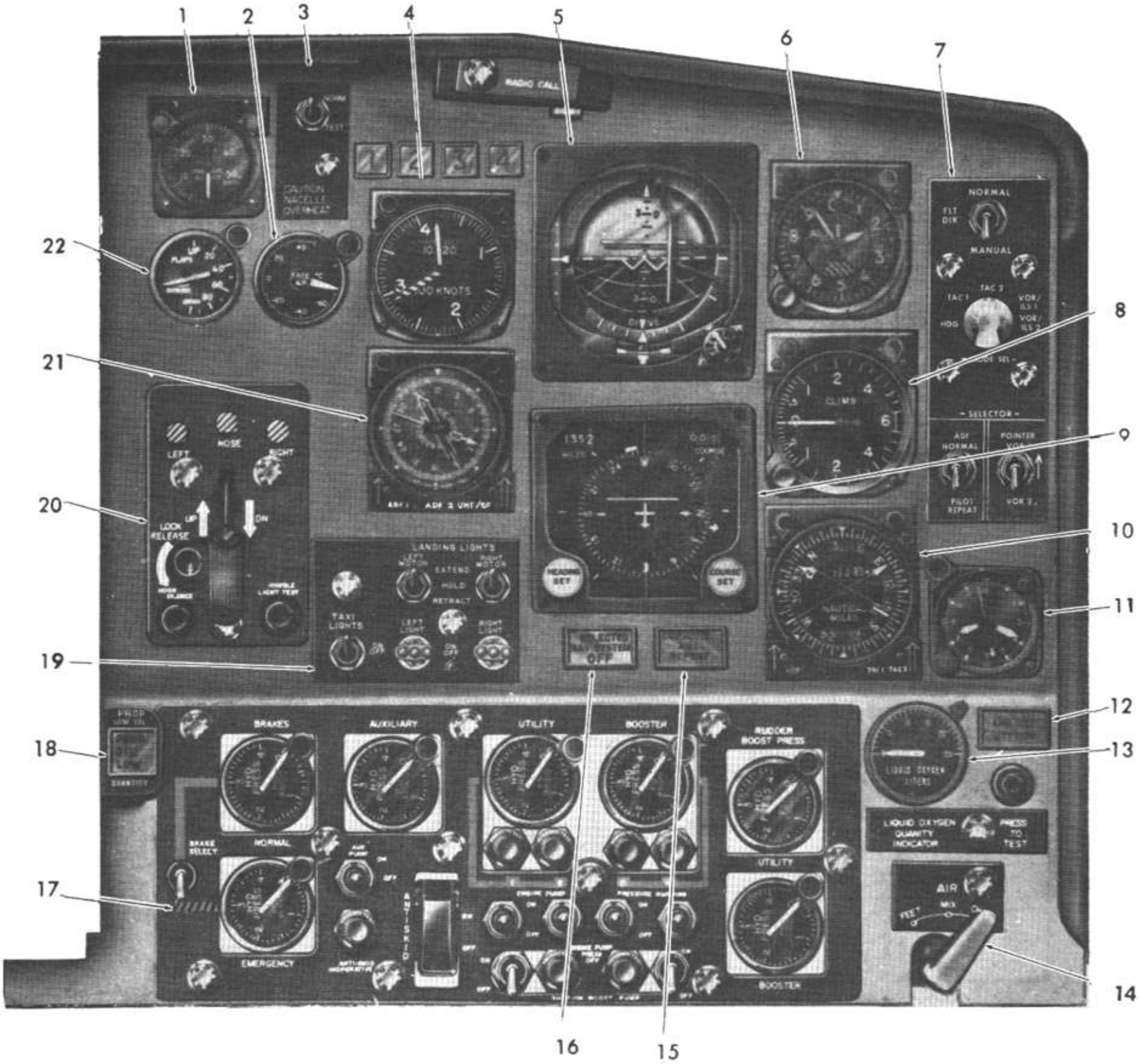
Figure 1-89. (Sheet 2 of 2)

copilot's instrument panel (EC-130G and EC-130Q BuNo 156170 through 156177)



1. CABIN ALTIMETER
2. FREE AIR TEMPERATURE INDICATOR
3. NACELLE OVERHEAT WARNING PANEL
4. AIRSPEED INDICATOR
5. ATTITUDE DIRECTOR INDICATOR
6. ALTIMETER
7. RADIO INSTRUMENTS SELECTOR PANEL
8. VERTICAL VELOCITY INDICATOR
9. HORIZONTAL SITUATION INDICATOR
10. BEARING-DISTANCE-HEADING INDICATOR (VOR, TAC1 OR TAC2)
11. CLOCK
12. LIQUID OXYGEN LOW QUANTITY WARNING LIGHT
13. LIQUID OXYGEN QUANTITY INDICATOR
14. AIR DIVERTER HANDLE
15. SELECTED NAV SYSTEM OFF LIGHT
16. COPILOT'S ADI REPEAT LIGHT
17. HYDRAULIC CONTROL PANEL
18. PROP LOW OIL QUANTITY MASTER WARNING LIGHT
19. LANDING AND TAXI LIGHTS CONTROL PANEL
20. LANDING GEAR CONTROL PANEL
21. RADIO MAGNETIC INDICATOR (ADF 1, ADF 2 OR UHF/DF)
22. WING FLAP POSITION INDICATOR

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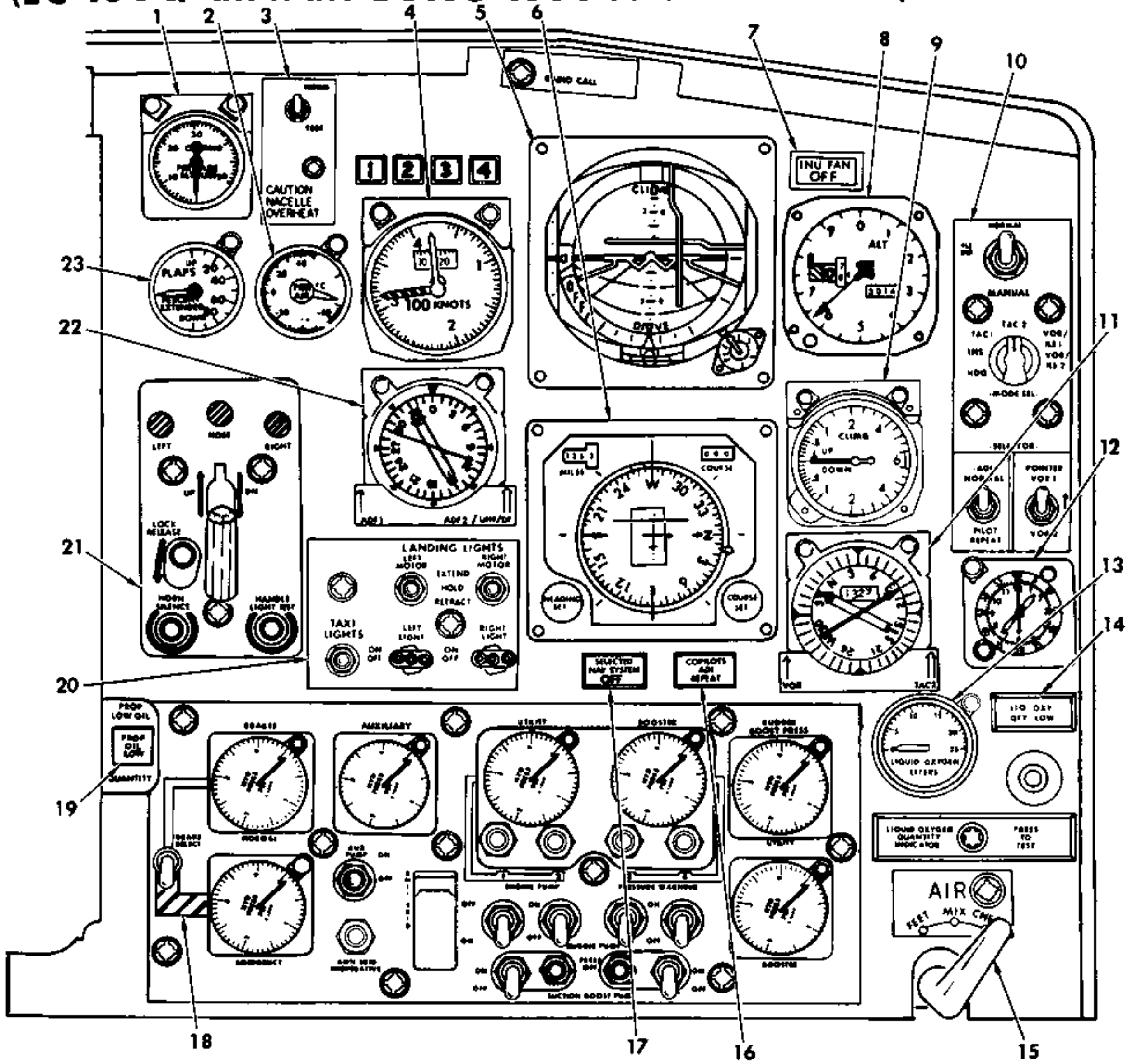
Figure 1-90. (Sheet 1 of 2)

copilot's instrument panel
(EC-130Q aircraft BUNO 159348 and 159469)



1. CABIN ALTIMETER
2. FREE AIR TEMPERATURE INDICATOR
3. NACELLE OVERHEAT WARNING PANEL
4. AIRSPEED INDICATOR
5. ATTITUDE DIRECTOR INDICATOR
6. HORIZONTAL SITUATION INDICATOR
7. INU FAN OFF LIGHT
8. ALTIMETER
9. VERTICAL VELOCITY INDICATOR
10. INSTRUMENTS SELECTOR PANEL
11. BEARING-DISTANCE-HEADING INDICATOR (VOR, TAC 2)
12. CLOCK
13. LIQUID OXYGEN QUANTITY INDICATOR
14. LIQUID OXYGEN LOW QUANTITY WARNING LIGHT
15. AIR DIVERTER HANDLE
16. SELECTED NAV SYSTEM OFF LIGHT
17. COPILOT'S ADI REPEAT LIGHT
18. HYDRAULIC CONTROL PANEL
19. PROP LOW OIL QUANTITY MASTER WARNING LIGHT
20. LANDING AND TAXI LIGHTS CONTROL PANEL
21. LANDING GEAR CONTROL PANEL
22. RADIO MAGNETIC INDICATOR (ADF 1, ADF 2/UHF/DF)
23. WING FLAP POSITION INDICATOR

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Figure 1-90. (Sheet 2 of 2)

table of communications and

TYPE	DESIGNATION	FUNCTION
Intercommunication Equipment	AN/AIC-18	Crew Intercommunication
Public Address System	AN/AIC-13	One-way Communication with Passenger Areas and Loading Crew
VHF Command Radio	AN/ARC-101 △4 VHF-101 △3	Two-way voice communication in the range of 116 to 149.95mc
UHF Command Radio (2)	U-1402 (AN/ARC-138)	Two-way voice communication in the range of 225 to 399.95 mc
HF Liaison Radio	AN/ARC-132	Airborne voice communication in the 2 to 30 mc range
Automatic Direction Finder (2)	AN/ARN-83 △1 AN/ARN-6 △2	For homing and bearing; also receives voice and code signals
VOR Receiver (2)	AN/ARN-87(V) △4 AN/ARN-14 △2 VOR-101 △5	Reception of all VHF/VOR, tone localizer and voice facilities in the 108 to 136 mc range
TACAN (2)	AN/ARN-52(V) △6 AN/ARN-21 △2 AN/ARN-84 △6	Receives bearing and distance information
IFF	AN/APX-72	Identifies aircraft as friend or foe
Marker Beacon Receiver	Collins 51Z-3 △2 Collins 51Z-4 △1	Receives Location Marker Signals
Glide Path Receiver (2)	AN/ARN-67	Receives Glide Path Information for Vertical Guidance in I.L.S. Operation
Radio Altimeter	AN/APN-133	To Determine Absolute Altitude of Aircraft Above the Terrain
Radar Altimeter	AN/APN-150 △4 AN/APN-194 △5	Indicates Absolute Altitudes of Aircraft Above the Terrain

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Figure 1-91. (Sheet 1 of 4)

associated electronic equipment

PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
Crew Members	Stations Within the Aircraft and External for Ground Crew	Flight Control Pedestal, Overhead Control Panel, Navigator's Control Panel, AN/USC-13 Area (refer to NAVAIR 01-75GAE-2-8 for details) Forward Left Bulkhead, and at Both Paratroop Doors.
Crew Members	Interior of Aircraft and Servicing Personnel	Navigator's Control Panel Auxiliary: Pilots Side Shelf Special Equipment Compartment Left Forward Bulkhead and At Left-Hand Paratroop Door
Pilot and Copilot	Line of Sight	Flight Control Pedestal
Pilot and Copilot	Line of Sight	UHF No. 2 Fwd of Copilots Side Shelf UHF No. 1 Flight Control Pedestal
Pilot and Copilot	100 to 2500 Miles on AM and Greatly Extended Range on SSB Depending on Operating Frequency, Altitude and Time of Day	Flight Control Pedestal
Pilot, Copilot and Navigator	20 to 200 Miles Depending on Power, Class of Ground Station, Frequency and Time of Day	Flight Control Pedestal and Navigator's Station
Pilot and Copilot	Localizer - 45 Miles, Omni - 200 Miles, Depending on Altitude	Flight Control Pedestal
Pilot and Copilot	Line of Sight Depending on Altitude	Flight Control Pedestal
Pilot and Copilot	----------------------------	Flight Control Pedestal Tacan No. 2 Fwd of Copilot's Side Shelf 5
Pilot	Any Altitude	Hi-Lo Switch on Pilot's Instrument Panel
Pilot and Copilot	15 Miles	Automatically Controlled From VHF Panel
Navigator	40,000 Feet Altitude	Navigator's Station
Pilot	1 to 5,000 Feet Altitude	Pilot's Instrument Panel

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Figure 1-91. (Sheet 2 of 4)

table of communications and

TYPE	DESIGNATION	FUNCTION
Emergency Transmitter	PTR-5	Emergency Sea Rescue
Flight Director System (2)	CPU-27 ⚠2 CPU-65 ⚠1	For ILS Approaches, VOR, VAR, or TACAN Courses, Heading Information, Pitch- and Roll Attitude.
Navigational Computer System	AN/ASN-41	Displays data in nautical miles, on distance to destination and crosstrack deviation.
UHF Direction Finder	AN/ARA-50 ⚠1 AN/ARA-25 ⚠2	Homing on UHF transmitter
Attitude Heading Reference System	AF/A24G-1A ⚠5	Provides roll and pitch reference signals to the autopilot system, flight director system No. 1 and the doppler radar system. Provides heading reference signals to the autopilot system, flight director system No.1,nav computer, tacan No.1, UHF receiver No.1 and radio compass No.1
Doppler Radar Navigation System	AN/APN-153V	Provides continuous ground speed and drift angle information while aircraft is in flight.
Compass	N-1 ⚠2 C-12 ⚠1	Detects and indicates Relative Heading Referenced to Magnetic North
Loran	AN/APN-70B	Navigation
Communication System	AN/USC-13	Special Mission refer to NAVAIR 01-75GAE-1M
Inertial Navigation System	LTN-51	Provides accurate navigation and position determination
OMEGA Navigation System	AN/ARN-99(V)-2	A space positioning navigational system that programs VLF radio signals from ground stations.

NOTE

⚠1 ON EC-130Q ONLY.

⚠2 ON EC-130G ONLY.

⚠3 ON EC-130G AND EC-130Q BUNO 159348 AND 159469

⚠4 ON EC-130Q BUNO 156170 THROUGH 156177

⚠5 ON EC-130G AND EC-130Q BUNO 156170 THROUGH 156177.

⚠6 ON EC-130Q BUNO 159348 AND 159469

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Figure 1-91. (Sheet 3 of 4)

associated electronic equipment

PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
Pilot and Copilot	1,000 Miles	On Transmitter Unit
Pilot and Copilot	-------------------	--------------------
Navigator	Distance to 999 Nautical Miles; Cross-track to 99.9 Nautical Miles	Navigator's Control Panel
Copilot	Line of Sight	Flight Control Pedestal
Navigator	All Latitudes in Northern or Southern Hemispheres	Navigator's Control Panel
Navigator	Ground Speeds 90 to 999 Knots; Drift Angles to 40 Degrees on Either Side	Navigator's Control Panel
Navigator	- - - - - - - - - - - - - - -	Navigator's Control Panel
Navigator	700-900 Miles During Day Up to 1,400 Miles at Night	Navigator's Station
Airborne Communicator and Reel Operator	- - - - - - - - - - - - - - -	AN/USC-13 Area
Navigator	Anywhere, in any Weather, without the Aid of Ground Stations	Navigator's Control Panel, Pilot's and Copilot's Instrument Panel
Navigator	--------------------------	Navigator's Control Panel and Main Instrument Panel

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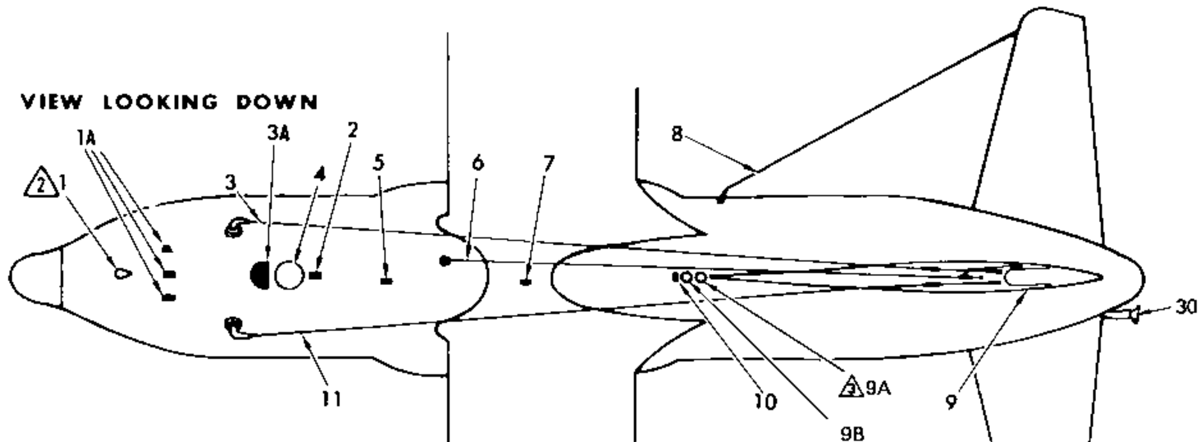
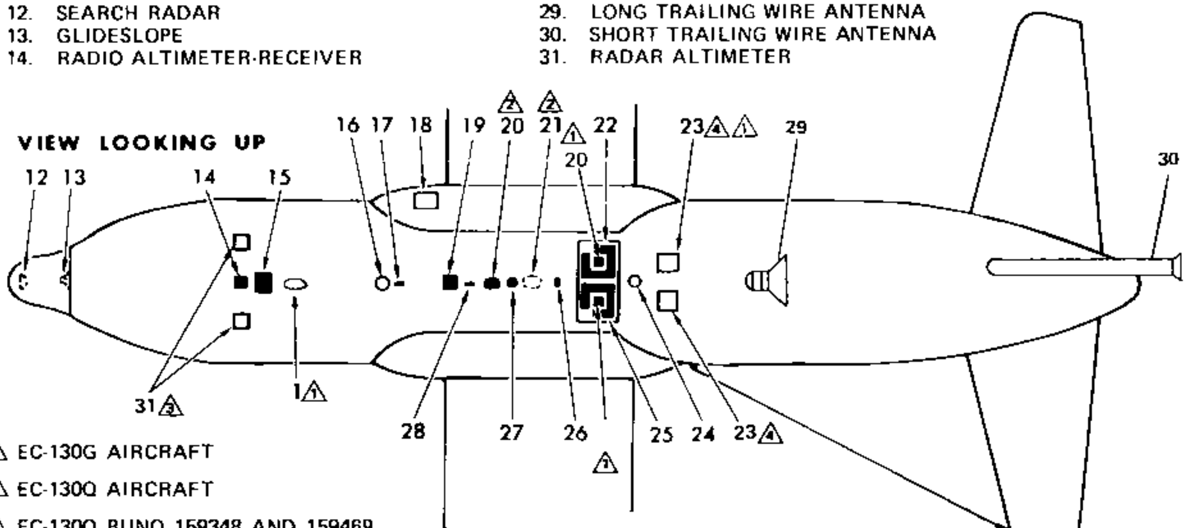
Figure 1-91. (Sheet 4 of 4)

antenna locations



1. VHF COMMUNICATION, NO. 1
1A. TACSATCOM ANTENNAS (3)
2. UHF COMMUNICATION, NO. 2
3. LIAISON (HF) COMMUNICATION, NO. 2
3A. TACSATCOM ANTENNA
4. IFF
5. TACAN, NO. 2
6. AUXILIARY LIAISON (HF NO. 3)
7. TACAN, NO. 1
8. AUXILIARY LIAISON (HF NO. 4)
9. VHF NAVIGATION (OMNI)
9A. VHF COMMUNICATION, NO. 2
9B. OMEGA NAV
10. UHF COMMUNICATION NO. 1
11. LIAISON (HF) COMMUNICATION, NO. 1
12. SEARCH RADAR
13. GLIDESLOPE
14. RADIO ALTIMETER-RECEIVER
15. DOPPLER
16. TACAN, NO. 1
17. UHF COMMUNICATION. NO. 1
18. MARKER BEACON
19. RADIO ALTIMETER TRANSMITTER
20. ADF LOOP NO. 1
21. ADF LOOP NO. 2
22. ADF SENSE NO. 1
23. RADAR ALTIMETER
24. IFF
25. ADF. SENSE NO. 2
26. UHF COMMUNICATION NO. 2
27. UHF DIRECTION FINDER
28. TACAN. NO. 2
29. LONG TRAILING WIRE ANTENNA
30. SHORT TRAILING WIRE ANTENNA
31. RADAR ALTIMETER



△1 EC-130G AIRCRAFT

△2 EC-130Q AIRCRAFT

△3 EC-130Q BUNO 159348 AND 159469

△4 EC-130Q BUNO 156170 THROUGH 156177

Note

Dogleg antennas are installed on some aircraft.

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Figure 1-92.

Intercommunication and public address communication are the only modes of transmission at this station. The auxiliary intercommunication control panels, installed on the special equipment compartment forward left bulkhead and at the left paratroop door, differ from the flight station panels both in appearance and capability. They are equipped with but two controls, a call button and a volume knob, and are restricted to voice communication through the intercommunication system. The installation at the special equipment compartment bulkhead includes a microphone headset with 75-foot extension cord stowed in a protective bag next to the control panel. The intercommunication system operates from 28-volt, dc power supplied from the isolated bus through the interphone circuit breakers on the copilot's upper circuit breaker panel.

Intercommunication System Control Panel (Flight Station).

Identical intercommunication control panels (figure 1-93) are installed on each side of the flight control pedestal, on the overhead control panel, and on the navigator's control panel. Similar control panels are installed above the pilot's upper circuit breaker panel. Each flight station control panel is equipped with monitoring or mixer switches, enabling all communications systems and all audio navigational systems to be connected to the intercommunication system. The switches are of the push-pull type (pulled for ON, pushed for OFF). They may be turned to regulate volume at the individal intercommunication station. One of the two intercommunication system control panels installed at each flight crew station is equipped with eight push-pull type switches which serve to provide interconnection with the following communication and audio navigational systems:

PA

BCN

ADF-1

ADF-2

VOR-2

TACAN-1

TACAN-2

The second control panel at each crew position is equipped with similar push-pull switches for:

UHF-1

UHF-2

HF

VHF

AUX

Push-pull switches are also provided on the second panel for interphone (INT) and hot mike (HOT MIC) operation; the latter uses a listen switch and a talk switch. This panel also carries a master volume control, a call button, and a rotary transmission selector switch.

TRANSMISSION SELECTOR SWITCH. The transmission selector switch on the control panels at the pilot's, copilot's, navigator's, and the flight instructor's stations may be set to any one of six positions, by rotation from left to right: INT - for interphone and public address sytem operation; UHF-1 - for transmission through the No. 1 UHF command radio; HF - transmission through the liaison radio; VHF - for transmission through the VHF command radio; and UHF-2 - for transmission through the No. 2 UHF command radio. Although the flight engineer's control panel, mounted on the overhead control panel, is equipped with an identical six-position selector switch, only the INT position is operable on this panel. When the transmission selector switch is set to AUX, transmission may be made through the communication systems contained in the COMM Central. Switching of the various communication systems within the Comm Central is accomplished locally.

HOT MIC SWITCHES (FLIGHT STATION CONTROL PANELS). The hot mike ("hot mic") mode of operation permits direction transmission to all other intercommunication stations on the aircraft without operating the individual microphone switches.

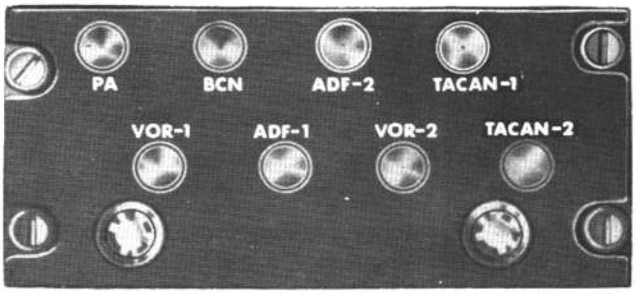
Note

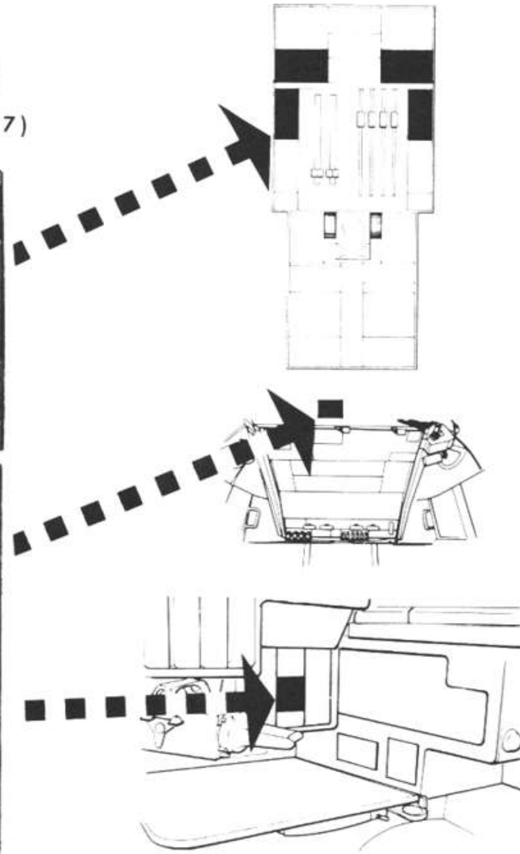
> On EC-130G aircraft the hot mike mode of operation is not available when the transmission selector switch is positioned to INT or to UHF-2.

When the hot mike system is not being used, the hot mic switches should be pushed in to restore the

intercommunication system control panels

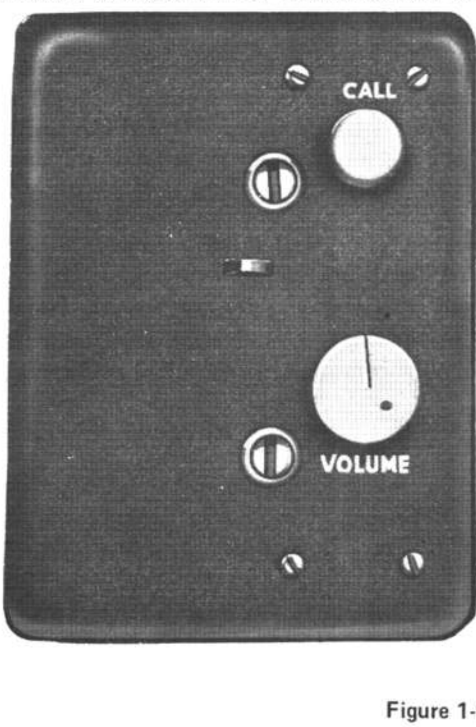
(EC-130G and EC-130Q BUNO 156170 through 156177)

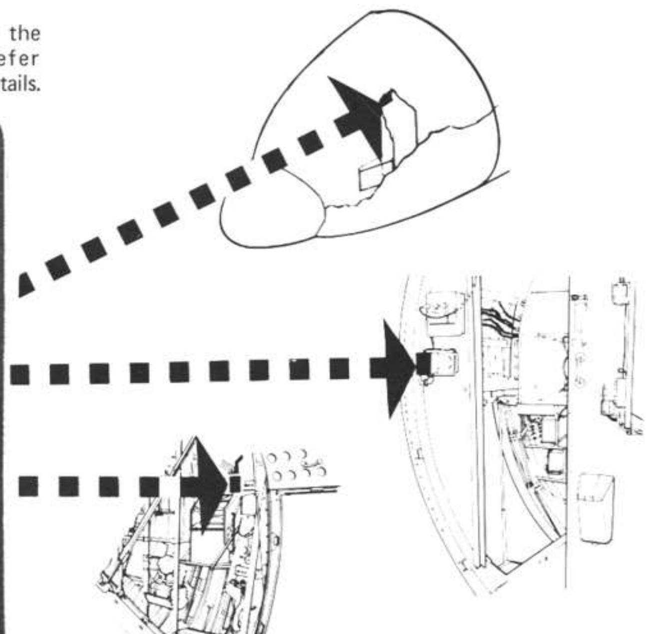




Note

Intercommunication system control panels on the AN/USC-13 equipment are not shown. Refer to NAVAIR 01-75GAE-2-8 for information and details.





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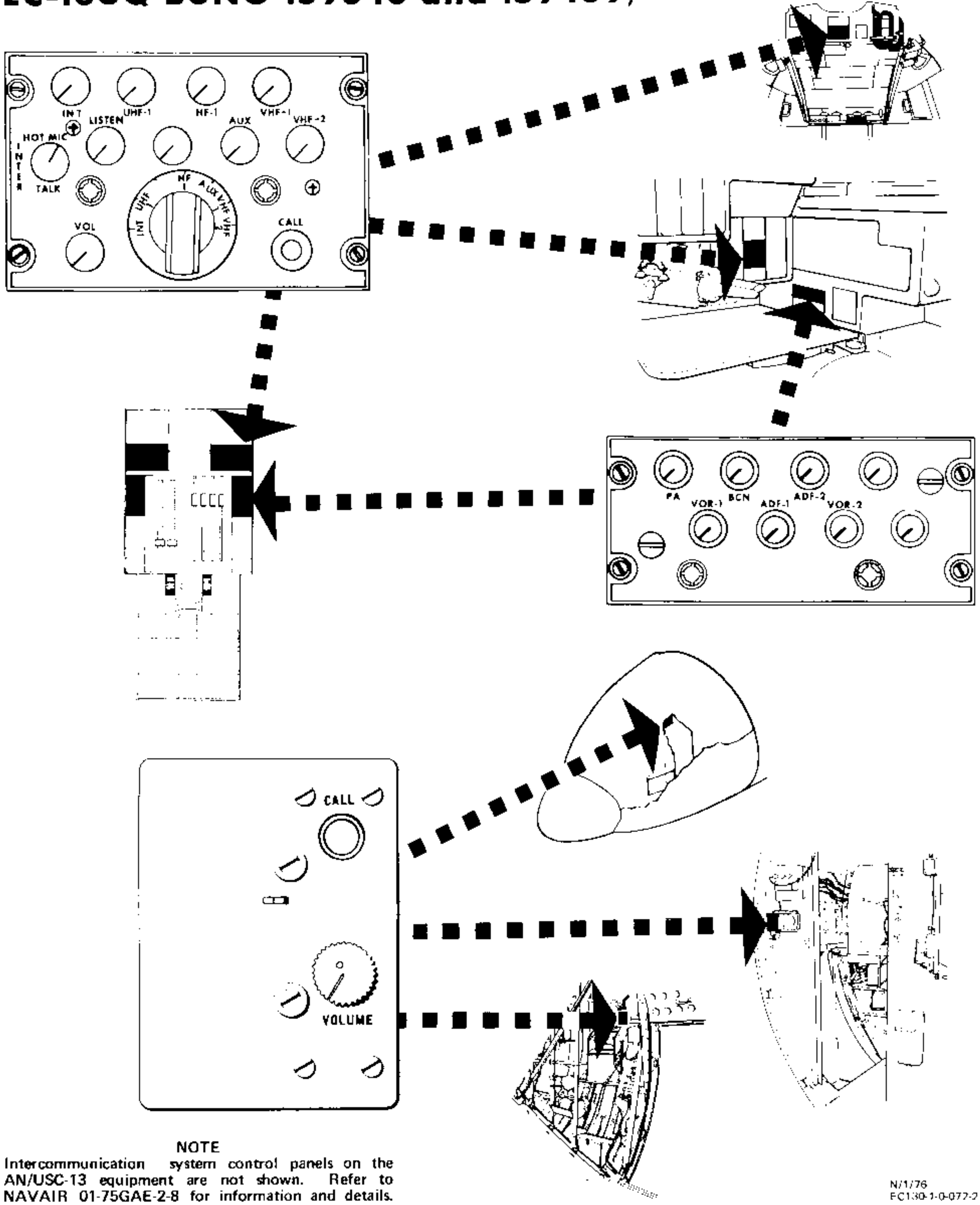
EC-130-1-0-072-1

Figure 1-93. (Sheet 1 of 2)

intercommunication system control panels (EC-130Q BUNO 159348 and 159469)



NOTE
Intercommunication system control panels on the AN/USC-13 equipment are not shown. Refer to NAVAIR 01-75GAE-2-8 for information and details.

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EC130-1-0-077-2

Figure 1-93. (Sheet 2 of 2)

intercommunication system to normal functioning. The three-position (INTER, OFF, MIC) microphone switches on the control wheels are spring-loaded to the OFF position. With the switch held at the INTER position, the pilot can transmit to all other intercommunication stations. If the switch is held to the MIC position, the pilot can transmit through the communication transmitter selected on the transmission selector switch. Foot-controlled microphone switches are located on the floor at the flight engineer's and navigator's stations.

CALL BUTTON. A call button is located at the lower right corner of each of the flight station intercommunication control panels. When the button is pressed, all radio receiver transmissions on the intercommunications system are subdued 6 db and all intercommunication stations are put into direct contact with the calling station.

Auxiliary Control Panels.

The intercommunication system auxiliary control panels (figure 1-93) are equipped only with a call button and a volume control. These are located at the special equipment compartment forward bulkhead, left side, and adjacent to the left paratroop door. The function of the call button on the auxiliary panels is the same as for the call buttons on the flight station control panels; pressing the button puts the calling station in direct communication with all other intercommunication stations and causes all radio receiver transmissions on the intercommunications system to be subdued 6 db.

Operation of the Intercommunication (Flight Station Positions).

The procedure for operating the intercommunication system from any of the flight station crew positions is as follows:

TO TALK: Set the transmission selector switch as desired. Press the microphone switch (except for "hot mic" operation), and speak into the microphone.

Note

Only the INT (interphone and public address) mode of operation is available at the flight engineer's station.

TO LISTEN: To listen to any radio communication receiver, pull the switch for the selected communication system; turn the switch after pulling to regulate the volume to a desired level. Push the switch in to disconnect the selected radio communication system. When the AUX switch is pulled out, the intercommunication system may be used to monitor communications from the patch panel in the comm central.

PUBLIC ADDRESS SYSTEM (AN/AIC-13).

The public address system provides one-way communication with the special equipment compartment through two loudspeakers located in the comm central area and one loudspeaker located in the aft equipment area. The main control panel for the public address system is located at the navigator's station, with auxilary control panels located on the pilot's side shelf, on the special equipment compartment forward left bulkhead, and adjacent to the left paratroop door. The public address system operates from 28-volt power from the main dc bus through a circuit breaker on the copilot's upper circuit breaker panel.

Public Address System Controls (Main Control Panel).

The main control of the public address system is from a pa control panel (figure 1-94) located at the navigator's station. Microphone connections to the public address system are made through the flight station intercommunication control panels and through microphone jacks on the special equipment compartment auxiliary control panels. A power switch, a speaker selector switch, four mixer switches, and a volume control constitute the controls on the main control panel.

POWER SWITCH. The power switch has PWR ON and OFF positions. When the switch is placed in the PWR ON position, power is supplied to all circuits of the system for normal operation.

SPEAKER SELECTOR SWITCH. The four-position (ALL, FWD, AFT, JUMP) speaker selector switch selects the speaker or combination of speakers to be operated. In the ALL position, all the speakers except the one located over the cargo ramp are in operation. In the FWD position, only the speaker in the special

public address control panels

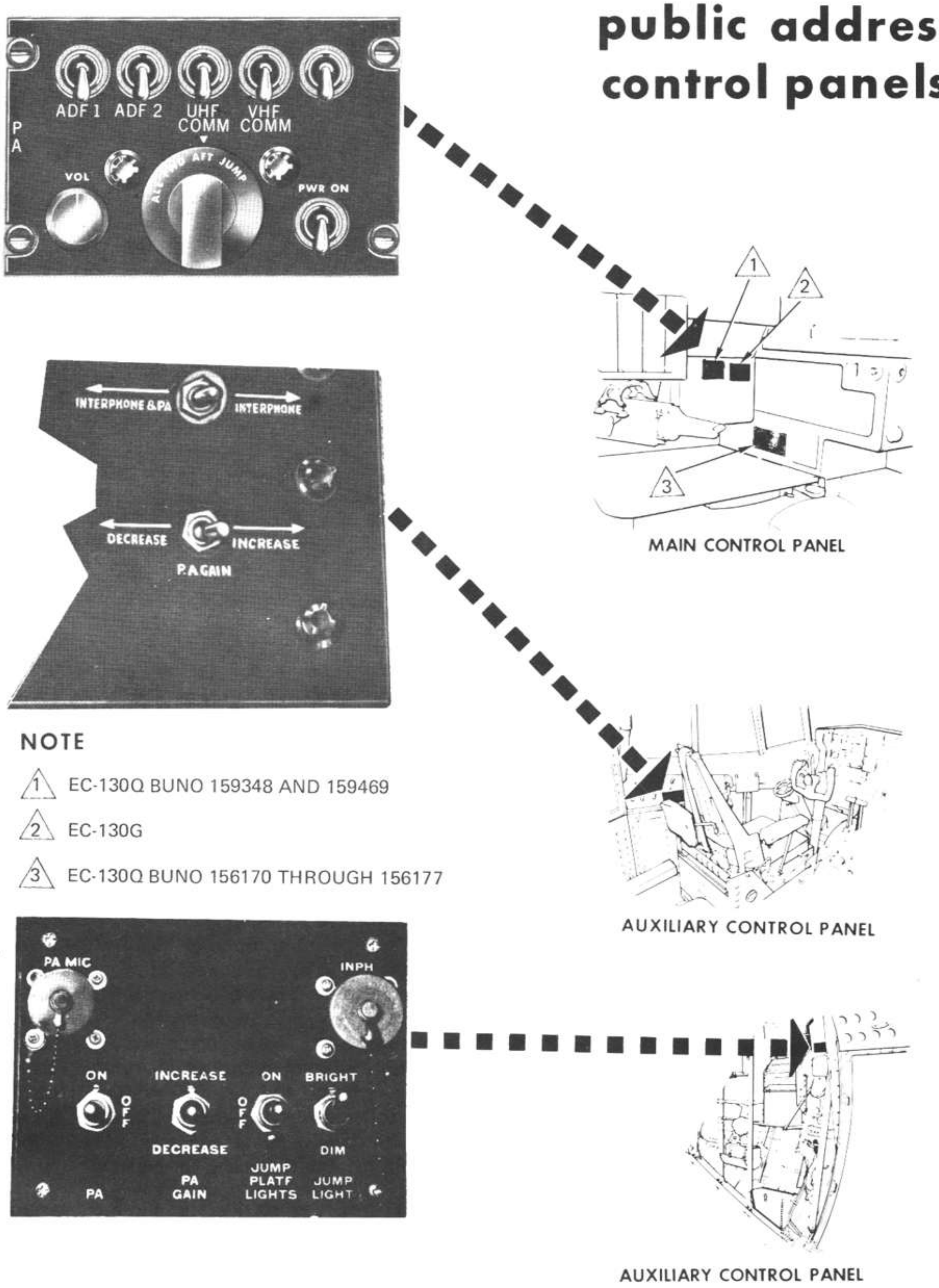

Figure 1-94. (Sheet 1 of 2)

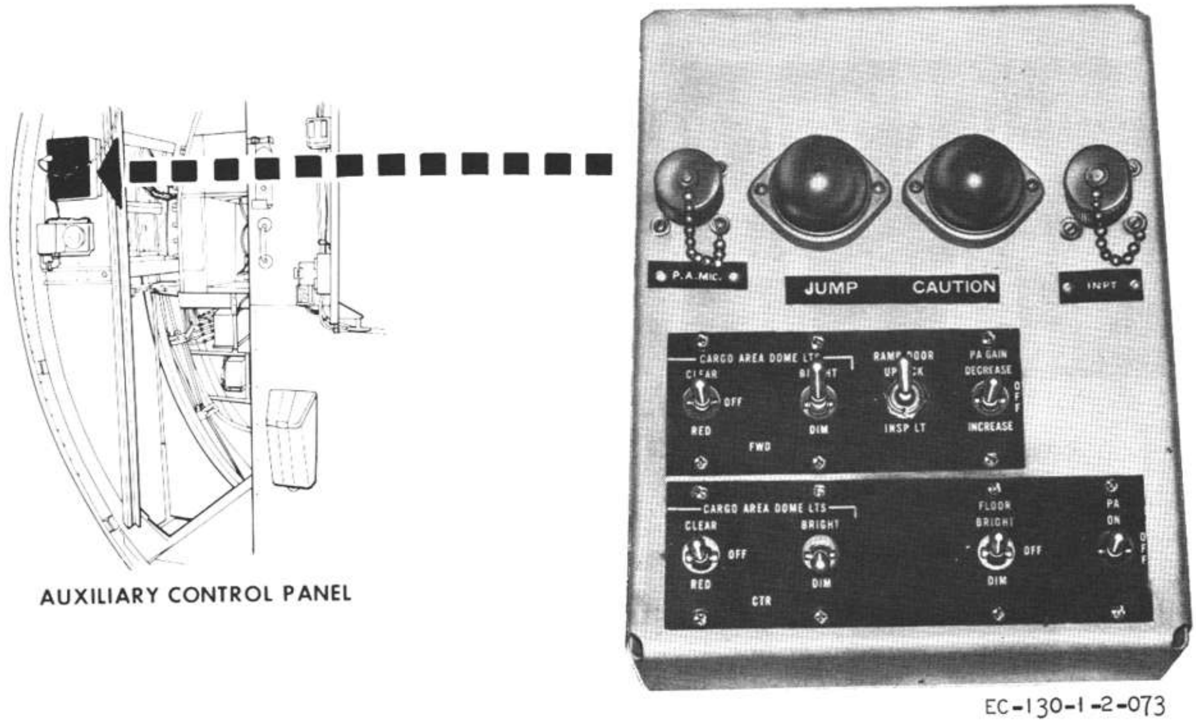

Figure 1-94. (Sheet 2 of 2)

equipment compartment forward area is in operation. In the AFT position, only the speaker over the cargo ramp is in operation. In the JUMP position, only the two speakers adjacent to the paratroop exit doors are in operation.

VOL CONTROL. The 11-position vol control switch is used to adjust the audio output of the public address system. This switch is manually controlled at the navigator's station and electrically actuated by the pa gain control switch on the pilot's side shelf and auxiliary control panels.

MIXER SWITCHES. Four mixer switches (ADF 1, ADF 2, UHF COMM, VHF COMM) are located on the main control panel for supplying radio receiver signals to the public address system. To connect a receiver to the system, place the mixer switch for that receiver in the ON (up) position, and place the interphone-public address switch in the INTERPHONE position.

Public Address System Controls (Auxiliary Control Panels).

Once the public address system has been turned on and speaker selections made at the main control panel, the auxiliary control panels (figure 1-95) can be used to operate the system. The interphone-public address switch on the pilot's side shelf serves to connect flight station intercommunication control positions to the pa system. The pa on-off switch on the auxiliary panels in the special equipment compartment serves to connect the associated stations to the pa system. Microphone connections permit pa voice communication from the special equipment compartment auxiliary control panels. Voice communication from the flight station intercommunication control positions is transmitted to the pa system through the intercommunication system. The audio output of the public address system is controlled by a pa gain control switch on each of the auxiliary control panels.

INTERPHONE-PUBLIC ADDRESS SWITCH. The two-position (INTERPHONE & PA, INTERPHONE) switch located on the pilot's side shelf is used to connect the interphone circuit to the public address system. When the switch is placed in the INTERPHONE position, interphone conversation is confined to the interphone circuit. When the switch is placed in the INTERPHONE & PA position, interphone conversation is supplied to the public address system, and radio receiver signals are eliminated from the public address system.

PA SWITCH. This switch, installed on the special equipment compartment auxiliary control panels, is a two-position (ON, OFF) momentary switch used to connect the associated cargo compartment auxiliary station to the public address system. This can be accomplished only when the interphone-public address switch on the pilot's side shelf is in the INTERPHONE position. If this condition is satisfied, holding the pa switch in the ON position permits voice communication through the speaker(s) selected on the main control panel. This function does not interrupt normal interphone conversation.

PA GAIN SWITCH. The pa gain switch is a three-position (INCREASE, OFF, DECREASE) momentary switch. When the switch is held in the INCREASE position, the audio output of the public address system increases. When the switch is held in the DECREASE position, the audio output of the system decreases. When the switch is released from either position, a spring return moves it to the OFF position. The manual control knob on the main control panel will be physically rotated by an electric motor controlled by these switches.

Normal Operation of the Public Address System.

To put the public address system into operation:

1. Place the power switch in the PWR ON position.

2. Place the speaker selector switch in the required position.

3. If the pa system is to be operated from the flight station, place the interphone-public address switch in the INTERPHONE & PA position. Radio receiver signals will be eliminated from the pa system, and voice communication from the flight station will be possible through the intercommunication system. If the pa system is to be operated from one of the auxiliary panels in the special equipment compartment, place the interphone-public address switch in the INTERPHONE position. Hold the switch on the auxiliary control panel in the ON position. The transmission from the auxiliary control panel will be heard through the public address speakers, and the normal interphone circuit will not be interrupted.

4. Press the microphone button, and talk.

5. If radio signals are to be heard over the public address system, place the required mixer switch in the ON (up) position, and place the interphone-public address switch in the INTERPHONE position.

6. To adjust the audio output of the system, rotate the vol knob on the main control panel, or actuate the pa gain switch on the auxiliary panel.

To turn the public address system off:

7. Place the power switch in the OFF position.

ICS Call/Antenna Control Panel .

An Intercommunication System Call/Antenna Control Panel is mounted on the flight control pedestal (figure 1-95). A push-on, push-off call switch is located just above a press-to-test CALL light. The push switch is used to signal personnel in the special equipment area. Illumination of the CALL light indicates the flight station is being signaled by special equipment personnel.

VHF COMMAND RADIO (AN/ARC-101) (EC-130Q BuNo 156170 THRU 156177).

NEW

The VHF communication system consists of a VHF transmitter, a VHF receiver, and a control unit. The VHF system provides communication facilities in the frequency range of 116.00 to 149.95 megacycles. All channels may be selected from the control panel (figure 1-96) located on the flight control pedestal. The VHF command radio receives 28 volt, dc power from the essential dc bus through the vhf xmtr and rcvr circuit breakers located on the copilot's upper circuit breaker panel. The VHF system also receives 115-volt, 400 cycle, ac power from the essential ac bus through the vhf xmtr and rcvr circuit breakers located on the copilot's upper circuit breaker panel.

VHF Command Radio Controls.

The AN/ARC-101 control panel on the flight control pedestal provides operating control for the VHF command radio. The controls consist of a frequency indicator, a power/vol switch, two frequency selector

ics call/antenna control panel

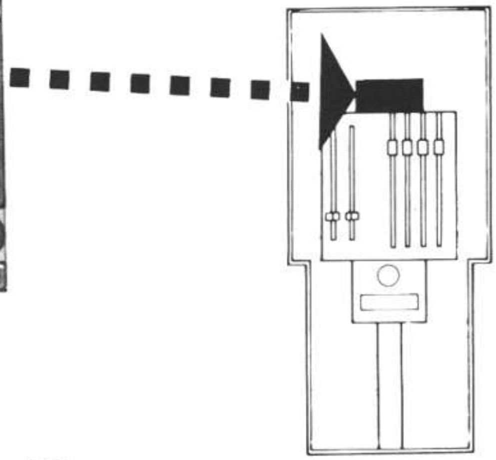

Figure 1-95.

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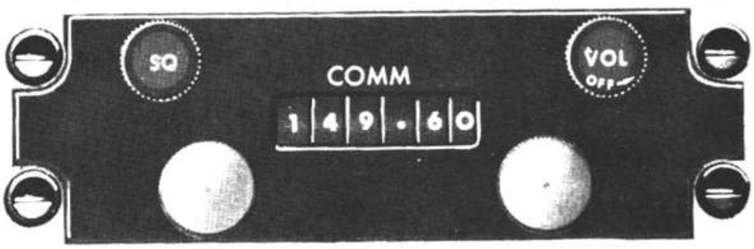
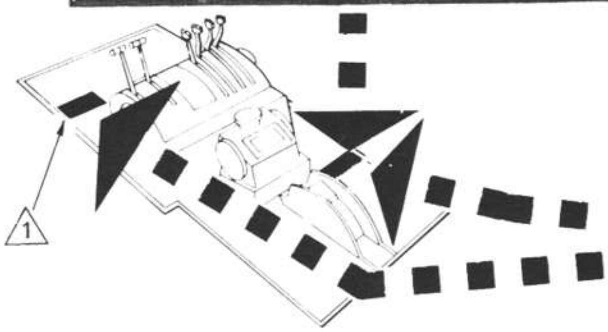
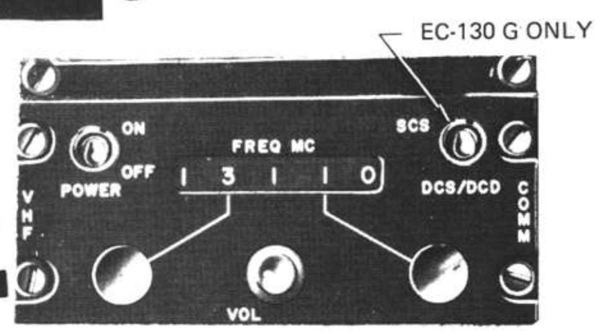
vhf command radio control panel

(AN ARC-101, EC-130Q, BUNO 156170 through 156177)







VHF-101 EC-130G and EC-130Q, BUNO 159348 and 159469

NOTE

1 EC-130Q BUNO 159348 AND 159469 ONLY

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Figure 1-96.

knobs, and a squelch control knob. One frequency selector knob controls whole megacycles and the other controls fractional megacycles which appear in the frequency indicator window. The power/vol knob controls the application of power to the system and varies the volume level in the interphone system. The sq control knob is provided to adjust the squelch threshold on the receiver output.

Normal Operation of the VHF Command Radio.

To put the VHF command radio into operation:

1. Place the power/vol switch to ON.

2. Allow 1 minute for warmup.

3. Select the desired operating frequency.

4. To receive, pull the VHF switch on the intercommunication control panel; turn the switch to adjust the volume.

5. Adjust the sq and vol controls as necessary to obtain a comfortable reception level.

6. To transmit, place the transmission selector on the intercommunication control panel to VHF.

To turn the VHF command radio off:

7. Place the power/vol switch to OFF.

VHF COMMAND RADIO (VHF-101) (EC-130G and EC-130Q Aircraft BuNo 159348 and 159469).

EC-130G aircraft are equipped with one VHF communication system; EC-130Q aircraft BuNo 159348 and 159469 are equipped with two systems. The VHF communication system consists of a VHF transmitter, a VHF receiver and control unit. The VHF system provides communication facilities in the frequency range of 116.00 to 149.95 megahertz with reception possible up to 151.95 megahertz. All channels may be selected from the control panel (figure 1-96) located on the pedestal. On EC-130G aircraft and EC-130Q aircraft BuNo 159348 and 159469, the VHF command radio(s) receives 28-volt dc power from the essential dc bus through the vhf transmitter and receiver circuit breakers located on the copilot's upper circuit breaker panel. The EC-130G aircraft VHF communication system also receives 115-volt, 400 Hz, ac power from the essential ac bus through the vhf transmitter and receiver fuses located on the pilot's lower circuit breaker panel. The EC-130Q aircraft BuNo 159348 and 159469 VHF communication system No. 1 receives 115-volt, 400-Hz, single-phase ac power from the main ac bus through the vhf No. 1 transmitter and receiver circuit breakers located on the copilot's upper circuit breaker panel. The No. 2 VHF system receives 115-volt, 400-Hz, single phase, ac power from the essential ac bus through the VHF No. 2 transmitter and receiver fuses located on the pilot's lower circuit breaker panel.

VHF Command Radio Controls.

A control panel (figure 1-96) located on the flight control pedestal provides operating control for the VHF command radio. The controls consist of a frequency indicator, and a power ON/OFF switch, and SCS-DCS/DCD switch (EC-130G aircraft only), two frequency selector knobs, and a dual control for squelch and volume control. The two frequency selector knobs are used to select an operating channel. The selected frequency appears as a direct reading number (in megahertz) in the frequency indicator window. The power ON/OFF switch controls the power application to the system. The VOL control is provided to adjust the receiver volume level in the interphone system. The SQ control is provided to adjust the squelch threshold on the receiver output. On EC-130G aircraft, the SCS-DCS/DCD switch is provided to select the mode of operation. When SCS (single-channel-simplex) is selected, the receiver and transmitter are tuned to the same frequency and the receiver is disabled during operation of the transmitter, thereby restricting operation to either transmission or reception on the assigned channel. When DCS/DCD (double-channel-simplex/double-channel-duplex) is selected, the operation is the same as SCS, except that the transmitter is automatically tuned to a frequency that is six megahertz above the receiver frequency indicated on the control panel.

Normal Operation of the VHF Command Radio.

To put the VHF command radio into operation:

1. Place the power switch in the ON position.

2. Allow one minute for warmup.

3. On EC-130G aircraft, select SCS mode of operation.

Note

On EC-130G aircraft, when operating in SCS, all transmissions and voice communications will be on the frequency indicated on the control panel. When operating in DCS, the receiver frequency is indicated on the control panel and the transmitting frequency will be automatically tuned six megahertz above the receiver frequency.

4. Select the desired operating frequency.

5. To receive, pull the VHF switch on the intercommunication control panel; turn the switch to adjust the volume.

6. Adjust the SQ and VOL control as necessary to obtain a comfortable reception level.

7. To transmit, place the transmission selector on the intercommunication control panel to VHF.

To turn the VHF command radio off:

8. Place the power switch in the OFF position.

UHF COMMAND RADIO (AN/ARC-138).

Two independently operating UHF command radio systems, each with its own antenna, are installed in the aircraft. The No. 1 system is controlled from a panel located on the flight control pedestal while the No. 2 system is controlled from a panel mounted on the copilot's window sill panel (figure 1-97). Each radio provides voice transmission and reception in the frequency range of 225.0 to 399.95 megaHertz. The UHF No. 1 radio receives 28-volt dc power from the essential dc bus through the uhf No. 1 circuit breaker located on the pilot's upper circuit breaker panel and 115-volt, 400 Hz ac power from the essential ac bus through the uhf No. 1 circuit breaker located on the pilot's upper circuit breaker panel. The UHF No. 2 command radio receives 28-volt dc power from the main dc bus through the uhf No. 2 circuit breaker located on the copilot's upper circuit breaker panel and 115-volt, 400 Hz ac power from the main ac bus through the uhf No. 2 circuit breaker located on the copilot's upper circuit breaker panel.

UHF Command Radio Controls.

Controls for the two uhf command radios are mounted in panels in the flight control pedestal and in the copilot's window sill (figure 1-97). Each panel has a channel selector, preset/manual/guard switch, three frequency selection knobs, a guard receiver power switch, fault light, tone and receiver test switches, squelch disable switch, volume control, mode selector, and channel and frequency displays. The preset/manual/guard switch selects use of preset frequencies and modes, enables manual controls, or selects guard receiver output. The guard receiver switch controls operation of the guard receiver. The channel selector is used when the preset/manual/guard switch is in preset. The channel selector controls the 20 preset channels; the selected channel number is displayed in the channel window. The three frequency controls select the frequency to be used when manual mode is selected. The volume control determines audio output level. The mode control switch selects the mode used: AM, FM, FSK (frequency shift key), or ADF in UHF No. 1 only (FSK mode is not available in either radio). The tone switch initiates transmitter testing; the receiver test switch initiates receiver testing. The squelch disable switch controls operation of the receiver squelch signal.

Normal Operation of the UHF Command Radio.

To operate a UHF command radio:

1. Set the preset/manual/guard switch to PRESET or MANUAL as desired.

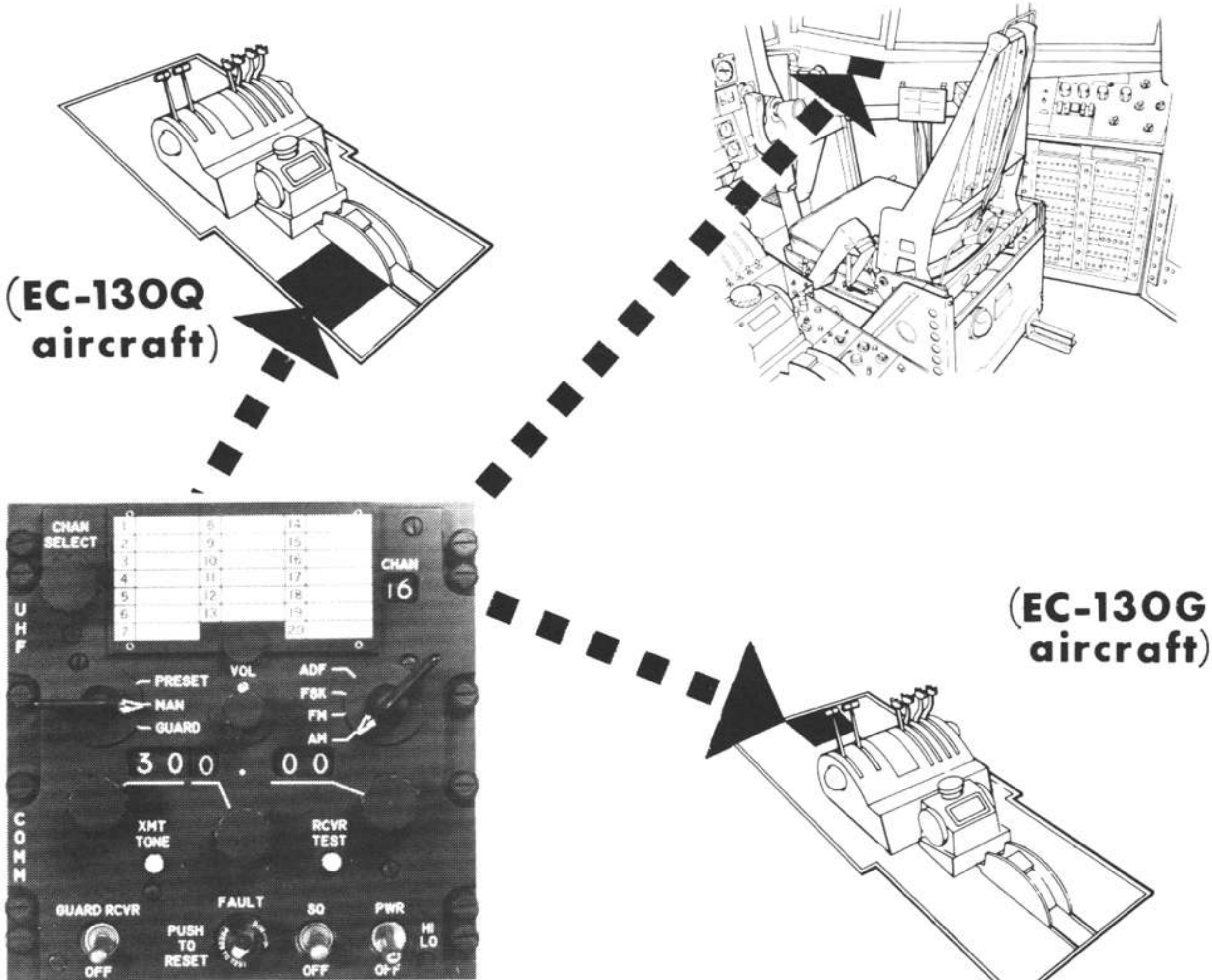
2. Set channel selector or frequency knobs as desired.

3. Set volume control as desired.

4. Set guard receiver switch to ON.

5. Set squelch switch to ON.

uhf radio control panels (an/arc-138)



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EC-130-0-0-076

Figure 1-97.

LIAISON RADIO (AN/ARC-132).

An HF radio is installed for long range communication. The control panel for this radio is located on the pilot's side of the flight control pedestal (figure 1-98). The frequency range is 2.0000 and 29.9999 MHz. USB, LSB, or AM modulation can be used. The essential dc bus supplies 28-volt dc power through the HF No. 1 circuit breaker on the pilot's upper circuit breaker panel, and the essential ac bus supplies 115-volt, 400-Hz power through the HF No. 1 circuit breakers (3-phase) on the pilot's upper circuit breaker panel.

Liaison Radio Controls.

Controls for the liaison radio are panel mounted on the pilot's side of the flight control pedestal. This panel contains four frequency selection knobs, a six-digit selected-frequency display, a mode control, a squelch control, and a not-ready status lamp.

Normal Operation of the Liaison Radio.

To operate a liasion radio:

1. Set the mode selector for USB, LSB, or AM as required.

2. Select the desired operating frequency (in megahertz).

3. Set SQL control for desired squelch level.

4. Allow minimum warmup time (five minutes).

5. Set the ICS transmission selector switch to HF No. 1 position.

6. Set AIRCRAFT/TACAMO antenna switch to AIRCRAFT.

7. Depress MIC button (this completes tuning).

8. Wait until NOT READY lamp is off before transmitting.

ANTENNA GUILLOTINE CONTROL PANEL.

An antenna guillotine control panel (figure 1-99) is located forward of the pilot's side shelf. Four guarded switches are located on this panel. Two switches are for the long wire antenna, and two switches are for the short wire antenna. Each two-position (ON/OFF) ARM switch enables a guillotine circuit when it is set ON; the two-position (ON/OFF) ACTUATE switch initiates guillotine action when it is set ON. Power to arm and actuate the guillotine comes from the battery bus through the pilot's side circuit breaker panel, GUILLOTINE circuit breaker.

ANTENNA TENSION INDICATOR.

A dual tension indicator (figure 1-100) is installed on the pilot's instrument panel to indicate the tension on the long wire and short wire antennas. Power and tension signals come from the long wire antenna console. Each meter in this dual indicator contains a tension warning lamp that lights to indicate that antenna tension is excessive.

LONG WIRE ANTENNA LENGTH INDICATOR.

A long wire antenna lenght indicator is installed on the pilot's instrument panel (figure 1-89) to provide a digital indication of the deployed length of the long wire antenna.

SHORT WIRE ANTENNA LENGTH INDICATOR.

A short wire antenna length indicator is installed forward of the pilot's side shelf, below the antenna guillotine control panel (figure 1-99). This indicator provides a digital indication of the deployed length of the short wire antenna.

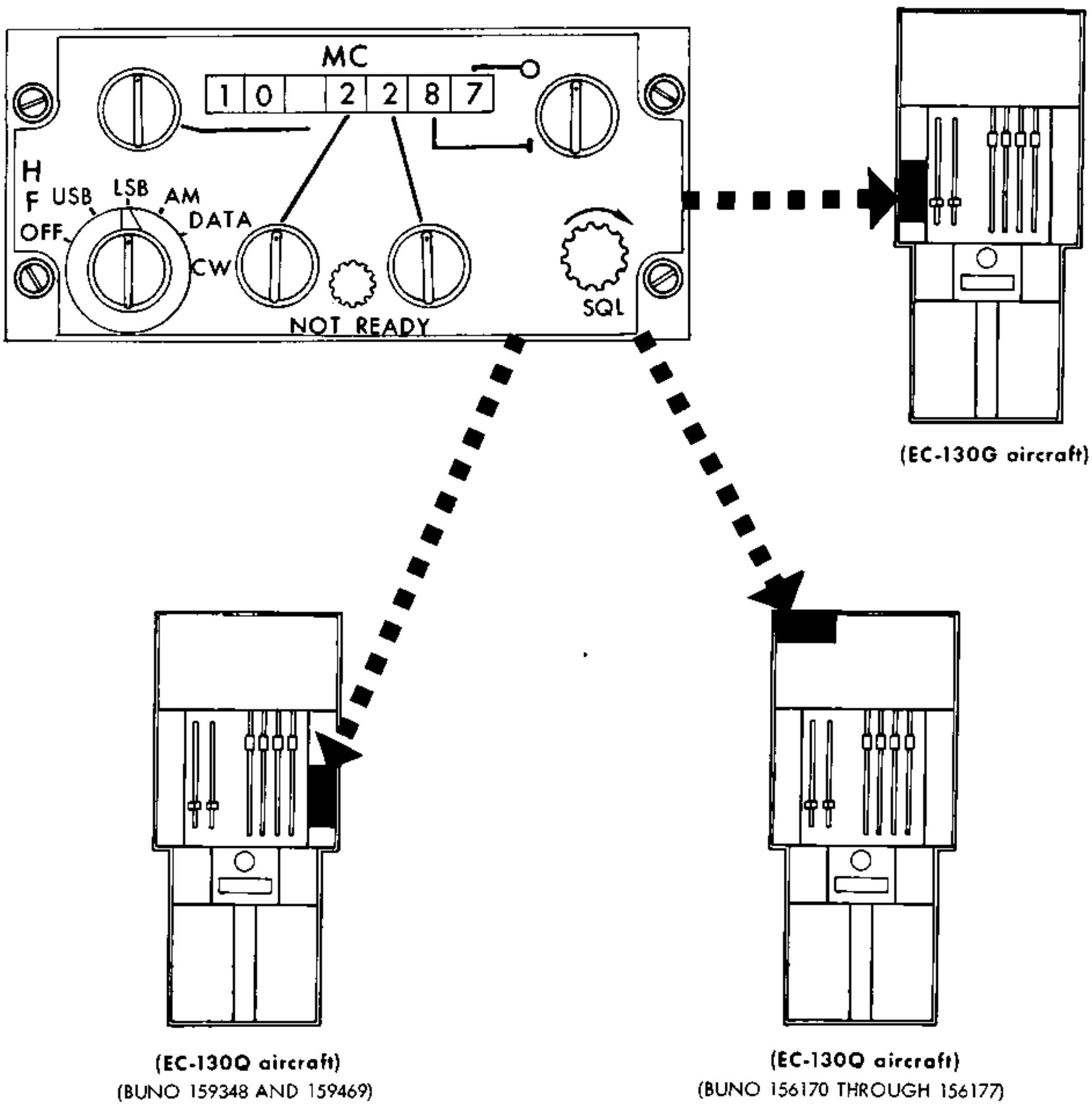
AUXILIARY HF ANTENNA.

An auxiliary HF (No. 3) antenna is installed on the aircraft for use in conjunction with special equipment. An additional auxiliary HF (No. 4) antenna is installed for use with the special equipment.

AUTOMATIC DIRECTION FINDER (AN/ARN-83) (EC-130Q AIRCRAFT).

Two AN/ARN-83 automatic direction finders are installed. The controls panels (figure 1-102) are located on the flight control pedestal and on the navigator's control panel. Each ADF system operates independently, with the No. 1 system positioning the No. 1 needles and the No. 2 system positioning the

hf liaison radio control panel (an/arc-132)



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EC-130-1-X0/7-077

Figure 1-98.

antenna guillotine control panel and short wire antenna length indicator

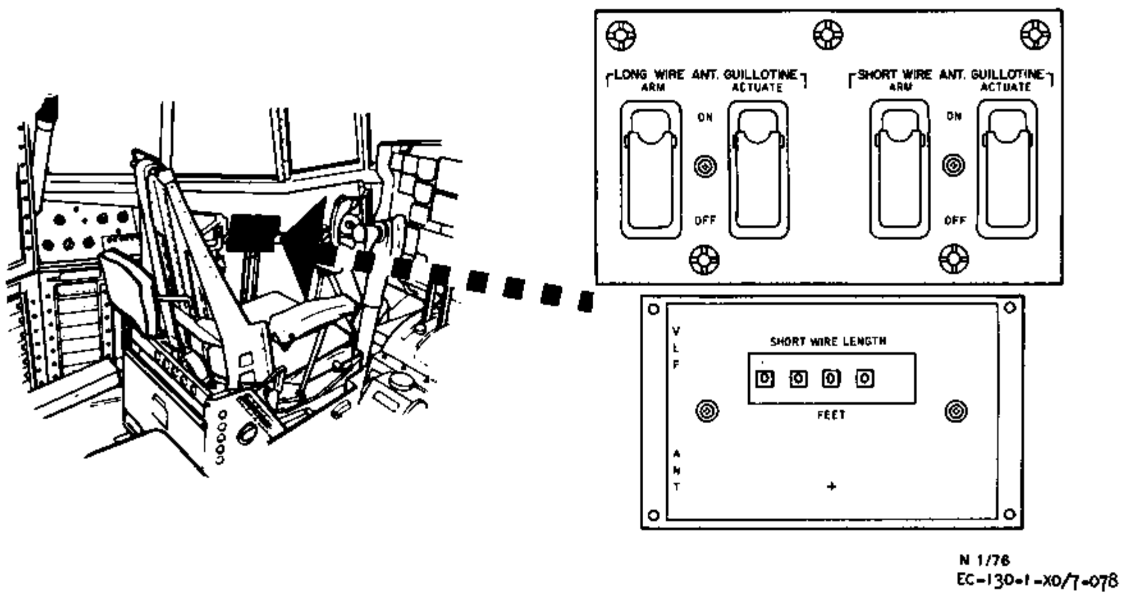


Figure 1-99.

antenna tension indicator

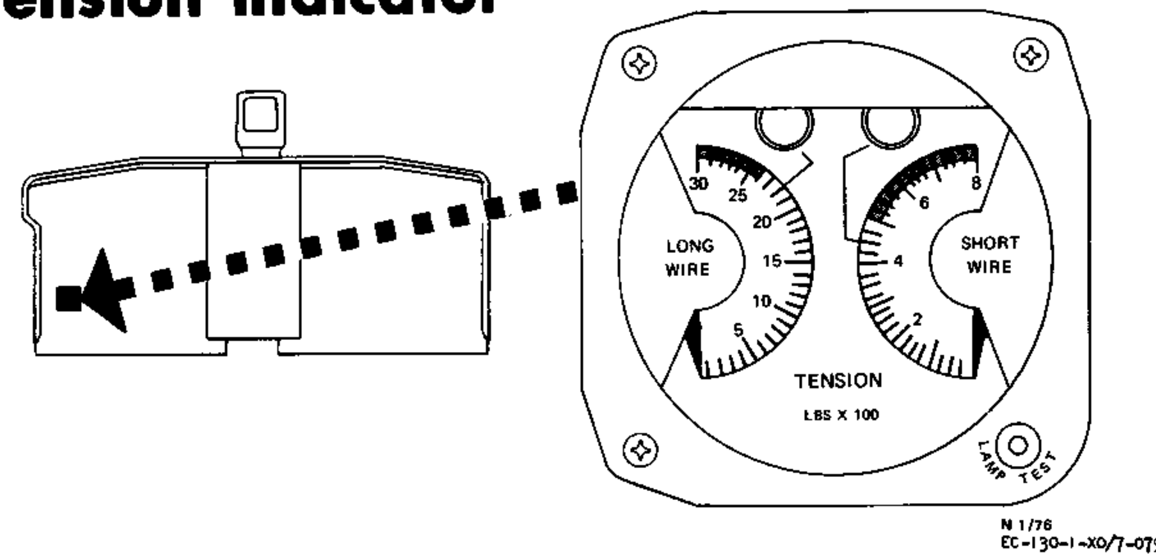
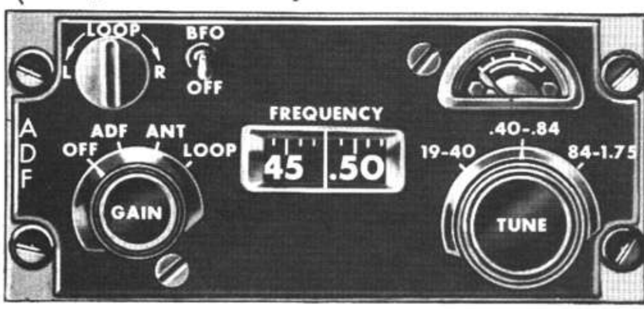
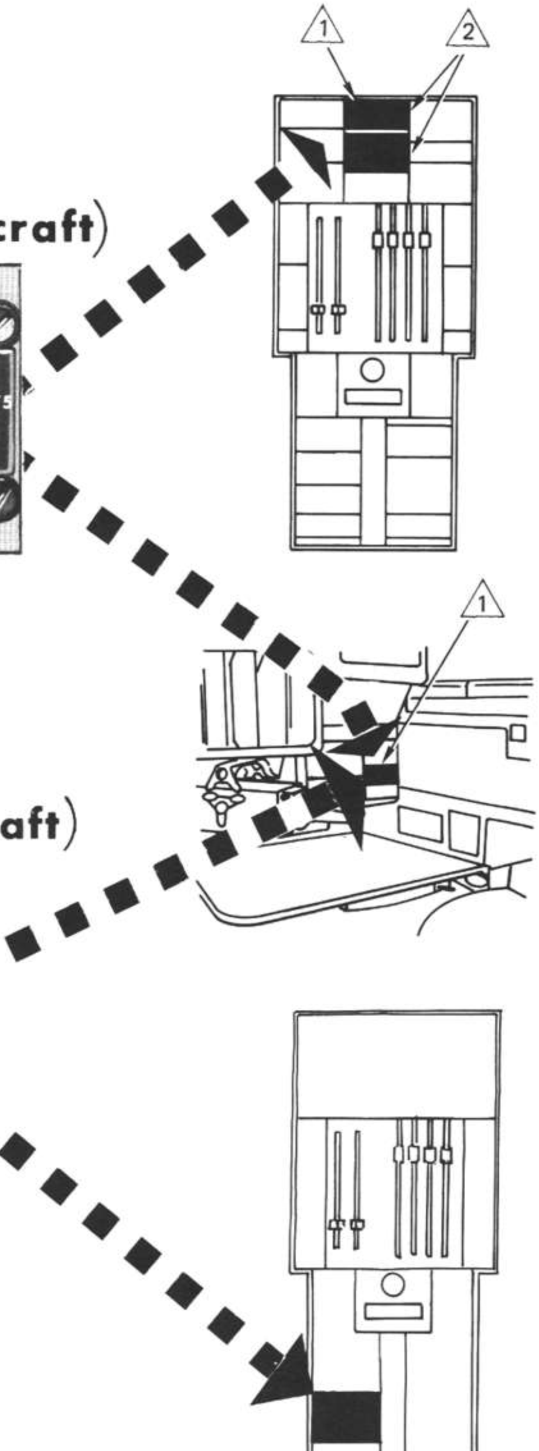


Figure 1-100.

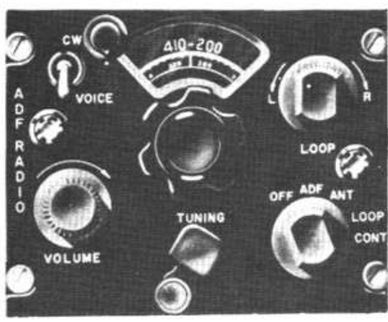
automatic direction finder control panel

(AN/ARN-83, EC-130Q aircraft)





(AN/ARN-6, EC-130G aircraft)



NOTE

THE AN/ARN-6 ADF IS A TEMPORARY INSTALLATION, AND WILL BE REPLACED BY THE AN/ARN-83 ADF WHEN IT IS AVAILABLE.

1 EC-130Q BUNO 156170 THROUGH 156177.

2 EC-130Q BUNO 159348 AND 159469.

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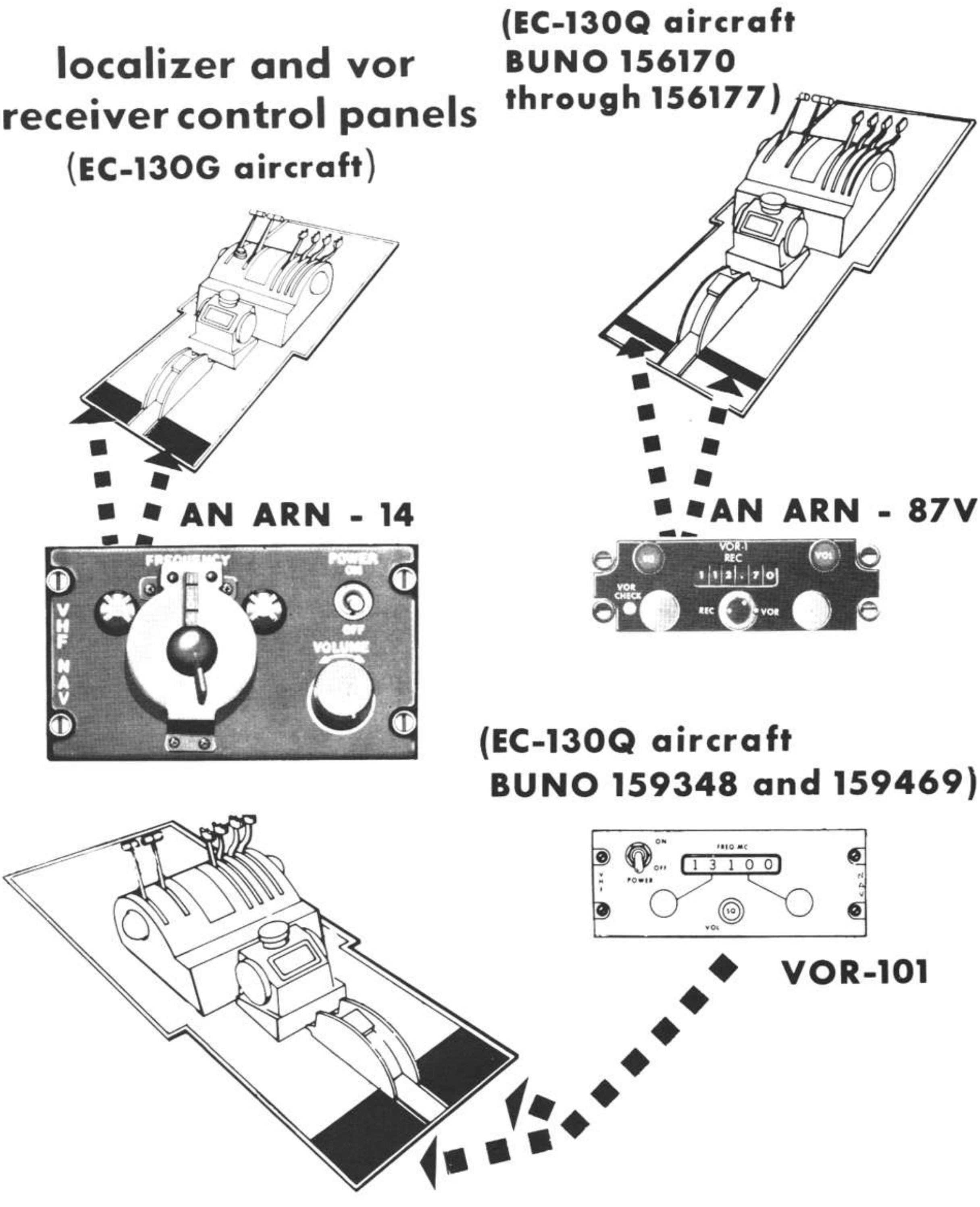
EC-130-1-0-080

Figure 1-101



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EC-130-1-0-081

Figure 1-102.

No. 2 needles of the pilot's, copilot's, and navigator's BDHI's. The ADF systems operate in the low to medium frequency range of 190 to 1750 kilohertz in three bands: 190 to 400 KHz, 400 to 840 KHz, and 840 to 1750 KHz. The ADF systems provide the following capabilities: automatic direction finding with continuous indication of the bearing to the selected radio station, manual direction finding, reception of navigation data from radio range stations, and conventional low frequency radio reception of voice and unmodulated radio signals. In all modes of operation the ADF systems provides an aural output of the modulated signals received through the intercommunication system. In addition, a beat frequency oscillator (BFO) is provided for use when receiving continuous wave signals. The ADF systems operate with 28 volt dc power from the essential dc bus through the radio compass No. 1 and radio compass No. 2 circuit breakers on the copilot's upper circuit breaker panel. System No. 1 receives 26 volt, 400 Hz ac power from the essential ac bus through the attitude heading reference unit phase A circuit breaker located on the pilot's upper circuit breaker panel. System No. 2 receives 26 volt, 400 Hz ac power from the essential ac bus through the C-12 compass secondary circuit breaker on the pilot's upper circuit breaker panel.

Automatic Direction Finder Controls.

A function switch with OFF, ADF, ANT, and LOOP positions selects the type of operation of the ADF's. The loop control knob provides for rotation of the loop antenna. The gain control knob controls the audio output to the intercommunication system. The band switching knob allows selection of the three frequency ranges and the tuning knob provides tuning within these bands. The tuning meter allows precise tuning of the selected station. The BFO switch is used for tuning a received signal for best reception by tuning out high and low tones on either side of center frequency.

Normal Operation of the Automatic Direction Finder.

To put the ADF into operation:

1. Place the function switch in the ANT position.

2. Allow 3 minutes for warmup.

3. Place the BFO switch in the desired position.

4. Pull the appropriate ADF switch on the intercommunication system control panel.

5. Select the operating frequency with the band switch and tuning knob.

To use the ADF for automatic position finding:

6. Move the function switch to ADF position.

Note

Do not use a station unless it can be identified by aural or cw signals, as appropriate.

To use the ADF for aural-null position finding:

7. Move the function switch to the LOOP position.

8. Rotate the loop with the loop 1-r control knob.

To turn the ADF off:

9. Place the function switch in the OFF position.

LOCALIZER AND VOR RECEIVER (AN/ARN-14) (EC-130G AIRCRAFT).

Two localizer and VOR receivers receive signals from VHF/VOR stations and signals from instrument landing system (ILS) localizers. Course information from the No. 1 receiver is supplied to the following:

Pilot's VOR/TAC radio magnetic indicator (rmi) No. 1 bearing pointer.

Navigator's VOR/TAC rmi No. 1 bearing pointer.

Copilot's VOR/TAC rmi No. 1 bearing pointer (when copilot's pointer selector switch is in the VOR 1 position).

Pilot's and copilot's flight director systems (when selected by the mode sel switches).

Course information from the No. 2 receiver is supplied to the following:

Copilot's VOR/TAC rmi No. 2 bearing pointer.

Pilot's VOR/TAC rmi No. 2 bearing pointer (when pilot's pointer selector switch is in the VOR 2 position).

Navigator's VOR/TAC rmi No. 2 bearing pointer (when navigator's pointer selector switch is in the VOR 2 position).

Pilot's and copilot's flight director systems (when selected by the mode sel switches).

Audio signals from VOR stations may be selected by pulling out the appropriate VOR button. The localizer and VOR receivers receive 28-volt, dc power from the essential dc bus through the vhf nav 1 and vhf nav 2 circuit breakers on the copilot's upper circuit breaker panel.

Course information from the no. 2 receiver is supplied to the following:

Navigator's VOR/TAC rmi or VOR/TAC bdhi No. 2 bearing pointer (when navigator's pointer sel switch is in the VOR 2 position).

Pilot's VOR/TAC rmi or VOR/TAC bdhi No. 1 bearing pointer (when pilot's pointer sel switch is in the VOR 2 position).

Copilot's VOR/TAC rmi or VOR/TAC bdhi No. 1 bearing pointer (when copilot's pointer selector switch is in the VOR 2 position).

Pilot's and copilot's flight director systems (when selected by the mode sel switches).

Audio signals from VOR stations may be monitored by pulling the appropriate VOR button. The localizer and VOR receivers are supplied 28-volt, dc power from the essential dc bus through the vhf nav No. 1 and VHF No. 2 circuit breakers on the copilot's upper circuit breaker panel.

Localizer and VOR Receiver Controls.

Controls for the localizer and VOR receivers are located on the VHF navigation panels (figure 1-103) on the flight control pedestal. On these panels are a two-position (ON, OFF) power switch, a frequency selector control, and a volume control. Any frequency in the range of 108.0 through 135.9 megahertz is tuned by the frequency selector and displayed in a vertical window. Reading down, the numbers represent hundreds, tens, units, and tenths of megahertz. Additional controls used in conjunction with the localizer and VOR receivers are discussed under the INSTRUMENT SELECTOR SWITCHES paragraph in this section.

Normal Operation of the Localizer and VOR Receiver.

Operate the equipment by the following procedure:

1. Place the power switch in the ON position.

2. Select the desired operating frequency with the frequency selector.

3. Set the pointer selector switches as necessary to connect the selected VOR receiver to the VOR/TAC rmi or VOR/TAC bdhi.

4. Select the appropriate VOR/ILS position with the mode sel switch.

5. Set the course to be flown with the course set knob on the horizontal situation indicator.

6. Place the flt dir switch in the NORMAL position.

7. Check station identification by pulling out the appropriate VOR intercom button, and adjust audio to a comfortable level by turning the VOR button.

To turn the receivers off:

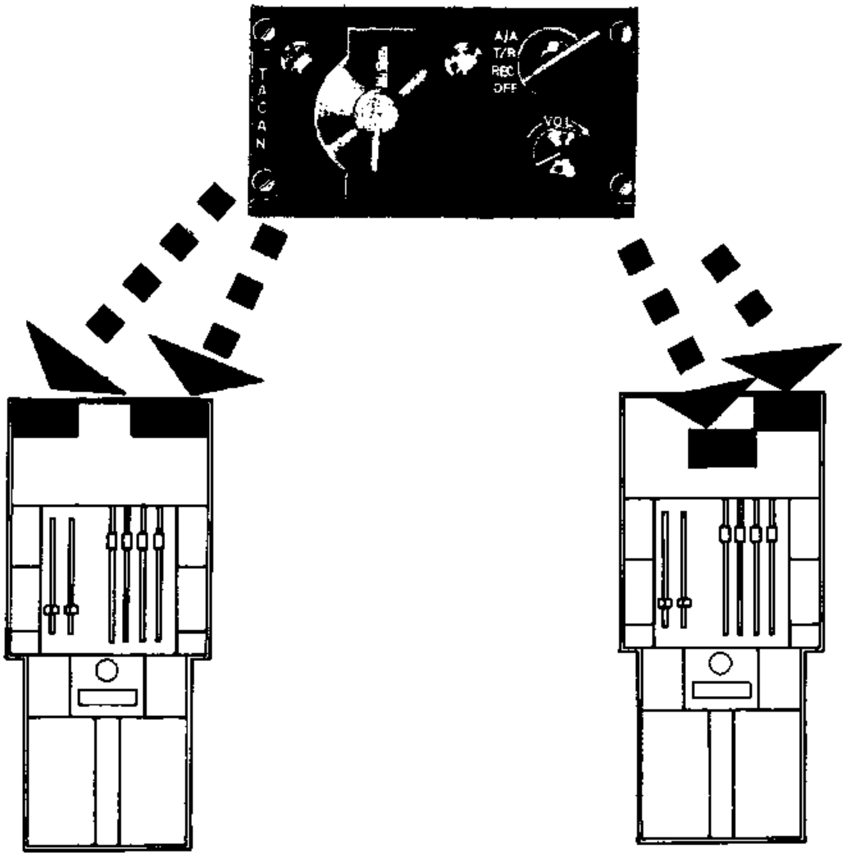
8. Place the power switch in the OFF position.

LOCALIZER AND VOR RECEIVER (AN/ARN-87V) (EC-130Q AIRCRAFT BuNo 156170 THROUGH 156177).

Two localizer and VOR receivers receive signals from VHF/VOR stations and from instrument landing system (ILS) localizers. Course information from the No. 1 receiver is supplied to the following:

Pilot's bearing-distance-heading indicator (BDHI) No. 1 needle (when the pilot's pointer sel switch is in the VOR 1 position).

tacan control panels



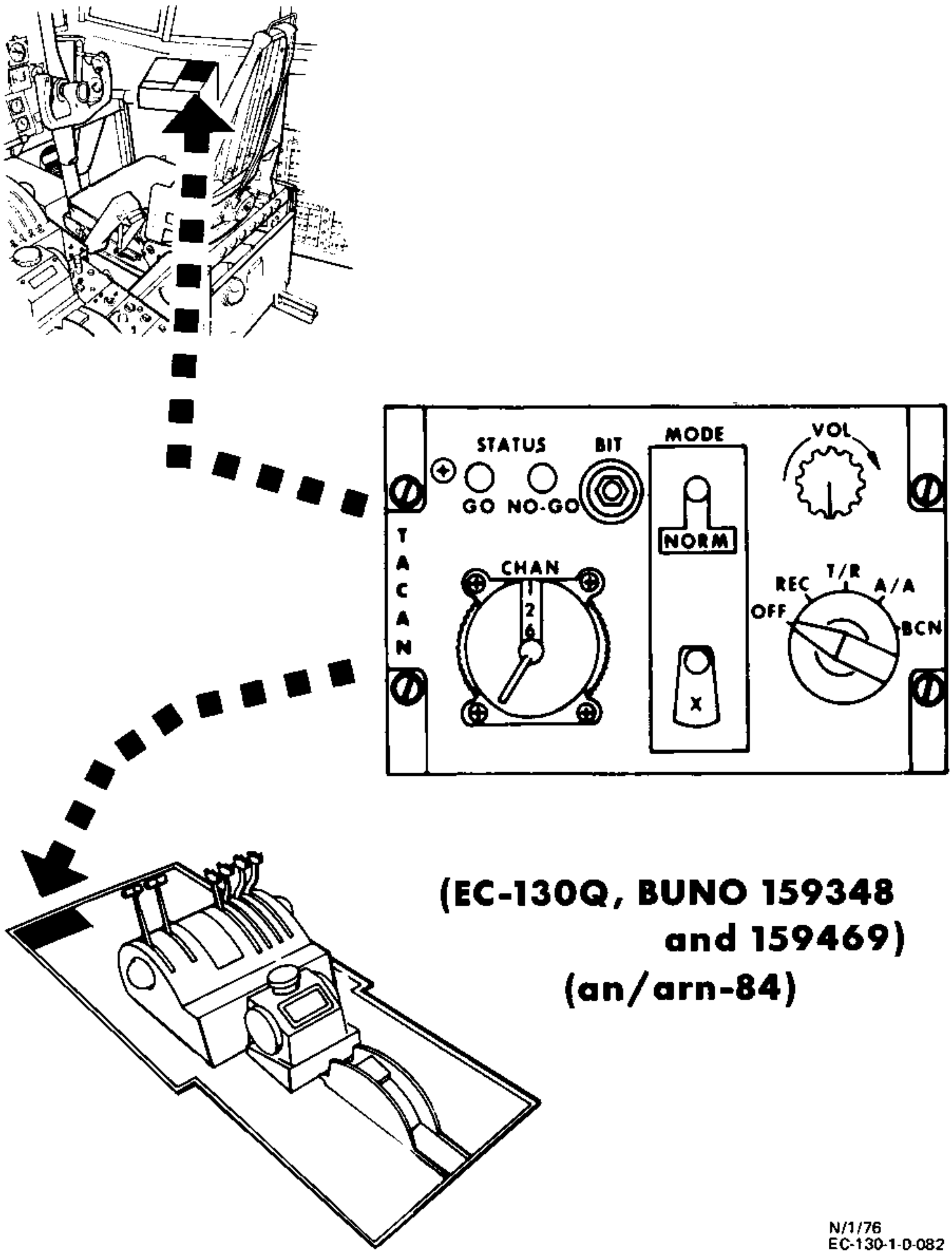
(EC-130G aircraft)
(an/arn-21)

(EC-130Q aircraft
BUNO 156170
through 156177)
(an/arn-52)

N 1/76

Figure 1-103. (Sheet 1 of 2)

tacan control panels



(EC-130Q, BUNO 159348 and 159469)
(an/arn-84)

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Figure 1-103. (Sheet 2 of 2)

Copilot's BDHI No. 1 needle (when the copilot's pointer switch is in the VOR 1 position).

Navigator's right hand BDHI No. 1 needle.

Pilot's and copilot's flight director systems (when selected by the mode sel switch).

Course information from the No. 2 receiver is supplied to the following:

Pilot's BDHI No. 1 needle. (When pilot's pointer sel switch is in the VOR 2 position.)

Copilot's BDHI No. 1 needle (when the copilot's pointer switch is in the VOR 2 position).

Navigator's right hand BDHI No. 2 needle (when the navigator's pointer sel switch is in the VOR 2 position).

Pilot's and copilot's flight director systems (when selected by the mode sel switch).

Audio signals from VOR stations may be monitored by pulling the appropriate VOR button. The localizer and VOR receivers are supplied 28 volt dc power from the essential dc bus through the vhf nav circuit breakers on the copilot's upper circuit breaker panel. AC power, 115 volt, 400 Hz is supplied from the essential ac bus through the VHF nav circuit breakers on the copilot's upper circuit breaker panel.

Localizer and VOR Receiver Controls.

Controls for the localizer and VOR receivers are located on the VOR-1 and VOR-2 control panels (figure 1-102) on the flight control pedestal. On these panels are a squelch knob, a power/vol knob, two frequency selector knobs, a two position (REC-VOR) mode switch, and a VOR check push button. Frequencies in the range of 108.00 to 151.95 megahertz are tuned by the frequency control knobs and are displayed in a horizontal window. When the REC-VOR switch is placed in the VOR position, the usable frequency range is limited to 108.00 to 117.95 megahertz. When the switch is placed in the REC position, the VOR receiver is available as an additional VHF receiver.

Normal Operation of the Localizer and VOR Receiver.

Operate the equipment by the following procedure:

1. Place the power vol switch to ON.
2. Allow five minutes for warmup.
3. Select the desired operating frequency with the frequency selector knobs.
4. Set the pointer selector switches as necessary to connect the selected VOR receiver to the BDHI's.
5. Select the appropriate VOR/ILS position with the mode sel switch.
6. Set the course to be flown with the course set knob on the horizontal situation indicator.
7. Place the flt dir switch in the NORMAL position.
8. Check station identification by pulling out the appropriate VOR intercommunication button and adjusting the audio to a comfortable level by turning the VOR button.
9. Depress the VOR check pushbutton. The bearing pointer on the horizontal situation indicator should go to 000°. The course deviation indicator should be centered with the course set knob, and the course selected should be 000° (± 4°).

To turn the receivers off:

10. Place the power/vor switch in the OFF position.

VOR RECEIVER (VOR-101) (EC-130Q AIRCRAFT BUNO 159348 AND 159469).

Two localizer and VOR receivers receive signals from VHF omnirange stations and from instrument landing system localizers. Bearing information data from the two systems is fed to pilot's, copilot's, and navigator's bearing distance heading indicators (BDHI) when selected by the instrument selector control panels (figure 1-106). The VOR receivers are tied in with the glideslope, C-12 compass No. 1 and No. 2, flight director systems No. 1 and No. 2, and autopilot. Audio signals from omnirange stations may be monitored on the intercommunication system by pulling the appropriate VOR-1 or VOR-2 button. The VOR receivers are controlled from the VHF nav control panels on the flight control pedestal (figure 1-16). The VOR receivers are supplied 28-volt dc and 115-volt ac power from the essential dc and ac buses (system No. 1) and the main dc and ac buses (system No. 2) through the VHF nav No. 1 and VHF nav No. 2 circuit breakers on the copilot's upper circuit breaker panel.

VOR RECEIVER CONTROLS.

Controls for the VOR receivers are located on the VHF nav control panels (figure 1-102) on the flight control pedestal. Each of the two controls (one for system No. 1 and one for system No. 2) contains a two-position (ON/OFF) power switch, two frequency selector controls, a volume control, and a squelch control. The power switch is used to place the system in operation. When the switch is placed in the ON position, the VOR and ILS systems are operating. In the OFF position, the systems are turned off. The frequency selector controls are used to select the desired operating frequency which will be displayed in horizontal windows on the control panel.

The volume control is used to adjust the amplitude of the received signal to the interphone system. The sq control is used to vary the VOR receiver squelch.

NORMAL OPERATION OF THE VHF NAVIGATION SYSTEM (VOR-101).

a. Place the power switch in the ON position.

b. Select the desired operating frequency with the frequency selector.

c. Set the pointer selector switches as necessary to connect the selected VOR receiver to the VOR/TAC RMI or VOR/TAC BHDI.

d. Select the appropriate VOR/ILS position with the mode sel switch.

e. Set the course to be flown with the course set knob on the horizontal situation indicator.

f. Place the flt dir switch in the NORMAL position.

g. Check station identification by pulling out the appropriate VOR intercom button, and adjust audio to a comfortable level by turning the VOR button.

To turn the receivers off:

h. Place the power switch in the OFF position.

VOR RECEIVER CHECK.

a. If VOT (VOR test facility) is available:

1. Tune both receivers to appropriate frequency.

2. Pilot selected to No. 1, copilot to No. 2.

(a) Bearing indications should be 180°.

(b) With course selected to 180°, course deviation bar should center.

(c) To-from indication should be To.

3. Deviation may not exceed 4° from station or between receivers.

b. If VOR only is available:

1. At a certified ground check point, "3" above applies.

2. At a certified airborne check point, deviation may not exceed 6° from station and 4° between receivers.

c. If no certified check-points are available, deviation may not exceed 4° between receivers.

TACAN (AN/ARN-21) (EC-130G AIRCRAFT).

Two independently operating, AN/ARN-21 tacan navigation systems are installed on EC-130G aircraft. The No. 1 tacan system is controlled by the pilot, and the No. 2 system by the copilot, by means of the tacan control panels (figure 1-103) on the flight control pedestal. When the No. 1 system is operating and the mode sel switch on the pilot's instrument selector panel is positioned to TAC 1, the following deployment of information is accomplished: bearing information is fed to the No. 2 bearing pointer of the pilot's bearing-distance-heading indicator (bdhi) and to the pilot's horizontal situation indicator; distance information is fed to the same two indicators; course deviation and to-from information is fed to the horizontal situation indicator; steering information is fed through the flight director computer system to the pilot's attitude director indicator; and, if the appropriate pointer sel switch on the navigator's instrument panel has been positioned to TAC 1, bearing and distance information will be available at the navigator's station on the No. 2 bearing pointer and on the range indicator, respectively, of the ADF/TAC bdhi. When the No. 2 system is operating and the mode sel switch on the copilot's instrument selector panel is positioned to TAC 2, a similar deployment of information is accomplished, except that the information goes to those indicators (bdhi, hsi, and adi) normally monitored by the copilot, rather than to those normally monitored by the pilot, and that the information available at the navigator's station is presented on the VOR TAC, rather than the ADF/TAC bdhi, when the appropriate pointer sel switch has been positioned to TAC 2. Distance information from the No. 1 system is presented on the pilot's horizontal situation indicator whenever system No. 1 is operating and the pilot's mode sel switch is in any position except TAC 2. Similarly, distance information from the No. 2 system is presented on the copilot's horizontal situation indicator whenever system No. 2 is operating and the copilot's mode sel switch is in any position except TAC 1. Tacan audio signals can be monitored by pulling the appropriate tacan button. The tacan system is powered by 28-volt, dc power and 115-volt, ac power from the essential ac and dc buses through tacan No. 1 and tacan No. 2 circuit breakers on the copilot's upper circuit breaker panel.

Tacan Controls.

Controls for the tacan systems are located on the tacan control panel(s) (figure 1-103) on the flight control pedestal. A four-position (OFF, REC, T/R, A/A) function switch selects mode of operation. With the switch in REC position, only bearing information is received; with the switch in T/R position, both bearing and range data are received; with the switch in the A/A position, range data only between two aircraft with 63 channel separation is received. The channel selector tunes the equipment to any of 126 frequency channels.

The volume control knob varies the volume of the audio signals received from the surface beacon and heard through the intercommunication system when the instrument select switch is in tacan position.

Normal Operation of the Tacan System(s).

1. Move the function switch to the desired position.

2. Place the appropriate pointer selector switch in the TAC position.

3. Place the required mode sel switch in the appropriate position for tacan operation.

4. Place the flt dir switch in the NORMAL position.

Note

Normal warmup time is 90 seconds. There is no delay when switching from REC to T/R.

5. Turn the chan selector knob to the desired tacan channel.

CAUTION

No attempt should ever be made to select a channel below 01 or above 126.

6. Check station identification by pulling out the appropriate tacan intercom button, and adjust audio to a comfortable level by turning the tacan button.

Note

Because of improperly adjusted or malfunctioning ground or airborne tacan equipment, it is possible for the tacan to lock-on to a false bearing. The error will probably be ± 40 degrees, but can be any value which is a multiple of 40 degrees. After take-off, the tacan should be cross-checked with ground radar, airborne radar, or VOR. When using tacan for instrument departures, penetrations, or letdowns, use airborne radar monitor or ground radar monitor when possible to verify tacan bearing information.

7. To turn the tacan system off, place the function switch in the OFF position.

Note

On aircraft with an operating automatic antenna selector excessive bearing and distance unlock conditions should be expected when within approximately 25 miles of the station. During banking maneuvers, on aircraft using only the bottom antenna, excessive bearing and distance unlock conditions should be expected when the aircraft is more than approximately 15 miles from the station.

TACAN (AN/ARN-52V) (EC-130Q AIRCRAFT BUNO 156170 THROUGH 156177)

The EC-130Q aircraft are equipped with two identical AN/ARN-52(V) tacan systems (figure 1-103). These systems are short-range omnibearing, distance measuring navigation systems. They provide continuous indication of the bearing and distance of the aircraft to any tacan surface beacon within a line-of-sight distance of 300 nautical miles. In addition, these systems may be used to determine the line-of-sight distance to another aircraft equipped with similar tacan equipment.

When the receivers are set 63 channels apart and the mode selector is placed to A/A in both aircraft, one tacan system in each aircraft transmits interrogation pulses that initiate reply pulses from the other aircraft. The reply signals received by each tacan system are used to derive the line-of-sight distance between the two aircraft. Bearing information is not available in A/A mode. Distance is displayed on pilot's, copilot's, and navigator's BDHI's.

When the No. 1 system is operating, the following deployment of information is accomplished: bearing information is fed to the No. 2 needle of the pilot's ID-1103 BDHI (bearing-distance-heading indicator) and to the pilot's horizontal situation indicator when the pilot's mode sel switch is placed in the TAC 1 position; distance information is fed to the same two indicators; course deviation and ambiguity information is fed to the horizontal situation indicator; steering information is fed through the flight direction system to the pilot's attitude director indicator; and, if the appropriate pointer sel switch on the navigator's instrument panel has been placed in the TAC 1 position, bearing and distance will be shown on the No. 2 needle and on the instrument face of the navigator's left-hand ID-1103 indicator. When the No. 2 system is operating and the copilot's mode sel switch is placed in the TAC 2 position, a similar deployment of information is accomplished, although information goes to indicators normally monitored by the copilot (bdh indicator, HSI, and ADI), rather than to those normally monitored by the pilot; and information available at the navigator's station is presented on the right-hand, rather than the left-hand, ID-1103 bdh indicator, when the appropriate pointer sel switch has been placed in the TAC 2 position. Distance information from the No. 1 system is presented on the pilot's horizontal situation indicator whenever system No. 1 is operating and the pilot's mode sel switch is in any position except TAC 2. Similarly, distance information from the No. 2 system is presented on the copilot's horizontal situation indicator when system No. 2 is operating and the copilot's mode sel switch is in any position other than TAC 1.

Tacan Controls.

Controls for the tacan systems are located on the tacan control panel(s) (figure 1-103) on the flight control pedestal. A four-position (OFF, REC, T/R, A/A) function switch selects mode of operation. With the switch in REC position, only bearing information is received; with the switch in T/R position, both bearing and range data are received; with the switch in A/A position, range data only between two aircraft with 63 channel separation is received.

The volume control knob varies the volume of the audio signals received from the surface beacon and heard through the intercommunication system when the instrument select switch is in tacan position.

Normal Operation of the Tacan System(s).

Note

When the tacan is operated on channels 1 through 11, it may blank out the IFF.

1. Move the function switch to the desired position.

2. Place the appropriate pointer selector switch in the TAC position.

3. Place the required mode sel switch in the appropriate position for tacan operation.

4. Place the flt dir switch in the NORMAL position.

Note

Normal warmup time is 90 seconds. There is no delay when switching from REC to T/R.

5. Turn the chan selector knob to the desired tacan channel.

CAUTION

No attempt should ever be made to select a channel below 01 or above 126.

6. Check station identification by pulling out the appropriate tacan intercom button, and adjust audio to a comfortable level by turning the tacan button.

Note

Because of improperly adjusted or malfunctioning ground or airborne tacan equipment, it is possible for the tacan to lock-on to a false bearing. The error will probably be ±40 degrees, but can be any value which is a multiple of 40 degrees. After take-off, the tacan should be cross-checked, with ground radar, airborne radar, or VOR. When using tacan for instrument departures, penetrations, or letdowns, use airborne radar monitor or ground radar monitor when possible to verify tacan bearing information.

7. To turn the tacan system off, place the function switch in the OFF position.

Note

During banking maneuvers, excessive bearing and distance unlock conditions should be expected when the aircraft is more than approximately 15 miles from the station.

TACAN (AN/ARN-84) (EC-130Q AIRCRAFT BUNO 159348 AND 159469).

Two independently-operating, AN/ARN-84 tacan navigation systems are installed. When the systems are operating and the pilot's or copilot's mode sel switch on the main instrument panel is positioned to TAC 1 or TAC 2, the following information is accomplished: TAC 1 or TAC 2 information is supplied to the pilot's and copilot's flight directors as selected. The pilot has priority of the system selected. Bearing, distance, course deviation, and to-from information is fed to the horizontal situation indicator. Steering information is fed through the flight director computer system to the attitude director indicator. TAC 1 distance is constantly displayed on the pilot's BDHI and the navigator's left-hand BDHI. TAC 1 bearing is displayed on No. 2 pointer of the pilot's BDHI and on No. 2 pointer of the navigator's left-hand BDHI if selected. TAC 2 distance is constantly displayed on the copilot's BDHI and the navigator's right-hand BDHI. TAC 2 bearing is diplayed on No. 2 pointer of the copilot's BDHI and on No. 2 pointer of the navigator's right-hand BDHI if selected. Distance information from the No. 1 system is presented on the pilot's horizontal situation indicator whenever system No. 1 is operating and the pilot's mode sel switch is in any position except DOP or TAC 2. Similarly, distance information from the No. 2 system is presented on the copilot's horizontal situation indicator whenever system No. 2 is operating and the copilot's mode sel switch is in any position except DOP or TAC 1. Tacan audio signals can be monitored by pulling the appropriate tacan buttons. The tacan system is powered by 28-volt, dc power and 115-volt, ac power from the essential ac and dc buses through tacan No. 1 and tacan No. 2 circuit breakers on the copilot's upper circuit breaker panel.

Tacan Controls.

Controls for the tacan system are located on the tacan control panel (figure 1-103). A five-position (OFF, REC, T/R, A/A, BCN) function selector switch is used to turn the set on and to select the mode of operation. With the switch in REC position, only bearing information is received; with the switch in T/R position, both bearing and range data are received; with the switch in A/A position, line-of sight distance information is received from other aircraft with tacan having air-to-air capability. The BCN position is inoperative.

The channel selector knob tunes the equipment to any of 126 channels in the X group of frequency channels.

The volume control knob varies the volume of the signals received from the surface beacon and heard through the intercommunication system when the select switch is in the tacan position.

The built-in-test (BIT) pushbutton is used to perform a self-test of the tacan system. The STATUS GO and NO-GO lights indicate the condition of the tacan system when the BIT pushbutton is depressed. See paragraph titled Tacan Systems Test Procedures in this section.

Tacan Systems Test Procedure.

To test the tacan systems, accomplish the following:

1. Rotate the function selector switch to REC.

Note

Normal warmup time is 2 minutes.

2. Depress the BIT pushbutton on the tacan control panel. Depressing the BIT pushbutton causes the STATUS GO and NO-GO lights to come on. Releasing the pushbutton causes both lights to go out. Approximately 21 seconds after the pushbutton is released the GO or NO-GO light will illuminate for 9 seconds, then go OUT. If the system is malfunctioning, the NO-GO light will have illuminated.

3. Rotate the function selector switch to T/R and repeat the test.

Normal Operation of the Tacan System(s).

1. Rotate the function selector switch the REC.

Note

Normal warmup time is 2 minutes.

2. Only the navigator's pointer sel switches require positioning. Select as follows at that station: TAC 1 for information from the pilot's tacan system, TAC 2 for information from the copilot's tacan system.

3. Place the mode sel switch in the appropriate position for tacan operation.

4. Place the flt dir switch in the NORMAL position.

5. Turn the chan selector knob to the desired tacan channel.

6. Check station identification by pulling out the appropriate tacan intercom button, and adjust audio to a comfortable level by turning the tacan button.

7. To turn the tacan system off, place the function selector switch in the OFF position.

IFF RADAR (AN/APX-72).

This system provides automatic radar identification of the aircraft when interrogated by surface or airborne radar sets. Also the system enables friendly aircraft to identify themselves apart from other friendly aircraft and provides a means of transmitting a special coded signal known as an emergency reply. In addition to the identification information the reply signal reports the altitude of the aircraft.

The radar identification system consists of a transponder control panel and on aircraft modified by C-130 AFC No. 133 an IFF antenna selector panel (figure 1-104) located on the copilot's side of the pedestal, and other equipment mounted on an IFF equipment rack overhead in the cargo compartment.

Antennas are provided on the top and bottom of the fuselage. On aircraft modified by C-130 AFC No. 133 an antenna selector panel (figure 1-104) is located on the copilot's side of the pedestal, to

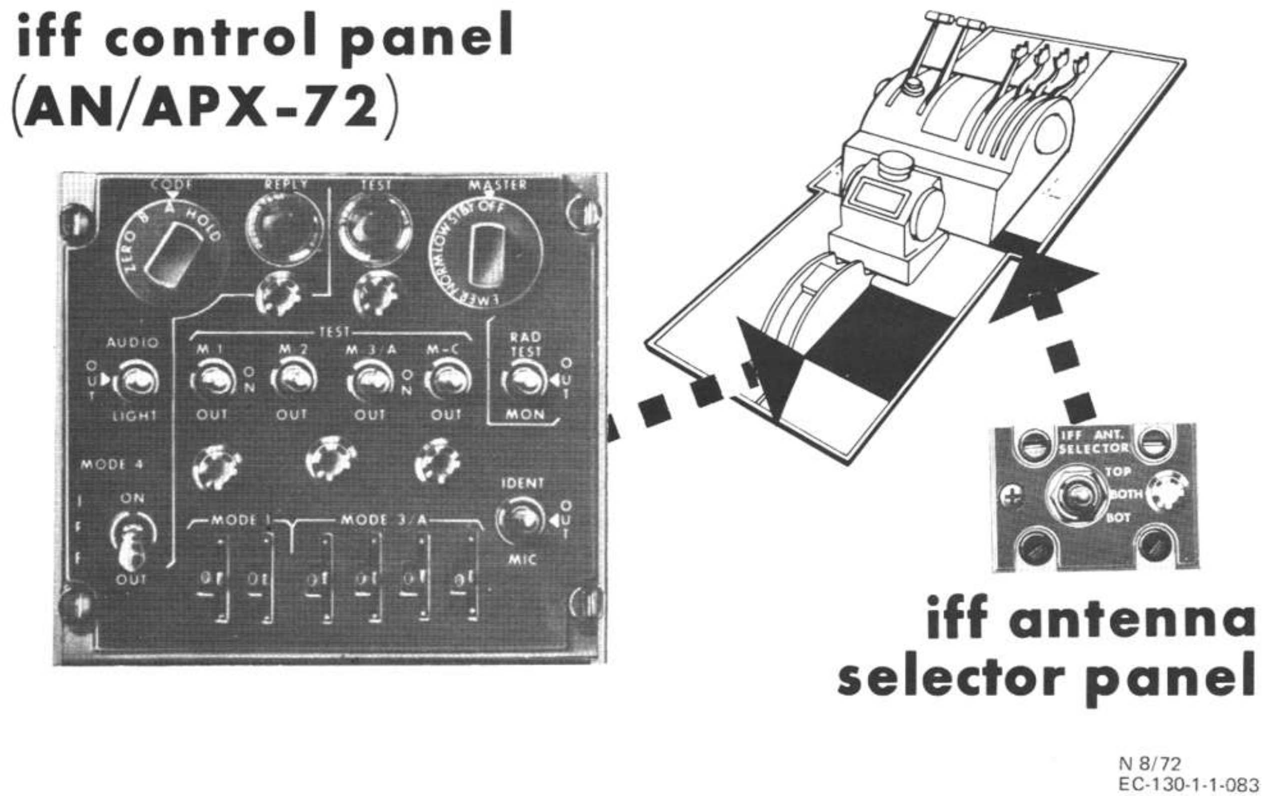


Figure 1-104.

allow selection of the top or bottom antenna. There are space provisions for a KIT-1A/T SEC computer transponder on the flight station radio rack. The IFF caution indicator on the pilot's instrument panel (figure 1-89) does not operate unless the computer is installed. An AAU-21/A altimeter-encoder is installed on the pilot's instrument panel.

The radar identification system receives, decodes, and responds to the characteristic interrogations of operational modes 1, 2, 3/A, C and 4 (when the computer is encoded). The receiver operates on a frequency of 1,030 megacycles, and the transmitter operates on a frequency of 1,090 megacycles. Specially coded identification of position (IP) and emergency signals may be transmitted to interrogating stations when conditions warrant.

Signals, consisting of pairs of pulses spaced to form a code, are transmitted from the interrogating station, and received by the receiver-transmitter. These signals are transferred to the decoder, where they are checked for valid code and proper mode (except for mode 4 interrogations, which are sent directly to the mode 4 board). If valid, the decoded signals are sent to the encoder board, which prepares the coded reply. The coded reply is sent through the transmitter and antenna to the interrogating station. The radar identification system can be operated in any one of the following categories of operation, each of which may be selected by the pilot or copilot at the control panel:

1. Low (sensitivity) operation
2. Normal (sensitivity) operation
3. Identification of position (IDENT-MIC)
4. Emergency operation

Five independent coding modes are available. The first three modes may be used independently or in combination. Mode 1 provides 32 possible code combinations, any one of which may be selected at the control. Mode 2 provides 4,096 possible code combinations, but only one is available for operation in flight, since the selection dials must be preset at the receiver-transmitter before flight. Mode 3/A provides 4,096 possible codes, any one of which may be selected from the control panel. Mode C (when the system is connected to the altimeter encoder) will indicate the pressure altitude of the aircraft interrogated. Mode 4 (when the system is connected to the computer) can be selected to display any one of many classified operational codes for security identification.

The range of the system is limited to line-of-sight transmission, since its frequency of operation is in the uhf band. This makes the range of operation dependent on the altitude of the aircraft.

The system has provisions whereby the position of the aircraft being interrogated can be obtained. This feature is used when a group of aircraft are being interrogated in the same area, and it is desired to single out one particular aircraft within the group. The IDENT reply can be made in Mode 1, Mode 2, or Mode 3/A, and appears as two short dashes on the interrogating radar indicator. This mode of operation is selected by placing the IDENT-OUT-MIC switch on the control panel to the IDENT position. The system will automatically transmit the reply during the time that the switch is held, and for 30 seconds after the switch is released. An emergency reply capability is also available, to allow identification of aircraft in distress. When the MASTER switch on the control panel is set to EMER, the system transmits an emergency signal, which is displayed as four dashes on the interrogating radar indicator.

Operation and control of the system is accomplished with the control panel. The control panel contains switches which are used to select the desired coded reply for Mode 1 and Mode 3/A. Mode 1 switches permit selection of a desired code from 00 to 73. Mode 3/A switches permit selection of a desired code from 0000 through 7777. The control panel contains the majority of the operating controls for the system. The MASTER switch allows the operator to select the following operating conditions for the receiver-transmitter: OFF, STDBY (standby), LOW (low sensitivity), NORM (normal sensitivity), and EMER (emergency). When the switch is set to OFF, all power is removed from the system. When the switch is set to STDBY, power is applied to the system and the system is warmed up. The transmitter circuits cannot be energized until after the 80-second warmup period. After the system is warmed up, the system may be placed in operation by positioning the switch to LOW or NORM. These two switch positions control the operating sensitivity of the receiver circuits. When the MASTER switch is set to EMER, the emergency circuits are operated to transmit distress replies to interrogations.

Three switches on the control panel enable or disable the system for Mode 1, Mode 2, or Mode 3/A replies are possible only when the MODE 1-OUT, or MODE 3-OUT switches are placed in the up position. The IDENT-OUT-MIC switch is spring-loaded to the OUT position. If identification operation is desired, the switch must be held in the IDENT position. This causes the system to transmit identification signals while the switch is held at IDENT, and for 30 seconds after the switch is released. When the switch is released, it returns to the OUT position. When the switch is held in the MIC position, the identification signal will be transmitted when the No. 1 or No. 2 AN/ARC-138 UHF transmitter is keyed, and for 30 seconds after the switch is released, when the transmitter is keyed.

When the KIT-1A/T SEC computer transponder is installed, Mode 4 interrogations bypass the decoder in the receiver-transmitter, and are applied directly to the KIT-1A/T SEC computer transponder. The Mode 4 interrogation signal is decoded and applied to a Mode 4 recognition circuit. When Mode 4 coincidence exists, the Mode 4 recognition circuit generates a signal to the Mode 4 computer, which in turn generates a signal to the Mode 4 reply. The REPLY light on the control panel illuminates to indicate that a Mode 4 reply is being transmitted. An IFF caution light on the pilot's instrument panel illuminates when Mode 4 interrogations are not properly decoded. The IFF caution light does not operate unless the KIT-1A/T SEC computer is installed.

The radar identification system contains an integral test set that tests the Mode 1, 2, 3/A and C functions of the receiver transmitter. It does this by sending a test pulse on command to the receiver-transmitter and analyzing the receiver-transmitter's response.

If the response is within certain parameters, such as pulse spacing, power output, and frequency, the test set accepts the output and notifies the operator in the flight station by illuminating the TEST light on the control panel. The test set also monitors the operation of the receiver-transmitter during operation, by comparing the interrogations received and the responses transmitted. If the system transmits the proper response, the TEST light on the control panel illuminates. The test set does not monitor Mode 4 operation.

Provisions are made for the installation of an IFF transponder computer in the flight station radio rack. When the computer is installed and connected, Mode 4 interrogations bypass the decoder in the receiver-transmitter and are applied directly to the computer. The coded interrogation pulses are decoded in the computer and a coded reply pulse is generated which is returned to the receiver-transmitter for transmission to the interrogating source. An IFF caution light on the pilot's instrument panel illuminates when Mode 4 interrogations are not properly decoded. The IFF caution light does not operate unless the computer is installed. The system is powered by 28-volt dc power from the essential dc bus through the IFF dc and IFF control circuit breakers on the copilot's upper circuit breaker panel. The system receives 115 volt ac power from the essential ac bus through the IFF ac circuit breaker on the copilot's upper circuit breaker panel. The altimeter encoder is powered by 115 volt ac power from the essential ac bus and 28-volt dc power from the essential dc bus through the altimeter ac and dc circuit breakers on the copilot's upper circuit breaker panel.

IFF Radar Identification System Controls.

The transponder control panel contains all of the controls and indicators (except Mode 2 select switches) normally required to operate the system. The functions of these controls and indicators are as follows:

CONTROL	POSITION	FUNCTION
MASTER control	OFF	Deenergizes the system
	STBY	Place system in warm-up (standby) condition.
	LOW	Allows operation of system at reduced receiver sensitivity.
	NORM	Allows operation of system at normal receiver sensitivity.
	EMER	Allows system to transmit emergency replies to Mode 1, 2 or 3/A interrogations regardless of mode control settings.
IDENT-MIC switch	IDENT	When spring-loaded switch is momentarily actuated, it initiates identification of position reply for approximately 30 seconds.
	OUT	Prevents triggering identification of position reply.
	MIC	Allows transmission of identification of position replies by depressing the microphone switch.
M-1 switch	ON	Allows system to reply to Mode 1 interrogations.
	OUT	Prevents reply to Mode 1 interrogations.
	TEST	Allows test set to locally interrogate receiver-transmitter in Mode 1.
M-2 switch	ON	Allows system to reply to Mode 2 interrogations.
	OUT	Prevents reply to Mode 2 interrogations.
	TEST	Allows test set to locally interrogate receiver-transmitter in Mode 2.

CONTROL	POSITION	FUNCTION
M-3/A switch	ON	Allows system to reply to Mode 3/A interrogations.
	OUT	Prevents reply to Mode 3/A interrogations.
	TEST	Allows test set to locally interrogate receiver-transmitter in mode 3/A.
MODE C TEST-ON-OUT switch	TEST	Tests the altitude reporting mode.
	ON	Allows system to reply to Mode C interrogations.
	OUT	Prevents reply to Mode C interrogations.
TEST indicator		Illuminates when system responds properly to test.
MODE 4 switch	ON	Allows system to reply to Mode 4 interrogations.
	OUT	Prevents reply to Mode 4 interrogations.
CODE control		Functions of this switch are operationally classified.
AUDIO-LIGHT switch	AUDIO	Enables aural and REPLY light monitoring of valid mode 4 interrogations and replies.
	LIGHT	Enables REPLY light only monitoring of valid mode 4 interrogations and replies.
	OUT	Disables aural and REPLY light monitoring of valid mode 4 interrogations and replies.
REPLY indicator		Lights when valid mode 4 replies are present.
RAD TEST-MON switch	RAD TEST	Allows receiver-transmitter to reply to TEST mode interrogations from an external test set (AN/UPM-92 or equivalent). Other functions of this switch position are classified.
	MON	Enables the monitor circuits of Test Set TS-1843/APX
	OUT	Disables the RAD TEST and MON features of the C-6280(P)/APX control.
MODE 1 code select switches		Select two-digit Mode 1 reply code.
MODE 3/A code select switches		Select four-digit Mode 3/A reply code.

Normal Operation of the IFF Radar Identification System.

To put the system in operation:

1. Set the MASTER switch to OFF.

2. Set the IDENT-MIC, M-1, M-2, M-3/A, M-C, and MODE 4 switches to OUT.

3. Set the AUDIO-LIGHT and RAD TEST-MON switches to OUT.

4. Set the required operational code in the MODE 1 and 3/A code select switches and ensure proper code insertion has been made for modes 2 and 4.

5. Set the required operational code in the MODE 2 code select switch on the receiver-transmitter.

6. Set the MASTER switch to STDBY and allow a one minute warmup for standard temperature, or a two minute warmup for cold weather operation.

7. Set the MASTER switch to LOW or NORM, depending on the receiver sensitivity required.

8. Set the M-1, M-2, M-3/A, M-C and MODE 4 switches to ON, as required by the operational codes being used.

9. Set the AUDIO-LIGHT switch to LIGHT.

10. Set the IDENT-MIC switch to OUT.

11. Set the RAD TEST-MON switch to MON.

To check that the system is operating properly:

12. Set the M-1 switch momentarily to TEST, and check that the TEST indicator illuminates.

13. Repeat step 12 for the M-2 and M-3/A switches.

Identification of Position (IP) Operation.

1. Hold the IDENT-MIC switch at IDENT.

Emergency Operation.

1. Pull the MASTER switch out and rotate it to the EMER position.

2. Let the MASTER switch remain in the EMER position during the emergency.

3. When the emergency is over, return the MASTER switch to NORM or LOW.

To turn the system off:

4. Set the MASTER switch to OFF.

MARKER BEACON RECEIVER.

A marker beacon receiver (Collins 51Z-3 on C-130G and Collins 51Z-4 on EC-130Q aircraft) gives visual and aural coded signals when the aircraft is in range of or passing over a marker beacon transmitter. The visual signal is given through three colored indicator lights on a panel (figure 1-89) on the pilot's instrument panel: blue for an ILS outer marker, amber for an ILS inner marker, and white for airway markers. A two-position (HI,LO) marker beacon switch, located below the three indicator lights, is used to select either high or low receiver sensitivity according to the strength of the incoming signal. The aural signal (400 cps for outer marker, 1,300 cps for inner marker, and 3,000 cps for airway markers) is provided through the intercommunication system. The marker beacon receiver operates from 28-volt, dc power supplied from the main dc bus through the copilot's upper circuit breaker panel.

Note

To narrow the apparent width of marker beacon transmissions, it is necessary to select the LO position of the marker beacon switch when flying at high alititudes.

GLIDEPATH RECEIVER (AN/ARN-67).

Two glidepath receivers are installed to provide vertical guidance information to the pilots' flight director systems. When an ILS frequency is selected, the glidepath receiver is automatically tuned to a frequency corresponding with the selected ILS frequency. The glidepath receivers operate on 28-volt dc power from the VOR receiver, which is supplied from the essential dc bus through the vhf nav No. 1 and vhf nav No. 2 circuit breakers on the copilot's upper circuit breaker panel.

UHF DIRECTION FINDER (AN/ARA-25) (EC-130G AIRCRAFT).

The UHF direction finder is used in conjunction with the AN/ARC-138 UHF command radio. The UHF direction finder receives 115-volt ac power from the main ac bus through the uhf df circuit breaker located on the copilot's upper circuit breaker panel.

A direction finder group is used to indicate the relative bearing of, and to home on, radio signals being received by the UHF command radio. Continuous indication of relative bearing is provided by the No. 2 needle of the radio magnetic indicators (rmi), on the pilot's and copilot's instrument panels. The UHF direction finder group operates from 28-volt, dc power supplied by the main dc bus through a direction finder UHF circuit breaker on the copilot's upper circuit breaker panel.

UHF Direction Finder Group Controls.

The direction finder group is controlled from the UHF command radio panel (figure 1-97) on the flight control pedestal. The direction finder is turned on by placing the function switch in the ADF position. The operating frequency of the direction finder is selected on the UHF command radio panel.

Normal Operation of the UHF Direction Finder Group.

HOMING. Home on UHF radio stations as follows:

1. Rotate the function switch on the UHF command panel to the ADF position.

2. Select the operating frequency on the UHF command panel.

3. Turn the aircraft to place the head of the No. 2 bearing pointer under the top index of the rmi.

4. To turn off, move the function switch on the UHF command panel from the ADF position.

DIRECTION FINDING. Perform direction finding as follows:

1. Rotate the function switch on the UHF command panel to the ADF POSITION.

2. Select the operating frequency on the UHF command panel.

3. Read the bearing to the received signal under the head of the NO. 2 bearing pointer on the compass card of the rmi.

4. To turn off, move the function switch on the UHF command panel from the ADF position.

Emergency Operation of the Direction Finder Group.

The direction finder group has no provision for emergency operation. If a fault in the direction finder interferes with operation of the UHF command radio, remove the P-101 power plug from J-101 on the front panel of the AM-608/ARA-25 electronic control amplifier. This amplifier is located on the left-hand underdeck rack.

UHF DIRECTION FINDER (AN/ARA-50) (EC-130Q AIRCRAFT).

The UHF direction finder is used in conjunction with the AN/ARC-138 UHF command radio. The UHF direction finder receives 115-volt ac power from the main ac bus through the uhf df circuit breaker located on the copilot's upper circuit breaker panel.

A direction finder group is used to indicate the relative bearing of, and to home on, radio signals being received by the UHF command radio. Continuous indication of relative bearing is provided by the No. 2 needle of the radio magnetic indicators (rmi), on the pilot's and copilot's instrument panels. The UHF direction finder group operates from 28-volt, dc power supplied by the main dc bus through a direction finder UHF circuit breaker on the copilot's upper circuit breaker panel.

UHF Direction Finder Group Controls.

The direction finder group is controlled from the UHF command panel (figure 1-97) on the flight control pedestal. The direction finder is turned on by placing the function switch in the ADF position. The operating frequency of the direction finder is selected on the UHF command panel.

Normal Operation of the UHF Direction Finder Group.

HOMING. Home on UHF radio stations as follows:

1. Rotate the function switch on the UHF command panel to the ADF position.

2. Select the operating frequency on the UHF command panel.

3. Turn the aircraft to place the head of the No. 2 bearing pointer under the top index of the rmi.

4. To turn off, move the function switch on the UHF command panel from the ADF position.

DIRECTION FINDING. Perform direction finding as follows:

1. Rotate the function switch on the UHF command panel to the ADF position.

2. Select the operating frequency on the UHF command panel.

3. Read the bearing to the received signal under the head of the No. 2 bearing pointer on the compass card of the rmi.

4. To turn off, move the function switch on the UHF command panel from the ADF position.

FLIGHT DIRECTOR SYSTEMS.

Two complete and separate flight director systems are installed in the aircraft, one each for the pilot and copilot. Each system consists of a CPU-27/A (EC-130G), CPU-65/A (EC-130Q) flight director computer, an ARU-2B/A attitude director indicator, an AQU-2/A horizontal situation indicator, an MC-1 rate gyro, an MD-1 gyro, a TRU-2A/A rate-of-turn sensor, and instrument selector switches for connecting navigation systems to the flight director.

The pilot's system has a vertical reference switch used to select the heading and attitude signal reference source supplied to the autopilot. The copilot has an indicator that comes on to indicate that the proper selection has been made for a repeat presentation of information appearing on the pilot's attitude director indicator, as computed by the pilot's flight director, during an ILS approach. Because the individual navigation systems are designed to supply only a certain number of instrument loads and only one course set knob can be used to control the course selected, it is necessary to have only one pilot using any one system at a time. The pilot has priority on selection of radio navigation display on his horizontal situation indicator and its use with the flight director computer. Therefore, the copilot is provided with a system off indicator that comes on when the copilot selects any mode of operation, other than HDG (heading), that is selected by the pilot. Flight director system No. 1 receives phases A and B essential ac power from the copilot's inverter bus through the No. 1 flt dir gyro & ind fuses on the pilot's lower circuit breaker and fuse panel. The system receives essential dc power through the attd hdg sw relays circuit breaker on the pilot's side circuit breaker panel. The system also receives essential dc power through the gyro circuit breaker, essential ac power through the comptr circuit breaker, and main dc power through the relays circuit breaker on the copilot's upper circuit breaker panel. Flight director system No. 2 receives phases A and B essential ac power from the copilot's inverter bus through the No. 2 flt dir gyro & fuses on the pilot's lower circuit breaker and fuse panel. The system also receives essential dc power through the gyro circuit breaker, essential ac power through the comptr circuit breaker, and main dc power through the relays circuit breaker on the copilot's upper circuit breaker panel.

Note

Power for the flight director system should be obtained from the essential ac bus during all modes of flight operation. In the event that standby power from the copilot's inverter is being used in lieu of the essential ac bus, the mode sel and flt dir switches on the instrument selector panels (figure 1-106)should be positioned to HDG and NORMAL respectively.

Horizontal Situation Indicators.

Each of the two horizontal situation indicators (figure 1-105) presents a plan view display of the aircraft with respect to heading, bearing, distance, displacement off course, and ambiguity information. A selected heading or course may be selected on either the pilot's or copilot's horizontal situation indicator and tied in with the flight director and navigation systems. The pilot's selection may be tied in with the autopilot. Navigation systems are connected to the horizontal situation indicators by means of a mode sel switch. The horizontal situation indicators receive 115-volt power from the essential ac bus through the HSI No. 1 and HSI No. 2 fuses on the pilot's lower circuit breaker panel. The horizontal situation indicators contain the following components:

COMPASS CARD (12). The compass card on the pilot's horizontal situation indicator repeats the heading of the No. 1 compass. The compass card on the copilot's horizontal situation indicator repeats the heading of the No. 2 compass.

HEADING MARKER (1). Set to the desired magnetic heading by the heading set knob (10); rotates with the compass card.

COURSE SELECTOR WINDOW (3). Gives a digital readout of the position of the course arrow.

COURSE ARROW (5). Indicates aircraft heading with the mode selector switch in the HDG position. Indicates the selected course with the mode selector switch in any of the nav aid positions. This arrow is set by the course set knob (7), and rotates with the compass card.

COURSE SET KNOB (7). Used to set course arrow, with the mode selector switch in any position except HDG.

COURSE DEVIATION INDICATOR (4). Presents displacement of the aircraft to the right or left of the selected course. The dot scale is calibraed at 5 degrees per dot on VOR and 1.25 degrees on ILS.

TO-FROM INDICATOR (14). Indicates which end of the course arrow points toward the selected VOR or tacan station.

BEARING POINTER (6). Indicates magnetic bearing of a selected VOR or tacan station.

RANGE INDICATOR (15). Indicates distance in nautical miles from the aircraft to a selected tacan station.

Attitude Director Indicator.

The attitude director indicators (figure 1-105) present the forward display of the aircraft and are the primary attitude instruments for combining roll and pitch, turn and slip, and computed steering information. The attitude director indicators receive power from the copilot's ac instrument bus through the flight director gyro No. 1 and 2 fuses on the pilot's lower circuit breaker panel. The attitude director indicator is made up of the following items:

ATTITUDE SPHERE (1). Provides an artificial horizon which, relative to the miniature aircraft (6), shows roll and pitch attitudes of the aircraft.

BANK POINTER (2). Rotates with the roll gimbal to indicate bank angle against the bank index scale (8).

PITCH TRIM KNOB (9). Used to adjust the position of the attitude sphere in the pitch axis.

BANK STEERING BAR (4). Supplies an indication for steering to and maintain a selected heading, with the flt dir switch in the MANUAL position.

Note

> For operation with the flt dir switch in the NORMAL position, refer to individual mode of operation this section.

SLIP INDICATOR (11). Indicates aircraft slip or skid information.

TURN NEEDLE (10). Used in conjunction with the slip indicator to indicate coordinated turns.

PITCH STEERING BAR (16). Supplies an indication for steering to intercept and maintain the glideslope beam.

GLIDESLOPE INDICATOR (13). Presents aircraft position relative to the glideslope, as indicated on the glideslope deviation scale (15). Each dot on the deviation scale equals 0.25 degree.

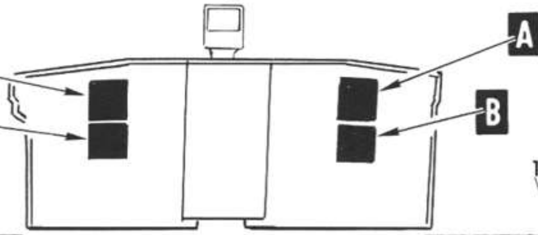
WARNING FLAGS (3) (14) (12). Each attitude director indicator contains three warning flags, the course warning flag (3), the glideslope warning flag (14), and the attitude warning flag (12). The course warning flag indicates loss of signal and monitors information from the VOR/ILS or tacan system and the flight director computer. The glideslope warning flag indicates loss of signal or invalid signal from the glideslope receiver.

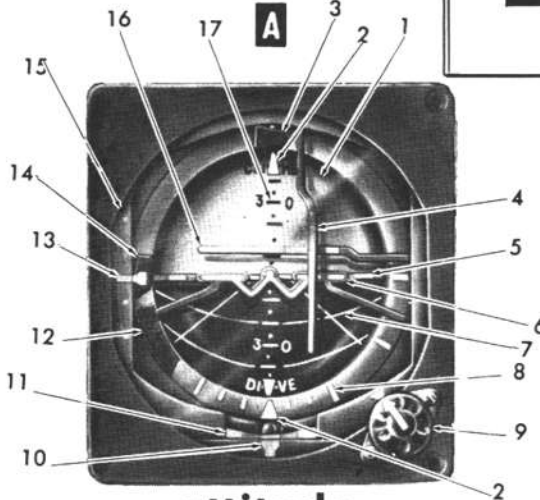
The attitude warning flag (12) indicates loss of power to the indicator.

Attitude Reference Switch(EC-130G and EC-130Q BuNo 156170 through 156177).

In the normal (Normal) mode the AHRS provides attitude information to the pilot's ADI. In the alternate (Alt) mode the MD-1, No. 1 gyro provides attitude information to the pilot's ADI. In the inertial navigation system (INS) mode, the inertial system provides attitude information to the pilot's ADI. The attitude reference switch does not

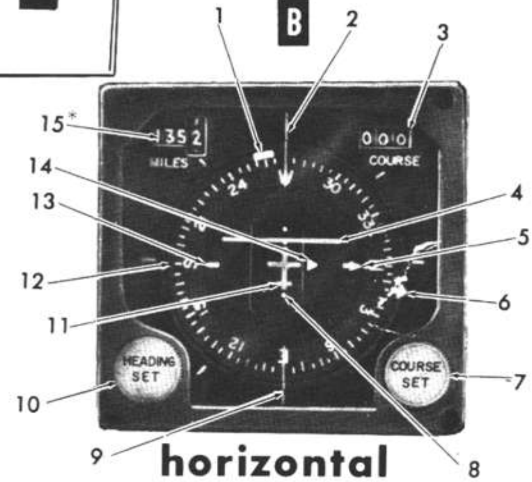
flight director system indicators





attitude director indicator

1. ATTITUDE SPHERE
2. BANK POINTER
3. COURSE WARNING FLAG
4. BANKSTEERING BAR
5. HORIZON BAR
6. MINIATURE AIRCRAFT
7. GROUND PERSPECTIVE LINES
8. BANK INDEX SCALE
9. PITCH TRIM KNOB
10. TURN NEEDLE
11. SLIP INDICATOR
12. ATTITUDE WARNING FLAG
13. GLIDE SLOPE INDICATOR
14. GLIDE SLOPE WARNING FLAG
15. GLIDE SLOPE DEVIATION SCALE
16. PITCH STEERING BAR
17. PITCH REFERENCE SCALE



horizontal situation indicator

1. HEADING MARKER
2. UPPER LUMBER LINE
3. COURSE SELECTOR WINDOW
4. COURSE DEVIATION INDICATOR
5. COURSE ARROW (HEAD)
6. BEARING POINTER
7. COURSE SET KNOB
8. COURSE DEVIATION DOTS
9. LOWER LUMBER LINE
10. HEADING SET KNOB
11. AIRCRAFT SYMBOL
12. COMPASS CARD
13. COURSE ARROW (TAIL)
14. TO-FROM INDICATOR
15. RANGE INDICATOR

*15. RANGE WARNING FLAG (NOT SHOWN)

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Figure 1-105.

affect the copilot's ADI which is provided attitude information by the MD-1 No. 2 at all times.

In the normal mode, the inertial navigation system provides attitude information to the pilot's ADI and the autopilot. The alternate (ALT) position provides inputs from the flight director gyro to the pilot's ADI.

Instrument Selector Control Panels (EC-130Q BuNo 159348 and 159469).

Each of the two instrument selector control panels (figure 1-106) contains a flt dir switch, a mode sel switch, and a pointer selector switch. The copilot's panel is also equipped with an ADI selector switch.

FLT DIR SWITCH. The two-position (NORMAL, MANUAL) flt dir switch controls the manner in which information selected by the mode sel switch will be supplied to the flight director computer and the attitude director indicator.

MODE SEL SWITCH. The multi-position mode sel switches are provided to connect a navigation system to the horizontal situation indicators and the flight director computers. The switch has five positions (HDG, TAC-1, TAC-2, VOR/ILS-1, and VOR/ILS-2), corresponding to the navigation system information to be displayed; a sixth position, INS, is available to the pilot in all aircraft and also to the copilot in BuNo 159348 and 159469.

POINTER SELECTOR SWITCHES. Pointer selector switches, located on the pilot's and copilot's instrument selector panels (figure 1-106) and on the navigator's instrument panel (figure 1-11) are provided to permit selection of the source of information to be displayed on radio magnetic indicators (rmi) or on bearing-distance-heading indicators (bdhi). The pilot and copilot can selectively direct VOR 1 or VOR 2 information on the No. 1 needle of the VOR/TAC rmi or VOR/TAC bdhi located on their respective instrument panels. The navigator can selectively direct TAC 1 or ADF 2 information to the No. 2 needle on his ADF/TAC rmi or ADF/TAC bdhi.

ADI (ATTITUDE DIRECTOR INDICATOR) SELECTOR SWITCH. The ADI selector switch (figure 1-106) is a two-position (NORMAL, PILOT REPEAT) toggle switch located on the copilot's instrument selector panel. When the ADI selector switch is placed in the PILOT REPEAT position during an ILS approach, the copilot's attitude director indicator displays the information being presented on the pilot's attitude director indicator. The copilot's ADI repeat indicator will illuminate when the ADI selector switch is placed in the PILOT REPEAT position, provided the pilot has selected VOR/ILS 1 or VOR/ILS 2 with the mode sel switch and an ILS frequency has been selected. The ADI repeat indicator receives power from the main dc bus through the No. 1 flt dir relay circuit breaker on the copilot's upper circuit breaker panel.

Selected NAV System Off Indicator.

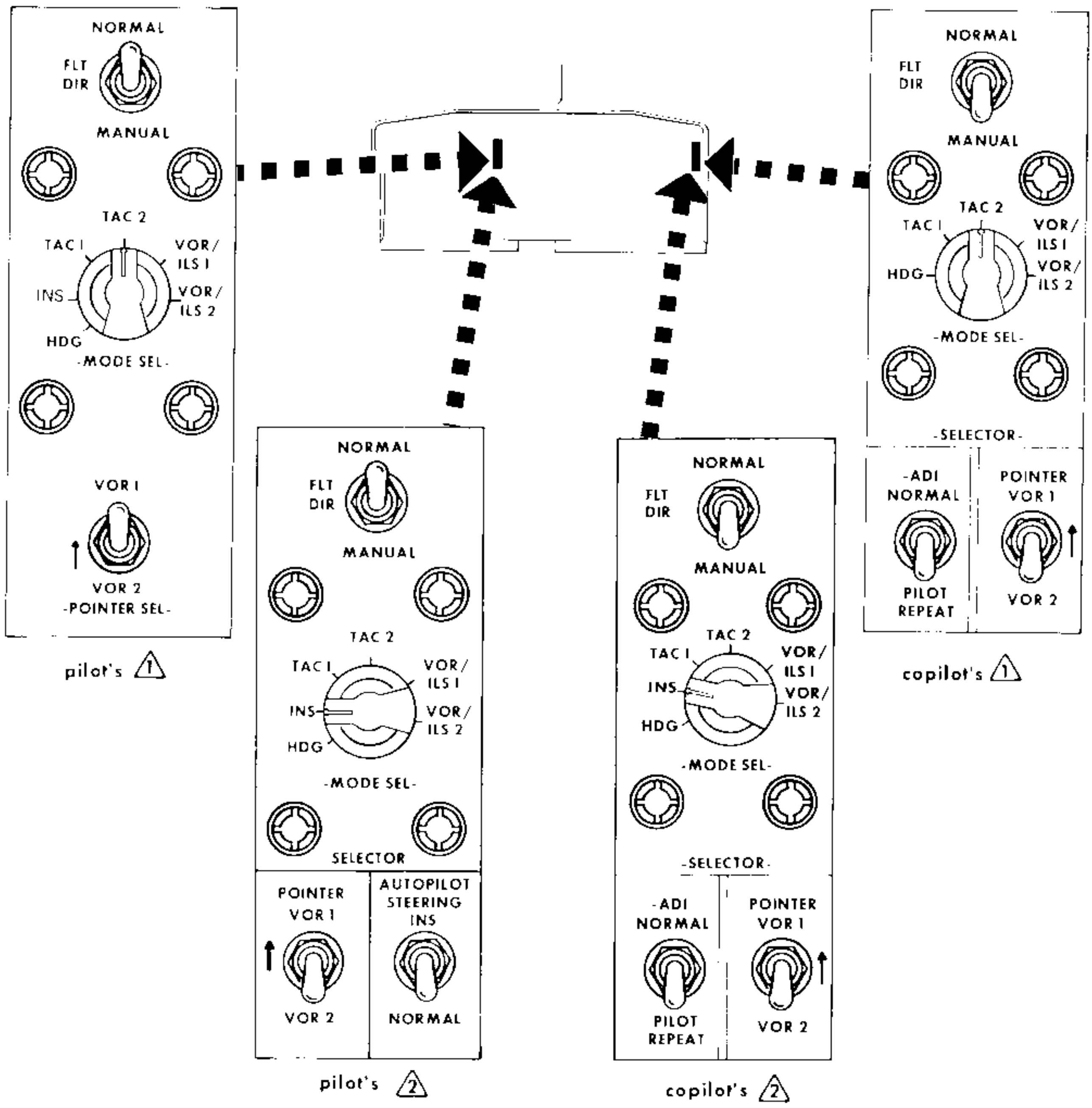
The selected nav system off indicator, located on the copilot's main instrument panel, will illuminate to indicate that the copilot's selection with the mode sel switch has been disconnected. Any selection made by the copilot, other than HDG, will be disconnected if the pilot selects the same mode of operation. The selected nav system off indicator is powered through the circuit breaker associated with the system selected by the pilot.

Mode Selector Operation.

In the following paragraphs, each position of the mode sel switch will be discussed with the flt dir switch in both the NORMAL and MANUAL positions, as applicable.

HDG (HEADING SELECTION). With the mode sel switch in HDG and the flt dir switch in NORMAL, the flight director computer operates in the auto nav mode. No radio aid is used in this mode, and the attitude director indicator operates as a basic attitude indicator. The horizontal situation indicator will function only as a compass repeater, with the range indicator connected to tacan. The course arrow is slaved to the respective compass heading signal, thus always pointing straight up. This gives a continuous digital indication of aircraft heading in the course selector window. By switching the flt dir switch to MANUAL, the flight director is in a manual heading mode. The horizontal situation indicator continues to operate as in auto nav, except that the heading set knob can be used to select a heading to fly as directed by the flight director computer on the bank steering bar of the attitude director indicator. The flight director computer combines heading error and bank angle so that a selected heading may be intercepted and maintained, by centering the bank steering bar and keeping it centered. The course warning flag remains out of view as long as the computer functions properly.

instrument selector control panels



NOTE

1. EC-130G AND EC-130Q BUNO 156170 THROUGH 156177.
2. EC-130Q BUNO 159348 AND 159467.

Figure 1-106.

Note

> The following paragraphs describe only the equipment. For normal operation, refer to TACAN, and VOR/ILS normal operating procedures in this section.

TAC 1 TAC 2 (TACAN) SELECTIONS. With the flt dir switch in NORMAL and the mode sel switch in TAC 1 or TAC 2, the assoicated flight director computer will be in the radio track mode, using information from the selected tacan system. Tune the tacan transceiver to the desired station. The course arrow on the associated horizontal situation indicator is set to the selected tacan radial to supply a course error signal to the flight director and to resolve the signals from the tacan receiver. The flight director combines the course error signal with course deviation and bank angle to drive the bank steering bar on the attitude director indicator so that an asymptotic intercept of the selected radial can be made and then maintained. The course warning flag remains out of view as long as the computer functions properly and is receiving valid information. All other pointers in the attitude director indicator remain out of view. Information displayed on the horizontal situation indicator consits of course deviation in degrees on the course deviation indicator, bearing to the selected tacan station on the bearing indicator, distance to the station on the range indicator, ambiguity on the to-from indicator, and heading. By switching the flt dir switch to MANUAL, the flight director computer selects the manual heading mode. The attitude director indicator will display steering information on the bank steering bar for a selected heading as set by the heading set knob on the horizontal situation indicator. The course warning flag remains out of view while a valid signal from the tacan set is maintained. The course set knob still controls the selection of the desired radial, and all other functions of the horizontal situation indicator remain the same as when the flt dir switch is in the NORMAL position.

VOR/ILS SELECTION. With the mode sel switch in VOR/ILS 1 or VOR/ILS 2 and the flt dir switch in NORMAL, the flight director will be in the radio track mode when the corresponding omni receiver is tuned to a VOR frequency. Information displayed on the horizontal situation indicator and the attitude director indicator is the same as described for tacan. When the flt dir switch is placed in the MANUAL position, the manual heading mode is selected by the flight director system, and the information displayed on the horizontal situation indicator and the attitude director indicator is the same as described for tacan. When an ILS frequency is selected, with the mode sel switch in VOR/ILS 1 or VOR/ILS 2 and the flt dir switch in NORMAL, the flight director computer selects the ILS mode, and the corresponding glideslope receiver is tuned to a frequency corresponding with the selected ILS frequency. The flight director now uses information from the localizer receiver. The course arrow on the horizontal situation indicator should be set to the inbound localizer course. The localizer course supplies the flt dir computer with a heading error signal that is combined with localizer deviation and bank angle to drive the bank steering bar on the attitude director indicator so that an intercept of the localizer beam can be made and maintained. The localizer warning flag remains out of view as long as valid information is being received and the flight director computer is functioning properly. The glideslope warning flag remains out of view as long as valid information is being received. The pitch steering bar remains out of view until the computer automatically switches to the ILS approach mode. No ambiguity or bearing information is available. When the flt dir switch is placed in MANUAL, the flt dir computer selects the ILS manual mode. The glideslope indicator continues to give glideslope information. The horizontal situation indicator display remains the same as described with the flt dir switch in the NORMAL position. The flight director computer will automatically switch from the ILS mode to the ILS approach mode when the aircraft is within approximately one needle width of the center of the glideslope while making an ILS approach from beneath the glideslope. On some airplanes it is possible to capture the glideslope from above or below. If the aircraft moves off the glidepath on localizer by approximately two dots (one dot on some aircrafts) the computer will automatically switch back to the ILS mode, and the pitch steering bar will disappear. On some aircraft it will be necessary to descend below the glideslope to reswitch the flight director automatically to the ILS approach mode and thereby regain the pitch steering bar. The flight director computer combines heading error, localizer deviation, and bank angle to drive the bank steering bar on the attitude director indicator. The flight director computer also combines glideslope deviation and pitch angle, which is displayed on the pitch steering bar as information to intercept and maintain the glideslope beam. The glideslope indicator and all information on the horizontal situation indicator continues to operate as in the ILS mode. If the flt dir switch is placed in the MANUAL position, the flight director computer goes into the ILS manual mode.

autopilot controls

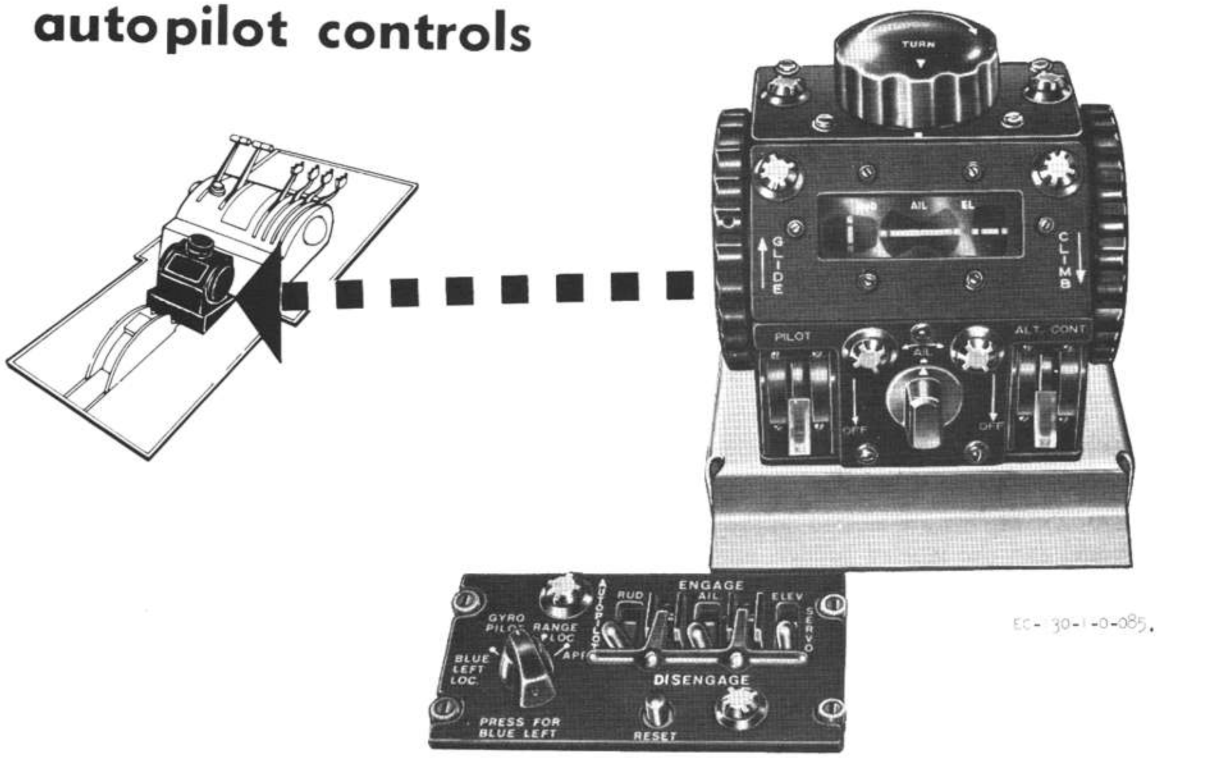


Figure 1-107.

INS SELECTION. With the mode sel switch in INS and the flt dir switch in NORMAL, the attitude director indicator operates as a basic attitude indicator. The horizontal situation indicator functions as a true heading reference if the INS is in the NAV mode, or as an INS platform reference in the ATT REF mode. The course arrow and course selector window indicate the INS desired track, and the course deviation indicator indicates aircraft position left or right of course. The MANUAL mode is not used in the INS mode selection.

AUTOPILOT.

The E-4 autopilot operates the flight control system of the aircraft to maintain normal stabilized attitude automatically. The autopilot also maintains any desired heading by using compass information from either the No. 1 or No. 2 heading reference system. The autopilot provides coordinated turn control, automatic elevator trim, constant-pressure altitude control, automatic VOR, and tacan tracking, and automatic ILS approach control for instrument landing system approaches. The autopilot is powered by 28-volt, dc power from the essential dc bus through circuit breakers on the copilot's lower circuit breaker panel and 115-volt, 400-cycle ac power from the essential ac bus through a circuit breaker on the pilot's upper circuit breaker panel.

Attitude Reference and Attitude Information

With the attitude reference switch in the normal mode (EC-130G/Q BuNo 156170 through 156177), the autopilot is provided heading and attitude information from the AHRS system. With the switch in the ALT mode, the C-12/N-1 compass system provides heading information and the K-6 gyro provides attitude information to the autopilot. In the INS (NORM for EC-130Q BuNo 159348 and 159469) mode, with the flight director switch in the INS position, the autopilot is provided heading and attitude information by the inertial navigation system.

AUTOPILOT CONTROLS.

The autopilot controls (figure 1-107) are located on the autopilot controller and the autopilot control panel on the flight control pedestal.

Pilot Switch.

A pilot switch on the autopilot controller (figure 1-107) controls the power to the electronic circuits of the autopilot.

Servo Engaging Switches.

There are three engaging switches for the autopilot (figure 1-107). These two-position (ENGAGE, DISENGAGE) switches are located on the autopilot control panel and are labeled rudder, aileron, and elevator. The ENGAGE position of the switches provides individual engaging of the rudder, aileron, elevator, and elevator trim tab servo controls.

Pitch Control Knob.

Two pitch control knobs, one on each side of the autopilot controller (figure 1-107), are mounted on a common shaft and control climb and glide. Forward rotation of the knobs gives nose down; aft rotation gives nose up. The climb or glide angle is proportional to the amount of rotation of the pitch control knobs.

Turn Control Knob.

A turn control knob, located on top of the autopilot controller (figure 1-107), provides for coordinated turns at all airspeeds. A climbing or descending turn can be made by using the pitch and turn knobs simultaneously. The turn control knob is left in the centered (detent) position at all times except when being used to maneuver the aircraft.

Aileron Trim Knob.

An aileron trim knob, lcoated on the autopilot controller (figure 1-107), is used to make minor corrections should a wing-low attitude occur when the aileron servo is engaged.

Altitude Control Switch.

A two-position (OFF, ON) altitude control switch is located on the autopilot controller (figure 1-107). Placing the switch in the ON position disengages the pitch control knob and engages a barometric pressure control unit, which then controls the elevator servomotor and the elevator trim tab control to maintain, a constant pressure altitude flight.

CAUTION

Do not engage the altitude control if the vertical velocity indicator gives an indication of ascent or descent greater than 300 feet per minute.

Autopilot Release Button.

A release button is installed on both the pilot's and copilot's control wheels. Pressing either of these pushbutton switches releases the pilot switch and the altitude control switch, allowing them to return to the OFF position; and it releases the engaging switches, allowing them to return to the DISENGAGED position.

Radio Beam Coupler Switch.

A four-position (BLUE LEFT-LOC, GYRO PILOT, RANGE-LOC APPROACH) radio beam couplers switch located on the autopilot control panel (figure 1-108) coordinates signals from the localizer and VOR receiver, the glideslope receiver, and the tacan receiver with the autopilot. The first switch position, BLUE LEFT-LOC, connects the localizer and VOR receiver to the autopilot for flying inboard on the back course of the localizer or outbound on the localizer beam. The switch must be depressed before it can be turned left to this position. The second position, GYRO PILOT, is used during all operations not involving the use of radio signals. With the switch in this position, the aircraft is kept straight and level by the gyros, unless maneuvered by means of the autopilot controller. The third switch position, RANGE LOC, connects the localizer and VOR receiver to the autopilot for normal localizer beam bracketing or when flying VOR or tacan courses. The fourth switch position, APPROACH, connects the localizer and VOR receiver and the glide slope receiver to the autopilot to control both azimuth direction of the aircraft and descent angle on final approach.

AUTOPILOT INDICATORS.

Autopilot indicators are provided to monitor the operation of the autopilot and warn of malfunction.

Trim Indicators.

The autopilot controller includes three trim indicators, labeled RUD (rudder), AIL (aileron) and EL (elevator). Average meter deflection away from zero, on the rudder and aileron indicators, is evidence that the aircraft is improperly trimmed and that an unnecessary load is being imposed on the servo system. The elevator indicator should show an average deflection of zero at all times, as the elevator trim tab is controlled by the autopilot in this installation.

Autopilot OFF Light.

The autopilot OFF light can be extinguished by pressing the reset button on the autopilot control panel. The aircraft is protected against possible malfunction of the autopilot by a system of circuit breakers and interlocking relays. Circuit overloads which could affect the operation of the autopilot will immediately cause the pilot switch to return to and lock in the OFF position. At the same time, the autopilot off light on the pilot's instrument panel will flash on and off to warn the pilot that the autopilot is no longer functioning. This light will also flash on and off when the pilot switch has been in the ON position and, either intentionally or unintentionally, is placed in the OFF position.

Beam Coupler OFF Light.

The beam coupler off light (figure 1-89) illuminates whenever the beam guidance coupler unit is inoperative and the radio beam coupler switch is in a position other than GYRO PILOT. The light does not indicate malfunctioning of a receiver or transmitter.

OPERATIONAL CHECKOUT OF THE AUTOPILOT.

When autopilot use is anticipated, perform the following operational check:

1. Check that the radio beam coupler switch is in the GYRO PILOT position and the pilot control switch is in the OFF position.

Note

With the pilot switch OFF, the servo engage switches should be in the DISENGAGED position and the altitude control switch should be in the OFF position. If they are not, a malfunction is indicated.

2. Check that the turn knob and aileron trim knob are centered and that the elevator tab power selector switch is in the NORMAL position.

Note

Placing the elevator tab power selector switch to NORMAL, directs power to the elevator servo control. The elevator servo is rendered inoperative if the elevator tab power selector switch is positioned to OFF or EMERGENCY.

3. Place the pilot switch in the ON position.

4. Check that the trim indicators on the pedestal controller are centered.

5. Place the servo engaging switches to the ENGAGE position.

6. Rotate the pitch knob forward and aft. The control columns should move forward and aft, and a deflection should be indicated on the elevator trim indicator.

7. Rotate the aileron knob to the left and right. The control wheels should turn to the left and right, and a deflection should be indicated on the aileron trim indicator located on the autopilot controller.

CAUTION

In the following checks, hold the control wheel and rudder pedals to cushion movement against limit stops. Accomplish the checks as rapidly as possible to avoid prolonged servo effort and possible overheating.

8. Rotate the turn knob to the left and right approximately 45 degrees. The control wheels should turn to the left and right, the rudder pedals should move slowly in the direction of the turn; and a deflection should be indicated in the rudder trim indicator located on the autopilot controller.

9. Place the altitude control switch to the ON position and rotate the pitch knob. The control columns should not move.

10. Push either the pilot's or copilot's release switch. The pilot switch should trip to OFF, the altitude control switch should trip to OFF, the servo engaging switches should trip to DISENGAGE, and the autopilot light should start flashing.

11. Push the autopilot reset button to extinguish the autopilot OFF light.

NORMAL OPERATION OF THE AUTOPILOT.

To place the autopilot in operation:

CAUTION

Do not operate the autopilot system at airspeeds in excess of 250 KIAS or aircraft airspeed limits, whichever is lower. Prior to engaging the autopilot, ensure that the aircraft is properly trimmed. Prior to disengaging any autopilot axis, maintain firm control of control wheel and rudder pedals. Failure to do so may result in an abrupt maneuver if an out of trim condition exists during disengagement.

1. Check that the pilot switch is in the OFF position.

Note

With the pilot switch OFF, the servo engage switches should be in the DISENGAGED position and the altitude control switch should be in the OFF position. If they are not a malfunction is indicated.

2. Check that the turn control knob is in the detent.

3. Check that the elevator tab power selector switch is in the normal position.

Note

Moving the elevator tab power selector switch from the NORMAL position renders pitch control inoperative.

4. Place the radio beam coupler switch in the GYRO PILOT position.

WARNING

Do not have the autopilot engaged below 1,000 feet above the terrain. The only exception allowed is for automatic ILS approach control. During the time of operational mode the controls shall be closely monitored. Failure to immediately recognize a pitch axis malfunction may result in a 1,000 foot altitude loss before completion of recovery with a two-G maneuver effectivity.

Note

The radio beam coupler switch should be in the GYRO PILOT position during all flights when the autopilot is not using radio signals. If the switch is accidently left in another position and VOR or localizer signal is intercepted, an undesirable maneuver may result.

5. For the N-1 Compass check that the selected heading reference system is operating and that the latitude control knob is in the OFF position. If the selected heading reference system is not operating, the rudder servo engaging switch will be locked in the DISENGAGED position by the autopilot interlock circuit. With this axis disengaged, the autopilot will not maintain a heading.

6. Trim the aircraft for hands-off flight. An improperly trimmed aircraft imposes an unnecessary load on the autopilot servomotors.

CAUTION

An improperly trimmed aircraft imposes an unnecessary load on the autopilot servomotors and may result in excessive maneuvers or structural loads in the event of a hardover malfunction. When making substantial changes in airspeed (20 to 30 knots) or airplane configuration, disengage the autopilot and retrim the airplane at the desired airspeed before re-engaging the autopilot. This will also avoid the gain or loss in altitude which results when airspeed is changed while the autopilot is engaged and the altitude control is on. The elevator trim switches are inoperative when the autopilot is engaged.

7. Place the pilot switch in the ON position.

Note

Check that the trim indicators on the autopilot controller indicate an average signal of zero before placing the engaging switches in the ENGAGE Position. A permanent deflection of any one of the meters indicates that the automatic synchronization is not functioning and that the servo for that axis should not be engaged.

Note

Engaging a servomotor for an axis with an out-of-trim condition may result in an abrupt maneuver.

8. Move the engaging switches to the ENGAGED position.

WARNING

During normal operation do not attempt to overpower or assist autopilot pitch control through use of the control column. To do so will cause the autopilot to oppose pilot input with elevator trim causing an adverse out-of-trim condition. If the autopilot is disconnected while in this condition, a violent pitch maneuver may result with possible structural damage. Do not operate with the autopilot engaged at gross weights above 155,000 pounds or above the maximum normal take-off weight (not overload) whichever is lower.

Note

Do not engage the autopilot when in a turn or just after a prolonged turn.

Note

Continually monitor the autopilot trim indicators during normal autopilot operation to ensure that the aircraft is properly trimmed. If a sustained out-of-trim condition is observed, disengage the appropriate autopilot axis, retrim the aircraft, re-engage the autopilot axis.

The aircraft is now under automatic control about all three axes. Any axis may be controlled manually by placing the engaging switch for that axis in the DISENGAGED position. Standard maneuvers may be executed with the pitch and turn knobs. However the autopilot should not exceed 39° angle bank.

In recovering from a turn, return the turn knob to the detent slowly. Returning the turn knob to the detent too quickly will result in a control overshoot and then stabilizing in a wing-low attitude.

Note

To preclude loss of altitude, do not exceed a bank angle of 39°.

CAUTION

To prevent possible structural damage to the vertical stabilizer in case a maximum rudder deflection signal occurs above 210 KIAS as a result of an autopilot malfunction, disengage the autopilot and do not immediately apply corrective rudder.

Automatic flight may be discontinued at any time by pressing the pilot's or copilot's autopilot release button, by placing the servo engaging switches in the DISENGAGED position, or by placing the pilot switch in the OFF position.

RADIO BEAM COUPLER EQUIPMENT.

The radio beam coupler equipment operates with the autopilot to provide automatic flight on ILS, VOR, and Tacan courses or to guide the aircraft on localizer and glidepath beams. The radio beam coupler amplifies and modifies signals received by the ILS, VOR, or tacan receivers, and supplies the modified signals to the autopilot to guide the aircraft on the selected course. The various functions of the radio beam coupler are connected to the autopilot by the radio beam coupler switch. The autopilot must be in operation for the radio beam coupler to function. The radio beam coupler is powered through the autopilot circuit breakers.

OPERATION OF THE RADIO BEAM COUPLER EQUIPMENT.

By radio signals received from the localizer and VOR or Tacan receiver and the glideslope receiver, and heading information from the AHRS the radio beam coupler controls the autopilot to accomplish automatic range flight or automatic approaches.

VOR and Tacan Operation.

To accomplish automatic flight on a VOR radial or tacan course:

1. Place the autopilot in operation.

2. Tune the Tacan or VOR receiver to the desired frequency.

3. Turn pilot's mode sel switch to desired system.

4. Set the desired course on the pilot's horizontal situation indicator.

5. Turn the radio beam coupler switch to the RANGE-LOC position.

If the aircraft is not on the selected course, the autopilot will turn the aircraft to approximately a 60-degree intercept heading. When the selected course is reached, the autopilot will turn the aircraft to bracket the course. After course interception and bracketing, the autopilot, through the beam coupler, will fly the aircraft along the selected course. When the "zone of confusion" over the station is reached, a sensor circuit cuts out coupler response to the erratic beam signal and provides smooth straight flight on a course that is dictated by gyro reference and corrected heading information. Upon reaching the far side of the "zone of confusion," the radio beam coupler smoothly reestablishes beam signal control. Within the "zone of confusion," course changes up to 30 degrees may be accomplished by selecting a new radial on the horizontal situation indicator. Between stations, course changes up to 5 degrees may be accomplished in the same manner. If larger course changes are required, it is necessary to re-cycle the radio beam coupler switch to the GYRO PILOT position after selecting the new course to re-establish the initial bracket coupler configuration; then the radio beam coupler switch should be returned to the RANGE-LOC position.

Automatic Approach.

To accomplish an automatic approach to an instrument landing facility:

1. Place the autopilot in operation.

2. Tune the localizer receiver to the desired frequency.

3. Set in the published localizer course using the HSI course set knob.

4. Establish an intercept course, up to 60 degrees, to the localizer beam.

Note

Interception must take place beyond the outer marker and below the glide path (EC-130G).

5. Turn the radio beam coupler switch to the RANGE-LOC position. The autopilot will fly the aircraft on the intercept heading and turn onto the localizer beam upon interception.

6. Turn the radio beam coupler switch to the APPROACH position when the localizer heading is established. When the glideslope is intercepted, the altitude control switch will go to the OFF position, and the aircraft will begin a descent down the glidepath.

Note

The beam guidance coupler is not out automatically in the "zone of confusion" over the localizer transmitter when making an ILS approach or when flying inbound on the back beam. The radio beam coupler system is not ar automatic landing system. Under all conditions, automatic control should be discontinued at a safe altitude and the landing completed manually. All operations of the radio beam coupling equipment can and should be monitored on the attitude-director indicators.

ATTITUDE HEADING REFERENCE SYSTEM (AHRS) (AF/A24G-1A EC-130G AND EC-130Q BUNO 156170 THROUGH 156177).

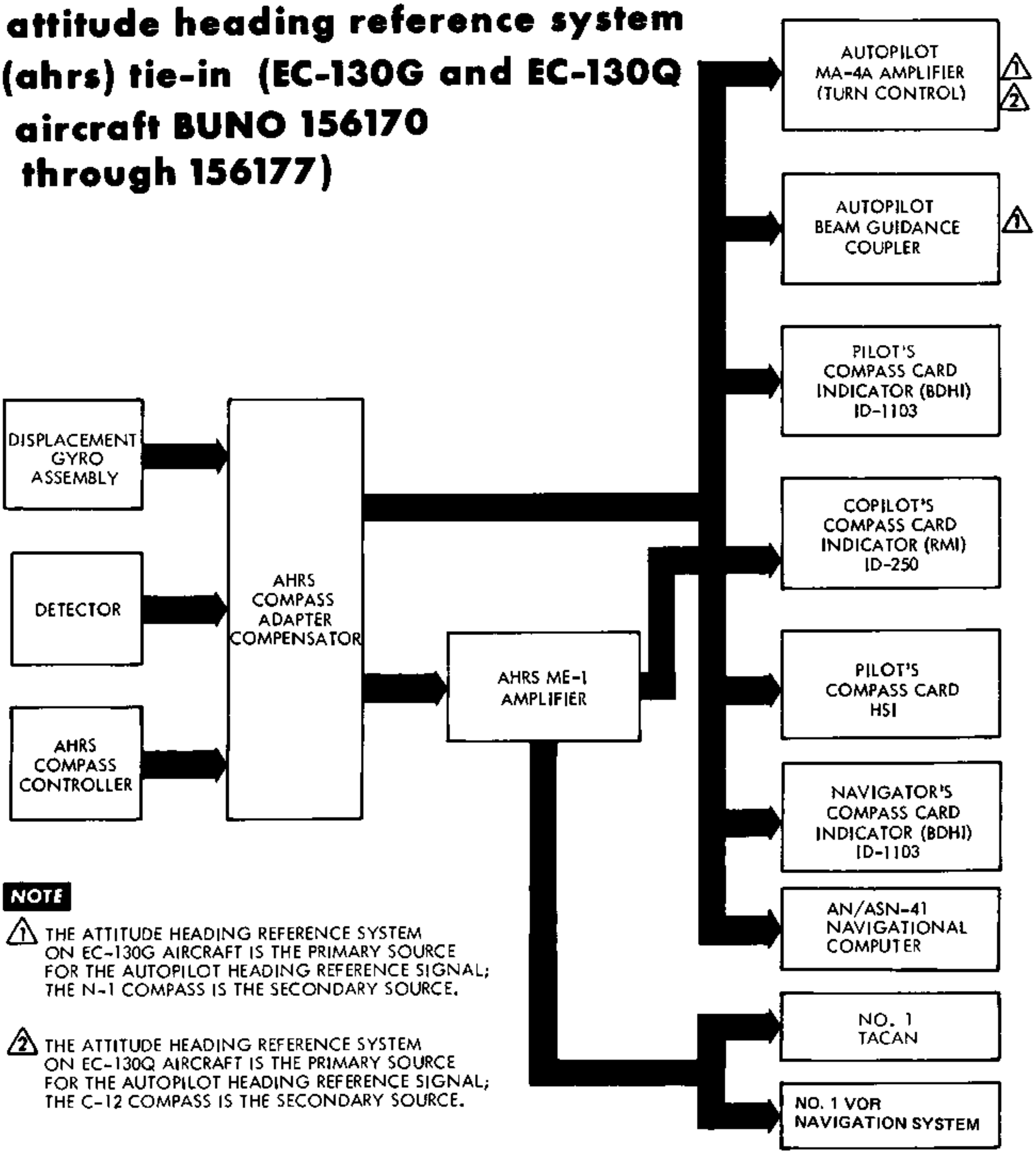
The AHRS system provides an attitude and azimuth reference for the flight and navigation systems. The system consists of a gyroscopic platform with complete freedom in three axes (pitch, roll, and azimuth), and associated controls and electronic equipment to provide pitch, roll, and heading outputs to the applicable aircraft systems. The system has two modes of operation, slaved and directional gyro. In the slaved mode the system operates as a magnetic compass, receiving signals from a detector (remote compass transmitter) in the right wing tip. In the directional gyro mode, the system operates as a latitude corrected directional gyro using an arbitrary gyro heading reference selected by the navigator. The system is the primary source for pitch and roll signal outputs to the autopilot and pilot's ADI and, in addition, provides antenna stabilization signals for the Doppler radar antenna. The AHRS also provides heading outputs to various systems and indicator compass cards. Figure 1-108 shows aircraft system tie-ins to the AHRS. A compass controller mounted on the navigator's control panel provides all the controls necessary for operation of the AHRS. The AHRS receives 115-volt, phase A power, from the essential ac bus through the attd hdg ref sys ME-1 amp circuit breaker and 115-volt, 3-phase power from the essential ac bus through the attd hdg ref sys circuit breakers on the pilot's side circuit breaker panel. The system also receives 28-volt dc power from the essential dc bus through the essential dc attd hdg ref sys circuit breaker on the pilot's side circuit breaker panel.

AHRS CONTROLS.

All controls for operation of the AHRS are on the compass controller (figure 1-109) at the navigator's station.

COMPASS CONTROLLER (EC-130G AIRCRAFT). A two-position (SLAVED, DG) rotary function selector switch on the controller selects the operating mode of the system. A rotary push-to-turn set hdg switch, spring-loaded to the center position, allows the operator to manually synchronize the system when operating in the slaved mode or to manually set the system heading when in the DG mode. When operating in the slaved mode a sync indicator on the controller shows if the system is in synchronization or not. The system is synchronized if the indicator needle is centered. A needle deflection toward + or - indicates that the system is not synchronized, and

attitude heading reference system (ahrs) tie-in (EC-130G and EC-130Q aircraft BUNO 156170 through 156177)



NOTE

1. THE ATTITUDE HEADING REFERENCE SYSTEM ON EC-130G AIRCRAFT IS THE PRIMARY SOURCE FOR THE AUTOPILOT HEADING REFERENCE SIGNAL; THE N-1 COMPASS IS THE SECONDARY SOURCE.

2. THE ATTITUDE HEADING REFERENCE SYSTEM ON EC-130Q AIRCRAFT IS THE PRIMARY SOURCE FOR THE AUTOPILOT HEADING REFERENCE SIGNAL; THE C-12 COMPASS IS THE SECONDARY SOURCE.

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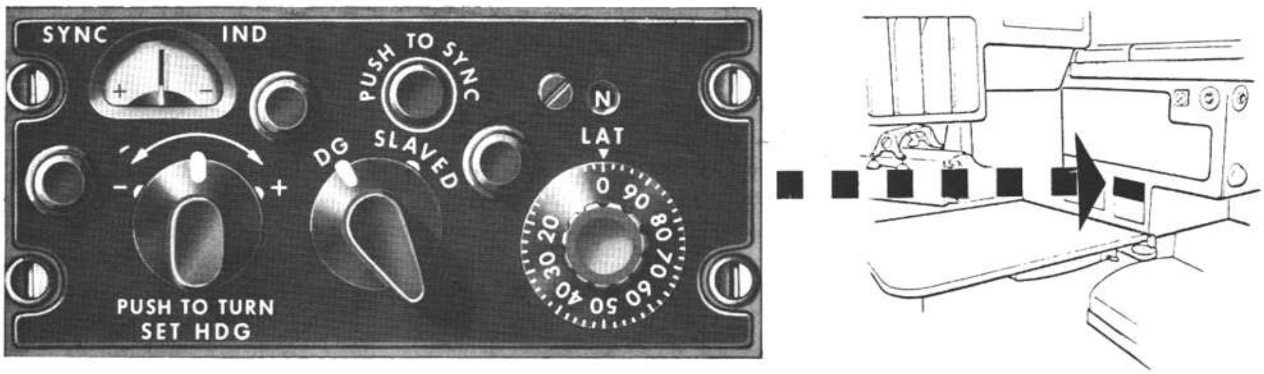
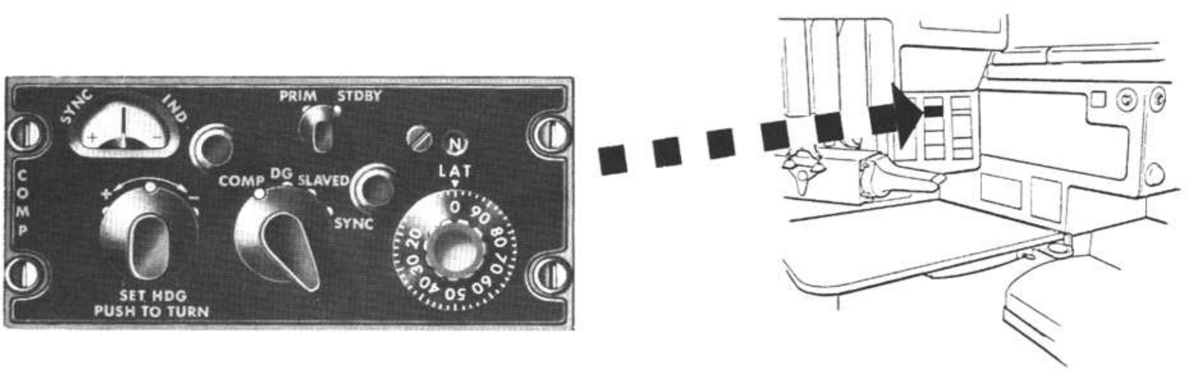
Figure 1-108.

compass controller panel



(EC-130G aircraft)



(EC-130Q aircraft BUNO 156170 through 156177)

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Figure 1-109.

shows the direction that the set hdg switch must be rotated (+ or -) to bring the system into synchronization. A push-to-sync pushbutton switch provides a means for initiating fast synchronization of the system while in the slaved mode. Fast synchronization is initiated by depressing and holding the pushbutton. When released, automatic synchronizing circuits maintain synchronization of the system. When either the set hdg switch or the push-to-sync pushbutton is operated or switched from DG to SLAVED, the autopilot heading signals are decoupled from the autopilot system. Latitude correction controls are also provided on the controller. These controls manually correct the system for apparent gyro drift due to the earth's rotation when operating in the DG mode. The latitude correction controls consist of a manually set dial control and a screwdriver-type slotted hemisphere switch. The dial control is marked from 0 to 90 degrees in 2-degree increments, with major increments marked at 10-degree intervals. The aircrafts present position latitude is set under the LAT index mark. The selection north or south hemisphere is made by setting the screwdrive-type hemisphere switch to N or S, whichever is applicable.

COMPASS CONTROLLER (EC-130Q AIRCRAFT). The compass controller on the EC-130Q aircraft functions essentially the same as that on the EC-130G aircraft, with the following exceptions:

The push to sync button is replaced by a SYNC position on the function selector switch.

The function selector switch has a fourth position (COMP) added, to allow the AHRS system to be slaved to the output of the navigational computer.

NORMAL OPERATION OF THE AHRS.

The AHRS operates whenever ac and dc power is available, but should be allowed about 5 minutes warmup before use. Operation of the system is controlled by the navigator as follows:

SLAVED OPERATION. For operation of the system in the slaved mode proceed as follows:

1. Place the function selector switch in the SLAVED position.

2. Observing the sync indicator, check that system is synochronized. The sync indicator's needle will be centered if the system is synchronized.

3. The system may be synchronized either by operation of the set hdg switch or by operation of the push-to-sync pushbutton. If the sync indicator's needle is deflected toward +, rotating the set hdg switch toward the + direction will manually synchronize the system. If the needle is deflected toward -, rotating the set hdg switch toward - will synchronize the system. Depressing the push-to-sync pushbutton will afford fast synchronization of the system. The pushbutton should be held depressed until the sync indicator's needle is centered.

4. Check heading shown on the navigator's VOR-TAC bearing-distance-heading indicator (figure 1-11) compass card with that shown on the pilot's standby compass to assure that the system synchronization was not attempted on the heading which is 180 degrees from the correct heading. Once the system is correctly synchronized, the compass cards of indicators supplied by the AHRS will continuously indicate the magnetic heading of the aircraft. During autopilot operation, the system will hold the aircraft on a constant magnetic heading.

Note

> When on autopilot, during slaved operation, rotation of the set hdg switch from the synchronized position will cause the rudder channel to disengage.

DIRECTIONAL GYRO OPERATION. For operation of the system in the directional gyro mode proceed as follows:

1. Place the latitude correction hemisphere switch in the N or S position, as applicable.

2. Rotating the latitude correction dial control set the aircraft's present position latitude under the LAT index mark. As the aircraft changes latitude in flight, the latitude correction dial control should be reset (at approximately 2-degree intervals) to the new latitude.

3. Place the function selector switch in the DG position.

4. Rotating the push-to-turn set hdg switch set the desired gyro heading on the navigator's VOR-TAC bearing-distance-heading indicator's compass card. The gyro reference datum is not referenced to a

geographical coordinate system, and if a constant heading is flown, the path of the aircraft will be a great circle course under a no-wind condition.

Note

> During directional gyro operation, repositioning the compass card with the set hdg switch will cause a change in the heading datum, and will disengage the rudder channel.

FAILURE OF AHRS HEADING INFORMATION. Presentations and operations of the AHRS orientated displays or equipment existing with the failure of the heading information from the attitude heading reference system are as follows:

Pilot's Indicators.

The pilot will not have VOR-1 or TAC-1 presentation on the ID-1103, but VOR-2 can be selected on pointer No. 1. The ID-250 presentation will be normal. The ID-1103 and ID-250 compass cards will be normal (EC-130G only; only ID-250 will be operative in the EC-130Q). The compass card on the HSI will be inoperative and VOR-1 or TAC-1 bearing will not be available; however, VOR-2 and TAC-2 bearing may be selected. The VOR-2 and TAC-2 bearing will indicate the station position relative to the HSI lubber line (which would represent the aircraft nose) and may still be used to navigate to the station.

Copilot's Indicators.

The copilot's ID-1103 and ID-250 compass cards will be inoperative. VOR-1 or TAC-1 bearing will not be available on the ID-1103 or the HSI. VOR-2 and TAC-2 bearing will be displayed on the ID-1103 No. 1 and No. 2 pointers and can be selected on the HSI. The HSI compass card will be normal. The ID-1103 pointers will indicate the station bearing relative to the lubber line (aircraft nose). The ID-250 pointers will indicate ADF station bearing relative to the lubber line.

Navigator's Instruments.

The left ID-1103 will not have TAC-1 bearing information available on the No. 2 pointer. The compass card will be normal.

The right ID-1103 compass card will be inoperative and VOR-1 information will not be available. VOR-2 or TAC-2 bearing relative to the lubber line may be displayed on pointer No. 2.

Autopilot.

The autopilot cannot be used to fly a radio course but can be used in the approach and gyropilot modes. In the gyropilot mode, the vertical reference switch should be placed to ALT prior to autopilot engagement.

Flight Director.

Steering information on the pilot's ADI will not be available.

N-1 COMPASS SYSTEM (EC-130G AIRCRAFT).

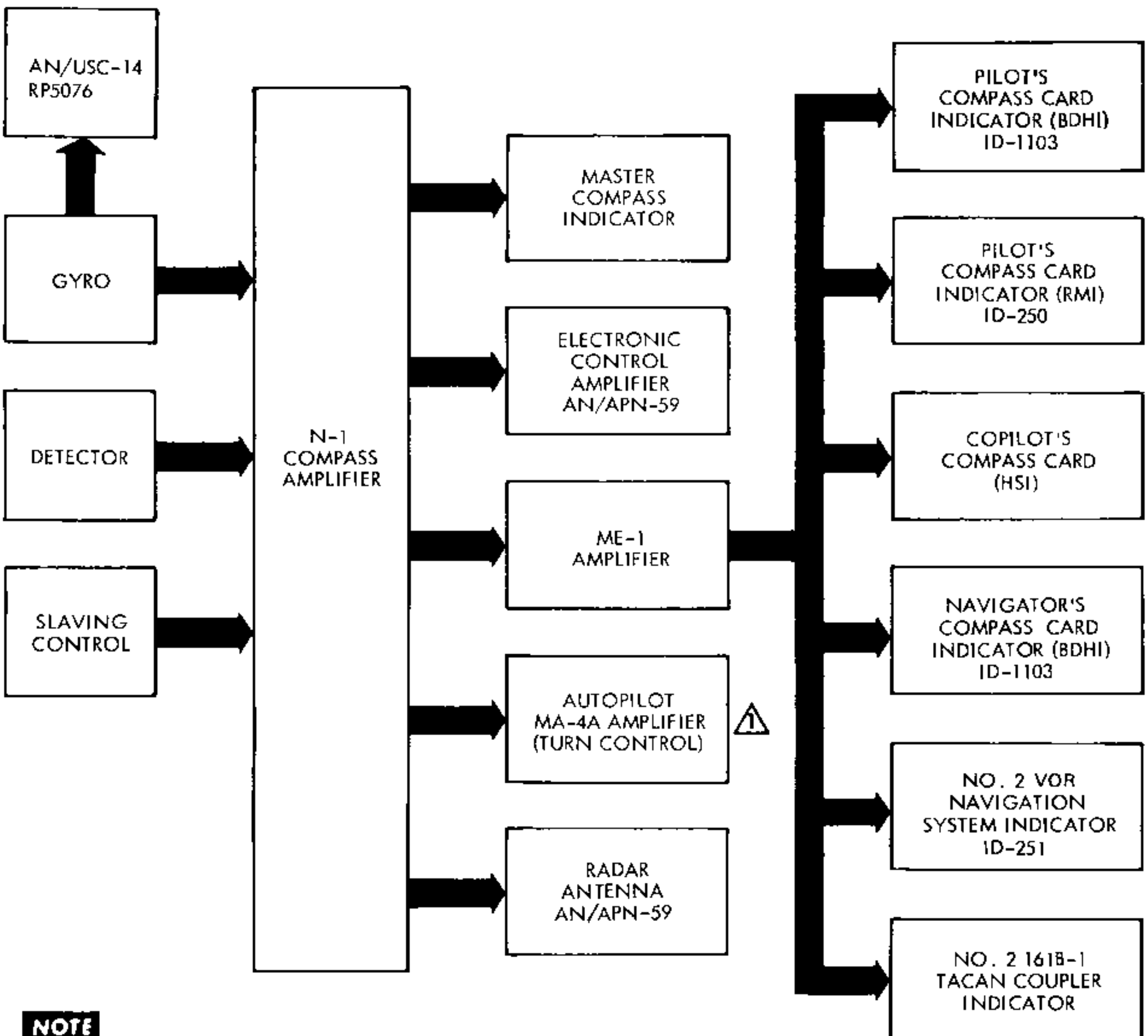
The N-1 compass system is designed for use at all latitudes. The system has two modes of operation, magnetic-slaved and directional gyro. In the magnetic-slaved mode, the directional gyro receives signals from the remotely located magnetic compass, and this stabilized magnetic indication is presented on the indicators. Magnetic-slaved operation may be used in any locality except near the magnetic poles or areas of severe magnetic disturbance. In directional gyro operation, the system uses an arbitrary gyro heading reference selected by the navigator. The directional gyro, which may be used in any latitude, is especially useful where the magnetic field is weak or distorted, or when used for grid navigation in the polar regions. The compass system supplies directional reference information to the pilot's VOR/TAC rmi or VOR/TAC BDHI and the copilot's hsi. A master indicator, incorporating the controls for the compass system is installed on the navigator's instrument panel. The compass system receives 28 volt, dc power from the essential dc bus through an N-1 compass circuit breaker on the copilot's lower circuit breaker panel, and 115-volt, three-phase, ac power from the essential ac bus through the ac instrument transformer, and 115-volt, single-phase, ac power from the essential ac bus through the N-1 compass circuit breakers on the pilot's upper circuit breaker panel. See figure 1-110 for N-1 compass system tie-in.

N-1 COMPASS SYSTEM CONTROLS.

The controls for the N-1 compass system are located on the master indicator at the navigator's station.

LATITUDE CORRECTION KNOB. A latitude correction knob is located on the upper right side of the master indicator (figure 1-111). Turning this knob

N-1 compass system tie-in
(EC-130G aircraft)



NOTE

1. THE N-1 COMPASS IS THE SECONDARY SOURCE FOR THE AUTOPILOT HEADING REFERENCE SIGNAL; THE ATTITUDE HEADING REFERENCE SYSTEM IS THE PRIMARY SOURCE.

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EC130-1-X0/7-344

Figure 1-110.

N-1 master compass indicators (EC-130G aircraft)

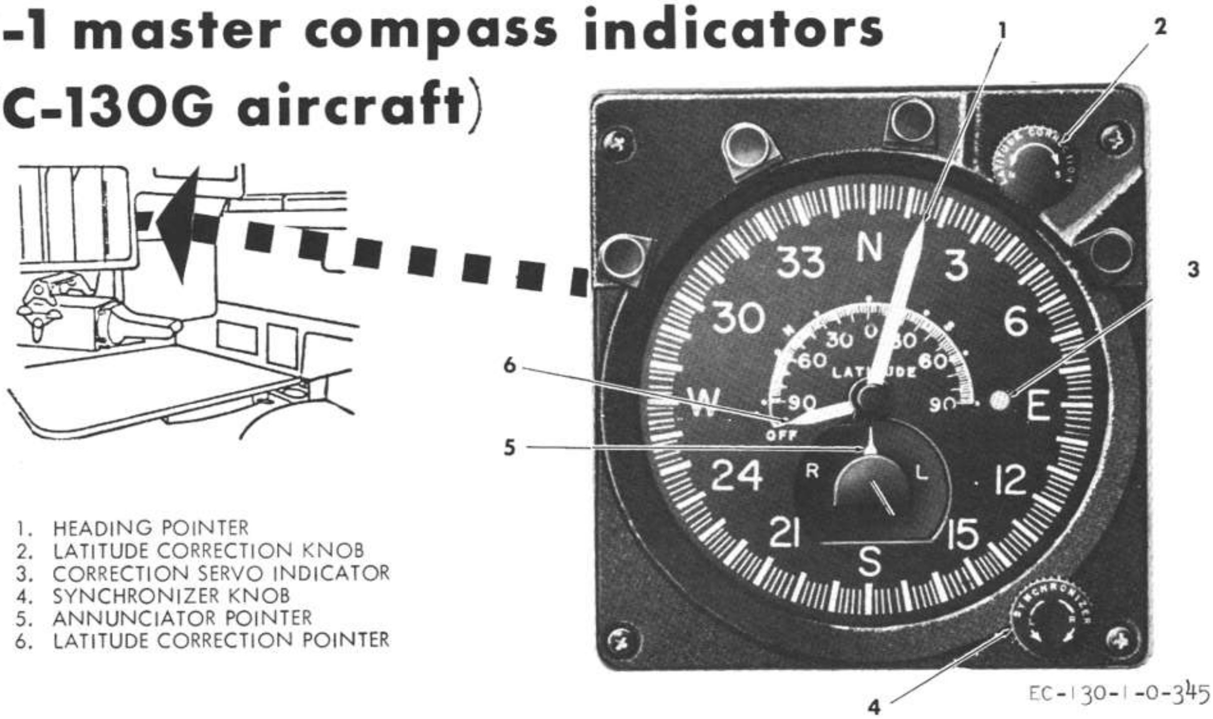


Figure 1-111.

positions the latitude correction pointer and latitude correction mechanism. Latitude correction compensates for the apparent drift of the gyro, due to rotation of the earth, while the system is in the directional gyro mode. In addition, the correction knob is the control switch which selects the mode of operation. When turned so that the latitude correction pointer is in the OFF position, the system is in the magnetic-slaved mode of operation. When turned so that the latitude correction pointer is anywhere on the latitude scale, the system is in the directional gyro mode.

SYNCHRONIZER KNOB. A synchronizer knob is located on the lower right side of the master indicator. Turning this control knob manually synchronizes the master indicator heading pointer with the correct magnetic heading when the system is in the magnetic slaved operation. In addition, the synchronizer knob provides a means of setting the master indicator heading pointer on the desired gyro heading reference when the system is in directional gyro operation. The annunciator pointer is located below the latitude correction pointer. This annunciator pointer indicates the direction in which to rotate the master indicator heading pointer to accomplish synchronization.

CORRECTION SERVO INDICATOR. This servo indicator intermittently displays a white dot to indicate that a correction is being supplied to the system. During magnetic-slaved operation, the system receives corrections because of apparent changes in the earth's magnetic field; and, during directional gyro operation, corrections are for apparent gyroscopic precession.

N-1 COMPASS SYSTEM INDICATOR.

The master indicator for the N-1 compass system presents directional information to the navigator.

MASTER INDICATOR. The master indicator, located on the navigator's instrument panel, provides control for the N-1 system and operational modes. The heading pointer and scale indicate the magnetic heading of the aircraft when the system is in magnetic-slaved operation, and they give the aircraft heading reference to the preselected gyro heading datum when the system is in directional gyro operation.

Note

> Erratic movement or oscillation of the heading pointer indicates a malfunction in the N-1 compass system, and that the master indicator cannot be relied

upon. Disengage the autopilot rudder axis if the autopilot is to be used.

A latitude correction scale has OFF and 90° N through 0° to 90° S markings, graduated in 2-degree increments. When the latitude correction pointer indicates OFF, the system is operating as a magnetic-slaved compass system. When the pointer is anywhere on the latitude scale, the system is operating in the directional gyro mode. The latitude indicated is the latitude for which correction is applied to the heading pointer due to apparent drift of the gyro. An annunciator scale and pointer indicate the direction in which to rotate the heading pointer to synchronize the system while in magnetic-slaved operation. The heading is synchronized when the annunciator is on the center index mark.

N-1 COMPASS SYSTEM FAILURE.

FAILURE OF N-1 COMPASS HEADING INFORMATION. Presentations and operations of the N-1 compass orientated displays or equipment existing with the failure of the N-1 compass heading information are as follows:

Pilot's Indicators.

The pilot's ID-1103 and ID-250 compass cards will be inoperative and VOR-2 information will not be available on the ID-1103 No. 1 pointer. VOR-1 and TAC-1 bearings relative to the lubber line will be displayed on the ID-1103 No. 1 and No. 2 pointers. ADF and UHF/DF bearings relative to the lubber line will be displayed on the ID-250. The HSI will be normal except VOR-2 information will not be available.

Copilot's Indicators.

The copilot's ID-1103 will not have VOR-2 or TAC-2 bearing information available, but VOR-1 bearing will be displayed on the No. 1 pointer. The ID-250 will be normal. The ID-1103 and ID-250 compass cards will be normal. Ths HSI compass card will be inoperative and VOR-2 and TAC-2 bearing information will not be available. VOR-1 and TAC-1 bearing relative to the lubber line can be selected.

Navigator's Indicators.

The left ID-1103 compass card will be inoperative. TAC-1 and ADF bearing relative to the lubber line will be displayed.

The right ID-1103 will not have VOR-2 or TAC-2 information available, but VOR-1 information will be displayed on the No. 1 pointer. The compass card will be normal.

Autopilot.

The autopilot can be used in all modes; however, the vertical reference switch must be placed to NORMAL when using the gyropilot mode.

Flight Director.

Steering information on the copilot's ADI will not be available.

APN-59 Radar.

The indicator displays will not be positioned with heading information in the REL bearing switch position.

NORMAL OPERATION OF THE N-1 COMPASS SYSTEM.

The N-1 compass system operates whenever ac and dc power is available, but it should be allowed about 10 minutes warmup before use. Operation of the N-1 compass system is controlled by the navigator, using the procedures which follow.

MAGNETIC-SLAVED OPERATION. For magnetic-slaved operation, proceed as follows:

1. Rotate the latitude-correction knob until the latitude-correction pointer reads OFF.

Note

> The system should be synchronized before use as a magnetic-slaved compass, since aircraft movement on the ground without power may cause the system to be out of synchronization. The system will automatically synchronize itself, but only at a slow rate which may consume a large amount of time if far out of synchronization. Manual synchronization greatly lessens the amount of time required.

2. Synchronize the master indicator by engaging and rotating the synchronizer knob until the annunciator pointer is on the center index. The synchronizer knob must be rotated counterclockwise when the annunciator pointer is in the L area of the scale, and clockwise

when the annunciator pointer is in the R area of the scale.

3. Check the heading pointer reading with the pilot's standby compass to assure that the system synchronization was not attempted on the heading which is 180 degrees from the correct heading. Once the system is correctly synchronized, the heading pointer will continuously indicate the magnetic heading of the aircraft. During autopilot operation, the system will hold the aircraft on a constant magnetic heading. During turns, the annunciator pointer may swing to the L or R area of its scale. This is a normal condition, requiring no correction. Do not attempt to reposition the master indicator heading pointer during or immediately after turns, since the system will remain in synchronization during and after the turn. When on autopilot, during magnetic-slaved operation, rotation of the synchronizer knob from the synchronized position will cause the aircraft to alter course at approximately 3 degrees per minute, and assume the new heading set on the master indicator heading pointer.

DIRECTIONAL GYRO OPERATION. For directional gyro operation, proceed as follows:

1. Rotate the latitude-correction knob clockwise until the latitude-correction pointer indicates the latitude of aircraft position. The system is then independent of the magnetic compass equipment, and latitude correction for apparent gyro drift is given to the heading pointer. As the aircraft changes latitude in flight, the latitude-correction pointer should be reset (at approximately 2-degree intervals) to the new latitude.

2. Set the master indicator heading pointer to the desired gyro heading datum with the synchronizer knob. The gyro reference datum is not referenced to a geographical coordinate system, and if a constant heading is flown, the path of the aircraft will be a great circle course under a no-wind condition.

Note

> During directional gyro operation, repositioning the heading pointer with the synchronizer knob will cause a change only in the heading datum, and will not cause the aircraft to change heading, whether on or not on autopilot.

C-12 COMPASS SYSTEM (EC-130Q AIRCRAFT).

A C-12 compass system is installed on the EC-130Q aircraft. This system provides an accurate heading reference to aid in navigation, regardless of the latitude position of the aircraft. In addition to providing a visual heading reference, the system furnishes heading information to other navigation systems in the aircraft (see figure 1-112 for the C-12 system tie-in). Operating controls and indicators for the compass system are located on the digital controller, located on the navigator's instrument panel. The system is capable of operating in either one of two modes. In the magnetic heading mode, used in latitudes where no distortion of the earth's magnetic field is encountered, the directional gyro in the system is slaved to the earth's magnetic field and the indicators display magnetic heading of the aircraft. In the directional gyro mode, used in latitudes where the magnetic meridian is distorted or weak, the system gyro acts as a directional gyro and maintains the position manually selected by the operator. The indicators display the manually established heading.

The C-12 compass system receives its power from the essential ac bus, through the C-12 compass circuit breaker on the pilot's upper circuit breaker panel.

DIGITAL CONTROLLER.

Controls and indicators for the compass system are located on the system digital controller (figure 1-113). The following paragraphs list the controls and indicators and describe their function in the system.

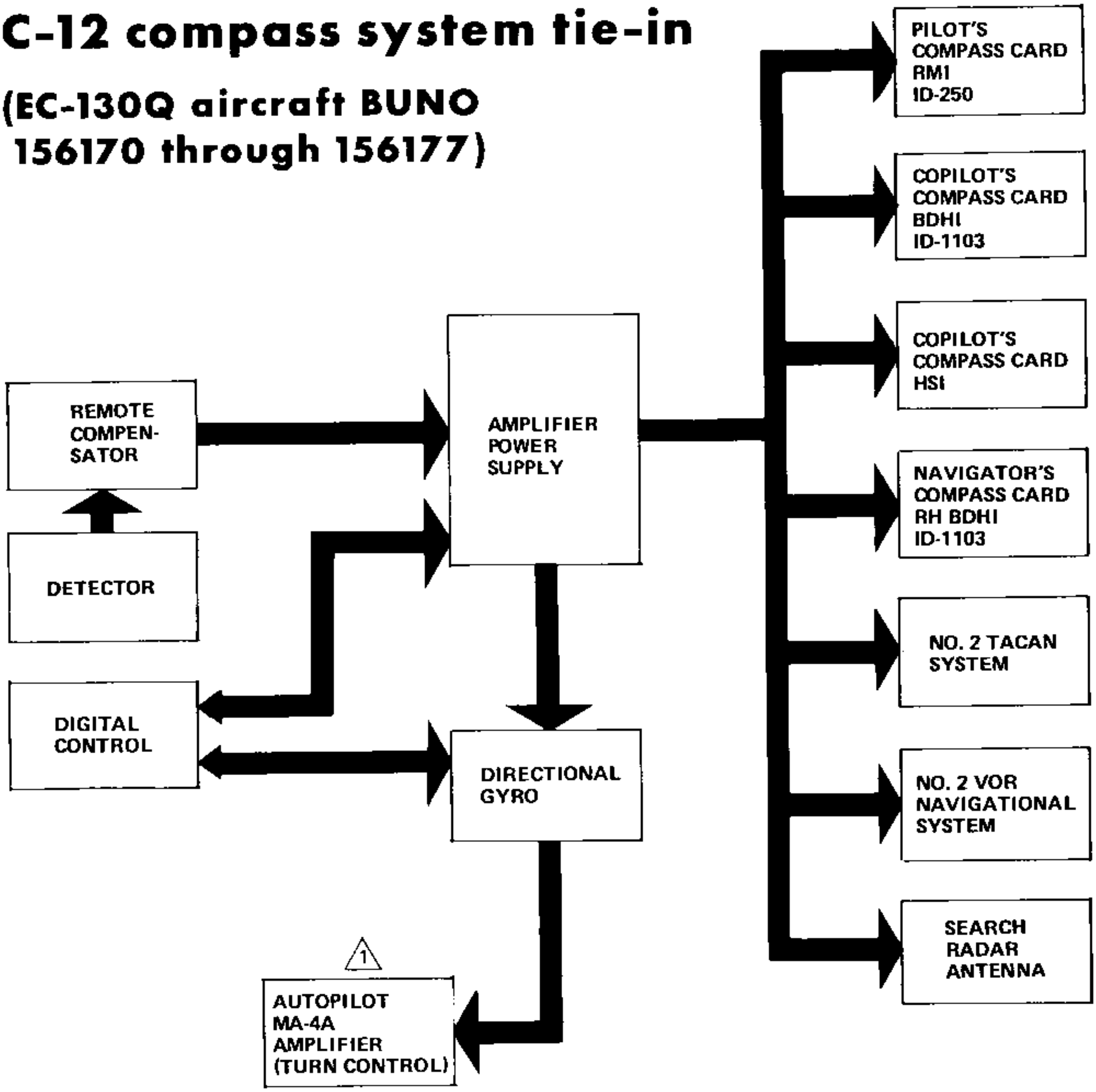
LATITUDE N-S SWITCH. The latitude N-S switch allows selection of north (N) or south (S) latitude correction, dependent on aircraft location.

LATITUDE KNOB. The latitude knob is rotated to set the correct latitude location, in degrees, of the aircraft position. This setting allows the compass system to automatically correct the earth rate and coriolis errors at the set latitude.

MODE SWITCH. The mode switch selects compass operating mode. When the switch is set in MAG position, the directional gyro in the compass is slaved to a magnetic azimuth detector. The digital reading on the heading indicator will show magnetic heading. This switch position is used in latitude where no distortion of the earths magnetic field is encountered.

C-12 compass system tie-in

(EC-130Q aircraft BUNO 156170 through 156177)



NOTE

1. THE ATTITUDE HEADING REFERENCE SYSTEM IS THE PRIMARY SOURCE FOR THE AUTOPILOT HEADING REFERENCE SIGNAL; THE C-12 COMPASS IS THE SECONDARY SOURCE.

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Figure 1-112. (Sheet 1 of 3)

(EC-130Q aircraft BUNO 159348 and 159469)

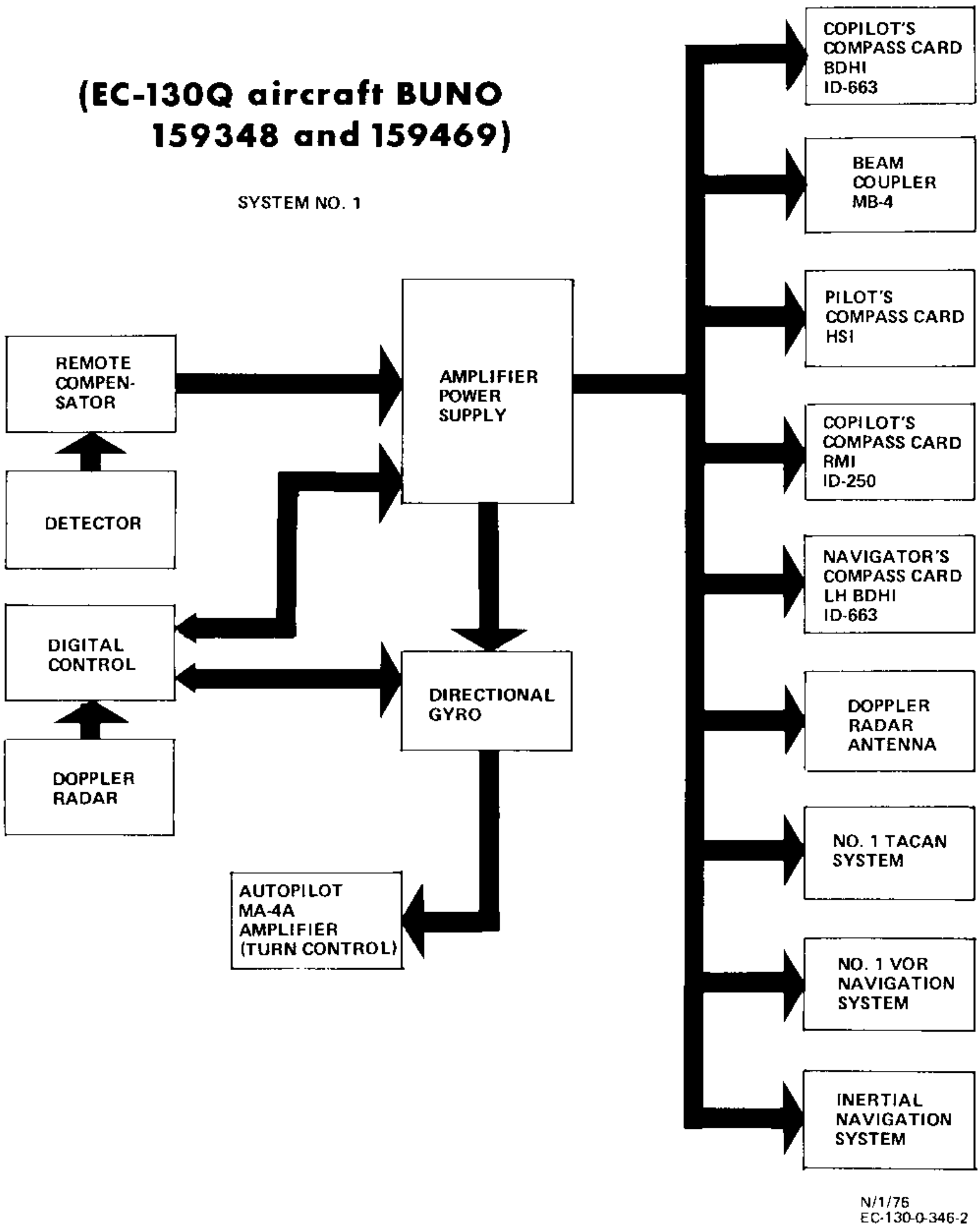

Figure 1-112. (Sheet 2 of 3)

(EC-130Q aircraft BUNO 159348 and 159469)

SYSTEM NO. 2

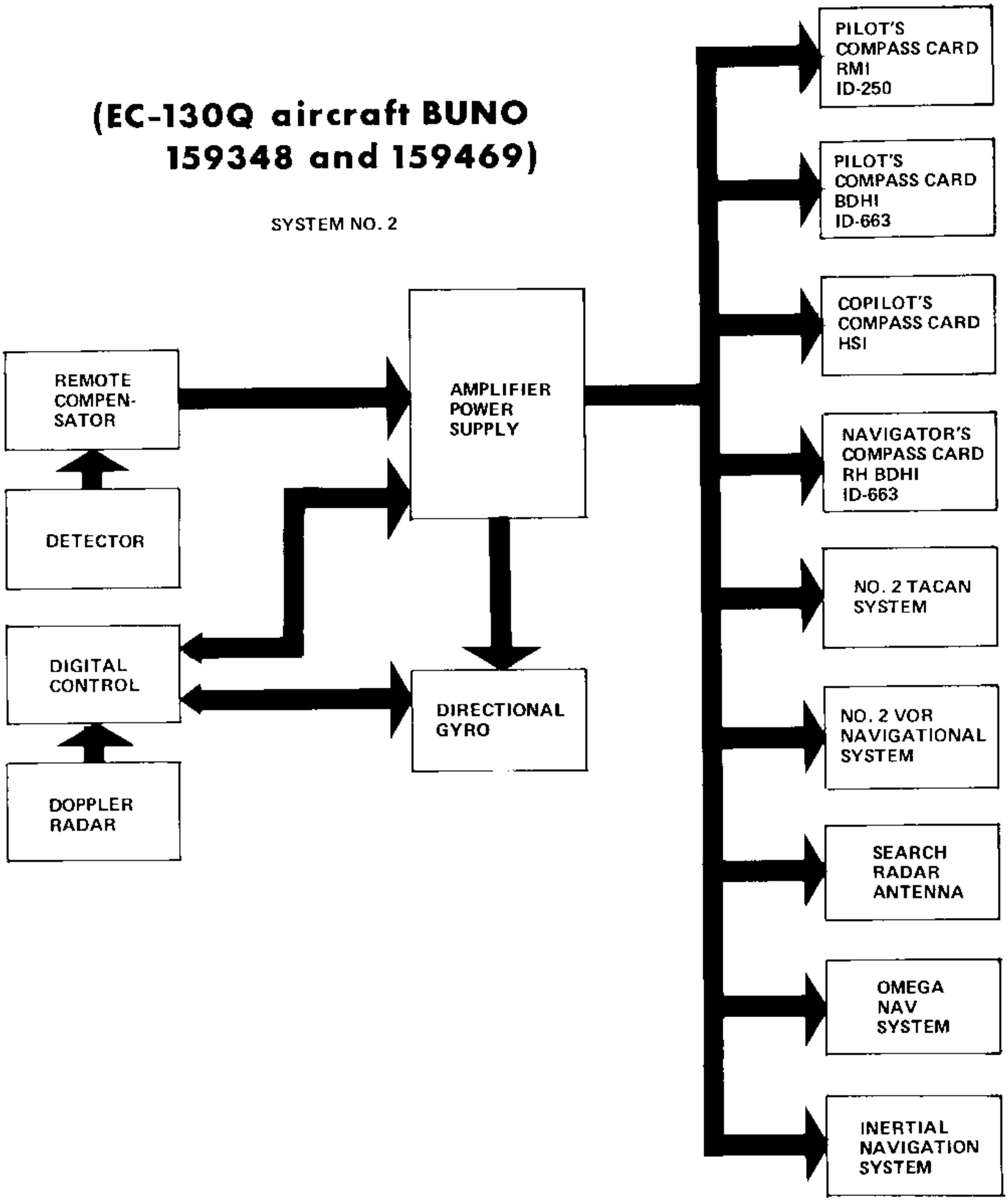

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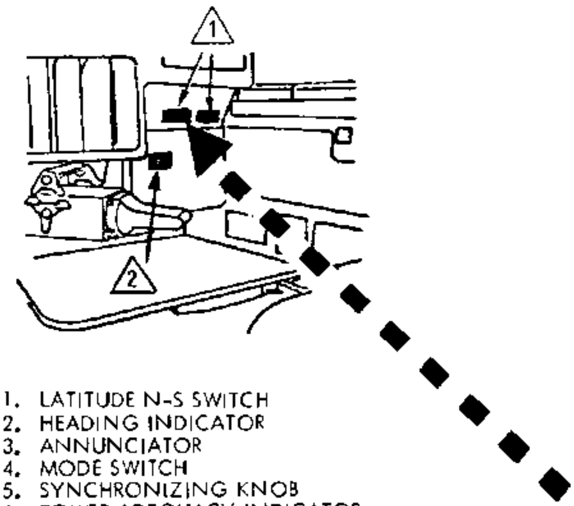
Figure 1-112. (Sheet 3 of 3)

C-12 compass system digital controller (EC-130Q aircraft)



1. LATITUDE N-S SWITCH
2. HEADING INDICATOR
3. ANNUNCIATOR
4. MODE SWITCH
5. SYNCHRONIZING KNOB
6. POWER ADEQUACY INDICATOR
7. LATITUDE KNOB

NOTE

⚠1 BuNo 159348 and 159469

⚠2 BuNo 156170 – 156177

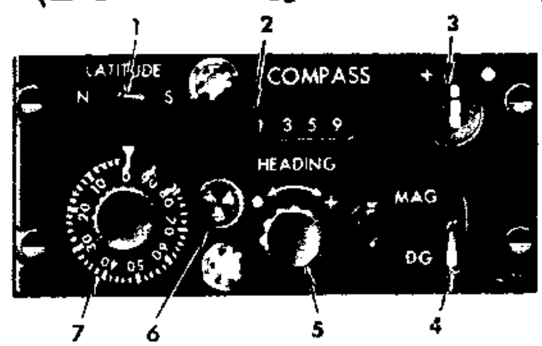


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Figure 1-113.

When the switch is set in DG the gyro acts as an independent directional gyro. The digital reading in the heading indicator is manually set with the synchronizer knob. This mode of operation is normally used for short range navigation in the upper latitudes where the magnetic meridian is distorted or weak.

SYNCHRONIZING CONTROL. The synchronizing control is used in conjunction with the annunciator to provide fast system synchronization when the compass system begins initial operation in the magnetic heading mode (MAG) selection of the mode switch. The synchronizer knob is rotated in the direction indicated by annunciator needle deflection markings above the annunciator until the needle is centered. When the needle is centered, the compass is synchronized in magnetic heading mode and the digital drums in the heading windows display the magnetic heading of the aircraft. When the directional gyro mode (DG) has been selected with the mode switch, the synchronizer knob is used to manually set the digital drums in the heading windows to the desired course heading.

ANNUNCIATOR. The annunciator provides visual indication of system synchronization when the compass system begins initial operation in the magnetic heading mode.

HEADING INDICATOR. The heading indicator provides digital readout of aircraft heading in 0.1-degree increments.

POWER ADEQUACY INDICATOR. The power adequacy indicator illuminates to indicate that system power input has dropped below safe operating level.

OPERATION OF THE C-12 COMPASS.

The C-12 compass system begins to operate when power is applied to the aircraft electrical ac busses. However, a 5-minute warmup is required for gyro stabilization.

To set the compass for desired aircraft heading:

1. Set latitude N-S switch to correct latitude for aircraft position.

2. Rotate latitude knob to set present aircraft position degrees of latitude under the index. Additional settings may be required depending on direction and time inflight.

3. Set desired compass operating mode with the mode switch (MAG or DG).

4. If MAG has been selected in step 3, allow annunciator needle to center automatically or manually synchronize the system with the synchronizing control.

5. If DG position has been selected in step 3, set desired aircraft heading in the heading windows with the synchronizing control.

Note

Illumination of the power adequacy indicator on the digital controller indicates that system power has dropped below safe operating level.

EMERGENCY OPERATION OF THE C-12 COMPASS.

Emergency operation of the compass system can be accomplished as follows:

1. If the compass system becomes inoperable, the aircraft can be flown by using the AHRS for heading reference.

2. If the Doppler radar becomes inoperable, the ground speed readout on the drift angle-ground-speed indicator will be fixed. Operation will be normal, and the difference between correct ground speed and the fixed groundspeed would require negligible compensation. Correction for any accumulated error can be accomplished by position-fixing.

Note

The coriolis error compensation circuits provide a maximum of about 4.25 degrees correction at a latitude of 80 to 90 degrees with a north or south ground speed of 500 knots. However, at a ground speed of about 250 knots at 80 degrees latitude, there would be about 1.25 degrees correction, and under normal operating conditions in the midlatitudes, the total compensation including Meridian convergence would be in the vicinity of 0.62 degree.

3. In the event of Doppler failure in the extreme conditions as noted above, or if desired, the compass system may be operated as a directional gyro (DG mode) which will bypass coriolis and meridian convergency compensation since these corrections are applied to the magnetic-slaving circuits.

INERTIAL NAVIGATION SYSTEM (LTN-51).

The inertial navigation system (INS), figure 1-114, is a self-contained navigational aid that provides accurate navigation and position determination anywhere on the earth, in any weather, without the aid of groundbased equipment. The INS is supplied 115-volt ac power from the essential ac bus through the inertial nav circuit breakers on the copilot's upper circuit breaker panel and 26-volt ac power from the essential ac bus through the INS circuit breaker on the pilot's upper circuit breaker panel. The system also receives 28-volt dc power from the essential dc bus through the inertial nav circuit breakers on the copilot's upper circuit breaker panel.

INS CONTROLS AND INDICATORS.

Mode Selector Unit.

The mode selector unit (MSU) is located on the navigator's control panel with an optional location on the pedestal. The five position (OFF, STBY, ALIGN, NAV, ATT REF) mode selector switch is detented in the NAV position to prevent the INS from inadvertently being switched out of the NAV position. The knob must be pulled away from the MSU panel before the switch can be moved out of the NAV position.

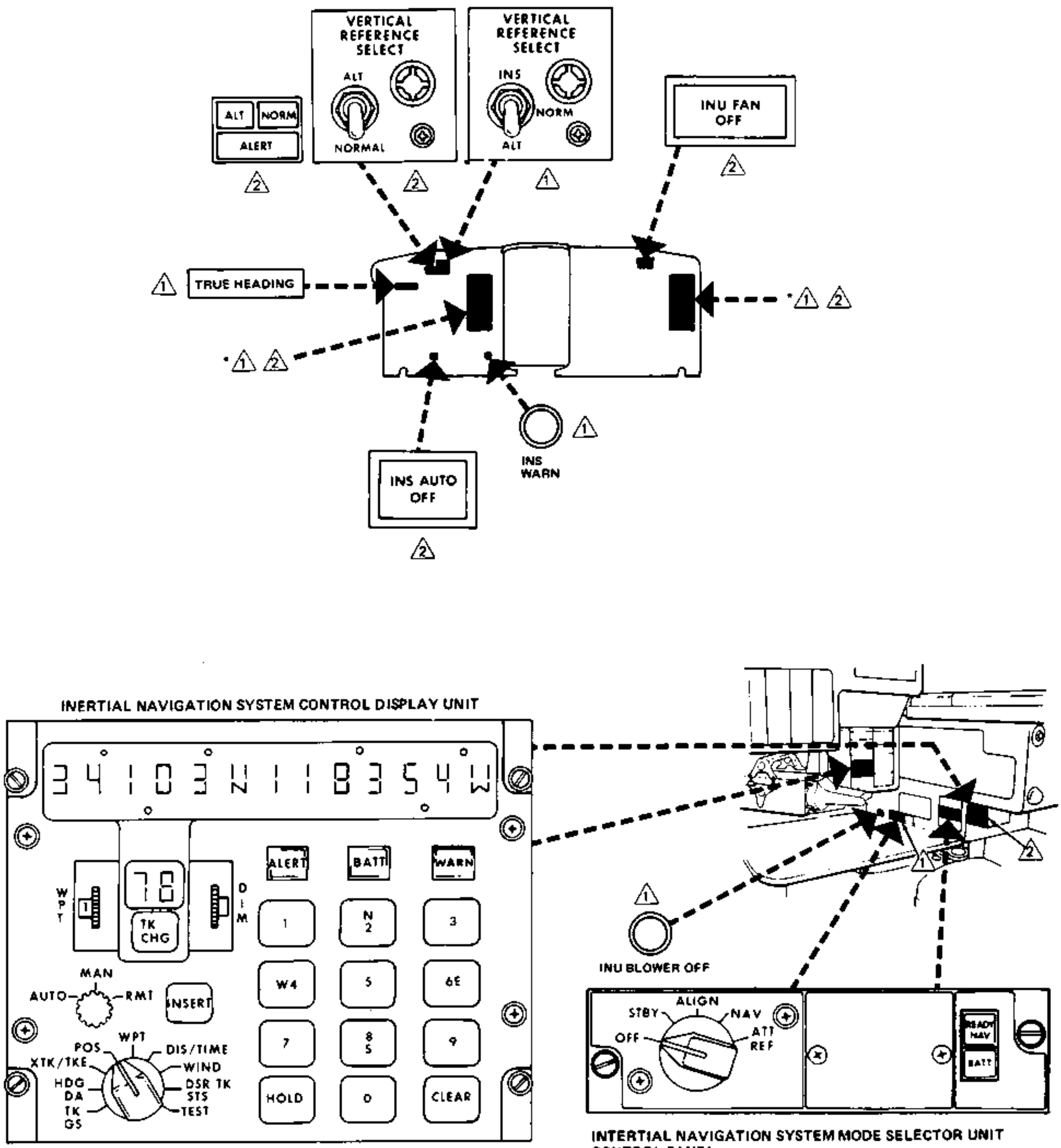
OFF. Power is applied only to the MSU and CDU edge lighting.

STBY. In standby, INS primary power is on and the CDU is operated to perform display test and to insert the airplane present position.

ALIGN. The automatic alignment sequence continues and a platform alignment sequence is initiated. When the automatic alignment sequence is completed, the READY NAV annunciator comes on to indicate that the navigate mode may be selected. The aircraft must not be moved when the mode selector switch is set to ALIGN.

NAV. In navigate, the aircraft may be moved and normal inflight operations are performed.

inertial navigation system controls and indicators (LTN-51)



NOTE

⚠1 EC-130G AND EC-130Q BUNO 156170 THROUGH 156177

⚠2 EC-130Q BUNO 159348 AND 159469

* SEE FIGURE 1-106 FOR PILOT'S AND COPILOT'S CONTROLS/INDICATORS FOR AIRCRAFT ⚠1 AND ⚠2

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Figure 1-114.

ATT REF. In attitude reference, the INS provides pitch, roll, and platform heading outputs only. No navigational capability exists and CDU numerical displays are blank.

READY NAV ANNUNCIATOR (GREEN). Comes on when the INS has completed alignment.

BATT ANNUNCIATOR (RED). Comes on when backup power is less than the minimum required to operate the INS.

Control Display Unit.

CDU controls, numerical displays, and annunciators are used to perform the following functions:

DISPLAY SELECTOR SWITCH. Selects data for presentation on left and right numerical displays. The nine positions of the switch are as follows:

1. Track Angle and Ground Speed (TK/GS). The track angle being made to the nearest tenth of a degree is shown on the left numerical display. Ground speed to the nearest knot is shown on the right numerical display.

2. Heading and Drift Angle (HDG/DA). The aircraft true heading to the nearest tenth of a degree is shown on the left numerical display. Drift angle to the nearest tenth of a degree is shown on the right numerical display.

3. Cross-Track Distance and Track Angle Error (XTK/TKE). Cross track distance to the nearest tenth of a nautical mile is shown on the left numerical display. Track angle error to the nearest tenth of a degree is shown on the right numerical display.

4. Present Position (POS). Aircraft present position latitude and longitude, to the nearest tenth of an arc-minute, are shown on the left and right numerical displays.

5. Waypoint Positions (WPT). Waypoint latitude and longitude to the nearest tenth of an arc-minute are shown on the left and right numerical displays.

6. Distance and Time to Waypoint (DIS/TIME). Distance to the nearest nautical mile is shown on the left numerical display, and is measured between the aircraft present position and the "To" waypoint of the track being navigated. Time-to-go, to the nearest tenth of a minute up to 480 minutes maximum, is shown on the right numerical display.

7. Wind Direction and Speed (WIND). Displays wind direction to the nearest degree (left display) and wind speed to the nearest knot (right display).

8. Desired Track Angle (DSR TK STS). Desired track angle to the nearest tenth of a degree is shown on the left numerical display.

9. Display Test (TEST). The display test enables the operator to verify that the CDU numerical displays, "From/To" displays, and annunciators are operating correctly. The display test may be performed with the mode selector switch set to STBY or ALIGN.

DIM CONTROL. Controls intensity of numerical and "From/To" display; intensity can be reduced to zero.

WPT SELECTOR SWITCH. When display selector switch is set to WPT, selects waypoint (1 through 9) for latitude and longitude insertion, or for display of waypoint coordinates on left and right numerical displays.

TK CHG PUSHBUTTON. Allows initiation of manual track leg change.

FROM/TO WAYPOINT DISPLAY. Displays "From" waypoint number and "To" waypoint number of track leg being navigated.

AUTO/MAN/RMT SWITCH.

1. (AUTO): Automatic sequential track leg change.

2. (MAN): Manually initiated track leg change.

3. (RMT): Used for distance between remote waypoints and manual insertion of true airspeed.

NUMERICAL DISPLAYS. Display data selected by display selector switch.

HOLD PUSHBUTTON. Holds present position on left and right numerical displays or initiates manual updating of present position.

DATA KEYBOARD. Provides ten keys (0 through 9) that are used to program navigational data. Clear key removes entered data if pressed before insert pushbutton is pressed.

INSERT PUSHBUTTON. Transfers entered data into INS computer.

ALERT ANNUNCIATOR (AMBER). Comes on two minutes before each approaching "To" waypoint is reached and then either goes off when a track leg change is automatically made (automatic operation) or flashes to indicate that a track leg change must be manually initiated (manual operation).

BATT ANNUNCIATOR (AMBER). Comes on when the INS is operating on backup power.

WARN ANNUNCIATOR (RED). Comes on when a system malfunction occurs; or, during the align mode, flashes to indicate that incorrect present position latitude is inserted or an INS alignment failure has occured.

Pilot's/Copilot's INS Control Indicators (EC-130Q BuNo 159348 and 159469).

NAV MODE SEL SWITCH. The INS position of the nav mode sel switch can be independently selected by the pilot and copilot to display INS nav information on the HSI. The flight director computer computes steering information for display on the ADI vertical pointer.

VERTICAL REFERENCE SELECT SWITCH. The two-position (NORMAL, ALT) vertical reference switch is located on the pilot's instrument panel.

1. NORMAL — Roll and pitch signals to the pilot's ADI and autopilot and autopilot heading are supplied by INS when INS is valid.

2. ALT — Roll and pitch signals to the pilot's ADI are from the flight director gyro. Roll and pitch signals to the autopilot are from the autopilot gyro. Heading information to the autopilot is from the No. 1 C-12 compass.

With the vertical reference switch in NORMAL, INS attitude is displayed when the INS signals are valid. If INS becomes invalid, the signals automatically switch to the alternate source (switch remains in NORMAL). Warning of this condition is given by the alt/norm/alert light.

ALT/NORM/ALERT LIGHT. The three section alt/norm/alert light is located on the pilot's instrument panel and illuminates as follows.

1. ALT — Illuminates when signals are from the flight director gyro, autopilot gyro, and No. 1 C-12 compass, vertical reference switch in ALT or NORMAL with INS invalid.

2. NORM — Illuminates when signals are from INS, vertical reference switch in NORMAL with INS valid.

3. ALERT — Illuminates if vertical reference switch is in NORMAL and INS is not valid (signals from alternate source). ALT is also illuminated.

AUTOPILOT STEERING SWITCH: The autopilot steering switch is located on the pilot's instrument panel. Switch functions are as follows.

1. NORMAL — Autopilot steering information is dependent upon the position of the radio beam coupler switch.

2. INS — Steering signals are supplied to the autopilot (in gyro pilot mode) from the INS.

INS AUTO OFF LIGHT: The INS auto off light is located on the pilot's instrument panel and illuminates when the autopilot steering switch is in INS and the INS is decoupled.

INU FAN OFF LIGHTS: The INU fan off lights are located, one on the copilot's instrument panel and one on the navigator's instrument panel. The lights illuminate when cooling air is not being supplied to the inertial nav unit. The inertial nav unit automatically shuts down when overheated.

Pilot's/Copilot's INS Control Indicators (EC-130G and EC-130Q BuNo 156170 through 156177).

NAV MODE SEL SWITCH. The INS position of the nav mode sel switch can be selected by the pilot to display INS nav information on the HSI. This position selects INS steering inputs to the autopilot.

VERTICAL REFERENCE SELECT SWITCH. The three-position (INS, NORMAL, ALT) vertical reference switch is located on the pilot's instrument panel.

INS. Roll and pitch signals to the pilot's ADI and autopilot heading are supplied by the INS in the navigational mode. Only roll, pitch, and platform heading signals are available in the ATT REF mode.

INS WARN LIGHT (AMBER). Comes on when a system malfunction occurs. Indicates navigational failure in the NAV mode or attitude reference failure in the ATT REF mode.

Note

Upon illumination of the INS Warn Light, the autopilot should be disconnected and selection should be made of either NORMAL or ALT attitude reference mode, as well as selection of a nav mode other than INS. System operation may be attempted in ATT REF. If the INS WARN light extinguishes, navigation only is affected and reliable attitude reference signals are available. If it remains illuminated, discontinue use for ATT REF. A leveling sequence in ATT REF mode may be attempted in three minutes of straight and level flight after first shutting the system off.

INU BLOWER OFF LIGHT (AMBER): The INU blower off light on the navigator's instrument panel illuminates when cooling air is not being supplied to the inertial nav unit. The inertial nav unit automatically shuts down when overheated.

TRUE HEADING INDICATOR (GREEN): The true heading indicator is illuminated when INS mode has been selected on the pilot's nav mode selector switch.

Note

The true heading indicator will remain illuminated regardless of whether or not magnetic variation has been manually inserted in the CDU to display magnetic heading on the pilot's HSI.

NORMAL OPERATIONS OF THE INS.

Entry Procedures.

PRESENT POSITION ENTRY.

1. Display selector switch — POS.
2. N or S pushbutton — Depressed.
3. Present latitude — Entered.
4. Insert pushbutton — Depressed.
5. W or E pushbutton — Depressed.
6. Present longitude — Entered.
7. Insert pushbutton — Depressed.

DISPLAY TEST.

1. Auto/Man/Rmt switch — MAN.
2. Display selector switch — TEST.
3. Displays and annunciators — Checked.

Left and right numerical displays, degree signs, decimal points, arc-minute signs, NS and EW, and From/To display, and ALERT, BATT, and WARN annunciators are on. All numerical displays "8's."

4. Nav mode sel switch (on pilots instrument panel) — INS.

Verify the HSI indicates a heading of 11.25 degrees and bearing pointer 22.5 degrees.

5. Vertical reference select switch (on pilot's instrument panel) — NORMAL.

Verify that ADI attitude warning flag goes out of view.

6. INS Mode Selector Switch — ALIGN.

Note

The ready nav annunciator shall illuminate within 18 minutes. Do not move the airplane during INS alignment.

WAYPOINT COORDINATES ENTRY.

1. Display selector switch — WPT.
2. WPT selector switch — As desired.

Note

The initial enroute waypoint coordinates are entered into waypoint "1" unless a return to point of departure track is desired in which case the initial enroute waypoint coordinates are entered into waypoint "2". Additional waypoint coordinates are then entered sequentially into subsequent waypoint storage locations.

3. N or S pushbutton - Depressed.
4. First waypoint latitude — Entered.
5. Insert pushbutton — Depressed.
6. W or E pushbutton — Depressed.
7. First waypoint longitude — Entered.
8. Insert pushbutton — Depressed.

Note

Repeat steps "2" through "8" for subsequent waypoint entries.

TAXI SPEED /TRACK ANGLE MONITORING. The INS displays taxi speed and meaningful track angle indications at taxi speeds in excess of 10 knots. Track angle and heading displays are the same at taxi speeds less than 10 knots.

1. Display selector switch — TK GS.

Read ground speed from right numerical display. Read track angle from left numerical display.

ATTITUDE REFERENCE SELECTION. When only pitch, roll, and platform heading outputs are required and navigational capability is not necessary, the INS can be operated in the attitude reference mode.

Note

To ensure that the INS inertial platform is level, keep the aircraft stationary for 3 minutes after placing the INS mode selector switch at ATT REF.

1. INS mode selector switch — ATT REF.

Note

The mode selector switch is detented in the NAV position and the knob must be pulled away from the MSU panel before the mode selector switch can be moved through the NAV position.

Inflight Procedures.

The terms "automatic" and "manual," as used in these procedures, apply only to track selection. When in the navigate mode, the INS provides the same navigation data whether the AUTO/MAN/RMT switch is set to AUTO (automatic) or MAN (manual). During automatic operation, the INS navigates through each selected waypoint in sequence and automatically changes track at each waypoint. During manual operation, the INS navigates from waypoint to waypoint, but the operator must initiate a track change at each waypoint. CDU display selection and waypoint position entry may be accomplished with the AUTO/MAN/RMT switch set to either AUTO or MAN.

INFLIGHT WARN INDICATIONS. The INS provides integral warn indications and signals that cause aircraft instruments to provide warn indications pertaining to INS operation. These warn indications are as follows:

INS WARN INDICATIONS. If the WARN annunciator comes on, the INS is malfunctioning and may not be providing accurate data. Refer to Attitude Reference Operation for operating procedure.

AIRCRAFT INSTRUMENT WARN INDICATIONS. The INS provides signals that cause aircraft instruments to provide warn indications as follows:

WARN SIGNAL	WARN INDICATION
Pitch or roll	ADI attitude warning flag
HSI	ADI course warning flag

Note

Do not set the mode selector switch out of NAV unless an INS malfunction occurs. If the INS is switched out of NAV, NAV cannot be reset in flight as the INS must be aligned on the ground.

WARNING

If the mode selector switch is set to ATT REF, the INS attitude outputs must not be used until the aircraft has been flown in a wings level attitude at a constant speed for the first 3 minutes after ATT REF is selected to allow the INS inertial platform to complete a level sequence. If this procedure is not followed, erroneous INS attitude outputs may occur.

Note

- If the CDU BATT annunciator comes on, the INS is operating on dc backup power. The dc backup power is a battery unit with approximately 2 hours duration for INS operation. If primary operating power cannot be restored within approximately 2 hours, action must be taken to substitute for the INS, particularly if the INS is providing information on the autopilot or flight director system.

- If the MSU BATT annunciator comes on, the dc backup power is less than the minimum required to operate the INS. Automatic INS shutdown will occur, and the warn annunciator will come on. The mode selector switch should be set to OFF if the MSU BATT annunciator comes on. If normal power if restored, ground alignment or inflight leveling may be attempted a maximum of three times.

MANUAL OPERATION. Manual operation includes track leg change at waypoint, track leg change from present position, track angle selection, waypoint bypassing, and waypoint position change.

TRACK LEG CHANGE AT WAYPOINT/TRACK LEG CHANGE FROM PRESENT POSITION.

1. AUTO/MAN/RMT switch — MAN.

2. TK CHG pushbutton — Depressed.

Verify that TK CHG and insert pushbuttons come on and From/To display blanks.

3. Enter waypoints desired on data keyboard — Entered.

Verify that From/To display is as entered.

4. Insert pushbutton — Depressed.

Verify that insert and TK CHG pushbuttons and alert annunciator go off, and From/To display is as entered in step 3.

Verify that new desired track is accurate.

INS TRACK SELECT MODE. The operator can initiate an INS track select mode of operation (referenced to true north) from the aircraft present track rather than a track between waypoints.

1. Display selector switch — DSR TK STS.

2. AUTO/MAN/RMT switch — MAN.

3. Data keyboard pushbutton O — Depressed.

Verify that left and right numerical and From/To displays blank, and that insert pushbutton comes on.

4. Enter desired track angle to the nearest tenth of a degree at data keyboard.

Verify that left numerical display is track angle entered.

5. Insert pushbutton — Depressed.

Verify that insert pushbutton goes off and From/To display is 99. DIS/TIME and XTK numerical displays are all zeros.

6. When desired, return to previous mode by initiating next track change.

WAYPOINT BYPASSING. The operator can bypass waypoints in one of two ways: by initiating a track change from waypoint, or by initiating a track change from present position. For example, if the waypoint to be bypassed is not the next waypoint, the track change may take place at the next waypoint. Assume that the aircraft is halfway to WPT 2 on track 1 2. A decision is made to bypass WPT 3 and go directly to WPT 4 from WPT 2. In this case, use the track change from waypoint procedure by entering track 2 4 on the data keyboard.

If one of the waypoints to be bypassed is the next waypoint, refer to Track Change From Present Position.

WAYPOINT POSITION CHANGE. The operator can change the coordinates of waypoints or use past waypoint storage locations as future waypoints. Enter waypoints as described in Waypoint Position Entry. If past waypoint storage locations are to be used as future waypoints, enter future waypoints sequentially starting with 1 and continuing through the last number used. Do not enter a waypoint that defines the leg currently in progress.

AUTOMATIC OPERATION. In automatic operation, the change to the next sequential track leg at each waypoint is initiated automatically by the INS. Two minutes before reaching each waypoint, the alert annunciator comes on, and goes out at 0.5 minute and the track leg change is made. The From/To display automatically changes to show the new track. Place the system in automatic operation by setting the AUTO/MAN/RMT switch to AUTO.

ATTITUDE REFERENCE OPERATION. Attitude reference operation enables the aircraft to use the INS as a source of pitch, roll, and platform heading (attitude) data. Attitude reference is selected in flight when the INS is providing attitude data, but no navigational data, as indicated when the warn annunciator comes on with the mode selector switch set to NAV, and goes off when the mode selector switch is set to ATT REF.

If the warn annunciator comes on:

1. INS mode selector switch — ATT REF.

If the warn annunciator remains on, the INS has malfunctioned and is not providing reliable attitude data. If the annunciator goes off, the INS is providing accurate attitude data but no navigational data.

If the warn annunciator goes off:

1. Verify that the left and right numerical and From/To displays are blank.

2. Fly the aircraft in wings level attitude at a constant speed for 3 minutes before using INS attitude outputs.

CAUTION

Three minutes under stable flight conditions are required to enable the INS inertial platform to level.

If the warn annunciator remains on:

1. INS mode selector switch — OFF.

2. Vertical reference select switch — ALT (EC-130Q 159348 and 159469) or NORMAL or ALT (EC-130G and EC-130Q 156170 through 156177), as desired.

3. Nav mode sel switch — As desired (except INS).

POSITION UPDATE, CHECK AND SELECTION. At any time during flight, the INS present position can be updated to a position fix apparently more accurate than the inertially-derived position. Present position can be updated a maximum 30 arc-minutes in both latitude and longitude for any one update. The INS retains the original un-updated present position for the duration of nav mode, thereby permitting future comparison of updated with un-updated positions. If in a future comparison the un-updated position proves more accurate than the updated position, the system may drop the updated position and revert to the un-updated position.

In the procedure, when the hold pushbutton is pressed, the present position display freezes. The INS, however, automatically compensates for position changes during the display freeze.

When aircraft is at a fix position:

1. Hold pushbutton — Depressed.

2. Display selector switch — POS.

3. Latitude and longitude of fix position — Entered.

Refer to steps 1 through 7 of Present Position Entry, noting that original (not updated) coordinate will appear on numerical display when insert pushbutton is pressed and will not be updated until second coordinate is inserted or hold pushbutton is pressed.

If both latitude and longitude have been updated, numerical displays will restart when the insert pushbutton is pressed the second time. If only latitude or longitude is updated, press hold pushbutton to restart display. Pushbutton goes out and position changes that occurred during the display freeze and updating procedures are automatically compensated for, and position display reflects new present position referenced from updated coordinates.

4. Check relative accuracy of updated position by pressing hold pushbutton when aircraft is over some known position.

5. Set display selector switch to POS.

Verify that coordinates of updated position appear in numerical displays.

6. Display selector switch — WPT.

Verify that coordinates of un-updated position appear in numerical displays. If updated position is more accurate than un-updated position, restart displays by pressing hold pushbutton. Updated position will continue to be displayed when display selector switch to set to POS.

If un-updated position is more accurate than updated position, remove updated position by performing steps 7 through 9 (hold pushbutton is still on).

7. Display selector switch — DSR TK STS.

8. Data keyboard pushbutton O — Depressed.

Note

If a 0 X track is being flown, re-initiate track to pick up new 0 position. If a track select mode is being flown, re-initiate the desired track angle.

9. Insert pushbutton — Depressed.

The hold pushbutton goes out. Un-updated position will be displayed when display selector switch is set to POS.

A new updated position can be entered at any time during nav mode by performing steps 1 through 3.

True Magnetic Grid Heading Display.

Select true heading as follows:

1. Display selector switch — DSR TK STS.

2. Data Keyboard pushbutton # 5 — Depressed.

Verify that insert pushbutton comes on.

3. Magnetic Variation — 000 entered.

4. Insert pushbutton — Depressed.

Verify that pushbutton goes out and right numerical display is the true heading. An "I" will appear in the left most character of the right display when true heading is being displayed.

Note

True heading will be displayed on the HSI card.

Select magnetic heading as follows:

1. Display selector switch — DSR TK STS.

2. Data Keyboard pushbutton # 5 — Depressed.

Verify that insert pushbutton comes on.

3. Magnetic Variation — Entered (East variation is entered by subtracting variation from 360 degrees and entering the result)to tenths of a degree.

4. Insert Pushbutton — Depressed.

Verify that pushbutton goes out and right numerical display is the magnetic heading. A "2" will appear in the left most character of the right display when magnetic heading is being displayed.

Note

Magnetic heading will be displayed on the HSI card.

Grid heading display enables a grid offset angle to be inserted into the INS so that the aircraft grid heading can be calculated and displayed on the right numerical display.

Because all INS displays and steering commands except the grid heading display are referenced to true north, and INS calculations are based on a great circle path, an INS course plotted on a map appears as a slightly curved line as opposed to a navigator's plot, which appears as a straight line. The rate that the curved line deviates from the straight line is referred to as grid transport precession (GTP), and is not considered when the INS calculates the aircraft grid heading, so that no correction for GTP is made. If a GTP correction is necessary, or if the map used to determine the original grid offset angle is changed, a grid heading update is made by determining the grid offset angle at the aircraft position at the time of correction and repeating the grid heading display section procedures.

Select grid heading as follows:

1. Hold pushbutton — Depressed.

2. Obtain grid offset angle at aircraft position.

3. Display selector switch — DSR TK STS.

4. Data Keyboard pushbutton # 5 — Depressed.

Verify that insert pushbutton comes on.

5. Grid offset angle — Entered to tenths of a degree.

6. Insert pushbutton — Depressed.

Verify that pushbutton goes out and right numerical display is the grid heading. An "0" will appear in the far left character of the right display when grid heading is being displayed.

Note

Grid heading will be displayed on the HSI card.

WIND COMPUTATION. The wind display is blank until TAS is entered.

1. Auto/Man/Rmt switch — RMT.

2. Display selector switch — DSR TK STS.

3. Data Keyboard pushbutton #5 — Depressed.

Verify that insert pushbutton comes on.

4. TAS to nearest knot — Entered.

5. Insert pushbutton — Depressed.

Verify that pushbutton goes out and right numerical display is the TAS.

6. Display selector switch — Wind.

PERISCOPIC SEXTANT.

The D-1 periscopic sextant is a precise and delicate navigation instrument; it should be handled with care. The sextant may be rotated in azimuth through 360 degrees, and minus 10 degrees to plus 92 degrees in elevation, with a true field of 15 degrees. An averaging device on the sextant gives a continuous moving average; after 30 seconds of use it can be terminated. The light for the sextant mount is powered by 28-volt, dc power from the main dc bus through the interior light, flt mech, navigator utility circuit breaker located on the copilot's lower circuit breaker panel. The sextant mount is located above the navigator's seat.

NORMAL OPERATION OF THE PERISCOPIC SEXTANT.

1. Insert the sextant in the mount.

a. Align the arrow on the tube of the sextant with the arrow on the mount.

b. Insert the sextant as far as possible, and turn it clockwise.

c. Open the mount shutter with the lever.

d. Pull out the knob marked "TO INSERT, REMOVE-PULL," and insert the sextant until the knob snaps into place.

e. Make the cable connection between the mount and the sextant.

f. Turn the light switch ON.

2. Adjust the size of the bubble as desired.

3. Check the alignment of the sextant mount.

a. Set 180.4 degrees in the azimuth counter.

b. Sight on the liaison tie-in bracket mounted on the vertical stabilizer. The heading in field of vision should be 0.

4. Remove the sextant from the mount.

a. Turn the light switch OFF, and disconnect the electrical cable.

b. Pull out the knob marked "TO RETRACT SEXTANT-PULL," and lower the sextant.

c. Close sextant port with the lever.

radio altimeter (AN/APN-133)

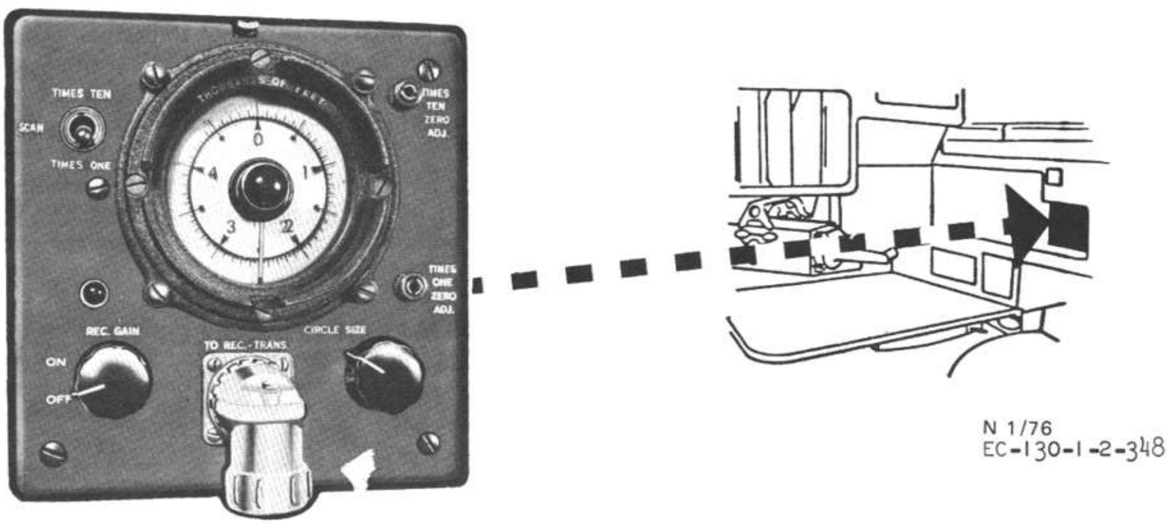


Figure 1-115.

RADIO ALTIMETER (AN/APN-133)

A radio altimeter (figure 1-115) is provided at the navigator's station to indicate the altitude of the aircraft above the terrain. The radio altimeter operates from 115-volt ac from the main ac bus through the high range altimeter circuit breaker on the copilot's upper circuit breaker panel.

Note

The terrain clearance indications received from the radio altimeter are unreliable when operating over large depths of snow and ice, since the radio waves will prenetrate the surface and indicate a greater terrain clearance than actually exists.

RADIO ALTIMETER CONTROLS.

All operating controls of the radio altimeter are located on the front panel of the indicator. Controls are provided for adjusting the circle size, range, receiver gain, and the reference lobe position.

NORMAL OPERATION OF THE RADIO ALTIMETER.

To put the radio altimeter into operation:

1. Rotate the rec gain knob clockwise to turn power on.

CAUTION

Do not turn on during normal ground operations. Receiver overloading may occur.

2. Position the scale switch to the desired range.

3. Allow a 3-minute warmup period.

4. Adjust rec gain and circle size as required. Set zero adjustment on the times 1 and times 10 scale prior to each reading taken, to position the counterclockwise edge of the altitude pulse on zero.

To turn the radio altimeter off:

5. Rotate the rec gain knob to the extreme counterclockwise position.

RADAR ALTIMETER (AN/APN-194) (EC-130Q AIRCRAFT BUNO 159348 AND 159469).

A radar altimeter on the pilot's instrument panel (figure 1-89) is provided to indicate the terrain clearance of the aircraft. Altitude above the terrain is indicated, in feet, on a calibrated indicator located on the pilot's instrument panel. The radar altimeter operates from 28-volt dc from the essential dc bus and 115-volt ac from the essential ac bus through low range altimeter circuit breakers on the copilot's upper circuit breaker panel.

Note

> The terrain clearance indications received from the radar altimeter are unreliable when operating over large depths of snow and ice, since the radar waves will penetrate the surface and indicate greater terrain clearances than actually exist. Indications are also unreliable above 5,000 feet absolute altitude.

RADAR ALTIMETER CONTROLS. The only control for the radar altimeter is the on-limit press-to-test knob. Rotating the on-limit knob to move the preset altitude indicator pointer above zero turns the radar altimeter on and sets the clearance altitude below which warning will be given. A warning altitude low light located adjacent to the radar altimeter glows when the aircraft is below the preset altitude. The press-to-test knob provides a self test of the radar altimeter. When held depressed, the knob causes the altitude pointer to move to 100 ± 10 feet and the green self-test light to illuminate.

NORMAL OPERATION OF THE RADAR ALTIMETER. To put the radar altimeter into operation:

1. Rotate the on-limit knob clockwise.

2. Set the desired altitude reference with the on-limit knob, and allow 5 minutes warmup before relying on the indications.

To test the radar altimeter for correct operation:

3. Hold the press-to-test knob depressed and observe that the indicator is indicating a test altitude of 100 ± 10 feet and that the self-test light illuminates.

To turn the radar altimeter off:

4. Rotate the on-limit switch to the extreme counterclockwise position.

RADAR SET (AN/APN-59).

Radar set AN/APN-59 is designed to operate as a navigational and search radar, a weather radar, or a racon (beacon) interrogator-receiver. When used as a search radar, it displays a map-like scope picture showing cities and smaller terrain features, rivers, islands, shorelines, mountains, ships, and other aircraft, up to a distance of 240 nautical miles. When used as a weather radar, it displays storm fronts, heavy rainfall, or other turbulent weather features with precipitation. When used for racon navigation, it transmits an interrogating signal and then displays, in plan position, the space-coded identification of the automatic racon replay or replies. The radar set enables the navigator to see targets or check points on the ground through clouds, fog, overcast, or darkness. It enables him to determine accurate ground speeds and ground tracks. It is not, however, a means of navigation by itself, but is a means of establishing an accurate position so that conventional methods of dead reckoning can be supplemented. The radar set operates on 28-volt, dc power from the main dc bus and 115-volt primary ac power from the main ac bus through the radar circuit breakers on the copilot's upper circuit breaker panel. The radar set is also protected by five fuses that are located on the receiver transmitter unit in the nose wheel well.

WARNING

> Dangerous voltages (at times as high as 15,000 volts) are present in radar set AN/APN-59. Do not attempt to make any internal repairs or adjustments. If such repairs or adjustments are necessary, notify authorized service personnel.

Radar Set Controls.

Note

The following indications are for operational use and should not be confused with maintenance instructions.

Functional control of the set is accomplished from a radar control panel, a synchronizer control panel, and by controls located on the two indicators (figure 1-116). Selection of radar function, range, type of scanning, and antenna tilt is done on the radar control panel. By selecting the proper combination of switches, the desired function and indicator presentation can be obtained. The following controls, located on the radar control panel at the navigator's station, are used for operating the radar set.

RANGE SELECTOR - Selects desired range.

FUNCTION SWITCH -

OFF position - No power to set.

STANDBY position - Used for the 3-minute warmup. In this function the magnetron is not operating.

SEARCH position - Presents a visual map-like scope picture.

BEACON position - Presents a space-coded identification of radar beacons.

WARNING position - Used to detect weather buildups.

TEST METER - MIXER CONTROL - Used to monitor line, magnetron, mixer and AFC systems voltages. Line voltage should be 0.6 (+10)% and steady. Magnetron voltage should read approximately 0.5 and steady. Mixer No. 1 and No. 2 and AFC No. 1 and No. 2 voltages should read 0.6 (+40)% and steady. If line voltage fluctuates, have the flight engineer check the aircraft power supply for fluctuation.

SCAN SELECTOR - Used to select type of antenna scan. The following selections may be made with the SCAN SELECTOR.

L - Rotates counterclockwise (12 rpm).

OFF - Antenna is stationary.

R - Rotates clockwise (12 rpm).

PPI - Rotates clockwise (12 or 45 rpm).

SECT. - Antenna scans back and forth across lubber line of the aircraft.

HDG SEL CONTROL - Numeral in window at left of control shows knob setting. Used in conjunction with the bearing switch.

GAIN CONTROL - Used to adjust receiver gain. OFF is fully counterclockwise.

TILT CONTROL - Used to control tilt of radar antenna beam.

STAB SWITCH - Used to select stabilization of antenna.

UP - The antenna is stabilized perpendicular to the earth throughout rotation.

NEW NEW NEW

CAUTION

Place the SCAN selector to OFF, prior to changing PATT switch.

DOWN - The antenna is locked to the plane of the aircraft (normally used during all ground operations or in turbulance above moderate).

STC CONTROL - Reduces gain on short range returns. Inner knob controls the amount of reduction. Outer knob controls the range (maximum of approximately 40 miles).

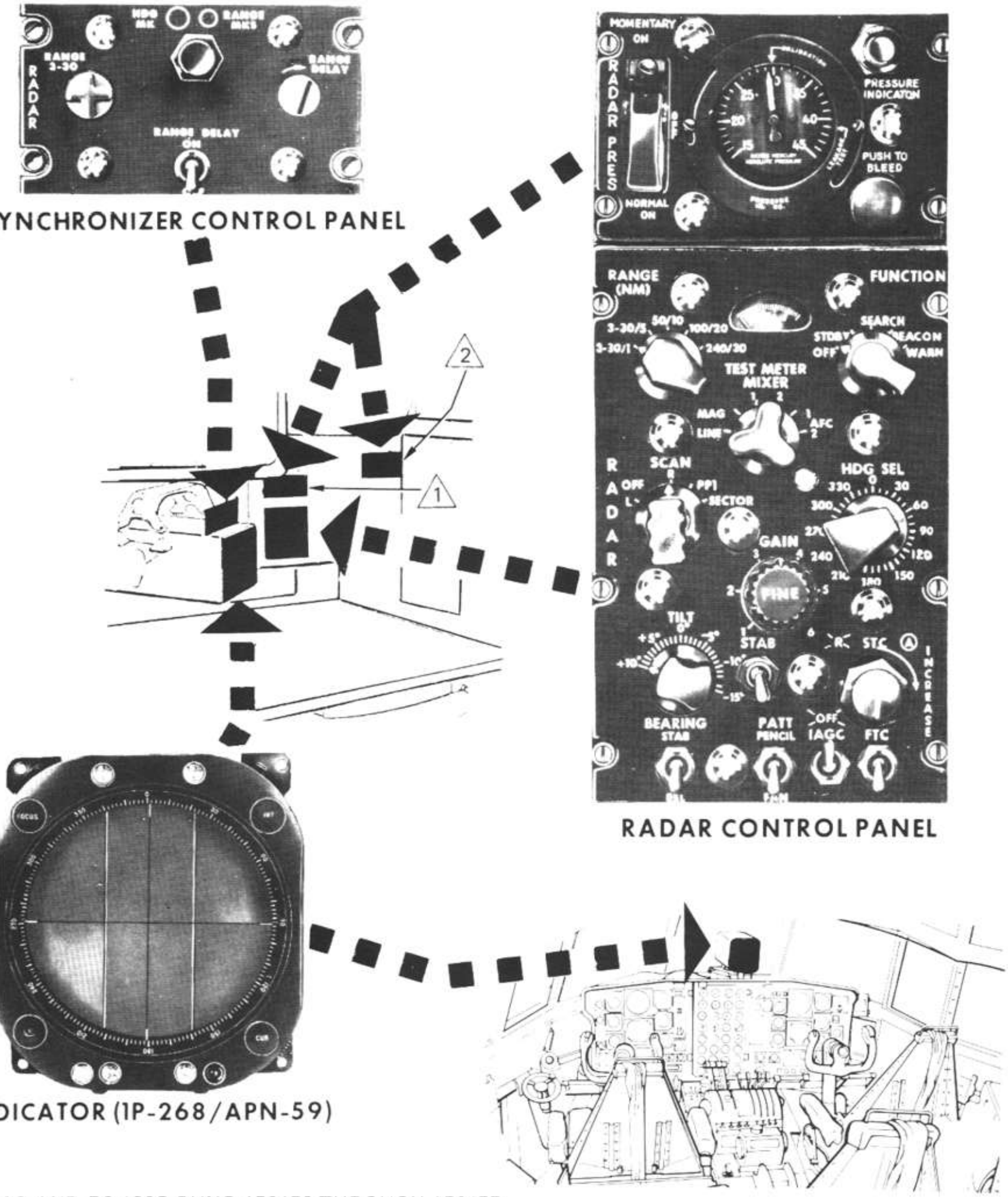
OFF - Turn inner knob fully counterclockwise.

BEARING SWITCH - Used to select PPI reference azimuth.

STAB - PPI top center is magnetic north plus HDG SEL setting.

REL - PPI top center is aircraft heading.

search radar control panels and indicator (AN/APN-59)



NOTE

1 EC-130G AND EC-130Q BUNO 156170 THROUGH 156177

2 EC-130Q BUNO 159348 AND 159469

N 1/76
EC-130-1-0-349

Figure 1-116.

PATT SWITCH - Used to select type of radar beam.

IAGC SWITCH - Used to reduce gain of strong returns. System is operating when in the up position.

FTC SWITCH - Used to break up large target area returns. In the down position the system is inoperative.

The following controls are located on the synchronizer control at the navigator's station:

RANGE DELAY CONTROL - Used to set in the amount of desired range delay.

RANGE DELAY SWITCH - Used to turn on range delay.

RANGE MKS - Used to adjust intensity of range marks.

RANGE 3-30 CONTROL - Will vary range on scope from 3 to 30 miles. Fully counterclockwise represents 3 miles on scope.

HDG MK CONTROL - Varies the intensity of the heading mark. The mark is black in its extreme clockwise position. As the control is turned in a counterclockwise direction, the mark disappears and then reappears as a bright mark on the extreme counterclockwise position.

The following controls are located on the IP-268/APN-59 indicators that are located above the main instrument panel and at the navigator's station:

INT. CONTROL - Used to adjust intensity of PPI trace for best signal visibility and contrast. Optimum setting is just visible with receiver gain at minimum.

FOCUS CONTROL - Used to adjust focus of sweep trace.

VIDEO GAIN ADJUSTMENT - Used to adjust intensity of PPI picture for best contrast.

S-R SWITCH - To select slaved ("S") or relative ("R") PPI orientation for pilot's indicator.

RETICLE - Used to facilitate offset-track flying.

RETICLE GEAR - Used to move reticle.

DIAL DIM CONTROL - Used to adjust azimuth ring illumination.

AZIMUTH RING - Used to read azimuth of targets.

CURSOR - Used to indicate azimuth of targets.

CURSOR CONTROL - Used to move cursor.

RANGE-INDICATOR LAMPS - Used to indicate range selected for display.

Normal Operation of the AN/APN-59B Radar Set.

To put the AN/APN-59 Radar Set into operation:

1. Turn all controls on control panel to off, zero, down or fully counterclockwise. The range switch selected to 50/10 NM or less.

2. Turn the synchronizer/indicator heading/range marks and intensity fully counterclockwise. Turn range delay OFF.

3. Turn function switch to STANDBY and allow a 3-minute warmup.

Note

For best results, avoid using the WARNING function, the 100/20, or the 240/30 ranges for the first 10 minutes of operation.

4. Turn function switch to SEARCH.

5. Check with the test meter for proper voltages in all systems.

6. Turn function switch to BEACON and check with test meter for proper voltages.

7. Turn the test switch to the MAG position for inflight monitoring.

8. Select type of scan desired.

9. Turn the intensity control (on indicator) until a faint sweep appears on the face of the scope.

10. Adjust the heading and range markers.

11. Adjust the gain control for best scope presentation; use the tilt control in conjunction with gain control.

To turn the radar set off:

12. Turn the intensity, range and heading mark controls on the synchronizer/indicator fully counterclockwise.

13. The radar control panel shut down sequence: Gain control fully counterclockwise, SCAN switch to OFF, STAB switch to OFF, function switch to STANDBY, and all remaining controls to down, off, zero, or fully counterclockwise.

14. After 30 seconds, turn the function switch OFF.

RADAR PRESSURIZATION.

Pressurized air for operation of the AN/APN-59 receiver-transmitter and a radio frequency wave guide is supplied by a pressure pump mounted on the right-hand under-deck rack. The pressure pump draws air from the cabin through a dehydrator, and then pressurizes the air before it is routed to the units. The pump operates from the main 28-volt dc bus through a circuit breaker on the copilot's upper circuit breaker panel.

Radar Pressurization Controls and Operation.

During the leakage test, hold the switch in the MOMENTARY ON position until the pressure gage indicates approximately 40 inches of mercury. The system should hold the pressure within 2 inches of mercury for approximately 10 minutes.

The radar pressurization system control panel (figure 1-117) at the navigator's station has a radar press switch, a pressure gage, and indicator light, a push to bleed valve. The radar press. switch is a 3-position (NORMAL ON, OFF, MOMENTARY ON), guarded toggle switch that selects the desired type of system operation. When the switch is in NORMAL ON position, operation of the pressure pump is controlled automatically by the action of a pressure switch in the system. When the switch is in the spring-loaded MOMENTARY ON position, the pressure pump is manually actuated, and continues to operate until the switch is released. The indicator light glows when the pump is in operation. If the pressure exceeds its specified limits, as indicated on the pressure gage, stop the pump by placing the radar press. switch in OFF position. Excessive pressure may be bled from the system by depressing the push to bleed valve.

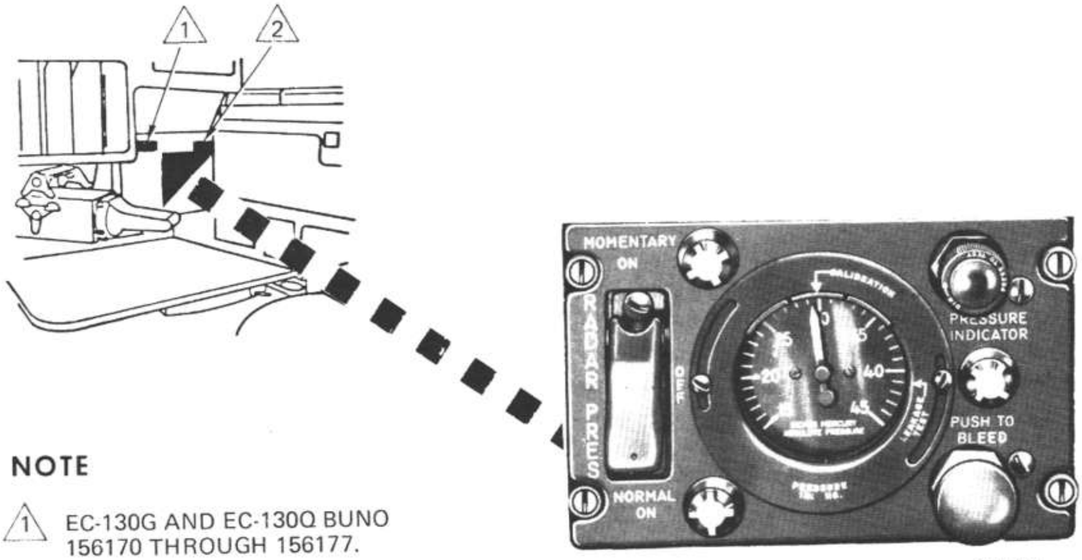
CAUTION

- At no time during this check should the pressure be allowed to exceed 41 inches of mercury or the aircraft structure may be damaged.
- Do not operate the radar set until the radar transmitter-receiver pressure gage reads 27 to 32 inches of mercury. By maintaining this pressure, arc-over is prevented within the receiver-transmitter and the waveguide pattern is held normal regardless of aircraft altitude.
- Monitor automatic pressurization inflight; select OFF and use MOMENTARY ON to manually maintain pressure if necessary.

DOPPLER RADAR NAVIGATION SYSTEM (AN/APN-153V).

The Doppler radar navigational system, provides continuous and directly measured groundspeed and drift angle information while the aircraft is in flight. This information is visually presented on the drift angle dial and the groundspeed counters located on the control indicator panel (figure 1-118) on the navigator's control panel. The Doppler information is also available as electrical output signals fed to the AN/ASN-41 navigation computer which computes and visually displays direct reading indications of track angle and distance. The Doppler radar navigation system is self-contained, operates at any altitude, and functions independently of any ground installation. The system is effective at all altitudes above 40 feet and at airspeeds of 80 knots and above. The system is capable of determining drift up to 40 degrees on either side of the aircraft heading. The system uses a stabilized antenna array. By measurement and comparison of beams of energy radiated from the transmitting antennas and reflected back to the receiving antennas, both groundspeed and drift angle are determined. The Doppler navigation system operates on 115-volt ac power from the essential ac bus through a Doppler radar circuit breaker on the copilot's upper circuit breaker panel.

radar pressurization control panel



NOTE

⚠1 EC-130G AND EC-130Q BUNO 156170 THROUGH 156177.

⚠2 EC-130Q BUNO 159348 AND 159469.

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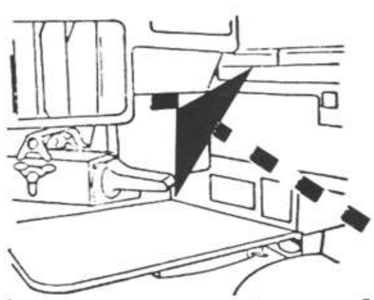
EC-130-1-0-350

Figure 1-117

doppler radar navigation control panel (AN/APN-153V)



(EC-130G aircraft)

(EC-130Q aircraft)

NOTE

⚠1 BUNO 156170 THROUGH 156177

⚠2 BUNO 159348 AND 159469

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Figure 1-118

Doppler Radar Navigation System Controls.

Controls and indicators for the Doppler radar navigation system (figure 1-118) are located on the navigator's control panel. The panel contains all the operating controls and operating indicators for the radar system.

MODE SELECTOR SWITCH. A five-position (OFF, STAY, ON-LAND, ON-SEA, TEST) rotary selector switch controls power to the radar, provides correct calibration for land or sea operation, or provides an overall go/no-go test of the operation. The OFF position of the selector switch removes all power from the radar; the STBY position applies power to all circuits with the exception of modulator power to drive the magnetron. The ON-LAND or ON-SEA positions apply power to all circuits and provide correct radar calibration for either land or sea operation. The TEST position provides an overall go/no-go check of the radar set.

DRIFT ANGLE AND GROUNDSPEED SELECT SWITCH. Drift angle (DA) and groundspeed (GS) push-to-turn controls allow the operator to insert drift angle and groundspeed information while the radar is off or in memory operation.

Doppler Radar Navigation System Indicators.

MEMORY LIGHT. The MEMORY light on the control panel goes on when the radar is in memory operation. The light goes out when the radar is operating normally or when the selector switch is in the TEST position. Power to operate the light comes from the 115-volt ac essential bus through the Doppler radar circuit breaker on the copilot's upper circuit breaker panel.

DRIFT ANGLE AND GROUNDSPEED INDICATOR. A drift angle and groundspeed indicator gives aircraft drift angle, left and right, up to 40 degrees of aircraft centerline. The gnd speed counters indicate aircraft groundspeed from 0 to 999 knots.

Operation of the Doppler Radar Navigation System.

The Doppler radar is controlled from the control indicator panel on the navigator's control panel. The system goes into operation when the aircraft reaches 40 feet of altitude and at a minimum groundspeed of 80 knots. Prior to reaching operating altitudes and groundspeed, the groundspeed and drift indicators remain at values manually set into the system prior to take-off. In this condition (memory mode) the memory warning light is on.

NORMAL MODE. This mode of operation is automatically achieved when the aircraft reaches minimum operating altitude and groundspeed. The selector switch on the control panel allows selection of LAND or SEA operation dependent on the aircraft location.

MEMORY MODE. The radar set goes into memory mode of operation when the Doppler return signals are weak or absent. This condition may occur over smooth water. As long as the radar is in memory mode, the memory light on the control panel will remain on and the groundspeed and drift angle readings will remain at the reading existing at the time the signal was lost. During memory operation, groundspeed and drift angle information may be manually inserted into the radar using the GS and DR push-to-turn controls on the control indicator. When a usable Doppler return signal is received, the radar will automatically lock-on the signal, the memory light will go off, and the radar will return to the normal mode of operation automatically.

Note

> The Doppler radar may go into memory mode as a result of a voltage transient such as is caused by starting the auxiliary hydraulic motor. After any transient voltage condition which causes the Doppler to go to memory mode, the Doppler must be turned to OFF and recycled to obtain proper operation. If the memory light remains on for 3 to 5 minutes and the cause of light is doubtful, recycle the system.

TEST MODE. The test mode allows the operator to make a quick self-test of the Doppler radar to determine if it is operable. When the radar is in test mode, the memory light is out, the gnd speed counter will indicate 121 (±3) knots, and the drift angle dial will indicate 0 (±2) degrees. If the memory light goes on when the radar is in test mode, a no-go condition occurs indicating a failure in the radar set.

SELF-TEST OPERATING PROCEDURES. The following procedure is used to perform the self-test operation of the Doppler radar system on the ground or while the plane is airborne:

1. Assure that the Doppler radar circuit breaker on the copilot's upper circuit breaker panel is engaged.

2. Place the selector switch on the Doppler control panel in the STBY position.

3. Observe that the memory light goes on within 5 seconds. If the light fails to go on, use the press-to-test feature of the light to ensure that the bulb is not defective.

4. Place the selector switch in the TEST position.

5. Observe that, within one minute, the memory light goes off, gnd speed counters indicate 121 (±3) knots, and drift angle dial indicates 0 (±2) degrees.

6. If the memory light remains on during the self-test, a no-go condition is indicated.

NAVIGATIONAL COMPUTER SYSTEM (AN/ASN-41).

The navigational computer combines both navigation and wind memory capabilities. The latitude and longitude of the aircraft's present position, the ground track angle, and the great circle distance and bearing from the aircraft's position to a preset target or to preset base coordinates are displayed by the computer. The great circle computation is changed to a rhumb line course when the aircraft is within 200 miles of destination.

The computer operates in three modes: doppler, memory, and air mass. In the doppler mode inputs of groundspeed and drift angle are fed in from the AN/APN-153V doppler system. At the same time airspeed and magnetic heading information is provided from the true airspeed synchrotel and the AHRS. On aircraft modified by C-130 AFC No. 126 airspeed information is provided from the true airspeed synchrotel through a servo repeater. The servo repeater conditions the true airspeed signal to match the computer input characteristics. These inputs are used to compute groundspeed and airspeed vectors. The groundspeed vector is used for dead reckoning and is compared with the airspeed vector to provide continuous values of wind direction and speed.

When the computer is in the memory mode the last reliable wind vector is retained and combined with new airspeed information to provide a new groundspeed vector. This mode is automatically entered by the computer when there is a temporary loss of doppler information.

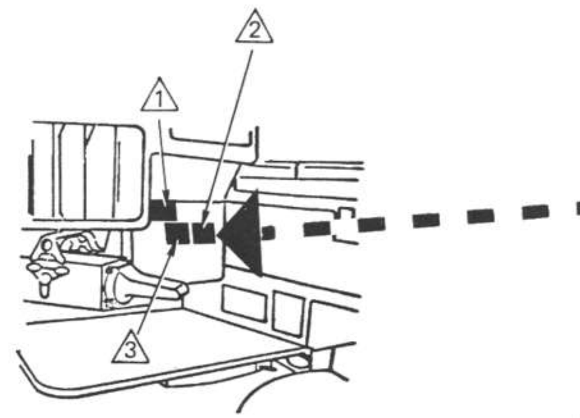
If the doppler is completely inoperative the computer is operated in the air mass mode. Wind direction and speed are manually slewed into the computer. The airspeed vector is combined with this wind vector to provide a readout of groundspeed and direction.

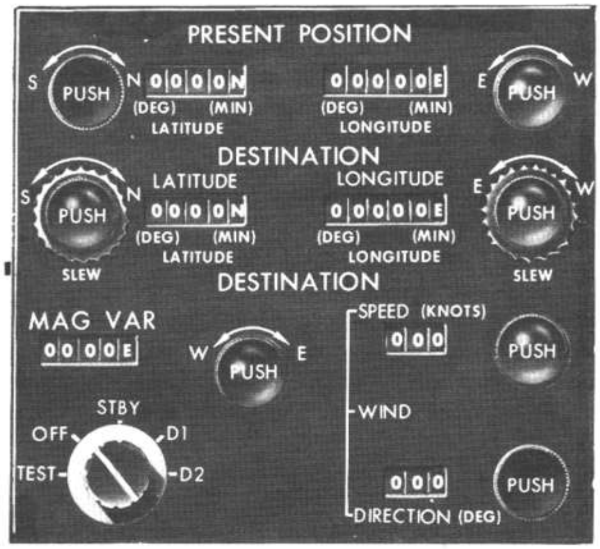
The navigational computer receives 115-volt ac power from the essential ac bus through the doppler computer circuit breaker on the copilot's upper circuit breaker panel.

Computer System Controls.

COMPUTER CONTROL. The computer control (figure 1-119), mounted the navigator's control panel, houses the computing mechanism, controls, and the cam compensators for calibration of the magnetic compass and true airspeed transmitter. A magnetic variation knob is used for manual insertion of magnetic variation. This datum is obtained from charts of local areas and usually is the average variation for the area to be traversed. A magnetic variation counter, adjacent to the knob, displays the manually inserted magnetic variations in one-degree increments to 180 degrees east and 180 degrees west. The display remains until manually changed. A wind direction knob is used for manual insertion of wind direction input. This datum is obtained from meteorological forecasts or from estimates based on known error accumulations during flight. When the computer is operating, this information is inserted only during air mass mode operation. A wind direction counter, adjacent to the knob, displays the manually inserted wind direction input in one-degree increments from 0 to 360 degrees. The display remains until manually changed. A wind speed knob is used for manual insertion of wind speed. This data is obtained from the same source as the wind direction and is inserted only during air mass mode operation. A wind speed counter adjacent to the knob displays the manually inserted wind speed in 1-knot increments from 0 to 200 knots. The display remains until manually changed. A five-position (TEST, OFF, STBY, D1, D2) function switch provides on-off control of the system and selection of the mode of operation. When placed in the TEST position, fixed inputs are inserted. This provides integrity testing of the complete system since a known test solution must be displayed by the computer. When the function selector is placed to OFF, the following values can be set into the computer: present position latitude and longitude, destination latitude and longitude, magnetic variation, wind speed, and wind direction. In STBY position, the computer will synchronize all circuits except the present position integrator (to prevent integration of minimum values of true airspeed). The first destination (D1) is stored at this time and the BDHI indicates the course and distance

navigational computer system AN/ASN-41 , controls





NOTE

1. EC-130Q BUNO 159348 AND 159469
2. EC-130Q BUNO 156170 THROUGH 156177
3. EC-130G

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Figure 1-119.

to D1. Upon takeoff, the function selector is set D1 which places the computer system on operation and starts integration of the present position. As soon as the doppler begins to feed in groundspeed and drift angle data, the computer switches into the doppler mode of operation. In this mode wind information is automatically computed. When the ground-track and the course-to-destination pointers on the BDHI are coincident, the pilot is flying the shortest course (great circle if over 200 miles) to his destination. Any time after this initital heading selection, the function selector can be set to D2, and the destination latitude and longitude for the second destination can be stored in the computer. By returning the function selector to D1 the pilot can continue to fly to the initial destination. The destination information cannot be removed by switching between D1 and D2.

Bearing-Distance-Heading Indicator.

A bearing-distance-heading indicator (BDHI) (figure 1-89) is located on the pilot's instrument panel. The indicator displays the true heading of the aircraft, the relative bearing to either D1 or D2, the relative ground track of the aircraft, and the distance to either D1 or D2 as selected. The relative bearing to D1 or D2, is read from the number 1 needle. The ground track of the aircraft is read from the number 2 needle. The distance to either D1 or D2 is displayed on a counter on the indicator. The counter reads in miles from 000 to 999. A warning flag with the word OFF on it is provided on the indicator.

Normal Operation of the Computer System.

1. Prior to take-off, with the selector switch in the OFF position, the present position latitude and longitude, destination latitude and longitude, magnetic variation, wind speed, and direction counters are manually set with the push-to-set knobs.

2. When ready for take-off, the selector is placed in STBY position. This applies power to all circuits except the present position integrators. The D1 coordinates are stored in the computer and the BDHI indicates the course and distance to D1.

3. On take-off, the selector switch is set to D1 which starts integration of the present position. The computer automatically switches to doppler mode when the doppler radar begins supplying groundspeed and drift angle data. In this mode, wind information is automatically computed.

4. When sufficient altitude is attained to assure proper doppler operation, the aircraft may be turned until the ground track and course-to-destination pointers of the BDHI coincide. The aircraft is then

flying the shortest course to the destination (great circle if over 200 miles to destination).

5. Anytime during the flight the computer can be switched to D2 and the coordinates for the second destination inserted. In addition the selector switch may be set to D1 or D2 at anytime to insert new present position data without disturbing the stored destination data or interrupting computations.

6. During flight magnetic corrections must be updated.

7. A new destination position may be inserted at any time with the selector switch set to either D1 or D2. Destination coordinates cannot be changed when the selector switch is in STBY. Thus any number of legs may be flown by alternately updating D1 and D2.

Emergency Operation of the Computer System.

Should the doppler radar fail, the computer will automatically switch to air mass mode. In this mode, wind data must be estimated and inserted into the computer. When doppler signals again become available, new wind data will automatically be computed.

Self-Testing the Computer System.

The AN/ASN-41 navigational computer incorporates a self-test feature. The self-test procedure is as follows:

1. Set the function selector switch to OFF.

2. Set the present position coordinates of the aircraft on the present position counters.

3. Set in the first destination coordinates on the destination counters.

4. Set in the magnetic variation (the average of the variation at the present position and the destination).

5. Place the function selector switch to STBY and allow 2 minutes for warmup.

6. Place the function selector switch to TEST.

7. The wind speed counter should read 223.6 (±1.5) knots. The wind direction counter should read 090.6 (±1.5) degrees. The present position latitude counters should move in a southerly direction, and the present position longitude counters should move in an easterly direction.

8. Observe the navigation computer BDHI on the pilot's instrument panel for distance and bearing to the destination.

9. Rotate the function selector switch to D2, and set in the coordinates of the second destination.

10. Return the function selector switch to D1, and allow the counters to stop.

11. Place the function selector switch to STBY, and make necessary corrections to the present position or destination coordinates.

RADIO COMPASS (AN/ARN-6) (EC-130G AIRCRAFT).

The dual radio compass installation provides direction finding and homing in the 100- to 1750-kilohertz range. It also may be used as a communication and range receiver in the 100- to 1750-kilohertz range. Control panel for the No. 1 radio compass is located on the navigator's panel, and for the No. 2 radio compass on the flight control pedestal. Bearing information is shown on the ADF rmi or ADF bdhi on the pilot's and copilot's instrument panels and on the ADF rmi or ADF/TAC bearing-distance-heading indicator (bdhi) on the navigator's instrument panel. The No. 1 bearing pointer of these indicators operates from the No. 1 radio compass, and the No. 2 bearing pointer operates from the No. 2 radio compass. ADF 2 information fed to the navigator's ADF/TAC rmi or ADF/TAC bdhi is displayed only if the tac 1, adf 2 pointer sel switch on the navigator's instrument panel (figure 1-11) is positioned to ADF 2. Audio signals from the radio compass(es) are available through the intercommunication system. The radio compasses operate from 28-volt, power from the essential dc bus through circuit breakers located on the copilot's upper circuit breaker panel. The loop antenna assemblies operate from 36-volt ac power through ME-1 amp circuit breakers located on the pilot's upper circuit breaker panel.

Radio Compass Controls.

A function switch with OFF, ADF, ANT, LOOP, and CONT positions selects the type of operation of the radio compass. A loop control knob provides for rotation of the loop antenna. The volume knob controls the audio output to the intercommunication system. The band switch and tuning crank provide for frequency tuning. A cw-voice switch controls the beat frequency oscillator.

Normal Operation of the Radio Compass.

To put the radio compass into operation:

1. Place the function switch in the ANT position.

2. Allow a 5-minute warmup period.

3. Place the cw-voice switch in the desired position.

4. Pull the appropriate adf switch on the intercommunication system control panel.

5. Select the operating frequency with the band switch and tuning crank.

To use the radio compass for automatic **position** finding:

6. Move the function switch to the ADF position.

To use the radio compass for aural-null position finding:

7. Move the function switch to the LOOP position.

8. Rotate the loop with the loop l-r control **knob.**

To turn the radio compass off:

9. Place the function switch in the OFF position.

LORAN LONG-RANGE NAVIGATION EQUIPMENT (AN/APN-70).

The loran navigation equipment provides reception of loran signals on both the high-frequency and low-frequency bands. The receiver is the direct-reading type, where the "indicated time difference" is shown in microseconds on revolution counters. Charts and tables are used for interpreting the loran readings to determine the geographical location of the aircraft. The equipment is powered by 28-volt dc and 115-volt ac power from the essential ac and dc buses through circuit breakers located on the copilot's upper circuit breaker panel. The loran indicator and receiver are located at the navigator's stations.

Loran Controls.

All operating controls of the loran equipment are located on a control panel (figure 1-120) on the loran receiver. Adjustment controls for focus and intensity of the signals shown on the indicator screen are located on the loran indicator. The purpose of each control is as follows:

W-DELAY AND Y-DELAY COUNTERS - These two cranks are revolution counters which give a direct reading of delay time in microseconds.

R-RATE CONTROL - Used in conjunction with channel selector to obtain desired loran station.

L-R SWITCH - Used to move the pulses to position the master (leading pulse) pulse on the master pedestal.

ADC (Automatic Drift Control) - Locks master pulse in position.

CHANNEL SELECTOR - Used in conjunction with r-rate selector to obtain the desired loran station. The channel selector has HF positions 1, 2, 3, and 4 and LF positions of 5 and 7.

GAIN CONTROLS - The three knobs are used to vary the corresponding pulse amplitudes. The master-xz knob controls the power to the set; the full counterclockwise position turns the set off.

FUNCTION SWITCH - The first three functions are used in taking fixes and in primary calibration of the set. Function four is used for homing and for r-rate variable delay cross check. Function five is used for set calibration.

HF-DELAY - This control is used to divide the set to permit taking time difference readings from two stations almost simultaneously.

loran controls

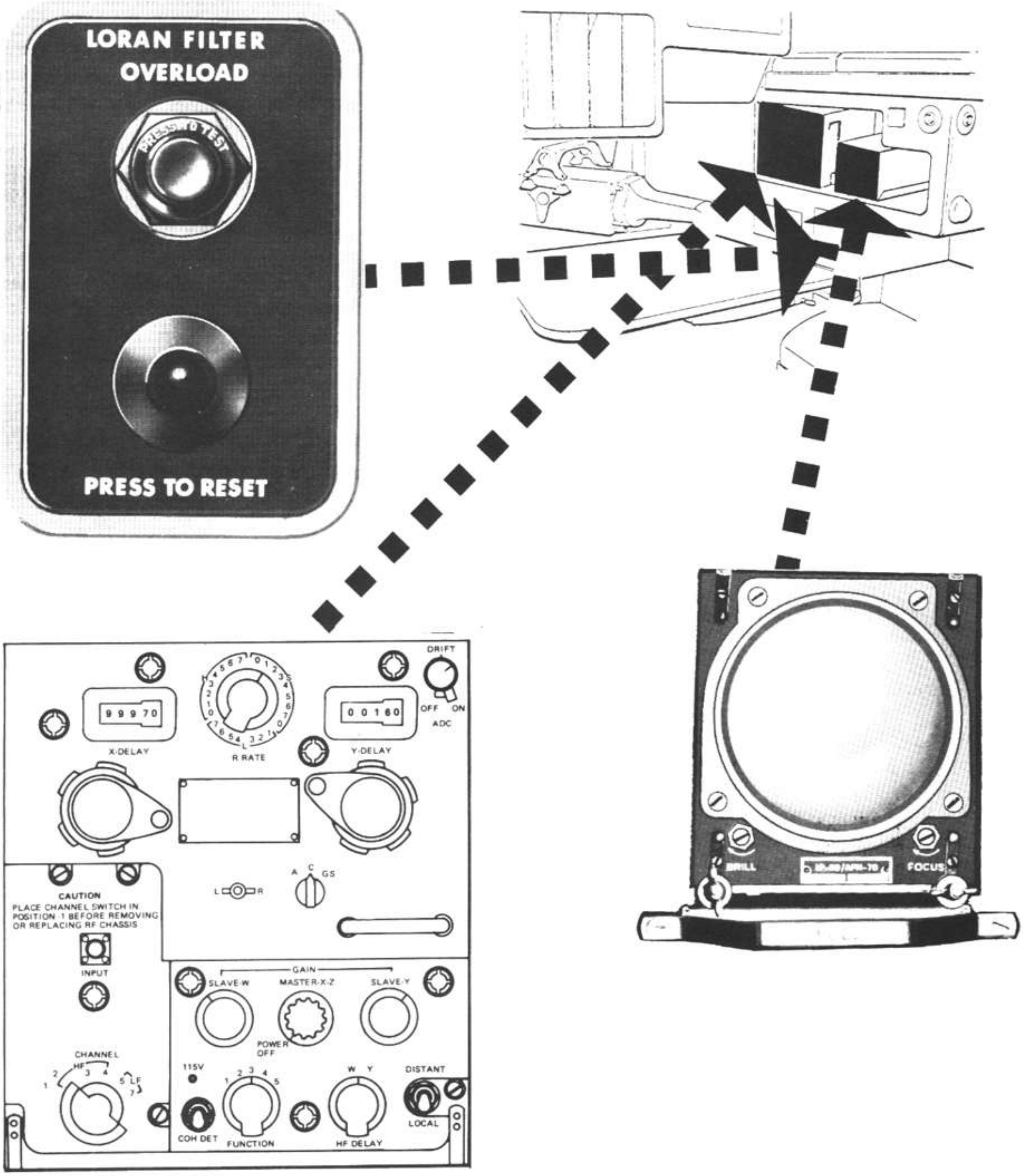

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Figure 1-120.

LOCAL-DISTANT SWITCH - This switch on the receiver changes signal amplification in the antenna coupler.

Loran Filter Overload Panel.

The Loran filter overload panel(figure 1-120)consists of an overload indicator light and a reset switch. When an overload condition exists, the overload light will illuminate. Pressing the reset switch will return the Loran to normal operation and extinguish the overload light.

Normal Operation of Loran.

1. Rotate the master-xz knob clockwise to turn the set on. Allow one minute for warmup.

2. Select desired mode of operation (A, C, or CS) with the mode selector.

3. Select and set in the desired loran station with the channel and r-rate selector switches.

4. Turn the function switch to 1.

5. Use the X controls to obtain the two pulses.

6. Position the leading pulse on the top pedestal by using the X delay knob and L-R switch.

7. Obtain LOP using functions 2 and 3.

8. Put hf-delay switch to Y.

9. Obtain a second LOP according to the instructions in steps 2 through 6.

10. To turn the set off, turn the master-xz switch fully counterclockwise.

11. When a Loran overload condition occurs, press reset switch.

Emergency Operation of Loran.

The two readings required to find the location of the aircraft are normally made on separate delay channels. If one of the delay channels becomes defective, both readings may be made on the operating delay channel. Since the two readings cannot be made simultaneously, allowance must be made for the time elapsed between the readings.

OMEGA RADIO NAVIGATION SYSTEM (ARN-99(V)4).

The omega radio navigation system (figure 1-121) uses VLF radio signals from strategically placed transmitting stations spotted over the globe. Synchronization of each station's transmission and the discrete frequency assignment of each station allows continuous sampling of data from the closest three of eight possible worldwide transmitting stations. These data are processed by the aircraft omega system to establish and display a continuous indication of the aircraft's longitude and latitude. By integration of the omega system data with data from the aircraft's true airspeed system and C-12 magnetic compass, range and bearing to a destination, track angle, ground speed, time enroute, and wind vectors can be resolved and displayed in digital form at the navigator's control indicator panel. The only pre-operation setup required by the operator is the entry of time (date/GMT) and aircraft position (latitude and longitude).

The omega system consists of the following units: The omega control indicator located on the navigator's control panel; a receiver-computer located under the flight deck bunk; and an antenna-coupler located on the upper center fuselage (fuselage station 712) just forward of the dorsal fin. The receiver-computer is supplied 115-volt ac power from the essential ac bus through the omega circuit breakers on the copilot's upper circuit breaker panel; the reference oscillator is supplied 28-volt dc power from the essential dc bus through the omega circuit breakers on the copilot's upper circuit breaker panel.

Omega Controls.

The control-indicator (C/I) is comprised of thirteen switches/indicators. These are used for numeric input, mode/station selection, and output display selection. The mode selector switch and annunciators are used to perform the following functions:

PANEL TEST. Actuation of the PANEL TEST pushbutton causes all of the indicators on the C/I unit to light up for a two-second period, then return to the quiescent state.

A secondary function of this switch is to reset the system malfunction indicator. If at the completion of the panel test routine the indicator remains off,

omega control-indicator panel arn-99(v)4

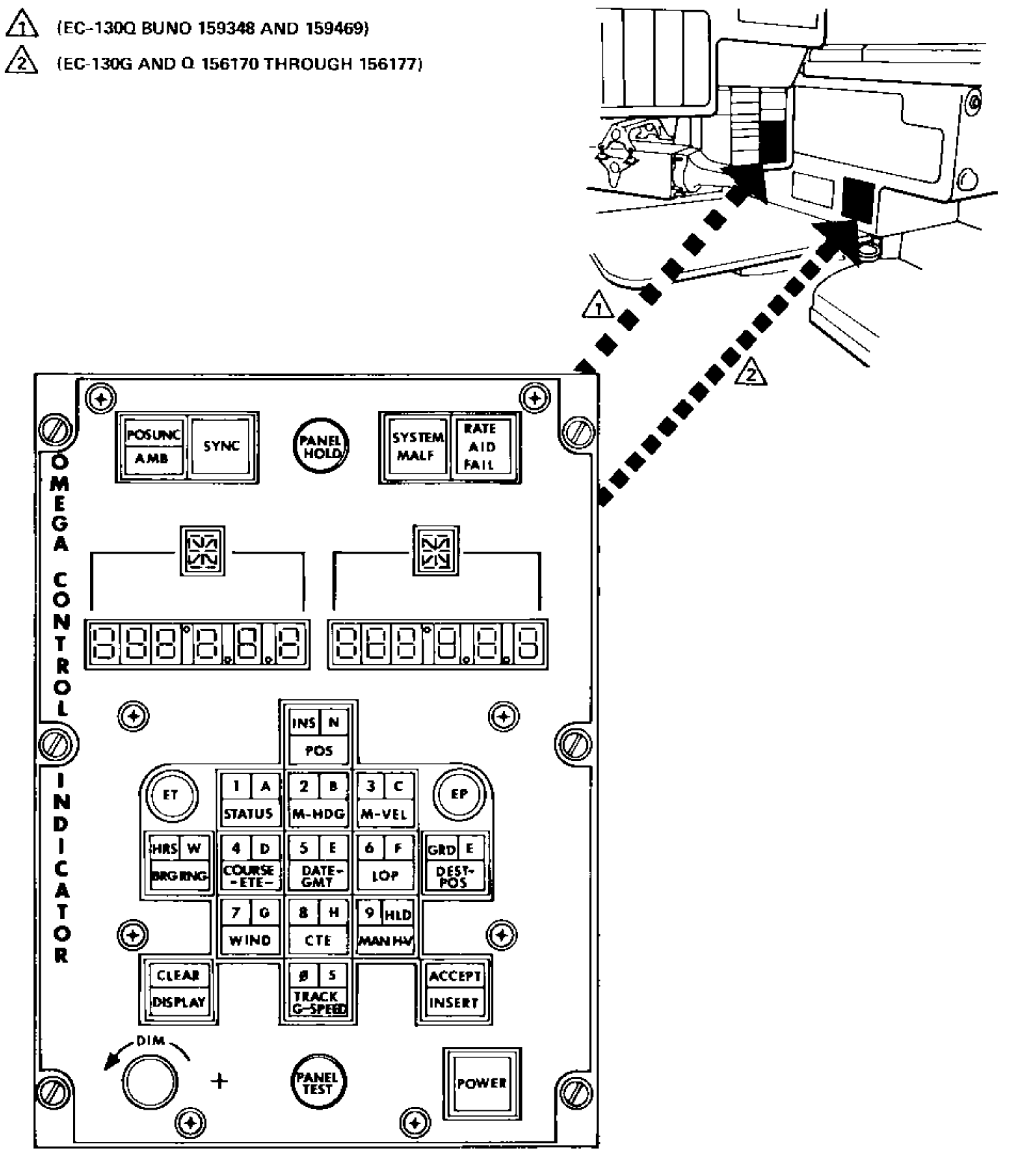

Figure 1-121.

the detected failure is of a one-time or an intermittent nature. The indicator will remain off until self-test has detected another failure. If the indicator remains on, the failure is of a "hard" type.

SEGMENT DISPLAYS. The two single-character alpha displays and the two six-character numeric displays show the data output selected by the keyboard pushbuttons.

DIM. This is a potentiometer which varies the intensity of the panel indicators, but does not control the edge lighting.

PANEL HOLD. The PANEL HOLD pushbutton is pressed to freeze the navigation parameters to allow data-taking at points of interest (on top marks, terminal position, etc.). Although the computer continues to navigate, the displayed data will be frozen at whatever values they were when the pushbutton was pressed. The PANEL HOLD is released and the light goes out when the pushbutton is pressed a second time.

ET AND EP. The ET and EP lights are indicators only. The ET light comes on after power on requesting a date/time input. Once date/time have been entered the indicator will remain off until the next power cycle. The EP light comes on after the ET light goes out requesting a present position input. After present position has been entered the EP light goes off and will remain off until the next power cycle.

SWITCH/INDICATORS. The remainder of the C/I panel is composed of switches/indicators, most of which are multi-function types and are completely under program control. In all input or output procedures, the program illuminates all valid switches in sequence. Actuation of any invalid or dark switch will result in the panel being cleared and returned to its quiescent state. The quiescent state of the panel is defined as the segment displays blanked out and the DISPLAY and INSERT switches/indicators on. The STATUS and SYSTEM MALF indicators will remain in their previous state. In effect, actuation of an invalid switch will be identical to actuation of the clear switch, described below.

SYSTEM MALF. The SYSTEM MALF indicator on the C/I panel is a red light that comes on automatically when a system failure is detected by the self-test routine. Once lit, the SYSTEM MALF indicator will remain on until power is cycled or the PANEL TEST pushbutton is pressed.

Two additional malfunction indicators are located on the front of the receiver-computer. The first is the BITE (built-in-test-equipment) indicator that will be set to a red state in parallel with the system indicator when self-test detects a failure. The BITE indicator can only be reset manually. The second indicator is POWER MALF, a red bulb that will be on when the computer power supply fails.

RATE AID FAIL. The RATE AID FAIL indicator is lit when the system detects the difference between true air speed and ground speed to be greater than 200 knots.

SYNC. The SYNC indicator comes on after initialization. It means that the system is in the process of synchronization to the omega signal pattern. Under normal signal conditions this process will be completed in less than two minutes whereupon the indicator will go off. It will remain off until power is cycled or a failure of the oscillator is detected.

AMB. The omega ambiguity indicator (AMB) will be on whenever more than one estimate of position exists in the system. Its normal implication is that signal reception is insufficient to completely resolve position. It also may be on initially if the system has more than one estimate of oscillator starting time.

POS UNC. The position uncertainty indicator (POS UNC) will be on whenever position variance is greater than four miles. The system operates in the difference frequency mode during this time. The indicator also is on initially until the oscillator is calibrated.

A secondary function of the POS UNC indicator is to provide a warning that the omega signals are weak. This warning is the result of an insufficient number of signal acquisitions. However, the set will continue to navigate under this condition.

DISPLAY/CLEAR. The DISPLAY pushbutton initiates all output data displays to the panel. Actuation of this switch results in all valid lower keyboard indicators being illuminated. The specific display is selected at this point. The CLEAR pushbutton is used to clear erroneously entered data from the segment display during data input procedures. Actuation of this switch will return the panel to its quiescent state. The CLEAR indicator lights following actuation of DISPLAY or INSERT.

ACCEPT/INSERT. This switch/indicator is used to input all data to the system. The INSERT portion initiates all input functions. Actuation of INSERT results in all valid keyboard indicators being illuminated. At completion of the input procedure the ACCEPT portion of the switch/indicator will come on. Actuation of ACCEPT results in the input data being accepted by the computer.

Normal Operation of the Omega System.

To put the omega system into operation:

1. Depress the POWER pushbutton. The ET indicator will illuminate, indicating that the receiver-computer requires julian date and zulu time (GMT) to be entered.

2. Date and Time (DATE/GMT). The system requires an initial julian date and zulu time input for omega signal propagation prediction purposes. The time input itself does not necessarily have to be accurate (within a few minutes of actual time). However, if accurate time output displays are desired the actual time should be inserted. Date/time is a one-time input and is only valid after initialization, i.e., ET indicator is off.

There are 2 options available for date/time insert. The first is so-called "old time" which is defined as the last date and time stored in computer memory at the previous power off condition. If power to the system has been off only a short time, such as in a power transfer or power dropout condition, old time would still be accurate and valid as an input. Input procedure is as follows:

	Switch	Indications
(a)	INSERT	All valid input functions
(b)	DATE/GMT	Old time displayed in segments: 0, 1, 2, ... 9; ACCEPT; DATE/GMT.
(c)	ACCEPT	Time display; DATE/GMT, ET OFF, EP ON.

The second option is "new time" which would be inserted after a cold start condition when the computer has been off for a long period and old time is inaccurate. Procedure is as follows:

	Switch	Indications
(a)	INSERT	All valid input functions
(b)	DATE/GMT	Old time displayed in segments: 0, 1, 2, ... 9: ACCEPT; DATE/GMT
(c)	XX XX XX (YR) (MO) (DATE) XX XX XX (HR) (MIN) (SEC)	12 digits representing julian date and zulu time; ACCEPT; DATE/GMT
(d)	ACCEPT	Time display; DATE/GMT; ET OFF; EP ON.

3. Present Position (POS). After date/time has been entered the EP indicator comes on requesting present position input. In addition to latitude and longitude, a quality of the known position accuracy is required. There are three types of quality inputs. These are defined as:

"A" Quality—known position accuracy of 0.5 mile.

"B" Quality—known position accuracy of 5.0 miles.

"C" Quality—known position accuracy of 36.0 miles.

The position stored in memory at previous power off is displayed at the beginning of the input routine and is available for use if the position is still accurate. The program automatically assigns a "B" quality to this input. Procedure is as follows:

	Switch	Indications
(a)	INSERT	All valid input functions
(b)	POS	Previous position displayed; N; S; POS; ACCEPT
(c)	ACCEPT	Position displayed; POS; EP Off

In most cases, a new position will be entered for present position input. Procedure is as follows:

Switch	Indications
(a) INSERT	All valid input functions
(b) POS	Previous position displayed; N; S; POS, ACCEPT
(c) N(S)	N(S) in alpha display; 0, 1, 2, ... 9; POS
(d) XX°XX.X	Latitude in segment display; E; W; POS
(e) E(W)	E(W) in alpha display; 0, 1, 2, ... 9; POS
(f) XXX°XX.X (Leading zero needed if longitude less than 100°)	Longitude in segment display; A; B, C; POS
(g) A (B, C)	A (B, C); ACCEPT: POS
(h) ACCEPT	Position displayed; POS, EP Off.

4. Modes of Operation-Rate Aids (STATUS). In the present installation there is only one speed input to the system. This is the true air speed (TAS) which is received as a synchro input. The system uses TAS as a gross tracking filter rate-aid and as a dead reckon (DR) source. There are two heading inputs to the system which are mag compass and true heading (INS) received as synchro inputs. The mag compass is used as a navigational input in all modes of operation.

The normal flight mode of operation is the TAS mode. In this mode the system uses the available omega station signals and the TAS as navigational inputs. The TAS mode is selected automatically by the program at turn-on. The system begins to use the TAS when the synchro input represents 120 knots or higher.

There are two back-up modes of operation available. The first is the DR mode whereby the TAS is used as a dead reckon source and no omega inputs are used. This mode would be used if adequate omega signals are not available. The second back-up mode is the no rate aid (NRA) mode whereby only omega signals are used for navigation. This mode would be used in event of a TAS failure.

Since both the DR and NRA are seldom-used backup modes, there is no indication that the system is actually in those modes. The DR mode is initiated by simply blocking all omega stations available by using the omega station selection (STATUS) procedure 5.

5. OMEGA Station Selection (STATUS). Any of the available stations may be disallowed or blocked out from use by the system. Signals from a disallowed station will not be used for either synchronization or navigational purposes. Procedure is as follows:

Switch	Indications
(a) INSERT	All valid input functions
(b) STATUS	A; B; C; D; H; ACCEPT; STATUS
(c) A (B, C, D, H) Disallowed Station	Remaining stations on; ACCEPT; STATUS

Note

The rate aid mode selection is simultaneously input with the omega station selection. Be certain that the desired rate aid mode and the desired omega station(s) are selected before pressing ACCEPT.

Switch	Indications
(d) ACCEPT	Allowed stations; STATUS

To enable a previously disallowed station(s), the procedure is the inverse. That is, the station(s) to be enabled is left on before actuating ACCEPT.

6. Fixpoint Update (POS). This input is used, If necessary, to update system position anytime after initial present position has been inserted. Its usual application is to update or fix position at an on-top

mark over a visual or radio checkpoint. The procedure is identical to present position insert with the exceptions that EP indicator is off and the old position is not displayed at the start of the routine. The A, B or C quality of known positon accuracy applies as in present position insert. The procedure is described in Present Position, paragraph 3.

7. Destination Position or Waypoint (DEST-POS). A total of 10 destination positions or waypoints can be entered into the system for flight route or any other purpose. These positions provide end points for the output displays of bearing and range, estimated time enroute, course, and cross track error. Procedure is as follows:

	Switch	Indications
(a)	INSERT	All valid input functions
(b)	DEST/POS	0, 1, 2, ... 9; DEST-POS
(c)	X (DP NO.)	N; S; DEST-POS
(d)	N (S)	0, 1, 2, ... 9; DEST-POS
(e)	XX°XX.X	Latitude displayed; E; W; DEST-POS
(f)	E (W)	0, 1, 2, ... 9; DEST-POS
(g)	XXX°XX.X	Longitude displayed; ACCEPT; DEST-POS
(h)	ACCEPT	Position displayed; DEST-POS; X (DP NO.).

8. Manual Mode. To enter the manual mode for either velocity or heading, the following panel procedure is required.

	Switch	Indications
(a)	INSERT	All valid input functions
(b)	STATUS	CLEAR, S, N, A, STATUS
(c)	A	INS, STATUS, CLEAR, HRS, M-HDG, M-VEL, MAN H-V
(d)	M-HDG	M-HDG, STATUS, CLEAR, ACCEPT
(e)	ACCEPT	

At step (d), any mode listed under step (c) indications may be selected.

To enter or change the actual velocity or heading values, the following panel procedure is required.

	Switch	Indications	
(a)	INSERT	All valid input functions	
(b)	M-HDG	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, CLEAR, M-HDG	
(c)	XXX		
(d)	ACCEPT	XXX°	____
	or		
(a)	INSERT	All valid input functions	
(b)	M-VEL	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, CLEAR, M-VEL	
(c)	XXX		
(d)	ACCEPT	____	XXX°

Navigational Output Functions.

The following are descriptions and display procedures for navigational outputs available in the present program. All outputs are initiated by actuation of the DISPLAY switch. This action results in all valid output functions represented on the keyboard coming on. The switch representing the desired output is then actuated and will remain lit throughout the display procedure. The first step, actuation of the DISPLAY switch, will not be repeated in the procedures.

1. Aircraft Position (POS). The system-derived present position of the aircraft is displayed in latitude and longitude.

Switch	Indications	
POS	N (S) XX°XX.X (Lat)	E (W) XXX°XX.X (Long)

2. Track Angle and Groundspeed (TRACK/G-SPEED). The track angle is displayed relative to true north. Groundspeed is displayed in knots along track.

Switch	Indications	
TRACK/G-SPEED	XXX° (Angle)	XXX (Knots)

3. Wind Direction and Speed (WIND). The wind direction is displayed in true angle in the direction from which it is blowing. Speed is displayed in knots. The computation is based on the difference between system track/groundspeed and true air speed/system true heading.

Switch	Indications	
WIND	XXX° (Angle)	XXX (Knots)

4. Date and Time (DATE/GMT). This display is an updated readback of the initially inserted julian date and zulu time, and its accuracy is the same as the input accuracy.

Switch	Indications
DATE/GMT	XX XX XX (Yr) (Mo) (Date) XX XX XX (Hr) (Min) (Sec)

5. Omega Line of Position (LOP). The lines of positon for two station pairs are displayed in lane count and percent of lane on any of the three frequencies. This display has little navigational value without an omega chart of the area.

	Switch	Indications		
(a)	LOP	A, B, C, D, E, F, G, H.		
(b)	XX (Pair 1) XX (Pair 2)	4, 5, 6 XX	XX	
(c)	X (4, 5, 6) Freq. Select 4 = 10.2-KHz 5 = 13.6-KHz 6 = 11.3-KHz	(Station Pair 1) XXXX.XX (LOP)	(Station Pair 2) XXXX.XX (LOP)	

Note

The selected stations will alternate in the two alpha displays.

6. Destination Position or Waypoint (DEST-POS). This display is a readback in latitude and longitude of previously inserted destination points.

	Switch	Indications	
(a)	DEST-POS	0, 1, 2, ... 9	
(b)	X (0, 1, 2, ... 9)	N (S) XX°XX.X (Lat)	E (W) XXX°XX.X (Long)

7. Bearing and Range from Aircraft Position to Destination Point (BRG/RNG). The bearing from the aircraft to any destination point (DP) is displayed as a magnetic great circle bearing. The magnetic variation value at aircraft positon is used in the computation. Range is displayed in nautical miles along the great circle.

	Switch	Indications	
(a)	BRG/RNG	0, 1, 2, ... 9	
(b)	X (DP NO)	XXX° (Angle)	XXXXX.X (Miles)

8. Course and Estimated Time Enroute (COURSE/ETE). The course from the aircraft position to the selected DP is displayed as true great circle course. The estimated time enroute from the aircraft to the selected DP is displayed in minutes with a maximum of 600. The display indicates the time to overfly the selected DP at the current groundspeed.

	Switch	Indications
(a)	COURSE/ETE	0, 1, 2, ... 9
(b)	X (DP NO)	XXX° (Angle) XXX (Minutes)

9. Crosstrack Error Between Any Two Destination Points (CTE). The crosstrack error between any two destination points is displayed as a perpendicular distance in miles right or left of the great circle track from the first to the second selected destination point. The right or left indication means the direction to which the aircraft must steer to intercept the desired track.

	Switch	Indications
(a)	CTE	0, 1, 2, ... 9
(b)	XY (DP No's)	R (L) XXXXX.X (Miles)

10. Manual Heading (M-HDG) and Manual Velocity (M-VEL). To display the present value, stored, as M-HDG and M-VEL the following panel procedure is required.

	Switch	Indications
(a)	DISPLAY	All valid display functions
(b)	MAN H-V	XXX° XXX

11. Present Operational Mode Display. To display the present operational mode of the omega system, the following panel procedure is required.

	Switch	Indications
(a)	DISPLAY	All valid display functions
(b)	STATUS	
(c)	Ø	4 5 6
(d)	4 or 5 or 6	MODE (INS, HRS, M-HDG, etc) Stations selected (A, B, C, etc) STATUS - Ø

12. Displays Affected by Panel Hold Switch. The data in the following output displays will be held or frozen when the PANEL HOLD switch is depressed.

(a) Aircraft position (POS)

(b) Track angle and groundspeed (TRACK/G-SPEED)

(c) Date and time (DATE/GMT)

(d) Bearing and range (BRG/RNG)

(e) Course and estimated time enroute (COURSE/ETE)

13. Grid Navigation. The selection of grid mode navigation can be accomplished by the following procedure.

	Switch	Indication
(a)	INSERT	All valid input functions
(b)	STATUS	CLEAR, S, N, A, STATUS
(c)	N	CLEAR, INS, GRD, HLD, STATUS
(d)	HLD	CLEAR, STATUS, HLD, ACCEPT
(e)	ACCEPT	RATE AID FAIL ON—INS, HLD, STATUS, INSERT DISPLAY, stations selected
	Slew Heading Synchro	
(f)	INSERT	All valid input functions
(g)	STATUS	CLEAR, S, N, A, STATUS
(h)	N	CLEAR, INS, GRD, HLD, STATUS
(i)	GRD	CLEAR, STATUS, GRD, ACCEPT

(j)	ACCEPT	RATE AID FAIL OFF—INS, GRD, STATUS, INSERT DISPLAY, stations selected

To return to normal heading mode repeat steps (d) through (h)

(i)	INS	CLEAR, STATUS, INS, ACCEPT
(j)	ACCEPT	RATE AID FAIL OFF—INS, STATUS, INSERT, DISPLAY, stations selected

Status Output Functions.

In the present program there are ten types of outputs under control of the STATUS switch which are available for display. These outputs include omega signal strength, acquisition, and coherency; system position variance; local magnetic variation; synchro input values; and malfunction fault isolation.

All outputs are initiated by actuation, in order, of the DISPLAY switch, STATUS switch, and the number code (0 to 9) which represents the desired display. Only the number code will be included in the following description and procedures.

1. OMEGA Signal Burst Strength, OMEGA Stations and Use and Selected Rate Aid Mode (STATUS 0). The signal burst strength from the available omega stations is displayed in the segments. The burst strength is a rough signal-to-noise measurement on a scale of 0 to 9. All eight stations are represented although all are not transmitting. Frequencies are selected by a number code of 4, 5, or 6 representing 10.2-KHz, 13.6-KHz and 11.3-KHz, respectively. The stations in use and the selected rate aid mode are displayed on the keyboard.

	Switch	Indications
(a)	0	4, 5, 6
(b)	X (4.5.6) Selected Freq. X (4.5.6) Selected Freq. 4 = 10.2-KHz 5 = 13.6-KHz 6 = 11.3-KHz	X X X X (A)(B)(C)(D) X X X X (E)(F)(G)(H) Stations in use (A, B, C, D, H) Rate-aid mode (HRS)

2. Omega Signal Acquisitions (STATUS 1). Signal acquisitions from each omega station on all three frequencies are displayed in the segments. In addition to the acquisitions, a tracking filter count and a tracking filter variance are also displayed. The signal acquisitions, also referred to as "Kalman dumps", represent the number of times that the specific frequency from the selected station has been used by the system for navigational measurements. The range of the acquisitions is 00 to 99 and the indications are reset to 00 when the number exceeds 99. The tracking filter count is represented by a single digit with a range of 0 to 7. The count must increase to 3 or more before an acquisition is made. The tracking filter variance is represented by a single digit with a range of 0 to 9. The variance must decrease to 3 or less before a count is made.

The format of the display is:

10.2-KHz				13.6-KHz				11.3-KHz			
K	K	N	V	K	K	N	V	K	K	N	V

K = Signal Acquisitions (00-99)
N = Tracking Filter Counts (0-7)
V = Tracking Filter Variance (0-9)

Procedure:

	Switch	Indications
(a)	1	A, B, C, D, E, F, G, H
(b)	X (A, B, C, D, H) Selected Station	KK NV KK NV KK NV (See Format)

3. Magnetic Variation and Position Variance (STATUS 2). The system position variance is displayed in nautical miles. The magnetic variation is displayed in degrees East or West and is the value at system present position.

If the POS UNC indicator is lit, the lower keyboard will indicate the problem. An "A" indicates the system is functioning in difference frequency. A "B" indicates that the Kalman dump rate is inadequate.

Note

For an adequate Kalman dump rate, the system must experience four Kalman dumps on three frequencies from two stations, and four Kalman dumps on two frequencies from one station within a 10-minute period.

Switch	Indications
2	E (W) XX° XX.X If POS UNC is lit, then A and/or B will light.

4. Magnetic Heading and True Airspeed (STATUS 3). The two synchro inputs from the aircraft are read in and scaled by the system for rate aid purposes. The display is mainly used for checkout purposes.

Switch	Indications
3	XXX° XXX (Angle) (Knots)

5. OMEGA Signal Calculated Coherency (STATUS 4). The calculated coherency of the signals from each station is displayed in the segments. Each frequency is represented by a pair of numbers indicating centicycles (CECs), or percent of lane. The three pairs of numbers in the left segment are a calculation based on geographic position. The three pairs of numbers in the right segment are a measurement of the tracking filter output. Ideally, the left and right segments will match. In normal operation a strong station will indicate only a few CEC's difference between the left and right segments. A weaker station will indicate a greater difference. The display format is as follows:

Geographic Position			Tracking Filter		
10.2	11.3	13.6	10.2	11.3	12.6

Procedure:

	Switch	Indications
(a)	4	A, B, C, D, E, F, G, H
(b)	X (A, B, C, D, H)	XX XX XX XX XX XX (See Format)

6. System Heading and INS True heading (STATUS 6). The system derived heading is displayed in True.

The TAS synchro angle is displayed in degrees of rotation. This output has no function other than installation checkout.

Switch	Indications
6	XXX° XXX° (Angle) (Angle)

7. Unmodified Coherency (STATUS 7). A coherence output not modified by geographical position is displayed in CECs similar to the calculated coherency display. However, a large table of values is needed to correlate this output. It is used only for installation checkout purposes. The procedure is identical to STATUS 4 and will not be repeated.

8. Malfunction Indication/Fault Isolation (STATUS 8). A system failure(s) detected by the self-test routine will result in the MALF SYSTEM indicator coming on. The program defines which test has failed by means of a code in this display. The failure code is as follows:

S = Memory Checksum

A = RF 10.2

B = Phase/Digital 10.2

C = RF 13.6

D = Phase Digital 13.6

E = RF 11.3

F = Phase/Digital 11.3

G = Analog/Digital

0 = Phase Counter Up

1 = Phase Counter Up-Down

2 = Direct Memory Access

3 = GP Test

4 = Receiver 10.2

5 = Receiver 13.6

6 = Receiver 11.3

Switch	Indications
8	See Code

9. Calculated Lines of Position (STATUS 9). The OMEGA lines of position are displayed as a geographical position calculation rather than a tracking filter output. This display has use as a checkout function only. The procedure is identical to LOP.

Control Indicator Procedures Short Form.

The following functions are a condensed version of the most commonly used input/output routines.

CONTROL-INDICATOR PANEL PROCEDURES (SHORT FORM)

Insert Routines

(1) Date/Time (ET On Only)
INSERT
DATE/GMT
XXXXXX (Yr. Mo. Day)
XXXXXX (Hr. Min. Sec.)
ACCEPT (ET Off)

(2) Present Position (EP On)
INSERT
POS
N/S XX°XX.X (Lat)
E/W XXX°XX.X (Long)
A (B, C)
ACCEPT (EP Off)

(3) Fix Point Update (EP-Off)
(Same as Present Position ACCEPT
(At On Top Mark))

(4) Destination Position (Flight Plan)
INSERT
DEST-POS
X (0 to 9)
N/S XX°XX.X (Lat)
E/W XXX°XX.X (Long)
ACCEPT

(5) Block Station(s)
INSERT
STATUS
A (B, C, D, H)
ACCEPT

Display Routines

(1) Date/Time
DISPLAY
DATE/GMT

(2) System Position
DISPLAY
POS

(3) Destination Position
DISPLAY
DEST-POS
X (0 to 9)

(4) Track/Groundspeed
DISPLAY
TRACT/G-SPEED

(5) Bearing/Range
Aircraft to DP
DEST-POS
DISPLAY
BRG/RNG
X (0 to 9)

(6) Course/Estimated
Time Enroute
DISPLAY
COURSE/ETE
X (0 to 9)

(7) Wind
DISPLAY
WIND

(8) Cross Track
Error
DISPLAY
CTE
XY (0 to 9)

(9) Mag Heading/True Air
Speed
DISPLAY
STATUS
3

(10) Mag Variation and
Position Variance
DISPLAY
STATUS
2

(11) Burst Data/Stations/Nav
Mode
DISPLAY
STATUS
0
4 (5, 6)

(12) Signal Acquisitions
DISPLAY
STATUS
1
X (A, B, C, D, H)

(13) Error Word
(System Malf)
DISPLAY
STATUS
8

(14) Omega Signal
Calculated Coherency
DISPLAY
STATUS
4
X (A, B, C, D, H)

(15) System Heading and TH
INS
DISPLAY
STATUS
6

landing lights control panel

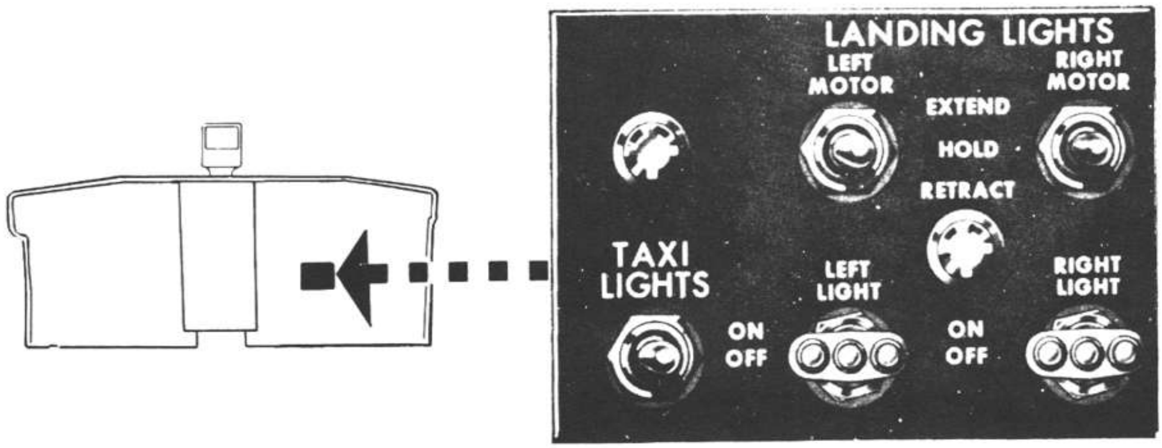

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Figure 1-122.

LIGHTING SYSTEM.

The lighting system is composed of exterior and interior groups of lights and their controls. Receptacles are also provided on the sides of the pilot's and copilot's side shelves for connecting a signal light. The pilot's and copilot's instrument lights and the engine instrument lights operate on ac power and all others operate on dc power. The pilot's and copilot's instrument lights and the engine instrument lights use 6-volt bulbs only. All other panel lights use 28-volt bulbs.

EXTERIOR LIGHTS.

The exterior group of aircraft lights comprises a landing light on the undersurface of each wing; two taxiing lights on the main landing gear doors; nine formation; six navigation and two anti-collision lights disposed around the aircraft; a light on each side of the fuselage to illuminate the wing leading edges, and two drogue lights mounted under the horizontal stabilizer. Power for all these lights is supplied from the essential and main dc buses through the exterior lights circuit breakers. Only the drogue lights are protected on the aft fuselage junction box.

Landing Lights.

A retractable landing light is mounted in the underside of each wing, in the leading edge and approximately midway between the inboard and outboard engine nacelles. Switches for extension and retraction and for illumination controls are located on the landing lights control panel (figure 1-122). The two extension and retraction switches, labeled right and left, are three-position (EXTEND, HOLD, RETRACT) toggle switches. The right switch energizes the right-hand landing light actuator, retracting or extending the light when the switch is moved to RETRACT or EXTEND positions. The left switch energizes the left-hand light actuator in the same manner. When either switch is moved to the HOLD position, the landing light actuator motor is deenergized, and the light will lock in position. Two two-position (ON, OFF) toggle switches control the illumination of the landing lights. When either switch is moved to the ON position, the corresponding light illuminates. When either switch is moved to OFF, the corresponding light is deenergized. Power for the landing lights is supplied from the essential dc bus through the lh and rh landing lights circuit breakers on the copilot's lower circuit breaker panel, and for the light extension and

exterior lights control panel

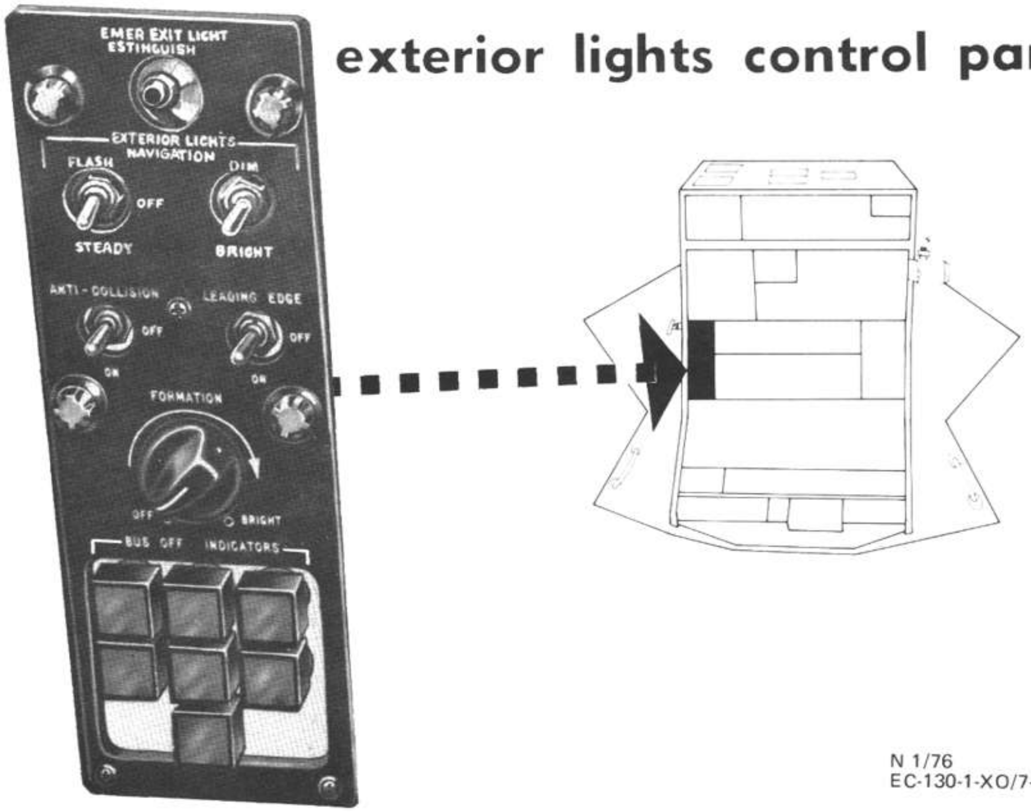

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Figure 1-123.

retraction actuators through the lh and rh landing lights mtr circuit breakers on the same panel.

CAUTION

Do not operate landing lights for prolonged periods while aircraft is on ground, since neither light has any cooling facilitiy.

Taxiing Lights.

Illumination of the two taxiing lights, one mounted on the inside of each main landing gear door, is controlled by a two-position (ON, OFF) toggle switch on the landing light control panel (figure 1-122). Power is supplied from the main dc bus through the taxi circuit breaker on the copilot's lower circuit breaker panel.

Formation Lights.

The nine formation lights comprise three on the outer panel of each wing and three on top of the fuselage aft of the wing. The illumination and brilliance of all nine formation lights is controlled simultaneously through a single rheostat switch on the exterior lights control panel (figure 1-123). The switch is turned clockwise from the OFF position to illuminate the lights and then further turned toward BRIGHT to increase the brilliance; rotation of the switch in the counterclockwise direction decreases the brilliance of the lights until the OFF position is reached. Power for the lights is supplied from the main dc bus through the formation circuit breaker on the copilot's lower circuit breaker panel.

Navigation Lights.

The navigation lighting system consists of six lights; a red light on the left wingtip, a green light on the right wingtip, two white lights on the trailing edge of the tail cone, a white light on top of the fuselage forward of the wing, and a white light on the lower surface of the fuselage. All lights can be set DIM or BRIGHT. The red and green wingtip lights and the white tail lights can also be set to flash or to glow continuously. The white lights on the top and bottom of the fuselage, however, will only illuminate continuously. The navigation lights selector switch turns the lights on and off and controls the flashing mechanism, and the navigation lights dimming switch controls the intensity of the lights. The selector switch is a three-position (STEADY, OFF, FLASH) toggle switch, located on the exterior lights control panel (figure 1-123). When the switch is in the STEADY position, the lights glow continuously. When the switch is in the FLASH position, the wingtip lights and the white tail light flash simultaneously. The navigation lights dimming switch is a two-position (BRIGHT, DIM) toggle switch and is located on the exterior lights control panel. Power for the lights is supplied from the essential dc bus through the navigation and position circuit breaker on the copilot's lower circuit breaker panel.

Anti-collision Lights.

The aircraft carries two anti-collision lights. On EC-130G and EC-130Q Buno 156170 through 156177, one light is on top of the vertical stabilizer and the other on the underside of the fuselage. On EC-130Q Buno 159348 and 159469, one light is on top of the fuselage forward of the center wing section and the other on the underside of the fuselage. Each light is contained within a red transparent housing and flashes through a motor-driven rotating reflector. The lights are controlled by a two-position (ON, OFF) toggle switch, located on the exterior lights control panel (figure 1-123), which also controls operation of the motor-driven reflector. When the switch is set to ON, the lights are illuminated and the reflector commences to rotate. Power for both the lights and the motors is supplied from the essential dc bus through the anti-collision circuit breaker on the copilot's lower circuit breaker panel.

Note

Operation of the anti-collision light when flying in actual instrument conditions is not recommended. The light reflecting on surrounding clouds may cause spatial disorientation.

Wing Leading Edge Lights.

A light is installed on each side of the fuselage in a position which will illuminate the engine nacelles and the immediate leading edge area of each wing. The lights are controlled through a two-position (ON, OFF) toggle switch on the exterior lights control panel and are powered from the main dc bus through the wing leading edge circuit breaker on the copilot's lower circuit breaker panel.

Drogue Lights.

A set of flood lights (figure 1-124) have been installed in the inspection cover on the bottom forward portion of the horizontal stabilizer. One of the lights faces forward and illuminates the bottom of the cargo ramp, while the other faces aft and down. Controls for the lights are located on the aft fuselage junction box panel (figure 1-125). The drogue lights receive 28-volt dc power from the aft fuselage junction box bus through the drogue lights circuit breaker on the aft fuselage junction box.

Signal Lamp.

A portable signal lamp and a case containing four colored lenses (red, amber, blue and green) are stowed at the navigator's station. An extension cord permits the lamp to be plugged into receptacles on either the pilot's or copilot's side shelves. The lamp is illuminated by depressing a trigger switch. Power is supplied from the main dc bus through pilot and copilot signal outlets circuit breakers on the copilot's lower circuit breaker panel.

INTERIOR LIGHTING.

Interior lighting consists of flight station and cargo compartment lighting. The various types of lighting, locations of light controls, and locations of circuit breakers for the light circuits are listed in figure 1-126. Locations of lighting control panels are shown in figure 1-127. The pilot's and copilot's instrument lights and the engine instrument lights are ac powered from the essential ac bus and protected by fuses on the ac distribution panel aft of the upper bunk and by circuit breakers located adjacent to the respective switches.

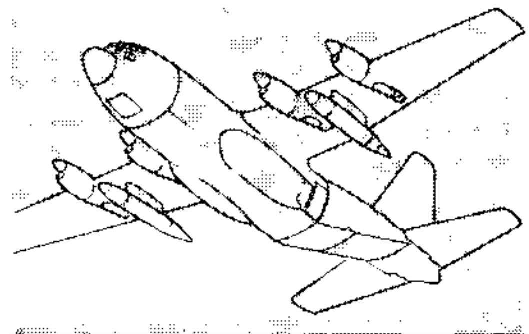
The copilot's secondary lights are powered by the isolated dc bus through a circuit breaker on the pilot's side circuit breaker panel. The pilot's and engine secondary instrument lights are powered by the essential dc bus through a circuit breaker on the

exterior lights locations

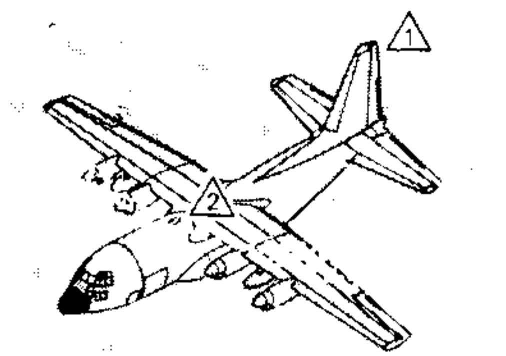
NOTE

⚠1 EC-130G AND EC-130Q BWINO 156170 THROUGH 156177

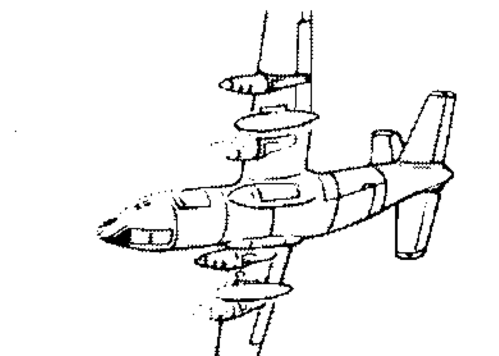
⚠2 EC-130Q BWNO 159348 AND 159469



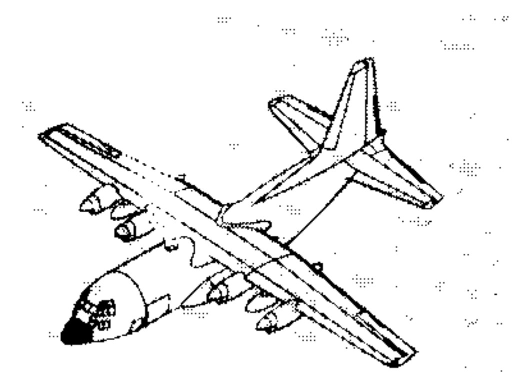
DROGUE LIGHTS



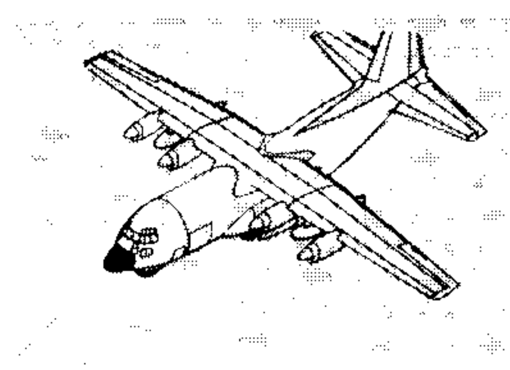
ANTI-COLLISION LIGHT



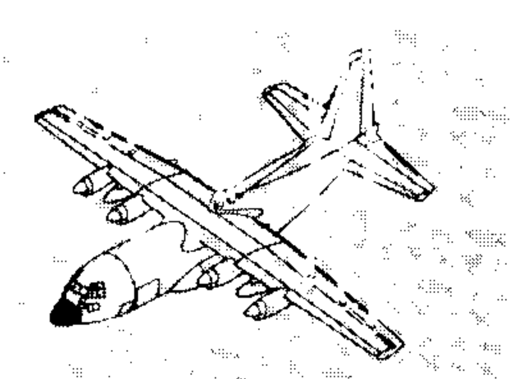
LANDING LIGHTS



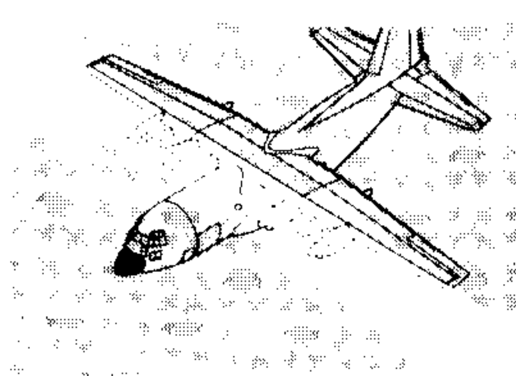
NAVIGATION LIGHTS



TAXI LIGHTS



FORMATION LIGHTS



LEADING EDGE LIGHTS

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Figure 1-124.

drogue lights control

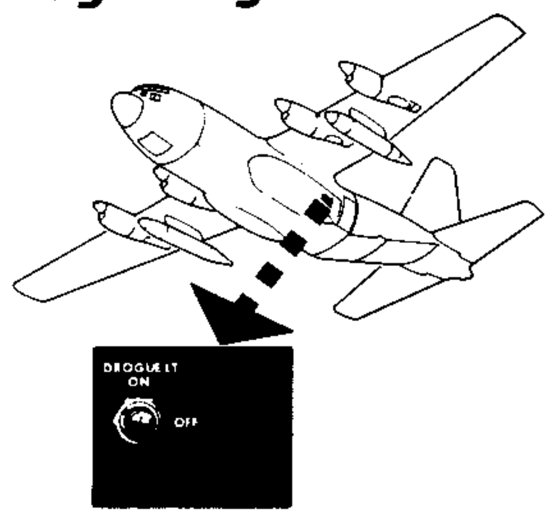


Figure 1-125

copilot's lower circuit breaker panel. All other interior lighting is dc powered from the main dc bus and protected by circuit breakers on the copilot's lower circuit breaker panel.

Lighting for the comm central area is provided by 12 overhead fluorescent lights. These lights are controlled by two switches inside the comm central doors. Power at the switches (28 volts dc) is routed from the main dc bus through the COMM CENTRAL LIGHTS circuit breaker on the copilot's lower circuit breaker panel. Each switch controls a relay mounted in the comm central overhead ballast box. Closed relay contacts route 115-volt 400-Hz power from the copilot's upper circuit breaker panel essential ac bus (COMM CENTRAL LIGHTS circuit breaker) to the fluorescent lights.

The lavatory light is controlled by a light switch. This switch and the lavatory operating mechanism receive 28-volt dc power from the copilot's lower circuit breaker panel main bus LAVATORY circuit breaker.

Thunderstorm Lights.

Thunderstorm lighting is provided by four white dome lights and two white thunderstorm flood lights. These lights are controlled by a two-position (ON, OFF) thunderstorm lights switch on the pilot's side shelf. Also, when the thunderstorm lights switch is placed in the ON position, the circuits to the instrument lights dimming relays are opened, thereby preventing the instrument and warnings lights from being dimmed.

Nose Wheel Well Light.

A nose wheel well light aids in visual inspection of the nose landing gear while on the ground or while in flight. The light may be controlled from within the wheel well or from within the aircraft by either one of two, two-position (ON, OFF), toggle switches (figure 1-127). The switch inside the aircraft is guarded to the OFF position, and is mounted adjacent to the nose landing gear inspection window on the aft bulkhead of the nose wheel well. The switch inside the wheel well is not guarded, and is mounted on the left side of the wheel well. The light receives 28-volt dc from the main dc bus through a nose wheel well light circuit breaker on the copilot's lower circuit breaker panel.

OXYGEN SYSTEM.

The aircraft is equipped with a 300 psi liquid oxygen system (figure 1-128) capable of maintaining oxygen supply for a minimum of 96 man-hours. The system uses diluter-demand automatic pressure-breathing regulators and operates at a pressure of 300 psi. Manual selection enables the system to provide oxygen diluted in varying proportions corresponding to changes in cabin altitude or, for emergency use, 100 percent oxygen. Seven portable units, chargeable through the main system, also are provided for use by crew members moving around within the aircraft or for emergency use.

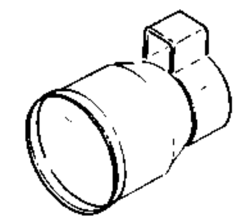
Oxygen is supplied from a 25-liter liquid oxygen converter in the right-hand side of the nose wheel well which is filled through an externally accessible valve. The oxygen supply is fed from the converter through two heat-exchanger units to six supply regulators in the flight deck and 13 in the special equipment compartment. The system also supplies four portable unit charging outlets, one outboard of each pilot's seat, and two in the aft compartment. Either smoke masks or oxygen masks may be used with aircraft system oxygen or the portable bottles.

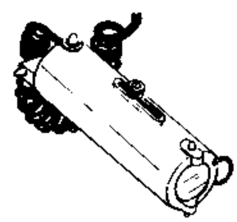
OXYGEN SYSTEM COMPONENTS.

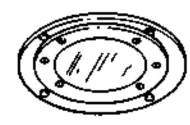
The components of the oxygen system comprise the ten diluter-demand automatic pressure-breathing

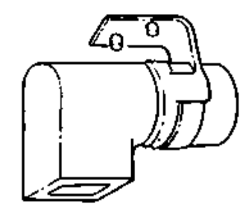
interior lighting

flight stations









LIGHTS	CONTROLS LOCATION	CIRCUIT BREAKER LOCATION
pilot		
Instrument White Lighting	Pilot's Side Shelf	Fuse on Main A-C Distribution Panel
Engine Instrument White Lighting	Pilot's Side Shelf	Fuse on Main A-C Distribution Panel
Center Stand and Pilot's Side Shelf White Lighting	Pilot's Side Shelf	Copilot's Lower Circuit Breaker Panel
Flight Deck White Dome Lights	Pilot's Side Shelf	Copilot's Lower Circuit Breaker Panel
Pilot's Utility Light on side of overhead panel	On light	Copilot's Lower Circuit
	(Thunderstorm Lights Switch turns on these lights)	
Two White Thunderstorm Lights on sides of overhead panel	Pilot's Side Shelf	Copilot's Lower Circuit Breaker Panel
Four White Dome Lights	Pilot's Side Shelf	Copilot's Lower Circuit Breaker Panel
	(Dome Lights Switch turns on these lights)	
Four White Dome Lights	Pilot's Side Shelf	Copilot's Lower Circuit Breaker Panel

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Figure 1-126. (Sheet 1 of 3)

LIGHTS	CONTROLS LOCATION	CIRCUIT BREAKER LOCATION
copilot		
Instrument White Lighting	Copilot's Side Shelf	Fuse On Main A-C Distribution Panel
Instrument Panel White Floodlighting	Copilot's Side Shelf	Pilot's Side Circuit Breaker Panel
Overhead Panel Edge Lighting	Copilot's Side Shelf	Copilot's Lower Circuit Breaker Panel
Overhead Panel White Floodlighting	Copilot's Side Shelf	Copilot's Lower Circuit Breaker Panel
Copilot's Side Shelf White Lighting	Copilot's Side Shelf	Copilot's Lower Circuit Breaker Panel
Copilot's Utility Light on side of overhead panel	On light	Copilot's Lower Circuit Breaker Panel
navigator		
Navigator's Instrument and Control Panel White Lighting	Navigator's Console	Copilot's Lower Circuit Breaker Panel
Navigator's Panel White Floodlighting	Navigator's Console	Copilot's Lower Circuit Breaker Panel
Navigator's Utility Light	On light	Copilot's Lower Circuit Breaker Panel
Sextant Lights	On Sextant	Copilot's Lower Circuit Breaker Panel
flight engineer		
Flight Engineer's Utility Light	On light	Copilot's Lower Circuit Breaker Panel
miscellaneous		
Pilot's Circuit Breaker Panels Edge Lighting	On panel	Copilot's Lower Circuit Breaker Panel
Copilot's Circuit Breaker Panels Edge Lighting	On Panel	Copilot's Lower Circuit Breaker Panel
Nose Wheel Well Inspection Light	Left Side of Nose Wheel Well and Below Flight Deck Near Nose Gear Inspection Window	Copilot's Lower Circuit Breaker Panel

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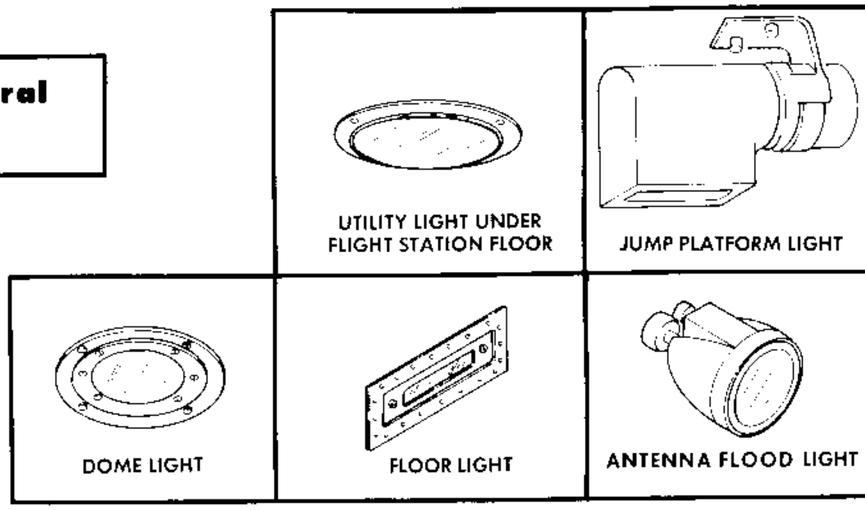
Figure 1-126. (Sheet 2 of 3)

interior lighting (cont.)

comm central area



LIGHTS	CONTROLS LOCATION	CIRCUIT BREAKER LOCATION
Floor Lights	Comm Central Area Interphone Panel	Copilot's Lower Circuit Breaker Panel
Forward Dome Lights (White or Red)	Forward Cargo Compartment Interphone Panel	Copilot's Lower Circuit Breaker Panel
Center Dome Lights (White or Red)	Forward Cargo Compartment Interphone Panel	Copilot's Lower Circuit Breaker Panel
Aft Dome Lights (White or Red)	Aft Fuselage Junction Box	Copilot's Lower Circuit Breaker Panel
Ramp Dome Lights (White or Red)	Aft Fuselage Junction Box	Aft Fuselage Junction Box
(Antenna Flood Lights)	Aft Fuselage Junction Box	Aft Fuselage Junction Box
Two Jump Platform Red Floodlights	Aft Cargo Compartment Interphone and PA Panel	Aft Fuselage Junction Box
Overhead Comm Central Lighting	Comm Central Light Control Panel	Copilot's Upper Circuit Breaker Panel
Lavatory Lighting	Lavatory	Copilot's Lower Circuit Breaker Panel
Utility Light under flight station floor	Swtich adjacent to Light	Copilot's Lower Circuit Breaker Panel

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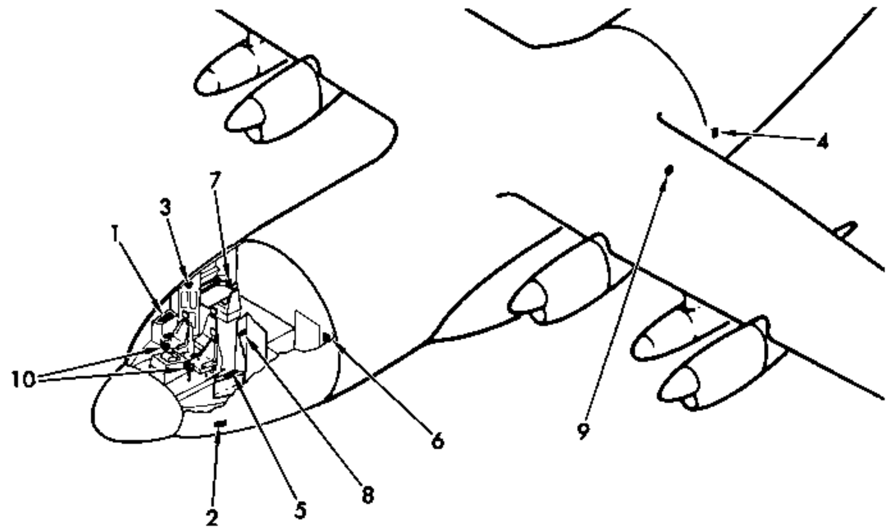
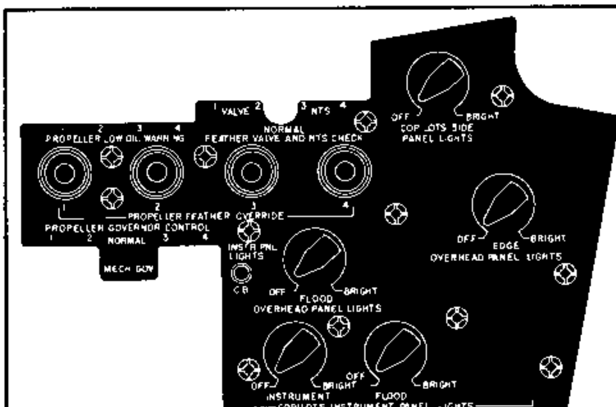
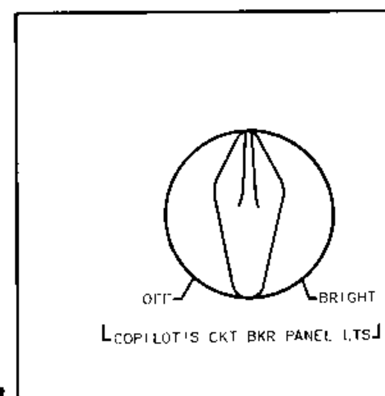
Figure 1-126. (Sheet 3 of 3)

interior lighting controls





1 COPILOT'S SIDE SHELF PANEL

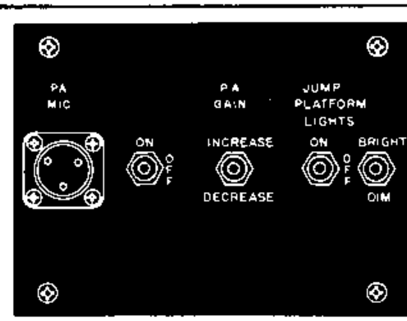


3 PILOT'S SWITCH PANEL

2 NOSE WHEEL WELL LIGHT SWITCH

NOTE

THE NOSE WHEEL WELL LIGHT IS CONTROLLED BY EITHER OF TWO SWITCHES, ONE LOCATED ON THE LEFT SIDE OF THE NOSE WHEEL WELL AND THE OTHER BELOW THE FLIGHT DECK NEAR THE NOSE GEAR INSPECTION WINDOW.



4 AN/USC-13 AREA INTERPHONE AND PA PANEL

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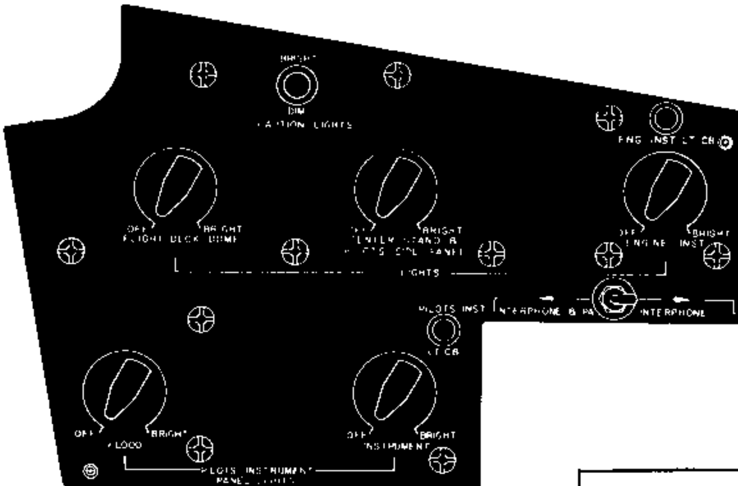
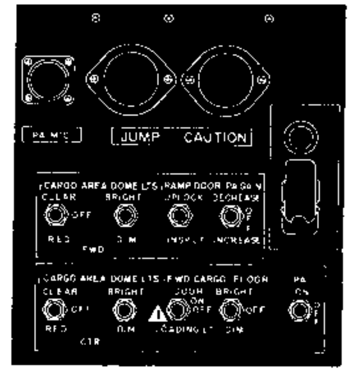
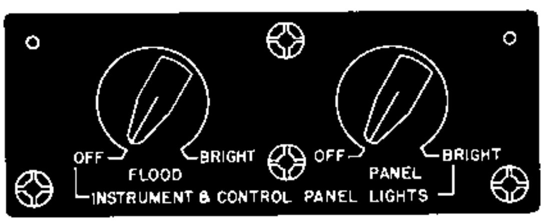
Figure 1-127. (Sheet 1 of 2)



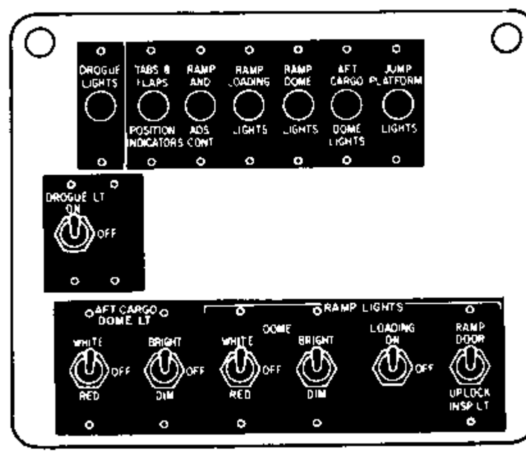
5 **PILOT'S SIDE SHELF PANEL**



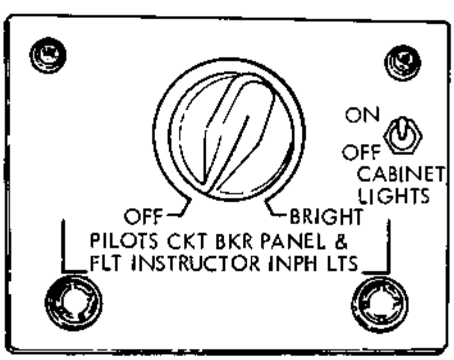
6 **AN/USC-13 AREA INTERPHONE PANEL**



7 **NAVIGATOR'S PANEL LIGHTS CONTROL PANEL**



9 **AFT FUSELAGE JUNCTION BOX PANEL**



8 **PILOT'S SWITCH PANEL**

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Figure 1-127. (Sheet 2 of 2)

oxygen system

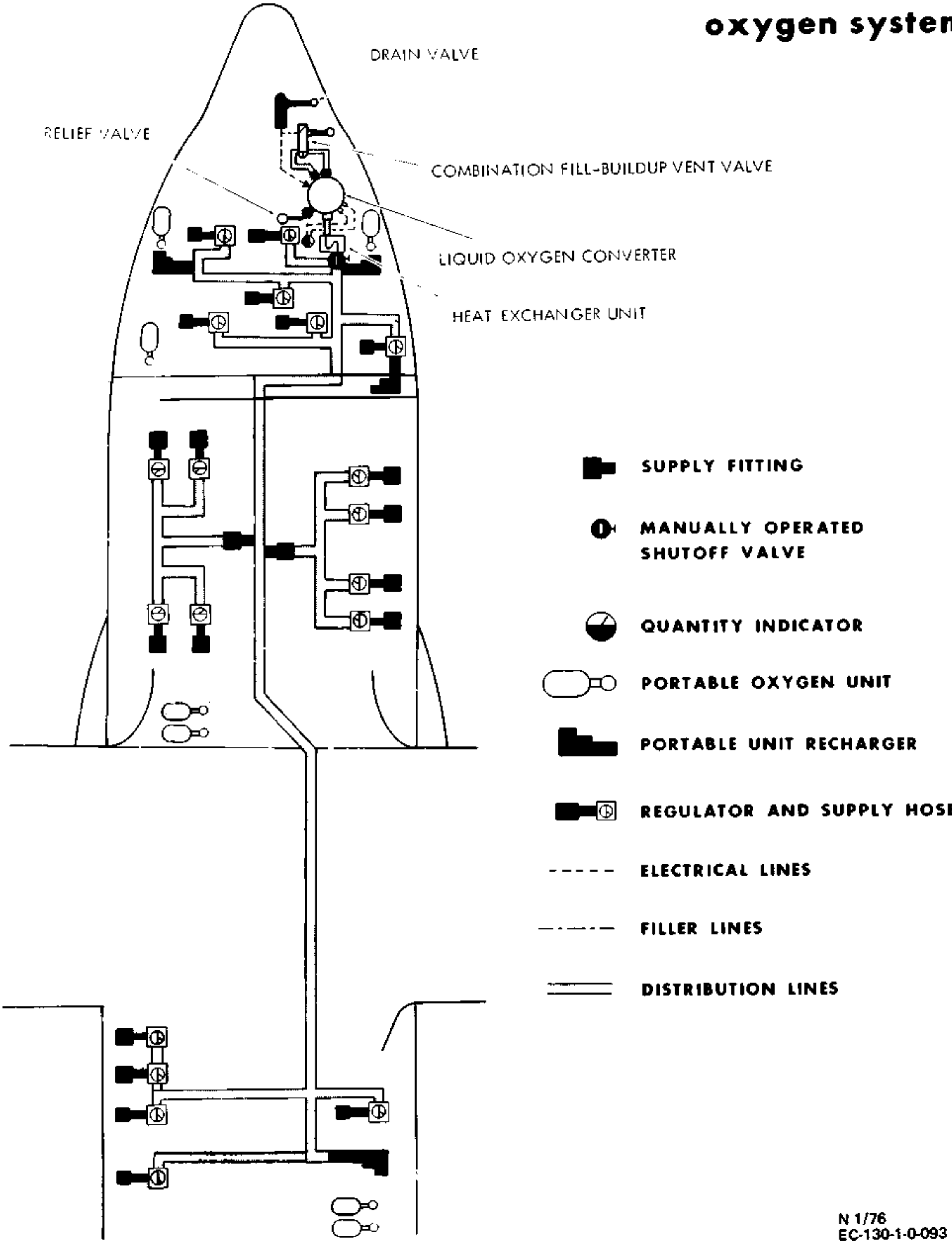

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Figure 1-128.

regulators, the 25-liter liquid oxygen converter connected to a filler box containing a combination filler-buildup-vent valve, two heat-exchanger units, a totalizing quantity indicator, and four portable units. A low-level oxygen warning light and a press-to-test switch for the quantity indicator are provided at the copilot's station.

Oxygen Regulators.

A diluter-demand automatic pressure-breathing regulator (figure 1-129) is installed at each crew member's station, at each end of the relief crew bunk in the flight deck, and at 13 locations within the special equipment compartment. The pilot's regulators are mounted on their respective side shelves, the navigator's regulator on the navigator's control panel, and the flight engineer's regulator at the rear of the overhead panel. The special equipment compartment regulators are located as follows: four at operator console positions, four at the crew rest area and 3 forward of the port paratroop door, and one aft of each paratroop door. Each regulator incorporates a visual flow indicator, a pressure gage, three toggle-type switches to control regulator operation, and an inlet filter to prevent the entry of foreign particles into the system.

OXYGEN SUPPLY LEVER. A manual, two-position supply lever is located at the lower right-hand corner of each regulator. When the lever is set to ON, oxygen is supplied to the regulator unit; when the lever is at OFF, the oxygen supply to the regulator is shut off to prevent any waste of oxygen from the regulator unit when not in use.

oxygen regulator

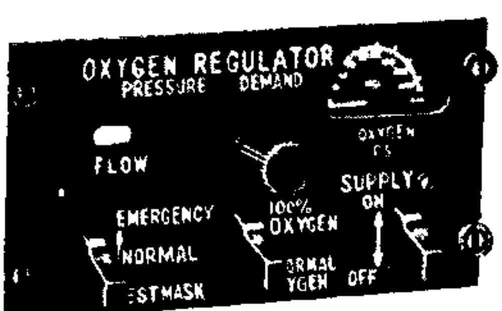

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Figure 1-129.

DILUTER LEVER. The two-position diluter lever on each regulator unit may be used to shut off the air port manually and allow the regulator to deliver pure oxygen at all altitudes or to provide automatic mixing of air and oxygen as required to maintain normal body oxygen needs at all altitudes. When set to 100% OXYGEN, the regulator supplies pure oxygen without air dilution; with the lever at NORMAL OXYGEN, the normal air/oxygen dilution characteristics of the regulator are maintained. The lever is designed to prevent intermediate settings between 100% OXYGEN and NORMAL OXYGEN.

EMERGENCY TOGGLE LEVER. The emergency toggle lever on each regulator may be set to one of three positions: EMERGENCY, NORMAL, and TEST MASK. With the lever at EMERGENCY, oxygen is supplied to the mask at continuous positive pressure for emergency use. With the lever at NORMAL, oxygen flow is controlled automatically by the regulator. The TEST MASK setting is used when a positive pressure is required at any altitude to test the fit of the mask around the face.

CAUTION

When positive pressure is required, it is mandatory that the oxygen mask be well fitted to the face. Unless special precautions are taken to ensure no leakage, the continued use of positive pressure under these conditions will result in rapid depletion of the oxygen supply. Except when unscheduled pressure increase is required, the emergency toggle lever should remain in the center (NORMAL) position.

VISUAL FLOW INDICATOR. The visual flow indicator on each regulator is a slide-and-window device in which, during normal use of the oxygen mask, the indicator shows oxygen flow by blinking with the breathing cycle of the user. The blinker is masked when the oxygen flow ceases.

PRESSURE GAGE. The pressure gage on the regulator is a dial-type instrument indicating system pressure in pounds per square inch.

Liquid Oxygen Converter.

The 25-liter liquid oxygen converter, enclosed within a removable fiberglas cover is mounted in the right side of the nose wheel well. It is filled through a combination filler-buildup-vent valve contained in a filler box adjacent to the converter but accessible through a door on the right side of the forward fuselage. The converter is also connected to a drain valve in the lower side of the nose wheel well skin. The function of the combination filler-buildup-vent valve is automatic, and charging of the oxygen system is accomplished automatically on completion of the filling operation.

Heat Exhange Units.

Two heat-exchanger units, interposed in the system below the flight deck floor, ensure the delivery of oxygen within the required temperature range to all regulators. The oxygen is warmed by passing through the heat exchangers and not by any form of controllable system heating.

Liquid Oxygen Quantity Indicator.

A capacitance-type quantity indicator, which permits monitoring of the total aircraft supply of liquid oxygen available in the converter, is installed at the lower right side of the copilot's instrument panel (figure 1-90). A press-to-test switch adjacent to the quantity indicator allows functional checking of the indicator. The indicator is powered by the ac instrument and engine fuel control bus through a circuit breaker on the pilot's lower circuit breaker and fuse panel.

Low Level Warning Light.

A warning light, which illuminates to indicate that the supply of liquid oxygen remaining within the converter has reached a low level of approximately 2.5 liters, is mounted on the copilot's instrument panel adjacent to the oxygen system quantity indicator. The warning light is powered by the essential dc bus through the liquid oxygen low level circuit breaker on the copilot's lower circuit breaker panel.

PORTABLE UNITS.

Seven Type MA-1 portable oxygen units (figure 1-128) are provided for use by crew members at high altitudes to facilitate movement within the aircraft or for emergencies. The portable unit consists of a Type A-6 cylinder and a Type A-21 pressure demand regulator. Two of the units are stowed within the flight deck, one outboard of the pilot and the other outboard of the copilot; one located on the aft side of the 245 bulkhead, two at the aft end of the COMM Central bench seat, and one aft of the right paratroop door. The recharging outlets are located outboard of the pilot and copilot, on the aft right side of the 245 bulkhead and aft of the right paratroop door. Recharging of the portable units is accomplished at the normal system pressure of 300 psi through a filler valve and flexible hose stowed in a clip at the recharging point.

OXYGEN SYSTEM OPERATION.

Note

> Each crew member should check his oxygen regulator, first with the diluter lever at NORMAL OXYGEN and then at 100% OXYGEN, by removing the mask and blowing gently into the oxygen hose as during normal exhalation. Resistance to blowing indicates that the system is functioning satisfactorily. Little or no resistance to blowing indicates a defective regulator or leaking mask-to-regulator tubing.

For normal operation of the system, the oxygen supply lever is placed in the ON position, and the diluter lever set at the NORMAL OXYGEN position. If any symptoms of anoxia are felt, or if doubt exists that the diluter mixture is sufficient, place the diluter lever in the 100% OXYGEN position. Use the 100% OXYGEN position when prolonged exposure to smoke or fumes is experienced. The emergency toggle lever is used for short emergency periods of time or to pressure-check oxygen mask operation and fit. The availability of oxygen, based on the 25-liter converter furnishing 670 cubic feet of oxygen for use and calculated for five- or ten-member crews, is shown in tabular form in figure 1-130; the total availability of oxygen, based on NORMAL OXYGEN and 100% OXYGEN selections, is shown by charts in figure 1-130.

EMERGENCY EQUIPMENT.

Various types of emergency equipment are furnished to minimize hazards to the aircraft and to personnel in case of fire or accident.

oxygen duration

ALTITUDE	REGULATOR SETTING	GAGE READING - LITERS (LIQUID) 25 (HRS MINS)	24 (HRS MINS)	22 (HRS MINS)	20 (HRS MINS)	18 (HRS MINS)	16 (HRS MINS)	14 (HRS MINS)	12 (HRS MINS)	10 (HRS MINS)	8 (HRS MINS)	6 (HRS MINS)	4 (HRS MINS)	2 (HRS MINS)
35,000 & ABOVE	100%	27:18	26:12	24:00	21:48	19:36	17:30	15:18	13:06	10:54	8:42	6:36	4:24	2:12
	NORMAL	27:18	26:12	24:00	21:48	19:36	17:30	15:18	13:06	10:54	8:42	6:36	4:24	2:12
30,000	100%	20:00	19:12	17:36	16:00	14:24	12:48	11:12	9:36	8:00	6:24	4:48	3:12	1:36
	NORMAL	20:18	19:30	17:54	16:12	14:36	13:00	11:24	9:48	8:06	6:30	4:54	3:18	1:36
25,000	100%	15:24	14:48	13:36	12:18	11:06	9:54	8:48	7:24	6:12	5:00	3:42	2:30	1:06
	NORMAL	19:06	18:18	16:48	15:18	13:48	12:12	10:42	9:12	7:36	6:06	4:24	3:06	1:30
20,000	100%	11:42	11:12	10:18	9:24	8:24	7:30	6:36	5:36	4:42	3:42	2:48	1:54	0:54
	NORMAL	21:36	20:42	19:00	17:18	15:36	13:48	12:06	10:24	8:36	6:54	5:12	3:30	1:42
15,000	100%	9:24	9:00	8:18	7:30	6:48	6:00	5:18	4:30	3:48	3:00	2:18	1:30	0:48
	NORMAL	26:18	25:18	23:12	21:06	19:00	16:54	14:48	12:36	10:30	8:24	6:18	4:12	2:06
10,000	100%	7:36	7:18	6:42	6:06	5:30	4:54	4:18	3:36	3:00	2:24	1:48	1:12	0:36
	NORMAL	26:18	25:18	23:12	21:06	19:00	16:54	14:48	12:36	10:30	8:24	6:18	4:12	2:06
DURATION OF OXYGEN SUPPLY (HOURS) FOR 5 CREW MEMBERS (NORMAL)														

ALTITUDE	REGULATOR SETTING	GAGE READING - LITERS (LIQUID) 25 (HRS MINS)	24 (HRS MINS)	22 (HRS MINS)	20 (HRS MINS)	18 (HRS MINS)	16 (HRS MINS)	14 (HRS MINS)	12 (HRS MINS)	10 (HRS MINS)	8 (HRS MINS)	6 (HRS MINS)	4 (HRS MINS)	2 (HRS MINS)
35,000 & ABOVE	100%	13:39	13:06	12:00	10:54	9:48	8:45	7:39	6:33	5:27	4:21	3:18	2:12	1:06
	NORMAL	13:39	13:06	12:00	10:54	9:48	8:45	7:39	6:33	5:27	4:21	3:18	2:12	1:06
30,000	100%	10:00	9:36	8:48	8:00	7:12	6:24	5:36	4:48	4:00	3:12	2:24	1:36	0:48
	NORMAL	10:09	9:45	8:57	8:06	7:18	6:30	5:42	4:54	4:03	3:15	2:27	1:39	0:48
25,000	100%	7:42	7:24	6:48	6:09	5:33	4:57	4:24	3:42	3:06	2:30	1:51	1:15	0:33
	NORMAL	9:33	9:09	8:24	7:39	6:54	6:06	5:21	4:36	3:48	3:03	2:12	1:33	0:45
20,000	100%	5:51	5:36	5:09	4:42	4:12	3:45	3:18	2:48	2:21	1:51	1:24	0:57	0:27
	NORMAL	10:48	10:21	9:30	8:39	7:48	6:54	6:03	5:12	4:18	3:27	2:36	1:45	0:51
15,000	100%	4:42	4:30	4:09	3:45	3:24	3:00	2:39	2:15	1:54	1:30	1:09	0:45	0:24
	NORMAL	13:09	12:39	11:36	10:33	9:30	8:27	7:24	6:18	5:15	4:12	3:09	2:06	1:03
10,000	100%	3:48	3:39	3:21	3:03	2:45	2:27	2:09	1:48	1:30	1:12	0:54	0:42	0:18
	NORMAL	13:09	12:39	11:36	10:33	9:30	8:27	7:24	6:18	5:15	4:12	3:09	2:06	1:03
DURATION OF OXYGEN SUPPLY (HOURS) FOR 10 CREW MEMBERS (MAXIMUM)														

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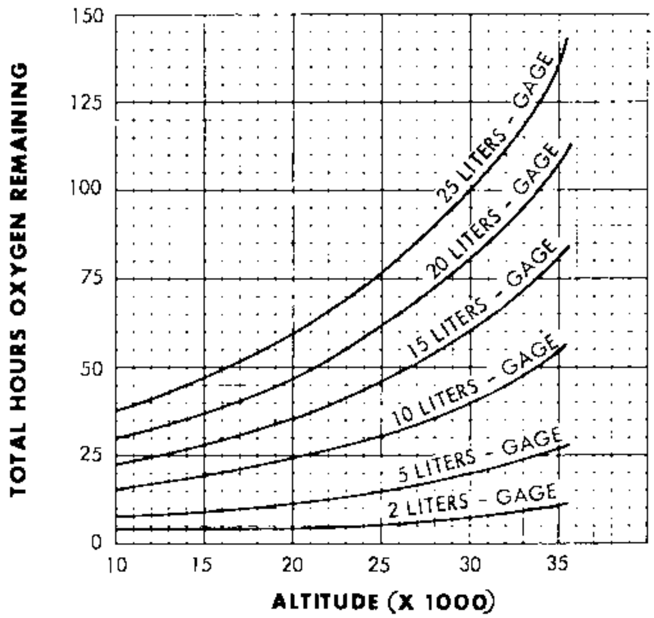
Figure 1-130. (Sheet 1 of 2)

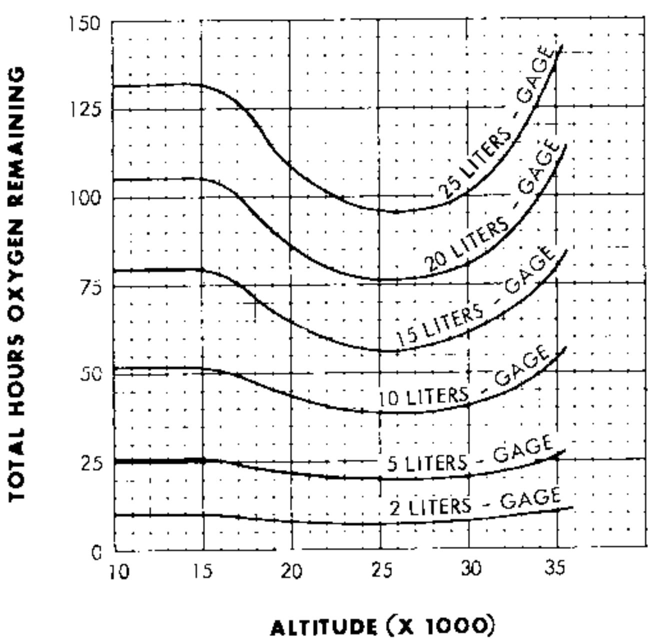
100% oxygen supply duration



NOTE

CURVES ARE FOR TOTAL HOURS OXYGEN SUPPLY PER GAGE READING. FOR ACTUAL OPERATIONAL HOURS AVAILABLE, DIVIDE TOTAL HOURS BY NUMBER OF CREW MEMBERS.

normal oxygen supply duration



NOTE

CURVES ARE FOR TOTAL HOURS OXYGEN SUPPLY PER GAGE READING. FOR ACTUAL OPERATIONAL HOURS AVAILABLE, DIVIDE TOTAL HOURS BY NUMBER OF CREW MEMBERS.

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Figure 1-130. (Sheet 2 of 2)

HAND-OPERATED FIRE EXTINGUISHERS.

Six portable bromotriflormethane fire extinguishers are provided for fighting interior fires: one on the forward side and one on the aft side of the flight station aft bulkhead by the crew entrance door, one on the aft side of the COMM CENTRAL forward bulkhead by the aft galley, one on the forward side of the COMM CENTRAL aft bulkhead by the No. 4 operator's seat, one aft of the left wheel well, one aft of the right paratroop door and one mounted on the long trailing wire antenna console. A trigger-type handle located at the top of the extinguisher permits one-handed operation.

ALARM SYSTEM.

The alarm system consists of four alarm bells in the special equipment compartment and two switches, one on the pilot's side shelf and the other on the copilot's side shelf. The alarm system is used for crew and passenger warning or paratroop warning. All the bells sound when either guarded switch is ON. Power for operation of the bells is supplied from the battery bus through the alarm bell circuit breaker on the pilot's side circuit breaker panel.

DOOR WARNING SYSTEM.

The door warning system consists of a master door warning light on the pilot's side of the glare shield (figure 1-89), a light and master light shutoff switch at each door and door warning switches on each door. The door warning system is supplied 28-volt dc power from the main dc bus through the door warning light circuit breaker on the copilot's lower circuit breaker panel.

Door Warning Lights.

The master door warning light is located on the pilot's side of the glare shield. It illuminates whenever any one of the door warning switches is closed. The switches are closed when the doors are not closed and latched. It can be turned off by the master light shutoff switch for the affected door, and then will be turned on again if a warning switch on another door closes. The left-hand paratroop door light is located on a panel next to the door. The right-hand paratroop door, ramp, and aft cargo door lights are located on a panel aft of the right-hand paratroop door. The crew door warning light is located forward of the crew entrance door. Any one of these lights will be turned on when the corresponding door is not securely locked, and these individual lights cannot be turned off except by securing the door.

Master Light Shutoff Switches.

The master light shutoff switches are located on the door warning light panels in the cargo compartment next to the individual door warning lights. One switch is provided for each door. The purpose of the switches is to permit turning off the master warning light on the pilot's instrument panel, thus rearming the light so that it can give a second warning if another door becomes insecure.

FIRST AID KITS.

Five emergency first aid kits (figure 5-1) are provided as follows: two in the flight station, one in the COMM Central, and one forward of each paratroop door.

HAND AXES.

Two hand axes (figure 5-1) are installed in the aircraft, one on the aft side of the forward bulkhead of the special equipment compartment and the other aft of the right paratroop door.

EMERGENCY LIGHTS.

Seven portable, battery-operated emergency lights (figure 5-1) are installed on stationary terminal blocks located near each normal or emergency exit. One light is installed near the crew entrance door, one near each of the two paratroop doors, one near the right side emergency exit, and one near each of the three overhead emergency exists. When installed, the lights can be either individually controlled by the three-position (ON, OFF, ARMED) switch on each light assembly or collectively extinguished by the emer exit light extinguish push button on the overhead electrical control panel (figure 1-35). In order for the emer exit light extinguish push button to be able to extinguish a light, however, the associated light assembly switch must be positioned to ARMED. An inertia switch in each of the light assemblies actuates the light when the aircraft is subjected to a decelerating force exceeding 2-1/2 g's. The lights will also illuminate if power on the essential dc bus fails. An individual light assembly can be removed for emergency portable use by pulling the release handle on the light assembly. The control system for the installed system is supplied 28-volt, dc power from the essential dc bus through the emer exit light control circuit breaker on the copilot's lower circuit breaker panel, and from the battery bus through the emer exit light extinguish circuit breaker on the pilot's side circuit breaker panel.

LIFERAFTS.

Stowage provisions exist for installation of four Type MK-20 20-man pneumatic liferafts (figure 5-1) in the trailing edge of the center wing section. Liferaft release handles are located as follows: two on the flight station bulkhead, below the escape hatch; two on the fuselage structure, aft of the right paratroop door; and two on the wing upper surface, inboard of each raft stowage compartment. The release handles on the wing upper surface can be reached by removing the protective canvas covering over the handle openings. The rafts are automatically inflated upon actuation of the release handles.

EMERGENCY TRANSMITTER.

A PRT-5 emergency radio transmitter (figure 5-1) is stowed in the liferaft compartment in the left section of the center wing.

Note

An AN/URT-33 emergency hand beacon radio transmitter may be used as an alternate to the PRT-5. The AN/URT-33 transmitter is stowed in each liferaft.

LIFE VESTS.

Life vests, carried for all crew positions, are stowed in COMM Central and in the aft compartment.

ANTI-EXPOSURE SUITS.

There are provisions for stowing six anti-exposure suits (figure 5-1) in the locker under the lower bunk on the flight station. Other anti-exposure suits are stowed in COMM Central and aft compartment.

EMERGENCY ESCAPE EXITS.

Three overhead emergency escape hatches and a side emergency exit panel are provided on the aircraft. The overhead emergency escape hatches are located forward of the flight station aft bulkhead, aft of the center wing section, and above the loading ramp. The side emergency exit panel is located forward of the right wheel well. An emergency escape lever is mounted on the fuselage adjacent to each emergency escape exit. Moving this lever releases the locking latches, and allows the hatch or exit panel to be pulled into the aircraft. The hatches and side exit panel may be released from outside of the aircraft by means of flush-type finger handles mounted in the fuselage skin. Pulling these handles releases the hatches and side emergency exit panel in the same manner as do the emergency escape levers. Emergency chopping locations are identified by yellow markings, both inside and outside the aircraft. These locations are above and forward of the paratroop door on each side of the aircraft.

Emergency Exit Luminous Markers.

Tritium-type luminous markers are installed at various locations within the aircraft to facilitate night identification of emergency exits. A luminous marker is installed in the handle of the side emergency exit hatch, in the handles of all overhead emergency exit hatches, on each paratroop door, and just above the crew entrance door handle.

ALTERNATE EXITS.

See Section V for air, ground, and water emergency exits.

EMERGENCY ESCAPE ROPES.

An emergency escape rope is installed aft of each overhead emergency escape hatch. One end of each rope is fastened to the fuselage structure. The ropes are looped into a bundle and are secured near the hatches in snap-fastened straps.

CREW ENTRANCE DOOR.

The crew entrance door is located on the forward left side of the aircraft. The door is opened from the outside by rotating the door handle downward. The door should be allowed to swing slowly downward until the spring-loaded telescoping counterbalance and door stop holds the door at the proper angle for use. Steps on the inside of the door facilitates entrance to the aircraft. A hand lanyard on the aft side of the inside face of the door is provided for pulling the door closed preparatory to flight. To open the door from the inside, turn the inside handle in a counterclockwise direction.

Crew Entrance Door Jettison Handle.

The crew entrance door jettison handle (figure 1-131) is a yellow handle located on the ceiling of the flight station, 3 feet to the left of the center line of the aircraft and slightly aft of the pilot's seat. Pulling the handle down actuates a cable through a bellcrank assembly to pull the locking pins from the top of the door at the same time that the hinge pins drop from the bottom hinge and the telescoping counterbalance is released.

SEATS.

The crew is provided with tapered-back seats (figure 1-132) designed for use with back-style parachutes. The flight engineer's and navigator's seats, on swivel bases, are adjustable both fore-and-aft and up and down. Headrests may be stowed when not in use at the rear of the pilot's or copilot's seats. Raising the vertical adjustment lever on the right side of each seat releases vertical locking pins and permits the seats to be raised by spring pressure or lowered by the weight of the occupant. A horizontal release lever on the left side of the seat, when raised releases horizontal locking pins and permits the seat to be moved forward or aft. Raising swivel release levers, located forward of the elevation release levers on the right side of the flight engineer's and navigator's seats, releases a locking device and permits this seat to be swiveled.

SEAT CONTROLS.

Seat controls are designed to adjust the seat position to the physical build of the individual crew member. They are easily adjusted to the comfort of the crew member and may be locked in any desired position.

Pilot's and Copilot's Seat Tilt Lever.

A seat tilt lever, located on the right side of the pilot's and copilot's seats, is a manual control which tilts the seat forward or aft.

Horizontal Adjustment Lever.

A horizontal adjustment lever, located on the left side of the seats, locks and unlocks the seat adjustment mechanism, allowing the seat to be adjusted from an aft to a forward position. Placing the lever in the FORWARD detent locks the adjustment mechanism. Placing the lever in the AFT detent unlocks the adjustment mechanism.

Swivel Release Lever.

A swivel release lever, located on the right side of both the flight engineer's and navigator's seat, controls the rotational movement of these seats. When the swivel release lever is raised, the seat-locking device is released and the seat can be rotated to any desired position. When the lever is released, the locking device engages to prevent rotation of the seat.

Vertical Adjustment Lever.

A vertical adjustment lever, which is spring-loaded to the lock position, is located at the right side of each seat. The seat itself is spring-loaded to its upper-most position. To adjust the seat for height, sit down in the seat, at the same time pulling up on the vertical adjustment lever. The seat will tend to move up or down, depending on the weight applied to it. When the desired height is attained, release the lever, which will lock the seat in the desired position.

SAFETY BELTS AND SHOULDER HARNESS.

All flight station crew seats are provided with a conventional seat safety belt and shoulder harness. Clevis-type attachment assemblies installed on the back rest of the lower bunk permit the installation of extra seat belts at this station.

SHOULDER HARNESS INERTIA REEL LOCK CONTROL HANDLE.

A two-position (LOCK, UNLOCKED) shoulder harness inertia reel lock control handle (figure 1-132) is located on the left of the pilot's, copilot's navigator's and flight engineer's seats. A latch is provided for retaining the control handle securely at either position. By pressing down on the top of the control handle, the latch is released and the handle may be moved freely from one position to another. When the control is in the UNLOCKED position, the reel harness cable will extend to allow a crew member to lean forward in his seat; however, the reel harness cable will automatically lock when an impact force of 2 to 3 g's on the aircraft is encountered. When the reel is locked in this manner, it will remain locked until the control handle is moved to LOCKED and then returned to the UNLOCKED position. When the handle is in the LOCKED position, the reel harness cable is manually locked so that the pilot is prevented from bending forward. The LOCKED position is used only when a crash landing is anticipated. This position provides a safety precaution in addition to the automatic safety lock. The navigator's and flight engineer's inertia reel will not function automatically nor will the shoulder harness provide proper restraint if the seats are facing sideways. This is due to the plane of the inertia weight and spring.

crew door jettison handle

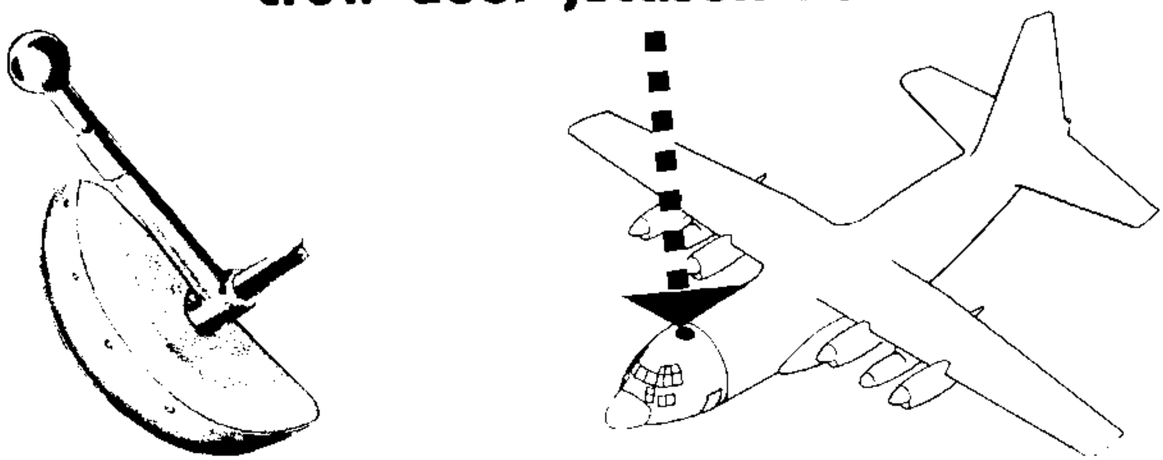


Figure 1-131.

FLIGHT CREW BUNKS.

The aircraft is equipped with four crew rest bunks. The bunks are arranged in upper and lower positions (figure 1-133) in the aft equipment area. Two bunks are installed on each side of the aircraft aft of the main wheel wells. Each bunk is equipped with a mattress and cover. Each lower bunk is equipped with three Type MD-2 safety belts and three folding legs to permit the bunk to be used as a seat/bunk combination. Each seat/bunk assembly provides side-by-side seating for four crewmembers during take-off, landing, and during in-flight periods. The bunks are attached to the fuselage sidewall by hinges. The upper bunks can be folded down to form a backrest for the lower seat/bunks. The bunks can be folded into the circumference of the aircraft when not in use to permit easy access to equipment.

ANTENNA OPERATOR'S SEAT.

An antenna operator's seat is installed in the aft equipment area just aft of the long trailing wire antenna control console at fuselage station 737.00 and left butt line 11.25. Blocks are provided for forward and aft seat adjustment. The seat is adjusted vertically by releasing the stop, which is on the lower left side of the seat. When desired position is reached, tighten stop. The seat backrest is adjusted vertically by releasing the stop, which is located on the aft side of the backrest. When desired height is reached, tighten stop. No swivel adjustment is necessary.

CREW LOUNGE.

One table and four seats (figure 1-134) are installed on the port side of the comm central area between fuselage stations 347 and 437. The table is attached at one end to the fuselage side wall by hinges and has a single folding pedestal leg at the other end. The table edges fold down to permit easy access to the seats. The seats are double folding with no adjustments. Each seat is equipped with a Type MD-2 safety belt.

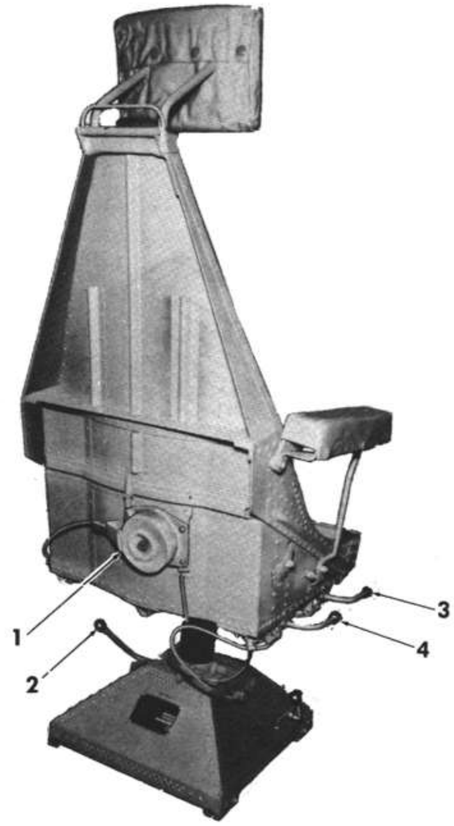
MISCELLANEOUS EQUIPMENT.

Miscellaneous equipment consists of windshield wipers, toilet and galley facilities, ladders, protective covers, blackout curtains, and alarm bells.

WINDSHIELD WIPERS.

Two electrically operated windshield wipers are installed; one on the pilot's windshield panel and one on the copilot's windshield panel. The speed of the

crew seats

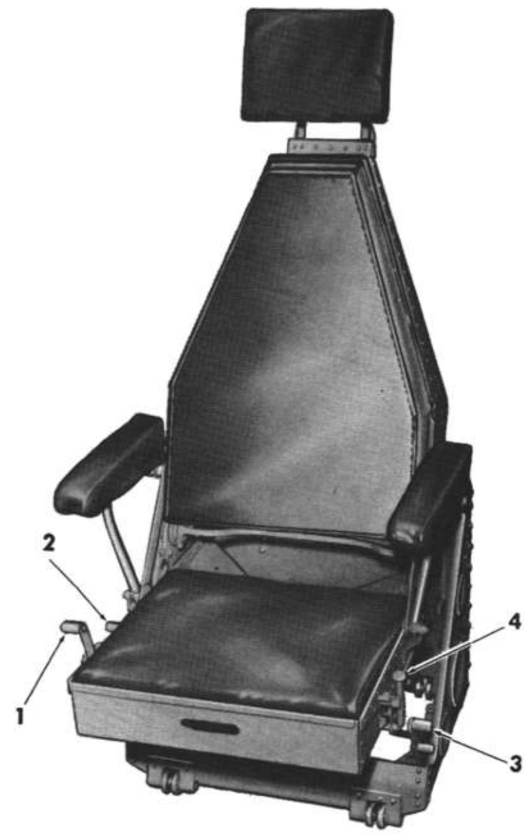


FLIGHT ENGINEER'S AND NAVIGATOR'S SEAT

1. INERTIA REEL
2. HORIZONTAL ADJUSTMENT LEVER
3. SWIVEL RELEASE LEVER
4. VERTICAL ADJUSTMENT LEVER

NOTE

THE NAVIGATOR'S SEAT DOES NOT HAVE ARM RESTS INSTALLED.



PILOT'S AND COPILOT'S SEAT

1. SEAT TILT LEVER
2. VERTICAL ADJUSTMENT LEVER
3. HORIZONTAL ADJUSTMENT LEVER
4. INERTIA REEL LEVER

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Figure 1-132.

flight crew bunks

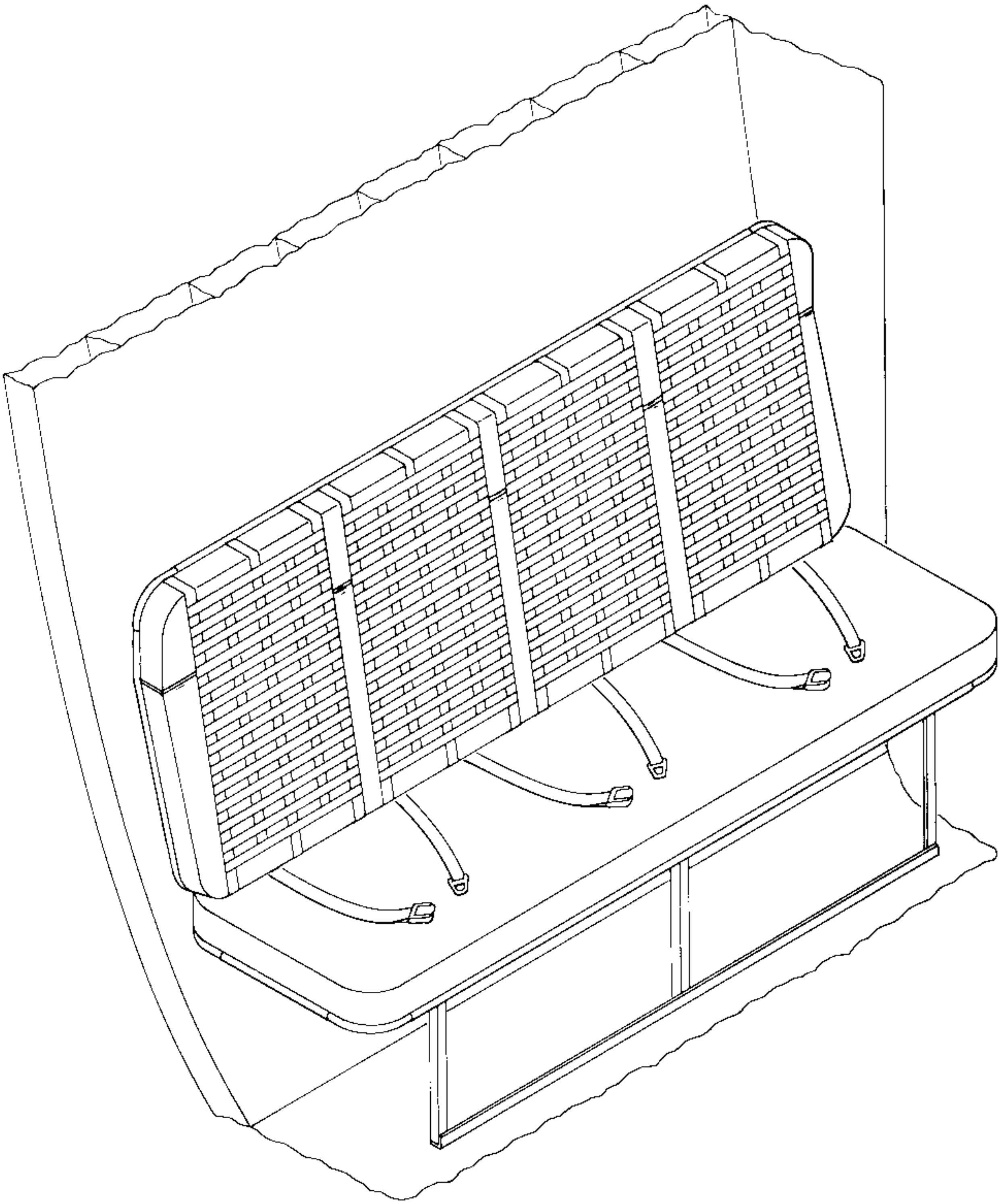


Figure 1-133.

crew lounge

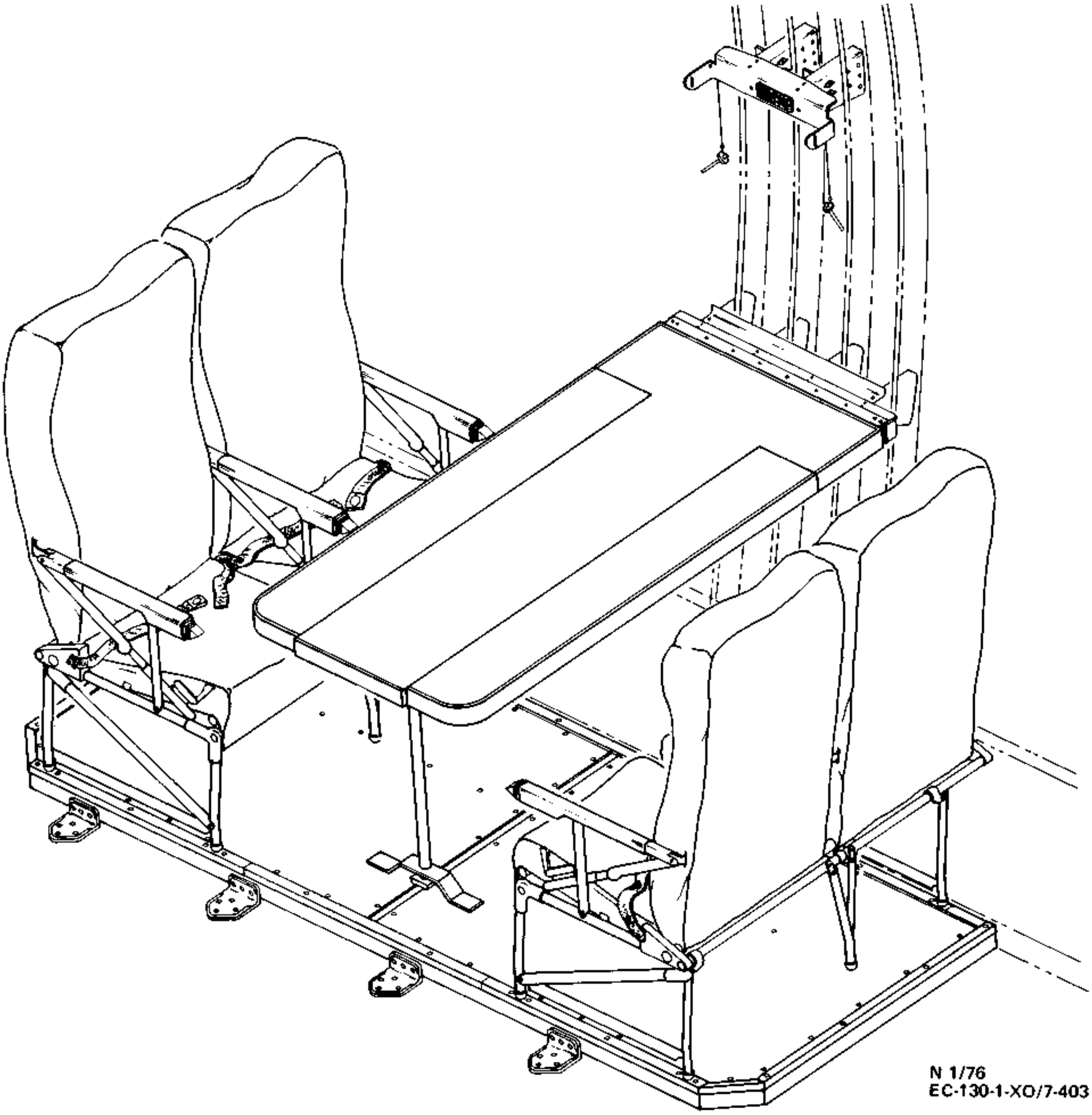


Figure 1-134.

windshield wipers is controlled by a six-position (PARK, OFF, SLOW, 2, 3, FAST) rotary-type windshield wiper control switch on the copilot's side shelf. The windshield wipers are powered by 28-volt dc power from the main dc bus through the windshield wiper circuit breakers on the copilot's lower circuit breaker panel.

TOILET FACILITIES.

A urinal is mounted aft of the left paratroop door and an enclosed lavatory is mounted on the right side of the cargo ramp, aft of the right paratroop door. The lavatory contains a chemical toilet and a washbowl. The 28-volt dc power required for operation of the toilet and the lavatory light is applied through the LAVATORY circuit breaker mounted on the copilot's lower circuit breaker panel. The 115-volt, 400-Hz power required for operation of the lavatory fan is applied through the LAVATORY circuit breaker mounted on the pilot's upper circuit breaker panel. Water is supplied to the washbowl from a water bottle mounted on the outside lavatory bulkhead. A quick-disconnect fitting on the water bottle permits easy disconnect facilities of the water hose. Water from the washbowl is drained through the bleed air system and ejected through the aircraft bottom fuselage.

GALLEY EQUIPMENT.

The flight crew galley (figure 1-135) is located on the left side of the flight deck near the crew entrance. It is provided with the following facilities:

1. A water tank connected by a tube to a pushbutton-type water spigot.

2. Two 2-gallon liquid containers with electrical heating elements for keeping liquids hot.

3. A cup dispenser.

4. An electrically operated oven.

5. Two food warming cups (115-volt ac only).

6. A 1.5-gallon sink.

7. A refrigerator, dry-ice-cooled and mechanically operated, with a compartment for frozen foods and one for foods not requiring freezing.

8. A refuse container.

9. Food storage compartments.

10. A wall-mounted can opener.

11. Galley work area and switch panel lights.

The galley is also equipped with an electrical switch panel which incorporates the following:

1. A two-position (ON, OFF) main power switch and indicator light.

2. Two timers and two indicator lights for the food-warming cups.

3. Two two-position (ON, OFF) switches and two indicator lights for the liquid containers.

4. A two-position (ON, OFF) switch and a dimmer control for the galley work area light.

5. Cartridge fuses for the work area light, liquid containers, and food-warming cups.

The galley is powered by 115-volt ac from the R/H ac bus through the special equipment compartment and flight deck circuit breakers on the pilot's upper circuit breaker panel. A second galley is located in the COMM central. This galley receives 115-volt ac from the R/H ac bus and 28-volt dc from the main dc bus through the forward iron lung outlet switch on the copilot's upper circuit breaker panel.

COMM CENTRAL GALLEY.

The comm central galley (figure 1-136) is located at the comm central area front entrance. This galley contains:

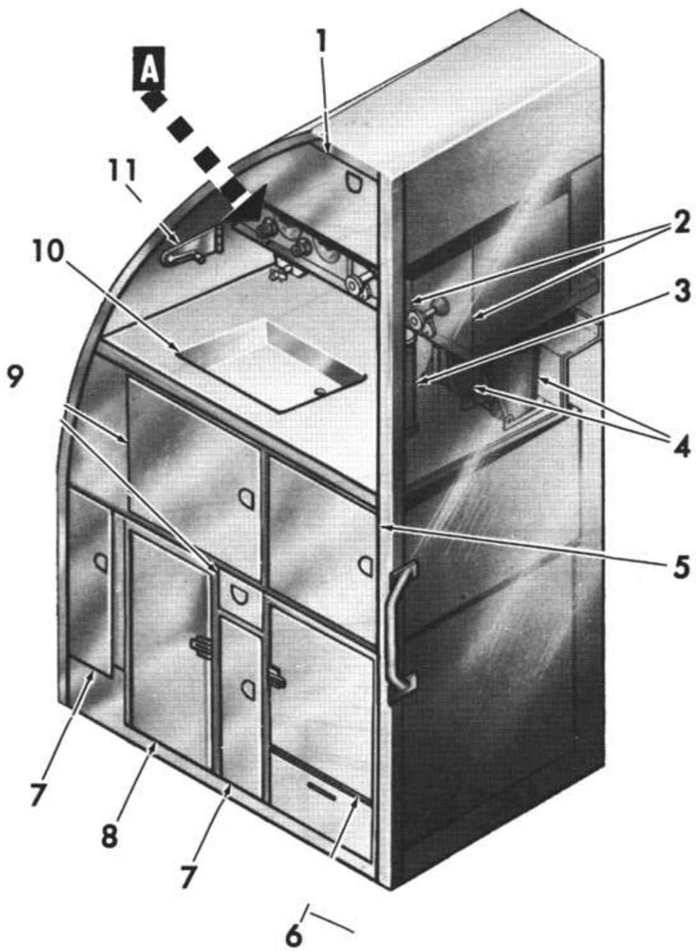
1. A refrigerator equipped with an internal thermostat control and two basket-type racks for food storage.

2. An electrical oven equipped with a manually operated thermostat and a timer selector.

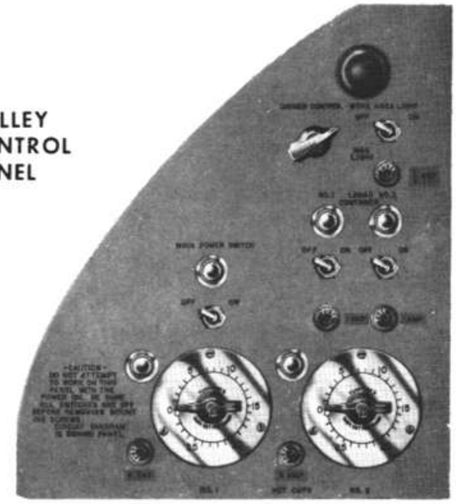
3. Two food warming cups.

4. Two electrically heated containers. One container is equipped with an ice well and can be used for cold liquid storage by placing dry ice in the ice well.

flight deck galley



GALLEY CONTROL PANEL



1. WATER TANK
2. LIQUID CONTAINERS
3. CUP DISPENSER
4. FOOD WARMING CUPS
5. REFUSE CONTAINER
6. REFRIGERATOR
7. STORAGE COMPARTMENTS
8. OVEN
9. FOOD STORAGE COMPARTMENTS
10. SINK
11. CAN OPENER

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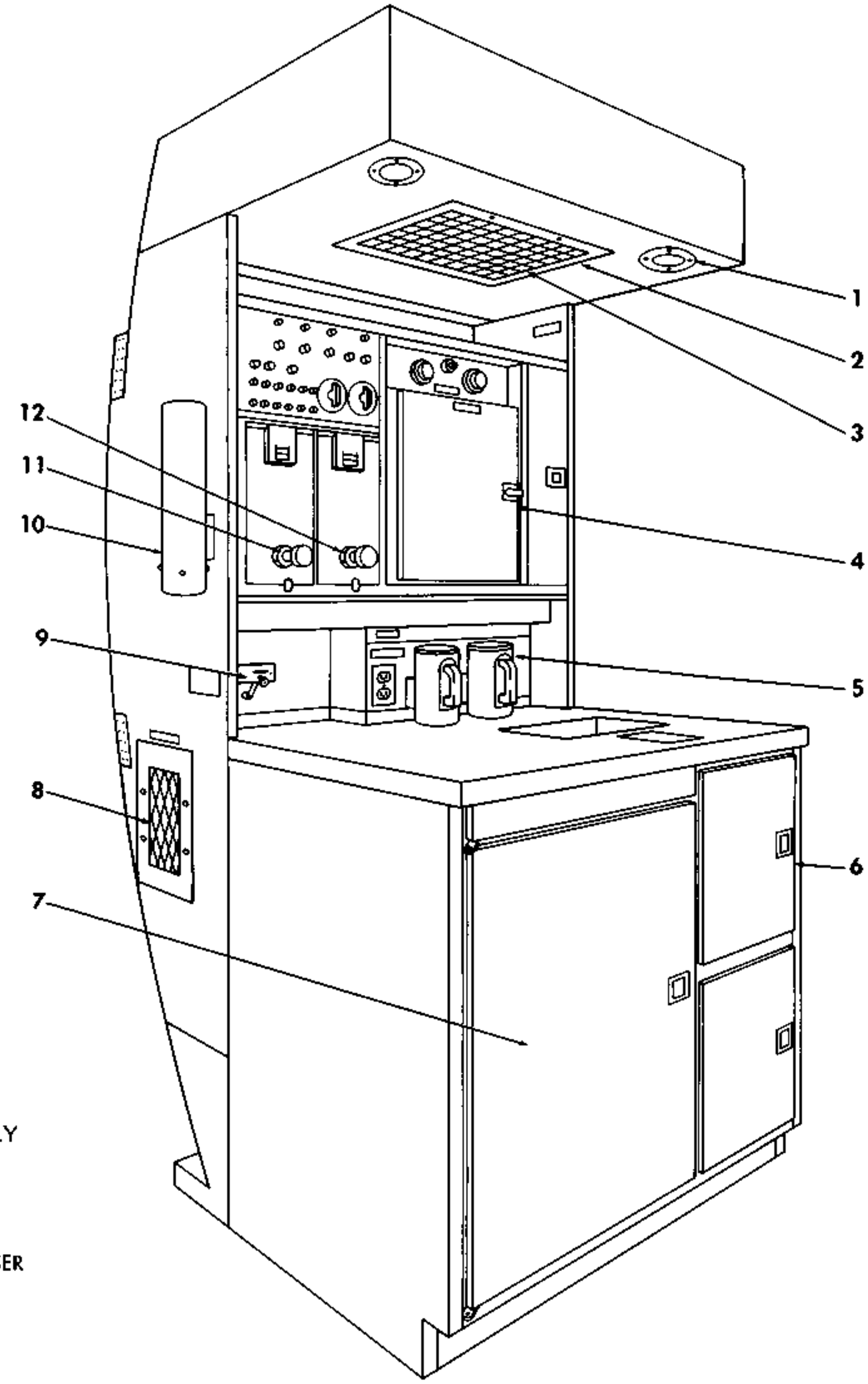
Figure 1-135.

comm central galley



1. LIGHT ASSEMBLY
2. BLOWER
3. FILTER
4. OVEN
5. HOT CUPS
6. WASTE DISPENSER
7. REFRIGERATOR
8. FILTER
9. CAN OPENER
10. CUP DISPENSER
11. HOT LIQUID CONTAINER
12. COLD LIQUID CONTAINER

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Figure 1-136.

ato system

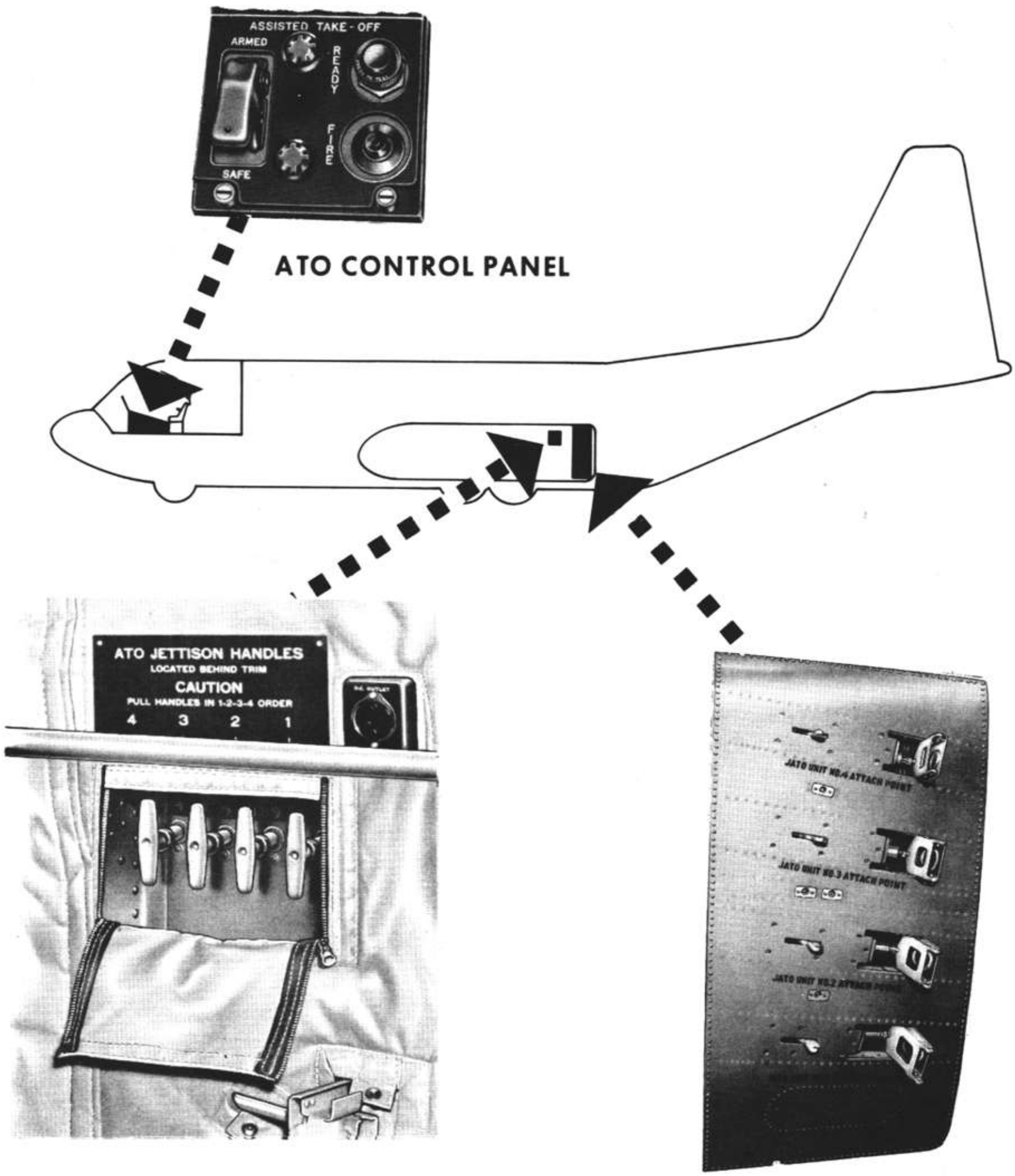

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Figure 1-137.

5. A cup dispenser.

6. A 1.5-gallon sink equipped with an overboard drain.

7. A refuse container.

8. Two filter systems.

9. A wall-mounted can opener.

10. Galley work area and light.

11. Dome lights.

12. Electrical blower and filter.

The galley is also equipped with an electrical control panel. This panel contains circuit breakers and switches to operate the galley equipment and indicator lights to monitor equipment operation. The galley is powered by 115/200 volts from the right ac bus through circuit breakers on the pilot's upper circuit breaker panel; the galley also receives 28-vdc from the forward iron lung C/B.

PROTECTIVE COVERS.

Protective covers for the engine tailpipes are stowed in a container attached to the left side of the special equipment compartment near the aft cargo door. Covers for the engine inlet air ducts are stowed on the left side of the special equipment compartment aft of the cargo door. Protective covers for the pitot tubes are stowed in the miscellaneous stowage container.

ASSISTED TAKE-OFF (ATO) SYSTEM.

Provisions are made for external mounting of eight solid-fuel ATO units of 1,000 pounds thrust each, which supply additional thrust when it is desired to shorten take-off distance. The system is electrically controlled and operated from the assisted take-off control panel (figure 1-137) on the flight control pedestal. The units are fired simultaneously and give thrust until the propellant is exhausted. After firing, the expended ATO units may be jettisoned to reduce aircraft weight and drag.

Should the requirement to use ATO for the EC-130 aircraft arise, it will be mandatory that applicable publications be referenced for its installation and operation.

WARNING

The hazardous nature of ATO allows only qualified personnel to install and operate this equipment.

PART 3

AIRCRAFT SERVICING

GROUND SERVICING AND SUPPORT EQUIPMENT.

The ground support equipment for the aircraft shall be those items pertaining to ramp servicing for dispatch and operation of the aircraft. (See figure 1-138 for ground servicing areas.)

EXTERNAL POWER REQUIREMENTS.

The ac external power source must provide 200/115-volt, 3-phase, 400-cycle power with a phase of A-B-C. The 28-volt, dc external source should have a capacity of at least 600 amperes.

CAUTION

When external ground equipment is used the units will be placed the maximum distance from the aircraft their cords or ducts will permit to avoid the danger areas depicted in figure 1-139.

EXTERNAL AIR REQUIREMENTS.

Engine ground starting may be accomplished with a standard air starting unit that will deliver a minimum of 90 PPM air flow at 25 psi pressure. The ground air start connection is located aft and adjacent to the GTC access door.

NORMAL OPERATION OF THE SINGLE POINT REFUELING SYSTEM.

At times it may be necessary for the flight crew to perform the refueling. Use only the fuels specified for this aircraft. If a single point refueling truck or fuel pit is available, the single point refueling system may be used. If a single point fuel source is not available, refueling must be accomplished through the individual wing tank filler ports.

REFUELING AND DEFUELING PROCEDURES.

Note

At times it may be necessary for the flight crew to perform refueling and defueling operations. Under these conditions, refer to NAVAIR 01-75GAE-2.

GROUND FLOTATION CHARACTERISTICS CHART.

The ground flotation characteristics chart (figure 1-140) is provided for generalized operational planning. This chart permits matching the load that the aircraft imposes on an airfield to the strength capability of the airfield. Ground floatation characteristics are correlated for the following five methods of evaluating airfield/runway strength.

FOOTPRINT LOADING (PRESSURE).

For operational planning purposes footprint loading is the same as tire inflation pressure. Figure 1-140 shows tire pressure values versus gross weights for normal operation from either high strength airfields or marginal strength airfields.

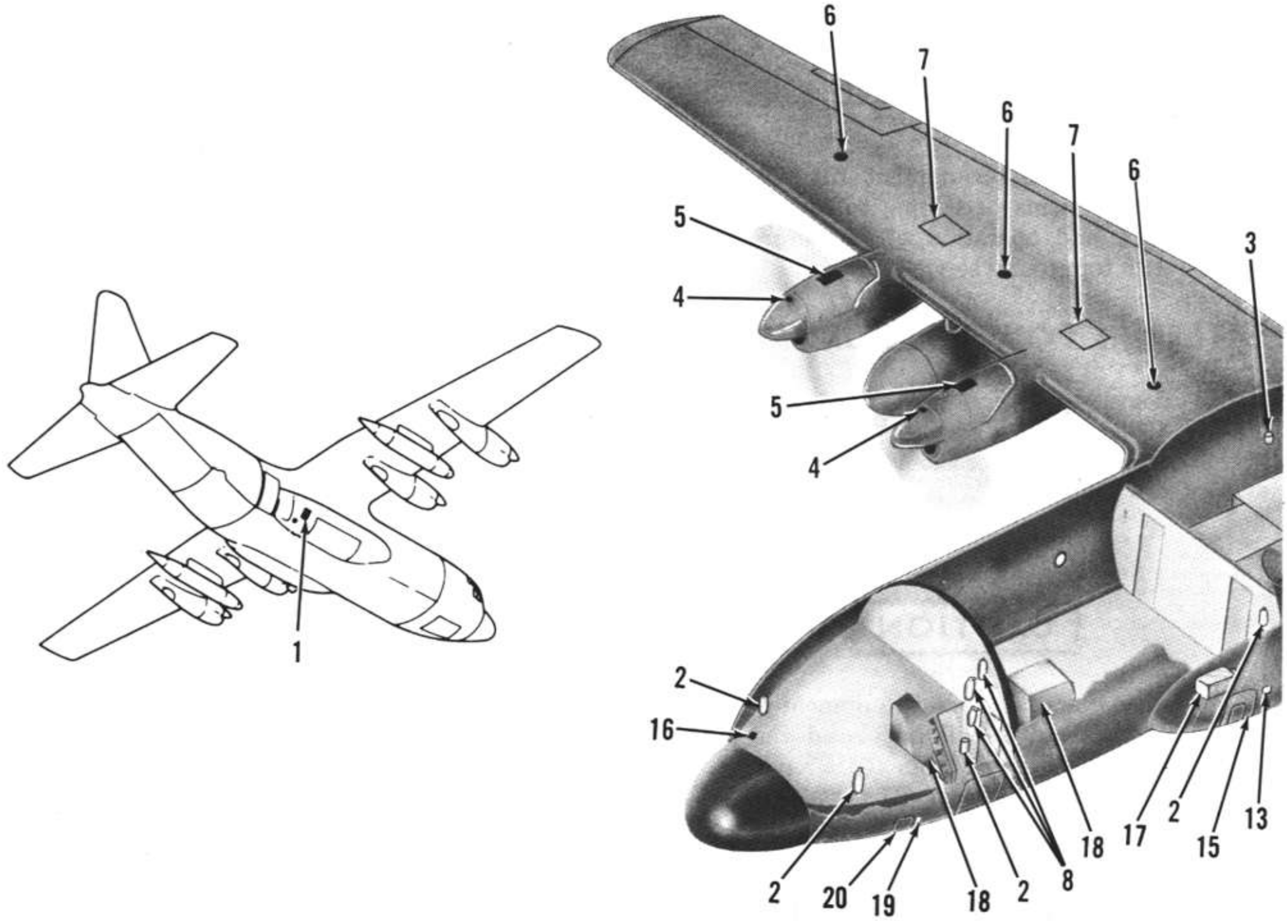
UNIT CONSTRUCTION INDEX (UCI).

UCI values are used to determine relative floatation characteristics of comparative aircraft and are seldom used in operational planning.

EQUIVALENT SINGLE WHEEL LOAD (ESWL).

Values of ESWL are determined from the geometry of the multiple wheeled landing gears, the number and size of the tires, and the aircraft gross weight. Where airfield strength data are given in terms of ESWL, values of UCI and LCN can be calculated from these values of ESWL when required.

servicing diagram



1. SINGLE POINT REFUELING ADAPTER
2. PORTABLE OXYGEN BOTTLES (5)
3. BOOSTER HYDRAULIC SYSTEM RESERVOIR
4. PROPELLER RESERVOIR
5. ENGINE AND STARTER OIL
6. FUEL FILLER POINTS
7. DRYBAYS
8. HAND OPERATED FIRE EXTINGUISHERS (6)
9. WATER BOTTLE
10. AUXILIARY SYSTEM HYDRAULIC RESERVOIR
11. FIRE EXTINGUISHER AGENT BOTTLES
12. ATM AND ATM OIL RESERVOIR
13. EXTERNAL AIR RECEPTACLE
14. UTILITY HYDRAULIC SYSTEM RESERVOIR
15. GTC
16. OXYGEN FILLER VALVE
17. GTC OIL RESERVOIR
18. GALLEY (2)
19. EXTERNAL POWER RECEPTACLES
20. BATTERY COMPARTMENT
21. AMPLIFIER-COUPLER WATER RESERVOIR
22. LAVATORY WATER RESERVOIR
23. LONG WIRE ANTENNA BRAKE COOLANT RESERVOIR
24. AN/USC-13 HYDRAULIC SYSTEM
25. SULPHUR HEXAFLUORIDE CYLINDER

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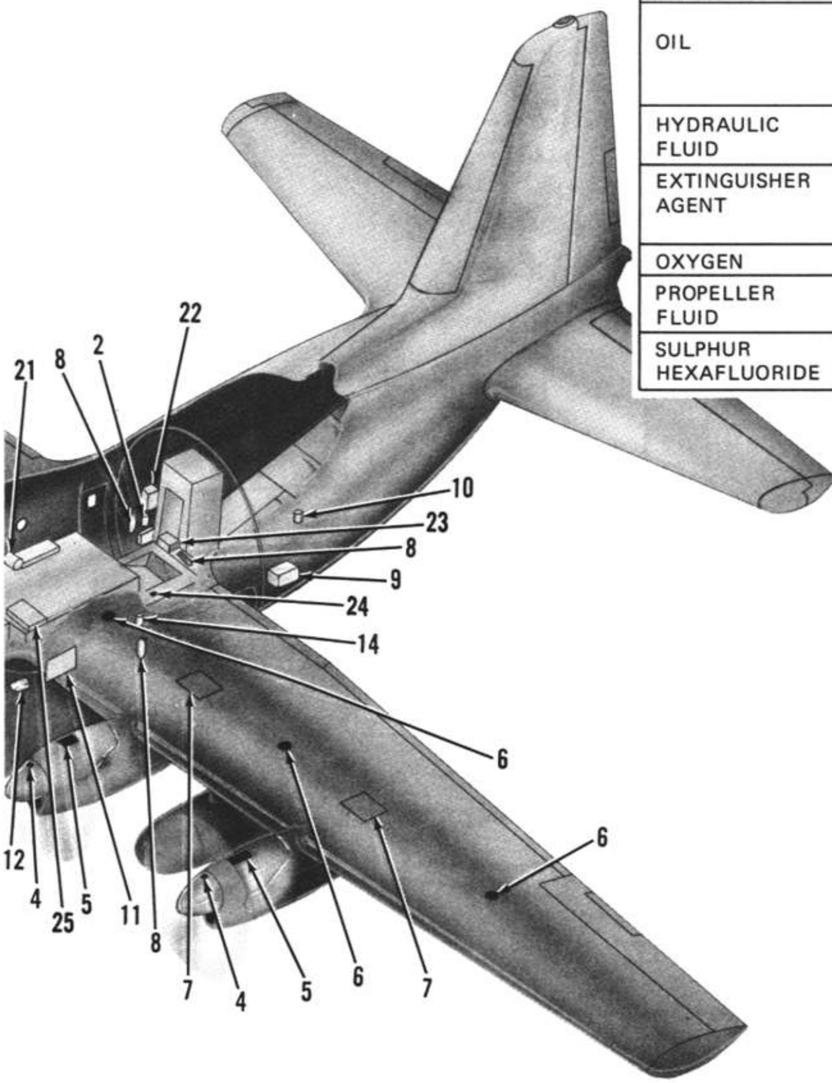
Figure 1-138. (Sheet 1 of 2)

	SPECIFICATION	NATO SYMBOL
PRIMARY FUEL	MIL-T-5624 JP-5 JP-4	F-44 F-40 F-34 F-45
ALTERNATE FUEL	REFER TO SECTION 1, PART 4 FOR ALTERNATE FUELS	0-148 0-156
OIL	ENGINE, GTC, STARTER, ATM } MIL-L-7808 OR MIL-L-23699 (1)	0-156
HYDRAULIC FLUID	MIL-H-5606 MIL-H-85282 (ALT)	H-515
EXTINGUISHER AGENT	ENGINE AND GTC-MIL-B-12218 HAND EXTINGUISHER-CARBON DIOXIDE	
OXYGEN	MIL-O-27210 TYPE II	
PROPELLER FLUID	MIL-H-5606 (2)	H-515
SULPHUR HEXAFLUORIDE	COMMERCIAL	



NOTE

(1) IN EMERGENCIES MIL-L-7808 AND MIL-L-23699 MAY BE MIXED. THE AMOUNT OF EMERGENCY OIL ADDED SHOULD NOT EXCEED ONE HALF TANK CAPACITY. AT FIRST OPPORTUNITY, THE OIL WILL BE DRAINED AND ENGINE SERVICED WITH PROPER OIL.

(2) THE TYPE OF FLUID TO BE USED IN THE PROPELLER IS SPECIFICATION MIL-H-5606. THIS FLUID IS THE ONLY TYPE AUTHORIZED.

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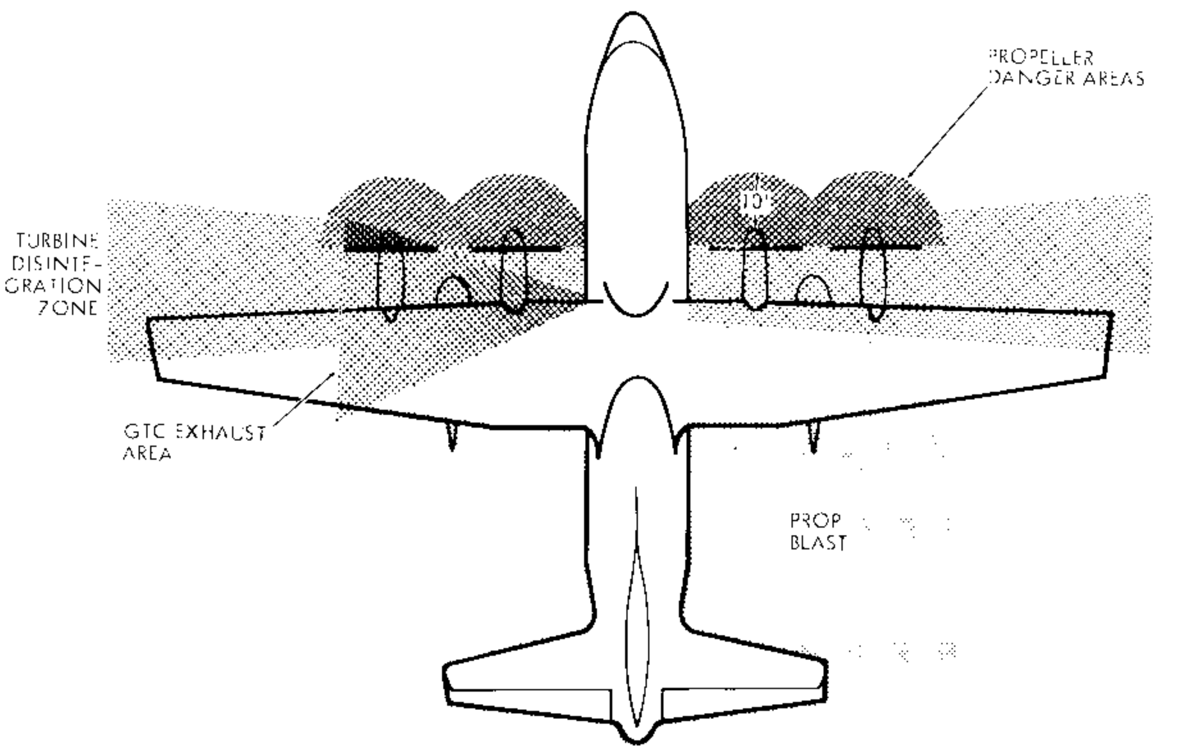
Figure 1-138. (Sheet 2 of 2)

danger areas

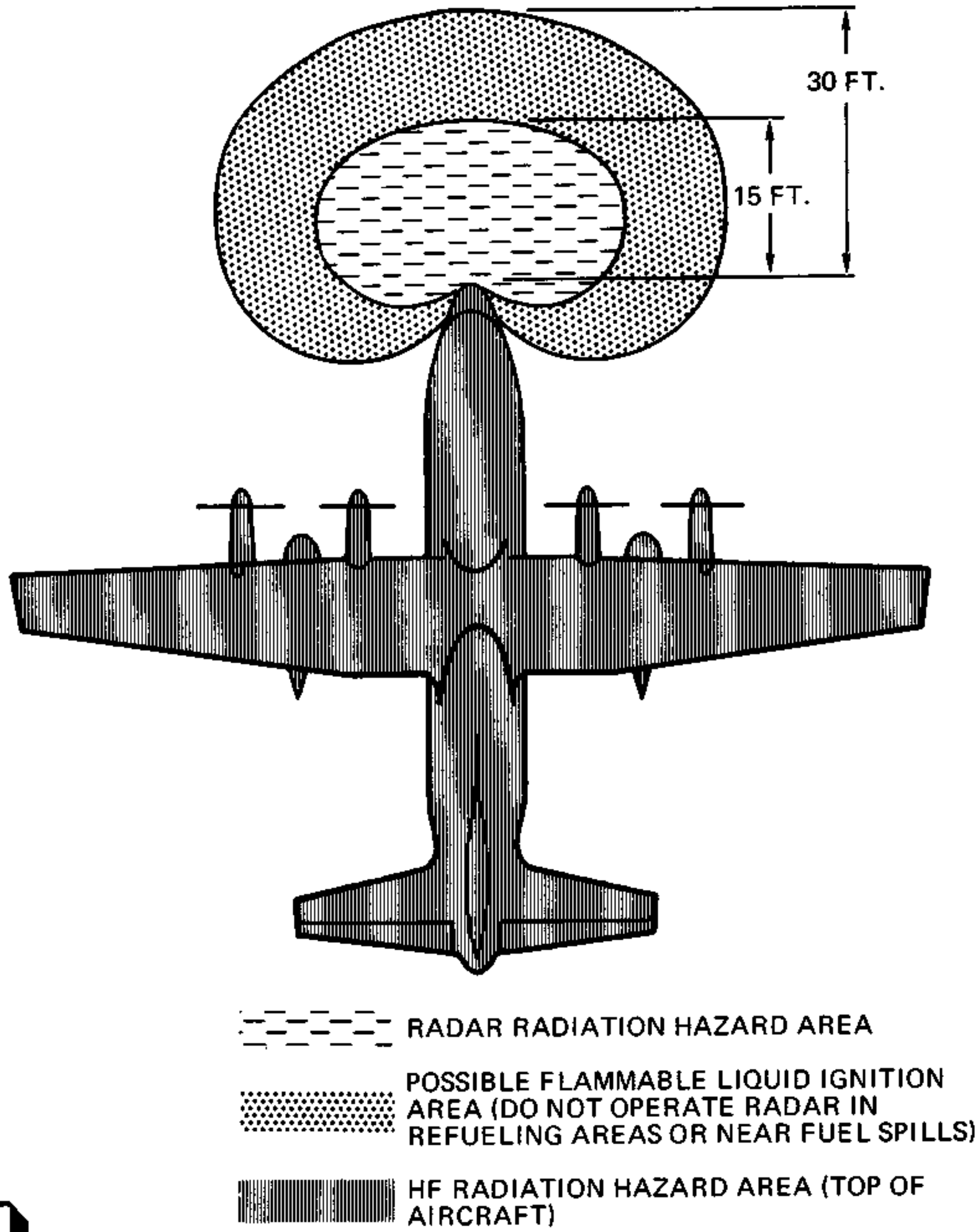
(prop/engine hazard areas)



At 500 feet with engines at full power, prop blast equals approximately 30 knots.

Figure 1-139. (Sheet 1 of 4)

(radiation hazard areas)



WARNING

ENTRY INTO THE SEARCH RADAR ANTENNA RADIATION HAZARD AREA DOES NOT NECESSARILY RESULT IN INJURY. IT IS GENERALLY THROUGH PROLONGED EXPOSURE THAT THE POSSIBILITY OF INJURY EXISTS.

ENTRY INTO THE HF ANTENNAS RADIATION HAZARD AREA MAY CAUSE INJURY.

Figure 1-139. (Sheet 2 of 4)

(noise hazard areas)

4 ENGINES RUNNING
OR GTC RUNNING AS INDICATED

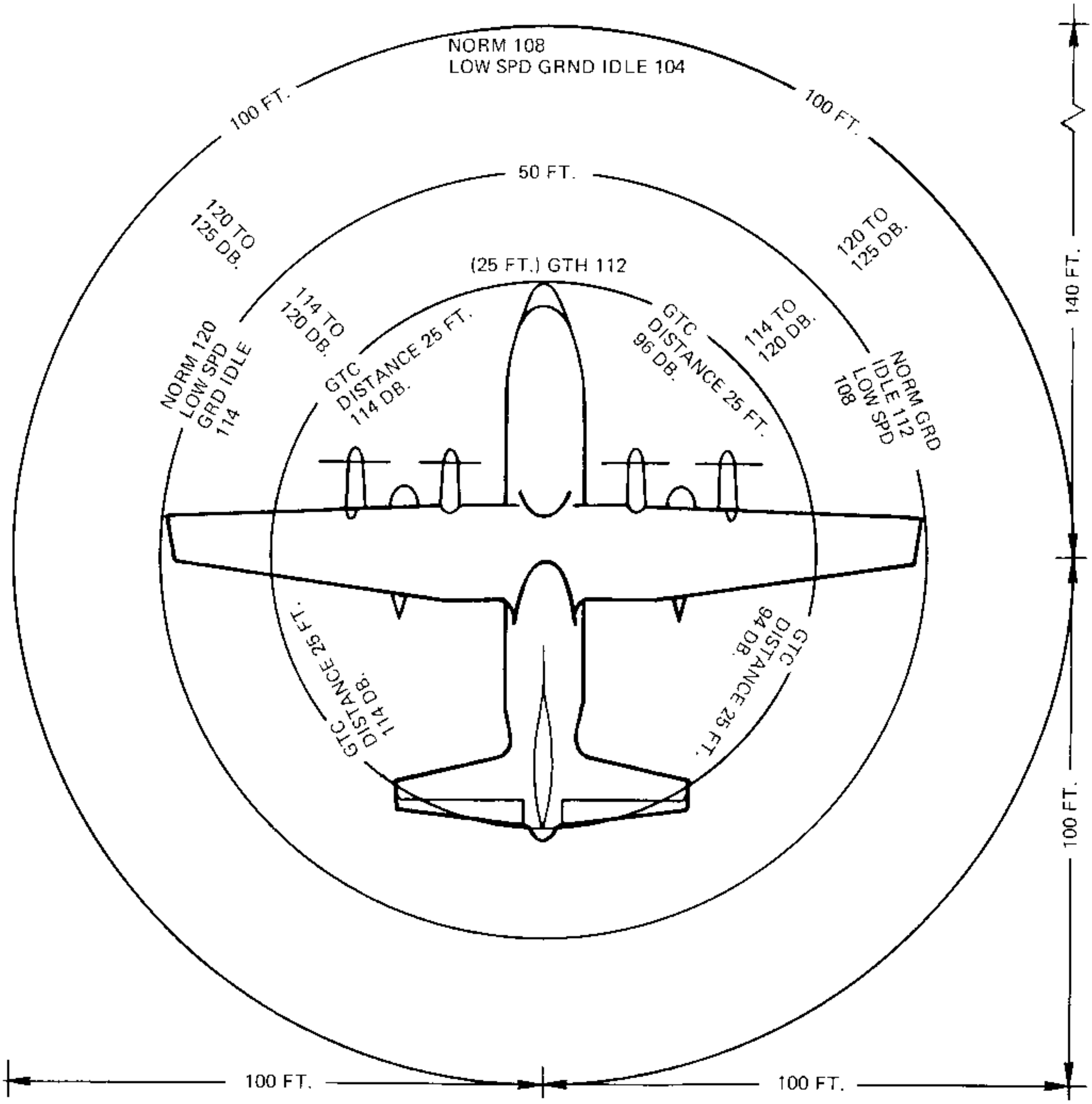


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Figure 1-139. (Sheet 3 of 4)

NOTE

EXPOSURE SHALL NOT EXCEED THAT SHOWN BELOW. THESE VALUES APPLY TO TOTAL TIME OF EXPOSURE PER WORKING DAY REGARDLESS OF WHETHER THIS IS ONE CONTINUOUS EXPOSURE OR A NUMBER OF OF SHORT TERM EXPOSURES.

DURATION PER DAY (IN HOURS)	SOUND LEVEL DB
8	90
4	95
2	100
1	105
1/2	110
1/4	115

EAR PLUGS CAN REDUCE THE NOISE BY 25 TO 30 DB. SOUND ATTENUATORS (MICKEY MOUSE EARS) CAN REDUCE NOISE BY AN ADDITIONAL 10 TO 15 DB, IF USED WITH EAR PLUGS.

SOUND ATTENUATORS ALONE REDUCE NOISE BY 30 DB.

NOTE

THE DB SOUND LEVELS INSIDE THE AIRCRAFT DURING TAXI WITH ALL ENGINES IN NORMAL GROUND IDLE ARE AS FOLLOWS:

INSIDE CREW ENTRANCE DOOR	116
COCKPIT	90
COMM CENTRAL	85
CREW REST AREA	85
REEL OPERATOR STATION	91

NOTE

THE DB SOUND LEVELS INSIDE THE AIRCRAFT DURING NORMAL CRUISE ARE AS FOLLOWS:

LOCATIONS	DB LEVEL
PILOT	88
COPILOT	89
FE	88
NAV	87
COCKPIT BUNKS	90
AFT GALLEY	92
OUTBOARD CREW REST SEAT	92
INBOARD CREW REST SEATS	90
COMM CENTRAL	90
UPPER AFT BUNKS	94
	*102
LOWER AFT BUNKS	92
	*102
REEL OPERATOR PANEL	93
	*97

*WITH LTWA RETRACTING

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Figure 1-139. (Sheet 4 of 4)

LOAD CLASSIFICATION NUMBER (LCN).

When LCN airfield strength data are used (primarily outside the United States) the data shown on the ground floatation chart can be used to estimate the capability of the aircraft to operate from a given airfield.

CALIFORNIA BEARING RATIO (CBR).

Values of CBR shown in figure 1-140 represent the required airfield surface hardness for operation of the aircraft in terms of gross weight and number of passes. Only unpaved surfaces (dirt, grass, gravel, coral, etc.) can be evaluated in terms of CBR.

AIRFIELD CONDITIONS.

High Strength Airfields.

Where airfield/runway strength data are available in terms of any of the methods shown in figure 1-140 the chart should be used as a guide to airfield - aircraft compatability. Where airfield/runway data are not available, the aircraft can operate satisfactorily from most smooth, relatively-hard surfaced airfields. Permanent type (paved) airfields are listed in the USAF/USN Flight Information Publications are adequate for most operations. For normal operation, tire pressure for a nominal tire deflection of 32 percent is recommended as shown by the high strength airfield line on figure 1-140.

Marginal Strength Airfields.

This category includes marginal strength airfields, temporary airfields such as airfields with minimum surfacing, or unsurfaced airfields such as would be encountered at forward area airfields used in airhead operations or airfields in remote areas of the world. The minimum soil strength required for operation is within the CBR values of 3 to 5. Operational feasibility on unsurfaced airfields depends upon the type soil, soil moisture content, and operational frequency. For marginal strength airfields, a tire deflection of 39 percent is used as shown by the marginal strength airfield line on figure 1-140.

CAUTION

Do not exceed 39 percent tire deflection.

USING THE CHART.

Example 1.

GIVEN: An EC-130G/Q is required to operate into an unsurfaced airfield with a gross weight of 110,000 pounds.

FIND: Footprint loading and ESWL for soft field operation.

SOLUTION: Enter figure 1-140 at the bottom of the chart on the vertical line represents 110,000 pounds gross weight. Proceed upward to the point of intersection with the footprint loading line for marginal strength airfields and read 53 psi (minimum) for main gear inflation pressure. Where the vertical line representing 110,000 pounds gross weight crosses the ESWL line read 25,000 pounds; then reduce this value by 10 percent for soft field operation to obtain a final ESWL value of 22,500 pounds.

Example No. 2.

GIVEN: An EC-130G/Q is required to operate into an airfield with an LCN of 25.

FIND: Footprint loading and maximum gross weight for unpaved runway operation.

SOLUTION: Enter figure 1-140 on the horizontal line representing an LCN value of 25; where this line crosses the LCN line, proceed vertically down from this point to read a maximum gross weight of 133,000 pounds. Proceed upward on the 133,000 pound gross weight line to the marginal strength airfields footprint loading line; then at the intersection of these lines, proceed horizontally to obtain a minimum main landing gear tire inflation pressure of 69 psi.

GROUND FLOTATION CHARACTERISTICS

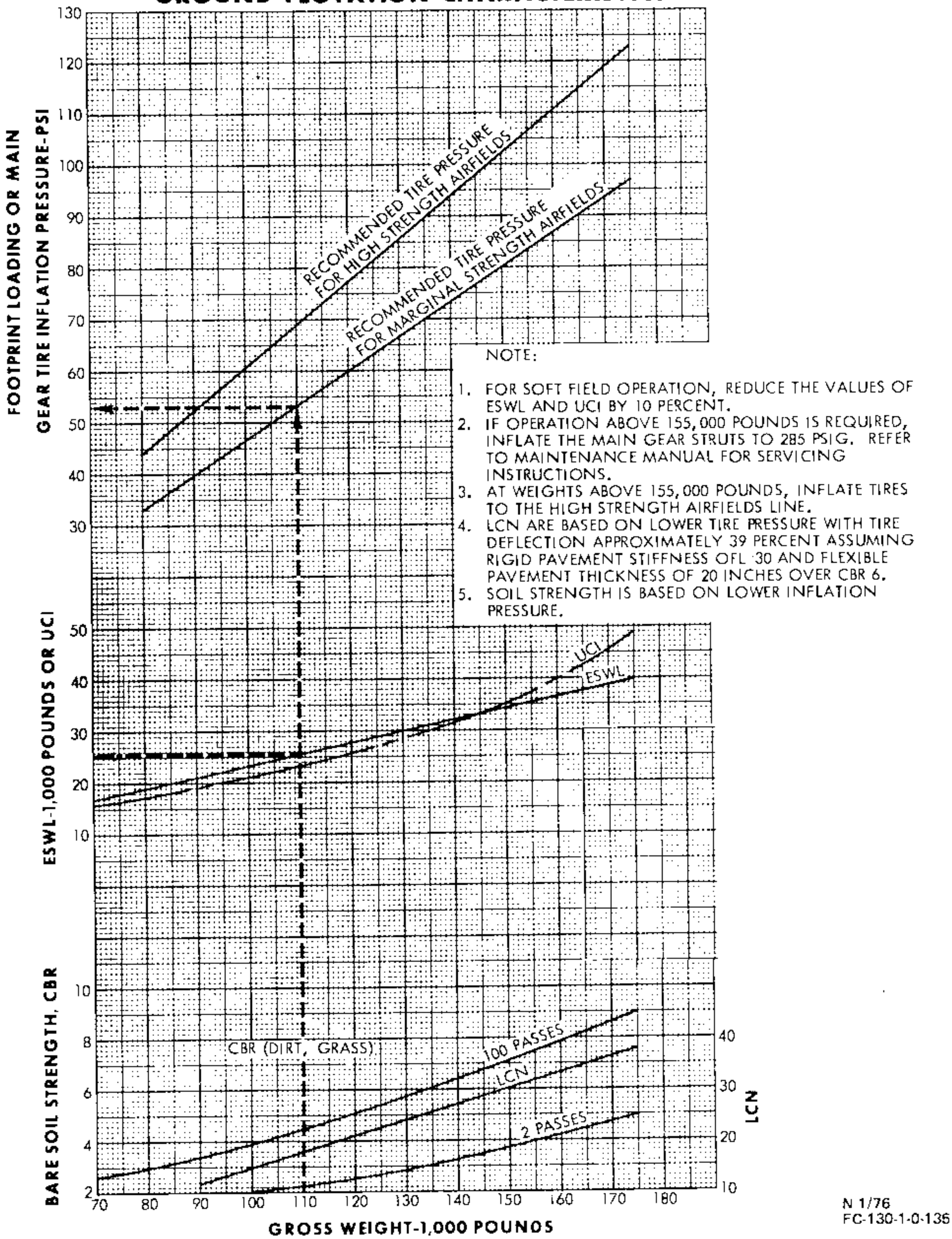


Figure 1-140.

PART 4

AIRCRAFT OPERATING LIMITATIONS

INTRODUCTION.

This aircraft has certain well-defined limitations to its operation. Maximum performance requires careful consideration of these limitations. The instrument marking illustration (figure 1-141) and the engine and propeller limitations illustration (figure 1-142) contain certain limitations which are not repeated in text. This fact should be remembered when using this part. A summary of limitations is shown in figure 1-149.

INSTRUMENT MARKINGS.

Flight and engine instrument markings are shown in figure 1-141 and are not repeated in text.

Note

The markings shown in this part are for flight station indications and are not to be confused with limits shown in the Handbook of Maintenance Instructions.

ENGINE AND PROPELLER LIMITATIONS.

Operating time limits, allowable observed turbine inlet temperature ranges, and oil temperature, oil pressure, engine speed, propeller governing, and starter operation limits, respectively, are tabulated in figure 1-142 and are not repeated in text.

Note

All limits given in figure 1-142 are flight station indicated limits and are not to be confused with maintenance manual limits.

GENERATOR OPERATING LIMITATIONS.

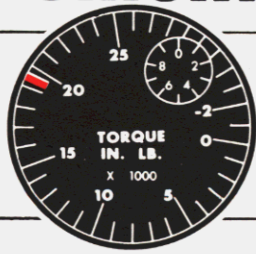
When operating above 20,000 feet, the following derating of the 40/50 and 60/90 KVA generator is necessary due to a thermal limit:

Altitude (ft.)	Loadmeter %
20,000	100
22,000	98
24,000	96
26,000	94
28,000	92
30,000	90
32,000	88
34,000	86
36,000	84

FUEL.

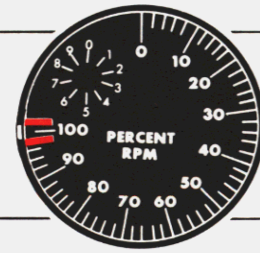
The approved emergency fuels for the T56-A-423 engine are listed in order of preference in figure 1-143. Mixing of these fuels with each other is permissible. In this case, the mixture will be considered as the grade which predominates in the mixture if it is at least 95 percent, and all operations will be in accordance with the operating instructions for that grade. If the mixture is less than 95 percent, consider the fuel to be the one with the least desirable characteristics. If it is necessary to use aviation gasoline with turbine fuels, foaming may occur.

instrument markings



NOTE

Instrument markings should reflect the corresponding numerical values. Actual numerical values govern.

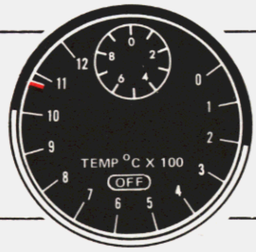


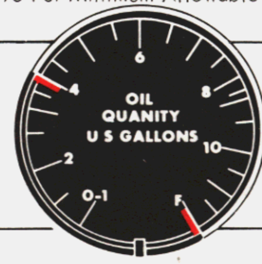
TORQUEMETER

- (red) 19,600 In. Lb. Maximum Allowable

TACHOMETER

- (red) 102 Pct Maximum Allowable.
- (white) 98 Pct To 102 Pct Normal.
- (red) 98 Pct Minimum Allowable.



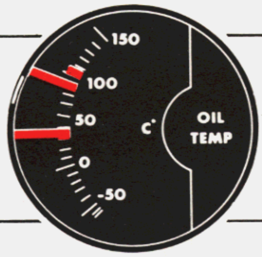


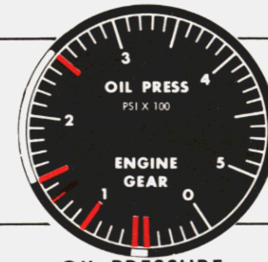
TURBINE INLET TEMPERATURE

- (red) 1083° C Maximum Allowable.
- (white) 200° C To 1010° C Normal (continuous).

OIL QUANTITY

- (red) 12 Gallons Maximum.
- (white) 4 To 12 Gallons Normal.
- (red) 4 Gallons Minimum Allowable.





OIL TEMPERATURE

- (red) 100°C Taxi Maximum. (30 Min.) And Inflight 5 - Minute Maximum
- (red) 85°C Maximum Continuous.
- (white) 60°C To 85°C Normal.
- (red) 40°C (And Increasing) Minimum Allowable.

FUEL GRADE JP-5 OR JP-4

OIL PRESSURE

Both Power Section And Gear Section Oil Pressure Are Indicated On This Instrument: Power Section Pressure By The Front Pointer; Gear Section Pressure By The Rear Pointer.

GEAR SECTION

- (red) 250 PSI Maximum Allowable-Except Start And Warmup (250 PSI May Be Exceeded During Start And Warmup With Ambient Temperature Below 15° C)
- (white) 130 PSI To 250 PSI Normal
- (red) 130 PSI Minimum Allowable (100% RPM, Oil Temp. Normal)

POWER SECTION

- (red) 100 PSI Maximum Allowable - Start and Warmup
- (red) 60 PSI Maximum After Warmup
- (white) 50 PSI to 60 PSI Normal
- (red) 50 PSI Minimum Allowable (Flight Idle And Above With Oil Temp. Normal)

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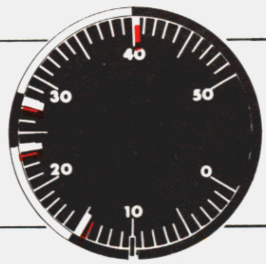
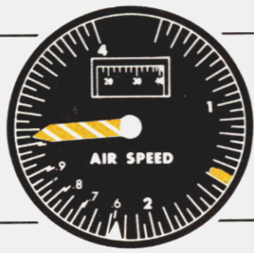
Figure 1-141. (Sheet 1 of 4)



NOTE The markings on this instrument are for preflight reference only. Inflight low-pressure warning is supplied by the pressure warning lights on the fuel control panel. However, boost pump pressure may be checked with this instrument at any time.

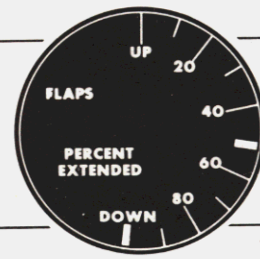
FUEL PRESSURE TEST INDICATOR

- 40 PSI Maximum Allowable - Aux And Ext Tanks.
- 28 PSI To 40 PSI Normal - Aux And Ext Tanks.
- 28 PSI Minimum Allowable - Aux And Ext Tanks.
- 24 PSI Maximum Allowable - Main Tanks.
- 15 PSI To 24 PSI Normal - Main Tanks.
- 15 PSI Minimum Allowable - Main Tanks.



AIR SPEED

- Radial; 145 Knots Maximum Allowable With Full Flaps.
- The Banded Pointer Constantly Indicates The Structural Speed Limit At Sea Level Only.
- The White Pointer (Not Shown) Shows Indicated Air Speed
- ▲ 0.64 Limiting Mach Number.



FLAP POSITION

- Flaps 50% Down
- Flaps 100% Down

CABIN DIFFERENTIAL PRESSURE GAGE

- 15.8 In. Hg. Maximum Allowable
- -1.2 In. Hg. To 15.8 In. Hg. Normal
- -1.2 In. Hg. Minimum Allowable

HYDRAULIC PRESSURE (AUXILIARY)

- 3,500 PSI Maximum Allowable Pressure
- 2,900 To 3,300 PSI Normal.

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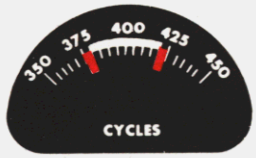
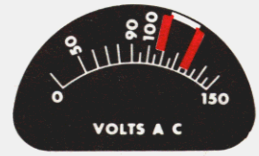
Figure 1-141. (Sheet 2 of 4)



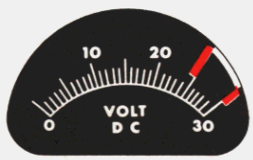
FREQUENCY METER

- 420 Cycles Maximum Allowable.
- 380 Cycles To 420 Cycles Normal.
- 380 Cycles Minimum Allowable.



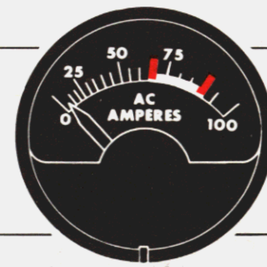
VOLTMETER (AC GENERATORS AND INVERTERS)

- 125 Volts Maximum Allowable.
- 110 Volts To 125 Volts Normal.
- 110 Volts Minimum Allowable.



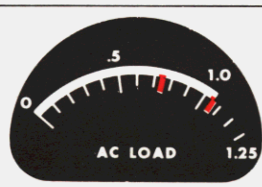
DC VOLTMETER

- 30 Volts Maximum Allowable.
- 25 To 30 Volts Normal.
- 25 Volts Minimum Allowable.



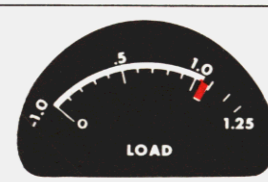
AMMETERS (SPINNER ANTI-ICING, SPINNER DE-ICING, AND BLADE DE-ICING)

- 90 Amps Maximum Allowable.
- 65 Amps To 90 Amps Normal.
- 65 Amps Minimum Sufficient.



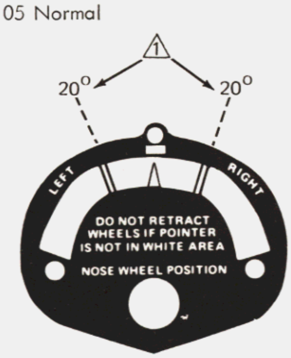
AC LOADMETER

- 0.72 Maximum Allowable. (Continuous Ground Operation.)
- 1.05 Maximum Allowable. (Continuous Inflight Operation.)
- 0 To 1.05 Normal



DC LOADMETER

- 1.03 Maximum Allowable.
- 0 To 1.03 Normal.

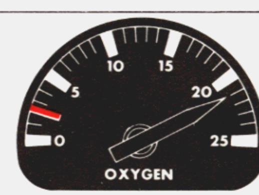


NOSE WHEEL POSITION INDICATOR

CAUTION

⚠1 TURN LIMIT

WHEN GROSS WEIGHT EXCEEDS 155,000 POUNDS OR TAXI SPEED IS 20 KNOTS OR HIGHER REGARDLESS OF RUNWAY TERRAIN CONDITIONS.



LIQUID OXYGEN QUANTITY

25 Liters (Full)

- 2.5 Liters (Minimum For Normal Use).

NOTE In Case Of Emergency, Oxygen Usage May Be Continued Until System Is Empty.

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Figure 1-141. (Sheet 3 of 4)

NOTE

All Hydraulic Instrument Markings Are For Static System Conditions.

NORMAL BRAKE PRESSURE

- (Red) 3,500 PSI Maximum Allowable.
- (White) 2,900 PSI To 3,200 PSI Normal.
- (Yellow) 2,250 PSI Minimum Pressure, One Brake Application Remaining.

BRAKE EMERGENCY PRESSURE

- (Red) 3,500 PSI Maximum Allowable Pressure.
- (White) 2,900 To 3,300 PSI Normal.
- (Yellow) 2,900 PSI Minimum Pressure, One Brake Application Remaining.

RUDDER BOOSTER PRESSURE (UTILITY AND BOOST)

- (Red) 3,500 PSI Maximum Allowable Pressure (15% To 100% Flaps).
- (Red) 1,600 PSI Maximum Allowable Pressure (0% To 15% Flaps).
- (White) 2,900 To 3,200 PSI Normal. (15% To 100% Flaps)
- (White) 1,100 PSI To 1,400 PSI Normal (0% To 15% Flaps).
- (Yellow) 1,400 PSI To 1,600 PSI Caution (0% To 15% Flaps).

HYDRAULIC PRESSURE (UTILITY AND BOOST)

- (Red) 3,500 PSI Maximum Allowable.
- (White) 2,900 PSI To 3,200 PSI Normal.

FIRE EXTINGUISHER SYSTEM PRESSURE GAGE READINGS

Temperature DEG C	Temperature DEG F	Gage Reading Minimum CB	Gage Reading Minimum DB	Gage Reading Maximum CB	Gage Reading Maximum DB
-7	20	535	490	605	570
-1	30	545	510	615	590
4	40	555	530	625	610
10	50	565	550	635	625
16	60	575	565	645	645
21	70	585	580	655	660
27	80	595	595	665	675
32	90	610	610	680	685
38	100	620	620	690	695
43	110	635	630	705	710
49	120	645	640	715	720
60	140	675	660	745	735
82	180	705	675	775	750

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Figure 1-141. (Sheet 4 of 4)

engine and propeller limitations (T56-A-423 engines)

ENGINE LIMITS

ENGINE CONDITION	TIT °C	RPM %	OIL PRESSURE (PSIG) R/G △1	OIL PRESSURE (PSIG) P/S △1	OIL TEMP °C	MAXIMUM INDICATED TORQUE IN-LB
GROUND OPERATION						
START LIMITS	See sheet 2.		Positive oil pressure indication by 35% RPM		100 -54	
LOW SPEED GROUND IDLE (start position)		75.5 69	250 △2 50	100 (warmup only)	100 For 30 minutes (flight idle and below) then 85 60 to 85 -54 to -40 △6	Minimum until oil temperature 15 above 0° C
NORMAL GROUND IDLE (start position)		102 94	250 △2	60		
MAXIMUM REVERSE (0°)		106 96			100 Maximum for 30 minutes then 85	4,500 maximum at oil temperature 0 to 40°C.
FLIGHT IDLE (34°)		100.5 92.5	130 △3	50 △4	0	
TAKE-OFF						
TAKE-OFF 90° throttle position	1083 (5 minutes max) 1067	102 98	250 130	100 (warmup only) 60 50	100 for 5 minutes, then: 85 60 - 85 40 and increasing	19,600
FLIGHT OPERATION						
MILITARY	1049 (30 minutes) △5	102	250	100 (warmup only) 60	100 for 5 minutes, then: 85	19,600 19,600
CLIMB	1010 △5				60 - 85	
MAXIMUM CONTINUOUS	1010 △5	98	130	50	40 and increasing	**NOTE** During Airstart, 4,500 is maximum at oil temperature of 0° to 40°C

NOTE

△1 Under stabilized conditions, allowable fluctuation is ± 10 PSI for the power section and ± 20 PSI for the reduction gear section.

△2 250 PSI may be exceeded during start and warmup with ambient temperature below 15°C.

△3 Operation below 130 PSIG when RPM is below 100 percent is permitted if 130 PSIG can be maintained at 100 percent RPM.

△4 If pressure is below 50 PSIG at low-speed ground idle, condition is acceptable provided pressure is within limits at 100 percent RPM.

△5 Use only when mission requirements demand higher power.

△6 -54°C is the minimum oil temperature for MIL-L-7808 oil. -40° C is the minimum oil temperature for MIL-L-23699 oil. (for start and warmup only)

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Figure 1-142. (Sheet 1 of 2)

OVERTORQUE OPERATION

CONDITION	ACTION REQUIRED
Torque exceeds 19,600 inch-pounds	**Record the discrepancy.** **Overtorque inspection required.**

OVERTEMPERATURE OPERATION

STARTING OVERTEMPERATURE

CONDITION	ACTION REQUIRED
	Record the discrepancy.
TIT exceeds 830°C (excluding momentary overshoot and peak at 94% rpm)	**Discontinue the start and record the discrepancy. One restart is permitted after cooling to below 200°C TIT. If TIT exceeds 850°C on second start, discontinue start and record. Restart is not recommended.**
TIT exceeds 850°C (excluding momentary peak at 94% rpm)	
TIT exceeds 965°C	**Discontinue the start and record the discrepancy. (An overtemperature inspection is required).**

A torch other than normal enrichment burst requires an overtemperature inspection.

POWER ACCELERATION PEAK

Exceeds 1083°C for more than 5 seconds or exceeds 1175°C momentarily.

Reduce power to hold temperature within limits. Record the discrepancy. (Overtemperature inspection required before next flight).

STARTER OPERATING LIMITS

1 minute ON, 1 minute OFF, 1 minute ON, 1 minute OFF, 1 minute ON, 30 minutes OFF
POP OUT - 56 to 75.5% RPM
PULL OUT - 75.5% RPM or stabilized low speed ground idle RPM, whichever is lower.

PROPELLER GOVERNING LIMITS

NORMAL LIMITS (Normal Or Mechanical Operation) 98.0 - 102.0 percent.

If stable RPM cannot be maintained (excluding allowable fluctuations of ± 0.5%), see PROPELLER FAILURES in Section V.

PROPELLER AUXILIARY PUMP OPERATING LIMIT

1 minute ON, 1 minute OFF, not to exceed 2 minutes operation in any 30 minute period.

NOTE

Underscored values on sheet 1 denote limits; values not underscored on sheet 1 denote normal operating values. All limits on this figure are flight station limits and are not to be confused with maintenance manual limits.

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Figure 1-142. (Sheet 2 of 2)

fuel preference and cross reference chart

		FLIP CODE MIL	FLIP CODE COMM	MIL FUEL GRADE	NATO SYMBOL	COMM ASTM GRADE	UNITED KINGDOM GRADE	FREEZES °F	FREEZES °C	AVERAGE LB/GL AT 60°F/15°C	AVERAGE BTU/LB 1000	AVERAGE BTU/GAL 1000
APPROVED FUELS	PRIMARY	J5		⚠3 JP-5	F-44		AVCAT/48	-51	-46	6.79	18.45	125
		J4		⚠3 JP-4	F-40		AVTAG	-72	-58	6.46	18.60	120
			TA1		F-34	JET A-1 JP-1	AVTUR/50	-58	-50	6.79	18.45	125
			TB		F-45	JET B		-58	-50	6.46	18.60	120
	ALTERNATE				F-42		AVCAT/40	-40	-40	6.79	18.45	125
			TA		F-35	JET A		-40	-40	6.79	18.45	125
EMERGENCY FUELS	NO LEAD NO TCP		D			73		-76	-60	5.76	18.90	109
			E			80		-76	-60	5.76	18.90	109
	LEAD NO TCP	C	C1	80/87	F-12	80/87		-76	-60	5.90	18.90	112
		B	B1	91/96	F-15	91/96		-76	-60	5.85	18.90	111
		A	A1	100/130	F-18	100/130		-76	-60	5.82	18.90	111
			G			108/135		-76	-60	5.81	18.90	110
		A+	A+1	115/145	F-22	115/145		-76	-60	5.80	18.90	110

NOTE

1. FUELS LISTED FROM TOP TO BOTTOM IN ORDER OF PREFERENCE.
2. REFER TO NAVAIRINST 10341.1 FOR CHANGES TO THE AIRCRAFT FUELS.

⚠3 CONTAINS FS II

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Figure 1-143. (Sheet 1 of 2)

aviation turbine fuels-brand names

OIL COMPANY	PRODUCT NAME	ASTM DESIGNATION
AMERICAN	AMERICAN JET FUEL TYPE A AMERICAN JET FUEL TYPE A-1	JET A JET A-1
ATLANTIC	ARCOJET A ARCOJET A-1 ARCOJET B	JET A JET A-1 JET B
BP TRADING	BP A.T.K. BP A.T.G.	JET A-1 JET B
BRITISH AMERICAN	B-A JET, FUEL JP-1 B-A JET, FUEL JP-4	JET A JET B
CALIFORNIA TEXAS	CALTEX JET A-1 CALTEX JET B	JET A-1 JET B
CITIES SERVICE	TURBINE TYPE A	JET A
CONTINENTAL	CONOCO JET-40 CONOCO JET-50 CONOCO JET-60 CONOCO JP-4	JET A JET A JET A-1 JET B
HUMBLE	ESSO (ENCO) TURBINE FUEL A ESSO (ENCO) TURBINE FUEL A-1 ESSO (ENCO) TURBINE FUEL B	JET A JET A-1 JET B
MOBIL	MOBIL JET A MOBIL JET A-1 MOBIL JET B	JET A JET A-1 JET B
PHILLIPS	PHILJET A-50 PHILJET JP-4	JET A JET B
PURE	PUREJET TURBINE FUEL TYPE A PUREJET TURBINE FUEL TYPE A-1	JET A JET A-1
RICHFIELD	RICHFIELD TURBINE FUEL A RICHFIELD TURBINE FUEL A-1	JET A JET A-1
SHELL	AEROSHELL TURBINE FUEL 640 AEROSHELL TURBINE FUEL 650 AEROSHELL TURBINE FUEL JP-4	JET A JET A-1 JET B
SINCLAIR	SINCLAIR SUPERJET FUEL SINCLAIR SUPERJET FUEL	JET A JET A-1
STANDARD OF CALIFORNIA	CHEVRON JET FUEL A-1 CHEVRON TURBINE FUEL B	JET A-1 JET B
STANDARD OF TEXAS	STANDARD TURBINE FUEL A-1 STANDARD TURBINE FUEL B	JET A-1 JET B
STANDARD OIL CO.	STANDARD JET A STANDARD JET A-1 STANDARD JET B	JET A JET A-1 JET B
STANDARD (OHIO)	JET A KEROSINE JET A-1 KEROSINE	JET A JET A-1
TEXACO	TEXACO AVJET A TEXACO AVJET A-1 TEXACO AVJET B	JET A JET A-1 JET B
UNION OIL	76 TURBINE FUEL UNION JP-4	JET A-1 JET B

Figure 1-143. (Sheet 2 of 2)

CAUTION

NATO fuels F-35 and F-42 should not be used if mission requirements necessitate operation in temperatures below -40° F. NATO fuels F-34 and F-44 should not be used if operating temperatures below -51° F are anticipated.

CAUTION

The presence of even relatively small quantities of TCP result in severe erosion, scaling, and pitting of the first-stage turbine nozzle vanes and the turbine inlet thermocouples. Automotive gasoline is not acceptable due to common use of TCP and a variety of other undesirable additives. The use of aviation gasoline containing tetraethyl lead (grades 80/87, 91/96, 100/130, and 115/145) should be held to the minimum necessary due to the heat-absorbing quality of the lead coating which is deposited in the turbine section. If engines are operated for 50 hours with leaded gasoline, the turbine blades must be inspected for possible overheat damage.

The engine power available when using different fuels is not affected in electronic fuel scheduling since a specific turbine inlet temperature is scheduled for each throttle position. However, external temperature datum valve adjustment may be necessary for consistent engine starts when using JP-5 type fuels (F-42 or F-44).

CAUTION

When attempting a start with JP-5 and kerosene type fuels at ambient temperatures below -32°C, the TIT and rpm should be closely monitored since stall and over-temperature may be experienced during the start.

The average fuel weight/specific gravity/temperature of various fuels is shown in figure 1-144.

HIGH RATES OF CLIMB.

High rates of climb may create a fuel boiling-venting problem. The rate of climb should be restricted to the values shown in figure 1-145, depending on the fuel used and the fuel temperature. (All figures estimated.)

EFFECT OF EMERGENCY FUEL ON RANGE.

The BTU content per pound of all fuels does not vary significantly, therefore, the range will depend on the pounds of fuel aboard.

Note

Do not exceed the usable fuel weights per tank shown in figure 1-30.

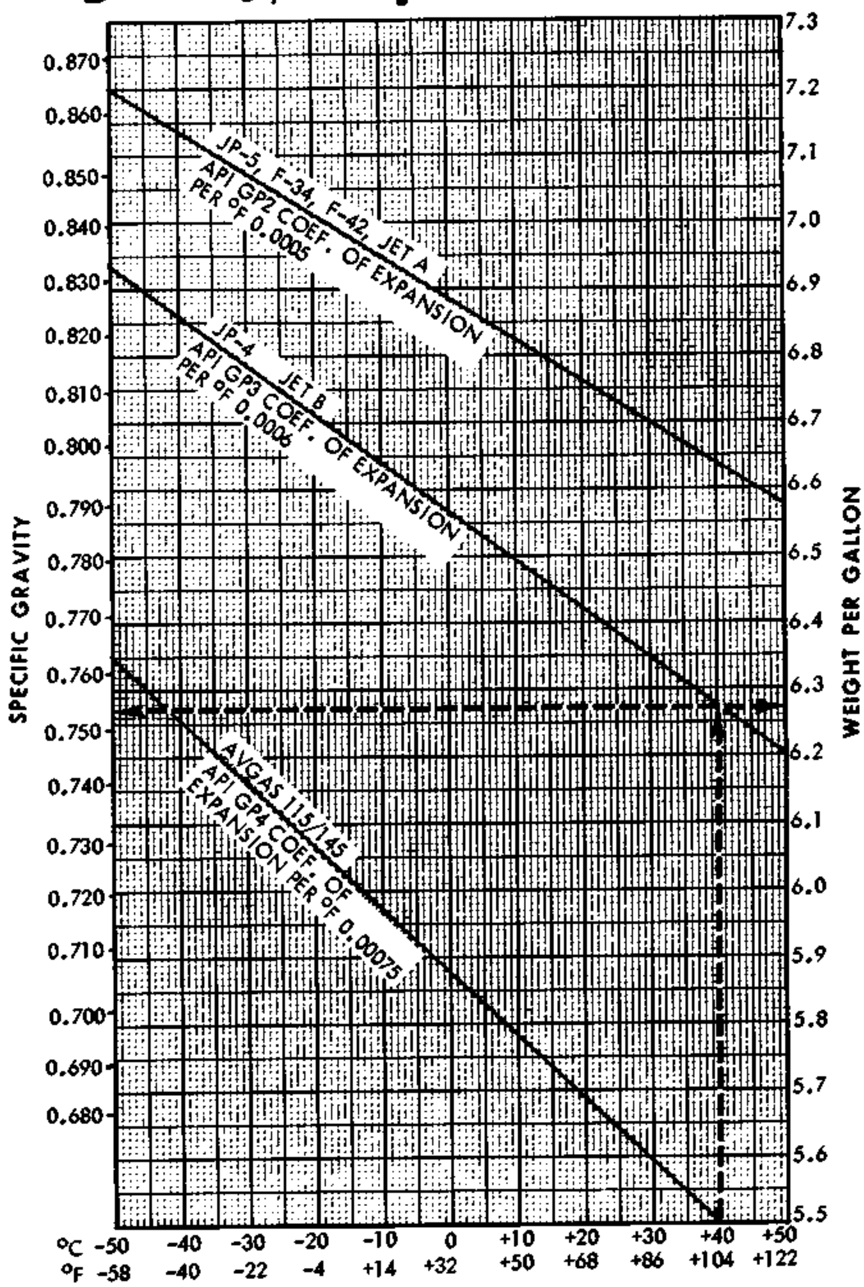
AIRSPEED LIMITATIONS.

The limiting airspeed for a mission is interrelated with the cargo weight and maneuver load factors required for the mission and the gust load that may be encountered in turbulence. Recommended and maximum airspeeds are shown on the Limit Flight Speed vs Altitude Chart, sheet 1 of figure 1-146. These speeds are referenced to specific fuel-cargo combinations on the Weight Limitations Chart of figure 1-146. Any cruise speed up to the recommended speed may be used up to and including moderate turbulence.

Note

Operation in the areas between the recommended speed limits and the maximum speed is permissible for initiating penetrations from 20,000 feet at 250 knots, provided the maneuver load factors on the charts are not exceeded.

average fuel weight/specific gravity/temperature chart



EXAMPLE

FUEL	JP-4
FUEL TEMP	+40°C
WT PER GAL (U.S.)	6.271
SPECIFIC GRAVITY	0.753

NOTE

1. TO CONVERT SPECIFIC GRAVITY TO WEIGHT PER GALLON, MULTIPLY SPECIFIC GRAVITY BY 8.3.

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Figure 1-144.

rate of climb restrictions

Type of Fuel	Fuel Temperature, Start of Mission	Rate of Climb	NATO Symbol
JP-5	Up to 135°F	Not restricted.	F-44
JP-4	Up to 125°F	Not restricted.	F-40
JP-4	125° to 135°F	Max rate of climb to 29,000 ft. Above 29,000 ft, 300 ft/min.	F-40
Aviation gasoline	80° to 90°F	Max rate of climb to 30,000 ft. Above 30,000 ft, 300 ft/min.	F-12 F-15 F-18 F-22
Aviation gasoline	90° to 100°F	Max rate of climb to 24,000 ft. Above 24,000 ft, 300 ft/min.	F-12 F-15 F-18 F-22
Aviation gasoline	100° to 110°F	Max rate of climb to 18,000 ft. Above 18,000 ft, 300 ft/min.	
Aviation gasoline	110° to 120°F	Max rate of climb to 14,000 ft. Above 14,000 ft, 200 ft/min.	

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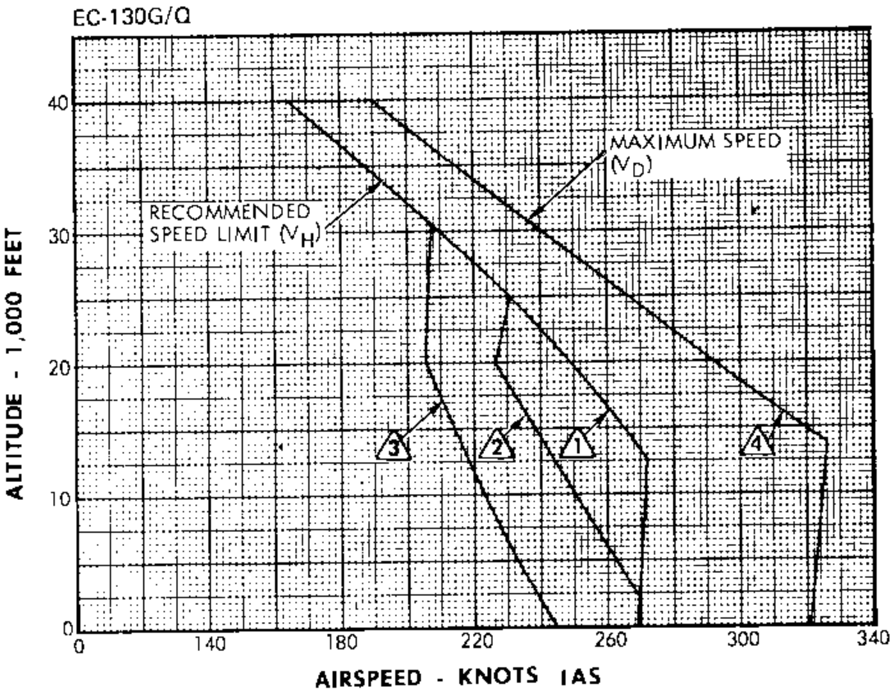
Figure 1-145.

limit flight speed vs altitude chart



RECOMMENDED SPEED

(1) V_H -- MAXIMUM RECOMMENDED SPEED FOR AREA A OF WEIGHT LIMITATIONS CHART.

(2) V_H – MAXIMUM RECOMMENDED SPEED FOR AREA B OF WEIGHT LIMITATIONS CHART.

(3) V_H – MAXIMUM RECOMMENDED SPEED FOR AREAS C AND D OF WEIGHT LIMITATIONS CHART.

MAXIMUM SPEED

(4) V_D – MAXIMUM SPEED FOR AREAS A , B , C , AND D OF WEIGHT LIMITATIONS CHART.

- FOR THUNDERSTORM OPERATION, REDUCE AIRSPEED TO 65 KNOTS ABOVE POWER-OFF STALL SPEED.
- NORMAL PENETRATIONS UP TO 250 KNOTS IAS ARE PERMISSIBLE IN SMOOTH TO MODERATELY TURBULENT AIR BELOW 20,000 FEET.
- THESE CHARTS ARE BASED ON THE FUEL MANAGEMENT PROCEDURES IN SECTION III, PART 3 AND ON THE STANDARD DAY DENSITY OF JP-4 (6.5 POUNDS/GAL.). DO NOT REFUEL THE AIRPLANE TO ITS VOLUME CAPACITY WITH JP-5 (STANDARD DAY DENSITY OF 6.9 POUNDS/GAL.), SINCE THE MAXIMUM PERMISSIBLE FUEL WEIGHT WILL BE EXCEEDED. (REFERENCE FIGURE 1-30).

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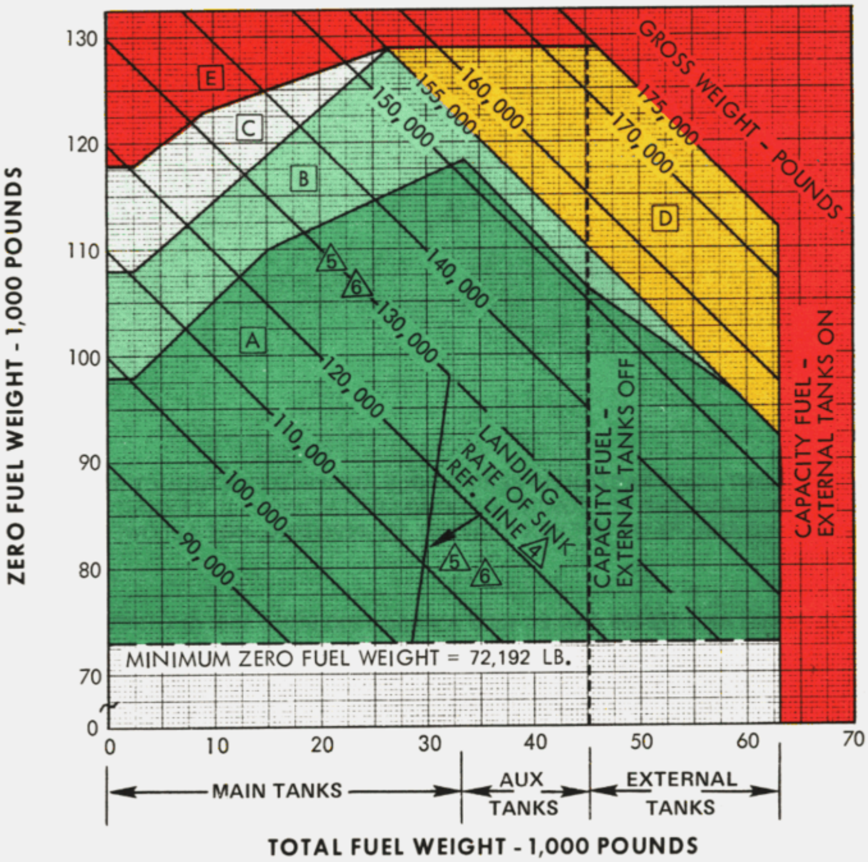
Figure 1-146. (Sheet 1 of 3)

and weight limitations

EC-130G/Q



AREA	STATUS	LOAD FACTOR UP TO V_H	LIMITS V_H TO V_D	MAX RECOMMENDED SPEED OF SHEET 1
A (dark green)	— RECOMMENDED —	−1.0 TO 3.0g	0.0 TO 2.5g	V_H ⚠1
B (light green)	— RECOMMENDED —	0.0 TO 2.5g	0.0 TO 2.5g	V_H ⚠2
C (white)	— RECOMMENDED —	0.0 TO 2.5g	0.0 TO 2.5g	V_H ⚠3
D (yellow)	— CAUTIONARY —	0.0 TO 2.25g	0.0 TO 2.25g	V_H ⚠3
E (red)	— NOT RECOMMENDED			

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Figure 1-146. (Sheet 2 of 3)

NOTE

- EXCEEDING THE LIMIT LOAD FACTOR OR PERMISSIBLE AIRSPEED CAN RESULT IN STRUCTURAL DAMAGE TO THE AIRCRAFT. OBSERVE THE FOLLOWING GROUND LIMITATIONS: (1) TAXIING, SMOOTH PAVEMENT ONLY, (2) BRAKING, AVOID ABRUPT OR UNEVEN BRAKING, (3) PIVOTING, NOT ALLOWED, (4) TURNING, ALLOWED WITHOUT BRAKING.

⚠5 EC-130Q BUNO 159348 AND 159469 AND EC-130G AND EC-130Q BUNO 156170 THROUGH 156177 BY C-130 AFC-119:

TO THE LEFT OF THIS LINE, MAXIMUM LANDING RATE OF SINK IS 540 FPM PROVIDED EACH OUTBOARD WING TANK CONTAINS LESS THAN 6,600 POUNDS OF FUEL. TO THE RIGHT OF THIS LINE, OR IF EITHER OUTBOARD WING TANK CONTAINS MORE THAN 6,600 POUNDS OF FUEL, MAXIMUM LANDING RATE OF SINK IS 300 FPM. THE PRIMARY PURPOSE OF AFC-119 IS TO REDUCE WING BENDING THEREBY PROVIDING LONGER SERVICE LIFE.

⚠6 EC-130G AND EC-130Q BUNO 156170 THROUGH 156177 NOT MODIFIED BY C-130 AFC-119:

TO THE LEFT OF THIS LINE, MAXIMUM LANDING RATE OF SINK IS 540 FPM PROVIDED EACH OUTBOARD WING TANK CONTAINS LESS THAN 5,420 POUNDS OF FUEL. TO THE RIGHT OF THIS LINE, OR IF EITHER OUTBOARD WING TANK CONTAINS MORE THAN 5,420 POUNDS OF FUEL, MAXIMUM LANDING RATE OF SINK IS 300 FPM.

- EXTERNAL TANKS OFF OPERATION IS PERMISSIBLE PROVIDED THAT ALLOWABLE ZERO FUEL WEIGHTS AND GROSS WEIGHTS ARE EACH REDUCED BY 1,610 POUNDS. ALSO, CAPACITY FUEL IS REDUCED TO 45,240 POUNDS.

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Figure 1-146. (Sheet 3 of 3)

CAUTION

The maximum speed limits should never be exceeded. The maneuver load factors and the weight limitations shown on the Weight Limitations chart (sheet 2 of figure 1-146) should also be carefully observed.

The airplane should not be operated in conditions of severe turbulence because gusts can be encountered that may impose excessive loads. However, if flight in severe turbulence cannot be avoided, flight should be in the range of 65 knots above power-off stall speed for the operating gross weight (see figure 4-1).

Never exceed the following indicated airspeeds for the condition noted:

1. FLAPS EXTENDED:

Percentage	Airspeed (knots)
10	220
20	210
30	200
40	190
50	180
60	165
70	155
80	150
90	145
100	145

2. LANDING GEAR EXTENDED: Do not exceed 165 knots with the landing gear extended.

3. AFT CARGO DOOR OPEN: Do not exceed 150 knots with the aft cargo door open regardless of the position of the paratroop air deflectors or whether the paratroop doors are open or closed.

4. PARATROOP AIR DEFLECTORS: Do not exceed 150 knots when operating the paratroop air deflectors or with the air deflectors extended regardless of whether the paratroop doors are open or closed.

5. PARATROOP DOORS: Do not exceed 150 knots when operating the paratroop doors.

6. LANDING LIGHTS EXTENDED: Do not exceed 165 knots with landing lights extended.

7. PAINTED FLIGHT CONTROL SURFACES: Do not exceed 250 knots when any flight control surface is painted, unless the underside of the ailerons and elevators and either side of the rudder have been stenciled as follows:

CAUTION

Subsequent repainting restricted to minor touch-ups unless performed at depot level; only minor touch-up is authorized.

8. FUEL DISTRIBUTION:

CAUTION

If the total fuel in both external tanks exceeds 9,355 pounds in combination with less than 25,000 pounds of internal wing tank fuel, do not exceed 290 KIAS.

TRAILING WIRE ANTENNA LIMITATIONS.

The following aircraft limitations exist when extending the antennas:

1. Aircraft Speed — 170 to 220 KIAS
2. Aircraft Bank Angle — 0 to 15°—Normal Deployment; 0 to 40°—Orbital Deployment (not recommended)
3. Aircraft Pitch Angle — 10° nose up, to 5° nose down

While the trailing wire antennas are being extended, are extended, or are being retracted, 2200 pounds tension on the long wire or 420 pounds tension on the short wire should not be exceeded.

The following aircraft limitations apply when retracting the antennas:

1. Aircraft Speed — 130 to 170 KIAS
2. Aircraft Bank Angle — 0 to 15° (orbital retract prohibited)
3. Aircraft Pitch Angle — 10° nose up, to 5° nose down

Note

> The life of the long trailing wire and exit wire bushing will be increased if the angle of bank during extension or retraction is 0° while the tension is more than 500 pounds. If the aircraft must be turned with the wire extended and tension greater than 500 pounds, wire movement should be stopped while turning.

ACCELERATION LIMITATIONS.

Never exceed the structurally-safe maneuver load factor for the applicable flight conditions and for the aircraft load distribution. The limit load factor for fuel load and cargo load combinations is given in the Weight Limitations chart (sheet 2 of figure 1-146). The aircraft is equipped with an accelerometer for the determination of a g loading. Since feel is often misleading, particularly when the pilot's attention is diverted or distracted, abrupt and unnecessary maneuvering must always be avoided.

LOAD FACTORS.

A load factor is the ratio of the load imposed on the object to the weight of the object. It is expressed in terms of g, 1.0g being 1 times the weight of the object. The letter "g" stands for gravity, the accelerating pull the earth exerts on all objects. Since gravity is an acceleration, it is easy to understand that other types of acceleration also can produce load factors. The accelerations in which the pilot is most interested occur as a result of changes in his flight path, such as turns, pull-ups, and touchdowns on landings.

Because the airplane structure (particularly the wings) can only withstand certain maximum forces acting on it, it is necessary to limit the g-number (the load factor) which may be safely applied. A load factor in excess of these safety limits may result in structural damage to the airplane.

Note

> The wing load factors on the weight limitations charts are valid only when the fuel sequence in FUEL MANAGEMENT, Section III, is followed.

CAUTION

> The maximum maneuver load factor, regardless of cargo load, with any flap extension is 2.0g.

WEIGHT LIMITATIONS.

Aircraft weight limits may be divided into two categories: gross weight limits, and limits on cargo-fuel weight combinations. Taxi and landing gross weights are limited by landing gear strength, and take-off gross weight is limited primarily by wing strength, performance, and handling characteristics. Cargo-fuel combinations, as functions of airspeed, maneuver load factor, and degree of atmospheric turbulence, are limited by wing strength.

GROSS WEIGHT LIMITS.

Aircraft gross weight limits are summarized in figure 1-147 for the conditions indicated.

Maximum Take-off Gross Weight.

Take-off gross weights must take into account the available runways, surrounding terrain, airfield elevation, atmospheric conditions, mission requirements, and the urgency of the mission.

aircraft gross weight limits

CONDITION	GROSS WEIGHT - POUNDS		LIMITATIONS
	EXTERNAL TANKS ON	EXTERNAL TANKS OFF	
MAXIMUM TAXI			
RECOMMENDED	155,000	153,390	
OVERLOAD	175,000	173,390	SEE TAXI AND GROUND LIMITATIONS
MAXIMUM TAKEOFF			
RECOMMENDED	155,000	153,390	
OVERLOAD	175,000	173,390	2.25g MANEUVER LOAD FACTOR
MAXIMUM LANDING			300 fpm RATE OF SINK
RECOMMENDED	155,000	153,390	
OVERLOAD	175,000	173,390	
NORMAL LANDING	130,000	130,000	540 fpm RATE OF SINK. SEE FIGURE 1-145 FOR FUEL LIMITS

NOTE

GROSS WEIGHTS ABOVE 155,000 POUNDS ARE AUTHORIZED WHEN REQUIRED BY OPERATIONAL NECESSITY.

Figure 1-147.

Note

Gross weights exceeding those required for the mission will result in unnecessary risk and wear of the airplane.

LANDING GROSS WEIGHTS.

The airplane is designed to be able to land at any gross weight up to the maximum for take-off provided limiting relationships between landing gross weight, contact rate of sink, and fuel weight are observed. The airplane is designed for a maximum contact rate of sink of 540 feet per minute at gross weights up to the normal landing gross weight with the fuel weight limitations given on the Weight Limitations Chart, figure 1-146. The airplane may be landed at a contact rate of sink of 300 feet per minute at the maximum landing gross weight, which is equal to the maximum take-off gross weight, or with capacity fuel.

Note

- Although the airplane can be landed at the maximum landing gross weight (overload), it is recommended that fuel be dumped to reduce gross weight to the maximum landing gross weight (recommended).
- The service life of the airplane will be increased if fuel is managed so that landings are made with no fuel in the external tanks.

WEIGHT LIMITATIONS CHART.

The Weight Limitations Chart, sheet 2 of figure 1-146 presents the cargo carrying capability of the airplane as a function of fuel weight, maneuver load factor, airspeed, and operating weight. The chart is divided into several areas which represent varying cargo capabilities with varying airspeeds, given on sheet 1 of the same figure, and varying maneuver load factors. The chart shows, for a given cargo weight, the minimum fuel weight at which a selected maneuver load factor and airspeed may be used, with a further reduction in fuel weight requiring a reduction in maneuver load factor and/or airspeed.

Fuel Distribution Effects.

The Weight Limitations Chart and The Limit Flight Speed Chart are based on JP-4 fuel at the standard day density of 6.5 pounds per gallon used, according to the fuel sequence given under FUEL MANAGEMENT in Section III. Under these conditions, the outboard tank contains 715 pounds more fuel than the inboard tank.

For flight, this distribution helps reduce wing upbending by maintaining a spanwise center of gravity of the fuel that is outboard of the center of lift on the wing. Increasing or decreasing the differential fuel weight between the outboard and inboard tanks increases or decreases the cargo capability shown on the Weight Limitations Chart. Fuel carried in the auxiliary and external tanks decreases the cargo capability because of their spanwise location.

CAUTION

It is recommended that the airplane not be flown with less fuel in the outboard tanks than in the inboard tanks. The airplane should be flown with the outboard tanks empty only as an emergency measure.

For landing, wing downbending considerations limit the rate of sink to 300 feet per minute with capacity fuel except on substandard airfields. For rates of sink from 300 to 540 feet per minute, fuel weights are limited to those shown on the Weight Limitations Chart. Fuel in the outboard tanks is limited, as shown on the Weight Limitations Charts, at landing rates of sink exceeding 300 feet per minute.

Note

Do not exceed the usable fuel weights per tank for JP-4 shown in the Fuel Quantity Data Table, figure 1-30.

Recommended Loading Areas.

The Weight Limitations Chart, sheet 2 of figure 1-146, has three areas of recommended cargo-fuel combinations, provided the associated limits on maneuver load factor and airspeed are observed. These recommended areas are shown in different shades of green. Area A encompasses those cargo-fuel combinations for which the maximum maneuver load factor is 3.0g at speeds up to the highest recommended speed, V_H ⚠1 on sheet 1 of figure 1-146. Increasing the cargo weight to the cargo-fuel combinations in areas B or C requires that the maximum maneuver load factor be reduced to 2.5g. As the cargo weight is increased, it is also necessary to reduce the recommended speed to preclude excessive forces due to turbulence, with a reduction to V_H ⚠2 for area B and V_H ⚠3 for area C.

Cautionary Loading Areas.

The cautionary loading area, Area D, is shown in yellow on the Weight Limitations Chart, sheet 2 of figure 1-146. Area D encompasses those cargo-fuel combinations which are permissible for Overload Operation when required by operational necessity, but which require extra caution to avoid damaging the airplane. For Area D, the recommended speed is V_H ⚠3 , shown on sheet 1 of figure 1-146, and the maximum maneuver load factor is 2.25g. Limitations given in TAXI AND GROUND LIMITATIONS of this section must be observed.

Loading Area Not Recommended.

The red area, area E, of the Weight Limitations Chart is composed of cargofuel combinations which present a high degree of risk of structural damage. Under conditions of extreme emergency, when the risk of damage to the airplane is secondary, the Commander will determine if the emergency warrants operation of the airplane at loadings appearing in the red zone. Fuel weights in the red area on the right of the chart represent a high risk of damage to the wing structure during ground operation. Cargo weights in the red area at the top of the chart represent a high risk of damage during flight. If used, the maximum maneuver load factor is 2.0g, and flight through severe turbulence is prohibited. Exceeding the maximum gross weight shown on the chart imposes a high risk of damage to the landing gear and supporting structure during taxi.

Note

> Whenever flights are conducted at weights shown in the red area of the chart, entry in aircraft records is required.

USING THE CHARTS.

The following examples illustrate the use of the Weight Limitations chart (sheet 2 of figure 1-146). Example 1 shows the method of adjustment when the weight of a particular aircraft differs from the nominal figures shown on the charts. In all cases, load conditions should be checked to determine condition over destination. It may be desirable to carry excess fuel on occasions to achieve higher allowable g limits at flight termination. Example 2 shows how the Weight Limitations chart can be used when operating at high zero fuel weights to obtain the maximum maneuver load factor and airspeeds until ballast (reserve) fuel requirements make it necessary to use a lower maneuver load factor and airspeed. Example 3 shows the method of determining the required excess fuel at flight termination to attain the same limit load factor and airspeed capability with a higher operating weight and a specified cargo load. Example 4 shows the effects of unusable auxiliary fuel on airspeed and maneuver load factor.

Example 1.

PROBLEM: Determine the amount of cargo which can be carried when field length restricts gross weight to 150,000 pounds and the mission requires 45,000 pounds of fuel and a 3.0g maneuver load factor. Basic operating weight is 78,000 pounds.

SOLUTION: Enter sheet 2 of figure 1-146 on the total fuel weight scale at 45,000 pounds and move vertically until the gross weight line of 150,000 pounds is reached. From this point, move horizontally to the left and read zero fuel weight of 105,000 pounds. Since zero fuel weight comprises the basic operating weight plus the cargo weight, subtract the basic operating weight (78,000) from the zero fuel weight (105,000 pounds) to obtain a cargo weight of 27,000 pounds permissible for the mission.

Example 2.

PROBLEM: Determine the maneuver load factors and airspeeds permissible for a mission transporting 38,358 pounds of cargo and a required fuel load of 35,000 pounds. The basic operating weight is 74,142 pounds.

SOLUTION: Obtain the zero fuel weight by adding the cargo load (38,358 pounds) and the basic operating weight (74,142 pounds) for a zero fuel weight of 112,500 pounds. Enter sheet 2 of figure 1-146 with a total fuel weight of 35,000 pounds and move vertically to the intersection of 112,500-pound zero fuel weight line, then move horizontally to the left until area B is intersected. Read a total fuel weight (horizontal scale) of 17,500 pounds. This chart shows that the aircraft is capable of operating at a 3.0g maneuver load factor and at the △1 airspeed shown on sheet 1 of figure 1-146 as long as the total fuel weight is above 17,500 pounds (ballast fuel). As the total wing fuel is consumed below the 17,500 pound value (while retaining the zero fuel weight of 112,500 pounds), area B is entered. Since fuel burnoff has caused operation to move into area B, enter the chart with a total fuel weight of 17,500 pounds. Move vertically to 112,500 pound zero fuel weight line. From this point, move horizontally to the left until area C is intersected. Read a total fuel weight of 3,550 pounds. This shows that the aircraft is capable of operating at a 2.5g maneuver load factor and the airspeeds shown in △2 sheet 1 of figure 1-146 at fuel weights above 3,550 pounds (ballast fuel). Operation below a total fuel weight of 3,550 pounds is in area C at 2.5g and airspeeds as shown in △3 , sheet 1 of figure 1-146.

Example 3.

PROBLEM: Determine the required amount of excess fuel at flight termination for a 2.5g maneuver load factor and the recommended airspeeds shown in △2 sheet 1 of figure 1-146 when transporting 40,000 pounds of cargo. The basic operating weight is 74,142 pounds.

SOLUTION: Compute the zero fuel weight by adding the cargo load (40,000 pounds) and the basic operating weight (74,142 pounds) for a zero fuel weight of 114,142 pounds. Enter area C sheet 2 of figure 1-146 at the zero fuel weight of 114,142 pounds and move horizontally to the right to the intersection of areas C and B. Move vertically down and read a required reserve total fuel weight of 7,600 pounds.

Example 4.

PROBLEM: Determine the effects on airspeed and load factor of a boost pump failure leaving 2,500 pounds of fuel in one auxiliary tank. The zero fuel weight is 110,000 pounds.

SOLUTION: Following boost pump failure, compute an effective zero fuel weight by adding the residual auxiliary tank fuel (2,500 pounds) to the zero fuel weight (110,000 pounds) to give 112,500 pounds. Because of its location in the center wing section, auxiliary fuel has the same effect on airspeed and maneuver load factor limits as an equal amount of cargo. Enter sheet 2 of figure 1-146 at the effective zero fuel weight of 112,500 pounds and move horizontally to the right until area A is intersected. Move vertically down and read a fuel weight of 17,500 pounds. When main tank exceeds 17,500 pounds, V_H △1 of sheet 1 and a maneuver load factor of 3.0g are permitted. When main tank fuel is reduced below 17,500 pounds, the recommended airspeed and load factor are reduced to V_H △2 of sheet 1 and 2.5g respectively. Similiarly, enter sheet 2 of figure 1-146 at the effective zero fuel weight of 112,500 pounds and move horizontally to the right until area B is intersected. Move vertically down and read a fuel weight of 5,800 pounds. When main tank fuel is reduced below 5,800 pounds, recommended airspeed is reduced to V_H △3 of sheet 1.

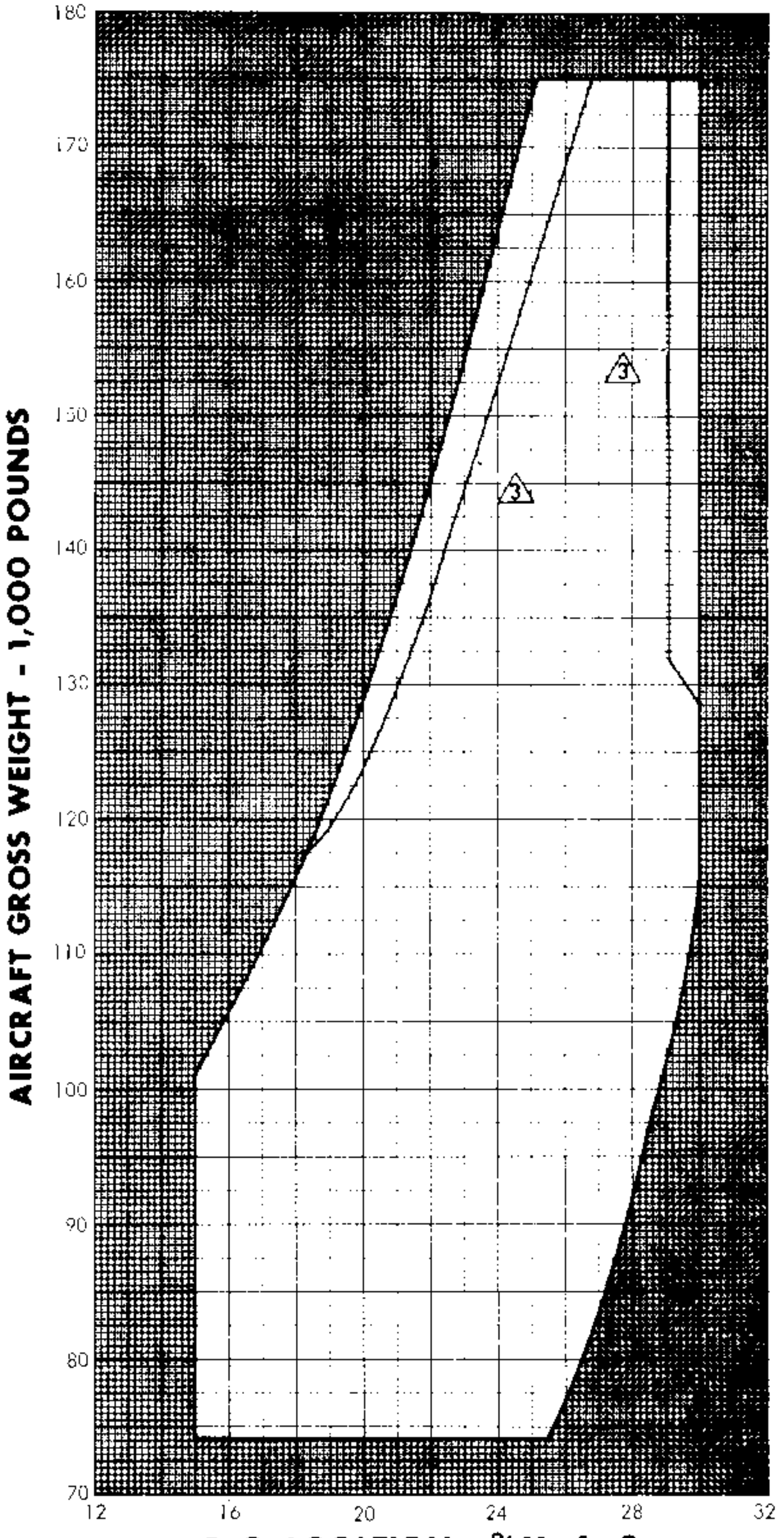
CENTER OF GRAVITY LIMITATIONS.

The location of the center of gravity for any gross weight configuration, determined from AN 1-1B-40, Handbook of Weight and Balance Data, must fall within the percent of the mean aerodynamic chord (MAC) shown on the center of gravity limitations charts (figure 1-148). These limitations represent the combined structural, aerodynamic, and control limitations that must be observed to obtain safe and effective airplane performance. For information and method of calculating the airplane center of gravity, refer to the Handbook of Weight and Balance Data.

PROHIBITED MANEUVERS.

Aerobatics of any kind (including those that produce a negative g condition), intentional spins, excessively nose-high stalls, steep dives, and any other maneuvers resulting in excessive accelerations are strictly prohibited. Do not exceed a 60-degree angle of bank with flaps retracted or a 45-degree angle of bank with flaps extended. Do not make hard rudder kicks that result in large angles of yaw.

center of gravity limitations



RECOMMENDED

NOT RECOMMENDED

NOTE

1. LOAD SUFFICIENTLY BEHIND THE FORWARD C.G. LIMIT SO THAT WEIGHT REDUCTION THROUGH FUEL CONSUMPTION WILL NOT BRING C.G. LOCATION OUT OF ALLOWABLE RANGE.
2. THIS CHART IS APPLICABLE FOR ALL CARGO WEIGHTS WITHIN LIMITS OF WEIGHT LIMITATION CHARTS.

3 C.G. LIMIT IF FUEL IS CARRIED IN EXTERNAL TANKS.

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Figure 1-148.

summary table of limitations

NOTE

REFERENCE SHOULD BE MADE TO APPLICABLE DISCUSSIONS WITHIN THIS SECTION FOR THE VALUES SHOWN BELOW.

WEIGHTS - POUNDS

MAXIMUM TAXI AND TAKE-OFF		MAXIMUM LANDING (300 FPM RATE OF SINK)	
RECOMMENDED	155,000	RECOMMENDED	155,000
OVERLOAD	175,000	OVERLOAD	175,000
		NORMAL LANDING (540 FPM RATE OF SINK)	130,000

SPEEDS - KNOTS INDICATED AIRSPEED

LANDING GEAR EXTENDED	165
LANDING LIGHTS EXTENDED	165
FLAPS EXTENDED:	

10%	220	60%	165
20%	210	70%	155
30%	200	80%	150
40%	190	90%	145
50%	180	100%	145

AFT CARGO DOOR AND RAMP OPEN	150
PARATROOP AIR DEFLECTORS OPEN	150
PARATROOP DOORS (OPENING OR CLOSING)	150
THUNDERSTORM OPERATION	65 KNOTS ABOVE POWER OFF STALL
MAXIMUM NOSE TIRE ROTATION (TYPE III)	139 KNOTS
MAXIMUM MAIN TIRE ROTATION (TYPE III)	174 KNOTS

SYSTEM LIMITS

FUEL

MAIN TANK BOOST PUMP PRESSURE	MIN 15 PSI — MAX 24 PSI
AUX AND EXT TANK BOOST PUMP PRESSURE	MIN 28 PSI — MAX 40 PSI

HYDRAULIC

UTILITY SYSTEM	NORMAL 2900 TO 3200 PSI-MAX 3500 PSI
BOOSTER SYSTEM	NORMAL 2900 TO 3200 PSI-MAX 3500 PSI
AUXILIARY SYSTEM	NORMAL 2900 TO 3300 PSI-MAX 3500 PSI

RUDDER BOOST:
0 - 15% FLAPS NORMAL 1100 TO 1400 PSI-MAX 1600 PSI
15 - 100% FLAPS NORMAL 2900 TO 3200 PSI-MAX 3500 PSI

ACCUMULATOR PRELOAD

UTILITY SYSTEM	1500 PSI ±100	NORMAL BRAKE	1500 PSI ±100
BOOSTER SYSTEM	1500 PSI ±100	EMERGENCY BRAKE	1000 PSI ±100
AUXILIARY SYSTEM	300 PSI ±100	FUEL SYSTEM SURGE SUPPRESSOR	40 PSI ± 5

PRESSURIZATION

CABIN DIFFERENTIAL PRESSURE MIN 1.2 IN HG—MAX 15.8 IN HG

LIQUID OXYGEN

FULL	25 LITERS
MINIMUM FOR NORMAL USE	2.5 LITERS

STARTER

1 MIN ON, 1 MIN OFF; 1 MIN ON, 1 MIN OFF; 1 MIN ON, 30 MIN OFF
POPOUT: 56 to 75.5% PULLOUT: 75.5% RPM OR STABILIZED LOW SPEED GROUND IDLE, WHICHEVER IS LOWER.

PROPELLER AUXILIARY PUMP

1 MIN ON, 1 MIN OFF, NOT TO EXCEED 2 MINUTES OPERATION IN 30 MINUTE PERIOD.

ELECTRICAL

FREQUENCY	MIN 380 Hz — MAX 420 Hz
AC VOLTS (GENERATOR AND INVERTER)	MIN 110 VOLTS — MAX 125 VOLTS
DC VOLTS	MIN 25 VOLTS — MAX 30 VOLTS
AC LOAD:	
ON GROUND	MAX CONTINUOUS 0.720
IN FLIGHT	MAX CONTINUOUS 1.050
DC LOAD	MAX CONTINUOUS 1.030
PROP DE-ICING	MIN SUFFICIENT 65 AMPS — MAX 90 AMPS

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Figure 1-149.

TAXI AND GROUND LIMITATIONS.

CAUTION

Avoid turns with brakes locked on one side to prevent damage to the tires on the main landing gear and supporting structure. Avoid braking in turns at any taxi speed, since damage to the nose landing gear and supporting structure may result. If hard braking is required during a turn, record it in aircraft records.

At gross weights up to 155,000 pounds, taxiing over rough terrain should be avoided. If this is unavoidable, extreme caution must be exercised and very low taxi speeds observed. Do not exceed the following taxi speeds, regardless of runway conditions:

1. 5 knots with nose gear deflected 60 degrees.

2. 20 knots with nose gear deflected 20 degrees.

For overload gross weights of 155,000 to 175,000 pounds, observe the following taxi limitations:

1. Taxi and take-off are permissible only on surfaces where qualities of smoothness and freedom from dips, depressions, and holes are comparable to those of a major air base.

2. Maximum taxi speed is 10 knots.

3. Taxi shortest distance possible.

4. Use minimum braking during all taxi operations.

5. Do not use brakes while turning.

6. Limit nose gear steering angle to 20 degrees.

7. Avoid abrupt or uneven application of brakes.

8. Pivoting is not permitted.

SECTION II

INDOCTRINATION

TABLE OF CONTENTS

This section of the NATOPS Manual prescribes minimum crewmember training requirements. This section and Section X are the primary directives for training and maintaining standardized operating procedures.

MINIMUM EXPERIENCE REQUIREMENTS.

Minimum requirements for qualification in crew position are listed in figure 2-1.

Training prior to requalification for previously qualified individuals, who have not been assigned for 12 months or more, will be determined on an individual basis by the Commanding Officer.

Minimum experience required for designating Third Pilots will be in accordance with OPNAV 3710.7 series and that required by Commanding Officers or higher authority.

MINIMUM CONTINUING REQUIREMENTS.

Crewmembers who fail to comply with requirements of figure 2-2 shall be scheduled to meet the requirements in which there is a delinquency. As determined by the Commanding Officer, delinquency in quarterly requirements will require a NATOPS evaluation in the delinquent area(s).

GROUND TRAINING SYLLABUSES.

The ground training syllabuses contained in this section are considered the minimum prerequisites for all crewmembers not previously qualified in the aircraft. Crewmembers previously qualified in the aircraft will, prior to being requalified for the crew position previously held, complete such portions of the syllabus as may be deemed necessary by the Commanding Officer. Ground training will be conducted by squadron personnel or by outside agencies, such as Naval Aid Mobile Trainers or factory training, if available. Additionally, simulator training may be waived, if not readily available; however, this simulator training is considered extremely valuable and should not be waived if at all possible to obtain. Ground training should be completed prior to the first flight as a crewmember.

MISSION COMMANDERS.

Training in all phases of mission responsibilities shall be completed. Both Naval Aviators (AC designation) and Flight Officers (ACO designation) are eligible to undertake this training which will include cross-training (AC/ACO) so that the trainee acquires the experience to discharge the responsibilities of the MC. A course of instruction shall be completed using the following outline as required by command:

1. Aircraft familiarization (ACO)
2. Aircraft mission status
3. CMS Publications
4. Communications publications
5. Operational publications

initial qualification requirements

	AC/ MC	ACO MC	AC	2P	3P	NAV	FE	2FE	ACO ACS	FT (IF REQD)	ACOM 2 FT RO
PILOT HOURS			1000	650							
IN-MODEL PILOT HOURS (1)			250	100	25						
INSTRUMENT RATING			STD	STD	STD	EXAM			EXAM (ACO)		
POSITION HOURS (2)		200 (ACO)					100	50	200	300	100
NATOPS EVALUATION (INDIVIDUAL)	X	X	X	X		X	X	X	X	X	X
EC-130 TRANSITION TRAINING			X	X	X		X	X			
VQ-4 REPLACEMENT TRAINING									X	X	X
PHYSIOLOGICAL TRAINING WITHIN PRECEDING 3 YEARS			X	X	X	X	X	X	X	X	X

Note

(1) This amount may be reduced at the discretion of the Commanding Officer

(2) MC (ACO) must have at least 200 hours as a qualified ACO

EC130-XO/7-140

Figure 2-1

recurring requirements

	MC	AC	2P	3P	NAV	FE	2FE	ACO ACS ACOM	FT 2FT RO
A. ANNUAL									
1. NATOPS EVALUATION (INDIVIDUAL)	X	X	X		X	X	X	X	X (5)
2. SIMULATOR (2)		X	X	X		X	X		
B. QUARTERLY (1)									
1. INDIVIDUAL FLYING TIME		20 (4)	20 (4)	20 (4)	20	20	20	20	20
2. INSTRUMENT PILOT HOURS (3)		3	3	3					
3. PRECISION APPROACHES		3	3	3					
4. NON-PRECISION APPROACHES		3	3	3					
5. NIGHT PILOT TIME		3	3	3					
6. LANDING		3	3	3					
C. PREVIOUS 3 YEARS									
1. PHYSIOLOGICAL		X	X	X	X	X	X	X	X

Note

1. Three consecutive calendar months.
2. If available.
3. 15 hours of C-130 simulator may be credited toward minimum quarterly requirements.
4. Pilot hours.
5. FT & 2FT if required.

N 1/76
EC130-XO/7-141

Figure 2-2

6. All mission requirements for preflight, enroute, and post flight

7. Aircraft emergencies

PILOT.

A formal course of instruction will be completed, using the following outline, as required by a command:

1. Aircraft systems and equipment

2. Normal and emergency procedures

3. Weight and balance

4. Performance, cruise, and operational charts

5. FLIP procedures (US and ICAO)

6. Written examination

FLIGHT ENGINEER (FE/2 FE).

A course of instruction shall be completed, using the following outline, as required by a command:

1. Aircraft systems and equipment

2. Special tools

3. Weight and balance

4. Forms and publications

5. Preflight and postflight inspection requirements

6. Comprehensive oral examination

7. Written examination

NAVIGATOR.

A formal course of instruction shall be completed, using the following outline as required by a command:

1. Aircraft familiarization

2. Normal and emergency procedures

3. Navigation equipment

4. Flight planning, operational procedures, and range control charts

5. Navigational equipment and procedures

6. Publications

a. FLIP (US and ICAO)

7. ADIZ penetrations & air defense identification and intercept procedures

8. AIREP and airways position reporting procedures

9. Air-sea rescue and intercept procedures

10. Written examination

AIRBORNE COMMUNICATIONS OFFICER (ACO)

AIRBORNE COMMUNICATIONS SUPERVISOR (ACS)

AIRBORNE COMMUNICATOR (ACOM)

FLIGHT TECHNICIAN (FT/2 FE)

A formal course of instruction will be completed, using the following outline, as required by command:

1. Aircraft familiarization

2. Normal and emergency procedures

3. Communications equipment, publications, and procedures

4. Inflight troubleshooting and maintenance requirements

5. RPS transfer, stowage, and destruction requirements

6. Security of aircraft

7. Logs and records

8. Coordination with flight station

9. Supervision of airborne communications and trailing wire antenna operation

10. Power amplifier (PA) maintenance (FT/2FT)

11. Written examination

REEL OPERATOR (RO).

A course of instruction shall be completed, using the following outline, as required by command:

1. Aircraft familiarization
2. Normal and emergency procedures
3. Preflight check of 0E-159
4. Reel operating procedures
   a. Interlocks
   b. Manual
   c. Automatic
   d. Emergency
5. Inflight maintenance procedures
6. Coordinating operations with flight station
7. Use of special support equipment
8. Logs and records
9. Written examination

FLIGHT TRAINING SYLLABUSES.

The flight training syllabus sets forth the minimum requirements for transitioning crewmembers to the aircraft. Crewmembers who are engaged in any part of the training program shall be considered "in-training" until satisfactorily completing a flight check, after which they shall be designated in writing.

PILOT.

Phase I training is designed to qualify aviators as third pilots. The syllabus will be repeated to train second pilots. Both Phase I and Phase II will be used to train aircraft commanders.

Phase I.

1. Preflight
   a. Flight planning/ICAO procedures
   b. Performance data (TOLD card)
   c. Weight and balance checkout
   d. Aircraft records familiarization
   e. Exterior/interior inspection
   f. Emergency equipment (use and location)
   g. Oxygen equipment
2. Use of checklists
3. Start, taxi, take-off, climb
   a. Start malfunctions
   b. Engine runup
   c. Engine and propeller limitations
   d. System checks (temp controlling)
   e. Before take-off briefing
   f. Emergencies prior to refusal speed
   g. Emergencies after refusal speed
4. Cruise
   a. Approach to stalls
   b. Unusual attitudes
   c. Basic airwork
      (1) 30-degree bank climbing turns
      (2) 45-degree bank level turns
   d. Systems (airborne discussion)
   e. NTS check, engine shutdown and restart
5. Approach and Landing
6. Instruments
   a. Flight director system

b. ADF/VOR/TACAN tracking

c. High/low altitude holding patterns and entry

d. Penetrations

e. GCA/ASR approaches

f. ILS approach

g. ADF/VOR/TACAN approaches

h. Circling approach

i. Missed approach

j. One and two-engine out instrument procedures

k. Automatic ILS approach

l. Normal pattern

m. Normal go-around

n. Landings

(1) 100% flap

(2) 50% flap

(3) 0% flap

o. Simulated one and two engine out approach and go-around

p. Go-around after full flap extension

q. Simulated engine out full stop

r. Simulated nosewheel steering loss

7. Night familiarization

a. Normal take-offs and landings

(1) Both landing lights

(2) One landing light

(3) Taxi light only

(4) Blackout landing

8. Navigation

a. ATC procedures

b. Strange field approaches and landings

c. Performance and cruise control charts

9. Postflight

a. After landing checklist

b. Failure of touchdown switch

c. Engine shutdown and postflight

d. Single point refueling demonstration

Phase II.

1. Oceanic procedures

a. ICAO procedures

b. Pilot - Navigator coordination

2. Mission operational procedures

a. Pilot - ACO coordination

b. Pilot - reel coordination

c. Pilot - use of trailing wire

FLIGHT ENGINEER FLIGHT TRAINING SYLLABUS.

The flight training syllabus is designed to correlate information received during ground training and simulator training and to integrate the flight engineer as a crewmember. Therefore, this syllabus deals with the use of checklists and crew coordination, the diagnosis of airborne malfunctions, and the remedial action that can be accomplished while airborne. It is imperative that prospective flight engineers be completely proficient and have demonstrated a thorough working knowledge of all the aircraft systems and auxiliary equipment prior to flight training. The syllabus shall cover the following:

1. Preflight inspections

2. Cockpit familiarization

3. Use of checklists

4. Engine start

a. Starting sequence

b. Correct and incorrect indications during start

c. Reasons for aborting a start and troubleshooting

d. Diagnosing malfunctions during start

5. Engine and propeller runup

a. Correct runup procedure

b. Pitch lock and fuel governing check

c. Re-indexing

d. Allowable engine and propeller indications

e. Full power check

f. Crossfeed system check

g. Temperature controlling check

h. Generator and load checks

6. Crew coordination duties during start, taxi, runup, take-off, cruise, landing, and after landing

7. Airborne systems checkout

a. Engine malfunctions

b. Propeller malfunctions

c. Fuel system and fuel management

d. Electrical system

e. Pneumatic system

f. Air conditioning and pressurization system

g. Anti-icing, deicing, and defogging system

h. Hydraulic systems

i. NTS system

8. Emergency procedures

a. Emergency equipment

b. Engine failure

c. Engine fire during start, ground operation, and flight

d. GTC fire, ATM overheat, special equipment compartment refrigeration overheat

e. Generator failure and bus failure

f. Hydraulic failure - emergency extension of landing gear

g. Propeller overspeed, low oil quantity

h. Fuselage fire - cabin overheat warning

i. Wing fire

j. Electrical fire

k. Smoke elimination

l. Loss of pressurization

m. Door warning light

n. Wing and/or empennage overheat warning light

o. Loss of inverters

p. Use of restraining harness

9. Landing checklist

10. After Landing checklist

11. Engine secure and NTS check

12. Securing the aircraft

13. Postflight inspection

SECOND FLIGHT ENGINEER (2FE)

The second engineer syllabus is the same as for the FE and is designed to effectively condition a prospective second flight engineer for qualification. Upon completion of the syllabus, he will be graded on the performance of his duties and designated as second engineer. After designation as a second engineer, the trainee will continue through the more comprehensive first engineer syllabus. Trainees should complete the syllabus and achieve designation as first engineer within 12 months after designation as second engineer. Failure to do so will result in reevaluation of his potential as a crewmember.

NAVIGATOR.

The navigator flight training syllabus is designed to correlate information received from previous training and formal ground school with operational commitments. The syllabus stresses the use of checklists and crew coordination, analysis of mission requirements and appropriate communications procedures, and the practical application of navigation training and procedures while airborne. Prior to flight training, the student navigator must complete a formal ground training syllabus or have had sufficient previous navigation experience as determined by the command. The syllabus shall cover the following areas:

1. Aircraft familiarization

   a. Navigator's panel

   b. Normal and emergency procedures

   c. Knowledge of all radios and communications

   d. Capabilities and locations of antennas

2. Preflight

   a. Mission planning

      (1) Point to point

   b. Preparation of flight plan and charts

   c. Procurement of necessary navigation equipment

   d. Inventory of publications

3. Inflight

   a. Complete necessary navigation logs and forms

   b. Range control

   c. Operation of compass systems

   d. Operation of all radios

   e. Operation of navigation equipment

   f. Use of FLIP publications (US and ICAO)

   g. Application of celestial navigation

   h. Application of DR navigation

   i. Application of consolan navigation

   j. Application of pressure pattern navigation

   k. Interpretation of weather

   l. Crew coordination

4. Postflight

   a. Completion of aircraft Postflight checklist

   b. Inventory and return of all navigation publications and equipment

   c. Aerology debriefing

   d. Preparation of appropriate messages

   e. Filing of logs and forms

AIRBORNE COMMUNICATIONS OFFICER (ACO)

AIRBORNE COMMUNICATIONS SUPERVISOR (ACS)

AIRBORNE COMMUNICATOR (ACOM)

This flight training syllabus is designed to correlate information received during ground training with operational employment of the AN/USC-13. The syllabus stresses the use of checklists and crew coordination, analysis of mission requirements and communications procedures, analysis of airborne malfunctions and remedial action that can be accomplished while airborne. Prior to flight training, the trainee must have a thorough working knowledge of the operation and capabilities of the AN/USC-13 equipment. The syllabus shall cover the following areas:

1. Aircraft familiarization

   a. Normal and emergency procedures

2. Preflight

a. Preparation of communications plan

b. Procurement of RPS material and crypto equipment

c. Inventory of equipment spares and maintenance of publications

d. Ensure completion of equipment preflight checks

(1) USC-13

(2) OE-159

e. Check oxygen system and other emergency equipment

3. Inflight

a. Mission requirements

(1) Knowledge of Naval communications

(2) System operational requirements and capabilities

(3) Crew coordination

(4) Mission logs and reports

b. USC-13 communication system

4. Postflight

a. Securing the USC-13 equipment

b. Zeroizing and securing crypto equipment

c. Completion of mission logs and records

d. Proper stowage of RPS material and crypto equipment

e. Coordination of preventive and corrective maintenance

REEL OPERATOR (RO)

The flight training syllabus for reel operators is designed to correlate information received during ground training with operational employment of the aircraft. The syllabus shall cover the following areas:

1. Aircraft familiarization

a. Normal and emergency procedures

b. Emergency landing gear and flap extension

c. AC and dc power sources and distribution

2. Preflight: a check of OE-159/USC-13(V) equipment, including drogues

a. Inventory of equipment fly-away spares

3. Inflight

a. ICS procedures

b. Reel operating procedures

(1) Interlocks

(2) Manual

(3) Automatic

(4) Emergency

c. Inflight maintenance

d. Drogue watch procedures

e. Before landing checks

4. Postflight

a. Completion of logs and records

b. Preventive and corrective maintenance

FLIGHT TECHNICIAN.

The flight technician will demonstrate proficiency in all aspects of repair to the USC-14/13 and related equipment. He will demonstrate an understanding of mission requirements. He will complete satisfactorily all required courses in replacement training.

1. Aircraft familiarization

2. Normal and emergency procedures

3. Post flight

a. Communication equipment

b. Use of authentication and encryption tables

4. Inflight

a. Repair, operate, and capabilities of the inflight performance monitor (IFPM) and familiarization with MNEMONIC codes.

b. Maintenance of teletype system

c. Logs and Records

d. Coordination with flight station

e. Flight-deck electrical systems and communications gear

PERSONAL FLYING EQUIPMENT REQUIREMENTS.

All safety and survival equipment shall be utilized as prescribed by the current OPNAV Instruction 3710.7 series.

1. Crewman shall use the following survival equipment:

a. Flight safety boots or safety shoes.

b. Flight Gloves

c. Fire resistant flight suit

d. Identification tags (dog tags)

e. Flashlight (for all night flights)

2. The requirements for crewmembers stated above are waived for passengers

MISSION COMMANDERS.

The mission commander shall meet the following requirements: be a qualified aircraft commander or airborne communications officer; hold a current instrument rating or an instrument qualification (if an NFO); and be designated in writing by the Commanding Officer. A Mission Commander shall be assigned for each mission in accordance with OPNAVINST 3710.7 (series).

SECTION III

NORMAL PROCEDURES

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LIST OF CHARTS

PART 1

BRIEFING AND DEBRIEFING

INTRODUCTION.

Commanding Officers will ensure that each crew is thoroughly briefed prior to an operational deployment. Crewmembers are normally briefed by the Operations Officer or his designated assistant prior to deployment. The briefing shall include, but is not limited to, intelligence, general weather trends for the period of deployment, and recent communications and procedural changes. Prior to individual missions the Aircraft Commander will ensure that the crew is properly briefed regarding enroute weather, surface conditions, destination, alternate weather, ADIZ procedures, SAR facilities, communication assignments, and any other significant information.

BRIEFING.

1. General

   a. Introductory remarks

   b. Crew members and assignments

   c. In-flight mess arrangements

2. Mission

   a. Starting, taxi, and take-off times

   b. ETE, TAS

   c. Fuel load and weight and balance

   d. Operating areas and mission details

   e. Enroute stops

   f. Destination and alternate airports

      (1) Maintenance support

      (2) Berthing and messing facilities

      (3) Transportation

      (4) Security requirements

      (5) Customs, immigrations, and immunization requirements

      (6) Local currency

3. Weather

4. Navigation and flight planning

5. Emergency Procedures

   a. SAR facilities

   b. Practice drills

   c. Personnel survival equipment

6. Intelligence and special instructions

DEBRIEFING.

ALL FLIGHTS.

After each flight, it is the responsibility of the Aircraft Commander/Mission Commander to bring to the attention of his flight crewmembers any discrepancies he has noted during the flight. Any deviation from the standardized procedures, as outlined in this manual, will be thoroughly reviewed and corrected. It is the responsibility of the Aircraft Commander/Mission Commander to ensure that all reports required have been completed, that the flight plan has been closed, weather debriefed and that all aircraft discrepancies have been recorded.

PART 2

MISSION PLANNING

Refer to Section XI to determine the capability of the aircraft for take-off, climb, cruise, descent, and landing for a complete mission under any combination of conditions and circumstances. Mission planning requires consideration of all factors affecting the successful completion of the assigned mission. Most commonly, mission planning determines the fuel load necessary for the safe accomplishment of a given mission for which on-station time and distance are known. The mission requirements will of necessity dictate the planning considerations. Survival equipment for the crew must be compatible with the mission to be flown.

WEIGHT AND BALANCE.

It is the responsibility of the Aircraft Commander to ascertain that the take-off and anticipated landing gross weights have been determined and that the center of gravity limits are not exceeded. Refer to "Handbook of Weight and Balance", AN 01-1B-40, and to Part 4, Section I of this manual for information on weight limitations. The weight and balance clearance (DD Form 365F) must be completed in accordance with OPNAV INST. 3710.7 series.

FLIGHT PLANNING PROCEDURES.

The nature of the mission will determine the type of cruise control to be employed. Data are presented in charts (Section XI) for the following cruise schedules:

1. Long-range cruise at cruise ceiling.

2. 2,000-foot step-climb cruise at the nearest odd or even altitude under cruise ceiling.

3. Cruise at constant altitude and long-range cruise speeds.

4. Cruise at constant 290 knots true airspeed.

5. Cruise at constant 280 knots true airspeed.

FACTORS AFFECTING RANGE.

EFFECT OF ALTITUDE ON RANGE.

Since engine specific fuel consumption improves with increasing altitude, maximum range is obtained by four-engine cruise-climb operation. Cruise-climb operation provides greater range than can be obtained by flying at a constant altitude or with partial power operation (three or two engines) at a lower altitude. One exception is under conditions of high wind shear, when operation at a lower altitude may provide greater ground miles per pound of fuel. Also, some missions may be restricted below optimum range altitude because of traffic control, passenger, oxygen, or pressurization considerations. The determination of optimum cruise altitude for maximum range capability requires a comparison of the actual ground miles per pound of fuel for the existing wind/altitude conditions under consideration.

EFFECT OF NONSTANDARD TEMPERATURE ON RANGE.

1. For long range cruise, utilizing the performance charts, fly constant standard day fuel flow. Range will increase two percent for each 10° C above standard temperature, and decrease two percent for each 10° C below standard temperature.

2. For high-speed cruise, fly constant maximum cruise power of 1010° C TIT. Range will increase 5 percent for each 10° C above standard temperature, and decrease 5 percent for each 10° C below standard.

3. The performance charts provide correction factors for temperature effects.

EFFECT OF WIND ON RANGE.

The specific range charts in Section XI are predicated on a zero wind condition, so that long range cruise may be defined as that airspeed that gives 99 percent of maximum range in still air. To maintain 99 percent long range cruise, as headwind is encountered, airspeed should be increased 1.5 percent for each 10 knots headwind. Above 70 knots however, in practice, this factor can be neglected with conservatism.

EFFECT OF GROSS WEIGHT ON RANGE.

For constant altitude operation, specific range increases with decreasing gross weights. Since maximum range is achieved by decreasing power settings and indicated airspeed with decreasing gross weights, it is recommended that a new power setting be established for each 5,000 pounds of fuel burnoff if utilizing the performance charts.

EFFECT OF PARTIAL POWER CRUISE ON RANGE.

Maximum range is obtained by four-engine operation at optimum cruise altitude. At altitudes below the optimum cruise altitude for any gross weight, specific range may be increased by partial power cruise, three- or two-engine operation. At lower altitudes (25,000 feet and below) range can possibly be extended by three-or two-engine operation; however, this consideration should be carefully planned, as any improvement in specific range is a function of gross weight, altitude, and headwind component. A false sense of fuel saving could easily result in a loss of range.

EFFECT OF ICING ON RANGE.

Since the aircraft pressurization and wing and empennage anti-icing is accomplished with bleed air from the engine compressor, a power loss occurs when these systems are used. The pressurization power loss is small, but the anti-icing power loss under severe conditions can result in losses up to 25 to 30 percent. Normally, the aircraft will cruise at altitudes at which most icing weather can be overflown. However, if operation is at an altitude where continuous icing is encountered, the effect on the cruising is considerable. Maximum anti-icing has the following effects on cruise control:

True airspeed is decreased 20 percent.
Fuel flow is decreased 6 percent.
Range is decreased 16 percent.

Note

Refer to Section XI, Performance Data, for altitude ceiling with all bleed air on.

EFFECT OF FUEL TEMPERATURE ON RANGE.

Maximum range is affected by fuel temperature variation because of the change in fuel density, pounds per gallon. For example, one gallon of JP-4 fuel at a temperature of 20° F weighs 6.6 pounds, whereas one gallon of JP-4 fuel at a temperature of 100° F weighs 6.3 pounds.

EFFECTS OF VARIOUS FUELS ON RANGE.

Various fuels, because of their density, also vary range capabilities. For example, at 60°F the aircraft has a singlepoint refueling capacity of 9,680 gallons of any fuel, or a maximum capacity of 65,824 pounds of JP-5; however, the wing limit weight is 62,920 pounds.

FUEL DENSITY

Fuel Temp	JP-5	JP-4	115/145
20° F	6.92	6.60	5.97
60° F	6.79	6.46	5.80
100° F	6.66	6.30	5.62

EFFECT OF INCREASED HEADWIND VERSUS HIGHER ALTITUDE.

For planning purposes, when maximum range becomes a consideration and the specific range performance charts are utilized, an increase of more than 5 knots of headwind component for each additional 1,000 feet of altitude climbed will result in a reduction of maximum range.

FUEL REQUIREMENTS.

Careful analysis of fuel requirements must be made for all flights. Fuel required will be in accordance with OPNAVINST 3710.7 series and squadron commanders or higher authority.

Average fuel for taxi and runup prior to take-off is 1,000 pounds. For taxi without runup, the average fuel requirement is 500 pounds.

ADDITIONAL OVERWATER REQUIREMENTS.

On all overwater flights longer than 1,000 miles, time to equal-time-point (ETP) will be figured at flight plan cruise altitude and 10,000 feet, on four engines, and entered in the remarks section of the flight clearance form. ETP is defined as the point (either in distance or time) at which the aircraft will be required to spend the same amount of time continuing to destination or returning to its departure point. Because it is obvious that depressurization is required and descent to a lower altitude may be mandatory, the distance for ETP should be computed at 10,000 feet of altitude. A TAS for ETP distance computations of 245 knots is recommended, because this is the average TAS at 10,000 feet four-engine long range cruise. Any TAS could be used and ETP distance will remain the same.

FORMS.

Standard navigational forms will be utilized on all flights. On overwater flights the navigator's Standard Flight Plan (MAC Form 25) the Navigator's Log (MAC Form 26) and Range Control (MAC Form 27) are recommended. Flight clearance will normally be filed on Military DD Form 175 but may be on the Federal Aviation Agency form or on the International Civil Aviation Organization form, as required.

PART 3

INSPECTIONS, CHECKLISTS, AND PROCEDURES

PREPARATION FOR FLIGHT.

FLIGHT RESTRICTIONS.

Strict adherence to the operating limitations contained in Section I Part 4 of this manual is mandatory for safe and efficient flight operations.

FLIGHT PLANNING.

The wide range of speeds and altitudes possible with the aircraft require that careful attention be given to mission planning and cruise control. Use the performance charts to find required fuel quantities, take-off distances, airspeeds, and power settings.

CHECKLIST.

The Aircraft Commander is responsible for assuring that all items in the Preflight Check checklist are complied with. The actual accomplishment may be delegated as required. Starting with the Before Starting Engines checklist, the remaining checklists in this section are of the challenge type. The copilot reads the item in the left column of a checklist aloud as a challenge, and the response listed in the center column is given by the crewmember indicated in the right column. When more than one crewmember has the same response to the same item, each crewmember subsequent to the initial crew member responding need respond only with his crew position. Before answering a challenge which indicates a complete control panel, the responsible crewmember will check that all switches and controls on the panel are in the positions indicated in the response. When the response is listed "as required," the crewmember will respond by stating the present operating status of the system. The codes P, CP, FE, N, GC, ACO, ACS (response is comm) and RO/O (response is reel) represent pilot, copilot, flight engineer, navigator, ground controller, airborne communications officer, airborne communication supervisor, and reel operator/observer. If the navigator (N) is not on board, the flight engineer (FE) will respond to his checks.

THRU-FLIGHT OPERATION.

When the aircraft is flown on the same mission and no maintenance or servicing is required, it is unnecessary for the Preflight Checks to be performed after the first flight of the day. When maintenance or servicing is required, only those items or systems affected need be checked prior to the next flight. The checklists have been designed so, for through-flight operation the flight crew may begin with the Cockpit Checklist to assure safe operation.

ENTRANCE.

PREFLIGHT CHECKLIST

Prior to entering the aircraft, check for:

1.	Aircraft status	Checked
2.	Chocks	In place
3.	Ground wire	Attached
4.	Fire bottle	If available
5.	External power	In place
6.	NLG ground lock	In place
7.	Dust excluders, duct plugs, and pilot covers	Removed

ENTRY TO THE AIRCRAFT.

Enter the aircraft through the crew entrance door. See figure 3-1 for instructions for opening the door.

WARNING

With crewmembers aboard, the crew entrance door shall be opened and closed from the inside only.

entrance to aircraft

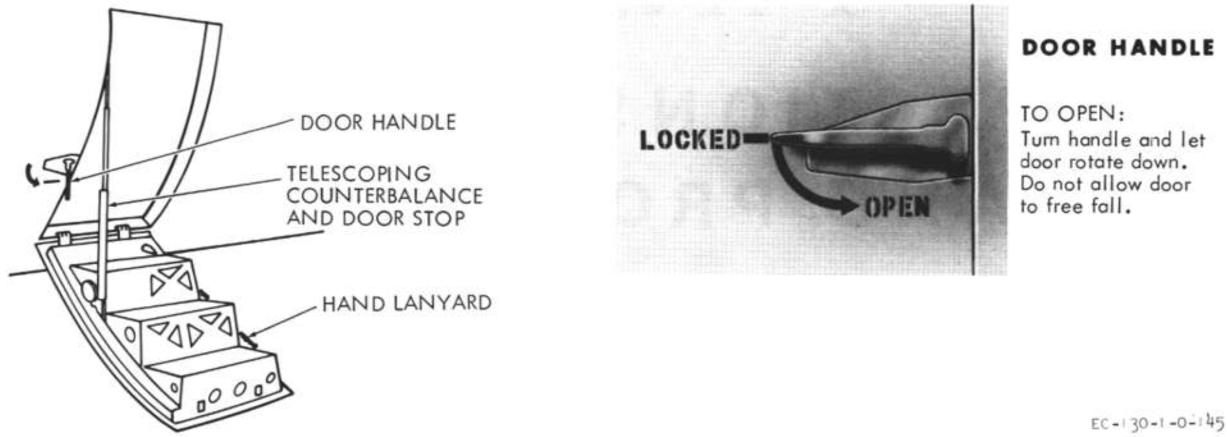

Figure 3-1.

CAUTION

When opening the door from the inside, use the hand lanyard to restrain the door if it should fall free.

PREFLIGHT CHECKLISTS.

The flight engineer will review previous discrepancies to find the status of the aircraft and check that the aircraft has been serviced with the proper amounts of fuel, oil, and oxygen. It is the responsibility of the Aircraft Commander to ensure that a preflight inspection has been performed as required by NAVAIR 01-75GAE-1. The aircrew inspection procedures outlined in this section are based on the assumption that maintenance personnel have completed all the requirements for turn around/servicing inspection in accordance with NAVAIR 01-75GAE-6-1, turn around/servicing "Maintenance Requirements Cards." Therefore, duplicate inspection and operational checks have been eliminated, except for certain items required in the interest of flight safety.

INTERIOR INSPECTION.

1. Fuel, oil, and oxygen service	As required
2. Special equipment compartment	Checked
a. Aft cargo door and ramp controls	6N/NEUTRAL
b. Auxiliary hydraulic pump switch	OFF
c. Hydraulic reservoirs fluid level	Checked

d. Spare fluids	As required
3. Navigator's station	Checked
a. Nose radome anti-icing switch	OFF
b. Radar function switch	OFF
c. Doppler	OFF
d. INS mode selector switch	OFF
e. Flight deck refrigeration shutoff valve manual override handle	NEUTRAL
4. IFF	OFF/IDENT OUT
5. Synchrophase master switch	OFF
6. Portable oxygen bottles	Checked
7. Circuit breakers	Checked

CAUTION

Circuit breakers that are pulled by maintenance shall be clamped and not reset until the proper repair has been made. Circuit breakers that are out and not clamped shall be investigated for cause.

8. Pyrotechnic pistol mount	CLOSED
9. Periscopic sextant outlet	CLOSED
10. Liferaft release handles	IN/safe wired

11. Miscellaneous and emergency equipment	Checked/secure

Note

A restraining harness shall be on the flight-deck for use in case a door warning light illuminates.

12. Galley switches	OFF
13. Crew entrance door jettison handle	Safe wired
14. Generator disconnect switches	NORMAL/safe wired
15. Fuel governing check switches	NORMAL/safe wired
16. Pressurization test valves	OPEN/safe wired
17. Emergency depressurization handle	IN/safe wired
18. Air-conditioning control panel	Set
a. Cargo compt and flight deck shutoff switches	NORMAL
b. Air-conditioning master switch	OFF
c. Cargo compt and flight deck temperature controls	OFF/NORMAL
d. Emergency depressurization switch	NORMAL
19. Anti-icing control panel	Set
a. Nesa windshield switches	OFF
b. Nacelle preheat switches (EC-130G aircraft only)	OFF
c. Prop & eng anti-icing master switch	AUTO

d. Pitot heat switches	OFF
e. Engine inlet duct anti-icing switches	OFF
f. Propeller ice control switches	OFF
g. Wing and empennage anti-icing switches	OFF
20. Wing isolation valves and engine bleed air switches	Set
a. Wing isolation valve switches	NORMAL
b. Engine bleed air switches	CLOSE/OFF
21. Fuel control panel	Set
a. Dump switches	OFF
b. Fuel boost pump switches	OFF
c. No. 2 crossfeed valve switch	OPEN
22. Clocks	Set
23. ATO switch	SAFE
24. Landing gear lever	DOWN
25. Hydraulic control panel	Set
a. Brake select switch	EMERGENCY
b. Aux pump switch	OFF
c. Engine pump switches	ON

d. Suction boost pump switches	OFF
26. Guillotine switches	OFF
27. Alarm bell and jump signals	CHECKED
28. Emergency lights	CHECKED
a. DC power switch	BATTERY
b. Bus tie switch	TIED
c. Emergency lights	OUT
d. DC power switch	OFF
e. Emergency lights	ON

Note

The bulbs of the emergency lights receive power from batteries contained within the lights. The check for bulb illumination should be accomplished as quickly as possible to conserve the batteries.

f. Emerg exit light extinguish switch	Pressed
29. Electrical control panel	Set
a. Generator switches	OFF
b. Gen. disc. switches	OFF/safe wired
c. Inverter switches	OFF
d. External ac power switch	EXT AC PWR (if available)
e. Bus tie switch	NORMAL

f. DC power switch — BATTERY

Note

External dc power may be used if external ac power is not available.

30. GTC control panel — Set

    a. GTC door switch — OPEN

    b. GTC control switch — OFF

    c. Bleed air valve switch — CLOSED

    d. Air turbine motor switch — STOP

31. Fire handles and test panel — IN/checked

    a. Fire handles — IN

    b. Place the turbine overheat switch in the TEST position. Check that the warning lights in the engine fire handles and the master fire warning light flash.

    c. Place audible warning switch to test, the audible speaker should sound and the number one fire handle, and master warning light and placard light should glow. Place the engine test switch in the test position. Check that the warning lights in the engine and GTC fire handles and the master fire warning light and placard light glow steady, and the audible speaker sounds. Position the audible warning switch to silence. The audible speaker should become silent and the lights in the handles and master fire warning light continue to glow. Release the switches to normal.

d. Position the nacelle overheat warning switch to TEST. Check that all four warning lights and placard light illuminate.

Note

Perform items 32, 33, 34, 35, and 36 only when external ac power is available.

32. Radio (UHF or VHF)

Note

AC power must be available for normal operation of any communication radio.

ON/checked

33. GTC clear and fireguard posted — Clear/posted

Note

When the GTC is started with dc power, UHF communication is not possible. VHF communication is limited to previously selected channel. Communications must be established prior to starting GTC.

34. Start GTC and pressurize air manifold — On speed/pressure up

CAUTION

Monitor the wing and empennage anti-icing indicators during operation of the GTC. A temperature rise indicates that an anti-icing valve is open, and the GTC should be shut down.

Note

Do not open GTC bleed air valve until onspeed light illuminates.

35. Bleed air system check — Complete

36.	ATM and ATM generator	ON/checked
37.	Interior lights	Checked
38.	Inverter system	Checked

a. Turn each inverter control switch to the DC BUS position. The selected power off light should not illuminate when the inverters have stabilized. Check flight director system and TIT gages for power indication.

b. Place the voltage & frequency selector switch to the INVERTER position.

c. Check the copilot's inverter by placing the phase selector switch to A and B phase and reading the voltage and frequency on each phase.

d. Check the ac instrument and engine fuel control inverter by placing the phase selector switch to the C phase and reading the voltage and frequency.

e. Turn each inverter control switch to the AC BUS position. The selected power off light should not illuminate. The frequency and voltage cannot be read in this position. Check attitude indicator and TIT gages for power indications.

39.	Fuel quantity and distribution	Checked

a. Press the indicator test buttons and observe that the respective fuel quantity indicators move toward zero.

WARNING

Failure of the indicator to test is indicative of a malfunction in the fuel quantity system. Maintenance action should be taken. If maintenance is not completed, pull and pin the circuit breaker for that indicator. Failure to comply may result in high voltage being routed to the fuel tank which could cause an explosion.

b. Check the sum of the individual gages against the totalizer indication. Refer to FUEL MANAGEMENT in this section for distribution.

40. ATM and ATM generator	As required
41. GTC	As required
42. External ac power (if available)	ON
43. Fuel system	Checked

Note

When the ATM generator is used for supplying ac power, only the No. 2 boost pump will be operative.

a. Turn all crossfeed valve switches to vertical position, with exception of crossfeed separation valve.

b. Turn No. 1 boost pump on. No. 1 and No. 2 low pressure lights should go out, No. 3 and No. 4 should stay on, and no pressure should be indicated on manifold pressure gage.

c. Open crossfeed separation valve. Check No. 1 boost pump pressure within limits, and that No. 3 and No. 4 low pressure lights go out.

d. Close No. 1 crossfeed valve. Deplete manifold pressure by depressing prime button. Turn No. 1 boost pump off.

e. Turn No. 2 boost pump on, and check manifold pressure within limits. Close No. 2 crossfeed valve and deplete pressure. Turn No. 2 boost pump off.

f. Turn left aux boost pump on and check pressure. Close left aux crossfeed valve and deplete pressure.

g. Open left bypass valve. Check manifold pressure gage to ensure it has opened. Close left bypass valve and deplete the pressure. Turn left aux boost pump off.

h. Turn left external fwd boost pump on. Check pressure within limits. Turn left external fwd boost pump off and deplete the pressure.

Note

External tank boost pump pressures will be slightly lower than auxiliary boost pump pressures due to distance from crossfeed manifold.

i. Turn left external aft pump on. Check pressure within limits. Close left external crossfeed valve. Deplete pressure. Turn left external aft boost pump off.

j. Turn right external aft boost pump on. Check pressure within limits. Turn right external aft boost pump off and deplete the pressure.

k. Turn right external fwd boost pump on. Check pressure within limits. Close right external crossfeed valve and deplete pressure. Open right bypass valve. Check manifold pressure gage to ensure that right bypass valve is open. Close right bypass valve and deplete pressure. Turn right external fwd boost pump off.

l. Turn right aux boost pump on. Check pressure within limits. Close right aux crossfeed valve and deplete the pressure, and turn right aux boost pump off.

m. Turn No. 3 boost pump on and check manifold pressure within limits. Close No. 3 crossfeed valve and deplete the pressure. Turn No. 3 boost pump off.

n. Turn No. 4 boost pump on. Check pressure within limits. Press crossfeed prime button for 30 seconds. Close No. 4 crossfeed valve and deplete the pressure. Turn No. 4 boost pump off and close the crossfeed separation valve.

44. Control surface boost shutoff switches — ON/safe wired

45. Oil cooler flaps switches — OPEN/FIXED

a. Open the cooler flaps fully and return to fixed.

46. Flight director system — Checked

a. Place the flt dir switch in the NORMAL position.

b. Place the mode sel switch in HDG

(1) All pointers and flags should be out of view.

(2) The course arrow should slave to the lubber line.

(3) The course selector window should indicate compass heading.

c. Place the flt dir switch in the MANUAL position.

(1) Set the heading marker to the aircraft heading. The bank steering bar should center.

(2) Rotate the heading marker left and right. The bank steering bar should move in the same direction.

(3) Rotate the pitch trim knob up and down. The attitude sphere should deflect up and down respectively. Align the horizon bar with the miniature aircraft.

d. Switch vertical reference to alternate (BuNo 151888 through 156177 only). Check pilot's ADI for proper erection and flags. Switch vertical reference to normal.

47. Nesa windshield switches — Checked/OFF

WARNING

Do not check the temperature of a crazed outer glass with the bare hand.

a. Place the Nesa windshield switches in the NORMAL position, and check for heating by feeling the outside glass panels. Place the switches in the OFF position.

CAUTION

Operation of the Nesa windshield anti-icing when outside air temperature is above 27°C (81°F) will increase the possibility of delamination within the Nesa panels.

Note

If the ambient temperature is below 27°C (81°F), turn Nesa to NORMAL. If the temperature of the glass is below -43°C (-45°F), the Nesa control system will not function automatically, and the coldstart switch must be used to raise the temperature of the glass into the normal operating range.

CAUTION

Do not exceed the operating limits of 5 seconds on, 10 seconds off when operating the coldstart switch.

48. Press-to-test lights — Checked

49. Oxygen system — Checked

50. All hydraulic systems pressure — Depleted

CAUTION

Pump brake pedals to deplete all hydraulic system pressure before opening or closing the ground test valve.

51. Hydraulic ground test valve — OPEN (GC)

    a. Ramp and door controls — NEUTRAL (GC)

CAUTION

When positioning the hydraulic ground test interconnect valve to either the normal or interconnect position, be sure the handle is moved through its full arc of travel and the internal ball detent in the valve engages. The engagement of the ball detent can be felt in the handle. If this is not done, then excessive return line pressures can cause damage to hydraulic motors.

52. Aux hydraulic pump switch — ON

53. Flaps — DN/100%

CAUTION

Do not perform the flight control check while the STWA is being checked. It may overload the auxiliary hydraulic system and cause it to shut down or the motor to overheat.

54. Flight controls and trim tabs — Checked (with GC)

a. Check for free and correct movement of all flight controls.

b. Check direction and movement of all tabs and coordination with the indicators. Check the elevator tab override feature, OFF position, and emergency power.

c. Return ELEVATOR TAB POWER switch to NORMAL.

55. Autopilot — Checked

Note

This check will be performed in accordance with the procedures outlined in Section I.

56. Aux hydraulic pump switch — OFF

57. All hydraulic systems pressure — Depleted

58. Hydraulic ground test valve — CLOSED (GC)

59. Air deflector doors — Checked/closed (GC)

60. Left exterior lights — Checked (with GC)

a. Empennage navigation light

b. Navigation light

c. Anti-collision lights

d. Leading edge light

e. Landing light

CAUTION

Do not operate the landing lights for a prolonged period while the aircraft is on the ground. The lights do not have cooling facilities and may overheat.

f. Taxi light

61. Feather No. 1 and No. 2 propellers — Checked (with GC)

CAUTION

Do not statically change the blade angle of a propeller that has been exposed to prolonged temperatures of 0°C (32°F) or below. If extremely cold temperatures are anticipated, a static feather check must be completed after engine shutdown prior to leaving the aircraft.

Note

Feather valve check - Place the feather valve and NTS check switch in the VALVE position. Place the condition lever in the FEATHER position. The blades should move to the feather position and the green test light should illuminate. The propeller feather override button should pull in during the feathering operation and then pop out when the blades reach the feather position. The amber light in the feather override button should illuminate while the button is pulled in and should go out when the button pops out. If the button does not pop out, pull it out manually to shut off the pump.

62. Unfeather No. 1 and No. 2 propellers — Checked (with GC)

WARNING

If hesitation is not observed, a malfunction exists in the mechanical low pitch stops which could allow the propeller to enter the ground range during flight. Maintenance action shall be completed prior to flight.

CAUTION

Do not exceed the propeller auxiliary pump operating time limit shown in Part 4, Section I.

Note

- Check that the throttle is in GROUND IDLE, and place the condition lever to AIR START until the blades stop in the ground idle position. Return the condition lever to GROUND STOP.
- When coming out of feather, the blades will hesitate momentarily at the flight idle blade angle (during retraction of the low-pitch mechanical stops) before continuing to the ground idle blade angle position.

63. Pitot heat — Checked (with GC)

64. Feather No. 3 and No. 4 propellers — Checked (with GC)

Note

Follow the procedures outlined in items 62 and 63 for feathering and unfeathering No. 3 and No. 4 propellers.

65. Unfeather No. 3 and No. 4 propellers	Checked (with GC)
a. Return the feather valve and NTS check switch to NORMAL.	
66. Right exterior lights	Checked (with GC)
a. Navigation light	
b. Leading edge light	
c. Landing light	
d. Taxi light	
e. Lower navigation light	
67. All unnecessary equipment	OFF
68. Emergency exit light extinguish switch	Pressed

Note

During the interior inspection, all loose equipment must be secured.

69. Crew Entrance Area	Checked
a. Crew door latch mechanism	
b. Crew door, master warning light shutoff switch (Normal)	
c. Radio and electrical equipment racks	
d. First aid kit and emergency light	
e. Interphone panel, light switches	
f. NLG emergency extension valve	NORMAL/safe wired

g. Fire extinguisher and hand axe

70. Special equipment compartment left side	Checked
a. Parachutes and life vests for proper stowage	As required
b. Oxygen regulators and portable bottles for correct pressures, and oxygen mask for proper stowage	
c. Emergency extension wrench	Stowed
d. Utility hydraulic panel	
e. Left MLG and flap emergency engaging handles and handcrank	IN/stowed

CAUTION

The main landing gear emergency engaging handles should not be pulled while the aircraft is on the ground.

f. Left bleed air manifold isolation valve	OPEN
g. Aileron hydraulic boost unit, flap motor, and autopilot servo	
h. First aid kits, fire extinguisher, and emergency lights	
i. Aft fuselage J-box circuit breakers and light control switches	
j. Left paratroop door master door warning shutoff light switch (NORMAL)	
k. Left paratroop door and up-latch mechanism	
l. Aft cargo compt interphone panel	
m. Left, aft oxygen regulator condition and pressure	

71. Ramp Area	Checked
a. Ramp and aft cargo door manual control valves	NEUTRAL
b. Auxiliary hydraulic system	
c. STWA hydraulic valves	CLOSED

CAUTION

Failure to close the STWA reel hydraulic valves will result in not being able to pressurize the auxiliary hydraulic system with the hand pump. Ensure that these valves are always closed when not using the STWA.

d. Ramp and door locks and telescoping arms	
e. Overhead escape hatch, emergency light, and escape rope	
f. Cabin pressure safety valve	
g. Rudder and elevator boost units and autopilot servos	
h. Aft cargo door uplock	Unlocked
i. Fire extinguisher and hand axe	
j. Parachutes and life vests for proper stowage	As required

k.	Liferaft release Handles	IN/safe wired
l.	Oxygen bottle	Checked
m.	Right paratroop door, ramp and aft cargo door master warning light shutoff switch	NORMAL
n.	Water bottles	Stowed/secured
o.	Manual Drogue handle	Stowed

72. Special equipment compartment right side — Checked

a.	Right cargo comp interphone panel	
b.	Right aft oxygen regulator	
c.	Right paratroop door and uplatch mechanism	
d.	First aid kits and emergency light, survival equipment, as required, aboard and stowed	
e.	Overhead escape hatch, depressurization hatch, emergency light, and rope	
f.	Right bleed air manifold isolation valve	OPEN
g.	Fire extinguisher	
h.	Right MLG emergency engaging handles and handcrank	IN/stowed
i.	Booster hydraulic panel	
j.	Special equipment disconnect panels	
k.	Side emergency exit	
l.	Emergency exit light	
m.	Oxygen regulators, condition and pressures	
n.	Oxygen manually operated shutoff valve	Checked/ON

o. Fire extinguisher

p. Overhead electrical equipment rack

EXTERIOR INSPECTION.

Walk-Around Inspection.

A walk-around inspection will be conducted, following the route shown in figure 3-2. Work stands or a ladder will be required when checking the engine inlet air ducts, the engine exhaust area, and the external tank caps.

1. Nose section — Checked

   a. Crew entrance door

   b. Battery compartment

WARNING

Do not operate the aircraft without a serviceable battery.

   c. NLG downlock and wheel well area

   d. Brake accumulator pressures

   e. Pitot masts and heads

   f. Radome and nose exterior general condition

   g. Radome lightning diverter strips

2. Forward fuselage, right side and bottom — Checked

   a. Oxygen filler valve - (Closed) — Checked

inspection diagram

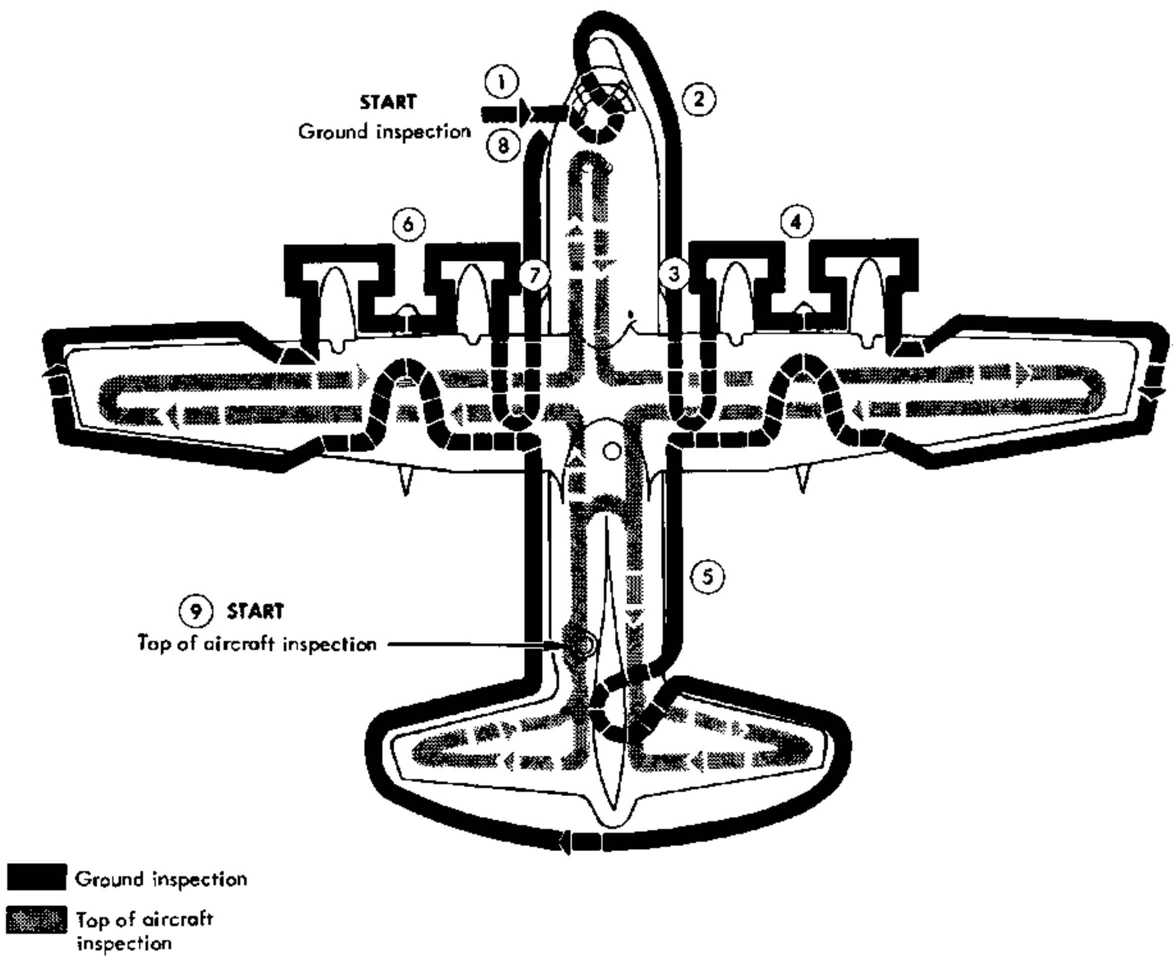

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Figure 3-2.

b. Flight deck air conditioning intake and exhaust

c. Exterior structure general condition

d. Static air ports

3. Right wheel well area and center fuselage — Checked

a. Special equipment compartment air conditioning intake and exhaust

b. Right MLG, wheel well area, MLG door attachment - (Secured)

c. Single point refueling panel

d. Air deflector door area

e. Exterior structure general condition

f. Auxiliary fuel tank magnetic sight gage

4. No. 3 and No. 4 Engine Nacelles. External fuel tank, propellers, right wing — Checked

a. Nacelle exterior structure general condition, fluid leaks, and oil servicing access panel

b. Engine inlet air ducts, oil cooler core for leaks and obstructions

c. Propeller spinner and blades

d. Lightning diverter

e. Engine exhaust areas

f. External fuel tank cap and tank structure general condition, fuel leaks

g. Flap, aileron, tab, and wing skin

5. Aft fuselage and empennage — Checked

a. Exterior structure

b. Cargo ramp and aft cargo door

c. Tail structure and control surfaces

d. Drogue lights

e. Lightning diverters

f. Tail skid

g. Drogue

h. Short-wire antenna exit fairing

i. PA cooling air outlet

6. No. 2 and No. 1 engine nacelles, external fuel tank, propellers, left wing — Checked

a. Flap, aileron, tab, and wing skin

b. Engine exhaust areas

c. Lightning diverter

d. Propeller spinner and blades

e. External fuel tank cap and tank structure general condition, fuel leaks

f. Engine inlet air ducts, oil cooler core for leaks and obstructions

g. Nacelle exterior structure general condition, fluid leaks, and oil servicing access panel

7. Left wheel well area and center fuselage — Checked

a. Hydraulic ground test valve safety pins

b. Air deflector door area

c. Fire extinguisher bottle charge - (Checked/within limits)

d. Left MLG, wheel well area, MLG door attachments - (Secured)

e. Exterior structure general condition

f. Auxiliary fuel tank magnetic sight gage

8. Forward fuselage, left side and bottom — Checked

a. ATM inlet and exhaust

b. GTC area

c. Exterior structure general condition

d. Static air ports

NEW e. Heat exchanger inlet

f. Heat exchanger ground access panel

9. Top of aircraft — Checked

WARNING

- Conducting this inspection during high winds or other severe weather conditions can be dangerous. Under these circumstances, the pilot may waive this inspection.
- Ensure that HF transmissions are not being conducted while topside of aircraft is being preflighted.

CAUTION

Use extreme care at all times to avoid scratching or denting the skin while walking on the fuselage

a. Empennage, fuselage, wing, control surfaces, and flaps

b. Dry bay areas for fuel or hydraulic fumes and leaks

c. Fuel tank caps — Secure

d. Emergency equipment access panels — Secure

e. Antennas — Secure

f. Escape hatches and release handles — Secure

COCKPIT CHECKLIST.

Note

This checklist will be completed prior to the BEFORE STARTING ENGINES checklist and will normally be completed by the flight engineer prior to the other crewmembers assuming their respective crew positions. A crewmember will remain at the aircraft after completion of this checklist. If this checklist is completed and the aircraft does not fly, complete the ENGINE SHUTDOWN checklist and the AIRCRAFT SECURE checklist before securing the aircraft.

1. NLG lock, pitot covers, ground wire, and PA air exhaust door.	Removed/secure
2. Navigator's panel	Set
a. Radome anti-icing switch	OFF
b. Radar switches	OFF
3. IFF master switch	OFF/IDENT OUT
4. Circuit breakers	Checked
5. Landing gear lever	DOWN
6. Airconditioning control panel	Set
a. Cargo compt and flight deck shutoff switches	NORMAL
b. Airconditioning master switch	OFF
c. Cargo compt and flight deck temperature controls	OFF/NORMAL

d. Recirculating fan switch	OFF
e. Emergency depress switch	NORMAL/safe wired
f. Aft cargo compartment temp control switch	OFF
7. GTC control panel	Set
a. GTC door switch	OPEN
b. GTC control switch	OFF
c. Bleed air valve switch	CLOSED
d. Air turbine motor switch	STOP
8. Anti-icing control panel	Set
a. Nesa windshield switches	OFF
b. Nacelle preheat switches (EC-130G only)	OFF
c. Prop & engine anti-icing master switch	AUTO
d. Pitot heat switches	OFF
e. Engine inlet duct anti-icing switches	OFF
f. Propeller ice control switches	OFF
g. Wing and empennage anti-icing switches	OFF

9. Engine bleed air valves switches	CLOSE/OFF
10. Fuel control panel	Set
a. Dump switches	OFF
b. Fuel boost pump switches	As desired
c. Crossfeed and bypass valve switches	CLOSED/No. 2 OPEN
d. Crossfeed separation valve	CLOSED
e. Aux tank pump switches	As required
11. Fire handles	IN
12. Paratroop control panel	Set
a. Air deflector door switches	CLOSED/OFF
b. Alarm bells and jump signals switches	OFF
13. Propeller control panel	Set
a. Feather valve and NTS check switch	NORMAL
b. Propeller feather override buttons	OUT
c. Propeller governor control switches	NORMAL
d. Propeller master trim knob	ZERO
14. Throttles	GROUND IDLE
15. Temp datum control valve switches	AUTO

Note

It is not recommended that an engine be started with the temp datum control valve switches in the NULL position. If a start must be made with the temp datum control valve switch in the NULL position, the TIT should be closely monitored since overtemperature protection is not provided.

16. Oil cooler flaps switches	AUTOMATIC
17. PA system	Set
a. PA main control panel switch/speaker selector	PWR ON/ALL
b. Pilot's auxiliary PA control panel switch	Interphone/PA

BEFORE STARTING ENGINES CHECKLIST.

1. Crew passenger briefing	As required	P
2. Electrical control panel	Set	FE
a. Generator switches	TEST	
b. Inverter switches	OFF	
c. External ac power switch	EXT AC PWR (if available)	
d. Bus tie switch	TIED	
e. DC power switch	BATTERY	

Note

External dc power may be used if external ac power is not available.

3. Radio (UHF or VHF)	ON/checked	CP

Note

AC power must be available for normal operation of any communication radio.

4. Clear GTC	GTC clear/fire guard posted	GC

Note

When the GTC is started with dc power, UHF communication is not possible and VHF communication is limited to the previously selected channel. Communication shall be limited prior to starting the GTC.

5. GTC panel	Set	FE
a. GTC control switch	START/RUN	
b. Bleed air valve switch	OPEN/pressure up	

CAUTION

Do not open the GTC bleed air valve until the on speed light has illuminated. Monitor the leading edge temperature indicators. A rise in temperature indicates that an anti-icing valve is open and the GTC must be shut down to prevent damage to a heated surface or fuel tank sealant.

6. ATM and generator	As required	FE

Note

If external ac power is available, the ATM should not be started at this time. The external ac power switch automatically goes to OFF when the ATM generator switch is placed to the ON position, regardless of whether the ATM and generator are operating.

7. Interior lights	Set	P, CP, FE
8. Inverters	Set	FE
a. Copilot's inverter switch	ESSENTIAL AC BUS	
b. AC inst & engine fuel control inverter switch	ESSENTIAL DC BUS	
9. INS alignment and data entry	Set	N

Note

Do not move the aircraft during INS alignment.

10. Fuel quantity and distribution	Checked	P, FE
11. Fuel enrichment switches	As required	P

Note

Under normal circumstances, fuel enrichment switches should be off. If fuel enrichment is required as a result of operating environment, place the fuel enrichment switches to NORMAL; however, when the engine indicates a TIT of 100°C or more, start with enrichment OFF. Do not select enrichment after the starter switch has been actuated.

12. Hydraulic control panel	Set	CP

Note

If utility system hydraulic pressure is indicated after the auxiliary hydraulic pump is turned on and before starting No. 2 engine, a malfunction of the hydraulic ground test valve is indicated.

a. Brake select switch	EMERGENCY	
b. Aux pump switch	ON/pressure up	
c. Anti-skid switch	OFF	
d. Engine pump switches	ON	
e. Suction boost pump switches	ON/lights out	

CAUTION

Starting an engine with an inoperative suction boost pump may result in damage to the engine-driven hydraulic pump.

13. Parking brake/chocks	Set/remove chocks	P

CAUTION

To avoid engaging the brakes on only one side of the aircraft when setting the parking brakes, the toe brakes must be firmly depressed and held until the parking brakes are engaged. This condition requires extreme care since toe brakes are difficult to actuate and set because of the angle of the brake pedals to the operator's feet.

Note

- Depress pedals individually and monitor the emergency brake pressure gage for pressure drop as each pedal is depressed.
- Direct ground control to remove wheel chocks. No response will be required at this time.

14. Oxygen	Checked/NORMAL/ 100%/OFF	P, CP, FE, N, ACS RO/O

Note

Each crewmember will check his oxygen regulator in accordance with instructions in Section I and leave the regulator in the following positions:

a. Emergency toggle lever	NORMAL	
b. Regulator diluter lever	100%	
c. Oxygen supply lever	OFF	
d. Oxygen mask	Connected	
15. Ground idle buttons	Set	FE
a. No. 1 and 4	LOW	
b. No. 2 and 3	NORMAL	

Note

If desired, any engine may be started in normal or low speed ground idle.

16. Flap lever	Set	CP

Note

Set flap lever to correspond with flap position indicator.

17. Wheel chocks	Removed	GC
18. Communications checklist	Complete	ACS
19. Anti-collision lights/Leading edge lights	ON/as required	FE

STARTING ENGINES CHECKLIST

The normal engine starting sequence is 3, 4, 2, 1.

1. Clear No. 3 engine	No. 3 clear/ Turning No. 3	GC P
a. Engine bleed air switch	OPEN/OVRD	
b. Condition lever	RUN	

Note

- Under low air density conditions (high temperature or high level altitude) GTC mass output will be reduced to power the engine during a start for normal acceleration. If the ATM and generator are being utilized, turn the ATM generator to OFF and the ATM switch to STOP during the engine start. Once the engine is started, use the ATM generator or the No. 3 engine generator as desired for ac power.

- Do not perform a start if the TIT is above 200° C. If TIT is above 200° C, it may be brought below 200° C by motoring the engine with the starter while the condition lever is in GROUND STOP.

c. Engine starter button	IN

(1) The starting cycle is automatic and requires no further action if the engine accelerates smoothly and continuously, if TIT is normal, and if the engine stabilizes on speed within one minute. Monitor the engine instruments continuously during a start. Keep one

hand on the condition lever and the other on the starter button of the enigne being started, and be prepared to discontinue the start immediately if an abnormal indication is received. The ground controller will monitor the propeller and report if the propeller fails to, or ceases to rotate. If no rotation is indicated within approximately 5 seconds after pilot states "turning," the ground controller will state "negative rotation." During normal start, the following sequence of events should be observed and called off on interphone by the flight engineer.

(a) Enrichment/fuel flow

(b) Ignition

(c) Oil pressures

(d) Hydraulic pressure

(e) Parallel

(f) Series

(g) Peak TIT

CAUTION

If the engine does not light-off before 35 percent rpm is reached, discontinue the start. (Move the condition lever to GROUND STOP and pull out the start button). If the engine does light-off normally but does not accelerate smoothly to ground-idle rpm and a rapid increase in TIT is indicated, a stalled start is taking place. Discontinue the start. Before attempting another start on that engine, motor the engine to approximately 25 percent rpm with the condition lever in GROUND STOP to remove the gases and unburned fuel from the turbine. Make the next start with the fuel enrichment switch in the OFF position.

NEW

Note

Should a malfunction occur which would necessitate discontinuing the start, the FE, CP, or P will call out "Stop Start" and state the malfunction. When the engine is on speed, the FE will ensure that the generator is developing voltage, turn the switch on, and state "Generator On." This indicates the CP is clear to continue the checklist.

(2) When the engine is at approximately 16 percent rpm, enrichment flow will be indicated, and light-off will follow. The secondary pump pressure light may illuminate momentarily, then go out. The light normally will illuminate again before the engine reaches 65 percent rpm.

CAUTION

- If there is no positive indication of oil pressure from the reduction and power section by 35 percent rpm, immediately discontinue the start by placing the condition lever in GROUND STOP and pulling out the starter button.

- After moving a condition lever to GROUND STOP, do not move the lever from this position until engine rotation has ceased. Moving a condition lever from GROUND STOP to RUN while the engine rpm is decreasing could result in damage to the engine. Do not re-engage the starter until rotation has stopped completely.

Note

Throttles must not be moved out of GROUND IDLE detent during ground starting because the resultant increase in propeller blade angle might overload the starter, reducing the rate of engine acceleration.

(3) The starter button should pop out before the engine rpm reaches pull-out limit.

CAUTION

If the starter button does not pop out before the pull-out limit is reached, manually pull the button and place the condition lever in GROUND STOP and close the respective bleed air valve. If start was made in low ground idle, restart in normal ground idle. If the starter button does not pop out before the pull out limit, manually pull the button, place the condition lever in GROUND STOP and close the respective bleed air valve. Record in yellow sheet.

(4) At approximately 65 percent rpm, the secondary fuel pump pressure light will go out.

Note

Refer to Part 4 of Section I for TIT and starter limits during engine start.

(5) The engine should accelerate to low speed ground idle rpm within one minute. If the engine does not stabilize on speed within one minute, discontinue the start, except that during extreme ambient conditions (high altitude, high temperature), the starting air supply may be inadequate to stabilize the engine within the time limit at low speed ground idle while start temperature indication is still within limits.

Under these conditions the start may be continued beyond the 60-second start time limit to 70 seconds, provided that the engine is accelerating smoothly and at constant rate. If in excess of 70 seconds, discontinue start (move condition lever to GROUND STOP, record in aircraft form for maintenance action). If engine acceleration hesitates or appears to be stagnating, the engine must be shut down immediately to avoid turbine damage as over-temperature may exist downstream of the thermocouples.

Note

Refer to Section I Part 4, for starter operating limits.

d. Engine generator switches — ON

Note

- The engine generator switches should remain in the test position until the engine has stabilized in normal ground idle.
- When turning engine generator switches ON, ensure that the 50 kva generator switch is turned on first to prevent the loss of aircraft systems electrical ac power through tripping of the external ac power switch.

e. Hydraulic pump and pressure — Pressure up/checked

Note

A positive hydraulic pressure indication should be noted by the time the engine is on speed, and the normal operating pressure should be indicated within 30 seconds after the engine is on speed. Check the No. 3 hydraulic pump by operating the flight controls. After the controls are stable, check the static pressure for normal limits. Similarly, check the hydraulic pump on each remaining engine after starting by operating the flight controls while the pump on that engine is the only source of pressure to its system.

2. ATM and generator — ON/checked — FE

Note

The external ac power switch automatically goes to OFF when the ATM generator switch is turned ON. The ATM generator must be ON for low-speed ground idle operation since the engine-driven generators will be off the line. If the ATM generator fails, the low-speed ground idle buttons must be disengaged in order to prevent a drain on the battery.

3. DC power switch	BATTERY	FE

Note

The pilot may direct removal of ground equipment at this time.

4. Clear No. 4 engine	No. 4 clear/ Turning No. 4	GC P

Note

Repeat items 1.a through 1.e for remaining engines.

5. GTC control panel	Set	FE
a. Bleed air valve switch	CLOSED	
b. GTC control switch	OFF	
c. GTC door switch	CLOSED	
6. Air conditioning master switch	AIR COND NO PRESS	FE

Note

After stabilization of the flight deck and Special equipment compartment temperatures, the temperature controls may be operated in auto or manual.

7. External power, and ground equipment	Removed/clear	GC
8. Clear No. 2 engine	No. 2 clear/ Turning No. 2	GC P
9. Clear No. 1 engine	No. 1 clear/ Turning No. 1	GC P

10. Ground idle buttons	As required	P, FE

CAUTION

The engines shall be changed to normal ground idle operation by disengaging the low-speed ground idle buttons rather than by throttle movement. Movement of the throttles beyond the limits of 9 to 30 degrees coordinator angle at ambient temperatures above 27°C may cause rpm stall or overtemperature. Should the low-speed ground idle buttons be inadvertently released with the throttles, return the throttles to ground idle; the engine should accelerate to normal ground idle rpm. When down-shifting from normal to low-speed ground idle, monitor the engine instruments. Shut down the engine if rpm stall (rpm continues to drop below low-speed ground idle) or an overtemperature of 850°C or greater occurs.

Note

Low-speed ground idle should be used as much as possible before and while taxiing to conserve fuel and to reduce the noise level.

BEFORE TAXI CHECKLIST.

Refer to Part 4, Section I for engine limitations.

The ground operation of each engine should be held to a minimum to conserve fuel.

1. Leading edge temperature	Normal	FE

2. Crew aboard, doors closed, lights out	Aboard/closed/checked/light out	GC
	Light out	FE

WARNING

Visually check the hooks on the crew entrance door to see that they contact the eyebolts

3. Compass system and heading indicators	Checked/Set___	N, P, CP
a. N-1 compass (EC-130G aircraft)		
(1) Latitude control knob	OFF	
b. C-12 compass(es) (EC-130Q aircraft)		
(1) Latitude N-S switch	Local latitude	
(2) Latitude knob	Local latitude	
(3) Mode selector switch	As required	
(4) Synchronize indicator	Synchronized	
c. AHRS Compass (EC-130G aircraft and EC-130Q aircraft BuNo 156170 through 156177).		
(1) Latitude N-S switch	Local latitude	
(2) Latitude control knob	Zeroed	

(3) Function selector switch	Slaved	
(4) Synch indicator	Synchronized	

d. The navigator will compare No. 1 and No. 2 compass headings and state heading of the No. 2 compass.

e. The pilot will compare headings of all three compasses and state the heading of the No. 1.

f. The copilot will compare headings of both compass systems and state the heading of No. 2.

4. Radios, IFF, Nav equipment, and Radar	ON/STDBY	CP, N
5. All warning lights	Checked	FE
6. Flaps	UP	CP
7. Hydraulic pressures and quantities	Pressures checked Quantities checked	CP RO/O
8. Altimeter	Set_____ (state setting)	P, CP, N

a. Obtain taxi clearance and altimeter setting. State altimeter setting.

WARNING

It is possible to set an altimeter in error by 10,000 feet. Special attention should be given to the altimeter to make sure that the 10,000-foot pointer is indicating correctly.

b. Pilot will turn on radar altimeter

9. INS mode selector switch	AS REQUIRED	N

TAXIING CHECKLIST.

Flight engineer items not requiring coordination may be accomplished by the flight engineer prior to the checklist challenge. This does not preclude response to the checklist when an item is called by the copilot.

Excessive oil temperatures and overheated brakes may be interrelated during ground operation. If throttles are advanced to provide better oil cooling, the higher thrust may increase the taxi speed and require the pilot to drag the brakes. If oil temperatures exceed limits, engine life is adversely affected; if brakes are overheated, wheel failures and brake fires may result.

To preclude excessive temperature build-up during hot weather operation, the oil cooler flaps should be FIXED/OPEN during start and for all ground operations. During taxi the oil temperatures should be monitored closely to avoid exceeding limits. The use of low speed ground idle will normally maintain oil temperatures within desired limits and keep a reduced taxiing speed.

Avoid the use of brakes as much as practicable during taxiing, particularly after a landing which involved braking. Care should be taken not to ride the brakes by inadvertent toe pressure. Placing the heels on the floor should preclude inadvertent brake application.

Skidding or skipping of the nose wheel may develop when the airplane is turning, either because of wet pavement or an aft center of gravity. These conditions can be prevented by avoiding abrupt steering changes or by asymmetrical power and brake applications.

CAUTION

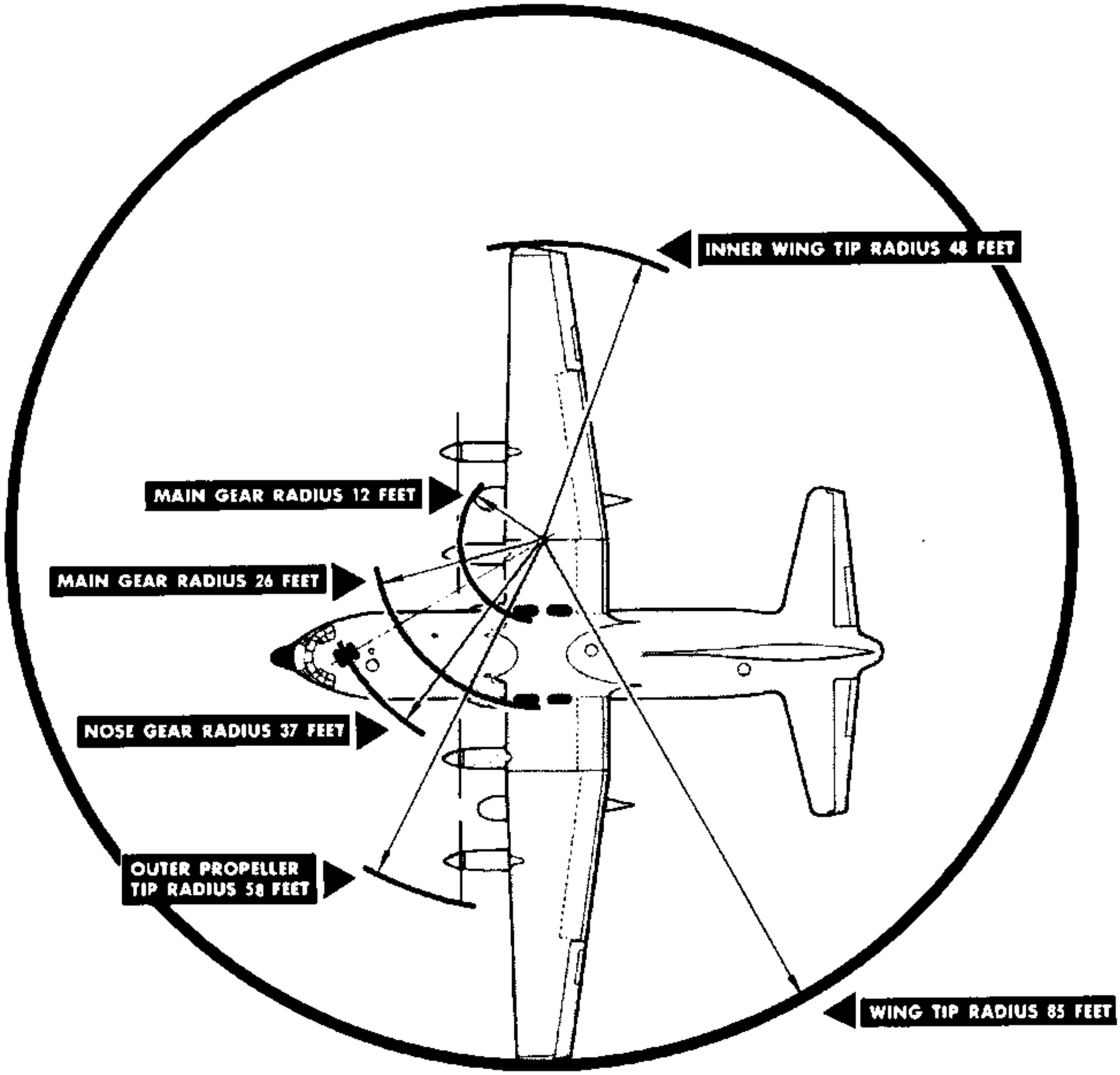
When taxiing over rough terrain, extreme caution must be exercised and very low taxi speeds observed.

Turns with brakes locked on one side are prohibited. When possible, avoid braking in turns, since damage to landing gear and/or structures may result. See figure 3-3 for the minimum space and clearance required for turning.

Note

If any taxi limitation has been exceeded (excessive braking, braking in turn, excessive oil temperatures), record as a discrepancy.

turning radii



VERTICAL CLEARANCES

WING TIP	12 FEET
VERTICAL STABILIZER TIP	38 FEET 6 INCHES
INBOARD PROPELLER	5 FEET 9 INCHES
OUTBOARD PROPELLER	6 FEET 5 INCHES

CAUTION

MINIMUM SPACE REQUIRED FOR TURNING IS 170 FEET WITH THE NOSE GEAR TURNED TO THE MAXIMUM OF 60 DEGREES

Figure 3-3.

1. Brakes	Checked	P
a. Check the emergency brake system.		
b. Switch to and check the normal brake system.		
c. Turn anti-skid on and check the brakes.		
2. Flight instruments	Checked	P, CP

Note

Check heading and turn and slip indicators for correct movement. Check airspeed and vertical velocity indicators for proper reading.

Items 4, 5, 6, and 7 will not be required on subsequent flights of the day.

3. Propeller reversing	Checked	P, FE

Note

The pilot will place symmetrical pairs of throttles in full reverse. The flight engineer will observe rpm within limits and advise pilot of symmetric torque differences of 1,000 inch-pounds or more. If greater than 1,000 inch-pounds, compensate as necessary for this differential during subsequent reverse operation and record the discrepancy.

4. Generators and loads	Checked	FE

a. Place the ATM generator switch to the OFF position and note that the No. 2 generator assumes the essential ac bus load.

CAUTION

Do not exceed generator ground load limit. (Refer to Part 4, Section I.)

b. Rotate the voltage and frequency selector to each engine generator position and note that voltage and frequency are within limits.

c. Rotate the phase selector switch to each phase position and check each engine generator loadmeter for an indication of a load within limits.

d. Check each TR unit loadmeter for an indication of a load within limits.

5. Prop and engine anti-icing	Checked	FE

a. Place the ice detector test switch in the No. 2 position. Note that the ice detection light illuminates. Place the prop & eng anti-icing master switch to the RESET position and note that the ice light is extinguished.

b. Place the ice detector test switch in the No. 3 position and note that the ice detection light illuminates.

c. Place each engine inlet duct anti-icing switch in the ON position (one at a time) and note a slight torque decrease and/or TIT increase. Place the switches in the OFF position (one at a time) and note a slight torque increase and/or TIT decrease.

d. Check propeller blade, spinner, and spinner base as follows:

(1) Determine the position of the deicing by turning each propeller ice control switch (starting with No. 1) ON, then OFF until a load is indicated on all three ammeters (spinner anti-ice, spinner deice, and blade deice).

(2) Leave propeller ice control switch ON until heating cycle is complete as noted by drop on the deicing ammeter.

(3) Turn next switch in sequence to ON, and check for an approximate 20-ampere increase on spinner anti-ice ammeter and 65 to 90 amperes on spinner and blade deice ammeters.

(4) Repeat step (3) for each succeeding propeller.

(5) When all propellers have been checked, place the prop and engine anti-icing master switch to RESET and note that the ice light is extinguished and there is no load on any of the anti-icing ammeters.

(6) Place all ice control switches to OFF.

CAUTION

- If the blade deicing ammeter falls below 65 amperes, do not fly into icing conditions.
- Never operate propeller anti-icing and deicing for more than two cycles while the aircraft is on the ground.

6. Fuel system/Fuel boost pump switches	Checked/as desired	FE

Note

The above step is necessary only if not accomplished during the preflight checks.

CROSSWIND TAXIING.

The aircraft can be taxied in a 30-knot, 90-degree crosswind by use of nosewheel steering and rudder control only. Taxiing can be accomplished in crosswinds up to 60 knots at 90 degrees by use of nosewheel steering, rudder and aileron control, differential braking, and differential power. Turns to a crosswind heading should be performed with great caution and at slow speeds to prevent centrifugal force from aiding the wind in tipping the aircraft.

BACKING THE AIRCRAFT.

Normally the aircraft will not be backed using reverse thrust and will not be intentionally parked in a location that would require a backing operation. When backing is necessary, the following procedures will be adhered to during backing.

1. Ensure that the maneuvering area is free of all debris which could cause damage to the propellers or injury to ground personnel.

2. Brief the taxi signalmen to ensure understanding of path and distance to be traversed and the maneuvering and stopping capability of the aircraft.

3. Position wing walkers forward of each wing tip with the ground controller acting as taxi director by providing the appropriate hand signals to the pilot. The crew entrance door should be raised.

4. Position a tail walker on the port side abeam the stabilizer clear of slipstream. He shall be in view of the taxi signalman and observe the movement of the tail, ensuring clearance of any obstacles.

5. Reverse all propellers simultaneously.

6. Use forward thrust to stop the backward movement of the aircraft. Avoid use of brakes while the aircraft is backing due to the possibility of damaging external structure.

7. Do not back the aircraft when engine oil temperature is at or above 100°C.

8. After backing, taxi the aircraft forward approximately 5 feet to realign the main landing gear.

ENGINE RUNUP CHECKLIST.

Engine runup will not be required on subsequent flights of the day by the same flight crew. Select an area which is free of foreign objects. Head the aircraft into the wind. (See figure 1-138 for danger areas.)

CAUTION

- Do not run up all four engines to maximum power simultaneously. The thrust available may be sufficient to skid locked wheels and chocks. Do not run up two engines on one side simultaneously. The thrust available is sufficient to skid the nose wheel sideways. Simultaneous full reverse power on all engines may lift the nose wheel off the ground.
- When operating the aircraft on either snow-covered surfaces at temperatures near freezing or on slippery surfaces, deviations must be made for engine and propeller check procedure. Check the engines in symmetrical pairs when necessary. Use reverse thrust on the remaining pair of engines to prevent the aircraft from sliding forward. Brakes alone will not prevent the aircraft from moving forward if each of the four engines is producing more than approximately 8,000 inch-pounds of torque. Avoid parking aircraft close together during ground tests. When runup must be conducted on slippery surfaces, do not attempt to make full power checks until the aircraft is lined up on the runway, ready for take-off.

Note

To achieve a satisfactory propeller governing check, the aircraft should be headed into the wind within 10 degrees of the wind direction when the wind velocity is in excess of 10 knots.

1. Nose wheel and parking brake	Centered/Set	P
2. Flaps 50 percent	Set	CP
3. Engine runup	Complete	FE
a. Ground idle rpm within limits	Checked	
b. Advance the throttles to FLIGHT IDLE and note the torque.	Checked	
c. Advance the throttles and observe the TIT change as electronic fuel controlling is reached (as indicated by the electronic fuel correction lights going out). The TIT at this point should be 800° C to 840° C. If no change in TIT is observed, perform temperature controlling check below, to ensure that the temperature datum system is operating.	Checked	

(1) Temperature controlling check

(a) Set symmetrical throttles for approximately 910°C TIT, and take bleed air from the engine by operating the wing and empennage anti-icing system.

CAUTION

Do not operate the wing and empennage anti-icing on the ground for more than 30 seconds.

(b) The TIT should rise slightly and then return to the previous setting. If the TIT does not return to the previous setting the electronic temperature controlling system has malfunctioned, and the engine should be operated in NULL.

CAUTION

When operating with the TD valve switch in NULL, move the throttle slowly to prevent an overtemperature condition.

(c) Turn the wing and empennage anti-icing OFF.

i. With throttles set at 8,000 to 9,000 inch-pounds of torque, check propeller rpm within limits in normal and mechanical governing. If re-indexing is required to bring rpm within limits, proceed with the following re-indexing procedure.

Note

Runup area wind conditions may cause excessive rpm fluctuations.

(1) Place all propeller governor control switches to mechanical governing.

(2) Select a master engine.

(3) Hold the prop resynchrophase switch in the RESYNC position.

(4) Place all slave propeller governor control switches to NORMAL and wait 15 to 30 seconds.

(5) Switch to the other master engine while still holding the propeller resynchrophase switch

(6) Place the propeller governor control switch of the first master to NORMAL GOVERNING and wait 15 to 30 seconds.

(7) Place the sync master switch to OFF.

(8) Release propeller resynchrophase switch

e. Check all engine instruments within limits. — Checked

f. Retard all throttles to FLIGHT IDLE. — Checked

Note

Flight idle rpm should be checked by retarding the throttles to FLIGHT IDLE from the governing range so the propellers are on the low-pitch mechanical stops.

g. Check flight idle torque. — Checked

WARNING

Torque should be at least 200 inch-pounds higher per engine than those values observed in step 3.b. If not, a low pitch stop malfunction exists. Maintenance action shall be completed prior to flight.

h. Retard Throttles to Ground Idle — Checked

WARNING

If a positive decrease in torque is not indicated when throttles are moved to ground idle, shut down the engine with the condition lever. Do not attempt to force the propeller out of flight idle with additional throttle movement. Maintenance action shall be completed prior to flight.

Note

During prolonged ground operation, if oil temperature approaches the maximum limit, the throttle should be advanced toward FLIGHT IDLE to increase air flow through the oil coolers.

TAKE-OFF CHECKLIST.

Only circled items need to be checked at Operational Stops.

(1) All exits	Secure	P, CP, FE, RO/O
a. Windows	Closed (P, CP)	

b. Aircraft doors	Closed/pins removed (FE, RO/O)	
c. COMM Central doors	Open/secure (RO/O)	
d. Hatches	Secured, pins removed (FE, RO/O)	
e. Galley floor	UP (FE)	
(2) Pressurization	Set	FE
a. Air conditioning master switch	AIR COND AUTO PRESS	

NOTE
Set the cabin altitude on the controller to the desired altitude, but never less than field elevation.

(3) Trim tabs	Set	P
a. Tab indicators	Checked	
b. Elevator tab power switch	NORMAL	
4. Autopilot	OFF	P
NEW (5) Flaps 50 percent	Set/checked	CP, P, RO/O
a. Check porition indicator (P, CP)		
b. Visually check flaps for symmetrical positioning (RO/O)		

6. Flight controls	Checked	P

Note

Restrain the control column when checking elevator movement to prevent the bobweight from slamming the controls against the stops.

(7) Hydraulic pressures and quantities	Pressures checked Quantities checked	CP RO/O
(8) Crew briefing (Refer to Section IX and XI)	Completed No questions	P CP, FE, N

a. State appropriate takeoff and landing data (P).

b. State emergency intentions and actions (P).

c. State departure procedures, radios (Communication & Navigation) instruments and cruise altitude (P).

d State normal procedures or variations (P).

e. Questions (CP, FE, N)

(9) Ground idle	NORMAL	FE
(10) Electrical control panel	Set	FE
a. ATM generator and ATM	OFF/STOP	
b. Engine generators	Checked	
c. AC instrument and engine fuel control switch	ESSENTIAL AC BUS	

d. Bus tie switch	NORMAL	
11. Fuel control panel	Set	FE
a. Crossfeed valves	CLOSED	
b. Main tank boost pumps	ON	
(12) Warning lights	Checked/as required	FE
(13) Safety belt/shoulder harness/ aircraft interior	Set	P, CP, FE N, ACS ("Lights set") RO/O ("Lights set")
(14) Instruments/Altimeters	Checked/set State setting	P, CP, FE, N
(15) Exterior lights	Set	CP,FE
a. Landing, Taxi	As required (CP)	
b. Navigation	As required (FE)	
16. Hot mike	Set	P, CP, FE, N, ACS

Note

The pilot, copilot, and flight engineer will set the control panels to LISTEN ON/TALK ON, all others will be set to LISTEN ON.

(17) Anti-icing control panel	Set	FE

CAUTION

Operation of the Nesa anti-icing when outside air temperature is above 27° C (81° F) will increase the possibility of delamination within the Nesa panels.

Note

Nesa should be operating for take-off to reduce the possibility of thermal shock.

a. Nesa windshield switches	NORMAL	
b. Pitot heat switches	ON	
c. Prop & eng anti-icing switches	ON/AUTO	
d. Wing & empennage anti-icing switches	OFF	
(18) IFF, radar, and radios	As required	CP, N
19. VLF power amplifier coupler	OFF	ACS
20. Anti-skid test (EC-130Q aircraft only)	Completed	FE

WARNING

After test switch is actuated to either forward or aft position, wait at least three seconds before selecting test switch to opposite set of wheels. A more rapid actuation of test switch could result in loss of brakes momentarily with normal brake system selected. Also faster actuation of test switch will result in erroneous test light indications.

CAUTION

Do not attempt to test the anti-skid system while aircraft is being taxied.

a. With anti-skid inoperative light out, fully depress and hold brake pedals.

b. Check that all four anti-skid test lights are out.

c. Place test switch in the FWD position and release. The two FWD lights should illuminate and then go out. A slight bump should be felt in the brake pedals, which indicates anti-skid control valves are functioning.

d. Place test switch in AFT position and release. The two AFT lights should illuminate momentarily and then go out. A slight bump should be felt in the brake pedals.

e. Check to ensure that the test switch is in the OFF position.

TAKE-OFF

The following paragraphs discuss normal, maximum effort and obstacle clearance, and crosswind take-offs. Use the performance charts as necessary to predict aircraft performance for any take-off. Refer to Section I for aircraft limitations. Refer to Section V for procedures to be followed during take-off emergencies. See figure 3-4 for take-off and initial climb pattern.

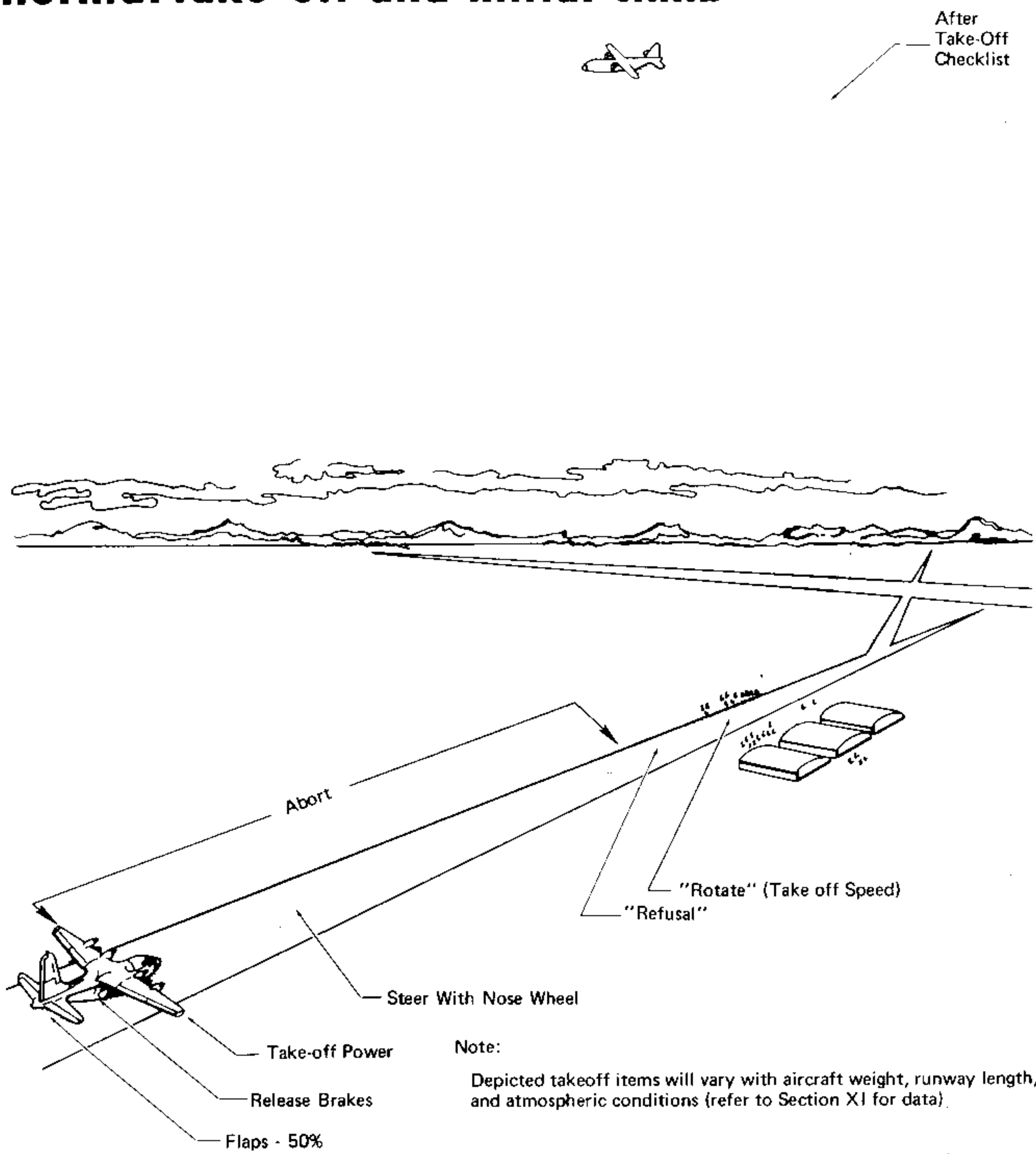
Note

When take-off performance is critical, cabin pressurization and air conditioning bleed should be turned off prior to take-off to utilize maximum power available.

NORMAL TAKE-OFF

The throttles are gradually advanced toward take-off power. The copilot will monitor the engine instruments and adjust throttles to prevent maximum allowable power from being exceeded during take-off. Normal take-off is made with 50 percent flaps. Any time maximum performance is desired, maximum power should be applied before the brakes are released as all take-off performance data is based on this type take-off.

normal take-off and initial climb



Note:

Depicted takeoff items will vary with aircraft weight, runway length, and atmospheric conditions (refer to Section XI for data).

N 1/76

Figure 3-4.

CAUTION

Under low ambient temperature conditions, the throttles must not be placed in the TAKE-OFF position without monitoring the torque meters because it is possible to exceed the maximum allowable torque before reaching the TIT specified in Section I. In addition, increasing ram effect during take-off will increase torque for any fixed TIT. This means that torque must either be set below maximum allowable when setting power for take-off or must be reduced as airspeed builds up.

During the take-off, the Pilot will set take-off power and maintain directional control with the nose wheel steering until rudder controls become effective (50-60 KIAS). Concurrently, the copilot shall hold the control column forward, keeping the wings level with the ailerons and monitor throttle positions. As speed increases, the pilot maintains control of the aircraft by coordinated use of the flight controls, according to the circumstances of speed, crosswinds, and runway conditions. The copilot will announce "REFUSAL" (at refusal speed) and "ROTATE" at take-off speed. If refusal speed is greater than computed rotation speed, only "ROTATE" will be announced. The word "ABORT" will be used to abort a take-off any time prior to refusal speed. This will be spoken over the interphone system by (and limited to) the pilot, copilot, and flight engineer detecting a discrepancy that would affect a safe flight.

Note

- If the aircraft is loaded to an aft center of gravity, forward pressure on the control column will aid in steering effectiveness.
- Nose wheel steering is required in addition to aerodynamic controls when take-off is continued after an engine failure and prior to reaching minimum control speed.
- If the runway or runway environment requires maximum effort performance, all engines bleed air should be shut off.

MAXIMUM EFFORT TAKE-OFF AND OBSTACLE CLEARANCE.

A maximum effort take-off is made by holding the brakes on until engines are stabilized at take-off power. For a maximum effort take-off, accelerate on the runway to take-off speed, and pull the nose up until the aircraft leaves the ground. Take-off speed will be such that minimum control speed is disregarded. Retract the landing gear and adjust the attitude of the aircraft to attain obstacle clearance speed. After clearing the obstacle, slowly retract the flaps while maintaining altitude and accelerate to best climb speed. Refer to Section XI for maximum effort take-off data.

CROSSWIND TAKE-OFF.

Crosswind take-offs, with regard to directional control of the aircraft, are made essentially the same as normal take-offs. Initially, the pilot maintains directional control with nose wheel steering and differential power while the copilot maintains a wing-level attitude with the ailerons. In higher crosswinds, a greater amount of differential power and ailerons must be applied. After lift-off the line of flight should be aligned with the runway until crossing the airfield boundary. Refer to Section XI for crosswind performance data.

AFTER TAKE-OFF CHECKLIST

As soon as airborne (and at the command of the pilot), retract the landing gear. When a safe altitude is reached and at no less than 20 KIAS above take-off speed, retract the flaps.

Note

Retracting the landing gear and flaps simultaneously will result in slower than normal operation of both and may cause the hydraulic low-pressure warning light to illuminate.

When airborne, accelerate to the desired climb speed as determined from the performance data or use the following table to prevent excessive nose-high attitudes:

180 KIAS to 10,000 feet
170 KIAS to 15,000 feet
160 KIAS to 25,000 feet
Performance charts above 25,000 feet

1.	Landing gear	UP	CP
2.	Flaps	UP/rudder pressures checked	CP
3.	Aux hydraulic pump	OFF	CP
4.	Hot mike	OFF	P, CP, FE
5.	Landing lights panel	SET	CP
	a. Landing light switches	OFF	
	b. Landing light motor switches	RETRACT/HOLD	
	c. Taxi lights	OFF	
6.	Synchrophase master switch	ENG 2/ENG 3	FE

Note

Use of the prop resynchrophase switch should be limited to correct for an out of synch condition. Allow at least one minute between actuations of the switch to allow synchrophaser signals to stabilize.

7. Pressurization	Checked	FE
8. Wings and aircraft interior	Checked	RO/O

a. The reel operator/observer shall check the wings and engines for fuel, oil, and hydraulic leaks, and flap position.

b. The aircraft interior shall be checked for fumes, smoke, hydraulic reservoir quantities, landing gear position, and loose gear.

9. Leading edge anti-icing	As required	P, FE

Note

- The wing and empennage check shall be coordinated with the pilot, and only after positive terrain clearance is assured.
- Leading edge anti-icing shall be checked on the first flight of the day. Turn the wing and empennage anti-icing on until a temperature rise is noted on the indicators. This will eliminate any moisture in the system.

10. Seat belts/smoking	As required	P

a. The pilot may clear the crew from ditching stations and light the smoking lamp if the aircraft is clear of fumes.

11. Galley floor	As required	FE
12. HF-1 28VDC circuit breaker	As required	FE
13. Pilot's PA switch	Interphone	P

CRUISE.

Refer to FUEL MANAGEMENT, in this section, for fuel management procedures. See Section XI, performance data, for cruise power settings.

CAUTION

Do not place the engine condition levers in the GROUND STOP position during flight.

Note

- Above FL 270 one pilot will have his oxygen/smoke mask readily available and the supply lever on.
- If offspeed or fluctuating condition occurs and resynch operation does not correct the condition, refer to PROPELLER MALFUNCTIONS, in Section V. Turbulent flight conditions may cause excessive rpm fluctuations.

FLIGHT CHARACTERISTICS.

Refer to Section IV for detailed information on the aircraft flight characteristics.

DESCENT.

WARNING

With the Nesa windshied anti-icing inoperative, do not exceed 187 KIAS below 10,000 feet (windshield penetration strength).

PENETRATION DESCENT.

Descents from high altitude to the initial pentration altitude of 20,000 feet shall be limited to speeds shown on the Maximum Flight Speed chart in Part 4, Section I. A penetration descent is made from 20,000 feet at a maximum of 250 KIAS, with throttles at FLIGHT IDLE, gear and flaps up, and both drogues retracted.

RAPID DESCENT.

Gear and Flaps Up.

The highest rates of descent are obtained by retarding all throttles to FLIGHT IDLE with gear and flaps retracted and descending at maximum speeds, as shown in the performance data and tabulated on the performance chart. Refer to the Rapid Descent at Dive Speed chart in the performance data.

Gear and Flaps Down.

At slow airspeeds, the highest rates of descent are obtained by retarding all throttles to FLIGHT IDLE, decreasing airspeed to flap limit speed (145 knots), and extending landing gear and full flaps. Descend at 145 knots. Refer to the Rapid Descent with Full Flaps chart in the performance data.

CAUTION

Actuation of the landing gear under full cabin pressure differential conditions is not recommended.

APPROACH CHECKLIST.

This check will be accomplished prior to traffic pattern entry and/or before commencing any type or instrument approach or penetration descent.

Note

Flight idle engine torque in descent and approach may go negative and cause an NTS signal on one or more engines. The use of wing and empennage anti-icing will further decrease flight idle torque. This will cause an rpm and power fluctuation, resulting in a yawing condition on the aircraft. To correct this condition, move the throttle(s) forward to bring engine torque out of the NTS range.

1. Pilot's PA switch	Interphone & PA	P
2. Crew briefing	Complete No Questions	P CP, FE, N

a. Landing data (P, CP)

b. Field elevation and description (P)

c. Approach and landing procedure (P)

d. Questions (CP, FE, N)

3. Pressurization	Set	FE

Note

On descent prior to landing, the pilot will advise the flight engineer of the landing field elevation. Cabin pressure should be zero for landing.

4. Fuel control panel	As required	FE
5. Temp datum control valve switches	As required	FE

Note

A landing is normally made with the temp datum control valve switches in the AUTO position. When the LOCKED position is used, it is recommended that the switches be placed in LOCKED with the engines operating in the temperature controlling range and at an aircraft altitude within 5,000 feet of field elevation.

6. Galleys	Set	FE, RO/O
a. Floor	UP (FE)	
b. Switches	OFF (FE, RO/O)	
c. COMM central doors	Open/secure (RO/O)	
7. Safety belt, shoulder harness and aircraft interior	Set/Ready for landing	P, CP, FE, N ACS, ("Lights set") RO/O ("Lights set")
8. Doppler	STBY	N
9. Altimeters (pressure and radar)	Set — (State setting)	P, CP, N

NEW

10. VLF Power Amplifier Coupler	OFF	ACS
11. Smoking Lamp	Out	P

LANDING CHECKLIST.

The pilot may lower the flaps and gear before calling for the Before Landing Checklist.

1. Flaps	Set/checked	CP, P
2. Landing gear	DOWN/checked/ centered	P, CP

Note

The landing gear position indicators are the primary system to indicate the position of the gear. The warning horn and light are backup systems.

3. Landing light panel	As required	CP
4. Hydraulic pressures/brake select switch/aux hydraulic pump	Checked/ON	CP

WARNING

The auxiliary hydraulic pump must be turned on if any malfunction in the utility system is noted. The brake select switch must be placed in the EMERGENCY position in the event of utility system failure.

5. Anti-skid test (EC-130Q aircraft only)	Completed	FE

a. Check that all four anti-skid test lights illuminate.

b. Hold test switch in FWD position. All four lights should go out.

c. Release test switch to OFF position. The two FWD lights should illuminate momentarily. After 2 to 3 seconds, all four lights should illuminate and remain illuminated.

d. Hold test switch in AFT position. All four lights should go out.

e. Release test switch to OFF position. The two AFT lights should illuminate momentarily. After 2 or 3 seconds, all four lights should illuminate and remain illuminated.

6. Synchrophase master switch	OFF	FE
7. Hot mike	SET	P, CP, FE, N, ACS, RO

a. The pilot, copilot, and flight engineer will set the control panels to LISTEN ON/TALK ON; all others will be set to LISTEN on.

LANDING PROCEDURES.

See figure 3-5 for approach and landing pattern.

NORMAL LANDING.

Normal landing configuration is with 50 or 100 percent flaps. Refer to performance data for landing speeds and distances.

CAUTION

It is possible to scrape the aft bottom of the aircraft when landing with extreme nose-high attitudes.

Every landing should be planned according to runway length available and the general prevailing operating conditions. Normal landings should also be planned so as to use all of the available runway length to promote safe, smooth, and unhurried operating practices; to preclude abrupt reverse power changes; and to save wear and tear on brakes. On final approach, begin to decrease airspeed from approach speed at a point that will allow a gradual slow-up to cross the runway threshold at threshold speed. Touchdown should be planned at the speed computed from the appropriate landing speed chart. (See performance data.) After the main wheels touch down, lower the nose wheel smoothly to the runway before elevator contol is lost. When the main and nose landing gear are firmly on the ground, the copilot must hold forward pressure on the control column and maintain a wing-level attitude with ailerons, as needed. Concurrently, the pilot maintains directional control and decelerates the aircraft through the coordinated use of the rudder, differential power, nose wheel steering, and differential brakes according to the speed, wind, and runway conditions. Reverse thrust is applied by moving the throttles from FLIGHT IDLE into GROUND IDLE and then into REVERSE range in coordination with nose wheel steering. Brakes must be checked during the landing roll.

WARNING

- Reversing propellers at high airspeeds, 115 KIAS or above, could result in one of more engines flaming out.
- Failure to reverse of one or more propellers may result in complete loss of directional control. After touchdown, if the throttles are moved to the reverse range with a movement that is too rapid, it is possible to lose control of the airplane before a propeller malfunction can be detected. The movement from the flight range to the reverse range should be made at a reasonable rate that will permit detection of a malfunction, such as failure of the low pitch stop to retract. At the first indication of directional control difficulties during reversing, immediately return all throttles to ground idle. Maintain directional control with flight controls, differential braking, and nose wheel steering as required. After identifying the affected propeller, symmetrical propellers may be reversed and the affected engine shut down while it is in ground idle. Rudder, differential power, and brakes are the primary means of direction control. During the final stage of landing roll, reduce reverse thrust, if conditions permit, to prevent debris from causing restriction to visibility or engine damage.

Gust Correction.

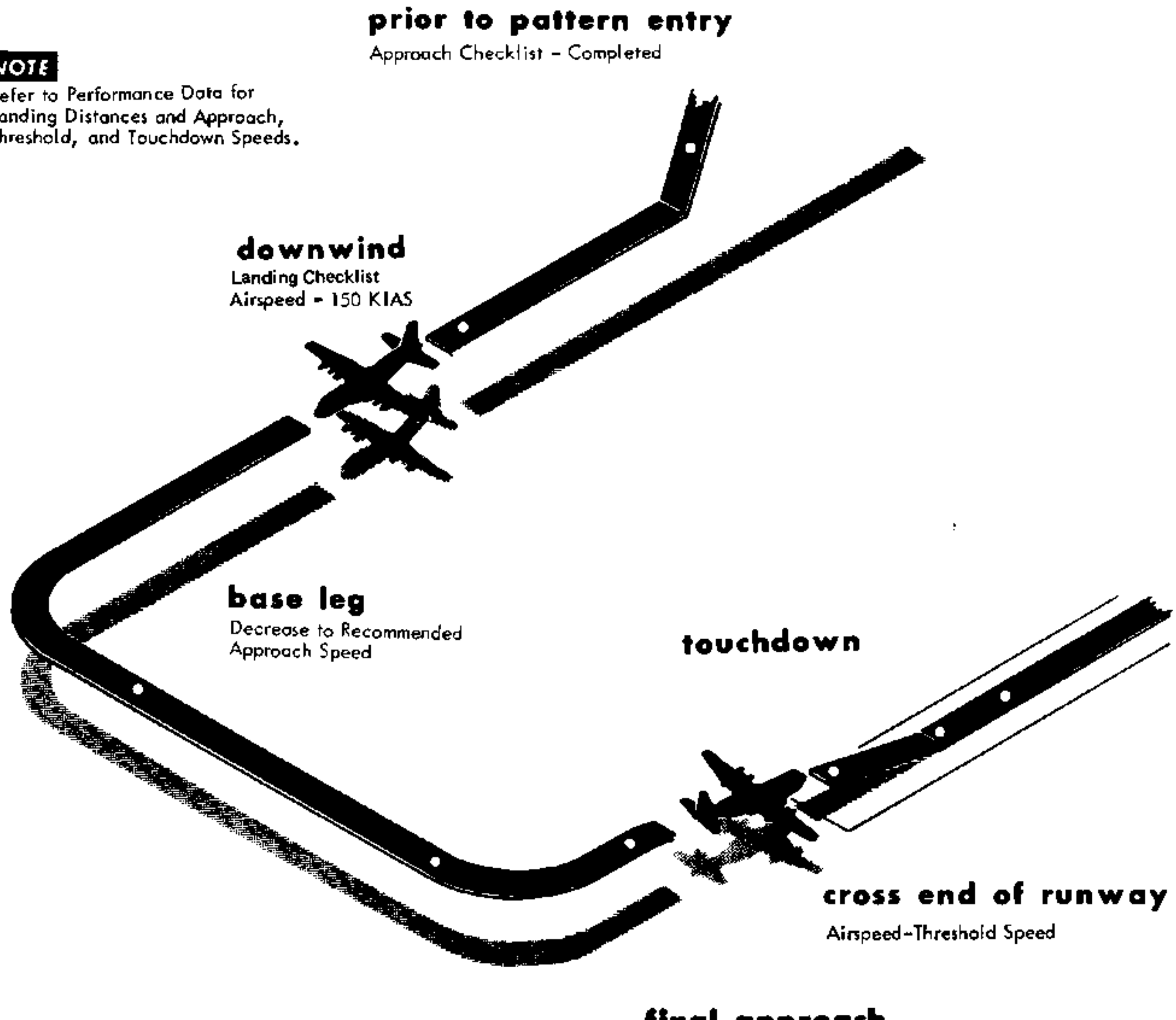
When gusty winds exist, a correction factor should be added to threshold and landing speeds to compensate for maneuver loads which the pilot may impose on the aircraft while correcting for gusts. The gust correction factor is determined by taking the reported gust velocity (the amount the wind is gusting over the constant wind). For example, if the wind is reported at 30 knots with gusts to 42 knots, the gust velocity would be 12 knots. A maximum of 10 is the gust correction in knots that should be added to threshold and landing speeds. Gust correction is introducted only on the final approach and is not applied throughout the landing pattern. If stopping distance available beyond the maximum estimated touchdown point is marginal, the pilot should select a longer runway or proceed to an alternate airport.

CAUTION

Propeller reversing with an unbalanced fuel load can cause an extreme wing-low attitude and undesirable control characteristics.

approach and landing - normal

NOTE
Refer to Performance Data for Landing Distances and Approach, Threshold, and Touchdown Speeds.



NOTE
Traffic Pattern Airspeed After the **Landing Checklist is Initiated** will be 150 KIAS Slowing to Initial Approach Speed on Final Approach

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Figure 3-5.

CROSSWIND LANDING.

To check the maximum allowable crosswind components for landing, refer to the performance data. Use normal final approach speeds if the wind is steady. When winds are gusty, a slight increase in approach airspeed is recommended. (At the lighter gross weights it is advisable to use less than 100 percent flaps in order to touch down main gear first at these touchdown speeds which are higher than normally recommended.) Immediately after the main wheels touch down, force down the nose wheels and hold in firm contact by using the elevators. During landing roll, control the aircraft directionally by using the following methods, listed in order of preference: aileron and rudder control, nose wheel steering, differential braking, and differential power. The upwind wing has a tendency to rise when reverse thrust is applied. Since this tendency is especially pronounced if flaps are extended, flaps should be raised before applying reverse power on landing in severe crosswinds.

CAUTION

An engine-out condition may add difficulty to a crosswind approach and landing by adding to the drift and weather-vaning.

LANDING ON WET RUNWAYS.

The anti-skid braking system, reverse thrust, and nose wheel steering capabilities minimize normal hazards associated with wet runways.

LANDING ON ICY RUNWAYS.

Operation of the aircraft on ice is hazardous and should be attempted only when the mission is of the nature that such operation is necessary. Caution must be exercised when landing or taxiing on ice. Use of nose wheel steering should be minimized and used with caution. Taxi speed must be slow and taxi turns should be planned for large radius turns. Directional control can be maintained with asymmetrical power and nose wheel steering at taxi speeds and with asymmetrical power and rudder at speeds above rudder effectiveness. Touchdown should be made from a power approach at the minimum safe speed possible. Hold the nose wheel "off" as long as possible to obtain maximum aerodynamic drag. Braking after lowering the nose wheel must be made with caution. Use symmetrical power and reverse thrust as the primary means to obtain braking action and to prevent sudden yawing and skidding. It is also very difficult for the pilot to sense that the wheels are skidding. Landing on ice-covered runways should not be attempted if existing crosswinds will require large crosswind approach or taxiing correction applications.

TOUCH AND GO LANDING CHECKLIST.

Touch and go landings require a significant element of caution because of the many actions that must be executed while rolling on the runway at high speed or while flying within the immediate proximity of the ground. Normal touch and go landings are permitted, however, while practicing emergencies, touch and go landings shall be made only when authorized or directed by the reporting custodian in accordance with a syllabus approved by appropriate authority. When touch and go landings are performed under simulated emergency conditions, a designated instructor pilot shall occupy one of the pilot's seats. The actions required during touch and go landings are divided into three categories: on the runway, after take-off, and before landing. This procedure and checklist is designed for use when touch and go landings are being accomplished and the aircraft remains in the traffic pattern area. Before the first touch and go, all normal checklists should be completed through the Landing Checklist. After the first touch and go, this checklist may be used until the aircraft either departs the traffic pattern or makes a full stop landing. Once the aircraft is on the runway the pilot will call for flaps 50 percent and the copilot will place the flap lever to the 50 percent position, re-set the trim tabs, and check the flap indicator for a 50 percent indication. The pilot will then advance the power and continue with a normal take-off.

On the Runway:

1. Flaps	50 percent/checked	CP
2. Trim tabs	Set for take-off	CP
3. Throttles	As required	P

After Take-Off:

4. Landing gear and flaps	As required	CP
5. Landing lights	As required	CP

Before Landing:

6. Flaps	As required	CP
7. Landing gear	DOWN/checked/ centered	P, CP
8. Hydraulic pressures/aux hydraulic pump	Checked/OFF	CP

Note

Recharge the emergency brake system by turning the auxiliary hydraulic pump on until emergency brake pressure is within limits.

9. Fuel panel	Checked	FE

GO-AROUND.

In the event of a go-round or missed approach, the pilot will immediately notify the crew and proceed as follows:

1. Advance throttles to MAX power.
2. Direct copilot to set flaps to 50%.
3. Ensure a positive rate of climb (indicated on VSI).

4. Raise gear.
5. Proceed as a normal take-off.

AFTER LANDING CHECKLIST (AFTER COMPLETION OF LANDING ROLL).

Flight engineer items not requiring coordinated action may be accomplished by the flight engineer after the pilot has called for the After Landing checklist. This does not preclude response to the checklist when called by the copilot.

Only circled items need to be checked at Operational Stops.

Note

All crew members shall remain seated (except these required to move about the aircraft) because of the possibility of abrupt braking.

(1) Flaps	UP	CP
(2) Radar altimeter, unnecessary equipment, and IFF.	OFF	P, CP, N

Note

- Turn IFF off as soon as possible after landing. This will eliminate signals from taxiing or parked aircraft which would otherwise block the controller's scope and interfere with the control of airborne aircraft.
- Classified IFF codes must be removed, or properly protected.

(3) Pressurization	No pressure	FE
(4) Electrical panel	Set	FE
a. ATM and generator	ON/checked	
b. Bus tie switch	TIED	

(5) Ground idle	As required	P, FE
(6) Exterior lights	Set	CP, FE
a. Landing	As required (CP)	
b. Taxi	As required (CP)	
c. Navigation	As required (FE)	
d. Deleted.		
(7) Anti-icing control panels	Set	FE,N
a. Nesa windshield switches	OFF (FE)	
b. Pitot heat switches	OFF (FE)	
c. Prop and eng anti-icing and de-icing switches	OFF (FE)	
d. Wing and empennage anti-icing switches	OFF (FE)	
e. Radome anti-icing switch	OFF (N)	
8. Fuel control panel	Set	FE
a. No. 2 crossfeed valve switch	OPEN	
9. GTC panel	Set	FE
a. GTC door switch	OPEN	
b. GTC control switch	START/RUN	
c. Bleed air valve switch	OPEN/pressure up	

ENGINE SHUTDOWN CHECKLIST.

Normally all four engines will remain running until the aircraft is parked.

CAUTION

During ground stop procedure, do not move the engine condition lever from STOP to RUN while the engine is still rotating

1. Comm Central	Secured	ACS
2. Radar/Doppler/INS	OFF	N
3. Nose wheel and parking brake	Centered/set	P
4. Shutdown and NTS check all engines	Complete	CP, FE

Note

If NTS lights do not illuminate when shutting down engines from low-speed ground idle, a recheck of the NTS must be made before the next flight.

a. Place feather valve and NTS check switch in NTS position (CP).

b. Place throttles in GROUND IDLE (P).

c. Place condition levers in GROUND STOP and observe zero fuel flows (CP, FE).

d. Observe the NTS lights, then return the feather valve and NTS check switch to NORMAL (CP).

e. Check for drip on all engines, and state if any engine fails to drip (RO/O).

Note

On engine shutdown, if the drip valves are working normally, some fuel will be seen draining from the engine drain mast. In the event of "no drip", the pilot will wait until the propeller has ceased rotation, and motor the engine to 25 percent rpm with the condition lever in GROUND STOP.

5. Fuel Boost Pump Switches	OFF	FE
6. Air conditioning control panel	Set	FE
a. Master switch	OFF	
7. Engine bleed air switches	CLOSE/OFF	FE
8. Engine generator switches	OFF	FE
9. Inverter switches	OFF	FE
10. Oil cooler flap switches	FIXED	CP
11. Temp datum control valve switches	NULL	FE
12. Oxygen regulators	NORMAL/100%/ OFF	P, CP, FE N, ACS, RO/O
13. Exit clearance	Props stopped/insert chocks	P

Note

Crewmembers may open the aircraft doors at this time. Direct ground control to insert wheel chocks. No response will be required at this time.

14. Anti-collision lights	OFF	FE
15. Hydraulic control panel	Set	CP

CAUTION

The engine pump switches are to be left in the ON position after engine shutdown. If the switch is left in the OFF position, pressure buildup due to the thermal expansion of the hydraulic fluid may cause the hydraulic suction line firewall shutoff valve to fail.

a. Suction boost pump switches	OFF	
b. Auxiliary hydraulic pump switch	OFF	
16. Wheel chocks	In place	GC

Note

Chock main wheels only.

17. Parking brake	Released	P
18. PA system	OFF	N
19. HF-1 28 VDC circuit breaker	Pulled	FE
20. Hot mike	OFF	P, CP, FE

AIRCRAFT SECURE CHECKLIST.

Make appropriate entries in the aircraft records covering any limits in the Flight Manual that have been exceeded during flight. Entries must also be made when, in the judgement of the pilot, the aircraft has been exposed to unusual or excessive operations such as hard landings or excessive braking action during aborted take-offs. The flight engineer will complete the following items as required.

CAUTION

Never install rig pins in the control system nor secure the flight deck controls as a means of locking the surfaces against wind gust. Otherwise, damage to the hydraulic booster and/or cable system is likely to result.

Note

The Flight Engineer will complete a brief general condition interior and exterior visual inspection prior to leaving the aircraft.

1. Lights	Set
a. Exterior	OFF
b. Interior	As required
c. Landing	RETRACT/HOLD/OFF
2. ATM generator and ATM	OFF/STOP
3. GTC control panel	Set
a. Bleed air valve switch	CLOSED
b. GTC control switch	OFF
c. GTC door switch	CLOSED
4. Radios	OFF
5. Bus tie switch	NORMAL
6. DC power switch and dc voltmeter switch	OFF/MAIN DC BUS
7. Emer exit light extinguish switch	Pressed

8. Nose lock and ground wire	Installed	

CRUISE ENGINE SHUTDOWN CHECKLIST.

This procedure is to be used only if authorized by Command Directive. Engine shutdown may be performed during cruise flight to achieve optimum fuel economy in order to meet mission requirements. Refer to performance data for charts containing range information.

1. Notify crew		P
2. Synchrophase master switch	As required	FE
3. NTS check	Complete	P, CP, FE
a. Feather valve and NTS check switch	VALVE (CP)	
b. Propeller governing	MECH GOV (CP)	
c. Throttle	4,000 inch-pounds torque or more (P)	
d. Empennage anti-ice	ON (FE)	
e. Engine bleed air switch (engine being checked)	OPEN/OVRD (FE)	
f. Bleed air switches (other engines)	CLOSE/OFF (one at a time) (FE)	
g. Slowly retard throttle observing decrease in torque value	Observed (CP, FE)	

Note

As torque decreases, read highest negative value. NTS should occur at -1260 (±600) inch-pounds. NTS action is indicated by an increase in torque and may fluctuate up to a positive 500 inch-pounds. NTS action should result in intermittent illumination of the valve check light.

h. Advance throttle into positive torque range	ADVANCED (P)	
i. NTS check	CHECKED	
j. Empennage anti-ice	OFF (FE)	
k. All switches and controls to normal operating position.	(CP, FE)	

CAUTION

If NTS action is not observed by -1860 inch-pounds, advance the throttle to normal operation. Record malfunction in aircraft records. Do not shut down an engine with an inoperative NTS unless an emergency exists.

4. Engine condition lever	FEATHER	CP

CAUTION

After shutdown of the first engine, Allow the TIT to decrease to the restart TIT (200° C) prior to shutdown of the second engine.

5. Bleed air switch	CLOSE/OFF	FE

Note

If starter, engine inlet scoop anti-icing, or oil cooler scoop anti-icing are required, place the engine bleed air switch to OPEN/OVRD.

6. Engine generator switch	OFF	FE
7. Fuel boost pump switch	OFF	FE
8. Throttle	One inch forward of FLIGHT IDLE	P

9. Synchrophase master switch — Reset as necessary — FE

NOTE
The above checklist is arranged in such a manner that the inoperative engine controls are set for immediate air starting by moving the condition lever to AIR START. See Section V for AIR START PROCEDURE.

ALERT PROCEDURES AND CHECKLIST.

NEW

When the aircraft is placed on the alert status, the preflight checklist shall be completed. For scramble, accomplish normal procedures starting with cockpit checklist or use the cocking or scramble checklists shown below.

PREFLIGHT.

Refer to the normal expanded checklists in this section, and accomplish the preflight checks, and the COCKPIT checklist except for Item 1 of the COCKPIT checklist.

COCKING.

1. Electrical control panel — Set
   a. Generator switches — OFF
   b. Inverters — OFF
   c. External ac power switch — EXT AC PWR

NOTE
Place the external power switch to OFF if external ac power is not available.

   d. Bus tie switch — TIED

e. DC power switch	BATTERY/EXT DC PWR
2. UHF and VHF radios	ON/as required
a. Hot mike	ON
3. Interior and exterior lights	Set/as required
4. Inverters	ON/checked
5. Hydraulic control panel	Set
a. Brake select switch	EMERGENCY
b. Aux pump switch	ON/pressure up
c. Engine and suction boost pump switches	ON
6. Parking brake	Set
7. Oxygen	Checked/set
8. Flaps and trim tabs	Set for take-off
9. Inverters	OFF
10. AC and dc power switches	OFF
11. External power and ground equipment	As required
12. Emer exit light extinguish switch	Pressed
13. Comm checklist	Checked

NEW

SCRAMBLE.

1. NLG lock, pitot covers, dust excluders, and plugs	Removed and stowed	GC
2. Electrical control panel	Set	FE
a. Generator switches	OFF	
b. Inverter switches	OFF	
c. External ac power switch	EXT AC PWR (if available)	
d. Bus tie switch	TIED	
e. DC power switch	BATTERY	

Note

External dc power may be used if external ac power is not available.

3. Clear GTC	GTC clear/fireguard posted	GC
4. Start GTC	Set	FE
5. ATM and ATM generator	As required	FE
6. Inverters	Set	FE
7. Wheel chocks	Removed	GC
8. Anti-collision lights	ON	FE
9. Clear No. 3 engine	No. 3 clear/ Turning No. 3	GC, P
10. External equipment	Removed/clear	GC

11. Start remaining engines (4, 2, and 1)	Clear/ Turning No. 4, No. 2, No. 1	GC, P
12. GTC panel	Set	FE
a. Bleed air valve	CLOSED	
b. Control switch	OFF	
c. Door switch	CLOSED	
13. Radios, radar, IFF, and hot mike	As desired	P, CP, FE, N, ACS, RO/O
14. Electrical panel	Set	FE
a. ATM generator and ATM	OFF/STOP	
b. Engine generators	Checked	
c. AC instrument and engine fuel control switch	ESSENTIAL AC BUS	
d. Bus tie switch	NORMAL	
15. Crew aboard, doors closed, lights out	Aboard/closed/ checked/light out	GC/FE
16. Start taxi	Rolling	P
17. Brakes	Checked/NORMAL/ anti-skid ON	P, CP
18. Hydraulic pressures and quantities	Checked	CP, RO/O
19. Flight instruments	Checked	P, CP

NEW

Note

Check heading and turn and slip indicators for correct movements. Check airspeed and vertical velocity indicators for proper reading.

a. Flight directors	Set	
20. Fuel control panel	Set for take-off	FE
21. Anti-icing control panel	Set	FE
a. Nesa windshield switches	NORMAL	
b. Pitot heat switches	ON	
c. Prop & eng anti-icing and deicing switches	ON/AUTO	
22. Propeller reversing, engine generators and loads	Checked	P,FE
23. Altimeters	Set ______ (state setting)	P, CP, N
24. Warning lights	Checked/bright	FE
25. Flaps/Flight controls	Checked	P, CP
26. Pressurization	As required	FE
27. Safety belt and shoulder harness	Fastened/unlocked	P, CP, FE, N, ACS, RO/O

AFTER TAKE-OFF.

After take-off, refer to the normal expanded checklist in this section, and start with the AFTER TAKE-OFF checklist.

Note

The following phases of operation have no particular chronological identification, but they will have to be used while the aircraft is on alert status as circumstances dictate.

DAILY PREFLIGHT.

Refer to the normal checklist and accomplish the EXTERIOR INSPECTION.

UNCOCKING.

Return to nonalert status. Refer to the normal expanded checklist in this section, and accomplish the AFTER LANDING and ENGINE SHUTDOWN checklists.

TAXI-BACK.

Return to alert status. Refer to the normal expanded checklist in this section, and accomplish the AFTER LANDING, ENGINE SHUTDOWN, and COCKING checklists.

FUEL MANAGEMENT.

Fuel management is accomplished at the fuel control panel (figure 1-31), which is located overhead within reach of both pilots and the flight engineer. Fuel routing is governed by fuel tank selection and crossfeed valve positioning. Fuel gages on the panel indicate quantities in each tank, and totalizer indicates total fuel remaining. An additional check of fuel quantity may be made by keeping a log based on engine fuel flow and time.

CAUTION

When the aircraft is parked with the fuel tanks more than three-quarters full, all crossfeed valves should be closed. Otherwise, low tanks may be overfilled by slow transfer of fuel through the boost pump check valve bleed orifice from the crossfeed manifold.

Note

Fuel tank gages should be read while aircraft attitude is within ±3 degrees roll and 0 degrees nose-up pitch to obtain most reliable readings. Because fuel tanks are located in the wings, it is important to maintain a balanced weight, within 1,500 pounds, between the left and right wing, except auxiliary tanks may differ so that one auxiliary tank is empty and one auxiliary tank is full provided the main and external tanks are equally distributed. However, the distribution should never vary more than 1,000 pounds between each pair of symmetrical main or external tanks. Outboard tank fuel should be maintained at 500 to 1,000 pounds more than the fuel in the corresponding inboard tank. If fuel weight becomes unbalanced through varied rates of consumption or from having one engine shut down, periodic trimming is required.

FUEL FLOW.

Design of the aircraft allows tank-to-engine or crossfeed fuel flow. Tank-to-engine routing is normally used at all times when fuel is being taken from the main tanks. Crossfeed is used when using fuel from the auxiliary or external tanks, when trimming a tank, or in other special uses. Boost pump operation is recommended at all times to ensure adequate engine supply pressure. Refer to figure 1-29 for the fuel system schematic diagram.

Take-off.

To obtain the correct fuel flow for take-off:

1. All crossfeed valves - CLOSED
2. All main tank boost pumps - ON

Note

This places all engines on tank-to-engine fuel routing.

Climb and Cruise.

Note

- A positive flow check should be made on the external and auxiliary tanks as soon as practical after completion of the AFTER TAKE-OFF checklist. To preclude unnecessary valve operation, the tanks to be used immediately should be checked last.
- As the auxiliary fuel tanks have only one boost pump, it is recommended that auxiliary fuel be used before external fuel on long-range missions. In the event of an auxiliary tank pump failure, this procedure would assure sufficient fuel to return to the point of departure. On short-range missions, it is recommended that fuel be used from the external tanks before the auxiliary tanks, to preclude landing with fuel in the external tanks.

Fuel flow for climb and cruise will be as follows:

1. Crossfeed separation valve - OPEN
2. Left (ext or aux tank) boost pump - ON
3. Left (corresponding) crossfeed valve - OPEN
4. No. 2 main tank crossfeed valve - OPEN

CAUTION

To maintain the inflight airspeed and weight limits shown in Section I, Part 4, use fuel from the auxiliary and external tanks before fuel from the main tanks.

Note

When opening main tank crossfeed valves, observe fluctuation of fuel pressure for indication that the valve has opened. Monitor TIT, torque, and fuel flow for approximately one minute.

5. Left (corresponding) boost pump - OFF
6. Left (ext or aux tank) crossfeed valve - CLOSED
7. Repeat steps 2 and 3 for left tank not checked.
8. No. 1 main tank crossfeed valve - OPEN
9. Crossfeed separation valve - CLOSED
10. Right (ext or aux tank) boost pump - ON
11. Right (corresponding) crossfeed valve - OPEN
12. No. 3 main tank crossfeed valve - OPEN

Note

Monitor TIT, torque, and fuel flow for approximately one minute.

13. Right (corresponding) boost pump - OFF
14. Right (ext or aux) crossfeed valve - CLOSED
15. Repeat steps 10 and 11 for right tank not checked.
16. No. 4 main tank crossfeed valve - OPEN

Note

Because the external or auxiliary tank boost pumps have a higher pressure than the main tank boost pumps, they will supply the engines with fuel until empty.

17. When tanks being used (ext or aux) are empty, turn tank boost pump - OFF
18. Corresponding crossfeed valve - CLOSED
19. Place other (ext or aux) boost pump - ON
20. Corresponding crossfeed valve - OPEN

When the (ext or aux) tank(s) are empty and/or it is desired to return to tank-to-engine operation:

21. Ext or aux tank boost pump(s) - OFF

22. Ext or aux tank crossfeed valve(s) - CLOSED

23. Main tank crossfeed valves for a tank-to-engine operation - CLOSED

CAUTION

When operating with less than 6,000 pounds of fuel in the main fuel tanks, place the crossfeed valve switch to OPEN and the boost pump switch to ON for all tanks containing fuel; place the crossfeed separation valve switch to OPEN. When fuel quantity of any main tank is less than 1,000 pounds, the engine being fed by that tank will be placed on crossfeed operation.

Fuel Tank Trimming.

To take fuel from a heavy tank:

1. Crossfeed valve (heavy tank) - OPEN

2. Crossfeed separation valve - OPEN

3. Crossfeed valve (light main tank or tanks) - OPEN

Note

The crossfeed separation valve must be in OPEN when feeding from tanks in one wing to engines on the other wing.

4. Boost pump (light main tank or tanks) - OFF

When trimming is complete:

5. All boost pumps - ON

6. All crossfeed valves - CLOSED

7. Crossfeed separation valve - CLOSED

Approach and Landing.

The crossfeed valve switches may be left in the OPEN position for approach, landing, and touch and go landing, provided all main tank boost pump switches are in the ON position and the crossfeed separation valve switch is in the CLOSED position.

GAS TURBINE COMPRESSOR FUEL FLOW.

Fuel for operation of the gas turbine compressor may be taken from any tank through the crossfeed manifold (figure 1-29). Selection of the fuel is made at the fuel control panel. To obtain fuel flow for the operation of the gas turbine compressor, proceed as follows:

Note

If fuel for GTC is used from the right side of the aircraft, the crossfeed separation valve must also be opened.

1. Place the No. 2 tank crossfeed valve switch in the open (vertical) position.

2. Momentarily turn the gas turbine compressor control switch to the START position.

NIGHT FLYING.

The aircraft presents no particular problems when night flying. The aircraft lighting system is excellent in the cockpit, fuselage, and exterior. In addition to the following, all procedures recommended for day VFR and IFR flights shall apply to night flying.

1. The landing lights should be used for all take-offs and landings so that they will be on in the event of any directional or control problems on the deck.

2. The aldis lamp should be plugged into the receptacle on the copilot's side panel and be readily available while taxing at night.

3. Do not remove the emergency exit lights stowed by the emergency exits for any use except an emergency. These are a part of the aircraft emergency equipment and should always be readily available.

4. The pilot's and copilot's utility lights, mounted on each side of the overhead panel, are excellent for use in the cockpit, since they are variable red/white,

and intensity. A flashlight shall be readily available in the cockpit for all night flying.

5. During ground operation, turn on the leading edge lights to prevent personnel on the ground from inadvertently walking into a propeller.

Note

Operation of the anti-collision lights when flying in actual instrument conditions is not recommended. The light reflecting on surrounding clouds may cause spatial disorientation.

PART 4

FUNCTIONAL CHECKFLIGHT PROCEDURES

GENERAL

CHECK PILOTS.

The most important factor in obtaining good checkflights on the aircraft is to pick experienced, conscientious check pilots. Commanding officers will designate, in writing, those pilots within their command who are currently eligible to perform this duty.

CHECKFLIGHTS AND FORMS.

Checkflights will be performed when directed by, and in accordance with, OPNAVINST 4790.2 series and the directions of NAVAIRSYSCOM, type commanders or other appropriate authority. Functional checkflight requirements and applicable minimums are described below. Functional checkflight checklists are promulgated separately.

CONDITIONS REQUIRING FUNCTIONAL CHECKFLIGHTS.

Checkflights are required under the following conditions (after the necessary ground check and prior to release of the aircraft for operational use:)

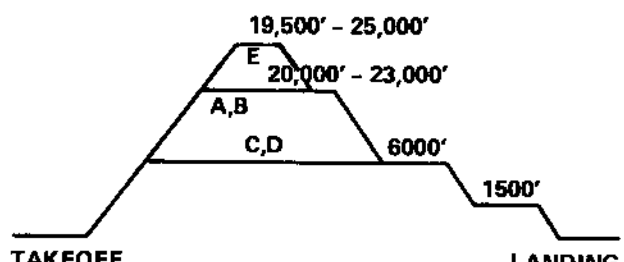
A. At the completion of aircraft rework and all acceptance inspections (all checkflight items required are prefixed A).

B. After the installation or reinstallation of an engine, fuel control, major fuel system components, or any other systems/components which cannot be checked in ground operation (minimum required are prefixed by B).

C. After the installation or reinstallation of a propeller, propeller governor or valve housing (minimum required are prefixed by C).

D. When fixed flight surfaces have been installed or reinstalled or when movable flight surfaces or flight controls have been installed or reinstalled, adjusted or rerigged and improper adjustment or replacement of such components could cause an unsafe operating condition (minimum required are prefixed by D).

E. When maintenance work on components of the communications system AN/USC-13 has been accomplished and a complete functional check cannot be accomplished on the ground (minimum required are prefixed by E).



FLIGHT PROFILE

The profile may be modified to meet specific requirements.

PROCEDURES.

The following items provide a detailed description of the functional checks, sequenced in the order in which they should be performed. In order to complete the required checks in the most efficient and logical order, a flight profile has been established for each checkflight condition and identified by the letter corresponding to the purpose for which the checkflight is being flown; i.e., A through D above. The applicable letter identifying the profile prefixes each check both in the following text and in the Functional Checkflight Checklists. Checkflight personnel will familarize themselves with these requirements prior to the flight. NATOPS procedures will apply during the entire checkflight unless specific deviation is required by the functional check to record data or ensure proper operation within the approved aircraft envelope. A daily inspection is required prior to the checkflight.

PROFILE	
	PRETAKE-OFF
A	1. Brakes.
	a. Check emergency system operation by assuring firm response upon application.
	b. Check normal system with anti-skid switch OFF.
	c. Check normal system with anti-skid switch ON.
	d. Check copilot's brake pedals.
A	2. Flight Instruments.
	a. Check heading and turn and slip indicators for correct movement in a turn. (Check both left and right hand turn.)
	b. Check airspeed and VSI for proper readings.
	c. Check ADI for proper operation.
A B C	3. Nosewheel Steering.
	a. Check nosewheel steering for smooth operation in both directions, no lag in response, ease of motion, and ease of return to center.
	b. An aircraft shall be deemed to require excessive steering control if it fails to track straight with the throttles adjusted as follows:
	(1) Fuel flow-maximum 50/lb./hr differential
	(2) Torque symmetrical
	c. A steering correction while tracking in a straight line which causes a pointer deviation outside the white radius on the steering position indicator is excessive.

PROFILE	
A B C	4. Propeller Reversing.
	Reverse propellers in symmetrical pairs and check rpm and torque differential; if torque differential is greater than 1000 inch-pounds, compensate on subsequent reversing and record discrepancy.
A B C	5. Engine Runup.
	a. Complete engine runup as prescribed in Part 3 of this section.
	b. Ensure that all engine instrument readings are within normal limits.
A D	6. Trim Tabs.
	a. Check trim tabs for freedom of movement and proper travel
	b. Check elevator trim tab in EMERGENCY.
	c. Check copilot's elevator control.
	d. Set trim tabs for take-off.
A D	7. Flight Controls and Boost Shutoff.
	a. Check ailerons, elevator and rudder for freedom of movement with booster system shutoff switches in the OFF position.
	Note
	Restrain the control column when checking elevator movement to prevent the bobweight from slamming the controls against the stops.
	b. Turn utility system shutoff switches to the OFF position and check flight controls for no boost operation.
	c. Turn on booster system switches and re-check flight controls.
	d. Turn on utility system switches and ascertain that all boost shutoff switches are in the ON position.
	TAKE-OFF CLIMB (Profile A and B 20,000 feet – 23,000 feet, or Profile E 19,000 feet – 25,500 feet, when TACAMO Reel Operation Is to be Checked; Profile C and D 6000 feet).
A B C	8. NTS Check.
	a. Perform NTS check on all engines in accordance with Section III.

PROFILE

A

9. Pressurization/Rate-of-Climb.

   a. Set cabin rate-of-climb to MIN, check climb rate 30-200 fpm.

   b. Set cabin rate-of-climb to MAX, check climb rate 1600-2900 fpm.

   c. Set rate-of-climb knob at a mid position and check rate between MIN and MAX limits.

A B C

10. Throttle Alignment.

   a. Adjust each throttle to obtain 1010°C TIT.

   b. Check throttle alignment with one-half knob width.

A

11. Flight Instruments.

   a. Check pilot's and copilot's ADI and HSI for smooth operation and accuracy, one against the other.

   b. In a standard rate turn, check turn needles for 30° turn in 10 (± 1) seconds.

   c. Check airspeed indicators for a maximum differential of 6 knots.

   d. Check pilot's, copilot's and navigator's altimeters against each other to be within 230 feet at 10,000 feet and 340 feet at 20,000 feet.

   e. Establish a constant rate-of-climb. Time altimeter for one minute to determine actual rate of climb. Both VSI's must agree within 100 fpm.

   f. Compare copilot's and navigator's OAT indicators for a maximum difference of 4°C.

LEVEL

A

12. Air Conditioning.

   a. Select AIR COND MANUAL PRESS and ensure positive control of the outflow valve by increasing and decreasing pressure.

   b. Hold manual pressure switch in the increase position. The safety valve should regulate cabin pressure to 15.9 (± .5) in Hg. Note the pressure.

WARNING

DO NOT exceed a maximum of 16.4 in. Hg. differential pressure.

PROFILE	
A	

c. Select AIR COND AUTO PRESS. The pressure should decrease slowly and the outflow valve should regulate cabin pressure to 15.4 (± .4) in. Hg. but lower than the pressure noted in step b.

d. Select AIR COND MAN PRESS and pressurize aircraft to pressure noted in step c. plus .2 in. Hg. (this will ensure that the outflow valve is closed).

e. Close all engine bleed air valves.

f. Time differential pressure decrease from 14 in. to 12 in. Time should be approximately 70 seconds at FL 230 or 65 seconds at FL 200.

g. Open engine bleed valves and repressurize to step c. pressure.

h. Select AIR COND AUTO PRESS.

i. Check windshield defogging for proper air flow.

j. Check control of flight deck, forward and aft cargo compartment temperature both manually and automatically.

A D

13. Autopilot.

a. With aircraft properly trimmed, engage autopilot. Aircraft should remain in straight and level flight. Check for proper operation of the autopilot switch and servo engaging switch.

b. Rotate pitch control slowly fore and aft. Aircraft should respond smoothly and maintain any pitch angle selected.

c. Return to level flight and turn on the altitude hold. Pressure altitude should remain constant ± 40 feet.

d. Rotate turn knob smoothly to its limit. Aircraft should roll in proper direction to a maximum of 39° and perform a coordinated turn. After a minimum of 90° of turn, return knob to the center (detent) position. When aircraft stabilizes altitude should be ± 40 feet of original altitude.

e. Repeat step d. in the opposite direction.

Note

If aircraft will not return to within prescribed limits, repeat step d. and e. using 30° angle of bank. If altitude still cannot be maintained, a discrepancy exists.

f. Tune and identify a VOR or TACAN station within 100 NM. Determine the heading toward the station and turn toward it. Adjust course selector to center CDI with a TO indication.

PROFILE

A D

g. Switch autopilot to RANGE-LOC position. Aircraft should track to the station. With the CDI centered, adjust course knob to offset CDI 3° (3/5 the distance to the first dot). The aircraft should correct toward the CDI but not exceed 6° angle of bank.

h. Adjust course set knob to offset 6°. Aircraft should correct toward CDI and not exceed 6° angle of bank. If the on-course mode of operation is broken, the maximum allowable bank angle to recapture is 25°.

i. Turn navaid OFF. Beam coupler light should not illuminate.

j. Turn the turn knob. Beam coupler should disengage and the beam coupler light should illuminate.

k. With the turn knob in the center (detent), rotate aileron trim knob to both extremes. Aircraft should roll smoothly in the proper direction.

l. Disengage autopilot with pilot's autopilot release button; reset autopilot and disengage with copilot's autopilot release button.

A

14. Radios and Navigation Aids.

a. Obtain a two way radio check on all transceivers.

b. Check for operation of ICS and PA system.

c. Check all navigation receivers for proper indications.

d. Check for proper operation of the radar and doppler.

e. Check for operation of radio altimeter.

f. Obtain IFF check on all modes including EMERGENCY and MODE CHARLIE.

A B C

15. Engine Cruise Operation.

Check and record all engine instruments at any cruise power setting above crossover for normal indications at a constant IAS.

A B C

16. Propeller Phase Angle Check.

With the GS 3940 Tester; check propeller phase angles and adjust as necessary.

E

17. Check communication Systems AN/USC-13 (As Required).

Note

Coordination must be exercised in completing the TACAMO system check and the reel check since the airborne TACAMO check requires the use of the antenna.

PROFILE

DESCENT to 6000 FEET

A 18. Fuel Dumping.

a. Prepare for fuel dumping utilizing the Fuel Dumping Procedures in the card checklist.

Note

Fuel dumping may be accomplished during descent.

b. Post observers at each paratroop door and establish ICS communications.

c. Commence dumping one tank at a time beginning with No. 1 tank. Observer should notify pilot when fuel is observed flowing from dump mast and when it stops.

d. When all tanks have been checked, clear manifold by sideslipping aircraft and resume normal operation.

LEVEL 6000 FEET

A B C 19. Engine Shutdown and Airstart.

a. Place synchrophaser switch to OFF, feather valve and NTS switch to VALVE and prop governor control switches to MECH.

CAUTION

NTS check must be accomplished prior to engine shutdown in all cases other than emergency.

b. Retard No. 1 throttle to flight idle.

c. Move condition lever No. 1 to GROUND STOP momentarily.

d. Return No. 1 condition lever to RUN.

CAUTION

Engine should continue to run normally. If engine does not continue to operate normally, immediately move condition lever to FEATHER.

e. Pull the No. 1 fire handle. Propeller override button should pull in and its amber light should illuminate. Rpm should decrease to zero within 10 seconds. When the propeller reaches the full feathered position, the override button should popout and the light extinguish. If the button fails to popout in 4-5 seconds, manually pull it out.

PROFILE	
A B C	f. Place the No. 1 condition lever to FEATHER.

Note

Prior to positioning condition lever to feather, ascertain that the prop has feathered with the fire handle.

g. Turn No. 1 generator to OFF/RESET.

h. Accelerate to 200 KIAS. Propeller should not rotate.

i. Check engine hydraulic pump pressure warning light — ON.

j. Reduce airspeed to between 150-180 KIAS.

k. Perform Airstart in accordance with Section V.

l. Repeat steps b. through k. for remaining engines.

A B C

20. Propellers Re-index (As Required).

Should an out-of-sync condition exist and re-indexing is required, follow the procedures set forth below.

a. All propeller governor switches — MECH.

b. Select a master engine.

c. Prop resynchrophase switch — RESYNC.

d. Place all slave propeller control switches to NORMAL and wait 15 seconds.

e. Switch to the other master engine while holding the propeller resynchrophase switch.

f. Remaining propeller control switch — NORMAL.

g. Wait 15 seconds and place sync master switch OFF.

h. Release resynchrophase switch.

i. Select a master engine.

A

21. Flap Operation.

a. Reduce airspeed below 145 KIAS.

b. Lower flaps, operating time should be 8-14 seconds.

PROFILE

A

c. Raise flaps, operating time should be 10-13 seconds.

d. Check operation of warning horn at 70% (± 5%) with the gear up.

WARNING

During normal flap operations, failure of certain components in the Jack-Screw area may cause a split flap condition resulting in a change in trim about the roll axis and aileron binding. Under these conditions, if it is possible to control the aircraft, no attempt should be made to move the flaps. If movement of the flaps must be attempted, move the controllable flaps in increments of 10 percent toward the position of the uncontrollable flap. During flap movement, check aileron control constantly. If it is noted that binding increases, stop flap movement immediately.

e. Pull the flap control circuit breaker.

f. Place the flap lever in the desired position. (This will give proper rudder boost pressure.)

(1) Station a crewmember at the forward face of the left wheelwell, and establish communications with the flight station by means of an intercommunications extension cord.

(2) Remove the left hydraulic panel cover and cannon plug from the flap selector valve.

(3) Reset the flap control circuit breaker.

(4) Depress the "raise" or the "lower" button on the flap selector valve for approximately one second so that the flaps move only an increment of about 10 percent; proceed with successive increments only if there is no change in roll trim, and as directed by the pilot.

g. Manual operation.

(1) Pull flap control circuit breaker.

(2) Set flap lever to 10%.

(3) Turn off the No. 1 and No. 2 hydraulic pumps, utility suction boost pump and deplete system pressure.

(4) Have a crewmember engage the handcrank, remove the input shaft pin, and shift to MANUAL drive.

(5) Manually lower the flaps to 10%.

(6) Remove handcrank, shift back to NORMAL drive and replace the input shaft pin.

(7) Turn on the utility suction boost pump and the No. 1 and No. 2 hydraulic pumps.

PROFILE

A

(8) Push flap control circuit breaker in and raise flap lever to 0%.

h. Ensure that normal flap operation has been regained.

A

22. Landing Gear Operation.

a. Normal operation.

(1) Lower gear normally, all gear should indicate DOWN in 10-19 seconds.

(2) Raise gear, all gear should indicate UP in 19 seconds or less.

b. Manual Override Operation.

(1) Pull landing gear control circuit breaker.

(2) Place the landing gear lever in the DOWN position.

(3) Have crewmember lower landing gear by depressing the override button on the down side of the landing gear selector valve.

Note

Verify that once the DOWN button is depressed, it will hold in until the extension is complete and the UP button is energized either manually or by restoring electrical power and activating the landing gear handle to the UP position.

(4) Push landing gear control circuit breaker IN.

(5) Raise landing gear.

c. Manual extension of the main landing gear.

(1) Pull the landing gear control circuit breaker.

(2) Lower the landing gear lever.

(3) Deplete all utility hydraulic pressure by securing the No. 1 and No. 2 engine driven hydraulic pumps and the utility suction boost pump.

Note

Establish communication with a crewmember stationed forward of each MLG wheel well. The crew member will remove the hydraulic panel cover. The crewmembers will respond with "Port" and "Starboard" when an action is complete.

(4) Pull and lock port and starboard emergency locking handle.

PROFILE

A

CAUTION

Do not force the emergency engaging handle out. To do so may result in a bent manual drive clutch lever, making it difficult or impossible to engage the manual drive. It may be necessary to place the extension handcrank on the emergency extension stub shaft and rotate slightly until the manual drive gear teeth align.

(5) If the MLG does not freefall, place the handcrank on the stub shaft and extend the gear by rotating the stub shaft approximately 330 turns in the direction of the arrow above the shaft.

CAUTION

- Make sure the ratchet on the handcrank is set for down rotation before placing it on the stub shaft.
- If the MLG starts to freefall after the handcrank is placed on the stub shaft, immediately remove the handcrank. The extension handle ratchet may change direction because of the rotation speed of the stub shaft.

(6) Note the MLG indicates DOWN and LOCKED.

(7) Have crewmember push emergency locking handle IN and rotate handcrank to verify disengagement.

d. Emergency Extension NLG.

(1) Position the NLG emergency extension valve to NLG EMERGENCY EXTENSION.

(2) Turn auxiliary hydraulic pump ON.

(3) Observe the NLG — DOWN and LOCKED.

(4) Turn the auxiliary hydraulic pump OFF.

(5) Position the NLG emergency extension valve to NORMAL.

e. Push the landing gear control circuit breaker IN.

f. Turn the utility suction boost pump ON.

g. Turn the utility hydraulic pumps ON and note all gear DOWN and LOCKED.

h. Raise the landing gear lever and note all gear UP and LOCKED.

i. Pull the landing gear control circuit breaker.

PROFILE

A

j. Deplete all utility hydraulic pressure by securing the No. 1 and No. 2 engine driven hydraulic pumps and the utility suction boost pumps.

k. Decrease airspeed to or below 120 KIAS.

l. Pull the NLG emergency release handle.

Note

The nose gear should extend into the slip stream. Allow the nose gear to extend until the forward gear door starts to close at reduced airspeed; this may require 30 to 45 seconds. Increase airspeed as rapidly as possible not to exceed 165 KIAS. The nose gear should extend to the DOWN and LOCKED position.

m. Position the landing gear lever DOWN.

n. Push the landing gear control circuit breaker IN.

o. Restore the utility system hydraulic pressure.

p. Note all landing gear indicates DOWN and LOCKED.

q. Recheck normal landing gear operation.

DESCENT TO 1500 FEET

A

23. Emergency Depressurization.

a. With aircraft pressurized to less than 3 in. Hg., place the emergency depressurization switch to EMERG DEPRESS. Ensure a rapid loss of remaining pressure.

b. Return the emergency depressurization switch to NORMAL.

A

24. Auxiliary vent system check.

a. Repressurize the aircraft to approximately 3 in. Hg.

b. Place the air-conditioning master switch to AUX VENT. AUX vent valve should not open until differential pressure has decreased to less than 0.6 in. hg.

c. Reset air-conditioning as desired.

A

25. Check radar altimeter (AN/APN-194).

SECTION IV

FLIGHT CHARACTERISTICS

TABLE OF CONTENTS

INTRODUCTION.

The EC-130G/Q aircraft contains equipment necessary to support operational requirements of higher authority. In this role, the aircraft has satisfactory flight characteristics in all ground and flight operating conditions. The aircraft accelerates rapidly and responds immediately and precisely to power and control applications.

STALLS.

Stall warning occurs in the form of airframe buffeting. The margin of airspeed between initial warning and actual stall is from 2 to 5 knots in the landing configuration and comfortably greater in other configurations. There is little or no stall warning with gear and flaps retracted at flight idle power. Power-off stalling speeds for typical configurations and flight attitudes are given in figure 4-1. Use care to avoid accidental stalls. Should a stall be entered, it is recommended that recovery be made as follows:

1. If in level flight, immediately drop the nose and apply power to limit loss of altitude. Use ailerons and rudder to counteract any wing-dropping tendency. Move controls smoothly, avoiding abrupt actions. Avoid diving the aircraft, and avoid abrupt or accelerated pull-up after recovery.

2. If in climbing or banked attitude, immediately drop the nose, level the wings, and apply power to limit loss of altitude. Move controls smoothly, and avoid abrupt actions. Avoid diving the aircraft, and avoid abrupt or accelerated pull-up after recovery.

3. Heavy gross weight cruise configuration stalls may be accompanied by fish-tailing of the aircraft and lightening of rudder and elevator control forces. Recovery should be made by abruptly applying nose down elevator and reducing power to flight idle.

PRACTICE STALLS.

Any practice in stall entry and recovery should be made at a maximum gross weight of 120,000 pounds. Practice at a minimum altitude of 10,000 feet above the ground. Do not delay recovery beyond the point of stall break. Avoid abrupt control movements, and avoid any control action that may result in sudden altitude change or in excessive acceleration or buffeting.

WARNING

Clean-configuration stalls should be discontinued at the onset of buffet. Power-on stalls should not be attempted because of the excessively nose-high attitude required.

SPINS.

Spins are a prohibited maneuver, and should never be intentionally entered into. Accidental spins can be prevented by immediate recovery from any stall condition. If a spin is accidentally entered, it is anticipated that a normal recovery for multi-engine aircraft will be effective. As in any maneuvering flight, proper care should be taken to avoid exceeding the structural limits of the aircraft by a sudden pull-up.

FLIGHT CONTROLS.

The flight controls are designed to be operated with hydraulic boost on at all times. With boost on, the aircraft can be controlled without undue effort by the pilot under any reasonable load, flap, and power combinations. Lighter stick forces are encountered in the power approach configuration with aft center of gravity loadings. At airspeeds below 100 knots CAS in the power approach configuration, a less positive roll stability effect is experienced. In case of complete failure of the hydraulically powered control systems, the aircraft can be controlled by careful manipulation of the trim tabs.

WARNING

Landing under these conditions will be marginal if turbulence or crosswinds are encountered. Do not deliberately turn off properly functioning boost control in flight. To do so may result in an uncontrollable attitude change and acceleration.

LEVEL-FLIGHT CHARACTERISTICS.

The range between slow- and high-speed flight is unusually large, but control and stability are normal for any trimmed condition. During landing at light gross weights, the aircraft has a tendency to float due to the large wing area, the propeller blade angle, and the flight idle horsepower.

MANEUVERING FLIGHT.

Maneuvering flight within the category of acrobatics is prohibited. Do not make hard rudder kicks that result in large angles of yaw. Normal maneuvers may be accomplished with moderate pilot effort, since control movement is assisted by the boost system. There are no conditions of normal maneuvering flight which will produce a reversal of control pressures, and maneuvers can be accomplished with ease. In executing turns under combat conditions, remember that 60 degrees is the maximum bank angle. The recommended speed for minimum-radius turns is the best climb speed at that altitude.

FIN STALL.

WARNING

Intentional stall maneuvers are prohibited.

If the aircraft is maneuvered to abnormally high sideslip angles (15-20 degrees) a fin stall resulting in large yawing transients and a decrease in directional stability can be encountered. This is an unusual flight maneuver and will not result from power transients, gusts, wake turbulence or execution of normal flight maneuvers. The fin stall condition is more likely to occur during abnormally high left rudder input steady heading sideslip maneuvers if held until fin buffet occurs. Fin stall can be achieved at all speeds between stall speed and approximately 170 knots in all flap configurations with power on. The susceptibility of encountering the fin stall condition is greatest at low speed with high power. Consequently, under these conditions, rapid yawing maneuvers can be produced with relatively small abrupt rudder inputs or abnormally large rudder deflections and should be avoided. As the aircraft attitude approaches the critical sideslip angle, heavy vertical fin buffet will develop.

A large change in yaw angle which could result in fin stall may also be caused by either a large asymmetric power condition or a rudder boost unit malfunction. Determination of which condition is causing the abnormal yaw angle can be made by checking the engine controls and instruments for normal operation and that the rudder controls are functioning normally.

Fin Stall Recovery.

Fin stall recovery at the onset of buffet can be accomplished by simply returning the rudder to neutral or by rolling to a wings level attitude. However, if the sideslip is allowed to increase past fin buffet conditions, the rudder pedal force required to maintain rudder position will decrease to zero or reverse and will be coupled with a nose up pitching tendency; recovery at this point can be affected by returning the rudder to neutral which will require from approximately 50 to 100 pounds rudder pedal force, and by rolling to a wings level attitude. (If flight conditions permit, pushing the nose down and reducing power will assist in recovery). To avoid large yawing and rolling transients on recovery do not over-control the rudder and ailerons. Sideslip maneuvers increase drag, reduce lift and permit large airspeed position errors to develop; therefore, degradation in performance and reduction of indicated airspeed may be experienced. Ensure that adequate flying speed is maintained during and immediately after recovery.

If the abnormal yaw angle cause is determined to be asymmetric thrust, leave rudder boost ON and use flight controls and trim as necessary to maintain balanced flight.

If it is determined that the abnormal yaw angle is caused by rudder boost unit failure, (confirmed by full rudder deflection) turn the rudder boost control switches to OFF.

WARNING

Greatly increased rudder forces will be required to move the rudder with the rudder boost OFF. The use of asymmetric power and increasing airspeed will assist in recovery from this condition.

CAUTION

Abrupt push-over to a negative g condition with flaps either up or down should be avoided. This type of maneuver will result in a reduction in maneuvering longitudinal stability, in that the angle of pitch-down and the negative g condition continue to increase even after the stick direction has been reversed. After movement of the stick toward the former position is begun, there is a time lag before the aircraft starts to reverse its pitching motion. Final recovery from the maneuver requires considerable pull force. This is due to the large pitching inertia of the aircraft and the longitudinal rotational effect on the hinge moments of the elevator. These characteristics could result in an excessive negative load factor, an uncomfortable nose-down attitude, and an excessive positive load factor due to an abrupt recovery.

DIVING.

Conduct dives or descents within the airspeed limitations given in Section I. Avoid abrupt pull-ups at any time.

MODEL: EC-130G/Q
T56-A-423 ENGINES

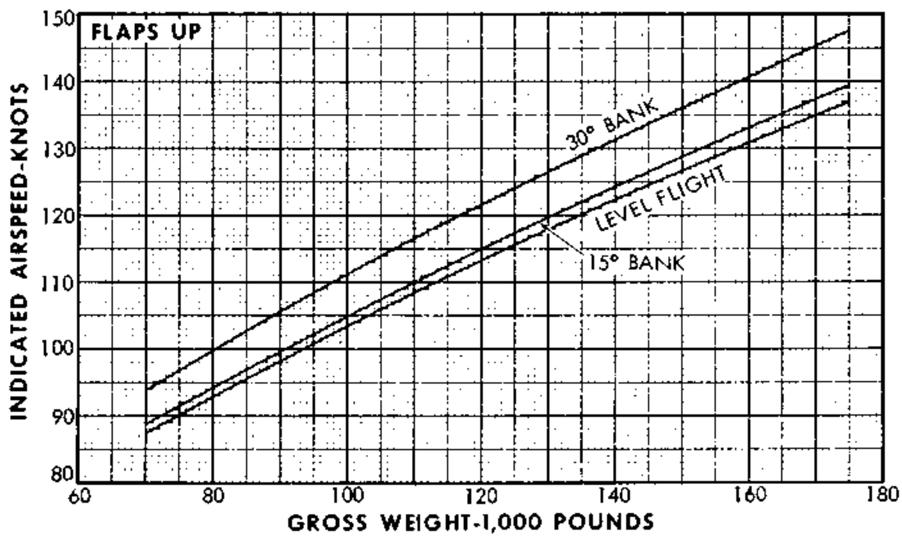
POWER OFF STALLING SPEEDS

SEA LEVEL
ICAO STANDARD ATMOSPHERE

DATE: JANUARY 1969
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. OUT OF GROUND EFFECT
2. GEAR UP OR DOWN



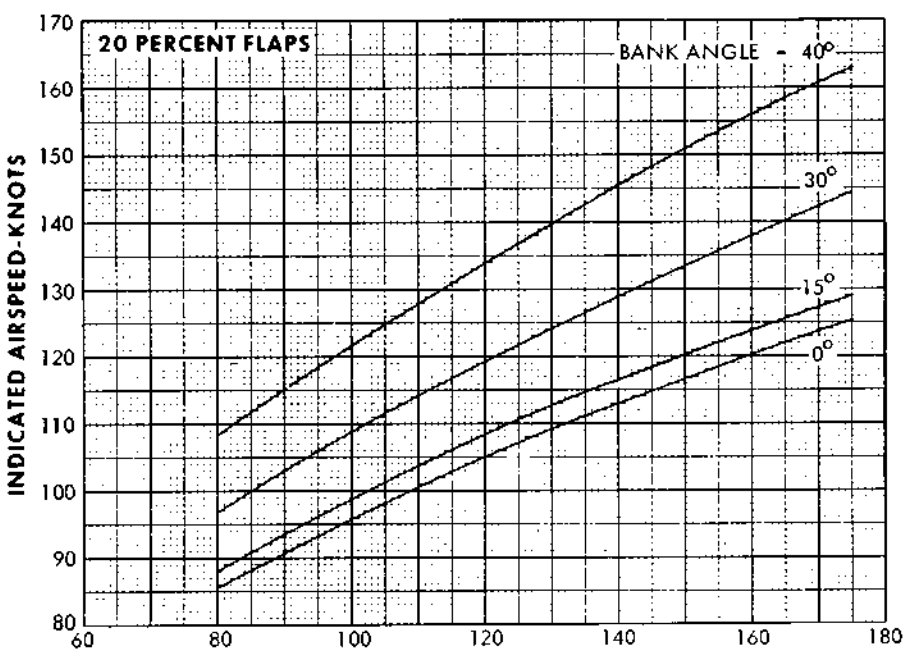
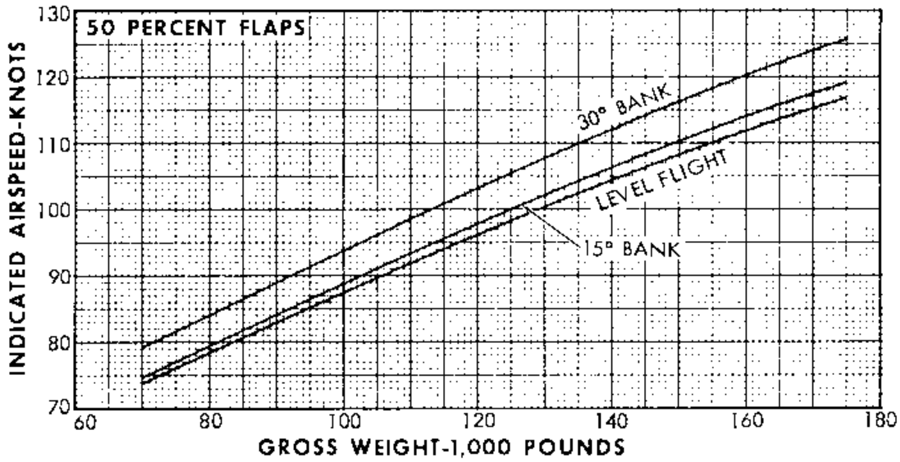


Figure 4-1. (Sheet 1 of 2)



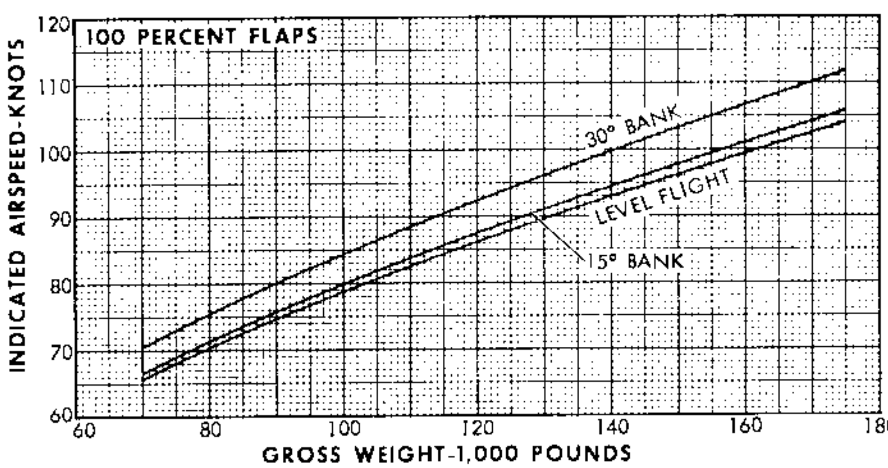


Figure 4-1. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

POWER ON STALLING SPEEDS

SEA LEVEL

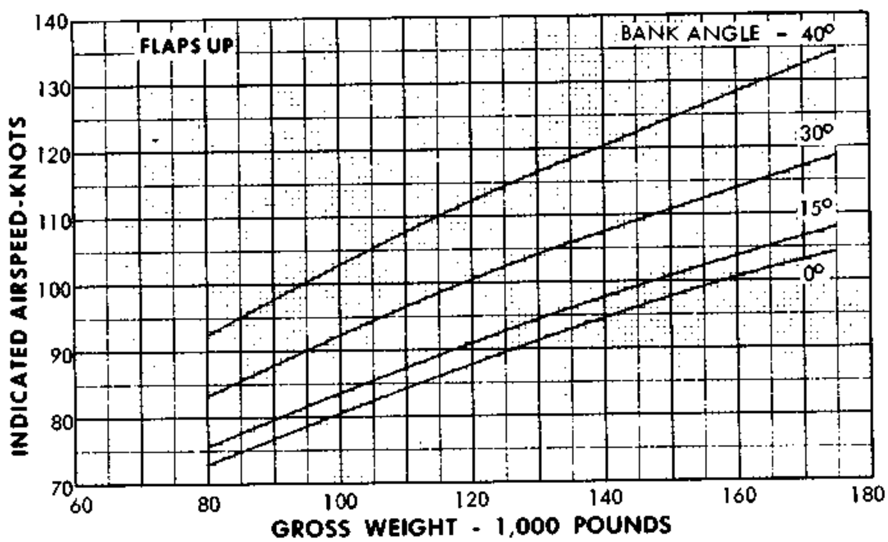
ICAO STANDARD ATMOSPHERE

DATE: JANUARY 1969

DATA BASIS. ESTIMATED ON FLIGHT TEST

NOTE

1. Out of ground effect.
2. Gear up or down.
3. Take-off power.



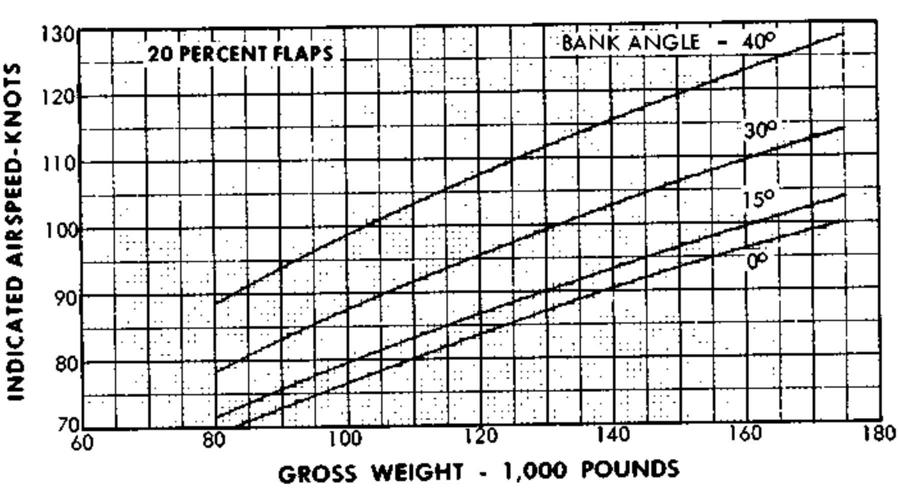


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Figure 4-2. (Sheet 1 of 2)

POWER ON STALLING SPEEDS

SEA LEVEL
ICAO STANDARD ATMOSPHERE

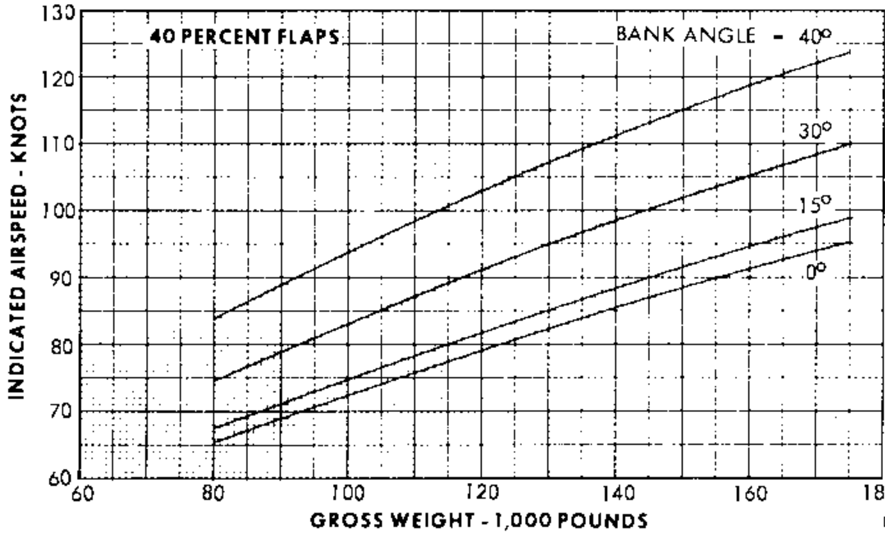


Figure 4-2. (Sheet 2 of 2)

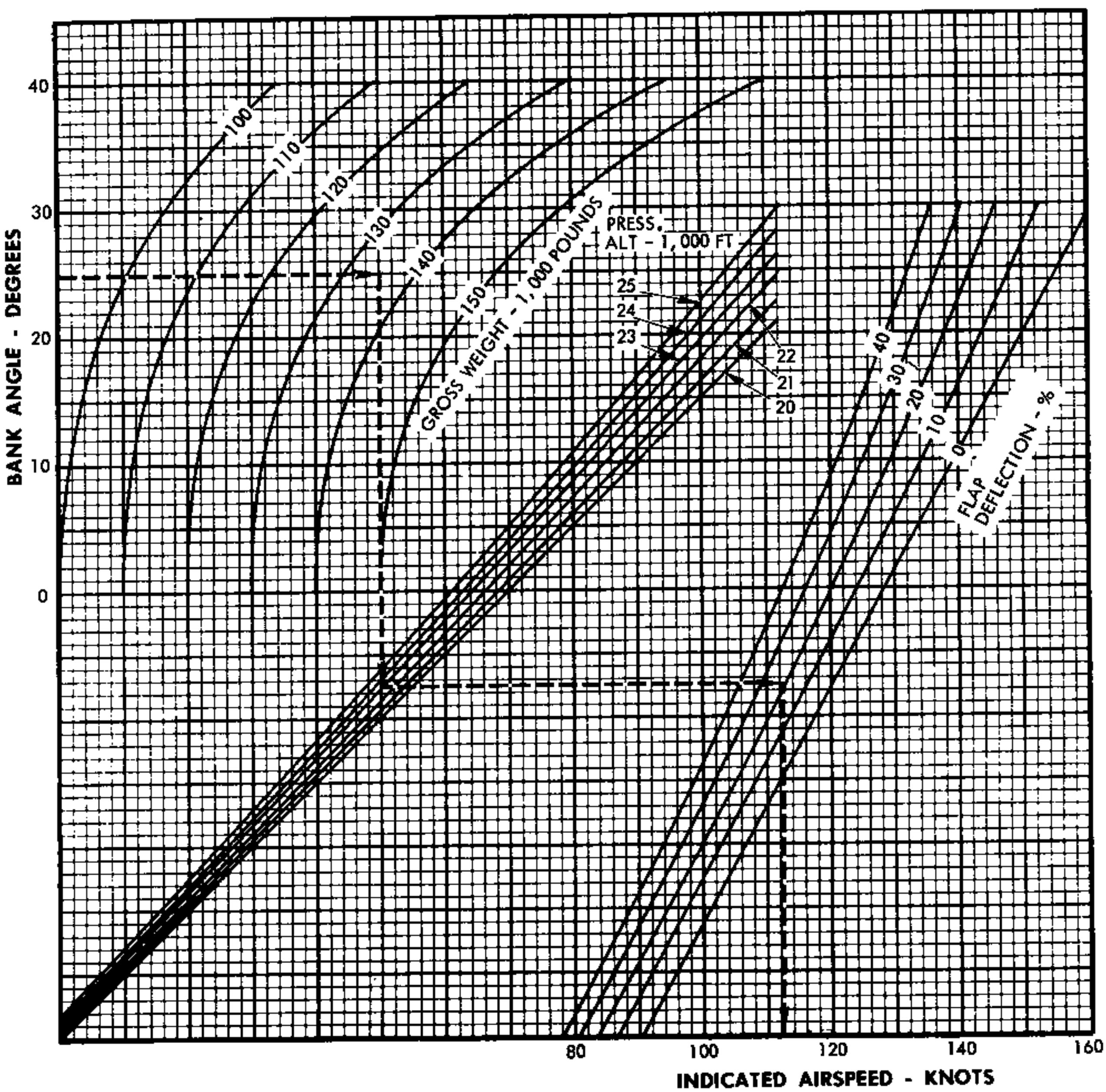
POWER - ON STALL SPEED
AT MAXIMUM CONTINUOUS POWER

ICAO STD ATMOSPHERE

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: MARCH 1971

DATA BASIS: ESTIMATED ON FLIGHT TEST



EC-130-1-2-361

Figure 4-3.

SECTION V

EMERGENCY PROCEDURES

TABLE OF CONTENTS

INTRODUCTION.

This section contains the procedures to be used in coping with the various emergencies that may be met during flight and landing. A thorough knowledge of these emergency procedures will enable crew members to perform their emergency duties in an orderly manner, and to judge more quickly the seriousness of the emergency. This will permit early planning for a bailout or forced landing and will greatly increase the crew's chances for survival. The procedures consist of items classified as critical or noncritical. The critical items are actions that must be performed immediately to avoid aggravating the emergency and causing injury or damage. Critical items are printed in bold type and must be committed to memory. Noncritical items are actions that contribute to an orderly sequence of events. After completing memory items, the pilot shall call for the appropriate checklist; the copilot shall read the checklist beginning with the first item. After determining that an emergency exists, the pilot should immediately establish communication with a ground station. The ground station should be given a complete description of the emergency, the action taken, and an accurate position report. The ground station should be further notified of any changes or developments in the emergency, so that the station can alert Aerospace Rescue and Recovery Service or other agencies to stand by, if necessary. In the checklists presented, the codes P, CP, FE, N, ACO, ACS, RO/O stand for pilot, copilot, flight engineer, navigator, airborne communications officer, airborne communications supervisor, and reel operator/observer. This presentation does not preclude the pilot from redelegating the duties at crew briefing.

Note

Never initiate a procedure before command of the pilot.

ENGINE SHUTDOWN CONDITIONS.

If any of the following conditions occur in flight or on the ground, shut down the affected engine when the necessary corrective action fails to remedy the adverse condition.

1. Unusual vibration or roughness.

emergency equipment

- ▲ HAND AXE (3)
- ■ EMERGENCY LIGHT (7)
- FIRST AID KIT (7)
- ● EXTINGUISHER (6)
- ESCAPE ROPE (3)
- ANTI-EXPOSURE SUITS (AS REQ.)
- LIFE VESTS (AS REQ.)
- PARACHUTES (AS REQ.)
- RESTRAINING HARNESS (1)
- PORTABLE OXYGEN BOTTLES (7)
- LIQUID CONTAINERS (8)

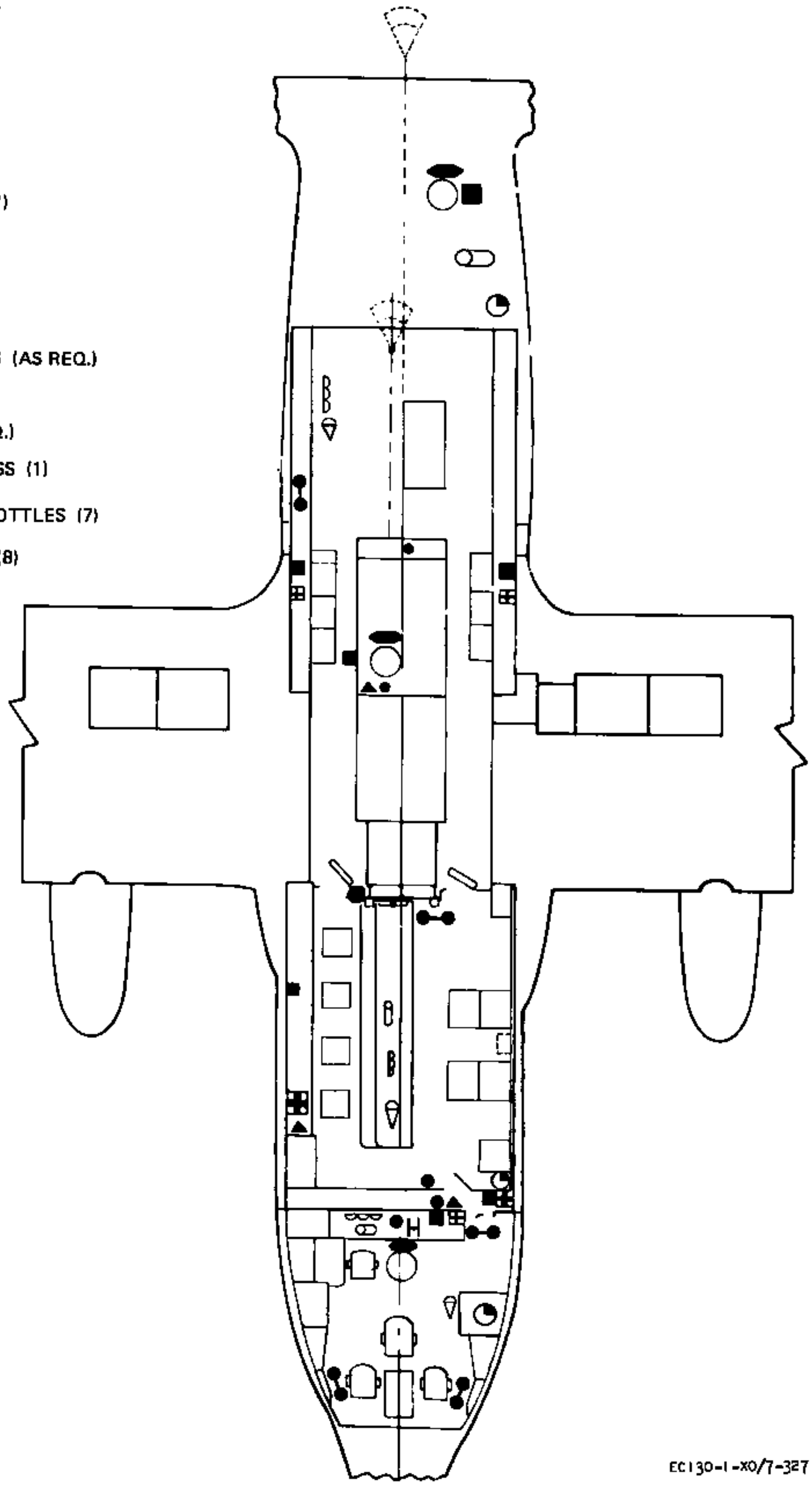


Figure 5-1.

2. An engine fire.

3. Engine (turbine) overheat.

4. Nacelle overheat.

5. Excessive or uncontrollable power.

6. Certain propeller malfunctions. (See PROPELLER MALFUNCTIONS in this section.)

7. An uncontrollable rise in TIT.

8. An uncontrollable drop in oil pressure.

9. An uncontrollable rise in oil temperature.

10. Throttle control cable failure.

11. Generator fails to disconnect.

When it is necessary to continue operation of an engine with any of these conditions present, in the interest of safety of the aircraft and crew, operate the engine with extreme caution, and at the minimum power required.

Note

Before making a precautionary engine shutdown, perform an NTS check using the procedure in Section III.

ENGINE SHUTDOWN PROCEDURES.

1. FIRE HANDLE — PULLED — CP

2. CONDITION LEVER — FEATHER — CP

CAUTION

When pulling a condition lever to FEATHER, pull it all the way to the detent to assure that the propeller is fully feathered when the engine fuel is shut off. If the lever is left at midposition, and NTS is inoperative, an engine decoupling is possible.

Note

If a propeller fails to feather, refer to PROPELLER FAILS TO FEATHER procedures in this section.

3. FIRE EXTINGUISHER — DISCHARGED (ONLY IF FIRE OR NACELLE OVERHEAT OR OTHER INDICATION OF FIRE PERSISTS). — CP

WARNING

If indication persists, a break in the bleed air manifold may exist. Isolate the wing by closing the wing isolation valve and shutting off the engine bleed air for the other engine on that wing.

A. IF INDICATION PERSISTS, DISCHARGE THE REMAINING BOTTLE.

4. FLAP LEVER	AS REQUIRED	CP
5. LANDING GEAR LEVER	AS REQUIRED	CP
6. Engine bleed air switch	CLOSED/OFF	FE
7. Generator switches	OFF	FE
8. Fuel boost pump switch	OFF	FE

Note

If on crossfeed, assure source of fuel to operate engines before shuting off fuel boost pump and crossfeed valve for the affected engine.

9. Crossfeed valve switch	CLOSED	FE
10. Propeller governor control switch	MECH GOV	CP
11. Synchrophaser master switch	Reset as necessary	FE
12. TD valve switch	NULL	FE
13. Throttle	Full forward	CP
14. Oil cooler flap switch	CLOSED/FIXED	CP

Note

Performance data should be checked. (Refer to Section X1.)

STATIC START PROCEDURE.

This static start procedure is predicated on a C-130 aircraft (or equivalent) providing the air blast. However, a similar procedure in most respects, should produce satisfactory results using piston engine type tricycle landing gear aircraft. Suitable on-the-spot modifications to the above, relating to a specific type, will then be necessary.

CAUTION

Prior to attempting a static start because of a defective starter, assure that the starter is removed as it may remain engaged with resultant damage to the starter, engine, or aircraft. Cover the starter pad with a cover plate.

1. Position C-130 or equivalent aircraft on starting area facing into wind with flaps up.

2. Run all engines to blast area clear.

3. Shut down all engines and visibly inspect the area in front and behind the aircraft to ensure it is free from foreign matter and objects.

4. Taxi or tow C-130 aircraft into position as indicated on figure 5-2. This position will provide clearance between the forward C-130 tail and nose of the aft C-130, should the aft C-130 swing during power application.

5. Brief crews of special signals that will be used during starting and position ground observers for visual sighting from each cockpit and each other.

6. Establish communication between aircraft.

7. Complete necessary checklists.

8. Place chocks fore and aft of each forward MLG wheel.

9. Start one of the inboard engines for electrical power.

10. Secure GTC and close GTC door.

11. Remove all ground equipment.

12. Position propeller blade cuff in line with the island on the spinner base.

13. Place throttle in Flight Idle.

14. Close all doors, windows and hatches.

15. Condition lever run, leave bleed air shut off until engine is on speed. NEW

16. Front aircraft, upon signal from rear aircraft, increase power to 900° TIT on all engines.

17. If propeller rotation does not begin, request maximum power on front aircraft.

18. After propeller rotation starts, observe normal start sequence and at 60 percent rpm place throttle to GROUND IDLE.

19. Signal front aircraft to reduce power.

aircraft position for static start

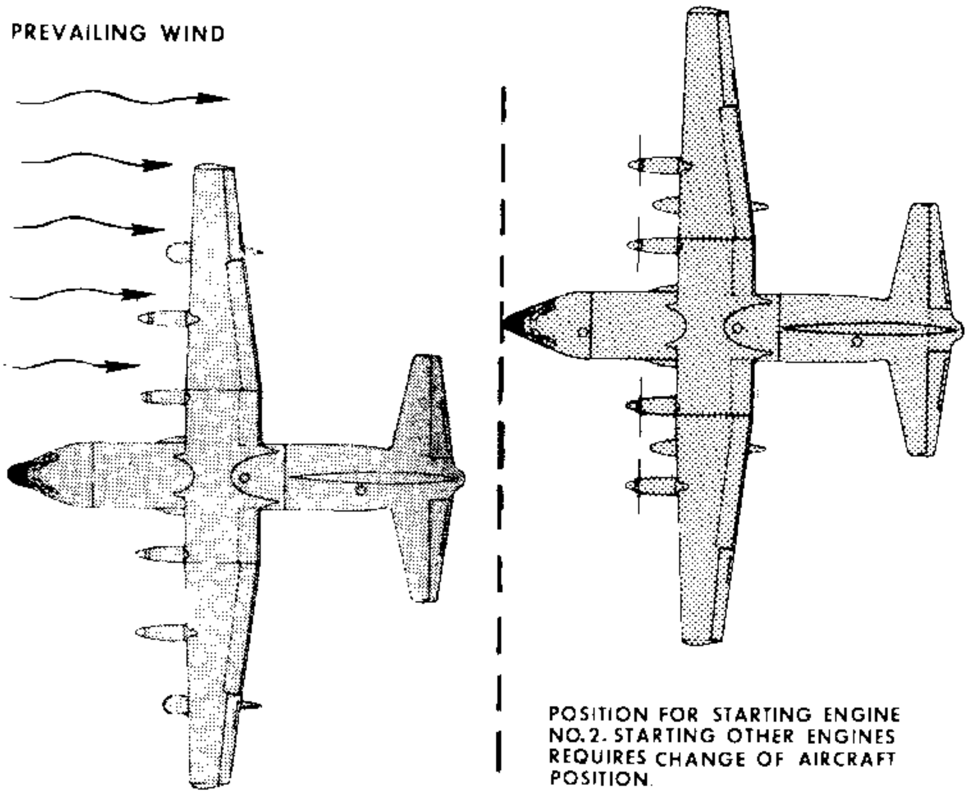


Figure 5-2.

Note

If constant acceleration fails to occur prior to 16 percent rpm, move condition lever to FEATHER position momentarily and return to RUN. Increased rpm and acceleration should occur. Do not move condition lever towards FEATHER after 16 percent rpm unless a stop start situation exists.

Note

In the event above procedures are ineffective, starting may be attempted by pre-setting propeller blade angles at an intermediate position between alignment with spinner base island and the full feather position. Continue start as outlined above.

WINDMILL TAXI START.

Note

Use of the following procedure is not recommended when operating the aircraft at gross weights above 135,000 lbs.

The following procedure can be used to start an engine if it cannot be started by normal procedures. It should be used only if mission requirements dictate. Complacency or operational abuse should not be allowed to result from the knowledge of this unusual capability. A runway length of 7,000 feet or more is recommended to assure safety in accomplishing a windmill taxi start.

CAUTION

Prior to attempting a windmill taxi start because of a defective starter, assure that the starter or starter shaft is removed, as it may remain engaged with resultant damage to the starter, engine, or aircraft.

1. Inspect engine to be started as necessary to assure maximum safety.

2. Place condition lever to FEATHER until the blade cuff is in line with the island on the spinner base.

3. Perform the BEFORE TAKE-OFF checklist to assure that all controls and switches are in the proper position.

Note

Flaps will be set at approximately 15 percent to provide full rudder boost pressure without inducing extra drag and creating lift at low speeds. Auxiliary hydraulic pump will be on to permit positive braking action if emergency brakes should be selected.

4. Place the throttle in the FLIGHT IDLE position.

5. Place the condition lever in the RUN position.

6. Align the aircraft on the runway with the parking brakes set. Advance the throttles to FLIGHT IDLE for the operating engines; then advance the throttles on the symmetrical engines to take-off power. Release the brakes and increase power on the other operating engine as directional control becomes available through coordinated use of nose wheel steering and rudder. The copilot should monitor the control column, maintaining positive pressure on the nose wheel and keeping the wings level. The pilot should maintain control of nose wheel steering, throttles, and rudder.

7. The propeller should start to rotate as the airspeed increases and a normal light-off should occur. As the rpm increases to about 40 percent, retard all four throttles to ground idle and reverse symmetrical on-speed engines and apply brakes. The engine should accelerate and come on speed as the aircraft is brought to a stop. Oil pressure and engine instruments should be monitored the same as for a normal start.

CAUTION

Regardless of the progress of the windmill taxi start, decelerate to a stop when the aircraft reaches a speed of 100 KIAS or a point where 4,000 feet of the runway remains, whichever occurs first.

8. Return to the active runway for a normal take-off.

GROUND EMERGENCIES.

GAS TURBINE COMPRESSOR FIRE.

If a fire occurs in the GTC compartment, proceed as follows:

1. GTC FIRE HANDLE	**PULLED**	**CP**
2. FIRE EXTINGUISHER	**DISCHARGED (IF REQUIRED)**	**CP**
A. IF INDICATION PERSISTS, DISCHARGE THE REMAINING BOTTLE.		
3. Ground crew	Notified	CP
4. Call a fire truck	Requested	CP
5. Engine condition levers	GROUND STOP	CP

NOTE

If taxiing, stop the aircraft before moving the engine condition levers to GROUND STOP.

6. ATM	STOP	FE
7. GTC control switch	OFF	FE

ATM COMPARTMENT OVERHEAT WARNING LIGHT.

When the ATM compartment overheat warning light illuminates, immediate steps to correct the overheat condition must be taken as follows:

Turn ATM generator switch to OFF.

Turn the air turbine motor switch to STOP.

Turn the GTC control switch to OFF.

If the overheat light does not go out, close both wing isolation valves. This will isolate the ATM duct system.

CAUTION

The wing isolation valves should not be reopened once they have been closed for an overheat condition. Damage to the warning system may prevent detection of subsequent overheat condition.

CARGO COMPARTMENT REFRIGERATOR OVERHEAT WARNING LIGHT.

When the cargo compartment refrigerator overheat warning light illuminates, immediate steps to correct the overheat must be taken as follows:

Turn the air conditioning shutoff switch for the cargo compartment to the OFF position.

Turn the GTC control switch to OFF.

If the warning light does not go out, position both wing isolation valve switches to the CLOSED position. This will isolate the ducts to the cargo compartment and should eliminate the overheat condition.

CAUTION

The wing isolation valves or the cargo compartment air conditioning shutoff valve should not be reopened once they have been closed for an overheat condition. Damage to the warning system may prevent detection of a subsequent overheat condition.

ENGINE FIRE.

Engine fires are indicated by a steady illumination in the respective fire handle and the master fire warning light on the pilot's instrument panel. In addition to visual warning, fires are indicated by an audible warning. The fire detection system design is such that it is unlikely that the wrong engine would be shut down. If an engine fire is experienced on the ground or in flight, shut down the engine in accordance with the ENGINE SHUTDOWN PROCEDURES in this section.

Tailpipe Fires or Torching During Engine Start.

A tailpipe fire is defined as abnormal flame or torching, coming from the engine tailpipe during starting. If the condition is reported before starter popout, the condition lever should be placed in GROUND STOP and the engine motored with the starter. This will normally clear the engine of unburned fuel. If flame continues, follow the ENGINE SHUTDOWN PROCEDURES in this section.

Note

Unless taxiing, instruct ground crew to use ground fire extinguishers if necessary.

Tailpipe Fire During Engine Shutdown.

If a tailpipe fire occurs during engine shutdown, proceed with the ENGINE SHUTDOWN PROCEDURES, and call for assistance.

CAUTION

Tailpipe fire during engine shutdown may be caused by an oil leak in the turbine section. Do not motor the engine when a tailpipe fire exists on engine shutdown.

ENGINE OVERHEATING.

There are four indications of overheating in the engines and nacelles: the engine (turbine) overheat warning light, nacelle overheat warning light, high TIT, and high oil temperature.

Engine Turbine Overheat Warning.

If an overheat condition is indicated by the flashing of the master fire warning light and/or by the flashing of lights in a fire handle, retard the throttle to GROUND IDLE. Proceed with the ENGINE SHUTDOWN PROCEDURES in this section.

Nacelle Overheat Warning.

When an overheat warning is indicated by a nacelle overheat warning light on the copilot's instrument panel, proceed with the ENGINE SHUTDOWN PROCEDURES in this section.

High Turbine Inlet Temperature.

Should an overtemperature be indicated by a high TIT, retard the throttle for the affected engine toward GROUND IDLE. If this fails to eliminate the overtemperature condition, place the condition lever in GROUND STOP.

High Oil Temperature.

For corrective action to be taken in case of high oil temperature, see ENGINE OIL SYSTEM FAILURE in this section.

EMERGENCY ENTRANCES.

Emergency entrances are those used by ground rescue personnel (figure 5-3).

External Releases.

The side emergency exit and the three escape hatches (figure 5-3) are equipped with external pull-type releases. The releases are flush-mounted on the fuselage surface next to the exit they release. Pulling the release permits the exit to be pushed inward, and entrance may be made.

Chopping Locations.

Chopping locations, marked in yellow (figure 5-3) are painted on each side of the fuselage above and forward of the paratroop jump doors. The locations are marked on the inside and outside of the fuselage.

GROUND EVACUATION.

If it becomes necessary to evacuate the aircraft, proceed as follows:

1. Parking brake — SET — P

WARNING

If main wheel well fire exists, set opposite brake only.

2. Tower	Notified	CP
3. Crew	Notified	P
4. Fire handles	Pulled	CP
5. Battery switch	OFF	FE
6. Alarm bell	One Long Ring	CP
7. Evacuate		ALL
8. Chock the aircraft		RO/O

WARNING

If a main wheel well fire exists, chock nose wheels only.

BRAKE SYSTEM MALFUNCTIONS.

Loss of Utility System Hydraulic Pressure.

The normal brake system will be inoperative if utility system hydraulic pressure is lost. If pressure is not available to the normal brake system, proceed as follows:

Position the aux hydraulic pump switch to ON.

Place the brake select switch to EMERGENCY.

CAUTION

Use brakes cautiously; no anti-skid protection is available on the emergency system. Avoid taxiing into congested areas due to the possibility of auxiliary hydraulic pump failure.

Note

The auxiliary hydraulic system handpump may be used for stopping the aircraft in an emergency by holding the brake pedals down while the handpump is being operated.

Dragging Brake

A dragging brake may be difficult to detect. If it is not evident to the pilot, the first knowledge of the problem may be a report from the tower operator that the brake is smoking. Continued taxiing with a dragging brake will result in a brake fire. Taxiing must be stopped, fire fighting equipment called, if required, and the brake allowed to cool or maintenance performed prior to moving the aircraft. A dragging brake may be caused by improper adjustment of a new or overhauled brake or by trapped air in the brake system.

Brake Fire.

If a brake fire occurs on the ground, the following procedure is recommended:

Request fire fighting equipment. Stop the aircraft using reverse thrust and the unaffected brake, if needed, holding the nosewheel straight.

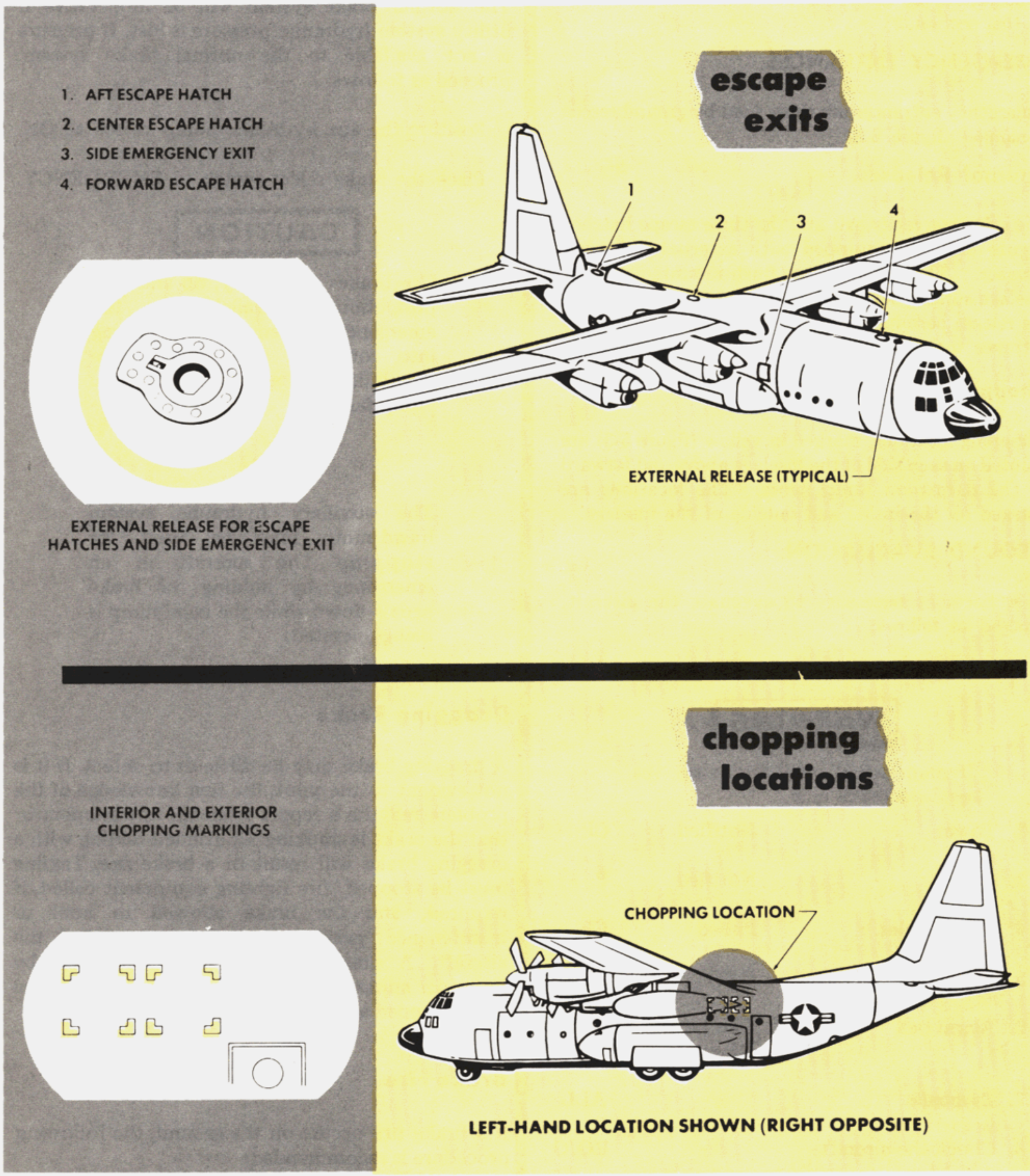

1. AFT ESCAPE HATCH
2. CENTER ESCAPE HATCH
3. SIDE EMERGENCY EXIT
4. FORWARD ESCAPE HATCH
escape exits
1
2
3
4
EXTERNAL RELEASE (TYPICAL)
EXTERNAL RELEASE FOR ESCAPE HATCHES AND SIDE EMERGENCY EXIT
chopping locations
INTERIOR AND EXTERIOR CHOPPING MARKINGS
CHOPPING LOCATION
LEFT-HAND LOCATION SHOWN (RIGHT OPPOSITE)

Figure 5-3.

Evacuate the aircraft (see GROUND EVACUATION PROCEDURES).

WARNING

All personnel other than those in the fire department should evacuate the immediate area. The area on both sides of the wheel will be cleared of personnel and equipment for at least 300 feet. Do not approach the main wheel area when extreme temperatures due to excessive braking are suspected. If conditions require personnel to be close to an overheated wheel or tire assembly, the approach should be from the fore or aft only.

CAUTION

Do not use CO_2 directly on the wheel. It may cause the wheel to shatter.

Spongy or Chattering Brakes.

This condition may be caused by air in the brake system or a defective anti-skid valve; the following procedure is recommended:

Turn the anti-skid OFF. If the condition persists, select EMERGENCY brakes.

Taxi with caution, using brakes as little as possible.

Fading Brakes.

Fading brakes would normally be the result of overheating caused by hard or continuous braking. If fading brakes are experienced, proceed as follows:

1. Avoid further braking.

2. Stop the aircraft by reversing.

3. Have a crewman exit via the crew entrance door with a chock and place the chock in front of the nosewheel.

4. If there is a brake fire, refer to BRAKE FIRE PROCEDURES in this section.

Anti-skid Test Unsatisfactory.

During test of the anti-skid system, failure of a wheel to test properly indicates that the wheel may have braking without anti-skid protection, or that the wheel may rotate freely without any braking capability. Use of the anti-skid system after an unsatisfactory test indication may result in uneven braking and a tendency for the aircraft to swerve when brakes are applied. The anti-skid switch should be placed in the OFF position if the test indicates a system malfunction.

Note

Failure of certain anti-skid or brake system components can result in loss of brakes or skid protection on one side of the aircraft without illuminating the anti-skid inoperative light.

Anti-Skid System Failure.

Whenever the anti-skid system is not operating as an integral part of the brake system, an anti-skid inoperative light will illuminate. Use of the anti-skid system after the light illuminates may result in uneven braking and a tendency for the aircraft to swerve. The anti-skid switch should be turned to the OFF position if the anti-skid inoperative light illuminates.

Note

On EC-130Q aircraft, the parking brake handle must be completely in to extinguish the anti-skid off warning light.

TAKE-OFF EMERGENCIES.

ABORT PROCEDURES.

If a serious malfunction occurs on the take-off roll prior to refusal speed, proceed as follows:

1. Announce "abort."
2. Retard all throttles to FLIGHT IDLE.
3. Maintain directional control of the aircraft.
4. Pull the fire handle for the affected engine.
5. Retard all throttles to GROUND IDLE.
6. Reverse symmetrical operating engines.
7. Apply brakes (as required).

TAKE-OFF CONTINUED AFTER ENGINE FAILURE.

WARNING

If a propeller malfunction is suspected proceed with PROPELLER MALFUNCTION PROCEDURES in this section.

If engine failure or fire occurs after reaching refusal speed, the take-off should be continued.

a. Maintain directional control with flight controls and engine power as necessary.

b. When safely airborne and above minimum control speed (V_{mca} out of ground effect) proceed with the ENGINE SHUTDOWN PROCEDURES in this section.

c. When certain that the aircraft will not touch down again, raise gear while accelerating to flap retraction speed.

d. After gear is up and airspeed permits, commence flap retraction.

WARNING

- If obstacle clearance is a consideration, pilots should be aware that obstacle clearance performance data are based on the assumption that gear retraction is initiated 3 seconds after take-off.
- It is necessary to obtain two engine minimum control speed as soon as possible after take-off and prior to raising the flaps above 15 percent.
- Flap retraction should be accomplished in 10-percent increments with airspeed increasing approximately 5 knots between retraction increments. This procedure wll prevent the aircraft from settling during flap retraction at heavy gross weights.

THREE-ENGINE TAKE-OFF.

This type of take-off requires particular caution because of the possibility of losing another engine during the take-off roll prior to reaching minimum control speed.

A three-engine takeoff may be attempted only when all of the following criteria are fulfilled:

1. Permission of commanding officer.
2. Minimum essential flight crew personnel.
3. No passengers or cargo.
4. Fuel as necessary for particular flight.
5. Three-engine take-off procedures are followed.

CAUTION

If the three-engine takeoff is being made because of an inoperative starter and the engine is to be air started, the starter must be removed as it may remain engaged with resultant damage to the starter, engine or aircraft.

A three-engine takeoff can be made with any of the engines inoperative. Refer to the Performance

Chart for three-engine performance data. Use the following procedure for three-engine takeoff.

Note

This procedure is limited to takeoff on a dry, hard surface runway with operable nose wheel steering. The nose wheel must remain on the runway until take-off speed is reached. If the runway is slick, power on the asymmetric engine may be increased as directional control becomes available.

1. Propeller on inoperative engine - Feather.

2. Inoperative engine oil cooler flaps - CLOSE/FIXED.

3. Before Takeoff checklist (section III) - Complete.

4. Flaps - 50 percent.

5. The copilot will maintain wings level with ailerons during the takeoff roll.

6. Adjust the rudder trim to 10 degrees toward the operating asymmetric engine.

7. Set the symmetrical engines to take-off power.

8. Release the brakes and apply and hold full rudder toward the operating asymmetric engine. Advance power for the other operative engine as directional control permits.

9. If nose wheel skipping occurs, reduce power on the asymmetric engine until normal steering is regained. Reapply power to the asymmetric engine as directional control and nose wheel steering will permit.

10. Steer with the nose wheel and do not release nose wheel steering until reaching rotation speed.

11. As soon as airborne, establish 5 degrees bank toward the operating asymmetric engine and continue to hold full rudder.

12. Continue acceleration to a minimum of 135 KIAS.

13. Upon reaching 400 feet or higher begin flap retraction in 10 percent increments. Do not retract the flaps above 15 percent increments until reaching 165 KIAS since additional hydraulic boost pressure is available to the rudder as long as the flap lever is below 15 percent.

CAUTION

Raising the flaps above approximately 15-percent will increase the minimum control airspeed due to reduction in rudder boost pressure from 3,000 to 1,300 psi.

14. Reduce to normal power and continue climb to cruise altitude.

Note

- If the inoperative engine could not be started because of a faulty starter, and if an air start of the inoperative engine is to be made, the starter should be removed prior to take-off.
- Before making the take-off, the propeller for the inoperative engine must be feathered.

SIMULATED THREE-ENGINE TAKE-OFF.

Before making a simulated three-engine take-off, advance the throttle for the simulated inoperative engine to a minimum of 8,000 inch-pounds of torque and then retard to FLIGHT IDLE. This will ensure that the propeller blade angle is on or above the low pitch stop setting. A simulated three-engine take-off should be made only when authorized.

PRACTICE TAKE-OFF ENGINE FAILURE.

If engine failure is simulated before refusal speed is reached:

1. Follow abort procedures as outlined in this section. Simulate engine shutdown procedure as required.

2. Apply symmetrical reverse thrust and brakes as required.

If engine failure is simulated after refusal speed:

1. Maintain directional control with flight controls and engine power as necessary.

2. When safely airborne and certain that the aircraft will not touch down again, raise gear while accelerating to flap retraction speed.

3. After gear is up, and airspeed permits, commence flap retraction.

Note

- Flap retraction should be accomplished in 10 percent increments with airspeed increasing approximately 5 knots between increments. This procedure will prevent the aircraft from settling during flap retraction at high gross weights.
- When air minimum control speed (one-engine-inoperative, in ground effect) is greater than the chart take-off speed, use this air minimum control speed for take-off speed. The obstacle clearance speed for this condition is the air minimum control speed (one-engine-inoperative, in ground effect) plus the difference between the chart take-off speed and the chart obstacle clearance speed. It is desirable to accelerate to the two-engines inoperative air minimum control speed as soon after take-off as feasible and before retracting flaps above the 15 percent flap position.

CAUTION

Raising the flaps above approximately 15-percent will increase the minimum control airspeed due to reduction in rudder boost pressure from 3,000 to 1,300 psi.

4. After gear and flaps are up, continue as a normal take-off, accelerating to three-engine climb speed.

Note

It should be remembered that a practice engine failure does not completely simulate an engine failure. In an actual engine failure, the negative torque required to actuate the engine negative torque control system will be less than flight idle engine torque of a simulated failed engine and add to the yawing tendency of the aircraft until feathering is completed.

PROPELLER MALFUNCTIONS

See PROPELLER MALFUNCTIONS, under INFLIGHT EMERGENCIES in this section.

INFLIGHT EMERGENCIES.

ENGINE FAILURE.

The effect of losing various combinations of engines must be understood and anticipated, because related systems are integrated between the engines (figure 5-4). In all combinations of two-engine failures, watch the generator loading. If generator loading is too high, shut off electrical equipment, as required, to keep loading within the range of available output.

WARNING

Two-engine operation above 120,000 pounds is marginal.

Flight Characteristics Under Partial Power Conditions.

The aircraft has excellent flight characteristics even when an engine is inoperative. All control surfaces are booster-operated, so that no great amount of pilot force is necessary to correct the turning action caused by uneven power conditions. Some trim changes will be required. More rudder deflection will be required at low speed to counteract the unbalanced thrust. With uneven power conditions, the minimum control speed will be limited by the available rudder effectiveness. Failure of an outboard engine may require the reduction of power on the opposite outboard engine. Consult the Performance Data for recommended cruise and climb procedure for two- and three-engine operation. In the event two engines fail and a safe altitude cannot be maintained, jettison fuel and equipment as necessary.

Practice Maneuvers With One or More Engines Inoperative.

Engine failures may be simulated for practice, when desired. To simulate a feathered propeller, retard one or more throttles to FLIGHT IDLE position. The checklist procedure for engine failure can be called out without actually performing the operations named. Practice maneuvers at a safe altitude. Select a base point and set up a simulated field elevation. Traffic patterns can be flown at the normal altitude above this base point.

WARNING

During take-off, or while airborne, do not move the throttles below the FLIGHT IDLE position. Placing any propeller in the taxi range may result in immediate loss of control of the airplane.

During practice feathering, perform engine shutdown by ENGINE SHUTDOWN PROCEDURES in this section. Prior to practice engine shutdown in flight, perform an NTS check as outlined in Section III.

Turns.

Turns can be safely made in either direction with one or more engines inoperative if airspeed is maintained sufficiently high in respect to minimum control speed and stall speed. Banking into the dead engine increases minimum control speeds.

Effect of Speed on Trim.

During engine-out operation, as in all other types of operation, trim is affected by speed. After trim is set, any increase of airspeed increases the effect of the trim tabs. Conversely, any decrease of airspeed reduces the effect of trim tabs.

Landing and Go-Around.

Landings and go-arounds with feathered engines may be simulated at altitude by flying a traffic pattern over a basic altitude. Roll out most of the trim as touchdown point is reached. During a go-around practice, note the altitude lost between the go-around decision and the time the aircraft is safely in a climb condition. Note the aircraft acceleration characteristics during these maneuvers.

two engines inoperative

CAUTION

IN ALL COMBINATIONS OF TWO ENGINE FAILURES, MONITOR GENERATOR LOADING TO KEEP IT WITHIN THE RANGE OF AVAILABLE OUTPUT.

ENGINES INOPERATIVE	SYSTEMS AFFECTED	
	HYDRAULIC	ELECTRICAL
NO. 1 AND NO. 4	ONE PUMP EACH FOR BOOSTER AND UTILITY SYSTEMS WILL BE OUT. OPERATION OF EQUIPMENT WILL TAKE LONGER.	NO. 1 AND NO. 4 GENERATORS OUT.
NO. 2 AND NO. 3	ONE PUMP EACH FOR BOOSTER AND UTILITY SYSTEMS WILL BE OUT. OPERATION OF EQUIPMENT WILL TAKE LONGER.	AUTOMATIC ICE DETECTION SYSTEM WILL BE OUT. DEICING SYSTEMS MAY BE OPERATED MANUALLY. NO. 2 AND NO. 3 GENERATORS OUT. SYNCHROPHASER MASTER WILL BE INOPERATIVE.
NO. 1 AND NO. 2	UTILITY SYSTEM PUMPS WILL BE OUT. WING FLAPS AND MAIN LANDING GEAR TO BE OPERATED MANUALLY. AUXILIARY SYSTEM, AVAILABLE FOR NOSE GEAR EXTENSION. AUXILIARY SYSTEM AVAILABLE FOR EMERGENCY BRAKE OPERATION. FLIGHT CONTROLS BOOST TO BE SUPPLIED BY BOOSTER SYSTEM AT HALF NORMAL FORCE. * **CAUTION** NOSE WHEEL STEERING AND ANTI-SKID ARE NOT OPERATIVE AFTER LOSS OF UTILITY SYSTEM.	NO. 1 AND NO. 2 GENERATORS OUT.
NO. 1 AND NO. 3	ONE PUMP EACH FOR BOOSTER AND UTILITY SYSTEMS WILL BE OUT OPERATION OF EQUIPMENT WILL TAKE LONGER.	NO. 1 AND NO. 3 GENERATORS OUT.
NO. 2 AND NO. 4	ONE PUMP EACH FOR BOOSTER AND UTILITY SYSTEMS WILL BE OUT. OPERATION OF EQUIPMENT WILL TAKE LONGER.	NO. 2 AND NO. 4 GENERATORS OUT.
NO. 3 AND NO. 4	BOOSTER SYSTEM PUMPS WILL BE OUT. FLIGHT CONTROLS BOOST TO BE SUPPLIED BY THE UTILITY SYSTEM AT HALF NORMAL FORCE.*	NO. 3 AND NO. 4 GENERATORS OUT.

* ADDITIONAL RUDDER HYDRAULIC BOOST MAY BE OBTAINED BY MOVING THE FLAP LEVER TO 15 PERCENT, OR GREATER.

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Figure 5-4.

AIR START PROCEDURE.

Before restarting an engine that has been shut down in flight, be sure that the TIT for that engine has dropped below 200° C. Temperature higher than 200° C will increase the likelihood of a hot start. Never move the throttle below the FLIGHT IDLE position in flight. The position of the engine condition lever is assumed to be FEATHER. The engine will normally come up to speed more rapidly if the airspeed is reduced to 180 knots or less. (Refer to Part 4, Section I for engine limits during start.)

CAUTION

- Do not attempt to restart an engine which was shut down because of evidence of fire. Do not attempt to restart an engine which was shut down because of fire warning without evidence of fire, or any other engine malfunction unless, in the opinion of the pilot, a greater emergency exists.

- Do not attempt to restart an engine with an inoperative NTS except in case of a greater emergency. Prior to air start of an engine on which the NTS has been previously determined to be inoperative, reduce the air speed to 130 KIAS and the altitude to below 5,000 feet.

1. Fire handle	IN	CP
2. Throttle	Set approximately one inch above FLIGHT IDLE	P
3. Fuel boost pump switch	ON	FE
4. Generator switches	TEST	FE
5. Oil cooler flap switch	AUTOMATIC	CP
6. Fuel enrichment switch	NORMAL	P
7. Propeller governor control switch	MECH	CP
8. NTS check switch	VALVE	CP
9. TD valve switch	AUTO	FE

10. Condition lever	AIR START	CP

CAUTION

- If, during an airstart at 10 percent rpm, the flight engineer has not called NTS, the copilot will return the condition lever immediately to feather whether or not lightoff has occurred. A second start attempt is not recommended unless, in the opinion of the pilot, a greater emergency exists.
- Normal lightoff should occur by the time engine rpm reaches 30 percent. If the engine does not lightoff prior to reaching 40 percent rpm, discontinue the start and return the condition lever to FEATHER immediately.

Note

- Hold the engine condition lever in AIR START until lightoff, then release to RUN. Monitor engine instruments as on a ground start. Monitor the NTS check light for an NTS indication as indicated by blinking of the light.
- If normal airstart cannot be accomplished because of failure of the propeller to rotate and the blade angle change is indicated by illumination of NTS light, an emergency start may be attempted by using the engine starter to help unlock the propeller blade.

11. Generator switches	CHECKED/ON	FE
12. Engine bleed air switch	OPEN/ON	FE
13. Prop governor control switch	NORMAL	CP
14. Prop resynchrophase switch	RESYNC/NORMAL	FE
15. Engine instruments	Within limits	FE

PROPELLER MALFUNCTIONS.

A propeller malfunction may be caused by electrical or synchrophaser malfunction, or hydraulic malfunction, and will be indicated by one of the following conditions:

Propeller low oil light or visible oil leak

An overspeed or underspeed

RPM surge or fluctuation

Failure of propeller to feather

Note

A tachometer generator failure will give a false indication of propeller failure when underspeeding or fluctuations of speed occur. Refer to Tachometer Generator Failure in this section.

Propeller Malfunctions During Take-off.

Note

Propeller malfunctions during take-off may be difficult to analyze at this most critical phase. If the engine is shut down immediately and the propeller fails to feather, it is possible that higher than normal minimum control speed may result. When fire is not indicated it is recommended that the engine be allowed to run until at least two-engine inoperative air minimum control speed is reached (at least 135 KIAS).

After Refusal Speed.

1. Continue the take-off.

2. Maintain directional control with flight controls and engine power as necessary.

CAUTION

Below two-engine inoperative air minimum control speed, it may be necessary to reduce power on the opposite engine to help maintain directional control.

3. When safely airborne and certain that the aircraft will not touch down, raise the gear while accelerating to two-engine inoperative air minimum control speed (at least 135 KIAS).

4. Place prop governing control switch to MECH GOV.

a. If rpm stabilizes within allowable limits, continue operation in MECH GOV.

b. If overspeed condition exists, accelerate to and maintain 150 knots true airspeed. When a suitable landing area is reached, shut down the engine in accordance with the ENGINE SHUTDOWN PROCEDURES in this section.

c. For other propeller malfunctions see Propeller Malfunctions During Flight in this section.

5. If propeller does not feather, a landing can be made with a windmilling propeller; however, the drag and yawing tendency will be greater than with a feathered propeller, and excessive rpm and noise may be experienced. Maintain airspeed above two-engine inoperative air minimum control speed until landing is assured (at least 135 KIAS).

WARNING

A go-around should not be attempted if airspeed is below two-engine inoperative air minimum control speed (at least 135 KIAS).

6. If a go-around is attempted, follow GO-AROUND PROCEDURES in this section. Go-around with a windmilling propeller may be marginal.

CAUTION

Positioning the flap lever above 15 percent or operating the gear or flaps will increase the minimum control speed due to reduction in available hydraulic pressure.

Propeller Malfunctions During Flight.

WARNING

If uncontrolled overspeed (above 105 percent rpm) occurs, reduce airspeed as rapidly as possible to the speed at which safe control of the aircraft or propeller can be maintained but not less than two-engine inoperative air minimum control speed (at least 135 KIAS). Do not adjust the throttle position for the affected engine before the malfunction has been analyzed.

WARNING

Certain synchrophaser malfunctions may require removing the synchrophaser from its rack. In these situations rapid throttle movement should be avoided as no throttle anticipation is available and a multiple propeller pitchlock is possible.

Note

If offspeed or fluctuating condition occurs and resync operation does not correct the condition, turn off the synchrophaser. Turbulent flight conditions may cause excessive rpm fluctuations.

RPM WITHIN ALLOWABLE LIMITS AND LOW OIL WARNING LIGHT ILLUMINATED.

1. Shut down the engine in accordance with the ENGINE SHUTDOWN PROCEDURES in this section.

RPM OUTSIDE ALLOWABLE LIMITS WITH LOW OIL LIGHT ILLUMINATED.

1. Place prop governing control switch to MECH GOV.

a. If rpm stabilizes within allowable limits, shut down the engine in accordance with the ENGINE SHUTDOWN PROCEDURES in this section.

2. If rpm does not stabilize within allowable limits, perform PITCHLOCK CHECK PROCEDURE.

RPM OUTSIDE ALLOWABLE LIMITS WITHOUT LOW OIL LIGHT ILLUMINATED.

1. Place prop governing control switch to MECH GOV.

a. If rpm stabilizes within allowable limits, continue operation in MECH GOV.

b. If rpm remains outside allowable limits, perform PITCHLOCK CHECK PROCEDURE.

Pitchlock Check Procedure.

1. Slowly move the throttle while maintaining a constant TAS.

a. If the rpm does not follow the throttle, shut down the engine in accordance with the ENGINE SHUTDOWN PROCEDURES in this section.

b. If rpm follows the throttle, operate the propeller in accordance with the following Pitchlock Propeller Operation.

Pitchlock Propeller Operation.

NEW NEW NEW NEW NEW

1. Establish 96 to 98 percent rpm with throttle and/or airspeed adjustment.

2. Continue to operate the propeller while maintaining 96 to 98 percent rpm.

3. When a suitable landing area is reached, descend at an airspeed which will allow 96 to 98 percent rpm to be maintained with throttle adjustment.

Note

- Operating a pitchlocked propeller in the underspeed range, 96 to 98 percent RPM, helps to assure continued positive pitchlock engagement. Maintaining at least 96 percent rpm will assure that the engine compressor bleed valves do not open with resultant loss of engine power.

- If an RPM of at least 96% cannot be maintained when slowing to 150 KTAS, it is reasonable to assume that the propeller is pitchlocked at a high blade angle. Shutdown at the airspeed where 96 percent RPM can no longer be maintained should give acceptable windmilling drag and rpm should the propeller fail to feather. This high blade angle pitchlock case is associated with propeller malfunctions at cruise speed.

- If 96 to 98 percent RPM can be maintained at 150 KTAS, the propeller is at a low blade angle. In this case, shutdown at speeds above 150 KTAS could produce excessive drag and overspeed if the propeller does not feather.

4. During the traffic pattern, attain a speed (not below 150 knots true airspeed) where 96 to 98 percent rpm cannot be maintained with throttle adjustment, and shut down the engine in accordance with the ENGINE SHUTDOWN PROCEDURES in this section.

Note

Shut down at 150 KTAS assures decoupling if propeller fails to feather.

5. If propeller does not feather, a landing can be made with a windmilling propeller; however, the drag and yawing tendency will be greater than with a feathered propeller and excessive rpm and noise may be experienced. Maintain airspeed above two-engine inoperative air minimum control speed until landing is assured (at least 135 KIAS).

WARNING

A go-around should not be attempted if airspeed is below two-engine inoperative air minimum control speed (at least 135 KIAS).

CAUTION

Below two-engine inoperative air minimum control speed, it may be necessary to reduce power on the opposite engine to help maintain directional control (at least 135 KIAS).

6. If a go-around is attempted, follow GO-AROUND PROCEDURES in this section. Go-around with a windmilling propeller may be marginal.

CAUTION

Positioning the flap lever above 15 percent or operating the gear or flaps will increase the minimum control speed due to reduction in available hydraulic pressure.

Propeller Fails to Feather.

If propeller rotation continues after feather has been initiated:

1. Below 150 Knots True Airspeed:

a. Maintain airspeed above two-engine inoperative air minimum control speed (at least 135 KIAS).

b. Use caution when applying asymmetrical engine power.

c. If rotation does not stop, hold feather override button in for 30 seconds and then pull button out.

d. If propeller rotation continues, with no indication of fire, restore oil to the engine by resetting the fire handle.

2. Above 150 Knots True Airspeed:

a. Control propeller rotation and/or overspeeding by slowing aircraft to the minimum safe airspeed, but not less than two-engine inoperative air minimum control speed (at least 135 KIAS).

b. If rotation stops, continue with engine out operation.

c. If rotation does not stop, hold feather override button in for 30 seconds and then pull button out.

d. If propeller rotation continues, with no indication of fire, restore oil to the engine by resetting the fire handle.

Inflight Decoupling of Engine and Propeller.

The reduction gear section decouples from the power section of the engine if a propeller attempts to drive the power section, and the engine negative torque control system fails to operate. As negative torque builds up before decoupling of an engine takes place, aircraft yaw may be noticed. However, there may be little or no difference in aircraft's feel, and the knowledge that an engine has decoupled must be gained from instrument indication. If the decoupling is caused by engine failure or flame out, torque, turbine inlet temperature and fuel flow will drop to near zero, and power section oil pressure will drop. RPM may temporarily increase, then settle to normal. Hydraulic pressure, generator output, and reduction gear section oil pressure will remain normal. Extremely low turbine inlet temperature and fuel flow for a given power lever position, accompanied by fluctuating and near zero torque, may be an indication of a decoupling in which the engine has continued to operate. When decoupling is observed, follow the ENGINE SHUTDOWN PROCEDURES in this section.

CAUTION

Do not restart the engine until the safety coupling has been replaced.

NEW

Throttle Control Cable Failure.

If a failure occurs in the throttle control system, the malfunction could cause the propeller to enter reverse pitch resulting in uncontrollable flight. If failure occurs, the controls may go to either full power or full reverse. An additional indication may be unrelated power changes or throttle movement not pilot initiated. If throttle movement or power changes occur not pilot initiated, a broken throttle control cable should be suspected. Do not move the throttle; immediately shut down the affected engine in accordance with the ENGINE SHUTDOWN PROCEDURES in this section. Adjust power on the remaining engines as required.

WARNING

Do not move the throttle prior to engine shutdown, to do so could cause the propeller to go into reverse pitch.

ENGINE FIRES.

Engine fires are indicated by a steady illumination in the respective fire handle and the master fire warning light on the pilot's instrument panel. In addition to visual warning, fires are indicated by an audible warning. The fire detection system design is such that it is unlikely that the wrong engine would be shut down. If an engine fire is experienced on the ground or in flight, shut down the engine in accordance with the ENGINE SHUTDOWN PROCEDURES in this section.

ENGINE OVERHEATING.

There are four indications of overheating in the engines and nacelles: the engine (turbine) overheat warning light, nacelle overheat warning light, high TIT, and high oil temperature.

ENGINE TURBINE OVERHEAT WARNING.

If an overheat condition is indicated by the flashing of the master fire warning light and/or by the flashing of lights in a fire handle, retard the throttle toward FLIGHT IDLE. If the overheat condition persists, proceed with the ENGINE SHUTDOWN PROCEDURES in this section.

NACELLE OVERHEAT WARNING.

When an overheat warning is indicated by a nacelle overheat warning light on the copilot's instrument panel, proceed with the ENGINE SHUTDOWN PROCEDURES in this section.

HIGH TURBINE INLET TEMPERATURE.

Should an overtemperature be indicated by a high TIT, retard the throttle for the affected engine toward FLIGHT IDLE, and place the temperature datum control switch in the NULL position. If this fails to eliminate the overtemperature condition, proceed with the ENGINE SHUTDOWN PROCEDURES in this section.

HIGH OIL TEMPERATURE.

For corrective action to be taken in case of high oil temperature, see ENGINE OIL SYSTEM FAILURE in this section.

ENGINE SYSTEMS FAILURE.

TD Control Valve System Malfunction.

A malfunction of the TD control valve system of an engine may cause a sudden increase or decrease in TIT with an accompanying change in torque and fuel flow indication. If this condition occurs during stabilized operation, place the TD control valve switch for that engine in the NULL position. If TIT stabilizes and returns to near normal, place the switch in the LOCKED position, and continue operation. If the malfunction persists, other engine systems are at fault. Monitor TIT closely during NULL operation as maximum TIT can often be exceeded at advanced throttle settings under these conditions.

Secondary Fuel Pump Pressure Light Illumination.

Illumination of the secondary fuel pump pressure light other than during engine start cycle may be caused by failure of the engine driven primary fuel pump or failure of the speed sensitive control.

If the light extinguishes when the ignition control circuit breaker for the corresponding engine is pulled, failure of the speed sensitive control is indicated. Leave circuit breaker pulled and continue operation. If the light remains illuminated when the ignition control circuit breaker is pulled, primary fuel pump failure is indicated. Reset ignition control circuit breaker.

Note

The ignition control circuit breaker must be reset before normal engine shutdown on the ground.

Engine Oil System Failure.

The indications of an engine oil system failure that may lead to engine failure are: loss of oil pressure or an oil temperature increase. High oil temperature may result from failure of an oil cooler flap to function in AUTOMATIC. To correct this, hold the oil cooler flap switch in the OPEN position until the oil cooler flap is open. Thereafter, manually open or close the oil cooler flaps as required to maintain normal engine oil temperature. The low oil quantity warning light glows when the oil level in a tank drops to approximatley 4.0 gallons. This condition warrants careful monitoring of the engine instruments for the engine with the low oil quantity gage reading, but no corrective action is required as long as the engine instrument readings are within limits. In case of a loss of oil pressure, shut down the engine in accordance with the ENGINE SHUTDOWN PROCEDURES.

CAUTION

If engine oil pressure loss was caused by a negative g condition, and gearbox and engine oil pressures do not return to normal within 10 seconds after returning to a positive g condition, shut down the engine in accordance with the ENGINE SHUTDOWN PROCEDURES. After the propeller stops rotating, an air start may be attempted according to the AIR START PROCEDURE in this section.

Tachometer Generator Failure.

A tachometer generator failure may be indicated by the following simultaneous indications:

Decrease or fluctuation of rpm.

Increase or fluctuation of fuel flow.

Decrease or fluctuation of torque.

If the above occurs, place the propeller governor control switch for the affected engine in the MECH GOV position. The engine need not be shut down unless fluctuations persist. (Refer to PROPELLER MALFUNCTION DURING FLIGHT in this section.)

CAUTION

If a tachometer generator failure occurs on the engine selected as the master engine, place the syncrophase master switch to the unaffected master engine position. Then place the affected master engine propeller governor control switch to MECH GOV.

FUEL SYSTEM FAILURE.

Fuel Boost Pump Failure.

In the event of a fuel boost pump failure as indicated by a low pressure warning light/tank empty light in a tank containing fuel:

1. Verify failure by use of the fuel pressure indicator.

2. Turn off boost pump switch.

3. Pull boost pump circuit breakers.

4. Set up another fuel supply if required.

5. If popout of A, B, or C phase circuit breaker is observed, complete steps 2, 3, and 4 above.

WARNING

- The fuel boost pump switch should not be turned on or the circuit breakers reset until proper inspection and repairs have been performed. Resetting of the circuit breakers and turning the switch on should be considered only to prevent fuel starvation of the engines when a landing can not be accomplished within the range of available fuel.
- If a main boost pump failure occurs during climb, crossfeed the engine from another tank and continue climb to mission altitude. Allow the fuel to stabilize for several minutes, then switch the engine back to the tank with the inoperative boost pump; closely observe fuel flow, TIT, and torque. If the engine operates satisfactorily in this condition, continue the mission as planned; if the engine will not operate satisfactorily in the tank-to-engine position, switch back to crossfeed operation.

Note

> When operating in tank-to-engine position, with an inoperative boost pump, avoid rapid acceleration or nose low attitudes. Descents should be made with minimum nose down attitude. If a high rate of descent is required, it is advisable to select crossfeed operation.

Wait several minutes and repeat preceding step. If engine fails to operate satisfactorily return to crossfeed operation. At this time it may be necessary for the pilot to change his flight plan to avoid major fuel unbalancing and loss of range due to unavailable fuel. If the mission can be accomplished at a lower altitude, descend until the engine will run satisfactorily on tank-to-engine flow.

Do not select crossfeed unless the crossfeed system is pressurized by operating boost pumps in other tanks.

Gradual power losses will occur between 12,000 feet and 20,000 feet during rapid climb out to an engine without boost pump pressure; this altitude will vary with the prevailing fuel temperature and type of fuel in the tanks (the higher the fuel temperature, the lower the altitude at which the power loss will occur). This condition results from the highly aerated condition of the fuel caused by rapidly decreasing atmospheric pressure during climb, allowing entrapped air in the fuel to expand. The period of time required for the fuel to stabilize from this aerated condition will depend upon both the rate of climb and fuel temperature.

Fuel stabilization should occur in a few minutes after level off at cruise altitude once the excess air has escaped from the fuel. Maximum power settings can be maintained up to altitudes of 30,000 feet with a boost pump inoperative if nose up or nose down attitude and rapid acceleration are avoided. Fuel aeration does not occur during descent. If a boost pump is lost, it may result in fuel starvation for the affected engine in an extreme nose-down attitude unless crossfeed operation is used. It is impossible to gravity feed fuel from a tank with an inoperative boost pump through the crossfeed system to another engine. If a partial tank and an empty tank are on crossfeed with the boost pump inoperative in the partial tank, the engine being fed from the empty tank will be starved by air being drawn into the fuel line.

Fuel Quantity Indicator Failure.

This system is designed as an electrically inert capacitance system specifically designed to eliminate the possibility of arcing from electrically charged components within the aircraft's fuel tank system. The cockpit fuel quantity indicator requires 115 volts 400 Hz power for proper operation. With the appropriate sequence of failures, the fuel probes, coax cable and associated wiring can operate as a vehicle for the introduction of high voltage power into the aircraft's fuel tank system

The fuel quantity indicator, electrical connectors, fuel probes and associated wiring should be operative before the aircraft is released for flight. If any of these components are inoperative by incomplete maintenance action, the following condition must be complied with for release of the aircraft for flight:

Pull and tag the fuel quantity indicator circuit breaker for that associated tank.

Inflight Failure.

A malfunction of any fuel quantity indicator is indicative of a possible failure that would, with the proper sequence of events, allow the introduction of high voltage electrical power into that associated aircraft fuel tank. In the event that a fuel quantity indicator goes to off scale high or off scale low, the following actions must be complied with:

Pull the associated fuel quantity indicator circuit breaker. Clamp the circuit breaker with a lock.

WARNING

> The fuel quantity indicator must not be swapped or the circuit breaker reset until proper inspection and repairs have been made. The aircraft may be flown on a subsequent flight with a malfunctioning indicator provided the circuit breaker remains pulled and the circuit breaker pin lock is installed.

External or Auxiliary Tank Crossfeed Valve Failure.

If an external or auxiliary tank crossfeed valve fails to open when crossfeed operation from that tank is desired, open the bypass valve for that tank and the operative external or auxiliary tank crossfeed valve on the same side.

External or Auxiliary Tank Dump Valve Failure.

If an external or auxiliary tank dump valve fails to open when fuel dumping from that tank is desired, the fuel may be dumped through the bypass valve and the operative dump system for the external or auxiliary tank on that side.

External Tank Boost Pump Failure.

If an external tank empty light illuminates when its respective quantity gage indicates fuel aboard, it can be due to failure of the pump or one of several other components. To locate the failure, first turn on the tank's alternate pump and turn off the one used when the light illuminated. If the light goes out, illumination was due to failure of the pump previously used.

However, if the light remains illuminated, go on main tank feed for all engines and check the external tank pump pressure on the manifold pressure gage. Open the crossfeed separation valve and close all crossfeed valves except for the external tank being checked. Check pressure from each of the pumps in the external tank. The crossfeed prime button may be used to bleed the crossfeed pressure to zero between checks.

If no pressure is obtained, the pump is inoperative. If both pumps are inoperative, fuel remaining in that tank will not be available and the flight must be altered accordingly. If a pressure of approximately 28 psi is indicated, the pumps are operating properly, and the pressure sensing external tank empty light switch is malfunctioning. Flight may be continued normally except that the quantity gage for that tank must be monitored to determine an empty condition. A pressure of less than 28 psi on a single boost pump is an indication of a possible failure. Operation under these conditions may be continued with caution, except that other boost pumps supplying pressure to the same manifold must be turned off to allow the tank with the lower boost pressure to dominate.

Refer to Part 4, Section I for allowable fuel unbalance.

FUEL DUMPING.

A fuel dump system is provided to enable all fuel (except approximately 1,600 pounds from each of the main tanks) to be dumped overboard. Should it become necessary to dump fuel in preparation for an emergency landing, to reduce gross weight in an emergency, or to provide for additional buoyancy in a ditching operation, follow the procedure outlined below:

1. Advise an air traffic control facility of the intentions to dump fuel.
2. Set the fuel system for tank-to-engine flow.

WARNING

> If the fuel dump switches for the auxiliary or external tanks are placed in the DUMP position while those tanks are supplying fuel to the engines, the respective tank crossfeed valves are automatically closed, shutting off fuel flow to the crossfeed manifold.

3. Turn all unnecessary radio equipment off.
4. Turn the radar off.
5. Turn all unnecessary electrical equipment off.
6. Turn off the anti-collision light.
7. Do not operate the landing lights.
8. No smoking while dumping.
9. Do not use wing and empennage anti-icing.
10. Place the fuel dump switches in the DUMP position.

Note

> Dump opposite tanks at the same time in order to maintain lateral balance.

11. Monitor the fuel quantity indicators closely.
12. Return the fuel dump switching to NORMAL when the fuel quantity in each tank has been decreased as required. With all eight fuel

dump switches in the DUMP position, fuel will be jettisoned at a rate of approximately 3,700 pounds per minute. The following procedures are recommended when dumping fuel if conditions permit:

Do not dump fuel under 6,000 feet above the terrain. This will prevent the possibility of a ground source igniting the fuel vapors.

Do not dump in a circular pattern; this will prevent turning into the dropping fuel.

Avoid engine power changes. Static charges could conceivably build up and ignite the fuel.

Note

After completing fuel dumping and if time permits prior to landing, the fuel dumping manifold should be cleared of residual fuel. Cross-controlling the aircraft and ensuring a wing-low attitude with slight skid, will deplete all residual fuel except that located at low points in the manifold. This will minimize the fire hazard of excessive fuel drainage coming from the fuel dumping jettison mast due to normal wing deflections and attitudes during taxi or while the aircraft is parked.

13. After the dumping operation, inspect the aircraft for fumes.

ELECTRICAL SYSTEMS FAILURE.

With modern complex aircraft, it is extremely difficult to anticipate all the possible electrical failures and to plan corrective action and procedure for each failure. However, a broad analysis of the situation indicates that failures fall into three possible categories:

Loss of one or more of the primary power sources.

Faults on the main bus or distribution system.

Faults within equipment items.

Faults in the distribution system and load circuits should be controlled through protective devices such as circuit breakers, fuses, and current limiters. Should one of these devices fail to operate, considerable smoke can result and some emergency action on the part of the crew may be needed.

CAUTION

Circuit breakers after popping may be reset once, except as noted in this section. Clamp and tag any circuit breaker that will not reset. Any circuit breaker that pops shall be recorded in the yellow sheet.

Loss of the essential ac bus is unlikely. Loss of one or more of primary power sources, however, will require the crew to take prompt action by closely watching electrical loads, so that the remaining power sources will not be overloaded.

Illumination of BAT DISCH Light.

Shutdown all equipment possible that receives power from the isolated DC bus. The BAT DISCH light on indicates that the battery charge is being depleted by the isolated DC bus loads due to failure of the reverse current relay.

Illumination of an AC BUS OFF Light.

When an ac bus off light illuminates, place the respective generator switch to the OFF position and monitor the loadmeter for the generator assuming the load. The low voltage condition may have been caused by a malfunctioning voltage regulator, generator, or bus fault. Monitor the bearing failure light for the affected generator. If the bearing failure light illuminates, disconnect the generator.

Generator Failure.

Generator malfunctions can result from mechanical failure or electrical faults within the generating system. Mechanical failures which cause the rotor to contact the stator will be indicated by illumination of the generator bearing failure light. Electrical faults which disconnect the generator from the bus will be indicated by illumination of the generator out light.

CAUTION

The bearing failure light is an indication of mechanical failure of the generator and is not always coincident with a generator out light.

Illumination of a Generator Out Light.

Illumination of a generator out light indicates the generator contactor for that generator is not energized.

1. Set the generator control switch to TEST. Monitor the generator voltage and frequency.

2. If the generator voltage and frequency are normal on all three phases, resume normal operation.

3. If the generator voltage and frequency are not normal assume that the generator has failed. Turn the generator off and monitor the failure light.

Illumination of a Generator Bearing Failure Light.

1. Generator disconnect switch—place to DISC position.

CAUTION

After placing disconnect switch to DISC position, place corresponding generator control switch on the 50- or 90-KVA generator control panel to OFF/RESET then TEST position and check for frequency/voltage indication. If frequency/voltage is indicated, disconnect has not occurred, and an engine shutdown shall be made. If the generator disconnect switch has been activated during engine operation, the engine shall not be restarted until the generator has been removed unless a greater emergency necessitates such action. Monitor electrical loads so that remaining power sources will not be overloaded.

Note

Placing the corresponding disconnect switch to DISC will mechanically shear the generator shaft from the accessory drive. The generator cannot be reconnected in flight.

Upon illumination of a bearing failure light while on the ground, proceed as follows:

2. Throttles to ground idle.

3. Engine condition lever for affected engine to ground step.

Loss of Electrical Systems.

The possibility of the loss of all electrical systems is very remote. In the event of a complete loss of electrical power, the following systems will be operable.

Flight instruments:

Altimeter

Airspeed Indicator

Magnetic Compass

Attitude Director Indicator (slip indicator portion)

Vertical Velocity Indicator

Accelerometer

Engines and Propellers:

Engine shutdown can be accomplished only by placing condition lever to FEATHER.

Full throttle control (no TD system)

Tachometer

Propellers will go to mechanical governing

Anti-Icing and De-Icing:

Engine air inlet scoop anti-icing

Pressurization and Air Conditioning:

EC-130G and EC-130Q aircraft BuNo 156170—156177.

Note

On EC-130Q aircraft BuNo 159348 and 159469, the engine bleed air regulators shut off the flow of air when deenergized.

Flight Controls:

Normal boost (rudder boost pressure reduced to low boost)

Wing flaps

Note

Due to the loss of power to the trim tab system, a no flap landing is recommended.

Fuel available from main tanks:

Normal brake system (no anti-skid)

Nose wheel steering

Landing gear system

Emergency lights

Oxygen system

Aft cargo door and ramp system (manual)

ATM COMPARTMENT OVERHEAT WARNING LIGHT.

When the ATM compartment overheat warning light illuminates, immediate steps to correct the overheat condition must be taken as follows:

Turn ATM generator switch to OFF.

Turn the air turbine motor switch to STOP.

If the overheat light does not go out in approximately one minute, close both wing isolation valves. This will isolate the ATM duct system.

WARNING

Closing the isolation valves will stop the airflow to both the flight deck and cargo compartment air conditioning units and depressurize the aircraft.

CAUTION

The wing isolation valves should not be reopened once they have been closed for an overheat condition. Damage to the warning system may prevent detection of a subsequent overheat condition.

CARGO COMPARTMENT REFRIGERATOR OVERHEAT WARNING LIGHT.

When the cargo compartment refrigerator overheat warning light illuminates, immediate steps to correct the overheat must be taken as follows:

Turn the air conditioning shutoff switch for the cargo compartment to the OFF position.

If the warning light does not go out in approximately one minute, position both wing isolation valve switches to the CLOSED position. This will isolate the ducts to the cargo compartment and should eliminate the overheat condition.

WARNING

Closing the isolation valves will shut off the air supply to both air conditioning units and depressurize the aircraft.

CAUTION

The wing isolation valve or the cargo compartment air conditioning shutoff valve should not be reopened once they have been closed for an overheat condition. Damage to the warning system may prevent detection of a subsequent overheat condition.

BLEED AIR DUCTING FAILURE.

A rupture of the bleed air manifold may be indicated by a simultaneous loss of torque on all engines supplying bleed air, depending on the location of the rupture. Additional indications may include the master fire warning light, an ATM compartment overheat light, an unsafe gear indication and/or visual evidence of fire in the wheel well or wing area. If a combination of these conditions indicates a bleed air ducting failure, proceed as follows:

1. Isolate the affected duct.

If the leaky duct cannot be determined proceed as follows:

2. Close both wing isolation valve switches to isolate wing areas.

WARNING

- Closing the isolation valves will stop the airflow to both the flight deck and cargo compartment air conditioning units and result in depressurization of the aircraft.
- A bleed air leak in the nose wheel well area due to a failure of the radome anti-icing bleed air ducting may result in overheating and/or explosion of the nose gear tires or the liquid oxygen converter or a fire as a result of hot bleed air igniting hydraulic fluid. Any combination of the following may indicate a bleed air leak in this area: Zero or fluctuating liquid oxygen quantity, inoperative or intermittent radar operation and/or a partial loss of cabin pressurization.

3. Shut off the engine bleed air for all engines to depressurize the bleed air manifold.

WARNING

- Positive closing of the engine bleed air valve/regulator must be determined by observing torque increase when closing the corresponding engine bleed air valve.
- If an engine bleed air valve/regulator fails to close with a blown or leaking pneumatic duct, it may be necessary to follow ENGINE SHUTDOWN PROCEDURES in this section for that engine to prevent fire in the area of the leaking or blown duct.

4. If visual evidence of fire exists, those crewmembers not required to control the aircraft shall immediately begin to fight the fire. NATOPS procedures for firefighting and removal of smoke and fumes shall be followed.

5. Land the aircraft as soon as possible.

CAUTION

Do not operate the system until the cause of malfunction has been determined. The warning system may have been damaged and subsequent overheat/fire conditions will not be detected because the warning lights will not come on.

EMERGENCY OPERATION OF CABIN PRESSURIZATION SYSTEM.

Two types of pressurization system failures may occur. One type can result only from failure of the outflow valve in a closed or nearly closed position when it cannot be opened either by automatic or manual control methods. In this case, cabin pressure might increase at an excessive rate and could not be reduced by normal means. If this condition is encountered proceed as follows:

1. Immediately shut off engine bleed air, one engine at a time, until the rate of pressure increase is at a safe value.

2. Control pressure by using engine bleed air as necessary to vary the amount of conditioned air supplied for pressurization.

3. If necessary for further control when descending, one of the air conditioning systems can be shut down to expedite depressurization of the aircraft. If the flight deck unit cannot be shut down normally, manually override the flight deck refrigeration shutoff valve by pulling it to the out position to stop the air flow.

The other type of pressurization system failure is loss of ability to pressurize or maintain pressurization on either automatic or manual control and may result from any of several causes. If this situation is encountered, proceed as follows:

1. The crew should don oxygen masks immediately while instituting a descent.

2. Descend to or maintain an aircraft altitude where oxygen is not required.

3. Check for excessive cabin leakage by checking doors, windows, hatches, and the safety valve.

WARNING

Do not attempt to lock or unlock any window, door, or hatch while the aircraft is pressurized. First, depressurize the aircraft; then turn the air conditioning master switch to AUX VENT.

4. Check the bleed air system for excessive external leakage. Turn off all pneumatic systems, and observe the bleed air pressure gage. Close all engine bleed air valves, and time the bleed air system pressure drop from 65 to 35 psi. The time required for the pressure to drop from 65 to 35 psi should not be less than 15 seconds.

EMERGENCY OPERATION OF AIR CONDITIONING SYSTEMS.

If a system is leaking hot bleed air into the aircraft, it should be shut down immediately. If the system cannot be shut off, because of regulator malfunctioning, and it is leaking bleed air, the engine bleed air valves must be closed to depressurize the bleed air system.

EMERGENCY OPERATION OF LEADING EDGE ANTI-ICING SYSTEM.

An emergency condition arises if any of the leading edge anti-icing regulators malfunction so that they allow an overtemperature condition. The condition is indicated by the anti-icing temperature indicators and overheat warning lights.

Wing Leading Edge Overheat.

1. Immediately position the wing anti-icing switch to OFF.

2. If the affected leading edge section temperature indicators do not return to normal readings with the system off, or if the over-temperature warning light does not go out within approximately one minute, shut off the affected wing engine bleed-air, one engine at a time, and close the wing isolation valve for that wing.

WARNING

- Shutting off all engine bleed air will shut off the air supply to both air conditioning units and depressurize the aircraft.
- Prolonged leading edge overheat may result in a wing fire.

3. If anti-icing is necessary, engine bleed air may be used as necessary provided the leading edge temperatures do not go above the normal operating range. After landing, an inspection is required for heat damage.

Empennage Leading Edge Overheat.

1. Immediately position the empennage anti-icing switch to OFF.

2. If the empennage temperature indicator does not return to normal reading with system off, or the over-temperature warning light does not go out within one minute, shut off all engine bleed air one engine at a time.

WARNING

Shutting off all engine bleed air will shut off the air supply to both air conditioning units and depressurize the aircraft.

3. If anti-icing is necessary, engine bleed air may be used as necessary provided the leading edge temperatures do not go above the normal operating range. After landing, an inspection is required for heat damage.

WING FIRE.

If a fire develops in the wing, notify the crew and proceed as follows:

1. Close the wing isolation valve and shut-off engine bleed air for engines on that wing.

2. Sideslip the aircraft to keep the fire away from the fuselage.

3. Land the aircraft or bailout as soon as possible.

CAUTION

The wing isolation valves should not be reopened once they have been closed for an overheat condition. Damage to the warning system may prevent detection of a subsequent overheat condition.

ELECTRICAL FIRE.

Because of the important part electrical controls play in the operation of this aircraft, electrical power should not be shut off until the Pilot is reasonably certain that it is, or will be, a contributing factor to smoke or fire, and that the loss of electrical controls will not be a greater hazard than the smoke or fire. In case the fire originates in a nacelle, refer to procedures given under ENGINE FIRES for extinguishing the flame. Turn the generator control switches for generators in that nacelle to the OFF position. If fire occurs in other areas, and electrical wiring or equipment is suspected as a potential hazard, open all circuit breakers to equipment in the area containing the fire, other than that equipment which is absolutely essential for flight. It should be noted that any short circuit will probably open the appropriate protective device, reducing the possibility of fires. If the source of fire can be determined, the nonaffected circuit breakers should be pushed in.

FUSELAGE FIRE (KNOWN OR SUSPECTED).

Any crewmember, detecting or suspecting any fire, shall immediately alert the flight station. Upon alert, notify the crew and proceed as follows:

1. OXYGEN	AS REQUIRED	ALL

WARNING

Prolonged exposure (10 minutes or more) to high concentrations (pronounced irritation of eye and nose) of bromotrifluoromethane (CF_3BR) or its decomposition products should be avoided. CF_3BR is an anesthetic agent of moderate intensity that can produce feelings of unsteadiness and giddiness. In confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

Note

For 100 percent oxygen on portable bottles, leave the control knob at NORMAL.

2. PRESSURIZATION	AS REQUIRED	FE
3. DESCENT	AS REQUIRED	P

Note

Good judgment should be exercised before deciding on an emergency descent in case of fuselage fire. When oxygen is provided for the entire crew, staying at high altitude and depressurizing may help to control fuselage fires.

4. ACTIVATE FIRE BILL	AS REQUIRED	P

Note

To minimize the fire hazard, it is advantageous to discharge the required amount of agent in the minimum possible time.

5. **SECURE COMM CENTRAL** — **AS REQUIRED** — **P/ACO**

CAUTION

- Pilot should exercise discretion in securing power to COMM CENTRAL. When COMM CENTRAL is secured, the ACS will be unable to transmit emergency messages.
- Before returning the master switch for the 90 KVA generator to normal, turn the individual generator switches to TEST to prevent damage to aircraft equipment.

Note

- Control power for HF-1 is secured from the flight station.
- If it is necessary to secure total power to Comm Central, turn off the master switch on the 90 KVA panel and the No. 4, 50 KVA generator.

6. Upon completion of fire bill and extinguishing of fire, return all except faulty equipment to normal operating position.

CAUTION

Any electrical equipment that has been secured by the use of circuit breakers should be turned off with the use of its power switch prior to resetting circuit breakers for the electrical component.

7. Eliminate smoke and fumes (see Smoke and Fumes Elimination in this section).

CREW RESPONSIBILITY, FIRE BILL

During pre-mission briefing, if all crew positions are not filled, those duties assigned to the position shall be delegated to another crewmember.

STATION	DUTY
1. Pilot	Turn PA system on and notify crew to activate fire bill.
2. Copilot	Assist pilot as required.
3. Flight Engineer	Remain at station and isolate systems as required
4. Navigator	Wake sleepers on flight deck, obtain aircraft position, draft emergency message and pass to co-pilot and Comm Central. Ensure that PA System is selected for ALL position.
5. Off-Duty Flight Engineer	Obtain fire bottle and portable oxygen bottle from forward side of flight station bulkhead. Inspect area under flight station and aft side of flight station bulkhead. If fire/smoke source is not found, return to station.
6. Third Pilot	Report to assigned station, go on station oxygen, and assist flight deck personnel as directed.
7. Crewmember	Go on oxygen and be prepared to assist as directed.
8. ACS	Acknowledge pilot's order to activate fire bill. Wake sleepers in crew lounge area, return to station, go on oxygen, inspect station and report when Comm Central personnel are on oxygen. Be prepared to transmit emergency message, secure Comm Central System if directed, and be prepared to assist station 13 (off duty tech).
9. ACO	Acknowledge pilot's order to activate fire bill. Obtain outboard portable oxygen bottle from the aft bulkhead of crew lounge. Report when crew lounge personnel are on oxygen. Direct crew efforts in locating and fighting fire, and keep the pilots informed of progress at all times.

WARNING

Remove personnel overcome by smoke/fumes from scene of fire before administering oxygen.

10. ACOM	Go on oxygen, inspect station, and be prepared to transmit an emergency message as directed.
11. CREWMEMBER	Go on oxygen and be prepared to assist as directed.

12. ON-DUTY TECH	Go on oxygen, inspect station, and be prepared to transmit an emergency message as directed.
13. OFF-DUTY TECH	Obtain inboard oxygen bottle from aft bulkhead of crew lounge. Go on portable oxygen and check galley area. Go to forward starboard side of Comm Central and remove overhead panel adjacent to the forward Comm Central bulkhead. Obtain assistance from ACS if needed. Replenish oxygen as needed from oxygen refill hose on 245 bulkhead, visually inspect overhead equipment bay for fire/smoke source. Remove other panels as necessary. Should fire/smoke source be located elsewhere, refill oxygen bottle, return to station 13 and go on station oxygen. Be prepared to assist station 15 and 16 as necessary.
14. ACOM	Go on oxygen, inspect station, be prepared to transmit an emergency message.
15. REEL OPERATOR	Wake sleepers in aft compartment. Obtain portable oxygen bottle from aft of the starboard paratroop door and obtain fire bottle from top of reel assembly. Inspect equipment along port passageway including OZ-1 equipment racks 3 and 4 for fire/smoke source. After inspecting area, return to station 15 and go on station oxygen.
16. REEL OPERATOR	Acknowledge pilot's order to activate fire bill. Wake sleepers in aft compartment and obtain oxygen bottle from aft of the starboard paratroop door. Report when aft compartment personnel are on oxygen. Obtain fire bottle from aft enclosure wall of the OG-127 Amplifier/Coupler. Inspect equipment along starboard passageway including OZ-1 equipment racks 1 and 2 for fire/smoke source. After inspecting area, return to station 16 and go on station oxygen.
17. CREWMEMBER 18 19 20 21 22	Proceed to stations. Go on oxygen. Be prepared to assist ACO and/or station 15 and 16.

Note

Portable bottles will be used unless aircraft stations 17-20 are equipped with oxygen regulators.

SMOKE AND FUME ELIMINATION.

If smoke or fumes are detected in the aircraft, notify crew and proceed as follows:

1. OXYGEN	ON/100 PERCENT	ALL

Note

For 100 percent oxygen on portable bottles, leave the control knob at NORMAL.

If the aircraft is pressurized, proceed as follows:

2. PRESSURIZATION	**EMERGENCY DEPRESSURIZE**	**FE**

WARNING

If oxygen equipment is not available for all crewmembers, descend to a lower altitude before actuating the emergency depressurization switch. If the emergency depressurization switch fails, pull the emergency depressurization control handle.

3. DESCENT	**AS REQUIRED**	**P**
4. Engine bleed air switches	CLOSE/OFF	FE

NEW

After depressurization is completed, proceed as follows:

5. Air conditioning master switch	AUX VENT	FE
6. Flight station emergency escape hatch	OPEN	FE
7. Paratroop doors	OPEN	RO/O

WARNING

- If flammable fumes are present, electrical equipment not required to complete the above procedure should not be turned on or off until fumes are eliminated.
- The RO/O shall wear a restraining harness when opening the paratroop doors.

INFLIGHT DOOR WARNING.

When the door warning light illuminates, notify crew and proceed as follows:

1. OXYGEN	AS REQUIRED	ALL
2. PRESSURIZATION	BEGIN DEPRESSURIZATION	FE
3. DESCENT	AS REQUIRED	P

Note

If range is an important consideration, the pilot may elect to have the flight crew go on oxygen, the aircraft depressurized, and the door inspection made at altitude.

4. Seat belts	Fastened	ALL
5. Doors	Checked	FE, RO/O

WARNING

The reel operator will immediately notify the crew to fasten their safety belts, and fasten his safety belt upon notification of a door warning light. If any crewmember observes an individual door warning light, he will notify the pilot which light has illuminated. If it is not determined which light illuminated, or if the light goes out during depressurization, the aircraft shall be completely depressurized before making a door check. If it is determined that the light illuminated for a paratroop door or the aft cargo door, complete depressurization will be at the discretion of the pilot.

6. Master door warning light switch — OFF — FE, RO/O

WARNING

Do not unlock any door with the aircraft pressurized. After depressurization, place the air-conditioning master switch to AUX VENT. The flight engineer and reel operator/observer will check the doors wearing a parachute or restraining harness. The restraining harness shall be worn to check the crew entrance door. If it cannot be determined what caused the door light to illuminate, the flight may be continued with partial pressurization (below the point where the light illuminates) and with all personnel secured by a safety belt, at the discretion of the pilot. If the doors are secure and the trouble is determined to be a limit switch, the aircraft may be fully pressurized.

INFLIGHT RELEASE OF LIFERAFT.

If severe vibration occurs in flight, cause unknown, immediately retard power and decrease speed. Lower the flaps, and have a crewmember make a visual inspection of the liferaft compartments and tail through a rear cargo compartment window. (The absence of a liferaft should be noticeable through one of the inspection windows provided on the lower sides of the liferaft compartments.) If a raft has released and lodged on the tail, "fish-tail" the aircraft slightly, or execute a shallow banking maneuver right or left. Make an emergency landing at the nearest suitable base, and conduct a thorough inspection.

WINDSHIELD AND WINDOW FAILURE.

If the inner or outer pane of the windshield or aft compartment windows crack during flight, reduce the cabin differential pressure to 10 inches of mercury or less. If both panes of the windshield crack, flight may be continued at 10 inches of mercury or less; however, if both panes of an aft compartment window crack, reduce the cabin differential pressure to zero.

WARNING

With NESA anti-icing inoperative, limit aircraft speed to 187 KIAS below 10,000 feet.

NEW NEW NEW

RAPID DECOMPRESSION.

If pressure loss is uncontrollable notify crew and proceed as follows:

1. OXYGEN	ON/100%	ALL
2. PRESSURIZATION	AS REQUIRED	FE

3. DESCENT AS REQUIRED P

WARNING

The flight engineer should make an inspection of the fuselage during descent (using a walk-around oxygen bottle and wearing a parachute or restraining harness) to determine what caused the decompression and the extent of any damage.

CAUTION

Type of descent is dependent upon degree of structural damage; use rapid descent (gear and flaps up) without structural damage, or rapid descent (gear and flaps down) when structural damage necessitates. If pressure loss occurred because of structural failure, the flight will be completed at a safe speed determined by the pilot. Any suspected or known structural failure may cause aircraft control problems, and will require a check of aircraft controllability prior to landing.

HYDRAULIC SYSTEMS FAILURE.

Illumination of Any Hydraulic System Warning Light.

1. Turn off all pump switches for the affected system.

2. Check fluid level in reservoir.

3. Isolate unit causing trouble, if possible.

4. If trouble is found, restore system pressure. If trouble is not found, leave switches for affected system off.

Engine-driven Pump Failure Verified.

When the engine's pump low pressure warning light illuminates:

1. Turn the applicable pump switch to OFF.

CAUTION

An actual internal engine pump failure can lead to a flight hazard for the following reasons:

There is approximately one gallon of hydraulic fluid trapped in the isolation circuit and a line or pump rupture can dump this fluid in the nacelle.

The engine-driven pump is geared directly to the engine and if the shear neck of the pump drive spline does not separate (mainly to protect the engine gearbox), the pump can disintegrate internally and this metal-to-metal disintegration can generate enough heat to cause a fire hazard.

Because of these hazards, pilot's discretion should be exercised as to the need of an actual engine shutdown.

WARNING

In the event utility or boost hydraulic pressure in excess of 3,450 psi is indicated, do not shut off the individual hydraulic pump switches. If the hydraulic pump switches are shut off, the pressure line between the hydraulic pump and the shutoff valve is isolated from its means of pressure control. Excessive pressure will build up until the hydrualic pump or line ruptures, dumping this fluid into the engine nacelle. If the hydraulic pressure exceeds 3,450 psi it is recommended that the engine be shut down using the condition lever.

Suction Boost Pump Failure Verified.

The electric suction boost pumps operate on ac power supplied through the essential ac bus. Power will be available to the pumps as long as any one of the four 50 KVA generators or the ATM generator is operating. In flight, loss of boost pump operation may be indicated by illumination of the suction boost pump pressure off light, and the only noticeable difference in hydraulic system operation will be that pressure will drop approximately 100 to 200 psi below normal and that additional time will be required to cycle controls.

1. Turn off suction boost pump.

2. Check hydraulic fluid level and respective system static pressure.

a. If fluid level is normal and system pressure reads 2,500 psi or above, leave switch OFF and continue system operation.

b. If fluid level has decreased or system static pressure reads less than 2,500 psi, turn off all pump switches for the affected system.

Utility System Failure.

Failure of the utility hydraulic system will result in loss of normal landing gear extension and retraction, flap retraction and normal extension, normal brake supply, nose wheel steering, and half the power supplied to the flight controls. In each case, alternate provisions are made for essential operations. For emergency operation of the particular systems, see LANDING GEAR SYSTEM FAILURE, FLAP SYSTEM FAILURE, and FLIGHT CONTROLS SYSTEMS FAILURE in this section. For emergency brake pressure, refer to BRAKE FAILURE in this section.

Booster System Failure.

Failure of the booster hydraulic system affects only the flight controls systems. See FLIGHT CONTROLS SYSTEMS FAILURE for information on emergency management.

Auxiliary System Failure.

Failure of the motor-driven pump in the auxiliary hydraulic system results in the loss of hydraulic pressure for normal inflight operation of the aft cargo door, loss of electrically controlled emergency hydraulic pressure for the emergency brakes, and loss of electrically controlled emergency hydraulic pressure for extension of the nose landing gear. If circumstances require opening the aft cargo door, supplying emergency brake pressure manually or lowering the nose landing gear without electrically controlled hydraulic system pressure, the handpump may be used. If both utility and auxiliary pressure are lacking for the brakes, stopping and taxiing control must be accomplished with reverse thrust and differential power application and brake application limited to normal and emergency system accumulator pressure. Stop the aircraft as soon as possible. Taxiing the aircraft under its own power without brakes is not recommended.

FLIGHT CONTROL SYSTEMS FAILURE.

WARNING

Never purposely remove the hydraulic assistance from the flight control boosters to simulate complete loss of boost assistance to the flight controls. To remove the assistance would result in an immediate pitch change and the requirement for high manual forces to move the flight controls.

Note

If a hydraulic leak develops in any of the flight control booster units, it may be isolated by placing the respective control boost shutoff valve switch to the OFF position.

Failure of only one control booster unit may indicate a leak or other malfunction within the unit. It should be examined immediately, if possible, to determine corrective action. Loss of hydraulic assistance for movement of the flight controls will result in loss of ability to move these controls in flight, except at low airspeeds. Maneuvering the aircraft at cruising speeds under these conditions must be accomplished with the trim tabs. Landing the aircraft without hydraulic assistance is a marginal operation and requires skillful handling of the trim tabs and engine power, plus coordinated efforts of the pilot and copilot on the flight controls. When possible, avoid crosswinds, short fields, or narrow runways since the chances of making a successful landing will be decreased. When a landing without hydraulic assistance for the flight controls is necessary, proceed as follows:

Reduce the weight of the aircraft as much as possible.

With elevator hydraulic assistance failure, land with minimum flaps.

Make a long, flat approach to reduce the amount of flaps necessary and fly the aircraft onto the ground.

WARNING

If a control boost unit is suspected of having failed in a hard-over position, turn the respective control boost switches to OFF (verified by the cockpit control matching the hard-over maneuver being experienced). Greatly increased forces will be required to move the control for which the hydraulic assistance has been turned off.

Rudder Failure.

If rudder control should fail (hydraulic assistance lost), the rudder can be moved manually, but only at a reduced airspeed and with greatly increased effort.

Note

With the autopilot engaged, if it suddenly drives the rudder channel to excessive limits, disconnect the autopilot and permit the aircraft to dampen itself prior to applying corrective rudder.

Elevator Failure.

If elevator control should fail (hydraulic assistance lost) or become erratic, the elevators can be moved manually, but only at a reduced airspeed and with greatly increased effort. Increasing airspeeds will require increased pilot effort on the controls.

Aileron Failure.

The ailerons are powered concurrently by both the utiltiy and the booster hydraulic system. Should both hydraulic systems fail, the ailerons can be moved manually, but only at a reduced airspeed, and with greatly increased effort. Increasing airspeeds will require increased pilot effort on the controls.

Aileron Trim Tab System Failure.

Failure or "run away" of the aileron trim tab will not cause a serious control problem. Should the aileron trim tab "run away", proceed as follows:

1. Hold the aileron trim tab switch in the opposite direction.

2. Pull the aileron trim tab power circuit breaker on the pilot's side circuit breaker panel.

Rudder Trim Tab System Failure.

Directional control cannot be maintained at high airspeeds if the rudder trim tab "runs away" to an extreme position. If this occurs, airspeed should be reduced until directional control is regained. Should the rudder trim tab "run away", proceed as follows:

1. Hold the rudder trim tab switch in the opposite direction.

2. Pull the rudder trim tab power circuit breaker on the pilot's side circuit breaker panel.

Differential power can be used to assist in directional control.

Elevator Trim Tab System Failure.

Should the elevator trim tab "run away," hold the elevator tab switch on the control wheel in the opposite direction of tab indicator movement, and place the elev tab power selector switch in the OFF position. This should stop the runaway tab. Place the elev tab power selector switch in the EMER position, and operate the elevator trim tab switch on the control pedestal to retrim the aircraft. If trouble is encountered using emergency power, return the elev tab power selector switch to OFF. Tab movement will be slower in EMER than in NORMAL.

Note

- The elevator tab switches on the control wheels will not operate the emergency system. Emergency operation is controlled only by the pedestal-mounted switch.
- When on autopilot operation and the elev tab power selector switch is in the EMER or OFF position, the elevator servo is disconnected from the autopilot and the elevator must be controlled manually.

Flap System Failure.

Flap system failures may be classified as follows: Electrical control system failure, failure of the utility hydraulic system, an asymmetrical positioning of the wing flaps, or a cocked flap causing obstructions to aileron movement. The flap system is normally powered by the utility hydraulic system and is controlled electrically. Protection against asymmetrical extension or retraction of the flaps is provided only when dc power and utility hydraulic pressure are simultaneously available for the flap system. A manually operated wing flap selector valve, located on the left hydraulic panel, provides flap control if the flap electrical control system fails. Also, a system is provided for mechanical operation of the flaps in case utility hydraulic pressure is lost.

WARNING

During normal flap operations, failure of certain components in the jack screw area may cause a split flap condition resulting in a change in trim about the roll axis and aileron binding. Under these conditions, if it is possible to control the aircraft, no attempt should be made to move the flaps. If movement of the flaps must be attempted, move the controllable flaps in increments of 10 percent toward the position of the uncontrollable flap. During flap movement, check aileron control constantly. If it is noted that binding increases, stop flap movement immediately.

Flap Electrical Control Failure.

If the circuit breaker is in, or if resetting the circuit does not clear the trouble:

1. Pull the flap control circuit breaker.
2. Place the flap lever in the desired position. (This will give proper rudder boost pressure.)
3. Station a crewmember at the forward face of the left wheel well, and establish communications with the flight station by means of an intercommunications extension cord.
4. Remove the left hydraulic panel cover and cannon plug from the flap selector valve.
5. Reset the flap control circuit breaker.
6. Depress the raise or the lower button on the flap selector valve for approximately one second so that the flaps move only an increment of about 10 percent, proceed with successive increments only if there is no change in roll trim, and as directed by the pilot.

WARNING

Failure of the flaps to move may be caused by asymmetric protective actuation of the emergency flap brakes, which must not be released in flight. Such asymmetric protection will not be available if electrical power through the wing flap circuit breaker is lost or if a bad connection occurs in the asymmetric detection circuit. Therefore, should a change in trim about the roll axis occur during any flap actuation, do not attempt further inflight movement of the flaps.

Loss of Hydraulic Pressure.

Normal operation of the flaps will cause a drop in utility hydraulic pressure as long as the flaps are in motion. A leak in the flap system hydraulic plumbing

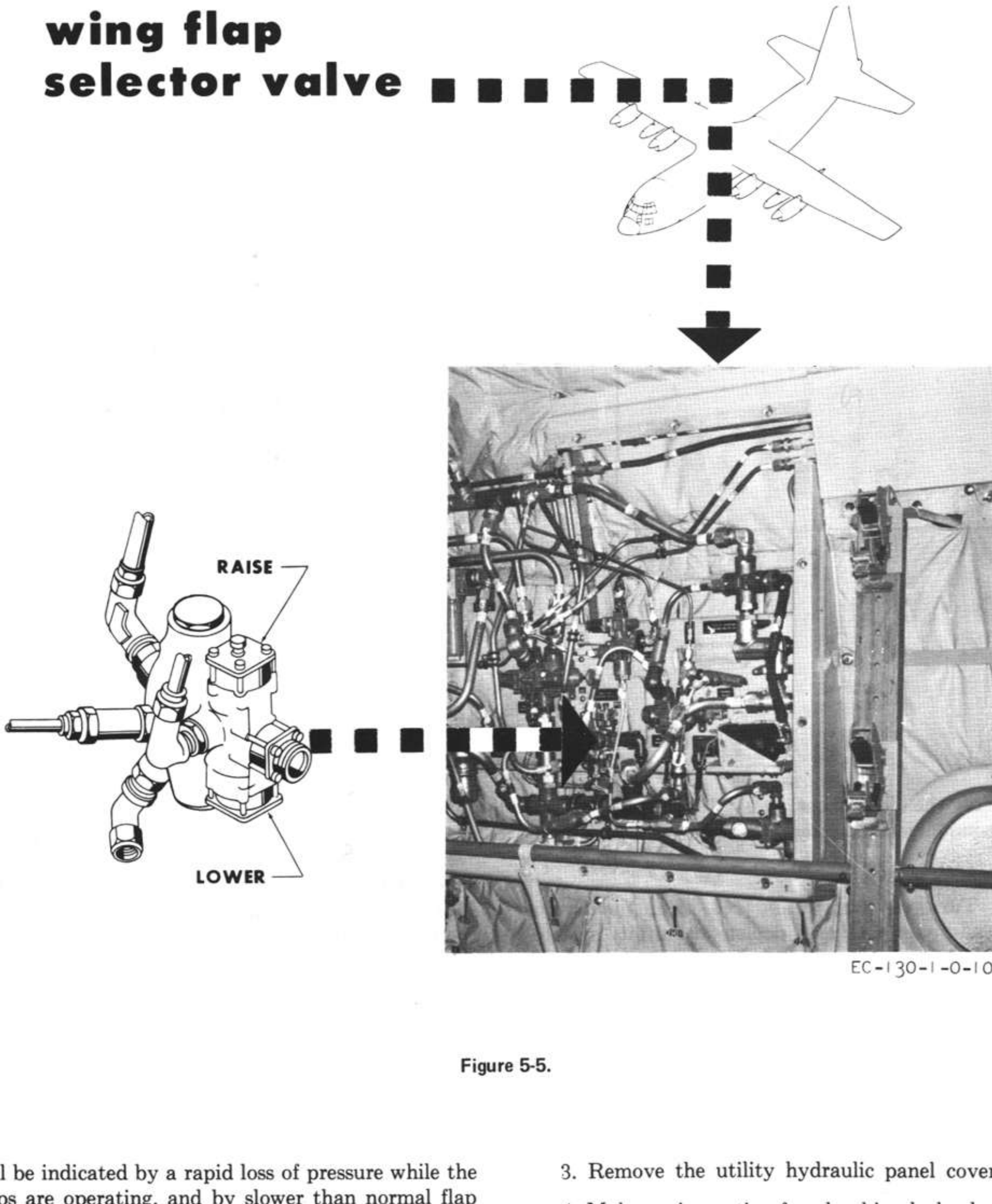


Figure 5-5.

will be indicated by a rapid loss of pressure while the flaps are operating, and by slower than normal flap movement. Under these conditions, proceed as follows:

1. Pull the wing flap control circuit breaker on the copilot's lower circuit breaker panel.

2. Place the flap handle in the desired position. (This will give proper rudder boost pressure.)

3. Remove the utility hydraulic panel cover.

4. Make an inspection for plumbing leaks, breaks, and any other faults. If fault is corrected, reset the wing flap control circuit breaker and proceed with normal flap operation.

If fault is not corrected:

5. Establish communications between the flight station and a crewmember stationed at the forward

wing flap manual operation control

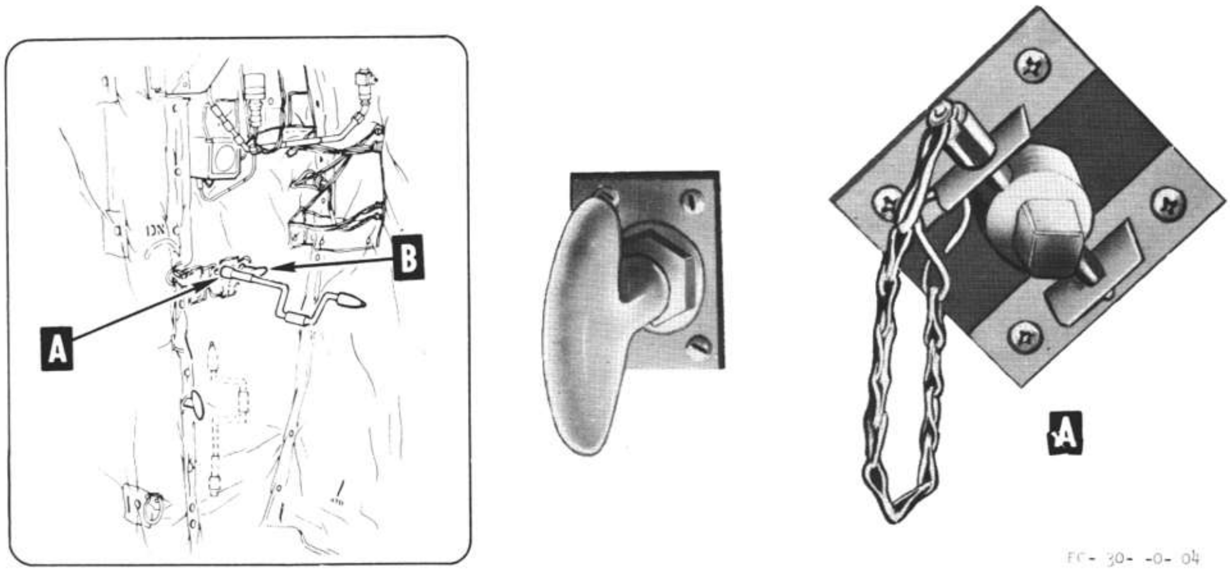


Figure 5-6.

face of the left wheel well by means of an intercommunication extension cord.

6. Turn the No. 1 and No. 2 engine-driven hydraulic pumps off and deplete the utility system pressure.

7. Remove the handcrank (figure 5-6) from the stowed position, in the special equipment compartment. Engage the handcrank on the input shaft, and hold the crank firmly to prevent rotation.

8. Remove the pin from the input shaft. It may be necessary to rotate the crank slightly in either direction to relieve binding on the pin.

9. Rotate the manual shift handle (figure 5-6) counterclockwise to its stop, and pull (approximately 2 inches) to engage the manual extension system. The handle will lock out after it is pulled.

10. Operate the flaps to the desired position (approximately 650 turns for full extension) as shown on the flap position indicator. A slip clutch is provided in the manual gearbox to prevent the operator from overloading the drive system. Slippage of the clutch indicates the screwjack nuts are bottomed, and the flaps are full up or full down, or that interference will not permit flap operation.

WARNING

Protection against asymmetrical operation is provided only during normal hydraulic flap operation. Should a failure of flap drive torque tubes occur during manual operation, resulting in a change in trim about the roll axis, stop flap movement immediately. Manually return the controllable flaps to the position assumed by the uncontrollable flaps.

11. Replace the pin in the input shaft to hold the flaps in the selected position.

12. Remove the crank and return to the stowed position.

13. Leave the manual shift handle out.

14. Turn No. 1 and No. 2 engine-driven hydraulic pumps on if available and no leaks are evident.

Practice Manual Flap Extension.

Practice manual extension of the wing flaps is accomplished by following the procedure for manual extension in paragraph LOSS OF HYDRAULIC PRESSURE. The shift from manual back to hydraulic drive after an actual inflight failure of the hydraulic system normally would be accomplished on the ground. However, after practice manual extension of the flaps, use the following procedure to shift back to hydraulic drive:

Rotate the manual shift handle clockwise against its stop, and push in as far as possible.

Remove the pin in the input shaft, and rotate the shaft with the handcrank. The shaft should turn freely, indicating that the manual drive has disengaged.

Replace the pin in the input shaft, and remove the handcrank and return it to the stowed position.

Place the flap lever to correspond with the position of the flaps.

Reset the wing flap control circuit breaker.

CAUTION

When the wing flap control lever is first moved after shifting from manual to hydraulic actuation, observe the utility hydraulic system pressure and the wing flap position indicator. A drop in pressure with no result in flap movement indicates a failure of the flap drive to re-engage. If this happens, immediately return the wing flap lever to its original position and pull the wing flap control circuit breaker. If these steps are not observed, serious damage to the wing flap drive could result.

Asymmetrical Flaps.

Should flap movement stop before the flaps have reached the position desired, failure of the flaps to move in either direction may be due to engagement of the emergency flap brake. The flap handle should be positioned to correspond to the position of the flaps, and no further inflight movement of the flaps should be attempted.

WARNING

While the aircraft is in flight, do not release the manual override on the emergency flap brake valve after an asymmetrical condition of the flap. This manual override is for ground use only.

Wing Flap Position Indicator Failure.

If no change in flap position is shown on the wing flap position indicator after movement of the flap lever, the trouble may be in the indicator rather than in the flap system. This trouble may be identified by observing hydraulic pressure and by observing the pitch attitude of the aircraft. Immediately after selecting a change in flap position, a pressure drop in the utility hydraulic system indicates either that the flaps are moving or that there is a hydraulic leak or failure in the actuating system. If the flaps are moving, this will be indicated by a change in the pitch attitude of the aircraft. During flap extension the pilot may direct a crewmember to make a visual inspection of the flap position. Also while in the aft compartment, check the tabs and flaps position indicators circuit breaker on the aft fuselage junction box.

LANDING GEAR SYSTEM FAILURE.

Emergency operation of the landing gears is accomplished by means of the landing gear lever, overriding controls, and manually actuated controls.

Note

Pressure-sealed doors are provided in the wheel well bulkheads to permit access while in flight to inspect the two gearboxes and hydraulic brake assemblies, and the vertical torque shafts in the event of a malfunction of the MLG system. A nose landing gear inspection window is provided in the nose wheel well aft bulkhead to permit visual inspection while in flight. This window may be removed to permit access to the NLG while in flight. The emergency extension handcranks fit the nuts on the MLG pressure-sealed doors and on the NLG inspection window. Depressurize the aircraft before removing the pressure-sealed doors or windows.

Emergency Extension.

If the main and nose landing gears fail to extend after normal operation of the landing gear control lever, attempt to identify the malfunction before making further attempts to lower the gear. Check circuit breakers, utility hydraulic pressure, and hydraulic fluid quantity. Check for evidence of hydraulic leaks. If a hydraulic leak is the cause of the malfunction, further attempts to extend the gear hydraulically may serve only to deplete the utility hydraulic system. If the fault is not located and there is no evidence of leaks, proceed to lower the gear by emergency operation.

Emergency Extension-Special Equipment Compartment.

Emergency extension of the landing gear from the special equipment compartment is accomplished by manually overriding the utility hydraulic control valve, by cranking the gear down manually or by using the emergency extension wrench.

Overriding the Utility Hydraulic Control Valve.

If the landing gears fail to extend while using utility hydraulic system pressure because of failure of the control valves to operate (no evidence of hydraulic pressure loss), proceed to extend them by overriding the utility hydraulic control valve.

1. Pull the landing gear control circuit breaker located on the copilot's lower circuit breaker panel.

2. Place the landing gear lever in the DOWN position.

3. Direct a crewmember to establish communications with the flight station by means of an intercommunication extension cord and to go to the left wheel well.

4. Remove the left hydraulic panel cover.

5. Depress the down button on the aft side of the landing gear selector valve (figure 5-7) to lower the landing gear.

CAUTION

If the landing gear does not extend, depress and hold the down button until the main and nose landing gear is extended. If the button requires holding to lower the gear, the mechanical detent in the landing gear selector valve has failed. If nose wheel steering is required, the button must be held in.

Note

The landing gear position indicators should continue to operate regardless of landing gear malfunction. The pilot should inform the crewmember when a down position is indicated so that the crewmember will know when to release the manual override button. If a malfunction of the landing gear position indicator is suspected, observe the main landing gear position through the glass panels on the wheel wells and the nose gear position through the nose wheel inspection window or by removing the access cover on aircraft not having a window.

CAUTION

If nose wheel inspection plate is removed, do not allow it to be blown through the opening.

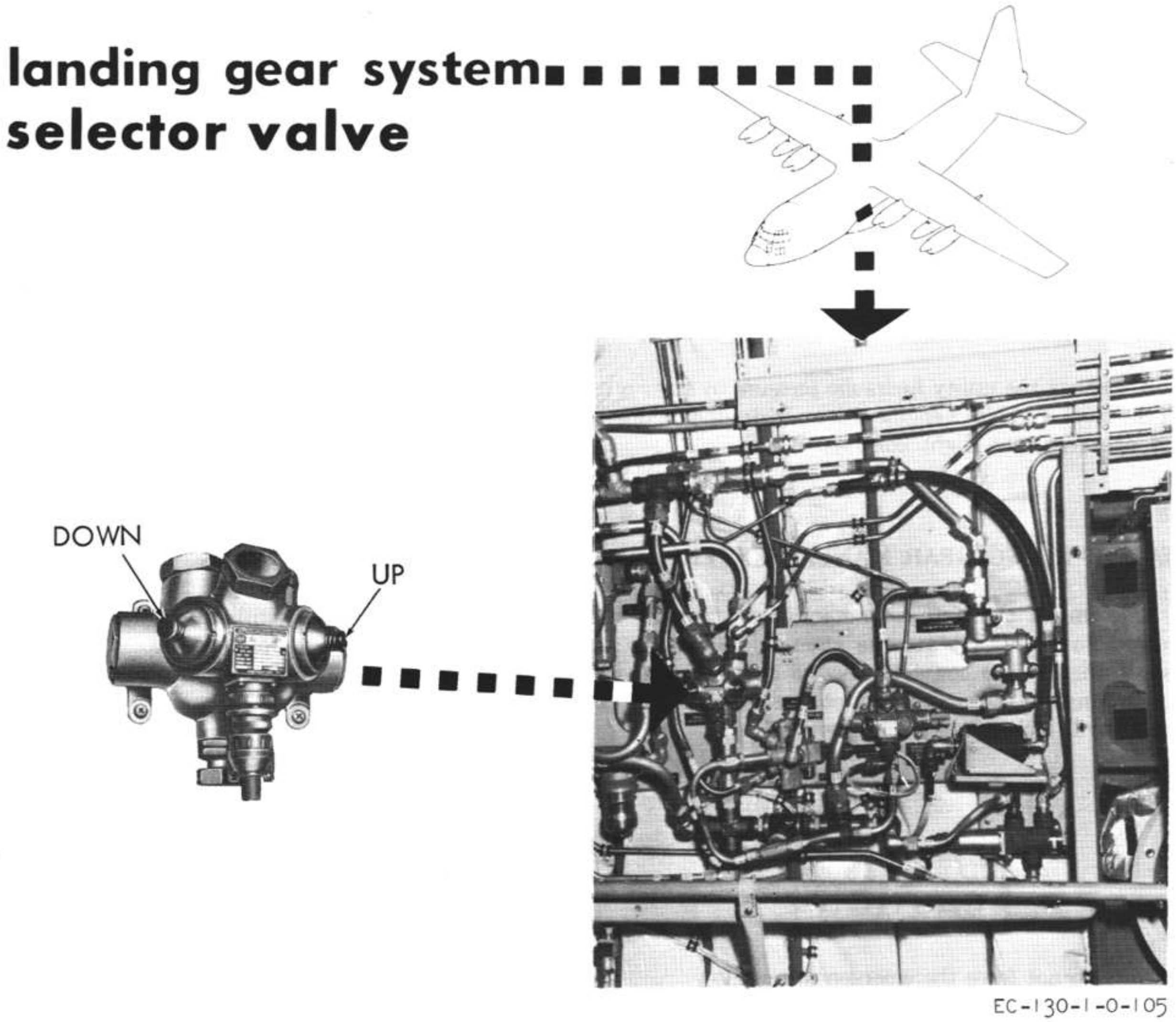


Figure 5-7.

Manual Gear Extension.

If the landing gear fails to extend and lock after the manual override control valves are used, manually extend the gear as follows:

1. Pull the landing gear control circuit breaker located on the copilot's lower circuit breaker panel.

2. Place the landing gear control handle in the down position.

3. Deplete the utility hydraulic pressure by turning off the No. 1 and No. 2 engine-driven hydraulic pumps and operating the flight controls.

MAIN LANDING GEAR MANUAL EXTENSION.

1. Remove the extension handcrank from the stowed position. Rotate the emergency engaging handle (figure 5-8) counterclockwise to its stop and pull to engage the manual extension system. The handle will lock out after it is pulled.

CAUTION

Do not force the emergency engaging handle out. To do so may result in a bent manual drive clutch lever, making it difficult or impossible to engage the manual drive. It may be necessary to place the extension handcrank on the emergency extension stub shaft and rotate slightly until the manual drive gear teeth align.

If the main landing gear does not free fall:

2. Place the extension handcrank on the emergency extension stub shaft.

3. Extend the landing gear by rotating the extension stub shaft approximately 330 turns in the direction of the arrow above the shaft.

WARNING

- Make sure the ratchet on the handcrank is set for down rotation before placing it on the emergency extension stub shaft.
- If the main landing gear starts to free fall after the handcrank is placed on the emergency extension stub shaft, immediately remove the handcrank. The extension handle ratchet may change direction due to the rotation speed of the emergency extension stub shaft.

4. Make sure that the landing gear is down and locked.

5. After manual operation, return the emergency engaging handle to the disengaged position by rotating clockwise to its stop and pushing in.

6. Verify proper disengagement by rotating the handcrank one turn in each direction.

Note

If the manual extension mechanism does not disengage, pull the emergency engaging handle again, and rotate the handcrank in each direction.

7. Reset the landing gear control circuit breaker.

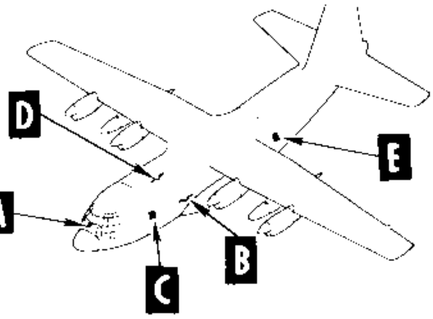
8. Turn on the utility suction boost pump, No.1 and No. 2 hydraulic pumps to obtain hydraulic pressure (when available) for operation of flaps, normal brakes, and nose wheel steering.

9. Check that the landing gear stays in the down position.

Note

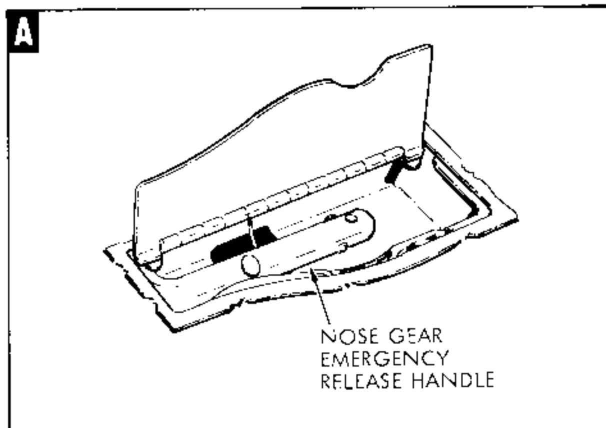
If the landing gear returns to the up position, place the utility hydraulic switches in the OFF position, and crank the landing gear down manually.

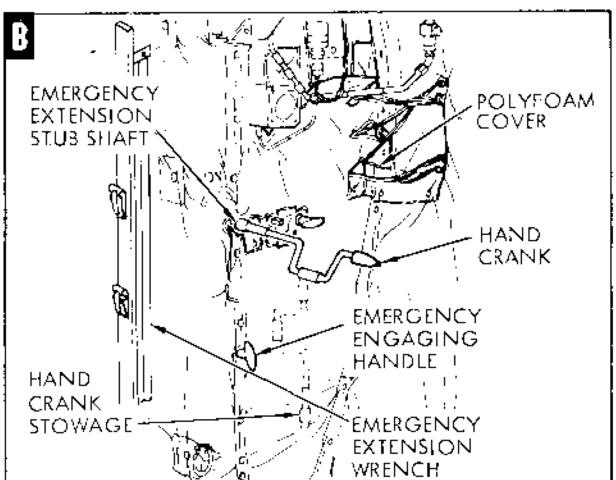
landing gear emergency extension controls

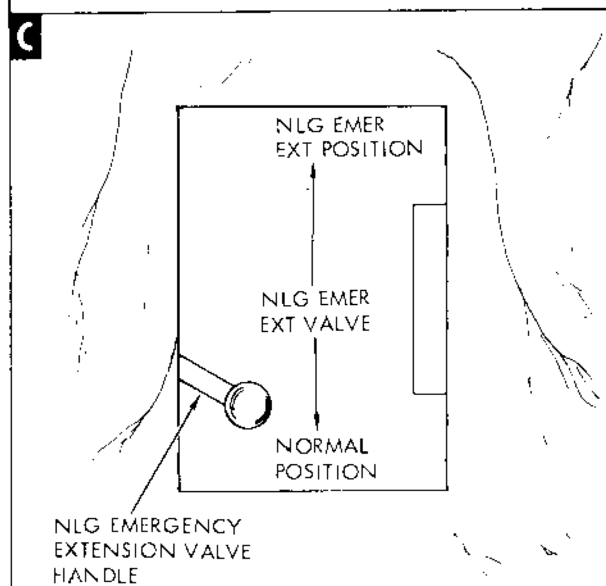


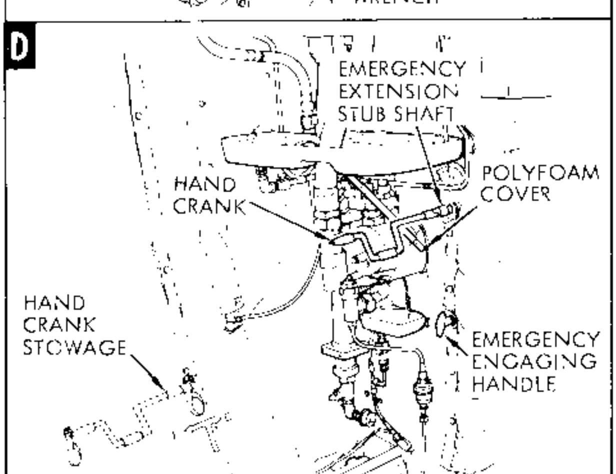
NOTE

PRESSURE FOR EMERGENCY EXTENSION OF THE NOSE LANDING GEAR SUPPLIED BY EITHER THE MOTOR-DRIVEN OR THE HAND-OPERATED PUMP OF THE AUXILIARY HYDRAULIC SYSTEM.









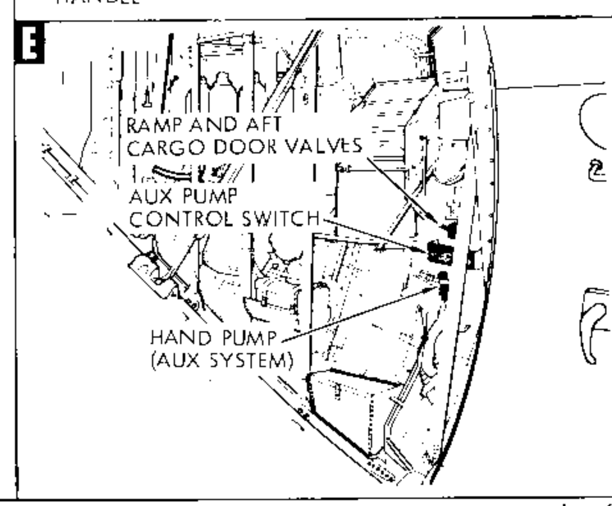


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Figure 5-8.

NOSE LANDING GEAR MANUAL EXTENSION.

Determine that the manual controls for the ramp and aft cargo door control valves (figure 5-8) are in the NEUT and 6N positions, respectively. Move the nose landing gear emergency extension valve handle, just aft of the cargo compartment forward bulkhead on the left side (figure 5-8), to the NLG EMER EXT position. Operate either the auxiliary system motor-driven pump or the auxiliary system handpump until the landing gear is down and locked.

CAUTION

Do not move the nose landing gear emergency extension valve handle from the NLG EMER EXT position until after the aircraft lands and the nose gear ground safety lock is installed. Maintain hydraulic pressure on the system.

If complete electrical failure occurs, the nose gear emergency release handle (figure 5-8), recessed into the flight station floor at the left of the copilot's seat, may be used to release the nose landing gear up lock. This will permit the nose gear to free-fall to the down, but not necessarily locked, position. Use the auxiliary system handpump to position the nose landing gear to the down and locked position.

Note

Dropping the nose landing gear by using the emergency release handle may allow air to enter the hydraulic system and may require bleeding before normal operation can be restored.

Emergency Nose Gear Extension.

1. Position the landing gear handle to the DOWN position.

2. Decrease airspeed to or below 120 KIAS.

3. Pull the nose gear emergency release handle.

Note

The nose gear should extend into the slip stream. Allow the nose gear to extend until the forward gear door starts to close at reduced airspeed; this may require 30 to 45 seconds.

4. Increase airspeed not to exceed 165 KIAS as rapidly as possible.

Note

The nose gear should extend to the down and locked position.

Main Landing Gear Extension After Normal and Emergency System Failure.

A malfunction that locks any component of the main landing gear extension system may also lock the remainder of the system. In such a case, if the universal joints on the vertical torque shaft are disconnected, the landing gear may free-fall to the down position. If the landing gear does not free-fall, each landing gear strut can be extended by rotating the ball screws or by using the emergency extension wrench. The emergency extension wrench is stowed on a litter stanchion forward of the left wheel well bulkhead (figure 5-8). Use this procedure to lower the main landing gear only after all other normal and emergency procedures have failed. Refer to figure 5-9 for access doors or cutting areas.

Note

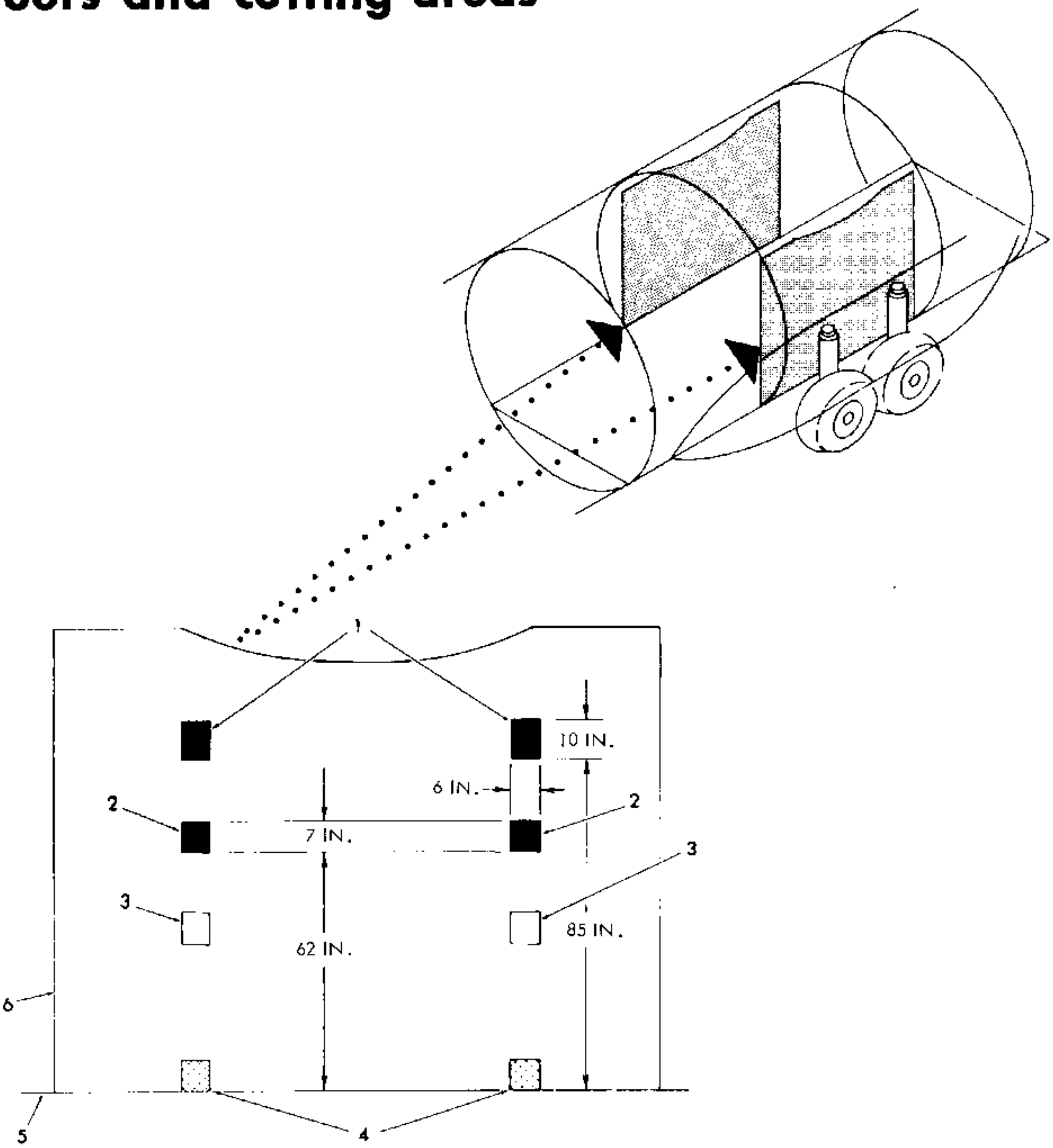
Extend the aft strut first. The main landing gear doors are opened by a mechanical connection to the aft strut, and damage to the doors could result if the forward strut is extended first.

Leave the main landing gear manual extension system engaged, the utility hydraulic system depleted, and the landing gear control circuit breaker pulled.

Depressurize the aircraft. Place the air conditioning master switch to AUX VENT.

Remove the two polyfoam covers from the forward side of each of the wheel wells.

mlg wheel well access doors and cutting areas



1. CUTTING AREAS
2. UPPER ACCESS DOOR
3. LOWER ACCESS DOOR
4. INSPECTION WINDOWS
5. CARGO COMPARTMENT FLOOR
6. MLG WHEEL WELL SIDE PANEL

Figure 5-9.

Remove the upper access doors with the emergency extension handcrank.

At the aft strut, remove the two outboard bolts and nuts connecting the companion flanges at the lower end of the vertical torque shaft.

Remove the nuts from the two inboard bolts, and remove the bolts without extending the hands through the access hole.

WARNING

> The weight of the landing gear may cause the gear to extend rapidly when released. If the above steps are not followed in proper sequence, serious injury to the hands may result when the gear falls.

Note

> If the strut does not free-fall, application of g forces may aid in extending the strut.

If the aft strut free-falls approximately halfway down, attempt to extend the forward strut using the manual extension system. The horizontal torque strut will prevent the landing gear strut from fully extending. If the landing gear does not extend using the above procedure, extend the struts using the emergency extension wrench (if available) or the vertical torque shaft.

To remove the vertical torque shaft on aircraft without the emergency extension wrench, cut a hole above the upper access door (figure 5-9). Secure the top of the vertical torque shaft to some point inside the cargo compartment with wire to prevent loss of the shaft. Remove the bolt and nut that retains the upper end of the shaft spline to the gearbox. Pull the vertical torque shaft into the cargo compartment through the upper access hole.

On aircraft having the emergency extension wrench, do not disconnect the upper end of the shaft, but move the vertical torque shaft clear of the companion flange on the upper end of the ball screw.

At the aft strut, slip the companion flange off the splines on the upper end of the ball screw.

Using the vertical torque shaft or the emergency extension wrench, engage the splines on the upper end of the ball screw. Rotate the ball screw counterclockwise approximately one-half revolution. Application of g forces may aid in extending the strut.

Note

> On aircraft with an emergency extension wrench installed, use the fixed end of the wrench to start the ball screw.

If the strut has not extended, rotate the ball screw counterclockwise to extend the strut halfway down.

Note

> Use the ratchet end of the emergency extension wrench to rotate the ball screw. The handcrank may be installed in the square drive of the wrench to extend the strut more rapidly.

Extend the forward strut using the above procedure. Fully extend the aft strut.

Emergency Retraction.

If the landing gear lever will not move to the UP position due to malfunction of the touchdown switch or down lock, manually release the down lock by pushing the lock release button on the landing gear lever panel. If either or both of the main gears fail to retract, an emergency retraction may be attempted at the discretion of the pilot. Investigation of the system should be made prior to manual retraction. To accomplish emergency retraction proceed as follows:

Remove the left hydraulic panel cover.

Depress and hold the UP button on the landing gear selector valve until the landing gears are retracted and the doors are closed. Release the button.

If the main landing gears fail to retract after operation of the manual override of the landing gear selector valve, proceed as follows:

Pull the landing gear control circuit breaker located on the copilot's lower circuit breaker panel.

Place the landing gear control handle in the UP position.

Deplete the utility hydraulic pressure by turning off the No. 1 and No. 2 engine-driven hydraulic pumps and operating the flight controls.

Rotate the emergency engaging handle (figure 5-8) counterclockwise to its stop, and pull while rotating the handcrank until the force required for rotation indicates engagement of the manual extension system. The handle will lock out after it is pulled.

Retract the main landing gears with the handcranks, reversing the rotational direction used in extending the gears.

After retraction, return the emergency engaging handle to the disengage position by rotating clockwise to its stop and pushing in.

Verify proper handle position by rotating the handcranks one revolution each way.

Check visually that the main landing gears are up.

Note

No provisions exist for manual retraction of the nose landing gear.

CAUTION

- When removing the inspection door and window, do not allow them to be blown through their respective openings.
- Do not attempt a take-off with a known or suspected main landing gear malfunctions.

Main Landing Gear Tiedown.

Before landing with a broken shelf bracket or drag pins not engaged in the shelf bracket, the following procedure will be used to tie down the landing gear. Four 10,000-pound chains and three tiedown devices are required for each side. (See figure 5-10.) The chains must be secured at the fittings at fuselage station 477 and 617 with 25,000 pound fittings.

Depressurize the aircraft and place the air conditioning master swtich to AUX VENT.

Remove the wheel well inspection windows at the struts to be tied down.

Pass the end of a 10,000-pound chain around the applicable strut.

Note

Securing a piece of safety wire to the end of the chain will make it easier to guide the chain around the strut.

Fasten the ends to the cargo floor as shown in figure 5-10. Repeat for the other strut.

Then use two 10,000-pound chains fastened end-to-end and tied down to the cargo floor to protect from whiplash of a broken chain as shown in figure 5-10.

Repeat the process for the other pair of opposite struts, if necessary.

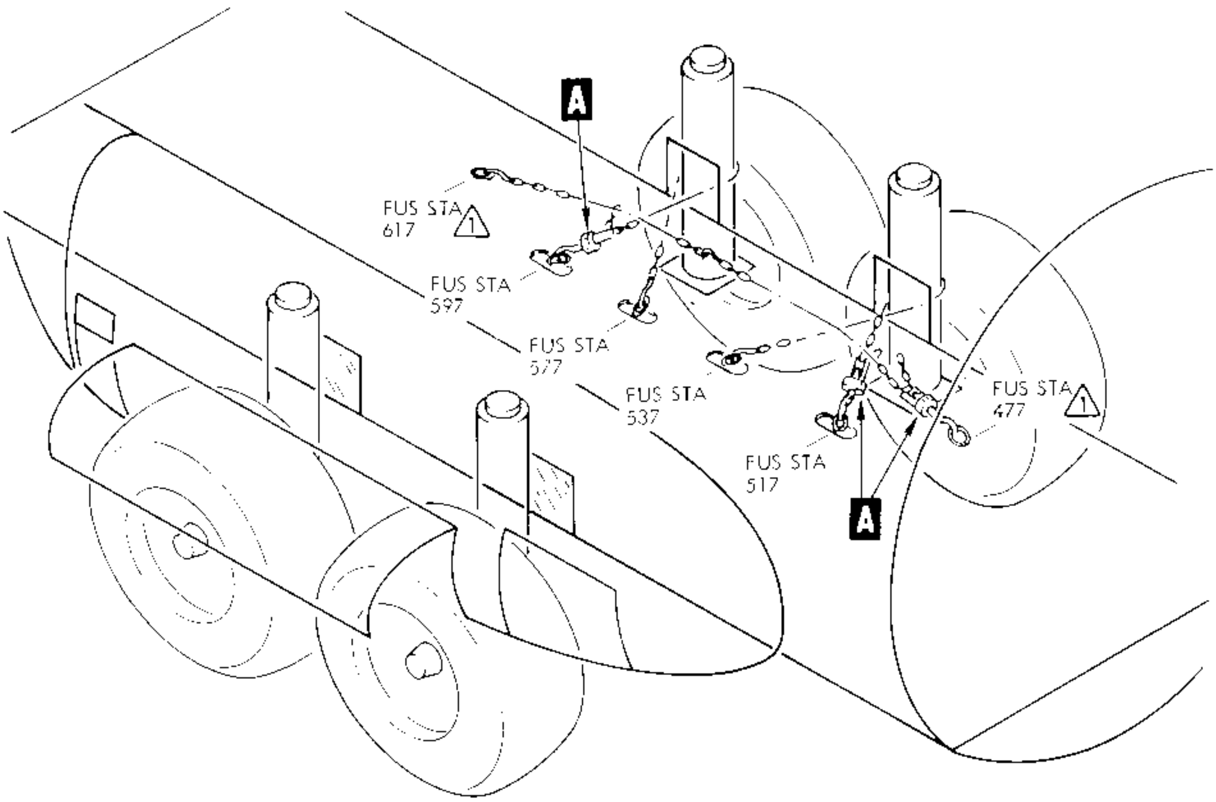
WARNING

Move all personnel to the forward and aft ends of the cargo compartment to prevent injury if a chain should break.

CAUTION

With this landing gear tiedown procedure, landings must be as gentle as possible since the struts will not absorb the normal maximum rate of sink at touchdown.

main landing gear tie-down



NOTE

1 25,000 POUND FITTING

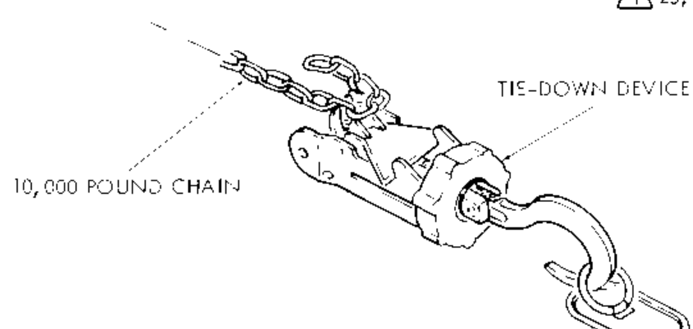


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Figure 5-10.

Unsafe Nose Landing Gear Indication.

Depressurize the aircraft.

CAUTION

When removing inspection door and window, do not allow them to be blown through their respective openings.

Note

Due to the configuration of the nose landing gear on these aircraft, tiedown is not necessary, nor is it practicable.

Remove the nose gear inspection panel. Visually check the pin which protrudes from the aft end of the actuator and operates the down-and-locked indicator switch. If indicator groove is visible on the pin, the down lock is engaged. If this band is not visible, the downlock is not engaged. In either case, maintain pressure on the down side of the nose landing gear hydraulic system.

During landing, hold the nose wheels off the ground as long as possible, but touch down while elevator effectiveness allows gentle lowering of the nose. Do not attempt to taxi the aircraft. Set the parking brake. Place chocks in front of the nose wheels, or jack the nose of the aircraft, and then install the ground lock pin. Chock the main landing gear fore and aft.

EQUIPMENT JETTISON.

Jettisoning of equipment can be dangerous, due to possible loss of aircraft control or structural damage; therefore, the aircraft commander must consider carefully the emergency situation, operational considerations, availability of suitable drop area and whether jettisoning is necessary.

Parachutes, or restraining harness will be worn by personnel jettisoning equipment. Depressurization will be required prior to jettison operations, and the crew members must use oxygen or the aircraft must descend to an alitiude below 10,000 feet. Equipment should be jettisoned out the aft cargo door opening; open the cargo door as follows:

1. Guillotine the short wire antenna.

2. Guillotine the long wire antenna if extended.

3. Rotate the spin wheel on the short wire antenna exit tube counterclockwise until the tube is disconnected.

Note

Sulphur hexafluoride pressure will leak when seal is broken.

4. Disconnect the exit tube by sliding it aft.

5. Open the aft cargo door:

a. Electrical operation: Turn on the aux hydraulic pump and select cargo door OPEN on the ramp control panel.

Note

The aft cargo door may not latch open in flight; therefore, the aux hydraulic pump should be left on.

b. Manual operation: (1) Ensure STWA valves are closed. (2) Place the manual control valve handle to OPEN. (3) Operate the hand pump.

CAUTION

Before manual handpump operation, check that aux hydraulic pump switch on ramp control panel is in the OFF position.

6. Jettison.

Relatively lightweight equipment should be jettisoned by hand. The paratroop door openings should be used for jettisoning when the aft cargo door cannot be opened or airspeed is to be maintained at 150 KIAS or below.

BAILOUT PROCEDURES.

Inflight evacuation exits are shown in figure 5-11. When time and aircraft control permit, proceed as follows:

1. Give bailout warning over the public address system, interphone, and three short rings on the alarm bell.

2. Depressurize the aircraft.

3. Place the air conditioning master switch in the AUX VENT position.

4. If possible, head the aircraft toward an isolated area, and engage the autopilot.

Note

Thorough consideration should be given to the consequences of scattering flight crewmembers over a large area of ocean without the benefit of life rafts. Bailout should be conducted with the aircraft circling to avoid widespread separation of crewmembers.

5. Turn on the aux hydraulic pump at the copilot's hydraulic control panel.

6. Guillotine the long and short wire antennas, if extended, to prevent parachute entanglement.

7. Reduce airspeed to below 150 KIAS if possible. If the airspeed can be reduced to below 150 KIAS, the priority of emergency exits is as follows:

a. Paratroop doors

b. Aft cargo door

c. Forward crew door

WARNING

If the airspeed cannot be reduced to below 150 KIAS, the aft cargo door will be the primary means of escape.

8. When airspeed is below 150 KIAS:

a. Open the air deflectors and paratroop doors.

b. Give the abandon aircraft signal over the public address system, interphone, and by one long ring on the alarm bell.

c. Evacuate the aircraft.

9. If the airspeed is above 150 KIAS or the paratroop doors will not open, open the aft cargo door as follows:

a. Guillotine the short wire antenna.

b. Guillotine the long wire antenna if extended.

c. Rotate the spin wheel on the short wire antenna exit tube counterclockwise until the tube is disconnected.

Note

Sulphur hexafluoride pressure will leak when seal is broken.

d. Disconnect the exit tube by sliding it aft.

e. Open the aft cargo door:

(1) Electrical Operation: Turn on the aux hydraulic pump and select cargo door OPEN on the ramp control panel.

Note

The aft cargo door may not latch open in flight; therefore, the aux hydraulic pump should be left on.

(2) Manual Operation: (a) Ensure STWA valves are closed. (b) Place the manual control valve handle to OPEN. (c) Operate the hand pump.

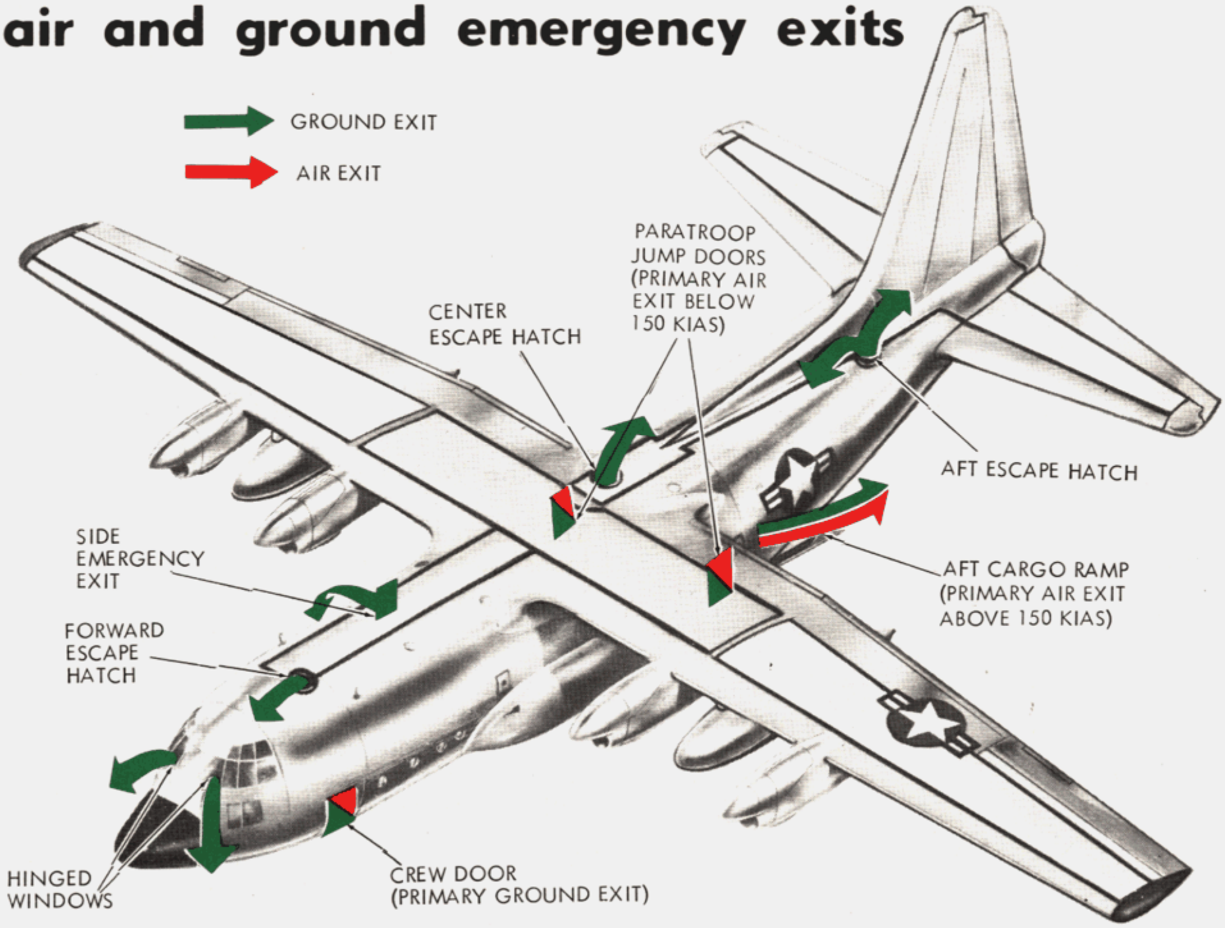
CAUTION

Before manual handpump operation, check that the aux hydraulic pump switch on the ramp control panel is in the OFF position.

f. Give the abandon aircraft signal over the PA system and by one long ring on the alarm bell.

g. Evacuate the aircraft.

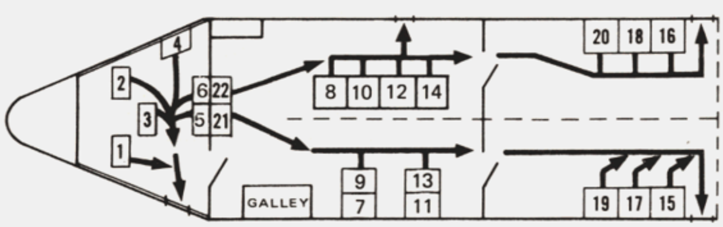
air and ground emergency exits



CRASH LANDING STATIONS AND EVACUATION ROUTES

WARNING

Position seats to ensure egress clearance. Ensure that the galley floor is up and locked.



1 PILOT
2 COPILOT
3 FLT ENG
4 NAVIGATOR
5 SEC FLT ENG
6 THIRD PILOT
7 CREWMEMBER
8 ACS
9 ACO
10 ACOM
11 CREWMEMBER
12 TECH
13 TECH
14 ACOM
15 REEL OP
16 REEL OP
17 CREWMEMBER
18 CREWMEMBER
19 CREWMEMBER
20 CREWMEMBER
21 CREWMEMBER
22 CREWMEMBER

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Figure 5-11.

10. When time and aircraft control do not permit crew use of the paratroop doors or the ramp door, proceed as follows:

a. Give bailout warning over the public address system, interphone, and by three short rings on the alarm bell.

WARNING

Ensure parachutes and applicable equipment are passed to the flight deck and the door area is clear prior to jettisoning the crew entrance door.

b. Jettison the crew door by pulling the emergency release handle just forward of the flight station emergency escape hatch release.

Note

It may not be possible to jettison the crew entrance door at a pressure differential greater than 3.1 inches of mercury due to the load on the door hinge and the latching mechanism.

c. Reduce airspeed if possible.

WARNING

Bailout from the crew entrance door is not recommended at airspeeds above 150 knots or with the landing gear extended.

d Give abandon-aircraft signal over the public address system, interphone, and by one long ring on the alarm bell.

e. Bail out of the crew entrance door from a squatting position at the rear. Push head first outward and downward, using the rear edge of door frame for leverage. Do not attempt to exit feet first or in a spread position.

LANDING EMERGENCIES.

LANDING WITH ENGINES INOPERATIVE.

Landing With One Engine Inoperative.

The approach for landing with one engine inoperative is made in the same manner as for a normal landing except flaps should not be extended more than 50 percent until landing is assured. Below 100 knots airspeed during flareout the combined flight idle thrust on the side with two operating engines will tend to turn the aircraft into the side with only one operating engine. This is particularly noticeable when a landing is made with an outboard engine feathered.

After nose wheel touchdown, retard throttles to GROUND IDLE, and use reverse thrust from symmetrical engines.

CAUTION

Reverse thrust on asymmetrical engines may cause the aircraft to veer to one side.

Landing With Two Engines Inoperative.

After loss of two engines, attempt to decrease aircraft weight, if necessary, dumping fuel and/or jettisoning equipment before landing.

CAUTION

If both No. 1 and No. 2 engines are inoperative, additional time is required to extend gear and flaps.

Change the landing procedures as follows:

DOWNWIND LEG

160 KIAS minimum

Gear and flaps as required

BASE LEG

160 KIAS

Gear and flaps are required

TURN TO FINAL

150 KIAS minimum

FINAL APPROACH

Maintain 150 KIAS, or approach speed, whichever is higher, until landing is assured.

Extend gear and flaps, as required

WARNING

A go-around is not recommended after flaps are lowered. Do not extend full flaps until landing is assured. When landing with two engines inoperative, assure firm nose wheel contact before reversing and use reverse thrust only as needed.

GO-AROUND WITH ONE OR TWO ENGINES INOPERATIVE.

CAUTION

If a go-around is attempted after landing, and if the touchdown speed is less than minimum control speed, directional control must be maintained by use of nose wheel steering and coordinated use of flight controls. It may be necessary to reduce power on the opposite engine to help maintain directional control until minimum control speed is obtained.

WARNING

The use of 5 degrees of bank away from the inoperative engine will aid in directional control when power is applied during go-around. Go-around with two engines inoperative on the same side should be avoided unless absolutely necessary. Every precaution should be taken so as not to let a situation develop that necessitates a go-around under these conditions. Descents below safe, comfortable altitudes and airspeeds should not be made until absolutely assured of landing.

1. Alert crew by giving command "go-around".

2. Begin the go-around at or above minimum control airspeed.

3. Advance throttles for all operative engines to maximum power as directional control will permit. Power applied to the asymmetrical engines will depend on the airspeed of the aircraft at initiation of go-around.

4. Give command to copilot to raise flaps to 50 percent.

CAUTION

Raising the flaps prematurely above approximately 15 percent or raising the gear will increase the minimum control speed due to reduction in available hydraulic pressure.

5. Raise gear when certain that aircraft will not touch down.

6. Continue to raise flaps as airspeed and altitude permit.

Note

- At low airspeeds, raise flaps in 10-percent increments with airspeed increasing approximately 5 knots between retraction increments.
- Two-engine minimum control speed must be obtained as soon as possible after initiation of go-around.

7. After gear and flaps are up, continue as a normal take-off, using three-engine climb speed if on three engines. Climb out airspeed, on two engines, should be at a minimum of V_{MCA} (two engines out) or engine out landing pattern airspeed of 160 knots if gross weight and altitude permit.

WARNING

The use of 5 degrees of bank away from the inoperative engine will aid in directional control when power is applied during go-around. Go-around with two engines inoperative on the same side, should be avoided unless absolutely necessary. Every precaution should be taken to not let a situation develop that necessitates a go-around under these conditions. Descents below safe, comfortable altitudes and airspeeds should not be made until absolutely assured of landing.

LANDING WITH TIRE FAILURE.

Nose Landing Gear Tire Failure.

If one nose wheel tire is flat at time of landing, a normal landing may be made. If both nose wheel tires are flat at the time of landing, keep the nose wheels off the ground as long as possible. After nose gear contact use maximum reverse thrust and minimum braking. This procedure gives minimum nose wheel loading. Taxiing is not recommended.

Main Landing Gear Tire Failure.

If a main landing gear tire is flat at the time of landing, touch down the nose gear as soon as possible and use maximum reverse thrust. Taxiing is not recommended. If both tires of the main landing gear are flat, there will probably be a tendency to swerve toward that side. Line up and land on the side of the runway with the good tires. Touch down the nose gear as soon as possible, hold full forward on the control column, and assure directional control with the nose wheel steering system. Use wheel brakes (on the side opposite the flat tires only) to assist the nose gear in maintaining directional control. Use reverse thrust cautiously, but to the fullest extent possible to reduce landing roll to a minimum. Do not attempt to taxi.

LANDING GEAR RETRACTED.

Landing With One or Both Main Gears Retracted.

If one main landing gear cannot be extended, the recommended procedure is to retract the other main gear and land with only the nose landing gear down, or to land with all landing gears retracted. (Refer to GEAR-UP LANDING.)

Landing With Nose Gear Retracted and Main Gears Down.

If the nose gear fails to respond to normal and emergency operating procedures, an emergency landing may be accomplished, holding the nose of the airplane up as long as possible. Use the following procedure to make a nose-gear-up landing:

Give warning over the PA system and give six short rings on the alarm bell.

Request foam on the runway (20 feet wide, 3,000 feet long—beginning 2,000 feet from the approach end of the runway).

Stow or secure all loose equipment.

Depressurize the aircraft and place all engine bleed air switches to CLOSE/OFF.

Open overhead emergency escape hatches and paratroop doors.

Turn off all unnecessary electrical equipment.

Take crash position.

Lock shoulder harness inertia reel.

WARNING

Ensure that all controls which cannot be easily reached are properly positioned before locking the harness.

Assume a normal landing attitude.

Give warning over the PA system and give one long ring on the alarm bell to indicate to brace for impact.

Immediately upon ground contact, apply sufficient up-elevator to keep the aircraft in a level attitude as long as possible. Do not use brakes.

After nose contact, use reverse thrust, but do not allow the nose to rise off the ground. When the aircraft comes to a complete stop, pull the fire emergency control handles. Evacuate the aircraft as soon as possible.

Gear-Up Landing.

Before making a gear-up landing, perform the following operations:

Give warning over the PA system and give six short rings on the alarm bell.

Request foam on the runway (30 feet wide, 3,000 feet long—beginning 1,500 feet from the approach end of the runway).

Stow or secure all loose equipment.

Depressurize the aircraft and place all engine bleed switches to CLOSE/OFF.

Dump or consume all unnecessary fuel. (Refer to FUEL DUMPING in this section.)

Open overhead emergency escape hatches and paratroop doors.

Turn off all unnecessary electrical equipment.

Take crash position.

Fasten shoulder harness and inertia reel lock.

WARNING

Ensure that all controls which cannot be easily reached are properly positioned before locking the harness.

Assume a normal landing attitude.

Give warning over the PA system and give one long ring on the alarm bell to indicate to brace for impact.

When the aircraft comes to a complete stop, pull the fire handles.

Evacuate aircraft as soon as possible.

No Flap Landing.

On a no flap landing make a normal landing pattern and approach adjusted for higher speeds utilizing zero flap speeds from Touchdown Speeds chart in Section XI.

CAUTION

Do not flare the landing as structural damage to the drogue exit tube and/or aft fuselage underside may result.

LANDING ON SOFT GROUND OR UNPREPARED RUNWAYS.

If it should become necessary to land on soft ground or an unprepared runway, the decision to land with landing gear extended or retracted must be made by the pilot.

LOSS OF NOSE WHEEL STEERING DURING LANDING.

Whenever a loss of nose wheel steering is indicated by an immovable pilot's steering wheel, no further attempt will be made to "force" the wheel to turn, as this might prevent the nose wheel from castering. Under this condition, the pilot will pull back on the control column to relieve pressure on the nose wheel and maintain directional control of the aircraft through the coordinated use a flight controls, differential power and differential brakes according to the prevailing circumstances of speed, crosswinds, engine out, and runway conditions.

LANDING WITH A COCKED NOSE WHEEL.

Basically, the procedure for landing with a cocked nose wheel is the same as landing with loss of nose wheel steering, with the following addition: Request foam on the runway (30 feet wide, 3,000 feet long—beginning 1,500 feet from the approach end of the runway).

NOSE WHEEL SHIMMY.

Nose wheel shimmy is an indication of an unbalanced condition of one or both of the nose wheel tires or failure of the steering system. If this occurs during take-off, the decision regarding whether to abort or to continue will depend on the severity of the shimmy and whether the refusal point has been passed. If shimmy occurs during the landing roll, decelerate gradually and apply up-elevator to keep as little load on the nose wheels as possible. In landing with a known shimmy condition, keep the nose wheels off the ground as long as possible, but touch down while elevator effectiveness allows gentle lowering of the nose.

DITCHING.

DITCHING CHARACTERISTICS.

Ditching characteristics of the EC-130G/Q aircraft are not known; however, NACA controlled ditching tests of models similar to the C-130 configuration indicate that there is a reasonably high probability that the aircraft can be landed on water without major collapse of structure or a sudden rush of water into occupied compartments. On the basis of these tests, it is concluded that the following results can be expected upon ditching:

WARNING

- These characteristics assume the aircraft is ditched at a nose high attitude with landing gear up, landing flaps extended and at an airspeed 10 knots above power-off stall speed. A 7° nose-up attitude is the optimum pitch angle for impact.
- Actual ditching of other type aircraft have indicated that excessive airspeed will cause control problems once on the water and increase the likelihood of nose section failure. Extremely rapid flooding of the aircraft would follow.

1. Upon contact with the water, moderate bottom damage may occur in the area immediately forward of the cargo loading ramp hinge. The bottom damage will tend to stabilize the aircraft laterally during the ditching run, maintaining the wings in an essentially level attitude. Wing dipping or water looping are not expected.

2. During the initial portion of the ditching run - the tail-down portion - the aft cargo door may be damaged. But the damage probably will not affect either the ditching run or the sinking rate since the location of the door is such that it will be above the water line when the nose settles during the latter part of the run. It is very unlikely that the ramp will open. The crew door, the emergency exit on the forward right side, and the paratroop doors, which will be out of the water during the tail-down portion of the ditching run, probably will not experience damage at any time during the ditching run.

3. When recovering from the tail-down attitude, porpoising may occur; but if it does, it probably will not result in further major structural damage. If porpoising does not occur, the aircraft will probably assume a trim-up attitude, holding the nose clear until a fairly low speed is reached. In all probability, the nose wheel well structure and the windows will not be damaged.

WARNING

- If a porpoise occurs, do not try to catch the aircraft but maintain backyoke and keep the nose out of the water. If control is reestablished, continue to keep the aircraft in a trim-up attitude. Hold the nose up as long as possible. Do not drop it.
- As the nose settles during the final part of the ditching run, the fuselage will fill with water fairly fast. The aircraft will sink to the wings, then float.

DITCHING PROCEDURES.

The ditching charts (figure 5-12) give duties of personnel prior to, and during ditching. Figure 5-13 illustrates the emergency exits and evacuation routes used during ditching. Figure 5-14 illustrates the liferaft releases.

ditching chart

CREW MEMBER	FIRST ACTION	DITCHING IMMINENT (10 Minutes Left)	AFTER DITCHING
PILOT (Station 1)	1. Order crew over interphone and PA to prepare for ditching and give approximate time remaining. 2. Order crew to start emergency procedures and commence depressurization procedures. (Obtain acknowledgements). 3. Transmit on VHF/UHF "Mayday" 3 times, and identification 3 times; transmit a tone for 20 seconds and request a fix or bearing. 4. Obtain a flashlight. 5. Don anti-exposure suit (if required) and life vest. Fasten shoulder harness and safety belt. 6. Dump fuel as required. 7. Ensure that all confidential gear is returned to Comm Central.	1. Alert crew with interphone PA and 6 short rings on alarm bell. 2. Order Copilot to transmit final distress signal. 3. If applicable, order all crew members to turn on emergency flashlights connected to life vests. 4. Order all overhead escape hatches removed. 5. Order all crew members to secure themselves in ditching position. 6. Lock shoulder harness. 7. Read "After Ditching" procedures. 8. Immediately before ditching, warn personnel over interphone and PA "Brace for Impact", and order Copilot to give 1 long ring on alarm bell. 9. Set gear UP, flaps to 100% and airspeed to 10 knots above power of stall.	1. Ensure that all personnel and emergency equipment have been evacuated. 2. Exit through flight station overhead escape hatch with flashlight. 3. Inflate life vest. 4. Board PORT life raft and receive emergency equipment.
COPILOT (Station 2)	1. Acknowledge Pilot's order to prepare for ditching. 2. Set IFF/SIF to emergency. Transmit emergency signal on HF radio followed as soon as possible by emergency message as provided by Navigator. 3. Obtain DF service, bearing, fixes, etc. 4. Obtain a flashlight. 5. Don anti-exposure suit (if required) and life harness and safety belt. 6. Continue transmitting outlined emergency message as required. 7. Assist Pilot as required	1. Transmit final distress signal and intention of Pilot to ditch. 2. Lock shoulder harness. 3. Read "After Ditching" procedures. 4. Turn on emergency flashlight on life vest (if required). 5. On orders from Pilot, give 1 long ring (of 10 seconds or more) on alarm bell. 6. Prepare for impact.	1. Check Pilot and Flight Engineer for injury. 2. Take liquid container from fwd galley. 3. Exit through flight station overhead escape hatch with flashlight. 4. Inflate life vest and board STARBOARD life raft.

Figure 5-12. (Sheet 1 of 5)

CREW MEMBER	FIRST ACTION	DITCHING IMMINENT (10 Minutes Left)	AFTER DITCHING
FLIGHT ENGINEER (Station 3)	1. Acknowledge Pilot's order to prepare for ditching. Ensure pilots PA switch is in "INTERPHONE/PA" position. 2. When directed by Pilot, depressurize aircraft. Set engine bleed air valve switches to CLOSE. 3. Dump fuel as directed by Pilot. 4. Pull landing gear warn light circuit breaker on copilot's lower circuit breaker panel. 5. Obtain a flashlight and crash axe. 6. Ensure that cockpit personnel are provided anti-exposure suits (if required) and life vests. 7. Don anti-exposure suit (if required) and life vest.	1. Remove and stow flight station overhead escape hatch when ordered. 2. Raise and lock galley floor. 3. Secure loose articles. 4. Set emergency depressurization switch to NORMAL and air conditioning master switch to AIR COND MAN PRESS. Hold manual press cont switch to INCREASE for 90 seconds. 5. Turn seat to face forward and lower seat to full down position. 6. Fasten safety belt and lock shoulder harness. 7. Read "After Ditching" procedures. 8. Turn on emergency flashlight on life vest (if required). 9. Prepare for impact.	1. Pull life raft release handles in flight station. 2. Check Pilot and Copilot for injury. 3. Exit through flight station overhead escape hatch with flashlight and crash axe. 4. Inflate life vest. 5. Check life rafts and radio for proper ejection. Discard crash axe. 6. Board PORT life raft.
NAVIGATOR (Station 4)	1. Acknowledge Pilots's order to prepare for ditching. Ensure PA in "ALL" position. 2. Provide position, time true heading, true airspeed, altitude, and estimated ditching position for inclusion in emergency message. 3. Collect essential naviation equipment and flashlight. 4. Don anti-exposure suit (f required) and life vest. 5. Inform Copilot and ACS of distance and direction to nearest land or rescue vessel.	1. Give final estimated ditching position. 2. Turn seat to face forward and lower seat to full down position. 3. Fasten safety belt and lock shoulder harness. 4. Read "After Ditching" procedures. 5. Turn on emergency flashlight on life vest (if required). 6. Prepare for impact.	1. Pull life raft release handles in flight station. 2. Exit through flight station overhead escape hatch with nav gear and flashlight. 3. Inflate life vest. 4. Check life rafts and radio for proper ejection. 5. Board STBD life raft.
FLIGHT ENGINEER (Station 5)	1. Acknowledge Pilot's order to prepare for ditching. 2. Assist in providing anti-exposure suits (if required) and life vests to cockpit personnel. 3. Don anti-exposure suits (if required) and life vest. 4. Obtain first aid kit.	1. When ordered, remove and stow flight station overhead escape hatch. 2. Raise and lock galley floor. 3. Fasten safety belt. 4. Read "After Ditching" procedures. 5. Turn on emergency flashlight on life vest (if required). 6. Prepare for impact.	1. Pull life raft release handles in flight station. 2. Take first aid kit. 3. Exit through flight station overhead escape hatch. 4. Inflate life vest and check port life raft radio. 5. Board PORT life raft.

Figure 5-12. (Sheet 2 of 5)

CREW MEMBER	FIRST ACTION	DITCHING IMMINENT (10 Minutes Left)	AFTER DITCHING
THIRD PILOT (Station 6)	1. Acknowledge Pilot's order to prepare for ditching. 2. Assist Navigator in collecting NAV gear. 3. Ensure that cockpit personnel are provided anti-exposure suit (if required) and life vest. 4. Don anti-exposure suit (if required) and life vest.	1. Fasten safety belt. 2. Read "After Ditching" procedures. 3. Turn on emergency flashlight on life vest (if required). 4. Prepare for impact.	1. Take water container and emergency exit light from crew entrance door. 2. Exit through flight station overhead escape hatch. 3. Inflate life vest. 4. Board STBD life raft.
CREW MEMBER (Station 7)	1. Assist ACO in preparing aft area for ditching and obtain first aid kit. 2. Don anti-exposure suit (if required) and life vest. 3. Fasten safety belt.	1. Read "After Ditching" procedures. 2. Turn on emergency flashlight on life vest (if required). 3. Prepare for impact.	1. Take liquid container from aft galley and first aid kit. 2. Exit through aft overhead escape hatch. 3. Inflate life vest. 4. Board PORT life raft.
ACS (Station 8)	1. Acknowledge Pilot's order to prepare for ditching. 2. When directed, commence emergency communications. 3. Don anti-exposure suit (if required) and life vest. 4. Prepare classified equipment for destruction. Place classified publications in weighted bag.	1. Deliver classified material in weighted bag to ACO. 2. Ensure emergency destruction of all classified material has been completed. 3. Fasten safety belts and lock shoulder harness. 4. Transmit final distress message. 5. Read "After Ditching" procedures. 6. Turn on emergency flashlight on life vest (if required). 7. Prepare for impact.	1. Take liquid container No. 2 from aft galley. 2. Ensure that all Comm Central personnel have exited the aircraft. 3. Exit through center overhead with liquid container. 4. Inflate life vest. 5. Board STBD life raft.
ACO (Station 9)	1. Acknowledge Pilot's order to prepare for ditching. 2. Take charge of the aft area and ensure that all crewmen are notified of impending emergency. 3. Obtain a flashlight. 4. Ensure that cockpit survival equipment is forwarded. 5. Don anti-exposure suit (if required) and life vest. 6. Ensure that all classified equipment and material are properly destroyed. 7. Ensure that all aft crew men are prepared for ditching	1. When directed, have center and aft overhead escape hatches removed and stowed. 2. Return to ditching station and fasten safety belt. 3. Report to Pilot when crew is ready for ditching. 4. Read "After Ditching" procedures. 5. Turn on emergency flashlight on life vest (if required). 6. Prepare for impact.	1. Take water container from port paratroop door. 2. Ensure that all aft crew members have exited the aircraft. 3. Exit through aft overhead escape hatch with flashlgiht and water. 4. Inflate life vest. 5. Board PORT life raft.
ACOM (Station 10)	1. When directed, commence emergency communications. 2. Don anti-exposure suit (if required) and life vest. 3. Assist ACO and ACS in emergency destruction of classified material.	1. Fasten safety belt and lock shoulder harness. 2. Read "After Ditching" procedures. 3. Turn on emergency flashlight on life vest (if required). 4. Prepare for impact.	1. Take emergency exit light and first aid kit from Comm Central. 2. Exit through center overhead escape hatch. 3. Inflate life vest. 4. Board STBD life raft.

Figure 5-12. (Sheet 3 of 5)

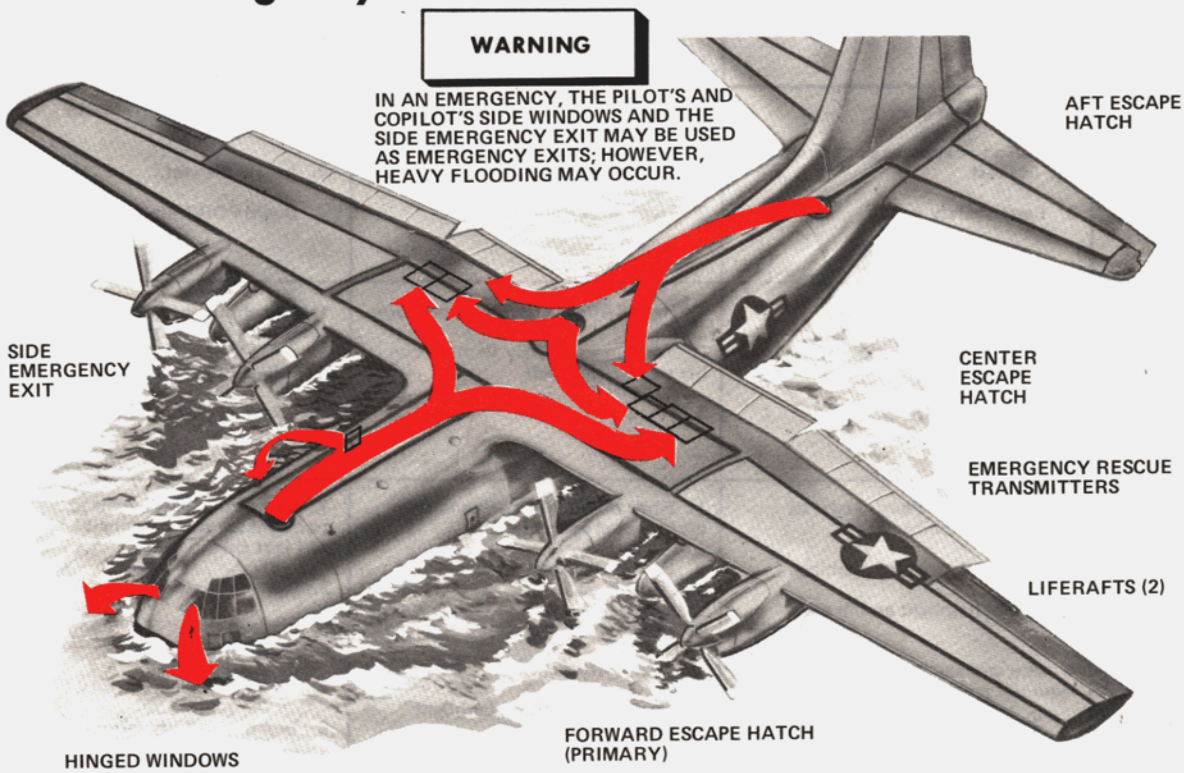
CREW MEMBER	FIRST ACTION	DITCHING IMMINENT (10 Minutes Left)	AFTER DITCHING
CREW MEMBER (Station 11)	1. Secure crew lounge table and loose gear. 2. Don anti-exposure suit (if required) and life vest. 3. Fasten safety belt.	1. Read "After Ditching" procedures. 2. Turn on emergency flashlight on life vest (if required). 3. Prepare for impact.	1. Take water from port para-troop door. 2. Exit through aft overhead escape hatch. 3. Inflate life vest. 4. Board PORT life raft.
TECH (Station 12)	1. When directed, commence emergency communications. 2. Don anti-exposure suit (if required) and life vest. 3. Assist ACO and ACS in emergency destruction of classified material. 4. Obtain first aid kit.	1. Fasten safety belt, and lock shoulder harness. 2. Transmit final distress message. 3. Read "After Ditching" procedures. 4. Turn on emergency flashlight on life vest (if required). 5. Prepare for impact.	1. Exit through center overhead escape hatch with first aid kit. 2. Inflate life vest. 3. Board STBD life raft.
TECH (Station 13)	1. Secure loose gear. 2. Don anti-exposure suit. 3. Fasten safety belt.	1. Read "After Ditching" procedures. 2. Turn on emergency flashlight on life vest (if required). 3. Prepare for impact.	1. Take water from port paratroop door. 2. Exit through aft overhead escape hatch. 3. Inflate life vest. 4. Board PORT life raft.
ACOM (Station 14)	1. When directed, commence emer-gency communications. 2. Don anti-exposure suit (if required) and life vest. 3. Assist ACO and ACS in emergency destruction of classified material.	1. Ensure that Comm Central emer-gency exit light is on. 2. Fasten safety belt and lock shoulder harness. 3. Read "After Ditching" procedures. 4. Turn on emergency flashlight on life vest (if required). 5. Prepare for impact.	1. Exit through center overhead escape hatch. 2. Inflate life vest. 3. Board STBD life raft.
REEL OPERATOR (Station 15)	1. Secure loose gear. 2. Don anti-exposure suit (if required) and life vest. 3. Fasten safety belt.	1. Read "After Ditching" procedures. 2. Turn on emergency flashlight on life vest (if required). 3. Prepare for impact.	1. Take water container from port paratroop door. 2. Exit through aft overhead escape hatch. 3. Inflate life vest. 4. Board PORT life raft.
REEL OPERATOR (Station 16)	1. Acknowledge Pilot's order to prepare for ditching. 2. Advise aft crewmembers of pending emergency. 3. Prepare aft area for ditching. 4. Obtain flashlight and first aid kit. 5. Don anti-exposure suit (if required) and life vest.	1. When ordered, remove and stow center overhead escape hatch. 2. Ensure each aft emergency exit light is on. 3. Fasten safety belt. 4. Read "After Ditching" procedures. 5. Turn on emergency flashlight on life vest (if required). 6. Prepare for impact.	1. Pull life raft release handles aft of STARBOARD paratroop door. 2. Exit through center overhead escape hatch with flashlight and first aid kit. 3. Proceed to STARBOARD life raft and check raft. 4. Assist in loading life raft. 5. Board STARBOARD life raft.

Figure 5-12. (Sheet 4 of 5)

CREW MEMBER	FIRST ACTION	DITCHING IMMINENT (10 Minutes Left)	AFTER DITCHING
CREW MEMBER (Station 17)	1. Secure loose gear. 2. Don anti-exposure suit (if required). and life vest. 3. Fasten safety belt.	1. Read "After Ditching" procedures. 2. Turn on emergency flashlight on life vest (if required). 3. Prepare for impact.	1. Exit through aft overhead escape hatch. 2. Inflate life vest. 3. Board PORT life raft.
CREW MEMBER (Station 18)	1. Secure loose gear. 2. Don anti-exposure suit (if required) and life vest. 3. Fasten safety belt.	1. Read "After Ditching" procedures. 2. Turn on emergency flashlight on life vest (if required). 3. Prepare for impact.	1. Exit through center overhead escape hatch. 2. Inflate life vest. 3. Board STBD life raft.
CREW MEMBER (Station 19)	1. Acknowledge Pilot's order to prepare for ditching. 2. Prepare aft area for ditching. 3. Obtain flashlight and first aid kit. 4. Don anti-exposure suit (if required) and life vest.	1. When ordered, remove and stow aft overhead escape hatch. 2. Ensure that each aft emergency exit light is on. 3. Fasten safety belt. 4. Read "After Ditching" procedures. 5. Turn on emergency flashlight on life vest (if required). 6. Prepare for impact.	1. Exit through aft overhead escape hatch with flashlight and first aid kit. 2. Inflate life vest. 3. Proceed to PORT raft and check raft and radio. 4. Assist in loading life raft. 5. Board PORT life raft.
CREW MEMBER (Station 20)	1. Secure loose gear. 2. Don anti-exposure suit (if required) and life vest. 3. Fasten safety belt.	1. Read "After Ditching" procedures. 2. Turn on emergency flashlight on life vest (if required). 3. Prepare for impact.	1. Exit through center overhead escape hatch. 2. Inflate life vest. 3. Board STBD life raft.
CREW MEMBER (Station 21)	1. Secure loose gear. 2. Don anti-exposure suit (if required) and life vest.	1. Read "After Ditching procedures. 2. Turn on emergency flashlight on life vest (if required). 3. Prepare for impact.	1. Take water, if possible. 2. Exit through aft overhead escape hatch. 3. Inflate life vest. 4. Board PORT life raft.
CREW MEMBER (Station 22)	1. Secure loose gear. 2. Don anti-exposure suit (if required) and life vest. 3. Fasten safety belt.	1. Read "After Ditching" procedures. 2. Turn on emergency flashlight on life vest (if required). 3. Prepare for impact.	1. Take water, if possible. 2. Exit through aft overhead escape hatch. 3. Inflate life vest. 4. Board STARBOARD life raft

Figure 5-12. (Sheet 5 of 5)

water emergency exits

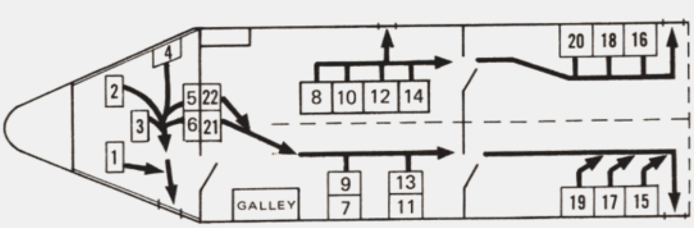


DITCHING STATIONS AND EVACUATION ROUTES

WARNING

Position seats to ensure egress clearance.
Ensure that the galley floor is up and locked.

1. STATIONS ARE NUMBERED IN RECOMMENDED ORDER OF MANNING.
2. IF FEWER THAN 11 CREW MEMBERS ON BOARD, THE ACS (STATION 8) SHOULD ALSO ASSUME THE DUTIES OF THE ACO (STATION 9).



STATION	RECOMMENDED CREW POSITION	LIFE RAFT
1	PILOT	PORT
2	COPILOT	STBD
3	FLT ENG	PORT
4	NAVIGATOR	STBD
5	SEC FLT ENG	PORT
6	THIRD PILOT	STBD
7	CREWMEMBER	PORT
8	ACS	STBD
9	ACO	PORT
10	ACOM	STBD
11	CREWMEMBER	PORT
12	TECH	STBD
13	TECH	PORT
14	ACOM	STBD
15	REEL OP	PORT
16	REEL OP	STBD
17	CREWMEMBER	PORT
18	CREWMEMBER	STBD
19	CREWMEMBER	PORT
20	CREWMEMBER	STBD
21	CREWMEMBER	PORT
22	CREWMEMBER	STBD

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Figure 5-13.

liferaft releases

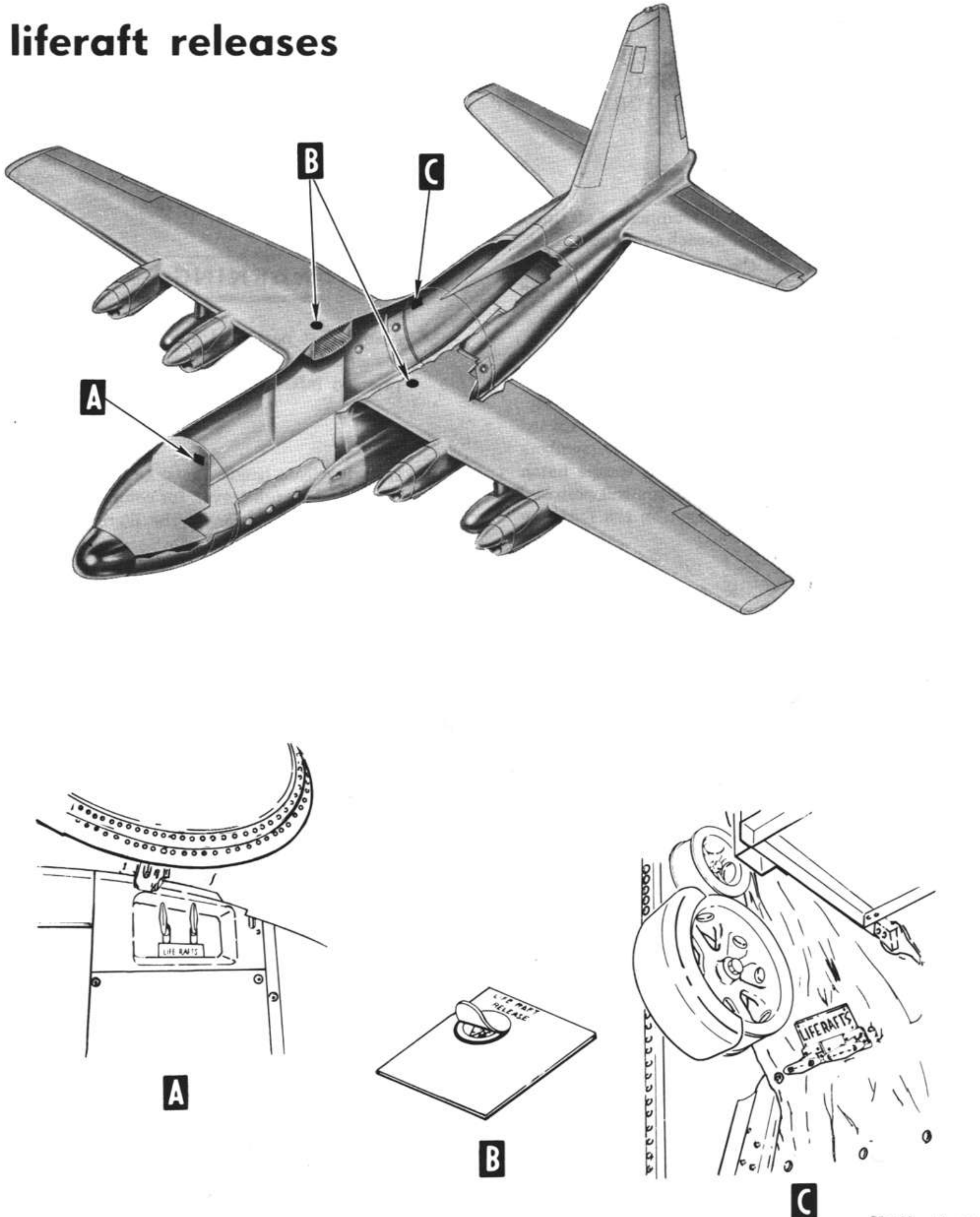


Figure 5-14.

The following are the standard alarm signals for ditching:

SIX SHORT RINGS	PREPARE FOR DITCHING
ONE LONG RING	BRACE FOR IMPACT

Emergency Ditching Equipment.

Ditching equipment should be in readiness at all times when flying over water. Prior to each overwater flight, the pilot will ensure that the necessary equipment is aboard, in serviceable condition, and stowed in the proper places.

Emergency Ditching Exits (Flight Crew).

Refer to figure 5-13 for emergency exits. Normally, crewmembers on the flight deck will use the forward escape hatch for exit after ditching. Crewmembers in the cabin will use the center or aft escape hatch for exit after ditching. All crewmembers will normally board the assigned liferaft as shown in the Ditching Chart (figure 5-12).

Preparation For Ditching.

Plan for ditching cannot be made without taking the wind direction into consideration. Waves move downwind, and the spray from wave crest is also blown downwind. Swells, however, do not always indicate wind direction and can be very large even when the wind is calm. Swells are the result of underwater disturbances. Over a sea, a pilot must be more exacting and alert when judging height.

Abandoning Aircraft.

Evacuation of the aircraft after ditching should be accomplished in an orderly manner in the shortest time possible. This cannot be done well without practice and in the event that the fuselage is dark and filling with water, further difficulty can be expected.

WARNING

The crew must not leave ditching positions until it is ascertained that the aircraft has stopped forward movement. Serious injuries can occur as the result of personnel unfastening safety belts prior to the aircraft coming to a full stop.

Immediately after the aircraft comes to a stop, additional emergency equipment may be collected and distributed to each crewmember. The crewmembers must carry out their after ditching duties (figure 5-12) and then evacuate the aircraft through the hatch previously assigned to them, in the correct order, and carrying the required equipment. They must also see that each piece of equipment for use in the liferaft is secured by lines to prevent its being lost overboard.

WARNING

- Assure that personnel are outside of the aircraft and clear of escape hatches prior to inflating life vests.
- Liferaft release handles must be pulled through their full travel, for complete ejection and inflation of the liferaft.
- In an emergency the pilot's and copilot's side windows and the side emergency exit may be used as emergency exits; however, heavy flooding may occur.

NEW

Ditching Technique.

If possible, use up or dump most of the fuel supply to lighten the aircraft and reduce stalling speed. Empty tanks also help keep the aircraft afloat.

If possible, jettison cargo to lighten the aircraft.

NORMAL POWER-ON DITCHING. Best results will be obtained by following the procedures outlined below:

Ditch while power is available. Power will allow the pilot to choose the spot for ditching, and the most favorable landing position and attitude.

Landing gear - up.

Use full flaps.

Ditch at 10 knots above power-off stall speed. This will give an approximate angle of ditching slightly above level flight. Under no circumstances should the aircraft be stalled in, since this will result in severe impact and cause the aircraft to nose into the water. NEW

In daylight it is recommended that the aircraft be ditched along the top of the swell, parallel to the rows of swells, if the wind does not exceed 30 knots. In high winds, it is recommended that ditching be conducted upwind to take advantage of lowered forward speed. However, it must be remembered that the possibility of ramming nose-on into a wave is increased, as is the possibility of striking the tail on a wave crest and nosing in.

PARTIAL POWER DITCHING. When ditching with one or more engines inoperative, the following should be borne in mind:

With the engines inoperative on the same side of the aircraft, use power on the inboard engine only.

If power is available from the No. 2 and 4 engines or the No. 1 and 3 engines, considerable power may be used to control the aircraft.

Use power as required to give flattest approach.

On final approach, it is advisable to hold speed 20 knots above power-off stall speed until flareout, at which time speed will be reduced to 10 knots above power-off stall speed.

CROSSWIND DITCHING. The basic rules for ditching listed in Normal Power-On Ditching will still apply, in addition to the following:

Crab the aircraft to kill drift.

Land on the downward side of the swell or wave.

UPWIND DITCHING. The basic rules for ditching listed in Normal Power-On Ditching will still apply, in addition to the following:

Maintain nose-up condition, avoid nose striking wave face.

Touchdown immediately behind the crest of a rising wave, avoid the face of the wave.

Hold nose up after first impact.

NIGHT DITCHING. Night ditching will be conducted with the aid of instruments to establish proper attitude of aircraft.

Make an instrument approach, holding airspeed 20 knots above power-off stall speed. At 500 to 700 feet above the water (use radio or radar altimeter if available) set up approximately 200 feet per minute rate of descent and establish an airspeed 10 knots above power-off stall speed, with full flaps.

Use landing lights as necessary.

Hold wings level to avoid digging a wing into the water and cartwheeling the aircraft.

Land at 10 knots above power-off stall speed, using full flaps.

SECTION VI

ALL-WEATHER OPERATIONS

TABLE OF CONTENTS

INTRODUCTION.

This section contains only those procedures that differ from or are in addition to the normal operating instructions covered in Section III, except for some repetition necessary for emphasis, clarity, or continuity of thought. References in this section to operation of the aircraft component systems or auxiliary equipment mean the operation described in Section I.

instrument flight procedures

The aircraft is completely equipped for the use of all standard radio navigational and flight aids. It is the responsibility of the pilot to ensure that each crew member is thoroughly briefed on the exact procedures he is expected to follow during all phases of aircraft operation. In planning IFR flights, remember that fuel requirements at low altitudes are greater than at higher altitudes. If required to land under IFR conditions, additional allowance must be made for letdown and holding procedures, and maximum range and endurance are reduced accordingly.

PRE-FLIGHT AND GROUND CHECKS.

Perform the normal preflight inspections as outlined in the normal operating procedures in Section III.

INSTRUMENT TAKE-OFF.

Note

Execute instrument take-off as outlined below. It is recommended that the take-off and climb be monitored by radar, when available, in the event that return to the field should become necessary.

1. Align the horizon bar of the pilots' attitude director indicator with the wings of the miniature aircraft.

2. Place the mode sel switch to the primary navigation aid to be used for departure (TAC, VOR/ILS 1, or VOR/ILS 2), and place the flt dir

switch to MANUAL. Set the departure course in the course window on the horizontal situation indicator.

3. Align the aircraft on the take-off runway. Set the heading marker under the lubber line to center the bank steering bar on the attitude director indicator.

Note

Any erratic movement or oscillation of the bank steering bar on the attitude director indicator indicates a malfunction, and the system should not be relied upon.

4. Use nose wheel steering (until rudder control becomes available) as the primary directional control during take-off roll.

5. At take-off speed, raise the nose wheel off the ground, smoothly establish a 7-degree nose-up attitude change on the attitude director indicator, and allow the aircraft to fly off the ground.

6. When the aircraft is in a definite climb as indicated by the altimeter and vertical velocity indicator, retract the gear.

7. Make the initial climb at 500 feet per minute, and retract the flaps when the aircraft accelerates to a minimum of 20 knots above take-off speed. Allow the aircraft to accelerate to the desired climb speed.

8. Minor trim changes may be required at flap retraction.

9. Establish climb power, and turn on anti-icing as required. Be alert for the loss of engine power that occurs when wing and empennage anti-icing is used.

INSTRUMENT CLIMB.

1. Complete the After Take-off checklist.

2. Limit the angle of bank to that required for standard rate (3 degrees per second) turns or 30 degrees, whichever is less.

3. Place the flight director switch to NORMAL prior to intercepting the departure radial.

CRUISE.

Conduct instrument cruise flight according to the normal operating procedures outlined in Section III, except that existing published instructions for utilization of radio aids and instructions from airway traffic control must be followed.

HOLDING.

Conduct holding operations at 170 KIAS. If maximum endurance is required, conduct holding operations at maximum endurance airspeed plus 20 KIAS according to instructions from the air traffic controller. This airspeed permits holding to be accomplished at a constant power setting and allows turns to be executed with little, if any, loss of airspeed. Any loss of airspeed may be regained when level flight attitude is resumed.

1. When using the flight director system with the flt dir switch in MANUAL, execute all turns by keeping the bank steering bar centered. Do not exceed 30 degrees of bank.

2. During descent in the holding pattern, when using the flight director system, execute all turns by keeping the bank steering bar centered. If the flight director system is inoperative, limit the angle of bank to that required for a standard rate turn (3 degrees per second) or 30 degrees, whichever is less.

PENETRATIONS.

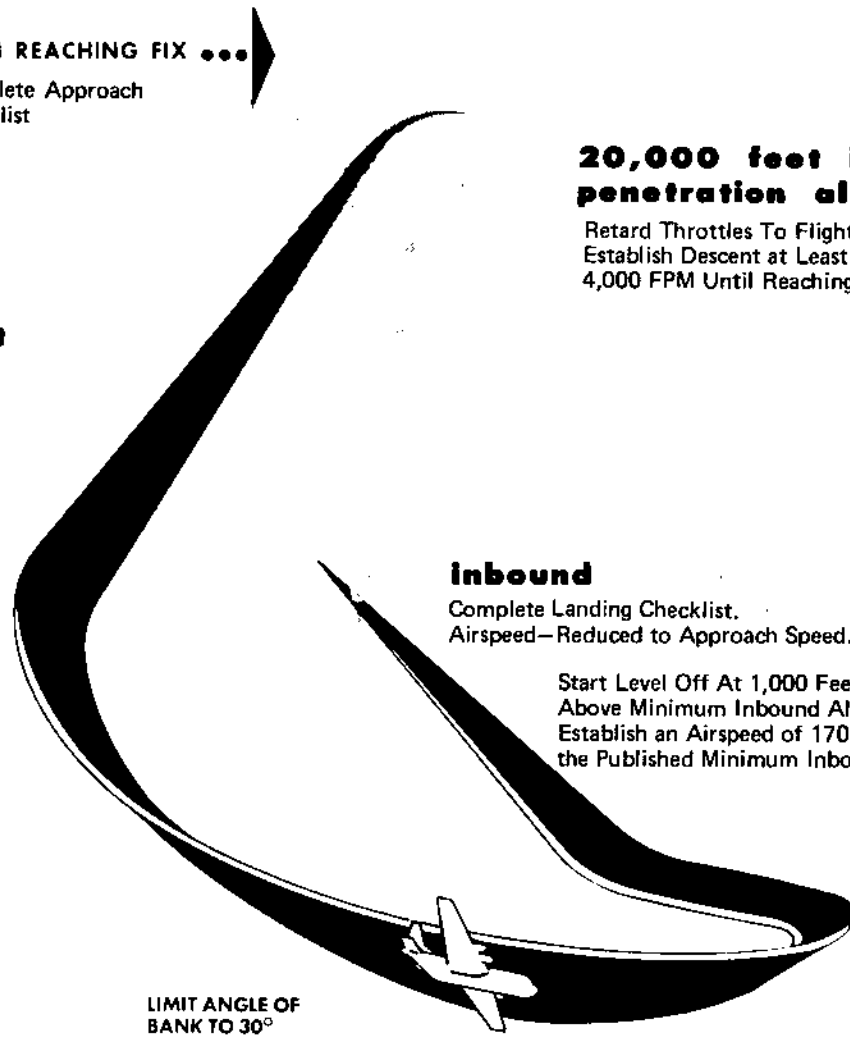
Penetrations may be accomplished in this aircraft, making certain that the current airspeed limitations in Section I are adhered to. Handling characteristics are very good and pitch attitude is not extreme. A typical penetration is shown in figure 6-1.

The recommended procedure is as follows:

1. Before or upon reaching the fix, complete the Approach checklist.

2. Begin the penetration at holding airspeed from the appropriate radio fix, in the clean configuration, by retarding throttles to FLIGHT IDLE and smoothly establish descent at least 4,000 fpm until reaching the penetration airspeed.

typical penetration



NOTE

For limitations in severe turbulence, refer to TURBULENCE AND THUNDERSTORMS, this section.

teardrop penetration

INITIAL ALTITUDE	20,000
Time (Min.)	8
Fuel (Lbs.)	360
Distance (NM)	14

procedure turn penetration

INITIAL ALTITUDE	20,000
Time (Min.)	8
Fuel (Lbs.)	400
Distance (NM)	14

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Figure 6-1.

Note

During penetration, turbulence may be encountered without warning.

3. Follow the published penetration procedure.

4. Start level-off 1,000 feet above the published minimum inbound altitude, and establish an airspeed of 170 KIAS.

5. Complete the Before Landing checklist prior to reaching the fix. Allow the airspeed to decrease to approach speed and execute an approach as depicted in figures 6-3 through 6-10.

INSTRUMENT APPROACHES.

All conventional systems of instrument approach may be used. Flight characteristics during instrument approaches do not differ from those encountered during normal visual flight. Normally, 170 knots IAS is used for entry. Airspeed after the BEFORE LANDING checklist is initiated will be commensurate with the approach and aircraft gross weight. Do not reduce to approach airspeed until on final approach to the station or fix. See figures 6-3 through 6-10 for typical approaches.

Automatic ILS Approach.

In automatic approach the ILS receiving equipment is coupled to the autopilot to provide automatic response of the aircraft to ILS signals. With the switch in the RANGE-LOC position, the aircraft may be flown to intercept the localizer beam, from either side of the runway, at an angle of 60 degrees or less from the runway heading. Altitude and distance from the runway should be such that the aircraft is beneath the glideslope beam when the localizer beam is intercepted. The Approach and Before Landing checklists should be completed prior to intercepting the localizer beam. Refer to figures 6-3 and 6-6 for aircraft configuration and airspeeds. When the edge of the localizer beam is reached, the switch may be rotated to APP. The aircraft will establish a heading such that its ground track is coincident with the center of the localizer beam. The aircraft will remain at a constant altitude until the glideslope is intercepted if altitude control is engaged.

Note

The aircraft will normally overshoot the glideslope center less than one-half scale deflection and then automatically return to and bracket the glideslope center in approximately 30 seconds. The reason for this is that, before the autopilot receives a signal to return to glideslope center, it is necessary to develop an initial glideslope error of sufficient amplitude to produce the nose-down attitude required to fly the glideslope.

The aircraft is brought down the intersection of the glideslope and localizer beam on a correct path for a normal landing. The pilot must monitor the flight instruments, including the course deviation indicator and maintain the desired airspeed with power applications. After visual contact has been established and the autopilot disengaged, the landing is executed in the normal manner. See AUTOPILOT and RADIO BEAM COUPLER EQUIPMENT in Section I for descriptive information on the radio beam coupler switch, the radio beam coupler, and RANGE-LOC position of the automatic approach controller.

USE OF FLIGHT DIRECTOR SYSTEM DURING ILS OPERATION. When using the flight director system during ILS operation, the recommended procedure is as follows:

1. Tune and identify station and place mode sel switch to VOR/ILS mode.

2. Set the front course heading in the course selector window on the HSI.

3. Use HSI course deviation indicator to intercept localizer.

4. The ADI pitch and bank steering bars should be utilized to fly the approach, however, the course deviation indicator and the ADI glideslope indicator shall be utilized as primary indicators when flying an ILS.

USE OF THE FLIGHT DIRECTOR SYSTEM DURING BACK COURSE ILS OPERATION.

1. Tune and identify station and place mode selector switch to ILS mode.

2. Set the front course heading in the course select window on the HSI.

3. Set the heading marker on the tail of the course arrow and place the flight director switch in the MANUAL position.

4. Use HSI course deviation indicator to fly the ILS.

Note

The attitude director indicator will display steering information on the bank steering bar for the selected heading as set by the heading set knob on the HSI. Disregard all indications of the pitch steering bar and the glide slope indicator and monitor for the ILS warning flag.

Circling Approach.

The penetration and approach procedures are based on straight in approach speeds. If a circling approach is required, delay final flap setting until on the final approach and maintain 150 KIAS or computed approach speed, whichever is higher, until on the final approach, then proceed with a normal landing.

Low Visibility Circling Approaches.

In the event it becomes necessary to make a circling approach to align the aircraft with the runway, one of the following methods may be used.

Note

Circling approaches should be conducted in strict observance of circling approach minimums.

270-DEGREE METHOD. The 270-degree method approach (figure 6-2) may be used when it is practical to cross the runway at 90 degrees from the low approach course of the aircraft. The runway is crossed at a 90-degree angle. Fly this heading straight ahead for approximately 13 seconds, then make a standard rate turn to the runway heading.

45-DEGREE METHOD. The 45-degree approach (figure 6-2) consists of a standard rate turn to a heading 45 degrees from the downwind heading. After holding this heading for 40 seconds, make a standard rate turn to the landing heading.

80- TO 260-DEGREE METHOD. The 80- to 260-degree method approach (figure 6-2) consists of a standard rate turn of 80 degrees, rolling out of this turn and into a standard rate turn to the runway heading.

BOXING RUNWAY METHOD. Boxing the runway (figure 6-2) is basically a close-in traffic pattern made by flying down the runway, making a standard rate 180-degree turn, and making another 180-degree turn.

Missed Approaches.

In the event of a missed approach, immediately apply required power and establish a climb. When a definite climb is shown on the vertical velocity indicator and altimeter, complete the normal go-round procedure described in Section III. For three-engine operation, complete the go-around procedure described in Section V. Accelerate to climb speed and maintain until reaching desired missed-approach altitude. Execute the appropriate missed-approach procedure.

Icing conditions

Avoid icing conditions whenever possible. The biggest danger caused by ice accumulation is the reduced aerodynamic efficiency of the aircraft. Specifically, ice accumulation may have the following effects:

Higher take-off, landing, and stall speeds.

Reduces rate-of-climb.

Increases power requirement, thus increasing fuel consumption and decreasing range and endurance.

Impairs control response.

Reduces engine power by obstructing the engine inlet air duct.

circling approaches

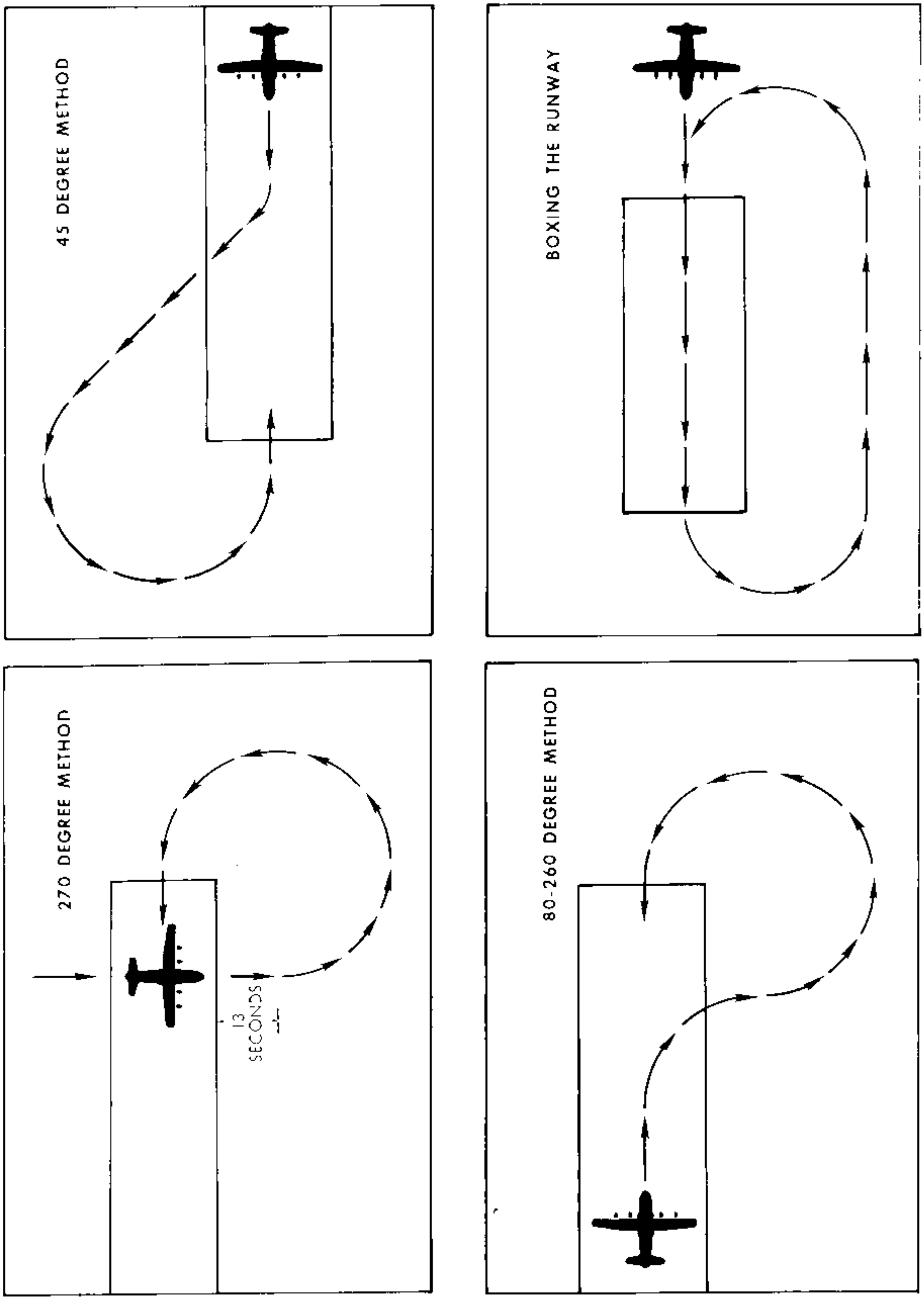

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Figure 6-2.

typical instrument approach four or three engines - adf, vor, or range procedures

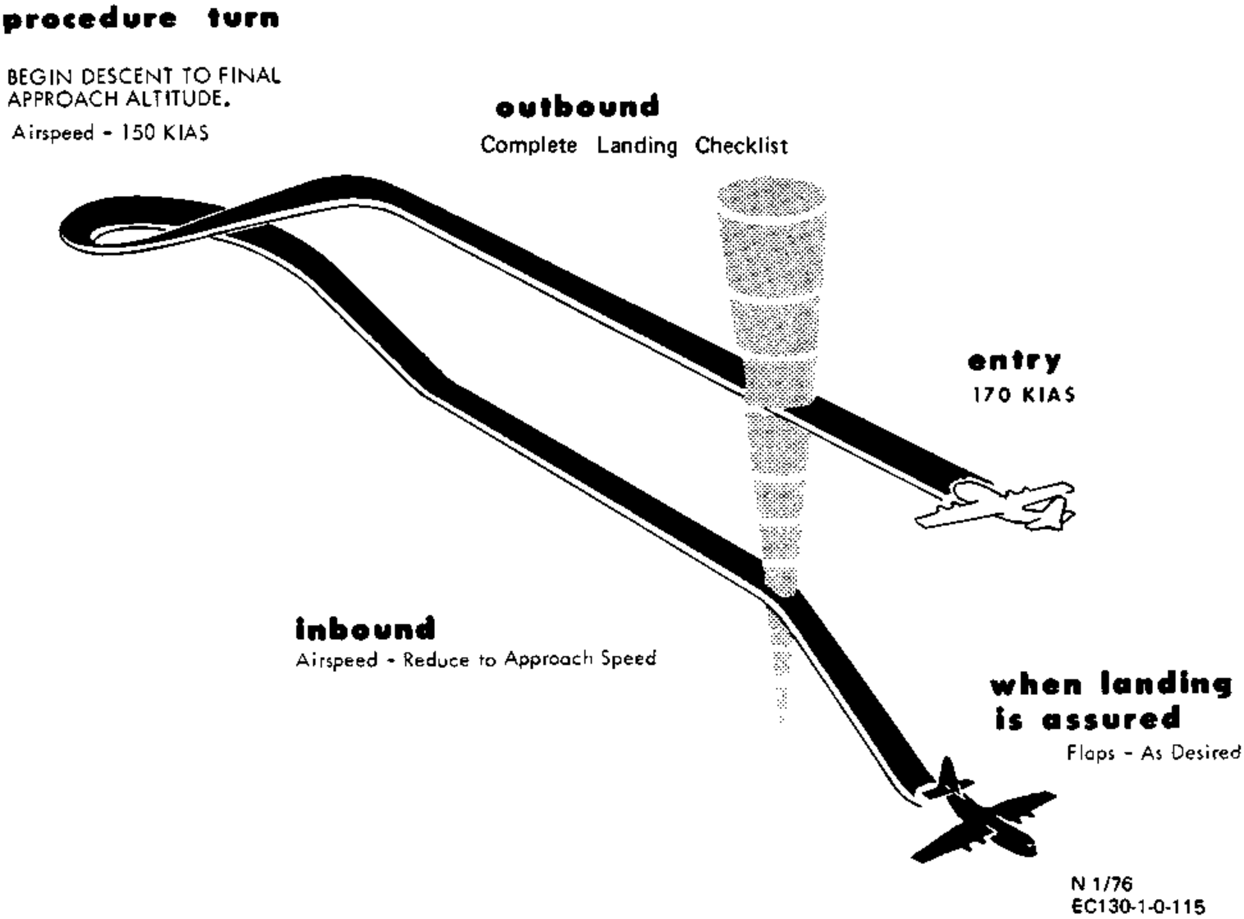


Figure 6-3.

typical instrument approach, two engines - adf, vor, or range

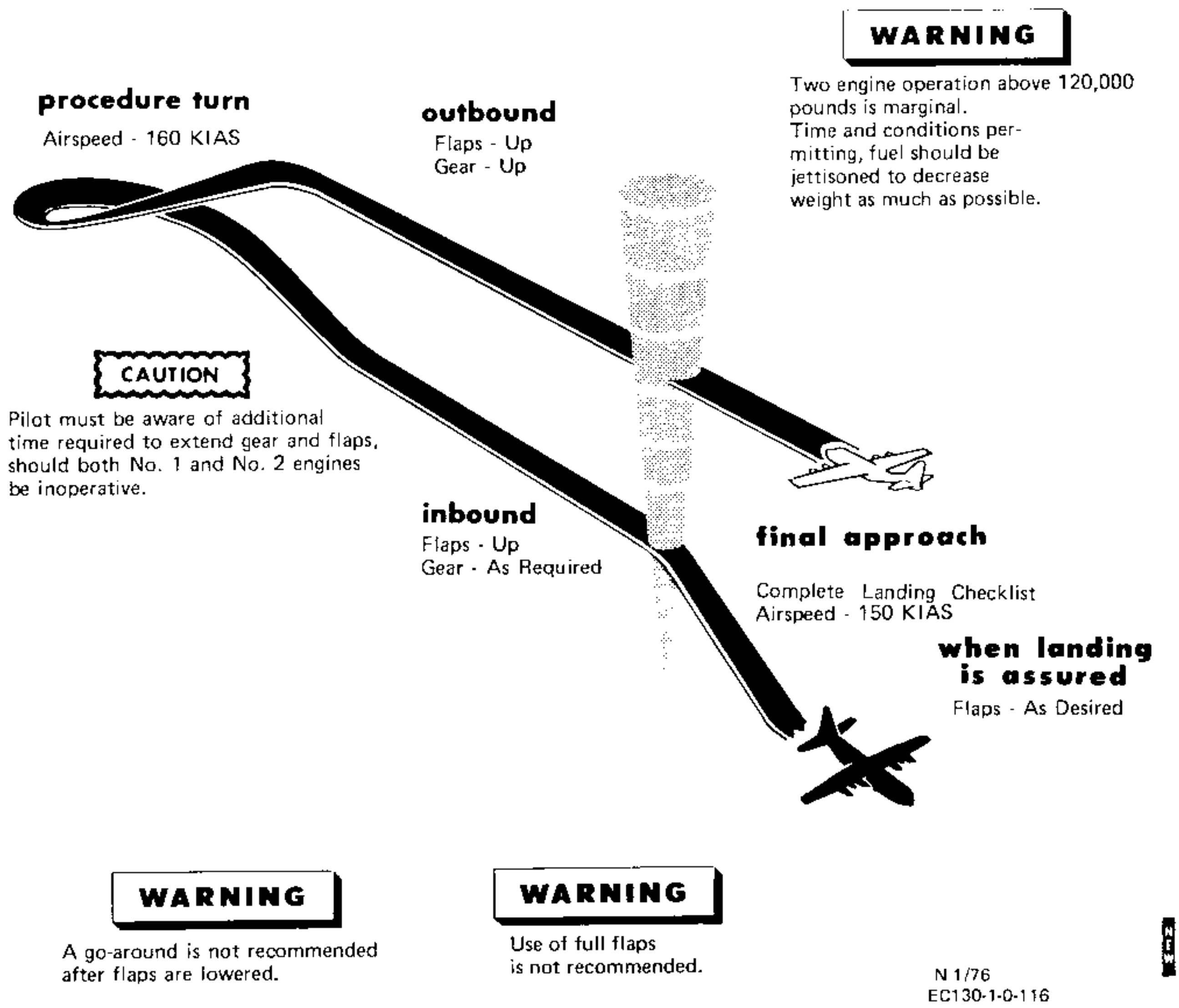


Figure 6-4.

typical -ils four or three engines

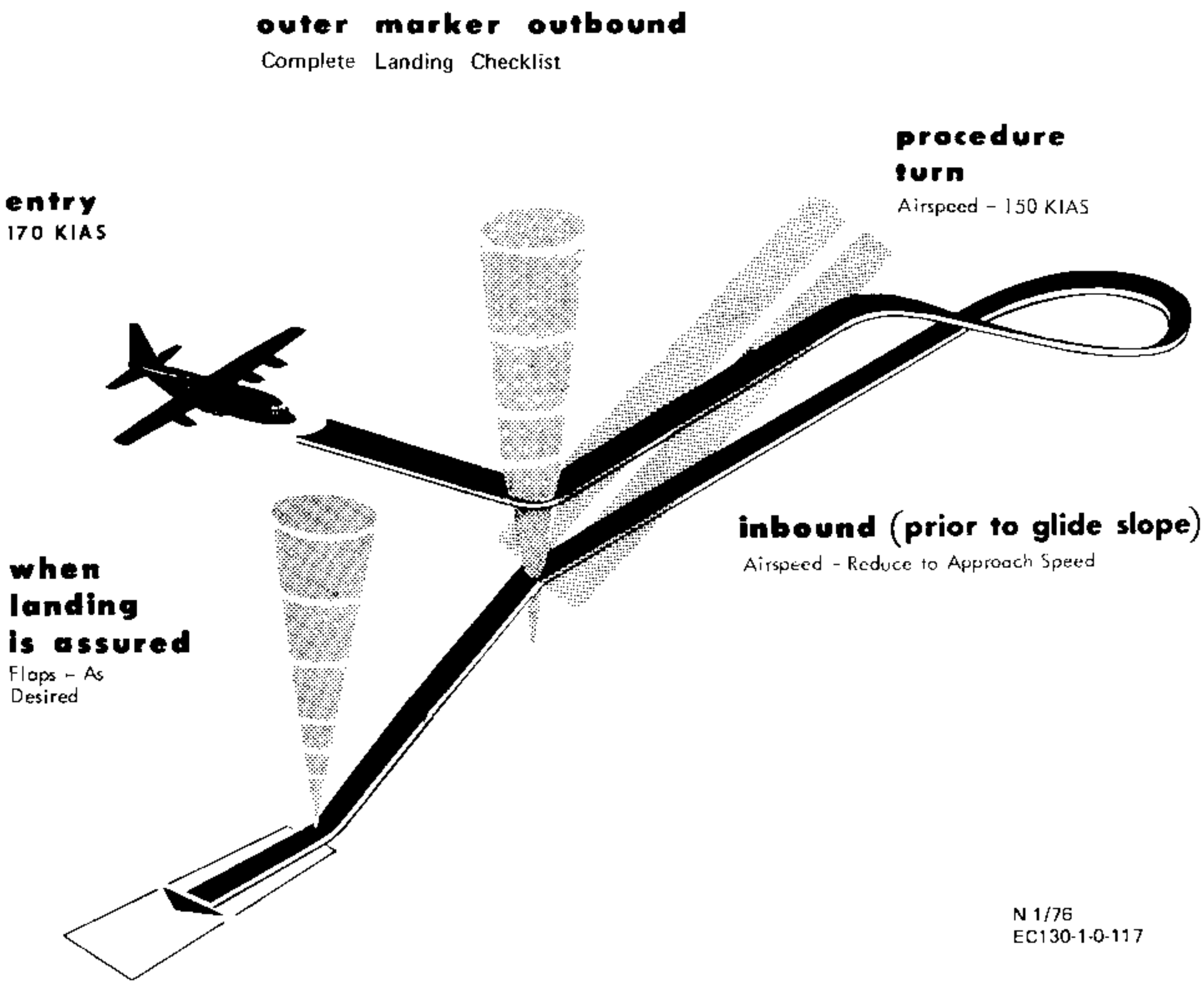


Figure 6-5.

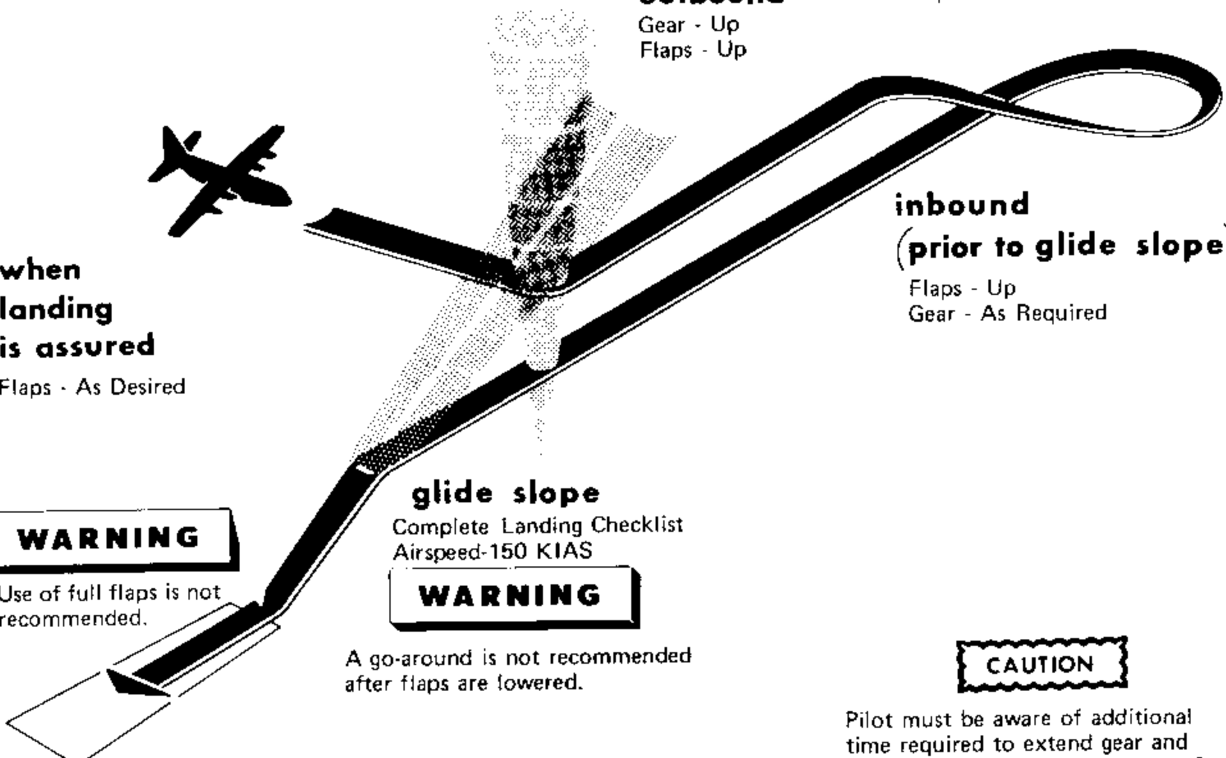
typical -ils two engines

WARNING

Two engine operation above 120,000 pounds is marginal. Time and conditions permitting, fuel should be jettisoned to decrease weight as much as possible.

procedure turn
Airspeed - 160 KIAS

outbound
Gear - Up
Flaps - Up



inbound (prior to glide slope)
Flaps - Up
Gear - As Required

when landing is assured
Flaps - As Desired

WARNING

Use of full flaps is not recommended.

glide slope
Complete Landing Checklist
Airspeed-150 KIAS

WARNING

A go-around is not recommended after flaps are lowered.

CAUTION

Pilot must be aware of additional time required to extend gear and flaps should both No. 1 and No. 2 engines be inoperative.

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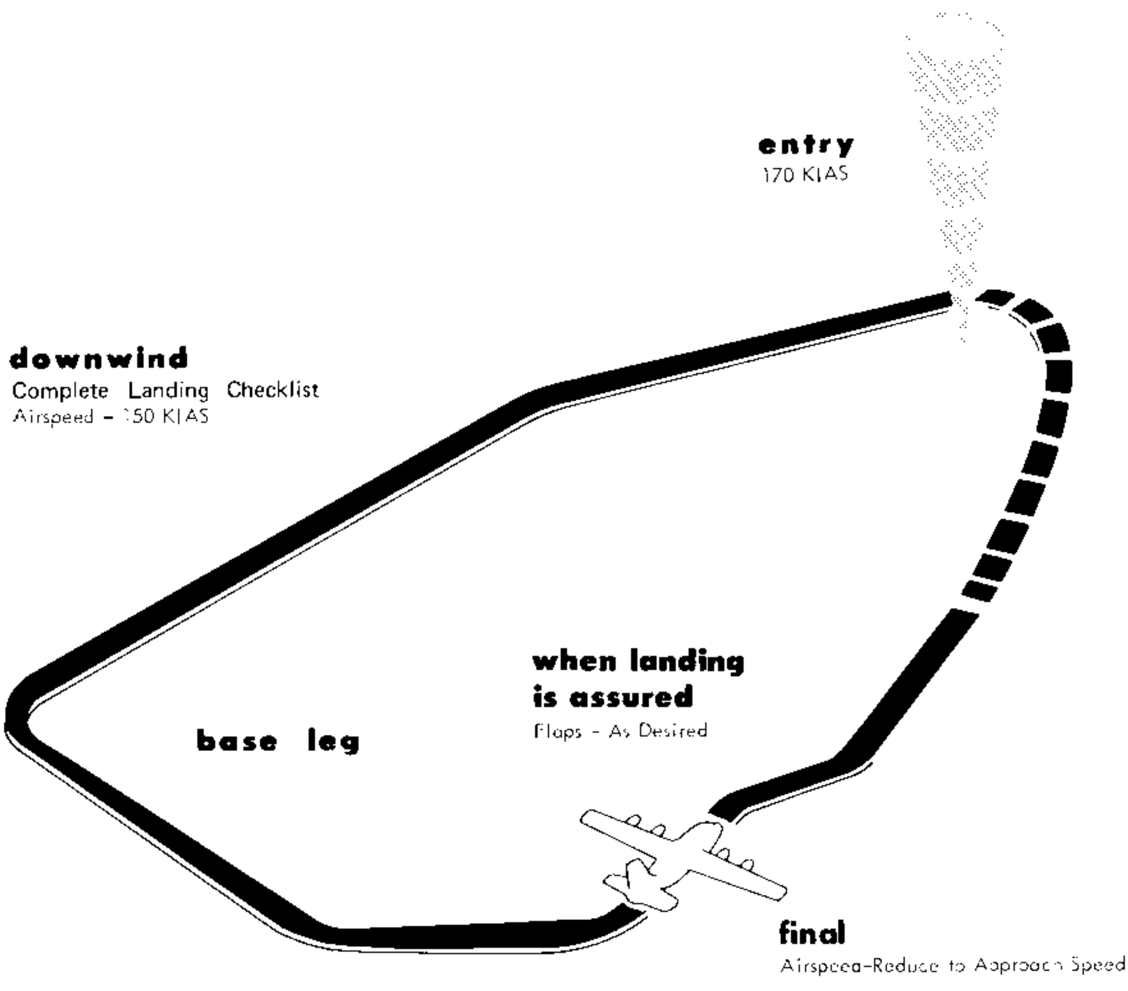
Figure 6-6.

typical radar approach pattern four or three engines



	TIME	FUEL
NORMAL PATTERN	9 MIN.	600 LBS.
MISSED APPROACH GO-AROUND	11 MIN.	800 LBS.

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Figure 6-7.

typical radar approach pattern
two engines

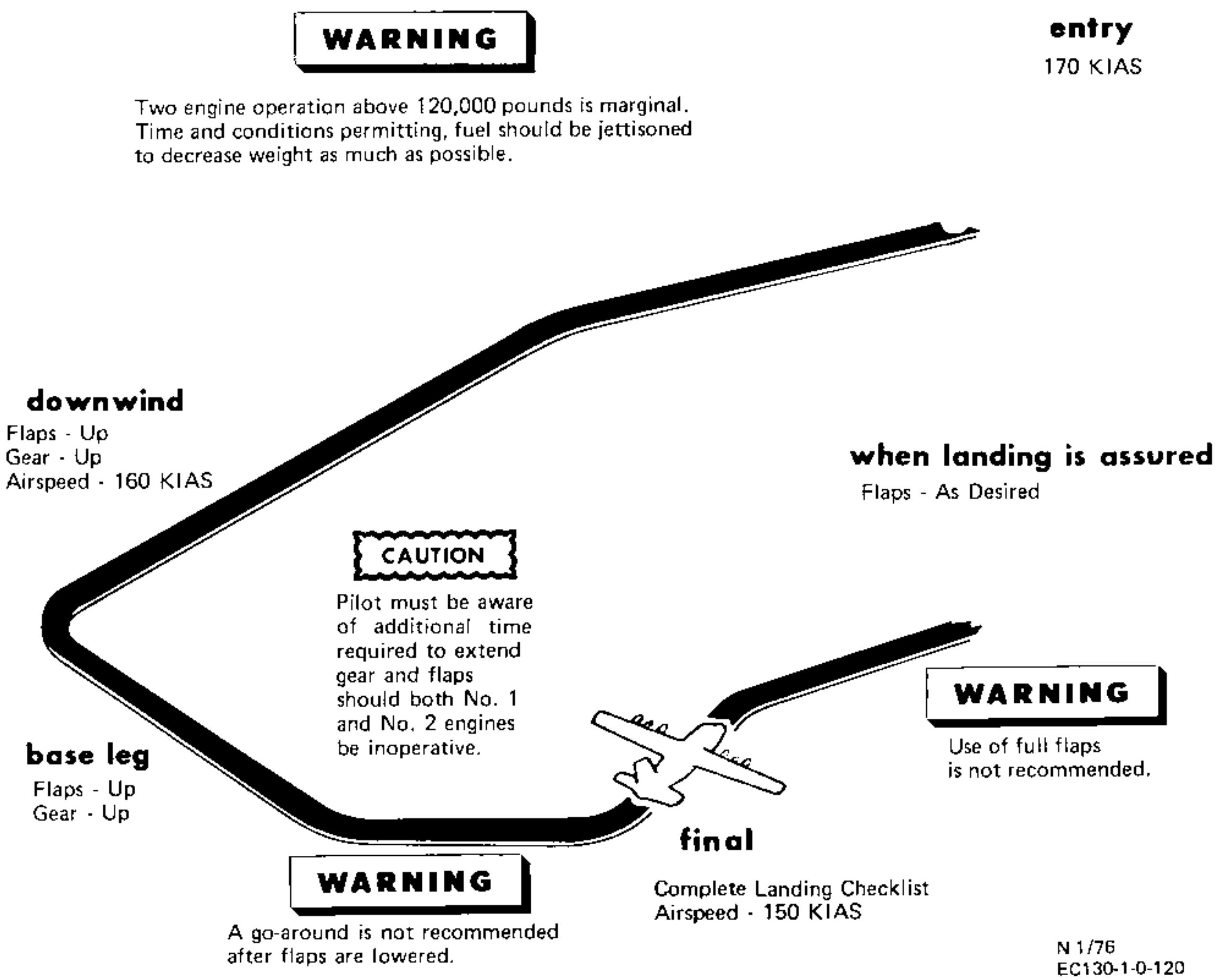


Figure 6-8.

typical tacan pattern four or three engines

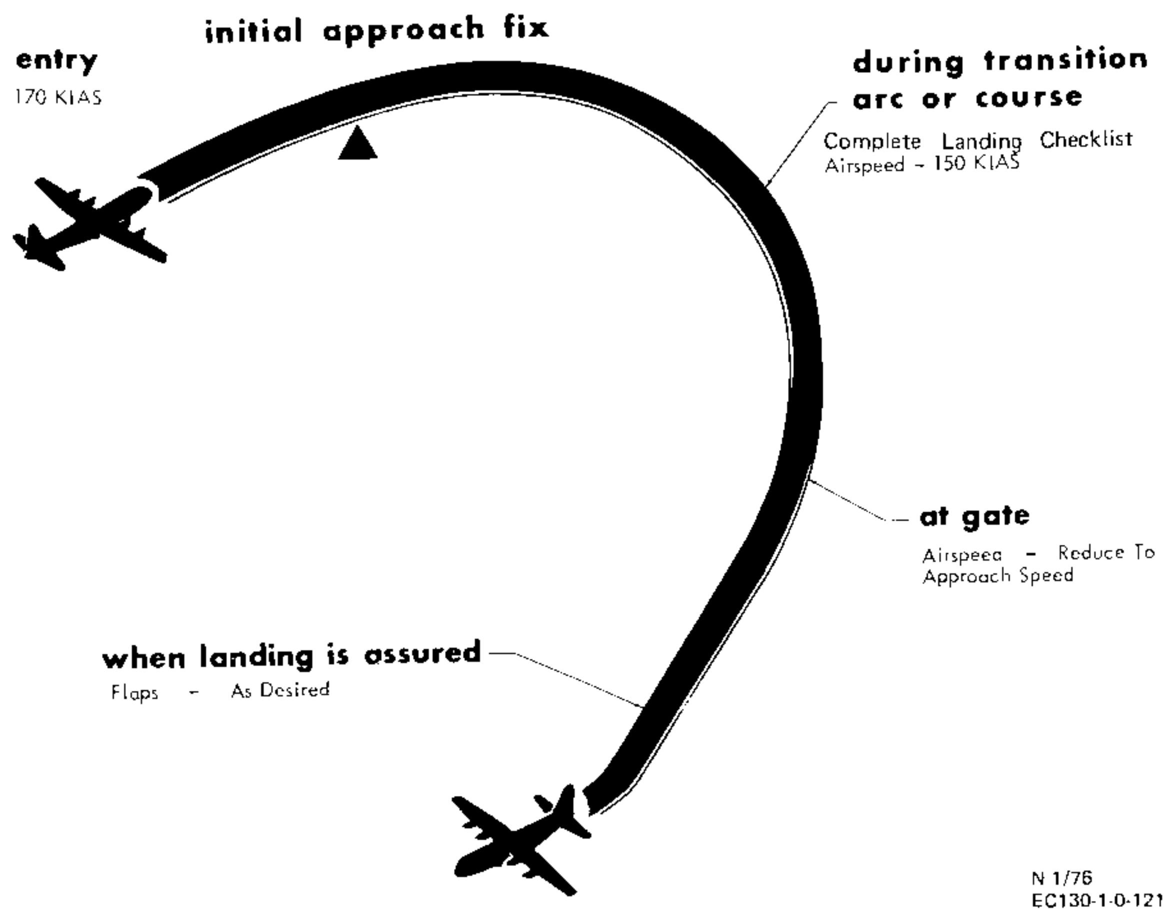
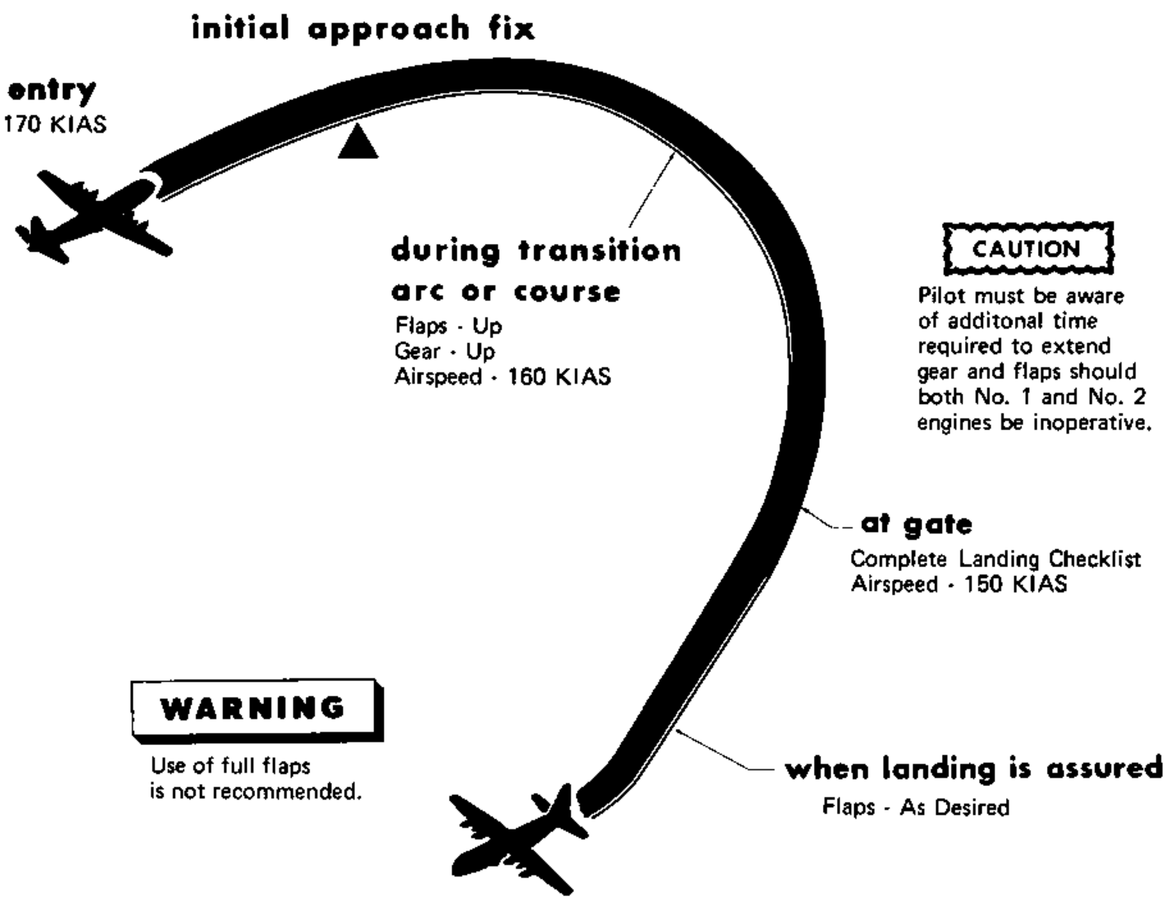


Figure 6-9.

typical tacan pattern two engines

WARNING

Two engine operation above 120,000 pounds is marginal. Time and conditions permitting, fuel should be jettisoned to decrease weight as much as possible.



CAUTION

Pilot must be aware of additonal time required to extend gear and flaps should both No. 1 and No. 2 engines be inoperative.

WARNING

Use of full flaps is not recommended.

WARNING

A go-around is not recommended after flaps are lowered.

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Figure 6-10.

If cruise must be made in icing conditions, consideration must be given to the effect of using bleed air from the engines for the anti-icing system. Use of bleed air for anti-icing will reduce speed, and thus range, for any power setting. Additional power or a descent to a lower altitude may be necessary to maintain cruise speed. Refer to performance data for cruise performance with anti-icing systems in operation.

When possible, change altitude to prevent icing. If climbing to a non-icing altitude is not possible, a check of fuel flow versus ground speed should be made to determine if range, or radius of action, will permit completing the mission. The aircraft can penetrate icing conditions, if the procedure given below is followed.

1. Consider outside air temperature, nature of clouds, type of icing (rime, clear) anticipated or being encountered, and duration of icing and select the least severe icing altitude consistent with the mission.

2. Place the radome anti-icing switch in the AUTO position.

Note

When the warning icing condition ON light illuminates, the propeller and engine anti-icing systems will automatically be turned on by the ice detection system. If wing and empennage anti-icing is required, the switches must be manually placed in ON position.

3. When icing conditions no longer exist or the NO ICE light illuminates, turn the prop & eng anti-icing master switch to the RESET position. When turned to the RESET position all anti-icing systems, except the wing and empennage, are automatically turned off. The wing and empennage anti-icing switches must be manually turned to the OFF position.

4. Delay extension of flaps and landing gear until absolutely necessary. This will help to avoid excessive ice accumulation on the flaps and landing gear. While flying through icing conditions, monitor the leading edge temperature indicators and the de-icing and anti-icing current indicators to make certain that anti-icing equipment is working properly. Make frequent visual checks of wing leading edges, engine inlet air duct leading edges, and propeller spinners. If leading edge anti-icing is seen to be inadequate for preventing ice accumulation, seek a non-icing or less severe icing level.

CAUTION

If possible avoid prolonged flight in freezing rain, particularly at low airspeeds with corresponding higher angles of attack, as there is a possibility of ice accretion on the upper inside surface of the engine inlet air ducts and other areas that are not normally exposed and that are not anti-iced.

CLEAR AIR ICING.

Engine inlet air duct icing in clear air is possible in some combinations of temperature and humidity, depending on the engine power setting and the airspeed. This icing is caused by the sudden drop in temperature resulting from pressure loss in the engine inlet air duct. Such icing is indicated by a falling torquemeter indication. If torquemeter indication falls for no apparent reason, assume that engine inlet air duct icing is occurring. Turn the prop & eng anti-icing master switch to the MANUAL position, and place the engine inlet air duct anti-icing switch in the ON position and take the following action immediately.

1. Increase airspeed to the maximum consistent with continuous operation, to increase ram pressure in the air duct.

2. Seek an altitude that is less likely to produce air duct icing.

Turbulence and Thunderstorms

Rain has no appreciable aerodynamic effects on the aircraft. At cruise speeds, however, visibility through the windshields will be reduced by streaking as the windshield wipers are ineffective at speeds above approximately 180 KIAS.

Flying under conditions of extreme turbulence, such as through thunderstorms, must be avoided whenever possible. When flying under conditions of low visibility, clear passage around or between thunderstorms can usually be found with the navigation and search radar. The possibility remains, however, that a storm cannot be dodged, or that flight through a storm may be a matter of military necessity.

Recommended airspeed for penetration into thunderstorms is 65 knots above power-off stall speed.

Note

The autopilot may be used and, in some cases, is desirable. The altitude hold mode should be disengaged and the autopilot not assisted or overpowered in the autopilot mode. If autopilot cannot control altitude, disengage and fly manually.

cold weather procedures

Extreme cold causes general bad effects on aircraft materials. Rubber, plastic, and fabric materials stiffen and may crack, craze, or even shatter when loads are applied. Oils and lubricants congeal. Adjoining metals contract differentially, and could result in adverse variations in tolerances. Moisture, usually from condensation or melted ice, freezes in critical areas. Tire, landing gear strut, fire extinguisher bottle, and accumulator air pressures decrease with a temperature decrease. Extreme diligence on the part of both ground and flight crews is required to ensure successful cold-weather operation. The procedures and precautions outlined here pertain to operating unhangared aircraft in cold weather and are in addition to the normal procedures given in Section III.

Note

Arrange the preheating period, whether by portable ground heaters or the gas turbine compressor, so that aircraft components will be warmed and inspected prior to starting the engines.

BEFORE ENTERING THE AIRCRAFT.

Perform a normal preflight inspection of the aircraft as outlined in Section III. In particular, check the following:

1. Check for removal of all exterior protective covers and shields.

WARNING

Do not attempt take-off with ice, snow or frost on the wings or empennage. The roughness caused by ice and snow on the surfaces varies the airfoil shape with a resulting loss of efficiency. Take-off run is increased and rate of climb is decreased. Stall speed is increased, and stall characteristics are unpredictable.

CAUTION

- Ensure that moisture from melted ice is not allowed to remain in critical areas where it may refreeze.
- Do not attempt to scrape or chip ice from flight surfaces or fuselage. Exercise care to prevent personal injury from slipping and falling.

Note

If anti-icing compound has not been used on the crew door telescoping rod, frozen condensation may prevent full opening until the rod is heated.

2. Check that fuel tank vents, fuel drains, filters, static ports, and pitot tubes are free of ice and snow.

3. Check for proper inflation of landing gear struts, tires, and hydraulic accumulators.

4. Check that landing gear strut extensions have been wiped with a hydraulic-fluid soaked cloth to remove ice and dirt.

5. Check that a warm well-charged battery has been installed.

6. Check that dry bays are free of hydraulic fluid and fuel seepage.

BEFORE STARTING ENGINES.

In addition to the normal procedures outlined in Section III, perform the following checks:

1. If isopropyl alcohol has been used to remove frost from the aircraft, check the interior of the aircraft for alcohol leaks and fumes. This condition may create a fire hazard.

2. If external ac power is available, energize the Nesa windshields. Bring temperature up gradually to prevent cracking glass. As ice and frost begin to melt, operate the windshield wipers to help clear the windshield. Other windows may be cleared by portable ground heaters.

Note

Either portable ground heaters or the gas turbine compressor may be used to heat the interior of the aircraft during the interior inspection. In extreme cold weather it may be necessary to preheat the gas turbine compressor before it can be started. During starting, torching may be observed. After start, allow approximately four minutes warm up before applying load.

3. After the gas turbine compressor is started and warmed up, start the air turbine motor and check operation of the emergency brake system. Operate brake pedals with light pressure several times before locking the parking brake. Have an inspection made of each main wheel for evidence of hydraulic leakage after full pressure has been applied to the brake pedals. Seeps and moderate leaks caused by hardened O-rings can often be stopped by direct application of hot air from a ground heater for a few minutes.

CAUTION

Do not attempt to taxi if evidence of hydraulic leakage is found in any main landing gear area. Danger of fire and loss of brakes exists when hydraulic fluid contacts hot brakes.

CAUTION

Do not statically change the blade angle of a propeller that has been exposed to prolonged temperatures of 0°C (32°F) or below; warm the propeller hub oil by using warm air or by running the engine at ground idle until engine oil temperature is within 60° to 80°C. Propeller blade seal damage and oil leakage may occur if this is not observed.

4. On EC-130G aircraft, when nacelle preheat is necessary, use it for approximately 5 minutes, and turn it off before starting engines.

Note

On EC-130Q aircraft, the nacelle preheat valves must be installed before the preheat system can be operated.

CAUTION

Nacelle preheat should be used only when the ambient temperature is below 0° F and only when necessary to remove frost or ice from equipment in the nacelle to facilitate engine starting. The bleed air for nacelle preheating is at approximately 600° F when supplied by engine or 400° F when supplied by GTC. Air at this temperature can quickly bake electrical cables and damage electronic components in the nacelle. Closely monitor the nacelle overheat warning light. If it illuminates, place the nacelle preheat switch to the OFF position.

5. Before starting engines, remove all ground heater ducts from the aircraft.

6. In extreme cold temperatures, the crew door seals may stiffen, thus making it impossible to close the door from inside the aircraft. When ground crewmen are not available to assist in closing this door, it may be necessary to have one or more flight crew members assist in closing the door from outside, and then enter the aircraft through one of the paratroop doors.

STARTING ENGINES.

Start the engines by following the procedures in Section III.

CAUTION

When attempting a start with JP-5 and kerosene type fuels at ambient temperatures below approximately -32° C (-25° F), the TIT and rpm should be closely monitored since stall and over-temperature may be experienced during the start.

BEFORE TAXI.

If not already accomplished with external power, energize the Nesa windshields, bringing temperature up gradually to prevent cracking the glass. As ice and frost begin to melt, operate the windshield wipers to help clear the windshield. Other windows may be cleared by air blast from the defogging ducts.

CAUTION

Do not overheat anti-icing systems on the ground. Do not operate propeller anti-icing and de-icing systems unless engines are running.

Note

During extremely cold temperatures, refer to normal operation on windshield anti-icing system in Section I.

TAXIING INSTRUCTIONS.

At the start of taxiing on snow or ice, visually check the landing gear to assure that the wheels are rotating. The combination of increased engine power at low temperatures and slippery ramp surfaces due to ice and snow require that utmost caution be used during taxiing operations. Ground handling characteristics of the aircraft on loose or compacted snow at temperatures below 0° F are good and braking action is fair to good. However, as temperatures rise toward freezing,snow-covered surfaces become more slippery and increasing caution must be exercised. Use of anti-skid is recommended during all taxiing in cold weather.

Nose wheel steering becomes ineffective when abrupt turns are attempted on slippery surfaces. Use nose wheel steering, differential braking, and differential power for best directional control. Maintain safe taxi speeds by use of brakes and partial application of reverse thrust.

WARNING

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

Note

Excessive reverse thrust will cause loss of visibility when taxiing over loose snow.

When operating on snow or slushy surfaces, use Nesa and pitot heat prior to and during propeller reversing.

GROUND TESTS.

Select the area that has the best available surface for braking and conduct the engine and propeller checks outlined in Section III. Avoid parking aircraft close together or near obstructions when performing ground tests.

Note

Surfaces covered with loose snow generally provide better braking than surfaces covered with compacted snow.

A modification of normal procedures may be required when making runup on slippery surfaces. Engines and propellers may be checked in symmetrical pairs while using reverse thrust on the other pair to prevent the aircraft from sliding forward. When runup must be conducted on snow-covered surfaces, do not attempt to make full power checks until the aircraft is lined up on the runway and ready for take-off.

TAKE-OFF.

If the aircraft starts to slide before take-off power is reached, release the brakes and begin the take-off run. Continue the power check during the early part of the run.

CAUTION

Under low ambient temperature conditions, never place throttles in TAKE OFF position without monitoring the torquemeters. At these temperatures, it is possible to exceed maximum allowable torque without exceeding the maximum allowable turbine inlet temperature. In addition, increasing ram effect during the take-off will increase torque for any fixed turbine inlet temperature. This means either that torque must be set below the maximum allowable when setting power for take-off or that power must be reduced as airspeed builds up.

After take-off from slushy runways, cycle the landing gear to reduce the possibility of doors freezing in the closed position.

Note

During operation of the propeller anti-icing system there is a possibility that an indicator "jitter" may occur in the turbine inlet temperature indicators, the torquemeters, tachometers, and fuel flow gages. This needle "jitter" may make monitoring the affected instruments difficult. If this condition occurs, momentarily turn the prop & eng anti-icing master switch to RESET; then read the indicators.

LANDING.

Make a normal pattern and landing as outlined in Section III. Use nose wheel steering gently. Use reverse thrust during the early part of the landing roll. As forward speed decreases, decrease reverse power. If reverse thrust is used at slow speeds on snow or slush-covered surfaces, complete loss of visibility may occur. Use Nesa and pitot heat during landing and be prepared to turn on windshield wipers.

Note

During use of maximum braking on slippery surfaces, cycling of the anti-skid system will be felt on the brake pedals.

LANDING ON ICY RUNWAYS.

Refer to Landing on Icy Runways as outlined in Section III.

STOPPING ENGINES.

Make a normal engine shutdown, as outlined in Section III.

BEFORE LEAVING THE AIRCRAFT.

Perform normal Before Leaving The Aircraft checklist as outlined in Section III and:

1. Remove ice and dirt from shock struts.

2. Install all exterior protective covers and shields.

3. If the aircraft is to remain outside more than 4 hours at temperatures below -29° C (-20° F), remove the battery and store it in a heated area.

4. Close all doors and hatches.

hot weather procedures

Hot-weather operation, as distinguished from desert operation, generally means operation in a hot, humid atmosphere. High humidity usually results in the condensation of moisture throughout the aircraft. Possible results include malfunctioning of electrical equipment, fogging of instruments, rusting of steel parts, and the growth of fungi in vital areas of the aircraft. Further results may be pollution of lubricants and hydraulic fluids, and deterioration of nonmetallic materials. The procedures essential to operation and maintenance under such conditions are given in the following paragraphs.

BEFORE ENTERING THE AIRCRAFT.

Perform a normal preflight inspection as outlined in Section III. Give special attention to the following:

1. Cool the flight station and special equipment compartments with portable coolers, if available.

2. Inspect for freedom of corrosion or fungus at joints, hinge points, and similar locations.

3. Check for hydraulic leaks, as heat and moisture may cause seals and packings to swell.

4. Inspect the shock struts for cleanliness.

5. Inspect tires for proper inflation.

6. Remove all protective covers and shields.

BEFORE STARTING ENGINES.

Continue the normal preflight inspection, as outlined in Section III; give special attention to the following:

1. If instruments, equipment, and controls are moisture coated, wipe them dry with a clean, soft cloth.

TAXIING INSTRUCTIONS.

Taxi the aircraft as directed in Section III. Use brakes as little as possible, to avoid overheating.

TAKE-OFF.

Execute normal take-off and climb, as outlined in Section III.

Note

Take-off run is considerably increased, and rate of climb decreased, in high temperatures. Refer to the appropriate performance charts.

CRUISE.

Follow normal procedures for the operation of the aircraft, as outlined in Section III.

Note

Fuel densities will decrease as the ambient temperature rises, resulting in a decrease in operating range. In addition, the boil-off rate will increase and it may be necessary to restrict rate of climb of the aircraft at altitude. Refer to FUEL in Section I.

LANDING.

Execute normal approach and landing, as outlined in Section III.

STOPPING ENGINES.

Make a normal engine shutdown as outlined in Section III. As soon as the aircraft is parked, chock wheels and release brakes in order to avoid possible damage to brake components from excessive heat generated when taxiing.

BEFORE LEAVING THE AIRCRAFT.

Make a normal postflight inspection as outlined in Section III, and:

1. Have appropriate protective covers installed for protection from the sun.

2. When weather conditions permit, leave flight station windows and compartment doors open to ventilate the aircraft.

desert procedures

Desert operation generally means operation in a very hot, dry, dusty, often windy atmosphere. Under such conditions, sand and dust will often be found in vital areas of the aircraft, such as hinge points, bearings, landing gear shock struts, and engine cowling and intakes. Severe damage to the affected parts may be caused by the dust and sand. Position the aircraft so that propwash will not expose other aircraft, personnel, and ground equipment to blown sand or dust. The necessary operations under such conditions are given in the following paragraphs.

BEFORE ENTERING THE AIRCRAFT.

Perform a normal preflight inspection as outlined in Section III. Give special attention to the following:

1. Cool the flight station and special equipment compartments with portable coolers, if available.

Note

Use of the GTC for ground air conditioning may pull in quantities of sand and dust.

2. Inspect all control surface hinge and actuating linkage for freedom of sand and dust.

3. Inspect tires for proper inflation.

4. Inspect shock struts for cleanliness.

5. Remove all protective covers and shields.

BEFORE STARTING ENGINES.

Continue the normal preflight inspection of the aircraft, as outlined in Section III. Give special attention to the following:

1. Inspect instrument panels, switches, and controls for freedom of sand and dust.

2. Operate all controls through at least two full cycles to ensure unrestricted operation.

TAXIING INSTRUCTIONS.

Taxi the aircraft as directed in Section III, using care to avoid blowing sand or dust on other aircraft, personnel, or equipment. Use brakes as little as possible, to prevent overheating. The use of reverse thrust may blow sand and dust into the air directly in front of the engine intakes. In deep sand, use differential power, rather than nose wheel steering, for directional control. Minimize ground operation to avoid excessive sand and dust intake by the engines.

TAKE-OFF.

Execute normal take-off and climb, as outlined in Section III. Avoid take-off during sand or dust storms, if possible. Sand and dust will cause damage to internal engine parts. Take-off run is considerably increased and rate of climb decreased in high atmospheric temperatures. Refer to the appropriate performance charts.

NEW

Note

When take-off performance is not critical, use rolling take-offs whenever possible to decrease time in adverse conditions.

CRUISE.

Follow normal procedures for the operation of the aircraft, as outlined in Section III. Avoid flying through dust or sand storms, when possible. Excessive dust and grit in the air will cause considerable damage to internal engine parts.

LANDING.

Execute a normal approach and landing, as outlined in Section III. Therefore, on very hot days, follow traffic and landing procedures strictly, and anticipate a longer landing roll. Avoid the use of reverse thrust, since reverse thrust may blow sand and dust into the air directly in front of the engine intakes.

STOPPING ENGINES.

Make normal engine shutdown as outlined in Section III. As soon as the aircraft is parked, chock the wheels and release the brakes to avoid damage to brake components due to excessive heat generated while taxiing.

BEFORE LEAVING THE AIRCRAFT.

Make a normal Before Leaving The Aircraft inspection, as outlined in Section III, giving special attention to the following:

1. Have all protective covers and shields installed.

2. Except in dust or rainy weather, leave flight station windows and compartment doors open to ventilate the aircraft.

SECTION VII

COMMUNICATION PROCEDURE

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INTRODUCTION.

The EC-130G/Q aircraft contains a highly specialized communications system. The system provides for operation in various modes and on many frequencies. It is important that all pilots, NFO's, and communicators thoroughly understand the system's capabilities. All pilots, NFO's, and communicators must also be thoroughly familiar with the applicable operational communication plan and communications procedures. Specific communications procedures and techniques are found in Federal Aviation Regulations, Flight Information Publications, ICAO regulations, Air Traffic Control Procedures, appropriate communications instructions, and Communications Tactical Publications.

RADIO COMMUNICATIONS.

The Aircraft Commander (AC) or Mission Commander (MC) maintains overall responsibility for all communications emanating from the aircraft. He shall ensure that all messages are dispatched in accordance with current regulations and procedures. He should normally sight and release all messages. (The message releasing authority may be delegated to other crew members.) He is also responsible to ensure proper radio watches are set and maintained on appropriate radio frequencies, and to ensure compliance with position reporting procedures and requirements contained in appropriate directives.

The Airborne Communications Officer (ACO) is responsible to the Mission Commander (MC) for directing and controlling all "Mission" communications functions in the aircraft. The ACO will have a thorough knowledge of the communications systems capabilities and appropriate communications instructions. The ACO will keep the MC informed of all equipment malfunctions and other communication difficulties.

Note

> The operational procedures and a detailed description of each position of the intercommunications equipment is located in Sections VII and VIII of this manual.

INTERNAL COMMUNICATIONS.

The EC-130G/Q aircraft has a highly flexible intercommunications system. The system is composed of two separate AIC-18 intercommunication systems and a public address sytem, AIC-13. Each system can be operated independently or in conjunction with the other.

Note

> The detailed description and operational procedures of all EC-130G/Q aircraft communications and navigation electronics equipment are located in Sections VII and VIII of this manual.

INTERCOM DISCIPLINE.

Intercom discipline comes only with training, and is achieved through obeying the following rules:

1. Be clear and brief.

2. Keep the voice natural. This indicates calmness and promotes understanding.

3. Know what is to be said, then say it with authority.

4. Once beginning a transmission, continue until it is finished.

5. Before transmitting, monitor the intercom circuit to prevent interruption of message traffic already in progress. (Interruptions to report emergency conditions are exceptions.)

6. Keep transmissions at a minimum.

7. Short and important transmissions should be completed without requiring acknowledgement prior to transmitting the text. Example: "Flight from aft station, smoke in special equipment compartment."

VISUAL COMMUNICATIONS.

The aircraft is equipped with an aldis lamp to transmit visual signals. The running lights and landing lights may be used as signals by utilizing the on-off switches. The Flight Information Publications delineate the correct use of visual signals.

EMERGENCY COMMUNICATIONS.

Emergency situations are so varied that exact rules cannot be established for each situation. However, when an emergency is encountered in a flight condition, the pilot is expected to act in accordance with the procedures set down in the Flight Planning Document, Enroute Supplements (IFR), and the applicable operational communication plan.

SECTION VIII

SPECIAL MISSIONS

Special Missions normally included in this section are contained in Classified Supplement NAVAIR 01-75GAE-1M

SECTION IX

FLIGHT CREW COMPOSITION, RESPONSIBILITY, AND COORDINATION

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CREW COMPOSITION.

MINIMUM CREW REQUIREMENTS.

The minimum crew required to operate the aircraft is composed of an aircraft commander, copilot, flight engineer, and aft observer. Additional crewmembers may be added, as required, at the discretion of the commander.

MISSION CREW REQUIREMENTS.

A mission shall consist of at least:

1. Mission Commander

Note

The MC shall be dual qualified as AC/MC or ACO/MC.

2. One AC
3. One copilot
4. One navigator
5. One flight engineer
6. One ACO
7. One ACS
8. Two ACOM's
9. Two flight technicians or ACOM's
10. One reel operator.

CREW RESPONSIBILITY.

Mission Commander (MC).

The MC shall be a properly qualified naval aviator or naval flight officer designated by the commanding officer. He shall be responsible for all phases of the assigned mission except those aspects of safety of flight which are related to the physical control of the aircraft and are considered beyond the qualification of the MC's designator. MC qualfication is outlined in Section II. The MC shall direct a coordinated plan of action and shall be responsible for the effectiveness of the flight.

Aircraft Commander (AC).

The AC shall be in command of the aircraft and responsible for the safe and orderly conduct of the flight. His responsibility exists from the time he enters the aircraft preparatory to flight until he is relieved from duty by proper authority. The authority and responsiblity of the AC for the flight is independent of the presence of other persons senior to him in the crew or passengers, except as stated in Article 1329, U. S. Navy Regulations, and OPNAVINST 3710.7 series.

He shall be thoroughly familiar with this manual, squadron manuals and directives, and all other directives from higher authority.

The AC has authority to delay or discontinue a flight when, in his opinion, conditions are unsafe for starting or continuing a flight.

He is vested with the authority to carry out the assigned mission, and is in command of the assigned crewmembers from the time they report for duty until the termination of such assignment. The AC's orders will receive prompt compliance; however, other crewmembers shall bring to his attention such information or factors of importance which could have a direct bearing upon his ultimate decision in instances that involve safety of flight.

COPILOT (2P/3P).

The copilot is second-in-command and is responsible for assisting the AC in the performance of his duties and such other duties as may be assigned.

The copilot may control the aircraft and may make instrument climbs, descents, landings, and take-offs, day or night, consistent with his instrument qualification. The AC shall use his discretion in each case of adverse weather or emergencies encountered in deciding if the copilot is capable of executing a safe departure or approach.

When in control of the aircraft, in the absence of the AC from the cockpit, the copilot will ensure the safe conduct of the flight and will notify the AC immediately of any unusual events or circumstances. In the event of disability of the AC during flight, the copilot with the highest designation will take command of the flight and assume the authority, duties, and responsibilities of the AC to the next enroute station or a closer alternate as the situation warrants.

The copilot shall constantly monitor all maneuvers being performed by the pilot, bringing to his attention any deviation from normal operation. When, in his opinion, the flight is bordering on unsafe conditions, it is the copilot's responsibility to advise the pilot, regardless of designations or rank.

NAVIGATOR.

The navigator plans the navigational phase of the mission. He attends briefings to obtain information on the mission to be performed and the conditions under which it must be accomplished. He prepares detailed navigation flight plans based upon latest available weather and intelligence information. He obtains navigational data and equipment such as maps, charts, flight publications, and navigational instruments needed for the mission. He navigates the aircraft to accomplish the mission.

He furnishes the pilot and other crewmembers with information on headings to be flown, estimated times of arrival, current positions, wind direction and velocity, and ground speed. During tactical missions, considerable coordination is necessary between the navigator and airborne communication officer.

NAVIGATOR'S CHECKLIST.

Preparation for Flight.

1. Aircraft status	Checked
2. Flight plan	Completed
3. Range control chart	Completed/as required
4. Maps and charts	Required courses and reporting points plotted and checked

5. Professional and personal equipment	Checked
6. Weather briefing	Attended
7. Survival equipment	Checked/Fitted

Interior (Power Off).

1. Navigation publications	Checked
2. Pyrotechnic/pressure lock	Checked
3. Radar	Checked
a. Range switch	50/10 or less
b. Function switch	OFF
c. Gain control	CCW
d. HDG/range marks	CCW
e. Range delay	OFF
f. Intensity	CCW
4. Doppler power switch	OFF
5. Computer function switch	OFF
6. Nose radome anti-icing switch	OFF
7. Public address system power switch	OFF
8. ADF	OFF

9. Loran	OFF
10. AN/APN 133 Radio altimeter	OFF

Interior (Power On).

1. Interior lights	Checked
2. Time hack	Obtained
3. Clocks	Synchronized
4. Radar pressurization system	Checked

Note

Set at 40 in. Hg, should hold a minimum of 38 in. Hg. for 10 minutes.

CAUTION

Do not exceed 41 in. Hg.

5. Search radar	Checked/OFF
6. Compass systems	Checked/set
a. N-1 compasses (EC-130G aircraft)	Latitude control knob - OFF (MAG) Lat Set (GRID)
b. C-12 compasses (EC 130Q aircraft)	Set
(1) Latitude N-S switch	Local latitude
(2) Latitude knob	Local latitude
(3) Mode selector switch	As required

c. AHRS compass (EC-130G aircraft and EC-130Q aircraft BuNo 156170 through 156177)	Set
(1) Latitude N-S switch	Local latitude
(2) Latitude knob	As required
(3) Mode selector switch	As required
d. Compass correction cards	Checked
7. Doppler	Checked/OFF
a. Power switch	Test
After warmup of one minute:	
b. G/S switch	Set/121K
c. DR switch	Set/0
8. Computer - main control indicator	Set target and base coordinates (as applicable)
9. ADF	Checked/OFF
10. Loran	Checked/OFF
11. INS	Checked/OFF
12. Radio altimeter	Checked/OFF
13. Periscopic sextant, mount, and alignment	Checked/moisture drained

a. Periscopic sextant	Checked/aligned/stowed
b. Periscopic sextant outlet	Closed
c. Periscopic case fasteners	One unfastened
14. Interphone	Checked
15. Fuel reading	Checked and entered on range control chart (as applicable)

Before Starting Engines.

1. Navigator's panel	Set
2. Lights	As required
3. INS alignment and data entry	SET
a. INS mode selector switch	OFF
b. CDU	SET
(1) Auto/man/RMT switch	MAN
(2) Display selector switch	POS
c. INS mode selector switch	STBY
d. CDU	SET
(1) Display selector switch	TEST
(2) Displays and annunciators	Checked

Left and right numerical displays, degree signs, decimal points, arc-minute signs, NS and EW, and From/To display, and ALERT, BATT, and WARN annunciators are on.

(3) Nav mode sel switch (on pilot's inst panel) — INS

Verify that HSI indicates a heading of 11.25 degrees and bearing point 22.5 degrees against azimuth card.

(4) Vertical reference select switch (on pilot's inst panel) — NORMAL

Verify that ADI attitude warning flag goes out of view.

e. Present position entry — Entered

(1) Display selector switch — POS

(2) N or S pushbutton — Depressed

(3) Present latitude — Entered

(4) Insert pushbutton — Depressed

(5) W or E pushbutton — Depressed

(6) Present longitude — Entered

(7) Insert pushbutton — Depressed

f. INS mode selector switch — ALIGN

Note

The ready nav annunciator shall illuminate within 18 minutes. Do not move the airplane during INS alignment.

g. Waypoint coordinates entry — Entered

(1) Display selector switch — WPT

(2) WPT selector switch	As desired

Note

The initial enroute waypoint coordinates are entered into waypoint 1 unless a return to point of departure track is desired in which case the initial enroute waypoint coordinates are entered into waypoint 2. Additional waypoint coordinates are then entered sequentially into subsequent waypoint storage locations.

(3) N or S pushbutton	Depressed
(4) First waypoint latitude	Entered
(5) Insert pushbutton	Depressed
(6) W or E pushbutton	Depressed
(7) First waypoint longitude	Entered
(8) Insert pushbutton	Depressed

Note

Repeat steps (2) through (8) for subsequent waypoint entries.

4. Oxygen	Checked/NORMAL/100%/OFF
a. Emergency toggle lever	NORMAL
b. Regulator diluter lever	100%
c. Oxygen supply lever	OFF
d. Oxygen mask	Connected
5. Public address system	ON/Checked

Before Taxi.

1.	Compass systems and heading indicators	Checked/set
2.	Radios	ON
	a. ADF	ON
	b. UHF and VHF	Monitored
3.	Altimeter	Set ______ (state setting)
	a. Compare against field elevation	
	b. Altimeter correction cards	Checked
4.	INS status check	Complete
	a. CDU display selector switch	DSR TK STS
	b. Status number	Checked

Note

After the status number decrements to 02 or less and 8 minutes have elapsed since the start of status 40, the READY NAV annunciator comes on. If the status number increases to 03 or more for a 2-minute period, the READY NAV annunciator goes off and stays off until the status number decrements to 02 or less.

	c. READY NAV annunciator	Illuminated
5.	INS mode selector switch	NAV

Note

Do not set the mode selector switch out of NAV except when an INS malfunction occurs as the alignment must be repeated on the ground by setting the mode selector switch to OFF, then to STBY and repeating present position entry procedures.

6. Radar and Doppler — STBY (when at least two engines will remain in normal ground idle or above)

Before Take-off.

1. Departure procedures coordinated with pilot — As required
2. Altimeter — Set ________ (state setting)
3. Radar — Standby
4. Radio altimeter — On/adjusted
5. Copy clearance — Complete
6. Safety belt and shoulder harness — Fastened/unlocked (seat facing forward)
7. Hot mike — Set
   a. Listen ON
8. Computer — As required

After Take-off.

1. Record take-off time and total fuel remaining — Completed
2. Radome anti-icing — As required

Note

Normally the radome anti-icing should not be used except when ice accumulation interfers with the scope presentation or for a 2-3 minute period on initial climb to remove moisture from the radome and anti-icing system valves. This check will normally be performed when the flight engineer performs the leading edge anti-icing check.

Enroute Climb/Cruise/Descent.

Note

Radar pressurization will be monitored continuously during flight.

Approach Checklist.

1.	Pilot's PA switch	PA
2.	Periscopic sextant	Stowed
3.	Altimeter	Set ________ (state setting)
4.	Radome anti-icing	As required
5.	Safety belt and shoulder harness	Fastened/unlocked
6.	Using the search radar, follow the pilot through letdown and landing	

Before Landing.

1.	Navigator's seat	Facing forward
2.	All loose equipment	Secured
3.	Hot mike	
	a. Listen ON	Set

After Landing.

1. Radar altimeter, unnecessary equipment, and IFF	OFF

Note

Classified IFF codes must be removed or properly protected.

a. Radar	STDBY
b. Doppler	STDBY
c. Computer	OFF
d. ADF	OFF
e. Loran	OFF
f. Radio altimeter	OFF
2. Anti-icing control panel (radome)	OFF

Engine Shutdown.

1. Radar and doppler	OFF
NEW 2. Oxygen	NORMAL/100%/OFF
NEW 3. Discrepancies	Entered
4. Panel lights	OFF

FLIGHT ENGINEER.

The flight engineer is directly responsible to the AC for the mechanical condition and operation of the aircraft. Because of this responsibility, he is designated in-charge of all enlisted personnel engaged in the preflight, enroute, and destination maintenance functions. He is responsible for all aircraft servicing, inspections and general aircraft condition. He will man the flight engineer's station during all taxi and flight operations except when conducting routine inspections and troubleshooting. Under the supervision of the AC, he is responsible for the completeness and accuracy of the aircraft records (OPNAV Form 4790/1). He is charged with using and accurately maintaining the aircraft supply packet as directed by squadron instructions.

SECOND FLIGHT ENGINEER.

The assigned second flight engineer may be a fully qualified flight engineer or a second flight engineer in training. The second engineer will assist the flight engineer in performing his ground and inflight duties. He will perform such duties as may be assigned by the flight engineer.

AIRBORNE COMMUNICATIONS OFFICER (ACO).

The airborne communications officer organizes and supervises the communications phase of the mission. He compiles information from current communications operation orders, messages, publications, and crypto material to plan and successfully fulfill mission requirements. He attends briefings and furnishes the pilot and crewmembers with communications schedules and operational commitments. The ACO is responsible for procuring and safeguarding all crypto material, equipment and other registered publications necessary for execution of the mission. He directs and coordinates the operation of the AN USC-13 system to accomplish the mission. He is responsible to the aircraft commander for security of the aircraft, crypto materials and equipment, and communications procedures. The ACO furnishes the pilot and other crewmembers with pertinent information regarding communication progress and equipment failure. He ensures the completion of all assigned communication logs, and report of mission effectiveness. An airborne communications officer (ACO) is dual qualified as a Navigator.

AIRBORNE COMMUNICATIONS SUPERVISOR (ACS).

The airborne communications supervisor is a designated airborne communicator qualified to coordinate and supervise the communications phase of the mission. He is responsible to the airborne communications officer and assists him in performance of all duties pertinent to the mission. The ACS ensures the completion of preflight inspection of the communications equipment, OG-127, and the flight station excluding the navigator's preflight items, and inventories fly-away spares and publications on board the aircraft. He directs in-flight training of airborne communicators and coordinates troubleshooting procedures and organizational maintenance of the USC-14, OZ-1, and OG-127. The airborne communications supervisor is responsible to the ACO for security of the aircraft, crypto materials and equipment, and communications procedures. He furnishes the ACO wih pertinent information regarding communication progress and equipment failure. He ensures the completion of all assigned maintenance reports, communication logs, and report of mission effectiveness.

AIRBORNE COMMUNICATOR (ACOM).

The airborne communicator operates the communications equipment, and OG-127 equipment in support of the communication phase of the mission. He is responsible to the airborne communications supervisor and assists him in performance of all duties pertinent to the mission. The ACOM performs the preflight inspection of the communications equipment, and OG-127, and the flight station excluding the navigator's preflight items, and inventories fly-away spares and publications on board the aircraft. He assists the ACS in troubleshooting procedures and performs maintenance on the communications equipment, and OG-127 when directed. The airborne communicator is responsible to the ACS for security of the aircraft, crypto materials and equipment, and communications procedures. He completes all assigned maintenance reports, communication logs, and reports of mission effectiveness. He assists the flight engineer in the maintenance and servicing of the aircraft, commensurate with his rating and experience.

FIRST FLIGHT TECHNICIAN (1ST TECH).

The first flight technician is responsible to the ACO for overall troubleshooting and maintenance of all communications/navigation equipment installed in the EC/130 aircraft. He is responsible to the flight engineer for the completion of all maintenance forms commensurate of his rating. He is qualified to operate all systems associated with position three (voice operator) and he directs the training of airborne communication technicians. Also the first technician ensures completion of the interior and exterior preflight. Technician preflight/postflight checklist is covered in NAVAIR 01-75GAE-1M.

Note

The flight technician is an optional crew position to be filled when required by the operational need and authorized by the commanding officer.

SECOND FLIGHT TECHNICIAN (2ND TECH).

The second flight technician is an aviation electronics technician (AT) who operates station three of communication central in support of the TACAMO mission. He is qualified to perform organizational maintenance on all systems associated with the voice operator's position. The second flight technician assists the first technician in inflight troubleshooting and corrective maintenance of the entire AN/USC-13 communication system. He also assists the first technician in his preflight as directed. The second technician completes pertinent communication logs, assigned maintenance reports, and he performs post flight preventive and corrective maintenance as required.

Note

The flight technician is an optional crew position to be filled when required by the operational need and authorized by the commanding officer.

AIRBORNE COMMUNICATIONS SUPERVISOR'S CHECKLIST.

Preflight Physical Inspection.

1. External physical inspection	Completed	POS 1/3
2. Internal physical inspection	Completed	POS 1/3

Preflight Communications Operational Check.

1. VLF Receivers	Checked/Set	POS 4
2. CW Regenerative Repeaters	Checked/Set	POS 4
3. CW Key/CW Key Control	Checked/Set	POS 4
4. Freq Time Standard	Checked/Set	POS 1/4
5. VLF Exciter group	Checked/Set	POS 4

6. 50 Baud TD/CW Converter	Checked/Set	POS 4
7. VLF Power Amplifier	Checked	POS 3/4
8. HF/UHF Radios	Checked/Set	POS 3
9. CCCS Keyset/Display	Checked/Set	POS 1/3
10. HF/UHF Keyline Control	Checked/Set	POS 3
11. Secure Voice (back to back)	Checked/Set	POS 3
12. Teletype Equipment (both systems)	Checked/Set	POS 2
13. Crypto Equipment (back to back)	Checked/Set	POS 2
14. Keyers/Converters	Checked/Set	POS 2
15. Data Modems	Checked/Set	POS 2
16. Loop Power	Checked/Set	POS 2
17. DC Patch Panel	Checked/Set	POS 2
18. Signal Quality Monitor	Checked/Set	POS 2
19. Tape Recorder	Checked/Set	POS 2
20. Audio Patch Panel	Checked/Set	POS 1
21. O' Scope	Checked/Set	POS 1
22. IFPM	Checked/Set	POS 1
23. Equipment Stowage	AS Assigned	POS 1
24. Lifevest/Parachute	Checked	POS 1, 2, 3, 4
25. Oxygen Regulators/Mask	Checked/NORMAL/100%/OFF	POS 1, 2, 3, 4
26. Safety Belts, Shoulder Harness	Set/Locked	POS 1, 2, 3, 4
27. Hot Listen	Set/Parallel	POS 1
28. Forms	Checked	POS 1

Before Landing.

1. Equipment Stowage	As Assigned	POS 1
2. Safety Belt/Shoulder Harness	Set/Locked	POS 1
3. Hot Listen	Set/Parallel	POS 1

After Landing.

1. Equipment	Set/OFF	POS 1, 2, 3, 4
2. Oxygen Regulators	Set/NORMAL/100%/OFF	POS 1, 2, 3, 4
3. Security Of Comm Central	Checked	POS 1

REEL OPERATORS.

The reel operator is directly responsible to the Airborne Communications Officer and indirectly to the aircraft commander for the extension and retraction of communication antennas. In conjunction with this responsibility he is charged with the maintenance of the electrical and hydraulic equipment associated with the antenna. He assists the flight engineer in the maintenance and servicing of the aircraft commensurate with his rating and experience. In addition, he is responsible for food preparation and crew comfort facilities. Reel operator preflight/postflight checklist is covered in NAVAIR 01-75GAE-1M.

AFT OBSERVER.

The AFT Observer is responsible to the Flight Engineer for preflight duties, ground observer duties, inflight duties (flap position, hydraulic reservoir levels, wing checks and general aircraft conditions), and postflight duties.

CREW COORDINATION.

TAKE-OFF PHASE.

The following guide to crew coordination is provided to clearly show the proper division of crew duties and procedures for normal take-off and may further be referenced as "Standard Crew Brief." (See Before Take-off in Section III.)

TAKE-OFF GUIDE

PILOT	COPILOT	FLIGHT ENIGNEER
1. Advances throttles to take-off power.	Monitors instruments & flies yoke to maintain wings level.	Monitors instruments.
2. Steers with nose wheel during initial take-off roll until rudder control speed is is reached, then with rudders.	Monitors instruments and continues flying yoke. Monitors throttle positions.	Monitors instruments.

TAKE-OFF GUIDE (CONTINUED)

PILOT	COPILOT	FLIGHT ENGINEER
3. Takes over yoke when rudder becomes effective.	Monitors instruments and throttles. Allows pilot to take control of yoke.	Monitors instruments.
4. Notes refusal speed has been reached, and continues take-off.	Calls out "Refusal" at refusal speed.	Monitors instruments.
5. Continues take-off, rotating at take-off speed.	Calls out "Rotate," at take-off speed.	Monitors instruments.
6. When safely airborne, orders "Gear up" verbally and "thumb up" hand signal.	Repeats "Gear up," retracts gear and lights, extinguishes lights. States "Gear up, lights out."	Monitors instruments.
7. Orders "flaps up" verbally when gear is fully retracted, but never less than 20 knots above takeoff speed.	Repeats "Flaps up," retracts flaps, and states "Flaps up."	Monitors instruments.

The following explanation is provided for amplification of the guide.

1. Take-off power can be applied either before releasing the brakes or during the take-off roll. The performance charts in the performance data assume that take-off power is applied prior to releasing the brakes. However, if passengers are being carried and runway length permits, a smooth take-off can and should be made by applying power during the roll. The pilot should keep his hand on the throttles at all times until well established in the climb. Under low temperature conditions, never place throttles to full take-off power without monitoring torquemeters. It is possible to exceed the maximum allowable torque limitations without exceeding allowable TIT. Take-off power limitations are outlined in Section I, Part 4. Except for the copilot calling out refusal speed, and rotation speed, there should be no other conversation during the take-off roll, unless some discrepancy is noted. Any crewmember observing any discrepancy during the take-off will immediately notify the pilot.

2. Nose wheel steering should not be necessary after 50 to 60 KIAS has been reached, because rudder control is adequate to steer the aircraft above this speed.

Note

Because the aircraft has an aft center of gravity, forward pressure on the yoke may be necessary to aid in steering effectiveness.

3. Keep the nose wheel on the ground until rotation speed has been reached.

CAUTION

Pilots should be aware that the aircraft will fly at speeds considerably lower than the recommended take-off speeds. If the nose wheel is raised off the ground before V_{mc} has been reached, it is possible to become airborne before V_{mc}.

Note

If V_{mc} is greater than take-off speed use V_{mc} for take-off speed.

4. For most normal operations, runways are of sufficient length to permit a safe abort on the remaining runway at speeds up to take-off speed. This means that the refusal speed under these conditions would be equal to or greater than the take-off speed. If these conditions exist, use the take-off speed for refusal speed. Also, when these conditions exist, the crew need only be concerned with V_{mc} and take-off speed. The take-off should be aborted if any emergency condition develops before take-off speed has been reached. The take-off should be continued after take-off speed has been reached.

5. When a shorter runway is used and refusal speed is less than take-off speed, if an emergency requiring an aborted take-off occurs prior to reaching refusal speed, abort on the runway. After reaching refusal speed continue acceleration to take-off speed or V_{mc}, whichever is greater, before becoming airborne.

6. Flaps should not be raised until the gear is fully retracted, a minimum of 20 KIAS above take-off speed has been reached, and the aircraft is clear of all immediate obstacles. When the flaps are retracted and the aircraft is well established in the climb, reduce to climb power and complete the Climb checklist.

Note

The pilot should keep his hand on the throttles except to give the "Gear up" signal, until the aircraft is well established in the climb and climb power has been set. The loss of an outboard engine at any time when full power is being used creates a high differential in power, resulting in control difficulty; however, sufficient control is available if airspeed is above V_{mc}. A slight reduction in power on the opposing outboard engine will serve to reduce the asymmetrical power condition, and aid in controllability. This procedure should be used only if conditions allow a reduction in power, or if the need for precise directional control is of greater importance than all other factors.

APPROACH AND LANDING PHASE.

The pilot will brief the copilot, flight engineer and navigator regarding the procedures to be followed during every approach to an airport. This will include missed approach intentions. These crewmembers will assist the pilot in accomplishing the planned procedure in accordance with his instructions.

The copilot will review the appropriate approach charts and keep a continual cross-check on the pilot. The flight engineer, copilot and navigator will monitor their respective instruments and will immediately advise the pilot when noting any deviation from the prescribed procedures for the type of approach being made. The copilot shall report passing every 5,000-foot level in the descent, "100 feet above minimums," "minimums," "field in sight," and "right or left" (if applicable). Pilots will simulate the clearing of a 50-foot obstacle at the approach end of the runway on all landings under normal conditions. Airspeed at this point will normally conform to the threshold speed prescribed in the performance data. Positive thrust will be maintained during approach and landing. Touchdown will normally be at the prescribed touchdown speed for the respective weight of the aircraft.

SECTION X

EVALUATION

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CONCEPT.

The standard operating procedures prescribed in this manual represent the optimum method of operating EC-130G/Q aircraft. The NATOPS evaluation is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatability with various operational commitments and missions of both Navy and Marine Corps Units. The prime objective of the NATOPS evaluation program is to assist the Unit Commanding Officer in improving unit readiness and safety through constructive comment. Maximum benefit from the NATOPS evaluation program is achieved only through the vigorous support of all pilots and flight crewmembers.

IMPLEMENTATION.

The NATOPS evaluation program shall be carried out in every unit operating naval aircraft. The various categories of flight crewmembers desiring to attain/retain qualification in the EC-130G/Q shall be evaluated in accordance with OPNAVINST 3510.9 series. Individual and unit NATOPS evaluations will be conducted periodically; however, instructions in and observation of adherence to NATOPS procedures must be on a daily basis within each unit to obtain maximum benefits from the program. The NATOPS coordinators, evaluators, and instructors shall administer the program as outlined in OPNAVINST 3510.9 series. Evaluees who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a re-evaluation. A maximum of 60 days may elapse between the date the initial ground evaluation was commenced and the date the flight evaluation is satisfactorily completed.

DEFINITIONS.

The following terms, used throughout this section, are defined as to their specific meaning within the NATOPS program.

NATOPS Evaluation - A periodic evaluation of individual flight crewmembers standardization to consist of an open book examination, a closed book examination, an oral examination, and a flight evaluation.

NATOPS Re-evaluation - A partial NATOPS evaluation administered to a flight crewmember who has been placed in an unqualified status by receiving an Unqualified grade for any of the ground examinations or the evaluation flight. Only those areas in which an unsatisfactory level was noted need be observed during a re-evaluation.

Qualified - That degree of standardization demonstrated by a very reliable flight crewmember who has a good knowledge of standard operating procedures and a thorough understanding of aircraft capabilities and limitations.

Conditionally Qualified - That degree of standardization demonstrated by a flight crewmember who meets the minimum acceptable standards. He is considered safe enough to fly as a pilot in command or to perform normal duties without supervision, but more practice is needed to become Qualified.

Unqualified - That degree of standardization demonstrated by a flight crewmember who fails to meet minimum acceptable criteria. He should receive supervised instruction until he has achieved a grade of Qualified or Conditionally Qualified.

Area - A routine of preflight, flight, or postflight.

Subarea - A performance subdivision within an area, which is observed and evaluated during an evaluation flight.

Critical Area/Subarea - Any area or subarea which covers items of significant importance to the overall mission requirements, the marginal performance of which would jeopardize safe conduct of the flight.

Emergency - An aircraft component or system failure or a condition which requires instantaneous recognition, analysis, and proper action.

Malfunction - An aircraft component or system failure or condition which requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

GROUND EVALUATION.

The purpose of the ground evaluation is to measure the pilot/crewmembers knowledge of appropriate publications and the aircraft. Prior to commencing the flight evaluation, an evaluee must achieve a minimum grade of Qualified on the open book and closed book examinations. The oral examination is also part of the ground evaluation but may be conducted as part of the flight evaluation. To assure a degree of standardization between units, the NATOPS Instructors may use the bank of questions contained in this section in preparing portions of the written examinations.

OPEN BOOK EXAMINATION.

The open book examination may consist of but shall not be limited to the questions from the question bank. The number of questions shall not exceed 100 or be less than 25.

CLOSED BOOK EXAMINATION.

Questions for the closed book examination may include but shall not be limited to questions from the question bank. The number of questions on the closed book examination will not exceed 50, or be less than 25. Questions designated as critical will be so marked. An incorrect answer to any question in the critical category will result in a grade of unqualified for the examination.

ORAL EXAMINATION.

The questions may be taken from this manual and drawn from the experience of the Evaluator/Instructor. Such questions should be direct and positive, and should in no way be opinionated.

FLIGHT SIMULATOR PROCEDURES EVALUATION IF APPLICABLE.

A flight simulator may be used to assist in measuring the crewmember's performance in the execution of prescribed operating procedures and his reaction to emergencies and malfunctions. In areas not served by this facility, this may be done by placing the crewmember in an aircraft and administering appropriate questions.

GRADING INSTRUCTIONS.

Examination grades shall be computed on a 4.0 scale and converted to an adjective grade of Qualified or Unqualified.

Open Book Examination.

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.5.

Closed Book Examination.

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.3.

Oral Examination and Flight Simulator Procedure Check. (If conducted).

A grade of Qualified or Unqualified shall be assigned by the evaluator/instructor.

FLIGHT EVALUATION.

The NATOPS Flight Evaluation is intended to measure pilot and crewmembers performance with regard to knowledge of and adherence to prescribed procedures. The number of flights required to complete the flight evaluation should be kept to a minimum, normally one flight. It may be conducted on any operational or training flight and only those areas observed will be graded. The grade for the flight evaluation and overall NATOPS evaluation shall be determined as outlined in this section.

GRADING CRITERIA.

Only those subareas provided or required will be graded. The grades assigned for a subarea shall be determined by comparing the degree of adherence to standard operating procedures with adjective ratings listed below. Momentary deviations from standard operating procedures should not be considered as unqualifying provided such deviations do not jeopardize flight safety and the evaluee applies prompt corrective action. (An asterisk (*) before an item indicates a critical area or subarea.)

QUALIFIED.

Well standardized; evaluee demonstrated highly professional knowledge of and compliance with NATOPS standards and procedures; momentary deviations from or minor omissions in non-critical areas are permitted if prompt and timely remedial action is initiated by the evaluee.

CONDITIONALLY QUALIFIED.

Satisfactorily standardized; one or more significant deviations from NATOPS standards and procedures, but no errors jeopardizing mission accomplishment or flight safety.

UNQUALIFIED.

Not acceptably standardized; evaluee fails to meet minimum standards regarding knowledge of and/or ability to apply NATOPS procedures; one or more significant deviations from NATOPS standards and procedures which could jeopardize mission accomplishment or flight safety.

GRADE DETERMINATION.

The following procedure shall be used in determining the flight evaluation grade: A grade of unqualified in any critical area/subarea will result in an overall grade of unqualified for the flight. Otherwise, flight evaluation (or area) grades shall be determined by assigning the following numerical equivalents to the adjective grade for each subarea. Only the numerals 0, 2, 4 will be assigned in subareas. No interpolation is allowed.

Unqualified	0.0
Conditionally Qualified	2.0
Qualified	4.0

To determine the numerical grade for each area and the overall grade for the flight, add all the points assigned to the sub areas and divide this sum by the number of subareas graded. The adjective grade shall then be determined on the basis of the following scale.

0.0 to 2.19	Unqualified
2.2 to 2.99	Conditionally Qualified
3.0 to 4.0	Qualified

EXAMPLE:
(Add subarea numerical equivalents)

$$\frac{4+2+4+2+4}{5} = 3.20\text{-Qualified.}$$

FINAL GRADE DETERMINATION.

The final NATOPS evaluation grade shall be the same as the grade assigned to the evaluation flight. An evaluee who receives an unqualified on any ground examination or the flight evaluation shall be placed in an unqualified status until he achieves a grade of conditionally qualified or qualified on a re-evaluation.

RECORDS AND REPORTS.

A NATOPS evaluation report (OPNAV Form 3510-8) shall be completed for each evaluation and forwarded to the evaluee's commanding officer. This report shall be filed in the individual flight training record and retained therein for 18 months. In addition, an entry shall be made in the pilot/NFO flight log book under "Qualifications and Achievements" as follows:

QUALIFI-CATION			DATE		SIGNATURE
NATOPS EVAL	Aircraft Model	Crew Position	Date	Authenticating signature	Unit which Administered Eval

In the case of enlisted crewmembers, an entry shall be made in "Administrative Remarks" of his Personal Record upon satisfactory completion of the NATOPS evaluation as follows:

(Date) Completed a NATOPS evaluation in (aircraft designation) as (flight crew position) with an overall grade of (qualified or conditionally qualified)

WORKSHEETS.

In addition to the NATOPS Evaluation Report, NATOPS Flight Evaluation Worksheets are provided for use by the evaluator/inspector during the evaluation flight. All of the flight areas and subareas are listed on the worksheets with space allowed for related notes.

PILOT (AC/2P)

Items preceded by an asterisk are considered to be critical areas.

*1. Predeparture

*a. Take-off performance computations

(1) Qualified . . . . Accurately utilized governing charts to ascertain V_{mc}, take-off distance, take-off speed, refusal speed, and take-off crew briefing.

(2) Conditionally Qualified . . . . Computed take-off performance with minor errors, not serious enough to affect safety of flight. Missed some items on take-off crew briefing.

(3) Unqualified . . . . Made mistakes that, if followed, safety of flight would be jeopardized.

*b. Fuel planning

(1) Qualified	Complied with and was familiar with governing directives concerning required fuel and fuel computations.
(2) Conditionally Qualified	Omitted minor items not affecting safety of flight.
(3) Unqualified	Was not familiar with governing directives and/or made erroneous computations that could affect safety of flight.

*c. Weight and balance

(1) Qualified	Checked accuracy of weight and balance against fuel required. Knows CG limits.
(2) Conditionally Qualified	Minor errors that would not affect the safe completion of the mission.
(3) Unqualified	Did not meet the criteria of Conditionally Qualified.

*d. Preflight inspection

(1) Qualified	Completed thorough aircraft inspection. Inspected data sheets of previous discrepancies and preflight inspection form.
(2) Conditionally Qualified	Completed aircraft inspection with omissions in minor areas which did not affect the safety of the proposed flight.
(3) Unqualified	Failed to conduct aircraft inspection properly and omitted important items which would affect the safety of the proposed flight.

*2. Start, Runup, and Taxi

*a. Start limitations

(1)Qualified	Knew limitations and ensured execution of proper procedure for malfunctions.

(2) Conditionally Qualified . . . . Knew most limitations and most procedures for malfunctions.

(3) Unqualified . . . . Did not know limitations or procedures for malfunctions.

*b. Starting procedures

(1) Qualified . . . . Utilize NATOPS checklist properly. Demonstrated a thorough knowledge of all items.

(2) Conditionally Qualified . . . . Completed checklist satisfactory. Minor omissions which did not jeopardize flight or system operation. Adequate understanding of all items.

(3) Unqualified . . . . Failed to complete checklist properly, there by affecting safe flight operations. Knowledge of items not adequate to assure safe and successful operation.

c. Taxi

(1) Qualified . . . . Procedures required by the NATOPS Flight Manual complied with. Checklists were accomplished without omission or discrepancy. Smooth use of throttles and brakes, and proper compliance with tower instructions were demonstrated.

(2) Conditionally Qualified . . . . Procedures required by the NATOPS Flight Manual accomplished with omissions, deviations, or discrepancies which did not either adversely affect successful completion of the mission, jeopardize safety or cause undue delay.

(3) Unqualified . . . . Any omission or discrepancy which either precluded successful completion of the mission, jeopardized safety, or caused excessive delay. Taxied in rough and hazardous manner; improper use of checklist.

*d. Runup procedure

(1) Qualified . . . . Accomplished engine runup checks in accordance with standard procedures.

(2) Conditionally Qualified . . . . Satisfactorily completed engine runup checks, but with minor deviations or in improper sequence.

(3) Unqualified . . . . Attempted engine runup in area that was not clear. Too preoccupied with other duties to notice movement of aircraft. Runup procedures not in accordance with NATOPS Flight Manual.

*e. Radio management

(1) Qualified . . . . Set up radios in accordance with those facilities needed for initial climbout and on-course navigation. Checked all communications/navigation equipment in accordance with the best means available. Operated equipment in accordance with NATOPS Flight Manual and appropriate directives.

(2) Conditionally Qualified . . . . Tuned, but did not identify radio signals, or use radio navigational aids for backup.

(3) Unqualified . . . . Radio equipment needed for flight not properly tuned or set prior to take-off.

f. Crew briefing

(1) Qualified . . . . Thoroughly briefs crew on normal and emergency cockpit procedures, aircraft performance, i. e. speeds (including V_{mc}, take-off, refusal speeds), and emergencies after take-off, reviews ATC clearance, assures radios are tuned to facilities associated with initial climbout and/or emergency return.

(2) Conditionally Qualified . . . . Same as qualified, but omits some minor items in the crew briefing.

(3) Unqualified . . . . Omits one or more items from the crew briefing.

*3. Take-off

a. The following criteria shall apply to normal, short field, and crosswind take-off.

(1) Qualified . . . . Performed normal, short field, and crosswind takeoff in a smooth manner according to prescribed procedures. Made smooth application of power, noting V_{mc}, refusal speed, and take-off speed. Made smooth transition to flight.

(2) Conditionally Qualified . . . . Same as qualified, except for minor deviations and technique not detrimental to flight safety.

(3) Unqualified . . . . Failure to note V_{mc}, refusal speed, or take-off speed. Erratic control on take-off, with a tendency to compromise safety. Made rough transition to flight below take-off speed, with marginal control of aircraft.

*b. Emergency return (includes abort)

(1) Qualified . . . . Maintains positive control of the aircraft; completes emergency checklists in accordance with standard procedures; and effects smooth transition to final approach and landing. Ensures adequate briefing is given crew, passengers, and traffic controller.

(2) Conditionally Qualified . . . . Carries out items listed in Qualified, but with some delay in executing checks.

(3) Unqualified . . . . Jeopardizes flight safety by failing to cope with emergency in timely fashion, or uses improper sequence of checks causing confusion in cockpit, resulting in compound of emergency.

*4. Climb to level-off

a. Climbout procedures

(1) Qualified . . . . Proper use of climb checklist. Aircraft checks complete and crew reports received. Maintained correct climb power setting. Climb airspeed maintained within plus or minus 10 knots. Prescribed headings within plus or minus 10 degrees.

(2) Conditionally Qualified . . . . Aircraft checks complete, but reports not received. Established but did not maintain correct climb power setting. Climb airspeed maintained within plus or minus 15 knots. Prescribed headings within plus or minus 15 degrees.

(3) Unqualified . . . . Failed to complete climb checklist. Did not establish correct climb power. Failure to satisfy requirements listed under Conditionally Qualified.

*5. Cruise procedures

(1) Qualified. . . . . Aircraft checks were completed. Headings were maintained within plus or minus 10 degrees. Airspeed was maintained within plus or minus 10 knots. Cruise power setting was properly maintained.

(2) Conditionally Qualified . . . . Cruise airspeed maintained within plus or minus 15 knots, headings within plus or minus 15 degrees.

(3) Unqualified . . . . Failed to satisfy requirements listed under Conditionally Qualified.

*6. Airwork

a. Normal and steep turns

(1) Qualified . . . . Demonstrated coordinated turns with smooth reversals. Angles of bank up to 45 degrees utilized for 180- and 360-degree turns. Altitude variation should be less than plus or minus 200 feet. Angle of bank should be within 10 degrees of that prescribed.

(2) Conditionally Qualified . . . . Maintained altitude within 300 feet, and angle of bank within 15 degrees.

(3) Unqualified . . . . Unable to meet above criteria.

b. Approach to stalls

(1) Qualified . . . . Initiated proper recovery technique and recovered with less than 300 feet loss of altitude.

(2) Conditionally Qualified . . . . Minor deviations in entering and recovery techniques. Recovered with less than 400 feet loss of altitude.

(3) Unqualified . . . . Improper technique and/or loss of more than 400 feet of altitude.

*7. Approaches and penetrations

(1) Qualified . . . . Smoothly transitioned to approaches and penetration and complied with procedures outlined in the NATOPS Flight Manual.

(2) Conditionally Qualified . . . . Complied with procedures as outlined in the NATOPS Flight Manual, with minor variations not compromising safety.

(3) Unqualified . . . . Did not follow NATOPS Flight Manual procedures and/or flew penetration in an unsafe manner. Exceeded aircraft limitations.

*8. VFR landing pattern

*a. Normal (50/100 percent flap landings)

(1) Qualified . . . . Maintained positive control of speed, power, and rate of descent. Aircraft aligned with runway throughout final approach. Maintained aircraft in trim. Nosehigh touchdown in first third of runway. Maintained directional control during rollout. Positive control of reverse. Smooth, effective use of brakes and nose wheel steering.

(2) Conditionally Qualified . . . . Had minor difficulty with transition. Handled aircraft roughly and used poor technique in either flare, landing, or rollout. Left excessive power on or made flat touchdown in first third of runway.

(3) Unqualified . . . . Had serious difficulty with transition. Failed to maintained positive control of aircraft during either flare, landing, or rollout. Did not touch down in first third of runway. Landed hard. Jeopardized safety.

*b. Crosswind

(1) Qualified . . . . Properly executed crosswind technique, maintaining positive directional control throughout the flare, touchdown, and rollout. Reverse thrust was used to best advantage to slow aircraft while transition to nose wheel steering gave assurances of continued positive directional control.

(2) Conditionally Qualified . . . . Insufficient measures to correct slight drift on final approach or touchdown. Improper technique used to maintain directional control, or aircraft landed in slight skid.

(3) Unqualified . . . . Safety of flight endangered by poor judgment of crosswind situation, or dangerous drift existed on touchdown.

*c. No flap landings

(1) Qualified . . . . Maintained correct altitude, pattern, and airspeed.

(2) Conditionally Qualified — Altitude, pattern, and airspeed correct except for minor deviations.

(3) Unqualified . . . . Pattern too wide/close-in. Unsatisfactory control of airspeed/altitude resulting in a go-around.

*d. Short field

(1) Qualified . . . . The approach was made in accordance with recommended procedures as outlined in the NATOPS Flight Manual. Touchdown was made on the centerline of the runway within 500 feet of the approach end. Reverse pitch and brakes were applied immediately and controlled so as to maintain directional control and minimum roll commensurate with the length of the runway. Maintained complete control of the aircraft at all times.

(2) Conditionally Qualified . . . . Minor deviations from above criteria. Safe approach and landing. Landed long, but within limits to make a safe stop.

(3) Unqualified . . . . Approach and landing deviated from the recommendations as outlined in the NATOPS Flight Manual. Touchdown was short, or so long that stopping within limits was doubtful. Poor control maintained during roll and uncoordinated applications of reverse and brakes caused erratic landing roll. Overall handling of landing tended to compromise safety.

*e. Landing with emergency (eng, out, hyd, etc.)

(1) Qualified . . . . Emergency analyzed correctly. Instant corrective action so as to assure safe approach and landing.

(2) Conditionally Qualified . . . . Minor discrepancies in handling emergency situation, but safe approach and landing was accomplished.

(3) Unqualified . . . . Incorrect technique in handling emergency, unsafe approach, or landing.

f. Two-engine landing

(1) Qualified . . . . Maintained positive control of speed, power, and rate of descent to touchdown. Nose-high touchdown in first third of runway. Maintained directional control through rollout. Proper usage of brakes and nosewheel steering.

(2) Conditionally Qualified . . . . Had minor difficulty with transition. Handled aircraft roughly and used poor technique in flare, landing, or rollout. Hard or flat touchdown in first third of runway.

(3) Unqualified . . . . Had serious difficulty with transition. Failed to maintain positive control of aircraft during flare, landing, or rollout. Did not touch down in first third of runway. Jeopardized safety or otherwise failed to satisfy requirements.

9. Secure and postflight procedures

(1) Qualified . . . . Completed appropriate checklist without omissions; visual exterior inspection conducted; completed necessary logs and forms. Assured that flight plan was closed out.

(2) Conditionally Qualified	Omitted checklist items and exterior inspection, and failed to note obvious maintenance discrepancy, none of which were considered unsafe.
(3) Unqualified	Major checklist items omitted; improper knowledge and use of post flight forms. No post flight inspection.
*10. Emergencies (the following criteria applies to all emergencies)	
(1) Qualified	Demonstrated proper technique, coordination, and/or knowledge of aircraft emergency and distress procedures.
(2) Conditionally Qualified	Same as qualified, except for minor deviations.
(3) Unqualified	Inadequate knowledge and/or poor technique of handling emergency or distress procedures.
11. Crew coordination and leadership	
(1) Qualified	Exhibited positive leadership of crew. Crew was well-coordinated and pilot was aware of the duties and responsibilities of each crewmember. Crew's performance as a team reflected pilot's emphasis on conformance to standard procedures by all crewmembers.
(2) Conditionally Qualified	Crew was coordinated in actions and pilot was generally aware of crew duties and responsibilities. Performance as a team did not jeopardize safety or crews ability to complete mission. Did not require crew to perform tasks in accepted manner.
(3) Unqualified	Crew performance showed complete lack of coordination by the pilot. Tasks were performed in violation of accepted publications.

*12. Use of checklists

(1) Qualified . . . . Checklists called for at proper times and executed correctly.

(2) Conditionally Qualified . . . . . . Late calling for or completing checklist. Minor deviations or omissions noted.

(3) Unqualified . . . . Failed to call for or complete checklist in time.

FLIGHT ENGINEER (FE/2FE).

Items preceded by an asterisk are considered to be a critical area.

1. Flight planning and preparation

a. Professional equipment

(1) Qualified . . . . Had all necessary personal and professional equipment. Displayed positive knowledge of the proper use, care, and operation of such equipment.

(2) Conditionally Qualified . . . . . . Marginal knowledge of the proper use, care and operation of personal and professional equipment.

(3) Unqualified . . . . Did not have required personal or professional equipment. The lack of this gear and proper knowledge of its use could cause compromise of safe operation. Successful survival in an emergency is doubtful.

b. Knowledge of weight and balance

(1) Qualified . . . . Displayed positive knowledge in computing and filling out Form "F." Minor errors in planning commitment for loading.

(2) Conditionally Qualified . . . . . . Completed Form "F" with minor deviations from established procedures. Such deviations did not compromise safe operations.

(3) Unqualified . . . . Unable to complete Form "F," or the computation was such that, if flown, safety of flight would be compromised. Unfamiliar with weight and balance of an aircraft.

c. Required logs and forms.

(1) Qualified	All logs and forms avilable and properly completed as required for type flight being contemplated. NATOPS Flight Manual current.
(2) Conditionally Qualified	Minor omissions not jeopardizing safety of flight.
(3) Unqualified	Safety of flight jeopardized by lack of logs, forms, or current NATOPS Interim Changes.

*2. Preflight

*a. Aircraft servicing

(1) Qualified	Displayed positive knowledge of requirements and proficiency in the servicing of engine, oxygen, and hydraulic system components as outlined in approved manual and directives. All safety precautions were heeded.
(2) Conditionally Qualified	Servicing of oxygen, engine, and hydraulic system components were accomplished with minor deviations of approved manuals and directives. Deviations did not compromise safety.
(3) Unqualified	Servicing of engine, oxygen, and hydraulic system components were not accomplished or not done in an approved manner. Safety precautions were partially or completely disregarded, thereby endangering aircraft and/or personnel.

*b. Preflight inspection and duties

(1) Qualified	Accomplished all necessary paper work and conducted a thorough and proficient inspection, utilizing approval checklist. Possessed positive knowledge of inspection requirements.
(2) Conditionally Qualified	Completed necessary paper work and inspection duties, but with minor deviations from established procedures. Such deviations did not compromise safe operation.

(3) Unqualified . . . . Did not accomplish required paper work and/or failed to complete exterior inspection or utilize approved checklist. Inspection was such that safe operation was doubtful.

c. Internal power unit operation

(1) Qualified . . . . Accomplished GTC start, operation, and required checks in the prescribed manner as outlined in approved manuals and directives. Possessed positive knowledge of emergency procedures. All safety precautions were heeded.

(2) Conditionally Qualified . . . . . . Accomplished GTC start, operation, and required checks with minor deviations of approved manuals and directives. Deviations did not compromise safety.

(3) Unqualified . . . . Errors were made during start and operation so as to endanger the aircraft. Doubtful of, or definitely did not know GTC procedures. Safety precautions were partially or completely disregarded.

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*d. Knowledge of Emergency Equipment and Procedures

(1) Qualified . . . . Displayed thorough knowledge of emergency equipment and procedures.

(2) Conditionally Qualified . . . . . . Did not fully understand emergency procedures and responsibilities.

(3) Unqualified . . . . Inadequate knowledge with obvious lack of responsibility for safety of flight.

*3. Pretake-off

*a. Engine start

(1) Qualified . . . . Accomplished engine start in the prescribed manner. Possessed knowledge of normal and emergency procedures during starts.

(2) Conditionally Qualified . . . . . . Accomplished engine start in the prescribed manner. Knowledge of normal and emergency procedures during start was weak.

(3) Unqualified . . . . . . Errors were made during start with use of switches and controls so as to endanger the aircraft. Doubtful of, or definitely did not know, start limitations and/or procedures. Checklist was not utilized.

*b. Before taxi and taxi

(1) Qualified . . . . Accomplished all system checks in accordance with prescribed procedures, in a positive manner. Knowledge of required system and checks was displayed so as to indicate a highly professional crewmember.

(2) Conditionally Qualified . . . . . . All required checks were conducted in accordance with the appropriate publications. Room for improvement in approved procedures.

(3) Unqualified . . . . All or some checks were ineffective and/or incomplete. Limited knowledge of required checks or corrective action, if malfunctions occurred. Procedure used could cause malfunction or damage to aircraft.

*c. Engine runup

(1) Qualified . . . . Demonstrated positive knowledge and proficiency in engine runup procedures, limitations, and required checks, including temperature controlling checks.

(2) Conditionally Qualified . . . . . . Marginal knowledge, proficiency in engine runup procedures, limitations, or required checks not to compromise safety.

(3) Unqualified . . . . Failed to accomplish checks, or accomplished them in other than approved manner. Did not interpret instrument indications properly; displayed lack of knowledge of systems when performing checks; doubtful determination of status of systems. Failed to notify pilot of malfunction.

d. Propeller indexing

(1) Qualified . . . . Used current NATOPS procedures for propeller indexing. Notified pilot commencing reindexing.

(2) Conditionally Qualified . . . . . . Did not notify pilot of commencing reindexing. Improper procedure used not jeopardizing safe operation.

(3) Unqualified . . . . Failed to meet requirements or any item jeopardizing safe operation.

*4. Take-off and engine failure on take-off

*a. Take-off

(1) Qualified . . . . Monitored engine and system indicators. Complied with pilot's briefing and approved remedial actions.

(2) Conditionally Qualified . . . . . . Alertness can be improved in monitoring engine and system indicators.

(3) Unqualified . . . . Did not monitor engine or system indicators. Failed to comply with pilot's briefing and/or approved remedial action.

*b. Engine failure on take-off

(1) Qualified . . . . Promptly called out malfunction clearly and correctly. Executed instructions from pilot in the same manner.

(2) Conditionally Qualified	Slow to call out malfunction, but called it correctly. Slow to execute instructions from pilot, but followed them correctly. Any discrepancy that would not jeopardize safe operation.
(3) Unqualified	Incorrect identification of malfunction. Failed to carry out pilot's instructions or did not carry them out correctly. Any discrepancy affecting safe operation.

*5. Climb

(1) Qualified	Completed all items on the checklist in proper sequence and complied with instructions, with no deviations. Systems knowledge, management, and procedures were outstanding.
(2) Conditionally Qualified	Completed all items on the checklist and complied with instructions, but in a hesitating manner. Systems knowledge, management, and approved procedures were marginal.
(3) Unqualified	Did not comply with checklist or instructions. Displayed a lack of knowledge of systems and their management and/or of approved procedures. Displayed an unsafe performance.

*6. Cruise - The following grading criteria shall be used for individual evaluation of the:

a. Fuel system and management

b. Hydraulic system

c. Pneumatic systems

d. Electrical system

e. Anti-icing and deicing systems

f. Propellers (demonstrate NTS check)

g. Engines and limitations

h. Power charts (cruise performance charts)

i. Fuel log

j. Instrumentation

k. Airframe limitations

(1) Qualified . . . . Positive knowledge of systems and system management and/or operation.

(2) Conditionally Qualified . . . . . . Marginal knowledge of systems and system management and/or operation.

(3) Unqualified . . . . Did not understand all the systems or their management. Operation of various components in the system(s) could cause possible damage to the aircraft or injury to personnel.

*7. Emergency and malfunction procedures

The following grading criteria will be utilized for individual evaluation of the listed emergencies and malfunctions:

a. Engine failure

b. Propeller failure

c. Fuselage fire

d. Smoke and fume elimination

e. Inflight door warning

f. Ditching and bailout drills

g. Fuel system

h. Electrical system

i. Hydraulic system

j. Pneumatic system

(1) Qualified . . . . An obvious understanding of the corrective action for existing malfunctions. Explained in detail all necessary actions and limitations. Conducted corrective action in a highly professional manner.

(2) Conditionally Qualified . . . . Understood the corrective action for existing malfunctions. Explained in detail all necessary actions with minor deviations not to compromise safety.

(3) Unqualified . . . . Did not display a positive knowledge of all corrective actions for existing malfunctions. Knowledge and actions were not up to standards for professional approach to malfunctions and emergencies. Actions indicated doubt as to whether actual emergencies could be handled. Needs supervision and instruction.

*8. Descent and landing

a. Landings

(1) Qualified . . . . Completed all checklist items in proper sequence. Demonstrated positive knowledge of required systems management and operating procedures

(2) Conditionally Qualified . . . . . . Completed checklist with minor deviations from proper sequence. Demonstrated knowledge of management and procedures. Actions displayed a need for improvement.

(3) Unqualified . . . . Did not utilize checklist. Management and procedures were unapproved and marginally safe or were unsafe. Needs supervision and instruction.

*b. Landing gear emergencies

(1) Qualified . . . . Demonstrated correct emergency landing gear extension. Demonstrated knowledge of methods of gear extension with electrical and hydraulic system failure. Had knowledge of landing gear airspeed limitations.

(2) Conditionally Qualified . . . . . . Demonstrates correct emergency landing gear extension with some difficulty.

(3) Unqualified . . . . Unable to demonstrate correct procedures.

*c. Air conditioning control

(1) Qualified . . . . Proper use of air conditioning system to ensure optimum crew comfort and equipment operation.

(2) Conditionally Qualified . . . . . . Minor crew discomfort caused by use of air conditioning system. Cross-checked cabin or flight station infrequently.

(3) Unqualified . . . . Failed to satisfy the requirements.

*9. Postflight

a. Inspection

(1) Qualified . . . . Extremely thorough and competent in accomplishing required inspections. No deviations from manuals or other directives.

(2) Conditionally Qualified . . . . . . Completed the required inspection as prescribed in appropriate manuals and documents, with minor deviations. Overall performance displayed room for improvement.

(3) Unqualified . . . . Did not, or was unable to, perform postflight inspection. Failed to advise pilot of aircraft discrepancies; consequently, the true status of the aircraft was unknown. Possibly needs supervision and/or further instruction.

*b. Servicing and securing

(1) Qualified . . . . Displayed professional knowledge of requirements and proficiency in refueling and securing aircraft. All safety precautions were heeded.

(2) Conditionally Qualified . . . . . . Refueling and securing were accomplished in accordance with approved manual and directives, but with minor deviations. Deviations did not compromise safety.

(3) Unqualified . . . . Refueling and securing were not accomplished, or were not accomplished in approved manner. Safety precautions were partially or completely disregarded, thereby endangering aircraft and/or personnel. Requires supervision and/or further instruction.

10. General

a. Use of forms

(1) Qualified . . . . Accomplished all necessary paper work as outlined in approved manuals and directives in a professional manner.

(2) Conditionally Qualified . . . . . . Accomplished all necessary paper work as outlined in approved manuals and directives with minor errors.

(3) Unqualified . . . . . . Did not accomplish required paper work as outlined in approved manuals and directives.

b. Cockpit discipline

(1) Qualified . . . . Coordinated actions smoothly and effectively with all crewmembers. Anticipated demands upon crew position.

(2) Conditionally Qualified . . . . . . Attempted to coordinate actions/requirements, but lacked the desired effect. Intercommunications discipline at times interfered with crew. Responses to checklist items were made with only minor deviations. Did not jeopardize mission accomplishment or other crewmembers' duties.

(3) Unqualified . . . . . . Displayed undesirable traits in crew coordination and discipline. Intercommunication discipline was nonexistent. Responses to checklist were vague or improper. Performance hindered the smooth accomplishment of the mission.

c. Ability to perform major/minor repairs (when observed)

(1) Qualified . . . . Displayed positive knowledge in the requirements and proficiency of repairs utilizing approved manuals for limitations and procedures. Coordinated repair actions with maintenance departments smoothly and effectively. All safety precautions were followed.

(2) Conditionally Qualified . . . . . . Displayed good knowledge in the requirements and proficiency of repairs, utilizing approved manuals but with minor deviations. Coordination with maintenance department lacked desired effect. Deviations or coordination did not compromise safety.

(3) Unqualified	Displayed undesirable traits in the requirements of repair and failed or did not fully use approved manuals. No coordination with the crew or local maintenance department. Safety precautions were partially or completely disregarded thereby endangering aircraft and/or personnel. Definite need of supervision and instruction.
d. Ability to perform preventive maintenance (when observed)	
(1) Qualified	Displayed positive knowledge of requirements and proficiency, utilizing approved manuals and directives. Has a continual alertness to the needs of preventive maintenance. All safety precautions were followed.
(2) Conditionally Qualified	Marginal knowledge of requirements or proper procedures. Utilized approved manuals and directives, but with minor errors. Errors did not compromise safety.
(3) Unqualified	Did not, or was unable to, perform preventive maintenance. Failed to advise maintenance of discrepancies; consequently the true status of the aircraft was unknown. Needs supervision and instruction.
e. Crew supervision	
(1) Qualified	Exercised positive preflight, in-flight and post-flight supervision of the crew. Crew was well coordinated and performed as a team.
(2) Conditionally. Qualified	Crew was generally coordinated. Leadership was usually apparent. Performance as a team did not jeopardize safety or crew's ability to complete mission. Crew did not always perform tasks in accepted manner.
(3) Unqualified	Crew performance showed complete lack of coordination. Tasks were performed in violation of accepted publications.

AIRBORNE COMMUNICATIONS OFFICER (ACO)

1. Preflight

   a. Mission planning

*(1) Qualified	All required communications publications, equipments, logs, forms, and message blanks on board. Demonstrated a thorough knowledge of all procedures for mission planning and possessed knowledge of all information in the communications brief. Communications publications updated, reviewed, and organized. Had knowledge of all frequencies and tests to be monitored during mission.
(2) Conditionally Qualified	Minor discrepancies noted.
(3) Unqualified	Major discrepancy noted indicating an obvious lack of mission planning.

   *b. Preflight inspection and test of equipments associated with the USC-14, OZ-1, OG-127, OE-159, crypto gear, and flight station navigation equipment

(1) Qualified	Had knowledge of known equipment discrepancies. Demonstrated thorough knowledge of preflight procedures. Closely monitored and properly evaluated results of preflight checks and tests.
(2) Conditionally Qualified	Omissions and deviations from preflight resulted in partial determination of equipment status. Lacked a thorough knowledge of preflight procedures. Discrepancies did not affect mission capabilities.
(3) Unqualified	Major discrepancies in preflight performed, or lacked significant knowledge of preflight procedures that could result in inability to determine mission capabilities.

   c. Status report

(1) Qualified	Obtained an equipment and circuit status report from appropriate personnel and reported preflight results to the Mission Commander, indicating any equipment that was inoperative or at reduced efficiency.

(2)	Conditionally Qualified	Failed to obtain a complete status report, but all mission-essential information reported.
(3)	Unqualified	Failed to obtain a complete status report and failed to report to the Mission Commander all mission-essential information.

2. Before take-off

*a. Stations rigged for take-off

(1)	Qualified	All ditching stations assigned and emergency equipment checked to ensure ample supply for all crewmembers.
(2)	Conditionally Qualified	Minor deviations noted.
(3)	Unqualified	Major deviations that would present a potential safety hazard.

*b. Visually inspected areas

(1)	Qualified	All loose gear tied down or securely stowed, all oxygen bottles filled to capacity, and all passageway doors properly secured.
(2)	Conditionally Qualified	Minor discrepancies noted.
(3)	Unqualified	Major discrepancies that would present a potential safety hazard.

c. Crewmembers prepared for take-off

(1)	Qualified	Visually inspected communications area to ensure all crewmembers and passengers are properly prepared for take-off.
(2)	Conditionally Qualified	Minor deviations noted.
(3)	Unqualified	Major deviations that would present a potential safety hazard.

*d. Mission preparation

(1)	Qualified	Had excellent knowledge of schedule of events for mission. Was aware of circuits established and communication conditions for the period of the mission. Demonstrated thorough knowledge of all procedures required to prepare for mission. ACS thoroughly briefed on mission requirements.
(2)	Conditionally Qualified	Minor discrepancies noted.
(3)	Unqualified	Lacked necessary knowledge of mission requirements. Preparation for mission inadequate.

3. After take-off

*a. Knowledge of mission

(1) Qualified	Demonstrated a detailed knowledge of mission to be performed during all DEFCON conditions. Possessed a thorough knowledge of all communication nets and internetting responsibilities, monitoring priorities, and dispersal plan procedures.
(2) Conditionally Qualified	Minor discrepancies in knowledge of mission noted, but had ability to locate necessary information in communication publications in adequate time.
(3) Unqualified	Inadequately prepared to handle various mission requirements.

b. Reported Communications Status to Mission Commander

(1) Qualified	During mission, kept the Mission Commander informed on all changes in circuit status, intelligence information received, and pertinent message traffic.
(2) Conditionally Qualified	Minor deviations noted.
(3) Unqualified	Did not keep the Mission Commander informed of changing events.

4. Operational knowledge

a. Equipment use

*(1) USC-14/OZ-1 transmitting/receiving equipment

(2) FSK conversion equipment

(3) Crypto equipment

(4) Teletype equipment

(5) Recording equipment

(6) Fault locating equipment

(7) ICS

*(8) Patching/interconnecting equipment

*(9) ART-50

*(10) OG-127

*(11) OE-159

(a)	Qualified	Demonstrated a detailed knowledge of equipment listed above. Had a thorough knowledge of operating controls and complete familiarity with individual equipment, capabilities, and theory of operation.
(b)	Conditionally qualified	Lacked a detailed knowledge of individual equipment capabilities and limitations. Did not fully understand the functions of all operating controls.
(c)	Unqualified	Significantly lacked knowledge of equipment capabilities, limitations, and theory of operation.

b. Teletype/voice procedures

(1)	Qualified	Demonstrated a thorough knowledge of teletype and voice procedures. Understood proper circuit discipline and possessed a complete knowledge of EMCON requirements and authentication procedures.
(2)	Conditionally qualified	Minor discrepancies noted.
(3)	Unqualified	Lacked knowledge of EMCON requirements or authentication procedures.

c. Logs/records

(1)	Qualified	Possessed a thorough knowledge of logs and records used during mission and reviewed them for errors during mission.
(2)	Conditionally qualified	Possessed a thorough knowledge of logs and records used during mission but missed minor errors during review.
(3)	Unqualified	Lacked knowledge of logs and records. Did not review them during mission.

*d. Encryption/decryption and encoding/decoding procedures

(1)	Qualified	Demonstrated a detailed knowledge of publications and procedures involved in encryption/decryption and encoding/decoding.
(2)	Conditionally qualified	Lacked a detailed knowledge of publications or procedures. Discrepancies would not lead to a compromise of systems.
(3)	Unqualified	Major discrepancies in knowledge which could lead to a possible compromise of systems.

e. Knowledge of publications

*(1) CMS Publications

*(2) OPORDERS/OPLANS

*(3) Communicators Operators Guide

*(4) Dispersal Packet

(5) JANAP 195

(6) ACP 131

(a) Qualified	Demonstrated a detailed knowledge of publications listed above.
(b) Conditionally qualified	Minor discrepancies noted in knowledge of publications, none of which could jeopardize mission requirements.
(c) Unqualified	Lacked significant knowledge which could result in jeopardizing of mission requirements.

f. General aircraft knowledge

(1) Qualified	Demonstrated knowledge of all radio and antenna locations, power panels, and power distribution. Had detailed knowledge of power sources and distribution.
(2) Conditionally qualified	Minor discrepancies in knowledge noted.
(3) Unqualified	Demonstrated a significant lack of knowledge of items listed.

5. Message handling procedures

*a. Coordination, equipment setup, and manning of positions

(1) Qualified	All appropriate personnel notified immediately, equipment set up, and positions manned indicating proper coordination. Demonstrated a complete knowledge of message-handling procedures.
(2) Conditionally qualified	Minor discrepancies noted in procedures of coordination.
(3) Unqualified	Appropriate personnel were not notified immediately, resulting in serious coordination problems. Any major discrepancies in procedures listed.

*b. Speed of message handling

(1) Qualified . . . . Time involved from message release to transmission was as expeditious as possible. Ensured that time used in changing modes of transmission was kept to a minimum.

(2) Conditionally qualified . . . . . . Very minor delays noted but overall time was good.

(3) Unqualified . . . . Any major delay indicating a lack of knowledge in message handling procedures.

*c. VLF transmission procedures

(1) Qualified . . . . Demonstrated a thorough knowledge of retransmission procedures.

(2) Conditionally qualified . . . . . . Very minor discrepancies noted, but knew which communication publications to use to locate necessary information.

(3) Unqualified . . . . Any discrepancies that would jeopardize mission requirements.

*d. Accuracy of message released

(1) Qualified . . . . Demonstrated a thorough knowledge of correctable message errors and piecing procedures. Possessed a thorough knowledge of procedures for transmitting a message with an uncorrectable error. Message process handled in accordance with these procedures.

(2) Conditionally qualified . . . . . . Minor discrepancies in knowledge, but had ability to locate necessary information in communication publications in adequate time.

(3) Unqualified . . . . Any discrepancies in knowledge that could jeopardize mission requirements. Message process handled incorrectly.

e. Accuracy/completeness of logs/forms

(1) Qualified . . . . All times and steps associated with message handling and transmission logged with reasons stated for any delays or procedural differences.

(2) Conditionally qualified . . . . . . Minor discrepancies noted.

(3) Unqualified . . . . Major discrepancies noted.

6. Knowledge of emergency procedures/equipment

*a. Qualified . . . . Demonstrated a thorough knowledge of emergency procedures/equipment.

*b. Conditionally qualified . . . . . . Minor discrepancies noted.

*c. Unqualified . . . . Major discrepancies noted that could have resulted in damage, personal injury, or death either to himself or to other crewmembers.

7. Landing and secure

*a. Preparation for landing

(1) Qualified . . . . Stations and crewmembers properly rigged for landing. Visually inspected aircraft for proper stowage of loose gear and equipment. Inventoried ACO Box.

(2) Conditionally qualified . . . . . . Minor discrepancies noted.

(3) Unqualified . . . . Major discrepancies noted that would present a potential safety hazard. Failed to inventory ACO Box.

*b. After landing

(1) Qualified . . . . All equipment secured and zeroized. All equipment discrepancies documented. Security provided for aircraft.

(2) Conditionally qualified . . . . . . Minor discrepancies noted.

(3) Unqualified . . . . Any discrepancy which could result in a security violation or damage to equipment.

*c. Mission reports and logs/forms review

(1) Qualified . . . . Reviewed mission reports and logs/forms for errors and ensured that all information pertinent to the mission was reported. Reports submitted at completion of mission and free of errors.

(2) Conditionally qualified . . . . . . Reviewed mission reports and logs/forms but missed minor errors.

(3) Unqualified . . . . Did not review mission reports or logs/forms, resulting in possibility of major errors present in mission reports.

NAVIGATOR.

1. Preflight

*a. Flight plan and chart preparation

(1) Qualified — Made appropriate entries of accurately computed data. Maintained a high degree of accuracy in all computer work, fuel planning, enroute time, and time to ETP. Was thoroughly familiar with all charts for proposed route and facilities enroute. Had a complete knowledge of all publications and NOTAMS concerning all portions of the flight.

(2) Conditionally Qualified . . . . . Completed flight plan and chart work with some errors in computations. Slow in his work, but not a detriment to flight safety.

(3) Unqualified . . . . . . Failed to complete navigational requirements because of errors that would have jeopardized flight or caused a flight violation. Must have supervision to complete mission.

*b. Analysis of weather data

(1) Qualified . . . . Knowledge of pressure systems, wind effects, and temperatures and able to read forecast symbols used on weather briefings so as to complete flight planning in an accurate manner.

(2) Conditionally Qualified . . . . . Possessed basic knowledge of meterology so as to be able to complete flight planning with only minor errors that would not jeopardize flight safety.

(3) Unqualified . . . . . . Unable to adequately analyze meterology data, consequently flight planning was inaccurate.

*c. Range control chart (if applicable)

(1) Qualified . . . . . . Was able to construct a range control chart (HOWGOZIT) in such a manner as to display accurate analysis of proper fuel management.

(2) Conditionally Qualified . . . . . Made minor errors in computation and/or plotting consumption which would not be detrimental to flight safety.

(3) Unqualified . . . . . . Unable to plot fuel points or made errors in computations so that the safety of flight would be compromised.

*d. Tactical planning

(1) Qualified	Was thoroughly familiar with the contents of the Altrev as set by the appropriate controlling authority. Maintained accuracy in all computations of controlled arrival times for tactical considerations.
(2) Conditionally Qualified	Limited knowledge of Altrev. Completed flight plan with minimum errors in computation and not considered a detriment to flight safety.
(3) Unqualified	Failed to comply with Altrev requirements that would result in a flight violation. Must have supervision to complete work.

e. Inspection of navigation equipment

(1) Qualified	Thorough and proficient inspection of all navigational equipment necessary for safe completion of flight. Had all personal and professional equipment.
(2) Conditionally Qualified	Accomplished inspection with minor omissions not affecting safety.
(3) Unqualified	Failed to complete the inspection properly. Could cause a compromise of the safety of flight.

2. Flight

*a. Dead reckoning

(1) Qualified	A plot of the intended tract was depicted with accurate dead reckoning position, plotted at least every hour, and necessary corrections made, if needed, to bring aircraft to programmed track. Complied with accepted DR procedures.
(2) Conditionally Qualified	Plotted dead reckoning positions with minor errors or omissions which would not affect the successful completion of the mission. Did not fully comply with DR procedures.

(3) Unqualified . . . . Did not comply with accepted DR procedures.

*b. Celestial

(1) Qualified . . . . Utilized accepted procedures in collecting necessary information for a celestial plot. Information received was properly evaluated and plotted.

(2) Conditionally Qualified . . . . Utilized accepted procedures in collecting necessary information for a celestial plot. Information received was evaluated and plotted with slight deviations from accepted methods. Plot was within accepted scope of error.

(3) Unqualified . . . . Deviated from accepted procedures in the collecting, evaluation, and plotting of a celestial fix. Errors and/or omissions were such that, if followed, they would have jeopardized accuracy in completion of the mission.

c. Pressure pattern

(1) Qualified . . . . Understood pressure systems and had sufficient knowledge to utilize them to best advantage. Familiar with the use of the radio altimeter and computation of drift angle.

(2) Conditionally Qualified . . . . Minor deviations from above criteria. Navigational log was not adversely affected, but need for improvement was indicated.

(3) Unqualified . . . . Deviated from accepted procedures. Such deviation and/or improper plot adversely affected successful completion of the navigational log.

*d. Loran

(1) Qualified . . . . Information received was properly interpreted and accurately plotted. Highly proficient in use of Loran equipment.

(2) Conditionally Qualified . . . . Same as Qualified except slight errors in interpretation and/or plotting. Did not adversely affect navigation.

(3) Unqualified . . . . Overall performance jeopardized accurate navigation.

e. Radar

(1) Qualified . . . . Utilized radar in all aspects of its capabilities. Was accurate in interpretation.

(2) Conditionally Qualified . . . . . . Utilized radar in all aspects of its capabilities, but was limited in interpretations. All procedures and operation of equipment did not jeopardize safety.

(3) Unqualified . . . . Failed to adequately tune and interpret radar presentations.

f. Radio aids

(1) Qualified . . . . Utilized radio aids with approved navigational procedures. Excellent coordination with pilot for proper utilization of aids.

(2) Conditionally Qualified . . . . . . Utilized radio aids to establish correct course for a given track. Average coordination with pilot for utilization of aids.

(3) Unqualified . . . . Did not know how to use radio navigation aids. Did not coordinate use of radio aids with pilot.

g. Consolan (if available)

(1) Qualified . . . . Successfully identified, tuned, and counted consolan and understood the theory of Consolan.

(2) Conditionally Qualified . . . . . . Possessed basic understanding of Consolan theory. Experienced some difficulty in accurately counting Consolan cycles. Did not adversely affect navigation.

(3) Unqualified . . . . Did not know how to use Consolan in theory or practice.

h. Doppler, NAV computer, and INS

(1) Qualified . . . . Properly tested, cycled and operated doppler. Correctly interpreted changes in drift and ground speed and derived doppler wind in orbit and/or straight and level flight. Properly programmed, tested and operated computer, utilizing it to the fullest extend.

(2) Conditionally Qualified . . . . Needed assistance in interpreting doppler information but was able to operate equipment satisfactorily. Experienced difficulty in operation of navigation computer.

(3) Unqualified . . . . Failed to operate doppler properly and/or adequately interpret information. Did not nunderstand the operation of the navigation computer.

*i. Use of logs

(1) Qualified . . . . Made appropriate recordings in time of entry, actual, proposed, and remarks sections. Recorded correct information in the computation section. Made entries with accuracy and neatness.

(2) Conditionally Qualified . . . . Made minor omissions in recording, yet recorded all necessary information.

(3) Unqualified . . . . Unable to make necessary entries; did not record necessary information.

*j. Use of charts

(1) Qualified . . . . Knows advantages and deficiencies of available navigation charts (Gnomonic, Conformal, Mercator). Uses proper plotting techniques and applies all required corrections. Able to select chart best suited for mission purpose and scope. Readily understands chart abbreviations and symbols.

(2) Conditionally Qualified . . . . Fair understanding of chart requirements. Minor errors in plotting techniques and correct applications. Passable understanding of chart symbols and abbreviations.

(3) Unqualified . . . . Unable to select proper chart for required mission. Poor understanding of chart differences. Major errors in plotting and correct application. Unfamiliar with chart symbols and abbreviations.

*k. HOWGOZIT

(1) Qualified . . . . Maintained a complete and up-to-date HOWGOZIT, exhibiting an appreciation of the HOWGOZIT'S significance and importance.

(2) Conditionally Qualified	Failed to keep HOWGOZIT current or, did not demonstrate complete understanding of HOWGOZIT.
(3) Unqualified	Overall comprehension and execution was inadequate.

*l. Analysis of weather data

(1) Qualified	Made accurate and frequent reevaluations of weather based on preflight and inflight information.
(2) Conditionally Qualified	Possessed a basic understanding of current weather but failed to utilize information properly.
(3) Unqualified	Failed to up date weather or to understand its significance.

*m. Tactical execution

(1) Qualified	Utilized all available navigational aids in effecting compliance with controlled arrival times. Demonstrated flexibility in tactical considerations and maintained excellent coordination with the pilot and airborne communications officer.
(2) Conditionally Qualified	Minor deviations from above criteria. Average coordination with pilot and airborne communications officer with need for improvement.
(3) Unqualified	Overall performance jeopardized the tactical mission.

n. Grid navigation (if applicable)

(1) Qualified	Able to use correct procedures and methods of compass corrections and plotting procedures. Knows proper celestial techniques.
(2) Conditionally Qualified	Limited knowledge of methods and techniques, but not to a degree of jeopardizing flight safety.
(3) Unqualified	Unable to obtain correct information or use information obtained correctly.

3. General

*a. General knowledge of aircraft

(1) Qualified . . . . A workable understanding of systems and system management within the scope of the assigned crew function.

(2) Conditionally Qualified . . . . Possessed a basic understanding of systems and management within the scope of the assigned crew function. Lacked detailed knowledge of systems.

(3) Unqualified . . . . Did not understand the system(s) or their function within the scope of assigned crew operation.

*b. Use of navigation forms

(1) Qualified . . . . Successfully completed all forms necessary for flight recording. Needed no assistance in their correct usage.

(2) Conditionally Qualified . . . . Minor errors in use of navigational forms, but knowledge of usage satisfactory.

(3) Unqualified . . . . Did not make proper or complete entries on forms. Failed to use forms in proper sequence.

*c. Emergency procedures

(1) Qualified . . . . Demonstrated thorough knowledge of emergency equipment and procedures. Was able to execute the drills expeditiously, safely, and correctly, requiring no supervision.

(2) Conditionally Qualified . . . . . . Demonstrated a satisfactory knowledge of emergency procedures. Minor errors not detrimental to safety were noted.

(3) Unqualified . . . . Did not display a positive knowledge of actions and procedures necessary to assist emergency operations.

d. Radio/ICS procedures

(1) Qualified . . . . Exercised radio and ICS discipline. Demonstrated thorough knowledge of voice, radio and ICS procedures. Familiar with position reporting and ocean station vessel reports.

(2) Conditionally Qualified . . . . . . Has knowledge of proper radio and ICS procedures, but minor discrepancies were noted. Reports adequate.

(3) Unqualified . . . . Major discrepancies noted. Obvious lack of knowledge in this area.

e. Postflight

(1) Qualified . . . . Complied with proper debriefing of flight. Information presented was exact and complete.

(2) Conditionally Qualified . . . . . . Same as above, but with minor errors in information presented. Bordered on incomplete description of debriefing requirements.

(3) Unqualified . . . . Failed to debrief on weather, wind factor, and/or other essential information. Did not meet standards for Conditionally Qualified.

AIRBORNE COMMUNICATIONS OFFICER (ACO) / AIRBORNE COMMUNICATIONS SUPERVISOR (ACS) / AIRBORNE COMMUNICATOR (ACOM).

Items that apply to some positions only are designated.

Items preceded by an asterisk are considered to be a critical area.

1. Preflight

*a. Equipment Preflight inspection and test of the USC-14(V), OZ-1(V), OG-127, and flight station equipment excluding the navigator's preflight items.

(1) Qualified . . . . Had knowledge of know equipment discrepancies. Demonstrated thorough knowledge of preflight procedures. Properly evaluated results of preflight checks and tests.

(2) Conditionally Qualified	Omissions and deviations from preflight resulted in partial determination of equipment status. Did not demonstrate a thorough knowledge of preflight procedures.
(3) Unqualified	No preflight performed. Major discrepancies resulted in erroneous determination of equipment status. Lacked significant knowledge of preflight requirements.
*b. Mission Planning	
(1) Qualified	Required communications publications, logs and message blanks on board. Had knowledge of frequencies and call signs expected to be used during the flight.
(2) Conditionally Qualified	Minor discrepancies noted.
(3) Unqualified	Major discrepancies noted. Obvious lack of mission planning.
c. Equipment Status Report	
(1) Qualified	Reported results of equipment checks and tests to the appropriate personnel.
(2) Conditionally Qualified	Failed to give complete status report.
(3) Unqualified	Failed to report equipment status to appropriate personnel.
Before take-off	
a. Stations properly rigged for take-off	
(1) Qualified	Seat back fully erect, seat fully lowered, head rest properly extended and lap belt and shoulder harness fastened. No loose gear at station.

(2) Conditionally Qualified . . . . . . Minor deviations from the procedures noted under qualified.

(3) Unqualified . . . . . . Major deviations that would present a potential safety hazard which could have resulted in injury or death.

b. Reporting

(1) Qualified . . . . Visually inspected communications area for proper stowage of equipment and made certain crew members and passengers in communications area are properly prepared for take-off. Reported information to pilot.

(2) Conditionally Qualified . . . . . . Minor deviations noted from items required for qualified.

(3) Unqualified . . . . . . Failed to report to pilot. Loose gear in communication area during takeoff. Discrepancies or omissions resulted in an unsafe condition.

*c. Knowledge of Mission

(1) Qualified . . . . Had excellent knowledge of schedule of events for mission. Was aware of circuits to be established, and communication conditions for the period of the mission. Demonstrated excellent coordination with other units.

(2) Conditionally Qualified . . . . . . Minor discrepancies noted in coordination of mission requirements and establishment of communication circuits.

(3) Unqualified . . . . Inadequate knowledge of mission requirements and lacked necessary coordination.

3. After take-off

a. Mission preparation (ACS)

(1) Qualified	Demonstrated a detailed knowledge of the mission to be performed. Distributed all logs, reports and forms to efficiently perform the mission. Organized and coordinated the preparations required to commence operations.
(2) Conditionally Qualified	Performance of duty lacking in some areas, not fully aware of responsibilities.
(3) Unqualified	Inadequate preparations made, needed constant guidance in performance of duty.

b. Reporting communication status

(1) Qualified	Properly reported to the appropriate personnel when communications were established on designated circuits. Kept appropriate personnel advised of any changes in communications status.
(2) Conditionally Qualified	Undue delays in keeping appropriate personnel advised of establishment of designated circuits and changes in communications status.
(3) Unqualified	Failed to report establishment of designated circuits, or status of communications during the mission.

4. Operational knowledge

*a. Equipment utilization

(1) Transmitting

(2) Receiving

(3) FSK conversion

(4) cryptographic

(5) Teletype

(6) Recording

(7) Fault location

(8) Emergency

(a) Qualified	Demonstrated a detailed knowledge of equipment listed above. Had thorough knowledge of operating controls and completely familiar with individual equipment, capabilities, and theory of operation.
(b) Conditionally Qualified	Lacked detailed knowledge of individual equipment capabilities and limitations.
(c) Unqualified	Lack of familiarity with individual equipments could result in damage to equipment.

*b. Patching and Interconnections of Equipment

(1) Qualified	Demonstrated a detailed knowledge of patching capabilities and limitations. Had thorough knowledge of how various equipments are interconnected.
(2) Conditionally Qualified	Lacked detailed knowledge of patching capabilities and limitations. Did not fully understand how various equipments are interconnected.
(3) Unqualified	Lack of knowledge concerning patching which could result in damage to equipments or poor performance. Significantly lacked a knowledge of interconnection of various equipments.

c. Intercommunication systems

(1) Qualified	Demonstrated a thorough knowledge of all functions and capabilities of the ICS. Had knowledge of all ICS controls and their function.

(2) Conditionally Qualified . . . . Lacked a thorough knowledge of ICS operating controls.

(3) Unqualified . . . . Failed to demonstrate a thorough knowledge of ICS functions and capabilities.

*d. Teletype and voice procedures

(1) Qualified . . . . Demonstrated thorough knowledge of teletype and voice procedures. Used proper circuit discipline. Spoke clearly and concisely on ICS system and voice circuits.

(2) Conditionally Qualified . . . . Minor discrepancies noted. Needs practice in teletype and voice circuit operation.

(3) Unqualified . . . . Major discrepancies noted. Was unable to effectively communicate on teletype or voice circuits.

*e. Logs and records

(1) Qualified . . . . Maintained all logs and records completely, neat and up to date.

(2) Conditionally Qualified . . . . Some information incomplete. Logs were confusing and obviously disordered.

(3) Unqualified . . . . Did not maintain adequate logs and records of mission.

*f. Authentication and Encryption Tables, and Crypto Publications

(1) Qualified . . . . Demonstrated a detailed knowledge of the correct use of the authentication and encryption tables/publications.

(2) Conditionally Qualified . . . . . . Lacked a detailed knowledge of crypto publications and the use of authentication and encryption tables. Such lack of knowledge would not lead to compromise of crypto systems.

(3) Unqualified . . . . Lacked knowledge of authentication and encryption tables/publications that could lead to compromise and prevent proper answering to challenge.

*g. CW/Teletype transmission and CW reception

(1) Qualified . . . . Demonstrated the ability to transmit and receive at a minimum speed as determined by the command.

(2) Conditionally Qualified . . . . No conditional qualifications.

(3) Unqualified . . . . Unable to perform as above.

5. Inflight maintenance of USC-14(V), OZ-1(V), and OG-127

a. General aircraft knowledge

(1) Qualified . . . . Demonstrated knowledge of all radio and navigation antenna locations, power panels, and distribution. Had detailed knowledge of power sources and distribution.

(2) Conditionally Qualified . . . . Lacked knowledge of location of all radio and navigation antennas, power panels, and distribution. Not completely familiar with power sources and distribution.

(3) Unqualified . . . . Demonstrated a significant lack of knowledge of items listed above.

*b. Troubleshooting procedures

(1) Qualified . . . . Demonstrated a detailed knowledge of troubleshooting procedures. Effectively used fault isolation equipment.

(2) Conditionally Qualified . . . . Lacked sufficient knowledge of troubleshooting procedures. Had some difficulty in the use of the fault isolation equipment.

(3) Unqualified . . . . Unable to correctly troubleshoot failures.

6. Emergencies, safety and survival

NEW *a. Emergency procedures and equipment

(1) Qualified . . . . Demonstrated thorough knowledge.

(2) Conditionally Qualified . . . . . . Demonstrated adequate knowledge. Experienced minimum difficulty. NEW

(3) Unqualified . . . . Inadequate knowledge. Demonstrated improper use of equipment which may have resulted in damage, personal injury, or death either to himself or other crewmembers.

7. Landing and secure

a. Preparation for landing

(1) Qualified . . . . Station properly rigged for landing. Visually inspected communications area for proper stowage of equipment (ACS/ACOM). Ensured crewmembers properly prepared for landing. Reported to pilot (ACS).
(2) Conditionally Qualified . . . . . . Minor deviations from procedures noted under qualified.
(3) Unqualified . . . . Failed to report readiness of communications area to pilot.

*b. Equipment secured

(1) Qualified . . . . All equipment located in communications area properly secured.
(2) Conditionally Qualified . . . . . . Lacked detailed knowledge of procedures required to properly secure equipment.
(3) Unqualified . . . . Improperly secured some equipment. Failed to zero the crypto equipment.

c. Equipment discrepancies (ACS)

(1) Qualified . . . . Aware of all electronic equipment discrepancies on the flight station and in the communications area.
(2) Conditionally Qualified . . . . . . Noted minor deviations in the performance of the above.
(3) Unqualified . . . . Not aware of electronic equipment discrepancies.

*d. Mission reports (ACS)

(1) Qualified . . . . Compiled all mission logs and reports correctly and neatly. Expeditiously submitted reports at completion of the mission.
(2) Conditionally Qualified . . . . . . Prepared data, but to a lesser degree of efficiency than required.
(3) Unqualified . . . . Logs and reports inadequately prepared.

*e. Security procedures

(1) Qualified . . . . Had a detailed knowledge of security regulations concerning equipment and material in aircraft. Provided proper protection for equipment and classified material.

(2) Conditionally Qualified . . . . . . Lacked a detailed knowledge of security regulations concerning classified equipment and material in the aircraft, but provided proper protection for classified material and equipment.

(3) Unqualified . . . . Had very little knowledge of security regulations. Did not provide proper protection for classified equipment and material.

FLIGHT TECHNICIAN (FT/2FT)

** - Critical item for first technician only.

1. Preflight

*a. Preflight of the external communications equipment such as the radar, ADF's, antennas, and miscellaneous equipment attached to the aircraft.

(1) Qualified . . . . Checked all equipment in accordance with local requirements.

(2) Conditionally Qualified . . . . . . Checked equipment required, but is not thorough in the preflight.

(3) Unqualified . . . . Overlooks obvious discrepancies.

*b. Preflight of all Comm/Nav equipment on the flight deck, under the flight deck, and equipment located in the aircraft except that which is inside Comm Central.

NEW (1) Qualified . . . . Completes a thorough operational check. Checked all equipment for safety wire, security, and cleanliness as required.

(2) Conditionally Qualified . . . . . . Is able to perform a check of all Comm/Nav equipment but overlooks some of preflight.

(3) Unqualified . . . . Fails to perform critical areas of a preflight.

*c. Preflight of all equipment associated with Comm Central position three.

NEW (1) Qualified . . . . Completes a thorough operational check. Checks all equipment located in the OZ-1 racks for security and cleanliness.

(2) Conditionally Qualified . . . . . . Overlooks minor items during preflight.

(3) Unqualified . . . . Fails to perform a preflight of equipment associated with position three.

*d. Preflight of survival equipment such as his Mae West, parachute, survival equipment issued to him, and flight equipment worn.

(1) Qualified . . . . Holds a complete and thorough preflight of his equipment.
(2) Conditionally Qualified . . . . Checks only those items he considers essential.
(3) Unqualified . . . . Fails to perform a preflight of his assigned survival equipment.

e. Reports equipment status to the ACS and the MC, listing operational status and deficiencies. Has a knowledge of what the MEL is and its functions.

(1) Qualified . . . . Reports known discrepancies from maintenance and AT shop and results of the equipment preflights.
(2) Conditionally Qualified . . . . Fails to give a complete status report or fails to check the ground maintenance facilities for discrepancies.
(3) Unqualified . . . . Fails to give an equipment status report.

f. Checks all spares carried on board to ensure sufficient quantities for the duration of the mission. Checks test equipment for completeness and operational status.

(1) Qualified . . . . Checks all spares and the test equipment and attempts to replace missing items.
(2) Conditionally Qualified . . . . Checks the spares aboard but makes no attempt to replace those items needed. Does not check operational status of the test equipment.
(3) Unqualified . . . . Does not check spares or test equipment.

2. Pre take-off/after take-off

*a. Station properly rigged for take-off

(1) Qualified . . . . Seat back fully erect, seat fully lowered, lap belt and shoulder harness fastened and locked. No loose gear at station.
(2) Conditionally Qualified . . . . Minor deviations from procedure noted under "qualified."
(3) Unqualified . . . . Deviations from procedures noted under qualified which could present a potential safety hazard.

b. Radio logs including heading, initial entries, and status of timed circuits, established or lost, suspected jamming and other similar circumstances.

(1) Qualified . . . . Knows what to write and report; reports it as soon as practicable to ACS.

(2) Conditionally Qualified . . . . . . Undue delays in reporting to ACS.

(3) Unqualified . . . . Fails to report status to ACS.

c. Knowledge of TACAMO mission and the publications pertinent to the mission.

(1) Qualified . . . . Understands the mission of TACAMO. Has a good knowledge of the squadron OP plan and associated instructions, forms, and publications.

(2) Conditionally Qualified . . . . . . Has limited knowledge of the OP plan and associated instructions, forms, and publications.

(3) Unqualified . . . . Not aware of the TACAMO mission or of the OP plan and associated instructions, forms, and publications.

3. Operational procedures.

a. Proper radio telephone procedures.

(1) Qualified . . . . Operates within the prescribed procedures as set forth in the ACP-125 and DNC-5.

(2) Conditionally Qualified . . . . . . Deviates slightly from that noted under qualified.

(3) Unqualified . . . . Not familiar with procedures set forth under qualified or used procedures which could lead to compromise.

b. Knowledge of operating limits and limitations of all equipment assigned to Comm Central position three including all of the OZ-1 mounted equipment.

(1) Qualified . . . . Demonstrates a detailed knowledge of operating assigned equipment and its limitations.

(2) Conditionally Qualified . . . . . . Lacked a detailed knowledge of position three equipment and could not attain full utilization of it.

(3) Unqualified . . . . Lacks enough knowledge of position three equipment that could lead to damage by improper operating procedures or utilization.

4. Inflight maintenance (abilities and procedures).

**a. Maintenance ability and equipment knowledge as pertains to flight deck Comm/Nav equipment.

(1) Qualified . . . . Able to troubleshoot with a high degree of accuracy with minimal resources.

(2) Conditionally Qualified . . . . . . Knows equipment location and can troubleshoot most equipment on the flight deck.
(3) Unqualified . . . . Unable to troubleshoot most equipment because of a definite lack of familiarity.

**b. Maintenance ability and equipment knowledge as pertains to HF, UHF, and CCCS.

(1) Qualified . . . . Able to troubleshoot with a high degree of accuracy with minimal resources.
(2) Conditionally Qualified . . . . . . Knows equipment location and can troubleshoot basic system.
(3) Unqualified . . . . Unable to perform normal troubleshooting because of lack of knowledge of the system.

**c. Maintenance ability and equipment knowledge as pertains to the OG-VLF TX system.

(1) Qualified . . . . Able to troubleshoot the OG-VLF TX system with a high degree of accuracy with minimal resources.
(2) Conditionally Qualified . . . . . . Basically troubleshoot OG-VLF TX system.
(3) Unqualified . . . . Unable to perform normal troubleshooting because of lack of knowledge of the system.

**d. Maintenance ability and equipment knowledge as pertains to the USC-14 equipment not covered in the above sections.

(1) Qualified . . . . Able to troubleshoot the miscellaneous USC-14 equipment with minimal resources.
(2) Conditionally Qualified . . . . . . Basically troubleshoot the miscellaneous USC-14 equipment.
(3) Unqualified . . . . Unable to perform normal troubleshooting of the various systems because of lack of familiarity.

5. Emergencies

*a. Knowledge of emergency equipment and procedures.

(1) Qualified . . . . Had thorough knowledge.
(2) Conditionally Qualified . . . . . . Minor deviations.
(3) Unqualified . . . . Lacked significant knowledge.

*b. Emergency radio procedures.

(1) Qualified . . . . Thoroughly knowledgeable of emergency radio procedures including emergency frequencies. Familiar with the operation of the AN/CRT-3A/PRT-5.

(2) Conditionally Qualified . . . . . . Familiar with emergency radio procedures and frequencies, with some minor deviation.
(3) Unqualified . . . . Lacks significant knowledge of that prescribed for qualified.

6. Safety

*a. Safety procedures.

(1) Qualified . . . . Fully aware of required safety procedures.

(2) Conditionally Qualified . . . . . . Minor deviations from that prescribed for qualified that would not cause injury or damage to personnel or equipment.

(3) Unqualified . . . . Uses procedures which could lead to serious injury to personnel or extensive damage to equipment.

7. Descent and landing

a. Disposition of classified materials.

(1) Qualified.................................Ensures delivery of all classified materials to the designated persons.
(2) Conditionally Qualified..........................Minor deviations from those noted under qualified but not serious enough to cause compromise.
(3) Unqualified............................Deviations from the procedures noted under qualified which could lead to compromise.

b. Equipment shutdown.

(1) Qualified.................................Ensures all equipment associated with position three is secured when told.
(2) Conditionally Qualified..........................Equipment is shut down but some switches are positioned wrong.
(3) Unqualified............................Fails to shut down equipment because of lack of knowledge.

c. Completion of radio logs.

(1) Qualified.................................Properly completed radio logs as noted in the ACP-125 and DNC-5.
(2) Conditionally Qualified..........................Minor deviations from that noted under qualified.
(3) Unqualified............................Major deviations from that prescribed under qualified.

d. Station properly rigged for landing.

(1) Qualified................................ Seat back fully erect, seat fully lowered, lap belt and shoulder harness fastened and locked. No loose gear at station.
(2) Conditionally Qualified.......................... Minor deviations from procedures noted under qualified that do not present a serious hazard.
(3) Unqualified............................ Deviations from procedures noted under qualified which could present a potential safety hazard.

8. Maintenance and records.

**a. Proper filling out of MAF's and SAF's.

(1) Qualified................................ Has full knowledge of MAF's and SAF's in accordance with the OPNAVINST 4790.2.
(2) Conditionally Qualified.......................... Appears to have the knowledge noted under qualified but with minor deviations.
(3) Unqualified............................ Unable to complete MAF's and SAF's.

b. Post flight responsibilities.

(1) Qualified................................ Performs required postflight duties completely and promptly.
(2) Conditionally Qualified.......................... Requires reminders to perform his post-flight duties.
(3) Unqualified............................ Fails to perform his postflight duties.

c. Equipment procurement or repair (deployed bases)

(1) Qualified................................ Makes an attempt at equipment procurement or repair as required at each enroute stop.
(2) Conditionally Qualified.......................... Makes little effort to procure or repair existing equipment discrepancies at each enroute stop.
(3) Unqualified............................ Makes no attempt to procure or repair equipment discrepancies at enroute stops.

d. Maintenance procedures.

(1) Qualified................................ Follows prescribed troubleshooting and/or maintenance procedures.
(2) Conditionally Qualified.......................... Deviated from prescribed troubleshooting and/or maintenance procedures.
(3) Unqualified............................ Follows no set troubleshooting and/or maintenance procedures causing excessive delays in repair.

REEL OPERATOR.

1. Preflight

*a. Preflight inspection duties

(1) Qualified . . . . Completed thorough preflight inspection in compliance with standard procedures. Ascertained that all equipment was aboard, including food, coffee and water.

(2) Conditionally Qualified . . . . . . Completed reel equipment inspection/duties with omissions in minor areas which did not cause delay, affect the safety of proposed flight or jeopardize the mission.

(3) Unqualified . . . . Failed to conduct proper aircraft/reel equipment inspection and/or omitted important items which would affect the safety of flight or jeopardize the completeness of the mission.

b. Equipment status report

(1) Qualified . . . . Reported results of equipment checks and tests to the appropriate personnel and indicated which equipment was inoperative or operating at reduced efficiency.

(2) Conditionally Qualified . . . . . . Minor discrepancies noted but did not affect performance of the mission.

(3) Unqualified . . . . . . Failed to report equipment status to appropriate personnel.

2. Flight

*a. Operation and care of reel equipment.

(1) Qualified . . . . Demonstrated thorough knowledge, correct operation and care of all reel equipment.

(2) Conditionally Qualified . . . . . . Experienced some difficulty in operation and care of equipment.

(3) Unqualified	Inadequate knowledge or improper operation of reel equipment.
*b. Reel operating emergency procedures	
(1) Qualified	Demonstrated thorough knowledge and proper execution of emergency procedures.
(2) Conditionally Qualified	Minor deviations of the above not affecting safety.
(3) Unqualified	Displayed inadequate knowledge and execution of emergency procedures.
c. Intercommunications systems	
(1) Qualified	Demonstrated a thorough knowledge of ICS equipment and proper procedures.
(2) Conditionally Qualified	Lacked a thorough knowledge of ICS equipment or procedures.
(3) Unqualified	Failed to demonstrate adequate knowledge of ICS equipment or procedures.
d. Logs and records	
(1) Qualified	Compiled all logs and records completely and neatly.
(2) Conditionally Qualified	Some information was incomplete.
(3) Unqualified	Did not maintain adequate logs or records.
*e. Troubleshooting procedure	
(1) Qualified	Demonstrated a detailed knowledge of troubleshooting procedures. Capable of correcting most equipment malfunctions.
(2) Conditionally Qualified	Lacked a detailed knowledge of some troubleshooting procedures. Was capable of correcting malfunctions with limited supervision.
(3) Unqualified	Unable to correctly troubleshoot malfunctions.
f. Inflight repair and maintenance	

(1) Qualified . . . . Demonstrated detailed knowledge of proper use of tools and test equipment in performing repairs and maintenance. Adhered to safety procedures.

(2) Conditionally Qualified . . . . Lacked a detailed knowledge in proper use of tools and test equipment. Was capable of repairing and maintaining equipment with limited supervision. Adhered to safety procedures.

(3) Unqualified . . . . Used tools and test equipment improperly. Unable to repair or maintain equipment. Did not adhere to safety procedures.

NEW

3. Knowledge of emergency equipment and procedures

a. Drills

(1) Qualified . . . . Demonstrated thorough knowledge.

(2) Conditionally Qualified . . . . . . Demonstrated adequate knowledge. Experienced minor difficulty.

(3) Unqualified . . . . Inadequate knowledge.

4. Landing and secure

a. Preparation for landing

(1) Qualified . . . . Station properly rigged for landing. Ensured crewmembers and passengers properly prepared for landing. Reported to pilot.

(2) Conditionally Qualified . . . . . . Minor deviations from procedures noted under qualified.

(3) Unqualified . . . . Failed to report readiness of after station area to pilot.

b. Equipment secured

(1) Qualified . . . . All equipment located in aft station area secured.

(2) Conditionally Qualified . . . . . . Minor deviations noted but not considered disqualifying.

(3) Unqualified . . . . Failed to properly secure equipment.

5. General

a. Customs/agriculture procedures

(1) Qualified . . . . Ensured all necessary forms were completed. Was familiar with customs regulations. Disinsected aircraft, if required.

(2) Conditionally Qualified . . . . . . Complied with agriculture and customs requirements, but committed minor errors in preparation of forms.

(3) Unqualified . . . . . . Failed to properly comply with customs or agriculture regulations.

b. Security procedures

(1) Qualified . . . . Had a detailed knowledge of security regulations concerning equipment and material in aircraft.

(2) Conditionally Qualified . . . . . . Lacked a detailed knowledge of security regulations concerning classified equipment and material in the aircraft.

(3) Unqualified . . . . . . Had very little knowledge of security regulations.

c. General knowledge of aircraft

(1) Qualified . . . . Displayed positive knowledge of the aircraft systems and servicing of aircraft within the scope of the assigned crew function.

(2) Conditionally Qualified . . . . . Possessed a basic understanding of systems and servicing of aircraft within the scope of the assigned crew function. Lacked detailed knowledge of systems.

(3) Unqualified . . . . . . Did not understand the system(s) or their function within the scope of assigned crew operation.

QUESTION BANKS.

The following bank of questions is intended to assist the NATOPS evaluator/instructor in the preparation of ground examinations and to provide an abbreviated study guide. The questions from the bank should be combined with locally originated questions as well as questions obtained from the Model Manager in the preparation of ground examinations.

PILOT/COPILOT QUESTION BANK.

1. During normal engine operation, the engine power should not be allowed to exceed what limit?

2. The safety coupling on the engine will disengage when negative torque reaches approximately__inch-pounds.

3. What does the secondary fuel pump pressure light indicate if it remains on after 65 percent engine rpm?

4. Full travel of the synchrophaser master trim knob will change the master engine___ percent rpm.

5. An engine ground start should be discontinued if there is no light off by___ percent engine rpm.

6. If during flight, the torque, TIT, and fuel flow are near zero and power section oil pressure is low, hydraulic pressure, ac generator, rpm and gearbox oil pressure are normal, what does it indicate?

7. During airstart, normal light off should occur by___ percent engine rpm. What action is necessary if light off is not obtained by___ percent engine rpm?

8. What is the maximum continuous torque and TIT?

9. The warning horn silence switch will silence the warning horn when any throttle is retarded or when the flaps are extended more than 70 percent.

   a. True

   b. False

10. The ATM generator is rated at___ KVA self-cooled and___ KVA with cooling air fan.

11. Power on stalls in the take-off configuration should be performed under what conditions?

12. During prolonged condition of negative torque, will the NTS eventually drive the propeller to feather?

13. Do not exceed___ KIAS with the paratroop air deflectors extended.

14. Directional control of the nose wheel is limited by mechanical stops to___ degrees right and left of center.

15. At what speed will the take-off speed be in the recommended area of the crosswind chart with a wind of 35 knots at 040 degrees on runway 9?

16. When refusal speed exceeds take-off speed, use___ speed as refusal speed.

17. What is the purpose of the engine drip valve?

18. An engine start should be discontinued if the time required for engine to accelerate to on-speed exceeds_ seconds.

19. With throttles in the full reverse position, reverse thrust will be approximately___ percent of take-off power.

20. The altitude hold control on the autopilot should not be engaged if the aircraft rate of climb or descent is greater than___ rpm.

21. The aircraft can be taxied in a 90-degree crosswind up to___ knots.

22. The recommended airspeed is___ knots in severe turbulence.

23. The aircraft is limited to__ degrees angle of bank: __ degrees angle of bank with 100 percent flaps.

24. What is the procedure for an inflight door warning?

25. What would the fuel flow per hour be on each engine if the aircraft is at 20,000 feet, CAS of 200 knots, and a power setting of 850° C TIT?

26. How much fuel will be used to climb from altitude of 4,000 feet to 26,000 feet with an aircraft gross weight of 120,000 pounds?

27. What is the service ceiling of the aircraft with the following conditions?

a. Four engines

b. 125,000 pounds

c. Standard day

d. Normal power

28. At a gross weight of 115,000 pounds, what is the recommended approach speed with 100 percent flaps? Threshold speed? Touchdown speed?

29. How is engine fuel heated and ice prevented from forming in the fuel filter?

30. With the aircraft under control and time permitting, what is the primary bailout exit?

31. What is the minimum time required for brake cooling between landings using maximum braking?

32. After an air start, allow oil temperature to reach 40° C before moving throttles above___ inch-pounds of torque.

33. Where is the aft compartment temperature controlled from?

34. The inertia reels on the back of the crew seats will lock automatically with a forward impact force of___ g's.

35. When using AvGas (non TCP), the first choice is___.

36. What is the primary exit for the pilot after an aircraft ditching?

37. The elevator trim tab travel is controlled by limit switches set at___ degrees nose down and___ degrees nose up, and mechanical stops set at___ degrees nose down and___ degrees nose up.

38. What is the purpose of the NTS system?

39. What are the recommended reasons for engine shutdown?

40. What action is required if an overheat condition is indicated by the flashing of the master fire warning light and flashing lights in the fire emergency control handle?

41. Where are the thermocouples located that sense temperatures that are indicated on the TIT indicators?

42. The engine fuel low pressure warning lights come on when pressure falls below approximately___ psi.

43. What is the normal power source for the elevator trim tab?

44. Because of expected characteristics of the aircraft during ditching, it is recommended that crewmembers or passengers:

45. The NTS system operates when negative torque reaches approximately___ inch-pounds.

46. What items are controlled through the touchdown switch?

47. What does a WARNING in the Flight Manual indicate?

48. At what position in a typical instrument approach should 50 percent flaps and landing gear be lowered?

49. Which items operate "hot" off the battery bus?

50. As engine speed is reduced and gearbox oil pressure drops,___ brings the propeller braking surfaces into contact.

51. What is the maximum allowable oil temperature in flight for continuous operation?

52. What is the procedure for a GTC fire?

53. What is the correct procedure to follow in the event of an engine fire in flight?

54. The pilot's pitot tube heater uses power from the___ bus.

55. Engine fuel flow is measured at what point?

56. When is the NTS inoperative?

57. When is fuel to the engine mechanically shut off?

58. Under what conditions does the TD system provide overtemperature protection?

59. The safety valve is controlled___ and operated___.

60. The crossover point at which throttle travel actuates switches to go from temperature limiting to temperature controlling is___ degrees.

61. Which of the radios are "line of sight"?

62. Should the outflow valve fail in the close position and cannot be opened either by automatic or manual control methods, the cabin pressure may increase at an excessive rate and could not be reduced by normal means. What should be accomplished if this condition is encountered?

63. What is the difference in a three-engine landing pattern and a normal landing pattern?

64. During starting, ignition is turned off at approximately___ percent rpm.

65. What is the purpose of parallel operation of the engine driven fuel pump?

66. What is the propeller auxiliary pump operating limit?

67. The engine starter operation limits are pop out at___ percent, pull out at___ percent.

68. If the radome anti-icing system is operated on the ground for testing, what is the maximum time the system may remain on?

69. If electrical arcing is observed in one of the Nesa panels, what action should be taken?

70. For engine starting, what is the maximum allowable TIT?

71. During ground start, what is the maximum RPM if the engine does not light off?

72. Why should the engine hydraulic pump switches be left on after engine shutdown?

73. What is the purpose of the acceleration bleed air valves?

74. How and when is fuel enrichment shut off?

75. List the functions of the speed sensitive control at 16 percent.

76. On engine start, a positive hydraulic pressure indication should be noted by when?

77. List the rpm limits for:

a. low-speed ground idle

b. normal ground idle

c. maximum reverse

d. flight idle

78. During start, what is the required action if the TIT exceeds:

a. 830° C

b. 850° C

c. 965° C

79. Under what condition will a buss-off light be illuminated without a generator-out light being illuminated?

80. What is the procedure for an illumination of a generator-out light?

81. What are the inflight limits for the following?

a. DC voltage

b. AC voltage

c. Frequency

d. RPM

82. The wing bleed air isolation valves are___closed and___opened.

83. On the ground, the leading edge anti-icing system must not remain on for more than___ seconds.

84. List the position of the outflow valve and safety valve with the air conditioning master switch in air conditioning no-pressure position.

85. What is the procedure when the cargo compartment refrigerator overheat light illuminates in flight?

86. If either of the inner or outer panels of the windshield or cargo compartment window cracks in flight, reduce cabin differential pressure to no more than___; if both panes crack,___.

87. What are the time limitations for starting the GTC?

88. Explain why the hydraulic pump switches should not be turned off if the pressure exceeds 3450 psi.

89. List the elements which get hydraulic power from the utility hydraulic system.

90. What is the normal rudder booster pressure with flaps 0 to 15 percent? With flaps 15 to 100 percent?

91. List the units operated by the auxiliary hydraulic system.

92. List the recommended airspeeds for holding; penetration; circling approach; missed approach.

93. During operation in low speed ground idle, after a stable start, the TD valve limits the TIT to___ °C.

94. List the limits for fuel balancing:

a. Between aux tanks

b. Between outboard and inboard tanks

c. Between each pair of symmetrical main tanks

d. Between wings

95. The low pitch stop prevents the propeller blade angle from decreasing below what angle in flight?

96. When will the propeller low oil warning light illuminate?

97. Does NTS action commit the propeller to feather?

98. During pitchlock operation, what rpm should be maintained? Why?

99. List the recommended flap setting and airspeed for ditching?

FLIGHT ENGINEER QUESTION BANK.

1. If the No. 4 40/50 KVA generator fails or if it assumes the load of another of the aircraft busses, which generator will assume the load for Communication Central?

2. Where do the generator bearing-failure lights get their power?

3. At what pressure will the auxiliary vent valve open in the cabin pressurization system?

4. What units will be actuated when a fire handle is pulled with only the battery bus energized?

5. When operating the engines in low speed ground idle, movement of the throttles beyond the low speed range could cause ______ .

6. What action is required if TIT exceeds 965°C on start?

7. In throttle positions between 0°C and 65°C the temperature datum control valve normally remains in the null position regardless of TD switch position.

8. What unit normally controls the engine RPM during flight?

9. The temperature datum control valve receives ______ power to release the TD valve brake.

10. What unit in the starting system ports air from the fourteenth stage of the compressor to close the fifth and tenth stage bleed valves?

11. The rudder booster pressure is failsafe to the ______ side.

12. The propeller pitch lock assembly is "cammed out" and will not pitch lock below ____ degree blade or above ____ degree blade angle.

13. The horizontal situation indicators receive power from the ______ .

14. The ignition system on the T-56 is a ______ type.

15. Propeller governing in flight is accomplished by the ______.

16. The Litton 51 is the primary source of heading reference for the autopilot on EC-130 aircraft.

17. The weight of F-44 fuel at -15°C is ____ per gallon.

18. What is the approximate standard day temperature at 27,000 feet?

19. Synchrophasing is accomplished by ______.

20. When fuel enrichment is selected ______ .

21. The fuel flow indicating system receives electrical power for operation of ______ .

22. What types of electrical power originate from the 50 KVA generators?

23. Aircraft modification by C-130 AFC No. 112 refers to what system?

24. The power for the 50 KVA generator control comes from the ______.

25. Power for operation of the ac instrument and engine fuel control bus comes from a phase of the inverter or essential ac bus.

26. The hydraulic pressure indicators receive electrical power from the ______ .

27. When a control boost warning light is on, it indicates ______ .

28. The flaps on the C-130 are ______ type.

29. The time for full extension or retraction of the flaps is ______ .

30. With flaps extended to 100%, the flaps form an angle of approximately ______ degrees with the wing.

31. The C/B for the flap position indicator is located on the ______ .

32. The main landing gear is locked up by ______.

33. C-130 AFC No. 104 pertains to ______.

34. Using the nose gear emergency release handle may ______ and/or ______ .

35. The landing gear position indicators are ______ .

36. When the brake selector switch is in the normal position, and the landing gear is down, the normal brake valve is ______ .

37. When the air condition master switch is in air condition GTC, the cargo compartment air flow regulator maintains ______ upstream of the valve.

38. The electrical power for the air flow regulators is supplied from the auxiliary vent and cabin pressure C/B located on the essential DC bus.

39. The water separators remove ______ to ______ percent of the moisture that condenses when air is refrigerated.

40. When the add heat system is in auto and the system is run full cold, the air for that system is conditioned by the cargo compartment air-conditioning system.

41. Electrical power to energize the safety valve solenoid is supplied from the ______.

42. If the air recirculating duct system fails, a check valve is installed in the special equipment compartment to prevent rapid loss of cabin pressure.

43. The leading edge anti-icing system is divided into _____ sections, each consisting of a shutoff valve, ejectors, and control components.

44. Bleed air used for radome anti-icing enters the radome at ______ and is mixed between ______ and ______ for radome anti-icing.

45. The spinner plateau is de-iced by phase "C" of propeller anti-icing system.

46. When the high position is selected on the Nesa anti-icing system, electrical power is supplied at a ______ .

47. The essential dc bus powers the GTC starting circuit for emergency starting.

48. The GTC oil cooler by-passes oil back to the oil tank through the oil cooler by-pass valve when the oil temperature is ______ .

49. An overspeed switch actuates to prevent an overspeed when the GTC RPM exceeds approximately ______ .

50. The GTC start light stays on until the GTC RPM reaches approximately ______ RPM.

51. The free air temperature indicator receives electrical power from the ______.

52. There are ______ command radios located on the flight station.

53. The emergency transmitter for emergency sea rescue is the ______ .

54. Do not engage the altitude control on the autopilot if the vertical velocity indicator gives an indication of ascent or decent greater than _____ feet per minute.

55. Do not operate the autopilot system at air speeds in excess of _____ KIAS or aircraft air speed limits, whichever is lower.

56. When accelerating or decelerating through _____ KIAS, the autopilot rudder trim axis should be disengaged, the aircraft retrimmed, and the autopilot re-engaged to prevent damage to the vertical stabilizer in the event of rudder malfunctions.

57. Ice and snow of great depths has no effect on the AN/APN-133.

58. The AN/APN 194 (radar altimeter) is ______ dc controlled ______ ac operated.

59. Landing lights should not be used on the ground for prolonged periods.

60. There are _____ hand-operated fire extinguishers on the EC-130G/Q aircraft.

61. There are _____ first-aid kits installed on the EC-130 type aircraft.

62. There are _____ crash or hand axes on the EC-130 type aircraft.

63. Electrical power to keep the emergency exit lights extinguished when the emergency lights are in the armed position comes from the ______ .

64. The life raft installed on the EC-130G/Q aircraft is the ______ .

65. There are _____ tritium type luminous markers on the EC-130G/Q aircraft.

66. Engine ground starting may be accomplished with a standard air starting unit that will deliver a minimum of _____ PPM air flow at _____ PSI pressure.

67. The NATO symbol for engine oil MIL-L-23699 is _______.

68. California Bearing Ratio (CBR) is used only to evaluate unpaved surfaces.

69. The oil temperature limit for starting an engine with MIL-L-7808 is _____.

70. When ambient temperature is below ________ and it is anticipated that JP-5 will be used, some JP-4 should be reserved for starting engines and GTC.

71. When starting engines at temperatures below _____ degrees F with kerosene type fuels, the TIT and RPM should be closely monitored since stall and over-temperature may be experienced.

72. Do not exceed a _____ degree angle of bank with flaps retracted, or _____ degree angle of bank with flaps extended.

73. There are _____ outlets for charging the portable oxygen bottles.

74. The liquid oxygen quantity indicator receives electrical power from _______ .

75. When flying high-speed cruise and constant maximum cruise power of 1010°C, range will increase _____ percent for each _____ degrees C, above standard temperature.

76. Under severe icing conditions, using the anti-icing system can result in power losses of _____ to _____ percent.

77. Maximum use of the anti-icing system has what effects on cruise control?

78. The flight engineer will perform a preflight inspection as required by _______ .

79. Checking the temperature of a crazed outer Nesa window with the bare hand comes under a _______ .

80. Do not perform a static feather check at oil temperatures of _____ or below.

81. During the interior inspection, "All loose equipment must be secured," comes under a _______ .

82. If the cockpit checklist is completed and the aircraft does not fly, what checklist must be completed before securing the aircraft?

83. When in low speed ground idle, movement of the throttles beyond the limits of _____ to _____ degrees coordinator angle at ambient temperatures above _____ may cause RPM stall or over-temperature.

84. On the taxiing checklist, flight engineers items not requiring coordination may be accomplished by the flight engineer prior to the checklist challenge.

85. Taxiing can be accomplished in crosswinds up to 60 knots at 90 degrees to the aircraft.

86. After backing, taxi the aircraft forward approximately _____ feet to realign the main landing gear.

87. When take-off performance is critical, cabin pressurization and air-conditioning bleed should be turned off prior to take-off to utilize maximum power available.

88. Allow at least _______ minute(s) between actuations of the synchrophase switch to allow synchrophaser signals to stabilize.

89. During rapid descent with gear and flaps down, limit the IAS to ____ knots.

90. Propeller reversing with an unbalanced fuel load can cause an extreme low-wing attitude and undesirable control characteristics.

91. Rigging pins may be used during high wind conditions to prevent damage to the aircraft control surfaces.

92. Propeller reversing is not required on the scramble checklist.

93. Fuel tank gages should be read while aircraft attitude is within plus or minus ____ degrees roll and ____ degrees nose-up pitch to obtain the most reliable reading.

94. Given: Four-engine operation, 20,000 feet, 10,400 inch-pounds torque. Find torque loss due to all bleed on inflight.

95. Given: Four engines for normal T/O, aircraft weight 148,000 lbs. Find obstacle clearance speed.

96. Given: Four-engine operation, maximum continuous power, begin climb weight 150,000 lbs, OAT 30°C (STD +15°C), begin cruise at 19,000 feet. Find fuel to climb.

97. Given: Four engines, normal bleed, maximum continuous power, 145,000 lbs, standard day -10°C. Find cruise ceiling.

98. Give complete description and meaning of the word "WARNING" as given in the NATOPS Manual.

99. According to NATOPS, give the meanings of the words, "shall", "should", "may", and "will."

NAVIGATION QUESTION BANK.

1. When notified of a fire in the fuselage, what should a navigator do?

2. What frequencies or frequency is available with the AN/PRT-5?

3. Can the escape hatches and side emergency exit be opened from the outside?

4. When ditching, are the escape hatches removed before or after entry into the water?

5. During fuel jettison, what electronic equipment may remain in operation?

6. How are the liferafts released externally?

7. Where is the flight deck flow regulator manual override located and what are its normal and emergency positions?

8. What does the on-duty navigator take with him, and where does he exit and which liferaft does he enter after ditching?

9. What is the primary instrument for steering the aircraft when the AHRS compass fails?

10. Why should the radome anti-icing system be off prior to landing?

11. In case a door warning light illuminates during pressurized flight, what should the navigator do?

12. Upon decision to ditch, what is the navigator's first duty?

13. How many portable fire extinguishers are carried in the aircraft?

14. Where are the hand axes located?

15. How many 20-man liferafts are carried on the aircraft?

16. What does the on-duty navigator do to prepare for ditching?

17. What is the first thing to be done when there is a sudden loss in cabin pressure?

18. What are the primary emergency exits after ditching?

19. Where is the AN/PRT-5 emergency transmitter located?

20. Where are the life-raft release handles located?

21. What is the primary emergency ground exit?

22. What is the primary emergency air exit below 150 KIAS? Above 150 KIAS?

23. How is a bailout warning indicated?

24. Where are the chopping areas on the aircraft located?

25. How is a ditching warning indicated?

26. One long ring immediately after take-off means what?

27. In what position should the Mode Selector Switch on the LTN-51 MSU be placed to enter present position latitude and longitude prior to alignment?

28. Which compass system provides antenna stabilization to the APN-153?

29. Which compass system provides antenna stabilization to the APN-59?

30. When can the navigator manually reset the indications on the APN-153?

31. What does the navigator set in the sextant mount azimuth for preflight?

32. How many emergency lights are there and where are they located?

33. Where are the portable oxygen bottle refill stations located?

34. After pressing the HOLD pushbutton on the LTN-51 CDU, are the INS internal calculations frozen to the moment the HOLD pushbutton was pressed?

35. What are the normal indications on the APN-153 when placed in the TEST mode?

36. Radar pressurization should be maintained between _____ and _____ inches of mercury to prevent arc-over.

37. Why does the navigator not normally set latitude correction on the N-1 compass system?

38. For best results, avoid using the APN-49 WARNING function, the 100/20, or 240/30 ranges for the first ____ minutes of operation.

39. What are the three switch positions available on the emergency lights and what position should they be set to during flight?

40. In what position should the ADF function switch be set for tuning?

ACO/ACS/ACOM QUESTION BANK.

1. How are the emergency exits identified on the outside of the aircraft?

2. Where are the chopping areas on the EC-130G/Q aircraft?

3. Where is the OG-127 Dummy Load located?

4. On what frequencies does the AN/PRT-5 transmit?

5. In what publication is the NUCO table found?

6. Where is the Emergency Radio located?

7. What times are radio silence observed on emergency frequencies?

8. What equipment has priority for emergency destruction?

9. How many portable fire extinguishers are there on the aircraft?

10. How many liferafts are carried in the aircraft and where are they located?

11. How many water exits are there in the aircraft?

12. How many hand axes are there in the aircraft?

13. Where are the emergency water jugs located?

14. Who is responsible for releasing the life rafts?

15. Are the overhead escape hatches released before or after ditching?

16. How many portable oxygen bottle refill stations are there on the aircraft and where are they located?

17. At what pressure is the oxygen fed to the regulators?

18. Where is the shutoff valve for the oxygen?

19. The alarm bell signal to prepare for ditching is ______.

20. The alarm bell signal to prepare for bailout is ______.

21. What items are on the Mae West?

22. What is the first thing to be done when there is a sudden loss of cabin pressure?

23. What is the first thing to be done when the pilot says prepare for ditching?

24. What is the purpose of the knurls on the end of the signal flare?

25. What is the first emergency action when there is fire/smoke in the aircraft?

26. In case a door warning light illuminates during a pressurized flight, the voice operator will ______ .

27. The marker beacon will operate on GTC power.

28. For what is 3710.3A used?

29. Is it possible to release the port liferaft without releasing the starboard liferaft?

30. Air-to-air DME is possible with both the ARN-21 and ARN-52, provided the channels are 63 channels apart.

31. Which equipment must be destroyed if emergency destruction is initiated?

32. Is seat 3 required to take food, water, or a First Aid Kit after ditching?

33. On what frequencies do WWV/WWVH transmit?

34. What is the intercommunication power source?

35. Should Comm Central doors be open or closed for all take-offs and landings?

36. The radar system gets inputs from which compass system or systems?

37. Seat 3 boards which raft after ditching?

FLIGHT TECHNICIAN QUESTION BANK

1. What frequencies or frequency is available with the PRT-5?

2. The Mark-20 liferaft is capable of opening upside down.

3. The LPP-1 Mae West has two CO_2 bottles to inflate the vest.

4. Which Comm Central seat is required to use the fire bottle on the forward Comm Central wall?

5. Seat 13 will exit from the center overhead hatch after ditching.

6. Seat 13 is responsible to the ACO/ACS during a smoke and fire situation.

7. Operation of OG-127 is possible without use of the coolant flow pump.

8. Ground power operation of the OG-127 is possible with the reel panel 28-volt toggle switch off.

9. Power for the RF input to the OG-127 normally comes from what aircraft bus?

10. Comm Central may receive power from any of four different engine generators.

11. What two engines are not capable of providing power to the OG-127?

12. Can the escape hatches and the side emergency exits be opened from the outside?

13. Is seat 13 required to take food, water, or a First Aid Kit after ditching?

14. The portable oxygen refill stations could be used as oxygen regulators in an emergency.

15. Where are the chopping areas on the aircraft located?

16. What type of visual communications equipment is aboard the aircraft?

17. Which section in NATOPS lists the location of all the portable oxygen refill stations?

18. The C-130 has a minimum of seven First Aid Kits located where?

19. In case a door warning light illuminates during a pressurized flight, the voice operator will ______.

20. The marker beacon will operate on GTC power.

21. For what is 3710.3A used?

22. Is it possible to release the port liferaft without releasing the starboard liferaft?

23. Air-to-air DME is possible with ARN-21, ARN-52, and ARN 84 if the channels are 63 channels apart.

24. Which equipment must be destroyed if emergency destruction is initiated?

25. Is seat 12 required to take food, water, or a First Aid Kit after ditching?

26. On what frequencies do WWV/WWVH transmit?

27. What is the intercommunication power source?

28. Should Comm Central doors be open or closed for all take-offs and landings?

29. The radar system gets inputs from which compass system or systems?

30. Seat 12 boards which raft after ditching?

REEL OPERATOR QUESTION BANK, AIRCRAFT

1. How can ac power be isolated from the OE-159?

2. What power is normally available to the OE-159?

3. On what panel is orbit or level flight selected?

4. How many extend and retract modes of operation are there for the long-wire antenna?

5. What and/or who determines the long-wire antenna length?

6. Where is the short-wire antenna hydraulic pressure indicated?

7. When the long-wire antenna emergency brake is full on, where will the hydraulic pressure applied to the brake be indicated?

8. How much wire is on the short-wire antenna spool when it is full?

9. When the elect/hyd drive "ON" switch is pressed, the indicator lights yellow then goes out after 4 seconds. What does this indicate?

10. What conditions will cause the application of the long-wire antenna emergency brake?

11. How is the long-wire antenna hydraulic system cooled during extended periods of ground operation?

12. How many hydraulic return lines are there between the short-wire antenna and the aircraft auxiliary hydraulic system?

13. What circuit card, when removed from the card cage, will disable both antenna assemblies?

14. What pressure indication will the reel operator have with the circulating and charge pumps on?

15. Which long-wire and short-wire antenna control panels have overspeed lights?

16. What applies the short-wire antenna emergency brake?

17. What pressure will cause a circulating pump "ON" indication?

18. What two things occur at 120% overspeed of the long-wire antenna?

19. What would be a typical indication on the drive high-pressure indicator during retraction?

20. At what point during extension of the long-wire antenna will the emergency brake come on due to an overlength condition?

21. List the "A" numbered panels used only by the long-wire antenna.

22. What circuit cards are interchangeable at the A13 card cage?

23. List the "A" numbered panels used only by the short-wire antenna.

24. What is the function of the electric motor and pump in the lower right area of the long-wire antenna console?

25. How is the maximum wear determined on the long-wire antenna normal service brake?

26. What does the velocity control on the velocity panels determine?

27. Which circuit breaker on the 28 vdc power panel (A4) is for the short-wire antenna?

28. When the elect/hyd drive "ON" switch is pressed, the indicator lights yellow for approximately four seconds then goes to green. What does this indicate?

29. When are the emergency brake switches for the long-wire and short-wire antennas placed to "OFF"?

30. What is the importance of setting the length command switches in the MANUAL mode?

SECTION XI
PERFORMANCE DATA

Page

LIST OF CHARTS

PART 1

INTRODUCTION

PURPOSE OF PERFORMANCE CHARTS

The purpose of the performance charts is for planning complete missions from take-off to landing for operating conditions normally encountered. The conditions and operating procedures on which the performance is based are shown on the charts, or in the text, and to realize the maximum performance from the aircraft, these conditions and procedures must be followed. The operating procedures are consistent with the normal procedures shown in Section III. The emergency procedures are shown in Section V, and all weather procedures are shown in Section VI.

The data basis for the aircraft performance is estimated on C-130E Category II flight test results adjusted for T56-A-423 engine performance with Hamilton Standard 54H60-91 propellers. The atmospheric conditions are for an ICAO atmosphere. The engine performance is based on the use of JP-4 fuel at 6.5 pounds per gallon with a lower heating value of 18,650 BTU per pound and with an engine rpm of 13,820. No factor of conservatism is used in establishing the aircraft performance. Should unusual conditions exist for which operating procedures are not established, the operating personnel are expected to use their best judgement under the existing circumstances.

AIRCRAFT CONFIGURATION.

The performance data contained in this manual are for the USN series EC-130G and EC-130Q aircraft. The configuration of these aircraft is the same.

CHART EXPLANATION.

Descriptive explanations and sample problems are included in the text to illustrate the use of the performance charts. Guide lines on the charts for the sample problems show the path to follow when using the charts.

ABBREVIATIONS AND SYMBOLS

ATO	Assisted take-off.
BTU	British Thermal Units.
°C	Temperature in degrees Centigrade.
CAS or V_c	Calibrated airspeed; indicated airspeed corrected for installation. (Position error.)
EAS or V_e	Equivalent airspeed; calibrated airspeed corrected for compressibility.
°F	Temperature in degrees Fahrenheit.
FPM	Feet per minute.
f_c	Climb-out factor.

ABBREVIATIONS AND SYMBOLS

$f_{t.o.}$	Take-off factor.
G.I.	Ground idle.
GS	Ground speed; true airspeed corrected for wind effect.
GW	Gross weight.
H_d	Density altitude.
H_p	Pressure altitude.
IAS	Indicated airspeed; the airspeed indicator reading corrected for instrument error.
ICAO	International Civil Aviation Organization.
in. Hg	Inches of mercury.
in.-lb	Inch-pounds, the measure of engine torque.
IOAT	Indicated outside air temperature.
Nau mi	Nautical miles.
NTS	Negative torque system.
OAT	Outside air temperature (actual).
psi	Pressure in pounds per square inch.
psig	Gage pressure, pounds per square inch.
R/C	Rate of climb.
R/D	Rate of descent.
rpm	Engine speed (revolutions per minute).
SHP	Engine shaft horsepower.
TAS or V_t	True airspeed; equivalent airspeed corrected for density.
TIT	Turbine inlet temperature.
V_{CEF}	Critical engine failure speed.
V_d	Maximum permissible speed.
V_h	Structurally limited maximum level flight speed.

ABBREVIATIONS AND SYMBOLS

V_{MCA}	Air minimum control speed.
V_{MCG}	Ground minimum control speed.
V_s	Power-off stall speed.
V/W_f	Nautical miles per pound of fuel.
Δ	Indicates an increment
ΔV_c	Compressibility correction.
ΔV_{pc}	Position correction.
ρ	Atmospheric density in slugs per cubic foot.
ρ_0	Standard sea level atmospheric density; 0.002378 slugs per cubic foot.
σ	Atmospheric density ratio.
$1/\sqrt{\sigma}$	Correction for air density applied to EAS (SMOE factor).
μ	Friction coefficient.
Headwind	Headwind is that component of the existing wind condition which acts opposite to the direction of travel.
Tailwind	Tailwind is that component of the existing wind condition which acts in the direction of travel.

AIRSPEED INDICATION CORRECTION CHARTS.

The airspeed indicator reading is affected by the airflow around the airplane fuselage. Changes in airplane attitude, configuration, and proximity to the ground (ground effect) vary the airflow, which affects the pressure sensed at the static ports of the pitot-static system, and thus causes the airspeed indicator to read incorrectly. This error is called the position error. The airspeed calibration charts provided in this part include the position error correction and show the relationship of indicated airspeed to calibrated airspeed.

The KIAS versus KCAS in ground effect for 50 percent and 100 percent flap setting is shown in figure 11-1. Figure 11-2 depicts the same for out of ground effect conditions.

Example:

Given:

Gross weight: 135,000 pounds.

Landing gear: Down.

Flaps: 50 percent.

Take-off speed: 107.2 KIAS.

Find:

Airspeed in KCAS in ground effect.

Airspeed in KCAS out of ground effect.

Procedure:

To find KCAS in ground effect for take-off, enter Figure 11-1 with 107.2 KIAS. Move vertically up to the take-off line and read 112.3 KCAS.

To find KCAS out of ground effect, enter figure 11-2 (gear down, flaps 50 percent) with 107.2 KIAS. Move vertically up to 135,000 pounds and find 107 KIAS.

AIRSPEED COMPRESSIBILITY CORRECTION CHARTS.

The correction to airspeed due to the compressibility of the atmosphere is shown in figure 11-3. This chart provides the speed increments for changing CAS to EAS. The Density Altitude Chart, figure 11-5 or the Density Altitude Table, figure 11-6 supplies the $1/\sqrt{\sigma}$ values required to convert EAS to TAS or vice versa. In addition, the density altitude can be found, although density altitude is normally not required for performance calculations. The relationships of the various speeds are expressed by the following equations:

$$CAS = IAS + \Delta V_{pc}$$
$$EAS = CAS - \Delta V_c$$
$$TAS = EAS \times 1/\sqrt{\sigma}$$

Example:

Given:

Pressure altitude: 25,000 feet.

True temperature: Standard -20°C. (When working with Indicated OAT, correct as shown in the Temperature Correction paragraph.)

Gross weight: 135,000 pounds.

Indicated airspeed: 187 knots.

Find:

True airspeed:

Procedure:

At the given altitude, the airplane would be in the clean configuration; therefore, enter figure 11-2, sheet 1 with 187 KIAS, move vertically up to the given weight line and to the left and read 188 KCAS. To convert CAS to EAS, enter the chart for compressibility correction, figure 11-3, with 188 KCAS. Move up to 25,000 feet and read a ΔV_c of 3.0 knots. The equivalent airspeed is then 188 -3.0 = 185 knots. From figure 11-7 determine the standard temperature at 25,000 feet as -34.5°C. Standard temperature minus 20°C is then -54.5°C. The SMOE ($1/\sqrt{\sigma}$) factor is found from figure 11-5 by entering with the standard temperature minus 20°C and moving vertically to the pressure altitude of 25,000 feet. A factor of 1.43 is read at the SMOE ($1/\sqrt{\sigma}$)-scale. The true airspeed is 185 x 1.43 = 264 knots.

TEMPERATURE CORRECTION.

The temperature read from the indicator during flight will show higher values due to the energy loss in airspeed at the pickup. The correct value for the outside air temperature must be obtained from the Temperature Correction chart, figure 11-4. This chart also has a scale from which the deviation from standard temperature can be read.

Example.

Given:

Indicated airspeed: 200 knots.

Pressure altitude: 20,000 feet.

Indicated outside air temperature: -20°C.

Find:

True outside air temperature.

Procedure:

Enter figure 11-4 with 200 KIAS and move horizontally to the right to the given pressure altitude. From this point, move vertically to -20°C indicated OAT. Move horizontally either to the left and read a true outside air temperature of -28°C, or move to the right, intersecting the given pressure altitude, and find a deviation from standard temperature of -3.5°C.

STANDARD ATMOSPHERE.

The Standard Atmosphere table, figure 11-7, is provided to show standard values of the atmosphere as defined by the International Civil Aviation Organization (ICAO). The ICAO assumes a temperature of +15°C (59°F) and a pressure of 29.92 inches of mercury (in.-Hg) as standard sea level conditions. The temperature variation (lapse rate) with altitude is approximately -2°C per 1,000 feet from sea level to 36,089 feet. At 36,089 feet, the stratosphere is assumed to begin and the temperature remains constant, for all practical purposes, with increase in altitude.

The Standard Atmosphere table shows values for every 1,000-foot increment in altitude and includes temperatures in both degrees Fahrenheit and degrees Centigrade. In addition, a Temperature Conversion chart, figure 11-8, is provided for conversion of temperatures.

AIRSPEED CALIBRATION
IN GROUND EFFECT
GEAR DOWN 50 PERCENT FLAPS

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: JUNE 1969

DATA BASIS: CATEGORY II FLIGHT TEST

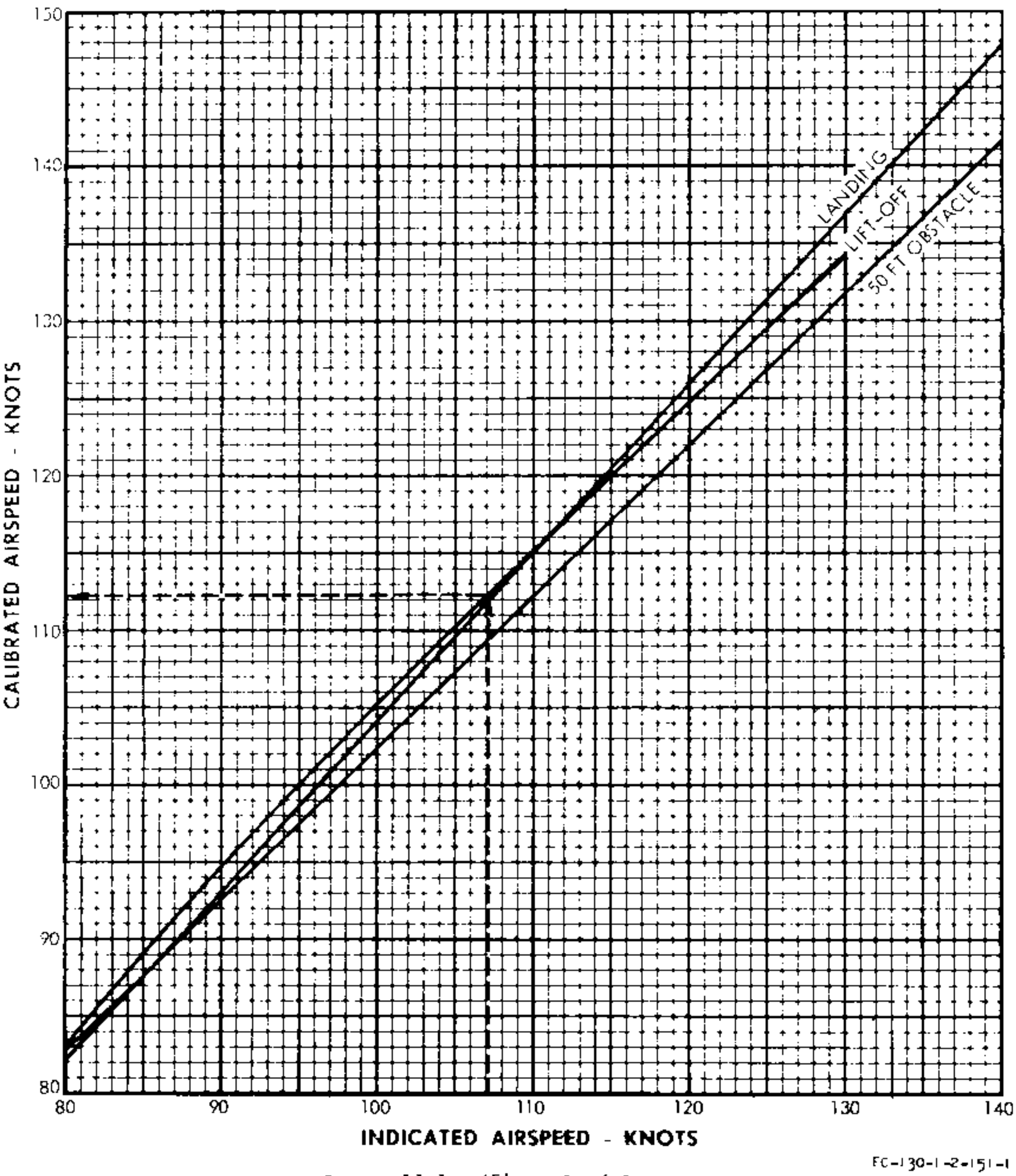


Figure 11-1. (Sheet 1 of 2)

AIRSPEED CALIBRATION

IN GROUND EFFECT

GEAR DOWN 100 PERCENT FLAPS

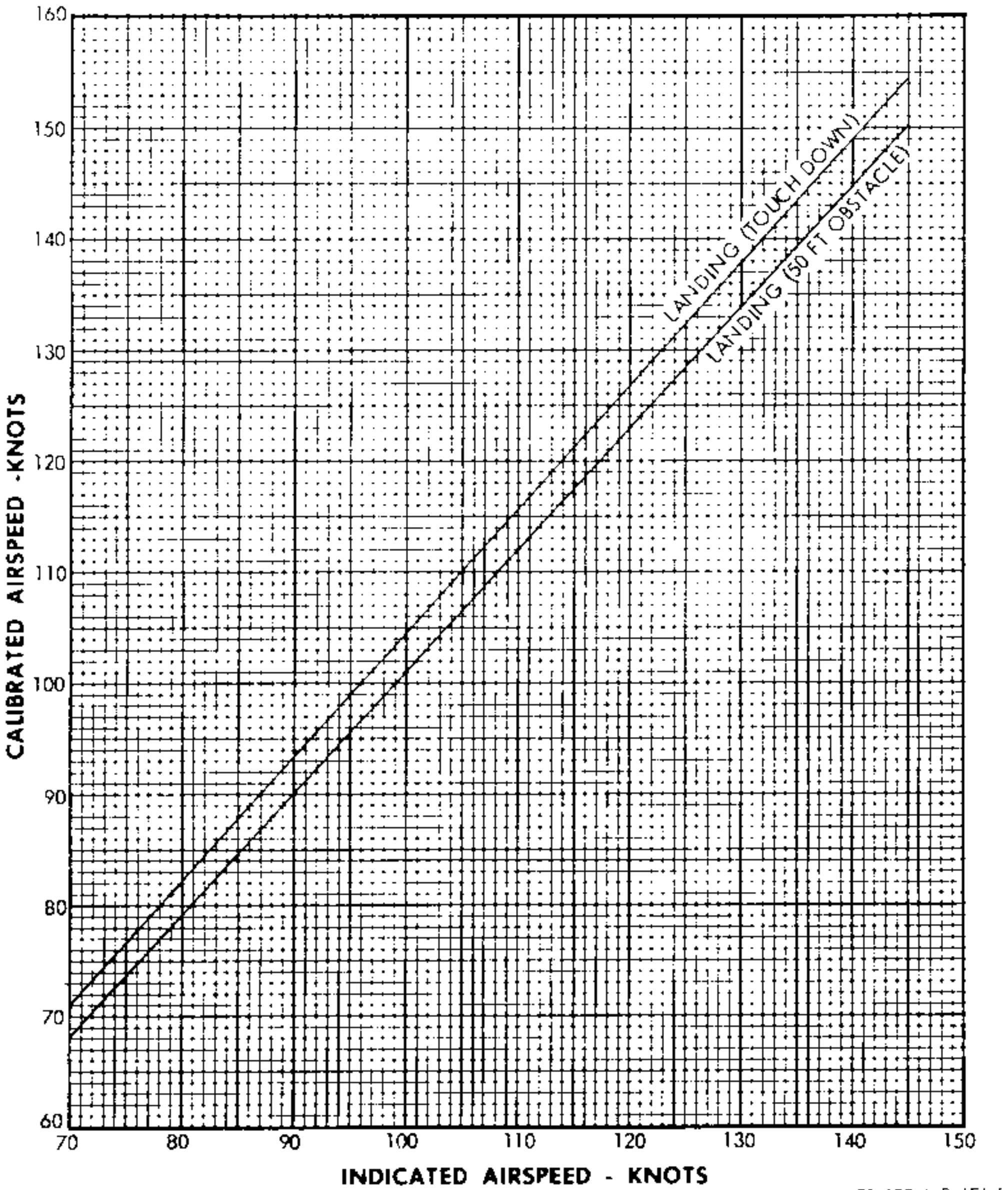


Figure 11-1. (Sheet 2 of 2)

AIRSPEED CALIBRATION
OUT OF GROUND EFFECT
GEAR UP FLAPS UP

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: JUNE 1969
DATA BASIS: CATEGORY II FLIGHT TEST

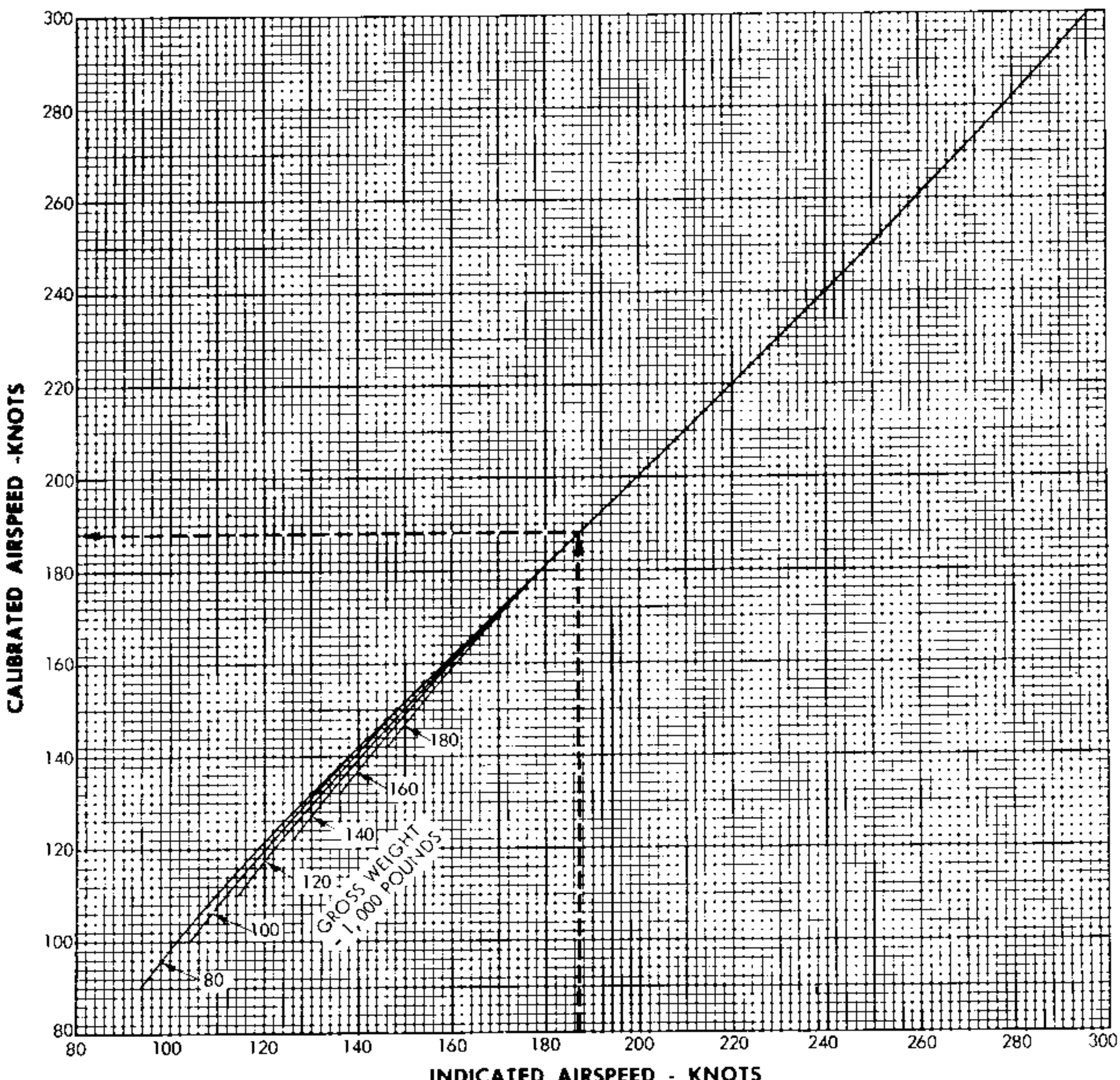
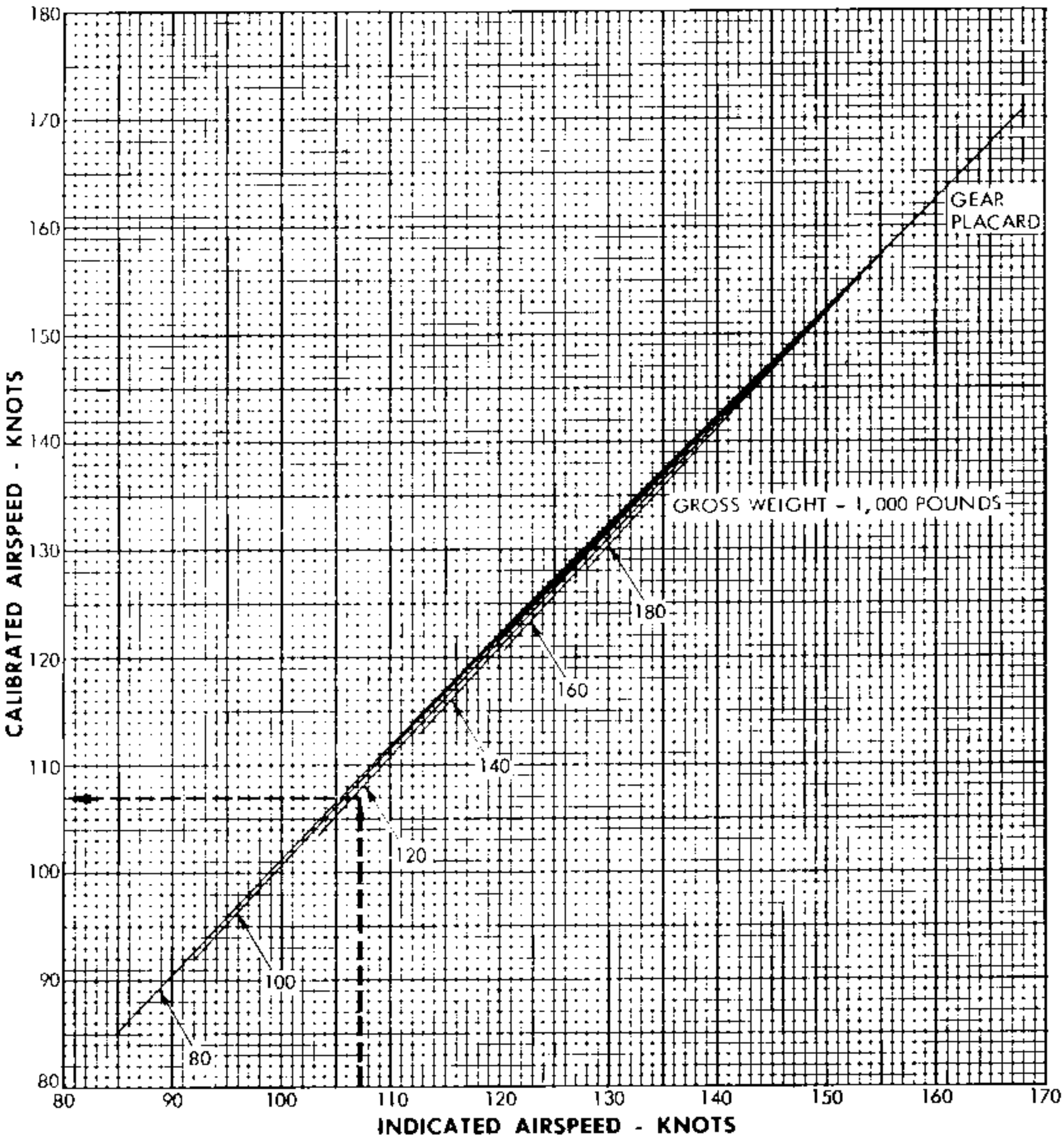


Figure 11-2. (Sheet 1 of 3)

AIRSPEED CALIBRATION
OUT OF GROUND EFFECT
GEAR DOWN 50 PERCENT FLAPS



EC-130-1-2-152-2

Figure 11-2. (Sheet 2 of 3)

AIRSPEED CALIBRATION

OUT OF GROUND EFFECT

GEAR DOWN 100 PERCENT FLAPS

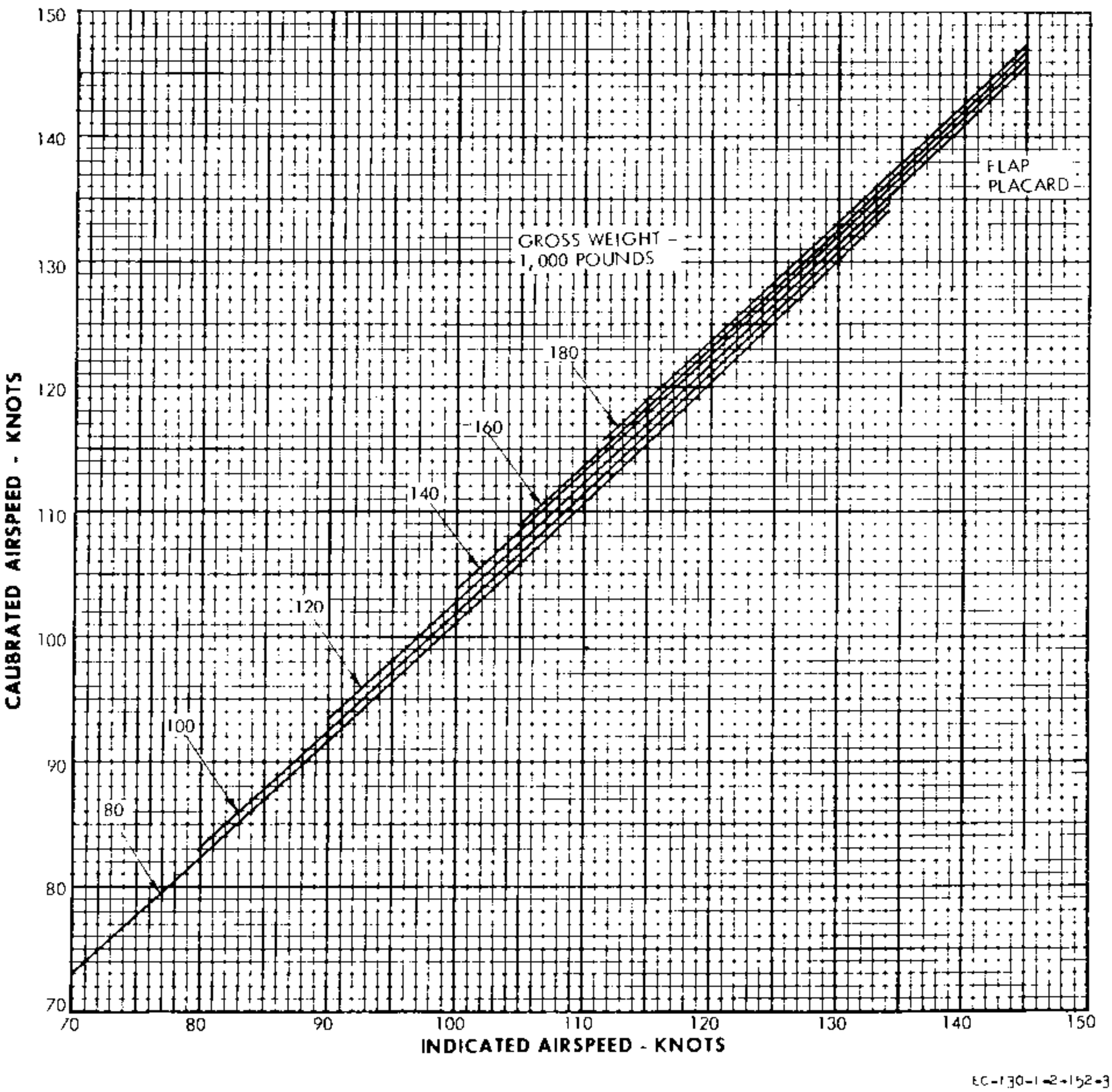


Figure 11-2. (Sheet 3 of 3)

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

DATE: OCTOBER 1967

DATA BASIS: CALCULATED

NOTE

Subtract Correction From Calibrated Airspeed To Obtain Equivalent Airspeed.

$V_E = V_C - \Delta V_C$

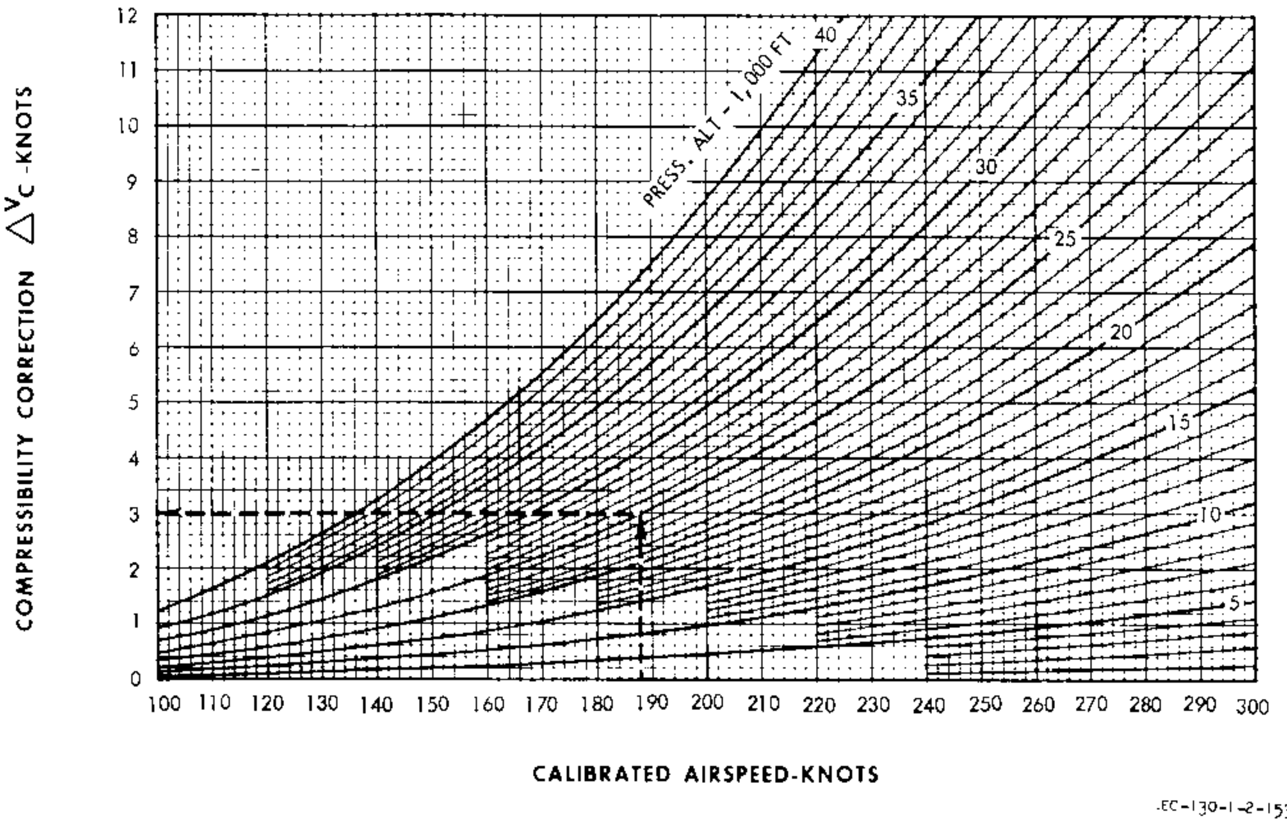


Figure 11-3.

TEMPERATURE CORRECTION

CRUISE CONFIGURATION
RECOVERY FACTOR = 0.9

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: MARCH 1964
DATA BASIS: CALCULATED

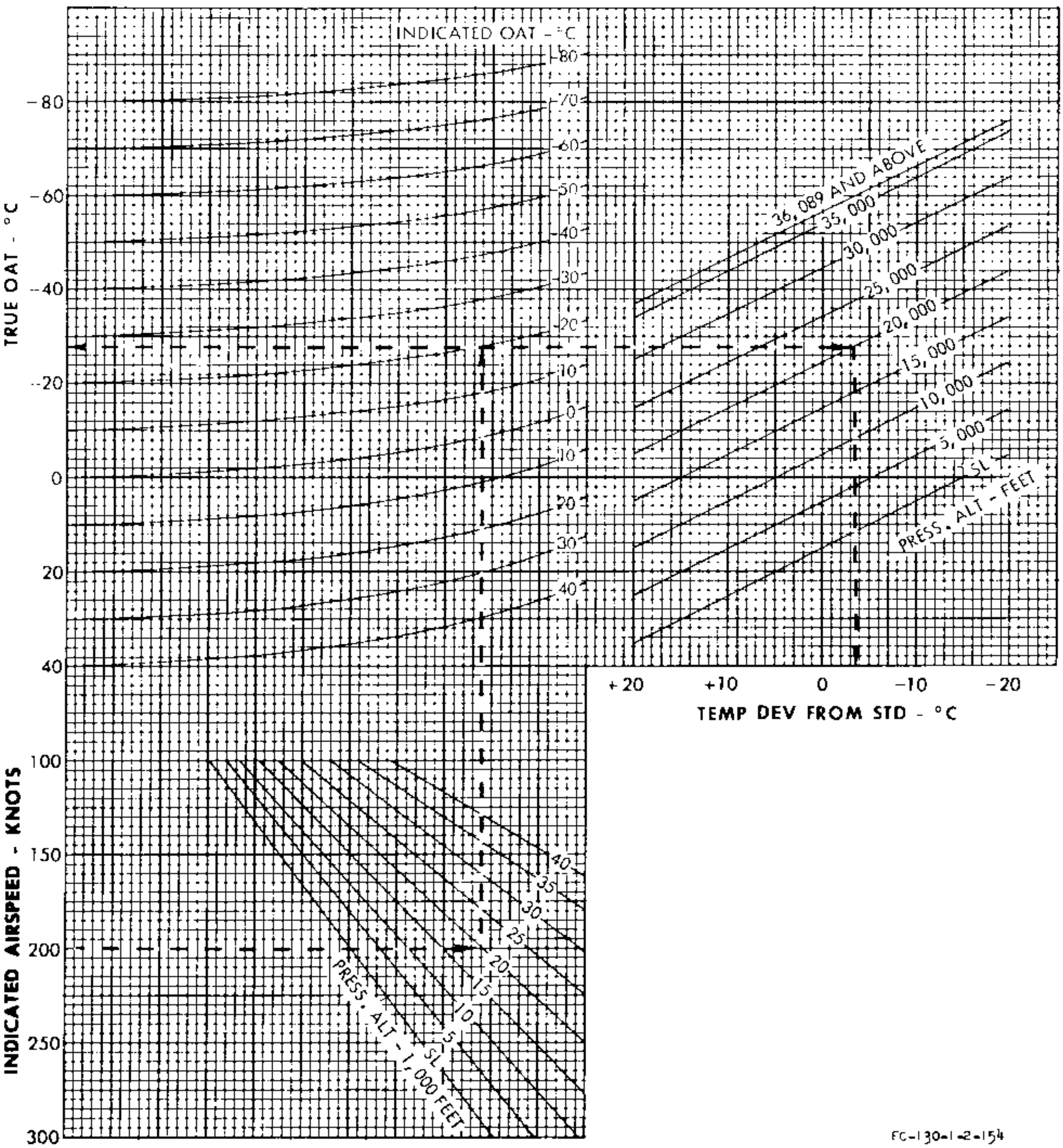


Figure 11-4.

DENSITY ALTITUDE CHART

DATE: JANUARY 1965
DATA BASIS. CALCULATED

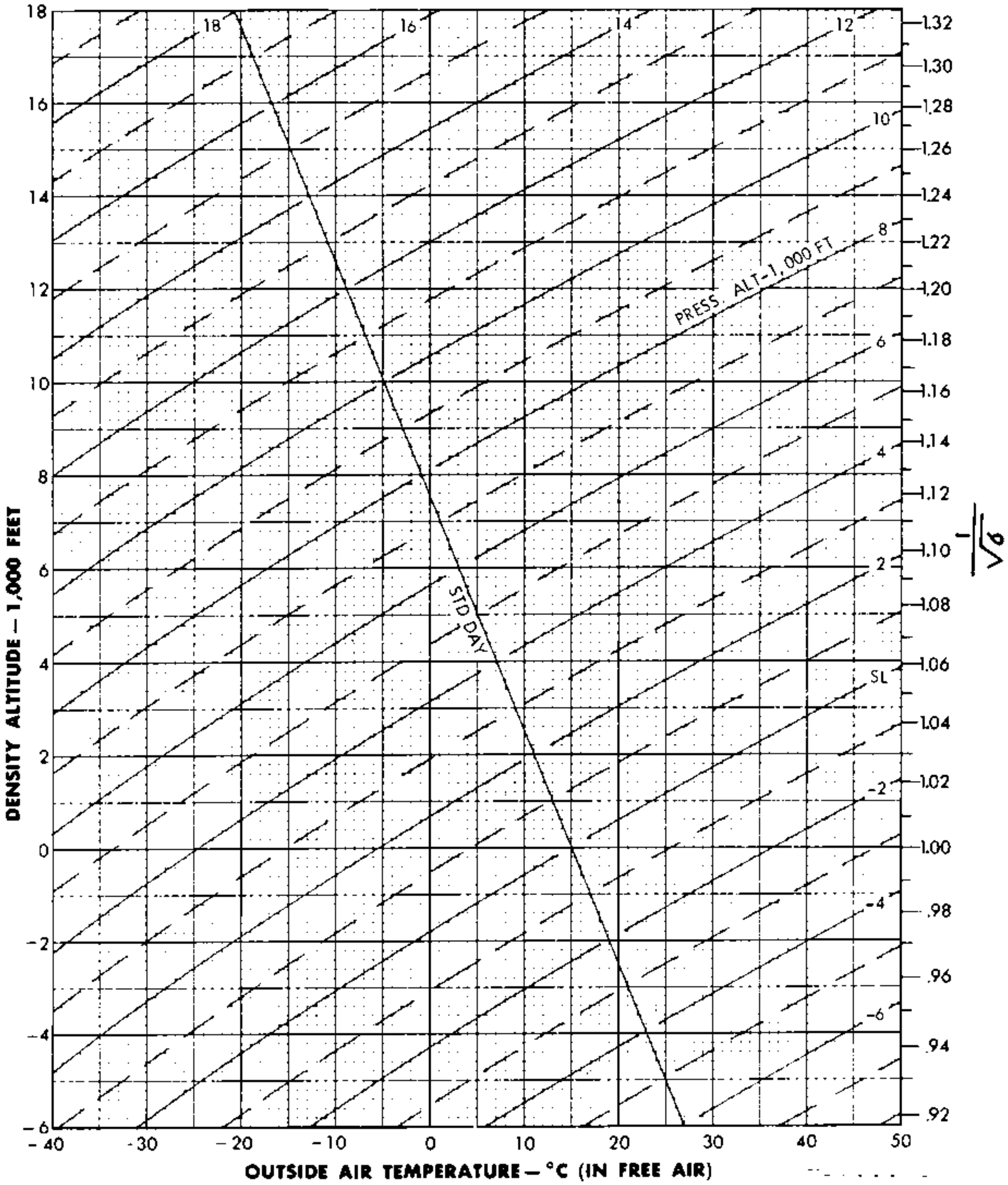


Figure 11-5. (Sheet 1 of 2)

DENSITY ALTITUDE CHART

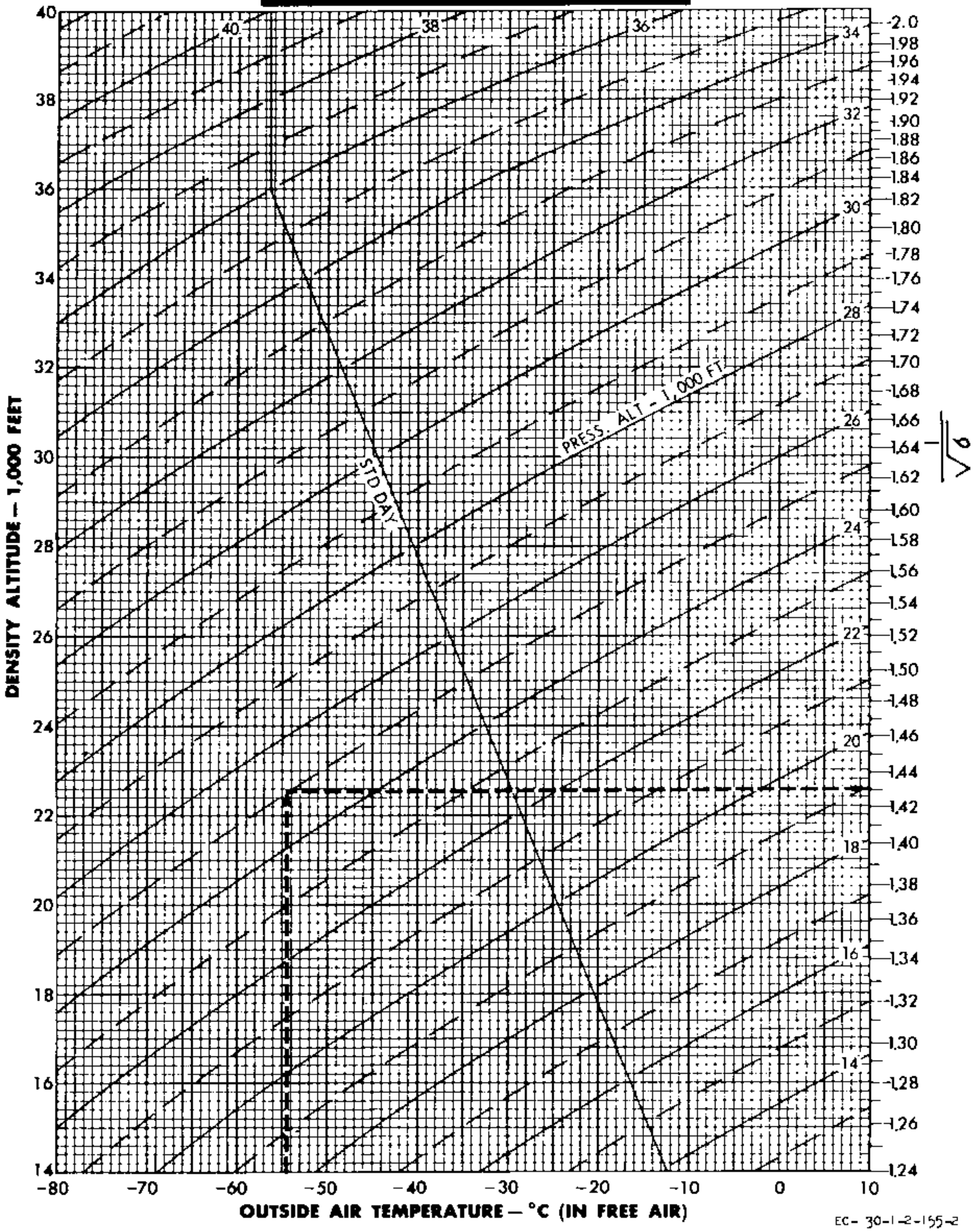


Figure 11-5. (Sheet 2 of 2)

DENSITY ALTITUDE TABLE

TRUE AIRSPEED = EQUIVALENT AIRSPEED X $\frac{1}{\sqrt{\sigma}}$

DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$
100	1.0015	3300	1.0501	6500	1.1022	9700	1.1582	12900	1.2185	16100	1.2835
200	1.0029	3400	1.0516	6600	1.1039	9800	1.1600	13000	1.2204	16200	1.2857
300	1.0044	3500	1.0532	6700	1.1056	9900	1.1618	13100	1.2225	16300	1.2878
400	1.0058	3600	1.0547	6800	1.1073	10000	1.1637	13200	1.2244	16400	1.2900
500	1.0074	3700	1.0564	6900	1.1090	10100	1.1655	13300	1.2264	16500	1.2920
600	1.0089	3800	1.0580	7000	1.1106	10200	1.1674	13400	1.2284	16600	1.2942
700	1.0103	3900	1.0595	7100	1.1123	10300	1.1692	13500	1.2303	16700	1.2963
800	1.0118	4000	1.0611	7200	1.1141	10400	1.1710	13600	1.2323	16800	1.2985
900	1.0138	4100	1.0627	7300	1.1158	10500	1.1729	13700	1.2343	16900	1.3006
1000	1.0148	4200	1.0644	7400	1.1176	10600	1.1747	13800	1.2362	17000	1.3028
1100	1.0163	4300	1.0660	7500	1.1192	10700	1.1766	13900	1.2382	17100	1.3050
1200	1.0178	4400	1.0676	7600	1.1210	10800	1.1784	14000	1.2404	17200	1.3070
1300	1.0193	4500	1.0692	7700	1.1227	10900	1.1804	14100	1.2424	17300	1.3092
1400	1.0208	4600	1.0708	7800	1.1245	11000	1.1822	14200	1.2444	17400	1.3115
1500	1.0223	4700	1.0724	7900	1.1261	11100	1.1840	14300	1.2464	17500	1.3137
1600	1.0239	4800	1.0740	8000	1.1279	11200	1.1860	14400	1.2484	17600	1.3158
1700	1.0253	4900	1.0756	8100	1.1297	11300	1.1878	14500	1.2505	17700	1.3180
1800	1.0268	5000	1.0772	8200	1.1315	11400	1.1896	14600	1.2525	17800	1.3201
1900	1.0284	5100	1.0789	8300	1.1331	11500	1.1916	14700	1.2545	17900	1.3224
2000	1.0299	5200	1.0805	8400	1.1349	11600	1.1935	14800	1.2566	18000	1.3247
2100	1.0315	5300	1.0821	8500	1.1368	11700	1.1953	14900	1.2587	18100	1.3268
2200	1.0330	5400	1.0839	8600	1.1384	11800	1.1973	15000	1.2607	18200	1.3291
2300	1.0346	5500	1.0855	8700	1.1403	11900	1.1992	15100	1.2626	18300	1.3314
2400	1.0361	5600	1.0872	8800	1.1421	12000	1.2011	15200	1.2647	18400	1.3335
2500	1.0376	5700	1.0889	8900	1.1438	12100	1.2031	15300	1.2668	18500	1.3358
2600	1.0392	5800	1.0904	9000	1.1456	12200	1.2050	15400	1.2689	18600	1.3380
2700	1.0407	5900	1.0922	9100	1.1474	12300	1.2069	15500	1.2710	18700	1.3403
2800	1.0422	6000	1.0937	9200	1.1492	12400	1.2088	15600	1.2731	18800	1.3425
2900	1.0437	6100	1.0954	9300	1.1510	12500	1.2108	15700	1.2752	18900	1.3448
3000	1.0454	6200	1.0971	9400	1.1527	12600	1.2127	15800	1.2773	19000	1.3470
3100	1.0469	6300	1.0988	9500	1.1546	12700	1.2146	15900	1.2794	19100	1.3493
3200	1.0484	6400	1.1005	9600	1.1563	12800	1.2165	16000	1.2814	19200	1.3515

Figure 11-6. (Sheet 1 of 2)

DENSITY ALTITUDE TABLE

TRUE AIRSPEED = EQUIVALENT AIRSPEED X $\frac{1}{\sqrt{\sigma}}$

DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$
19300	1.3539	22500	1.4300	25700	1.5124	28900	1.6023	32100	1.7001	35300	1.8070
19400	1.3661	22600	1.4325	25800	1.5152	29000	1.6051	32200	1.7033	35400	1.8103
19500	1.3585	22700	1.4349	25900	1.5179	29100	1.6080	32300	1.7065	35500	1.8139
19600	1.3607	22800	1.4374	26000	1.5207	29200	1.6111	32400	1.7097	35600	1.8175
19700	1.3630	22900	1.4399	26100	1.5232	29300	1.6139	32500	1.7129	35700	1.8208
19800	1.3654	23000	1.4424	26200	1.5260	29400	1.6171	32600	1.7161	35800	1.8245
19900	1.3676	23100	1.4443	26300	1.5288	29500	1.6200	32700	1.7194	35900	1.8278
20000	1.3701	23200	1.4474	26400	1.5314	29600	1.6228	32800	1.7227	36000	1.8315
20100	1.3723	23300	1.4499	26500	1.5342	29700	1.6260	32900	1.7259	36089	1.8350
20200	1.3746	23400	1.4524	26600	1.5370	29800	1.6289	33000	1.7292	36100	1.8352
20300	1.3770	23500	1.4550	26700	1.5396	29900	1.6319	33100	1.7325	36200	1.8396
20400	1.3793	23600	1.4575	26800	1.5425	30000	1.6348	33200	1.7355	36400	1.8485
20500	1.3816	23700	1.4601	26900	1.5451	30100	1.6380	33300	1.7388	36600	1.8574
20600	1.3841	23800	1.4626	27000	1.5480	30200	1.6410	33400	1.7422	36800	1.8664
20700	1.3864	23900	1.4652	27100	1.5509	30300	1.6439	33500	1.7455	37000	1.8753
20800	1.3887	24000	1.4678	27200	1.5535	30400	1.6469	33600	1.7489	37200	1.8844
20900	1.3912	24100	1.4704	27300	1.5564	30500	1.6502	33700	1.7522	37400	1.8935
21000	1.3935	24200	1.4730	27400	1.5593	30600	1.6532	33800	1.7556	37600	1.9026
21100	1.3959	24300	1.4756	27500	1.5620	30700	1.6562	33900	1.7590	37800	1.9117
21200	1.3982	24400	1.4782	27600	1.5649	30800	1.6592	34000	1.7624	38000	1.9210
21300	1.4008	24500	1.4808	27700	1.5676	30900	1.6622	34100	1.7655	38200	1.9302
21400	1.4031	24600	1.4832	27800	1.5706	31000	1.6656	34200	1.7690	38400	1.9395
21500	1.4055	24700	1.4859	27900	1.5733	31100	1.6686	34300	1.7724	38600	1.9488
21600	1.4079	24800	1.4885	28000	1.5763	31200	1.6717	34400	1.7759	38800	1.9583
21700	1.4104	24900	1.4912	28100	1.5790	31300	1.6748	34500	1.7794	39000	1.9677
21800	1.4128	25000	1.4939	28200	1.5820	31400	1.6779	34600	1.7825	39200	1.9772
21900	1.4152	25100	1.4966	28300	1.5848	31500	1.6810	34700	1.7860		
22000	1.4176	25700	[illegible]	28400	1.5878	31600	1.6841	24800	1.7895		
22100	1.4201	25300	1.5017	28500	1.5906	31700	1.6875	34900	1.7931		
22200	1.4225	25400	1.5044	28600	1.5934	31800	1.6903	35000	1.7963		
22300	1.4251	25500	1.5072	28700	1.5964	31900	1.6938	35100	1.7999		
22400	1.4276	25600	1.5099	28800	1.5992	32000	1.6969	35200	1.8034		

Figure 11-6. (Sheet 2 of 2)

ICAO STANDARD ATMOSPHERE TABLE

PRESSURE ALTITUDE -FEET	DENSITY RATIO - $\rho/\rho_0 = \sigma$	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND RATIO - $a/a_0 = \sqrt{\theta}$	SPEED OF SOUND - KNOTS	PRESSURE	
			DEG C	DEG F			IN. Hg	RATIO - $P/P_0 = \delta$
0	1.000	1.000	15	59.0	1.000	661.7	29.92	1.000
1,000	.9711	1.0148	13.019	55.4	.9966	659.5	28.86	.9644
2,000	.9428	1.0299	11.037	51.9	.9931	657.2	27.82	.9298
3,000	.9151	1.0454	9.056	48.3	.9896	654.9	26.82	.8962
4,000	.8881	1.0611	7.075	44.7	.9862	652.6	25.84	.8637
5,000	.8617	1.0773	5.094	41.2	.9827	650.3	24.90	.8320
6,000	.8359	1.0937	3.113	37.6	.9792	647.9	23.98	.8014
7,000	.8106	1.1107	1.132	34.0	.9756	645.6	23.09	.7716
8,000	.7860	1.1279	-.850	30.5	.9721	643.3	22.22	.7428
9,000	.7620	1.1456	-2.831	26.9	.9686	640.9	21.39	.7148
10,000	.7385	1.1637	-4.812	23.3	.9650	638.6	20.58	.6877
11,000	.7156	1.1822	-6.794	19.8	.9614	636.2	19.79	.6614
12,000	.6932	1.2011	-8.775	16.2	.9579	633.9	19.03	.6360
13,000	.6713	1.2204	-10.756	12.6	.9543	631.5	18.29	.6113
14,000	.6500	1.2404	-12.737	9.1	.9506	629.1	17.58	.5874
15,000	.6292	1.2607	-14.718	5.5	.9470	626.7	16.89	.5643
16,000	.6090	1.2814	-16.700	1.9	.9434	624.3	16.22	.5420
17,000	.5892	1.3028	-18.681	-1.6	.9397	621.9	15.57	.5203
18,000	.5699	1.3247	-20.662	-5.2	.9361	619.4	14.94	.4994
19,000	.5511	1.3470	-22.643	-8.8	.9324	617.0	14.34	.4791
20,000	.5328	1.3701	-24.624	-12.3	.9287	614.6	13.75	.4595
21,000	.5150	1.3935	-26.605	-15.9	.9250	612.1	13.18	.4406
22,000	.4976	1.4176	-28.587	-19.5	.9213	609.6	12.64	.4223
23,000	.4806	1.4424	-30.568	-23.0	.9175	607.2	12.11	.4046
24,000	.4642	1.4678	-32.549	-26.6	.9138	604.7	11.60	.3876
25,000	.4481	1.4939	-34.530	-30.2	.9100	602.2	11.10	.3711
26,000	.4325	1.5207	-36.511	-33.7	.9062	599.7	10.63	.3552
27,000	.4173	1.5480	-38.492	-37.3	.9024	597.2	10.17	.3398
28,000	.4025	1.5763	-40.473	-40.9	.8986	594.7	9.72	.3250
29,000	.3881	1.6051	-42.455	-44.4	.8948	592.1	9.30	.3107
30,000	.3741	1.6348	-44.436	-48.0	.8909	589.5	8.89	.2970
31,000	.3605	1.6656	-46.417	-51.6	.8870	587.0	8.49	.2837
32,000	.3473	1.6969	-48.398	-55.1	.8832	584.4	8.11	.2709
33,000	.3345	1.7292	-50.380	-58.7	.8793	581.8	7.74	.2586
34,000	.3220	1.7624	-52.361	-62.2	.8754	579.2	7.38	.2467
35,000	.3099	1.7963	-54.342	-65.8	.8714	576.7	7.04	.2353
36,000	.2981	1.8315	-56.324	-69.4	.8675	574.0	6.71	.2243
37,000	.2844	1.8753	-56.500	-69.7	.8671	573.8	6.40	.2138
38,000	.2710	1.9210	-56.500	-69.7	.8671	573.8	6.10	.2038
39,000	.2583	1.9677	-56.500	-69.7	.8671	573.8	5.81	.1942
40,000	.2462	2.0155	-56.500	-69.7	.8671	573.8	5.54	.1851
41,000	.2346	2.0646	-56.500	-69.7	.8671	573.8	5.28	.1764
42,000	.2236	2.1148	-56.500	-69.7	.8671	573.8	5.03	.1681
43,000	.2131	2.1662	-56.500	-69.7	.8671	573.8	4.79	.1602
44,000	.2031	2.2189	-56.500	-69.7	.8671	573.8	4.57	.1527
45,000	.1936	2.2729	-56.500	-69.7	.8671	573.8	4.35	.1455
46,000	.1845	2.3282	-56.500	-69.7	.8671	573.8	4.15	.1387
47,000	.1758	2.3848	-56.500	-69.7	.8671	573.8	3.96	.1322
48,000	.1676	2.4428	-56.500	-69.7	.8671	573.8	3.77	.1260
49,000	.1597	2.5022	-56.500	-69.7	.8671	573.8	3.59	.1201
50,000	.1522	2.5631	-56.500	-69.7	.8671	573.8	3.42	.1144

Standard Sea Level Air:
T 15°C (59°F)
P_0 14.70 lb sq in. 29.921 in. of Hg

w 0.07651 lb cu ft
1 in. Hg 70.727 lb sq ft 0.49116 lb sq in.
a_0 661.7407 knots 1116.89 ft sec

ρ_0 0.002378 slugs cu ft

Figure 11-7.

TEMPERATURE CONVERSION

DATE: APRIL 1966

DATA BASIS: CALCULATED

NOTE:

°F = (9/5 °C) + 32

°C = 5/9 (°F −32)

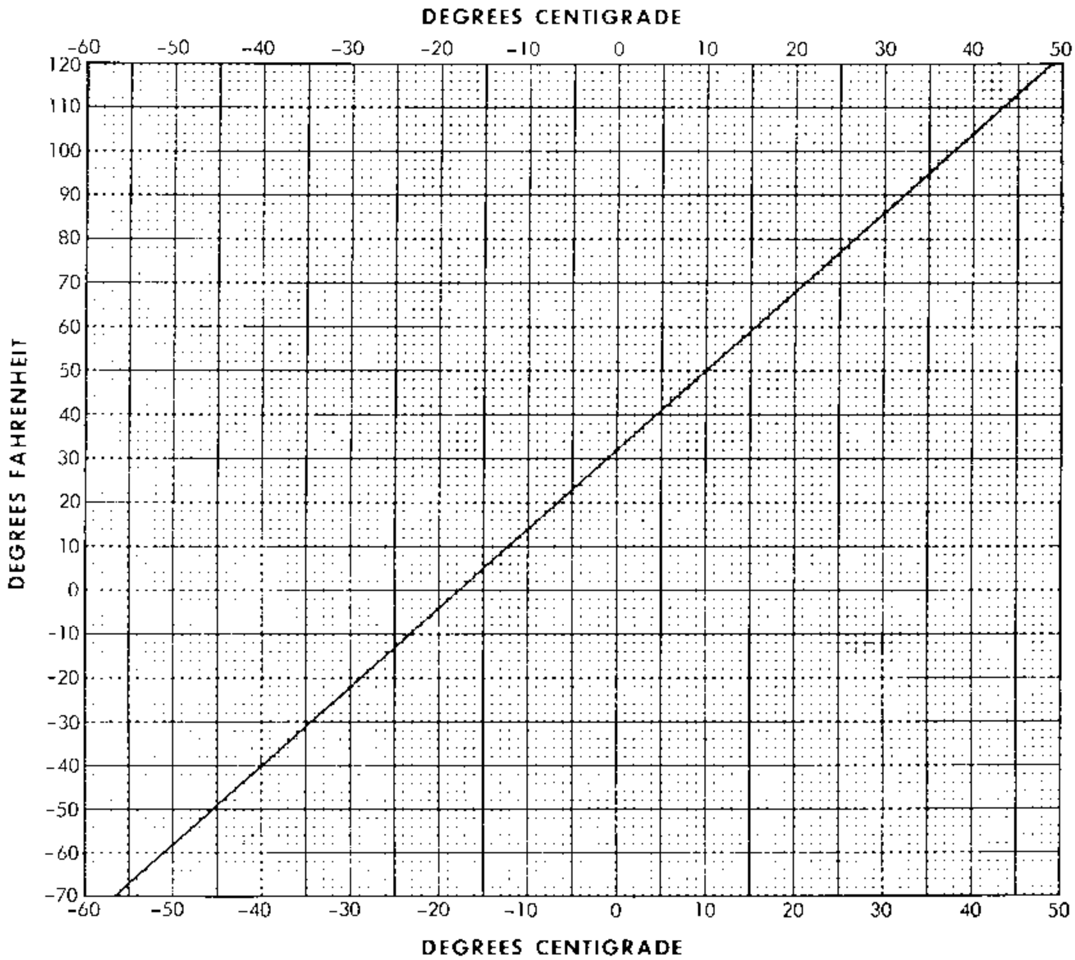


Figure 11-8.

PART 2

ENGINE POWER AND FUEL FLOW

INTRODUCTION.

Engine operating data for inflight operations are presented in this part. The basic data are shown on a torque and a fuel flow chart for normal operating conditions. Changes in the data, due to changes in engine bleed flow for other conditions, are shown in additional charts. These data were derived from EC-130G Category II flight test results and include the effects of ram efficiencies, normal power extraction, and pressurization and air conditioning bleed. The T56-A-423 turboprop engines operate at a constant 13,820 rpm. (See Section I.) The shaft horsepower, given by the engine manufacturer's specifications and corrected as noted above, is converted to torque in inch-pounds by the following equation:

$$\text{Torque} = 4.56 \text{ SHP}$$

Rearranging this equation, using indicated torque from the charts, gives shaft horsepower:

$$\text{SHP} = \frac{\text{torque}}{4.56} = 0.2193 \text{ Torque}$$

CHART DESCRIPTION.

Figures 11-9 and 11-10 show engine torque and fuel flow for any combination of altitude, airspeed, temperature, and TIT when engine bleed condition is normal. This condition exists when all engines are operating and when anti-icing bleed is not required. With one or more engines shut down, the air conditioning and pressurization systems require more bleed from the operating engines, so corrections to the basic charts are required. Figures 11-11 and 11-12 show engine torque and fuel flow corrections due to additional bleed requirements for anti-icing. The reference numbers on the Inflight Power Available and Inflight Fuel Flow charts are used to facilitate transferring from the first page of the chart to the second. Note that the reference number used to find torque may not be used to find fuel flow at the same condition.

NUMBER OF OPERATING ENGINES.

Three-engine operation will result in a torque loss of 257 inch-pounds per engine and a fuel flow loss of 8 pounds per hour per engine, for all altitudes, based on normal bleed requirements for all operating engines. Two-engine operation will result in a fuel flow loss of 24 pounds per hour per engine, and the following torque loss at the altitude listed:

ALTITUDE (feet)	TORQUE (inch-pounds per engine)
Sea Level	824
5,000	806
10,000	788
15,000	770
20,000	752
25,000	735
30,000	717

EXAMPLE OF USE OF CHARTS.

Given:

Cruise altitude: 25,000 feet.

Cruise speed: 200 knots CAS.

IOAT: -20° C.

TIT: 750° C.

Four-engine operation (normal bleed).

Find:

Torque per engine.

Fuel flow per engine.

PROCEDURE:

To find torque per engine, enter sheet 1 of figure 11-9 with a pressure altitude of 25,000 feet, move horizontally to 200 knots CAS, vertically to -20° C IOAT, and horizontally to the TIT reference line. From this point, follow the guidelines down to 750° C TIT, move horizontally and read a reference number of 8.10. Enter sheet 2 with this reference number, move horizontally to a pressure altitude of 25,000 feet, and read a torque of 6,400 inch-pounds per engine. Using figure 11-10 in the same manner, fuel flow is found to be 765 pounds per hour per engine.

MODEL: EC-130G/Q
T56-A-423 ENGINES

INFLIGHT POWER AVAILABLE

4 ENGINES

NORMAL BLEED 100% (13,820) RPM

DATE: APRIL 1966

DATA BASIS ESTIMATED ON FLIGHT TEST

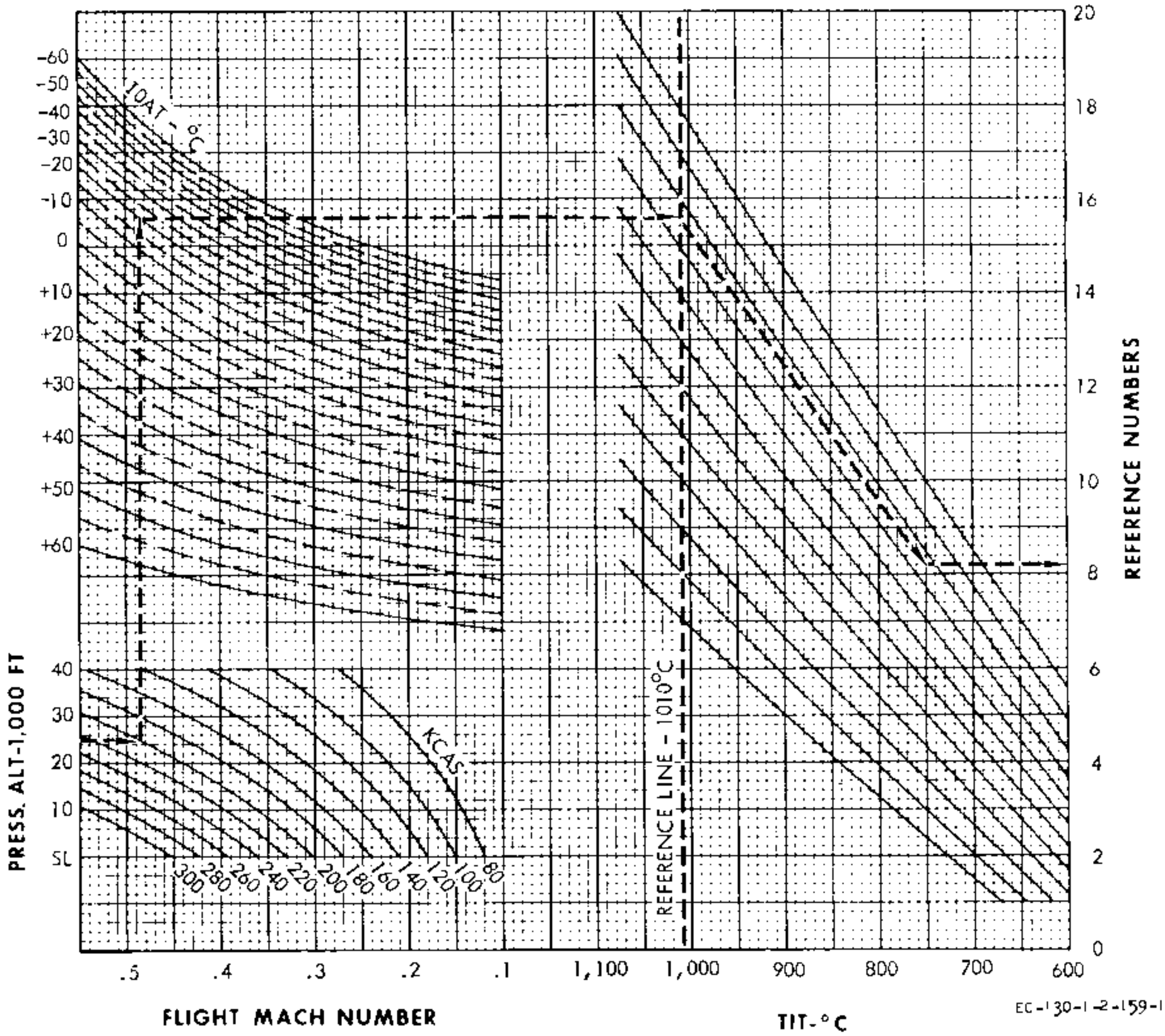
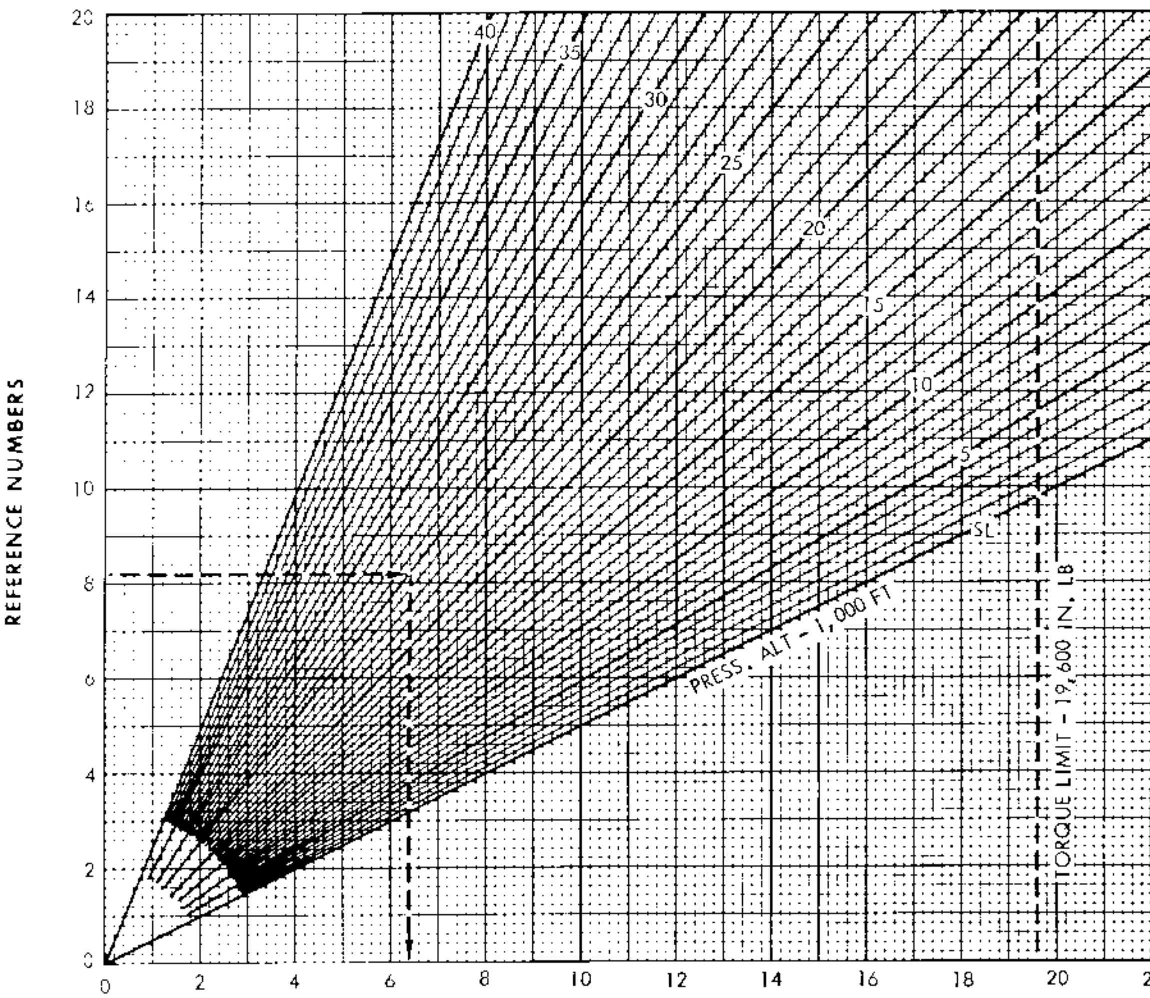


Figure 11-9. (Sheet 1 of 2)

INFLIGHT POWER AVAILABLE

4 ENGINES

NORMAL BLEED 100% (13,820) RPM



EC-130-1-2-159-2

Figure 11-9. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

INFLIGHT FUEL FLOW

100% (13,820) RPM

4 ENGINES NORMAL BLEED

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

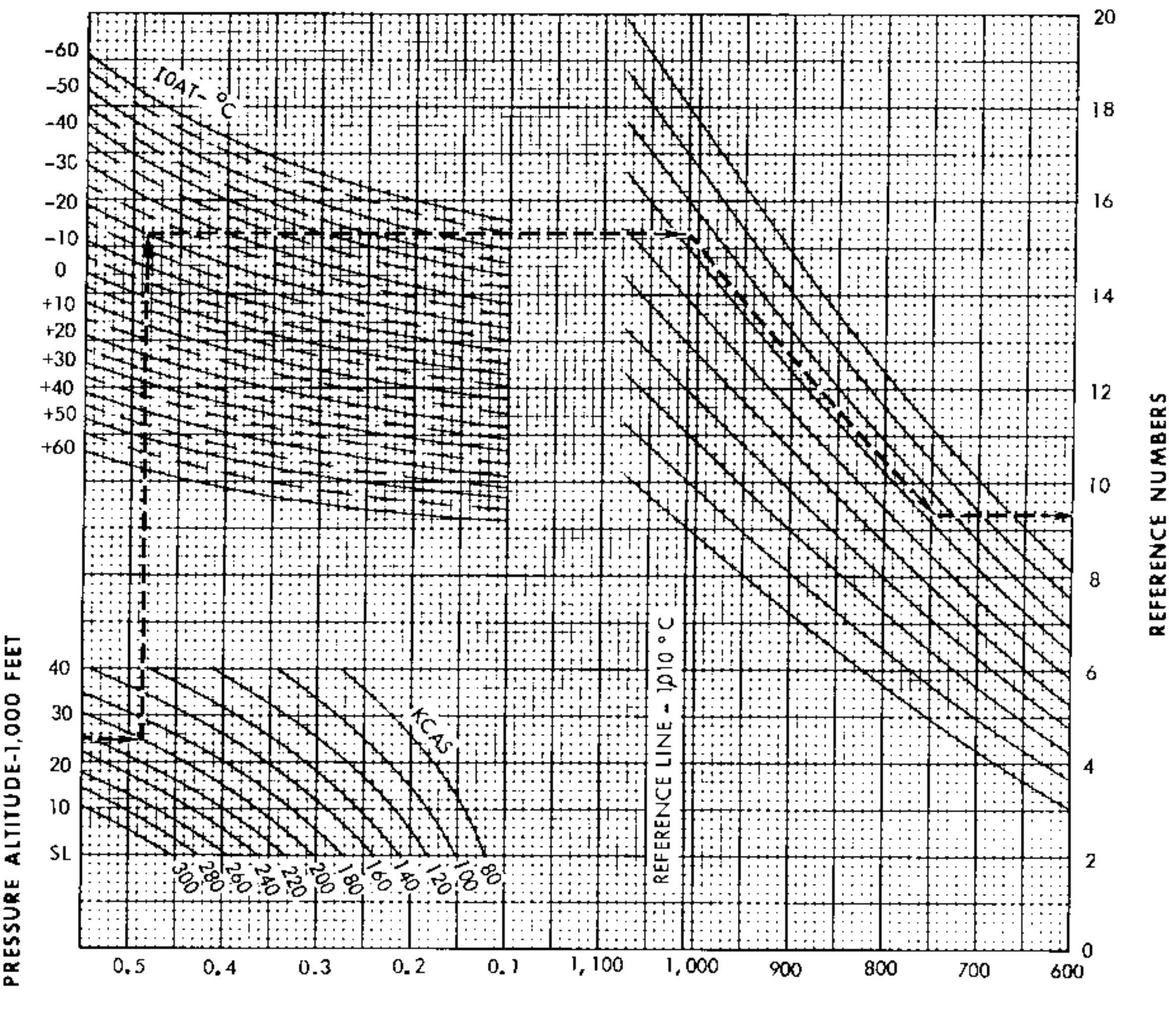


Figure 11-10. (Sheet 1 of 2)

INFLIGHT FUEL FLOW

100% (13,820) RPM

4 ENGINES NORMAL BLEED

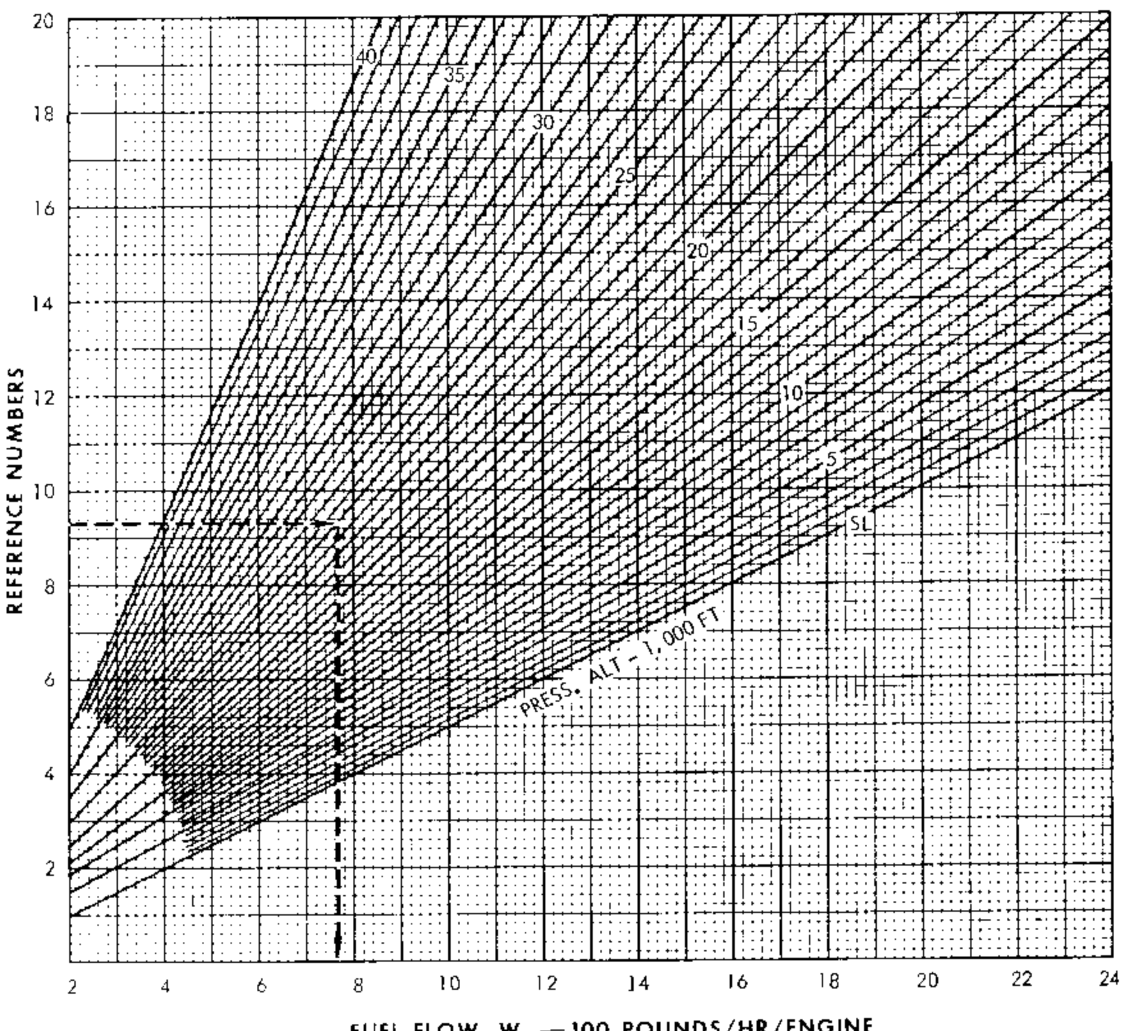


Figure 11-10. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

TORQUE LOSS DUE TO ALL BLEED ON INFLIGHT

4-ENGINE OPERATION

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

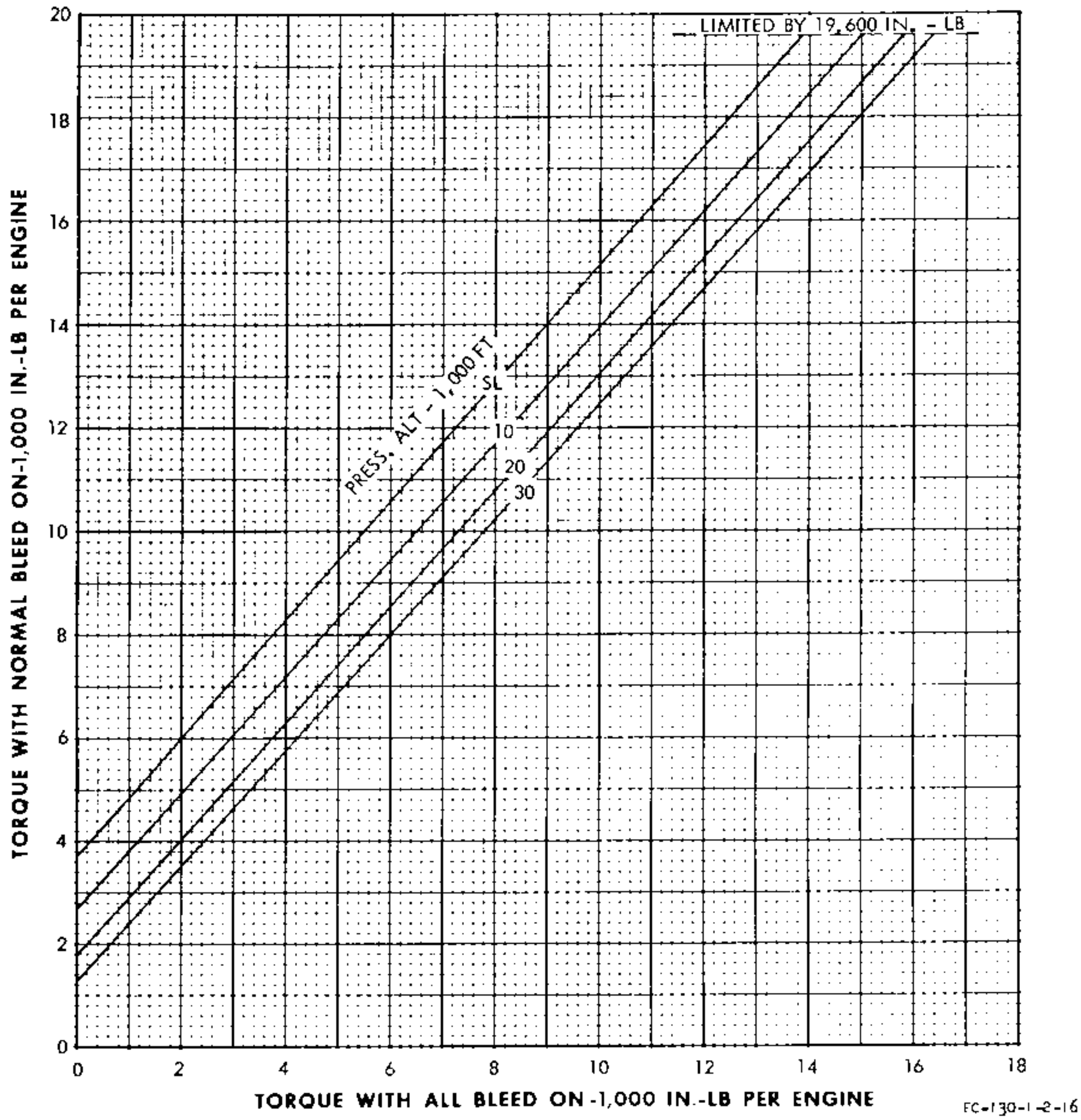


Figure 11-11.

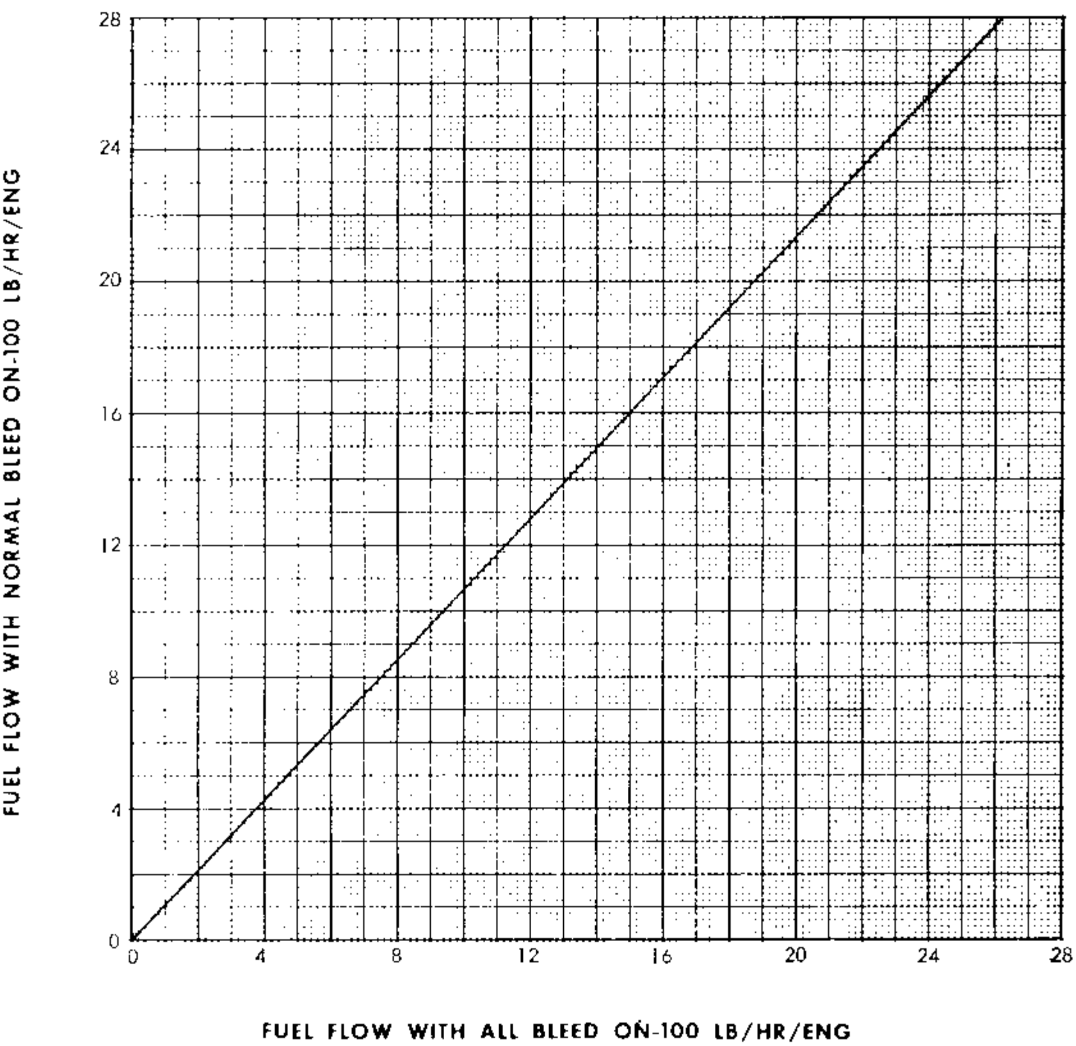
MODEL: EC-130G/Q
T56-A-423 ENGINES

FUEL FLOW CHANGE DUE TO ALL BLEED ON

4 ENGINES

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST



EC-130-1-2-162

Figure 11-12.

PART 3

TAKE-OFF PERFORMANCE

INTRODUCTION.

Take-off performance is important in the operation of the aircraft, since payload and range may be seriously cut by the maximum weight limitations imposed by take-off conditions. Generally, the runway length available imposes the most stringent limits on take-off weight. However, obstacle clearance and climb performance may also determine the gross weight limit. Factors affecting the take-off and climb-out performance of the aircraft include pressure altitude, outside air temperature, wind velocity, runway slope, runway condition, and surface covering. In this part, data is presented for determining the take-off performance and applicable limitations for both four- and three-engine operation with and without ATO. The normal take-off configuration is all engines at maximum power with air conditioning and pressurization bleed on, 50 percent flaps, and gear down. The take-off performance data consider ground effect where it is applicable. Ground effect, in general, refers to a reduction in the drag of an aircraft when operated in close proximity to the ground. The degree of drag reduction will vary with distance of the wing from the ground, being greatest when the wing is at ground level, and will have disappeared when the wing is one-half of the wing span above the ground. The reduction in drag is greatest at low velocities.

GRAPHIC TAKE-OFF ILLUSTRATIONS.

Figures 11-13, 11-14, and 11-15 provide graphic illustrations of the various conditions and factors which are encountered during take-off. The normal four-engine acceleration curve depicts the speed-distance acceleration characteristics of the aircraft. The acceleration is computed from the start of roll to take-off speed at the end of a four-engine ground run. The three-engine acceleration curve shows the speed-distance relationship from the point of assumed engine failure to the takeoff point. The braking roll curve is computed from refusal point to a complete stop at the end of the runway. This includes a 3-second transition from the point of failure to the point of brake application. This allows the pilot to recognize the situation, make a decision to stop, reduce power, and apply brakes.

Runway Available Longer Than Critical Field Length (Recommended).

This condition is graphically illustrated in figure 11-13. With this condition, refusal speed (V_R) is always higher than critical engine failure speed (V_{CEF}). This is because V_R is based on runway available, while V_{CEF} is based on the required critical field length. The ground minimum control speed (V_{MCG}) is arbitrarily shown in Figure 11-13 as being greater than V_{CEF} but less than V_R, therefore the ground minimum control speed determines minimum decision speed. If an engine failure occurs at this point (at V_{MCG}), some reserve in runway length is available whether the decision is to go or to stop.

RUNWAY AVAILABLE LONGER THAN CRITICAL FIELD LENGTH (RECOMMENDED)

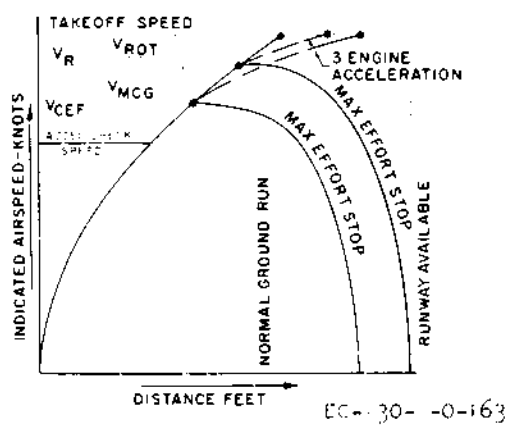


Figure 11-13.

If V_{MCG} has been less than V_{CEF}, V_{CEF} would have determined the decision speed, and the decision to continue on three engines or to stop would still have made some reserve in runway length available.

If V_{MCG} had been equal to V_R, then this speed would have been the point of decision. Note that, although the decision to continue on three engines would require even less runway than from the above illustrated decision speeds, the decision to stop would demand the maximum stopping capability of the aircraft.

Runway Available Equal to Critical Field Length (Minimum Recommended).

This condition is graphically illustrated in figure 11-14. When the runway available is equal to the critical field length and an engine failure occurs at the refusal point, the distance to continue on three engines just equals the distance to stop. Note, therefore, that for this condition the critical engine failure speed and refusal speed are coincident. Ground minimum control speed must be equal to or lower than critical engine failure speed to satisfy this condition (otherwise downloading would be required); decision speed is therefore determined by V_{CEF}.

Runway Available Less Than Critical Field Length.

This condition is graphically illustrated in figure 11-15. In this condition there is a region just past the refusal point where, if an engine fails, it is not possible to either stop or continue the take-off within the remaining runway. Note that it is impossible to select a speed for decision speed. If the runway available is less than the critical field length, the aircraft should be downloaded for a safe take-off.

TAKE-OFF TORQUE SETTING.

The take-off torque setting chart (figure 11-16) presents indicated torque for various values of outside air temperature and pressure altitude for maximum power (1077°C TIT), with the maximum allowable torque limit shown at 19,600 inch-pounds. The torque values presented are for zero airspeed (static conditions) with air conditioning and pressurization bleed on. At airspeeds greater than zero, there is an increase in torque due to inlet ram pressure, and a torque increment at 100 knots IAS is shown on the chart. The increased torque values due to ramp pressure are included in the take-off calculations and are not to be used when determining take-off factor. A correction

RUNWAY AVAILABLE EQUAL TO CRITICAL FIELD LENGTH (MINIMUM RECOMMENDED CONDITION)

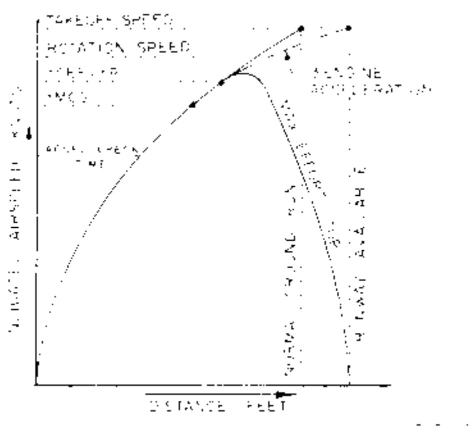


Figure 11-14.

RUNWAY AVAILABLE LESS THAN CRITICAL FIELD LENGTH (NOT RECOMMENDED)

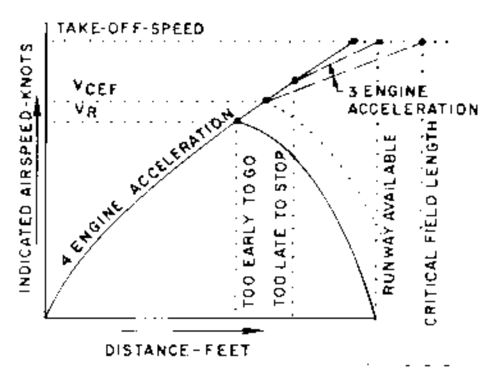


Figure 11-15.

is included on the chart to adjust torque values for all bleed off. Should it be necessary to operate the anti-icing system during take-off, the torque correction due to all bleed on (figure 11-17) should also be used. This chart shows indicated torque with all bleed on as a function of normal torque and altitude. If take-off performance is critical prior to brake release, the actual values of torque should be compared with the chart values. Take-off performance shown in this section can be achieved only if the average static torque produced by the engines matches that shown on the chart. If predicted torque including ram rise has not been obtained by the time refusal speed is reached, the take-off should be aborted.

Note

> When take-off performance is marginal with existing runway length and atmospheric conditions, it is recommended that all bleed air systems be turned off to ensure that maximum power is obtained under these atmospheric conditions.

Example:

GIVEN:

Outside air temperature: +10° C

Pressure altitude: 6,000 feet

FIND:

Torque per engine with normal bleed and all bleed on.

PROCEDURE:

Enter the take-off torque setting chart (figure 11-16) with the temperature of +10° C and move vertically up to the 6,000-foot altitude line and then horizontally to the right and find 19,250 inch-pounds per engine with normal bleed. Now enter the chart for effect of all bleed (figure 11-17) with 19,250 inch-pounds of torque, move to the right to the pressure altitude of 6,000 feet and read below a torque of 14,280 inch-pounds with all bleed on.

TAKE-OFF FACTOR.

To simplify the determination of the take-off performance, a take-off factor is used. This take-off factor combines the parameters of torque, field pressure altitude, and runway temperature. The determination of take off factor is based on zero airspeed take-off torque setting (figure 11-16). when take-off is performed with other than normal air conditioning and pressurization bleed air on, the corrected static torque should be used to determine the take-off factor.

Example:

GIVEN:

Outside air temperature: +10° C

Pressure altitude: 6,000 feet

FIND:

Take-off factor with normal bleed.

Take off factor with all bleed.

PROCEDURE:

Enter the take off factor chart (figure 11-18) with +10° C, move horizontally to the intersection with the 6,000-foot line, proceed vertically to the horizontal scale and read a take-off factor of 2.73. To correct this factor for all bleed on, enter figure 11-19 with a normal bleed take-off factor of 2.73 move to the right, interpolate for a +7° C variation from standard day, and read a corrected take-off factor of 3.92.

THREE-ENGINE CLIMB LIMITATION.

Take-off gross weight, limited by three-engine climb performance, is presented in figure 11-20 for various rates of climb in the climb-out configuration as follows:

50 percent flaps

Gear up

Maximum power on all available engines

Inoperative engine with propeller feathered

Normal climb-out speed (figure 11-27)

Out of ground effect

Note

The capability of the aircraft to climb prior to reaching climb-out speed is seriously reduced while the gear is retracting (18 seconds) and the propeller is being feathered.

Criteria for minimum rates of climb on take-off are specified by applicable command regulations. When such a criterion has been selected, figure 11-20 can be used to determine the maximum permissible take-off weight.

Example:

GIVEN:

Take-off factor: 3.92

Weight: 130,000 pounds

Rate of climb: 300 feet per minute

FIND:

Does the three-engine climb capability limit the take-off gross weight to less than 130,000 pounds.

PROCEDURE:

To find the take-off gross weight permitted by the Three-Engine Climb Capability, enter figure 11-20 with the take-off factor of 2.73, move vertically up to the temperature line of Standard Day +7°C. From there move to the right intersecting the 130,000 pound line and read below 845 feet per minute rate of climb. This is in excess of the required 300 fpm and the climb capability is not limiting.

RUNWAY CONDITION AND RUNWAY SURFACE COVERING.

Runway condition reading (RCR) is a value which relates the average braking effectiveness of the particular runway surface to the braking capability of the aircraft. The measured RCR, therefore, becomes a factor in determining any performance which involves braking, such as critical field length and refusal speed. Many airfields will continue to report braking action in accordance with ICAO documents. This is the "good," "medium," and "poor" categorization of braking action on unusual runway surface condition. In order to relate this categorization to an RCR or when RCR values are not available, the following relationship will be used:

Runway Condition	ICAO Report	RCR
Dry	Good	23
Wet	Medium	12
Icy	Poor	05

Note

For operation in loose, dry snow (snow that will drift in a 10-knot wind), enter charts with a depth of RSC equal to 1/3 actual depth. This factor is applicable only for depths of loose, dry snow up to 3 inches.

Runway surface covering (RCS) is a value which relates to depth and type of runway covering such as water or slush, and is reported in tenths of an inch in depth (1 inch is the equivalent of an RSC of 10). The surface covering affects both the acceleration and stopping performance of the aircraft and, therefore, is a factor in determining such performance as take-off ground run, critical field length, and refusal speed. Under average conditions the depth of the surface covering would vary widely in different locations on the runway, and it is preferable to plan the take-off such that the lift-off point should have the least depth reported. The retarding force is a function of many variables such as tire pressure, density of covering, ground speed, weight, and tread and spray pattern of the tire.

WIND DEFINITIONS.

The following definitions apply to the discussions of winds:

Steady Wind Value -	Reported steady wind.
Gust Increment -	Reported wind in excess of steady wind value.

Component -	Effective wind parallel or across the runway.
Headwind -	Effective wind parallel to the runway, determined from the steady wind value.
Tailwind -	Effective wind parallel to the runway, determined from the steady wind value plus the gust increment.
Crosswind -	Effective wind across the runway, determined from the steady wind value plus the gust increment.

APPLICATION OF WINDS TO TAKE-OFF AND LANDING.

Wind Direction and Velocity.

Winds are usually measured at some fixed point on the airfield and, within instrument limitations, are valid for the point where measured. However, if the airfield is located in an area of variable terrain, the possibility exists that over various portions of the airfield, wind velocity and direction will vary. Like-wise, wind shear can result in varying winds during climb-out and landings.

Because of these variables, it is recommended that 50 percent of the headwind component and 150 percent of the tailwind component be applied (except acceleration check) per attached chart.

Gusts may cause a temporary increase in airspeed, therefore, rotation speed, take-off speed, threshold speed, and landing speed computed without gust consideration should be increased by the full gust increment, but not to exceed 10 knots. Distances should only be adjusted for gusts when they accompany a tailwind.

Accounting for Wind.

Benefits derived from headwinds should be accepted as an increased margin of safety. Headwind should only be considered when necessary for mission accomplishment. When using this concept, wind will be considered only when computing the acceleration check. Always apply tailwinds. When headwinds or tailwinds are applied, all distances and speeds except take-off speed and ground minimum control speed must be corrected during take-off planning.

WIND SUMMARY

TYPE OF WIND	HOW TO OBTAIN COMPONENTS	USE OF WIND COMPONENT
HEADWIND	Runway Component	Apply 100 percent of component to acceleration check speed and ground run distance.
	Enter wind component chart with steady wind value.	Apply 50 percent of component to all take-off and landing distances except for acceleration check.
		Do not apply headwinds for terrain clearance.

WIND SUMMARY

TYPE OF WIND	HOW TO OBTAIN COMPONENTS	USE OF WIND COMPONENT
TAILWIND	Runway Component	Apply 100 percent of component to acceleration check speed and ground run distance.
	Enter wind component chart with steady wind value plus the gust increment.	Apply 150 percent of component to all take-off and landing distances except for acceleration check.
CROSSWIND	Crosswind component	Apply 150 percent of component for terrain clearance.
	Enter wind component chart with steady wind value plus the gust increment.	Adjust ground minimum control speed for 100 percent of component. Check necessity of increased take off and landing speeds.
GUSTS	Gust Increment	Increase rotation speed, take-off speed, threshold speed, and landing speed by the full gust increment not to exceed 10 knots.
	Reported wind in excess of steady wind value.	

TAKE-OFF CROSSWIND CHART.

The take-off crosswind chart (figure 11-34) presents headwind and crosswind components in knots for wind directions of zero to 90 degrees from the runway heading and wind speeds up to 60 knots. For crosswind components in excess of 35 knots, a high degree of pilot skill is necessary for crosswind correction. Variations in asymmetrical power and use of less flaps than normally recommended will result in improved crosswind capability. When the crosswind component and normal take off speed fall within the caution area, the take-off speed should be increased until the recommended area is reached, or the airspeed has been increased 10 knots. If the recommended area still has not been reached after increasing airspeed 10 knots, then caution should be exercised during take-off. Refer to WIND DEFINITIONS and APPLICATION OF WINDS TO TAKE-OFF AND LANDING paragraphs in this part for a discussion of winds.

CRITICAL FIELD LENGTH.

The critical field length is the total length of runway required to accelerate on all engines to critical engine failure speed, experience an engine failure, then continue the take-off or stop in the same distance. It is used during take-off planning together with the climb-out data to determine the maximum gross weight for a safe take-off and climb-out. For a safe take-off the critical field length must be no greater than the length of runway available. Critical field length is determined from figure 11-21 by using take-off factor, take-off weight, and applying the corrections for runway slope, wind, RCR, and RSC as required.

Example:

GIVEN:

Weight: 130,000 pounds

Take-off factor: 2.73

Runway available: 6,000 feet

Tower reported wind: 10 knots headwind

RCR: 12

RSC: 2.5

Runway slope: 2 percent uphill

FIND:

Critical field length

Critical engine failure speed (Example lines not shown on chart)

PROCEDURE:

Enter the critical field length chart (figure 11-21) with the take-off factor 2.73, move vertically up to the 130,000 pound line and then to the right obtaining an uncorrected critical field length of 4,175 feet. Continuing across to sheet 2 of the same figure, correct the critical field length for a slope of 2 percent, wind of 5 knots, RCR of 12, and RSC of 2.5 following the guidelines and determine a corrected critical field length of 4,125 feet. The critical engine failure speed is found for the EC-130Q from figure 11-22. Entering with the take-off factor of 2.73 read across to the found critical field length of 4,125 feet and down to the take-off weight of 130,000 pounds. Then to the right and read an uncorrected speed of 83 knots IAS. Continuing across to sheet 2 and correcting for wind, RCR, and RSC obtain a corrected critical engine failure speed of 78 knots IAS.

REFUSAL SPEEDS.

Refusal speed is based on the runway available and is defined as the maximum speed to which the aircraft can accelerate with engines at maximum power and then stop within the remainder of the runway available, with two engines in reverse thrust and maximum braking. Refusal speeds are presented in figure 11-22 as a function of take-off factor, available runway length, gross weight, runway surface condition and covering, and wind. When corrected refusal speed exceeds take-off speed, use take-off speed as refusal speed. Refer to Section V for emergency operating procedures. The distance required to accelerate to refusal speed from brake release is defined as refusal distance. To determine refusal distance see test under ACCELERATION CHECK TIME DURING TAKEOFF GROUND RUN.

Example:

GIVEN:

Weight: 130,000 pounds

Take-off factor: 2.73

Runway available: 9,000 feet

Tower reported wind: 10 knots headwind

RCR: 12

RSC: 2.5

FIND:

Refusal speed

PROCEDURE:

Enter the Refusal Speed Chart (figure 11-22) with the take-off factor 2.73, move to the right and intercept the 9,000-foot line, then proceed vertically down to the 130,000-pound weight line. Now move horizontally to the right and read the uncorrected speed of 140 knots IAS. Then correct the refusal speed for wind and runway conditions by entering figure 11-22 sheet 2 with 140 KIAS. Since the wind is not measured at the runway, the headwind used for correction is 50 percent of 10 knots or 5 knots. Follow the guideline to a headwind of 5 knots and then horizontally to the RCR baseline. From there follow the guideline to an RCR of 12 and horizontally across to the zero line of RSC. Following the guideline to an RSC of 2.5 gives a corrected refusal speed of 135 knots IAS.

CRITICAL ENGINE FAILURE SPEED.

Critical engine failure speed (V_{CEF}) is based on critical field length and is that speed to which the aircraft can accelerate, lose an engine, and then either continue to take-off with the remaining engines, or stop in the same total runway distance. Critical engine failure speed may be found from the refusal speed chart by substituting critical field length for available runway length. Acceleration distances are based on all engines set at maximum power, not exceeding 19,600 inch-pounds of torque. Stopping distances are based on two engines in reverse thrust, one engine in ground idle, one propeller windmilling, and maximum braking.

CLIMB-OUT FLIGHT PATH.

The climb-out factor (figure 11-23) depends on gross weight and the take-off factor which previously incorporated the parameters of field pressure altitude and torque. The climb-out flight path charts present the climb-out flight path for various values of climb-out factor. Figure 11-24 presents the four-engine, 50 percent flaps, climb-out; figures 11-25 and 11-26 show the three-engine climb-out flight path with 50 percent flaps. The four-engine climb-out flight path is based on four-engine acceleration to lift-off. Gear retraction is initiated 3 seconds after lift-off while the aircraft climbs at obstacle clearance speed. After gear retraction, the aircraft accelerates to flap retraction speed, at which time flap retraction is initiated. As soon as the flaps are up, the aircraft is accelerated to best climb speed and continues climbing at that speed. The three-engine climb-out charts are based on four-engine acceleration from brake release to critical engine failure speed, and three-engine acceleration from critical engine failure speed, throughout the climb-out. The charts also assume gear retraction initiation 3 seconds after take-off and propeller feathering initiation 6 seconds after take-off. These charts permit the determination of the distance from brake release required to clear a given obstacle height as a function of climb-out factor. The critical field length portion of the total distance shown is for a dry, level runway. However, for other than dry runway conditions or with an uphill slope, critical field length is extended, resulting in a reduced inflight distance to the obstacle. For this case, it is necessary, before entering the chart, to decrease the known distance from brake release by the difference between actual critical field length (corrected for RCR, RSC, and gradient) and the critical field length for dry, level runway. In determining the corrected critical field length do not apply a correction for headwind, but always apply tailwind correction. Refer to text on Definition and Application of Winds to Take-Off and Landing.

Example:

GIVEN: Three-engine climbout.

Take-off factor: 3.92 (with all bleed)

Gross Weight: 130,000 pounds

Obstacle height: 1,500 feet, 4 miles from brake release

FIND:

Climb-out factor

Height of aircraft 4 miles from brake release

PROCEDURE:

Enter the climb-out factor chart, figure 11-25, with the take-off factor of 3.92 and move horizontally to the 130,000-pound line, then vertically down and read a climb-out factor of 17.9. Now enter the three-engine climb-out flight path chart (figure 11-26) with 4 miles, move vertically to the climb-out factor line of 17.9 and then horizontally to the left, and find the vertical distance to be 490 feet. The aircraft must not take off at this weight.

TAKE-OFF AND OBSTACLE CLEARANCE SPEEDS.

All operational speeds for use during take-off and climb-out have been established to provide adequate margins above stall speed, to guarantee comfortable flight characteristics, and to provide tolerance for gusts and for the maneuvering which may be required in following a proper flight path. Due to the position errors inherent in airspeed measuring system, the indicated stall speeds (Section IV) must be corrected prior to the increase by specific percentage margins. The position error is then applied to the increased speed to obtain the indicated take-off or obstacle clearance speed. The appropriate margins are used to define the take-off and obstacle clearance speeds which are shown in the speed charts and all the performance has been computed using those speeds. The take-off and obstacle clearance speeds presented in figure 11-27 have been corrected and are presented as indicated airspeeds. Figure 11-27 presents the take-off and obstacle clearance speeds for normal and maximum effort take-offs. The normal take-off and obstacle clearance speeds are based on 1.1 V_S and 1.15 V_S power-off, respectively, while the maximum effort take-off and obstacle clearance speeds are based on 1.2 V_S power-on and 1.3 Vs power-on, respectively. The flap setting for take-off is 50 percent. When air minimum control speed (one engine inoperative, in ground effect) is greater than the chart take-off speed, use this air minimum control speed for take-off speed. The obstacle clearance speed for this condition is the chart obstacle clearance speed or air minimum control speed (one engine inoperative, in ground effect) whichever is greater. For a maximum effort take-off, air minimum control speeds are ignored and hence only the maximum effort take-off and obstacle clearance speeds are used for determining take-off performance. For a normal take-off, the minimum flap retraction speed is obstacle clearance speed, however, normal flap retraction speed is take-off speed plus 20 knots IAS. The minimum flap retraction speed for a maximum effort take-off is obstacle clearance speed plus 10 knots IAS.

AIR MINIMUM CONTROL SPEEDS.

Air minimum control speed (V_{MCA}) is defined as the minimum speed at which directional control of the aircraft can be maintained for a set of specified conditions. With one engine inoperative, the air minimum control speed is the minimum speed for directional control with maximum power on all operative engines, the inoperative engine propeller windmilling on NTS, 180 pounds rudder pedal force, and 5 degrees of bank away from the failed engine. The two-engine-inoperative air minimum control speed is the minimum speed for directional control with the two engines inoperative on the same side, with the propeller feathered on the inboard inoperative engine and the propeller windmilling on NTS on the outboard, the operative engines at maximum power, 180 pounds rudder pedal force, and with 5 degrees of bank away from the failed engines. Increasing the bank away from the failed engine reduces air minimum control speed because of the favorable effect of the sideslip angle which must accompany the increased bank angle (not to exceed 10 degrees). For the one-engine-inoperative condition, full hydraulic system pressure (3,000 psi) is assumed to be effective. As described in Section I, the 3,000-psi pressure is obtained only when the flap lever is placed between the approximately 15 and 100 percent flap positions. Placing the flap lever between zero and 15 percent flap positions reduces the effective rudder pressure to 1,300 psi and will reduce the maximum rudder deflection, which results in higher air minimum control speeds. The yawing tendency caused by both asymmetric thrust and windmilling drag of the failed engine is increased with decreasing speed. This yawing tendency must be balanced by the aerodynamic controls, which become less effective with decreasing speed. The air minimum control speed is then the minimum speed at which the yawing tendency caused by the asymmetric thrust and wind-milling propeller can be balanced with maximum rudder at the specified bank angle. Air minimum control speeds are presented in figures 11-28 and 11-29 as functions of altitude and temperature and are shown for in-ground-effect and out-of-ground-effect, respectively. The in-ground-effect speeds should be used up to the 50-foot obstacle; above 50 feet, the out-of-ground-effect air minimum control speeds should be used.

GROUND MINIMUM CONTROL SPEEDS.

Ground minimum speed (V_{MCG}) is the minimum airspeed at which the aircraft may lose an outboard engine during the ground run and still maintain directional control. Ground minimum control speeds in KIAS are shown in figure 11-30.

TAKE-OFF GROUND RUN CHARTS.

The take-off ground run is defined as the distance required to accelerate to take-off speed and leave the runway. These distances are presented as a function of gross weight, take-off factor, runway slope, wind, and RSC, and are based on all engines set at maximum power during the take-off run.

Normal Take-off.

Figure 11-31 is for normal take-offs without ATO, using take-off and obstacle clearance speeds from figure 11-27, 50 percent flaps, and normal take-off procedures.

Example:

GIVEN:

Take-off gross weight: 130,000 pounds

Take-off factor: 3.9

Runway available: 9,000 feet

Tower reported wind: 10 knots headwind

RCR: 12

RSC: 2.5

Runway slope: 2 percent uphill

FIND:

Obstacle clearance speed

Take-off speed

Take-off ground run

PROCEDURE:

To find the take-off and obstacle clearance speeds, enter figure 11-27 with the gross weight of 130,000 pounds, move up to the normal take-off speed line, then to the right, and read a take-off speed of 105 knots IAS. The obstacle clearance speed is found in the same manner from figure 11-27 as 113.2 knots IAS. The air minimum control speed in ground effect is found from chart 11-28 by entering on the horizontal scale with 10°C, proceeding vertically and interpolating for the 6,000-foot pressure altitude, then to the right and reading an air minimum control speed in ground effect of 95 knots IAS. The air minimum control speed out of ground effect is found from chart 11-29 as 99 knots IAS. A comparison of the take-off and obstacle clearance speeds with the air minimum control speeds show that take-off and obstacle clearance speeds are not limited by air minimum control speeds. Enter the take-off ground run chart (figure 11-31) with the take-off factor 3.9, move up to the 130,000-pound line, and find the uncorrected ground run of 5,000 feet. Proceed across to sheet 2, correcting for slope, wind, and RSC, and determine a corrected ground run of 5,500 feet. When the total take-off distance to 50 feet has to be found and must be corrected for wind, apply the wind correction to the distance to 50 feet only.

Maximum Effort Take-off.

The curves shown on figure 11-32 present performance for minimum ground run on a hard surface paved runway, using take-off and obstacle clearance speeds from figure 11-27. Critical engine failure speeds and refusal speeds are the same as for normal operation.

Note

When the take-off performance is critical, cabin pressurization and air-conditioning bleed should be turned off prior to take-off to utilize maximum power available.

Three-engine Take-off and Climb-out.

Figure 11-33 presents three-engine take-off performance using take-off and obstacle clearance speeds from figure 11-27. The three-engine performance is based on normal take-off speed or one-engine-inoperative air minimum control speed, whichever is greater, and the propeller feathered on the inoperative engine or the propeller removed. The procedure for a three-engine take-off is described in Section V.

The three-engine obstacle clearance distance from brake release can be determined using the Three-Engine Climb-out Flight Path chart (figure 11-26) The horizontal distance in figure 11-26 includes the critical field length, which is different from the three-engine take-off distance (figure 11-33). In order to use the Climb-out Flight Path chart, 3 engines, figure 11-26 sheet 2, determine for the given conditions the critical field length and subtract it from the three-engine take-off distance. The obstacle distance has to be reduced by this positive difference prior to establishing the climb-out capability.

Example:

GIVEN:

Take-off factor: 2.73

Gross weight: 130,000 pounds.

Runway slope: 2 percent uphill.

Wind: 10-knot headwind tower reported.

Obstacle height: 200 feet.

Obstacle distance from brake release: 7000 feet.

FIND:

Take-off ground run on three engines from brake release, climb-out capability.

PROCEDURE:

Enter the Take-off Ground Run (figure 11-33) 3 Engines chart with the take-off factor of 2.73, read up to the weight line of 130,000 pounds and, applying the slope and wind correction as shown before, find the ground run to be 5,600 feet. Now enter, with the same take-off factor, the Critical Field Length chart (figure 11-21) and subtract this uncorrected field length from the ground run (5,600 -4,175 =1,425 feet). Enter figure 11-26 sheet 2 with the obstacle distance of 7000 feet reduced by the difference above (7,000 -1,425 =5,575 feet). Move up to the climb-out factor of 16.5 from figure 11-25 and find a vertical height above brake release of 190 feet.

ACCELERATION CHECK TIME DURING TAKE-OFF GROUND RUN.

The take-off performance, as shown on the charts, can be realized only if normal acceleration is attained. Dragging brakes, excess flap deflection, low power output, and similar factors will reduce the rate of acceleration. The Acceleration Check Time chart (figure 11-35) provides the time normally required to accelerate to a given speed. The acceleration check should be made at speeds approximately 10 knots below the refusal speed. The chart also shows the effects of runway slope and wind on acceleration time. To obtain the true time, a correction grid for altitude (SMOE) is provided.

This chart can also be used to determine the refusal distance by multiplying the refusal speed (converted into feet/second divided by two) by the true time and a constant of .845.

Example:

GIVEN:

Altitude: 2,000 feet.

Outside air temperature: +30°C.

Take-off factor: 2.10.

Gross weight: 130,000 pounds.

Runway available: 5,000 feet.

Refusal speed: 97 knots. (Figure 11-22).

Check speed: 87 knots.

Runway slope: 2 percent uphill.

Wind: 10-knot headwind.

FIND:

True time to accelerate to given check speed.

PROCEDURE:

Enter figure 11-35 sheet 1 with the take-off factor of 2.10. Move to the 130,000-pound weight line, and then vertically down to the check speed line of 87 KIAS. This check speed is derived from refusal speed (97 KIAS) minus 10 KIAS. Find an uncorrected time of 24 seconds. Correct this in the normal manner for runway slope and wind. (Note that 100 percent of the wind is to be used.) From figure 11-5 find the SMOE factor of 1.064 for an altitude of 2,000 feet and outside air temperature of +30°C. This results in the corrected true time of 29 seconds.

Example.

GIVEN:

Same as example above.

FIND:

Refusal distance.

PROCEDURE

Proceed as in the example above, but use the refusal speed as check speed. Find a true time of 29.5 seconds. The refusal distance is then the true time multiplied by 0.845 V_R, where V_R is the average true airspeed in knots that converts to feet/second (97 KIAS=103KTAS). Refusal distance =0.845 x 29.5 x 103 =2562 feet.

RUNWAY SLOPE CORRECTION GRID.

The Critical Field Length Chart (figure 11-21) contains a correction grid for runway slopes up to 3 percent. To correct these distances for slopes greater than 3 percent, figure 11-36 must be used. These charts are entered with an uncorrected ground run and the corrected ground distance is determined by the intersection with the known slope. After determinimg the ground distance corrected for slope, return to the respective chart and correct this distance for wind, RCR, and RSC. Limit lines are shown on both the uphill and downhill slope corrections. The limits on the uphill slopes represent the three-engine climb capability at liftoff, where the intersections with the slope lines indicate that the climb capability is equal to the runway slope, and hence a zero rate of climb relative to the runway. The gross weights applicable to these limitations may be determined by entering the charts with the slope and altitude of the runway and reading the corresponding ground distance with no slope. Then return to the respective chart (figure 11-31) and enter it with the ground distance determined and take-off factor for the altitude and atmospheric conditions of the runway. Proceed vertically with the take-off factor and horizontally with the ground distance to the intersection of these two lines, which gives the gross weight for which the three-engine rate of climb at lift-off is equal to the runway slope.

The limit on the downhill slope represents the maximum downhill slope for which the retarding force of the brakes is effective; for steeper slope, the brake energey speed is less than the critical engine failure speed and hence, for engine failure at these steeper slopes, there is no retarding force available with the brakes.

Example:

GIVEN:

Altitude: 6,000 feet

Temperature: 10°C

Weight: 130,000 pounds

Take-off factor: 3.92 (with all bleed)

Tower reported wind: 10 knots headwind

Runway slope: 5 percent uphill

RCR: 12

RSC: 2.5

FIND:

Four-engine ground distance

Gross weight for which three-engine climb capability is equal to the runway slope.

PROCEDURE:

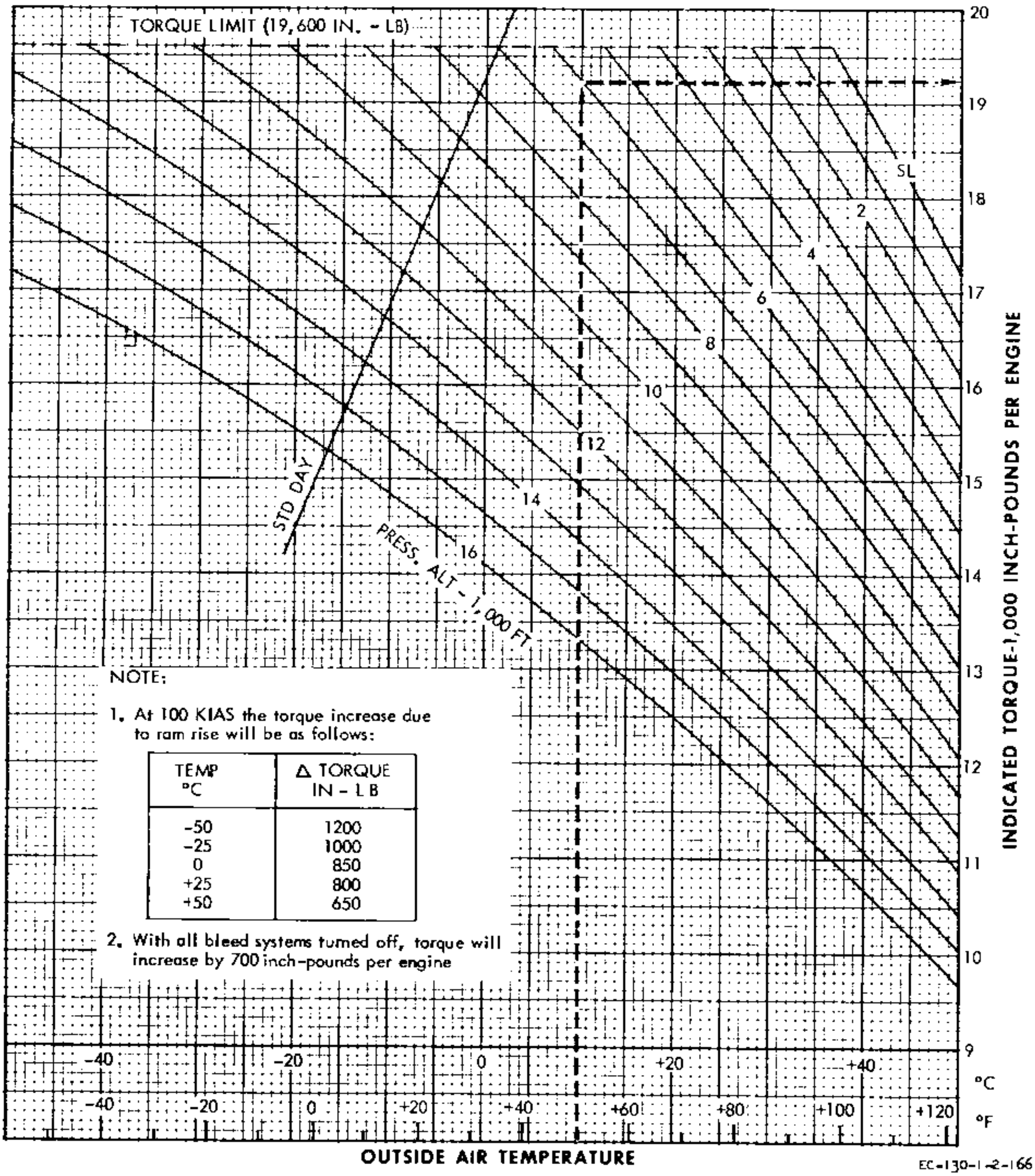
In the example following the normal take-off paragraph, the uncorrected take-off ground run is 5,000 feet. Enter figure 11-36 with this take-off ground run, intersect the 5 percent slope line, and read a corrected ground run of 7,150 feet. Observe that this exceeds the three engine climb-out capability; however, this may be improved by cutting off the anti-icing bleed, which gives a shorter take-off ground run and hence a better three-engine climb-out slope. (See note under TAKE-OFF TORQUE SETTING.) For operation with all bleed on at 6,000 feet, the gross weight at which the three-engine climb-out slope is equal to the runway slope is determined as follows: Interpolate between 12,000 feet and sea level on the 5 percent slope line and determine the four-engine ground roll distance (no slope) to be 4,430 feet. Then return to figure 11-31 , enter this chart with the 4,430-foot ground roll and a take-off factor of 3.92, and read a gross weight at the intersection of 123,000 pounds.

MODEL: EC-130G/Q
T56-A-423 ENGINES

TORQUE SETTING FOR TAKE-OFF POWER

AIR CONDITIONING AND PRESSURIZATION BLEED ON
STATIC 1,077°C TIT
4 ENGINES

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST



NOTE:

1. At 100 KIAS the torque increase due to ram rise will be as follows:

TEMP °C	Δ TORQUE IN - LB
-50	1200
-25	1000
0	850
+25	800
+50	650

2. With all bleed systems turned off, torque will increase by 700 inch-pounds per engine

Figure 11-16

MODEL: EC-130G/Q
T56-A-423 ENGINES

EFFECT OF ALL BLEED ON TAKE-OFF POWER

4 ENGINES STATIC

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. These torque values are limited by 1,077 °C TIT or 19,600 inch – pounds of torque whichever occurs first.

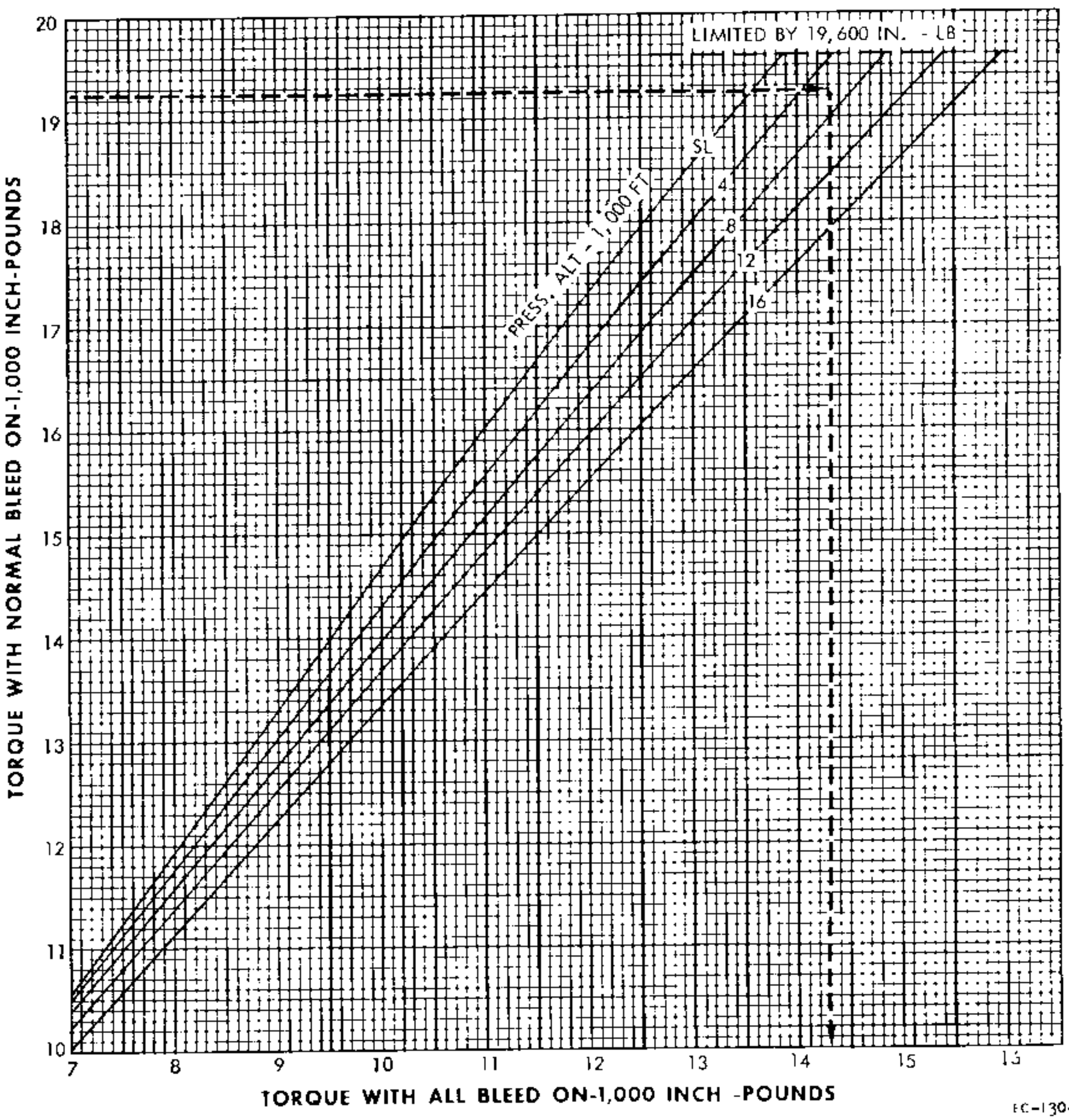


Figure 11-17.

MODEL: EC-130G/Q
T56-A-423 ENGINES

TAKE-OFF FACTOR CHART

4 ENGINES NORMAL BLEED

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. The take-off factor chart is derived based on the torque values of the take-off power available chart.

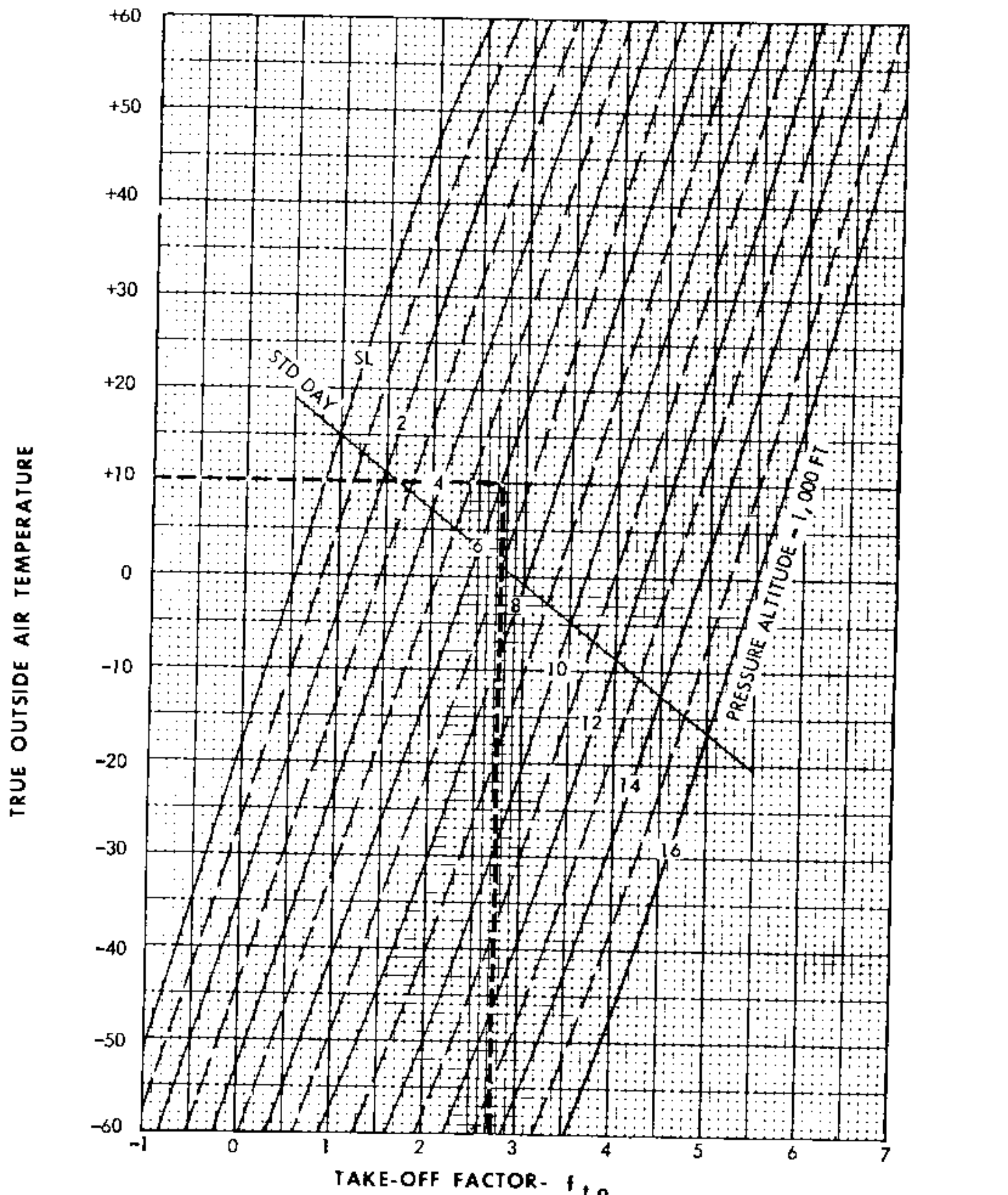


Figure 11-18.

MODEL: EC-130G/Q
T56-A-423 ENGINES

EFFECT OF ALL BLEED ON TAKE-OFF FACTOR

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

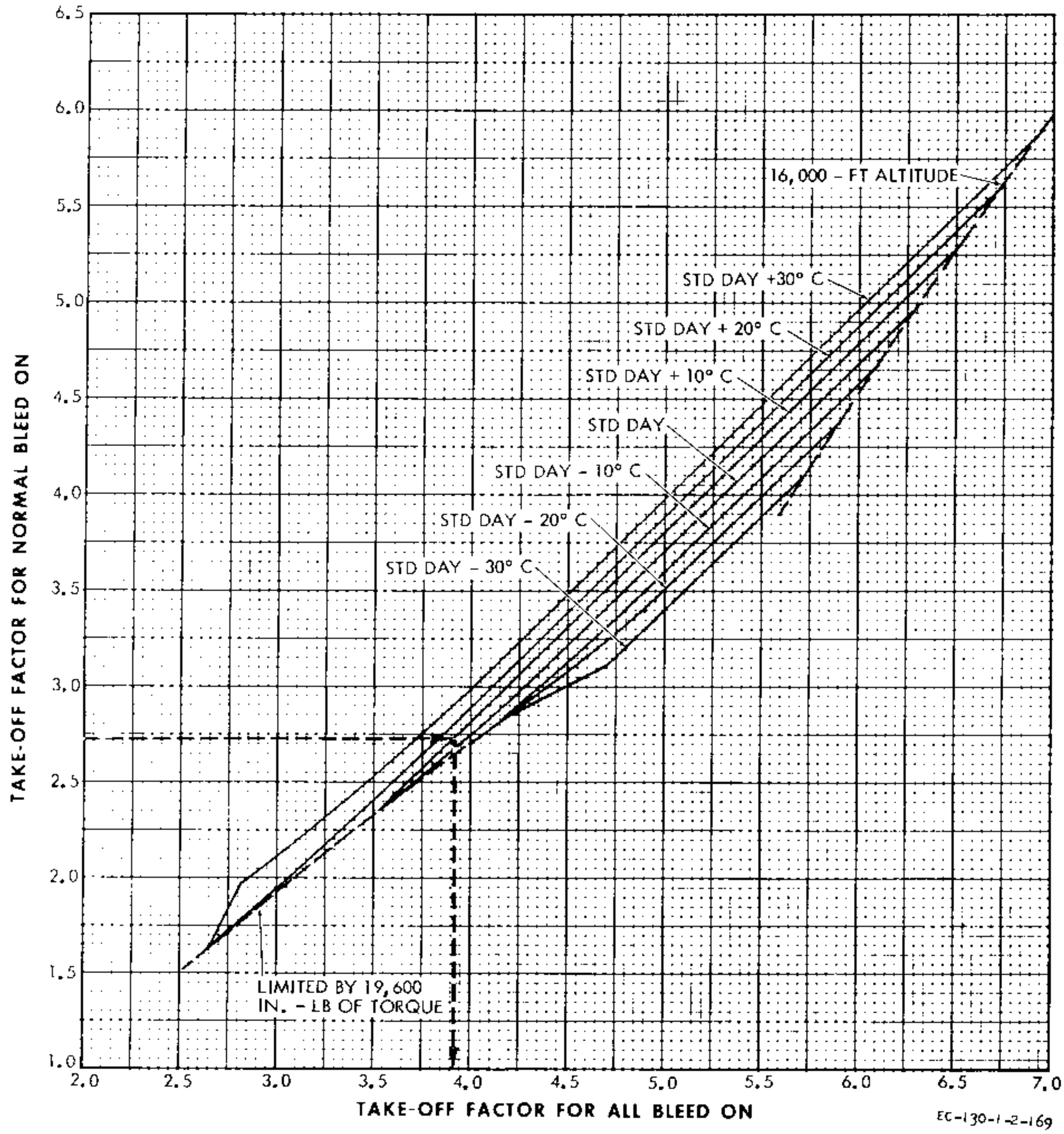


Figure 11-19.

MODEL: EC-130G/Q
T56-A-423 ENGINES

TAKE-OFF GROSS WEIGHT LIMITED BY THREE-ENGINE CLIMB PERFORMANCE

50 PERCENT FLAPS OUT OF GROUND EFFECT GEAR UP

DATE: MARCH 1971
DATA BASIS:
ESTIMATED ON FLIGHT TEST

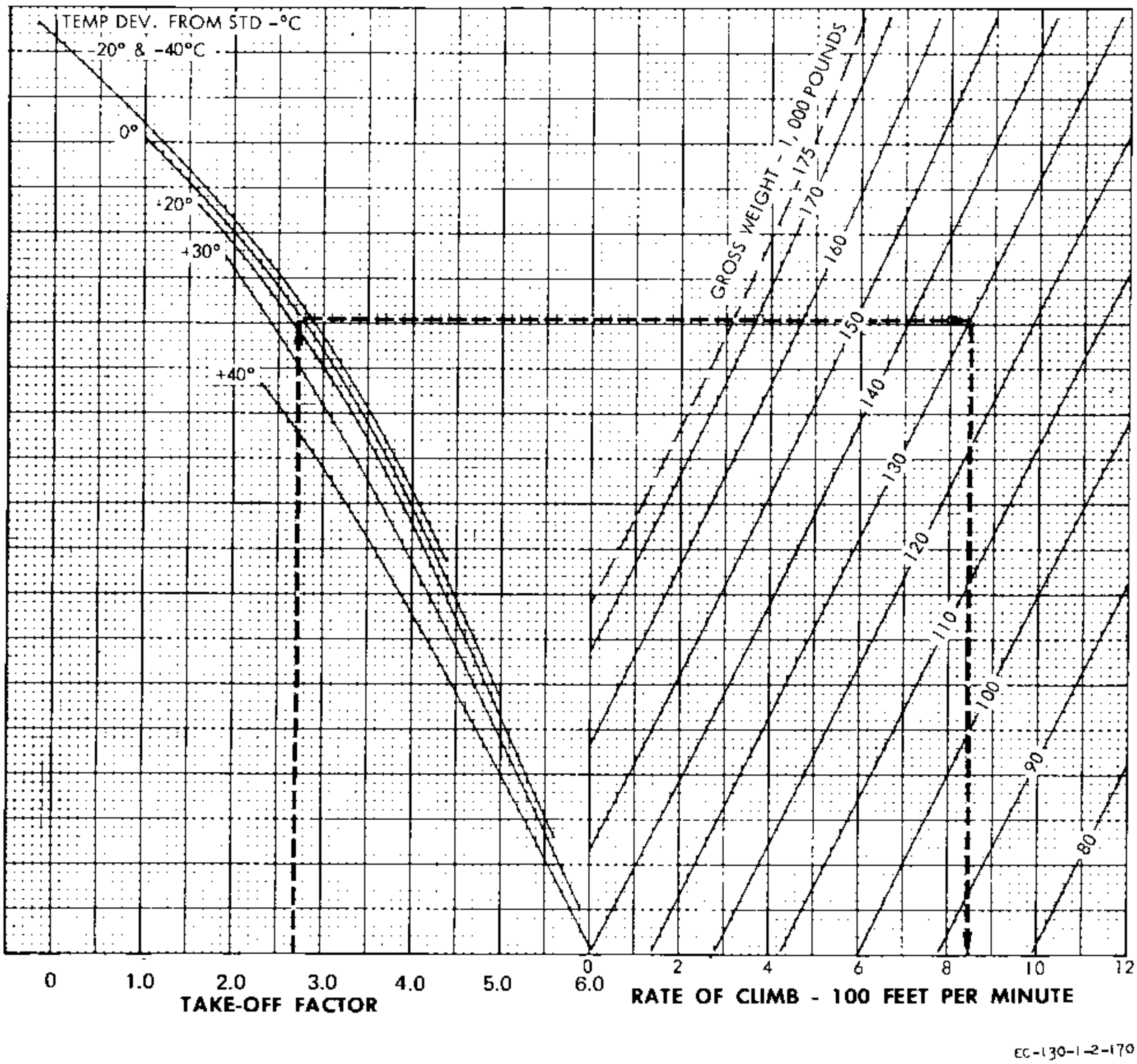


Figure 11-20.

CRITICAL FIELD LENGTH

4 ENGINES MAXIMUM POWER
50 PERCENT FLAPS NO ATO

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: JULY 1967

DATA BASIS: ESTIMATED

NOTE

1. Stop based on two engines in reverse, one engine in ground idle, one propeller windmilling.
2. An RSC value of 10 is equivalent to one inch of slush or water.
3. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.
4. If $V_{EF} = V_{MCG}$, do not correct for runway slope.

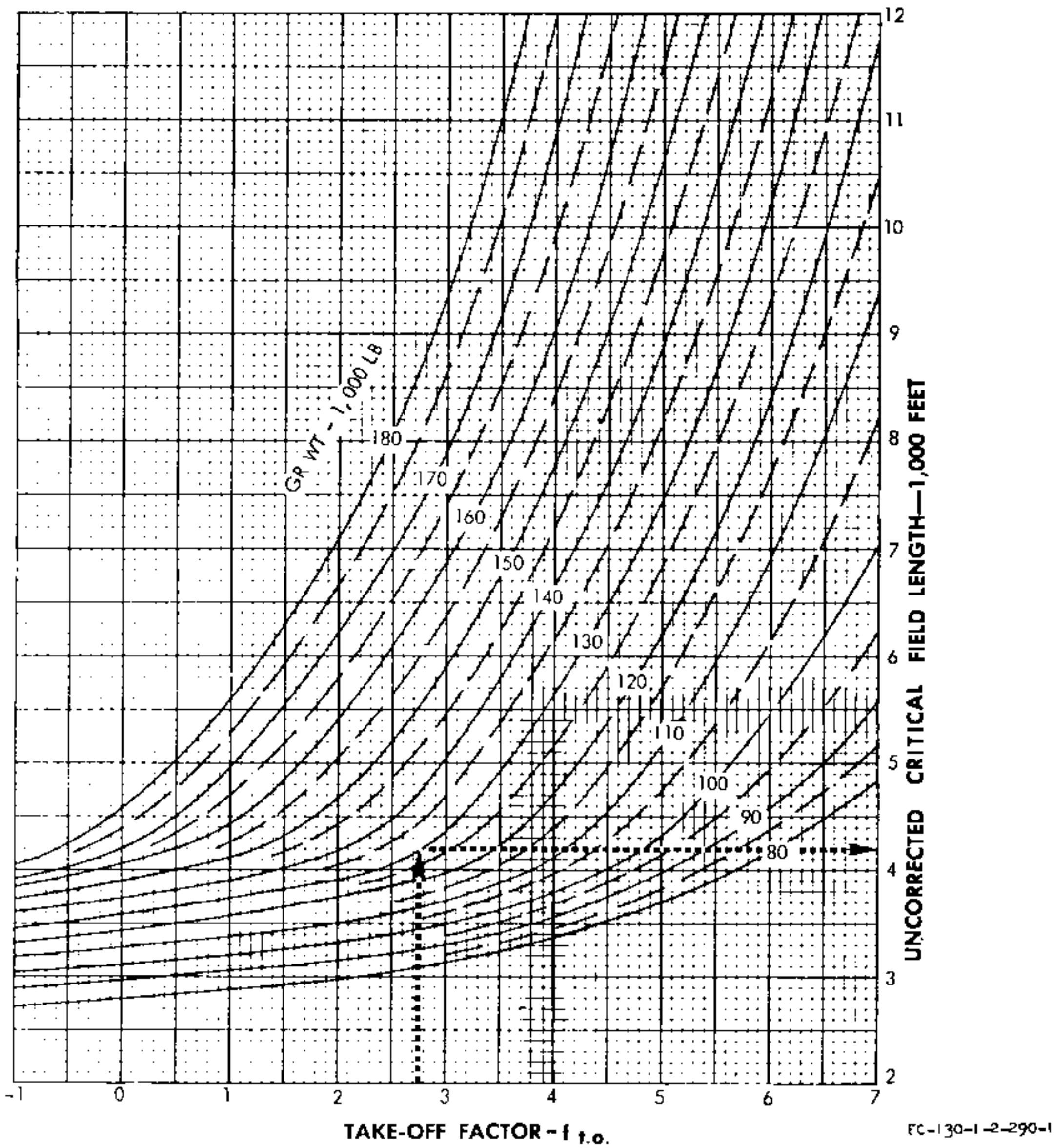


Figure 11-21. (Sheet 1 of 2)

CRITICAL FIELD LENGTH

4 ENGINES — MAXIMUM POWER

50 PERCENT FLAPS — NO ATO

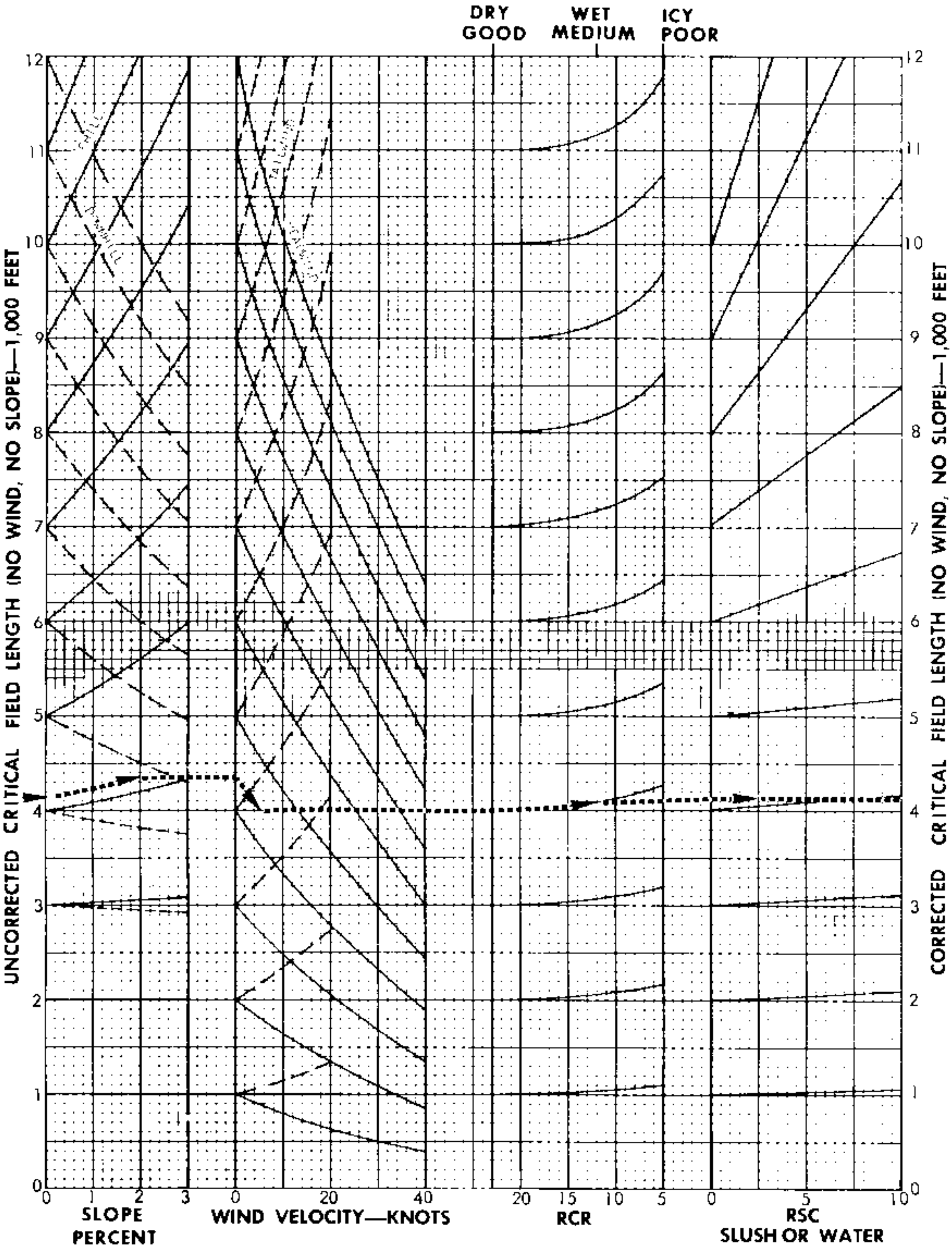


Figure 11-21. (Sheet 2 of 2)

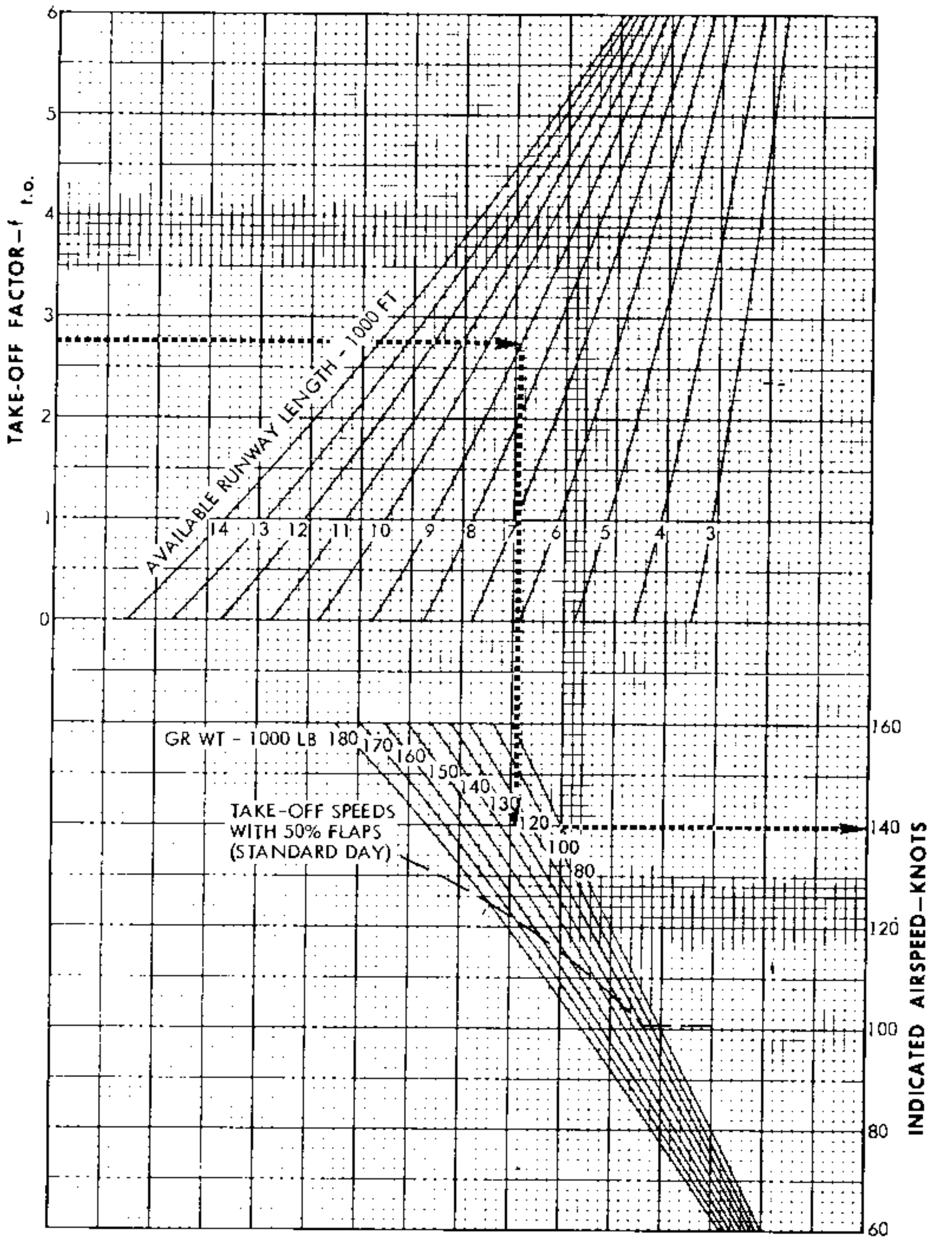
EC-130-1-2-290-2

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: JULY 1967
DATA BASIS ESTIMATED

REFUSAL SPEED AND CRITICAL ENGINE FAILURE SPEED

50 PERCENT FLAPS NO ATO



EC-130-1-2-291-1

Figure 11-22. (Sheet 1 of 2)

REFUSAL SPEED AND CRITICAL ENGINE FAILURE SPEED

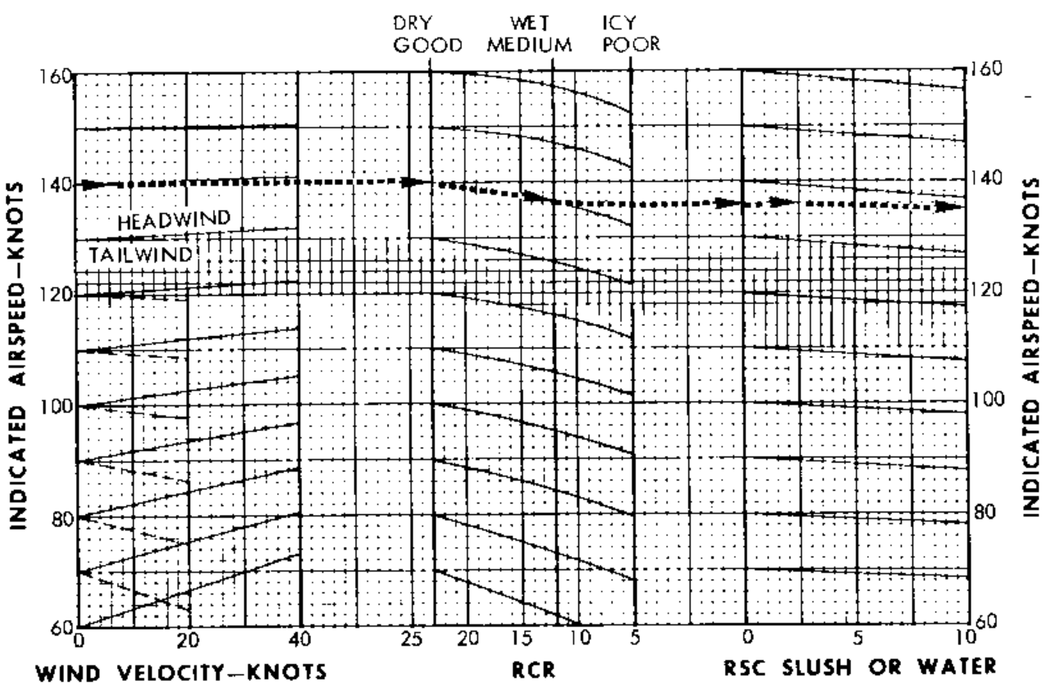
50 PERCENT FLAPS — NO ATO

NOTE

1. Based on engines set at maximum power.
2. Stop based on two engines in reverse, one engine in ground idle, one propeller windmilling, and with maximum anti-skid braking.
3. When refusal speed exceeds take-off speed, use take-off speed as refusal speed.
4. For determination of critical engine failure speed, use corrected critical field length as runway length.
5. When an RCR value is not available, the following representative values are recommended as typical of the conditions noted:

CONDITION	RCR
Dry Runway	23
Wet Runway	12
Icy Runway	5

6. An RSC value of 10 is equivalent to one inch of slush or water.
7. Use 50% of reported headwinds and 150% of reported tailwinds with the correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.



EC-130-1-2-291-2

Figure 11-22. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

CLIMB-OUT FACTOR FOR CLIMB-OUT FLIGHT PATH

4 ENGINES

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

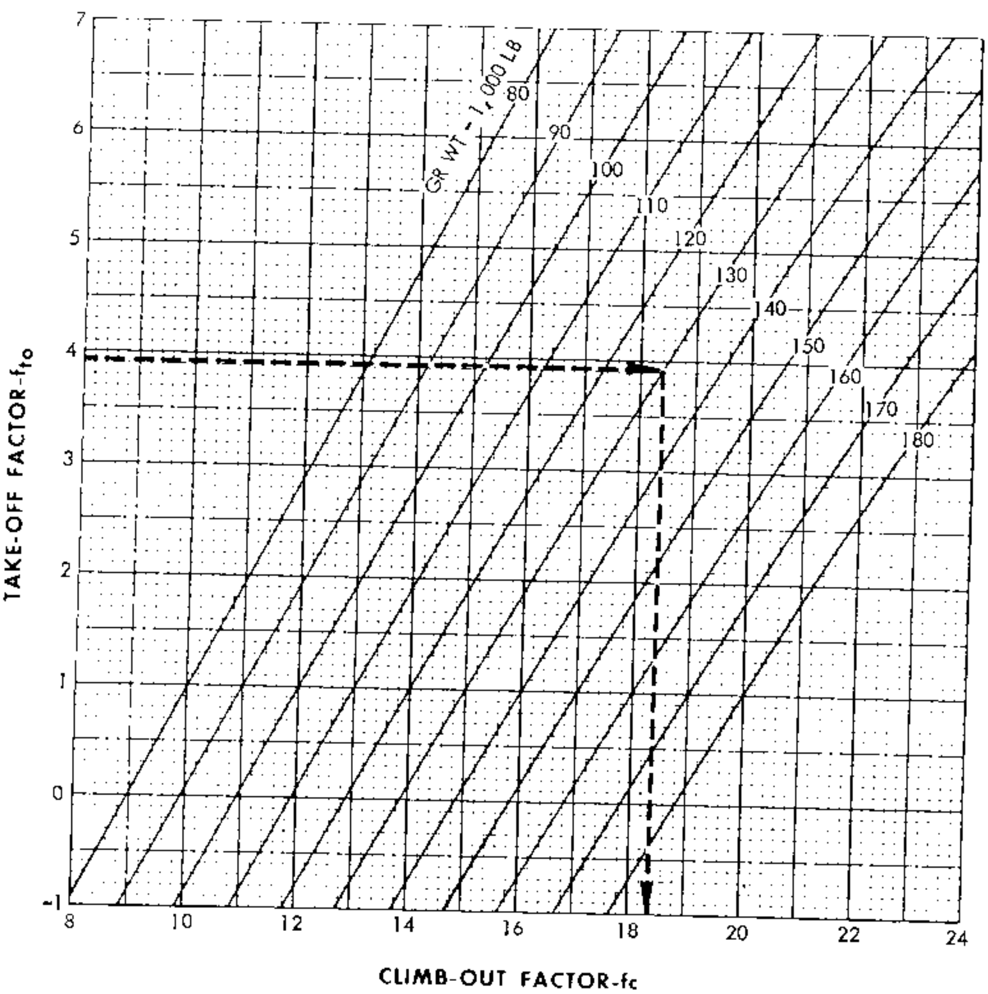


Figure 11-23.

EC-130-1-2-173

MODEL: EC-130G/Q
T56-A-423 ENGINES

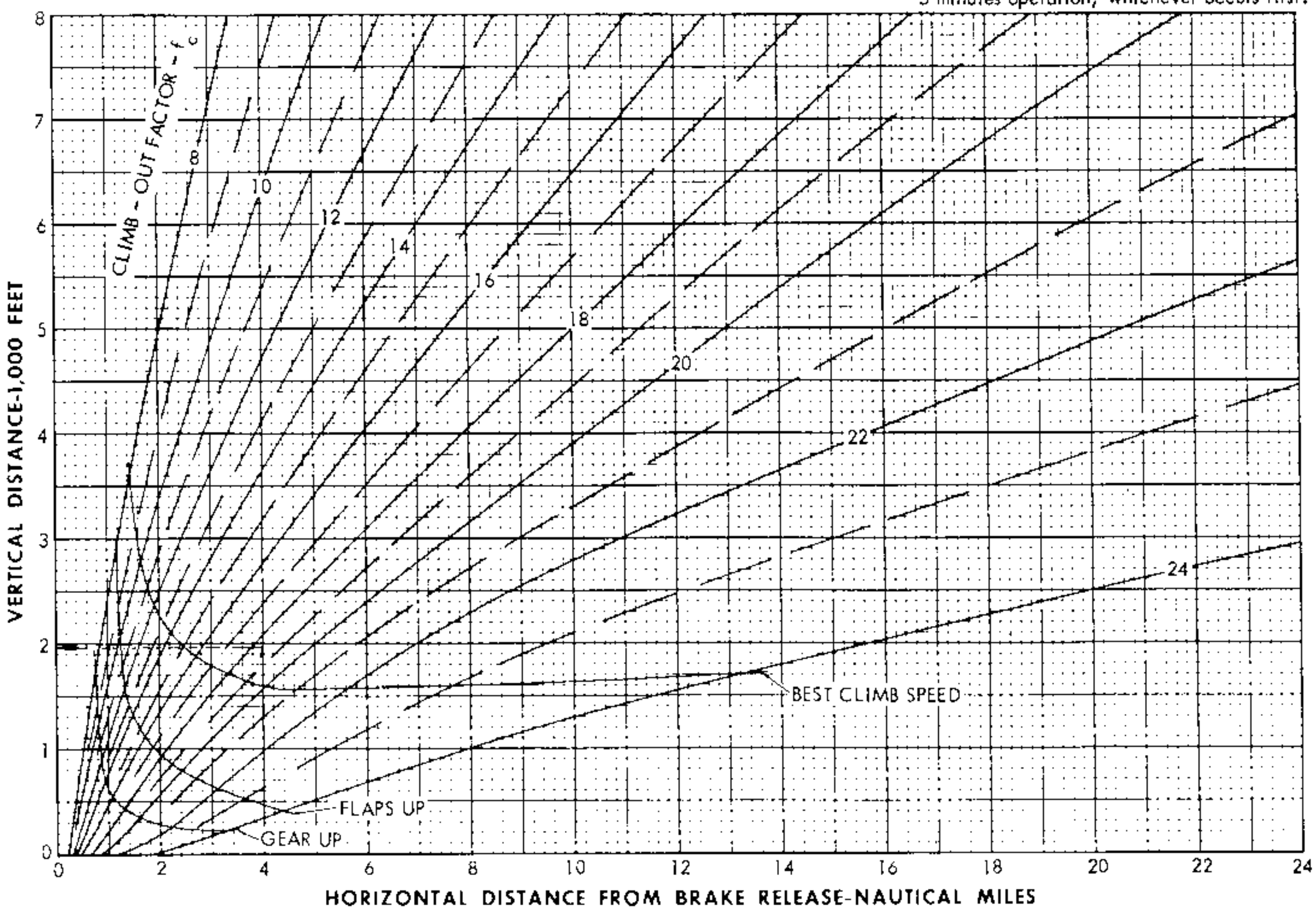
CLIMB-OUT FLIGHT PATH

4 ENGINES — MAXIMUM POWER
50 PERCENT FLAPS

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Horizontal distances from brake release are based on 4 - engine normal take-off.
2. Maintain maximum power until best climb speed is reached or 5 minutes operation, whichever occurs first.



FC-130-1-2-(74-1

Figure 11-24.

MODEL: EC-130G/Q
T56-A-423 ENGINES

CLIMB-OUT FACTOR FOR CLIMB-OUT FLIGHT PATH

3 ENGINES

DATE: JULY 1967
DATA BASIS: ESTIMATED

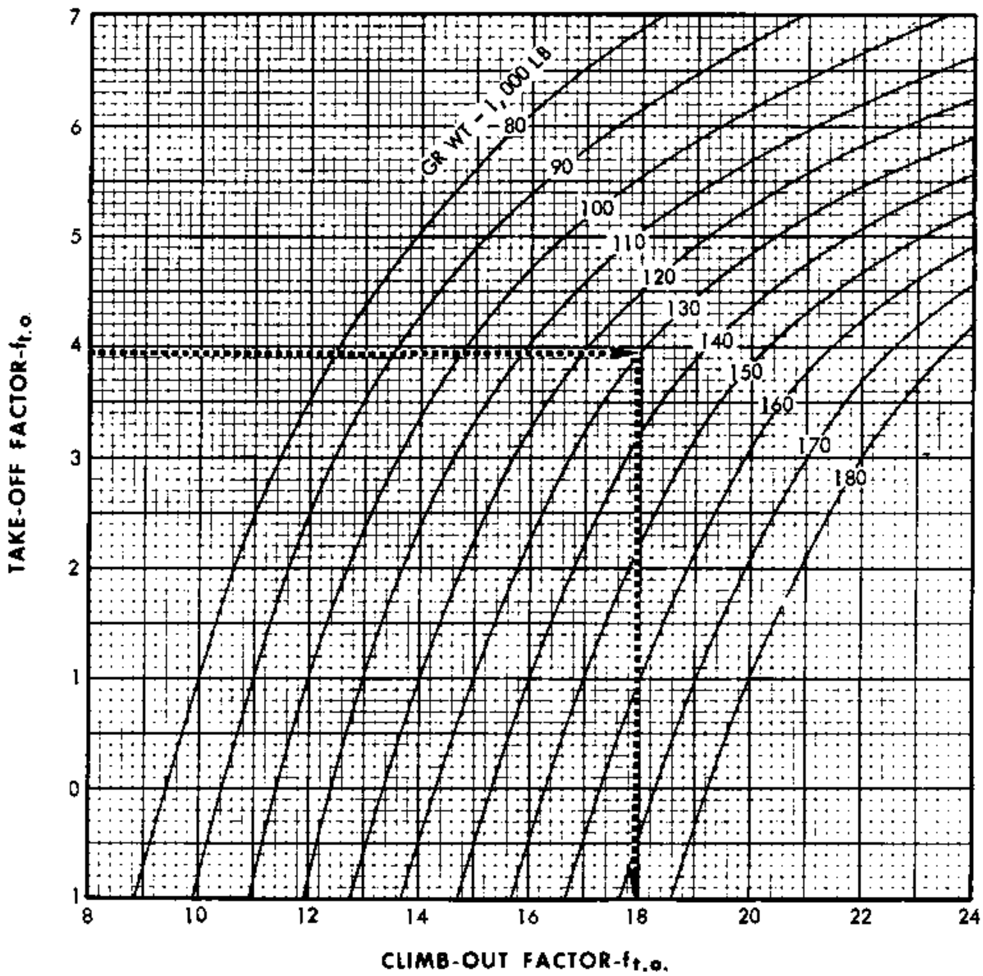


Figure 11-25.

CLIMB-OUT FLIGHT PATH

3 ENGINES MAXIMUM POWER

50 PERCENT FLAPS

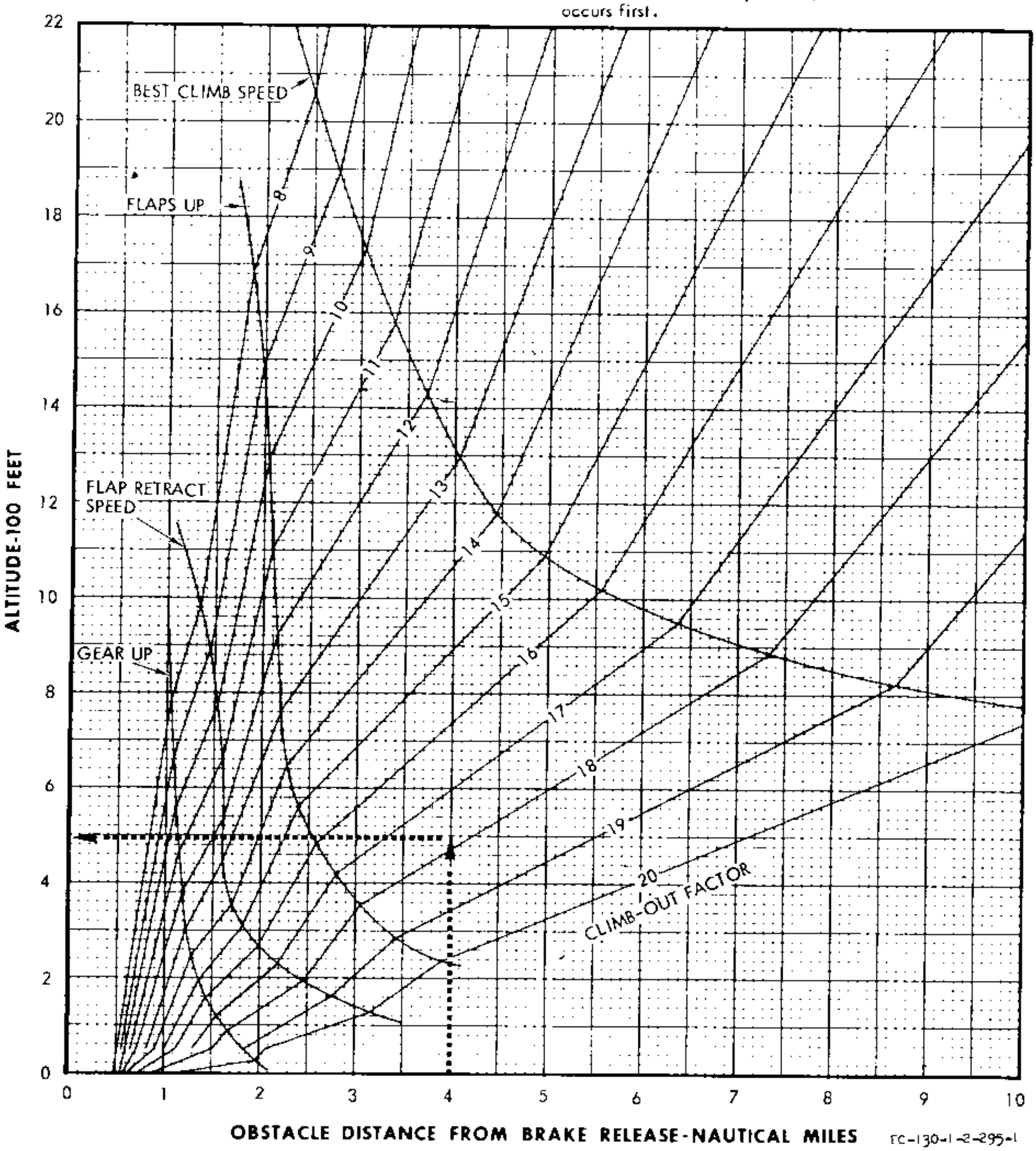
MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: MARCH 1971

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Obstacle distances from brake release are based on critical field length.
2. Maximum power until best climb speed is reached or 6 minutes operation, whichever occurs first.



FC-130-1-2-295-1

Figure 11-26. (Sheet 1 of 2)

CLIMB-OUT FLIGHT PATH

3 ENGINES MAXIMUM POWER

50 PERCENT FLAPS

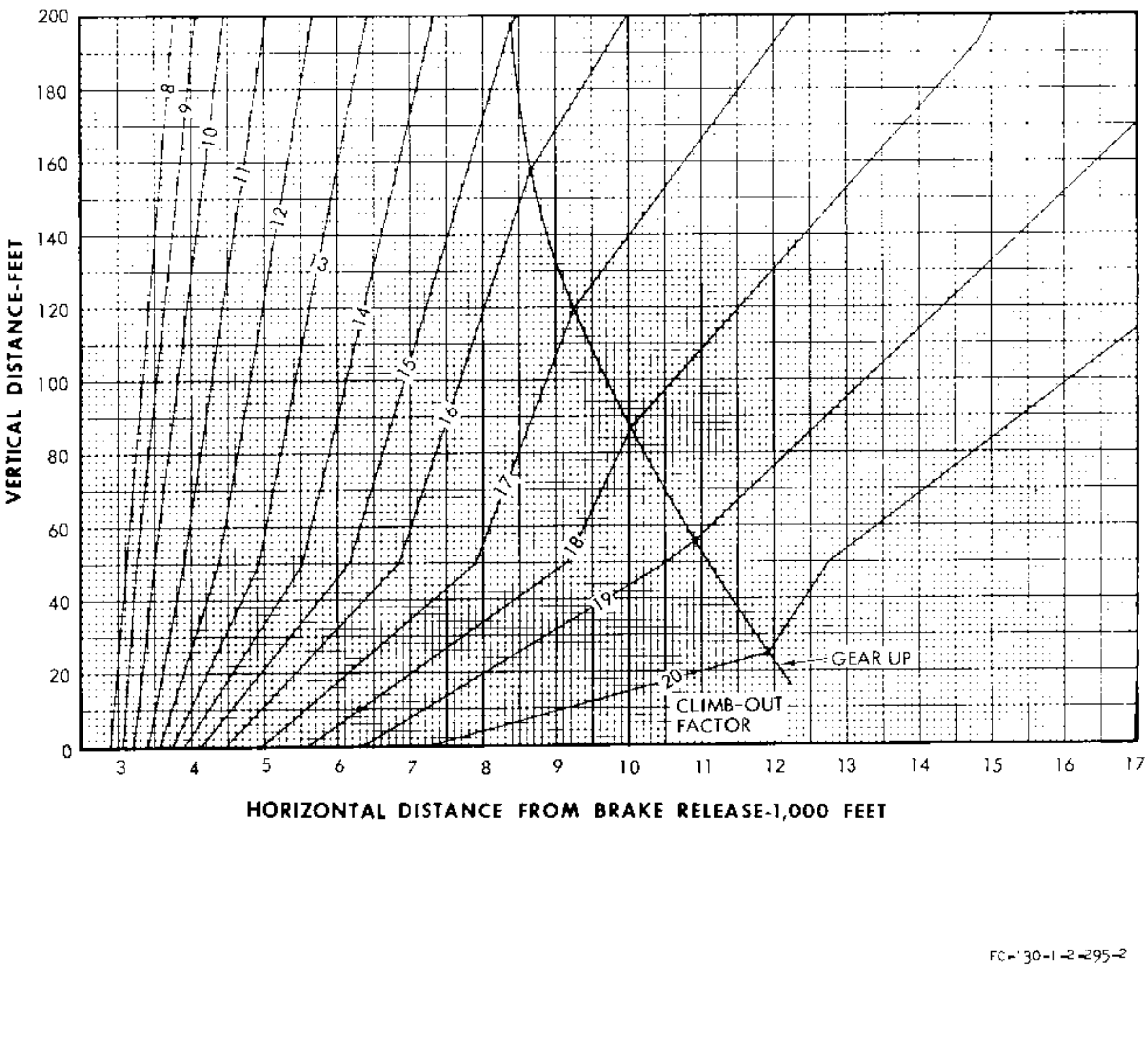


Figure 11-26. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

TAKE-OFF AND OBSTACLE CLEARANCE SPEED

4 AND 3 ENGINES 50 PERCENT FLAPS

NOTE

1. When V_{MCA} (in ground effect) is greater than the chart take-off speed, use this air minimum control speed. The obstacle clearance speed is the chart speed or air minimum control speed, whichever is higher.
2. Rotation speed is 5 KIAS less than plotted take-off speed but not less than air minimum control speed. V_{MCA} (one engine inoperative).
3. Minimum flap retraction speed is obstacle clearance speed plus 10 knots.
4. For maximum effort take-off the take-off speed is less than air minimum control speed for most conditions.

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

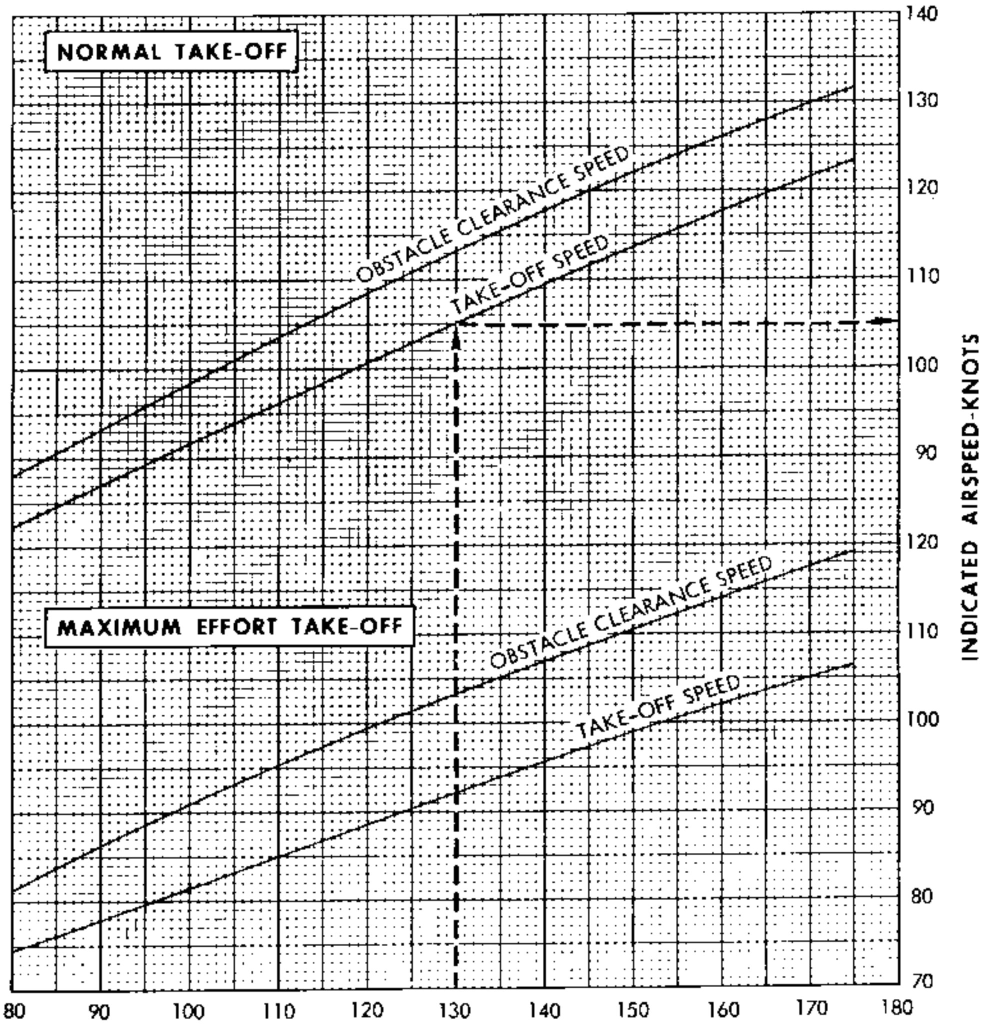


Figure 11-27.

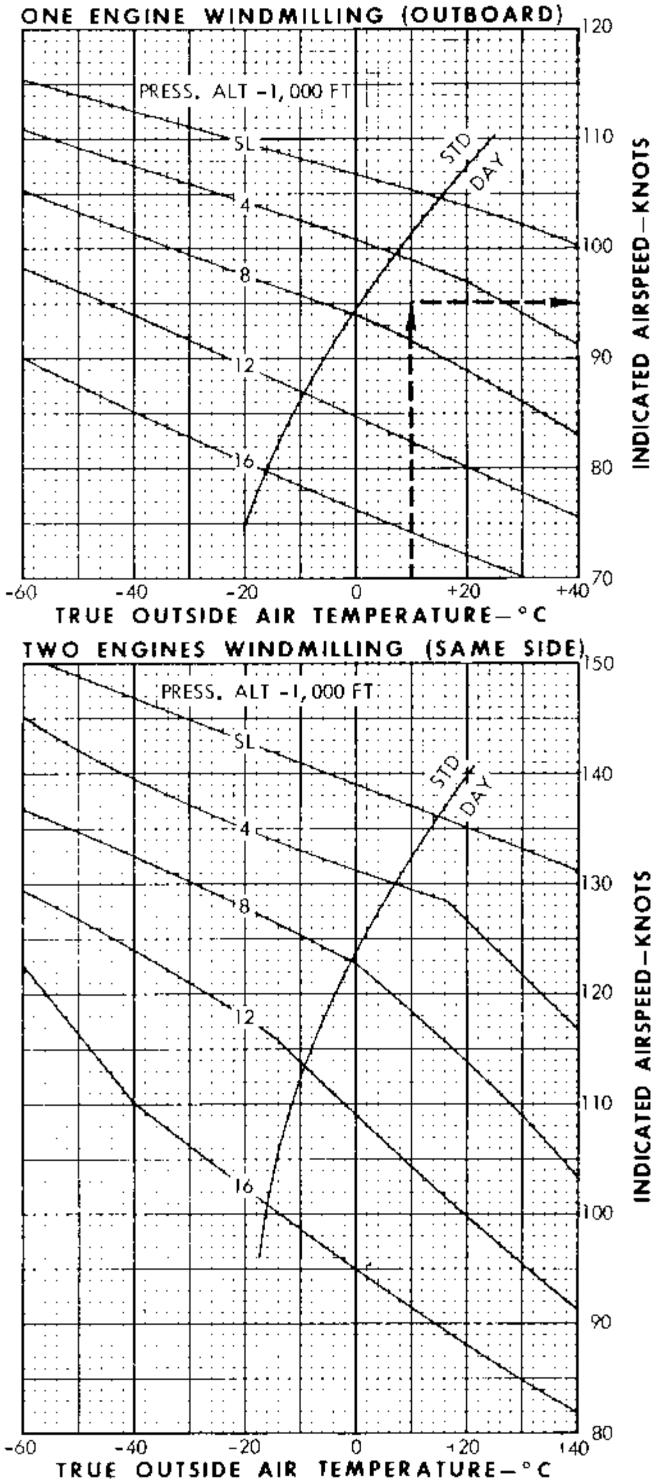
MODEL: EC-130G/Q
T-56-A-423 ENGINES

DATE: JULY 1967

DATA BASIS: ESTIMATED

AIR MINIMUM CONTROL SPEED IN GROUND EFFECT

50 PERCENT FLAPS GEAR DOWN



EC-130-1-2-298

Figure 11-28.

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: JULY 1967
DATA BASIS: ESTIMATED

AIR MINIMUM CONTROL SPEED
OUT OF GROUND EFFECT
50 PERCENT FLAPS GEAR DOWN

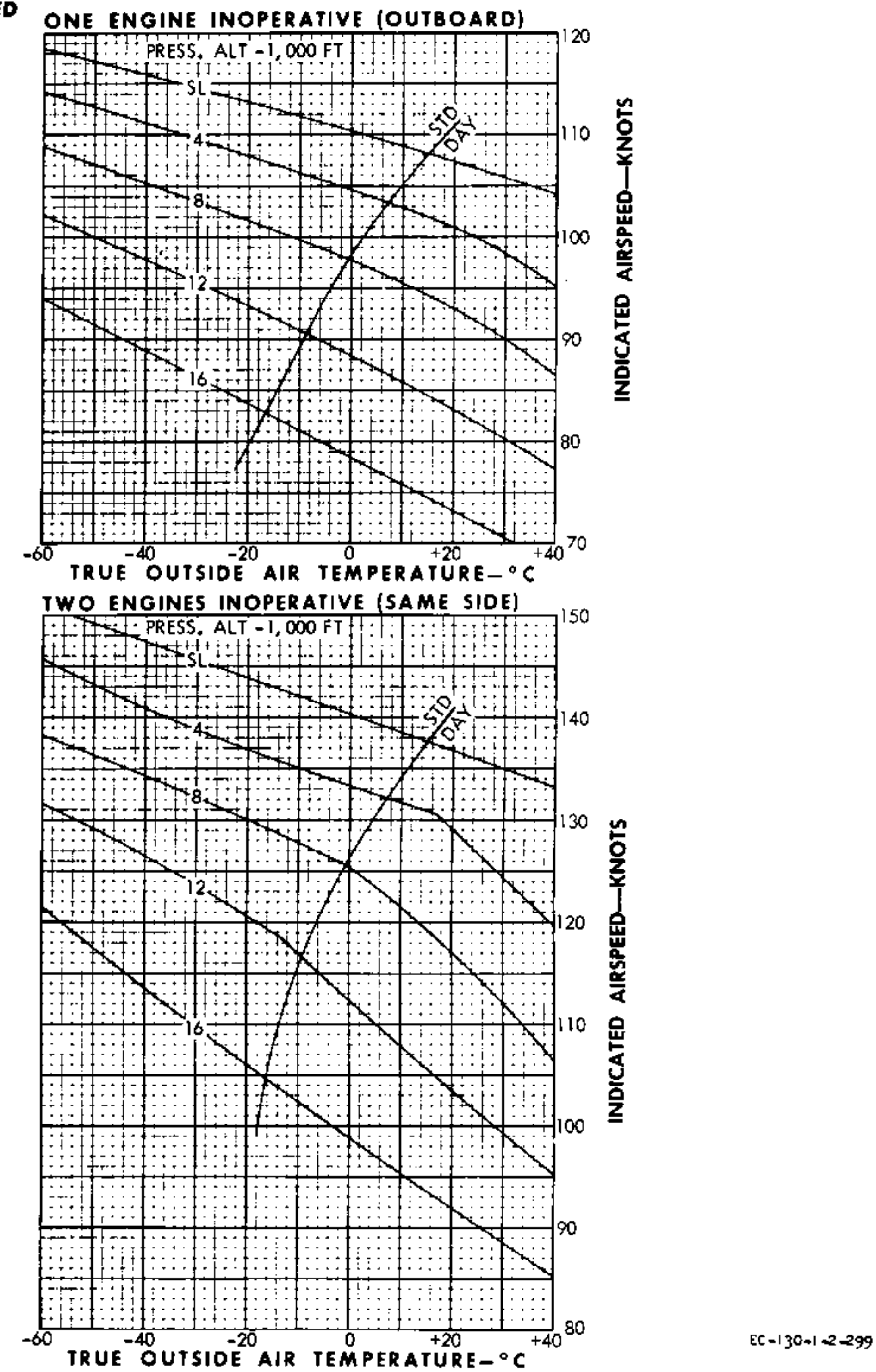


Figure 11-29.

MODEL: EC-130G/Q
T56-A-423 ENGINES

GROUND MINIMUM CONTROL SPEED

50 PERCENT FLAPS MAXIMUM POWER

NOTE

1. No. 1 engine windmilling.
2. Maximum rudder deflection.
3. 25 - foot deviation from centerline to rotation.

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

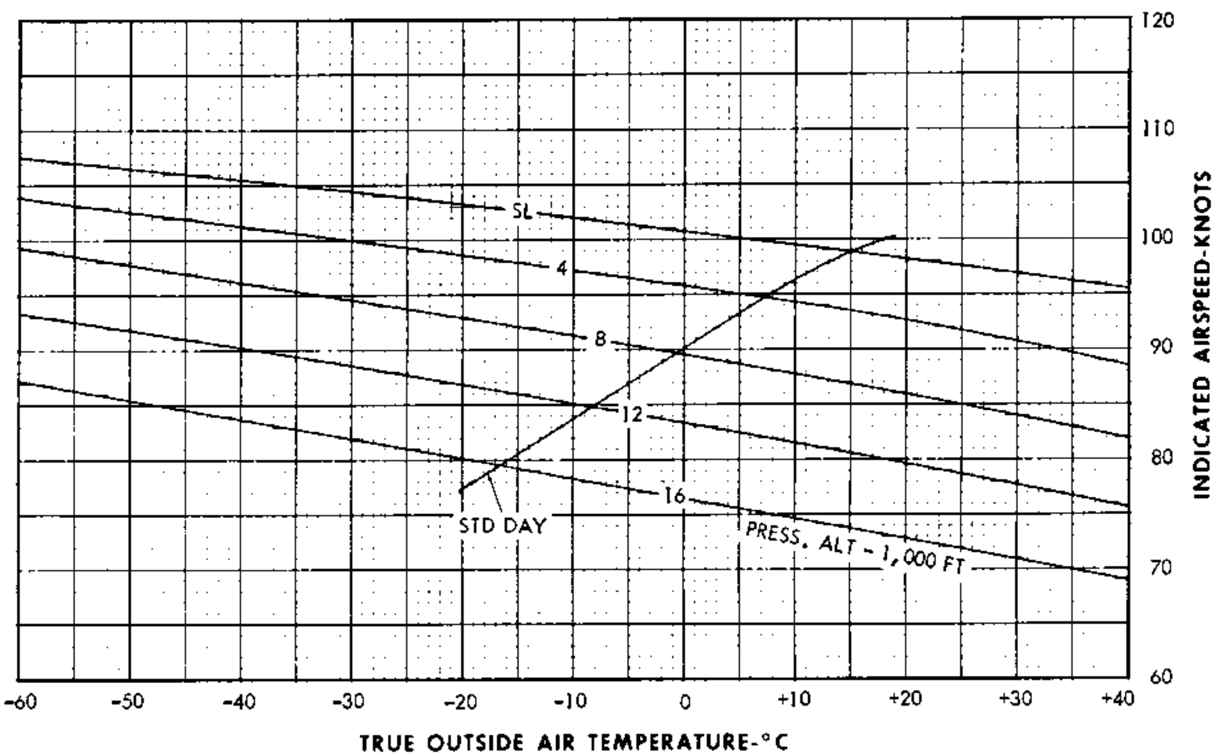


Figure 11-30.

EC-130-1-2-186

TAKE-OFF GROUND RUN

4 ENGINES NO ATO

50 PERCENT FLAPS

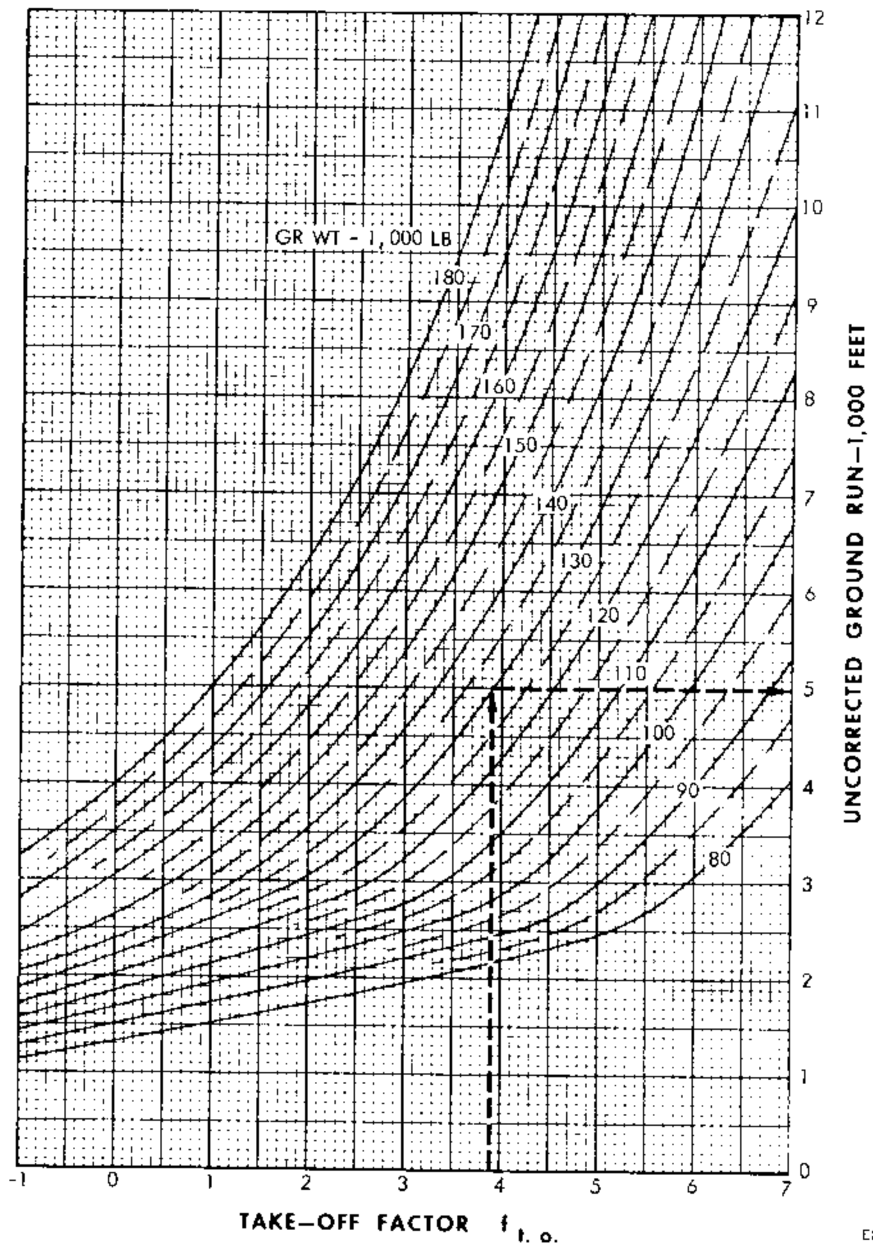
MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: JULY 1967

DATA: BASIS-ESTIMATED

NOTE

1. Use take-off speeds shown on the take-off and obstacle clearance speed chart.
2. Observe engine power limitations in Section V.
3. An RSC value of 10 is equivalent to one inch of slush or water.
4. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if the wind is recorded at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.
5. When determining total distance to 50 feet with wind, apply the wind correction to distance to 50 feet only.



EC-130-1-2-300-1

Figure 11-31. (Sheet 1 of 2)

TAKE-OFF GROUND RUN
4 ENGINES NO ATO
50 PERCENT FLAPS

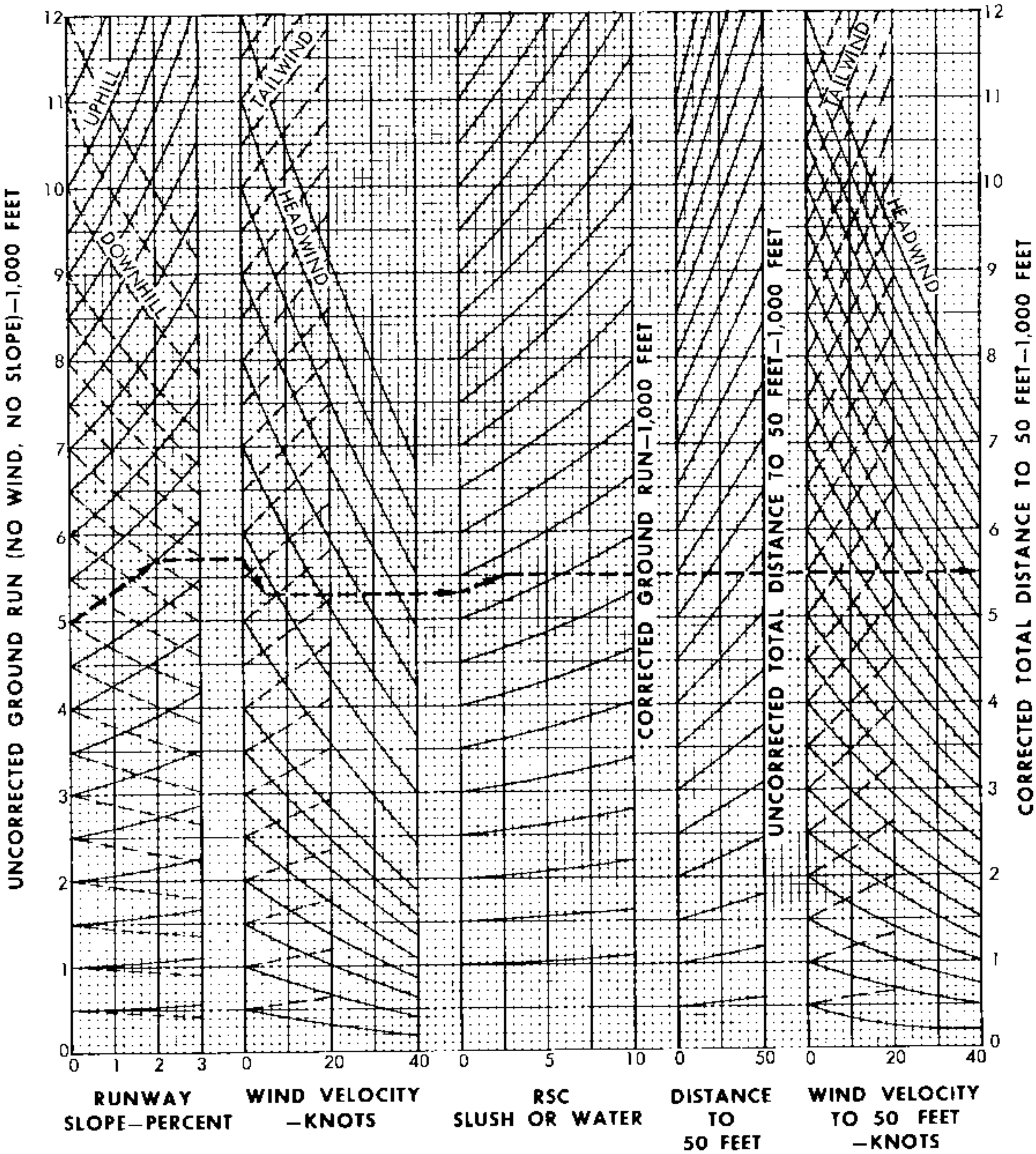


Figure 11-31. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

TAKE-OFF GROUND RUN
MAXIMUM EFFORT
4 ENGINES MAXIMUM POWER
50 PERCENT FLAPS NO ATO

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Use take-off speeds shown on the maximum effort take-off, obstacle clearance, and air minimum control speeds charts.
2. Observe engine power limitations in Section V.
3. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.

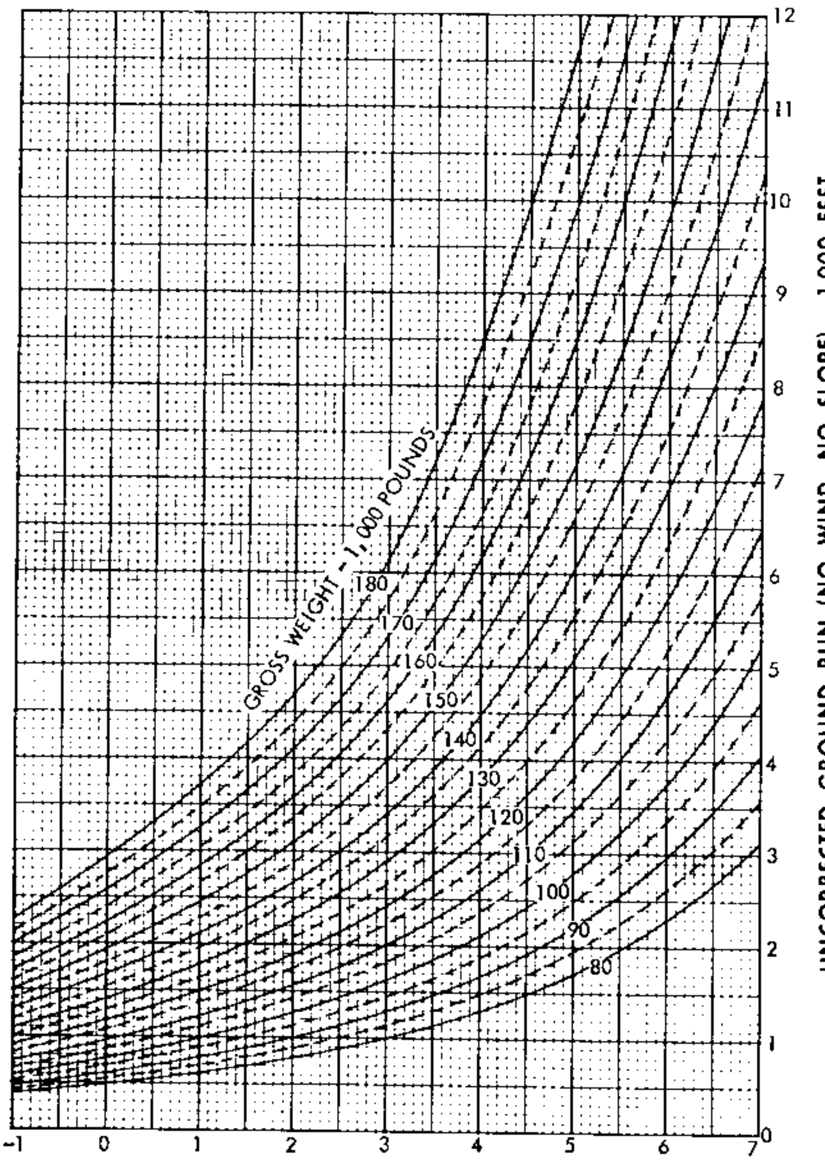


Figure 11-32. (Sheet 1 of 2)

EC-130-1-2-178-1

TAKE-OFF GROUND RUN
MAXIMUM EFFORT
4 ENGINES MAXIMUM POWER
50 PERCENT FLAPS NO ATO

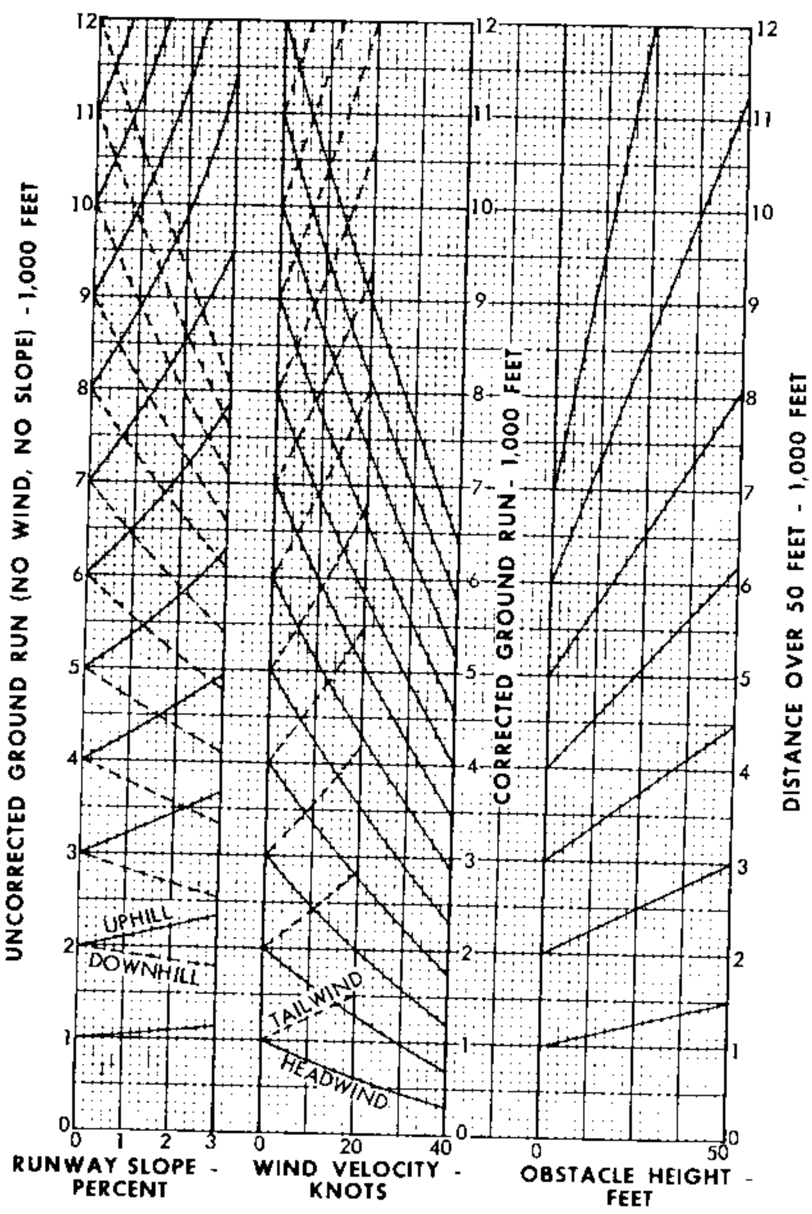


Figure 11-32. (Sheet 2 of 2)

EC-130-1-2-178-2

MODEL: EC-130G/Q
T56-A-423 ENGINES

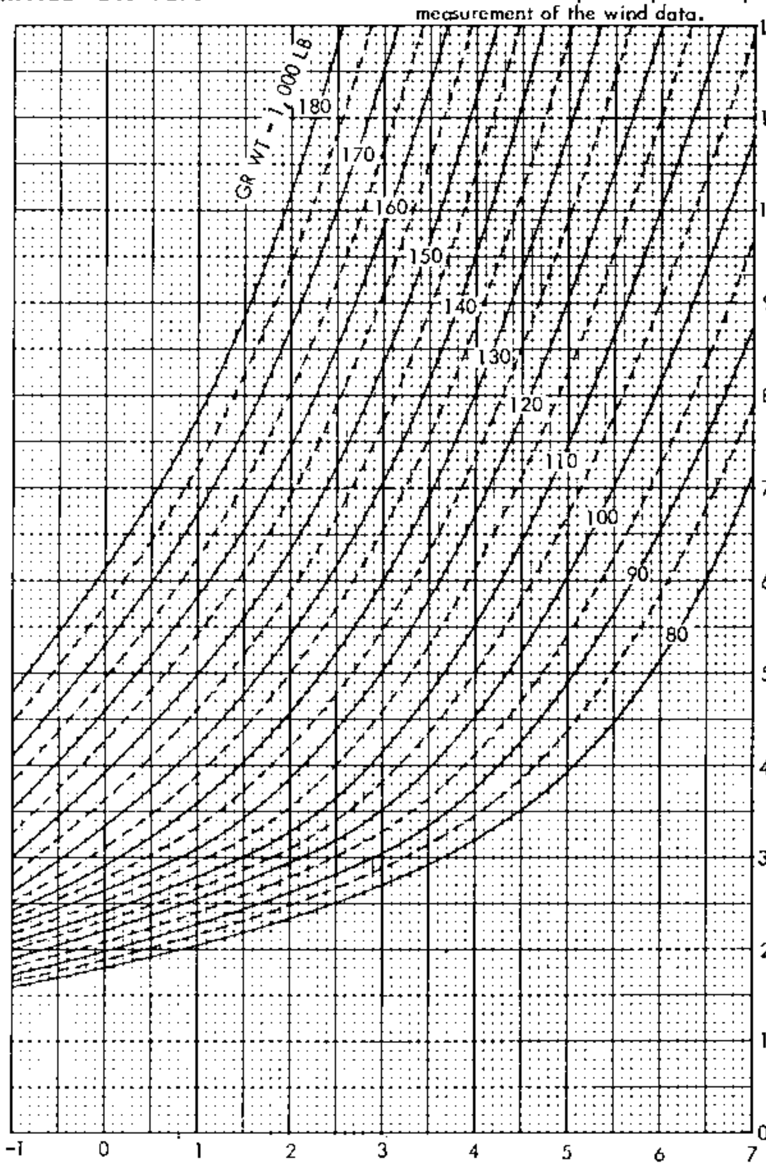
TAKE-OFF GROUND RUN

3 ENGINES MAXIMUM POWER
50 PERCENT FLAPS

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Use take-off speeds shown on the three engine take-off, obstacle clearance, and air minimum control speeds charts.
2. Observe engine power limitations in section V.
3. Propeller feathered on inoperative engine.
4. One outboard engine is assumed inoperative with power applied on asymmetric operative engine as directional control permits.
5. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.



EC-130-1-2-187-1

Figure 11-33. (Sheet 1 of 2)

TAKE-OFF GROUND RUN

3 ENGINES MAXIMUM POWER
50 PERCENT FLAPS

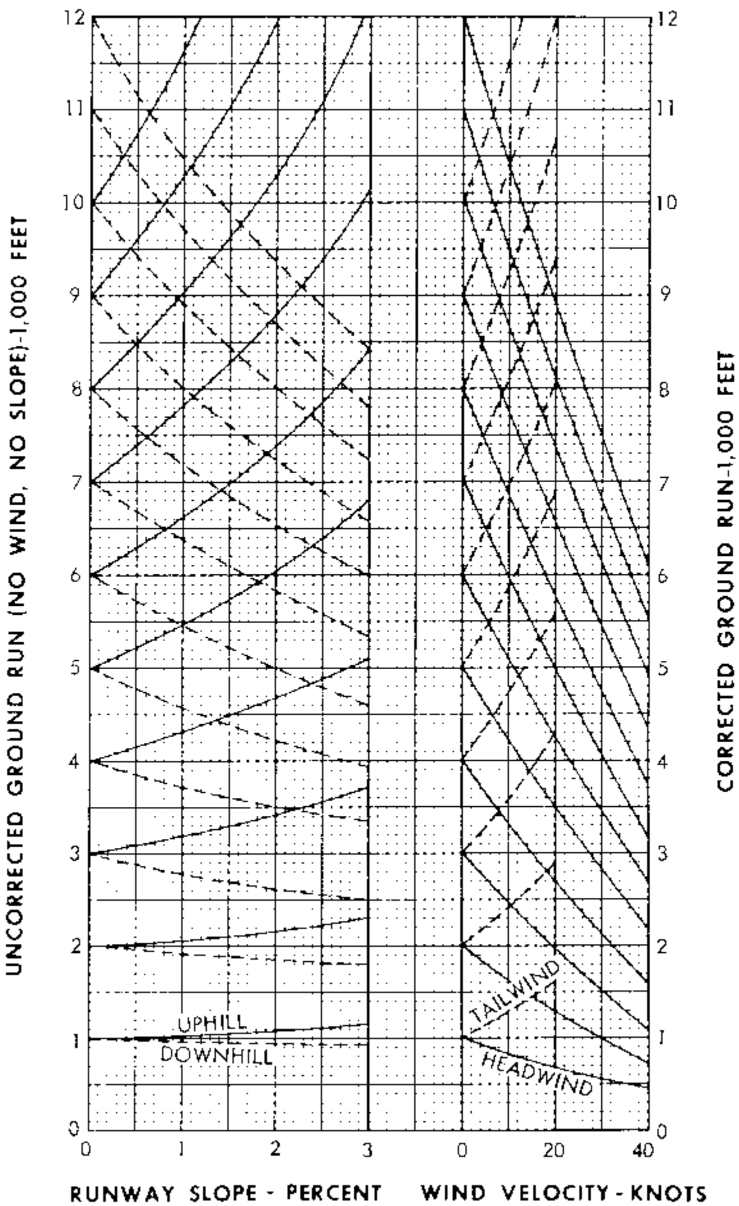


Figure 11-33. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56 A 423 ENGINES

DATE: April 1966

DATA BASIS: ESTIMATED

TAKE-OFF CROSSWIND CHART

50 PERCENT FLAPS

EXAMPLE:

GIVEN: Take-off Runway 12 wind 180° at 20 knots gusting to 32 knots. Gross weight 135,000 pounds.

FIND: Is take-off in normal zone at predicted take-off speed.

SOLUTION:
1. From take-off speed chart determine predicted take-off speed of 107 knots.
2. Runway wind angle is (180°— 120°) = 60°C .
3. At wind velocity (with gusts) of 32 knots and 60° runway wind angle, find crosswind component of 28 knots.
4. Proceed vertically to predicted take-off speed of 107 knots and determine take-off is in the CAUTION zone.
5. Increase the take-off speed until the recommended zone is reached or until the airspeed has been increased 10 knots. The new take-off speed is 117 knots.

REMARKS: See text for explanation of crosswind take-offs.

If take-off is made in the caution zone, a slight yaw may be expected between rotation and lift-off.

See Section II for crosswind taxiing capabilities.

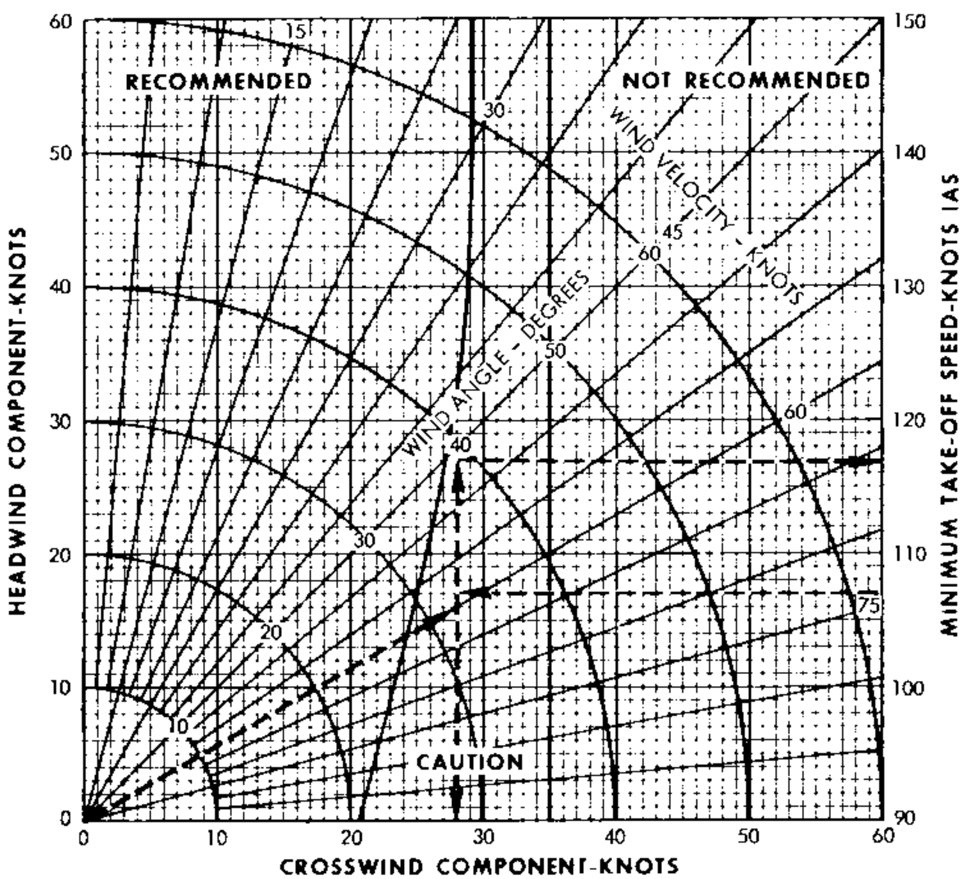


Figure 11-34.

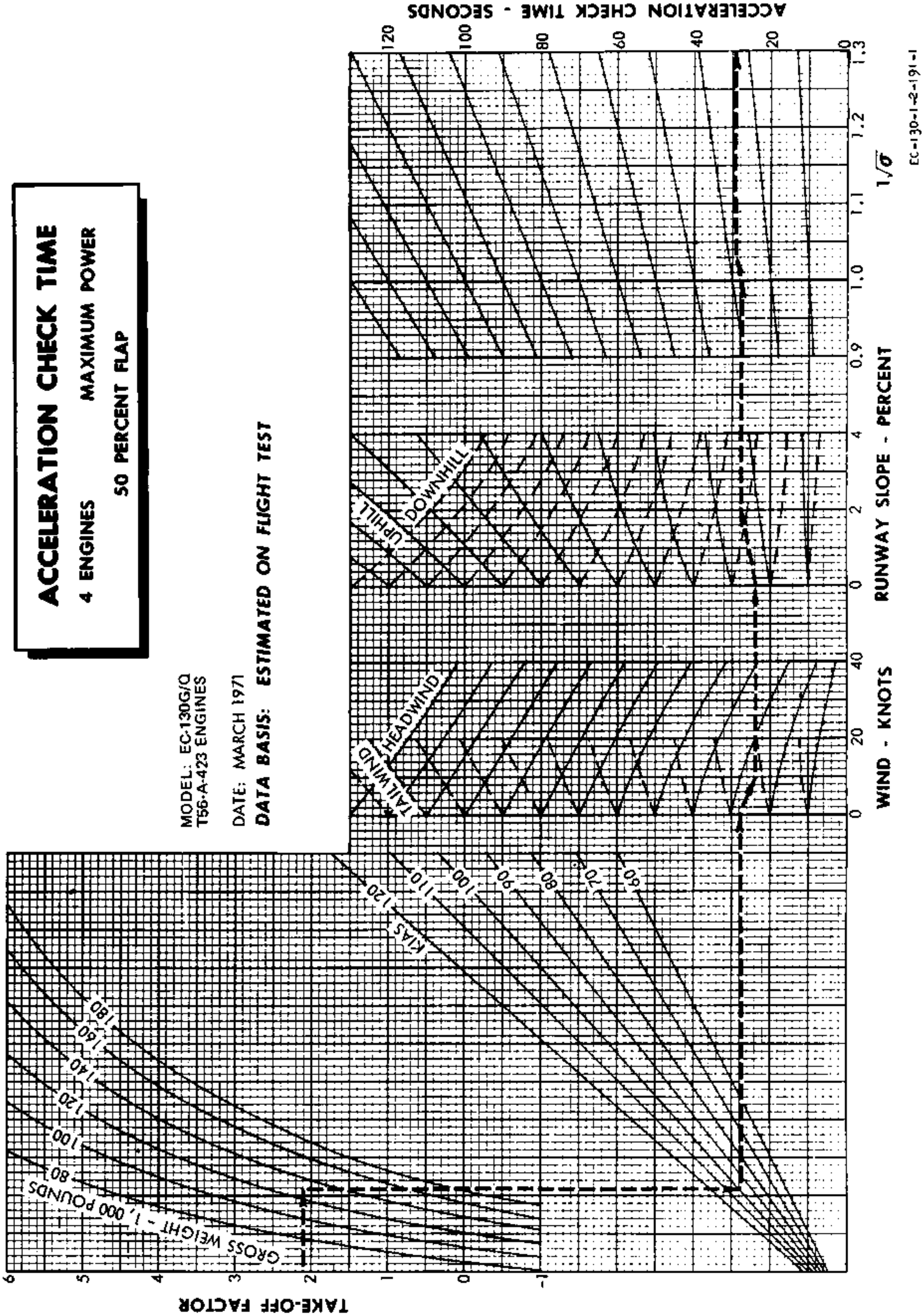


Figure 11-35. (Sheet 1 of 2)

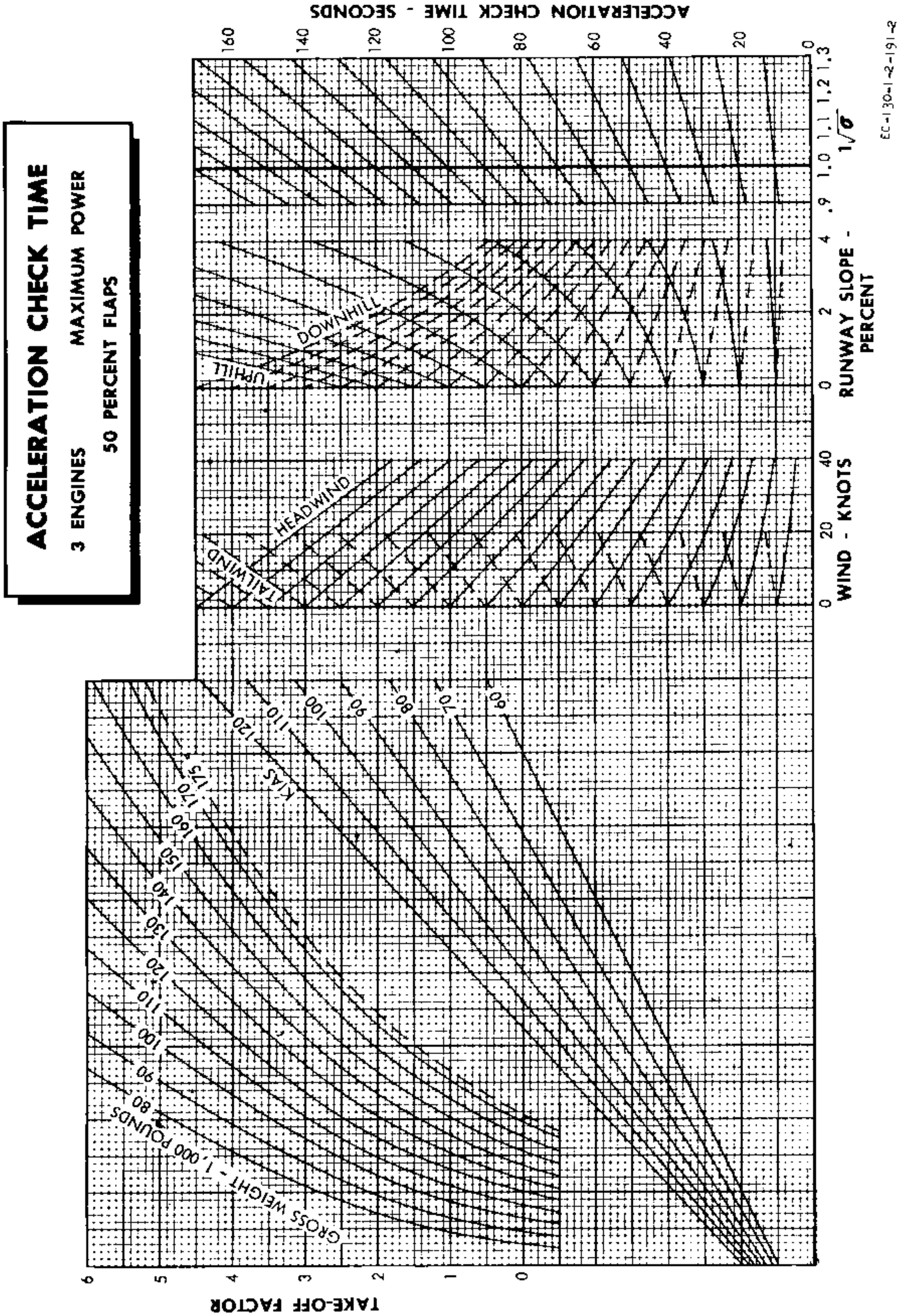


Figure 11-35. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

EFFECT OF RUNWAY SLOPE ON NORMAL TAKE-OFF DISTANCE

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Three-engine climb gradient at lift-off is equal to runway slope.
2. Downhill gradient limit below which retarding force of brakes is ineffective.

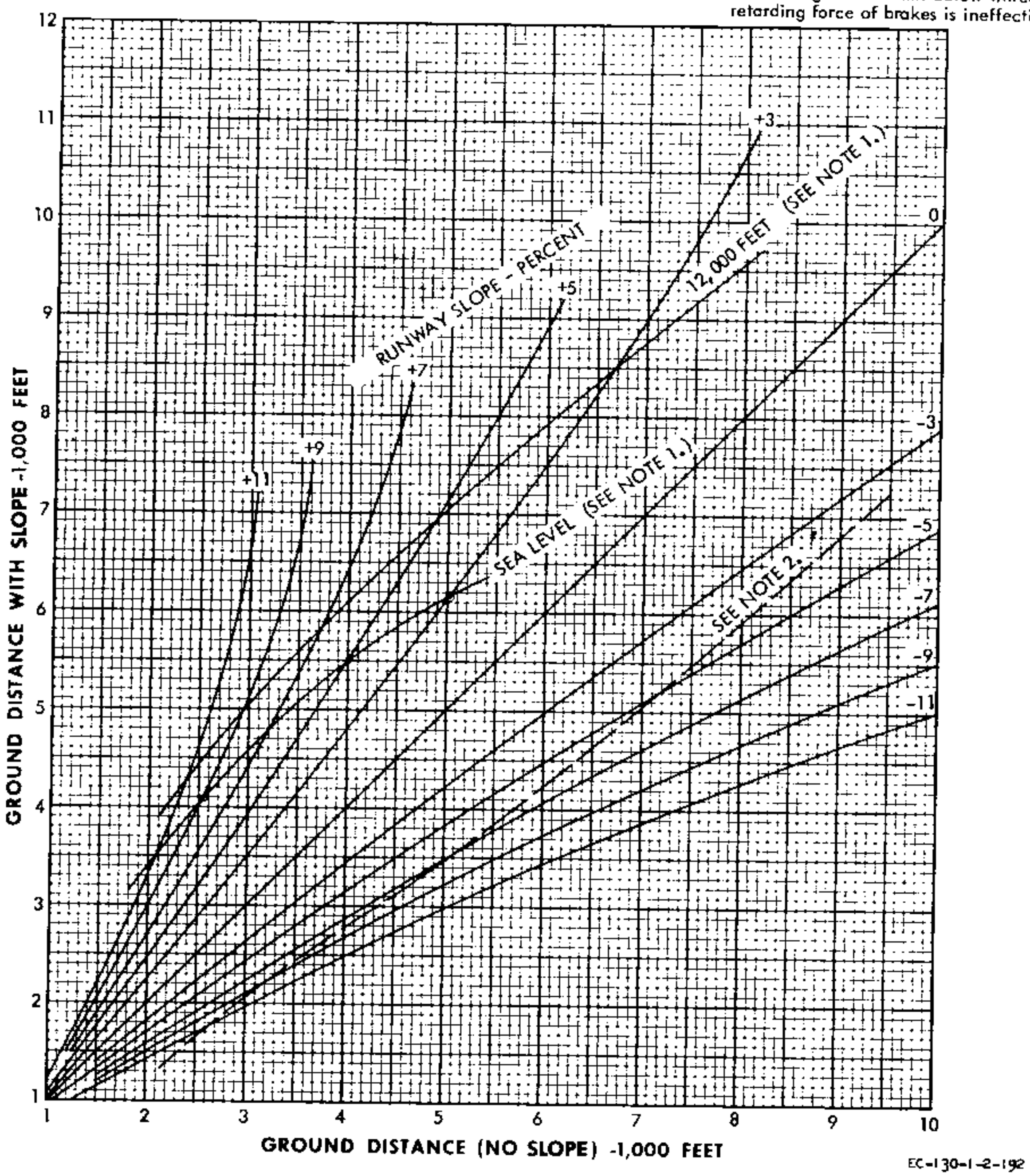


Figure 11-36.

PART 4

CLIMB PERFORMANCE

CLIMB.

Charts are presented to find the time, distance, and fuel required to climb from any altitude to any other altitude up to the service ceiling. Service ceiling is the altitude where the aircraft rate of climb capability is 100 feet per minute. Charts of recommended climb speeds are shown also. It is recommended that the normal power cruise ceiling not be exceeded for cruise operation, as the range capability is decreased above this altitude. Cruise ceiling is the altitude where the aircraft rate of climb capability is 300 feet per minute. The standard-day cruise and service ceilings are shown on the climb charts. To find the temperature effect on ceilings, refer to Part 5.

Climb may be performed at maximum continuous power, 1,010°C TIT. TIT gages occasionally give erroneous readings indicating lower than actual TIT's. Prolonged operation at TIT settings greater than recommended results in abnormally fast engine deterioration.

Climb at 970°C TIT significantly reduces sulfidation and erosion of the turbine and turbine inlet guide vanes. Figure 11-37 provides climb data for 970°C TIT.

FOUR-ENGINE CLIMB.

The four-engine climb charts for time, distance, fuel, and speeds are presented in figures 11-38 through 11-41 for climb at maximum continuous power (1,010° C TIT). The data are presented as a function of gross weight. The guidelines extending upward from the weight scale represent the effect of fuel burnoff during the climb. Since fuel burnoff has a negligible effect on the climb speeds, the guidelines are not shown on the climb speed chart. Temperature affects the climb time, distance, and fuel as shown in terms of deviation from the standard temperature for a range of ±20° C from standard. Climb performance deteriorates with anti-icing bleed on. Use the all bleed on correction chart (figure 11-42) for the effect on four-engine climb performance.

Example of Use of Charts.

GIVEN:

Four-engine operation.

Begin climb weight - 138,000 pounds.

OAT - 25° C (Standard +10° C).

Begin cruise at 20,500 feet pressure altitude.

Climb power - Maximum continuous.

FIND:

Time, distance, and fuel to climb.

Climb speed at 10,000 feet.

Distance and fuel if anti-icing system is used.

PROCEDURE:

Enter the time to climb chart (figure 11-38) with 138,000 pounds at zero variation from standard day. Follow the guidelines to standard +10° C, move vertically to the baseline on the time to climb scale, follow parallel to the guidelines, and interpolate for a pressure altitude of 20,500 feet. Next move horizontally and read a time to climb of 14.4 minutes. In a similar manner, read a distance to climb (figure 11-39) of 50 nautical miles, and fuel to climb (figure 11-40) of 1,660 pounds. To determine the best indicated climb speed at 10,000 feet, enter the four-engine normal power climb speed chart (figure 11-41) at a pressure altitude of 10,000 feet, interpolate for 138,000 pounds, and move down vertically to the zero baseline on the temperature variation scale. Next, move upward parallel to the guidelines to standard +10° C, then upward vertically to the scale, and read an indicated airspeed of 174 knots. To determine the effect of anti-icing bleed on climb, enter figure 11-42 with normal bleed values for a standard day - 10° C, and read time, distance, and fuel to climb, as follows:

Time 25.8 minutes

Distance 85 nautical miles

Fuel to climb 2,580 pounds

THREE-ENGINE CLIMB.

The data presented for three-engine climb (figures 11-43 through 11-46) are shown for maximum continuous power, 1,010° C TIT. These charts are used in the same manner as the four-engine climb charts.

EMERGENCY CLIMB.

Emergency climb charts are presented in figures 11-47, 11-48, and 11-49. These charts may be used to determine the go-ground capability, should it be necessary, with 50 percent flaps for four, three, or two engines operative. The rate of climb is shown with the landing gear down. With the landing gear up, add 100 feet per minute to the rate of climb shown.

Example of Use of Charts.

GIVEN:

Gross weight: 110,000 pounds.

Pressure altitude: 5,000 feet.

Indicated airspeed: 145 knots.

OAT: -5° C (Standard -10° C).

Four-engine operation.

FIND:

The maximum rate of climb.

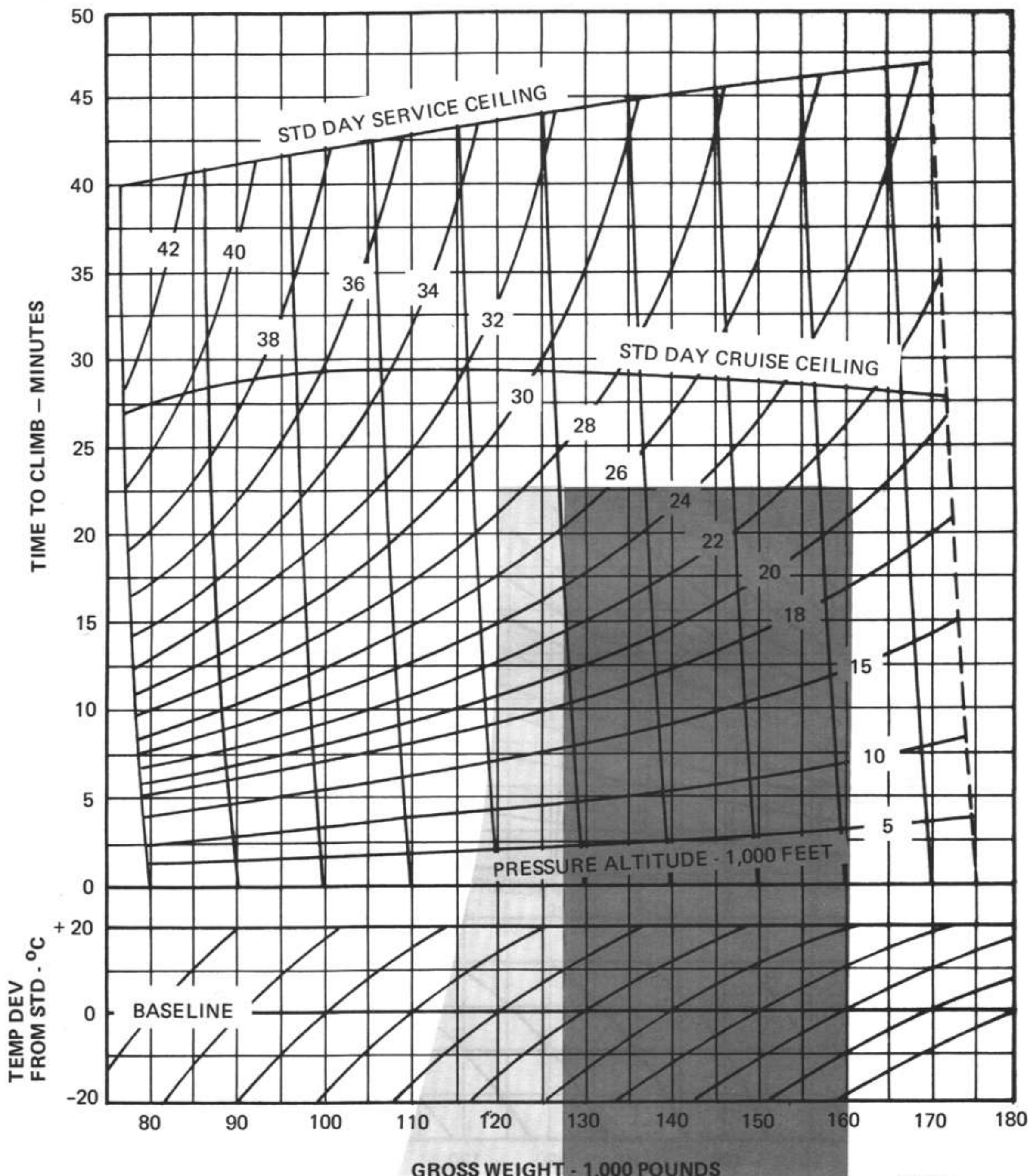
PROCEDURE:

Enter figure 11-47 with -5°C, move up to the interpolated 5,000-foot line, then move to the right intersecting the 110,000 pound weight line. The rate of climb is read as 2,620 FPM on the horizontal scale below. Moving up from the intersection to the SL to 8000 foot line, a climb speed of 137 KIAS is found.

MODEL: C-130H
T56-A-423 ENGINES
DATE: FEBRUARY 1974
DATA BASIS: CATEGORY II FLIGHT TEST

TIME TO CLIMB

4 ENGINES 970°C TIT



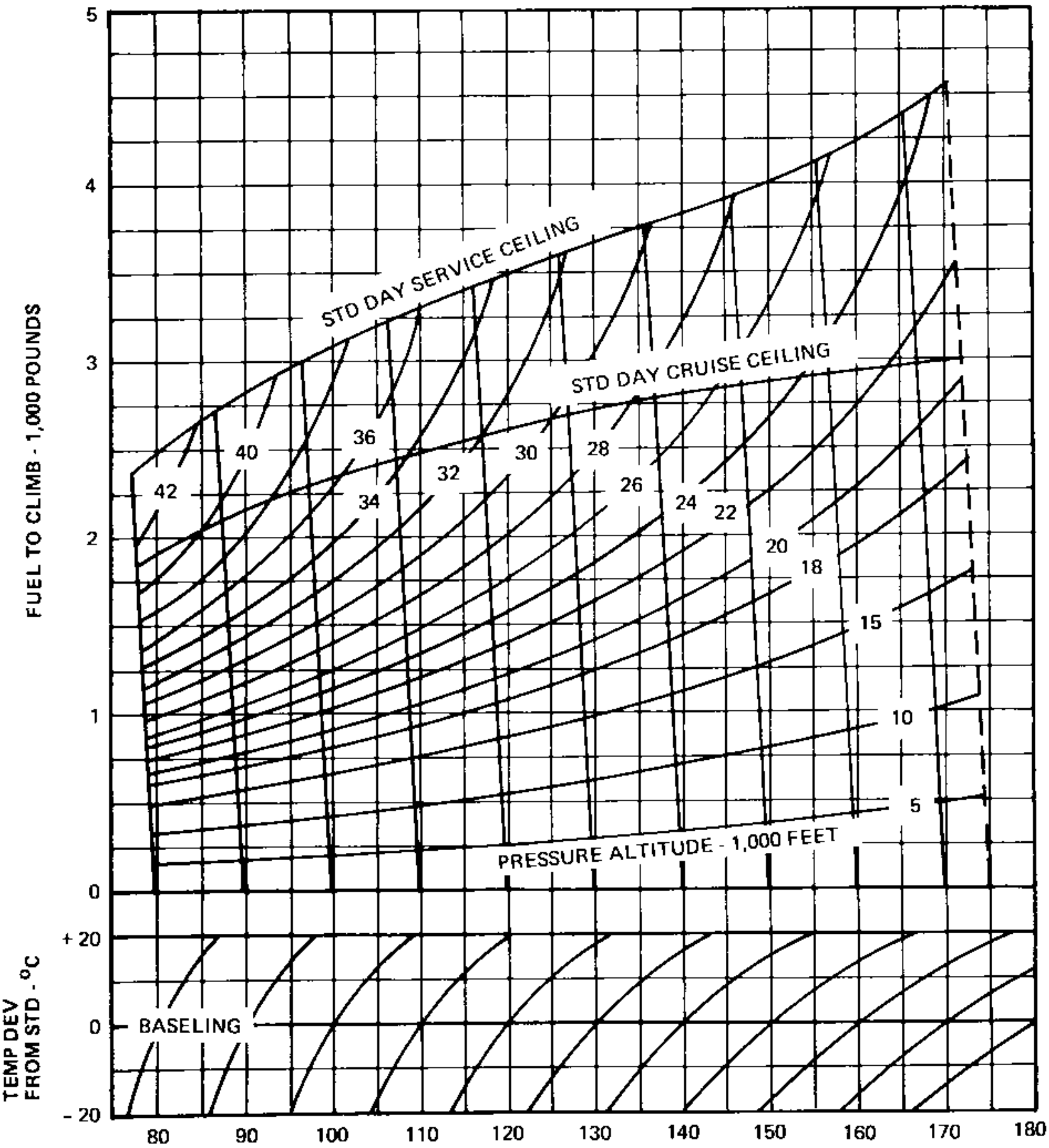
N 1/76
130B-(1-1)-X10/4-0410
(WP-OC-15F

Figure 11-37. (Sheet 1 of 4)

MODEL: C-130H
T56-A-423 ENGINES
DATE: FEBRUARY 1974
DATA BASIS: CATEGORY II FLIGHT TEST

FUEL TO CLIMB

4 ENGINES 970°C TIT



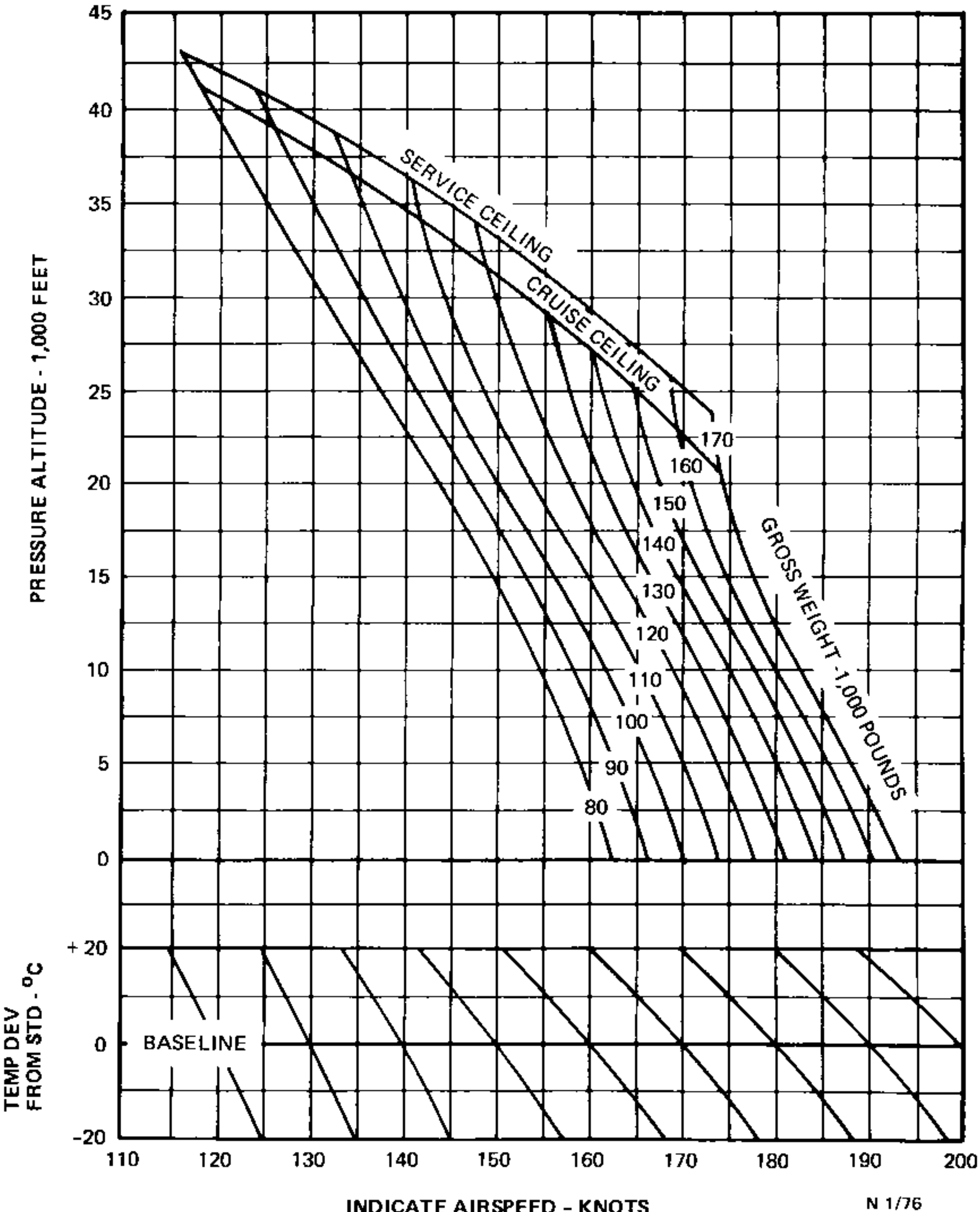
N 1/76
130B-(1-1)-X10/4-0412
(WP-OC-15F)

Figure 11-37. (Sheet 2 of 4)

MODEL: C-130H
T56-A-423 ENGINES
DATE: FEBRUARY 1974
DATA BASIS: CATEGORY II FLIGHT TEST

CLIMB SPEEDS

4 ENGINES 970°C TIT



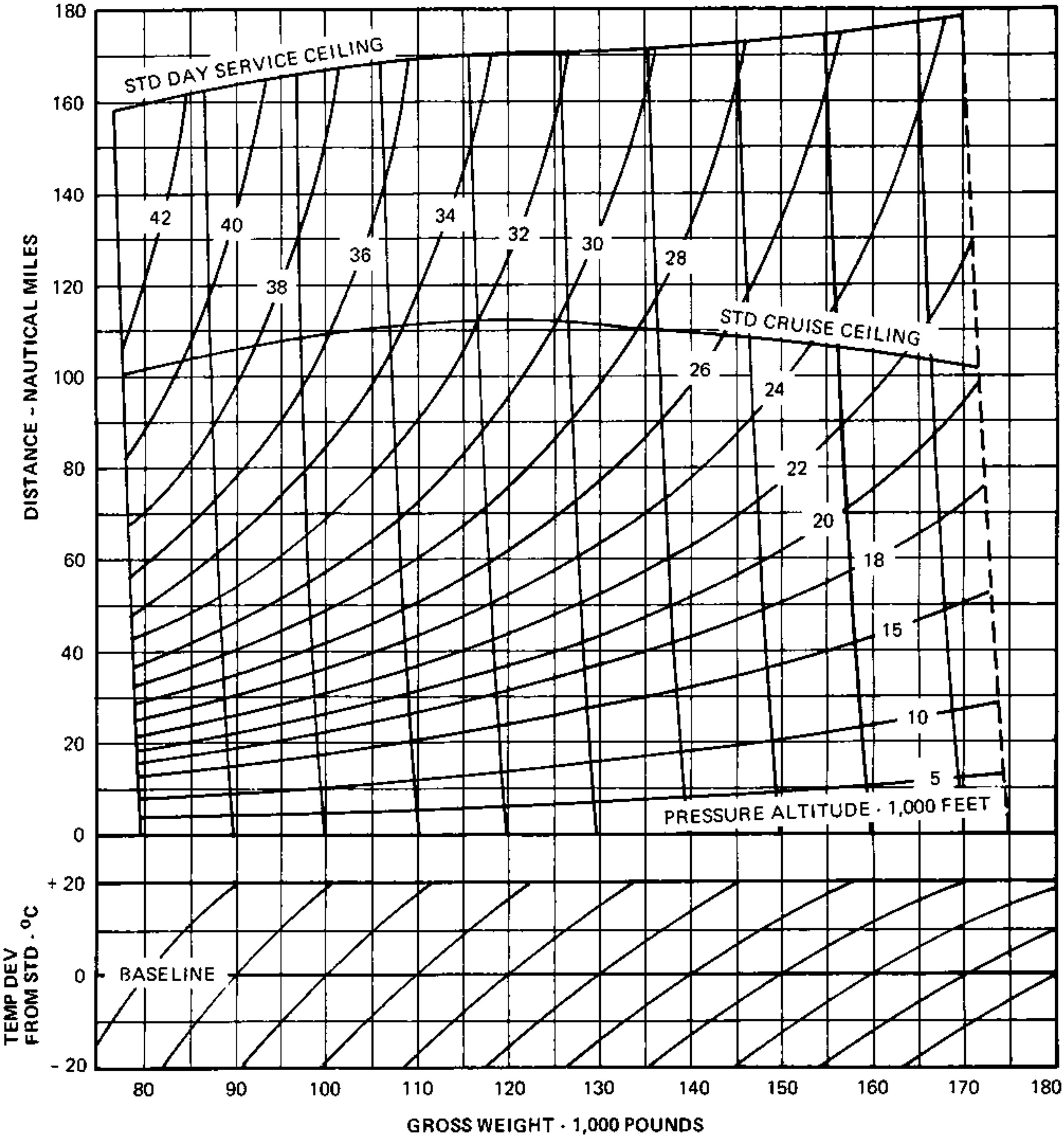
N 1/76
130B-(1-1)-X10/4-0413
(WP-OC-15F)

Figure 11-37. (Sheet 3 of 4)

MODEL: C-130H
T56-A-423 ENGINES
DATE: FEBRUARY 1974
DATA BASIS: CATEGORY II FLIGHT TEST

DISTANCE TO CLIMB

4 ENGINES 970°C TIT



N 1/76
130B-(1-1)-X10/4-0411
(WP-)C-15F)

Figure 11-37. (Sheet 4 of 4)

MODEL: EC-130G/Q
T56-A-423 ENGINES

TIME TO CLIMB
4 ENGINES
MAXIMUM CONTINUOUS POWER

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

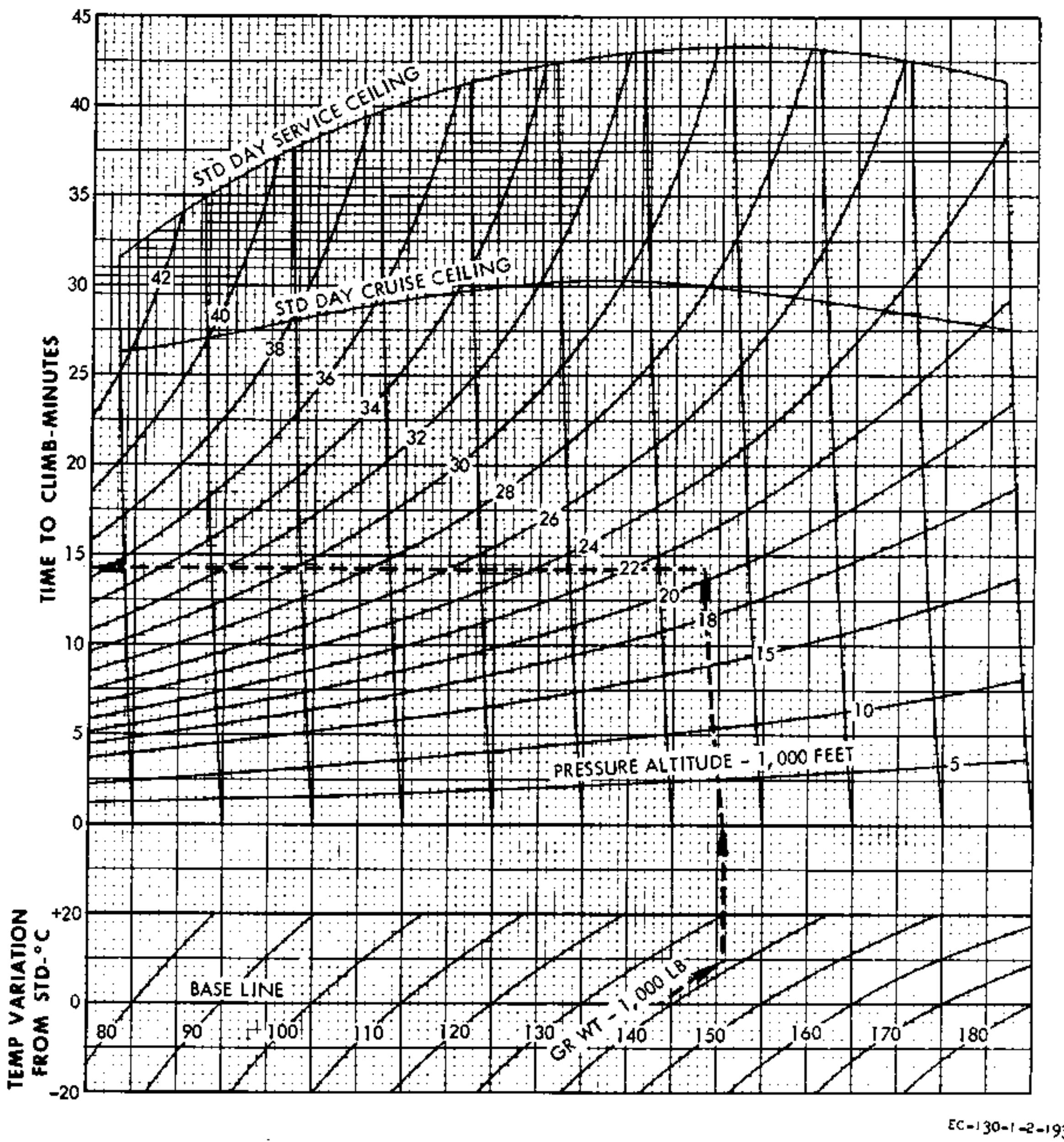
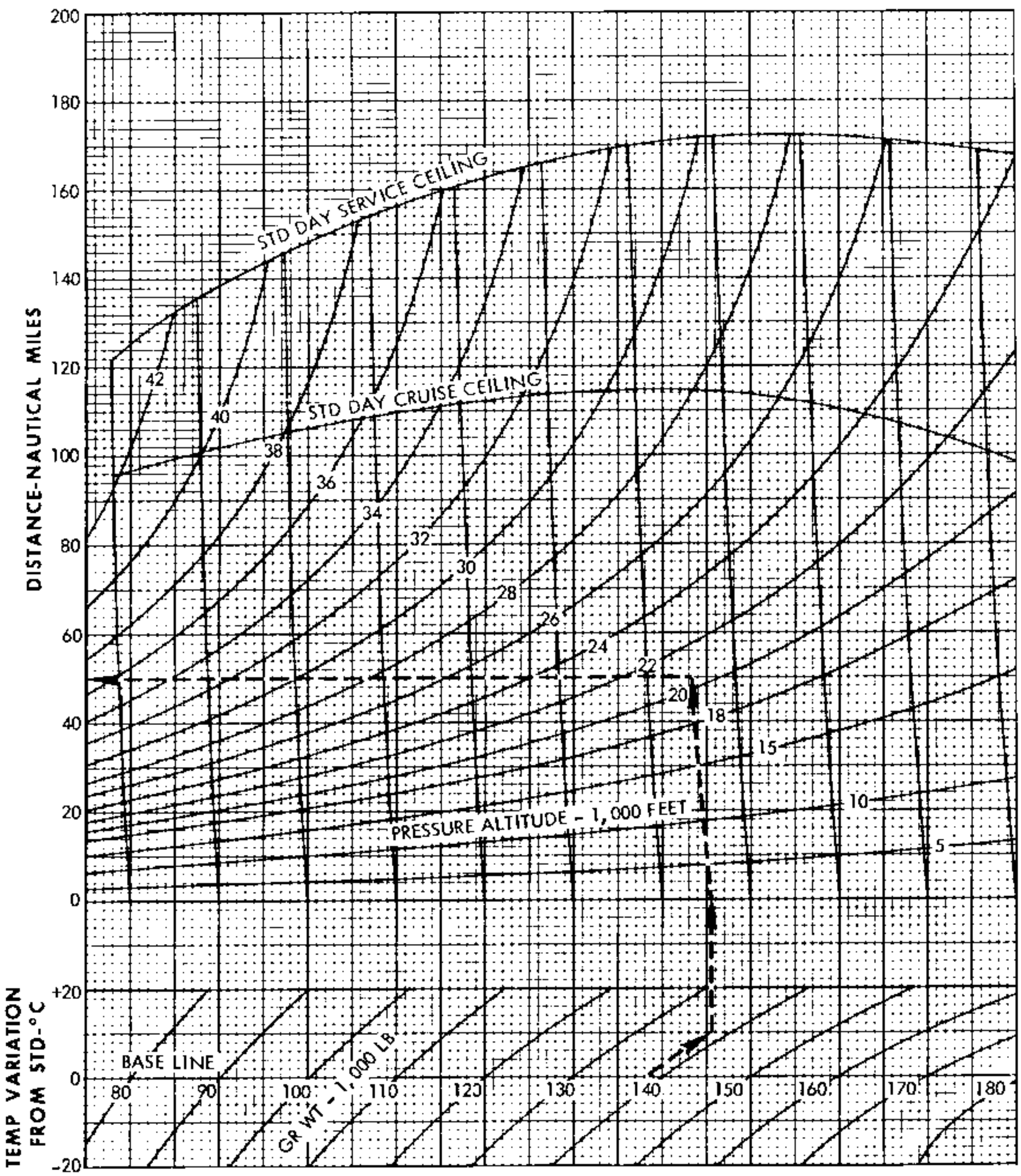


Figure 11-38.

MODEL: EC-130G/Q
T56-A-423 ENGINES

DISTANCE TO CLIMB
4 ENGINES
MAXIMUM CONTINUOUS POWER

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST



EC-130-1-2-194

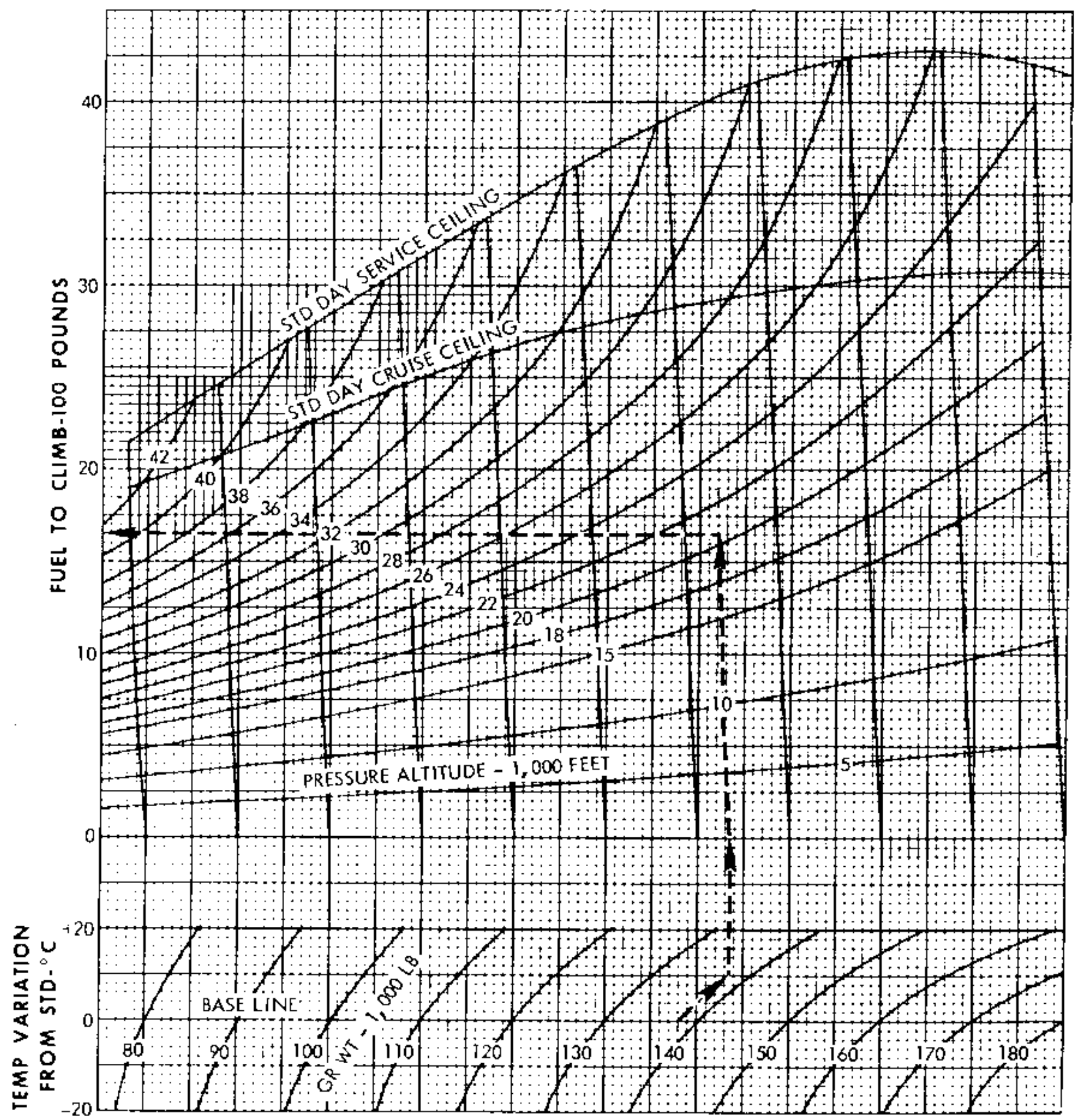
Figure 11-39.

MODEL: EC-130G/Q
T56-A-423 ENGINES

FUEL TO CLIMB
4 ENGINES
MAXIMUM CONTINUOUS POWER

DATE: APRIL 196?

DATA BASIS: ESTIMATED ON FLIGHT TEST



EC-130-1-2-195

Figure 11-40.

MODEL: EC-130G/Q
T56-A-423 ENGINES

CLIMB SPEEDS
4 ENGINES
MAXIMUM CONTINUOUS POWER

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

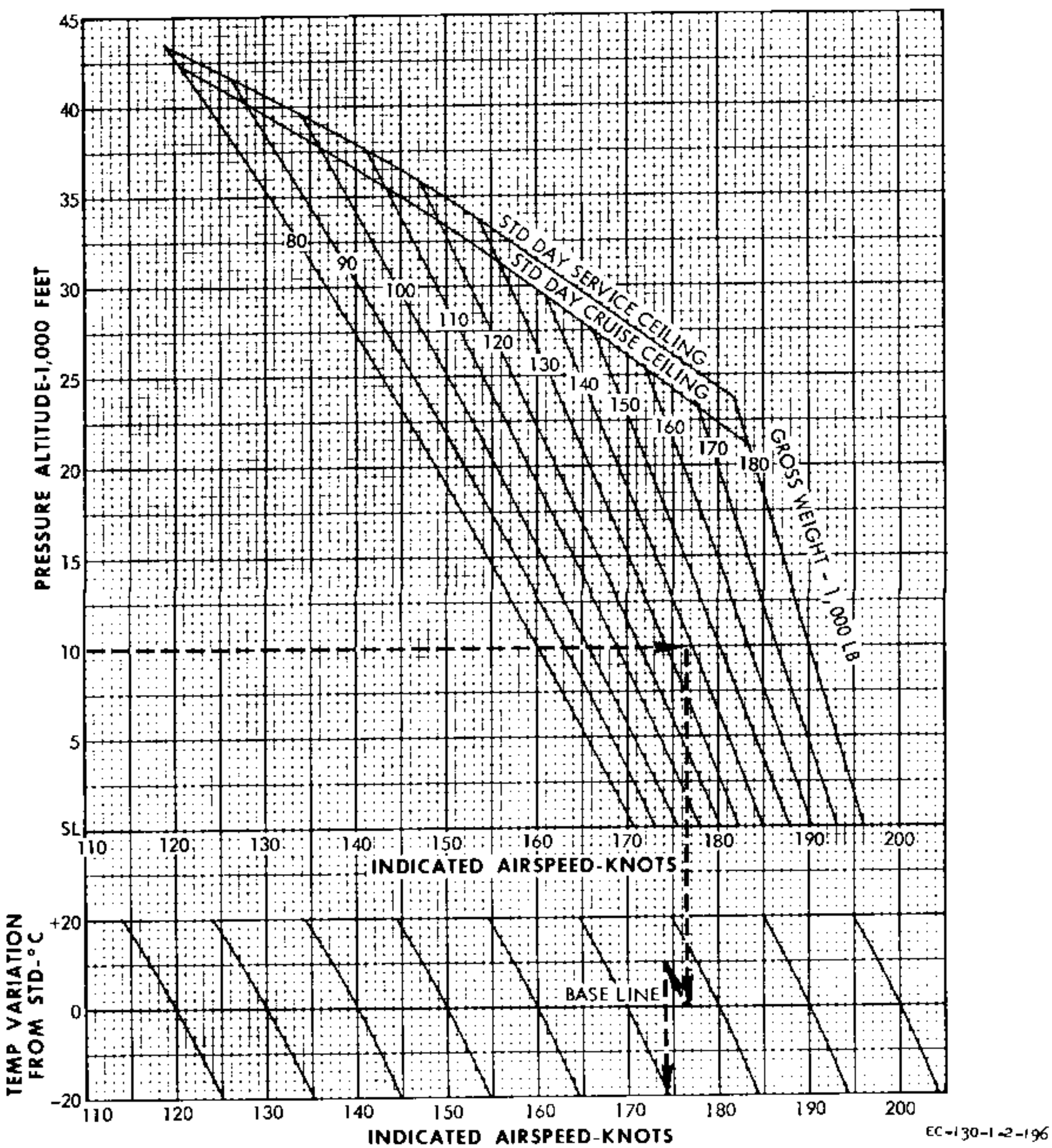


Figure 11-41.

MODEL: EC-130G/Q
T56-A-423 ENGINES

TIME DISTANCE AND FUEL TO CLIMB CORRECTIONS DUE TO ALL BLEED ON

APRIL 1966

DATA BASIS: CATEGORY II FLIGHT TEST

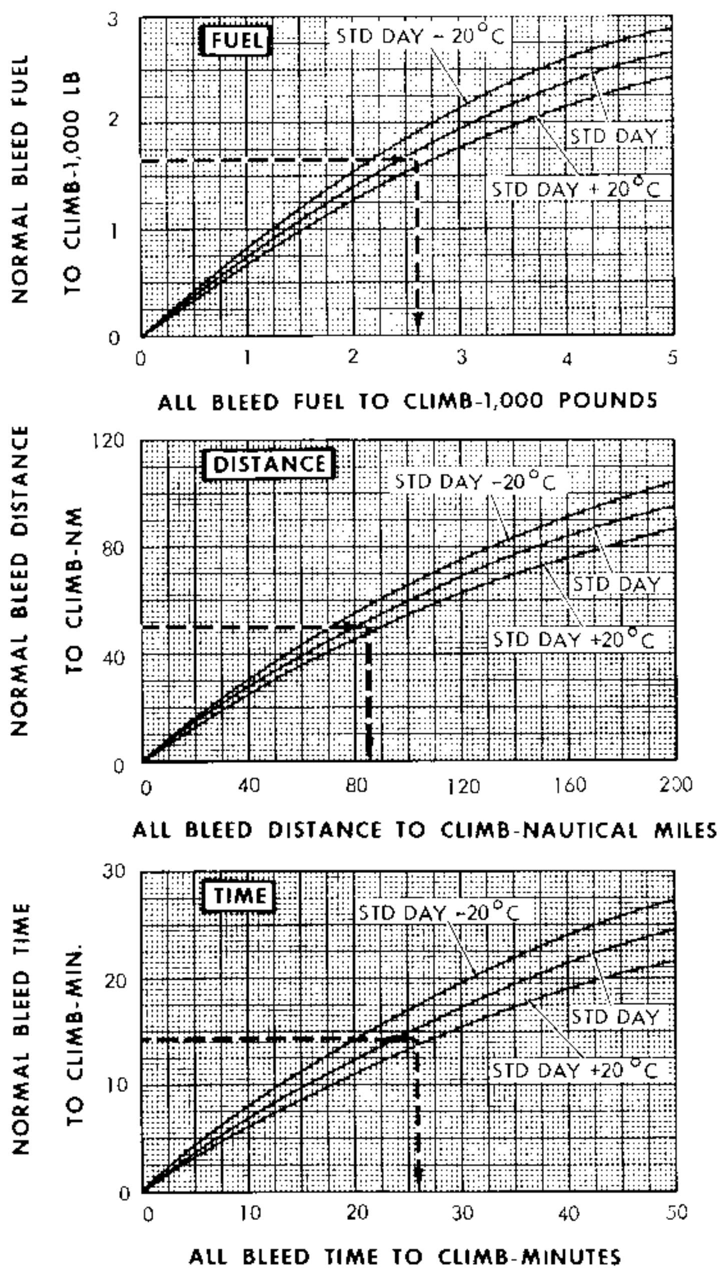


Figure 11-42.

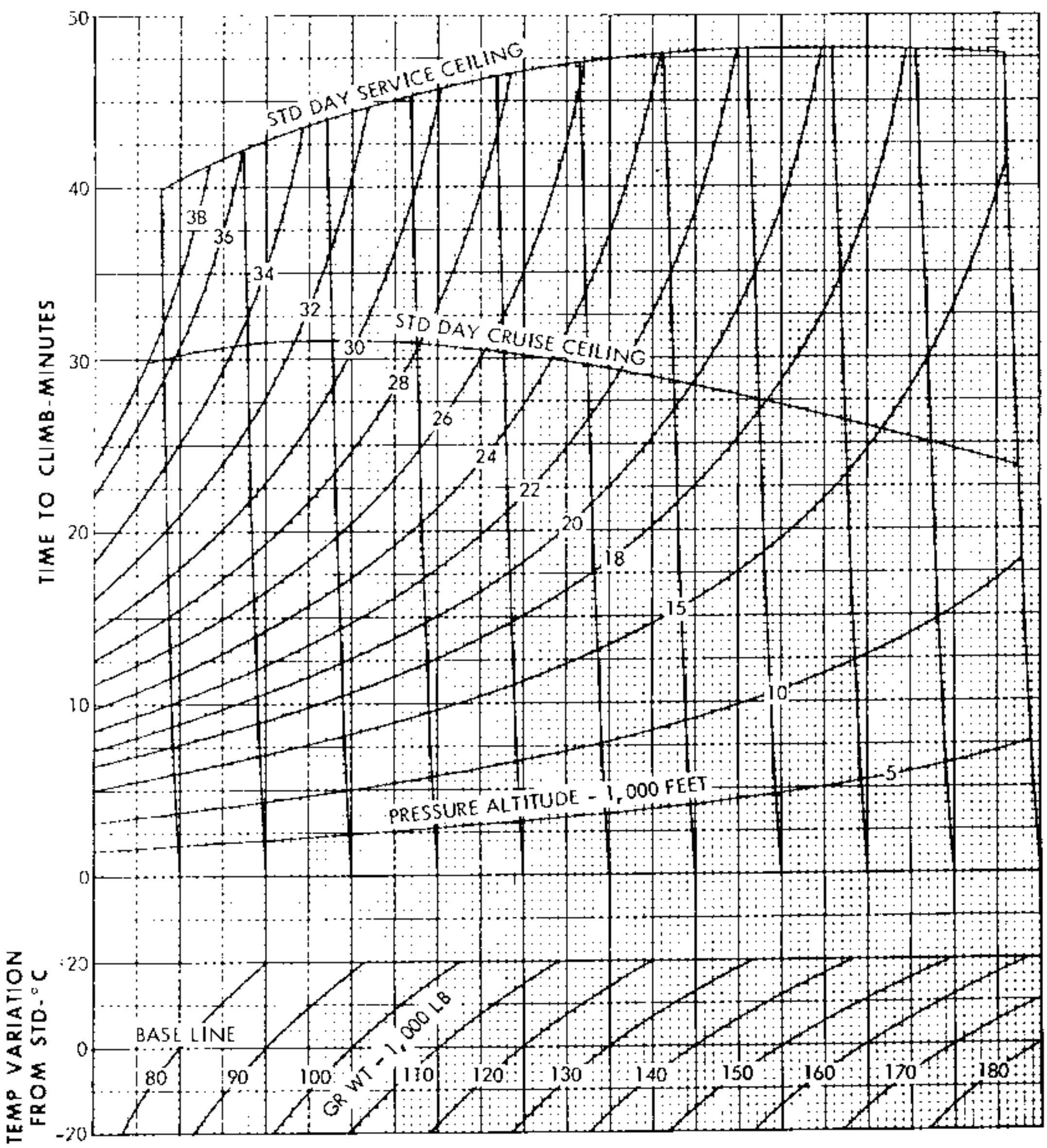
MODEL: EC 130G/Q
T56-A-423 ENGINES

TIME TO CLIMB
3 ENGINES
MAXIMUM CONTINUOUS POWER
NORMAL BLEED

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.



FC-130-1-2-198

Figure 11-43.

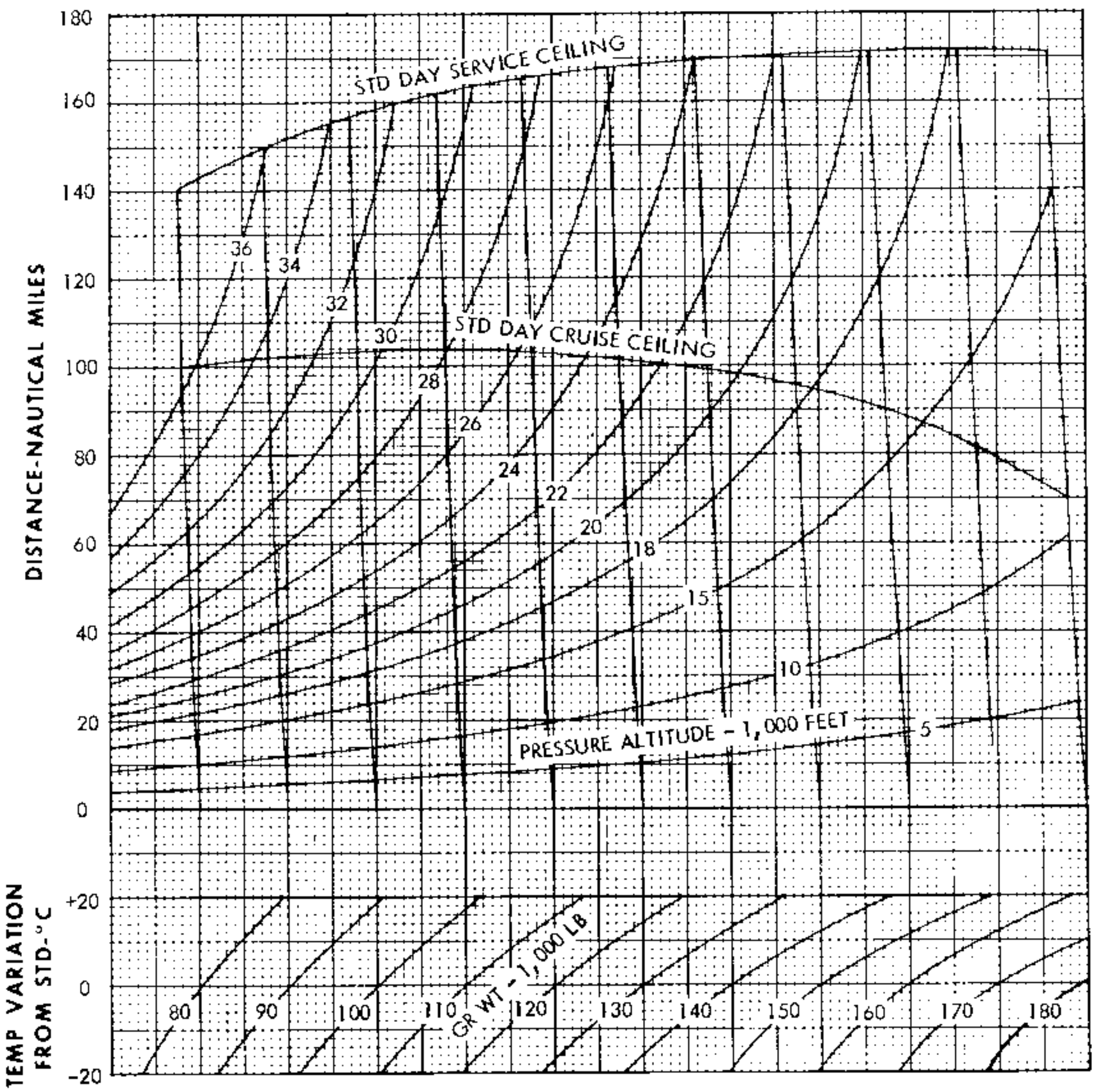
MODEL: EC-130G/Q
T56-A-423 ENGINES

DISTANCE TO CLIMB
3 ENGINES
MAXIMUM CONTINUOUS POWER
NORMAL BLEED

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.



EC-130-1-2-199

Figure 11-44.

MODEL: EC-130G/Q
T56-A-423 ENGINES

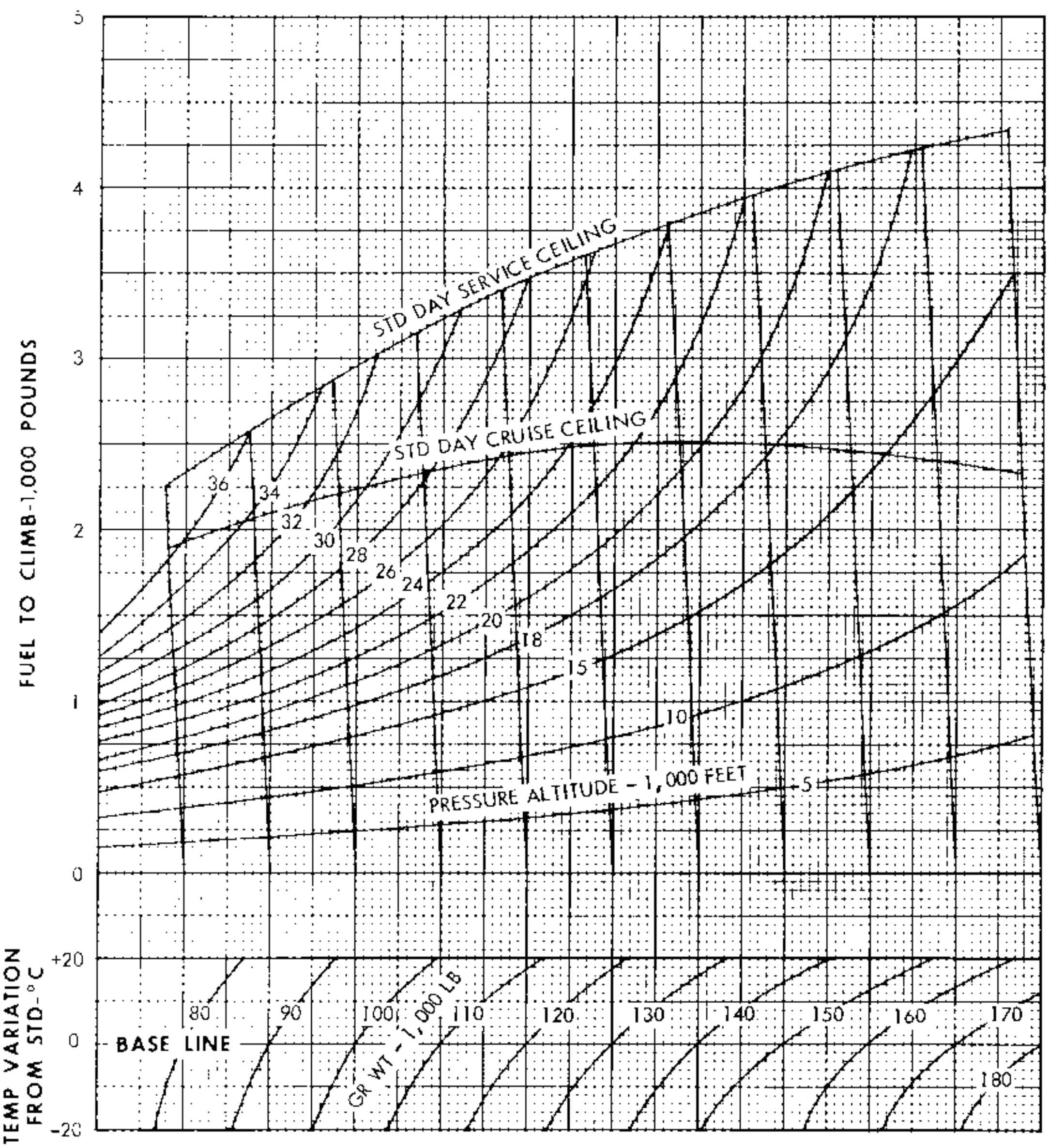
FUEL TO CLIMB

3 ENGINES
MAXIMUM CONTINUOUS POWER
NORMAL BLEED

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.



EC-130-1-2-200

Figure 11-45.

MODEL: EC-130G/Q
T56-A-423 ENGINES

CLIMB SPEEDS

3 ENGINES MAXIMUM CONTINUOUS POWER

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.

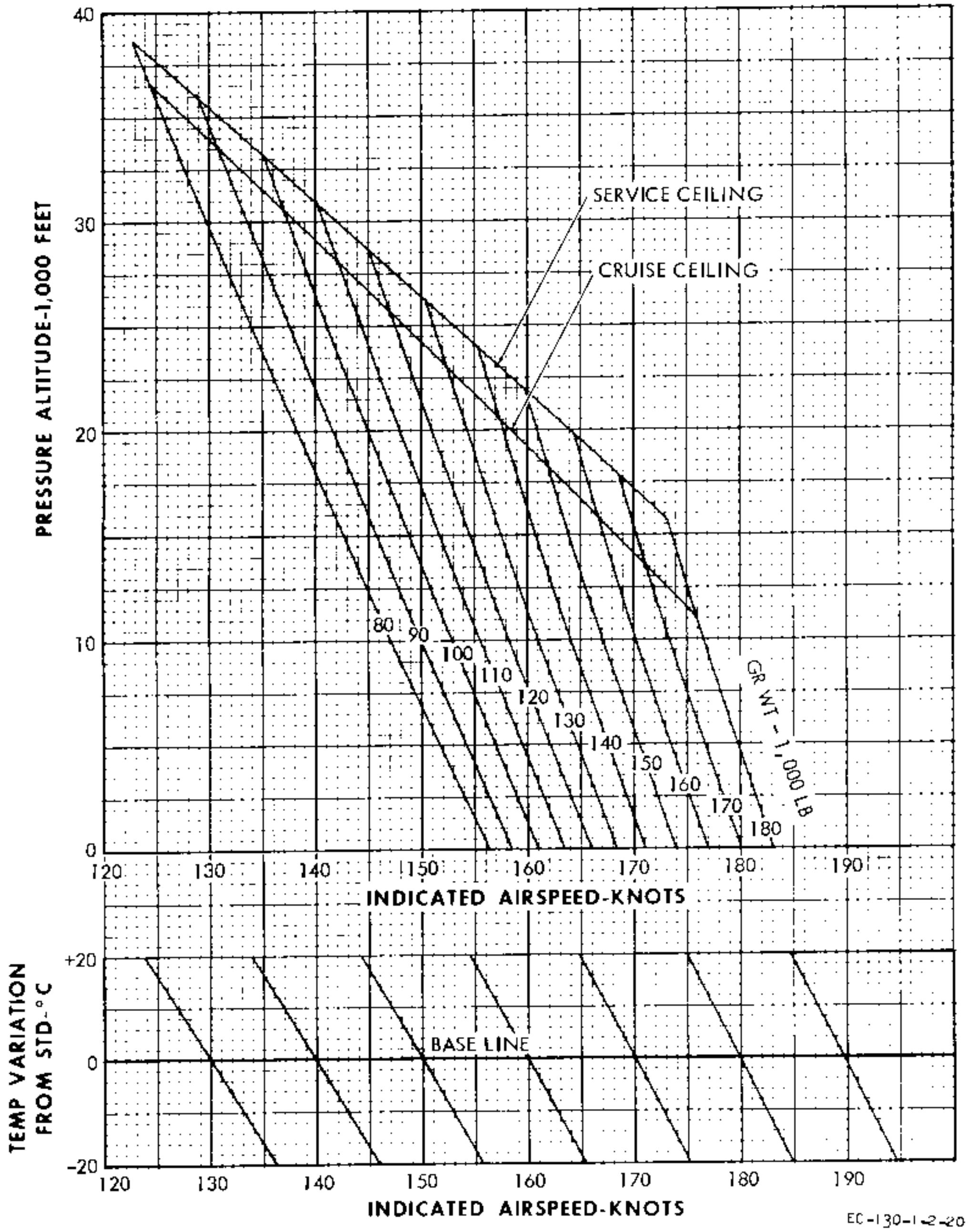


Figure 11-46.

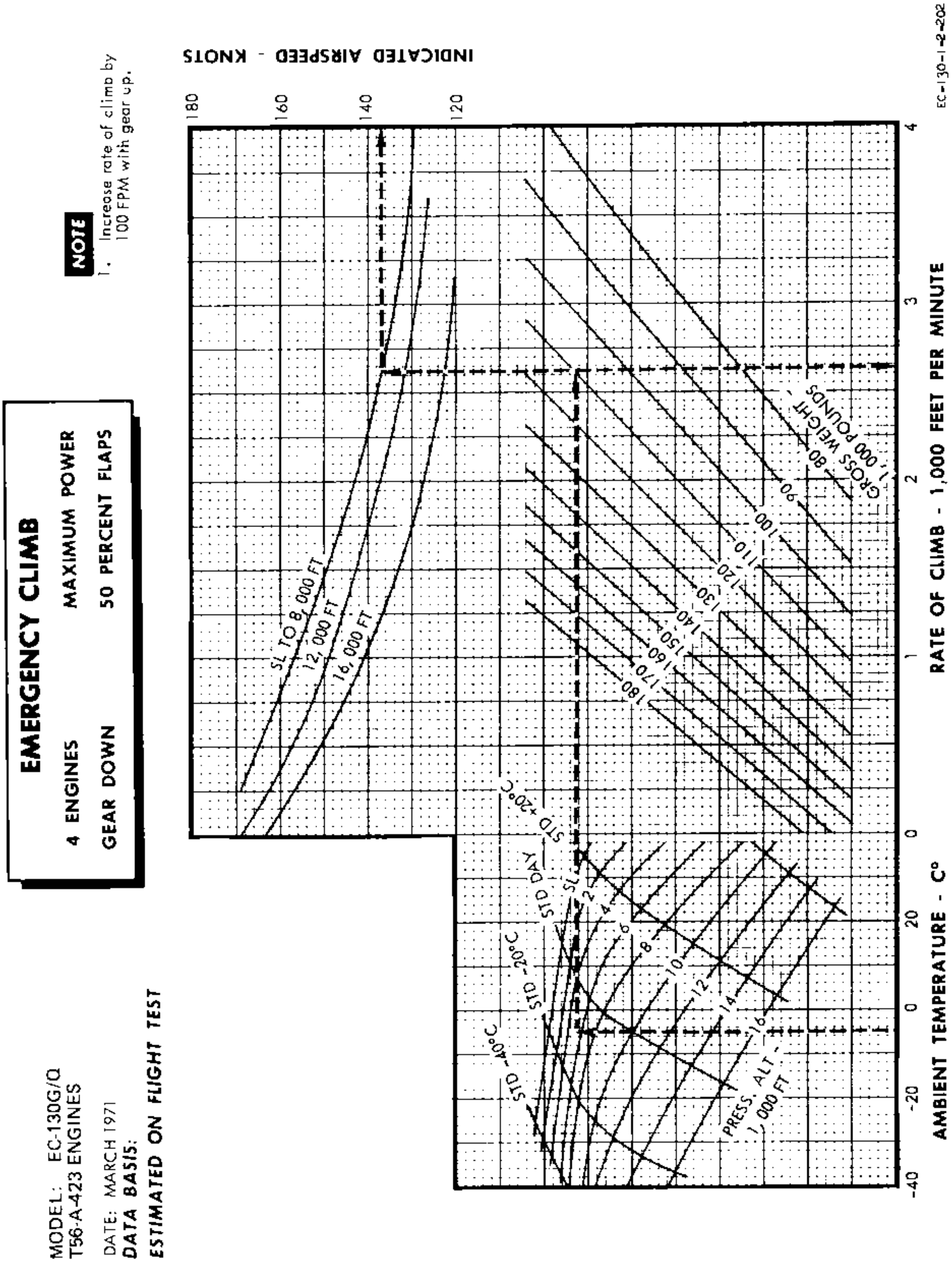

EMERGENCY CLIMB
4 ENGINES
GEAR DOWN
MAXIMUM POWER
50 PERCENT FLAPS
MODEL: EC-130G/Q
T56-A-423 ENGINES
DATE: MARCH 1971
DATA BASIS:
ESTIMATED ON FLIGHT TEST
NOTE
1. Increase rate of climb by 100 FPM with gear up.
INDICATED AIRSPEED - KNOTS
180
160
140
120
SL TO 8,000 FT
12,000 FT
16,000 FT
GROSS WEIGHT - 1,000 POUNDS
80
90
100
110
120
130
140
150
160
170
180
STD +20°C
STD DAY
STD -20°C
STD -40°C
PRESS. ALT - 1,000 FT
SL
2
4
6
8
10
12
14
16
RATE OF CLIMB - 1,000 FEET PER MINUTE
0
1
2
3
4
AMBIENT TEMPERATURE - C°
-40
-20
0
20
EC-130-1-2-202

Figure 11-47.

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: MARCH 1971

DATA BASIS:
ESTIMATED ON FLIGHT TEST

EMERGENCY CLIMB

3 ENGINES — MAXIMUM POWER
GEAR DOWN — 50 PERCENT FLAPS

NOTE

1. Increase rate of climb by 100 FPM with gear up.

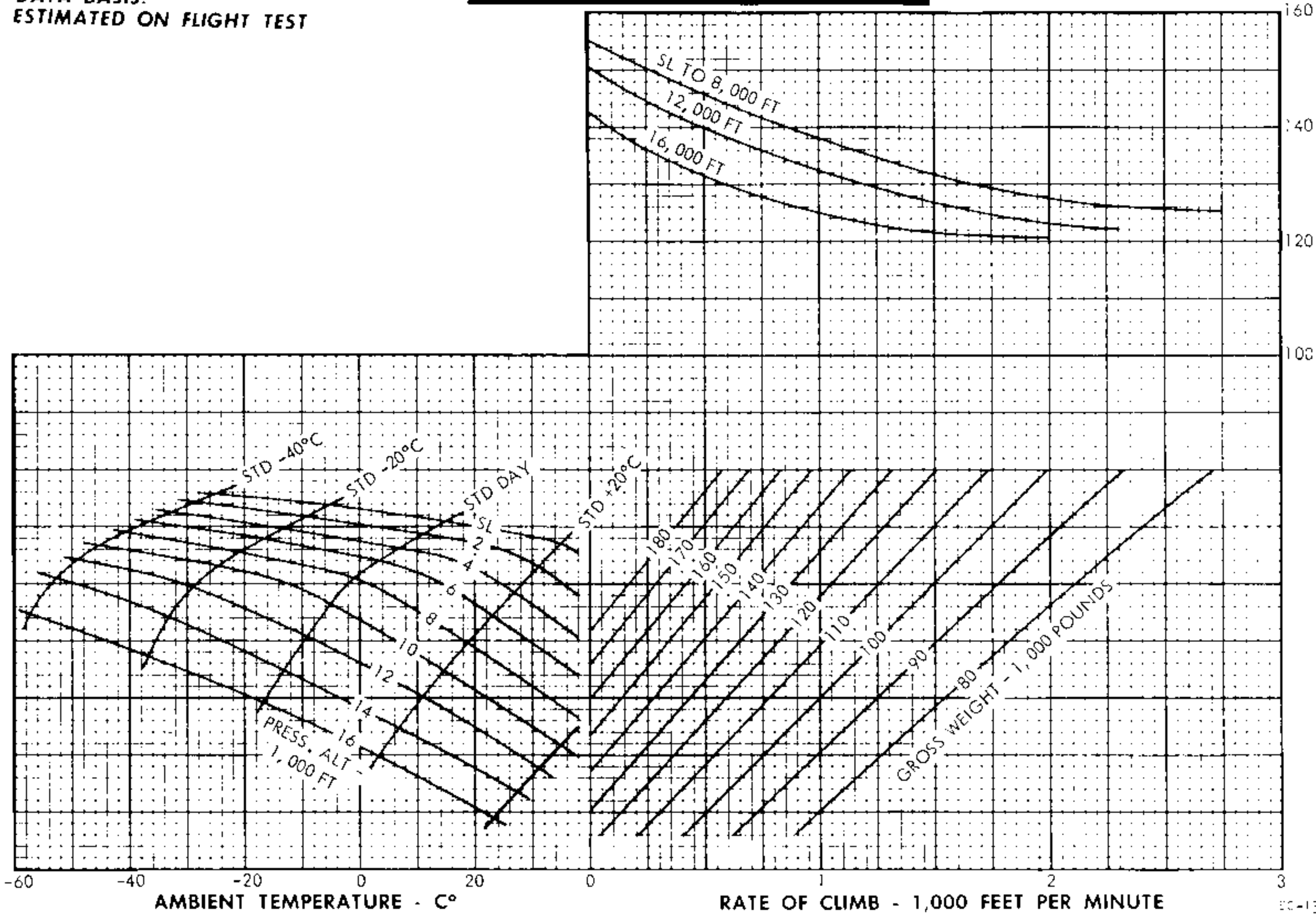


Figure 11-57.

Figure 11-48.

EMERGENCY CLIMB

2 ENGINES — MAXIMUM POWER

GEAR DOWN — 50 PERCENT FLAPS

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: MARCH 1971

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Increase rate of climb by 100 FPM with gear up.

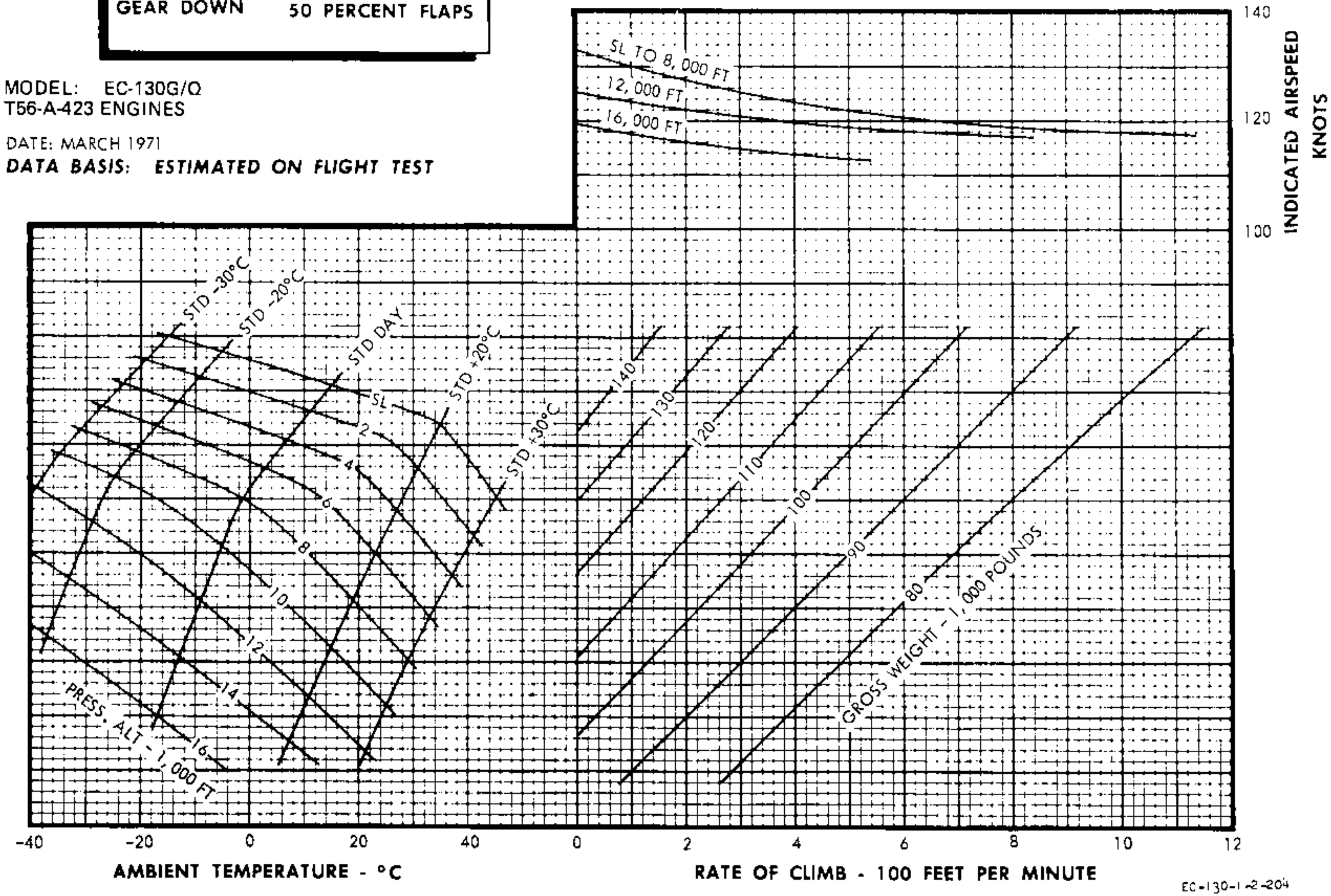


Figure 11-49.

PART 5

RANGE

INTRODUCTION.

Range capability is a function of fuel consumed and ground speed. Since fuel consumption increases with an increase in power (at a given aircraft gross weight and cruise altitude), maximum range capability does not normally occur at maximum speed. For a given mission when flying at altitudes below the normal power cruise ceiling where fuel economy is more important than speed, the best results will be obtained by flying at reduced power settings. The information contained in this part enables a pilot to choose a cruise option which best suits his particular mission.

CAUTION

Structural limit speeds are presented in this part (see figure 11-55), but for a complete explanation of speed restrictions, refer to Part 4, Section I.

Note

The charts contained herein are corrected for bleed losses required for cabin pressurization and air conditioning. When conditions are encountered which require the operation of anti-icing equipment, the procedures outlined in the RANGE CORRECTION DUE TO ANTI-ICING BLEED paragraph should be consulted.

Definitions.

The following is a list of expressions and terms used in describing cruise procedures. Some of the terms are essentially synonymous and may be used interchangeably.

Cruise Ceiling - The altitude at which the maximum rate of climb capability at normal power and best climb speed is 300 feet per minute.

$V \div W_f$ Specific range. True airspeed divided by total fuel flow; or nautical miles per pound of fuel.

$(V \div W_f)$ MAX. The maximum value of specific range for a given weight and altitude.

99% $(V \div W_f)$ MAX - The value of specific range resulting from increasing true airspeed from the speed at $(V \div W_f)$ MAX to give a value of specific range which is less than $(V \div W_f)$ MAX.

Long Range Cruise - Used to describe conditions when the aircraft is flying at the speed for 99% $(V \div W_f)$ MAX

V_{LIM} Aircraft structural limit speed. Refer to the applicable speed chart in Part 4, Section I, with associated text, for a complete definition.

Normal Bleed - The engine bleed condition when compressor bleed air is used to operate the air conditioning and pressurization system.

All Bleed On - The engine bleed condition when compressor bleed air is used to operate the engine anti-icing system and the wing and tail surface anti-icing system in addition to the normal bleed.

RANGE PERFORMANCE.

Range performance is determined by the cruise schedule flown in the cruise portion of a mission. The type of mission determines the type of cruise schedule. Therefore, to accomplish a desired mission, the particular cruise schedule must be selected to maximize or minimize the parameter that will assure the most efficient accomplishment of the mission. Data are presented in charts for the following cruise schedules:

1. 2,000-foot step-climb cruise at the nearest odd or even altitude under cruise ceiling.

2. Cruise at constant altitude and long-range cruise speeds.

3. Cruise at constant 290 knots true airspeed.

Outside air temperature has a significant effect on aircraft performance. Data in this part are presented for an ICAO standard atmosphere, with non-standard temperature correction lines shown where feasible. The temperature corrections are shown as a function of the variation from standard temperature in degrees Centigrade. Figure 11-4 in Part I of this section may be used to determine the variation from standard-day temperature for given conditions of pressure altitude, calibrated airspeed, and indicated outside air temperature.

Maximum range during the cruise portion of the mission is obtained by flying at long-range cruise speed at the cruise ceiling. Cruise ceiling is determined from figures 11-50, 11-51, 11-53, and 11-54, which show ceiling as a function of gross weight with lines of constant temperature deviation. These data are presented for four engines with both normal bleed and all bleed on, for three engines with normal bleed, and for two engines with normal bleed. The cruise ceiling profile for maximum range is one where the altitude increases gradually as the fuel is burned off, maintaining the potential 300 feet per minute rate of climb capability at a constant power setting (approximately 980°C TIT).

The recommended step for a step-climb cruise profile is 2,000 feet. Range prediction charts are included for this type of cruise schedule. To obtain maximum cruise performance for this condition, the following procedure is recommended.

1. Determine the initial aircraft gross weight.

2. Determine the cruise ceiling.

3. Select the desired altitude below cruise ceiling.

4. Enter the Range Summary charts to determine cruise speed, fuel flow, torque setting, and TIT.

5. Set the recommended power, and fly at this setting until the aircraft gross weight has been reduced to a value which gives a cruise ceiling 2,000 feet above the altitude being maintained.

6. At this point, advance power to maximum continuous power and climb 2,000 feet, and repeat the procedure in (4) and (5) above.

Cruise at constant altitude and speeds for 99 percent maximum range for long-range missions may give as much as 10 percent less range for the same mission flown at the step-climb cruise schedule. However, this is the most efficient constant altitude cruise schedule.

Cruise at a constant airspeed approximating long-range cruise speed and at constant altitude provides an operationally convenient schedule at fast speeds, but it results in average powers less than maximum continuous power for most missions, thus improving engine reliability. To facilitate planning for this type of cruise control, data are presented for cruise at a constant true airspeed of 290 knots. Maximum altitude at which this cruise speed can be attained, is shown in figure 11-52. The maximum altitudes recommended for cruise at this constant airspeed at reduced power are either the cruise ceilings (at which 300 feet per minute rate of climb can be attained at the best climb speed) or the maximum altitude at which the appropriate true airspeed can be attained at a turbine inlet temperature of 950 degrees centigrade, not to exceed the maximum continuous power cruise ceiling. This turbine inlet temperature cannot be used as a precise value because of the variability of engine condition.

EFFECT OF WIND ON RANGE.

The direct effect of winds on aircraft range is to increase or decrease the distance flown in proportion to the tailwind headwind component. For large headwinds the airspeed for best miles per pound of fuel increases. The magnitude of this increase is such that, for winds less than 70 knots, the miles per pound at the no wind long-range cruise increases from the normal 99 percent value to a value closer to 100 percent. Therefore, no correction to air miles per pound of fuel is required for headwinds less than 70 knots. The 290-knot cruise speed is generally above long-range cruise speed when flying below cruise ceiling so that the same comments apply. When tailwind components exist, the benefits can be maximized by flying at somewhat lower airspeeds, however, conservative flight planning would dictate that no advantage be taken of tailwind effects.

The discussion above is applicable for any known wind condition. If winds are significantly different at different altitudes, another consideration becomes important. For example, if severe headwinds are encountered when flying at high altitudes but lesser headwinds are known to exist at lower altitudes, the trade-off between wind effects and the effect of altitude on range must be considered. A careful analysis should be made of the existing conditions in any specific instance before electing to change altitude on this account.

SPECIFIC RANGE CHARTS.

The charts in figures 11-56 through 11-73 present specific range data for 4-engine operation from sea level to 35,000 feet in 5,000-foot increments, for 3-engine operation from sea level to 25,000 feet in 5,000-foot increments, and for 2-engine (asymmetrical power) operation from sea level to 15,000 feet in 5,000-foot increments. For 2-engine operation under symmetrical power conditions, the specific range should be increased by 3.5 percent. These charts show specific range at constant weights as a function of airspeed. Lines of constant fuel flow are shown on the charts in addition to the recommended long-range cruise speed lines. Maximum continuous and military power lines are also shown on the charts.

Example.

GIVEN:

Cruise altitude: 25,000 feet.

Cruise weight: 120,000 pounds.

Cruise speed: 180 knots CAS.

Four-engine cruise.

Standard day, no wind.

FIND:

Nautical miles per pound of fuel.

Fuel flow per engine.

TAS.

PROCEDURE:

The data are obtained from the 4-engine specific range chart for 25,000 feet pressure altitude, figure 11-61. Enter the chart with 180 knots CAS, move vertically to the true airspeed scale and read 265 knots. Continue vertically from this point to a gross weight of 120,000 pounds and interpolate between the fuel flow lines for a fuel flow of 870 pounds per hour per engine. From this point, move to the left and read 0.0761 nautical mile per pound of fuel.

RANGE SUMMARY.

Four Engines Operating.

A summary of range data at long-range cruise speeds is presented in figures 11-74 and 11-75 for constant altitudes in 2,000-foot increments from sea level to cruise ceiling. These data are presented in terms of calibrated airspeed versus gross weight and fuel flow versus gross weight. A summary of long-range cruise torque is presented in figure 11-76 in terms of torque versus altitude for line of constant weight.

Summaries of range data at a constant speed of 290 knots TAS are shown in figures 11-77, 11-78, and 11-80. These charts present indicated airspeed versus pressure altitude, fuel flow versus gross weight, and turbine inlet temperature versus gross weight for constant altitudes in 2,000-foot increments from sea level to cruise ceiling. Temperature correction curves for variations from standard-day temperatures are included on the charts. A summary of 290-knot cruise torque is presented in figure 11-79 in terms of torque versus altitude for lines of constant weight. For gross weights above 155,000 pounds, the structural speed limit is less than 290 KTAS, and hence the structural speed limitations presented in figure 11-55 should be used. Refer to Part 4, Section I for complete information on structural limit speeds.

Example.

The use of the range summary charts for operation at constant altitude is illustrated by the following example.

GIVEN:

Initial cruise weight: 140,000 pounds.

Temperature deviation from standard day: +10° C.

No wind.

Four engines.

FIND:

Initial cruise airspeed, fuel flow, and torque for long-range cruise at a constant altitude of 16,000 feet.

PROCEDURE:

Enter the 4-engine range summary airspeed chart, figure 11-74, at the initial cruise weight of 140,000 pounds, move vertically to the constant altitude of 16,000 feet, and across to the baseline of the temperature variation scale. Follow the above standard temperature guide lines to a temperature deviation of +10° C. From this point, read straight across to 214 knots calibrated airspeed. Following the same procedure for fuel flow in figure 11-75, read a value of 1,145 pounds per hour per engine. For initial cruise torque, enter figure 11-76 at the constant altitude of 16,000 feet, move horizontally to the initial cruise weight of 140,000 pounds, and read a torque value of 10,420 inch-pounds per engine.

One or Two Engines Inoperative.

Range summary data for 3-engine and 2-engine operating conditions are shown in figures 11-81 thru 11-86. Cruise conditions for 3-engine and 2-engine long-range cruise at constant altitude, 2,000 foot step-climb cruise profile, and long-range cruise at cruise ceiling are determined from the respective 3-engine and 2-engine range summary charts in the same manner as the 4-engine cruise conditions were determined in the preceding example. The 2-engine range summary charts are for asymmetrical power. For symmetrical 2-engine operation, cruise performance would show a 3.5 percent improvement.

RANGE PREDICTION.

Four-Engine Range Prediction - Distance.

The 4-engine range prediction-distance charts presented in figures 11-87 through 11-92 are used to predict distance traveled for cruise at long-range cruise speeds or a constant 290 knots TAS at constant altitudes, and for the 2,000-foot step-climb cruise profile. These data are presented in charts of distance versus gross weight for a standard day and +20° C variation from standard day temperatures. The step-climb curves are a summation of the constant altitude segments for both odd and even altitude steps. Distance and fuel to climb from one altitude to another have been accounted for in the step-climb profile. The altitudes used for the step climb curves are the next lowest flight level from the highest altitude for the particular weight and cruise condition.

Three-Engine Range Prediction - Distance.

The 3-engine range prediction-distance charts presented in figures 11-93 through 11-95 are used to predict distance traveled for cruise at long-range cruise speeds at constant altitudes, and the 2,000-foot step-climb cruise profile. These data are presented in the same format as the four-engine charts.

Four-Engine and Three-Engine Range Prediction - Time.

The 4-engine and the 3-engine time prediction charts presented in figures 11-96 through 11-101 are used to predict time traveled for cruise at long-range cruise speeds at constant altitudes, and the 2,000-foot step-climb profile. These data are presented in terms of time versus gross weight for a standard day and +20° C deviation from standard day temperatures. For constant-speed cruise of 290 knots at constant altitudes, the cruise time is found by dividing the incremental distance from the range prediction-distance chart by the constant cruise speed. For 290-knot step-climb cruise, the time for each segment of the cruise and climb must be determined and added. The increment in time for each cruise segment is found by dividing the incremental distance from the range prediction-distance chart by 290 knots constant cruise speed. The increments for climb are found from the climb data in Part 4.

Example 1.

GIVEN:

Initial cruise weight - 149,500.
No wind.
Four-engine, 2,000-foot, step-climb cruise.
Temperature - standard day.
Cruise distance - 2,200 nautical miles.

FIND:

End cruise weight.
Fuel used during cruise.
Time enroute.

PROCEDURE:

Enter the 4-engine range prediction-distance chart, figure 11-88, with the initial cruise weight of 149,500 pounds. Read up to the variable cruise altitude line and across to a distance of 8,330 miles. Enter the distance scale at a value of 10,530 miles (8,330 +2,200), read across to the variable cruise altitude line, and down to the end cruise weight of 119,000 pounds. The fuel burned during cruise is the initial cruise weight of 149,500 pounds less the end cruise weight of 119,000 pounds, or 30,500 pounds.

To find the cruise time, enter the 4-engine range prediction-time chart, figure 11-97, with the initial cruise weight of 149,500 pounds. Read up to the variable cruise altitude line and across to a time of 26.15 hours. Repeat this procedure with the end cruise weight of 119,000 pounds, and read a time of 27.75 hours. The time enroute is 33.50 less 26.15, or 7.35 hours.

Example 2.

GIVEN:

Four-engine constant altitude cruise at 10,000 feet at long-range cruise with required engine power settings of less than normal power.

Begin cruise weight - 150,000 pounds.

End cruise weight - 110,000 pounds.

Temperature deviation from standard day - +20°C.

Wind - 20-knot tailwind.

FIND:

Cruise distance.

Cruise time.

PROCEDURE:

Enter the 4-engine range prediction-distance chart, figure 11-87, with the initial cruise weight of 149,500 pounds. Read up to the 10,000-foot altitude line and across to a distance of 3,200 miles. Repeat this procedure with the end cruise weight of 110,000 pounds, and read a distance of 5,390 nautical miles. The cruise distance is 5,390 less 3,200 or 2,190 nautical miles. The ground distance covered is obtained by multiplying this air distance by the ratio of ground speed to true airspeed. From figure 11-74, the cruise calibrated airspeed at the average gross weight of 130,000 pounds is 219 knots. Applying the appropriate corrections, the true airspeed is found to be 255 knots.

$$\text{Ground distance} = \frac{255-20}{255} \times 2{,}150 = 2{,}365$$

To find the cruise time enter the 4-engine range prediction-time chart, figure 11-96, with the initial cruise weight of 150,000 pounds. Read up to the 10,000-foot altitude line and across to a time of 12.40 hours. Repeat this procedure with the end cruise weight of 110,000 pounds, and read a time of 20.75 hours. The time enroute is 20.75 less 12.40 or 8.35 hours. Wind has no effect on the time required.

Wind corrections to distance covered for cruise at a constant true airspeed are obtained in the same manner as shown above for long-range cruise except that the true airspeed is known without reference to a chart.

Jettisoning.

In the event of failure of one or more engines, some equipment jettisoning may be necessary to increase range in order to reach a suitable landing base. After drift-down has been initiated, decide on the most suitable landing base, considering distance and terrain clearance. The following example illustrates the use of the 3-engine range prediction charts in determining the amount of equipment which has to be jettisoned.

Example.

GIVEN:

Weight at engine failure - 130,000 pounds.

Cruise altitude for 4-engine operation - 30,800 feet.

Standard Day.

Cargo on board - 25,000 pounds.

End cruise weight - 107,892 pounds.

Distance from destination at point of engine failure - 1,700 nautical miles.

FIND:

Jettisoning requirements.

PROCEDURE:

Enter the 3-engine Range Prediction-Distance chart, figure 11-94, and determine the range capability with 25,000 pounds of cargo. Enter the chart with the begin cruise weight of 130,000 pounds, read up to the variable cruise altitude line and across to a distance of 5,580 miles. Repeat the procedure for the end cruise weight of 107,892 pounds and obtain a distance of 7,200 miles. The range capability remaining with 25,000 pounds of cargo is 1,620 miles (7,200-5,580). Determine the range remaining if the 25,000 pounds of cargo is jettisoned. Enter figure 11-94 with the begin cruise weight of 105,000 pounds (130,000 - 25,000), and read up to the variable cruise altitude line and across to a distance of 7,440 miles. Repeat the procedure for the end cruise weight of 82,892 pounds (107,892-25,000), and read a distance of 9,550 miles. The range capability remaining with zero cargo is 2,110 miles (9,550-7,440).

Since the range increase required is 80 miles of a total increase of 490 miles which could be achieved by jettisoning the full 25,000 pounds of equipment, approximately one-fifth of the equipment, or 5,000 pounds, must be jettisoned.

RANGE CORRECTION DUE TO ANTI-ICING BLEED.

The compressor bleed air used to operate the air conditioning and pressurization system, the engine anti-icing system, and the wing and tail surface anti-icing system subtract from the engine power delivered to the propeller. The charts in this section have been corrected to take into account the losses due to normal pressurization and air conditioning. However, when anti-icing equipment is in operation, aircraft performance will be further reduced. Range correction due to anti-icing bleed is presented in figure 11-102 in terms of long range cruise specific range with normal bleed versus long range cruise specific range with all bleed on. This correction is based on the assumption that the power setting is increased to maintain a given flight condition (airspeed and altitude) after the anti-icing system is turned on. This will require a torque equal to that required for normal bleed at the same flight condition. The correction is valid for a temperature range of ±20°C from standard day. The change in torque due to change in bleed is obtained from figure 11-11. However, to maintain the same altitude and speed, the torque will have to be increased back to the initial value which existed for the normal bleed condition, provided maximum continuous power is not exceeded.

Example.

GIVEN:

Altitude - 20,000 feet.

Weight - 120,000 pounds.

Four-engine operation.

Standard conditions.

Nautical miles per pound of fuel -0.0687.

Fuel Flow - 1,050 pounds per hour per engine.

Torque - 8,850 inch-pounds per engine.

FIND:

Torque loss per engine due to engine air bleed for the above conditions with the anti-icing equipment in operation.

Corrected nautical miles per pound of fuel.

Corrected fuel flow per engine.

PROCEDURE:

Enter the torque loss due to anti-icing bleed chart, figure 11-11, with the normal bleed torque of 8,850 inch-pounds. Read across to the 20,000-foot altitude line and down to the all-bleed-on torque of 6,250 inch-pounds. The torque loss is 8,850 less 6,250, or 2,600 inch-pounds. In order to maintain the same altitude and speed, the all-bleed-on torque must be increased back to the initial value which existed for the normal bleed condition (8,850 inch-pounds per engine).

The corrected specific range with all bleed on is determined from figure 11-102 by entering with a normal bleed specific range of 0.0687 nautical miles per pound of fuel and reading corrected specific range of 0.0600 nautical miles per pound of fuel with all bleed on. The corrected fuel flow is determined by increasing the normal bleed fuel flow by the same proportion that the normal bleed specific range decreased, as follows:

Fuel flow (all bleed on)   fuel flow (normal bleed)
x Specific range (normal bleed)

Specific range (all bleed on)

W_f (all bleed on) $\frac{1,005 \times 0.06870}{0.06000}$ pounds per hour per engine

W_f (all bleed on)   1,150 pounds per hour per engine

DRIFTDOWN.

If failure of one or two engines should occur during 4-engine cruise operation, it may be necessary, due to loss of power, for the aircraft to descend to a lower altitude. This forced descent is called driftdown. It is important for the pilot to know the driftdown procedure and to be able to predict the loss in altitude as well as the distance traveled and the time required during driftdown. Use of the proper procedure will produce the optimum utilization of fuel during this phase of flight, which will be followed by cruise at a lower altitude where fuel consumption will be greater. This information can be obtained from figures 11-103 and 11-105. These charts present driftdown data for maximum range descent, and are based on speeds for maximum lift-to-drag ratio. The procedure for driftdown is to maintain the recommended speed until the rate of sink decreases to 100 feet per minute. From this point, a procedure may be selected by the pilot, depending upon range and/or terrain clearance requirements. If clearance requirements dictate, the driftdown speed should be maintained; otherwise, the appropriate long range cruise speed may be selected and maintained permitting further driftdown until the cruise ceiling is reached. The data presented in these charts are based on the assumption that the propellers are feathered on the inoperative engines and that the operating engines are set at maximum continuous power.

Example.

GIVEN:

Gross weight - 132,000 pounds.

Initial cruise altitude - 30,000 feet.

Assume loss of one engine and driftdown at speeds for maximum range.

FIND:

Loss in altitude during driftdown to 3-engine service ceiling.

Distance traveled during driftdown.

Time for driftdown.

PROCEDURE:

Enter the 3-engine driftdown chart, figure 11-104, with a gross weight of 132,000 pounds, and move vertically to the 30,000-foot altitude line. Read an altitude loss of 4,600 feet. The service ceiling following driftdown is 30,000 -4,600 or 25,400 feet. Continuing vertically along the 132,000-pound line, the driftdown speed is 177 knots CAS, the driftdown distance from 30,000 feet to 3-engine service ceiling is 144 nautical miles, and driftdown time is 32 minutes. This same procedure can be used for a 2-engine case, using figure 11-105. For nonstandard day conditions, use the Standard Day increments for altitude lost and subtract from the nonstandard day 4-engine cruise ceiling.

MODEL: EC-130G/Q
T56-A-423 ENGINES

CRUISE CEILING
MAXIMUM CONTINUOUS POWER

4 ENGINES NORMAL BLEED

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

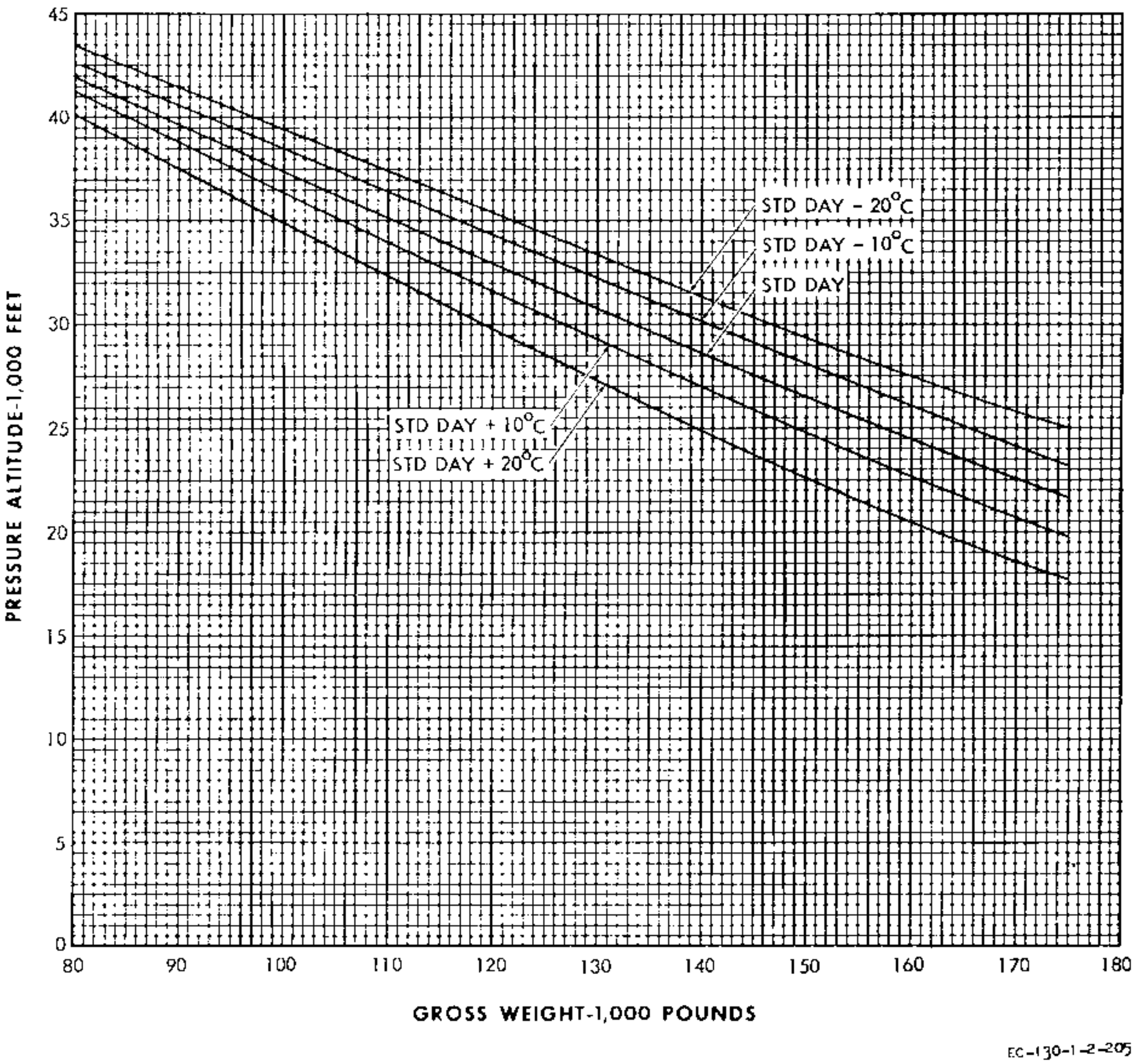


Figure 11-50.

MODEL: EC-130G/Q
T56-A-423 ENGINES

CRUISE CEILING
MAXIMUM CONTINUOUS POWER

4 ENGINES **ALL BLEED ON**

DATE: APRIL 1966
DATA BASIS: CATEGORY II FLIGHT TEST

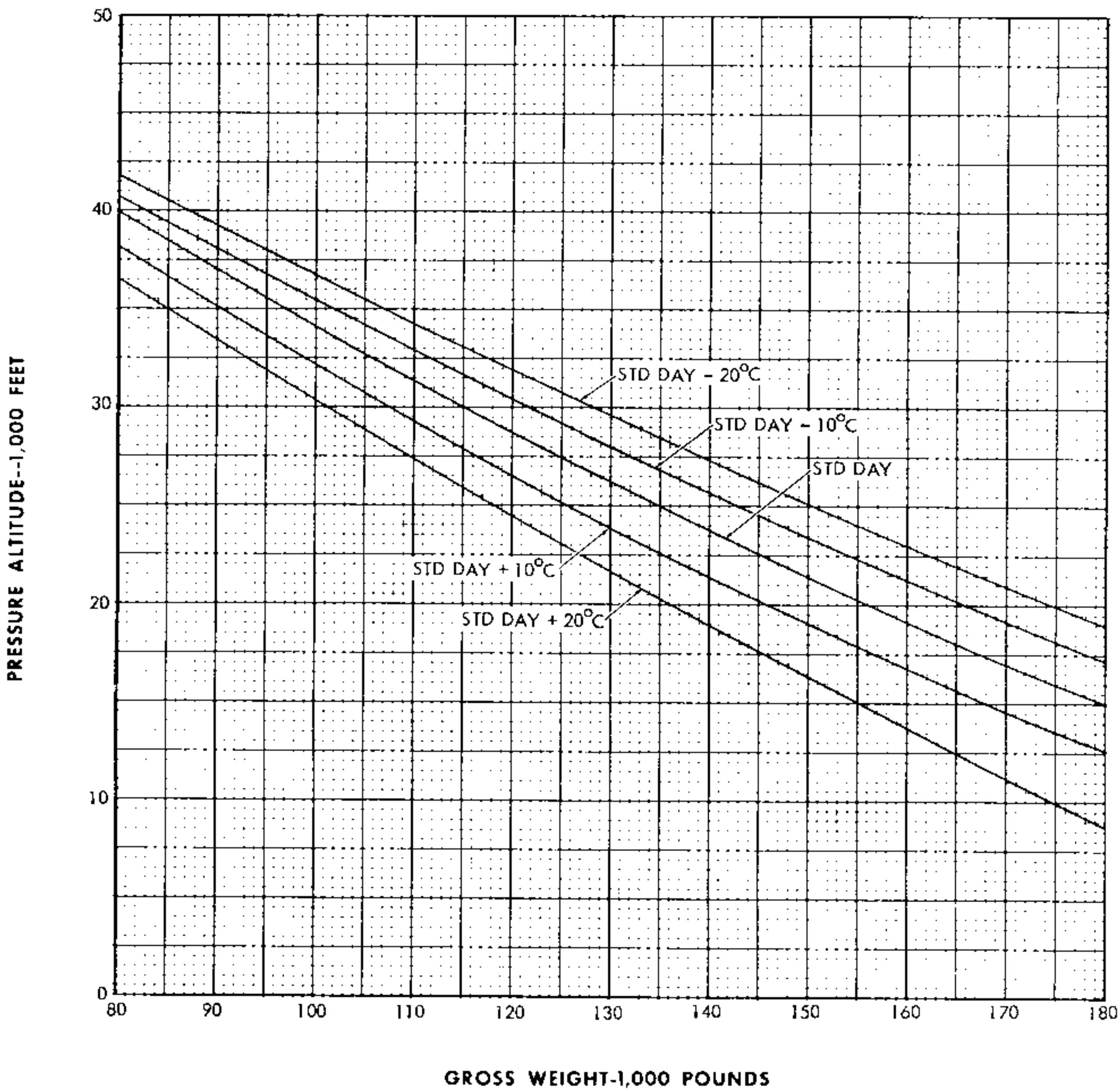


Figure 11-51.

MODEL: EC-130G/Q
T56-A-423 ENGINES

290 KTAS MAXIMUM CRUISE ALTITUDE AT LESS THAN MAXIMUM CONTINUOUS POWER

4 ENGINES 950°C TIT

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

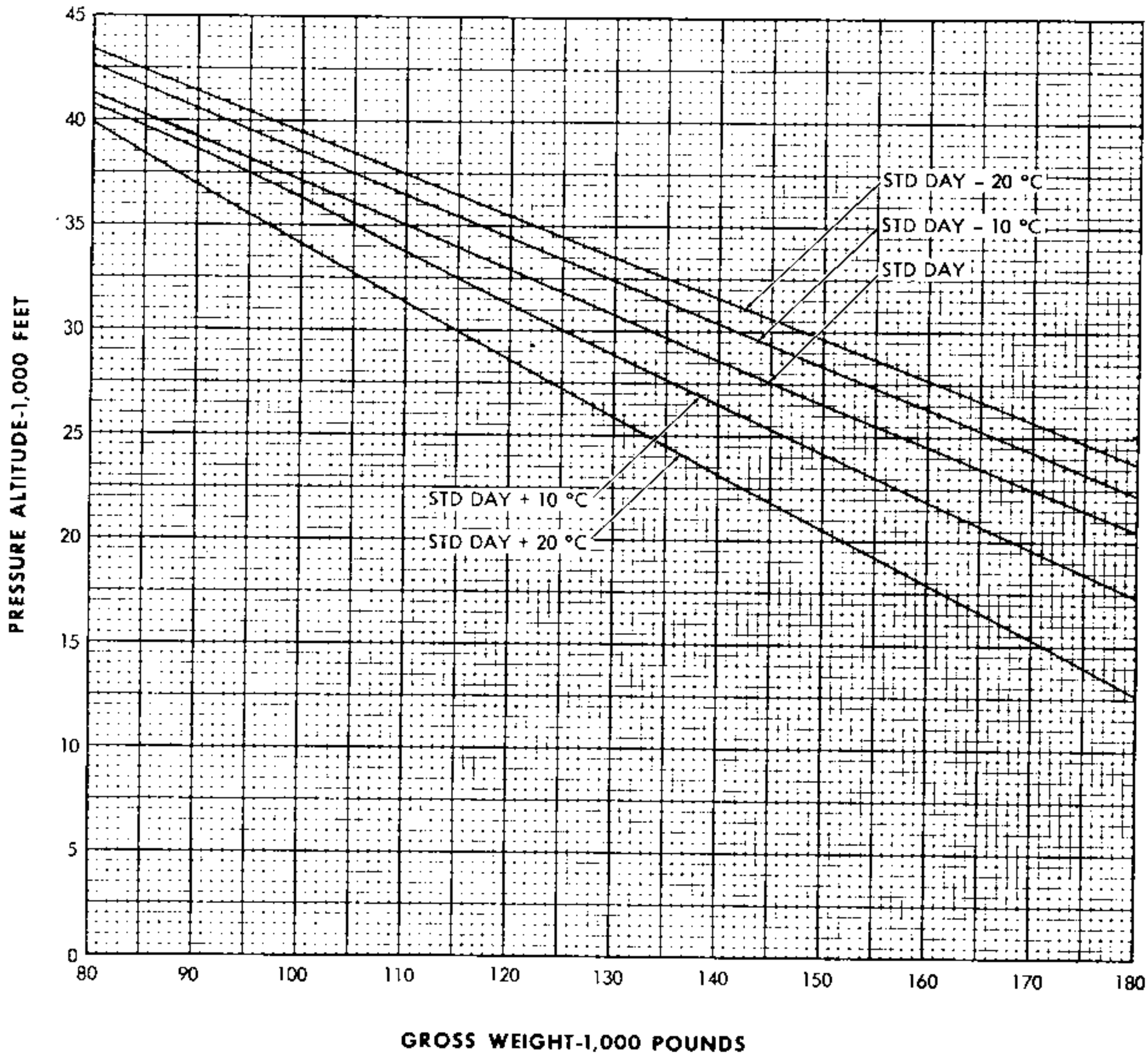


Figure 11-52.

EC-130-1-2-207

MODEL: EC-130G/Q
T56-A-423 ENGINES

CRUISE CEILING MAXIMUM CONTINUOUS POWER

3 ENGINES

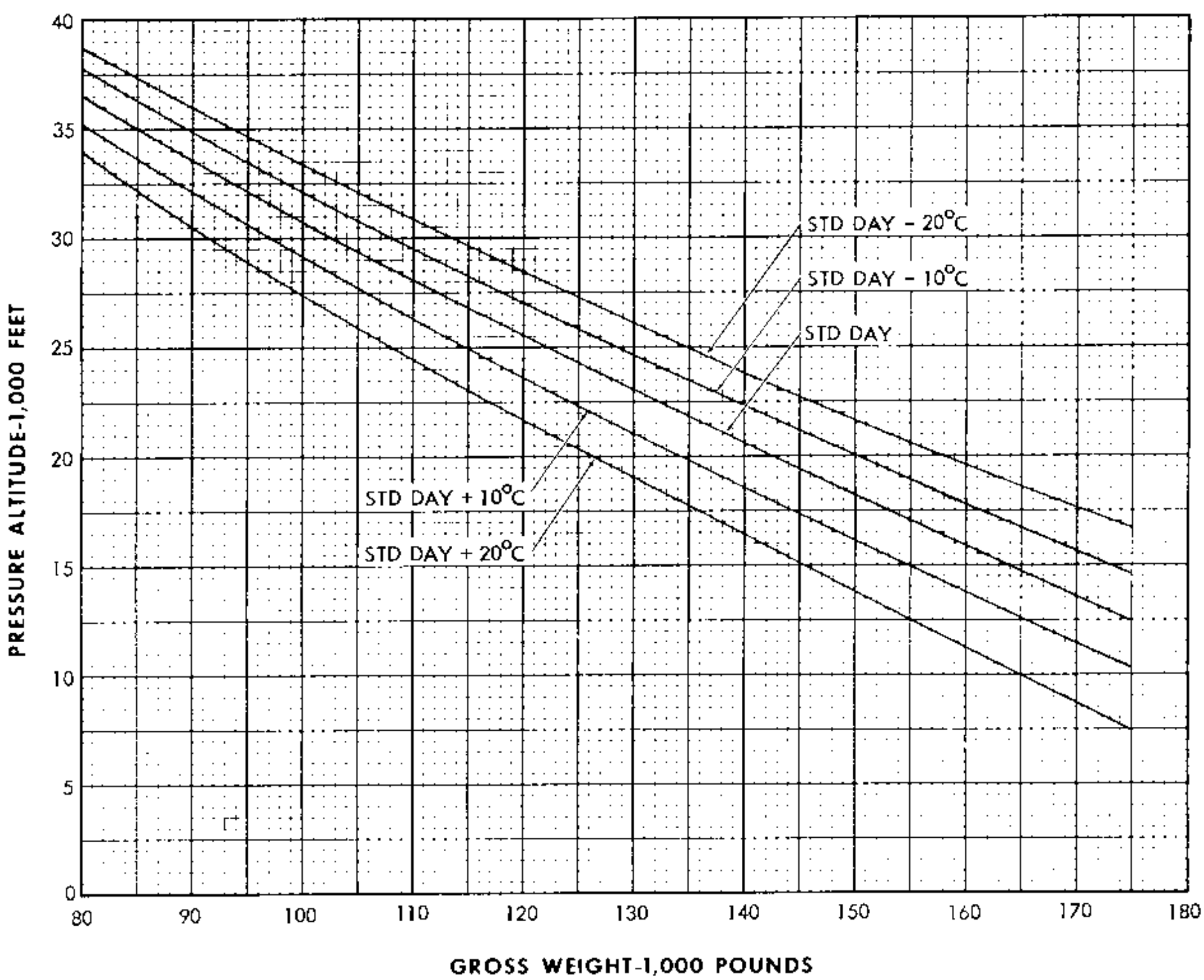
NO. 1 ENGINE INOPERATIVE

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine



EC-130-1-2-208

Figure 11-53.

MODEL: EC-130G/Q
T56-A-423 ENGINES

CRUISE CEILING
MAXIMUM CONTINUOUS POWER
2 ENGINES
ASYMMETRICAL POWER

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propellers feathered on inoperative engines.

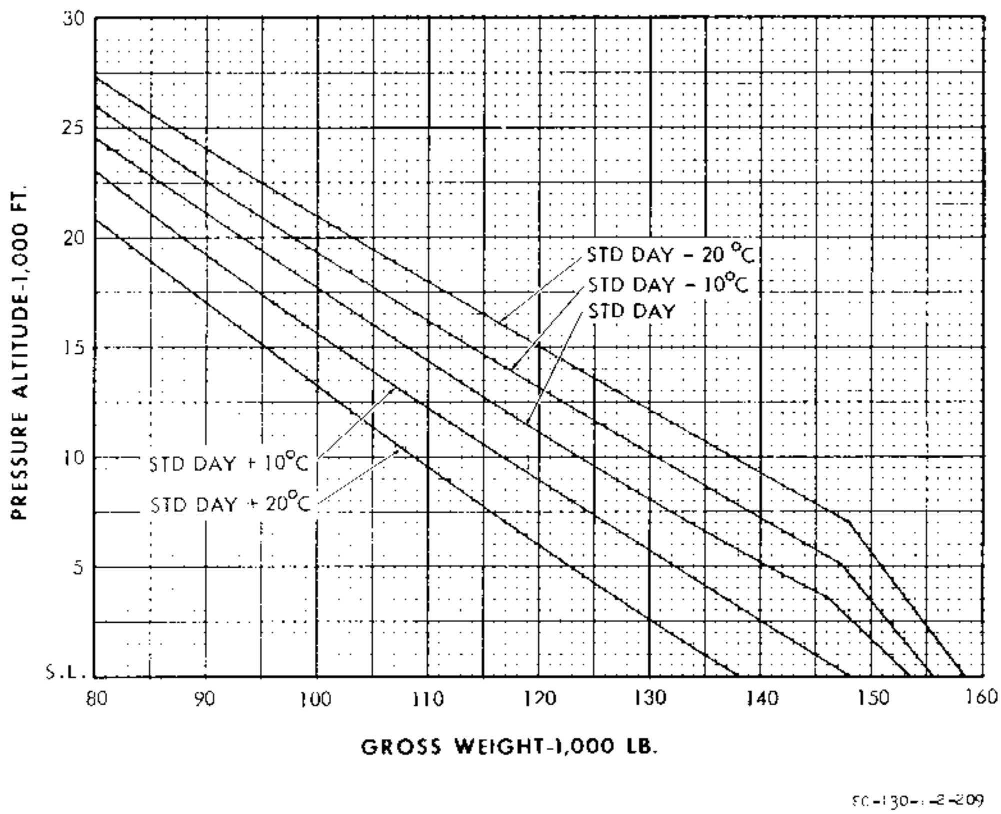


Figure 11-54.

MODEL: EC-130G/Q
T56-A-423 ENGINES

STRUCTURAL LIMIT SPEEDS

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. See Part 4 of Section I for complete information on structural limit speeds.

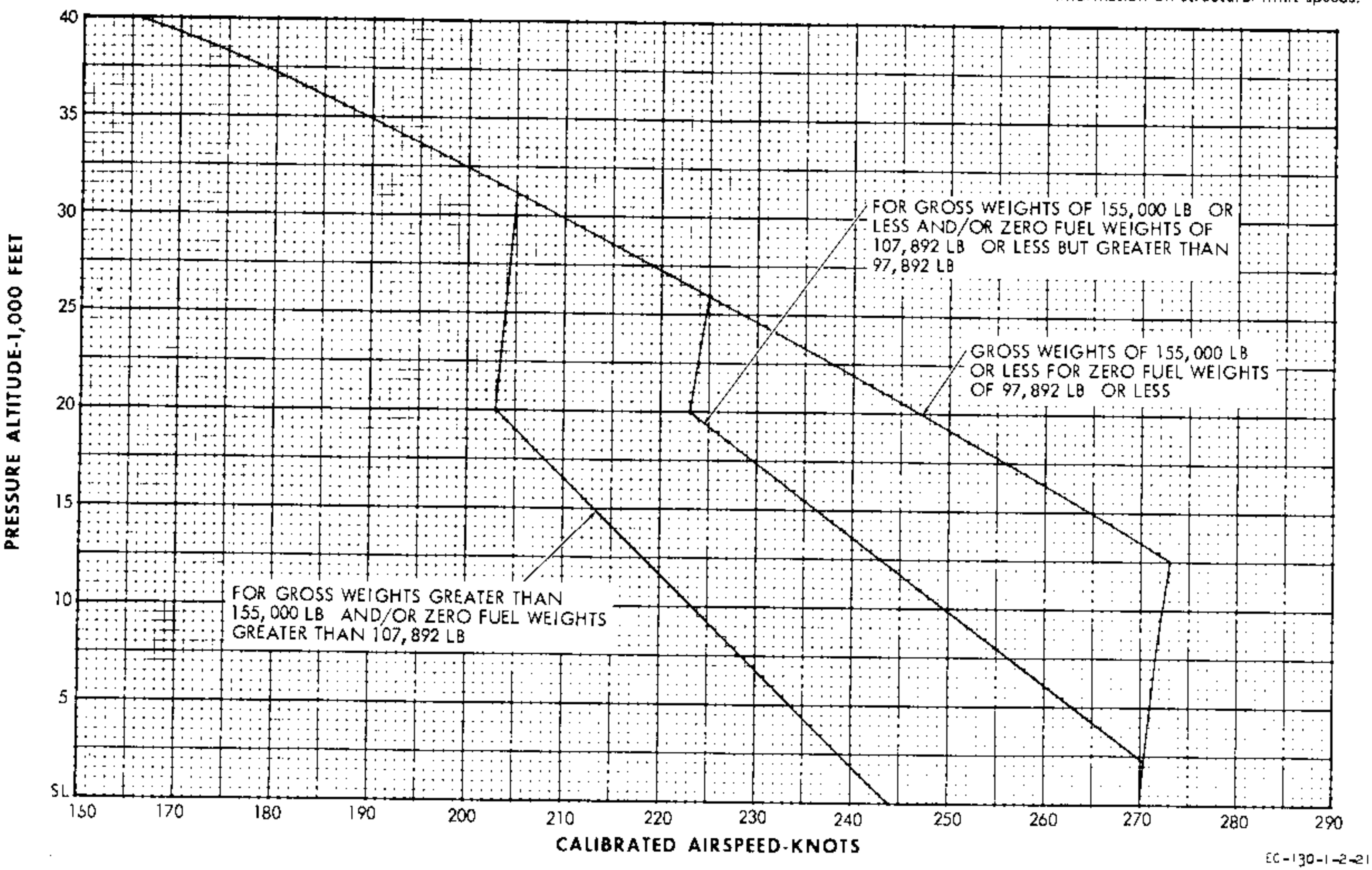


Figure 11-55.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

4 ENGINES SEA LEVEL

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$\sqrt{\frac{1}{\sigma}} = 1.000$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound x $\frac{\text{Ground speed}}{\text{True airspeed}}$

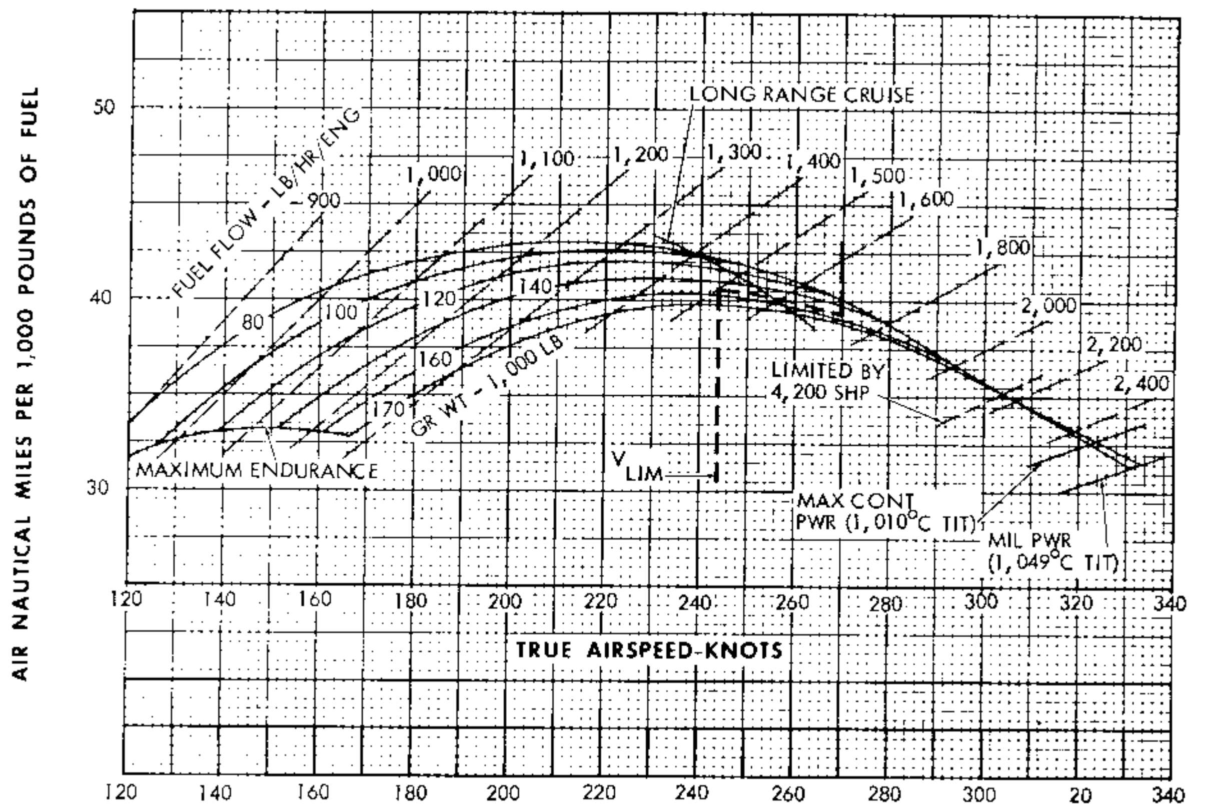


Figure 11-56.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

4 ENGINES **5,000 FEET**

NOTE

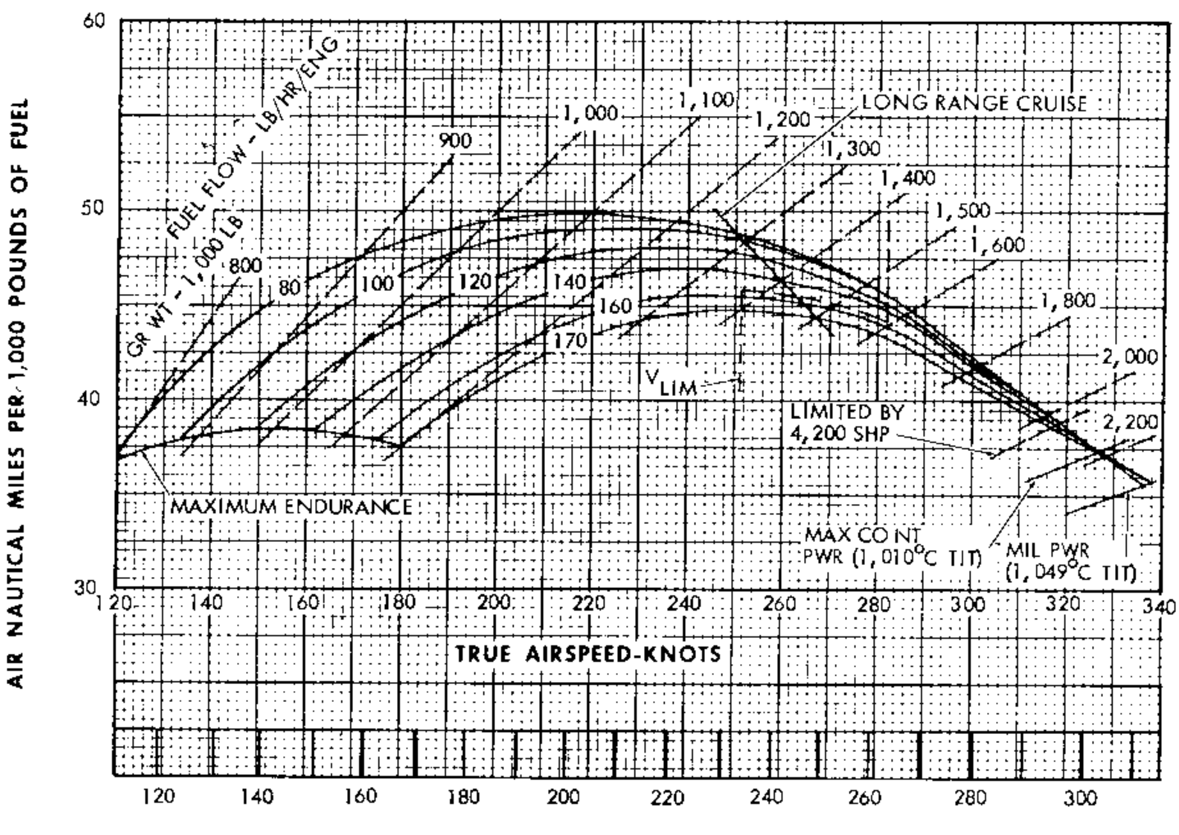
1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound × $\frac{\text{Ground speed}}{\text{True airspeed}}$

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$$\sqrt{\frac{1}{\sigma}} = 1.0773$$



CALIBRATED AIRSPEED-KNOTS

Figure 11-57.

EC-130-1-2-212

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

4 ENGINES **10,000 FEET**

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound x $\frac{\text{Ground speed}}{\text{True airspeed}}$

CONDITIONS
ICAO STANDARD ATMOSPHERE

$\sqrt{\frac{1}{\sigma}} = 1.1637$

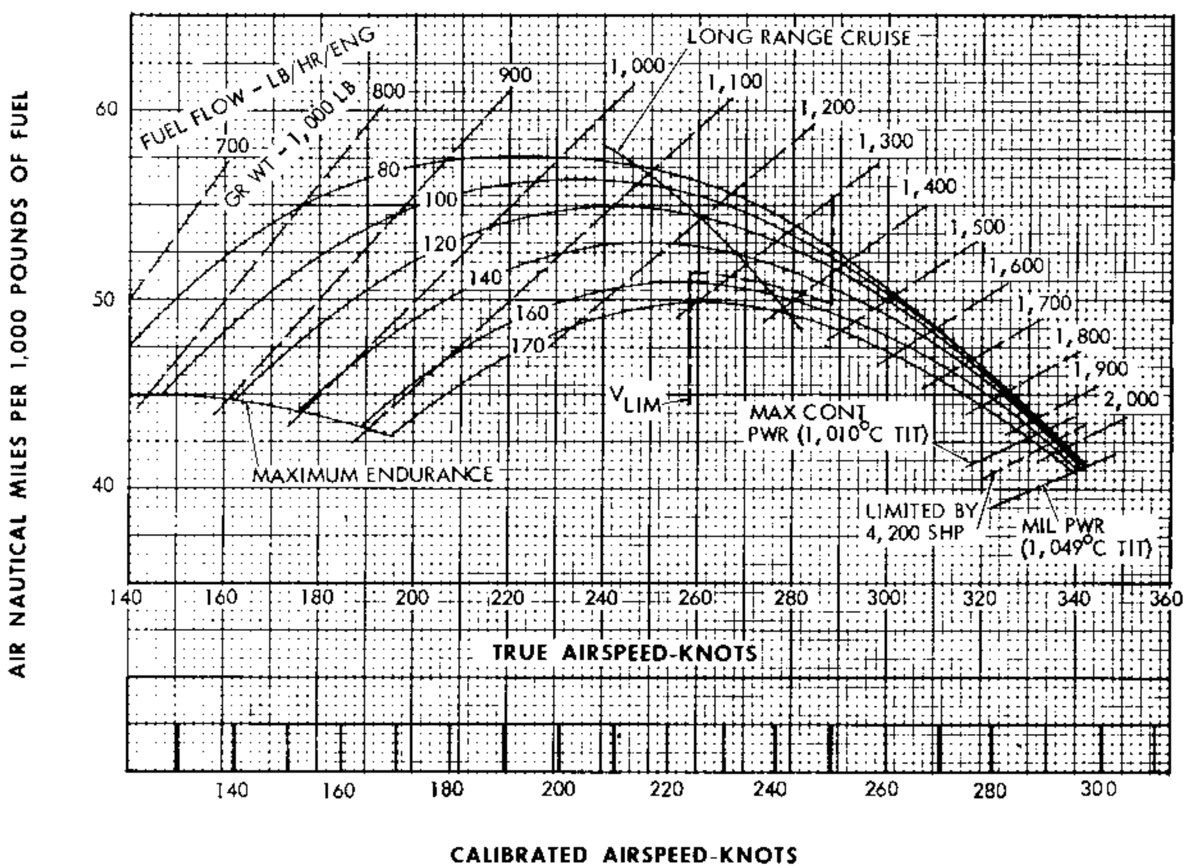


Figure 11-58.

EC-130-1-2-213

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

4 ENGINES 15,000 FEET

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Wind Correction: Ground Nautical miles per pound ≈ air nautical miles per pound x $\frac{\text{Ground speed}}{\text{True airspeed}}$

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$\frac{1}{\sqrt{\sigma}} = 1.2607$

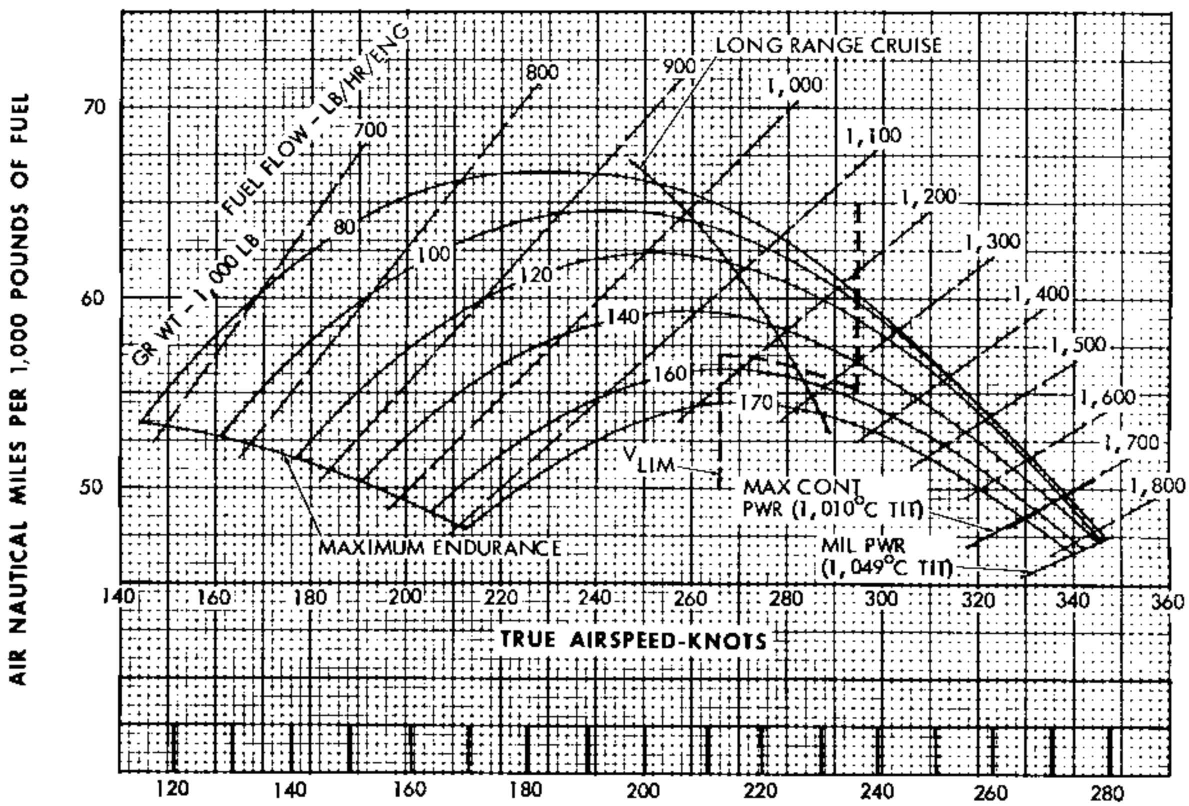


Figure 11-59.

EC-130-1-2-214

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

4 ENGINES 20,000 FEET

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:

ICAO STANDARD ATMOSPHERE

$\sqrt{\frac{1}{\sigma}} = 1.3701$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound x $\frac{\text{Ground speed}}{\text{True airspeed}}$

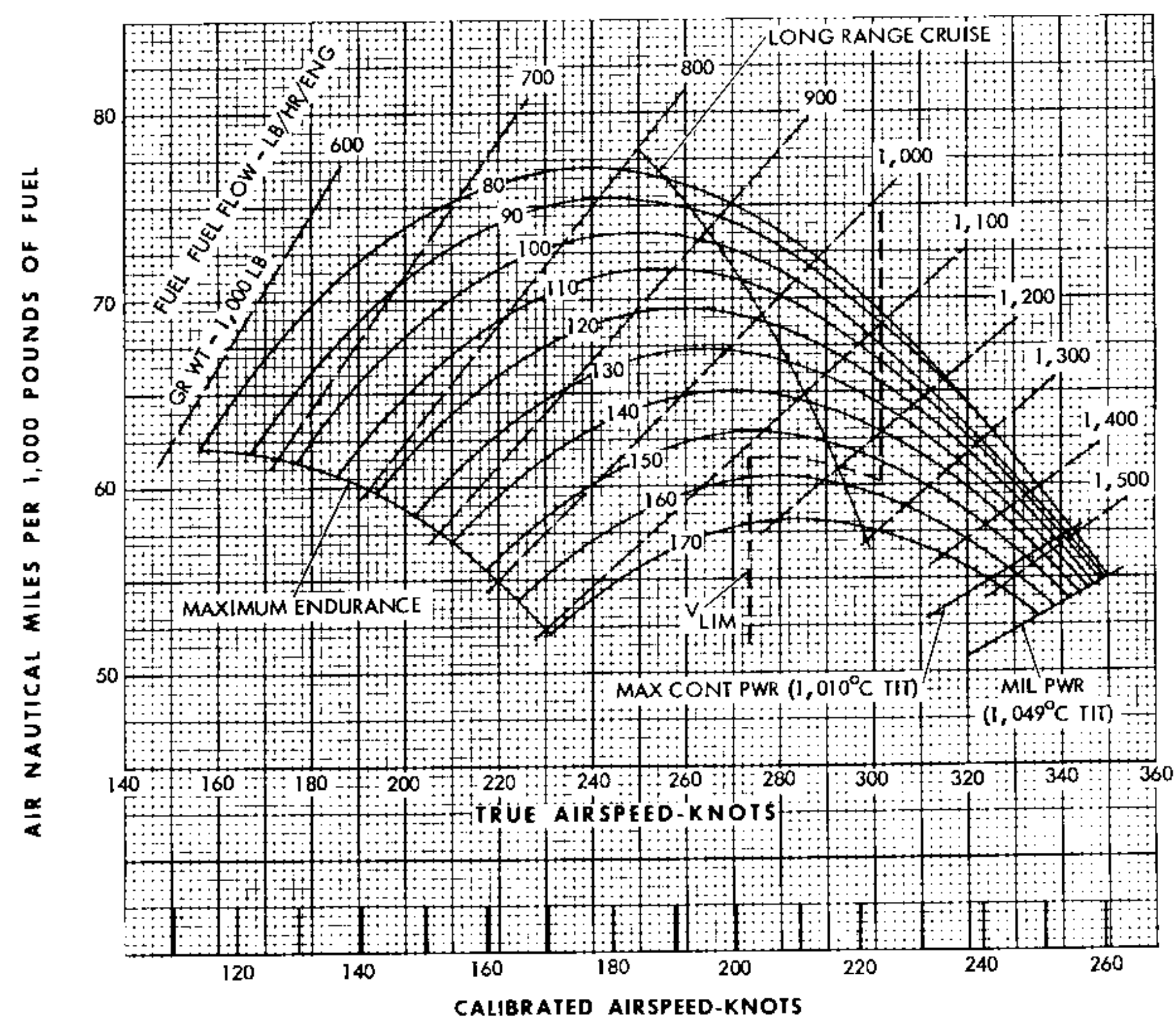


Figure 11-60.

EC-130-1-2-215

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

4 ENGINES 25,000 FEET

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE
$\sqrt{\frac{1}{\sigma}} = 1.4939$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound x $\frac{\text{Ground speed}}{\text{True airspeed}}$

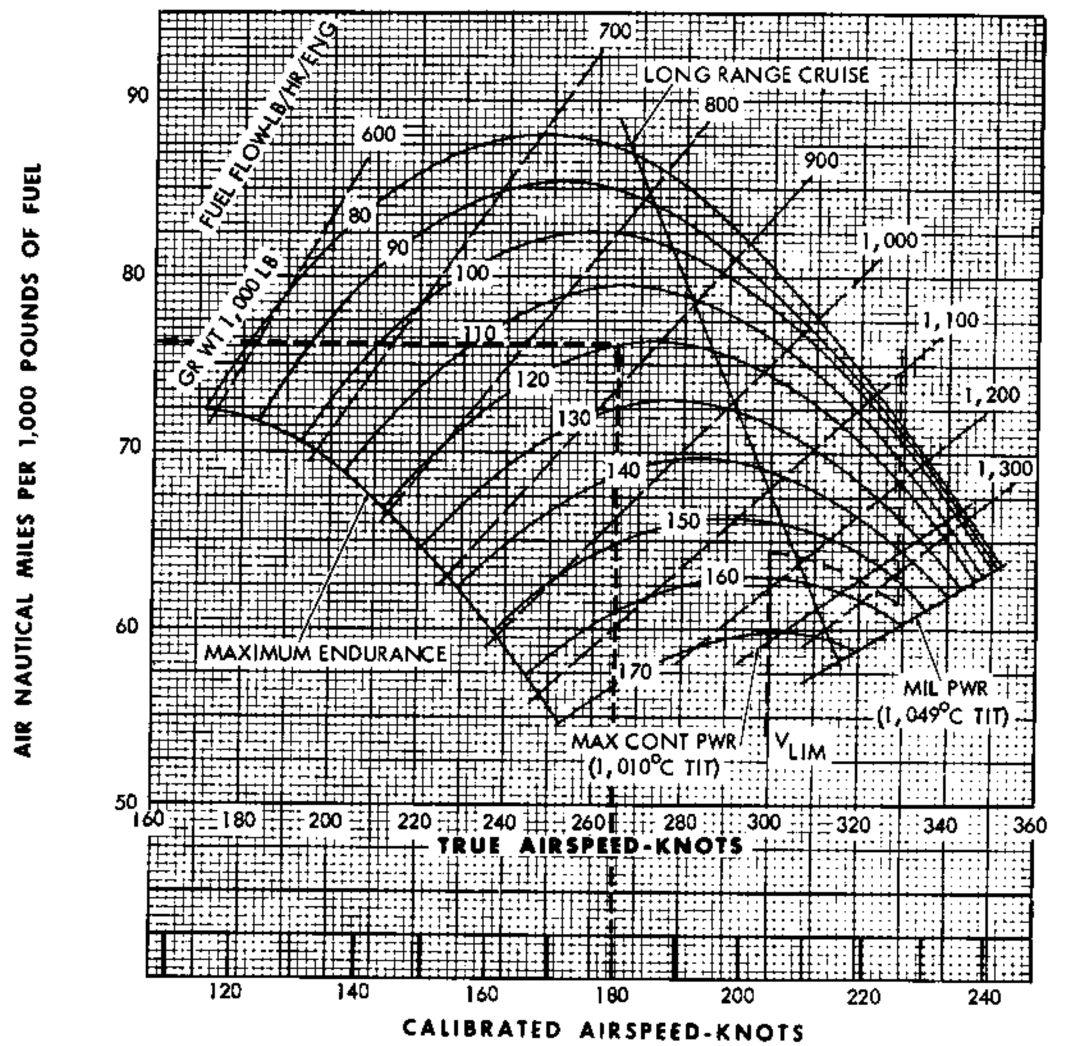


Figure 11-61.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

4 ENGINES 30,000 FEET

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:

ICAO STANDARD ATMOSPHERE

$\sqrt{\frac{1}{\sigma}} = 1.6348$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound x $\frac{\text{Ground speed}}{\text{True airspeed}}$

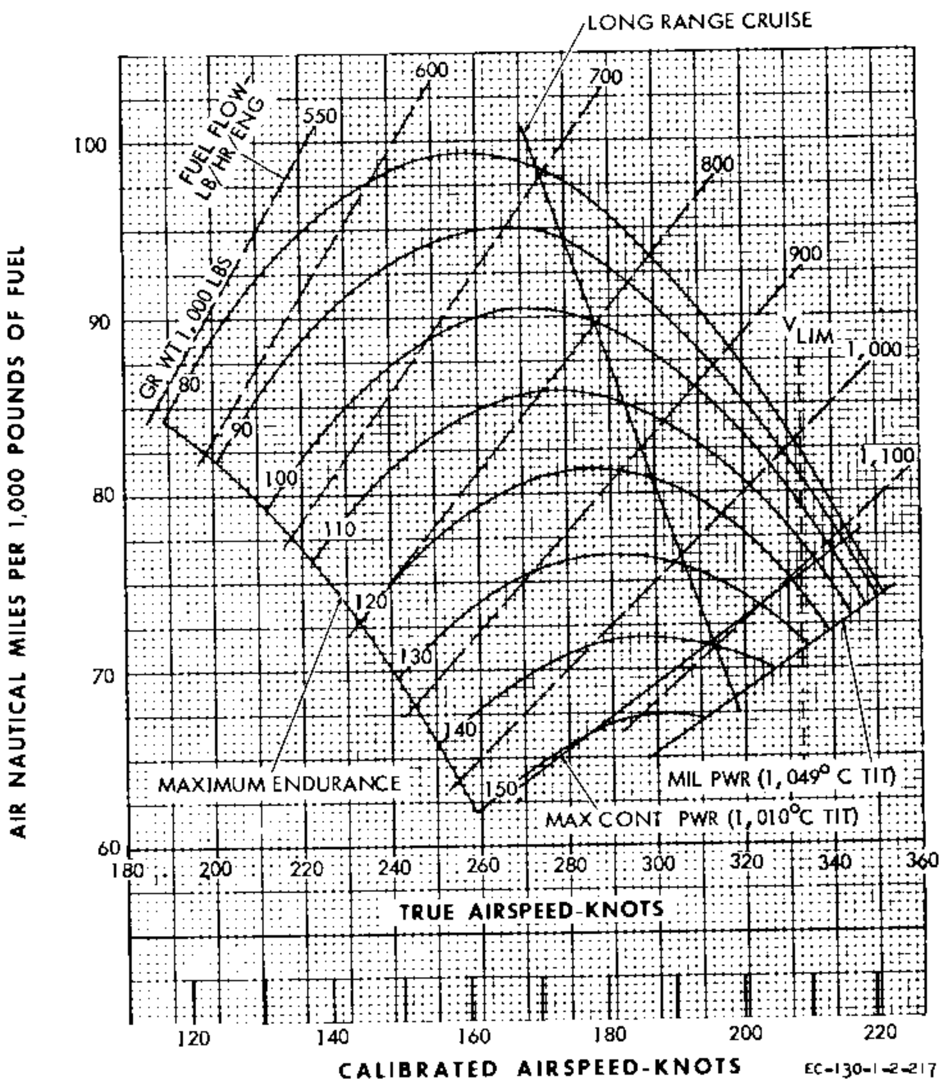


Figure 11-62.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

4 ENGINES 35,000 FEET

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$

CONDITIONS:
ICAO STANDARD ATMOSPHERE
$\frac{1}{\sqrt{\sigma}} = 1.7963$

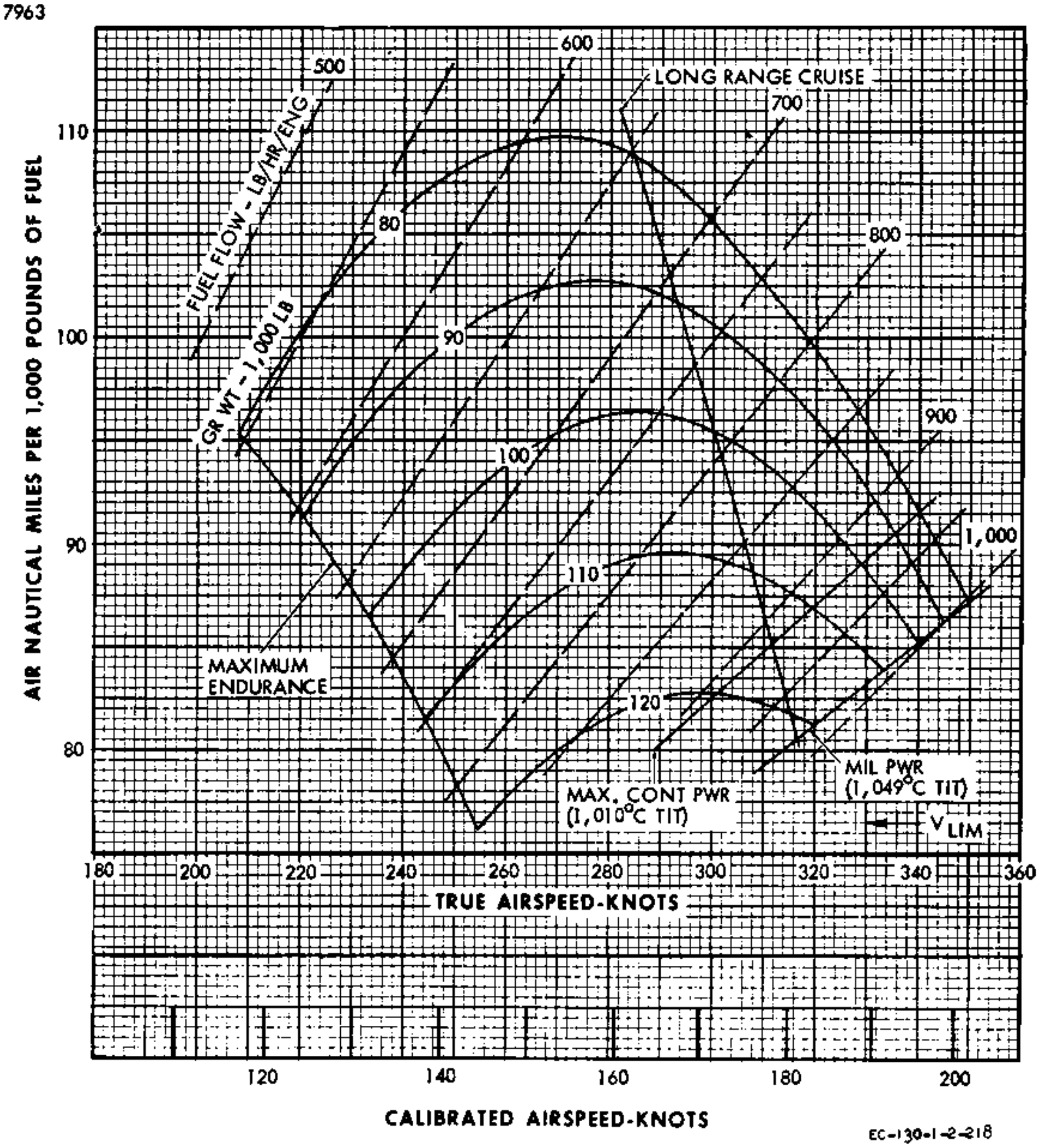


Figure 11-63.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

3 ENGINES SEA LEVEL

DATE: APRIL 1966

DATA BASIS : ESTIMATED ON FLIGHT TEST

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound x $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propeller feathered on inoperative engine.

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$\frac{1}{\sqrt{\sigma}} = 1.000$

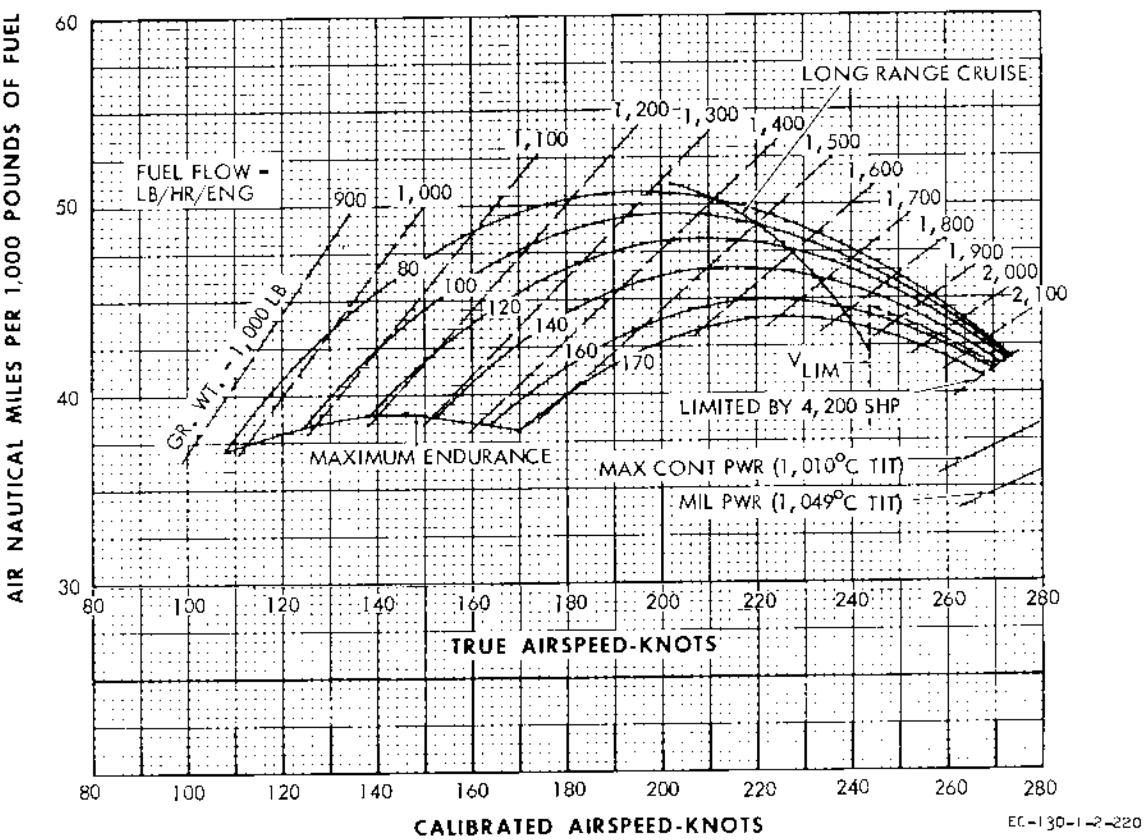


Figure 11-64.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

3 ENGINES 5,000 FEET

DATE: APRIL 1966

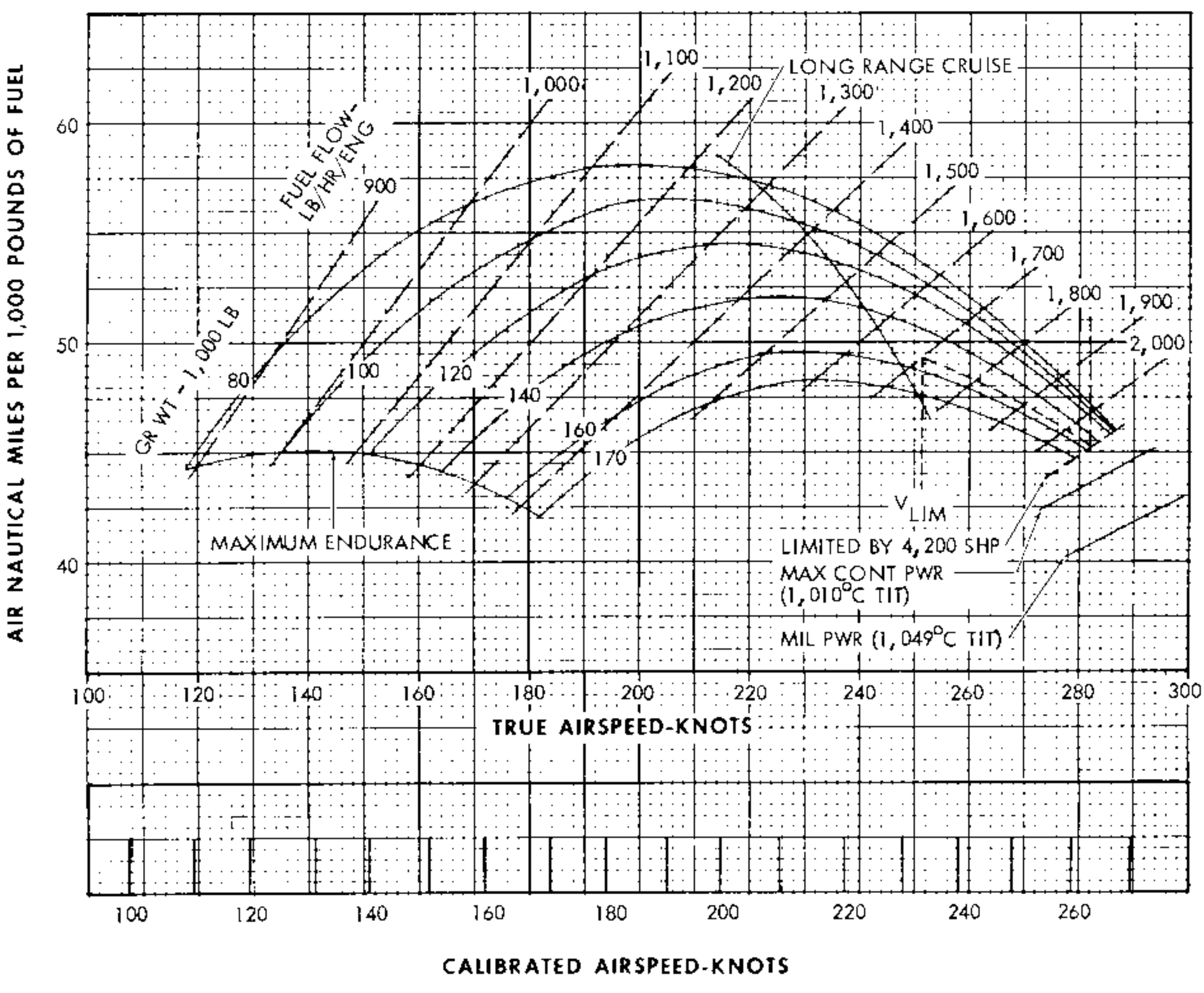
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propeller feathered on inoperative engine

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$\frac{1}{\sqrt{\sigma}} = 1.0773$



EC-130-1-2-221

Figure 11-65.

MODEL: EC-130G/Q
T56-A-423 ENGINES

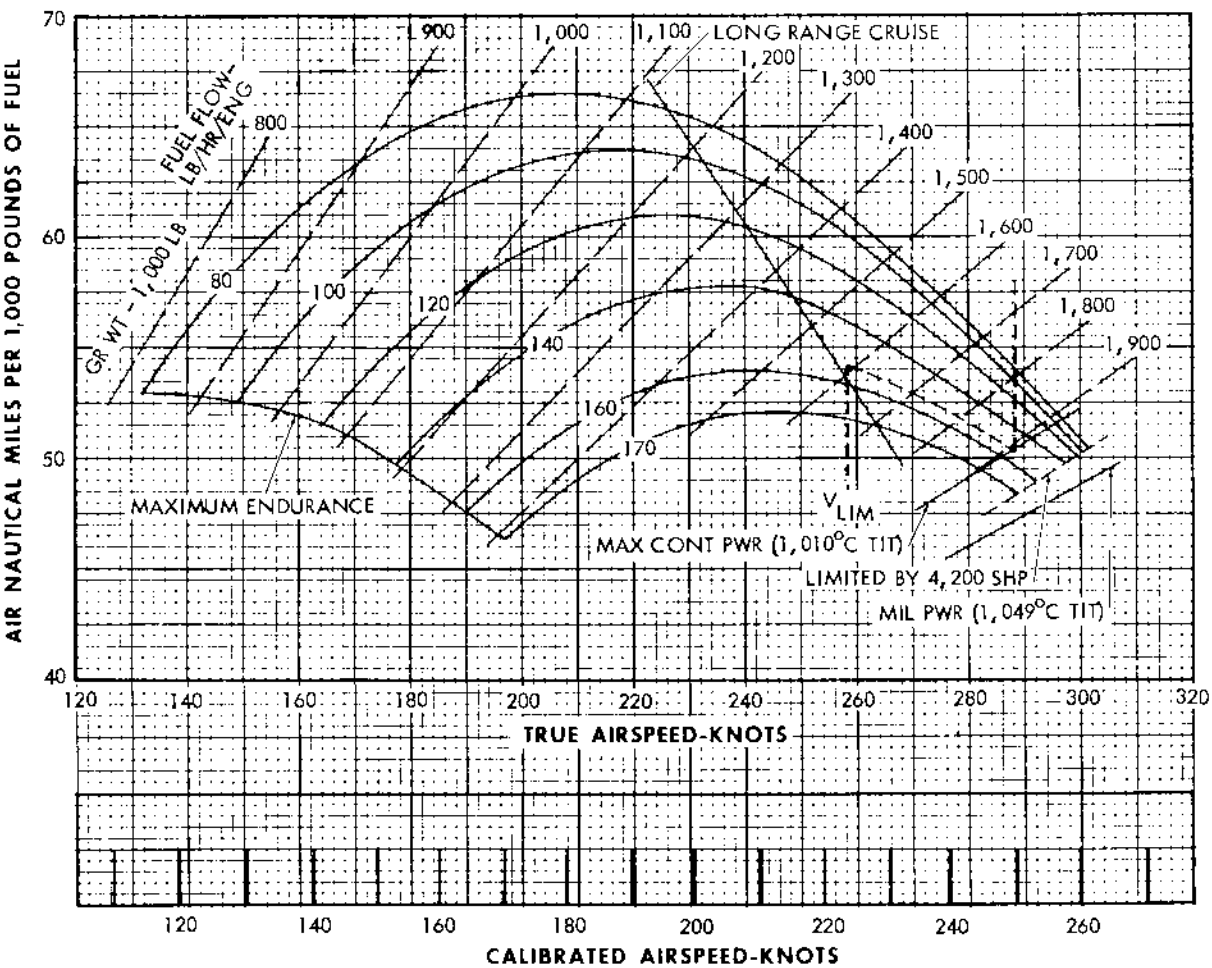
SPECIFIC RANGE
3 ENGINES 10,000 FEET

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE
$\frac{1}{\sqrt{\sigma}} = 1.1637$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propeller feathered on inoperative engine.



EC-130-1-2-222

Figure 11-66.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

3 ENGINES 15,000 FEET

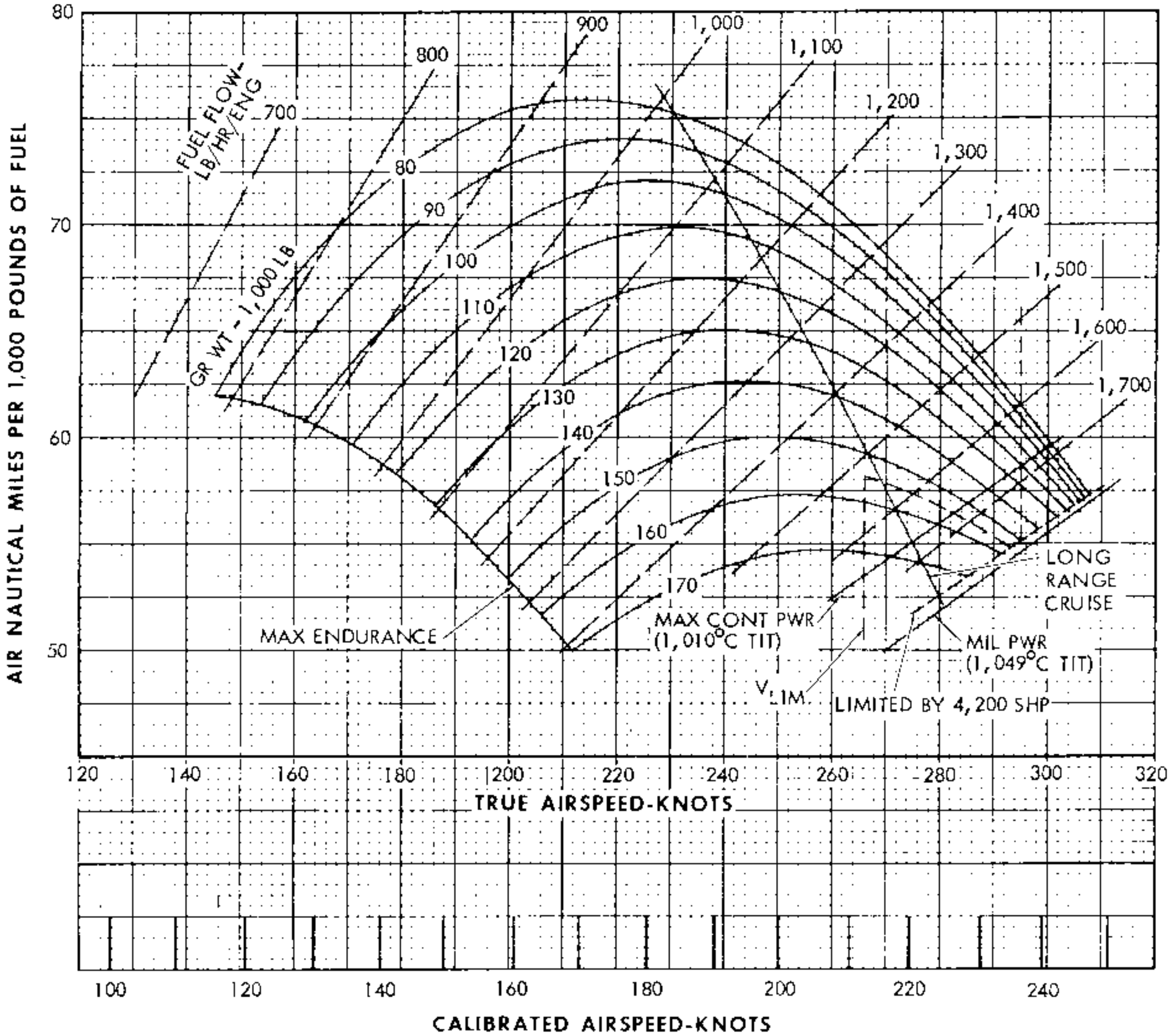
DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$\sqrt{\frac{1}{\sigma}} = 1.2607$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propeller feathered on inoperative engine.



EC-130-1-2-223

Figure 11-67.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

3 ENGINES **20,000 FEET**

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE
$\sqrt{\frac{1}{\sigma}} = 1.3701$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propeller feathered on inoperative engine.

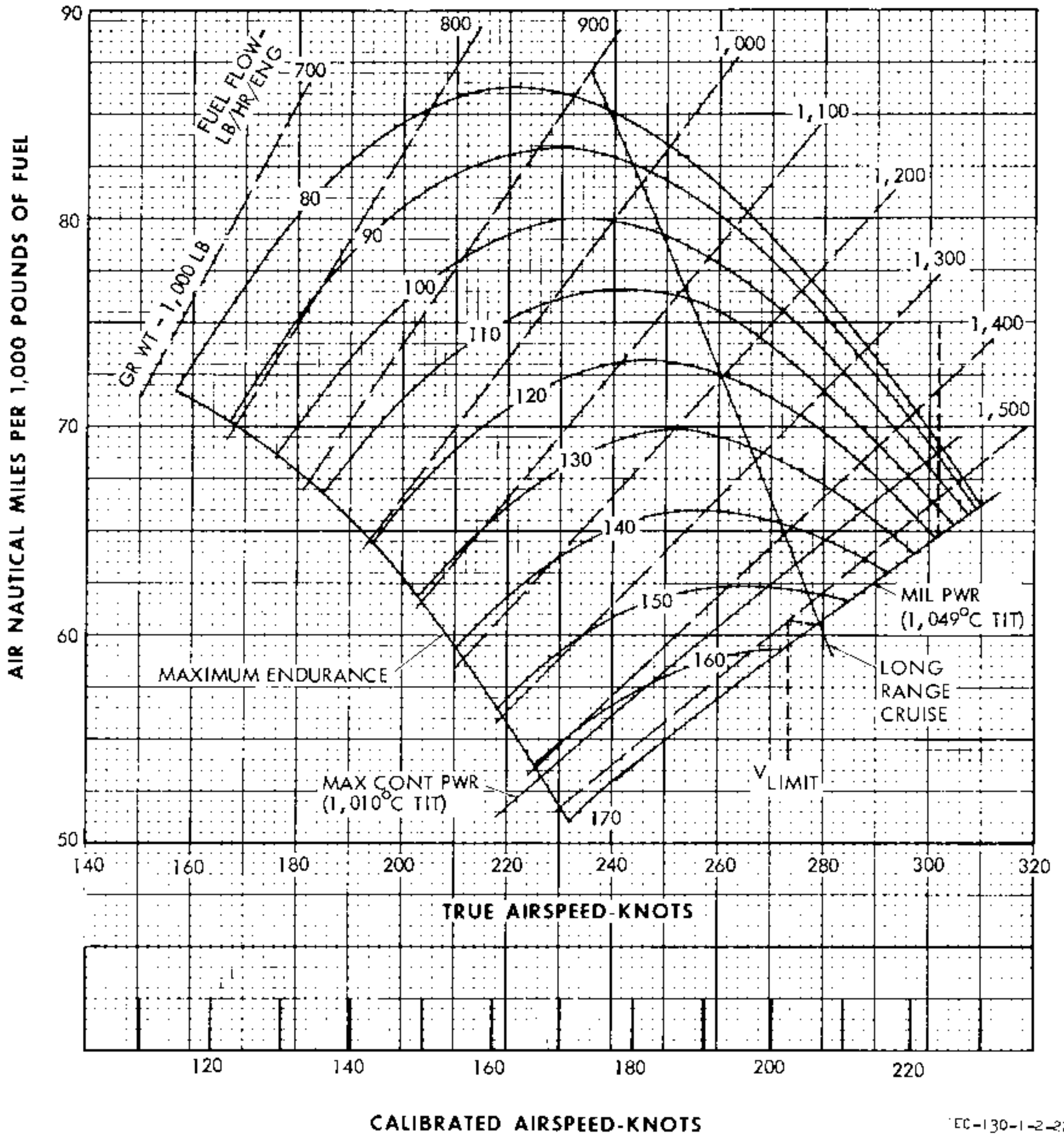


Figure 11-68.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

3 ENGINES 25,000 FEET

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$\frac{1}{\sqrt{\sigma}} = 1.4939$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propeller feathered on inoperative engine.

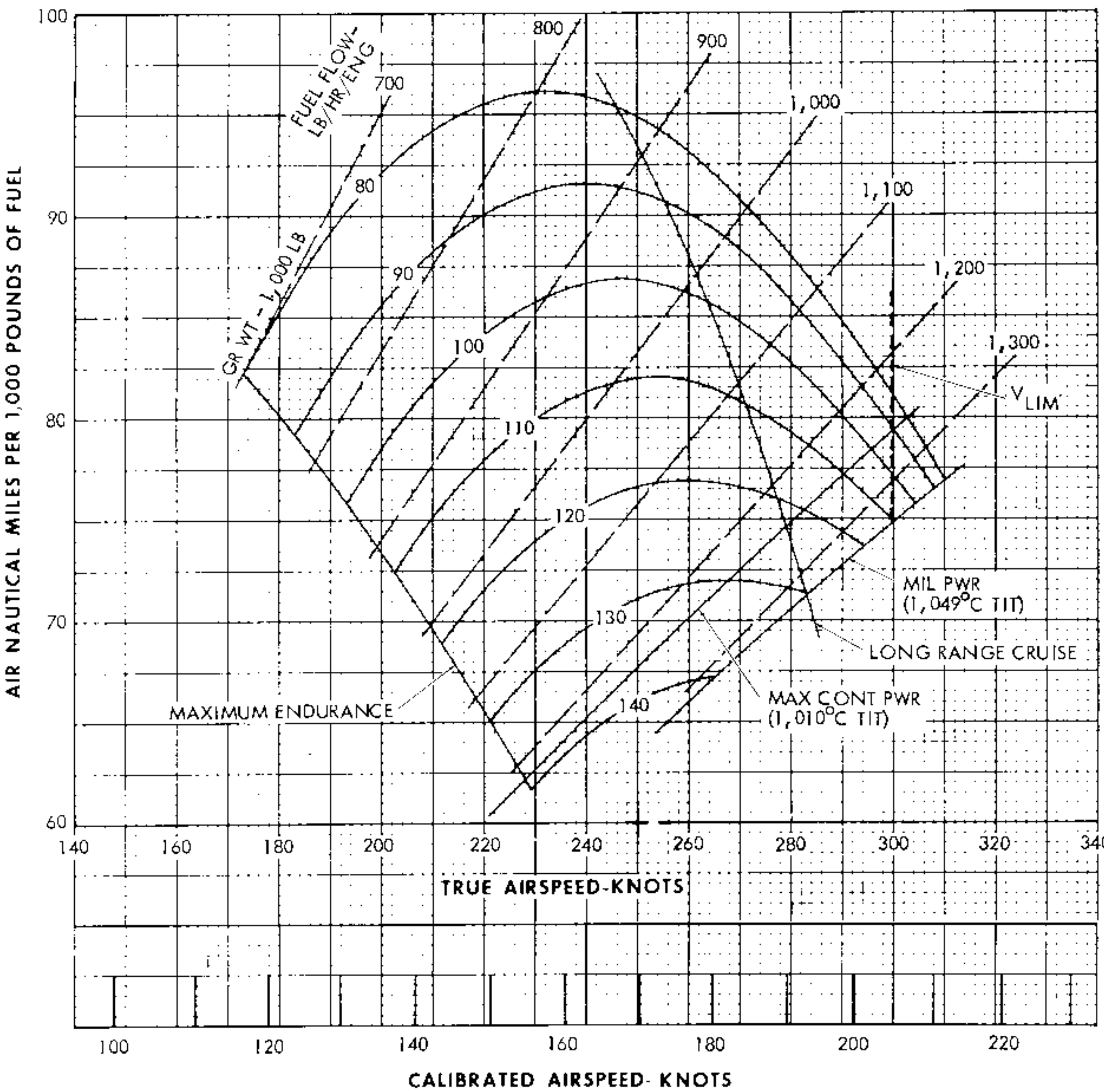


Figure 11-69.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

ASYMMETRICAL POWER

2 ENGINES SEA LEVEL

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$\frac{1}{\sqrt{\sigma}} = 1.000$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propellers feathered on the inoperative engines.

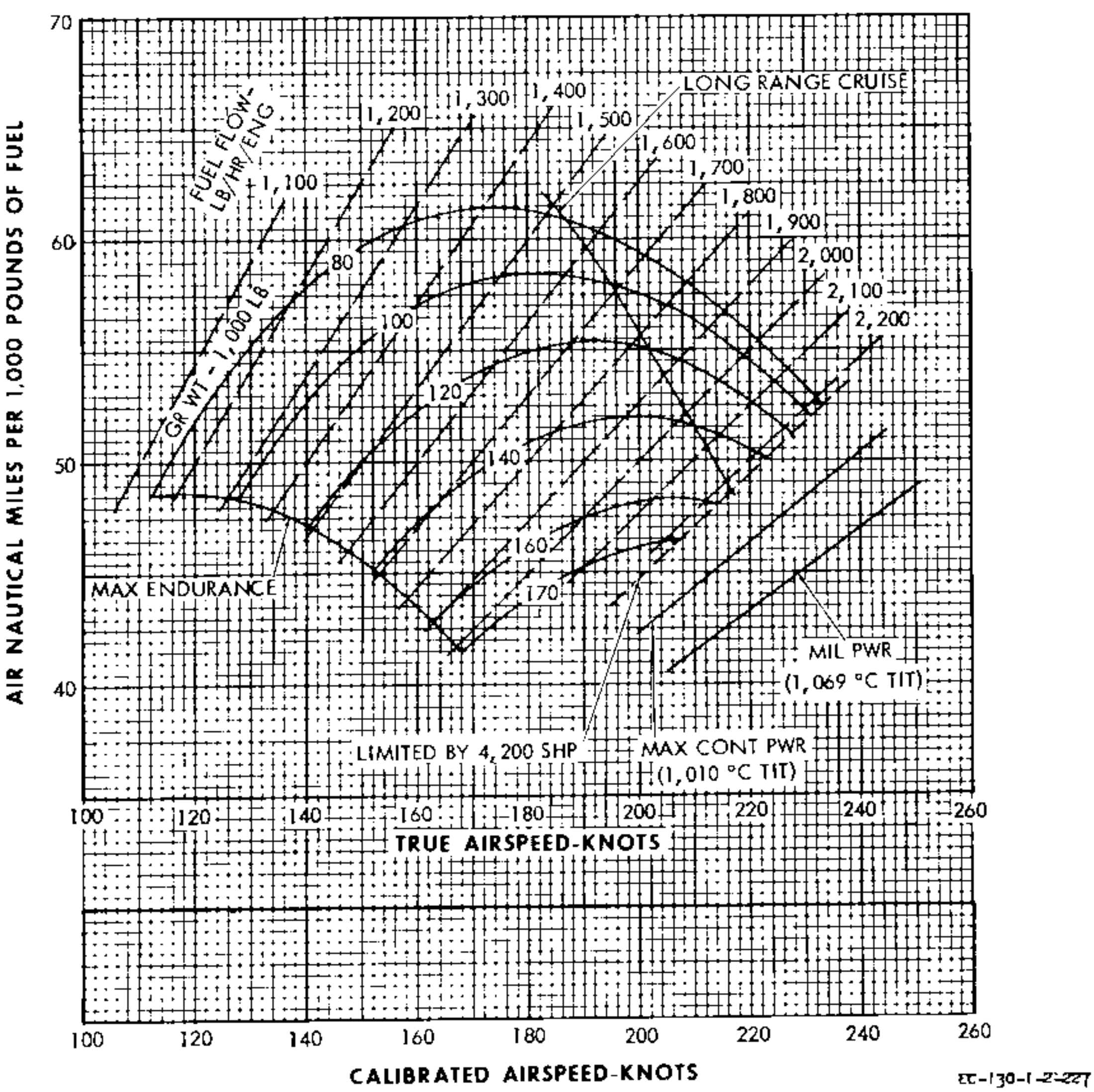


Figure 11-70.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE
ASYMMETRICAL POWER
2 ENGINES 5,000 FEET

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE
$\frac{1}{\sqrt{\sigma}} = 1.0773$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propellers feathered on inoperative engines.

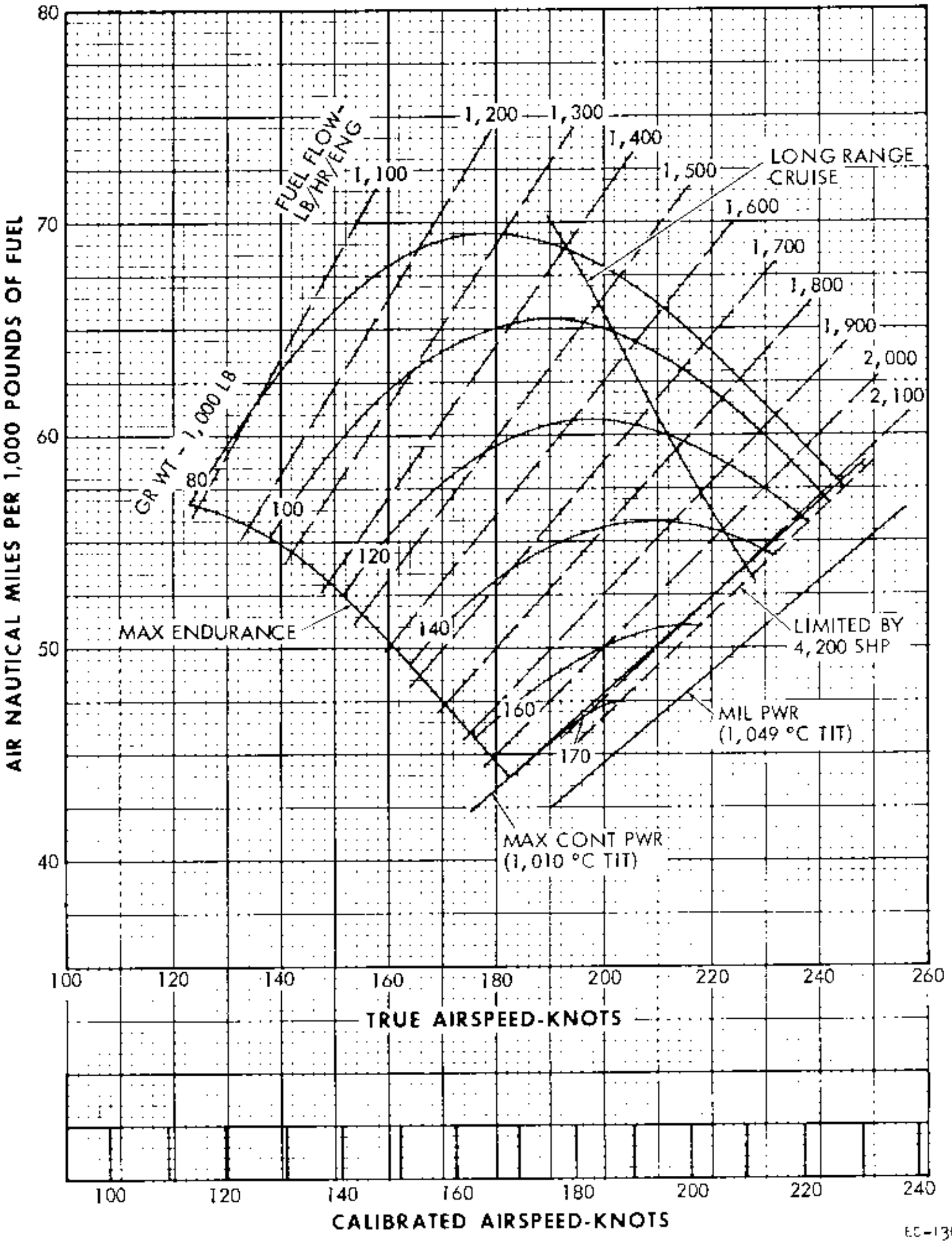


Figure 11-71.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE

ASYMMETRICAL POWER

2 ENGINES 10,000 FEET

DATE: APRIL 1966

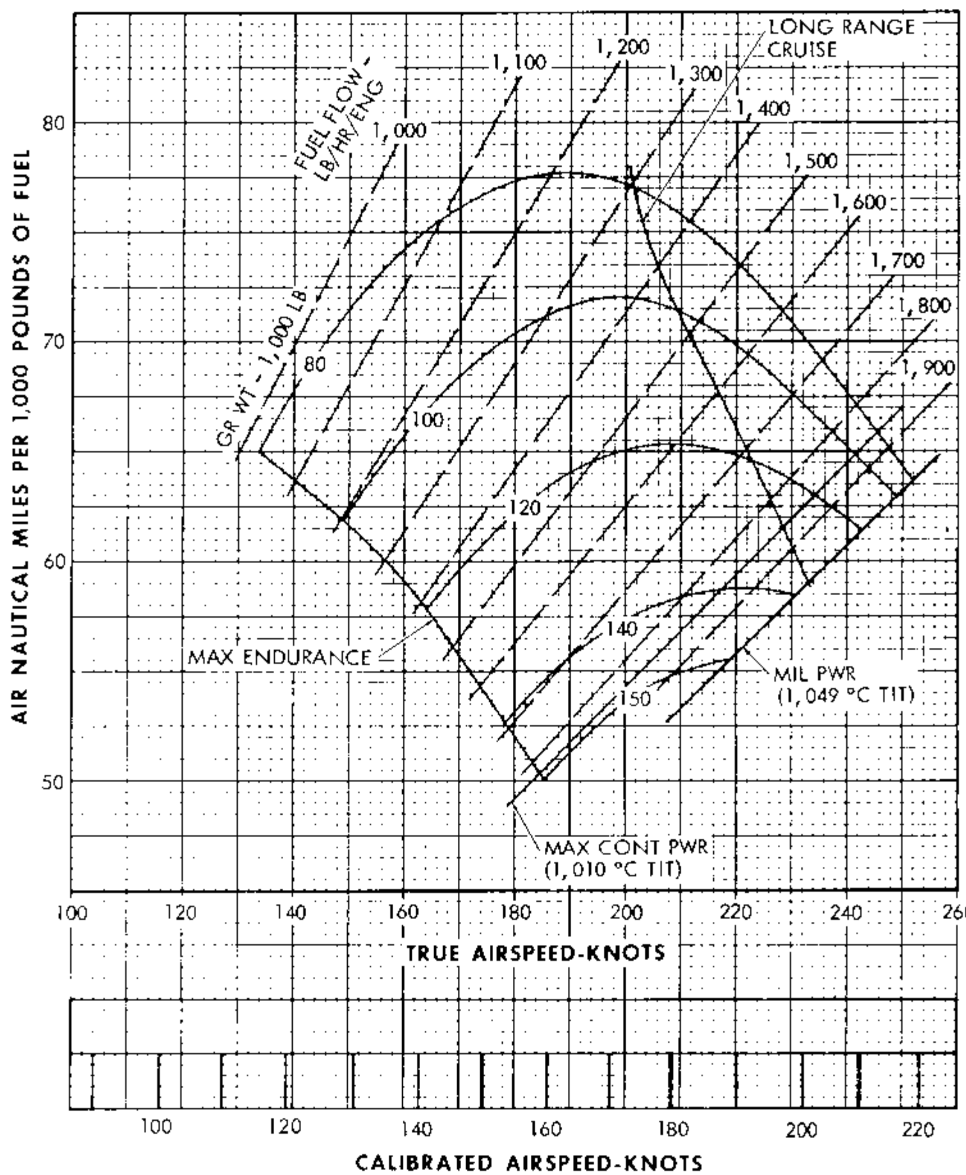
DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$\sqrt{\frac{1}{\sigma}} = 1.1637$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propellers feathered on inoperative engines.



EC-130-1-P-229

Figure 11-72.

MODEL: EC-130G/Q
T56-A-423 ENGINES

SPECIFIC RANGE
ASYMMETRICAL POWER
2 ENGINES 15,000 FEET

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

CONDITIONS:
ICAO STANDARD ATMOSPHERE

$\sqrt{\frac{1}{\sigma}} = 1.2607$

NOTE

1. Wind Correction: Ground Nautical miles per pound = air nautical miles per pound X $\frac{\text{Ground speed}}{\text{True airspeed}}$
2. Propellers feathered on the inoperative engines.

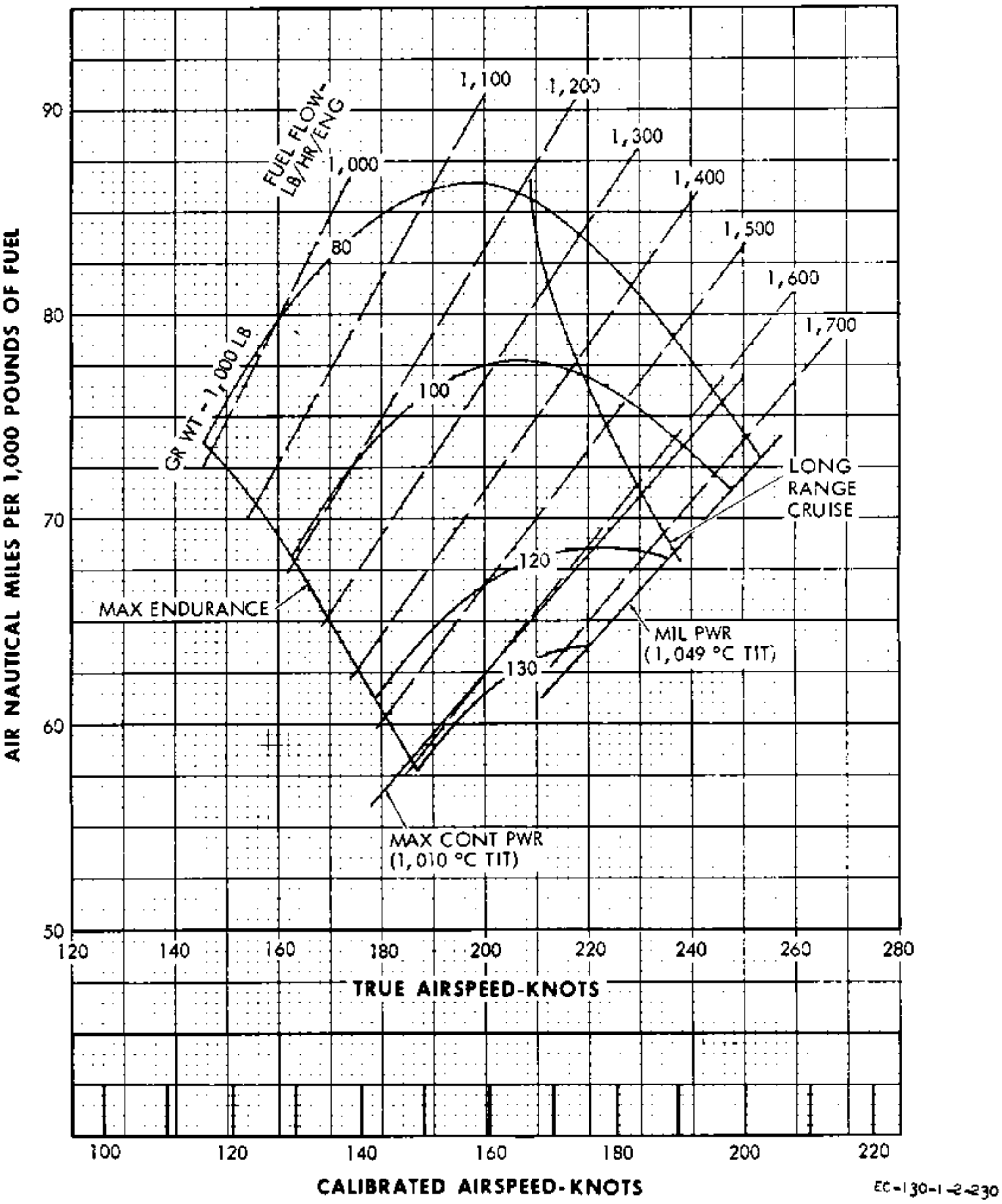


Figure 11-73.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY-LONG RANGE CRUISE

4 ENGINES AIRSPEED
NORMAL BLEED

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. These speeds applicable up to zero fuel weights of 107,892 lb. See Part 4 of Section I for speed restrictions above 107,892 lb. zero fuel weight.

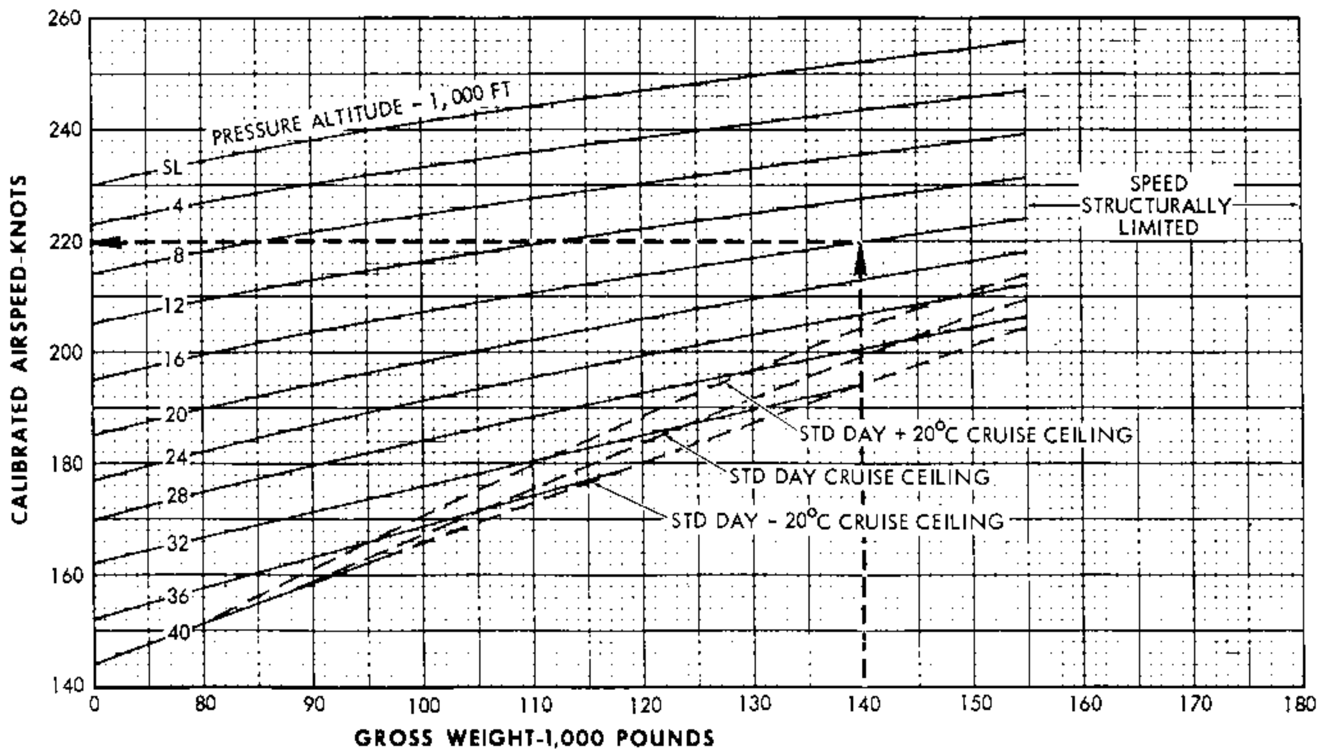


Figure 11-74.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY LONG RANGE CRUISE

4 ENGINES FUEL FLOW
NORMAL BLEED

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. To facilitate the reading of this chart, std day - 20° C cruise ceiling is approximated by the std day cruise ceiling.
2. **Speed structurally limited above 155,000 lb., refer to Part 4 Section I for limitations.**

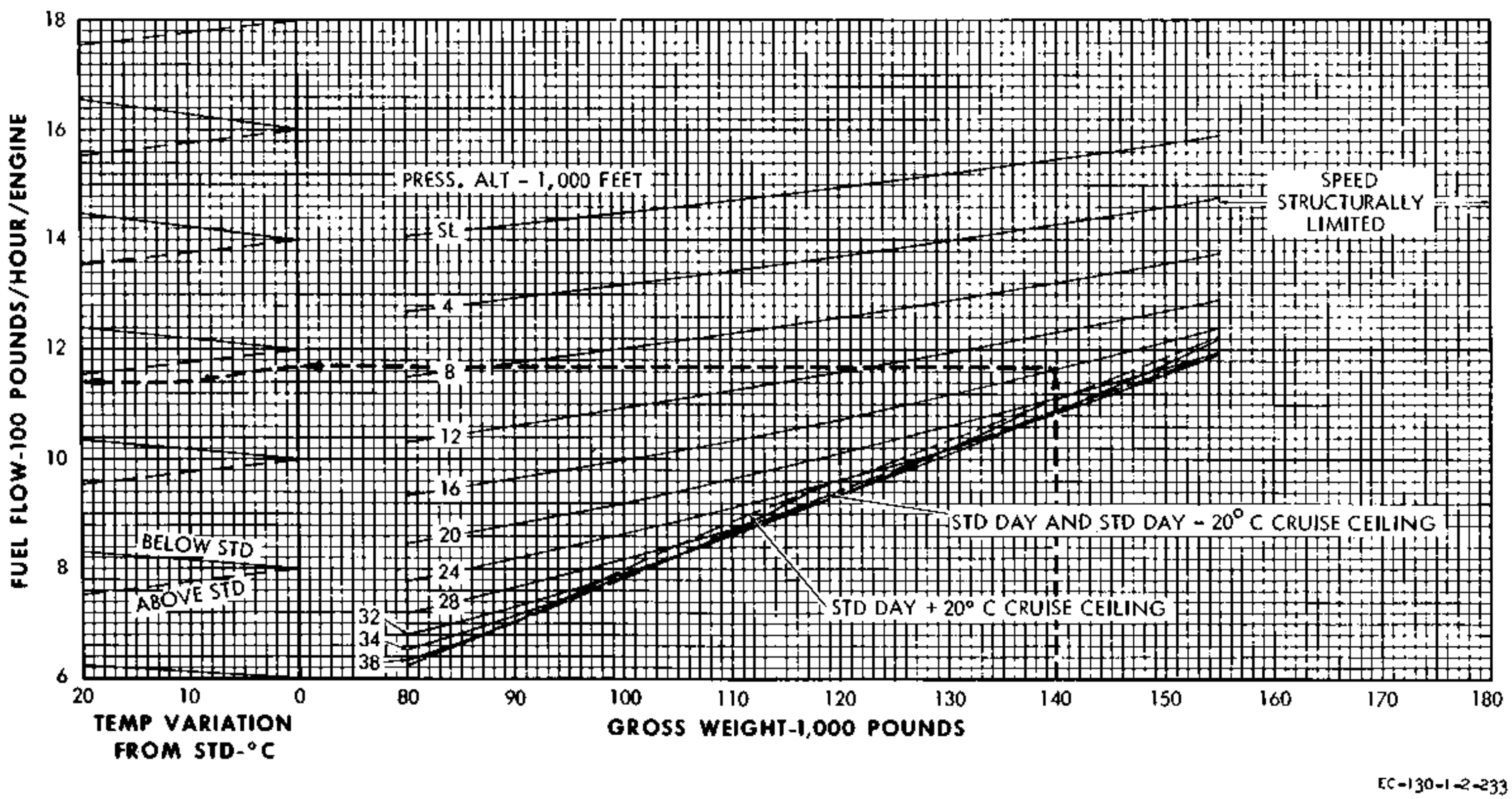


Figure 11-75.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY-
LONG RANGE CRUISE

4 ENGINES TORQUE

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

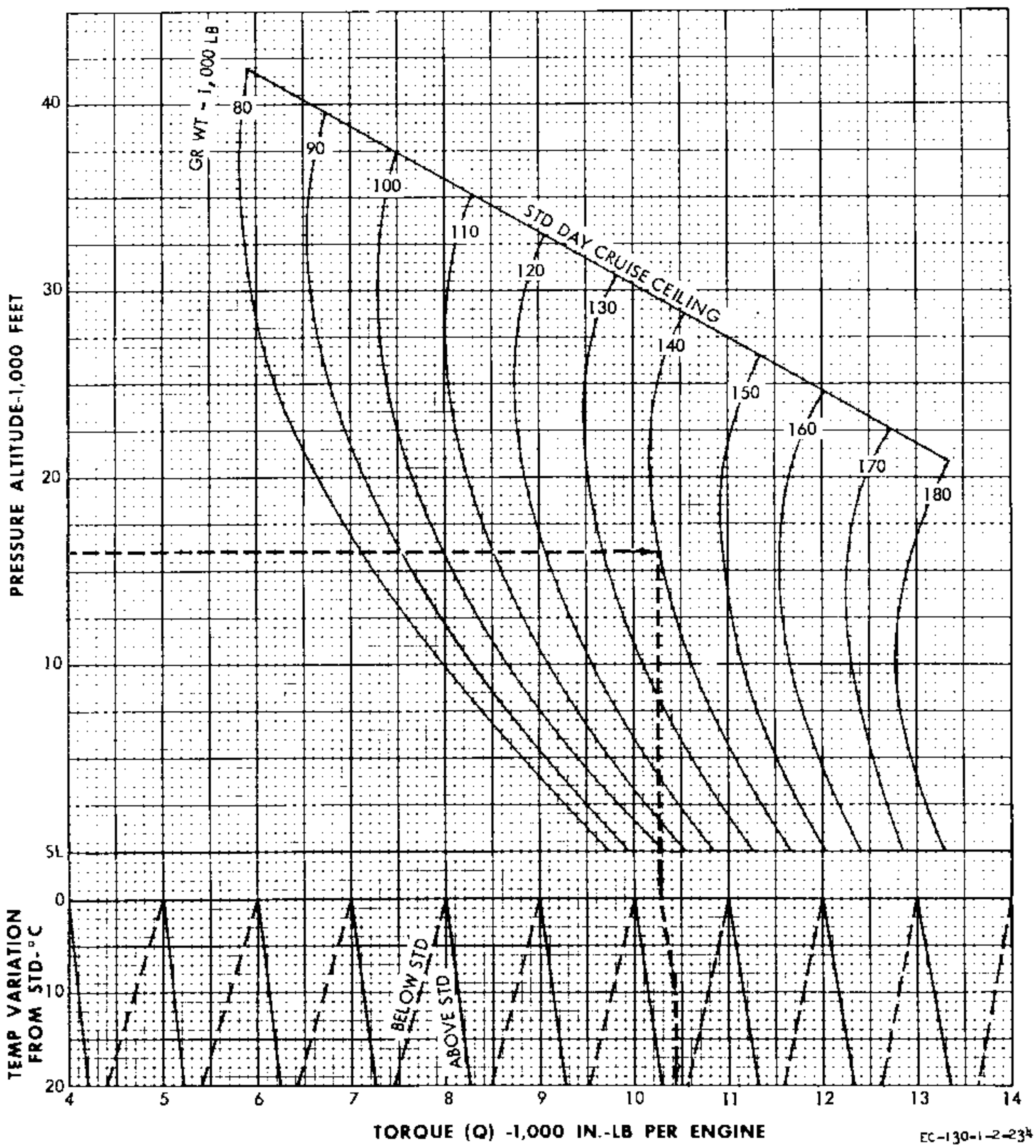


Figure 11-76.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY- CONSTANT 290 KTAS
4 ENGINES INDICATED AIRSPEED

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

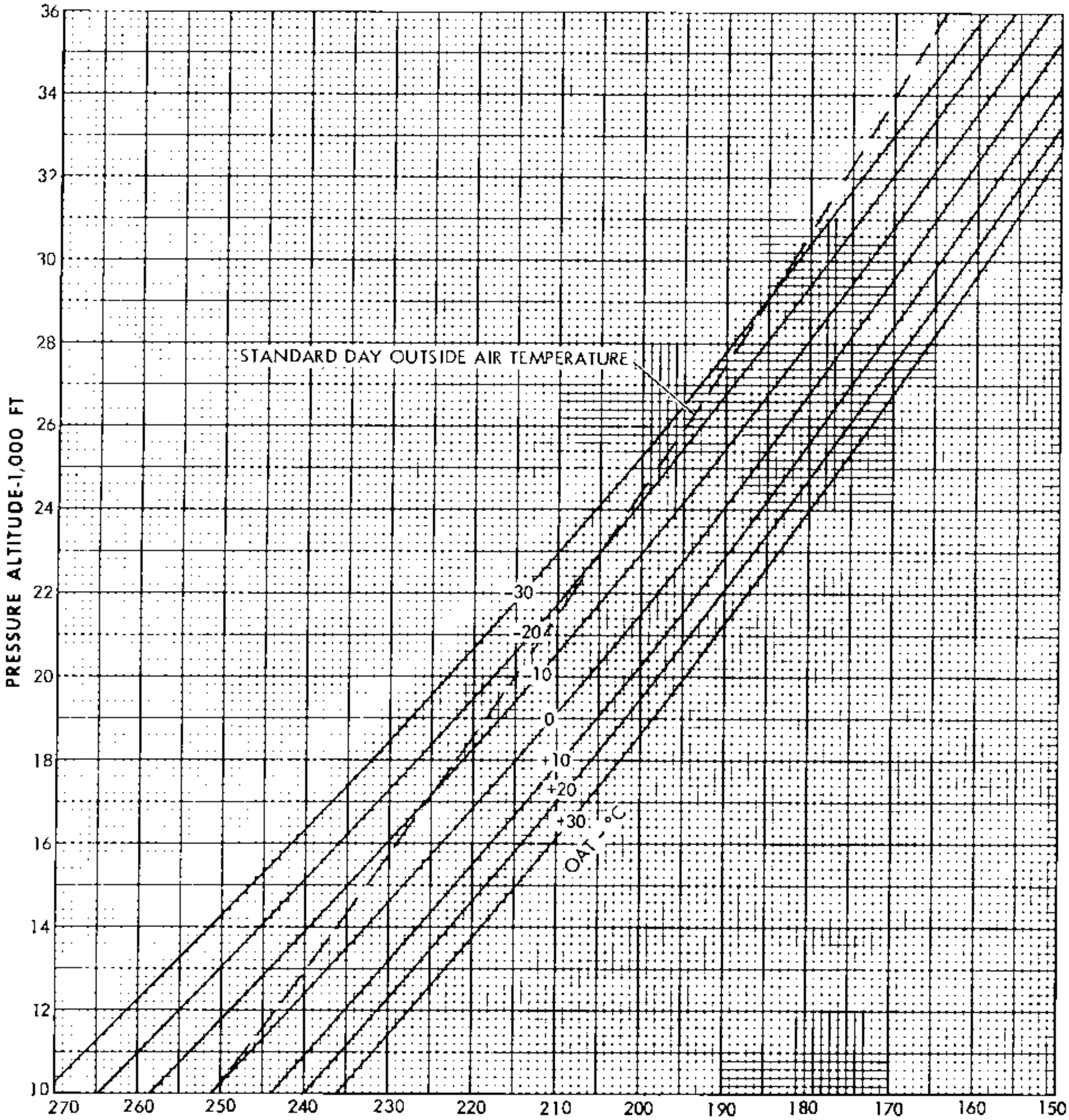


Figure 11-77.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY CONSTANT 290 KTAS

4 ENGINES FUEL FLOW

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Speeds structually limited to less than 290 KTAS for gross weights greater than 155,000 lb.

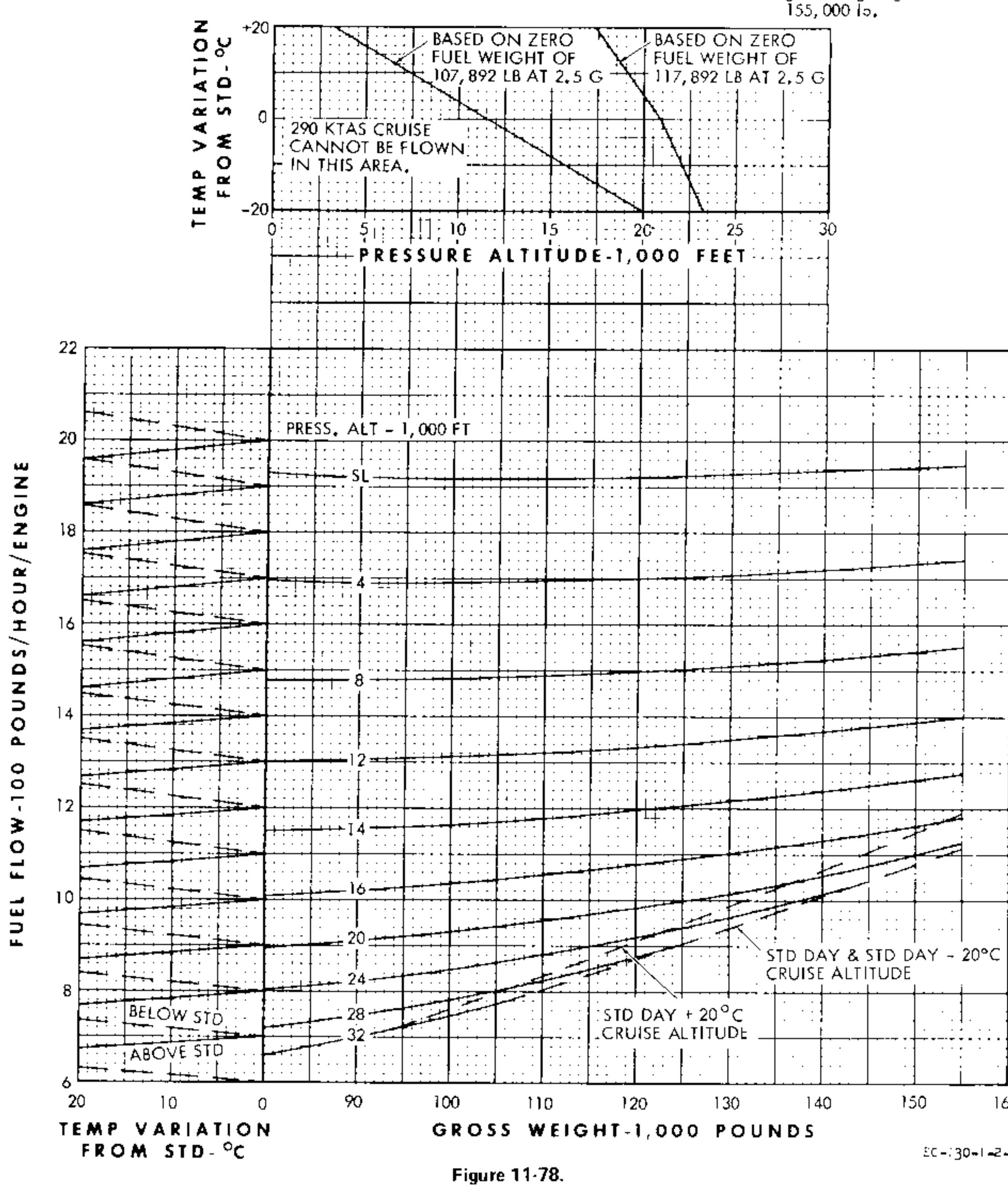


Figure 11-78.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY CONSTANT 290 KTAS

4 ENGINES TORQUE

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Speeds structually limited to less than 290 KTAS for gross weights greater than 155,000 lb.

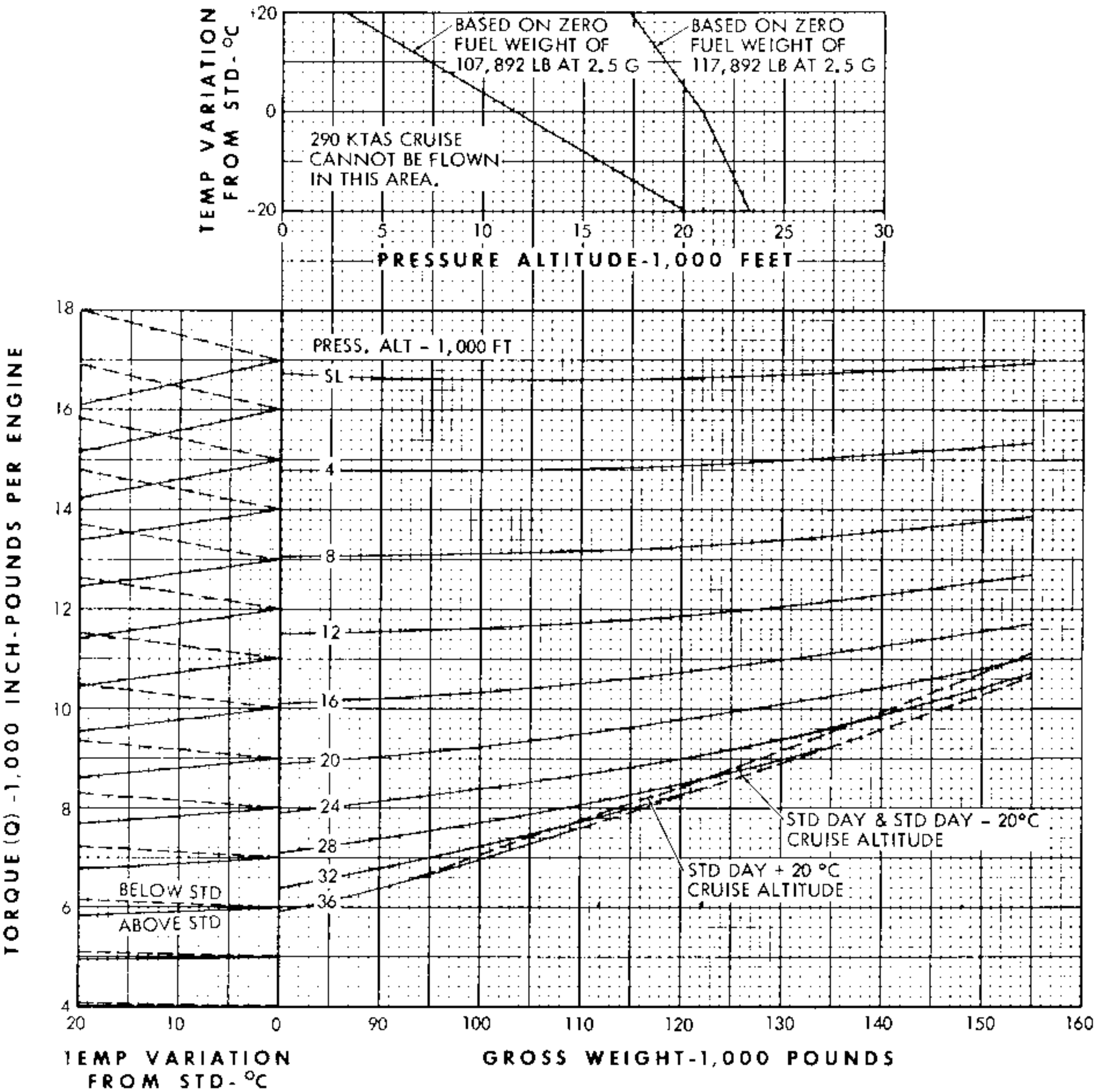


Figure 11-79.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY
CONSTANT 290 KTAS
TURBINE INLET TEMPERATURE
4 ENGINES

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

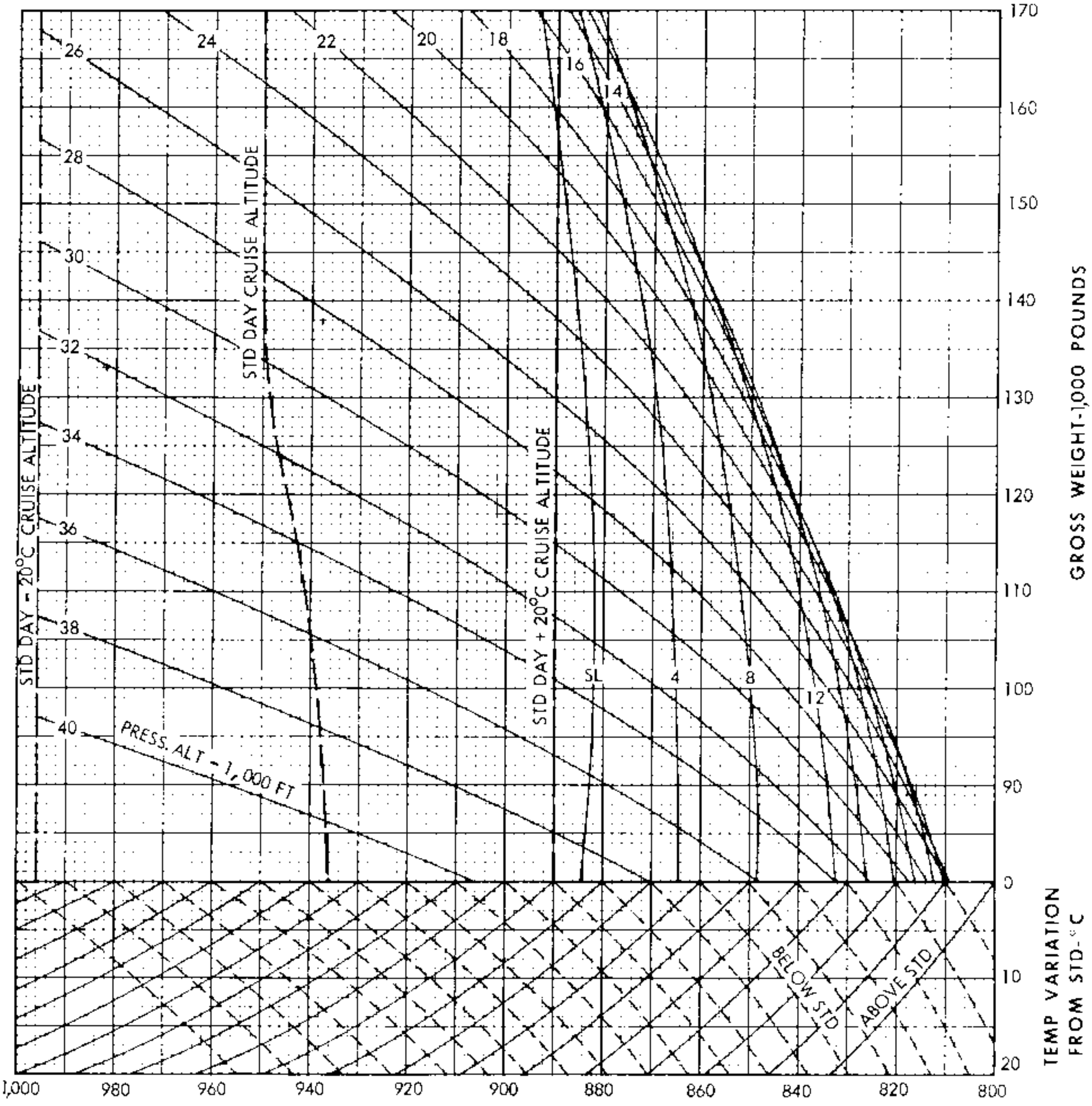


Figure 11-80.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY-
LONG RANGE CRUISE

3 ENGINES AIRSPEED

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.
2. These speeds applicable up to zero fuel weights of 107,892 lb. see Part 4, Section I for speed restrictions above 107,892 lb. zero fuel weight.

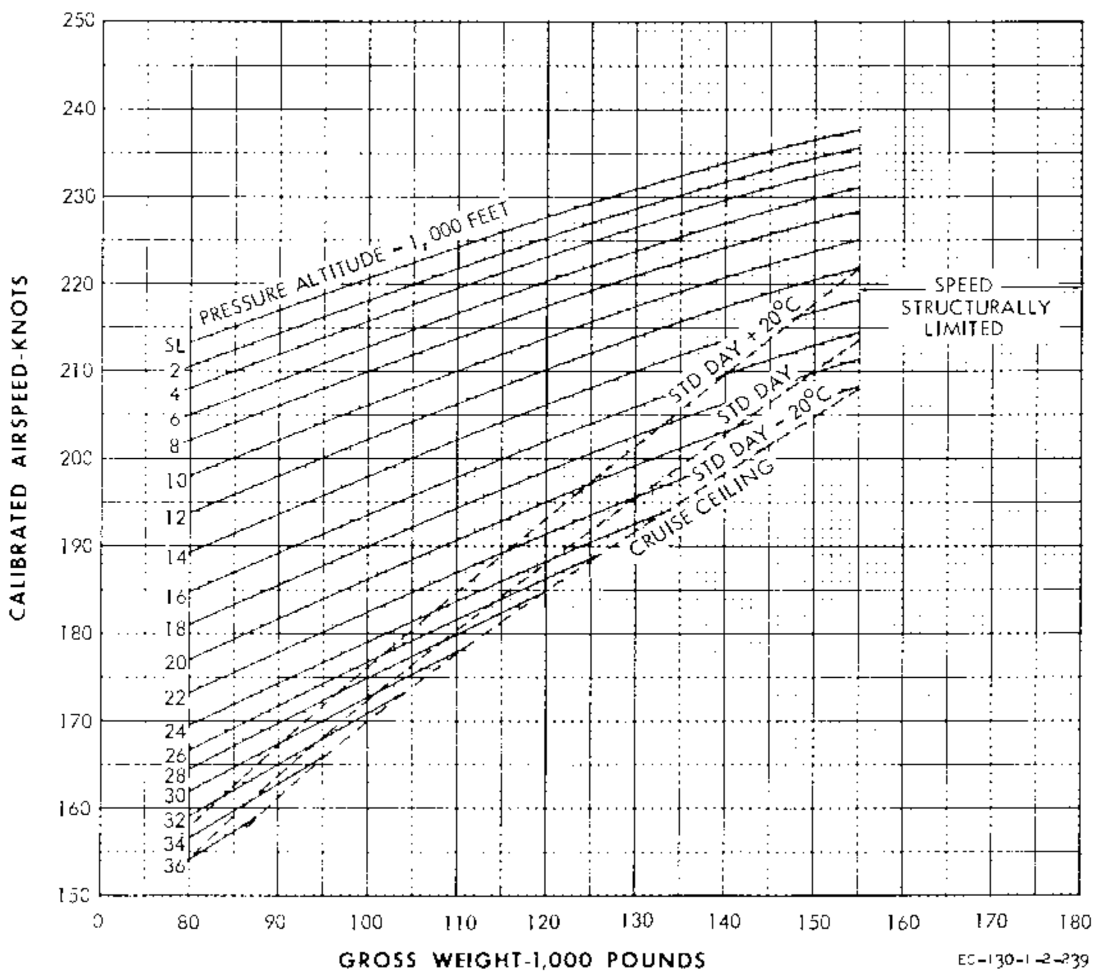


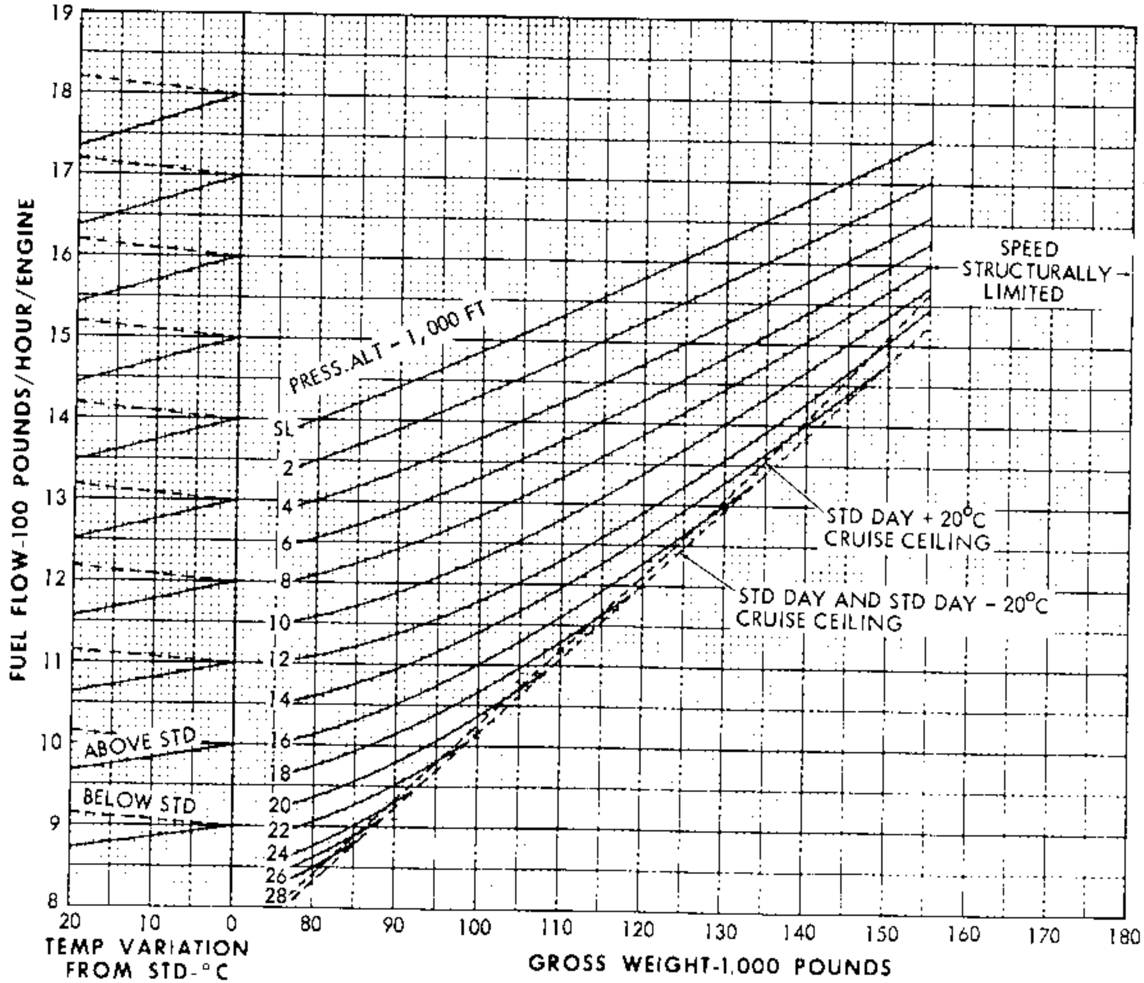
Figure 11-81.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY- LONG RANGE CRUISE

3 ENGINES
NORMAL BLEED
FUEL FLOW

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST



NOTE

1. To facilitate the reading of this chart, Std Day - 20°C cruise ceiling is approximated by the standard day cruise ceiling.
2. Speed structurally limited above 155,000 lb. refer to Part 4, Section I for limitations.

EC-130-1-2-240

Figure 11-82.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY-
LONG RANGE CRUISE

3 ENGINES **TORQUE**

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.

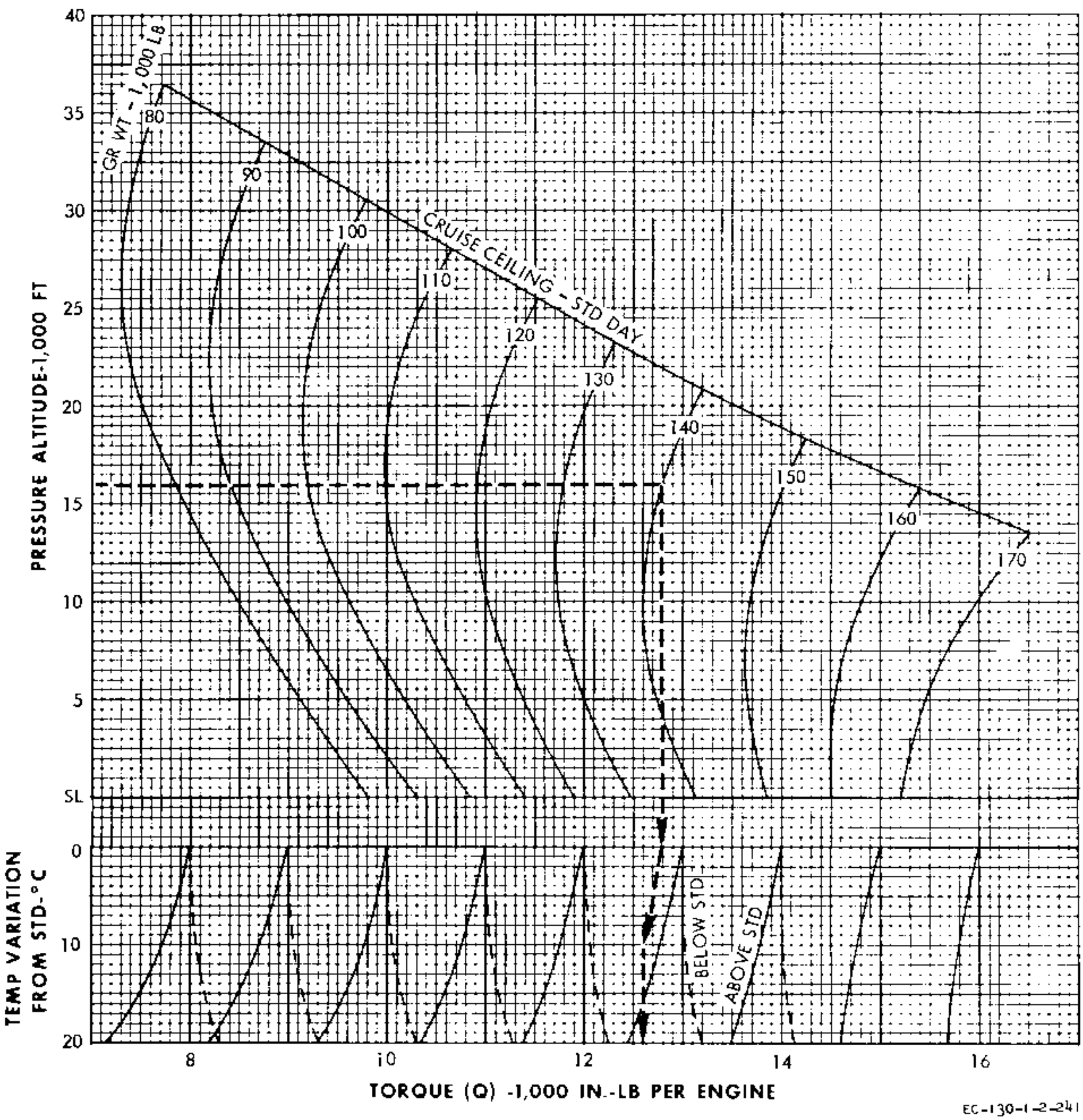


Figure 11-83.

MODEL: EC-130G/Q
T56-A-423 ENGINES

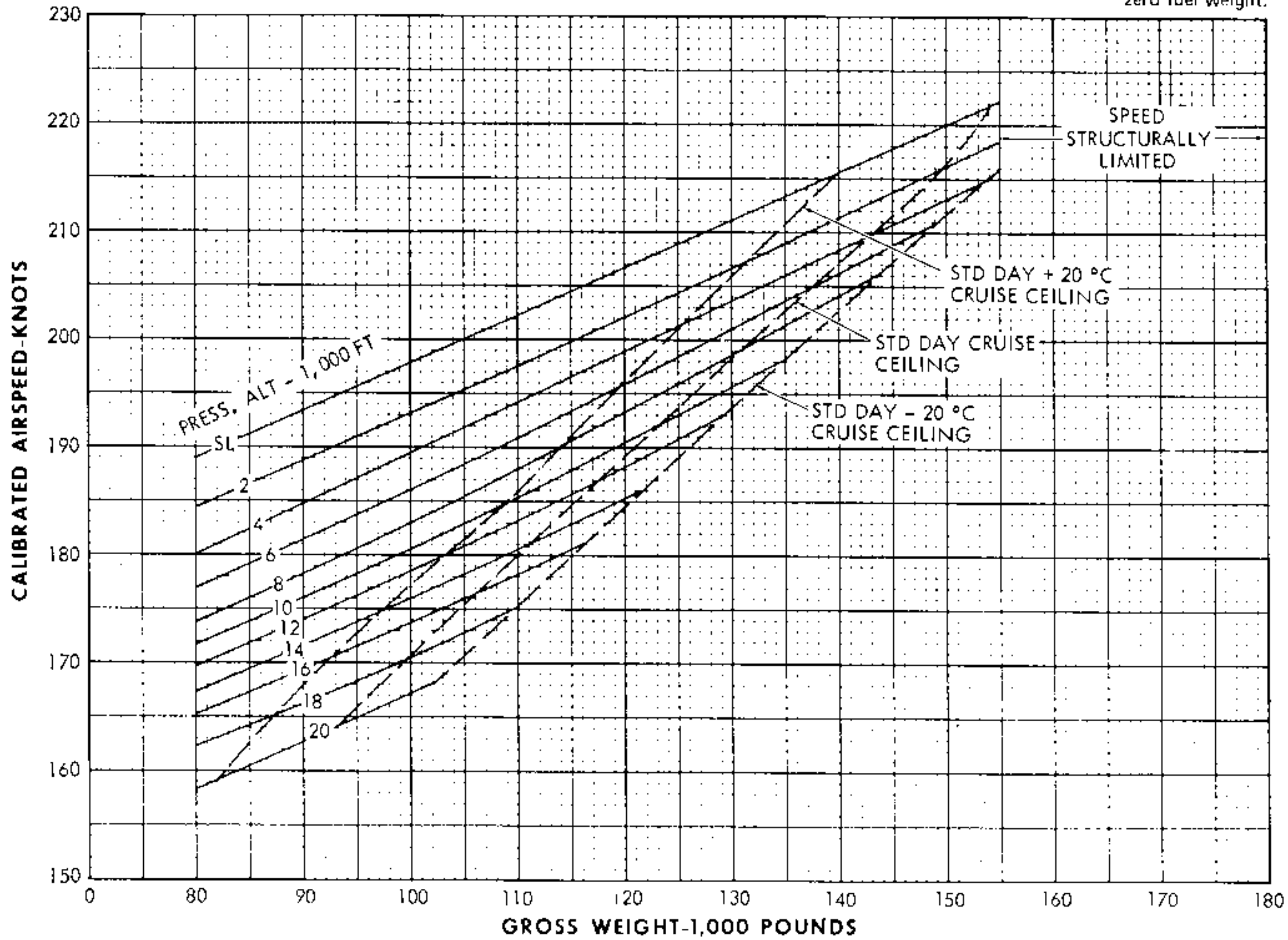
RANGE SUMMARY-LONG RANGE CRUISE

2 ENGINES AIRSPEED
ASYMMETRICAL POWER

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.
2. These speeds applicable up to zero fuel weights of 107, 892 lb., see Part 4, Section I for speed restrictions above 107,892 lb. zero fuel weight.



EC-130-1-2-242

Figure 11-84.

MODEL: EC-130G/Q
T56-A-423 ENGINES

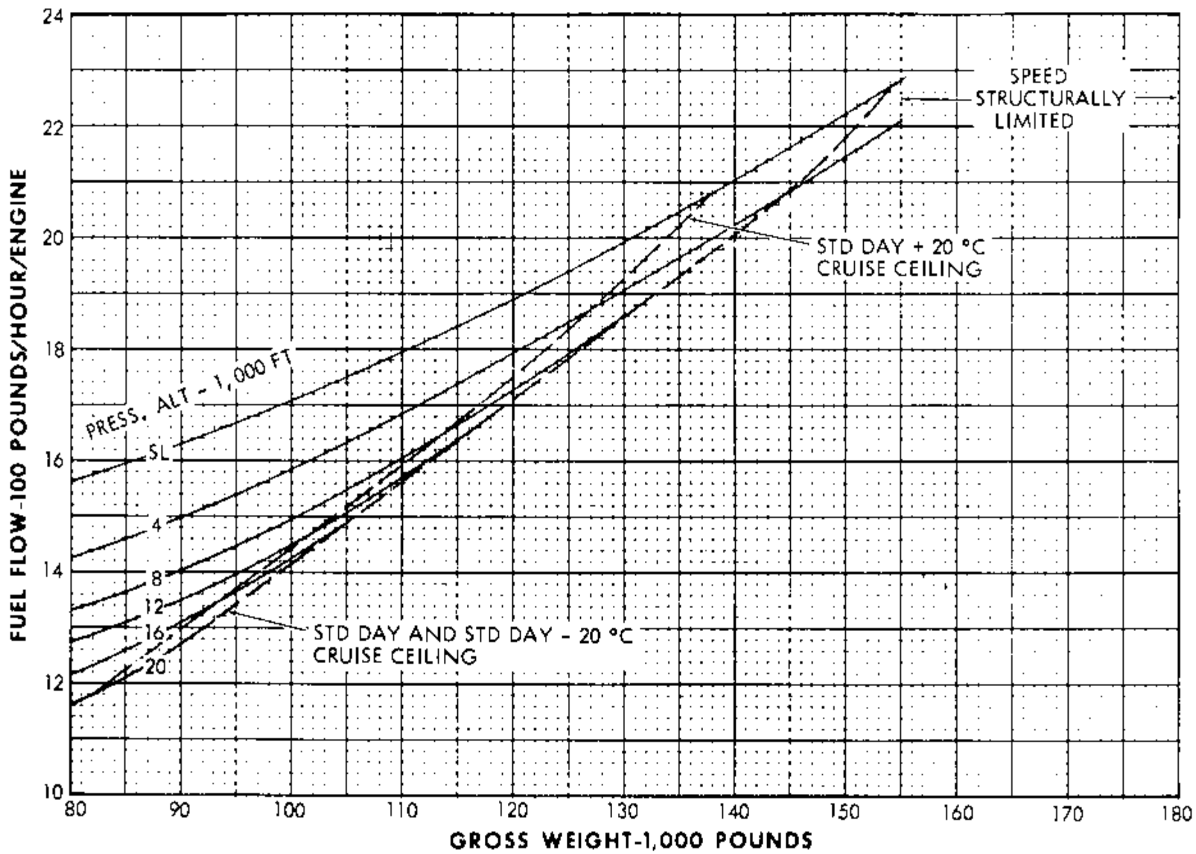
RANGE SUMMARY-
LONG RANGE CRUISE

2 ENGINES FUEL FLOW
ASYMMETRICAL POWER

NOTE

1. Propellers feathered on inoperative engines.
2. Fuel flow good for all temperatures.
3. To facilitate the reading of this chart, Std Day – 20°C cruise ceiling is approximated by the Std Day cruise ceiling.
4. Speed structurally limited above 155,000 lb, refer to Part 4, Section I for limitations.

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST



EC-130-1-2-243

Figure 11-85.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE SUMMARY-
LONG RANGE CRUISE

2 ENGINES TORQUE

ASYMMETRICAL POWER

NOTE

1. Propellers feathered on inoperative engines.

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

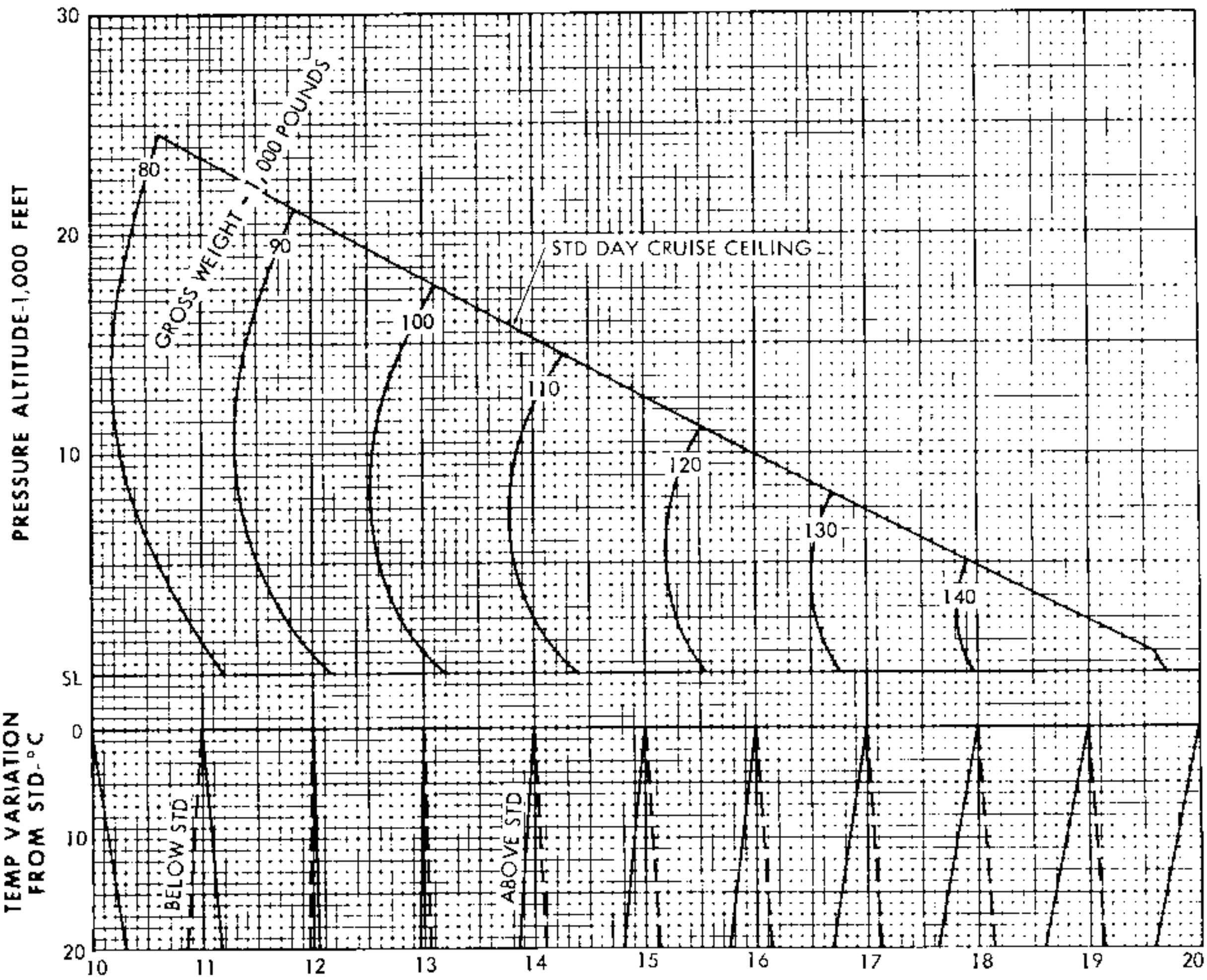


Figure 11-86.

MODEL: EC-130G/Q
T56-A-423 ENGINES

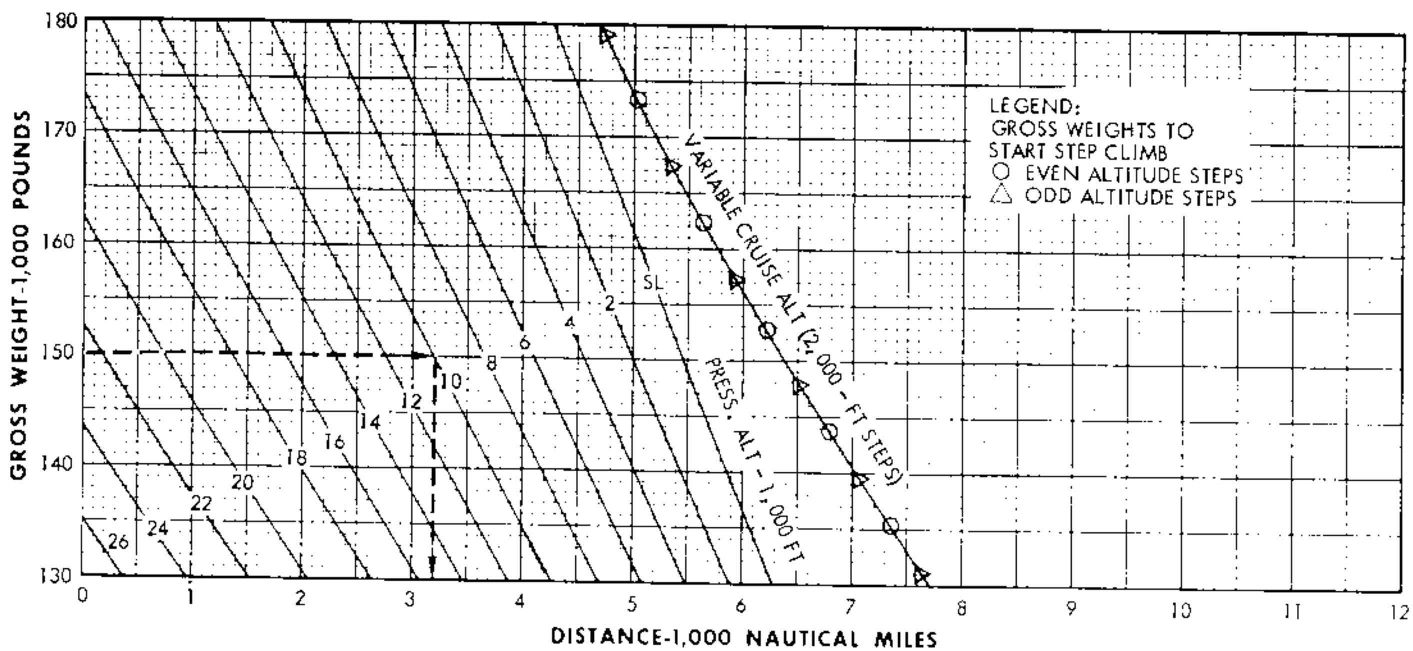
RANGE PREDICTION-DISTANCE

4 ENGINES **LONG RANGE CRUISE**
STANDARD DAY +20°C

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Speed restrictions shown or speed summary chart are applicable.



FC-130-1-2-245-1

Figure 11-87. (Sheet 1 of 2)

RANGE PREDICTION-DISTANCE

4 ENGINES LONG RANGE CRUISE

STANDARD DAY +20°C

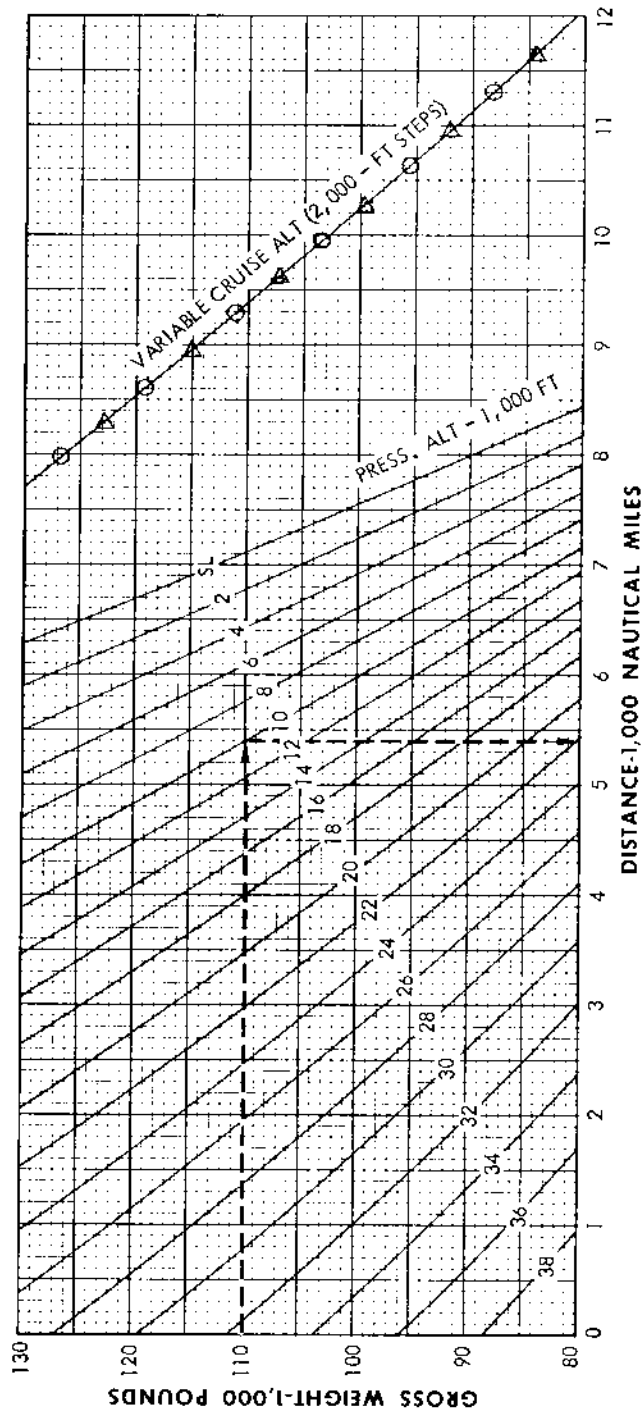


Figure 11-87. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-DISTANCE

4 ENGINES LONG RANGE CRUISE

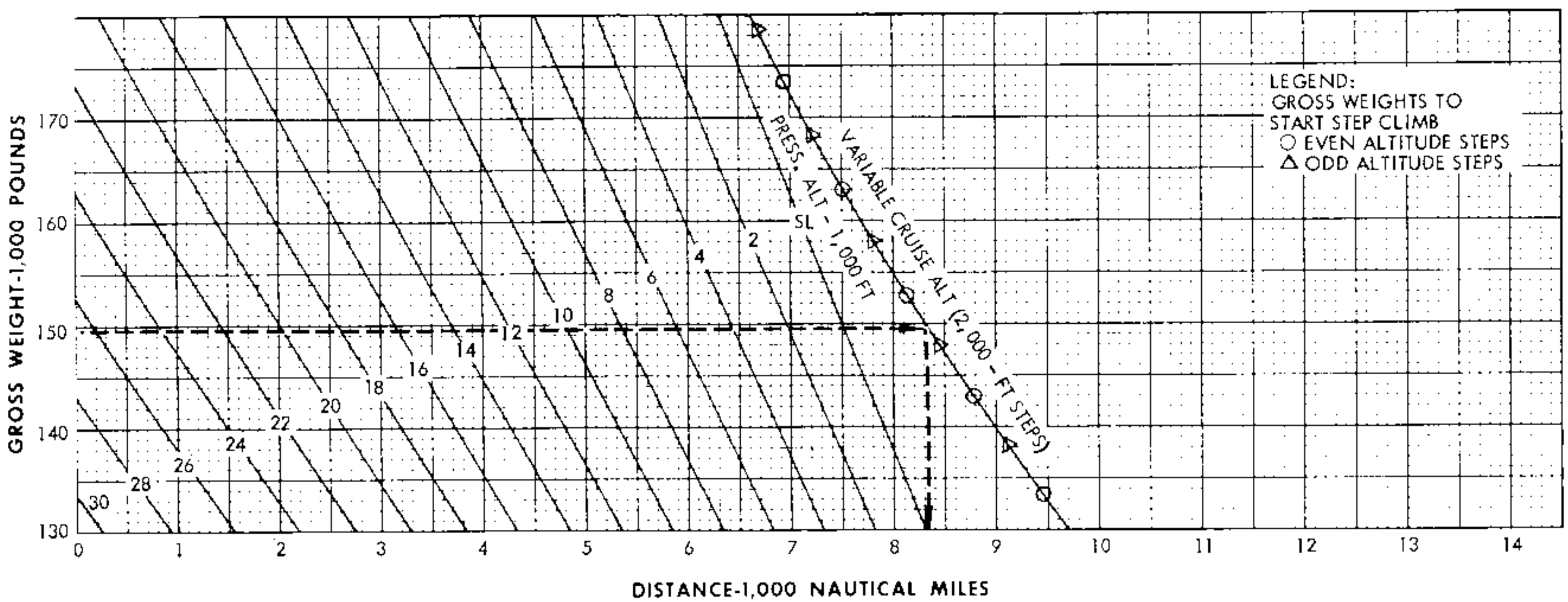
STANDARD DAY

DATE: APRIL 66

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Speed restrictions shown on speed summary chart are applicable.



EC-130-1-2-246-1

Figure 11-88. (Sheet 1 of 2)

RANGE PREDICTION-DISTANCE

4 ENGINES LONG RANGE CRUISE
STANDARD DAY

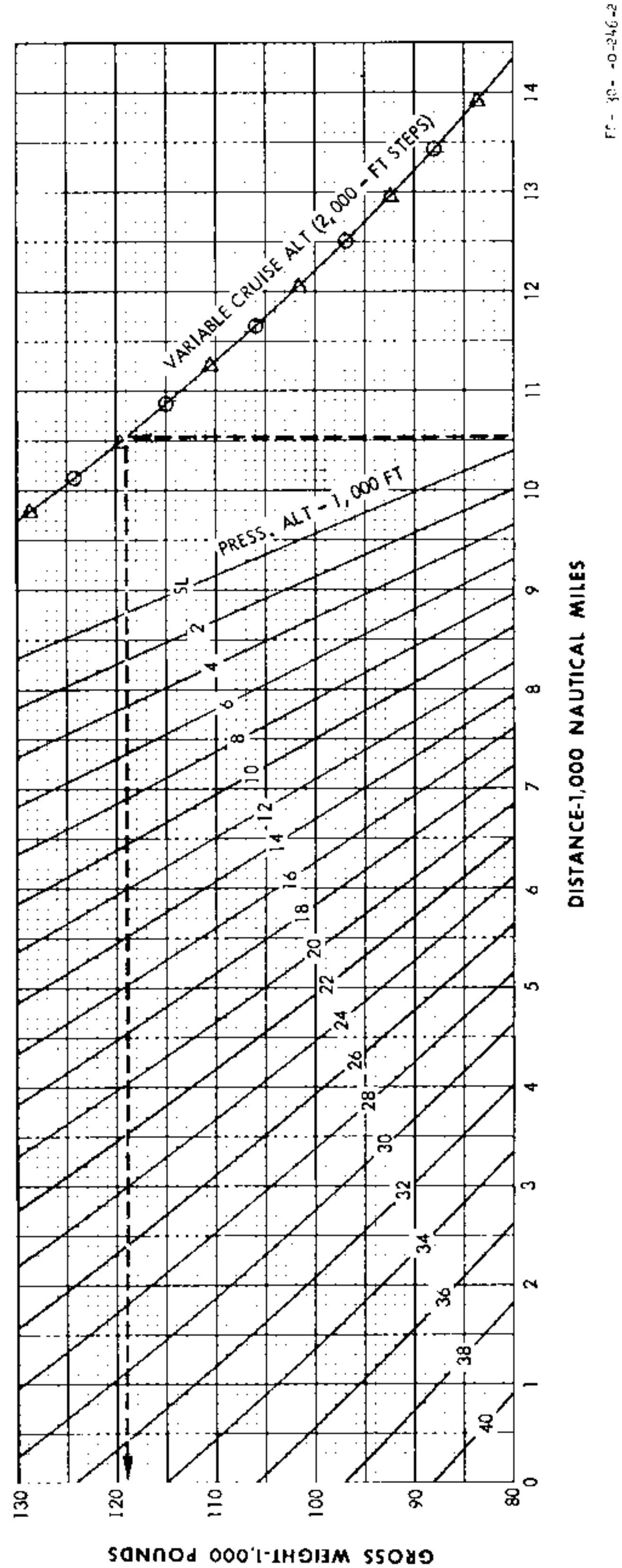


Figure 11-88. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

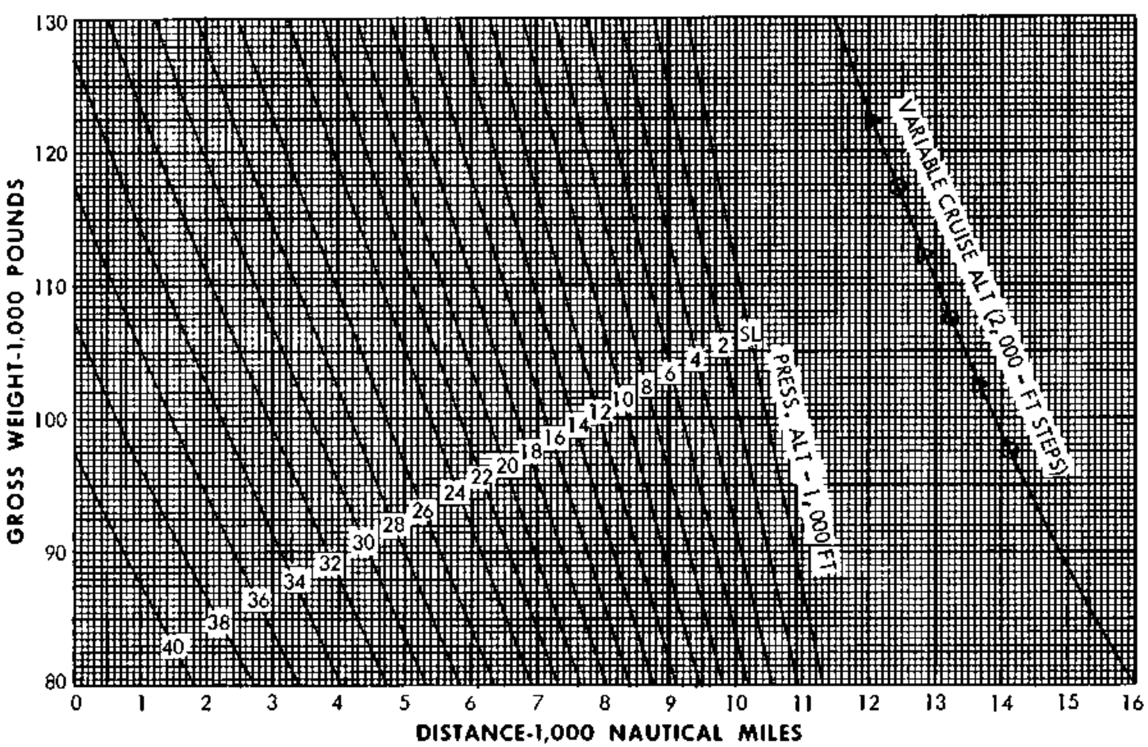
RANGE PREDICTION-DISTANCE

4 ENGINES LONG RANGE CRUISE
STANDARD DAY -20°C

NOTE

1. Speed restrictions shown on speed summary chart are applicable.

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST



EC-130-1-2-247-1

Figure 11-89. (Sheet 1 of 2)

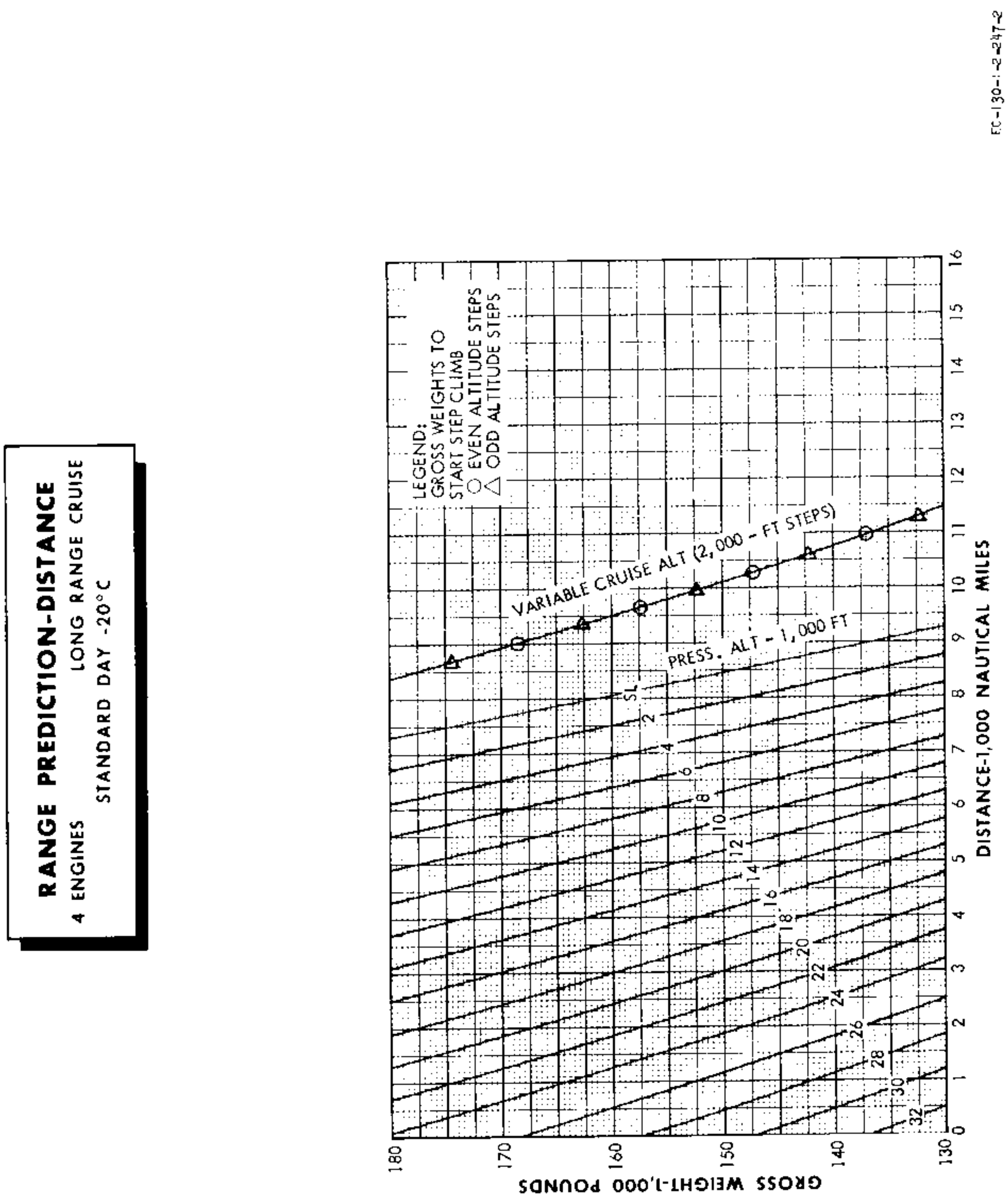


Figure 11-89. (Sheet 2 of 2)

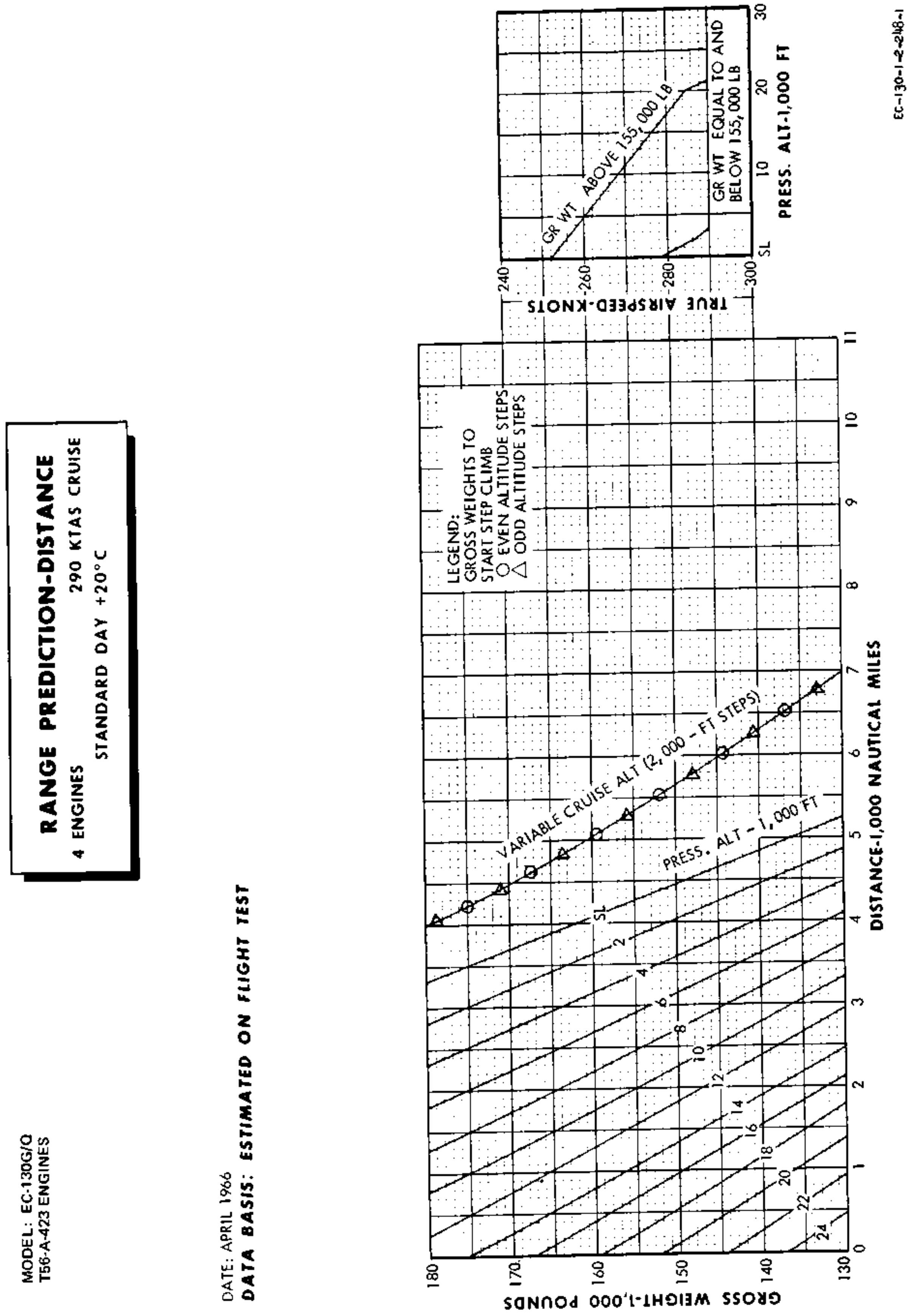


Figure 11-90. (Sheet 1 of 2)

RANGE PREDICTION-DISTANCE

4 ENGINES 290 KTAS CRUISE

STANDARD DAY +20°C

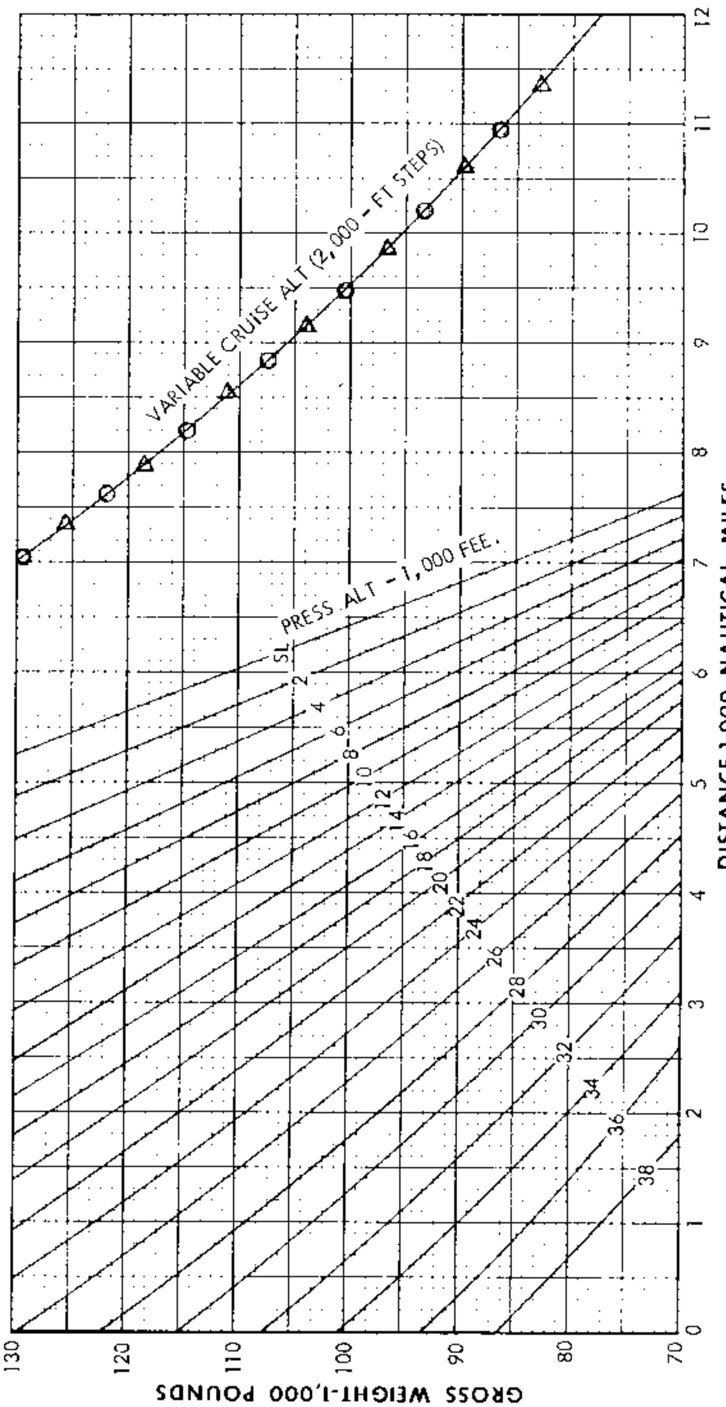


Figure 11-90. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-DISTANCE

4 ENGINES **290 KTAS CRUISE**

STANDARD DAY

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

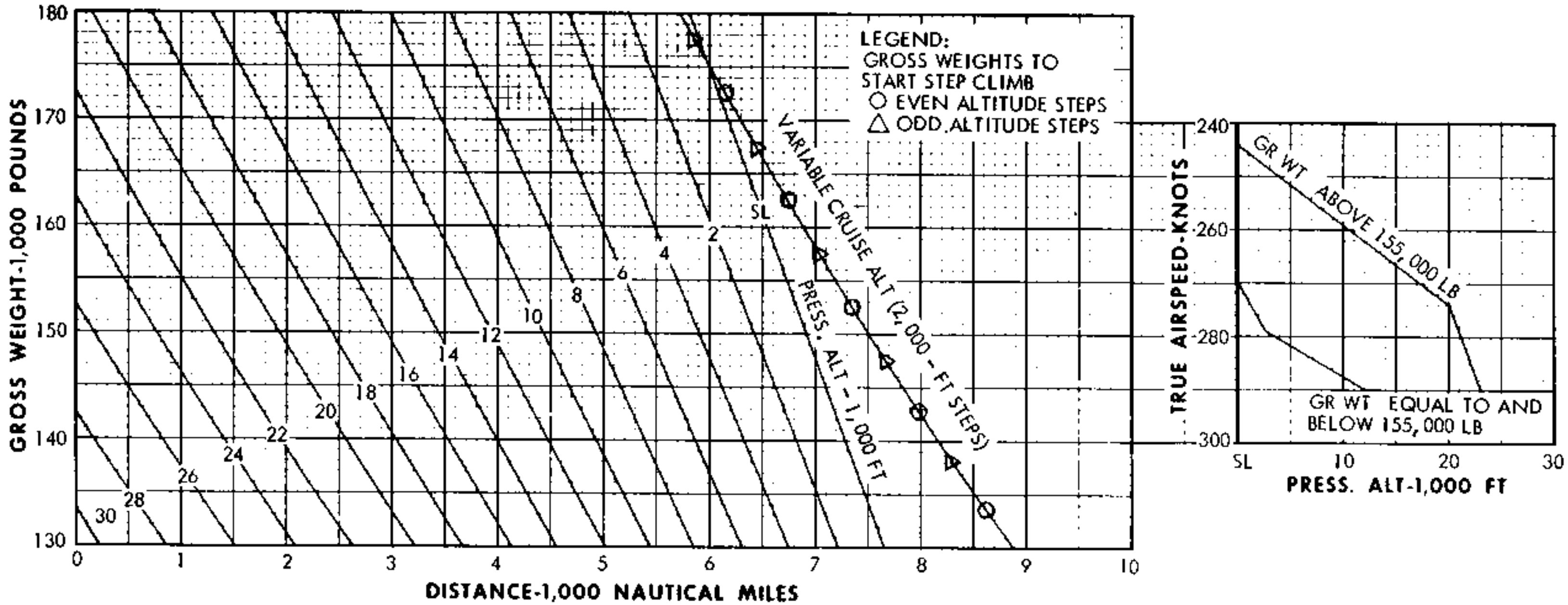


Figure 11-91. (Sheet 1 of 2)

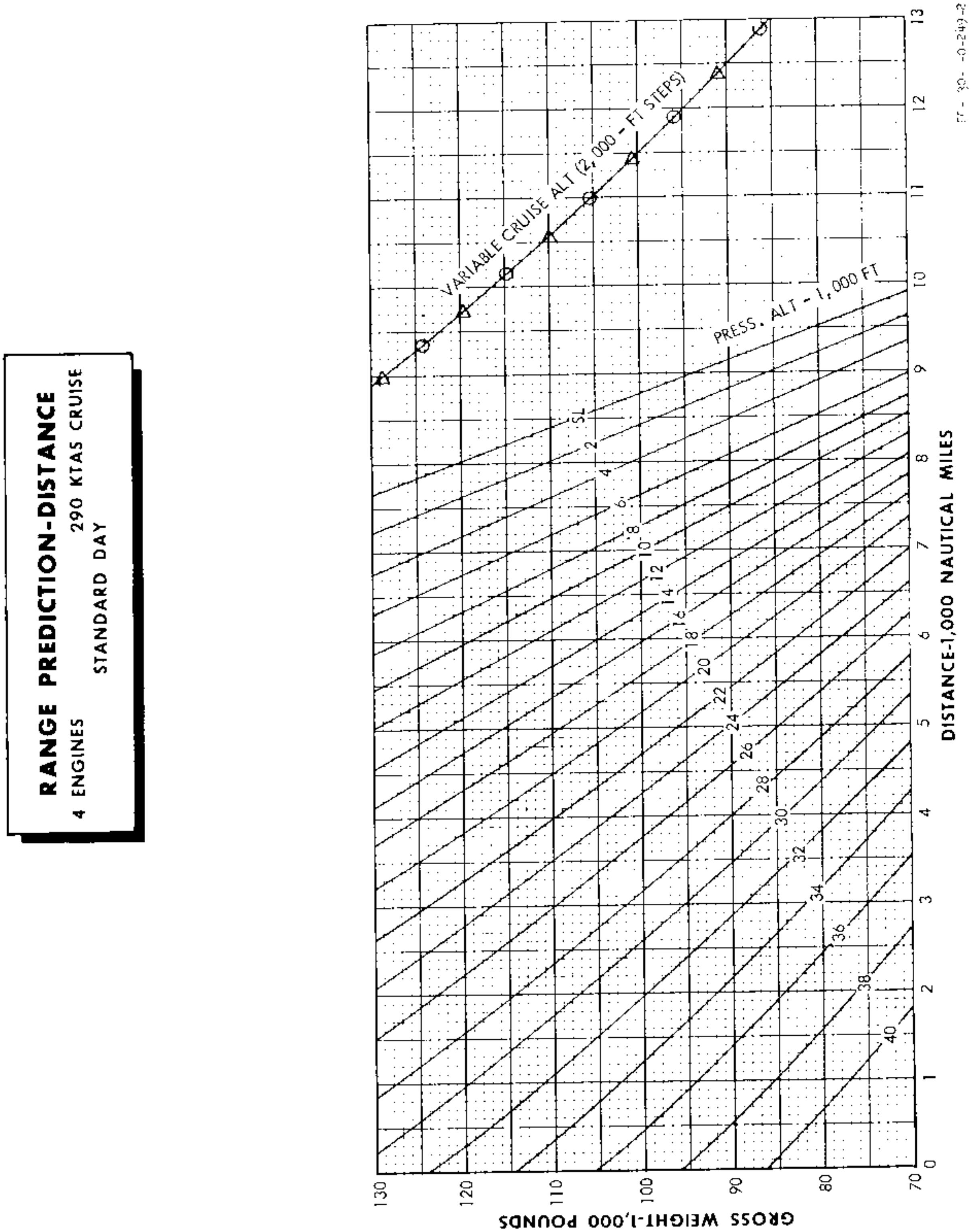


Figure 11-91. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-DISTANCE

4 ENGINES **290 KTAS CRUISE**
STANDARD DAY −20°C

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

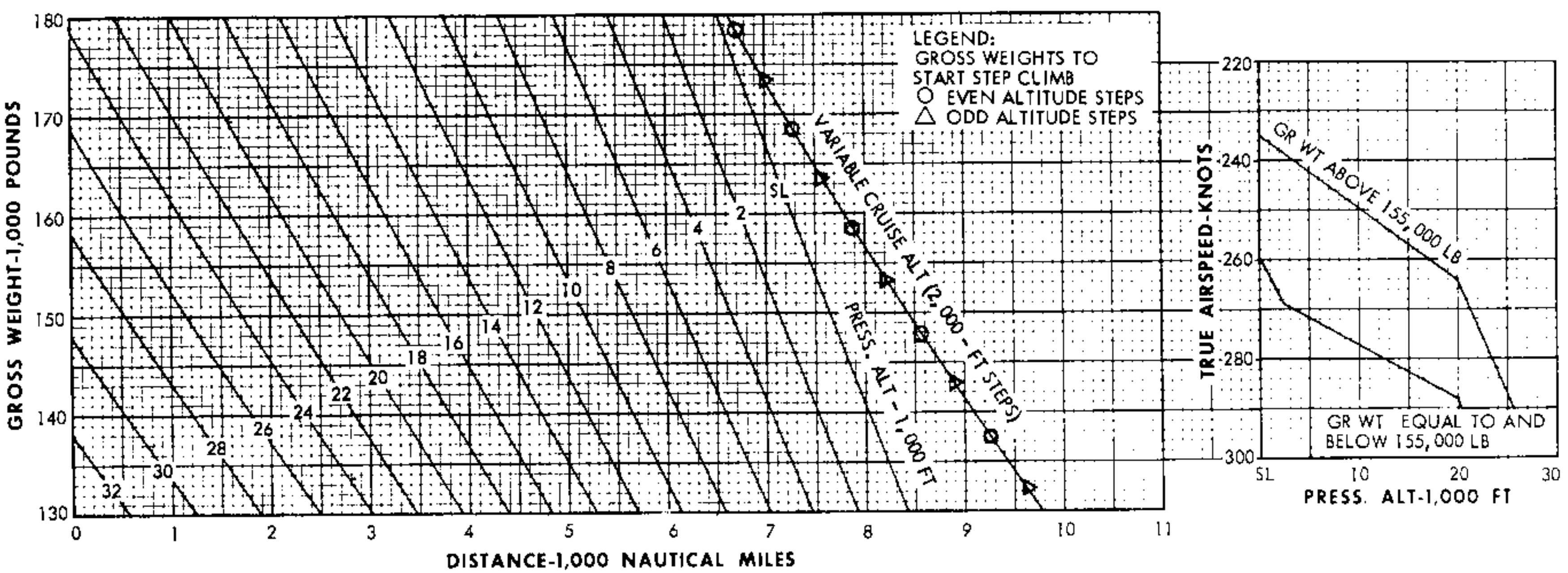


Figure 11-92. (Sheet 1 of 2)

RANGE PREDICTION-DISTANCE

4 ENGINES 290 KTAS CRUISE

STANDARD DAY −20°C

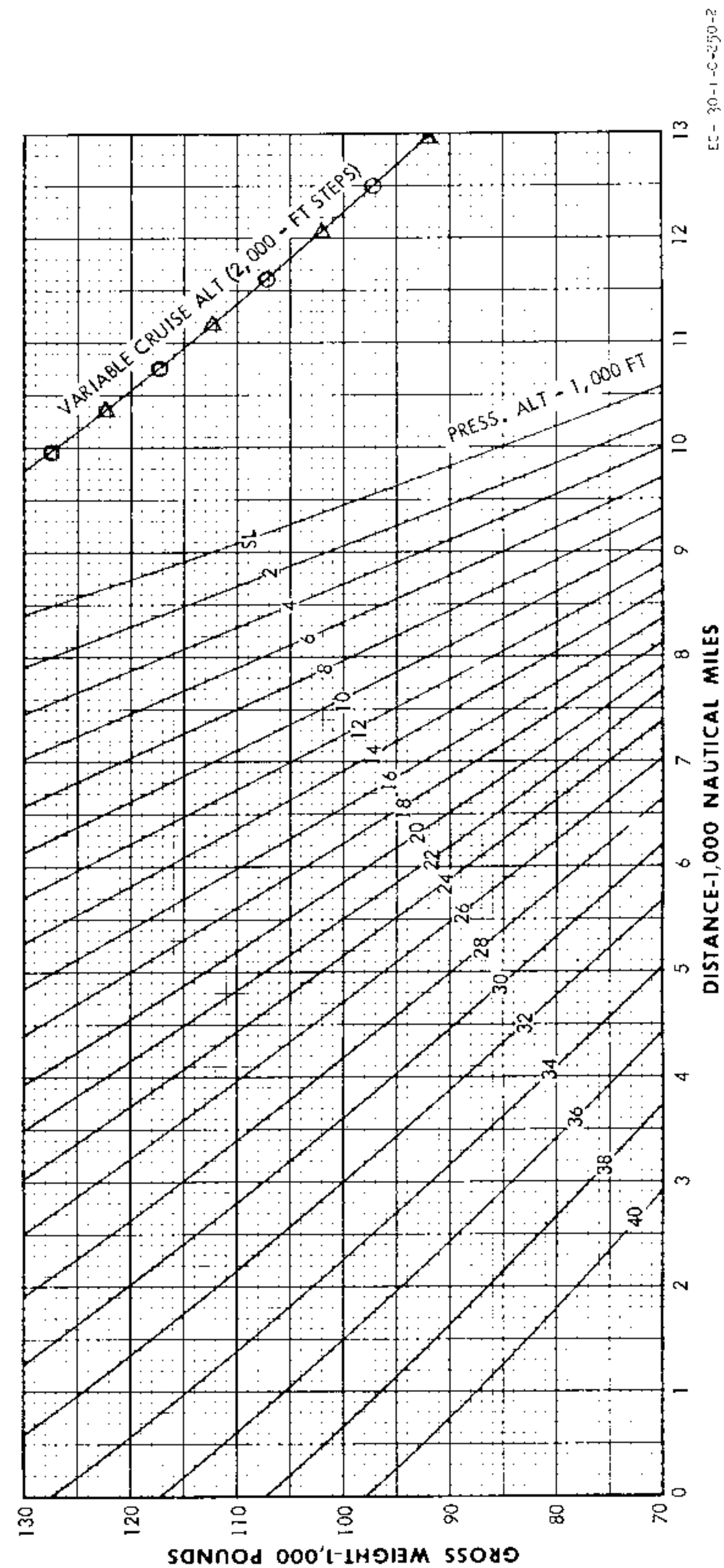


Figure 11-92. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-DISTANCE

3 ENGINES LONG RANGE CRUISE
STANDARD DAY +20°C

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.
2. Speed restrictions shown on speed summary chart are applicable.

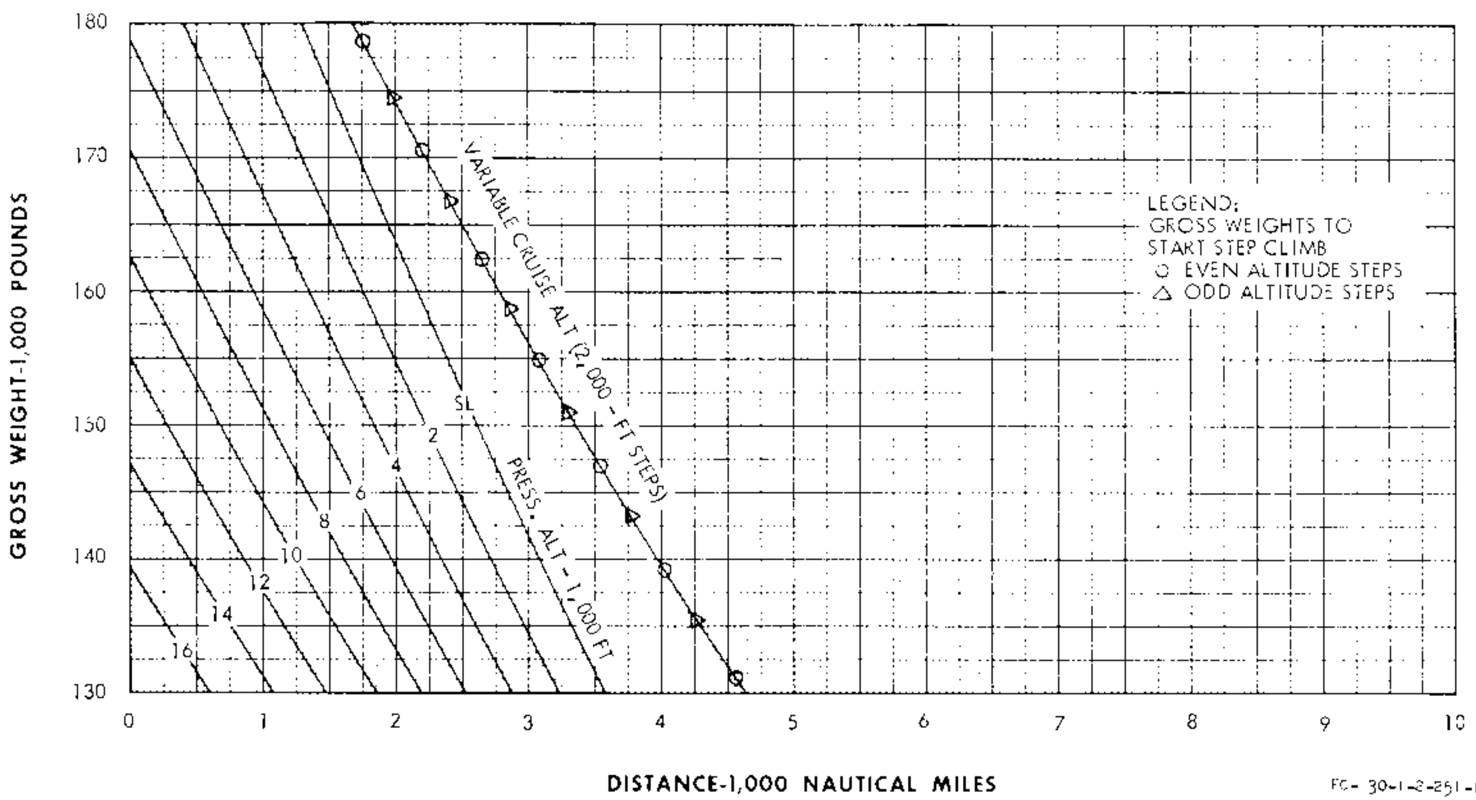


Figure 11-93. (Sheet 1 of 2)

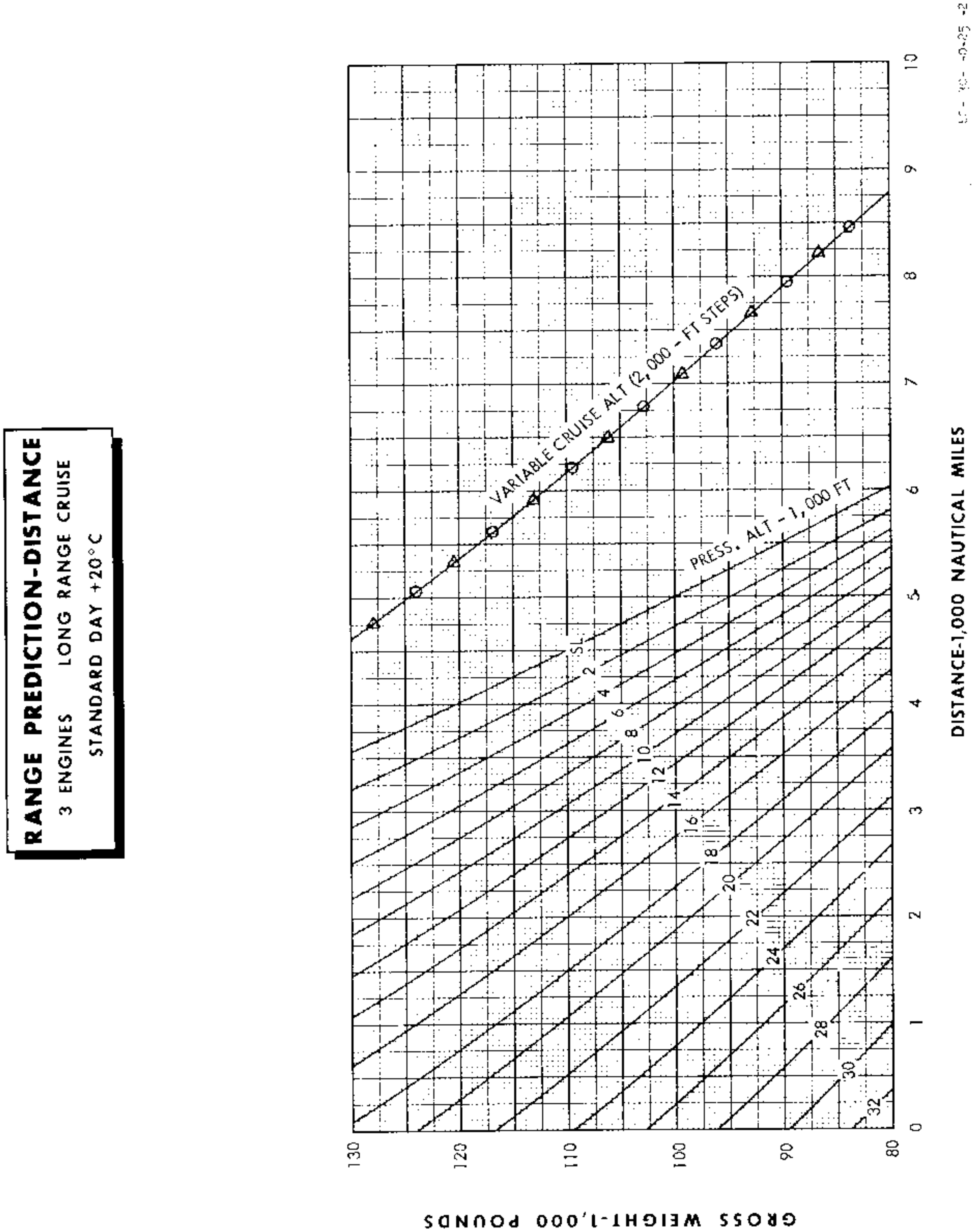


Figure 11-93. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-DISTANCE

3 ENGINES LONG RANGE CRUISE

STANDARD DAY

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.
2. Speed restrictions shown on speed summary chart are applicable.

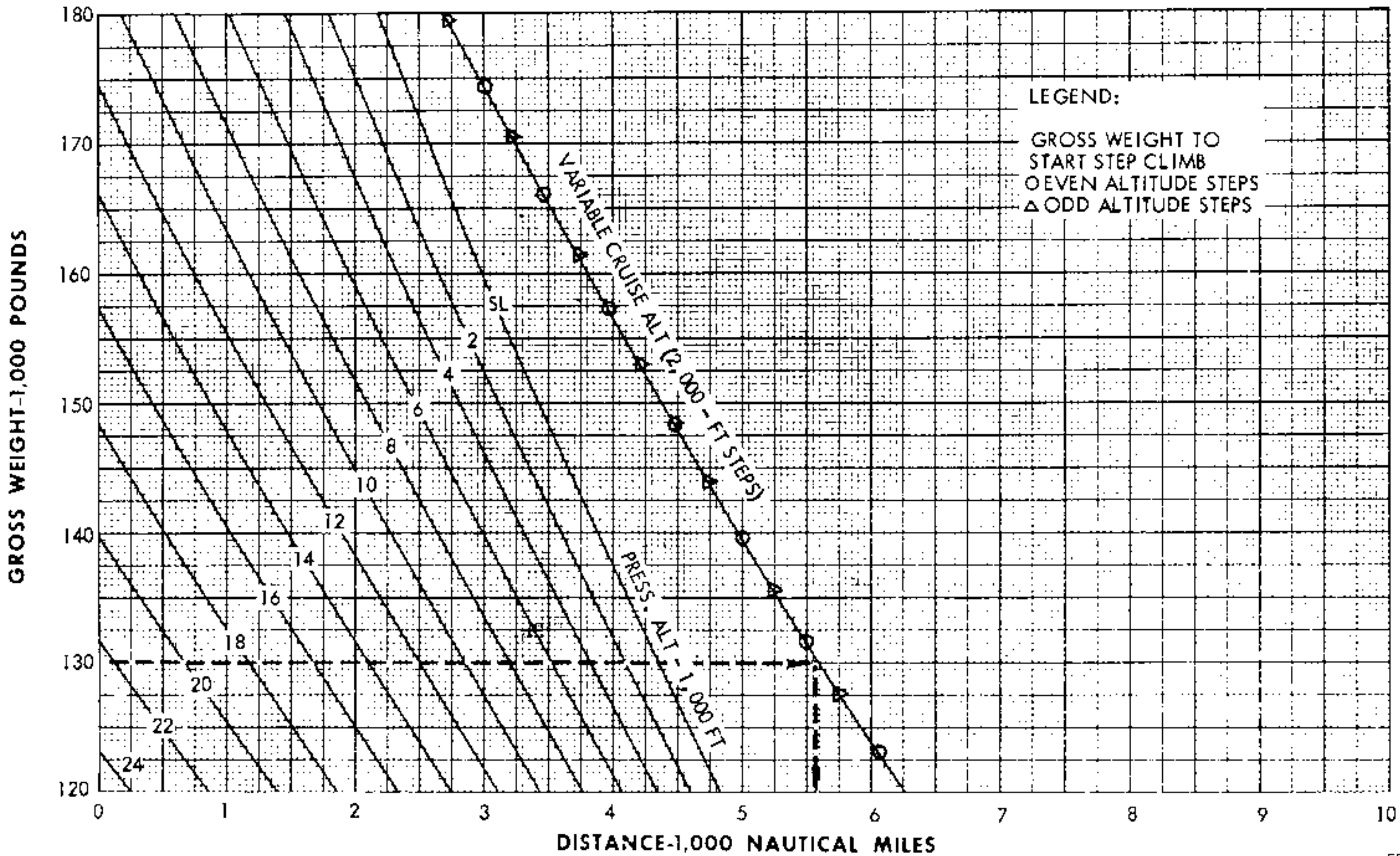


Figure 11-94. (Sheet 1 of 2)

NOTE

1. Speed restrictions shown on speed summary chart are applicable.

RANGE PREDICTION-DISTANCE
3 ENGINES
LONG RANGE CRUISE
STANDARD DAY

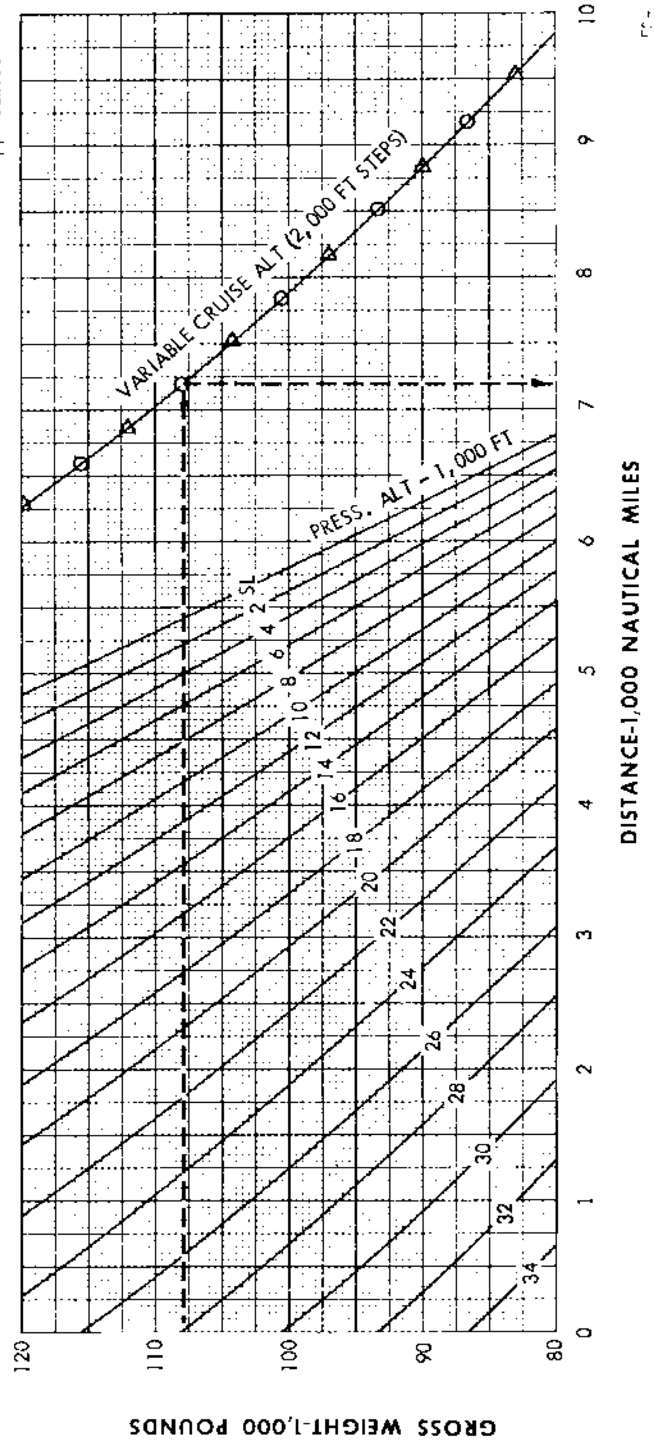


Figure 11-94. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-DISTANCE

3 ENGINES LONG RANGE CRUISE
STANDARD DAY-20°C

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine
2. Speed restrictions shown on speed summary chart are applicable.

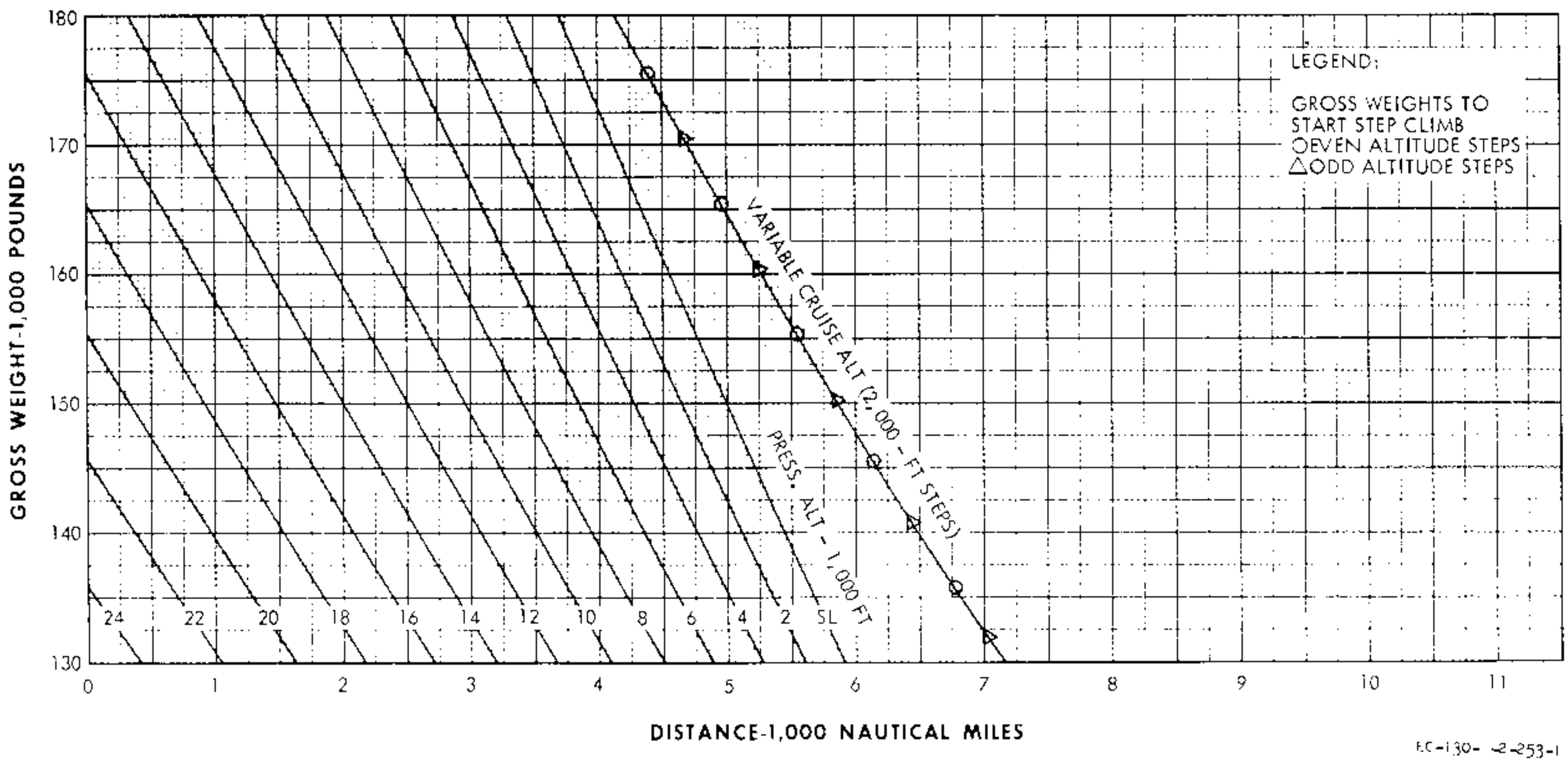


Figure 11-95. (Sheet 1 of 2)

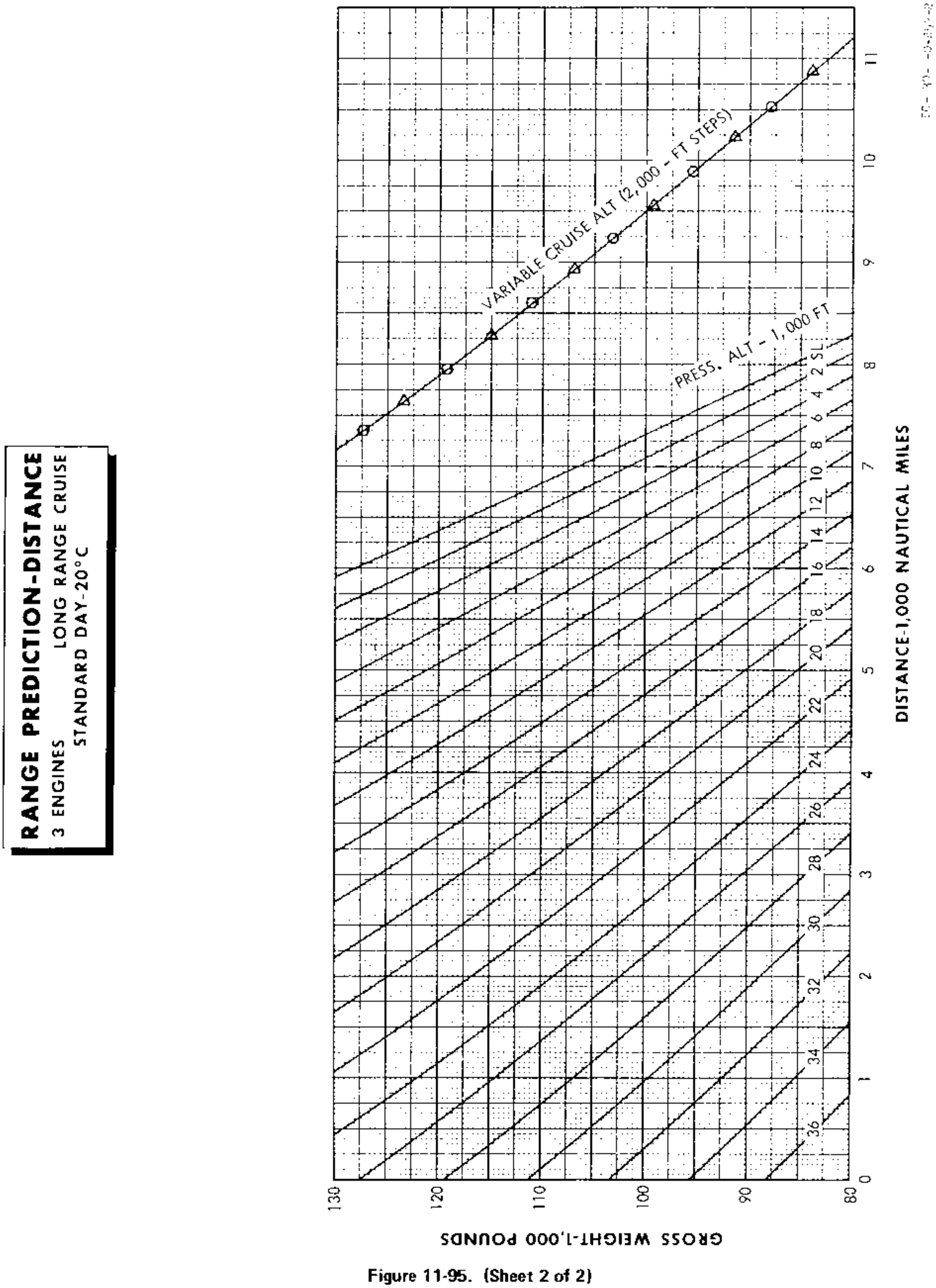


Figure 11-95. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-TIME

4 ENGINES — LONG RANGE CRUISE

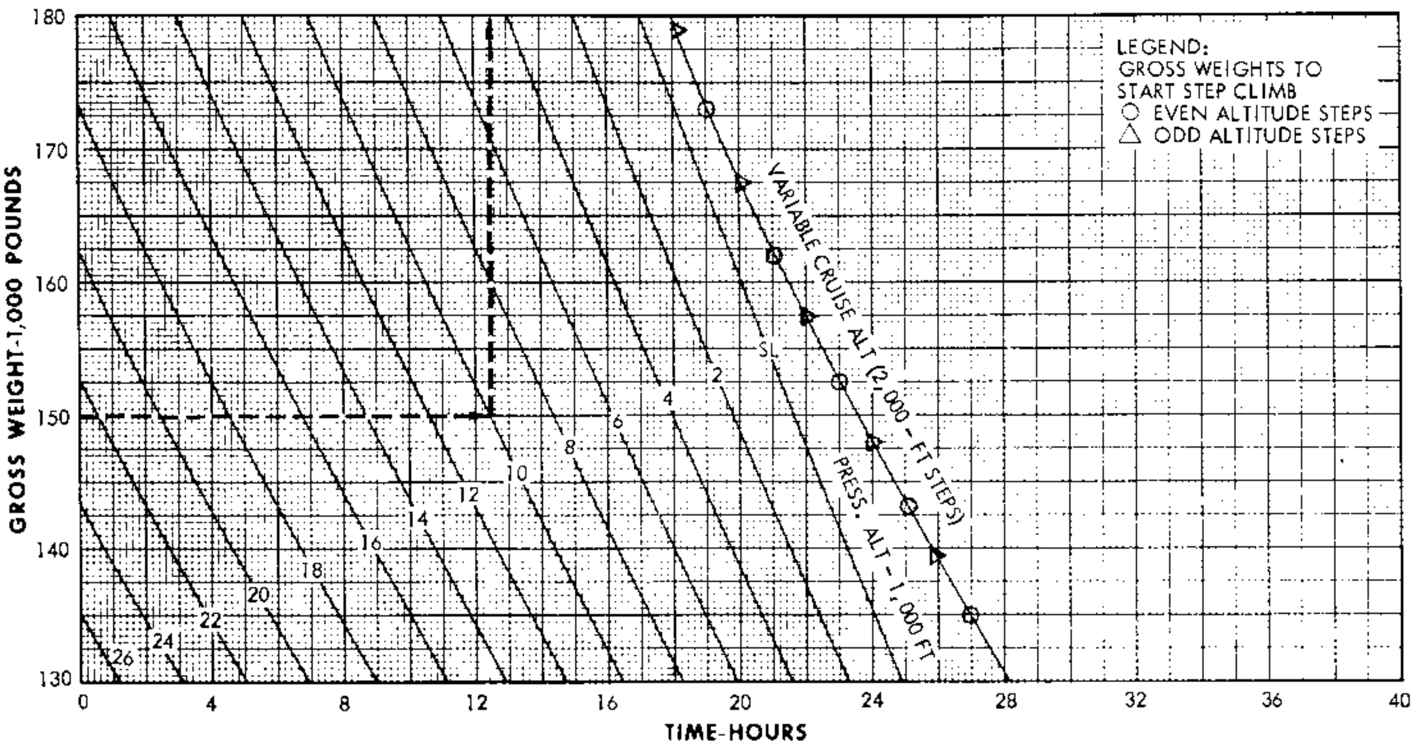
STANDARD DAY +20°C

DATE: APRIL 1966

DATA BASIS ESTIMATED ON FLIGHT TEST

NOTE

1. Speed restrictions shown on speed summary chart are applicable.



EC-130-1-2-254-1

Figure 11-96. (Sheet 1 of 2)

RANGE PREDICTION-TIME

4 ENGINES LONG RANGE CRUISE

STANDARD DAY +20°C

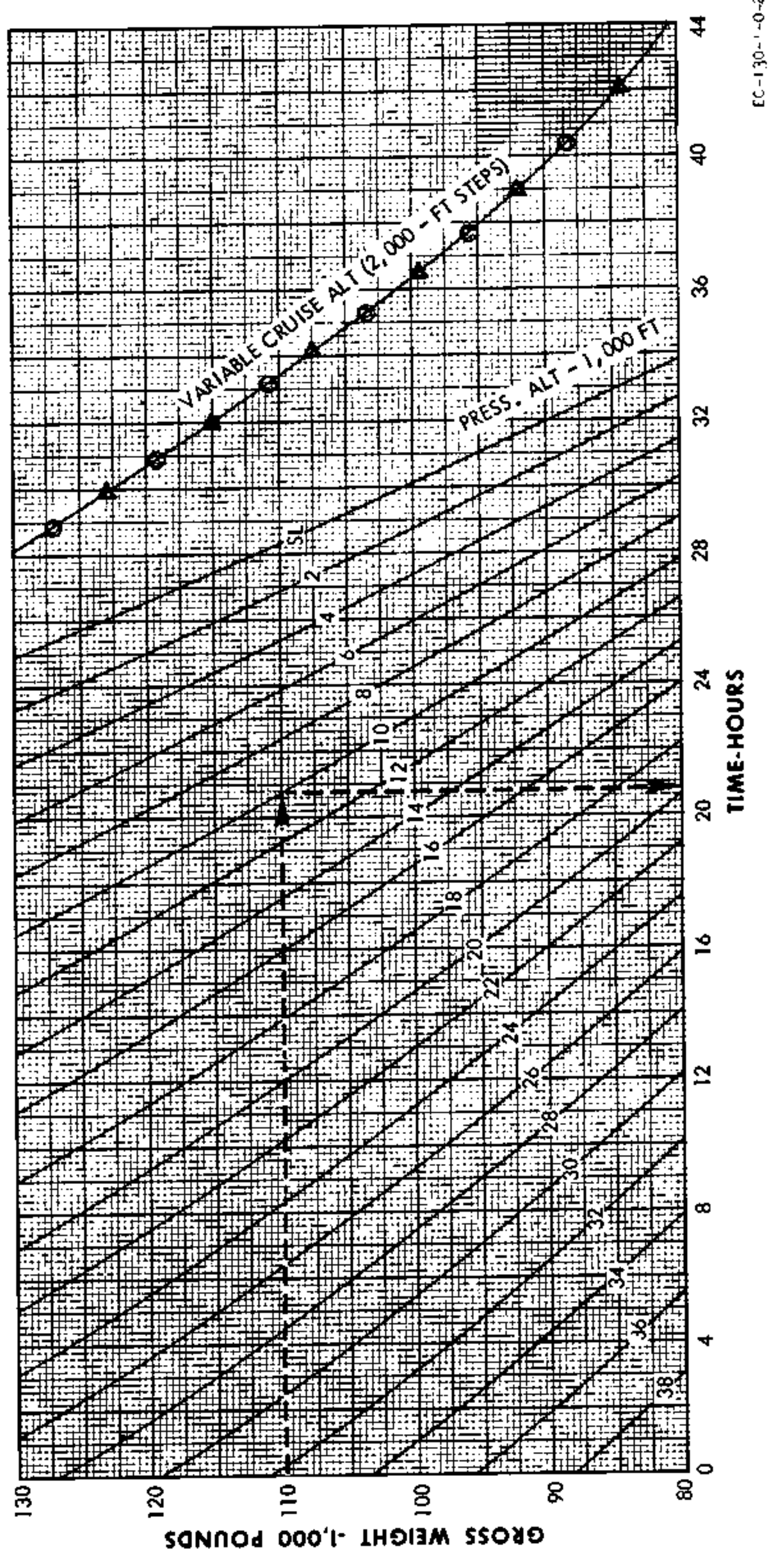


Figure 11-96. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-TIME

4 ENGINES **LONG RANGE CRUISE**

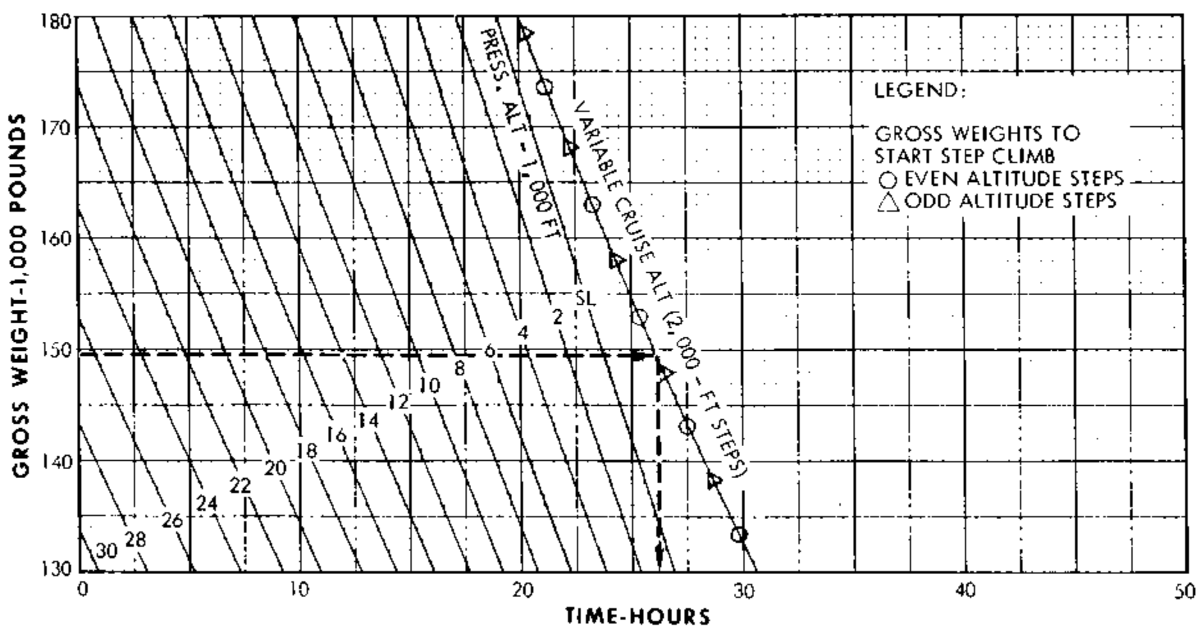
STANDARD DAY

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Speed restrictions shown on speed summary chart are applicable.



EC-130-1-2-255-1

Figure 11-97. (Sheet 1 of 2)

RANGE PREDICTION-TIME

4 ENGINES LONG RANGE CRUISE

STANDARD DAY

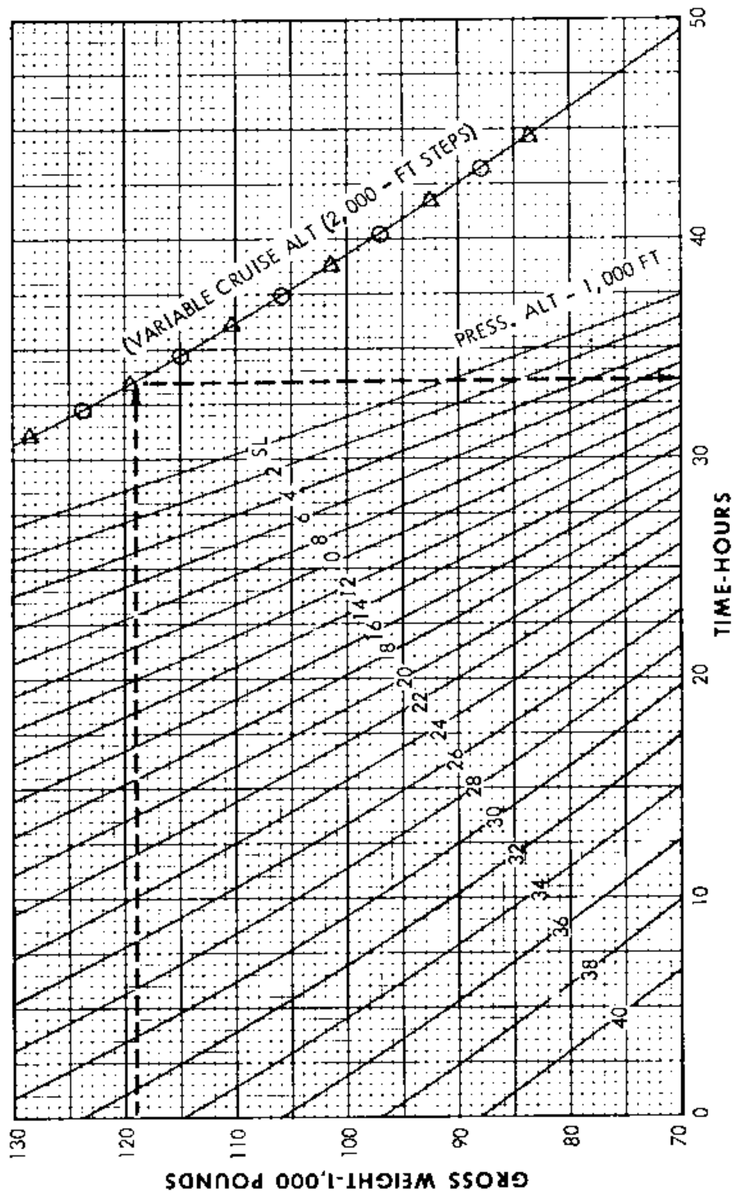


Figure 11-97. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

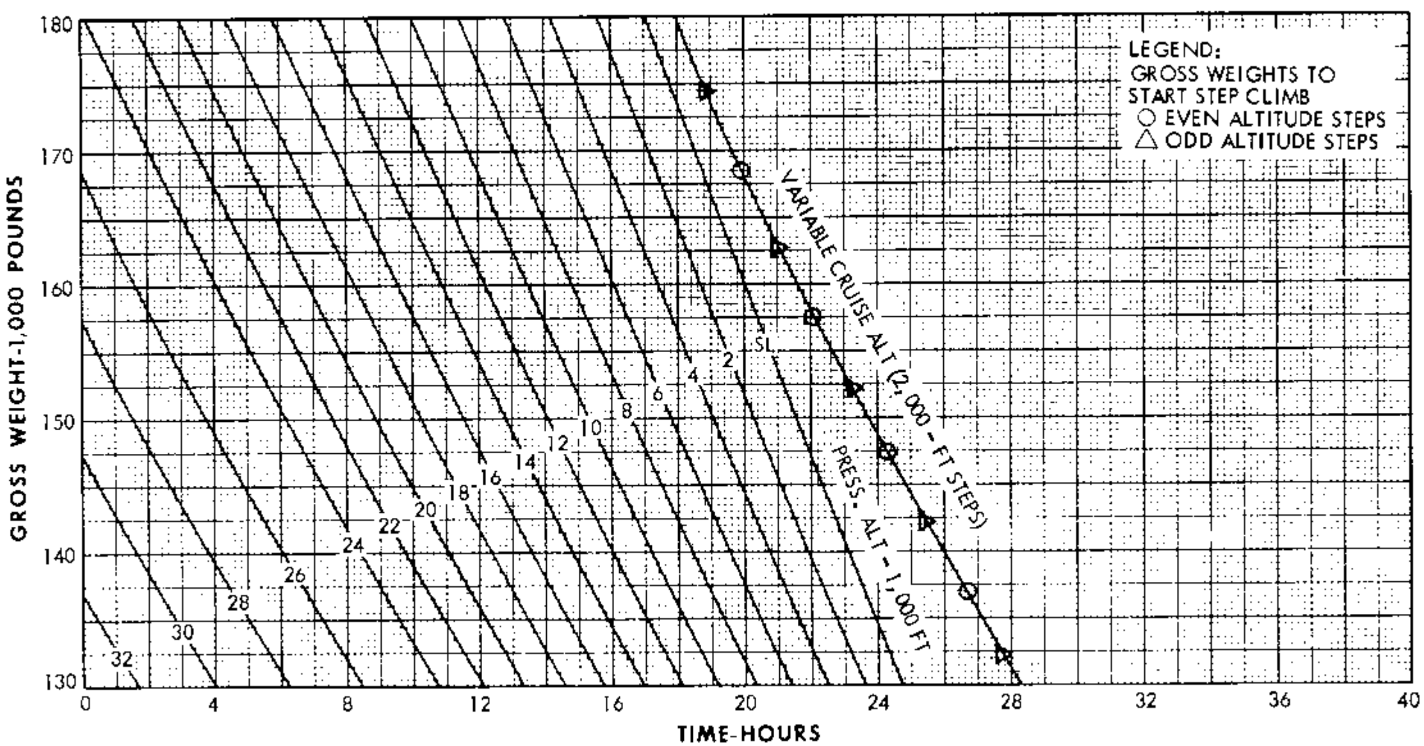
RANGE PREDICTION-TIME

4 ENGINES LONG RANGE CRUISE
STANDARD DAY -20°C

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Speed restrictions shown on speed summary chart are applicable.



EC-130-1-2-256-1

Figure 11-98. (Sheet 1 of 2)

RANGE PREDICTION-TIME

4 ENGINES LONG RANGE CRUISE

STANDARD DAY -20°C

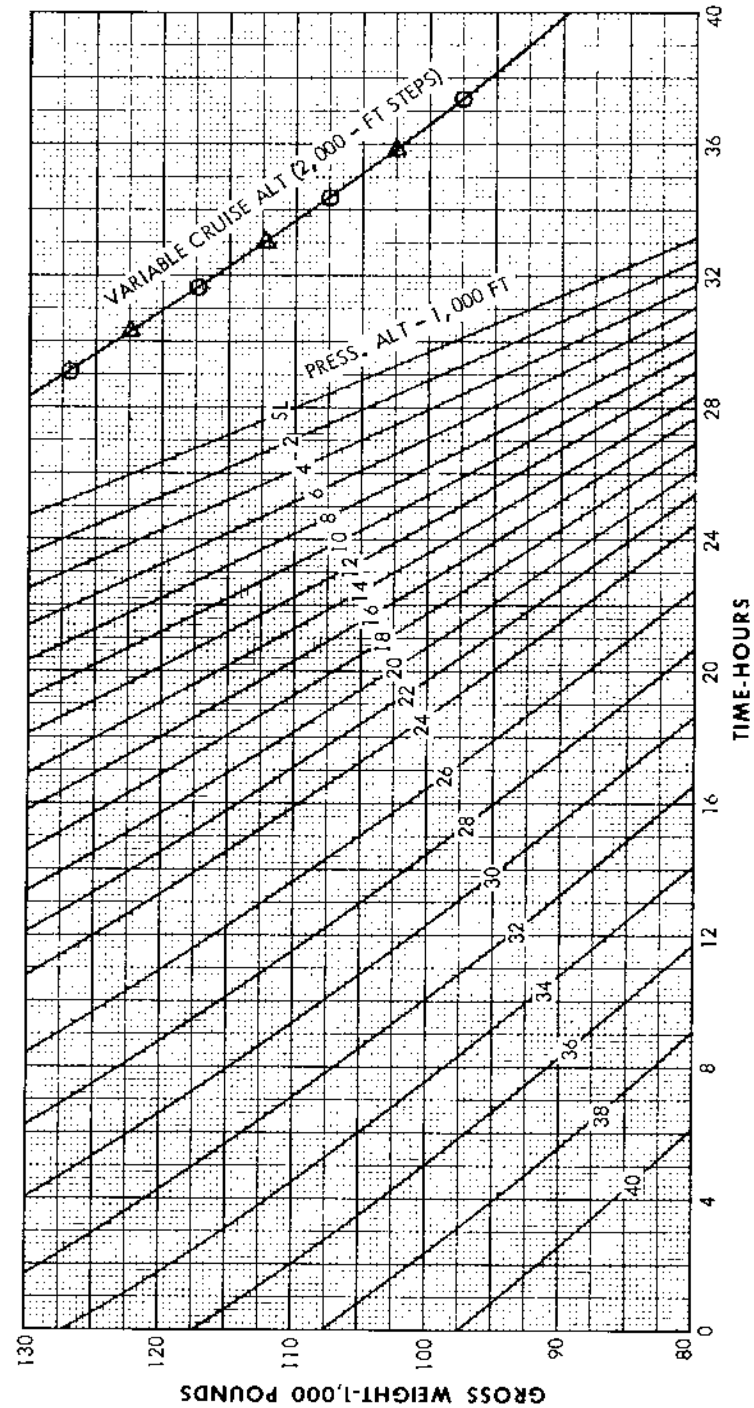


Figure 11-98. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION - TIME

3 ENGINES LONG RANGE CRUISE
STANDARD DAY +20°C

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.
2. Speed restrictions shown on speed summary chart are applicable.

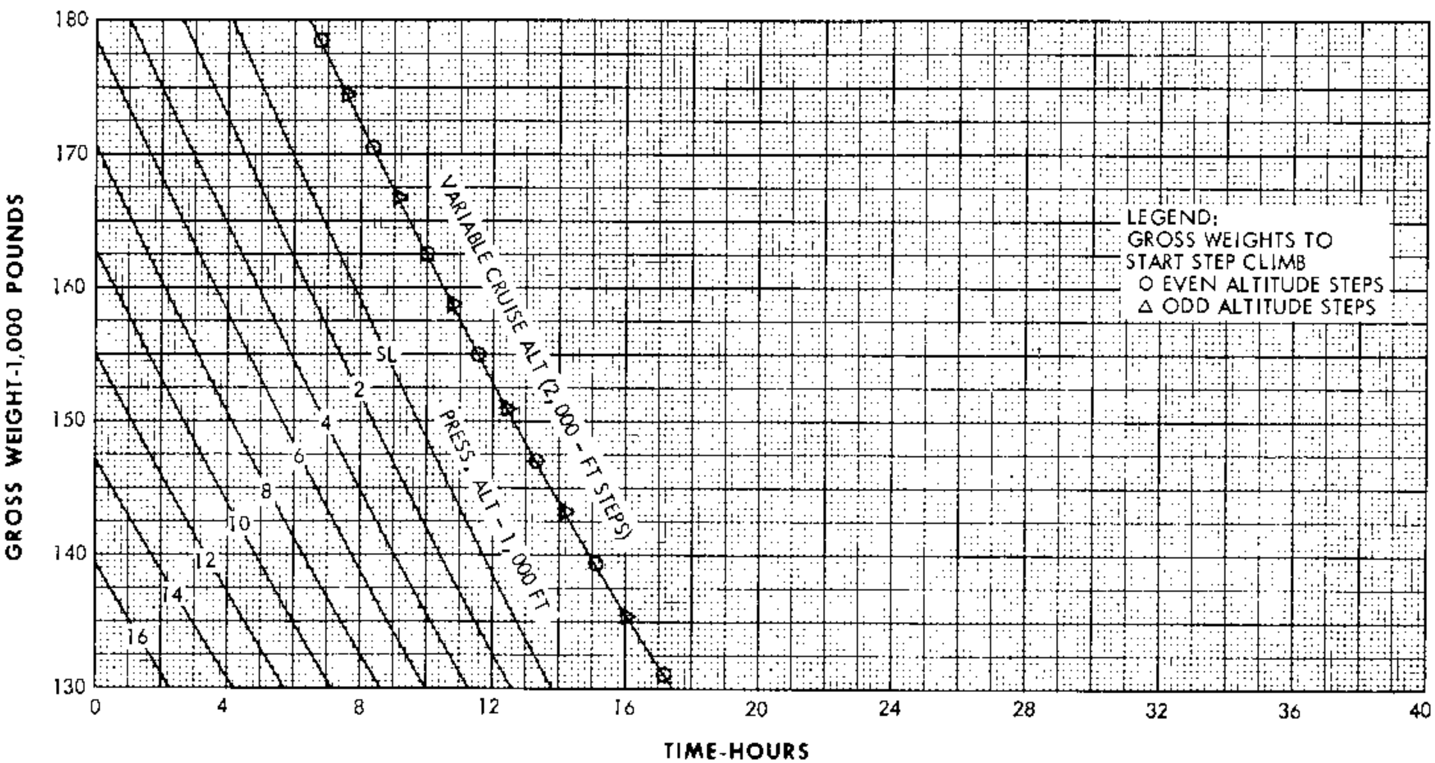


Figure 11-99. (Sheet 1 of 2)

RANGE PREDICTION-TIME

3 ENGINES LONG RANGE CRUISE

STANDARD DAY +20°C

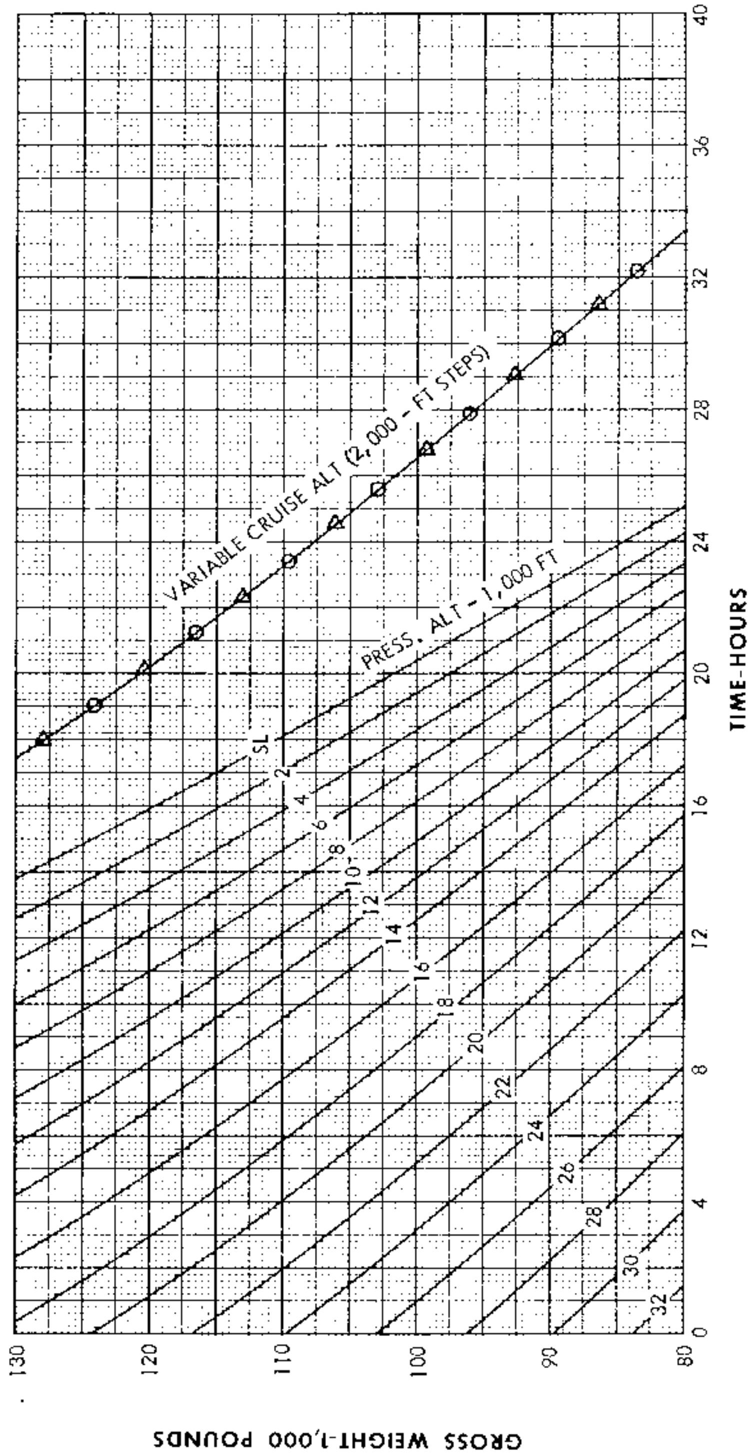


Figure 11-99. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-TIME

3 ENGINES LONG RANGE CRUISE
STANDARD DAY

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.
2. Speed restrictions shown on speed summary chart are applicable.

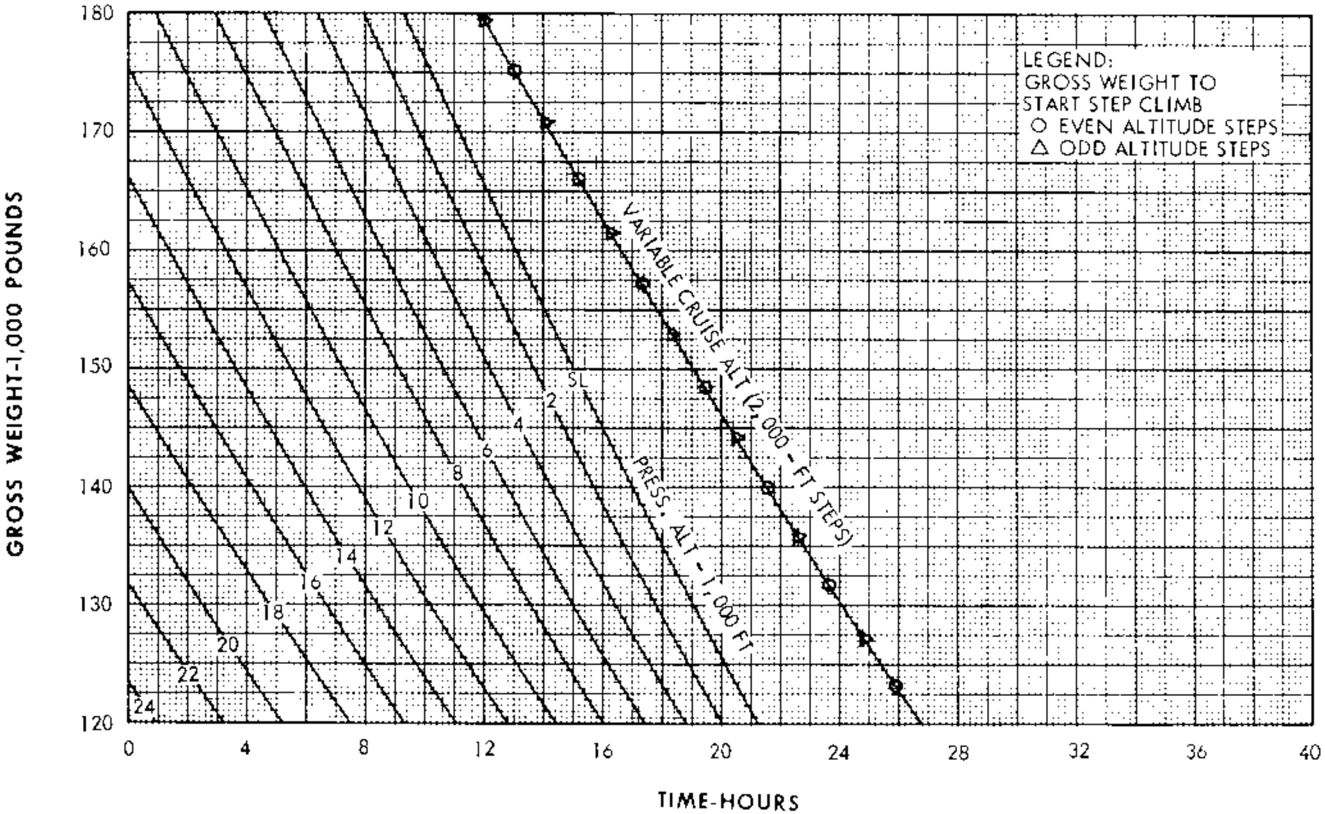


Figure 11-100. (Sheet 1 of 2)

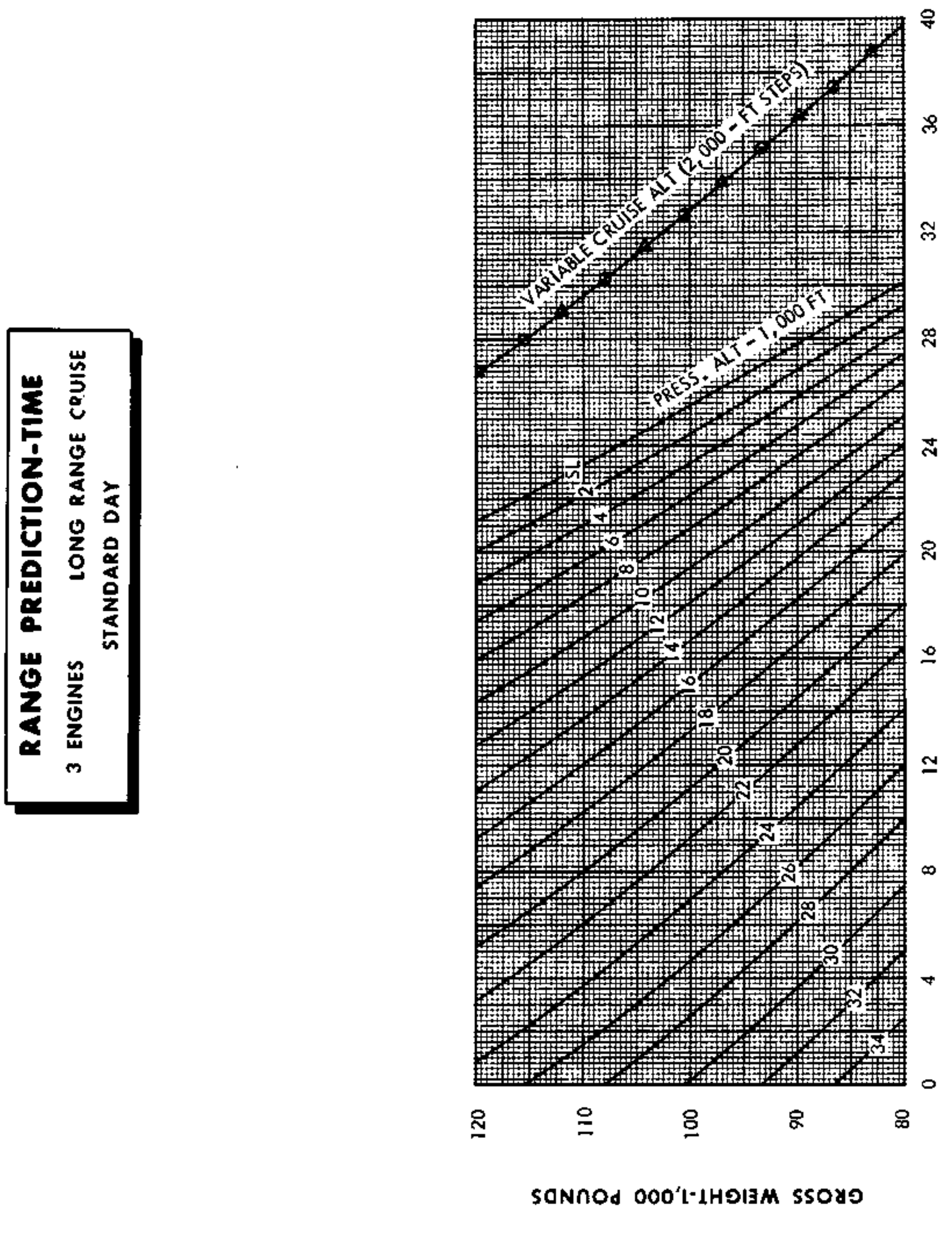


Figure 11-100. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE PREDICTION-TIME

3 ENGINES LONG RANGE CRUISE
STANDARD DAY-20°C

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine
2. Speed restrictions shown on speed summary chart are applicable.

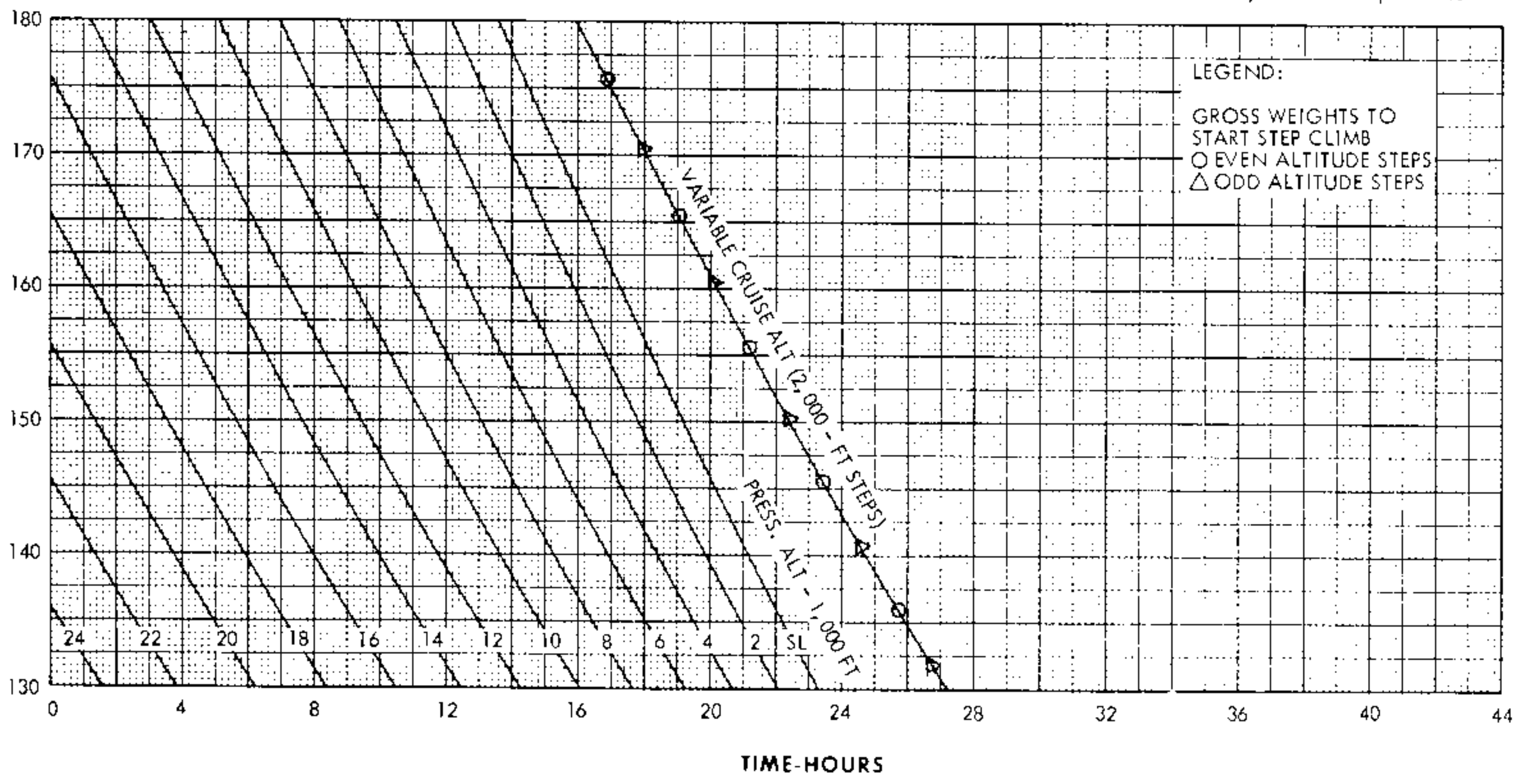


Figure 11-101. (Sheet 1 of 2)

RANGE PREDICTION-TIME
3 ENGINES LONG RANGE CRUISE
STANDARD DAY-20°C

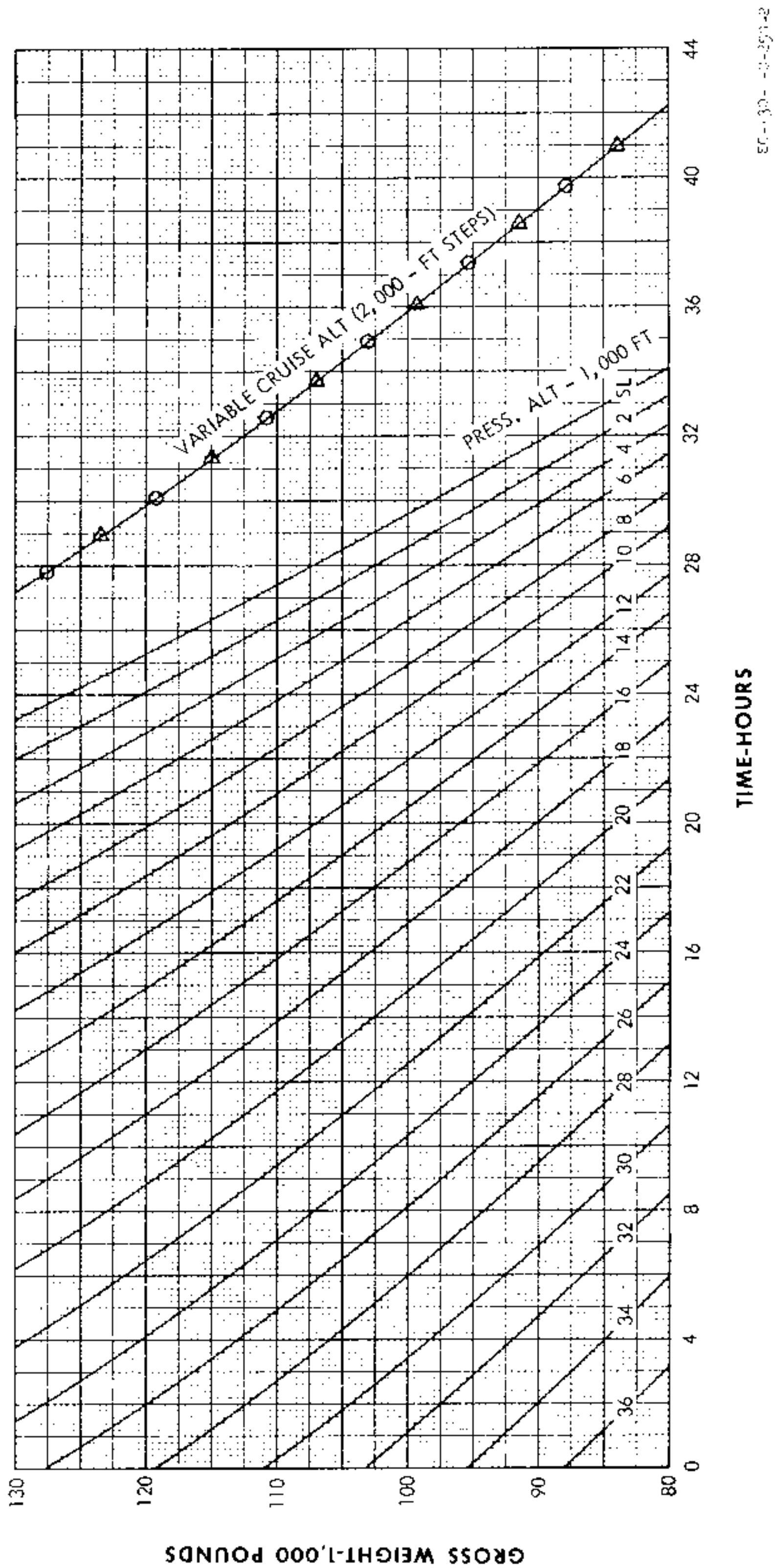


Figure 11-101. (Sheet 2 of 2)

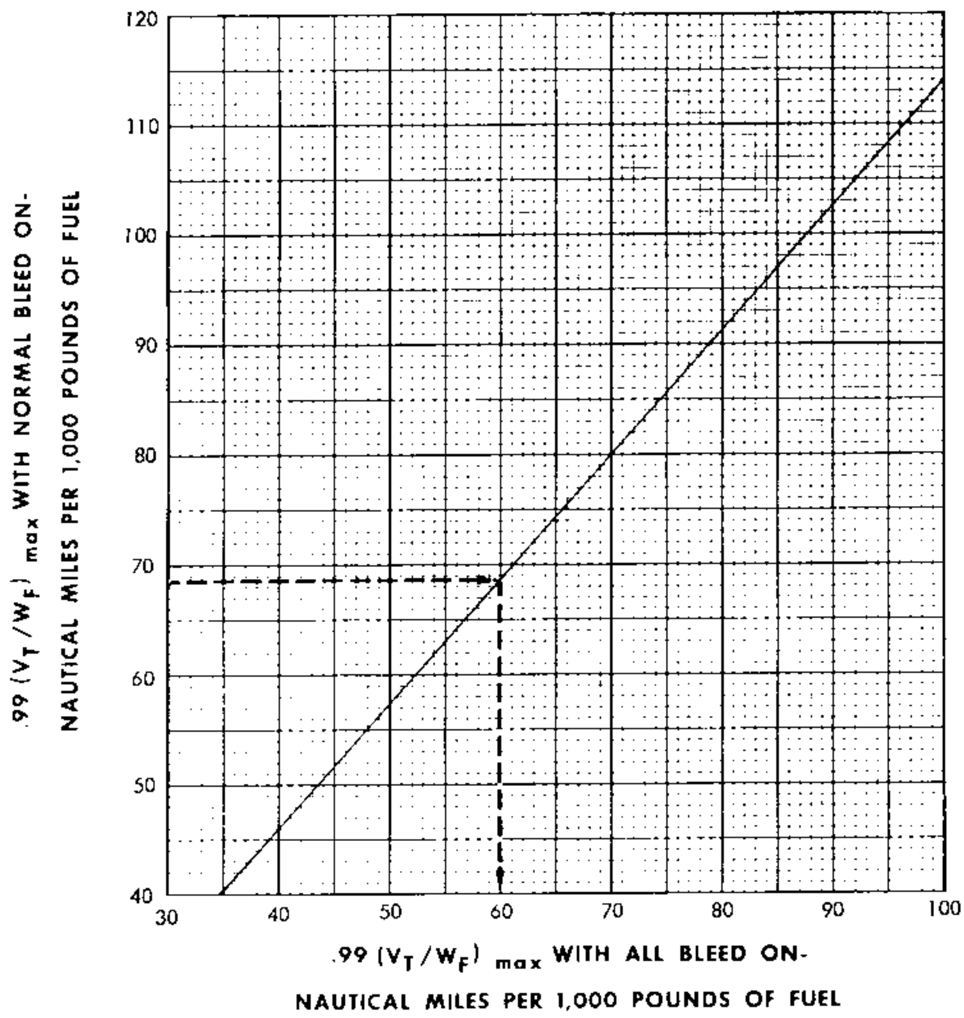
MODEL: EC-130G/Q
T56-A-423 ENGINES

RANGE CORRECTIONS DUE TO ALL BLEED ON

4 ENGINES

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST



EC-130-1-2-260

Figure 11-102.

SERVICE CEILING

MAXIMUM CONTINUOUS POWER

3 AND 2 ENGINES

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: MARCH 1971

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engines.

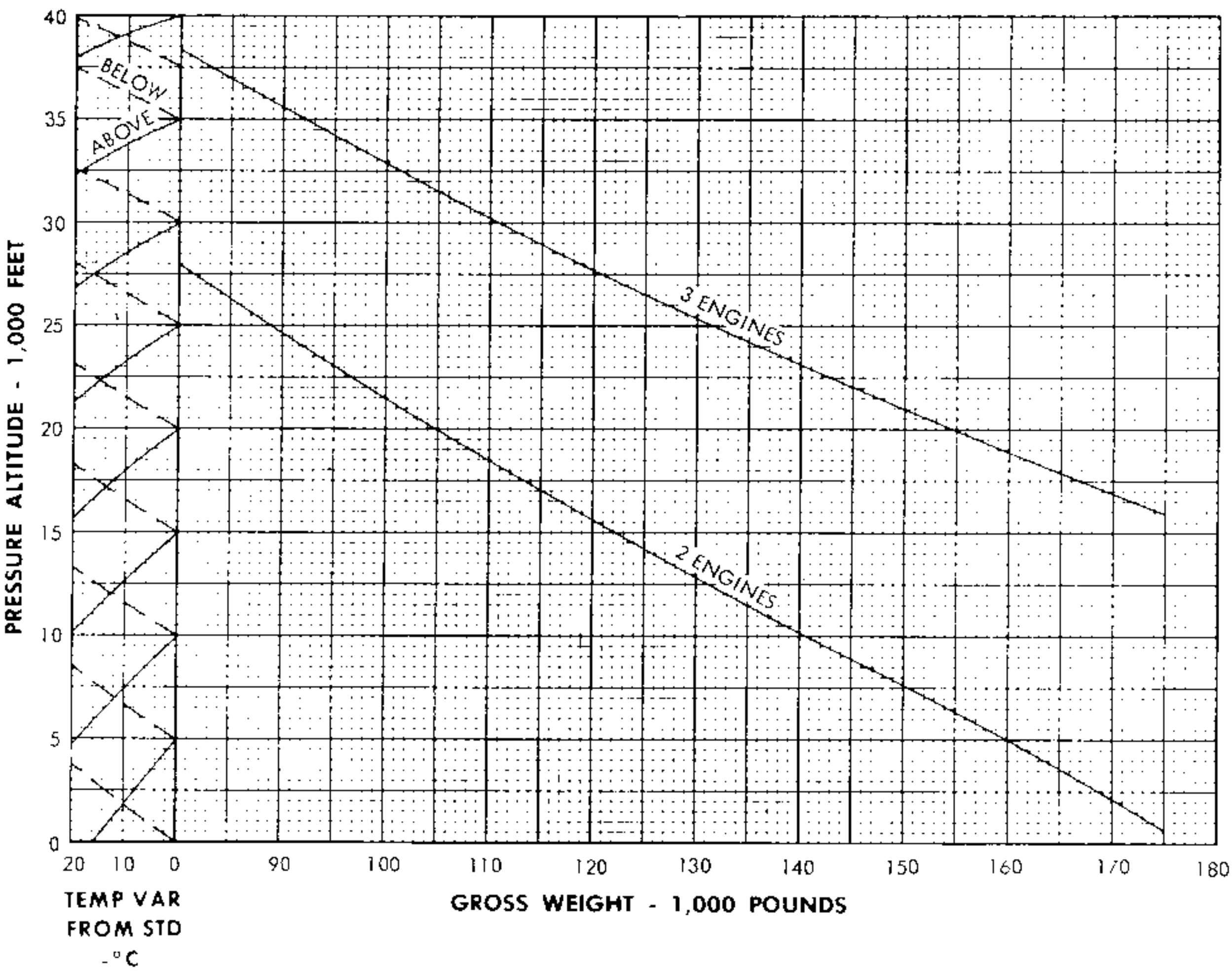


Figure 11-103.

DRIFTDOWN

3 ENGINES FLAPS UP GEAR UP

MAXIMUM CONTINUOUS POWER

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: MARCH 1971

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.
2. Rate of descent is based on 100 FPM to service ceiling.

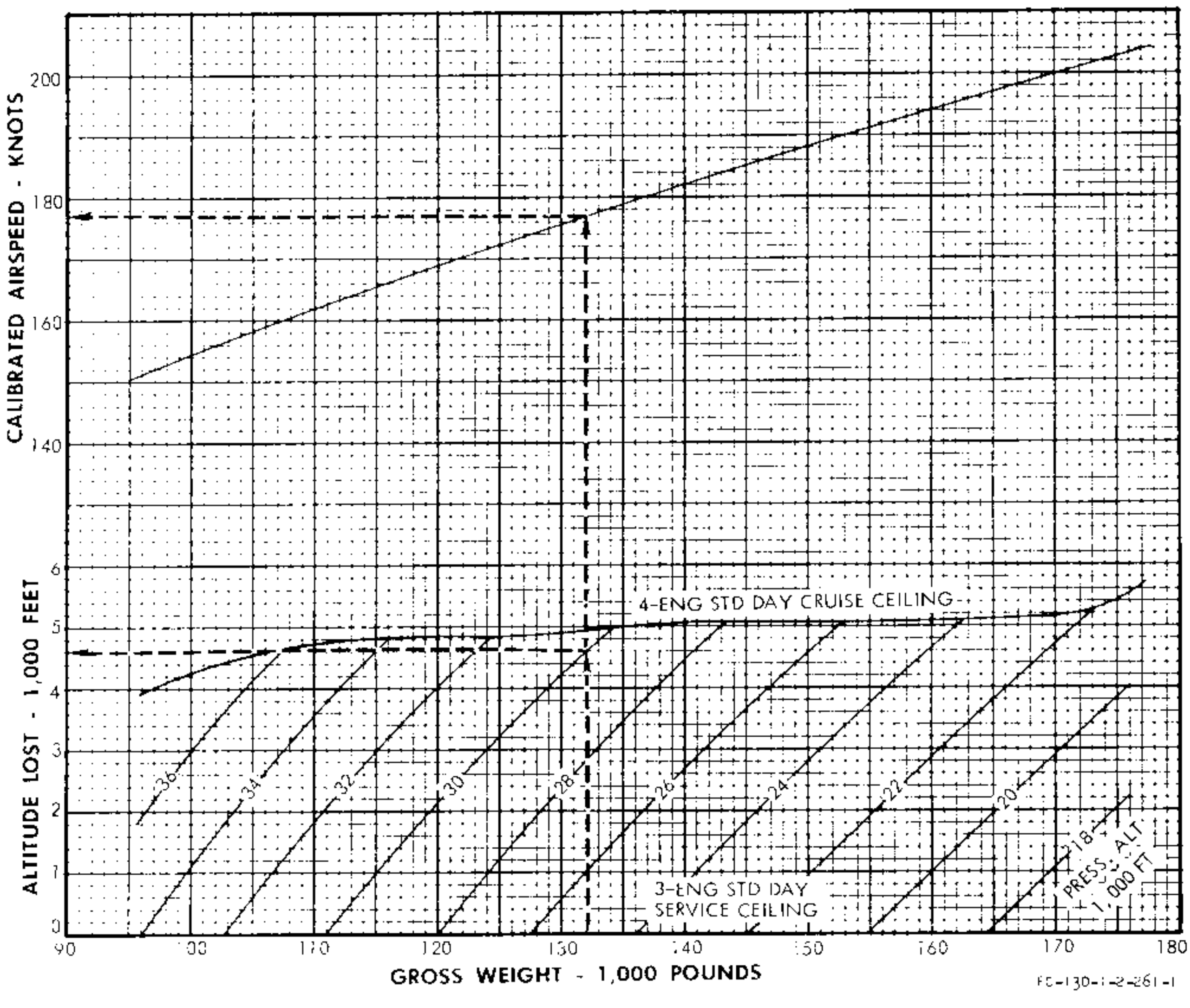


Figure 11-104. (Sheet 1 of 2)

DRIFTDOWN

3 ENGINES FLAPS UP GEAR UP

MAXIMUM CONTINUOUS POWER

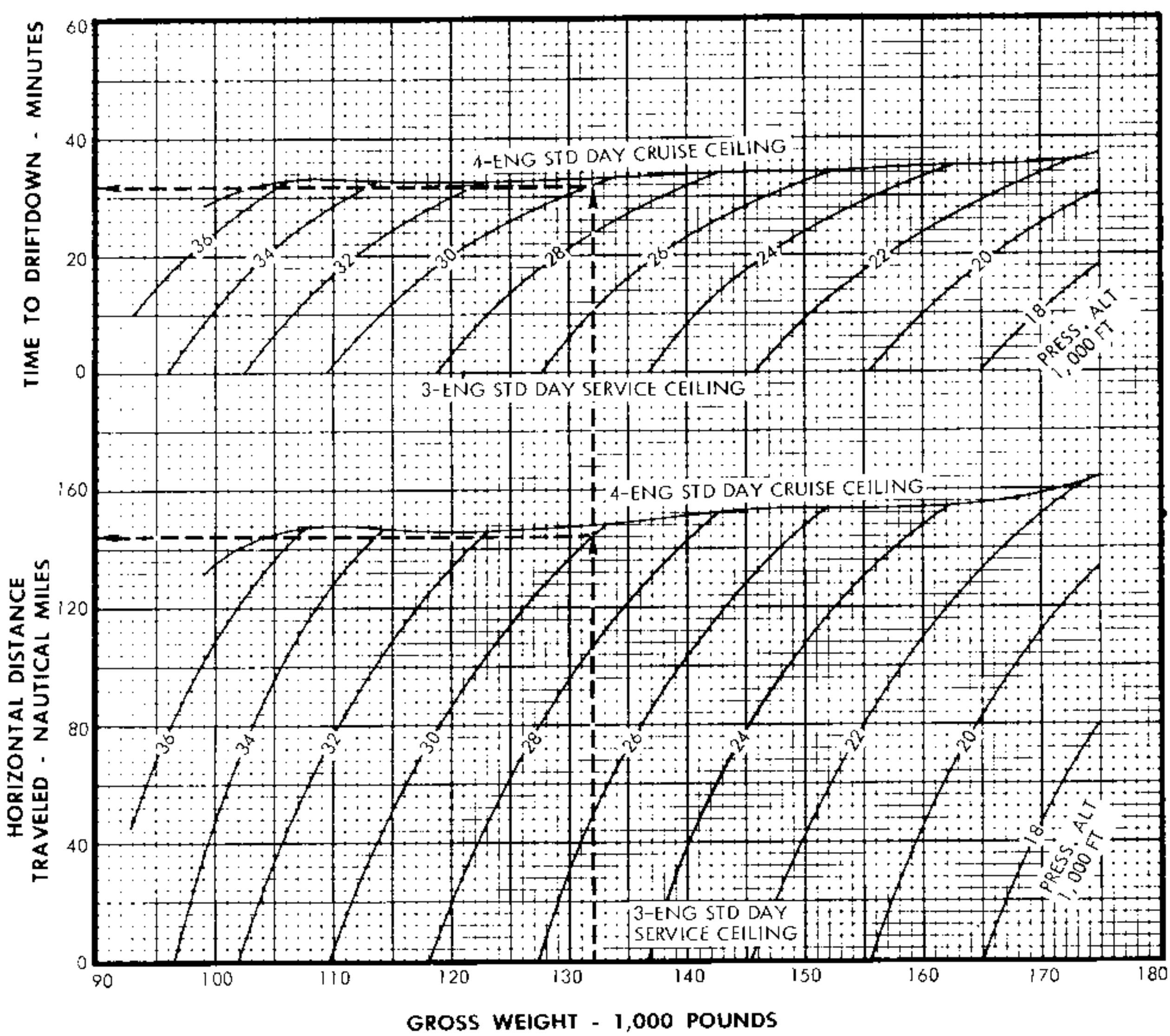


Figure 11-104. (Sheet 2 of 2)

MODEL: EC-130G/Q
T56-A-423 ENGINES

DRIFTDOWN

2 ENGINES MAXIMUM CONTINUOUS POWER

FLAPS UP GEAR UP

DATE: MARCH 1971
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propellers feathered on inoperative engines.
2. Rate of descent is based on 100 FPM to service ceiling.

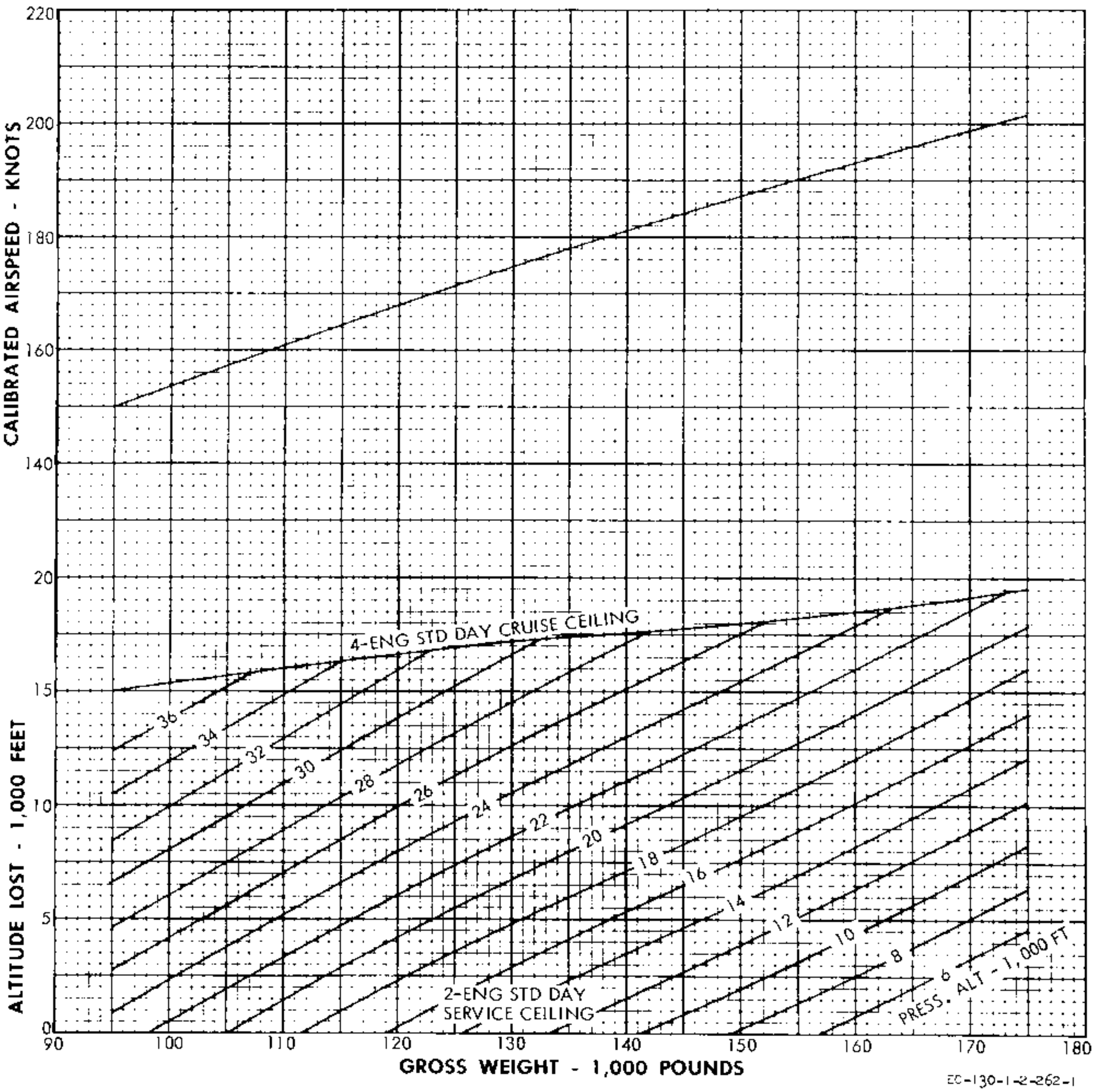


Figure 11-105. (Sheet 1 of 2)

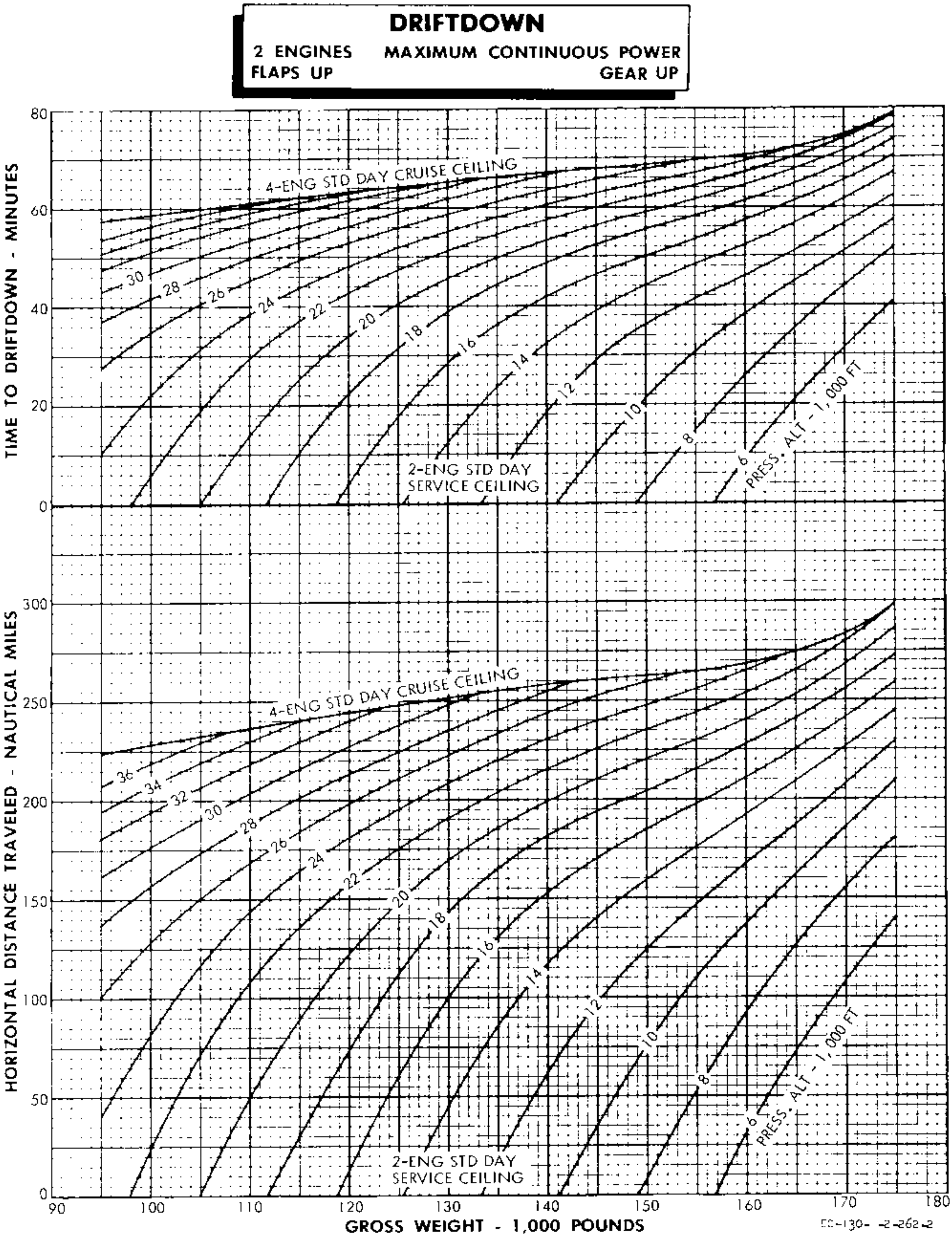


Figure 11-105. (Sheet 2 of 2)

PART 6

ENDURANCE

INTRODUCTION.

Endurance operation is flight at conditions which result in minimum fuel used for a given time; it is used for holding patterns, rendezvous, search, and loiter. In some cases, such as loiter, the speeds, altitudes, and configuration may be selected to give the optimum endurance. In other cases, such as search and rendezvous, an altitude is specified and the speed may be selected to give the maximum endurance. This part contains charts of maximum endurance with the standard-day optimum endurance line superimposed. The following nomenclature is used to describe the two types of endurance operation described above:

Maximum endurance - operation at the speed which results in the minimum fuel flow for the given configuration and atmospheric conditions at a given altitude and gross weight.

Optimum endurance - operation at the speed and altitude which results in the minimum fuel flow for the given configuration, atmospheric conditions, and gross weight.

For holding patterns, both the speed and altitude may be specified and, therefore, neither maximum endurance operation is permitted. If this is the case, the endurance can be determined from the specific range charts in this section. Temperature has a negligible effect on endurance at a given calibrated airspeed and altitude.

FACTORS AFFECTING ENDURANCE.

Airspeed and Altitude.

The most economical endurance operation can be achieved only when the recommended flight techniques are used. However, some variations may be permitted with a small effect. The airspeed may be allowed to vary by ±10 knots IAS, and the altitude may be allowed to vary by ±1,000 feet without affecting endurance appreciably.

Number of Operating Engines.

Endurance may be increased by shutting down one or two engines at the lower altitudes. This increase results because specific fuel consumption is lower and propeller efficiencies are higher at the higher power settings. However, operation with engines shut down is dependent on the gross weight, atmospheric conditions, and altitude; therefore, the number of operating engines must be selected for existing conditions.

Bank Angle.

When holding or conducting search operation over a limited area, it may be necessary to fly a fairly large bank angle. This kind of flight pattern will reduce the endurance time as shown on figure 11-106.

CHART DESCRIPTION.

Endurance data for all engines operating are shown on figure 11-107 with normal bleed, and on figure 11-108 with all bleed systems operating. Normal bleed condition data for three and two engines operating, respectively, are shown on figures 11-109 and 11-110. Torque values for maximum endurance may be derived through the procedure in Part 2, using figures 11-10 and 11-9. Figure 11-10 is entered first with the endurance parameters to obtain TIT, which then may be entered on figure 11-9 to obtain four-engine normal bleed torque. Torque values for three- and two-engine endurance are found by using the same procedure, entering figure 11-10 with the appropriate flight conditions and the fuel flow from the three-engine or the two-engine endurance charts. Torque values obtained by this process should be increased by 230 inch-pounds for three-engine conditions and 590 inch-pounds for two-engine conditions.

EXAMPLE OF USE OF CHARTS.

Given:

Pressure altitude - 15,000 feet.

Begin holding weight - 143,000 pounds.

Holding time - 1 hour.

OAT - standard plus 10°C.

4 engines

Find:

Holding speed.

Fuel used.

Procedure:

The first step is to determine the approximate average holding weight. This weight is found by entering figure 11-107 with 15,000 feet altitude and 143,000 pounds holding weight, and reading a fuel flow of 965 pounds per hour per engine for an OAT of standard plus 10°C. By using this fuel flow in the following equation, the average holding weight is found.

$$\text{Avg Hold Wt} \quad \text{Begin Hold Wt} - \frac{(\text{No. operating Eng X Fuel Flow X Hold Time})}{2}$$

$$= 143{,}000 - \frac{(4 \times 965 \times 1)}{2} = 141{,}070$$

This average holding weight is used to find the airspeed and fuel flow for the approximate average holding weight. Enter figure 11-107 with 141,070 pounds, and read 154 knots CAS and 955 pounds per hour per engine fuel flow. The fuel used will be:

Fuel Used = No. Operating Eng x Fuel Flow x Hold Time = 4 x 955 x 1 = 3,820 pounds

The above procedure may be used for short loiter times; however, if extended loiter is required, the following table should be used:

Gross Weight Lb	Fuel Weight Lb	Average Weight Lb	Fuel Flow Per Eng Lb/Hr	Air speed KCAS	Total Fuel Flow Lb Hr	Time Hr	Summation of Times Hr
143,000							0
	3,000	141,500	955	154	3,820	.785	
140,000							.785
	5,000	137,500	938	151	3,752	1.333	
135,000							2.118
	5,000	132,500	912	149	3,648	1.370	
130,000							3.488

EFFECT OF BANK ANGLE ON ENDURANCE

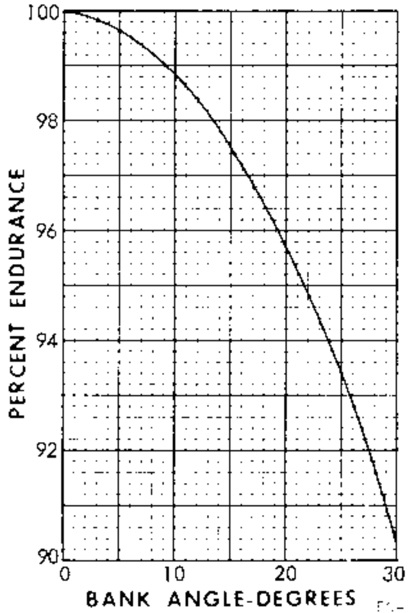


Figure 11-106.

MODEL: EC-130G/Q
T56-A-423 ENGINES

MAXIMUM ENDURANCE

4 ENGINES NORMAL BLEED

NOTE

1. Good for all temperatures.

DATE: APRIL 1966

DATA BASIS : ESTIMATED ON FLIGHT TEST

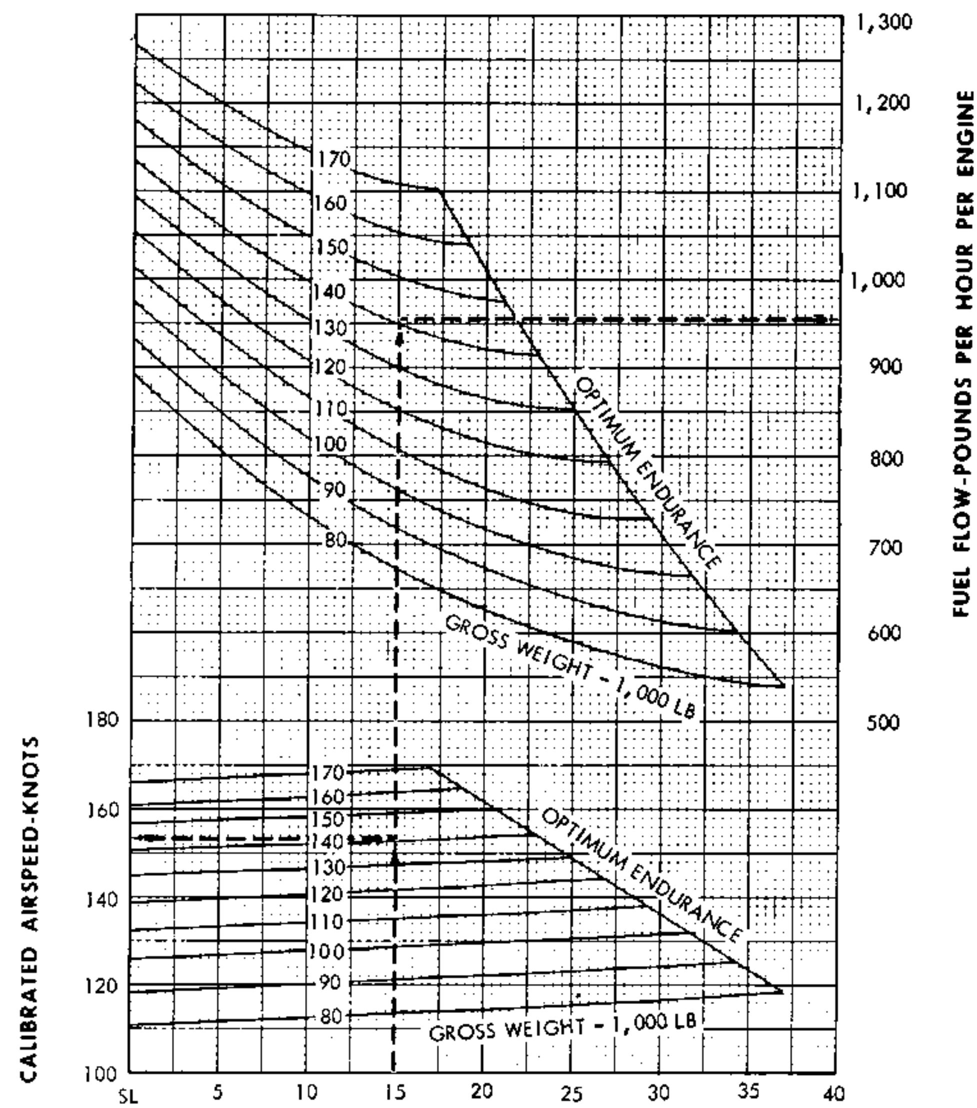


Figure 11-107.

EC-130-1-2-264

MODEL: EC-130G/Q
T56-A-423 ENGINES

MAXIMUM ENDURANCE

4 ENGINES — ALL BLEED ON

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Anti-icing, air conditioning and pressurization on (all bleed on)
2. Fuel flows good for all temperatures.

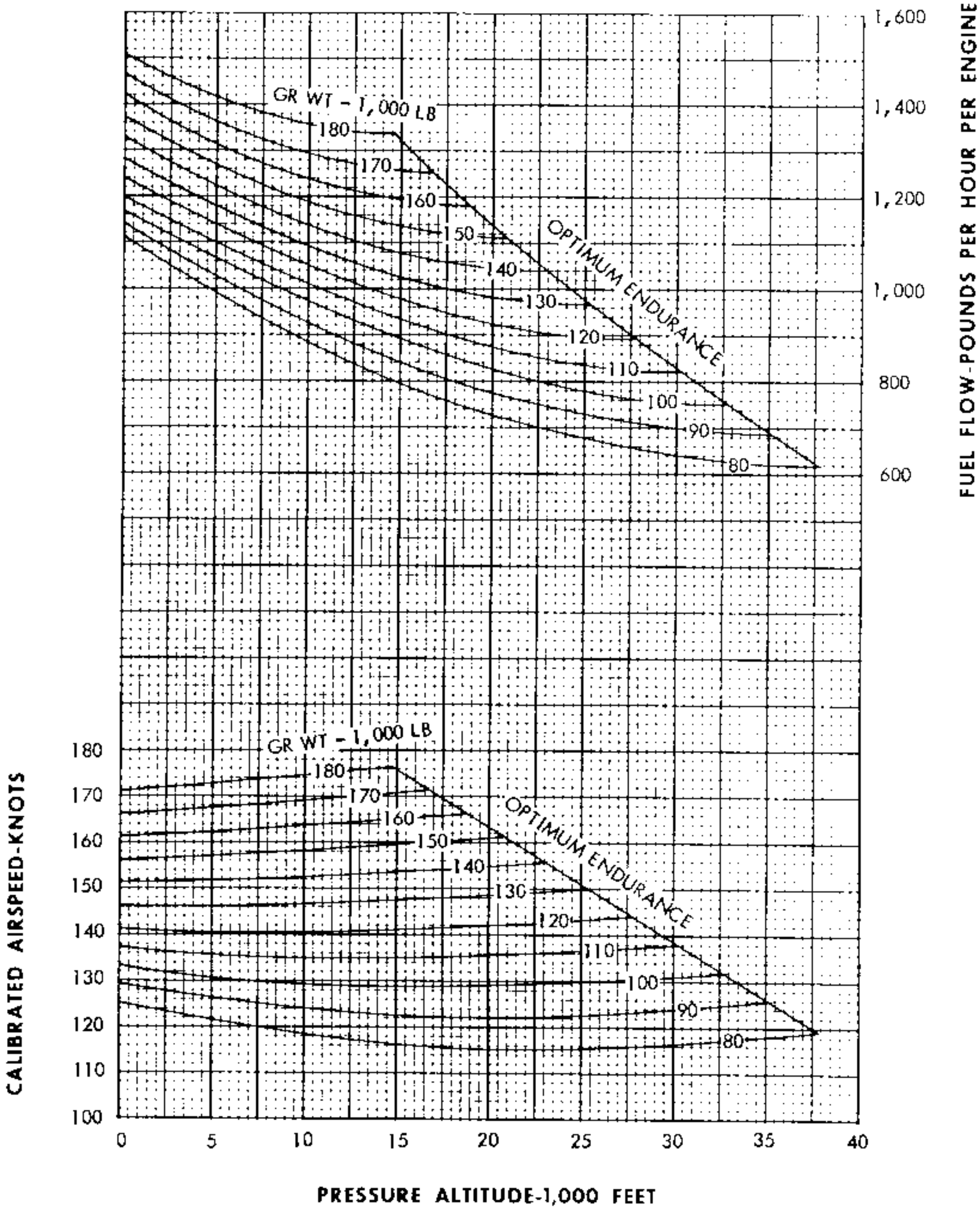


Figure 11-108.

MODEL: EC-130G/Q
T56-A-423 ENGINES

MAXIMUM ENDURANCE

3 ENGINES

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Propeller feathered on inoperative engine.
2. Normal bleed.

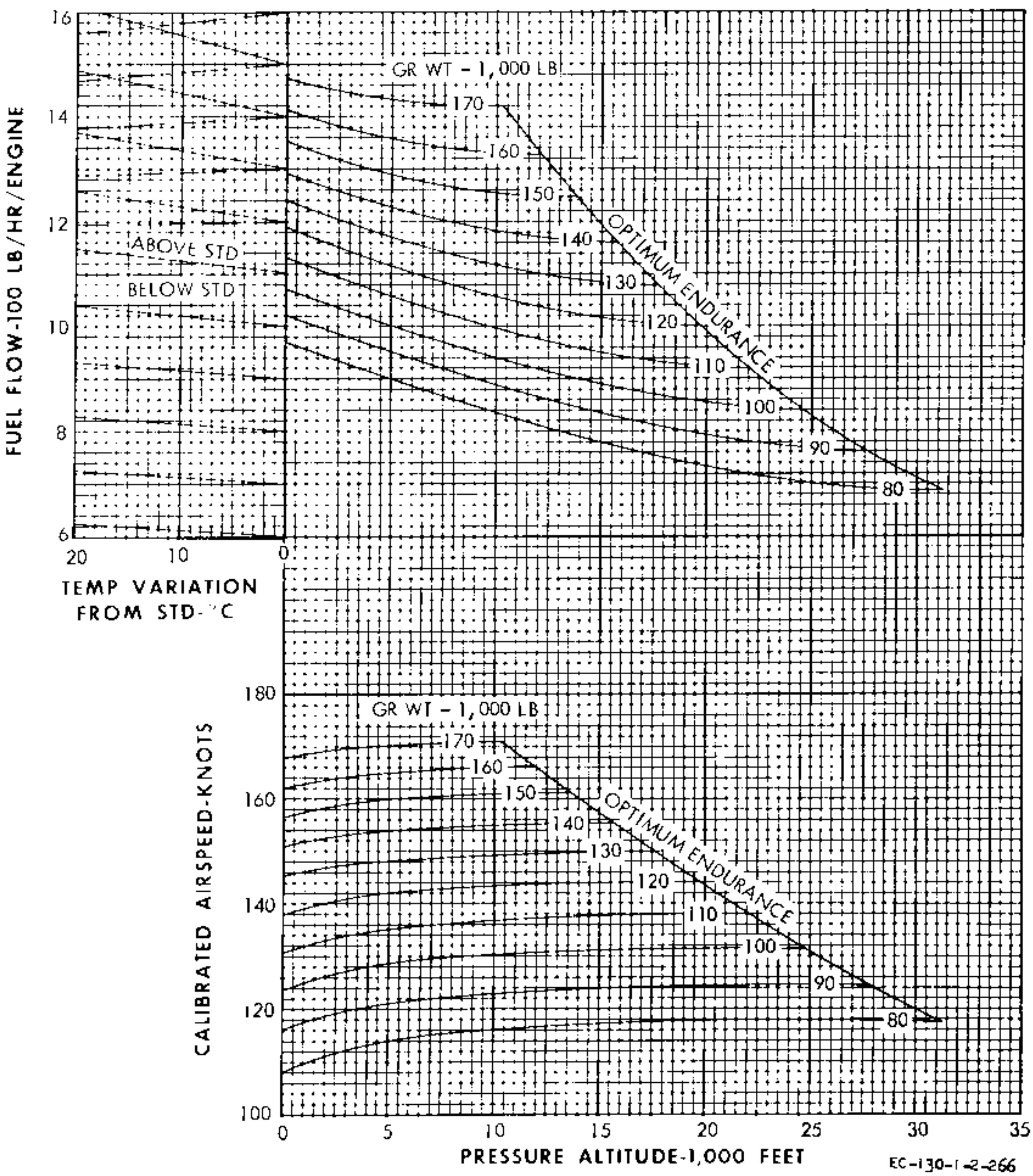


Figure 11-109.

MODEL: EC-130G/Q
T56-A-423 ENGINES

MAXIMUM ENDURANCE

2 ENGINES NORMAL BLEED

NOTE

1. Propellers feathered on inoperative engines.

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

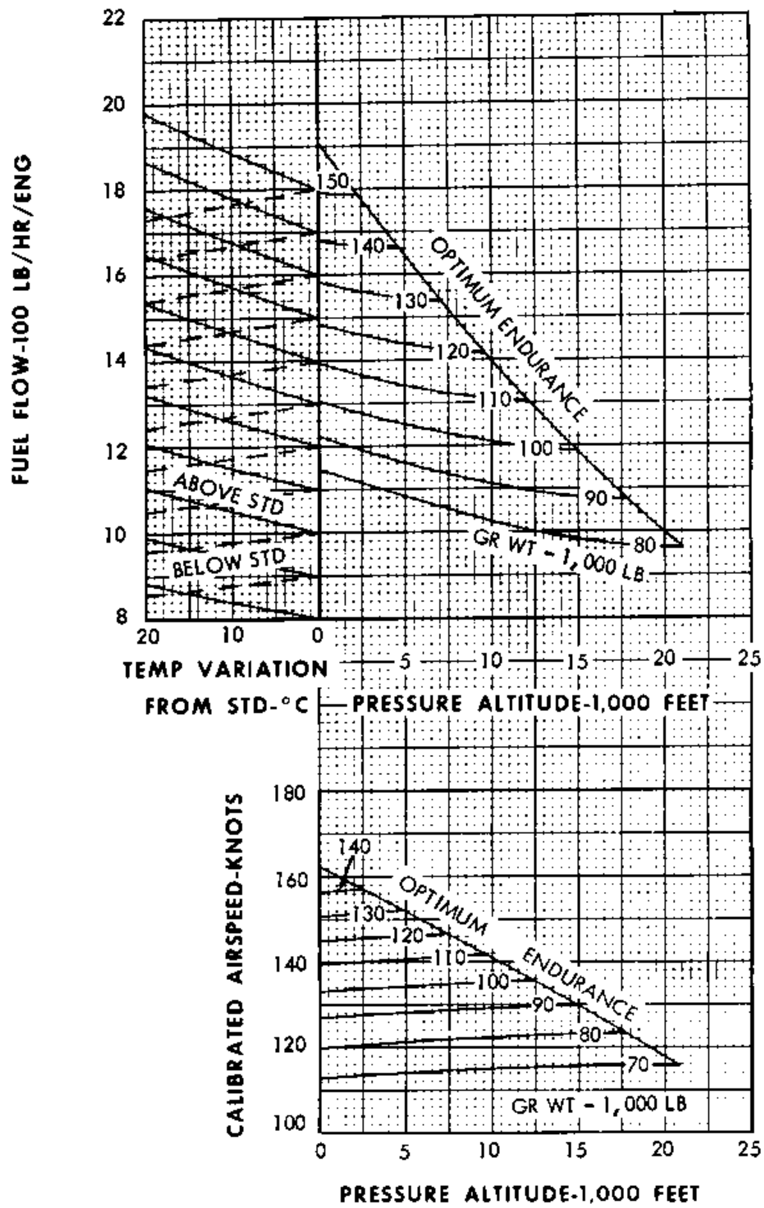


Figure 11-110.

PART 7

DESCENT PERFORMANCE

INTRODUCTION.

As in climb performance, the important factors in planning mission descent are elapsed time, distance flown, and fuel consumed.

PENETRATION DESCENT.

This time of descent is made in two segments, first from altitude down to 20,000 feet at maximum lift over drag speeds as given in figure 11-111 with throttles at flight idle and with gear and flaps retracted. From 20,000 feet on down, the descent speed is a constant 250 KIAS.

RAPID DESCENT.

Gear and Flaps Down.

At slow airspeeds, the highest rates of descent are obtained by retarding all throttles to flight idle, decreasing airspeed to flap placard speed (145 knots), and extending landing gear and full flaps (figure 11-112. Descend at 145 knots.

Gear and Flaps Retracted.

The highest rates of descent are obtained by retarding all throttles to flight idle with gear and flaps retracted and descending at the maximum speed, as shown in Part 4, Section I. The rapid descent data shown in figure 11-113 are based on the tabulated speeds shown.

TEMPERATURE EFFECT.

For each 10° C below standard temperature, decrease rate of descent by 2 percent, and increase time and fuel by 2 percent. For temperatures above standard, reverse the direction of the correction. No corrections are required for distance.

EXAMPLE OF USE OF CHARTS.

The following example demonstrates the use of the charts for all types of descent.

Given:

Penetration Descent.

Gross weight - 120,000 pounds.

Altitude - 22,000 feet.

Power - Four engines at FLIGHT IDLE.

Descend at speeds shown.

Find:

Horizontal distance covered during descent to sea level.

Elapsed time for descent to sea level.

Fuel consumed during descent to sea level.

Procedure:

All information required for this descent is given in figure 11-111. Enter this chart at the end cruise altitude of 22,000 feet, move up to the 120,000-pound weight line and across to the descent distance of 34 nautical miles. Reading respective scales at the intersection of the 22,000-foot pressure altitude, the time to descend to sea level is 7.5 minutes, and the fuel consumed is found to be 250 pounds.

MODEL: EC-130G/Q
T56-A-423 ENGINES

PENETRATION DESCENT
TIME, DISTANCE, AND FUEL

NOTE

1. Cruise ceiling based on four engines at maximum continuous power.
2. ICAO Standard Atmosphere speed schedule:

WT - 1,000 LB	KIAS
80	133
100	148
120	163
140	176
160	188
180	200

From 20,000 feet down at all weights - 250 KIAS

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST

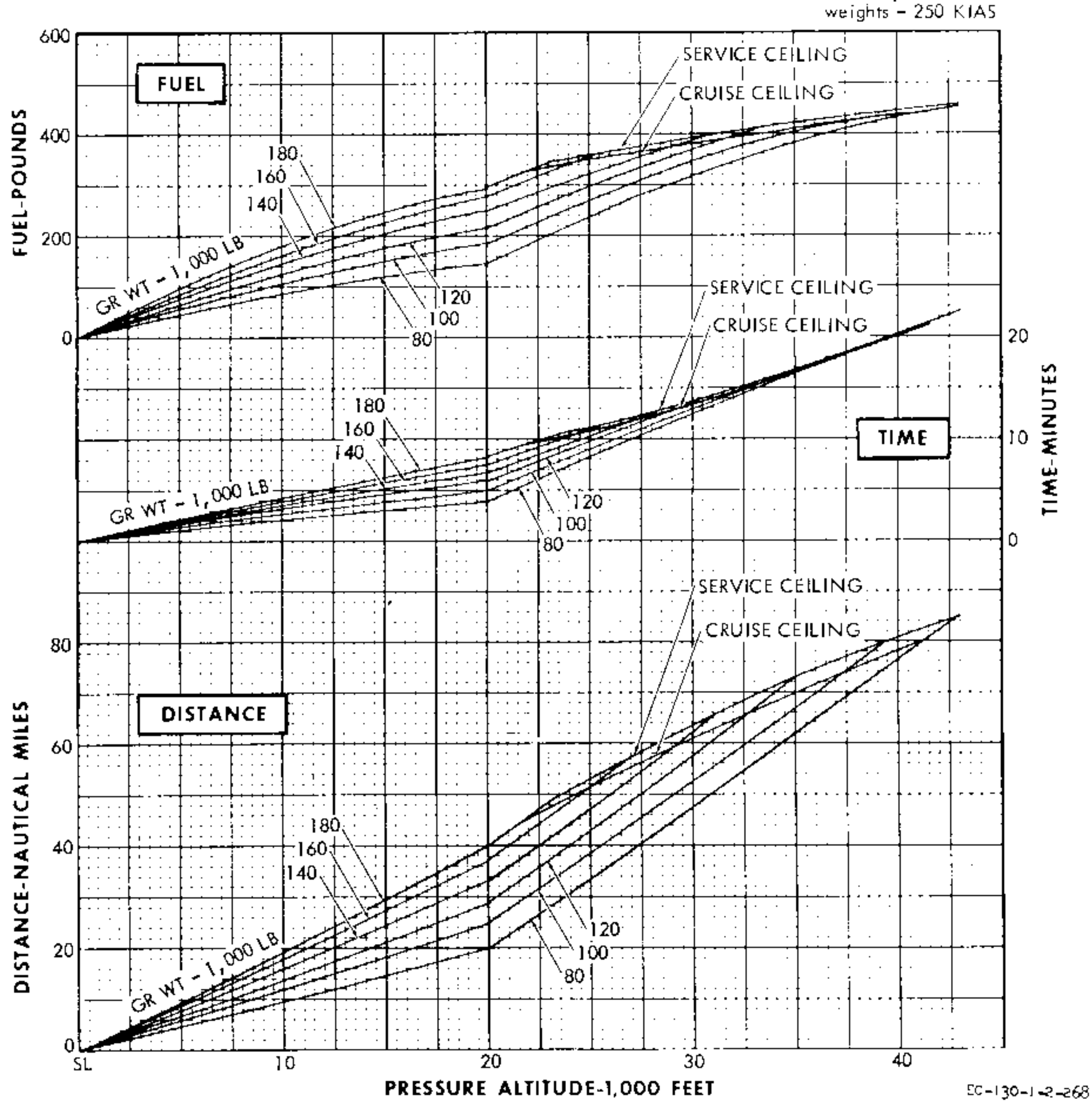


Figure 11-111.

MODEL: EC-130G/Q
T56-A-423 ENGINES

RAPID DESCENT WITH FULL FLAPS

TIME, DISTANCE, AND FUEL

4 ENGINES FLIGHT IDLE POWER
GEAR DOWN 145 KIAS

NOTE

1. Cruise ceiling based on four engines at normal power.
2. ICAO Standard Atmosphere.

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

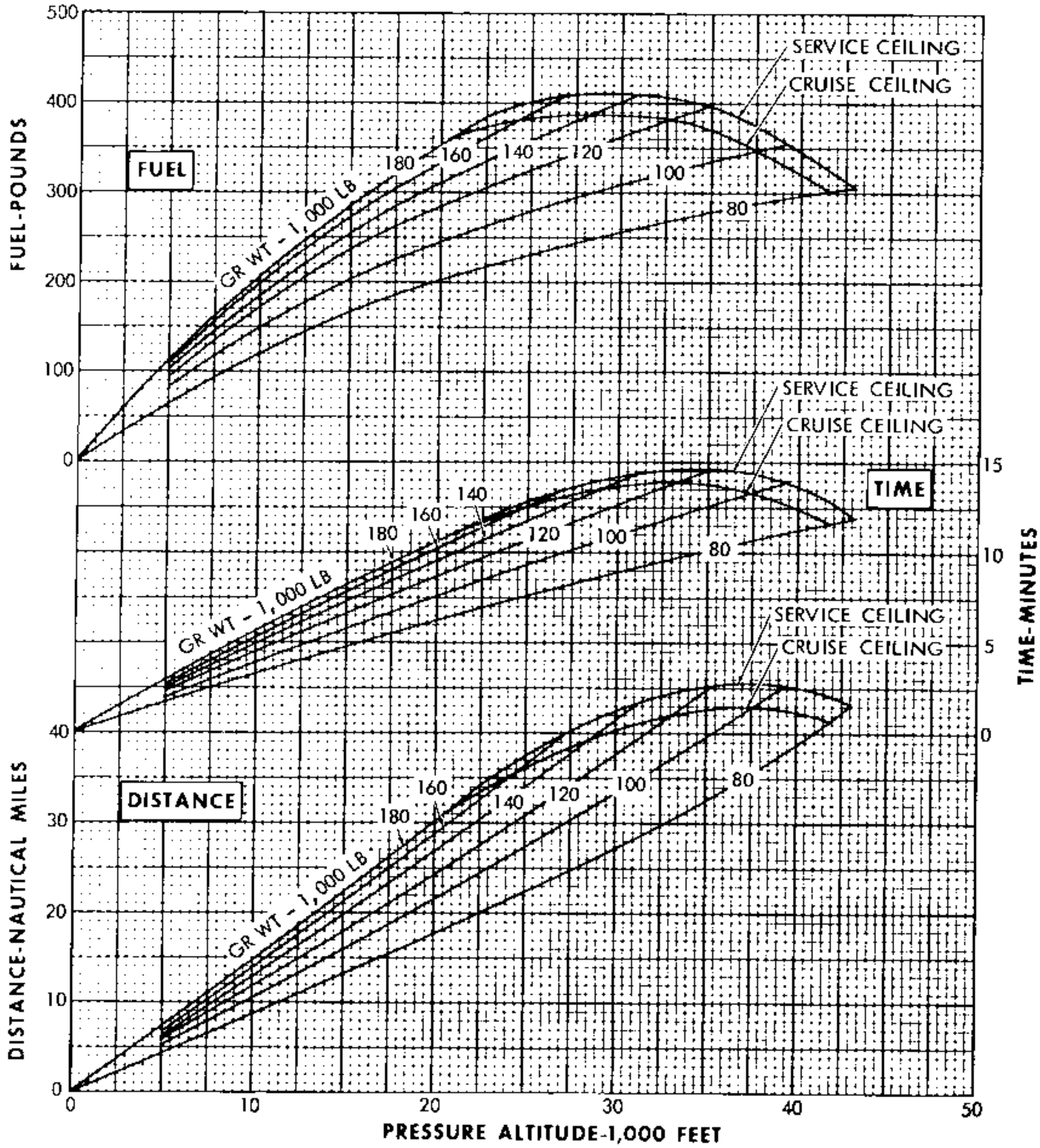


Figure 11-112.

EC-130-1-2-269

MODEL: EC-130G/Q
T56-A-423 ENGINES

RAPID DESCENT AT DIVE SPEED

TIME, DISTANCE, AND FUEL

4 ENGINES FLIGHT IDLE POWER

GEAR AND FLAPS UP

V DIVE @ 325 KEAS OR M=0.64

NOTE

1. Cruise ceiling based on four engines at maximum continuous power
2. ICAO Standard Atmosphere

Speed Schedule:

ALT 1,000 FT	KIAS
0	324
5	326
10	328
15	321
20	293
25	266
30	241
35	216
40	193

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

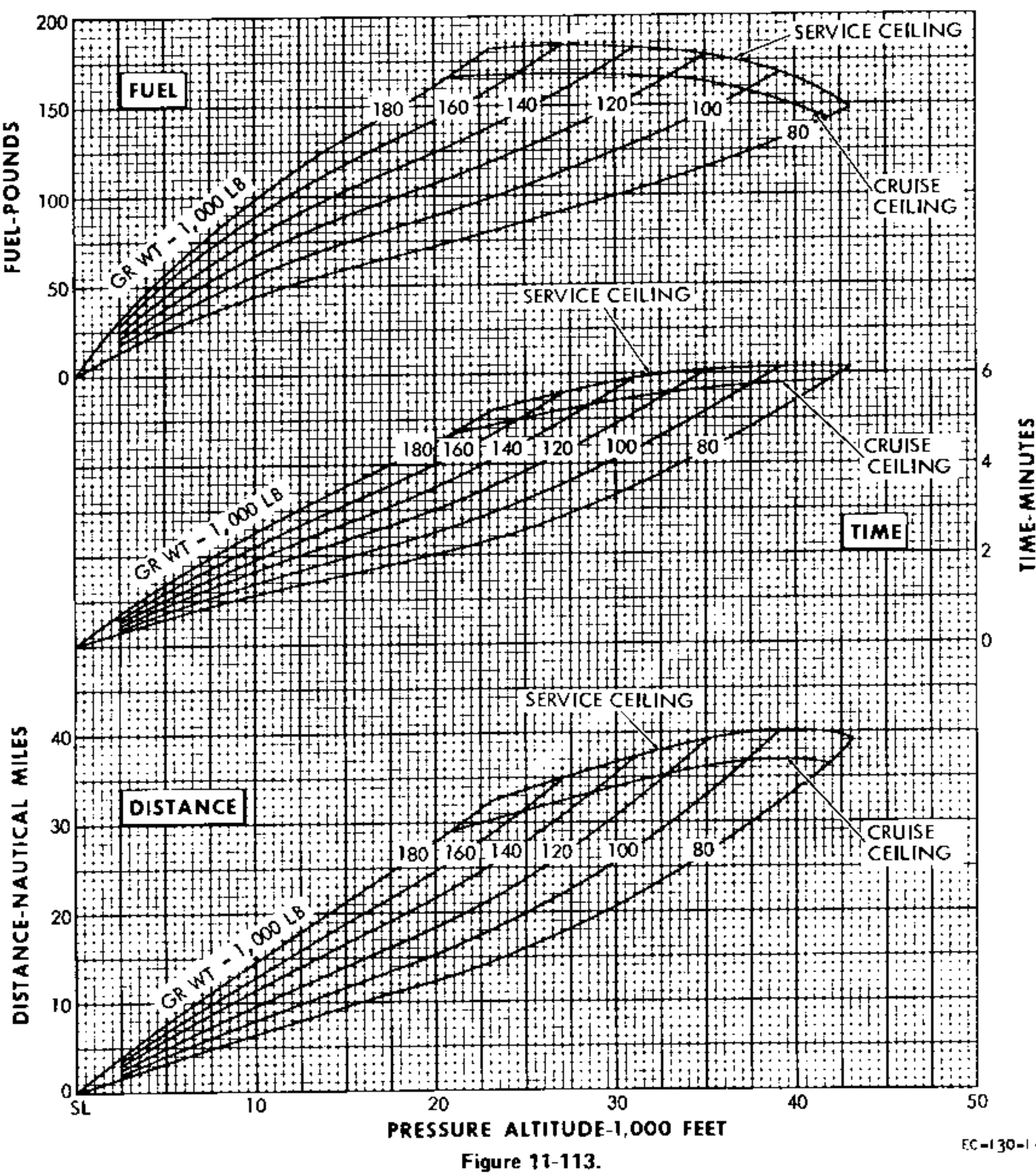


Figure 11-113.

PART 8

LANDING PERFORMANCE

INTRODUCTION.

Landing performance closely parallels take-off performance, and the variables of aircraft gross weight, configuration, runway condition, and atmospheric conditions have similar effects on landing performance as on takeoff performance.

The aircraft is designed for 100 percent flap landings; however, variable flap settings may be used for all landings. During landings with flap settings of less than 50 percent, the following conditions prevail and caution must be exercised:

1. Because of the high angle of attack at touchdown, it is possible for the aft end of the fuselage to contact the ground.

2. There will be no appreciable stall warning.

3. Stall and float characteristics due to low pitch stop are unpredictable. However, landings with 0 to 50 percent flaps may be accomplished.

Refer to Section III for a typical approach and landing pattern and to Part 4, Section I for maneuver limits during landing approach.

Note

Landing gross weight should be below 155,000 pounds except in an emergency.

TOUCHDOWN, THRESHOLD AND APPROACH SPEEDS.

Touchdown Speeds.

The touchdown speeds presented in figure 11-114 are the initial speeds at point of contact in landing. The touchdown speeds are shown for three flap settings: 100 percent, 50 percent, and zero flaps. The speeds represent 1.2 times power-off stall speeds for each flap setting. These touchdown speeds are the criteria for calculating the ground roll distances shown on the landing distance charts and must be adhered to if consistency with these charts is expected.

Threshold and Approach Speeds.

The threshold and approach speeds are dependent upon touchdown speeds and landing configuration. Threshold speed is an increment of speed above touchdown speed, and approach speed is defined as 10 knots above threshold speed. Use the table below or the table in figure 11-114 to determine threshold and approach speeds.

Threshold Speed = Touchdown Speed + ΔV

Approach Speed = Threshold Speed + 10 KIAS

	KIAS	Threshold Speed KIAS	Approach Speed KIAS
100% Flaps			
Normal	15	TD + 15	TD + 25
Max Effort	8	TD + 8	TD + 18
50% Flaps	15	TD + 15	TD + 25
Zero Flaps	20	TD + 20	TD + 30

Air Minimum Control Speeds.

The air minimum control speeds for one or two engines inoperative are presented in figure 11-29. These speeds are shown for various altitudes and temperatures from sea level to 16,000 feet as indicated, and are based on the minimum speed for which full directional control of the aircraft may be maintained when all operative engines are at maximum power, by using full rudder pedal deflection and a 5-degree bank away from the failed engine(s). The one-engine inoperative minimum control speed is based on the assumption that the inoperative engine is outboard, that NTS is operative, and that the propeller is windmilling. The two-engine inoperative speed is based on the assumption that the inoperative engines are on the same side, that NTS is operative, and that the inboard propeller is feathered and the outboard propeller is windmilling. Refer to Section V for further discussion of minimum control speeds.

Note

When landing with one or two engines inoperative, it is recommended that the inflight minimum control speed be compared to the recommended approach speed and the higher of the two speeds used.

CROSSWIND LANDING.

The crosswind chart (figure 11-115) provides a convenient method for resolving the wind into its components, and indicates the minimum recommended touchdown speed for the crosswind component. This touchdown speed must be compared to the touchdown speed determined from the Touchdown Speed Chart and the higher speed used. When touchdown is made at a speed greater than that shown on the Touchdown Speed chart, the increased increment in speed must be used to determine the increased ground roll on the landing distance charts. The 100 percent flap placard method of correction is adequate for crosswind components equal to or less than indicated by minimum touchdown speeds. For crosswind components greater than indicated by minimum touchdown speeds but less than 35 knots, a crab method or a combination crab and sideslip method is necessary. For crosswind components in excess of 35 knots, a high degree of pilot skill is necessary for crosswind correction. Variation in asymmetric power and use of less flaps than normally recommended will result in improved crosswind capabilities.

WARNING

With two engines inoperative on the same side, rudder power is reduced. Refer to Section III for landing procedures.

LANDING DISTANCE.

Landing distances for 100, 50, and 0 percent flap positions are shown on figures 11-116 through 11-122. These data are presented as functions of outside air temperature (OAT), pressure altitude, gross weight, engine configuration, runway condition reading (RCR), wind, and runway slope. The total distance from 50 feet to stop for 100 percent flaps, 50 percent flaps (figure 11-119), and zero flaps (figure 11-121) is based on the touchdown speeds shown on the Touchdown Speed chart (figure 11-114). The maximum effort total distance from 50 feet to stop for 100 percent flaps (figure 11-118) is based on the maximum effort threshold and touchdown speeds shown on figure 11-114.

Note

Should obstacles be located near the end of the runway such that the 50-foot height must be exceeded, the effect of the additional height must be considered. Since the effect is not shown on the charts, sufficient margin must be allowed based on the pilot's judgement and experience.

The landing ground roll charts for 100 percent flaps (figure 11-117), 50 percent flaps (figure 11-120), and zero flaps (figure 11-122) show the distance from touchdown to stop. The basic data on the landing distance charts are based on the following assumptions:

1. Dry asphalt or concrete runways with an RCR of 23.

2. A one-second allowance for distance traveled during transition from touchdown to a taxi attitude.

3. Full wheel brakes and reverse power application upon reaching taxi attitude.

For other conditions, corrections to the basic data may be applied in the following manner:

ENGINE CONFIGURATION. The basic data assume flight idle power in the approach phase and full reverse thrust during the ground roll phase. For other engine configurations, the increased landing distances may be estimated by use of the correction scale on the charts.

RUNWAY CONDITION READING (RCR). The increase in landing ground roll due to a wet or icy runway surface is dependent on many factors, and each situation should be considered on the basis of past experience. Runways covered with snow have a variable braking coefficient between wet and icy. The most critical factor should be applied in computing the landing data. When the tower reports a measured RCR, the ground roll must be modified to account for the variation. Many airfields will continue to report braking action in accordance with ICAO documents. This is the "good," "medium," and "poor" categorization of braking action on unusual runway surface condition. In order to relate this categorization to an RCR or when RCR values are not available, the following relationship will be used.

RUNWAY CONDITION	ICAO REPORT	RCR
Dry	Good	23
Wet	Medium	12P
Icy	Poor	5

The basic data on the charts assume a dry runway. For a landing during which no brakes are applied, assume an RCR of 2. With other conditions, the increased landing distances may be estimated by using the correction scale on the charts. The baseline on this correction scale is an RCR of 23. Variations are caused by the deterioration of braking performance with increasing weight giving the effect of a decrease in RCR. Therefore, correction may be made for an RCR lower than the baseline level while no correction is necessary for an RCR value higher than the baseline. To correct for RCR, enter the correction scale with the uncorrected distance until the weight line for the gross weight of the aircraft is reached. This establishes the baseline. From this point, follow parallel to the guide lines to the RCR value if the RCR is to the right of the baseline. If the RCR is to the left of the baseline, no RCR correction is necessary. For a landing in which no brakes are applied, use an RCR of 2.

INCREASED LANDING SPEED. The basic data on the charts are based on the touchdown speeds shown on the Touchdown Speed chart (figure 11-114). When touchdown speeds are increased for any reason, the increased ground roll may be estimated by applying the increment in KIAS to the correction scale on the charts. The approach speed is assumed to remain the same as shown in the Note on the Touchdown Speed chart, and no correction for increased touchdown speed is necessary for the total distance from 50 feet, as the decrease in flare distance tends to compensate for the increase in ground roll.

WIND AND SLOPE. The basic data on the charts assume a zero wind and slope. For other conditions, the landing distances may be estimated by using the correction scales on the charts.

EXAMPLES OF USE OF CHARTS.

Example 1.

Given:

Normal landing with 100 percent flaps, reverse thrust on four engines, and maximum wheel brakes.

Gross weight: 120,000 pounds.

Field elevation: 2,000 feet

OAT: 15°C.

Measured wind: 30 knots from 60 degrees left of runway heading.

Reported RCR: 10.

Runway slope: 2 percent downhill.

FIND:

All landing data.

PROCEDURE:

To find the recommended approach, threshold, and touchdown speeds, enter the Touchdown Speed chart for 100 percent flaps (figure 11-114) with a gross weight of 120,000 pounds, move up to the touchdown speed line and read a touchdown speed of 103 KIAS. The threshold speed and approach speed are determined by adding the speed increments shown in the Note on figure 11-114. Threshold speed will be 15 KIAS above touchdown speed, or 118 KIAS. Approach speed will be 25 KIAS above touchdown speed, or 128 KIAS.

The landing crosswind data are determined by entering the landing crosswind chart (figure 11-115) with a wind velocity of 30 knots and wind direction of 60 degrees. Read a headwind component of 15 knots and a crosswind component of 26 knots. Enter the chart on the airspeed scale with a touchdown speed of 103 knots, and move across to the crosswind component of 26 knots. This intersection falls within the caution area of the chart. To determine a touchdown speed that falls within the recommended area of the chart, move vertically from this intersection until the recommended area of the chart is intersected. From this point, read a minimum touchdown speed of 112 KIAS. This new touchdown speed is greater than the touchdown speed determined from the Touchdown Speed chart, giving an increased speed increment of 9 KIAS (112-103).

To determine the landing distance from 50 feet, enter figure 11-116 with an OAT of 15°C, move across to the 2,000-foot pressure altitude, down to 120,000-pound gross weight, and read an uncorrected landing distance of **3,000 feet.** To correct for RCR, move across to the RCR correction scale, follow the guideline to an RCR of 10, and read a corrected landing distance of **3,600 feet.** To correct for runway slope, move across to the slope correction scale, follow the downhill guideline to a gradient of 2 percent, and read a corrected distance of **4,200 feet.** To correct for wind, move across to the wind correction scale, follow the headwind guideline to 15 knots, and read a corrected landing distance from 50 feet of **3,600** feet.

The landing ground roll is determined from figure 11-117 by entering the chart with 15°C OAT, 2,000-foot pressure altitude, 120,000-pound gross weight, and reading an uncorrected ground roll of **1,450 feet.** To correct for RCR, move across to the baseline in the RCR correction scale, follow the guideline to an RCR of 10, and read a corrected ground roll of **1,700** feet.

To correct for the increased touchdown speed, move across to the speed correction scale, follow the guideline to the increased speed increment of 9 knots, and read a corrected ground roll of **1,850** feet. Correct for runway slope and wind in the same manner, and read a corrected landing ground roll of **1,625** feet.

Example 2.

GIVEN: Normal landing with 50 percent flaps, two engines in reverse thrust, two engines in ground idle, and maximum wheel brakes.

Gross weight: 140,000 pounds.

Field elevation: 2,000 feet.

OAT: 15°C.

No wind or runway slope.

Reported runway RCR: 21.

FIND:

All Landing data.

PROCEDURE:

To find the recommended approach, threshold, and touchdown speeds, enter the Touchdown Speed chart (figure 11-114) with a gross weight of 140,000 pounds, and move up to the 50 percent flap touchdown speed line. Read a touchdown speed of 118 KIAS. The threshold speed and approach speed are determined by adding the speed increments shown in the Note on figure 11-114. Threshold speed will be 15 KIAS above touchdown speed, or 133 KIAS. Approach speed will be 25 KIAS above touchdown speed, or 143 KIAS.

To determine the landing distance from 50 feet, enter figure 11-119 with an OAT of 15°C, move across to the 2,000-foot pressure altitude, down to 140,000-pound gross weight, and read an uncorrected landing distance of **4,550** feet. To correct for engine configuration, move across to the correction scale. Follow the guideline to the engine configuration of 2 reverse thrust and 2 ground idle, and read a corrected landing distance from 50 feet of **4,700** feet. To correct for RCR, move across to the RCR correction scale, follow the guideline to an RCR of 21, and read a corrected landing distance of **4,800** feet.

To find the landing ground roll distance, follow the above steps using figure 11-120. The uncorrected ground roll will be **1,950** feet, and the corrected ground roll will be **2,130** feet.

TOUCHDOWN SPEEDS

4 ENGINES FLIGHT IDLE

FLAPS AS INDICATED

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST

NOTE

1. Touchdown Speed = 1.2 V_{stall} (Power Off)
2. Threshold Speed = Touchdown Speed + ΔV
   Approach Speed = Threshold Speed + 10 KIAS

	ΔV KIAS	THRESHOLD SPEED KIAS	APPROACH SPEED KIAS
100 PERCENT FLAPS			
Normal Landing	15	TD + 15	TD + 25
Max Effort Landing	8	TD + 8	TD + 18
50 PERCENT FLAPS	15	TD + 15	TD + 25
ZERO FLAPS	20	TD + 20	TD + 30

3. If a go-around is anticipated, the minimum control speeds (V_{MCA}), should be observed.

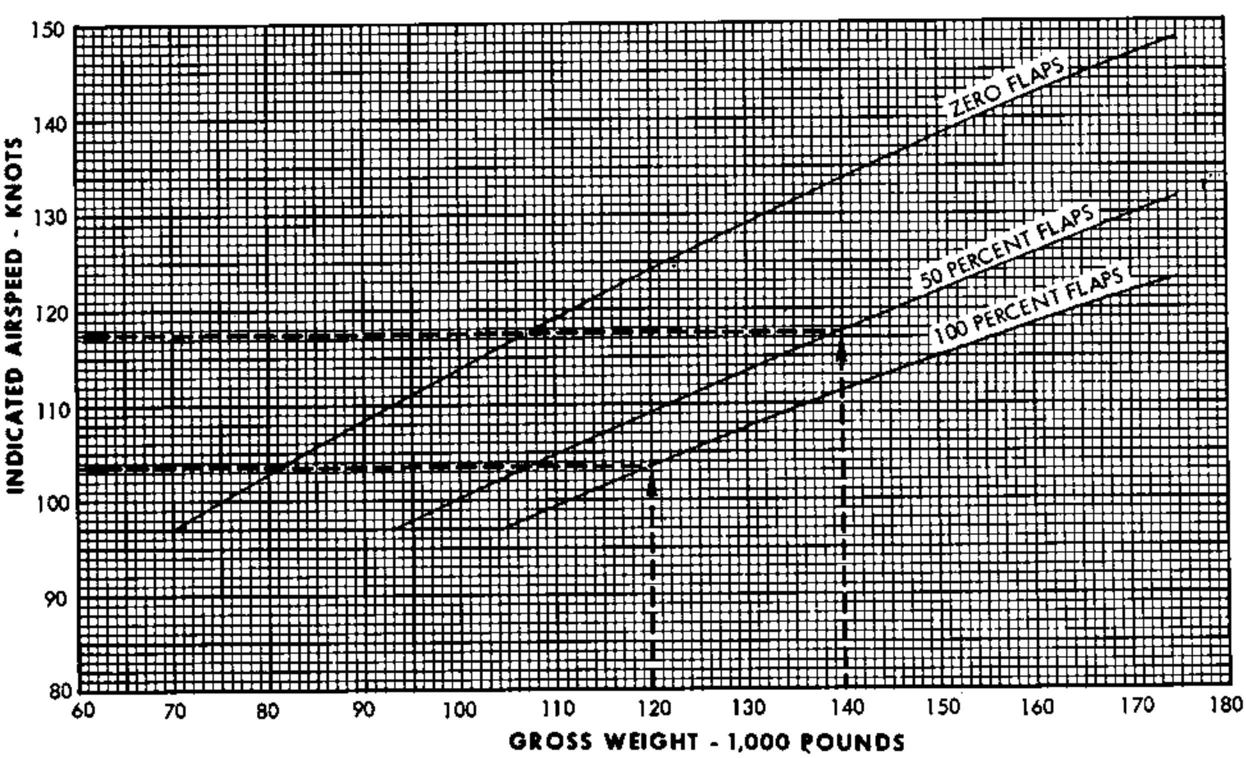


Figure 11-114.

EC-130-1-2-271

MODEL: EC-130G/Q
T56-A-423 ENGINES

LANDING CROSSWIND CHART

100 PERCENT FLAPS

DATE: APRIL 1966
DATA BASIS: ESTIMATED

EXAMPLE:

GIVEN: Landing runway 12, wind 180° at 20 knots gusting to 30 knots. Landing weight 120,000 pounds.

FIND: Is landing recommended with landing flaps (100%).

SOLUTION:
1. From landing speed chart determine touchdown speed with landing flaps of 103 knots.
2. Runway wind angle is (180° - 120°) 60°.
3. Enter chart at wind angle 60° and maximum wind velocity, including gusts, of 30 knots and determine crosswind component of 26 knots.
4. Proceed vertically to touchdown speed at 103 knots and determine landing is in caution zone.
5. Use of 50% flaps will increase touchdown speed to 109 knots, still in the caution zone. Flaps up will increase the touchdown speed to 126 knots which is in the recommended zone.

REMARKS: See text for explanation of crosswind landings.
If landing must be made in the caution zone, a slight yaw may be expected between main gear contact and nose gear contact.
See Section II for crosswind taxi capability.
Increased touchdown speeds will increase the landing ground roll as shown on the ground roll distance charts.

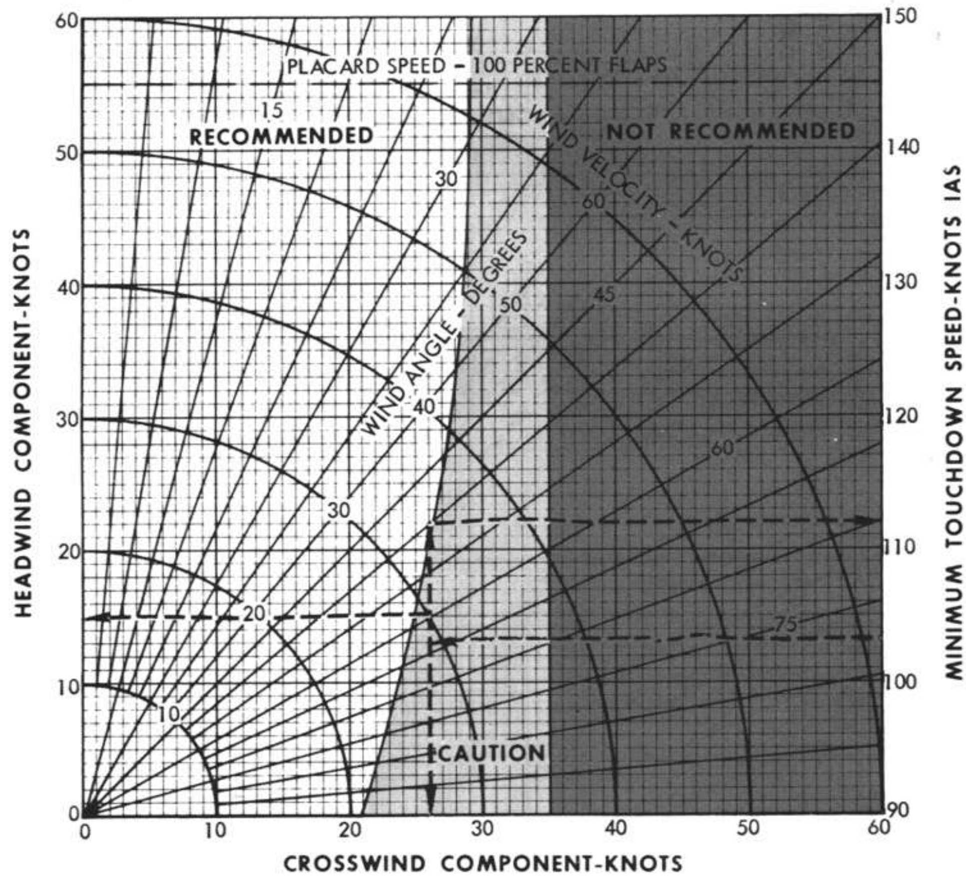


Figure 11-115.

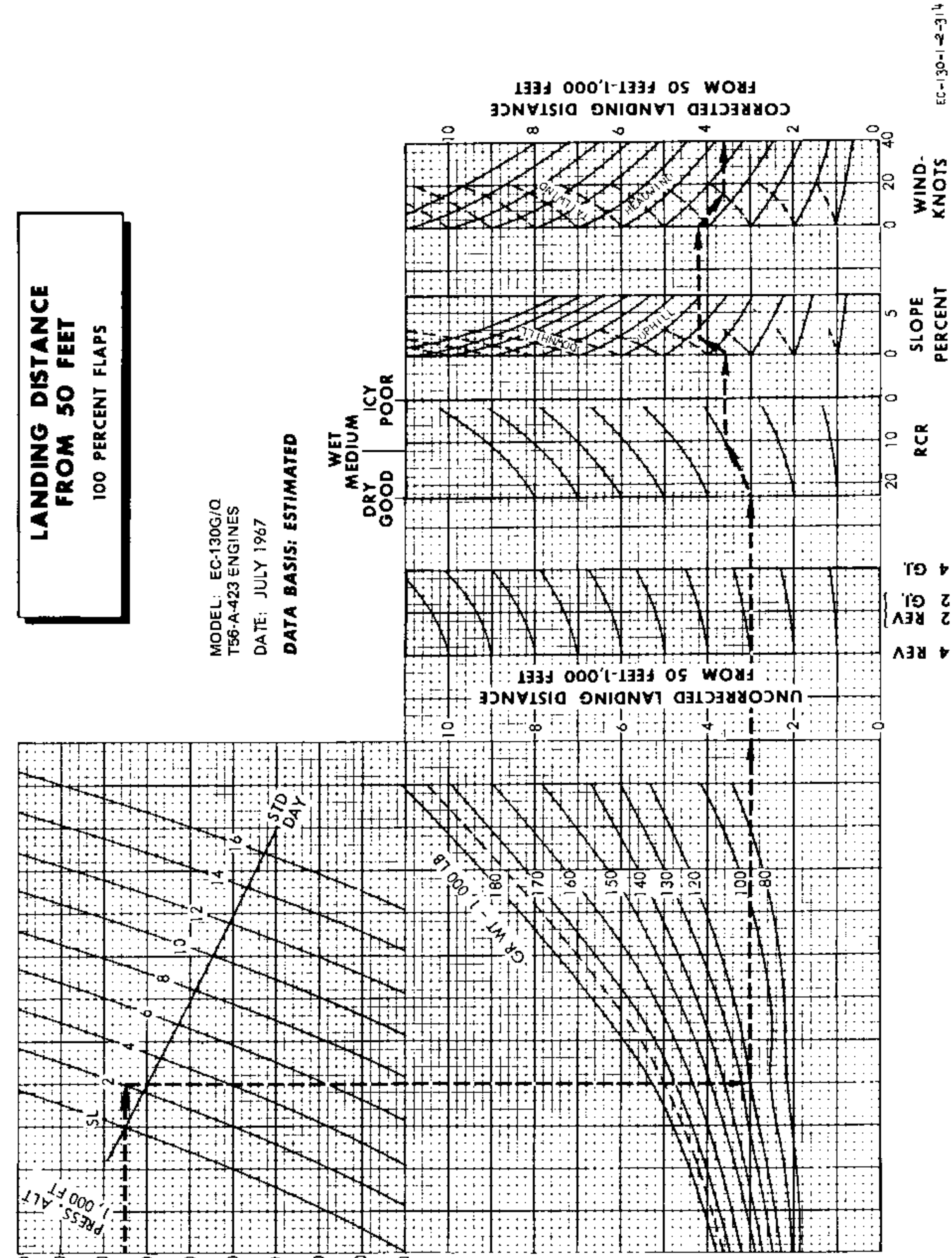


Figure 11-116.

LANDING GROUND ROLL

100 PERCENT FLAPS

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: JULY 1967

DATA BASIS: ESTIMATED

NOTE

Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.

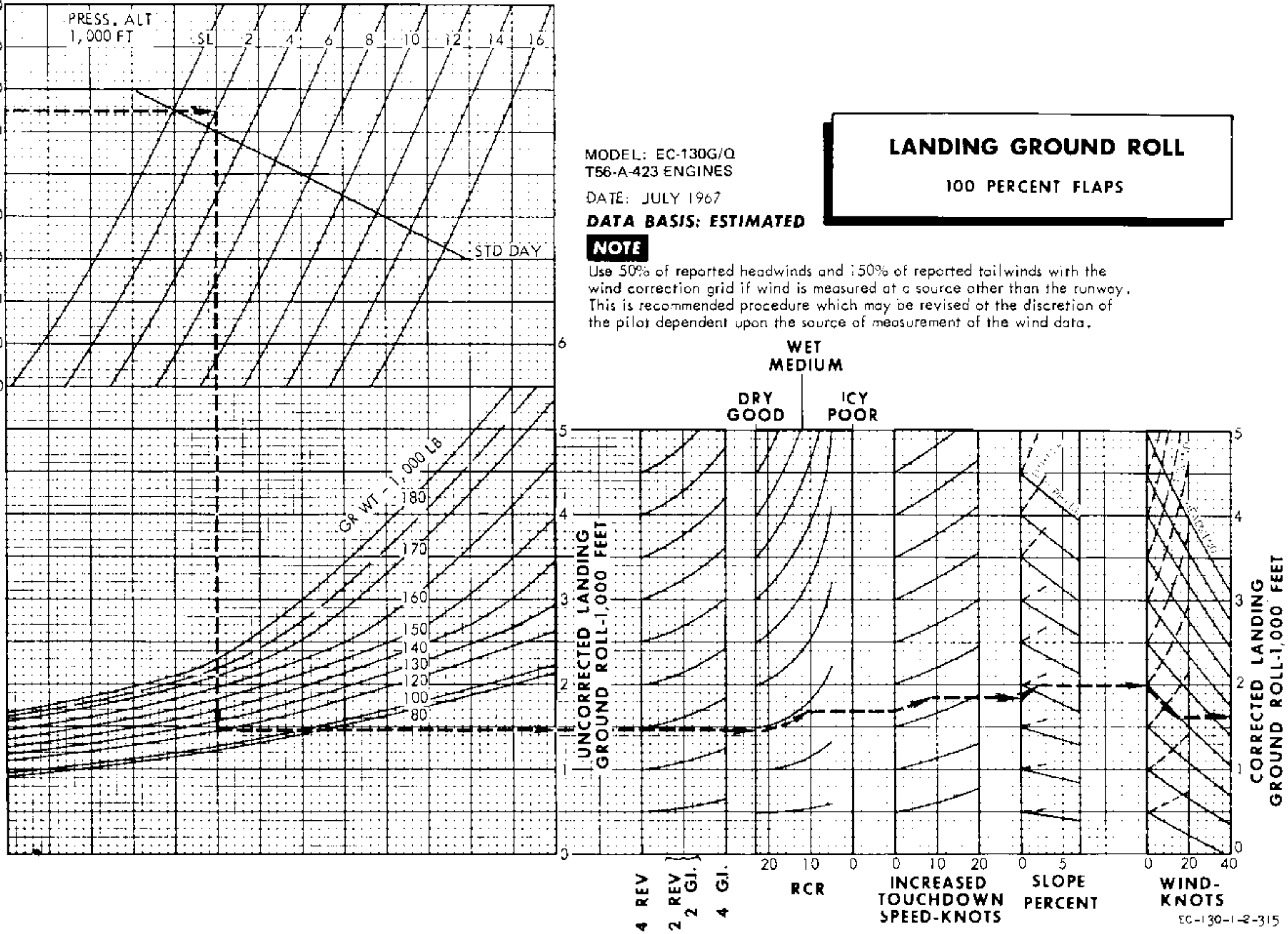


Figure 11-117.

MAXIMUM EFFORT LANDING DISTANCE FROM 50 FEET

100 PERCENT FLAPS

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: JULY 1967

DATA BASIS: ESTIMATED

NOTE

Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot, dependent upon the source of measurement of the wind data.

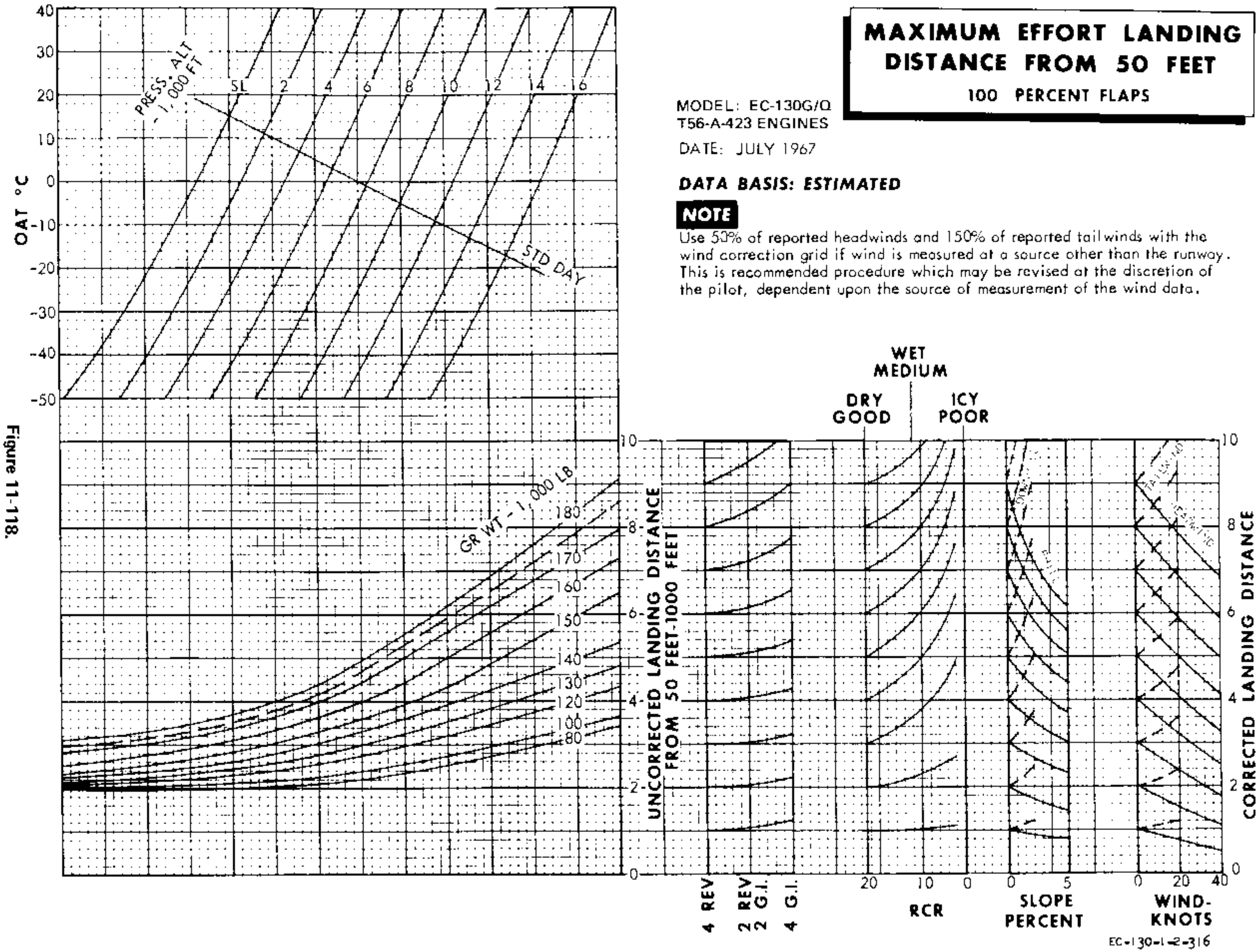


Figure 11-118.

LANDING DISTANCE FROM 50 FEET

50 PERCENT FLAPS

MODEL: EC-130G/Q
T56-A-423 ENGINES
DATE: JULY 1967

DATA BASIS: ESTIMATED

NOTE

Use 50% of reported headwind and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is the recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.

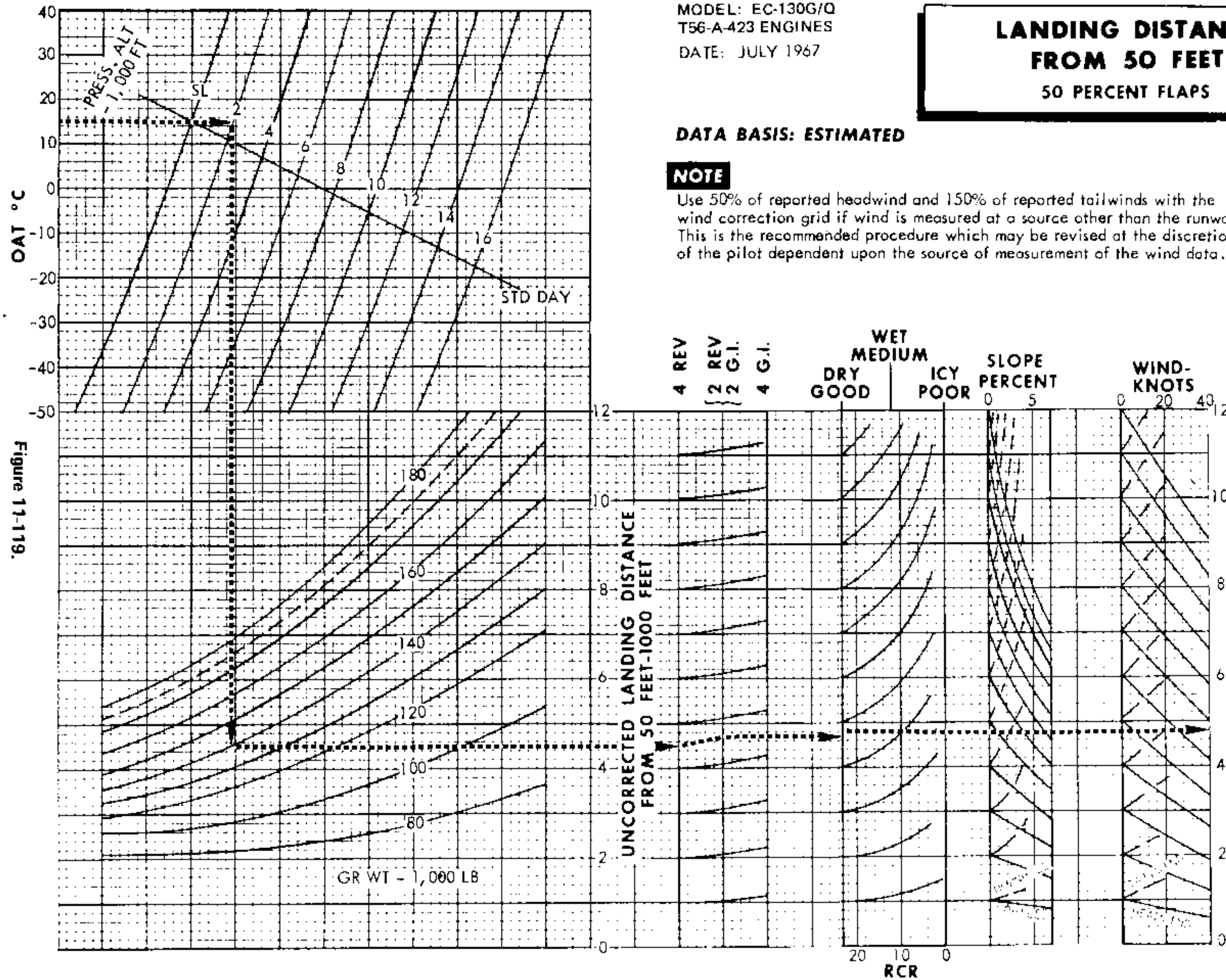


Figure 11-119.

EC-30-2-317

LANDING GROUND ROLL

50 PERCENT FLAPS

MODEL: EC-130G/Q
T56-A-423 ENGINES

DATE: JULY 1967
DATA BASIS: ESTIMATED

NOTE

1. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction if wind is measured at a source other than the runway. This is recommended proceedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.

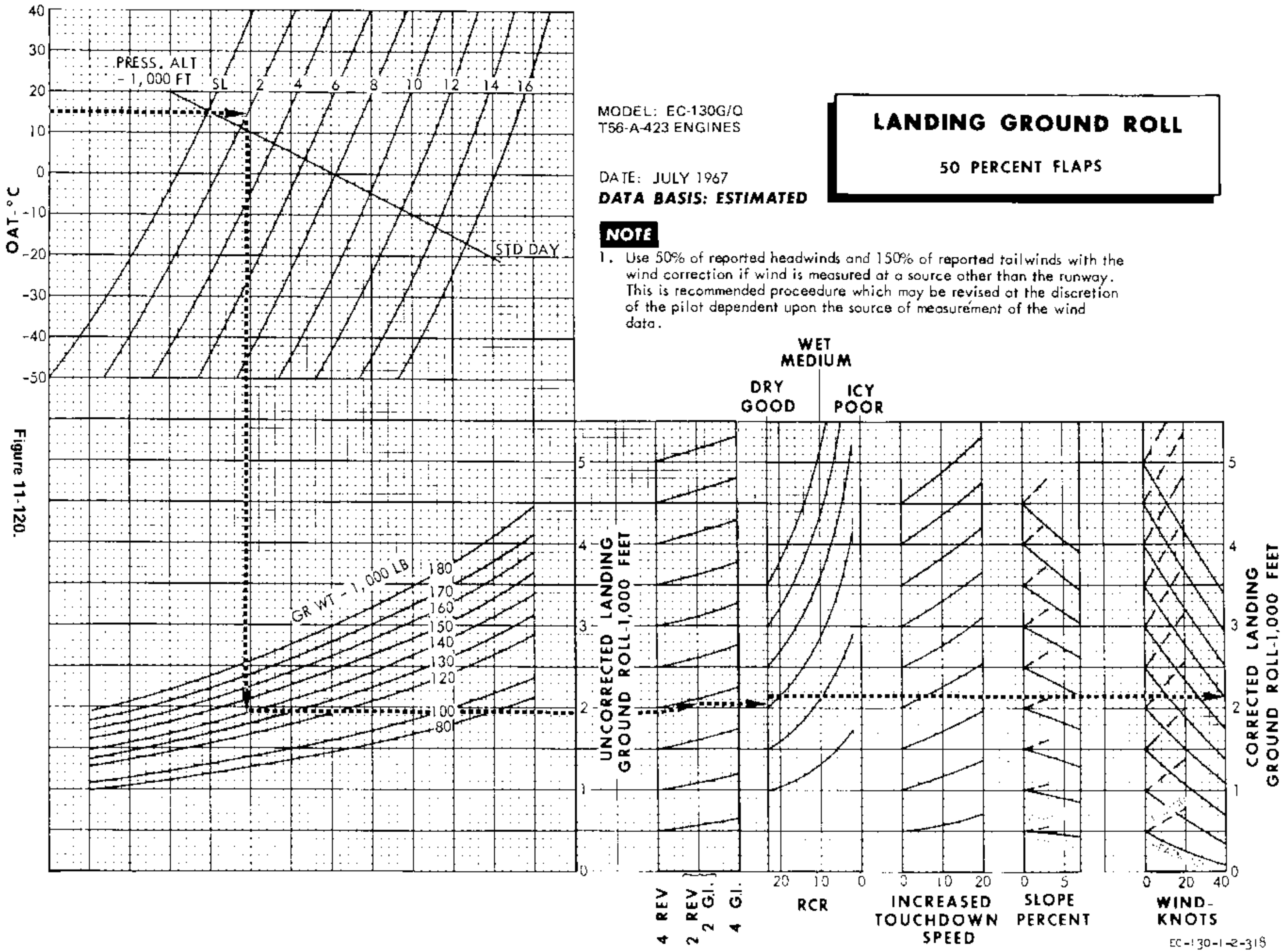


Figure 11-120.

LANDING DISTANCE FROM 50 FEET

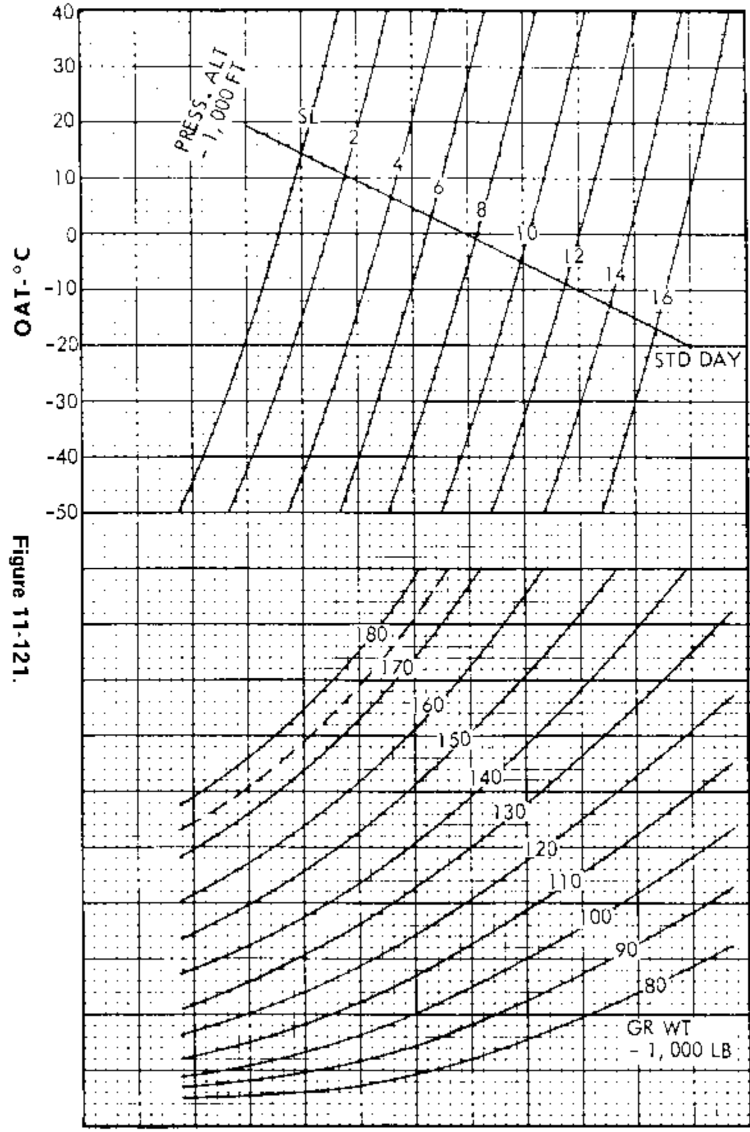
FLAPS UP

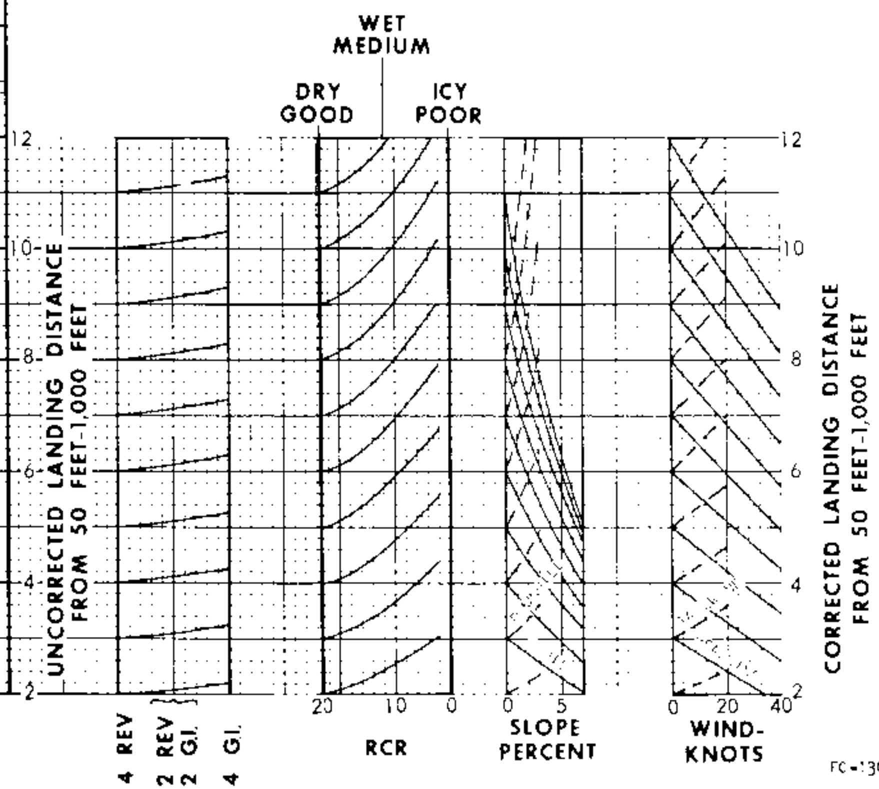
MODEL: EC-130G/Q
T56-A-423 ENGINES
DATE: JULY 1967

DATA BASIS: ESTIMATED

NOTE

1. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.





FC-130-1-2-319

Figure 11-121.

LANDING GROUND ROLL

FLAPS UP

MODEL: EC-130G/Q
T56-A-423 ENGINES
DATE: JULY 1967
DATA BASIS: ESTIMATED

NOTE

1. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.

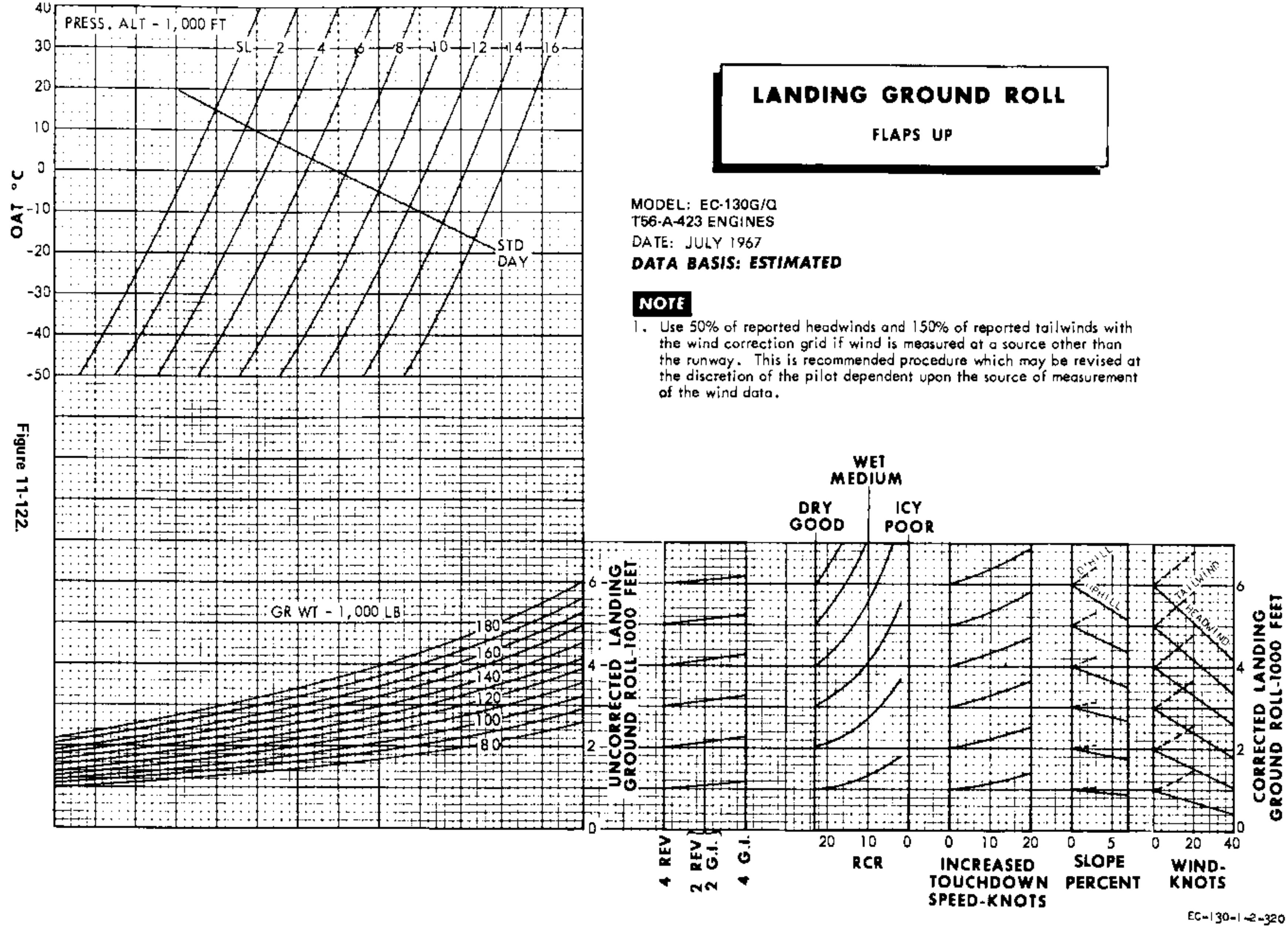


Figure 11-122.

PART 9

MISSION PLANNING

INTRODUCTION.

The importance of adequate planning to the successful performance of any mission is well known. This part is intended to demonstrate the proper use of the charts and the procedures to be followed in mission planning. Therefore, it should be the responsibility of the users of this section to become thoroughly familiar with this part and the examples throughout the section so that mission planning may be accomplished quickly and accurately. Also, familiarization with this part and the examples will aid in coping with emergency situations. A TOLD card (figure 11-123) may be used to display appropriate take-off and landing data.

TAKE-OFF AND LANDING DATA.

The following are definitions of terms which are applicable to the take-off and landing phases of a typical mission:

TO GROSS WEIGHT. Gross weight of aircraft in pounds at start of take-off run.

TEMPERATURE. Runway temperature in degrees centigrade as predicted by the weather office for the time of take-off. If runway temperature is not available, use OAT +2° C if OAT is standard or above. Use actual OAT if OAT is below standard.

PRESSURE ALTITUDE. Obtained from briefing or tower operator.

WIND DIRECTION AND VELOCITY. Obtain from weather/operations briefing.

RUNWAY LENGTH. Obtain from operations or Flight Information Publication (FLIP) Charts, etc.

RUNWAY SLOPE. Obtain from operations or Flight Information Publication (FLIP) Charts, etc.

OBSTACLE HEIGHT AND DISTANCE. Obtain from operations or Flight Information Publication (FLIP) Charts, etc.

FUEL DUMP TIME. Obtain fuel dump rate per minute from Section V and compute number of minutes required to dump desired amount of fuel.

CRITICAL FIELD LENGTH. Obtain from figure 11-21.

GROUND RUN. Obtain from figure 11-31.

TAKE-OFF FACTOR/CLIMB-OUT FACTOR. Obtain take-off factor from figure 11-18. Obtain climb-out factor from figure 11-23.

MAXIMUM ALLOWABLE GROSS WEIGHT. This weight will be either:

1. Maximum allowable take-off gross weight for the condition.

2. Gross weight limited by 3-engine rate of climb Obtained from figure 11-20.

3. Gross weight limited by critical field length. Obtained from figure 11-21.

4. Gross weight limited by climb-out over obstacle. Obtained from figure 11-24.

LIMITED BY. If gross weight is limited by 2, 3, or 4 above, enter limiting condition.

Note

If take-off gross weight is not limited by 2, 3, or 4 above, record the fact that each item has been computed and found not limiting.

TORQUE. Obtain from figure 11-16.

MINIMUM CONTROL SPEEDS. Obtain from figures 11-28 through 11-30.

ACCELERATION CHECK, TIME/SPEED. Obtain from figure 11-35.

told card sample

TOLD

GROSS WEIGHT ______

PRESSURE ALTITUDE ______

RUNWAY LENGTH ______

TEMPERATURE ______ SLOPE ______

RCR ______ RSC ______

WIND DIR ______ °V ______ KTS.

OBSTACLE HGT. ______ DIST. ______ KTS.

TAKE OFF FACTOR ______ CL FACTOR ______

CRITICAL FIELD LENGTH ______

MAXIMUM EFFORT PERFORMANCE DATA WILL BE COMPUTED IF AVAILABLE RUNWAY IS LESS THAN CRITICAL FIELD LENGTH. ENVIRONMENTAL CONDITIONS MAY ALLOW OPERATIONS BETWEEN MAXIMUM AND NORMAL PERFORMANCE DATA.

FRONT

TAKEOFF DATA

TORQUE	MIN CONTL SPEED	REFUSAL SPEED	TAKEOFF SPEED	OBS CLEAR SPEED	3 ENG CL SPEED

TAKEOFF GROUND RUN ______

LANDING DATA

THRESHOLD SPEED	TOUCHDOWN SPEED
0% ______	0% ______
50% ______	50% ______
100% ______	100% ______

LANDING GROUND ROLL 50% ______ 100 % ______

BACK

Figure 11-123.

Note

For computing acceleration check, indicated airspeed (IAS) and calibrated airspeed (CAS) are the same prior to rotation.

REFUSAL SPEED. Obtain from figure 11-22.

TAKE-OFF SPEED. Obtain from figure 11-27.

FLAPS UP SPEED. Obtain from figure 11-27.

APPROACH SPEED, FLAPS 50%. (For landing immediately after take-off) obtain from figure 11-29.

APPROACH SPEED. Obtain from figures 11-114 and 11-29.

THRESHOLD SPEED. Obtain from figure 11-114.

LANDING GROUND ROLL DISTANCE. Obtain from figures 11-116 and 11-117. Normal landing distance will be computed using brakes plus 2 engine reverse configuration.

CHART USE IN MISSION PLANNING.

The discussion that follows is based on a typical mission with performance computed for a routine situation in which no emergencies arise. To demonstrate the use of a chart for an emergency, an assumption is made as to the emergency; and the proper use of the chart is shown. When emergencies arise, it is necessary to determine the best course of action for the existing circumstances. If the aircraft performance is affected, revised performance computations may be necessary to determine the course of action. The detailed mission calculations are not shown for emergency conditions, since a clear understanding of the other information shown will enable use of the data for these conditions. The examples shown for the charts are the same as used in the mission planning discussion, where applicable.

PLANNING A TYPICAL MISSION.

Mission Requirements.

The mission is assumed to be from the West Coast to Hawaii, a distance of 2,145 nautical miles. The take-off weight will be limited by the maximum normal structural limit of 155,000 pounds or the take-off and climb-out criteria, as applicable. The equipment will be the maximum that can be carried the given distance as limited by available fuel or take-off weight, but it must not exceed 45,000 pounds. Cruise will be 2,000-foot step climb cruise at long-range cruise speeds.

An 8,000-foot runway length is assumed for take-off at sea level pressure altitude.

Weather, Temperature, and Wind Conditions.

The following conditions are predicted for the mission:

Ceiling and visibility unlimited.

Temperatures.

At home base: 25° C.

Enroute: Standard plus 10° C

At destination: 25° C

Winds.

At home base: 20-knot headwind.

At destination: 15-knot headwind.

Take-Off Weight.

With the assumed atmosphere conditions, the maximum power torque is found to be 19,600 inch-pounds (figure 11-16), which corresponds to a take-off factor of 1.30 (figure 11-18). Figure 11-20 shows that no take-off weight limit is required to account for three-engine rate-of-climb capability, and figure 11-21 shows a critical field length of 4,650 feet for 155,000 pounds gross weight, using 50 percent of the reported headwind. The refusal speed is found to be 122 knots (figure 11-22). Therefore, from a performance standpoint, there is no take-off weight limit and the mission will be planned with a take-off weight of 155,000 pounds.

Climb.

The start climb weight is the take-off weight less 755 pounds. The 755 pounds is a fuel allowance used for taxi, warm-up, and take-off. Therefore, the begin climb weight is 155,000 pounds less 755 pounds, or 154,245 pounds. The time, distance, and fuel for climb to 18,000 feet which is slightly under the cruise ceiling are:

Time: 15 minutes (figure 11-38).

Distance: 53 nautical miles (figure 11-39).

Fuel: 1,760 pounds (figure 11-40).

Climb speeds: from figure 11-41.

The end climb weight, begin cruise out, is 154,245 pounds less 1,760 pounds or 152,485 pounds.

Cruise.

It is assumed that cruise is at long-range cruise speeds with 2,000-foot step climb increments. Cruise fuel is computed at that condition from the end of climb to the point over the destination.

Begin cruise weight - 152,485 pounds (from climb calculations).

Distance to cruise - total distance less climb distance (2,145 - 53 = 2,092 nautical miles).

Since the temperature assumed for this example is midway between the standard day and the standard day +20°C condition, it is best to determine fuel used for each of those conditions and to use an average value. For standard +20 °C (figure 11-96) and standard (figure 11-97) conditions, the fuel requirements are:

	Standard +20	Standard
Distance at Begin Cruise Weight	6,210	8,150
Cruise Distance	2,092	2,092
Distance at End Cruise	8,302	10,242
End Cruise Weight	122,800	122,800
Average End Cruise Weight		122,800

Cruise Fuel 152,485 - 122,800 29,685 pounds.

The range prediction charts for variable cruise altitude have been prepared for 2,000-foot step conditions, and the weights at which each climb step should be initiated are indicated by symbols on the curves. Cruise time is found by a similar process, from figures 11-96 and 11-97 to be 7.05 hours.

To find the speeds, power settings, and fuel flows, at any time or condition during the mission, the range summary charts, figures 11-74 thru 11-76 are used in the manner demonstrated by the examples for those charts.

Landing

Landing weight (average end cruise weight): 122,800 pounds.

Threshold speed: 120 knots IAS (figure 11-114).

Approach speed: 130 knots IAS (figure 11-114).

Touchdown speed: 105 knots IAS (figure 11-114).

Landing distance: 3,550 feet with no wind; 3,200 feet with 50 percent reported headwind (figure 11-116).

Ground roll distance (brakes plus reverse): 2,050 feet with no wind; 1,800 feet with wind (figure 11-117).

Descent.

For the cruise fuel calculations, cruise was assumed to a point over the destination. A small amount of fuel may be conserved if descent is planned so as to reach the traffic pattern altitude at the destination, conditions permitting. Penetration descent is used if it is desired to conserve the maximum amount of fuel. End cruise altitude is 30,000 feet. The penetration descent data are shown in figure 11-111.

Note

It is not important to know the exact weight at the beginning of descent.

EMERGENCY CLIMB.

Emergency Climb Charts are presented in figures 11-47, 11-48, and 11-49. These charts may be used to determine the go-around capability, should it be necessary, with 50 percent flaps for four, three, or two engines operative.

Fuel for descent: 370 pounds.

Descent speed: 163 knots IAS down to 20,000 feet, 250 knots IAS from 20,000 feet down.

Endurance.

On arriving at the destination, assume that it is necessary to hold for an hour prior to landing. Also, assume that holding will be at 10,000 feet at maximum endurance. The gross weight is determined to be 122,800 pounds under the cruise discussion.

Fuel flow: 920 pounds/hour/engine (figure 11-107).

Airspeed: 142 knots CAS (figure 11-107).

Fuel required: 3,680 pounds (figure 11-107).

Reserve Fuel.

The reserve fuel allowance is assumed to be one hour cruise at long-range cruise at the end of cruise ceiling plus 1-3/4 hours at maximum endurance at 10,000 feet. The assumption will also be made that the one hour at cruise will be calculated beginning with the calculated end cruise weight of 122,800 pounds, and that the endurance fuel is calculated beginning with the weight at the end of the one hour cruise.

Weight at beginning of one hour cruise: 122,800

Fuel required: 940 x 4 = 3,760 pounds (figure 11-75).

Weight at begin endurance: 122,800 - 3,760 = 119,040 pounds.

Endurance fuel: 900 x 4 x 1-3/4 = 6,300 (figure 11-107).

Reserve fuel: cruise fuel + endurance fuel (3,760 + 6,300 = 10,060 pounds).

Allowable Cargo.

Operating Weight - 74,133 pounds.

Allowable cargo = take-off weight - (warm-up, taxi, and take-off fuel + climb fuel + cruise fuel + reserve fuel) - operating weight = 155,000 - (755 + 1,760 + 29,685 + 10,060) - 74,133 = 38,607 pounds.

SECTION XII

EC-130G SINGLE DISK BRAKE SYSTEM

PERFORMANCE DATA

TABLE OF CONTENTS

BRAKE SYSTEM.

On EC-130G aircraft, a hydraulically operated, disk-type multiple puck brake is installed on each of the four main landing gear wheels. The nose landing gear wheels do not have brakes. The brakes normally operate from utility hydraulic system (figure 12-1) pressure with an alternate supply available through the auxiliary hydraulic system. If electrical power is off, the system which has the higher pressure will supply pressure to operate the brakes. Fluid flows through a brake pressure selector valve to the right and left brake control valves. When the fluid leaves the brake control valves, it flows through the anti-skid valves and shuttle valves to the brakes. Each of the two halves (left and right) of the brake system contains a brake control valve, an anti-skid valve and two brake shuttle valves. The auxiliary system supply flows through the emergency brake pressure selector valve. When the emergency brake system is actuated, fluid is directed to the brake control valves, then through shuttle valves directly to the brakes, bypassing the anti-skid valves. Utility or auxiliary system pressure is selected by manually positioning a brake pressure switch. Auxiliary system handpump pressure can also be used for brake operation for towing operations when utility or auxiliary hydraulic system pressure is not available. This will give only one brake application, therefore the brake pedals should be depressed firmly and held when braking is required. System pressure will not build up when the brake pedals are pumped on and off while the auxiliary system handpump is being operated.

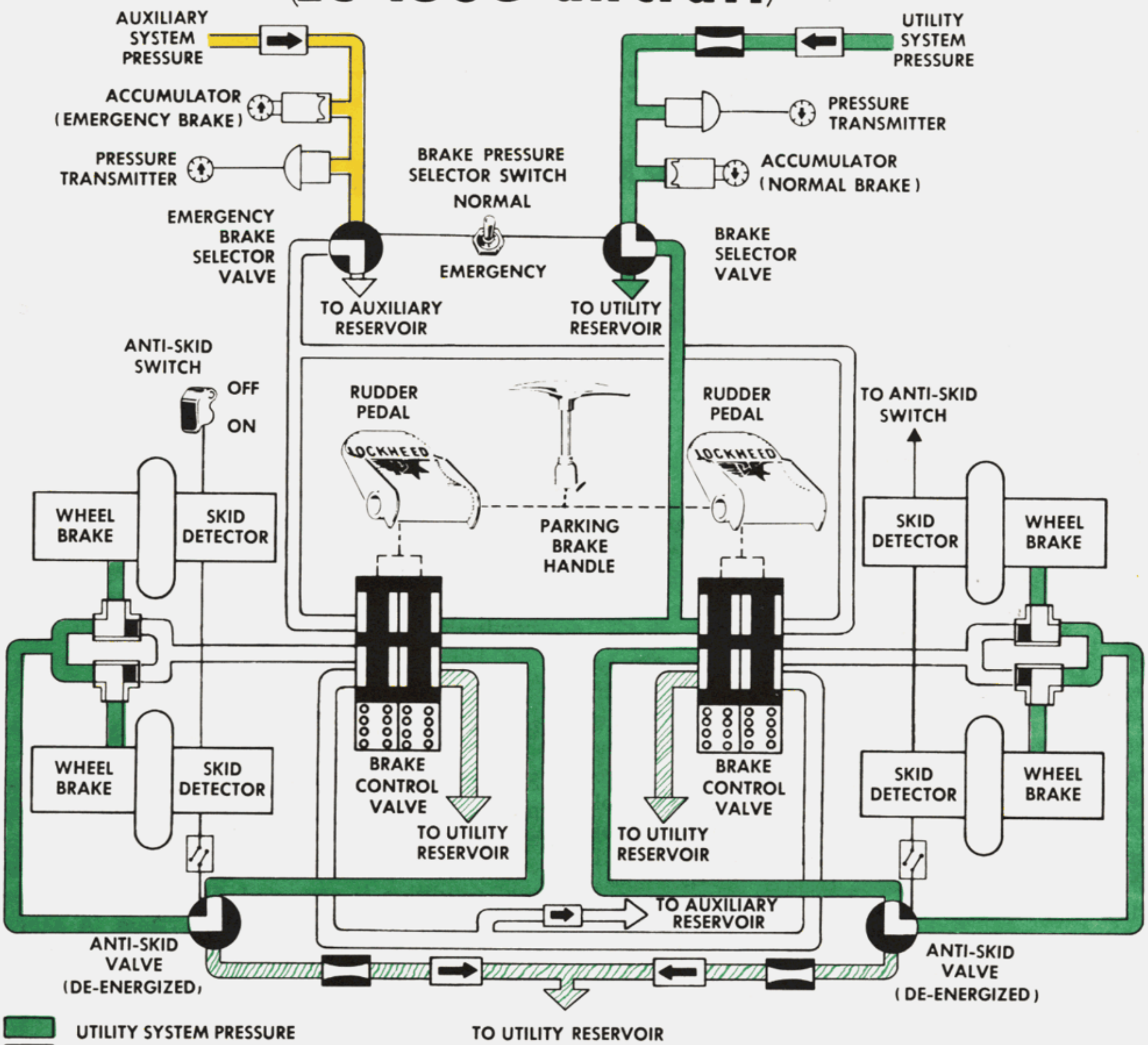
BRAKE ANTI-SKID PROVISIONS.

Skidding due to excess brake application during normal brake operation is controlled by an anti-skid system, which is actuated as skidding commences and releases brake pressure until the skid condition is corrected. The EC-130G aircraft uses a paired on-off anti-skid system. A skid at either wheel on one side of the aircraft will remove pressure to both brakes on that side.

CHARTS.

A selection of charts for the EC-130G single disk brake system is given in figure 12-2 through figure 12-12. These charts can be used to determine critical field length, refusal speed, landing distance, and landing ground roll in different configurations.

main landing gear brake system (EC-130G aircraft)



UTILITY SYSTEM PRESSURE

UTILITY SYSTEM RETURN

AUXILIARY SYSTEM PRESSURE

CHECK VALVE

TWO-WAY RESTRICTOR

ONE-WAY RESTRICTOR

SHUTTLE VALVE

TOUCHDOWN SWITCH

ELECTRICAL ACTUATION

MECHANICAL ACTUATION

NOTE

Brake pressure selector switch shown in NORMAL (up) position, with brake selector valve de-energized and emergency brake selector valve energized. In EMERGENCY position (switch down) the normal brake selector valve is energized (to return) and the emergency brake selector valve is de-energized, connecting auxiliary pressure. Complete power failure leaves both valves open to supply pressure from their respective systems. Upper two valves are solenoid controlled-Lower two valves are solenoid-operated.

EC-130-1-1-043-1

Figure 12-1.

MODEL: EC-130G
T56-A-423 ENGINES

DATE: MARCH 1971
DATA BASIS: ESTIMATED ON FLIGHT TEST

CRITICAL FIELD LENGTH

4 ENGINES MAXIMUM POWER

50 PERCENT FLAPS

EC-130G SINGLE DISK BRAKES

NOTE

1. Stop based on two engines in reverse, one engine in ground idle, one propeller windmilling.
2. An RSC value of 10 is equivalent to one inch of slush or water.
3. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.
4. If $V_{EF} = V_{MCG}$, do not correct for runway slope.

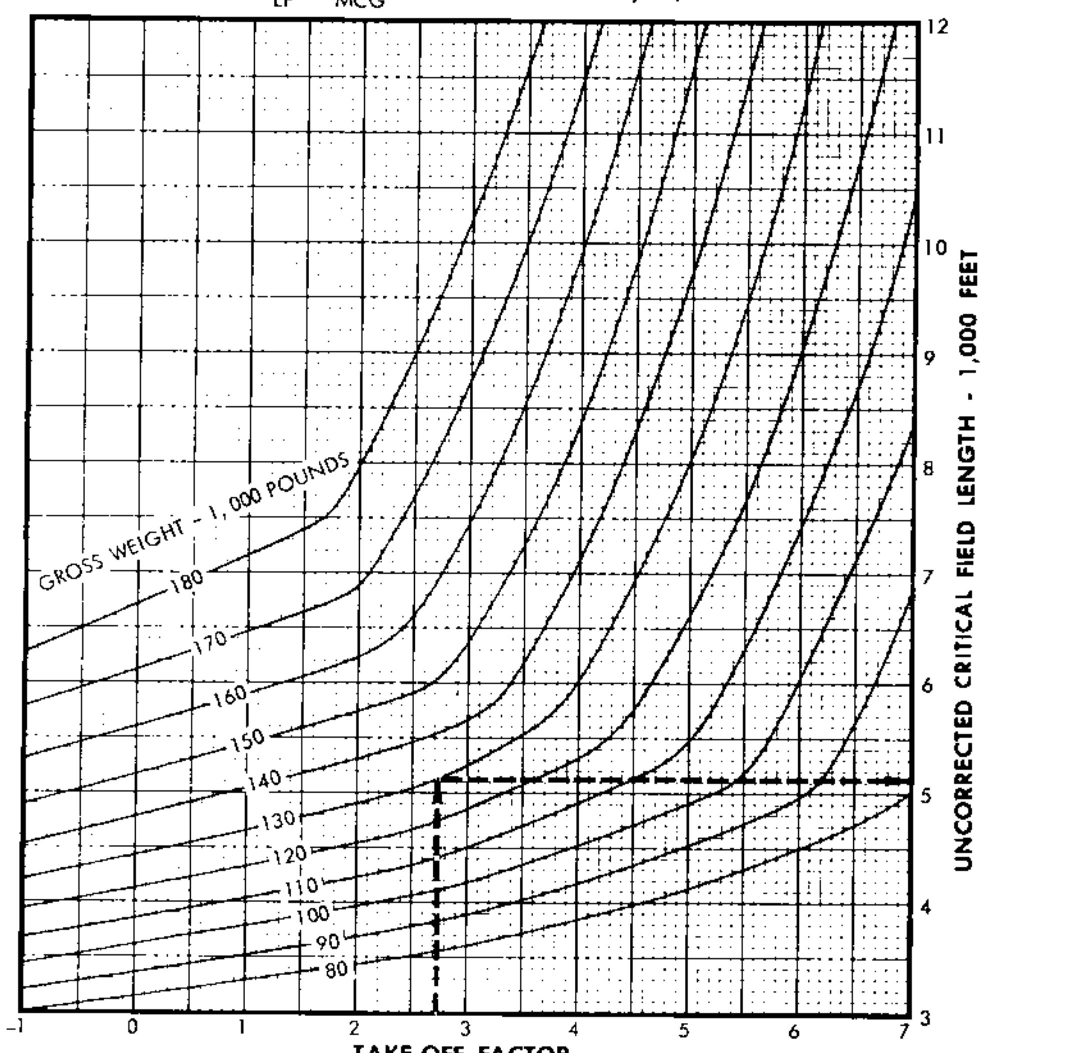


Figure 12-2. (Sheet 1 of 2)

CRITICAL FIELD LENGTH

4 ENGINES MAXIMUM POWER

50 PERCENT FLAPS

EC-130G SINGLE DISK BRAKES

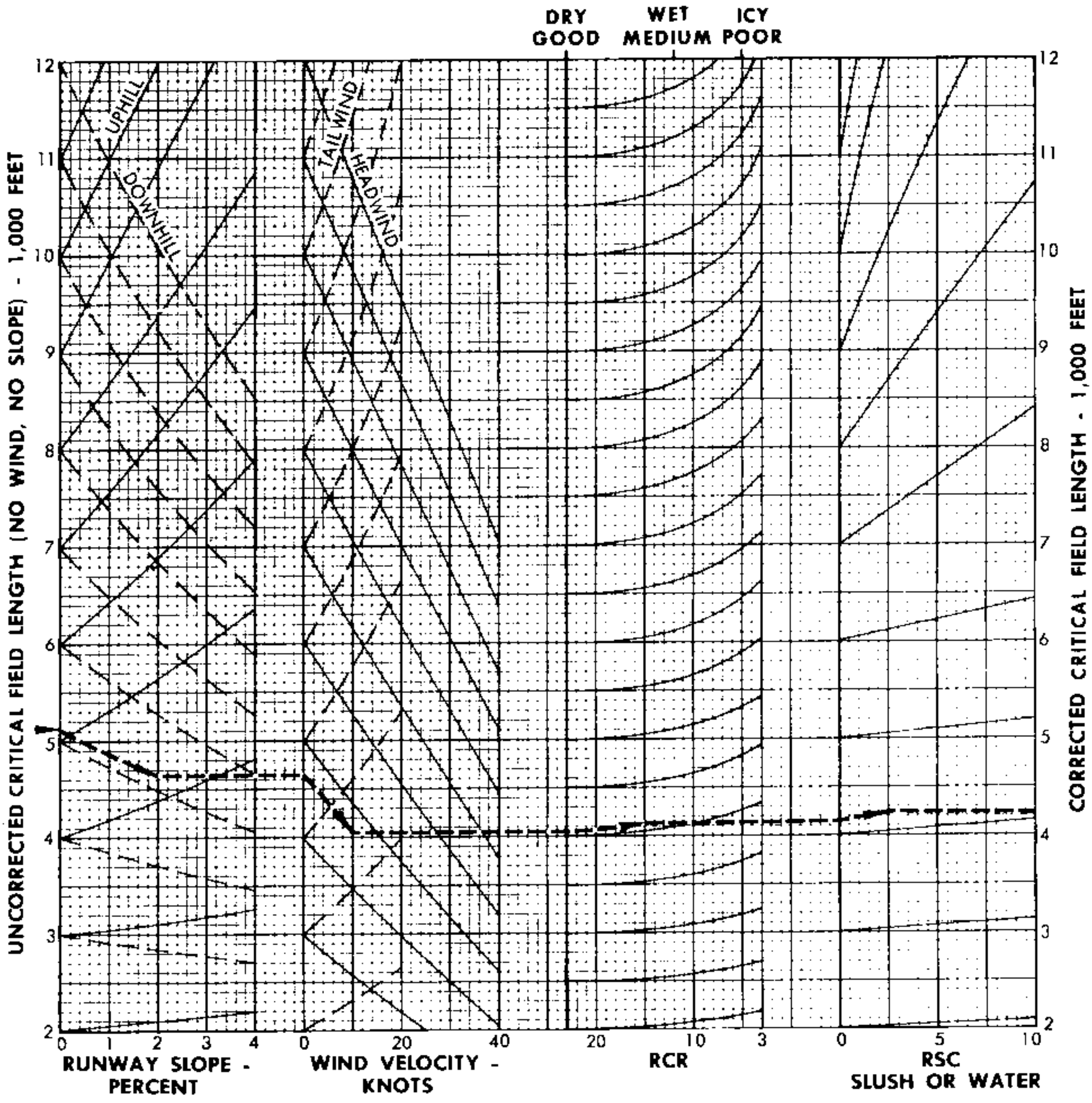


Figure 12-2. (Sheet 2 of 2)

MODEL: EC-130G
T56-A-423 ENGINES

DATE: MARCH 1971

DATA BASIS: ESTIMATED ON FLIGHT TEST

REFUSAL SPEED AND CRITICAL ENGINE FAILURE SPEED

50 PERCENT FLAPS

EC-130G SINGLE DISK BRAKES

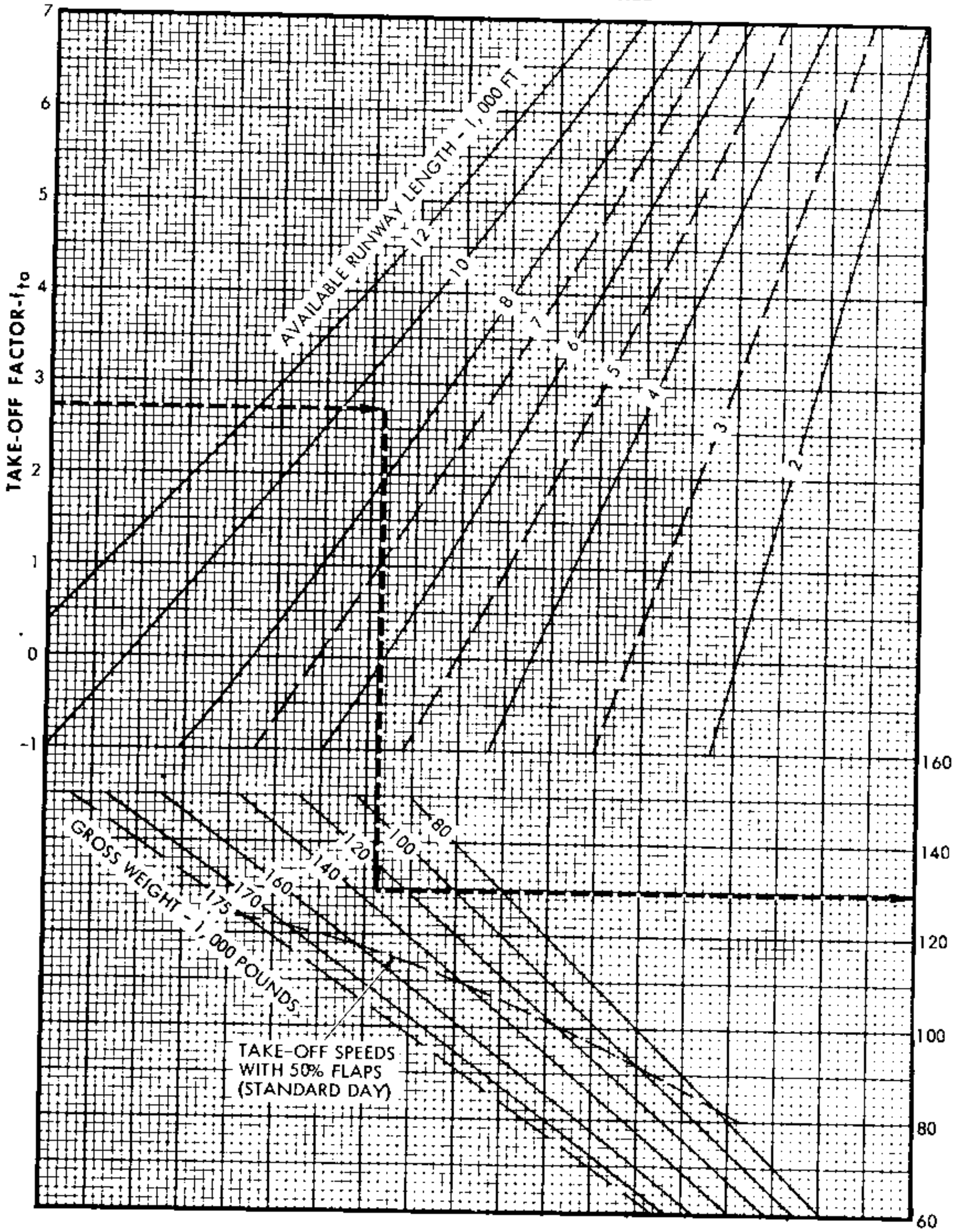


Figure 12-3. (Sheet 1 of 2)

EC-130-1-2-172-1

REFUSAL SPEED AND CRITICAL ENGINE FAILURE SPEED

50 PERCENT FLAPS

EC-130G SINGLE DISK BRAKES

NOTE

1. Based on engines set at maximum power.
2. Stop based on two engines in reverse, one engine in ground idle, one propeller windmilling, and with maximum anti-skid braking.
3. When refusal speed exceeds take-off speed, use take-off speed as refusal speed.
4. For determination of critical engine failure speed, use corrected critical field length as runway length.
5. When an RCR value is not available, the following representative values are recommended as typical of the condition noted:

CONDITION	RCR
Dry Runway	23
Wet Runway	12
Icy Runway	5

6. An RSC value of 10 is equivalent to one inch of slush or water.
7. Use 50% of reported headwinds and 150% of reported tailwind with the correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.

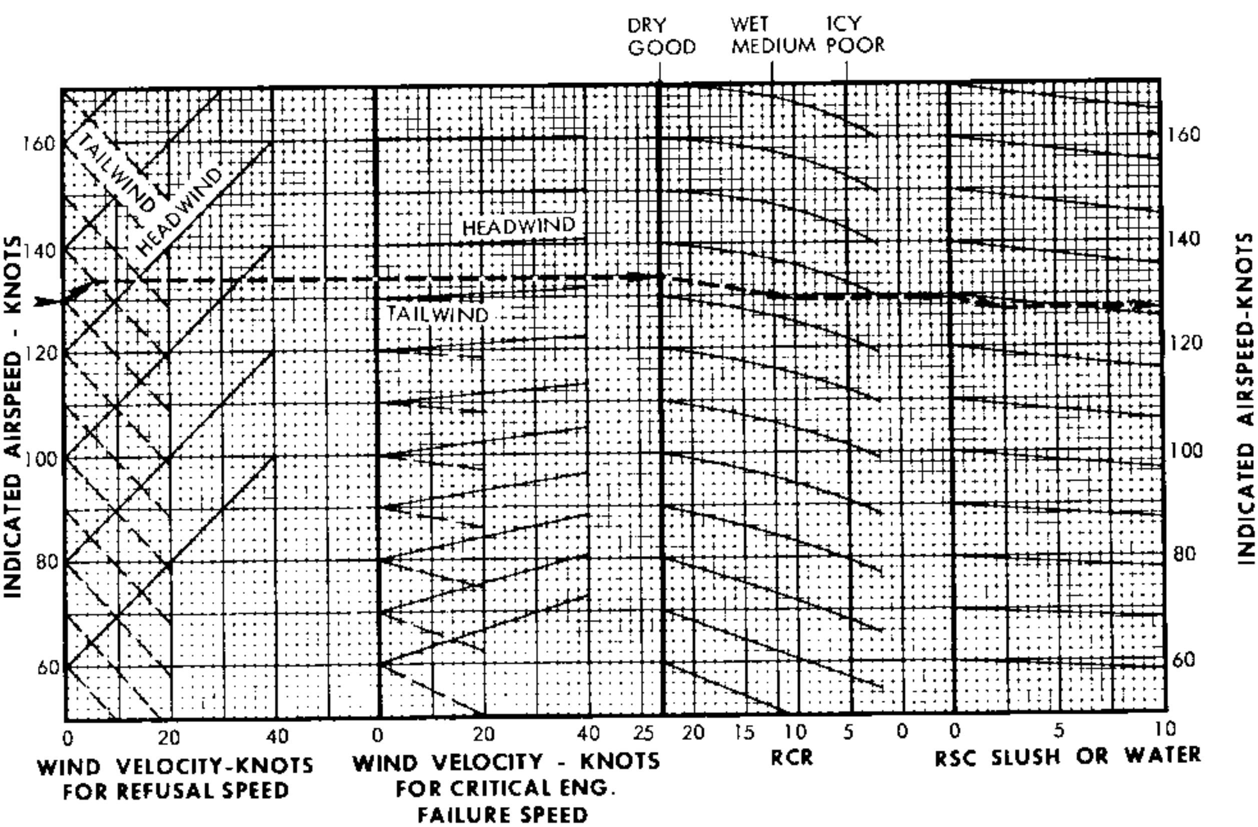


Figure 12-3. (Sheet 2 of 2)

EC-130-1-2-172-2

LANDING DISTANCE FROM 50 FEET

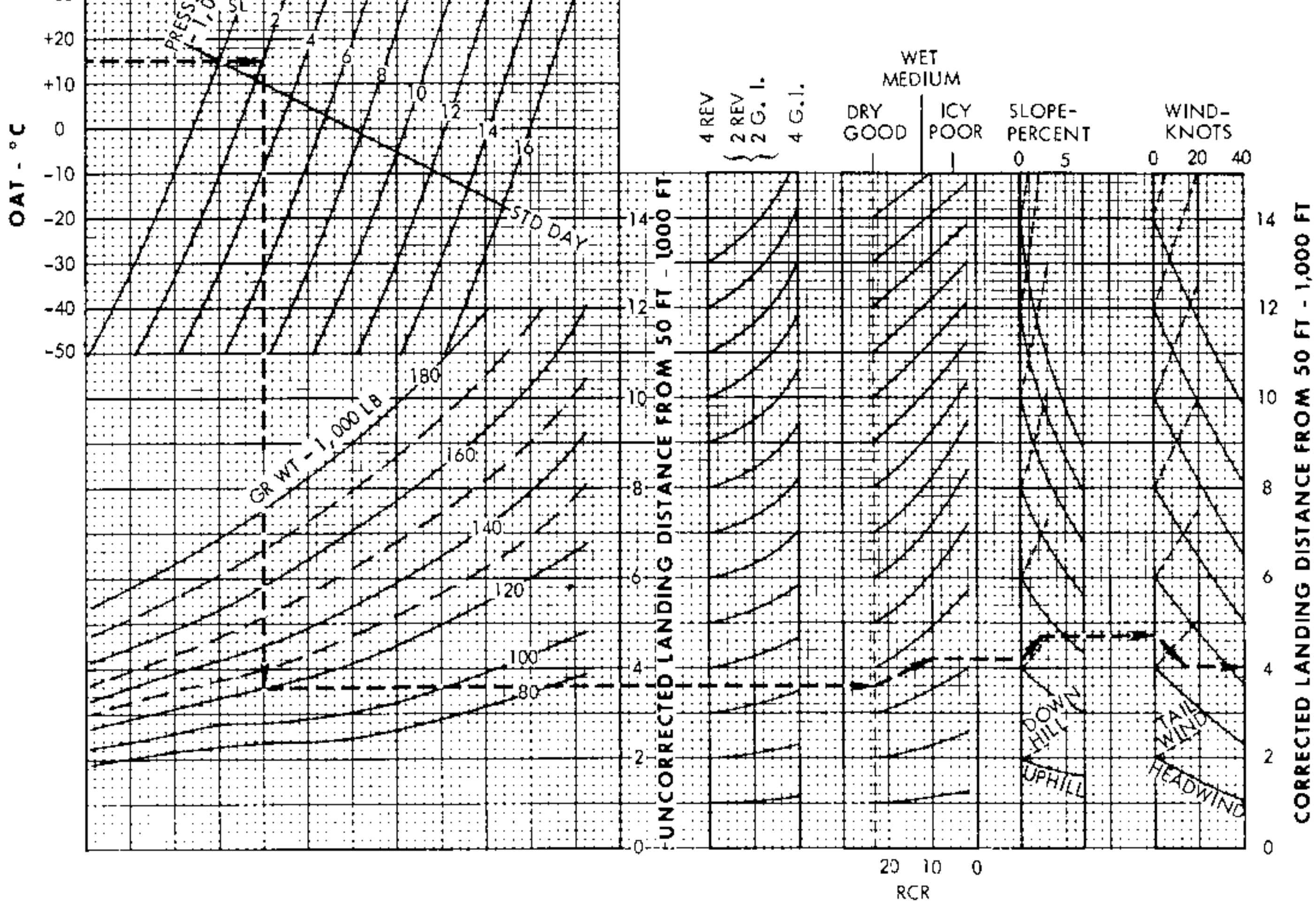
100 PERCENT FLAPS

MODEL: EC-130G
T56-A-423 ENGINES

DATE: APRIL 1966

EC-130G SINGLE DISK BRAKES

DATA BASIS: ESTIMATED ON FLIGHT TEST
CORRECTION SCALES-ESTIMATED



NOTE

1. Use 50% of reported headwinds and 150% of reported tailwinds withthe wind correct – ion grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.

EC-130-1-2-274

Figure 12-4.

LANDING GROUND ROLL

100 PERCENT FLAPS

MODEL: EC-130G
T56-A-ENGINES

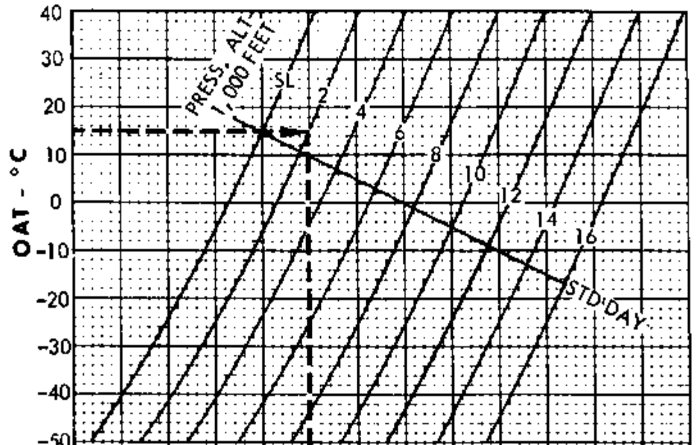
EC-130G SINGLE DISK BRAKES

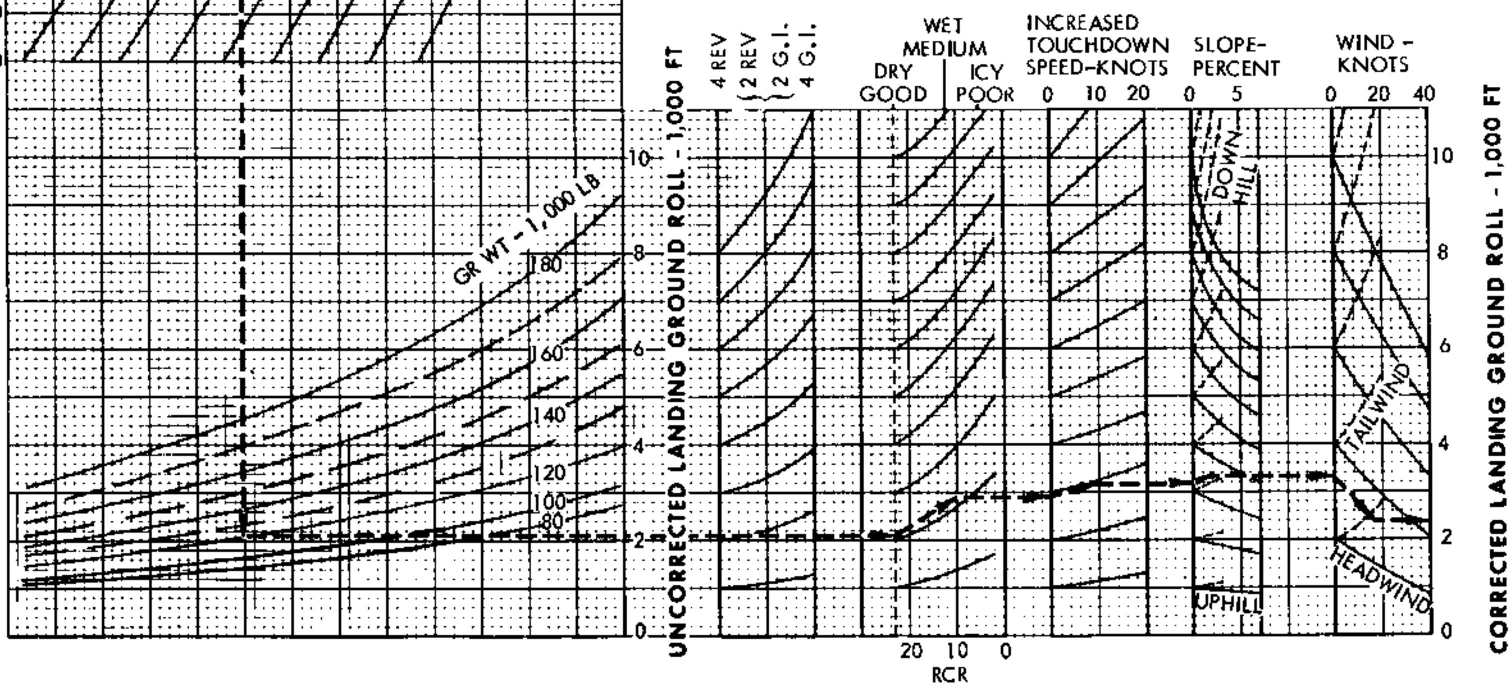
DATE: APRIL 1966

DATA BASIS: ESTIMATED ON FLIGHT TEST
CORRECTION SCALES-ESTIMATED

NOTE

1. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.





EC-130-I-2-275

Figure 12-5.

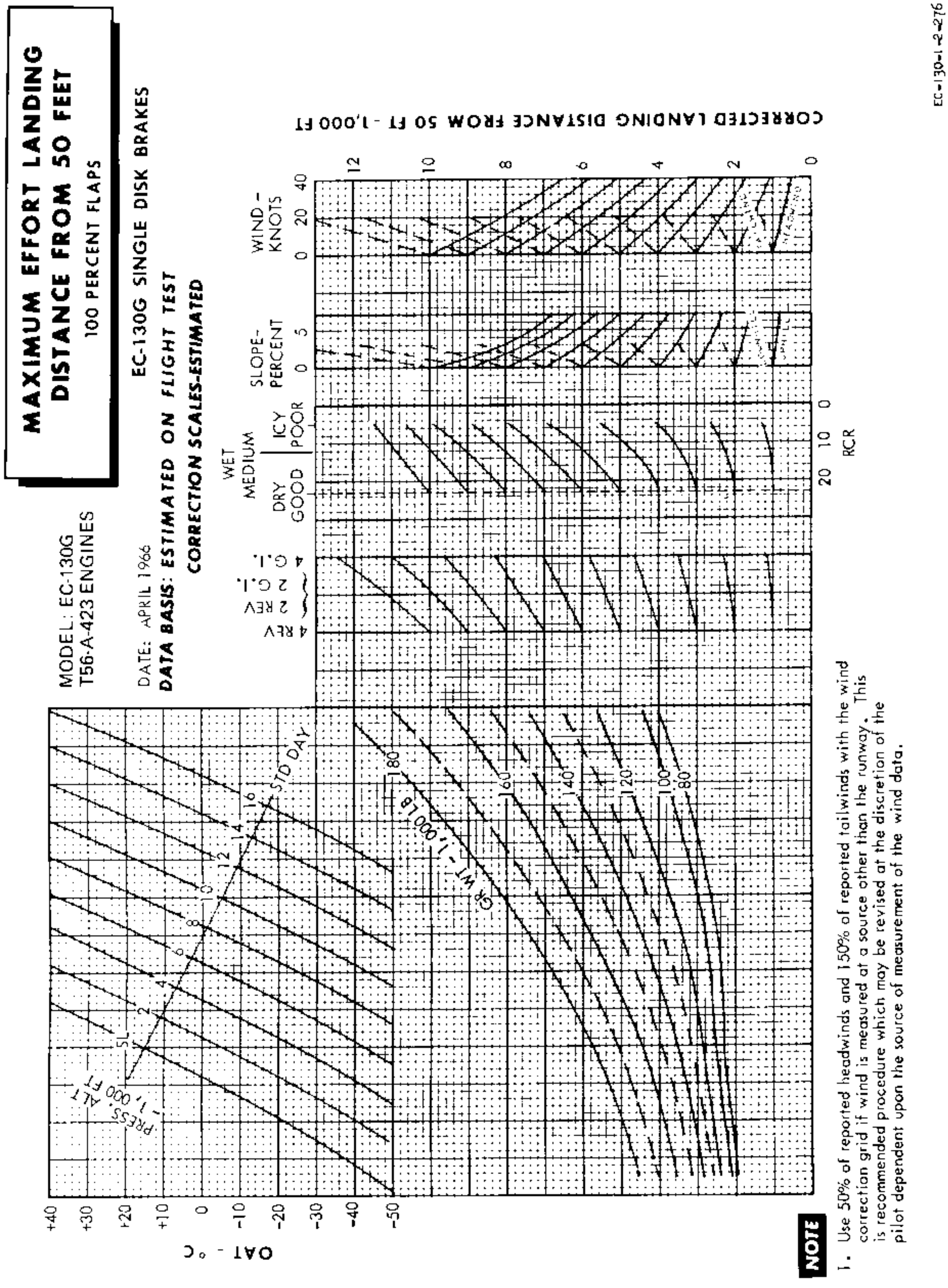

MAXIMUM EFFORT LANDING
DISTANCE FROM 50 FEET
100 PERCENT FLAPS
EC-130G SINGLE DISK BRAKES
MODEL: EC-130G
T56-A-423 ENGINES
DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST
CORRECTION SCALES-ESTIMATED
OAT - °C
+40
+30
+20
+10
0
-10
-20
-30
-40
-50
PRESS. ALT - 1,000 FT
SL
2
4
6
8
10
12
14
16
STD DAY
GR WT - 1,000 LB
180
160
140
120
100
80
4 REV
2 REV
2 G.I.
4 G.I.
WET
DRY
GOOD
MEDIUM
ICY
POOR
20
10
0
RCR
SLOPE-
PERCENT
0
5
WIND -
KNOTS
0
20
40
CORRECTED LANDING DISTANCE FROM 50 FT - 1,000 FT
12
10
8
6
4
2
0
NOTE
1. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.
EC-130-1-2-276

Figure 12-6.

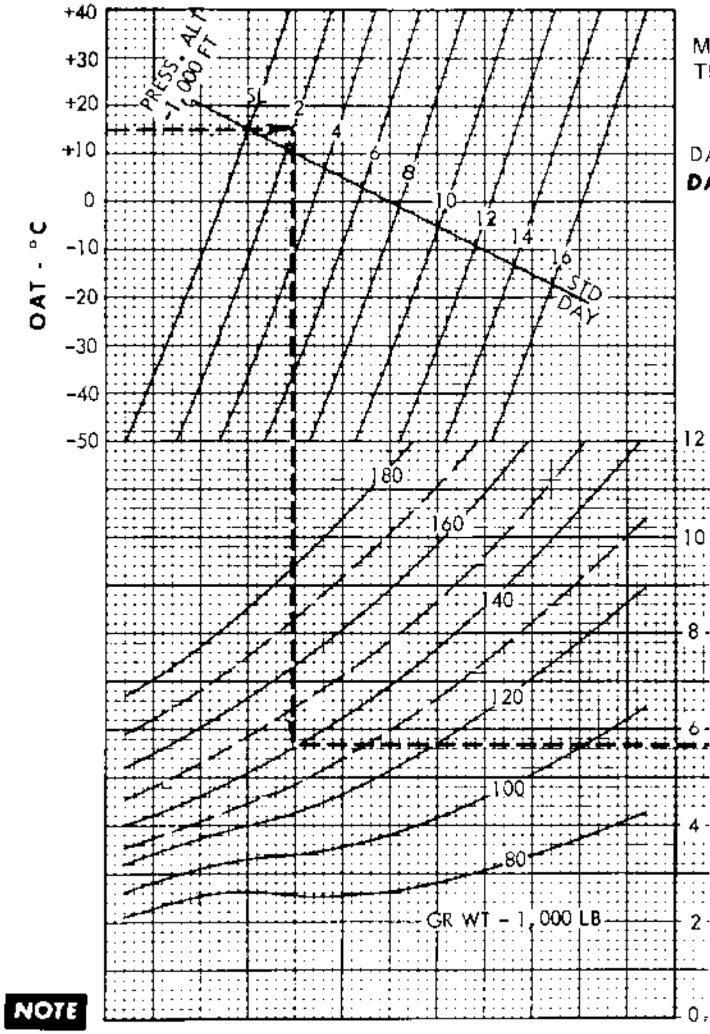
LANDING DISTANCE FROM 50 FEET

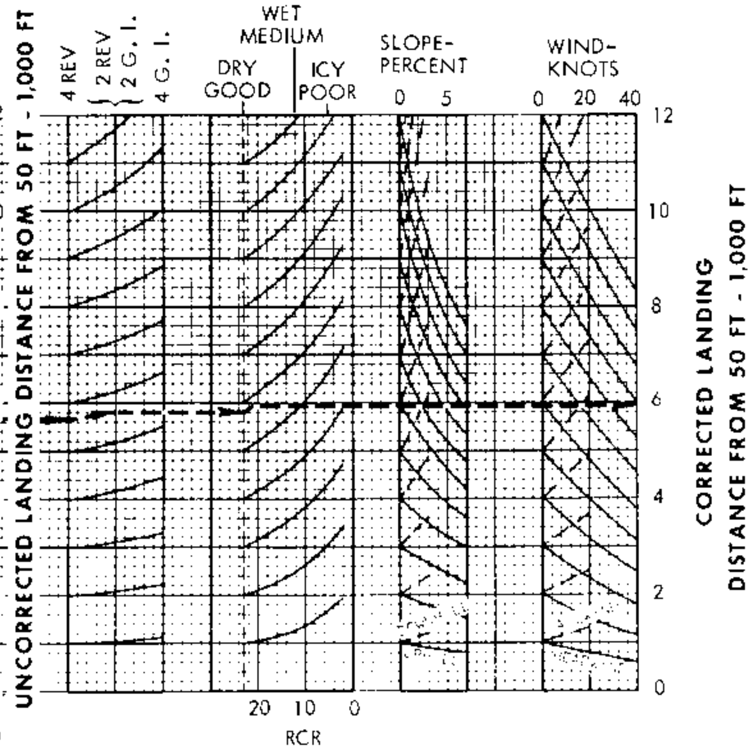
50 PERCENT FLAPS

MODEL: EC-130G
T56-A-423 ENGINES

EC-130G SINGLE DISK BRAKES

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST CORRECTION SCALES-ESTIMATED





NOTE

1. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.

EC-30-1-2-277

Figure 12-7.

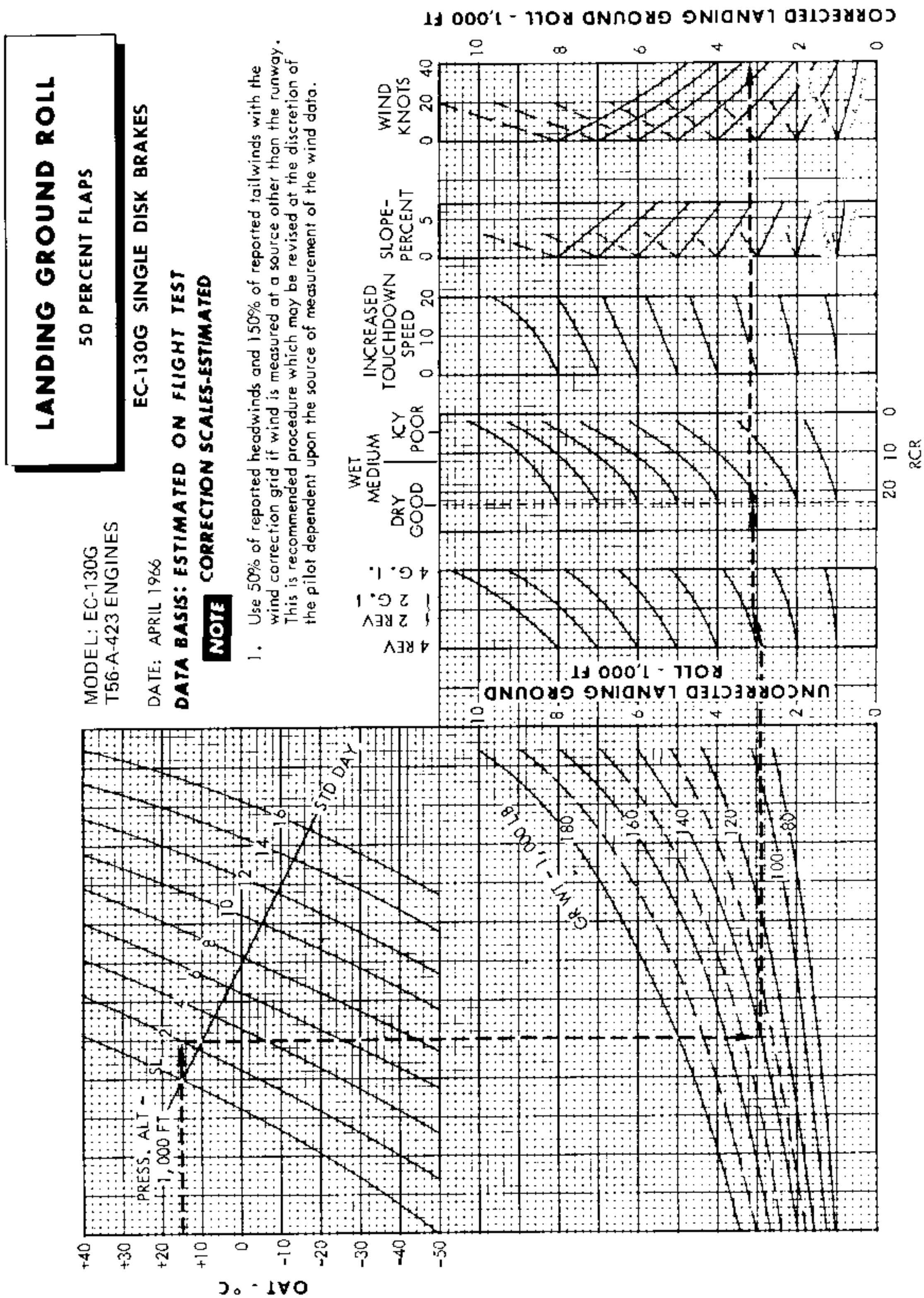

LANDING GROUND ROLL
50 PERCENT FLAPS
EC-130G SINGLE DISK BRAKES
MODEL: EC-130G
T56-A-423 ENGINES
DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST
CORRECTION SCALES-ESTIMATED
NOTE
1. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.
OAT - °C
+40 +30 +20 +10 0 -10 -20 -30 -40 -50
PRESS. ALT - 1,000 FT
SL 2 4 6 8 10 12 14 16
STD DAY
GR WT - 1,000 LB
180 160 140 120 100 80
UNCORRECTED LANDING GROUND ROLL - 1,000 FT
10 8 6 4 2 0
4 REV
2 REV
2 G.I.
4 G.I.
DRY GOOD
WET MEDIUM
ICY POOR
RCR
20 10 0
INCREASED TOUCHDOWN SPEED
0 10 20
SLOPE-PERCENT
0 5
WIND KNOTS
0 20 40
CORRECTED LANDING GROUND ROLL - 1,000 FT
10 8 6 4 2 0
EC-130-1-2-278

Figure 12-8.

MODEL: EC-130G
T56-A-423 ENGINES

LANDING DISTANCE FROM 50 FEET

FLAPS UP

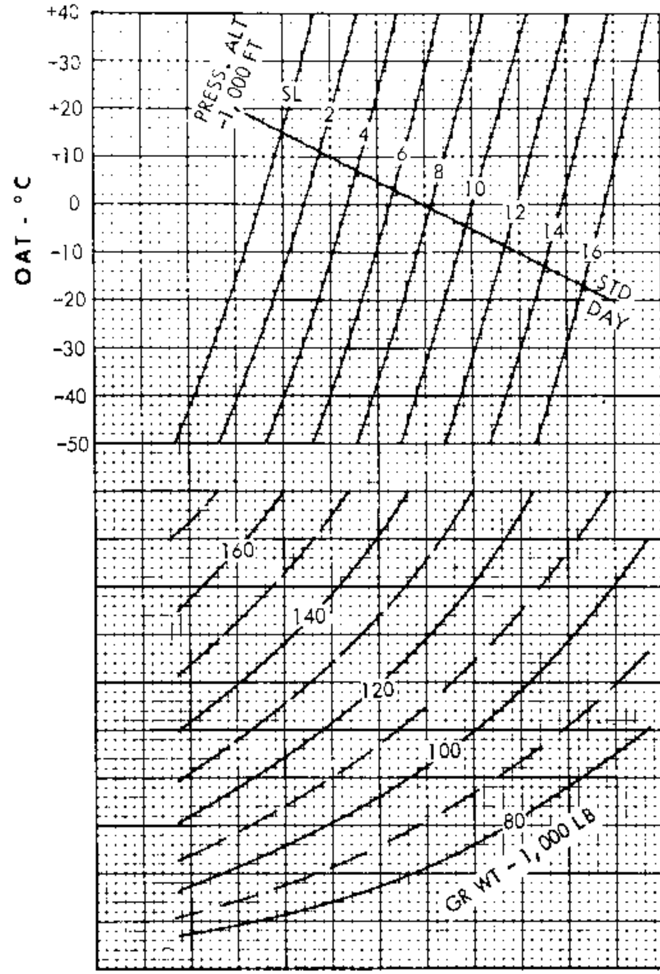
EC-130G SINGLE DISK BRAKES

DATE: APRIL 1966

DATA BASIS: ***ESTIMATED ON FLIGHT TEST***
CORRECTION SCALES-ESTIMATED

NOTE

1. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.



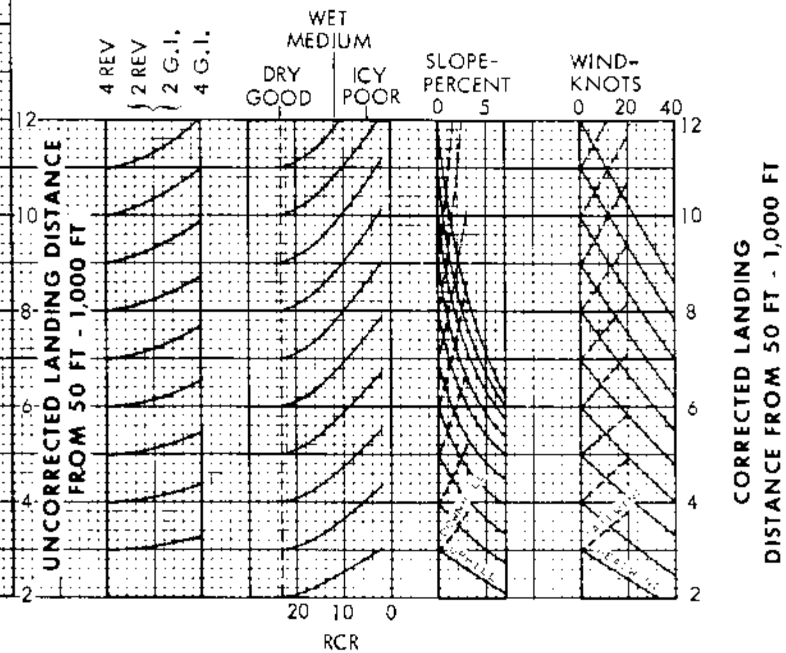


Figure 12-9.

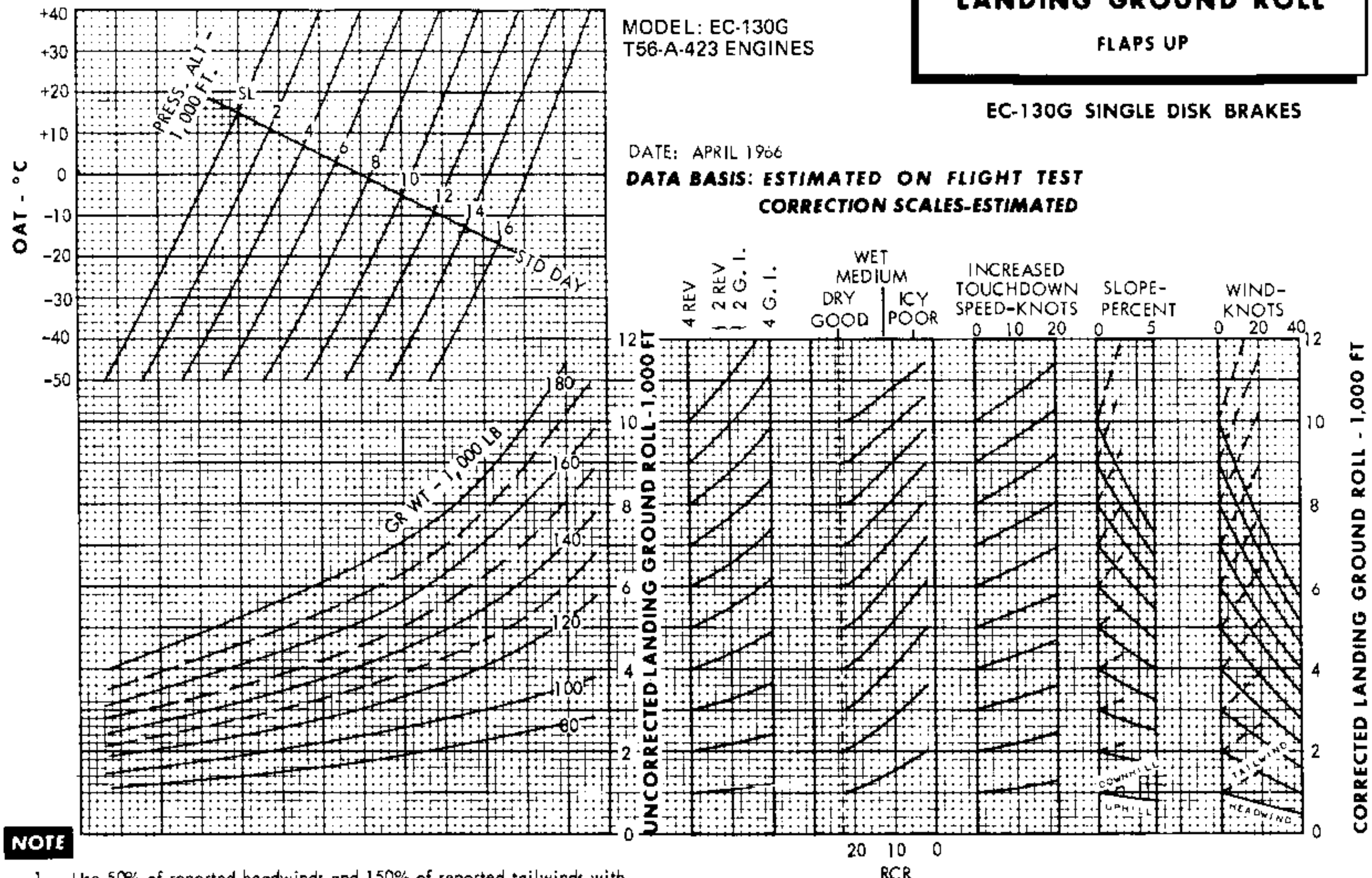
LANDING GROUND ROLL

FLAPS UP

EC-130G SINGLE DISK BRAKES

MODEL: EC-130G
T56-A-423 ENGINES

DATE: APRIL 1966
DATA BASIS: ESTIMATED ON FLIGHT TEST CORRECTION SCALES-ESTIMATED



NOTE

1. Use 50% of reported headwinds and 150% of reported tailwinds with the wind correction grid if wind is measured at a source other than the runway. This is recommended procedure which may be revised at the discretion of the pilot dependent upon the source of measurement of the wind data.

EC-130-1-2-280

Figure 12-10.

ALPHABETICAL INDEX

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PAGE NUMBERS IN PARENTHESES DENOTE ILLUSTRATIONS

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PAGE NUMBERS IN PARENTHESES DENOTE ILLUSTRATIONS

Subject *Page*

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