

the pump output will again charge the system to 3100 PSI. This process of the regulator opening and closing is called "cycling." The "cycling" can be checked by watching the pressure rise and fall between 2650 and 3100 PSI on the system pressure gauge.

Main Hydraulic Pressure Accumulators

The main pressure accumulators, connected in parallel, are used to store fluid under pressure, prevent sudden surges in the system and to aid the pumps under peak loads. These accumulators are located in the fuselage accessories compartment. The two pressure gauges near the accumulator indicate the air charge when the main system pressure gauge in the cockpit reads zero. The accumulator air charge is 1000 (+200, -0) PSI.

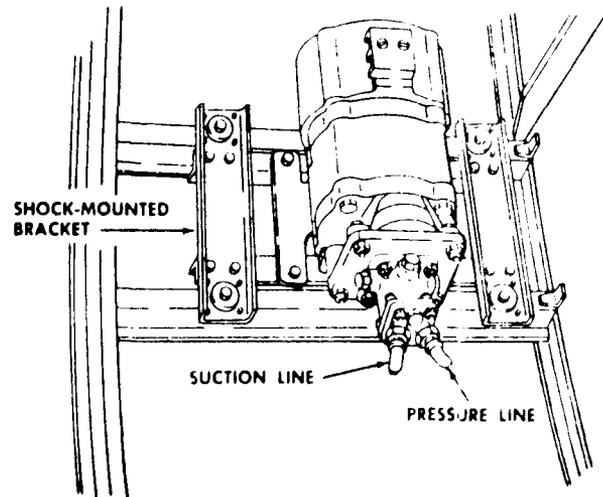
System Relief Valve

The hydraulic system relief valve is mounted on the hydraulic power manifold in the fuselage accessories compartment. It prevents excessive system pressure if the pressure regulator fails to bypass fluid when the pressure exceeds 3100 psi. The valve starts to relieve at 3300 psi. One important point to understand is that the system relief valve does not assure that the pressure will be 3300 (+100, -0) PSI, if the pressure regulator fails. The pressure indicated on the gauge will depend on the volume of fluid passing through the valve. At take-off rpm, the pumps are putting out approximately 12 gpm. Under this flow the pressure in the system would be above 3400 PSI.

Emergency Hydraulic Pump

An electrically-driven auxiliary hydraulic pump, mounted in the hydraulic

accessories compartment, provides an emergency source of pressure. The momentary-contact controlling switch is marked "EMERG. HYD. PUMP" ON-OFF and is located aft of the hydraulic and oxygen instrument panel. The auxiliary pump can be used if the engine-driven pumps fail or if pressure is desired while the aircraft is on the ground and the engine inoperative.



Emergency Hydraulic Pump

Emergency Pump Relief Valve

There is an auxiliary pump relief valve mounted in the fuselage accessories compartment. The purpose of this valve is to prevent the auxiliary pump from building up excessive pressure. This valve is set to open at 3000 ± 50 PSI.

Emergency Pump Selector Handle

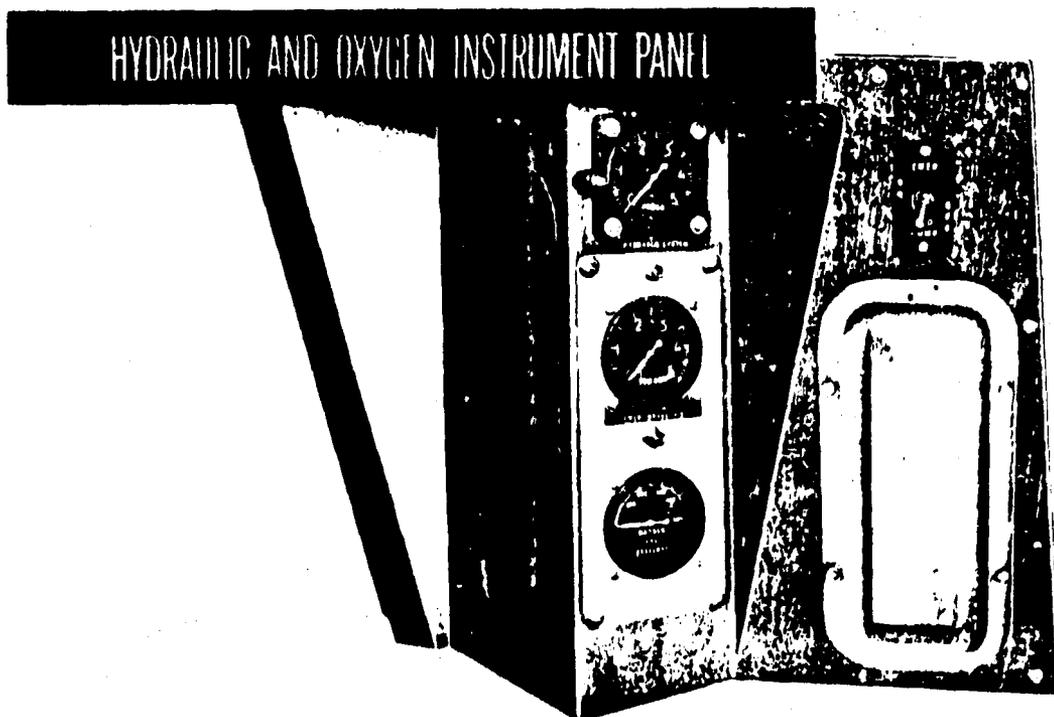
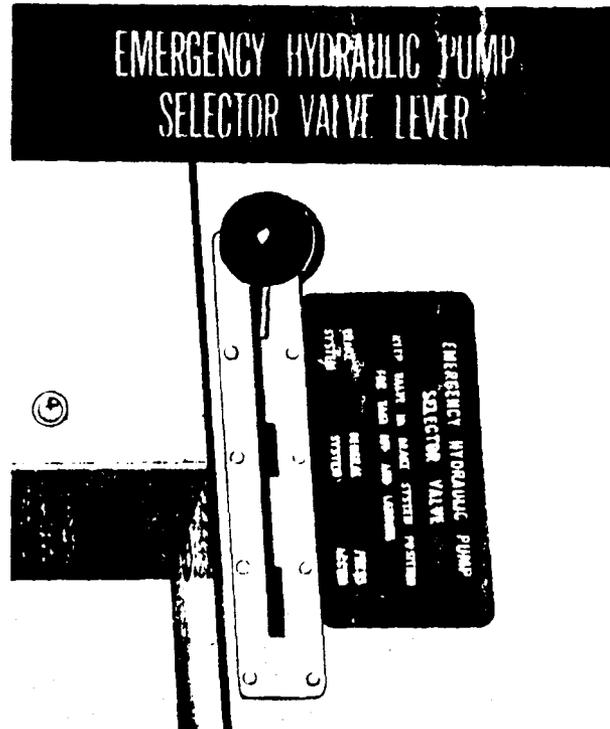
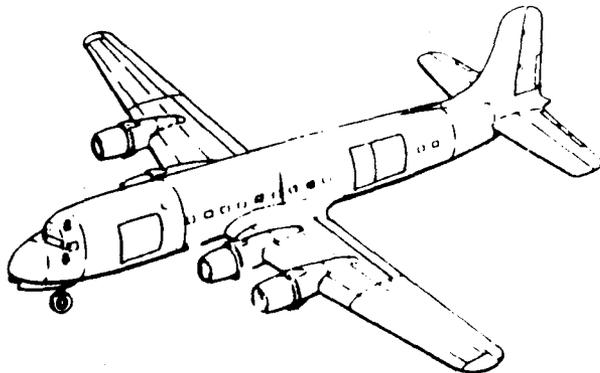
The selector valve lever for the auxiliary pump operation is located on the floor left of co-pilot's seat. The lever has three positions; brake system, general system and pressure accumulator. The control lever will normally be left

in the brake system position.

BRAKE SYSTEM- (forward position)
fluid directed to brakes and cargo doors only.

GENERAL SYSTEM- (center position)
Fluid directed to general system, brakes, and cargo doors.

PRESS. ACCUM. (aft position)
Fluid directed to brakes, general system, pressure accumulators, and cargo doors.



Chapter 2

LANDING GEAR SYSTEM

The landing gear hydraulic system uses full system pressure to both retract and extend the gear. The system consists of a control valve, landing gear actuating struts, nose gear down-latch bungee strut, nose gear bungee gland, nose gear up line orifice and the necessary lines and fittings. A control lever, located on the aft face of the control pedestal in the flight compartment, actuates the landing gear control valve through a two-way cable system. A spring-loaded over-center assist cable reduces the effort required to shift the control lever to either the UP or DOWN position and aids in insuring that the lever will be fully positioned at either end of the quadrant.

In the event of hydraulic failure, movement of the control lever to the DOWN position will release the uplatches and permit emergency extension by gravity. In the event of control cable failure, a spring on the control valve piston automatically places the valve in NEUTRAL allowing emergency extension by free fall. During emergency extension by free fall any vacuum created in the down line is relieved by the down-line vacuum relief line connected to the reservoir. A check valve in this line prevents any loss of pressure during normal gear operation.

Landing Gear Safety Solenoid Pin

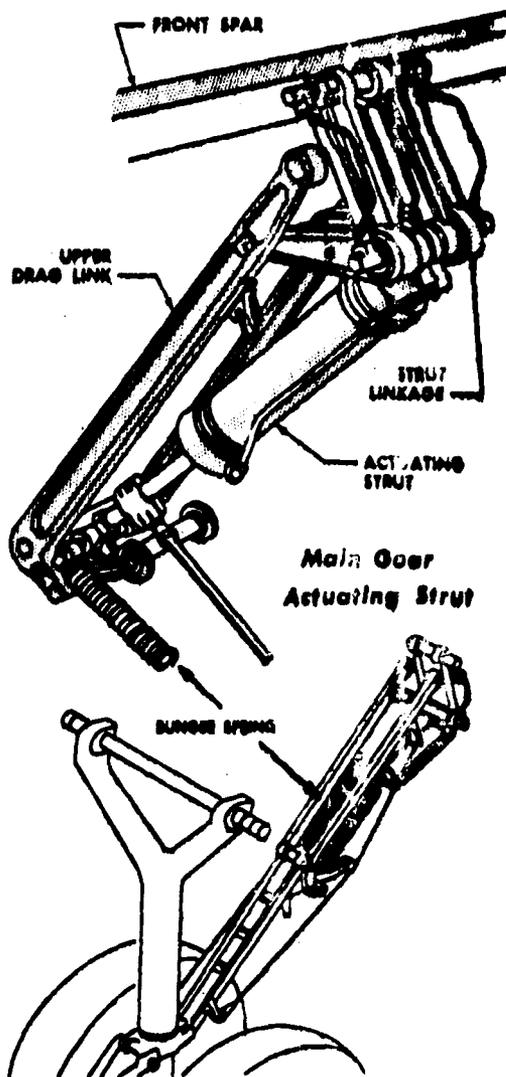
A solenoid operated pin which projects across the control lever prevents moving the gear control handle to the UP position when the aircraft is on the ground. The circuit energizing this safety solenoid is wired through a switch on the right main gear. When the right gear strut is extended the switch is closed. This energizes the safety solenoid which pulls the pin

SQUAT
Switch

out of the way allowing the gear handle to be placed into the UP position.

Main Gear Bungee Springs

The bungee is formed of two independent springs held under tension to pull the down-latch into the locking position when the landing gear is lowered without hydraulic pressure. The bungee also aids in down locking the gear during normal extension,



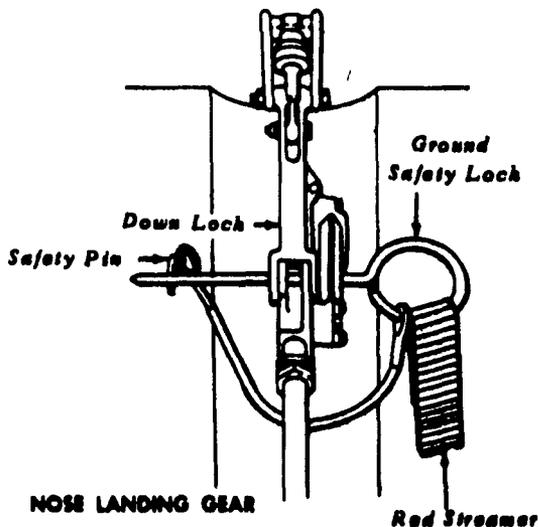
Nose Gear Bungee Strut and Downlatch

The nose gear downlatch, which locks the nose gear in the extended position, is formed by two short links between the knee-joint of the drag linkage and the center of the shock strut supporting yoke. The downlatch is controlled by a hydraulically operated spring-loaded bungee strut mounted on the yoke and connected to the downlatch at the piston end.

When the nose gear is extending, the spring in the bungee strut extends the bungee piston, forcing the downlatch knee $1/16$ inch past center and locking the nose gear in the DOWN position. During retraction, hydraulic pressure is directed to the bungee strut to overcome spring tension and force the bungee piston to retract. This breaks the downlatch knee-joint and allows the gear to retract.

Ground Safety Pins

Landing gear ground safety pins should be installed in the landing gear retracting links to prevent inadvertent collapsing of the gear while on the ground. The ground safety pins are stowed in the aircraft when not in use.

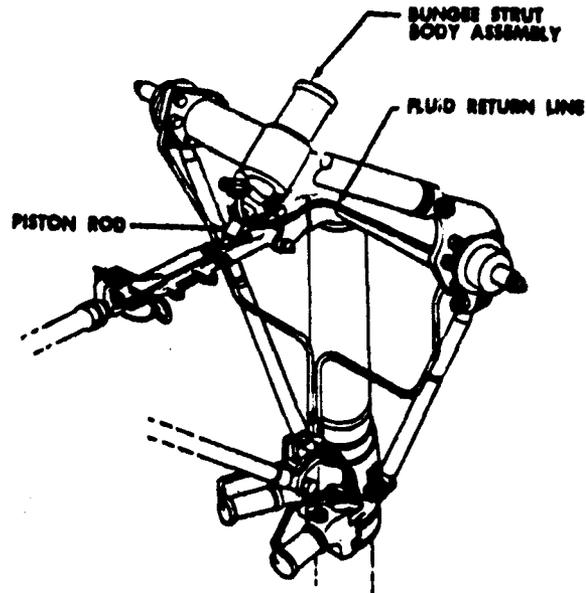


6-8

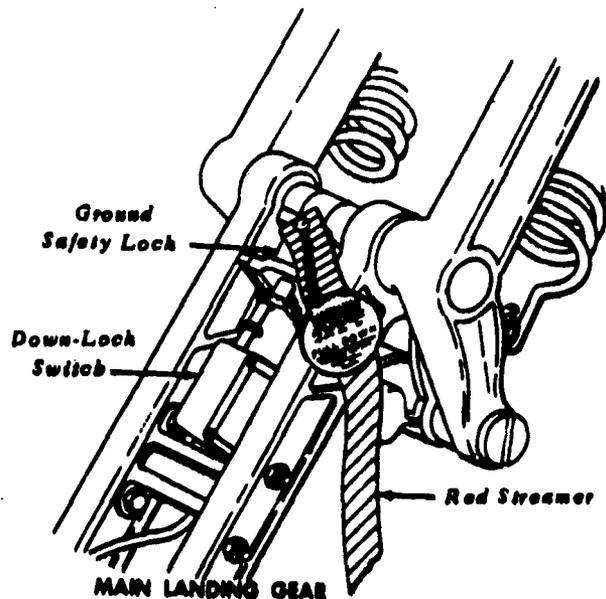
Landing Gear Ground Safety Locks

Landing Gear Limitations

The maximum airspeed for landing gear extension is 170 knots. The landing gear should retract in 7 to 10 seconds and free-fall in a maximum of 1 minute.



Nose Landing Gear Down-Lock Bungee Strut



Chapter 3

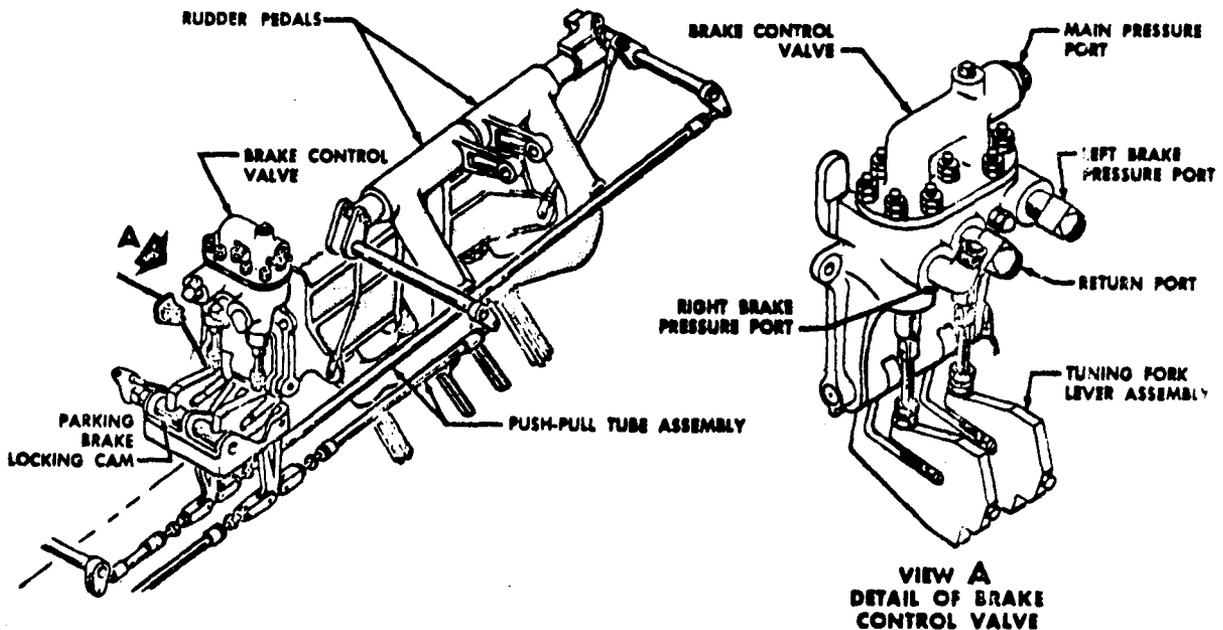
BRAKE SYSTEM

An expander tube type brake on each main gear is operated by hydraulic pressure. The major units of the system are the brake control valve, four deboosters cylinders, four shuttle valves and two main gear glands. System pressure 2650 to 3100 psi is directed to the brake control valves from the landing gear down line permitting operation of the brakes only when the landing gear control lever is in the DOWN position. The brakes operate under a maximum pressure of 630 ± 15 psi, the reduction from main system pressure

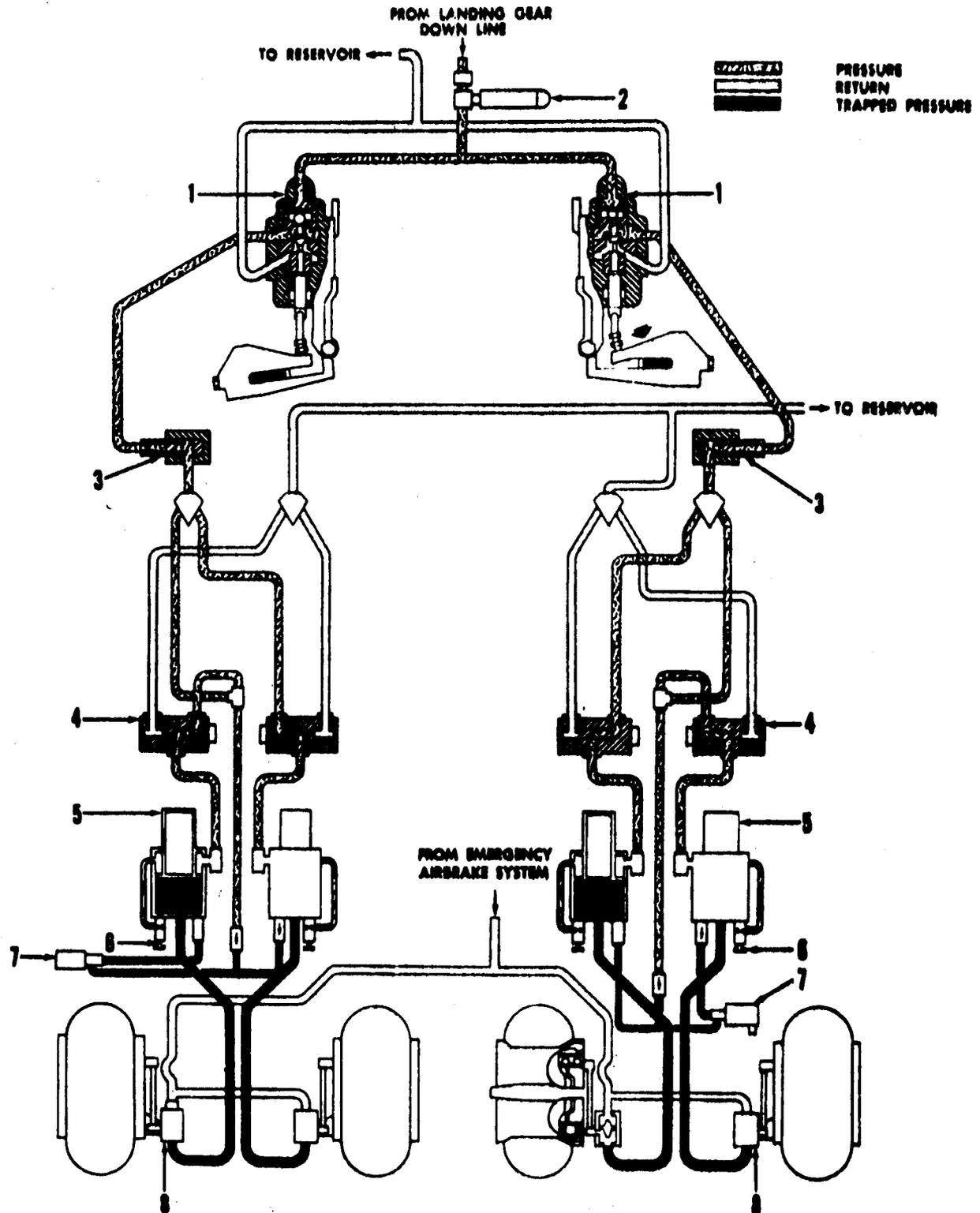
is accomplished by the brake control valve and the deboosters cylinders. The deboosters cylinders also prevent hydraulic failure in one brake from affecting the operation of the other brake.

Brake Control Valve

A dual power brake control valve is located in the top of the nose wheel well. This valve meters pressure to the deboosters at approximately 1800 psi. This valve is controlled by both the pilot and co-pilot brake pedals through a mechanical linkage.



Brake Control Valve



- 1 Control Valve
- 2 Pressure Modulator
- 3 Brake Glend

- 4 Antiskid Control Valve
- 5 Deboaster Cylinder
- 6 Bypass Valve

- 7 Relief Valve
- 8 Shuttle Valve

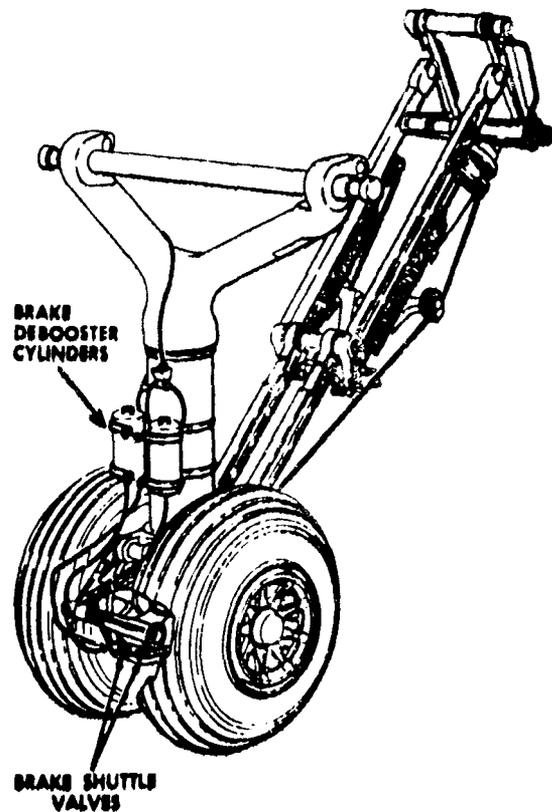
Landing Gear Brake Hydraulic System, Schematic Diagram

Brake Deboosters

There are four brake deboosters. They are mounted two on the rear of each main strut. The purpose of the deboosters is to give quick application and quick release of the brakes. The ratio of the brake deboosters is 2.86 to 1. They reduce approximately 1800-psi from the power brake control valve to 630 ± 15 psi to the brakes.

Brake Line Shuttle Valves

The shuttle valves are located at the junction of the hydraulic and emergency air pressure lines at the brake assemblies on the main gear. A small spring, assisted by hydraulic pressure, keeps the cone seated on the air pressure port during normal hydraulic brake operation. When the air brake valve is opened, air pressure pushes the cone off the seat on the air port and over a seat on the hydraulic line. This blocks off hydraulic pressure and directs the air pressure to the brakes.



Landing Gear Brake System

Parking Brakes

The parking brake control handle is installed on the left side of the control pedestal. To set the parking brakes, make certain that full hydraulic pressure is available, depress the pilot's brake pedals, then turn the parking brake handle to the "ON" position, releasing the brake pedals while holding the parking brake handle in the "ON" position. Brake engagement can be checked by moving the parking brake lever forward. Freedom of movement indicates that the parking brake is engaged. To release the parking brakes, fully depress the brake pedals.

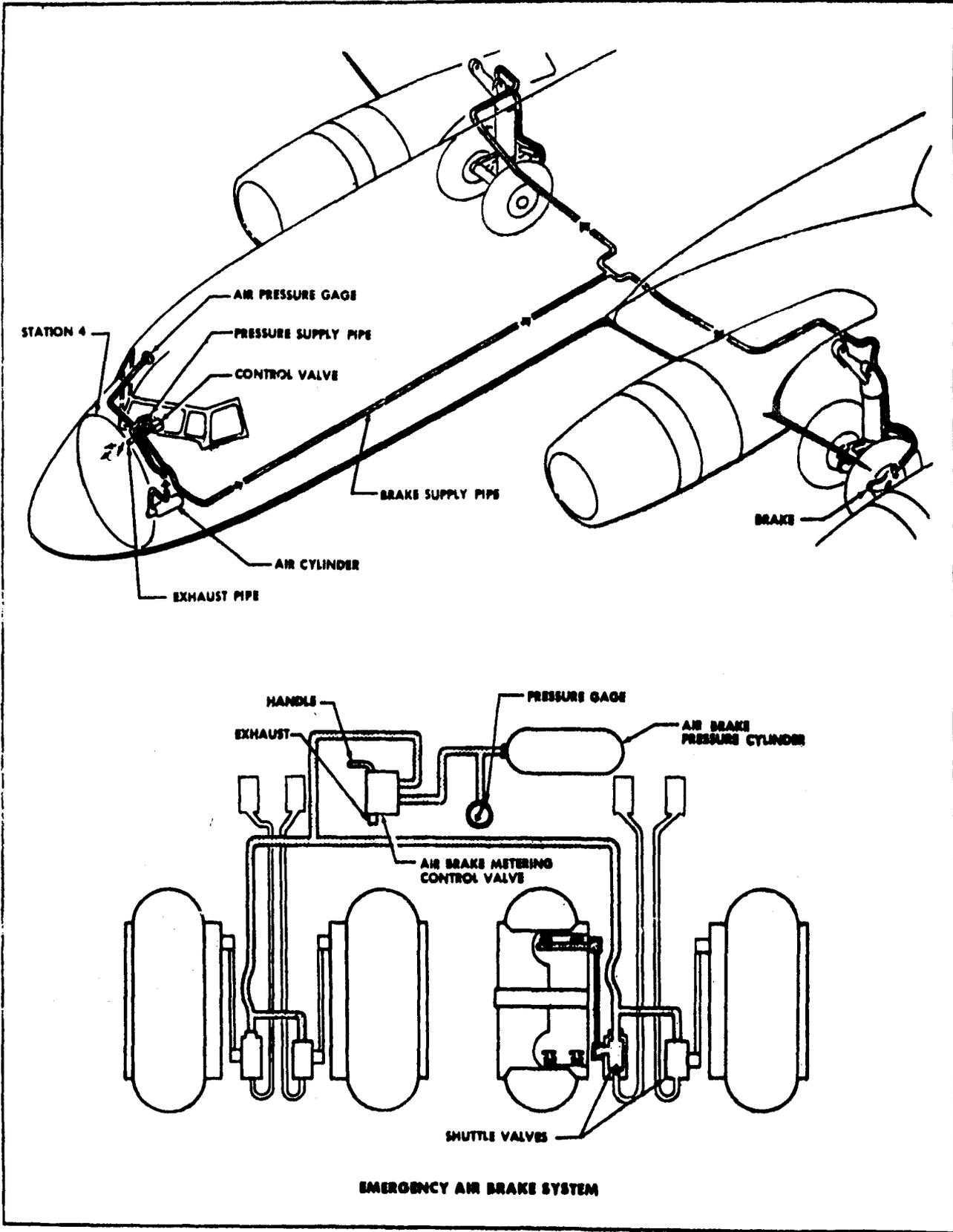
Emergency Air Brake System

The emergency air brake system consists of a storage pressure cylinder, pressure gauge, pressure control valve and shuttle valves which admit the air

pressure to the brakes. The cylinder is located in the right nose wheel well tunnel and is charged to 1000 ± 50 PSI. The pressure gauge is on the hydraulic and oxygen instrument panel, and the control valve is on the main fire extinguisher panel, convenient to the pilot only. The control valve handle meters the air into the brake system and has three positions: OFF, HOLD, and ON. Sufficient air pressure is available for three full brake applications. The brake hydraulic system must be bled after operation of the air brake system.

Air Brake Operation

If no hydraulic pressure is available to the brakes, stop the airplane with the air brake system. Do not use the air brakes before the nose wheel has touched the ground. Apply the brakes slowly and intermittently after



and braking
in accident



Brake Unit

The system is designed to provide maximum braking during landing. As the aircraft slows down, the possible braking force is increased and the system is designed to provide maximum braking force.

The system is designed to provide maximum braking during landing. As the aircraft slows down, the possible braking force is increased and the system is designed to provide maximum braking force. The nose wheel well. The modulator reduces pressure to the brakes simultaneously with each skid control cycle. After cycling stops, brake pressure gradually increases and maximum braking is produced as the aircraft weight increases on the runway.

The system is designed to provide maximum braking during landing. As the aircraft slows down, the possible braking force is increased and the system is designed to provide maximum braking force. The nose wheel well. The modulator reduces pressure to the brakes simultaneously with each skid control cycle. After cycling stops, brake pressure gradually increases and maximum braking is produced as the aircraft weight increases on the runway.



Chapter 4

WING FLAPS AND WINDSHIELD WIPERS

Wing Flaps

The wing flaps are controlled by a lever located on the aft face of the control pedestal. Control cables are routed from the wing flap selector handle to the hydraulic selector control valve in the fuselage accessories compartment. This causes hydraulic pressure to be directed to the ports of the four flap actuating struts when the control lever is operated.

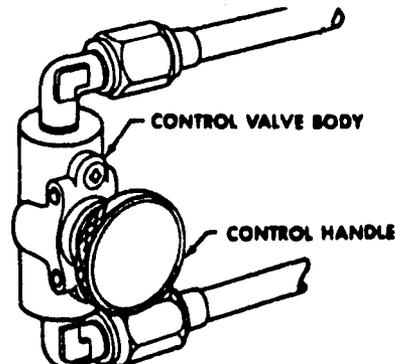
As the flaps move in response to the applied hydraulic force, the flap synchronizing (mechanical bus system) cables in the wing rotate a double drum at the rear spar in the wing center section. Follow-up cables, locked to the smaller of these drums travel forward to a linkage that actuates the selector control valve. The follow-up cables return the hydraulic selector control valve to neutral when the flaps reach the preset angle fixed by the position of the control lever on the control pedestal. Any tendency of one flap to travel ahead of the other is instantly checked by the bus cables, thus insuring uniform travel.

A two-speed flap control valve is connected to the control valve linkage for the purpose of restricting the flaps retraction speed between 20 degrees DOWN and the full UP position. There is no neutral or OFF position for the control handle. The handle is marked in degrees of flap travel from 0° (full UP) to 50° (full DOWN). At an airspeed of 105 knots, the flaps will extend from 0° to 50° in 10 to 15 seconds, retract from 50° to 20° in 9 seconds, and retract from 20° to the full UP position in 13 seconds. Maximum speed for flap extension is 170 knots to 30° DOWN and 150 knots over 30° DOWN.

A pressure relief valve, and two pressure-operated check valves are installed in the wing flap control valve. The relief valve will relieve any excessive pressure caused by the wing flaps being forced up by airloads during flight. The two pressure operated check valves are installed to prevent wing flap droop.

Windshield Wipers

The two synchronized windshield wipers are operated by system pressure. The speed control valve, located on the nose wheel steering panel acts as an ON-OFF control and regulates wiper speed by varying the size of the opening through which the fluid must pass. The blades are locked in place when the speed control is turned OFF. Full or partial stoppage of one blade will not interfere with complete operation of the other blade.



Windshield Wiper Speed Control Valve

Chapter 5

NOSE WHEEL STEERING SYSTEM

The nose wheel is steerable from the flight compartment through a combined hydraulic and mechanical system. A separate pressure accumulator serves to dampen any tendency of the nose wheel to shimmy during taxiing. The nose wheel is steerable to a maximum of 67 degrees in either direction. The steering wheel in the cockpit is located to the left of the pilot's seat. Two matching white lines indicate when the nose wheel is centered.

Steering Selector Valve

The steering selector valve is located on the left side of the nose wheel well. An access door is located on the left side of the fuselage just above the nose wheel doors. This valve is controlled by a differential mechanism which is connected by cables to the steering wheel in the cockpit. The purpose of the steering selector valve is to select pressure as desired for left and right turning actions.

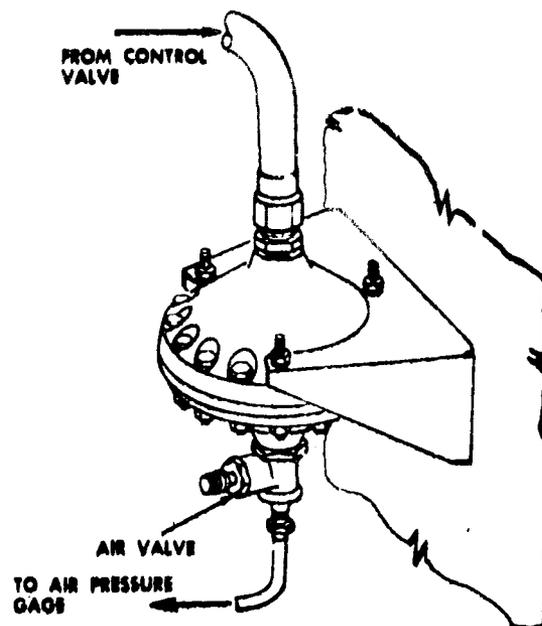
Steering Relief Valve

The steering relief valve maintains a snubbing pressure of 150 psi in the steering accumulator and on the steering struts. The relief valve is mounted on the selector valve. It stops the flow of fluid in the return line until pressure from the accumulator builds up to 150 psi.

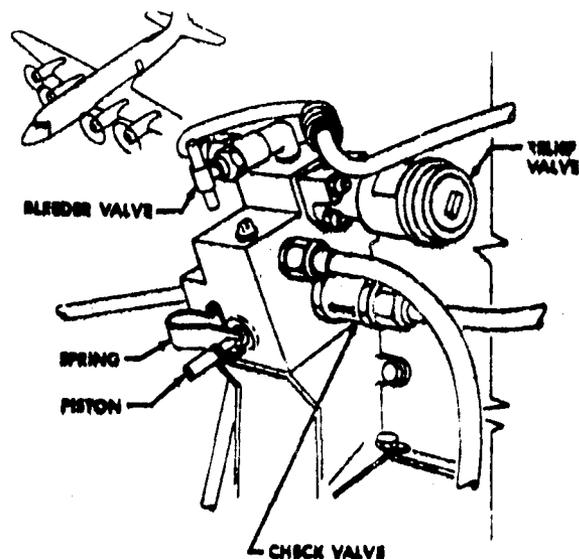
Steering Pressure Accumulator

The steering accumulator is located on the left side of the nose wheel well near the steering selector valve. The purpose of the accumulator is to hold 150 psi snubbing pressure to the steering struts to help dampen shimmy of the nose wheel. Initial air charge is 50+5-0 psi. Snubbing pressure must be relieved

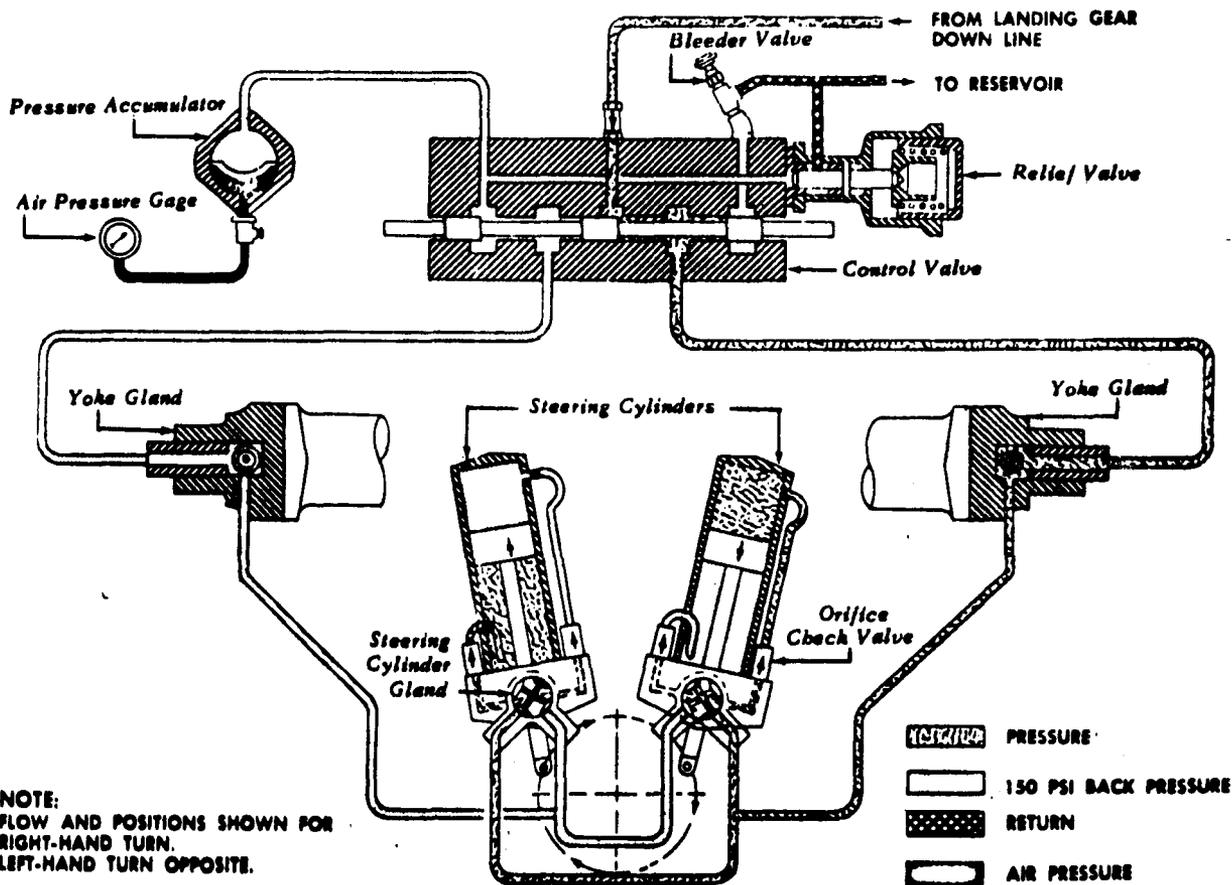
by opening the bleeder valve when charging the accumulator with air. The gauge for the air pre-load of the accumulator is located at the bottom of the accumulator.



Nose Wheel Steering Pressure Accumulator

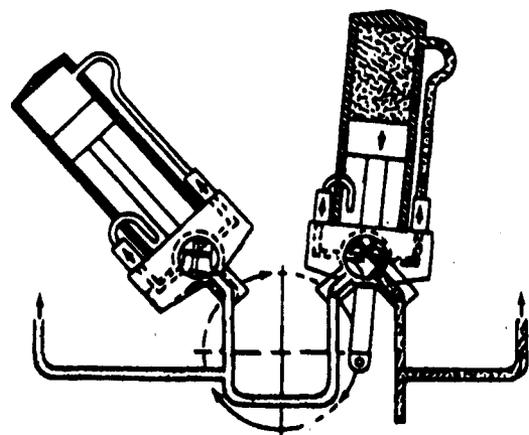


Nose Wheel Steering Control Valve Assembly

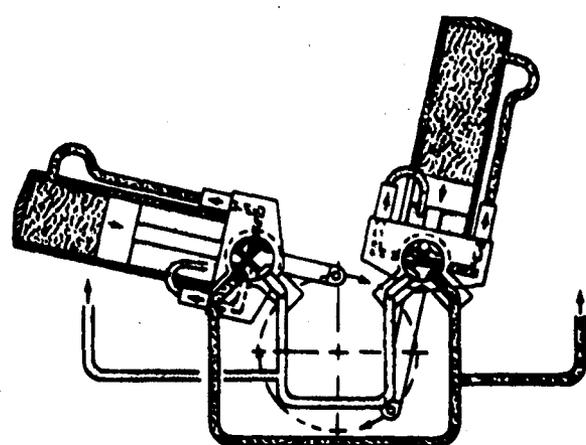


NOTE:
FLOW AND POSITIONS SHOWN FOR
RIGHT-HAND TURN.
LEFT-HAND TURN OPPOSITE.

① NOSE WHEEL STRAIGHT AHEAD.
CONTROL VALVE SET FOR
RIGHT-HAND STEERING.



② NOSE WHEEL TURNING RIGHT.
LEFT-HAND STEERING CYLINDER
ON CENTER.



③ NOSE WHEEL IN MAXIMUM
RIGHT TURN. LEFT-HAND
STEERING CYLINDER PAST CENTER.

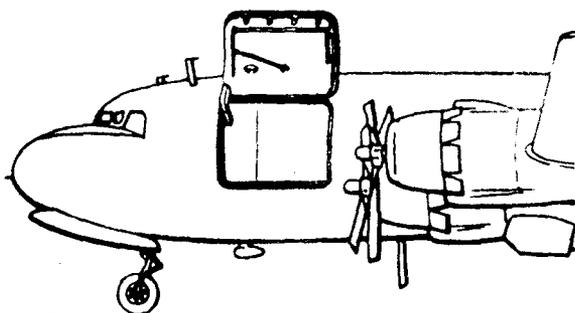
Nose Wheel Steering System Schematic

Chapter 6

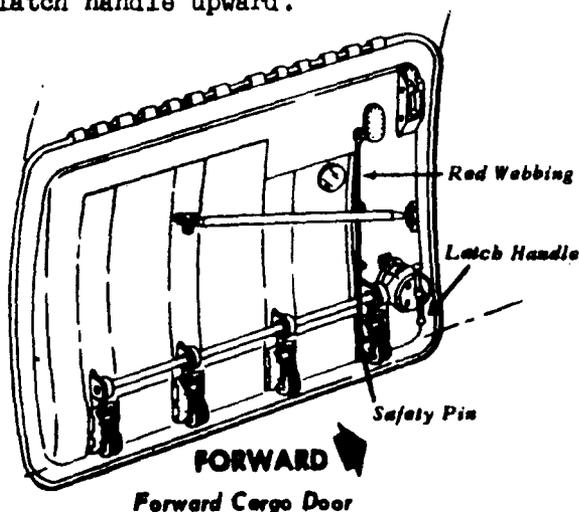
CARGO DOORS

Forward Cargo Door

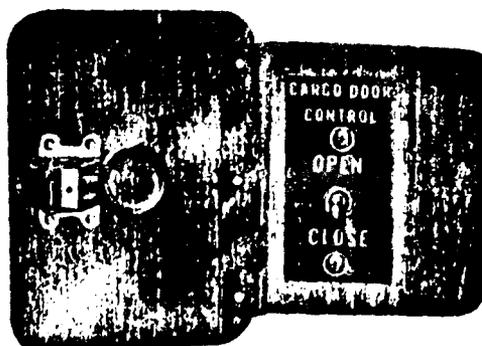
The forward cargo door on the left side of the aircraft opens outward and upward to approximately 172 degrees.



Before the door can be operated hydraulically it must be unlatched. The door can be unlatched from inside the aircraft by removing the safety pin from the latch and engaging the plunger in the handle. The lock lever is then released by pushing upward and turning the latch handle clockwise. The door is unlatched from the outside by actuating the lock lever, located directly above the latch handle, and moving the latch handle upward.



After unlatching, the door may be operated hydraulically and controlled from either of two switches. One switch is on the exterior of the fuselage under an access door, just forward of the cargo door. The other switch is inside the fuselage just forward of the door.



Holding the switch in the OPEN position turns on the emergency hydraulic pump and opens the door. The door may be stopped at any desired opening by releasing the switch.

The door is closed by holding the switch in the closed position until the door is completely closed.

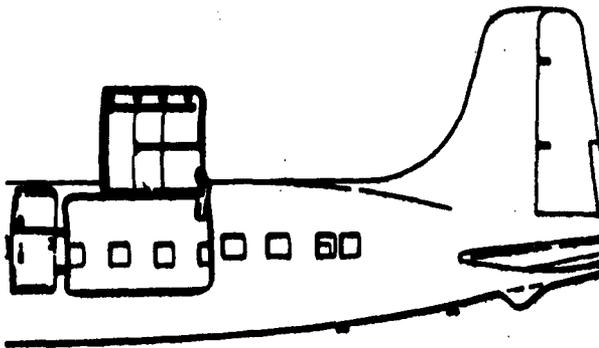
The door is latched from inside the aircraft by turning the latch handle counterclockwise until the lock lever engages, then install the safety pin in the forward latch.

CAUTION

All latches must be overcenter and against link stops when the door is in latched position. Do not attempt to open door without first removing safety pin.

Aft Cargo Door

The aft cargo door assembly, on the left side of the aircraft, consists of two doors. The main entrance door portion permits entry without operating the aft cargo door. The main entrance door opens outward and forward. The door controls consist of a set of eight latch bolts which are operated simultaneously by the door handle. A hold-open mechanism in the door will hold the door against the fuselage in full open position.



The aft cargo door opens outward and upward. A removable latch handle is stowed adjacent to the fire extinguisher just forward of the door. A safety pin, attached to the door structure with a length of red webbing, is installed through the forward latch.

CAUTION

Do not attempt to open aft cargo door without first removing safety pin.

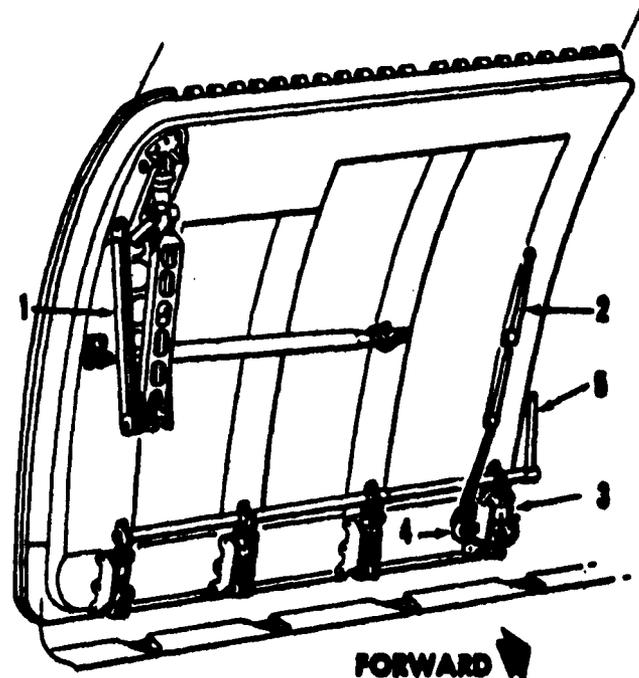
After unlatching the door by operating the latch handle, the door may be operated hydraulically and controlled by a switch just forward of the main entrance door. A hold-open catch is actuated by a limit switch in the circuit. To operate the door hold the control switch in

the OPEN position until the desired degree of opening is obtained. The main entrance door must be full open and latched before the aft section will operate.

NOTE: The portion of the circuit normally completed by the aft cargo door hold-open catch is automatically actuated by an emergency switch if the main entrance door is jettisoned in flight.

Close the door by holding the switch in the CLOSED position. When fully closed, latch the door with the latching handle and reinstall the safety pin.

The auxiliary hydraulic pump selector valve handle should be in the Brake System (normal) position for cargo door operation.



- | | |
|--------------------------|------------------|
| 1 Actuating Linkage | 3 Latch Assembly |
| 2 Red Webbing | 4 Safety Pin |
| 5 Removable Latch Handle | |

Aft Cargo Door

GUIDE SUPPLEMENT

1953 SERIES AIRCRAFT

VERSUS

1953 SERIES AIRCRAFT

1. HYDRAULICS

Smaller firewall connections.

2. AUXILIARY HYDRAULIC EQUIPMENT

a. Not utilized.

b. Not utilized.

c. Goodrich brake systems.

d. Brake deboosters.

1. HYDRAULICS

Larger firewall connections.

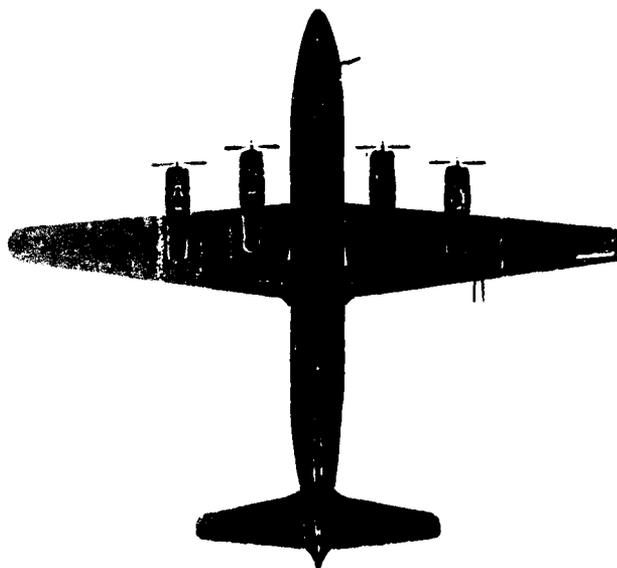
2. AUXILIARY HYDRAULIC EQUIPMENT

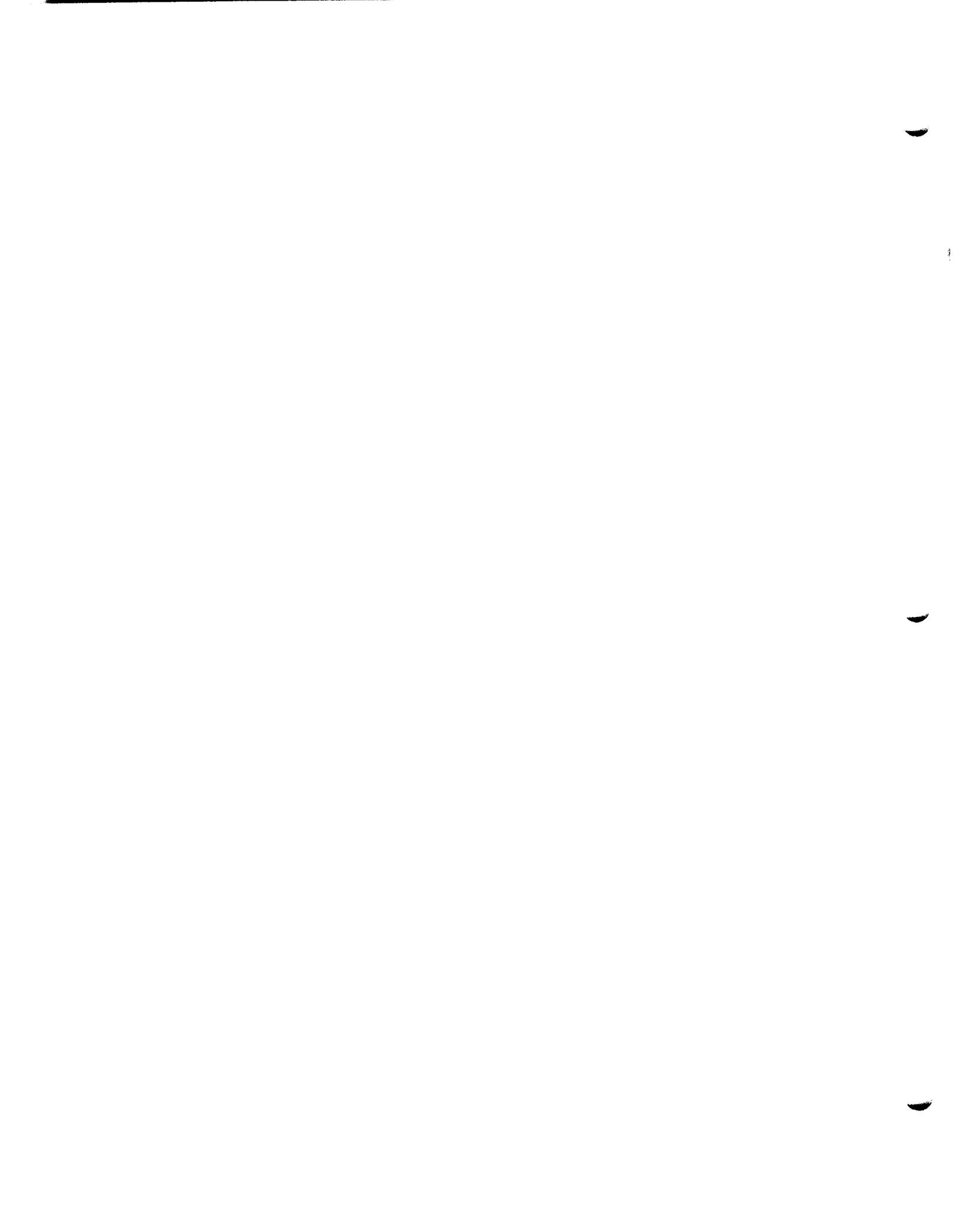
a. Anti-skid brake system.

b. Utilizes the micro-switch on the left main strut.

c. Goodrich brake system.

d. Brake deboosters.





COMMUNICATIONS



TABLE OF CONTENTS

Chapter 1	General	7-1
Chapter 2	Interphone System	7-11
Chapter 3	Command and Navigation System	7-14
Chapter 4	Emergency Equipment	7-32
Chapter 5	Inflight Voice Communications	7-37

Chapter 1

GENERAL

Equipment

Communications to, from, or within the C-118 aircraft is accomplished by

16 basic communications systems. Nr 17 and 18 are emergency radios aboard.

<u>NOMENCLATURE</u>	<u>COMMON IDENTIFICATION</u>	<u>USE</u>
1. AN/AIC-10	Interphone	Intercommunications
2. MI-36	Public Address	Loudspeaker
3. AN/ARC-49	VHF Command	Line of sight communications
4. Collins VHF-101	VHF Command	Line of sight communications
5. AN/ARC-27A	UHF Command	Line of sight communications

<u>NOMENCLATURE</u>	<u>COMMON IDENTIFICATION</u>	<u>USE</u>
6. AN/ARA-25	UHF Homing Adapter	UHF Homing
7. 618S-1 618S-1/MC	H.F. #1 and H.F. #2	Long Range Communications
8. AN/ARN-6	Radio Compass	LF/MF Reception and Homing
9. AN/ARN-12	Marker Beacon	Marker Beacon Reception
10. AN/ARN-14	OMNI	VHF Navigation
11. AN/ARN-18	Glide Path	Glide Path Reception
12. AN/ARN-21	TACAN	UHF Navigation
13. AN/APN-22	Pilot's Radio Altimeter	Absolute Altitude (Low)
14. SCR-718	Nav. Radar Altimeter	Absolute Altitude (High)
15. AN/APX-25	IFF	Identification
16. AN/APS-42A	Radar	Search Radar
17. AN/URC-4 or URC-11	Emergency Transceiver	Emergency VHF and UHF Communications
18. AN/CRT-3	Gibson Girl	Emergency Transmitter

Frequency And Operating Ranges

<u>COMPONENT</u>	<u>FREQUENCY RANGE</u>	<u>OPERATING RANGE</u>
1. ARC-49 VHF Command	100 - 156 mc	Line of Sight
2. Collins VHF-101 Command	Receiver 116 - 152 mc Transmitter 116 - 150 mc	Line of Sight Line of Sight
3. ARC-27A UHF Command	225 - 400 mc	Line of Sight
4. 618S-1 618S-1/MC High Freq.	2.0 - 25 mc	Long Range
5. ARN-6 Radio Compass	100 - 1750 kc	Short Range
6. ARN-12 Marker Beacon	75 mc	Radiation Pattern
7. ARN-14 OMNI	108 - 135.9 mc	Line of Sight
8. ARN-18 Glide Path	329.3 - 335 mc	Radiation Pattern
9. ARN-21 TACAN	962 - 1213 mc	Line of Sight
10. CRT-3 Gibson Girl	500 kc 8364 kc	Short Range Long Range
11. URC-4 Emergency Trans.	121.5 and 243.0 mc	Line of Sight

Location

The majority of the basic components are located on the main or auxiliary radio rack. The exceptions

are listed below.

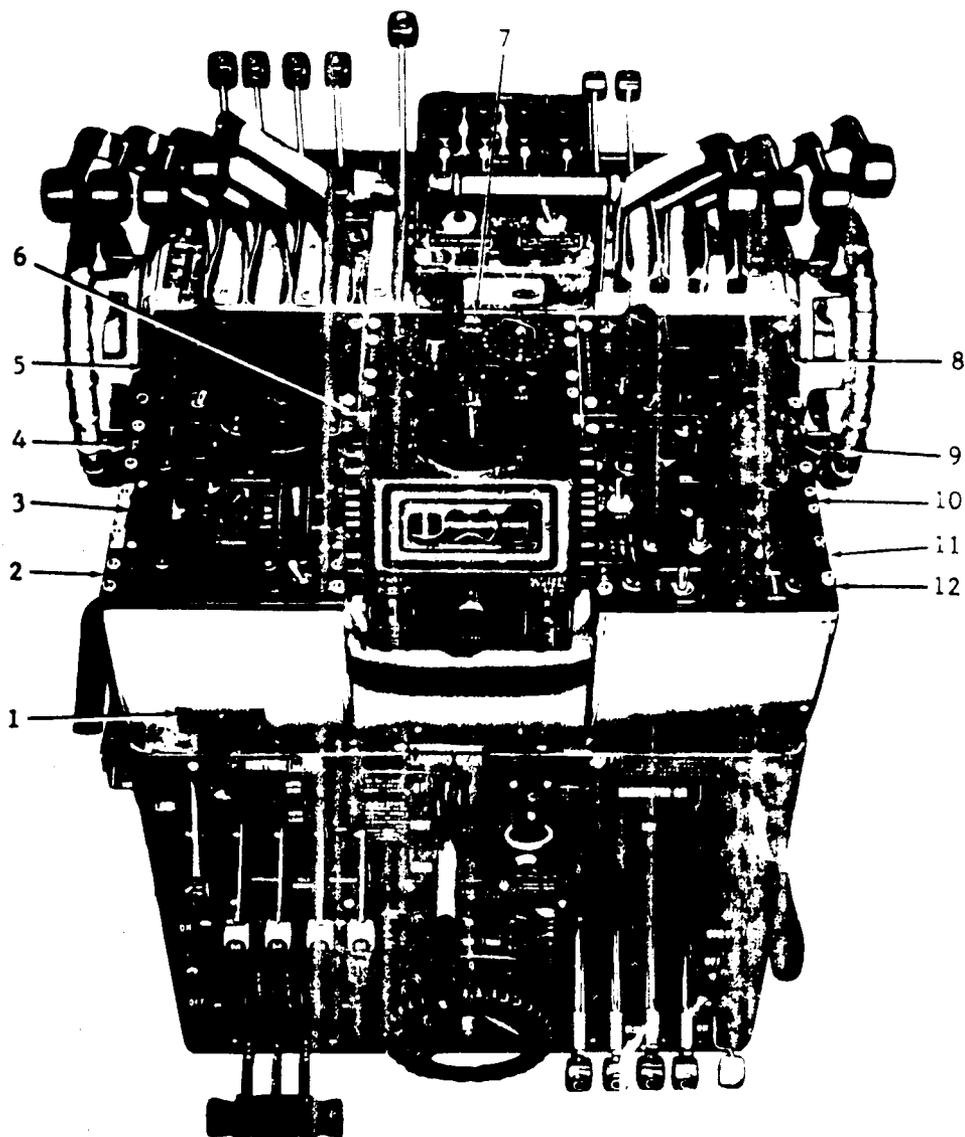
Note: See next four pages.

<u>COMPONENT</u>	<u>LOCATION</u>
1. AN/AIC-10, Dynamotors	Dynamotor compartment
2. AN/ARC-49, VHF Power Junction Box	Dynamotor compartment
3. 618S-1, H.F. #2 Antenna Tuner	Copilot's bulkhead
4. AN/ARN-21, TACAN Transceiver	Under navigator's table
5. AN/APS-42, Radar Transceiver	Nose wheel well

All of the remote controls are located on the pilot's pedestal or at the

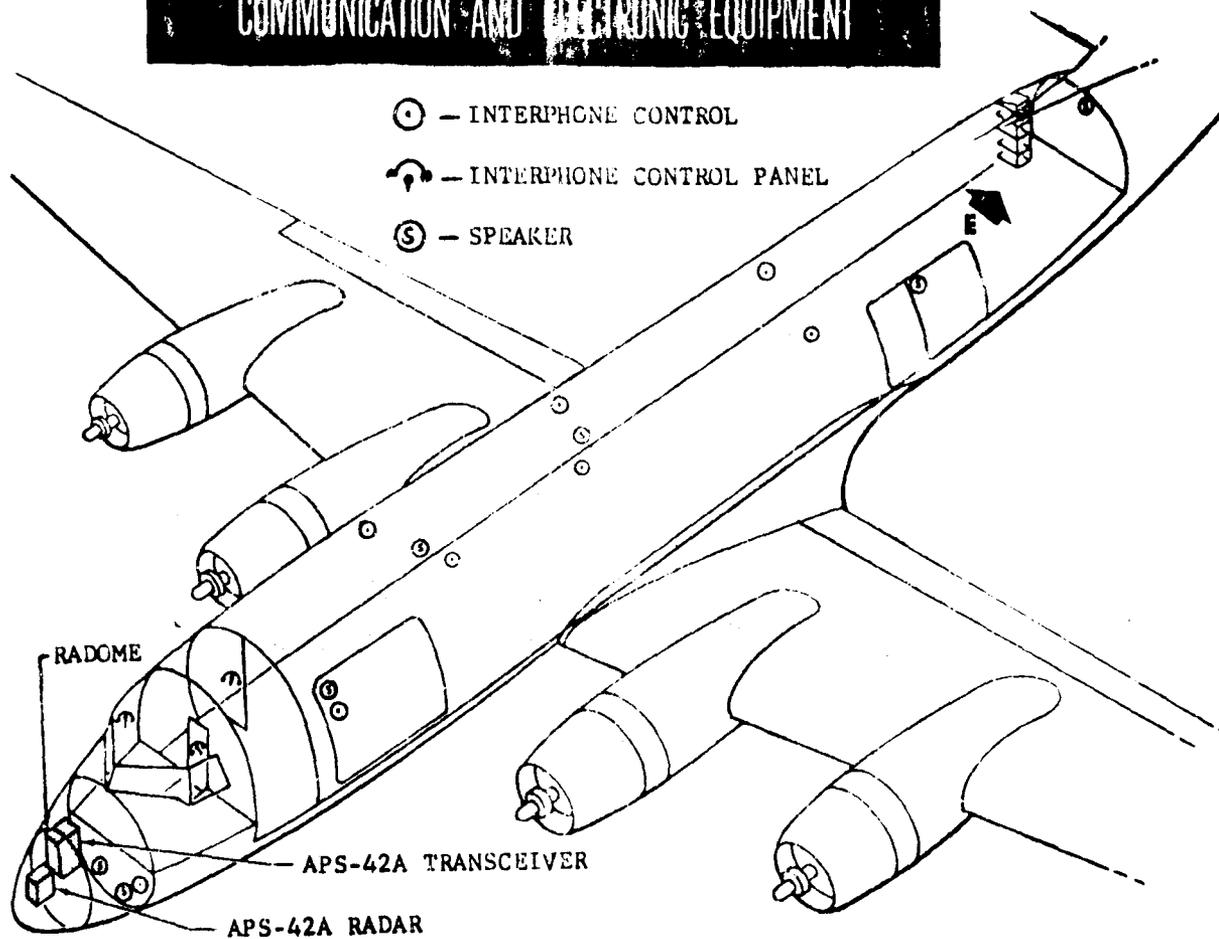
navigator's position except the radar pressurization control.

CONTROL PEDESTAL—Typical

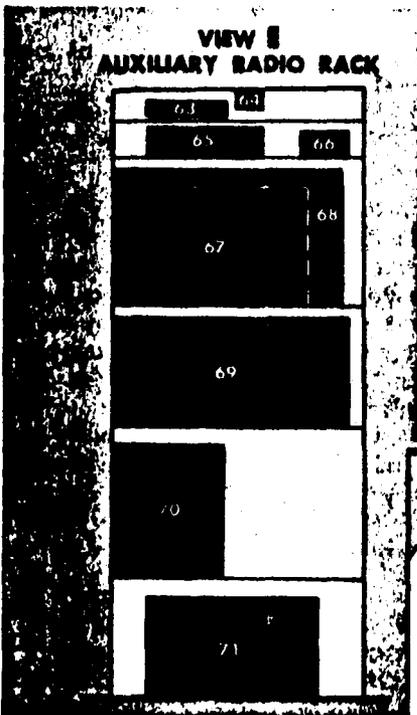
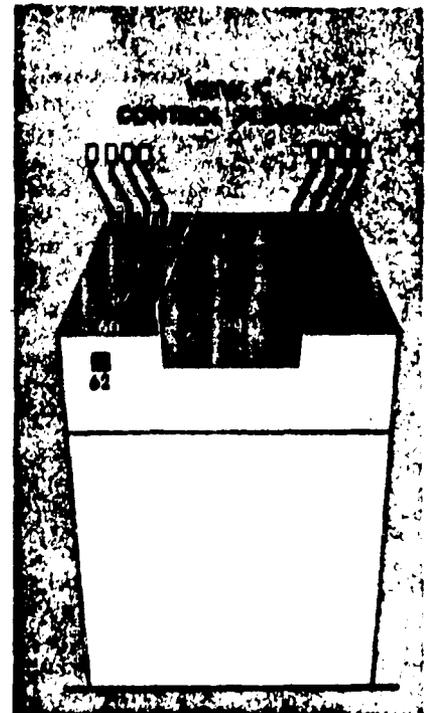
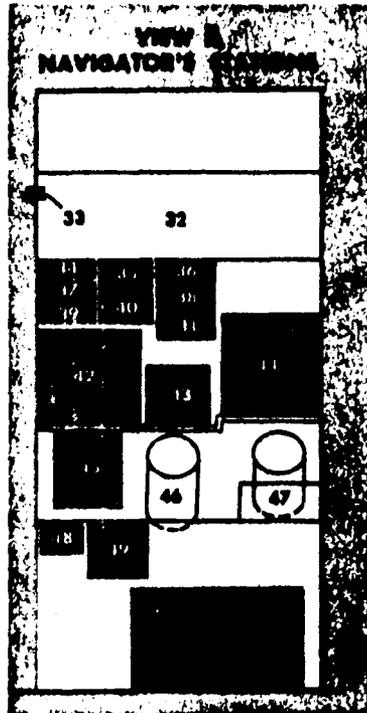
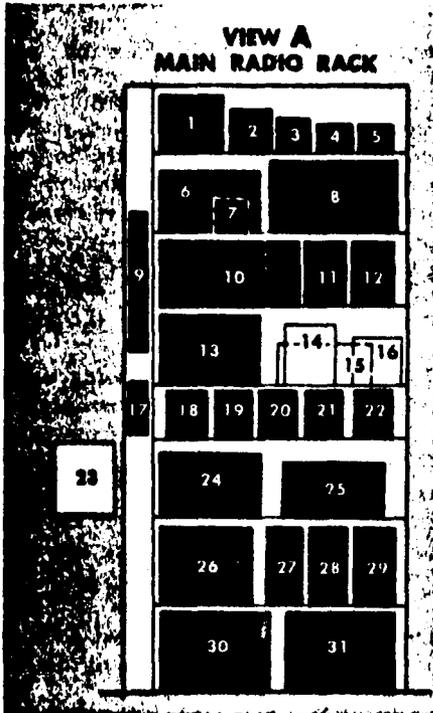


- | | |
|---------------------------------|-------------------------------|
| 1. RADIO PANEL LIGHTS RHEOSTAT | 7. UHF CONTROL PANEL |
| 2. ADF TUNING PANEL | 8. ADF-2 CONTROL PANEL |
| 3. VHF CONTROL PANEL | 9. HF-2 CONTROL PANEL |
| 4. HF-1 CONTROL PANEL | 10. TACAN CONTROL PANEL |
| 5. ADF-1 CONTROL PANEL | 11. VOR-TACAN TRANSFER SWITCH |
| 6. VHF NAVIGATION CONTROL PANEL | 12. PUBLIC ADDRESS PANEL |

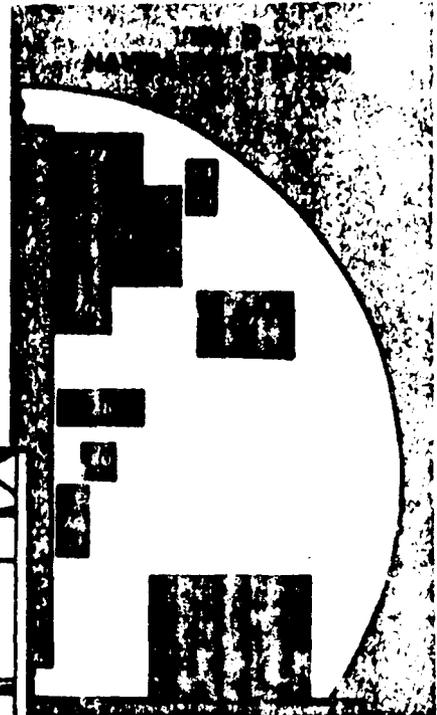
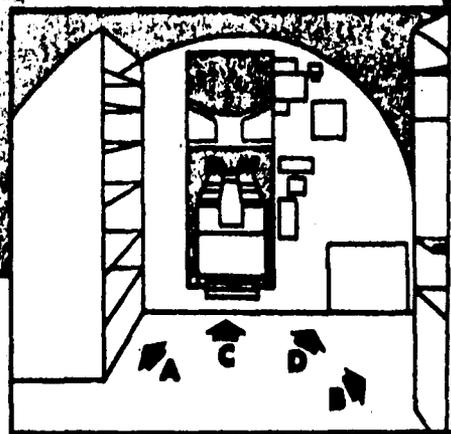
COMMUNICATION AND ELECTRONIC EQUIPMENT

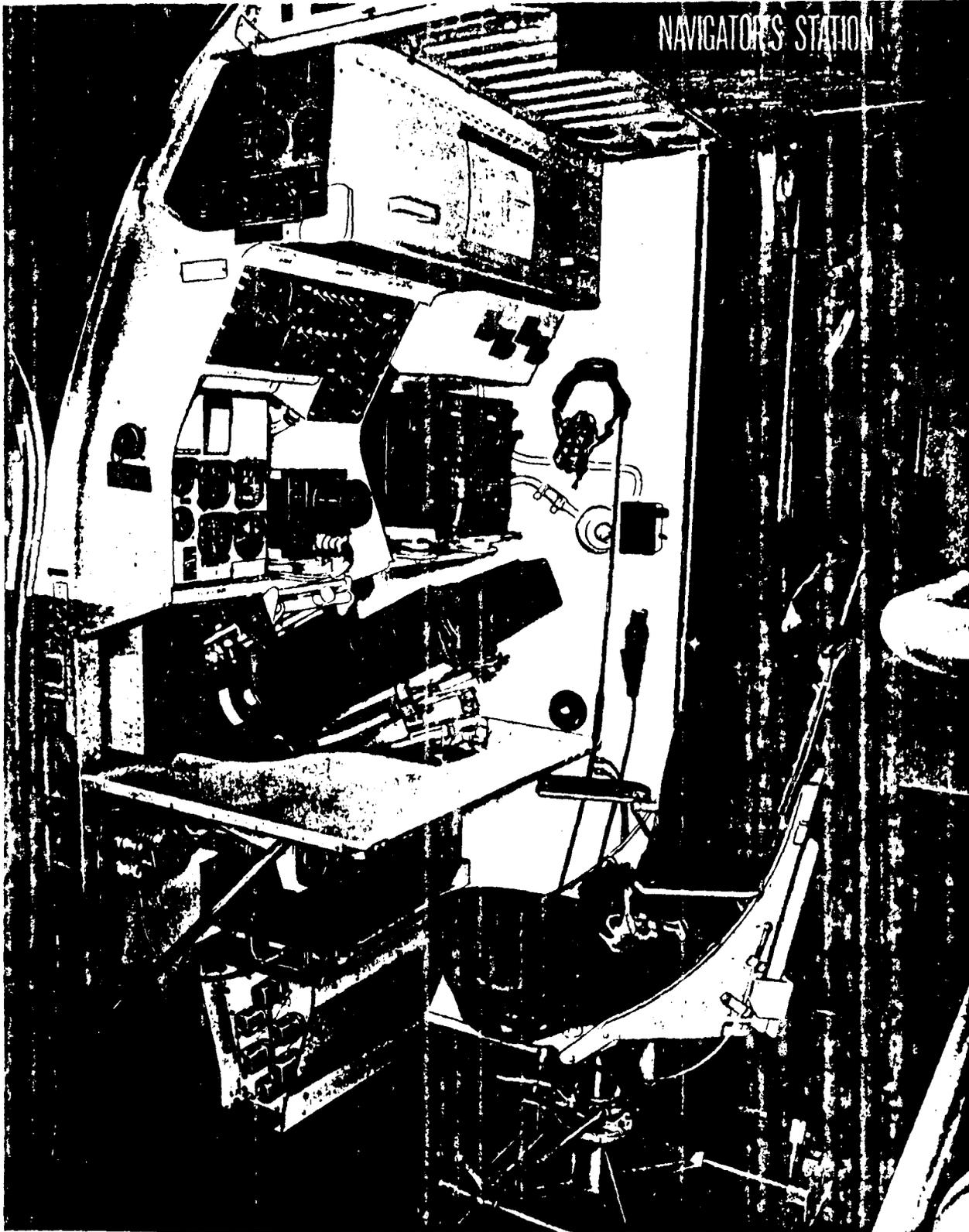


- | | | |
|------------------------------------|------------------------------------|--|
| 1. S-2 COMPASS AMPLIFIER | 29. PUBLIC ADDRESS AMPLIFIER | 57. VHF CONTROL PANEL |
| 2. CABIN PRESSURE AMPLIFIER | 30. ADF-1 RECEIVER | 58. AUTOPILOT CONTROLLER |
| 3. REPEATER AMPLIFIER | 31. ADF-2 RECEIVER | 59. TACAN CONTROL |
| 4. FIRE DETECTOR RELAYS | 32. NAVIGATOR CHART STOWAGE | 60. ADF TUNING METER |
| 5. FIRE DETECTOR RELAYS | 33. STANDARD POWER TEST RECEPTACLE | 61. VOR-TACAN TRANSFER SWITCH |
| 6. HF-1 ANTENNA TUNER | 34. SPACE ONLY | 62. PEDestal RADIO PANEL LIGHT INDICATOR |
| 7. SPACE ONLY | 35. INTERPHONE CONTROLS | 63. CIRCUIT BREAKERS |
| 8. HF-1 TRANSCEIVER | 36. BLANK PANEL | 64. IFF AND VOR TEST RECEPTACLE |
| 9. RADIO CIRCUIT BREAKERS | 37. SPACE ONLY | 65. NAV. RADAR ALT. TRANSCEIVER |
| 10. HF-2 TRANSCEIVER | 38. ADF-1 CONTROL PANEL | 66. VOR OBI |
| 11. HF-2 POWER SUPPLY | 39. IFF CONTROL PANEL | 67. VOR DYNAMOTOR |
| 12. HF-1 POWER SUPPLY | 40. INTERPHONE CONTROLS | 68. VOR RECEIVER |
| 13. SEARCH RADAR SYNCHRONIZER | 41. ADF-2 CONTROL PANEL | 69. UHF TRANSCEIVER |
| 14. MARKER BEACON RECEIVER | 42. NAVIGATOR'S EQUIPMENT PANEL | *70. IFF TRANSCEIVER |
| 15. COMPASS SIGNAL POWER AMPLIFIER | 43. AUTIMETER INDICATOR | *71. PILOT'S RADIO ALT. AMPLIFIER |
| 16. UHF HOMING AMPLIFIER | 44. LORAN RECEIVER | 72. HF-2 ANTENNA TUNER |
| 17. RADIO FUSE PANEL | 45. RADAR CONTROLS | 73. ANTENNA RELAY |
| 18. OIL QUANTITY AMPLIFIERS | 46. RADAR INDICATOR | 74. ENGINE ANALYZER CONTROLS |
| 19. OIL QUANTITY AMPLIFIERS | 47. LORAN INDICATOR | 75. LORAN COUPLER |
| 20. FUEL QUANTITY AMPLIFIERS | 48. PHASE DETECTOR NETWORK | 76. PRESSURIZING KIT CONTROLS |
| 21. FUEL QUANTITY AMPLIFIERS | 49. AZIMUTH INDICATOR | 77. ENGINE ANALYZER POWER SUPPLY |
| 22. ADF TUNING AMPLIFIER (TWO) | 50. TACAN TRANSCEIVER | 78. PRESSURIZATION PUMP |
| 23. EMERGENCY TRANSMITTER | 51. ADF-1 CONTROL PANEL | 79. INDICATOR |
| 24. VHF TRANSMITTER | 52. UHF CONTROL PANEL | 80. SWITCH |
| 25. VHF RECEIVER | 53. ADF-2 CONTROL PANEL | 81. DYNAMOTOR COMPARTMENT |
| 26. AUTOPILOT AMPLIFIER | 54. HF-1 CONTROL PANEL | |
| 27. AUTOPILOT APPROACH AMPLIFIER | 55. VOR CONTROL PANEL | |
| 28. GLIDE SLOPE RECEIVER | 56. HF-2 CONTROL PANEL | |
- *SPACE TRANSCEIVER ONLY



For location of view E
See opposite page





Power

All of the communication and radio navigation equipment except the radar altimeter and IORAN requires DC power.

Some of the equipment requires additional AC power. The components and its inverter power source is listed below:

<u>Radar Inverter</u>		<u>Radio Electrical Inverter</u>	
1. AN/APS-42A	Radar	1. 6183-1 618S-1/MC	HF Nr 1 and HF Nr 2
2. AN/ARN-21	TACAN	2. AN/ARN-18	Glide Path
3. SCR-71E	NAV Altimeter	3. FMIs	Radio Magnetic Ind.
		4. UHF/ADF	Homing Adapter
		5. AN/APN-22	Pilot's Altimeter
		6. ID-249	Donut Needle
		7. AN/APX-25	IFF

Protective Devices

All communications and navigation equipment is protected by a fuse or circuit breaker on the main or auxiliary radio rack fuse and circuit breaker panels. Additional protection is provided as indicated.

- 1. VHF Power junction box
- 2. 618S-1 618S-1/MC Power units
- 3. AN/APX-25 Front of transponder
- 4. SCR-71E R/T unit
- 5. AN/APS-42A Synchronizer

reflection of these skywave signals makes long range communications possible.

Very high and ultra high communications contain only skywaves. These skywaves are not normally reflected by the ionosphere, as a result only line of sight communications are possible in these frequency ranges.

Note: See illustrations on next two pages.

Radio Wave Propagation

- 30 - 300 kc - Low Freq. (LF)
- 300 - 3000 kc - Medium Freq. (MF)
- 3 - 30 mc - High Freq. (HF)
- 30 - 300 mc - Very High Freq. (VHF)
- 300 - 3000 mc - Ultra High Freq. (UHF)

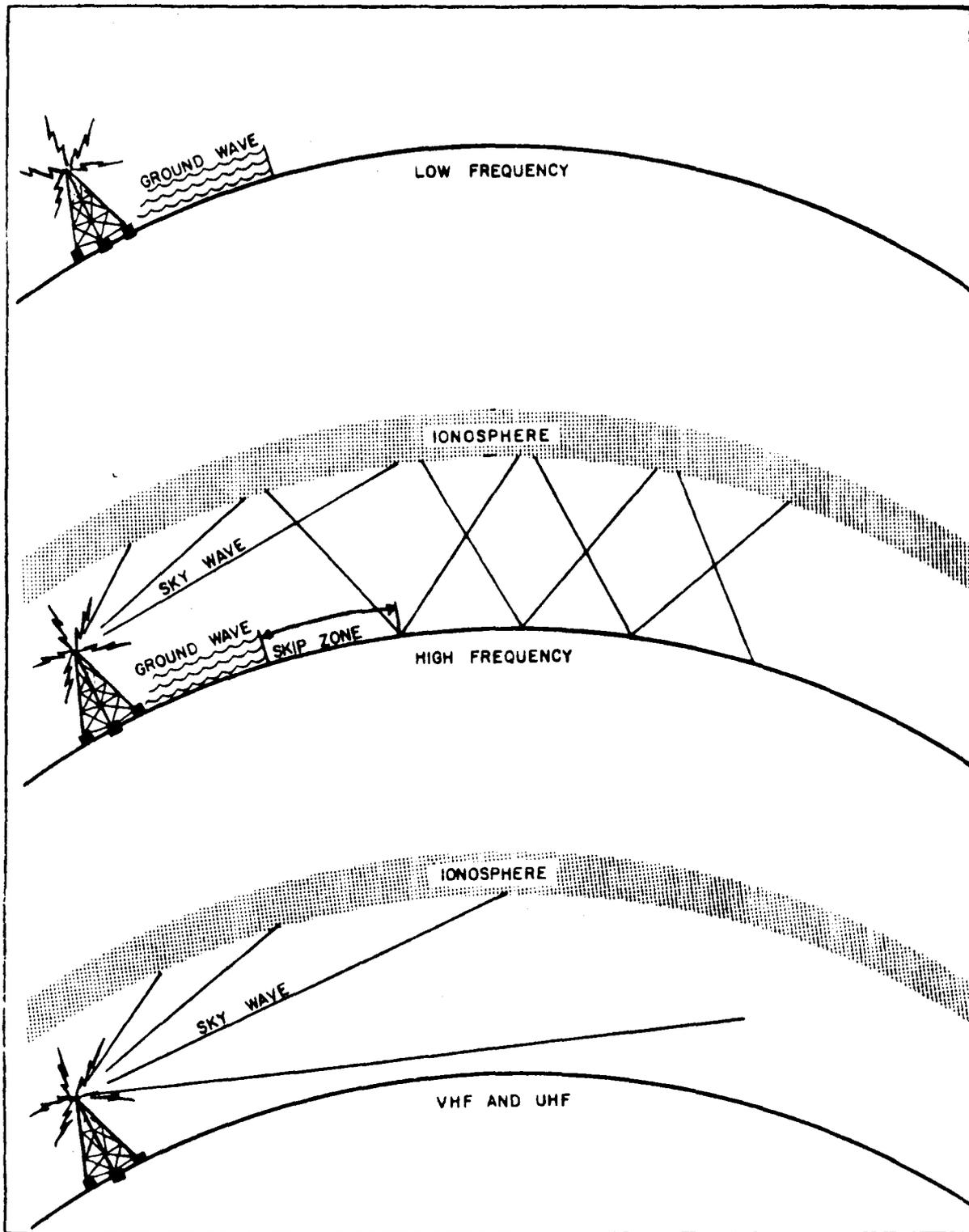
Low frequency and medium frequency communications are primarily ground waves. The range of ground waves is limited by the transmitted power.

High frequency communications contain both a ground and skywave. The skywave is predominate and is usually reflected back to earth by the ionosphere. The ionosphere being comprised of electrically charged particles. The

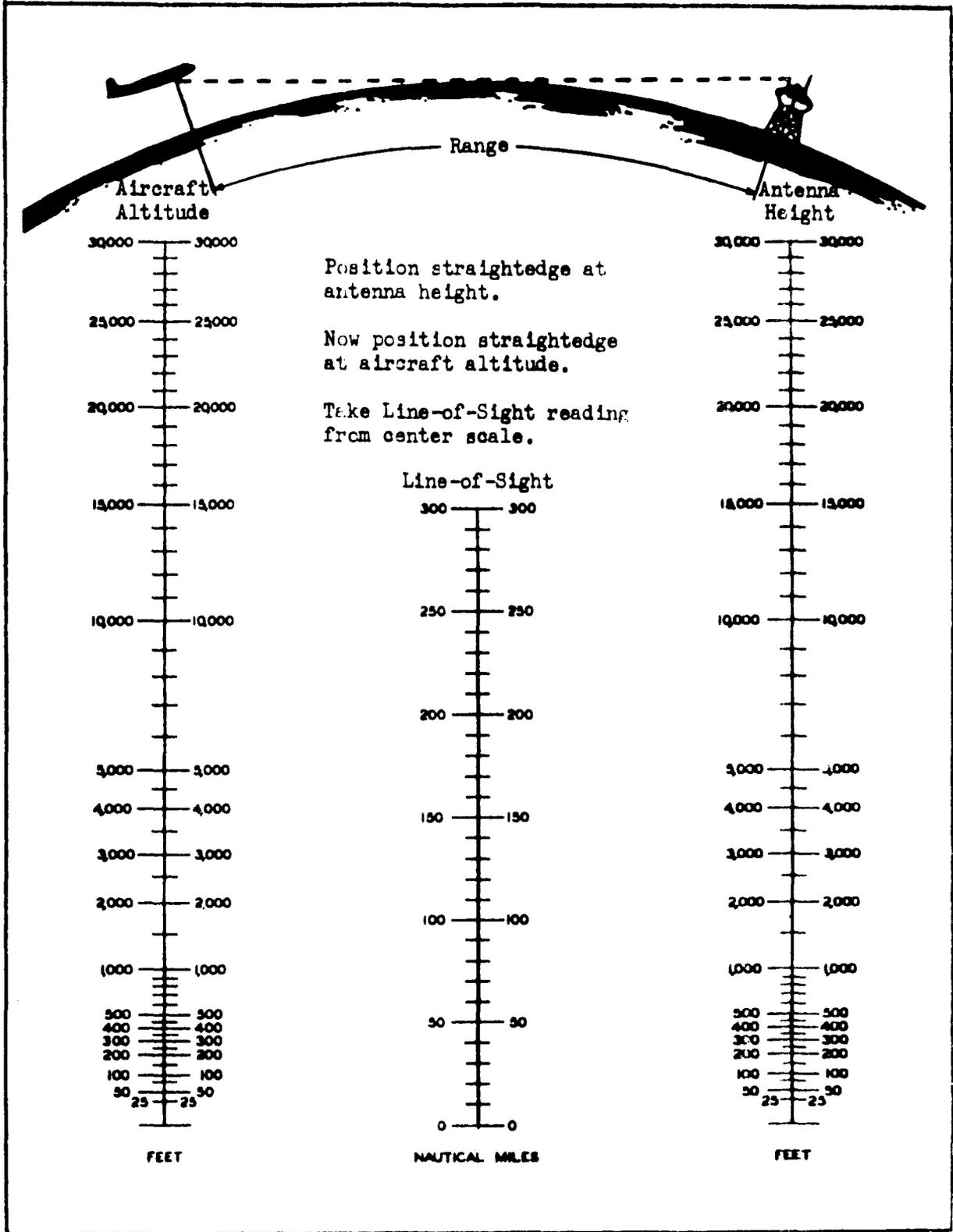
Communication Phraseology

The following words or phrases are commonly used in association with communication and navigation equipment.

- Dynamotor
 - Power junction box
 - Power supply
 - Power unit
- } These four phrases denote a component which modified the power available from the aircraft to that required by the radio equipment.
- Volume Control - A variable control that varies the volume of a received signal.



RADIO WAVES

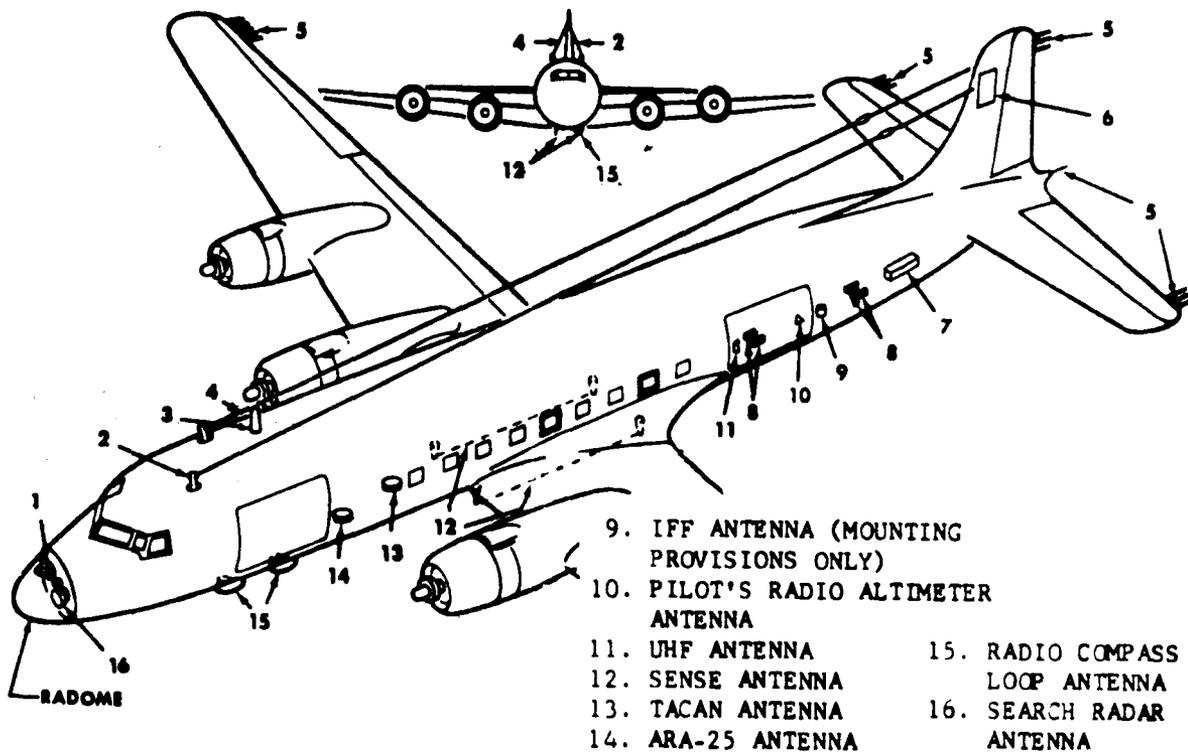


EARTH CURVATURE NOMOGRAPH

- Receiver — The component which converts received electrical currents into visual and/or audible signals.
- Transmitter — The component which produces and emits electrical currents (radio waves).
- R/T Unit Receiver-Transmitter Transceiver — A component which is capable of receiving and transmitting radio signals.
- Transponder — A component that must receive and interrogate the proper signal before it will trigger the transmitter to make a reply.
- Radar — Radio ranging and detecting.
- TACAN — Tactical air navigation.
- Remote control — A control that is located distant from the component which it controls.

RADIO ANTENNAS

- | | |
|-----------------------------------|--|
| 1. GLIDE SLOPE ANTENNA | 5. STATIC DISCHARGES |
| 2. HF-1 ANTENNA | 6. VOR ANTENNA (FLUSH) |
| 3. VHF ANTENNA | 7. MARKER BEACON ANTENNA |
| 4. HF-2 ANTENNA AND LORAN ANTENNA | 8. NAVIGATOR'S RADAR ALTIMETER ANTENNA |



Chapter 2

INTERPHONE SYSTEM

The AN/AIC-10 interphone system provides:

1. Voice Communication between all Crew members.
2. Communication outside the aircraft by integration with radio equipment.
3. Ability to monitor one or more radio receivers simultaneously.
4. Ability to attenuate low frequency range or voice signals.

The AN/AIC-10 interphone system has:

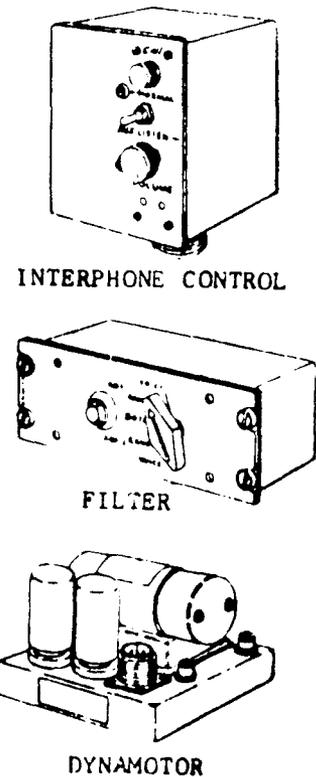
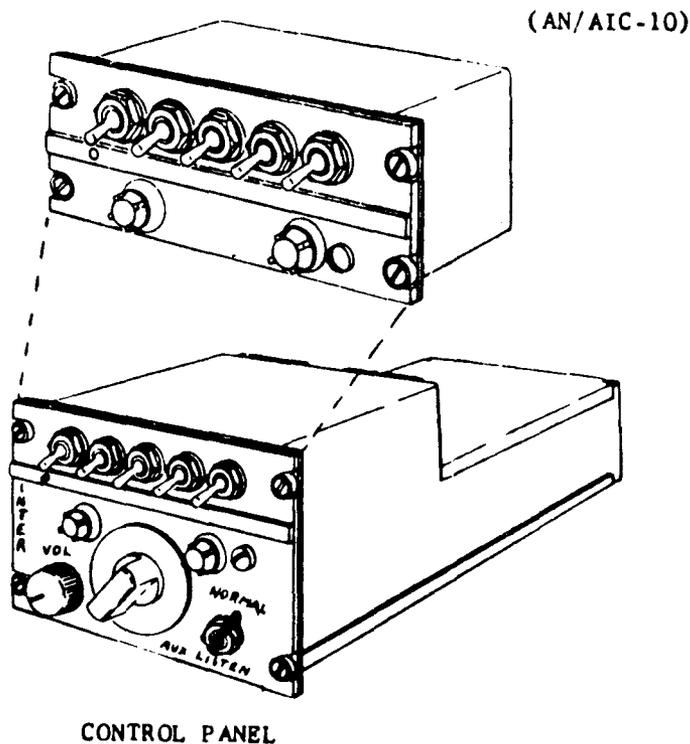
- 3 - interphone control panels
- 8 - interphone controls
- 2 - dynamotors
- 2 - low frequency range filters

Interphone Control Panels

There is an interphone control panel at the pilot's, copilot's and navigator's position. The system is so designed that a malfunction of one control panel will not normally affect the other control panels. On each control there are 10 audio selectors, a microphone selector, volume control and a normal/aux listen switch.

Audio Selectors

The 10 audio selectors are two-way toggle switches, which are electrically connected to the various receivers. Positioning the selector to the "UP" (on) position allows that crew position to monitor the selected receiver. It is possible to monitor all 10 audio selectors simultaneously.



Microphone Selector

The microphone selector connects the operator's microphone to the various transmitters. The spring loaded CALL position furnishes the operator with a "hot" microphone and permits that crew member to transmit and be received at all crew stations, regardless of the position of the audio selectors at the various stations. All other reception is interrupted at all stations and only the call transmission is heard.

The microphone selector will automatically supply the user with both a talk and listen facility regardless of the position of the associated audio selector.

Volume Control

The volume control allows the operator to vary the volume of received signals in the NORMAL position only.

Normal/Aux Listen Switch

The Normal/Aux Listen switch is a two-way toggle switch which is safety wired to the NORMAL position. The AUX LISTEN position is used only when the system is not operating normally. The purpose of this switch is to bypass the mixer amplifier.

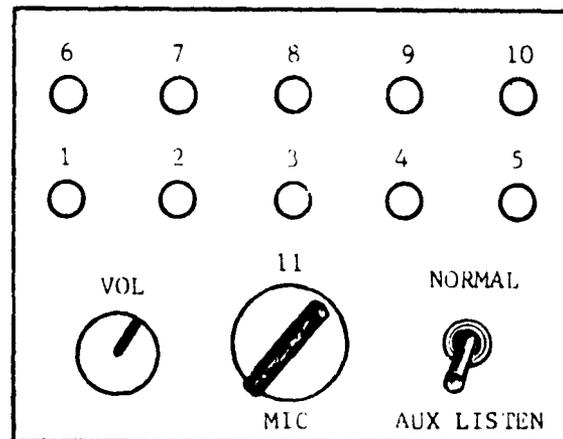
Mixer Amplifier

Mixer amplifier is the common terminology for a subassembly of the AN/AIC-10 interphone system. There is a mixer amplifier located in each interphone control panel and each interphone control. This subassembly performs three functions.

1. Audio amplifier, which amplifies weak audio signals received.
2. Interphone amplifier, making interphone transmission possible.

3. Preamplifier for the microphone making voice transmission possible.

Since the mixer amplifier is in the headset and microphone circuit, a malfunction will cause loss of all reception and voice transmission at the associated crew position. Reception can be maintained by using the Aux Listen Circuit. In the AUX LISTEN position, the mixer amplifier is bypassed, thereby limiting the operator to single reception and CW transmission. To preclude the possibility of two systems being selected, a priority system has been incorporated so that only one audio circuit will be received, regardless of the control settings. Refer to the following diagram for the priority system.



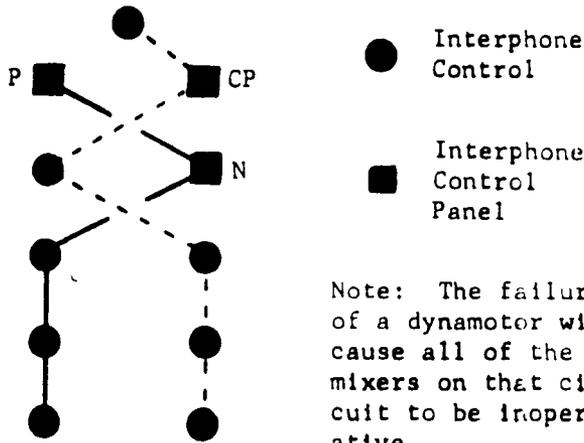
Interphone Controls

The interphone control furnishes the operator with communications between crew members only. Located on the control is a Call button, Volume Control and Normal/Aux Listen switch. There are eight interphone controls in the C-118 A/C as follows:

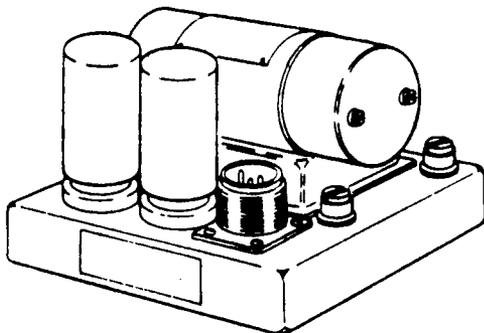
- 1 - nose wheel well
- 1 - forward cargo loading door
- 6 - main cabin

Dynamotors

Two dynamotors furnish 175 volts DC to the mixer amplifiers. Below is a diagram of the separate and independent circuits:



Note: The failure of a dynamotor will cause all of the mixers on that circuit to be inoperative.

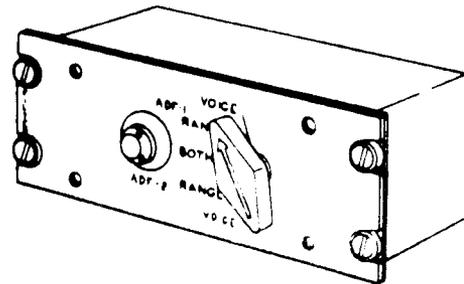


DYNAMOTOR

F-90 Filter

A filter is located at the pilot's and copilot's position. It enables the operator to diminish the unwanted portion of the dual transmission from a radio range station. The operator must select the facility desired. For example, in the "Voice" position, the range signal will be diminished. In the "Range" position the voice signal

will be diminished. In the "Both" position, there will be no filtering action, so both the range and voice feature will be heard.



FILTER

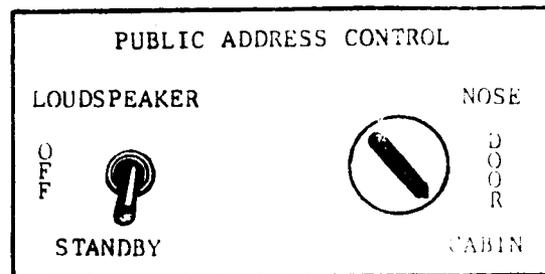
MI-36 Public Address System

The public address system has 7 speakers, 2 amplifiers, a volume control, and a remote control. Complete operation is possible from the cockpit. The function selector located on the remote control has three positions, Standby, Off, and Loudspeaker.

The three position speaker selector provides the operator with a choice of speakers. (Doors, Cabin, Nose)

A volume control on the forward cargo loading door controls the volume of that speaker only.

To operate, select Loudspeaker on the function selector and the desired speakers. Next position the microphone selector to Interphone, now any transmission on interphone will be broadcast over the public address system.



Chapter 3

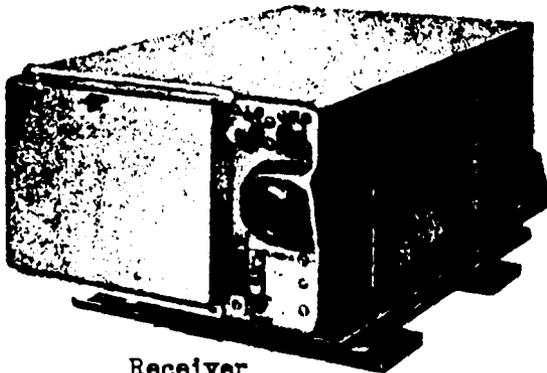
COMMAND EQUIPMENT

AN/ARC-49 (VHF)

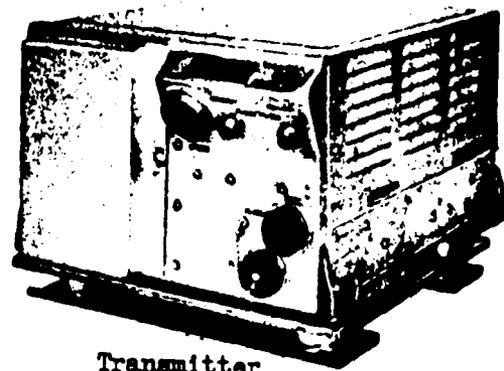
A very high frequency command communications system, the ARC-49 provides short range (line of sight) 2-way radio communication with ground stations or other aircraft. The operating range of the VHF command set is determined by altitude and the power output of the transmitter. This may vary from approximately 40 miles at 1,000 feet to approximately 135 miles at 10,000 feet, which is the maximum reliable range due to the limited power of the transmitter.

The main units and their purpose are:

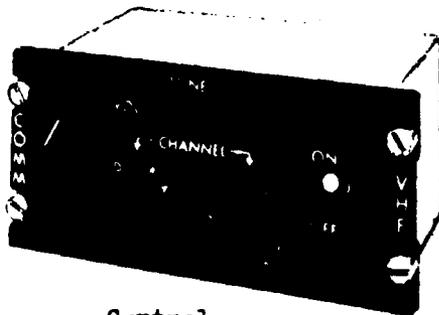
1. Transmitter - Voice, CW or MCW transmission in the 100-156 megacycle range.
2. Receiver - Voice or MCW reception in the 100-156 megacycle range.
3. Power Junction Box - Converts 24-28V DC input to high voltage DC for operation of the transmitter and receiver.
4. Control Panel - Enables the operator to select the desired channel, turn set ON or OFF and to transmit MCW (tone) by depressing the tone button.



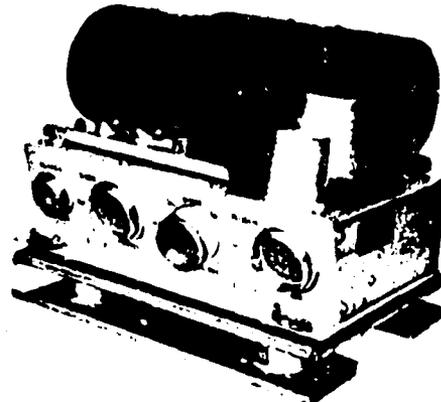
Receiver



Transmitter



Control



Power Junction Box

ARC-49 VHF COMMAND COMPONENTS

Tuning is accomplished by the selection of any one of forty-eight automatically tuned crystal-controlled channels.

Operation:

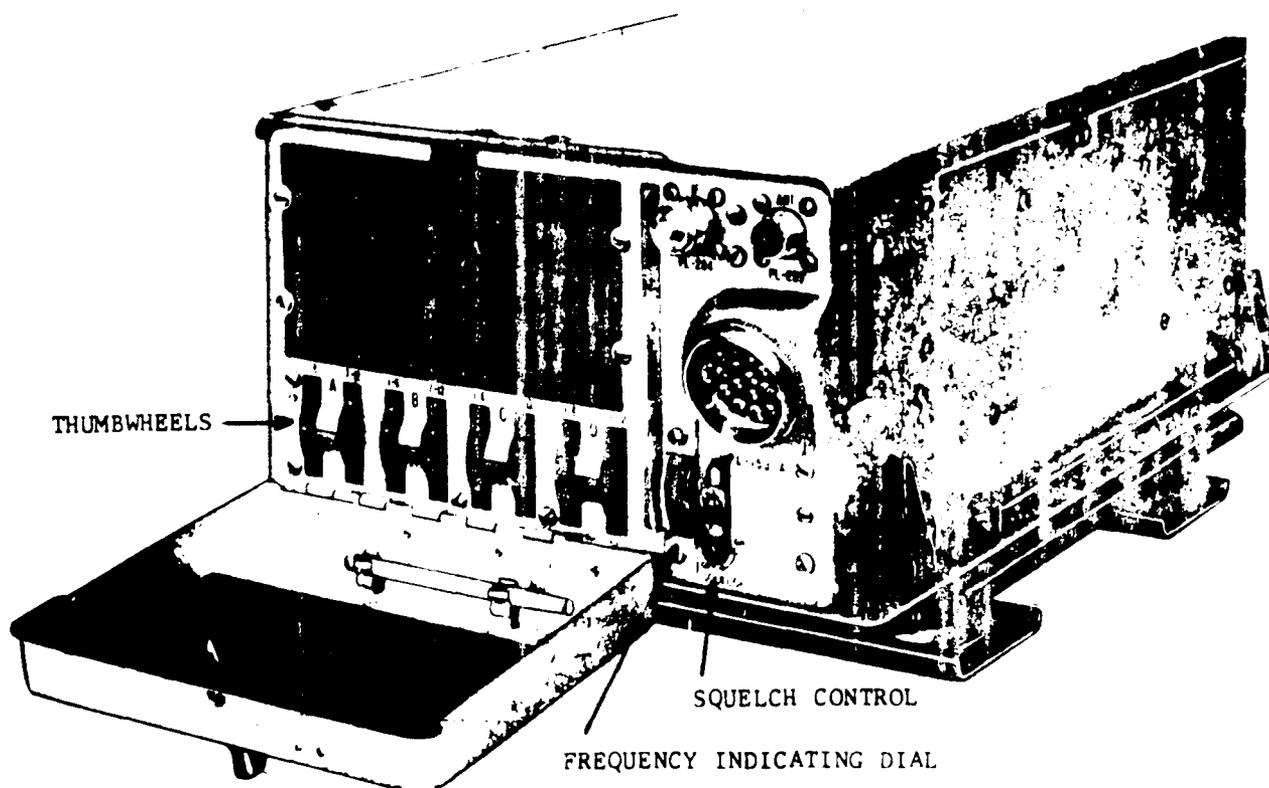
To use the VHF Command Set, the microphone selector on the interphone control panel must be in the VHF Command position.

Move the ON-OFF switch on the VHF Remote Control to the ON position and the channel selectors to the desired channel. Wait 30 to 45 seconds for the equipment to warmup. During the latter portion of this period, an audio tone will be heard in the headset. When this tone stops, the receiver and transmitter have tuned to the selected channel and operation should then be possible.

Depress the microphone button and speak into the microphone. Speech (side-tone), which modulates the transmitter, should be audible in the headset. If none is heard check to make sure a crystal has been inserted for that channel of the transmitter.

NOTE: On certain modifications of the transmitter, sidetone will be heard in the headset, even though no crystal is installed and the transmitter is not generating radio frequency power.

When the transmitter is keyed, the high voltage is disconnected from the receiver, making it inoperative. Releasing the microphone press-to-talk switch will restore the receiver to operation. The level of audio signal is controlled by the volume control on the VHF control panel.



ARC-49 CRYSTAL COMPARTMENT DOOR OPEN

Note: If either the transmitter or receiver have tuned incorrectly, select some other channel and then reselect the desired channel. Repeated mistuning indicates a defective crystal, an incorrect setting of the thumb wheels, a low DC bus voltage, or some defect in the equipment that cannot be corrected in flight.

Squelch Control

The Squelch control is a screwdriver adjustment located on the front of the receiver. This control is utilized to adjust the level of background noise and operating range of the receiver. Rotation of this control will increase or decrease the sensitivity of the receiver. An increase in the squelching action will result in a less sensitive receiver, allowing less background noise and limiting the operating range. A decrease in the squelching action will make the receiver more sensitive, increasing background noise and operating range. Normal adjustment of this control is accomplished so that comfortable listening level of background noise is heard in the headset. This should insure a satisfactory operating range.

CAUTION

1. Do not turn the set off while it is channeling.
2. Do not turn set on for at least 1 minute after set has been turned off.

Collins VHF-101

The Collins VHF-101 provides the operator with the ability to communicate on 680 operating frequencies in the frequency band of 116 to 150 mc. The equipment consists of a transmitter, receiver, and remote control. The operating controls, and a brief

description of their functions are listed below.

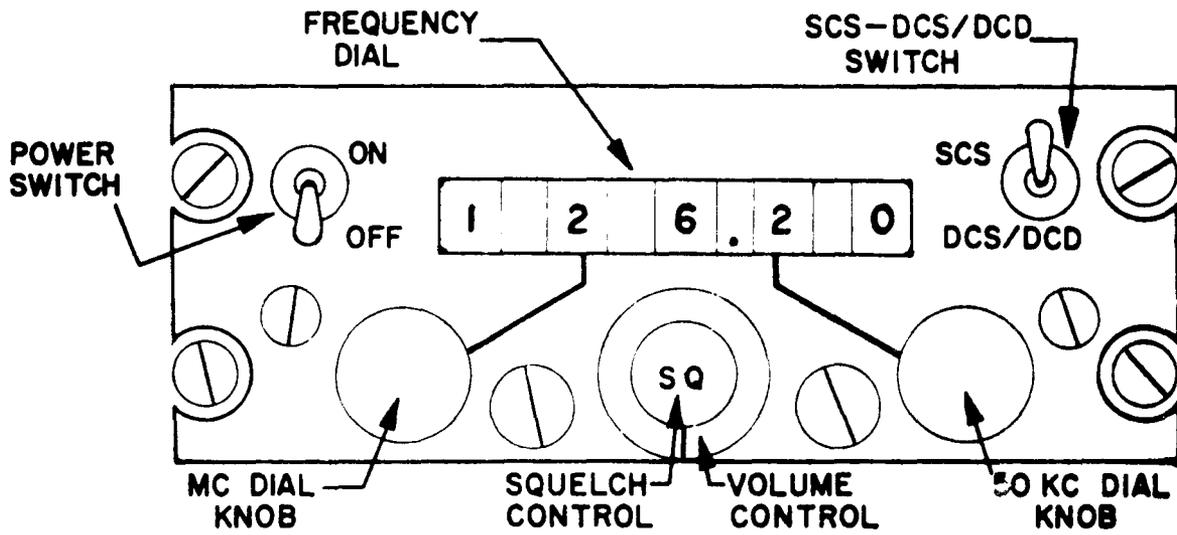
1. Power Switch - turns equipment ON or OFF.
2. SCS-DCS/DCD Switch -
 - SCS - Single Channel Simplex
 - DCS - Dual Channel Simplex
 - DCD - Dual Channel Duplex

This switch enables the operator to select the same operating frequency for transmitting and receiving (SCS), or a transmitting frequency six megacycles above the receiving frequency (DCS/DCD).

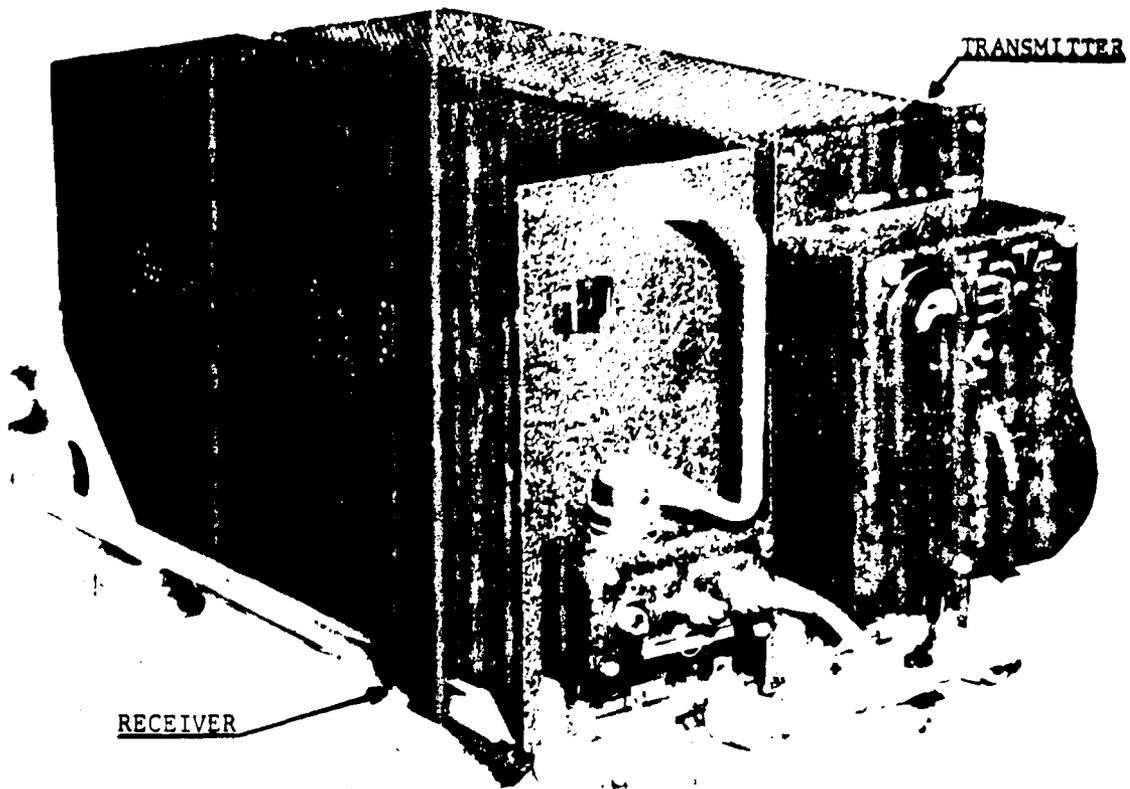
3. Frequency Dial - Indicates the selected operating frequency.
4. MC Dial - Used to select the whole megacycle of the desired frequency such as 126.00 mc.
5. 50 kc Dial - Used to select the 50 kilocycle step of the desired frequency such as 126.20 mc.
6. Volume Control - Increase or decrease the signal level in the headset.
7. Squelch Control - Used to reduce background noise in the headset.

Operation

1. DC Power - ON
2. Power Switch - ON
3. SCS-DCS/DCD Switch - SCS
4. MC Dial - Desired whole megacycle
5. 50 kc Dial - Desired 50 kc step of frequency
6. Volume Control - As desired



REMOTE CONTROL



COLLINS VHF 101

7. Squelch Control - Comfortable listening level of background noise

Note: The SCS-DCS/DCD switch is normally safety wired to the SCS position.

UHF Command AN/ARC-27A

This UHF Radio is a complete airborne transmitting and receiving station, providing two-way communication on any one of 1750 frequencies (225.0 to 400 mc). Any twenty of these frequencies may be preset on the twenty channels for remote operation from the cockpit. The set also has a guard channel in which the frequency could be changed, but for standardization should always be on the emergency frequency of 243.0 mc. Continuous monitoring of the emergency frequency is possible by using the guard receiver. A manual channel is also provided so the operator can use a frequency that has not been preset.

Operation

1. DC Power - ON
2. Function Selector - T/R
3. Channel Selector - Desired Channel
4. Volume Control - As Desired

Note: The above procedure will enable the operator to transmit and receive on the selected channel only. To monitor the guard frequency simultaneously, select the T/R + G position.

Installing a Frequency on the Manual Channel

1. Function selector to T/R
2. Channel selector to manual
3. Dial desired frequency on frequency

selector

Sensitivity Adjustment

There are two sensitivity adjustments on the ARC-27A located on the transceiver. To adjust the sensitivity controls on the transceiver:

1. Select the T/R position.
2. Vary the main receiver sensitivity control so that a comfortable noise level is obtained.
3. Select the T/R + G position.
4. Repeat step No. 2 using the guard receiver sensitivity adjustment.

UHF Homing Adapter AN/ARA-25

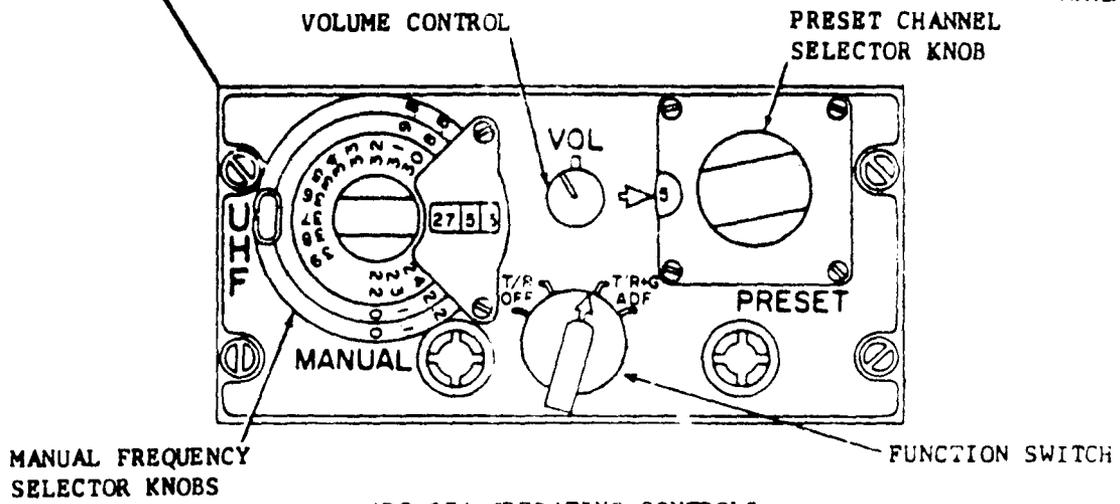
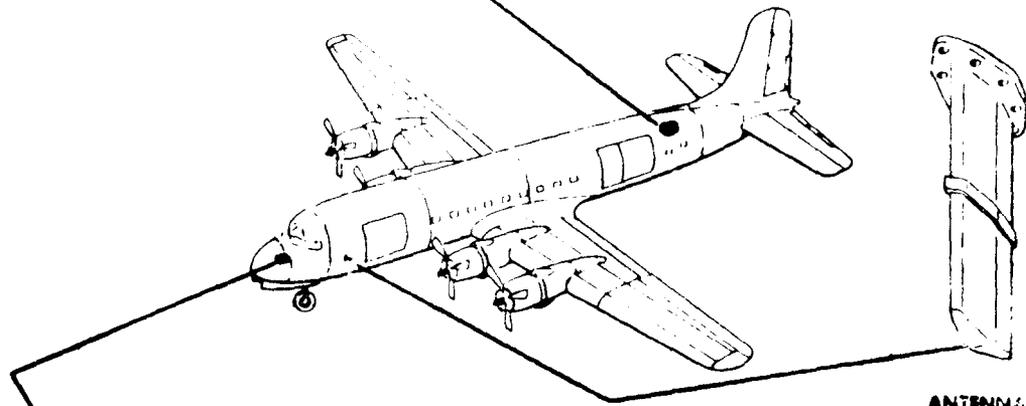
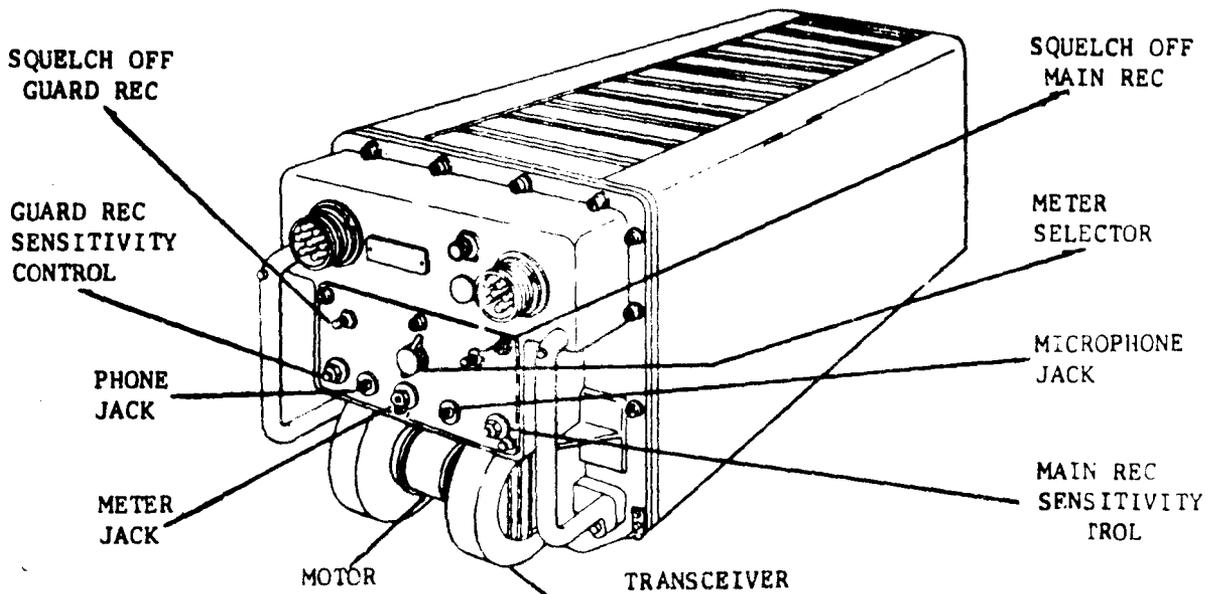
The UHF Homing Adapter is used in conjunction with AN/ARC-27A UHF command equipment to provide the pilot with relative and magnetic bearings to any UHF transmitter, that is transmitting in the frequency range (225 to 400 mc).

The homing adapter is put into operation by selecting the ADF position on the UHF remote control. No warmup time is necessary if the function selector was in the T/R or T/R + G position.

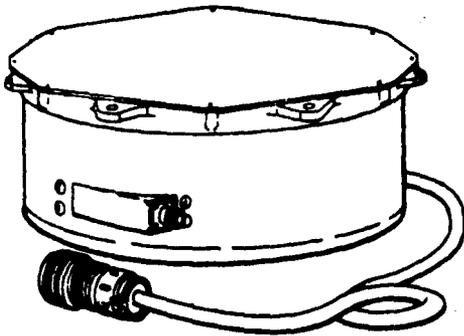
This equipment may be utilized for homing or direction finding depending on the pilot's need. Information displayed on the radio magnetic indicator (RMI) will be accurate within + or - 4°.

Operation

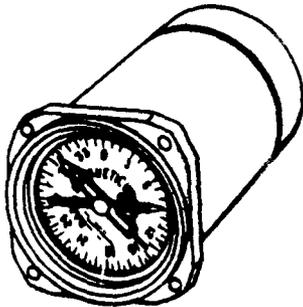
1. DC and AC Power - ON
2. Function selector - ADF
3. Select frequency and insure station is transmitting.
4. Read RMI.



ARC-27A OPERATING CONTROLS



ANTENNA



RADIO MAGNETIC INDICATOR

HF Command Radio Set 618S-1

The 618S-1 is a complete airborne station providing the pilot with communications of short and long range in the HF Band (2.0 - 25.0 mc or 2,000 - 25,000 kc).

The main components and their purposes are:

1. Transceiver - Voice or CW transmission and reception.
2. Power Supply - Converts aircraft power supplies to higher power for operation of the transceiver and antenna tuner.

3. Antenna Tuner - Electronically shortens antenna wire to match operating frequency.
4. Remote Control - Allows operation to turn set on or off, select desired frequency, and adjust volume of received signals.

The controls are located on the control pedestal. Operation requires AC and DC voltage. The equipment is protected by fuses and circuit breakers on the power supplies in addition to the main circuit breaker panel.

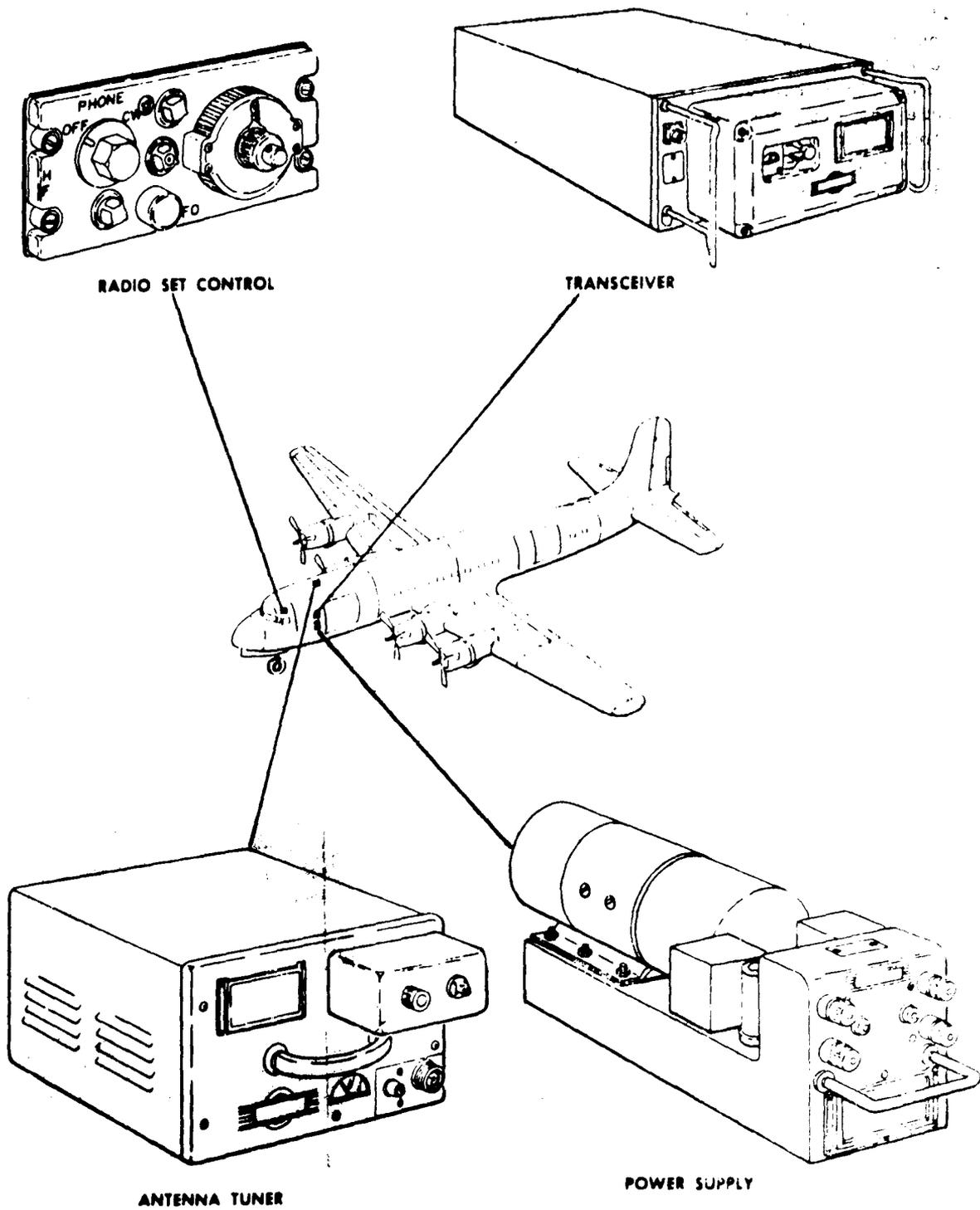
Operation Reception

1. DC and AC (inverter power) - ON
2. Function Selector - Phone (for Voice or MCW reception)
3. Channel Selector - Desired Channel
4. Volume Control - As Desired

Transmission

1. DC and AC (inverter power) - ON
2. Function Selector - Phone (for voice transmission)
3. Channel Selector - Desired Channel
4. Volume Control - As Desired
5. Depress microphone button momentarily and observe red light on the remote control. When the light goes out the set is ready for operation.

Note: 618 S-1 Antenna Tuners are equipped with a thermal time

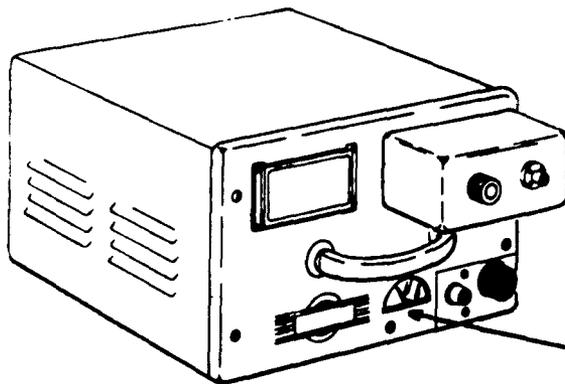


Radio Set 618S-1, Component Locations

delay switch. Should a malfunction of the equipment occur, the thermal switch will be energized to prevent overheating of the system. After attempting to tune for 45 seconds, the equipment will become inoperative. Do not attempt to tune any frequency for a period of one minute, in order to allow the antenna tuning unit to cool. After the antenna tuning unit has cooled the operator should channel away from the present frequency and immediately back to the desired frequency and again engage the microphone to return the antenna.

SWR Meter

The SWR meter located on the antenna tuner measures the standing wave ratio. Standing wave ratio being the transmitting power lost due to a malfunction in the Antenna tuner. The SWR meter needle deflection provides the operator with an indication of the amount of transmitting power which is lost, or how well the antenna tuner is functioning. The meter has a scale from 0 to 10, the lowest possible reading is desirable to insure satisfactory transmitting ability. Should the reading be in excess of 3.5, transmission would be unsatisfactory and the operator should select another operating frequency.



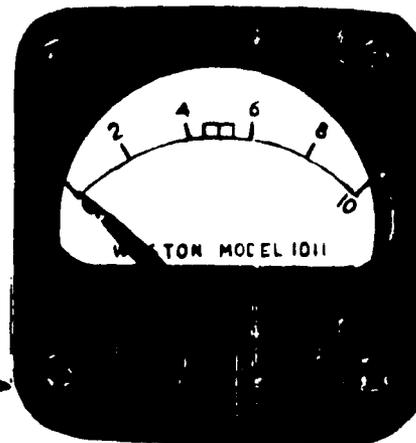
ANTENNA TUNER

Multimeter

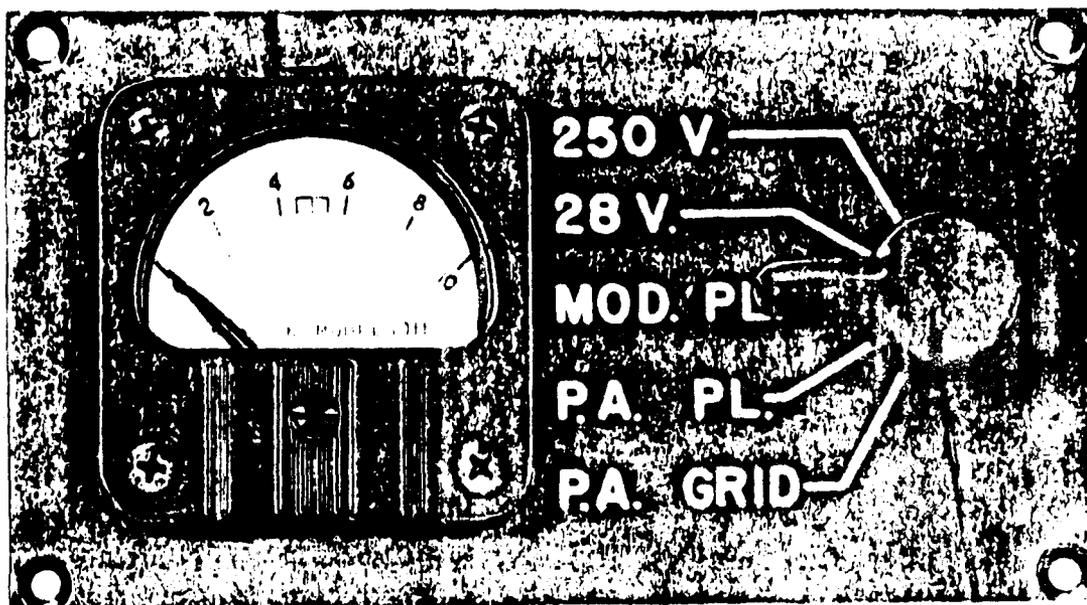
The multimeter on the front of the transceiver measures voltage in five circuits of the equipment by use of a five position switch. When the switch is placed in the 250V position, the indicator will deflect to the red area indicating the high voltage supply is normal. A faulty power supply or inverter will cause an abnormal reading. The fuses on the power unit should be checked if no reading is present.

Placing the switch to the 28 Volt position measures the input DC voltage and again a red indication is normal. Selecting the MOD. PL. (modulator plate) position and depressing the microphone will cause a slight deflection of the needle. When talking into the microphone, the needle should deflect close to the red area, indicating the modulator (voice transmission) is normal.

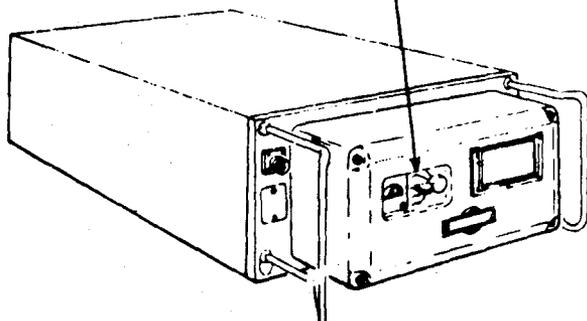
Selecting the P.A. GRID or P.A. PL. position and depressing the microphone will cause the needle to deflect close to the red area. A minimum reading indicates the transmitter section is inoperative. Check the fuses and circuit breakers on the associated power unit.



SWR METER



MULTIMETER



TRANSCIEVER

Radio Magnetic Indicators

The ID-25C is commonly referred to as the RMI because it displays both radio and magnetic information. Radio information is fed to the needles and

magnetic information is fed to the card.

The five RMIs are located: 2 on pilot's inst. panel, 2 on co-pilot's inst. panel, and 1 on navigator's inst. panel.

Visual information from the ADF #1 and ADF #2 will usually be displayed on the #1 RMI. Information from the UHF/ADF and OMNI/TACAN will usually be displayed on the #2 RMI. The RMIs should be placarded to indicate the navigational aid associated with each needle.

The RMIs require 26 Volts, 400 cycle, AC for operation. The power is supplied by the radio electrical inverter, through the C-1 compass amplifier.

Operation

Radio magnetic indicators normally

display the following information. Fiducial Marker - magnetic heading of the aircraft. Needles - magnetic bearings, aircraft to station.



The ADF needles will always point to the station, displaying relative information, when power and radio information is being fed to them.

Note: Relative bearings must be computed from the fiducial marker to the desired needle. The OMNI/TACAN equipment operates on a different principle and should continue to display magnetic bearings to the station if the RMI card fails.

OMNI (AN/ARN-14)

Omni provides the pilot with radio aids to navigation in the Very High Frequency (VHF) range of 108.0 to 135.9 mc. It also can receive the majority of the communications (VHF) now available for airborne communications. This reception range includes both military

and commercial communication channels, Omni Directional range channels, and 90/150 cycle tone modulated Omni Localizers.

The control is located on the pilot's control pedestal. It provides the pilot with 280 crystal controlled channels which are selected by setting in the desired frequency. However, any frequency in the range of 108.0 to 135.9 mc can be received by setting the selector switch to the nearest tenth of a megacycle. For example, the frequency of 126.18 cannot be selected because the frequencies are graduated every tenth megacycle but it can be received by setting the control to 126.2, which is the nearest tenth megacycle.

The range of this equipment is determined primarily by the line of sight distance between the antennas.

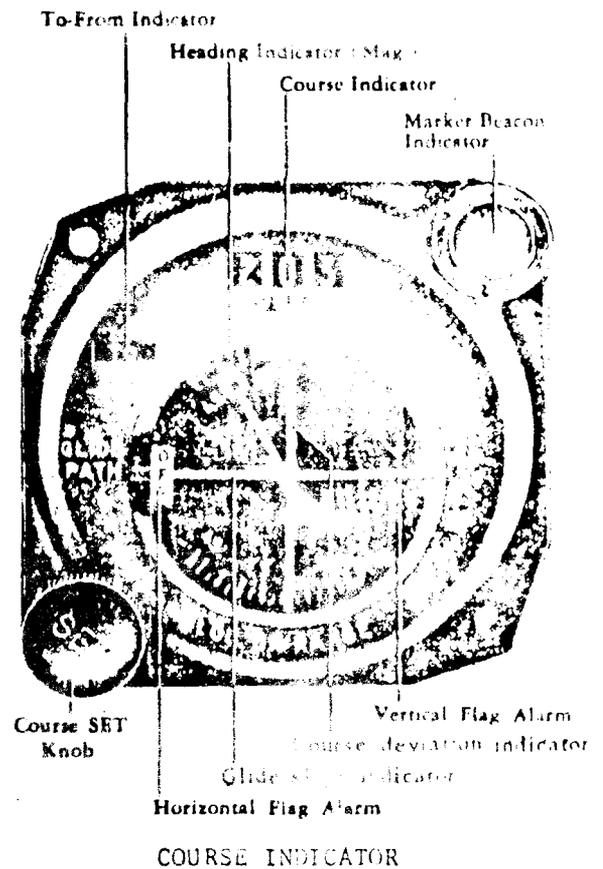
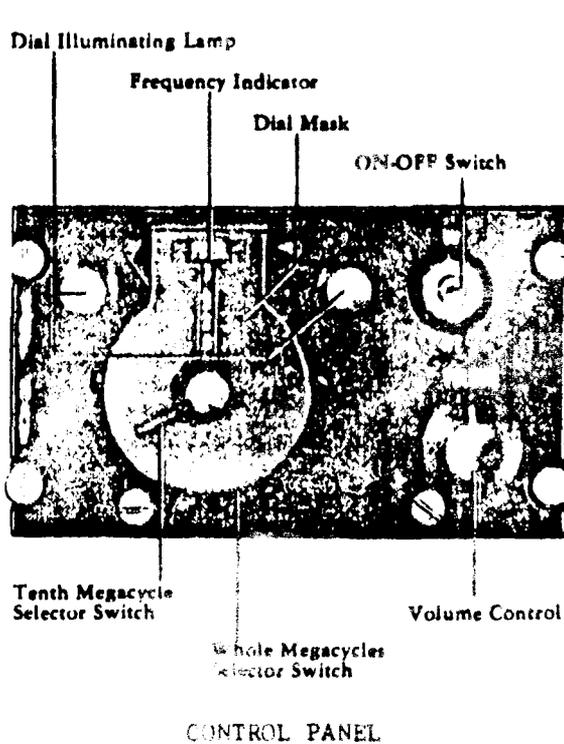
DC power is required for minimum instrumentation. For complete operation 26 Volts, 400 cycles, AC (from the C-1 amplifier) is required for certain indicators.

The indicators requiring AC power are the RMI, Heading Indicator (donut), and the Glide Slope Indicator. It can be seen that the primary indicators are DC operated and that it is possible to use the Omni equipment for radio navigation with only DC power.

All presentations from this equipment are visual and are available to the pilots from two indicators. These are the Radio Magnetic Indicator (RMI) and the Course Indicator.

Operation

1. ON-OFF Switch - ON
2. Dial desired frequency
3. Volume Control - As desired.



Course Indicator

The course indicator is a multi-purpose indicator consisting of:

1. Course Selector
2. TO-FROM Indicators
3. Course Deviation Indicator
4. Glide Slope Indicator
5. Heading Indicator (Donut Needle)
6. Flag Alarms
7. Marker Beacon Light

The following is a brief description of the functions performed by

these various indicators.

Course Selector

The course selector consists of a course indicating window and course set knob. The Pilot may select any one of 360 Radials of an "OMNI" or "TACAN" Station, or the approach bearing to a localizer equipped runway.

TO-FROM Indicators

This equipment solves ambiguity for the Pilot when using "OMNI" or "TACAN." "TO" in the window indicates the course selected is toward the "OMNI" or "TACAN" Station. "FROM" in

the window indicates the course selected is away from the "OMNI" or "TACAN" station.

Course Deviation Indicator (CDI)

The Course Deviation Indicator displays lateral positional deviation from the selected "OMNI" or "TACAN" course. It also indicates the lateral positional deviation from the centerline of a runway localizer.

Glide Scope Indicator (GSI)

The Glide Slope Indicator displays the aircraft's position above or below the Glide Path.

Heading Indicator (Donut Needle)

The heading indicator displays the magnetic heading of the aircraft relative to the course selected.

Flag Alarms

The Flag Alarms associated with the "CDI" and "GSI" are visible when the signal level falls below a value sufficient to provide reliable operation.

Marker Beacon Light

Illumination of this light indicates passage over a Marker Beacon transmitting a 75 mc signal.

Reception of 90/150 Cycle Tone Localizer Signals in the 108.0 to 111.9 Megacycle Band

When the radio receiver is tuned to the operating frequency of a TONE type runway localizer and the aircraft is flying within receiving distance of the station, the facilities of the localizer will be available to the pilot to aid him in making a safe landing under adverse weather conditions. Actual-

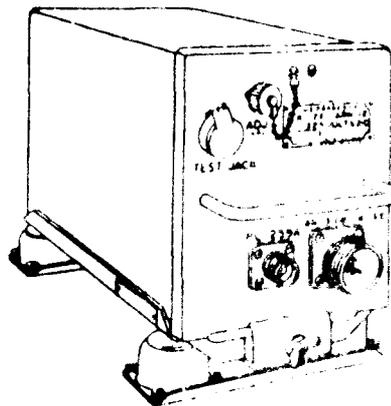
ly, the localizer provides an imaginary vertical plane extending along the centerline of the runway in the direction of the final approach course. The Course Indicator is used to provide the pilot with a visual indication of his positional deviation from this imaginary centerline when making the final approach to the runway.

Glide Slope Receiver AN/ARN-18

The Glide Slope Receiver operates in conjunction with the Omnidirectional Receiver. Operation is UHF (329.3 - 355.0 mc) and is automatically selected by selecting a localized frequency (108 - 112 mc) on the OMNI remote control. The glide path receiver information is presented visually by the glide slope indicator of the course indicator. The glide path receiver requires AC power for operation.

Marker Beacon AN/ARN-12

The function of the Marker Beacon Receiver is to receive modulated 75 mc signals transmitted by a ground beacon transmitter and deliver an aural and visual indication of the received signal. When the marker signal is of sufficient strength, a light on the course indicator will be actuated giving a visual

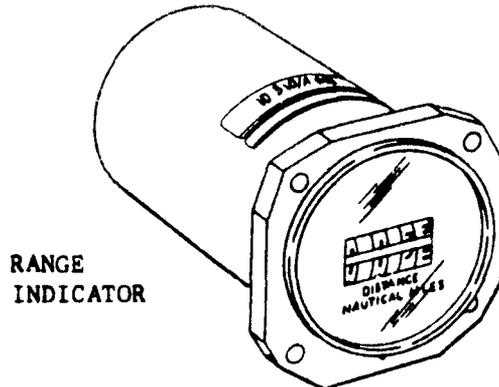


MARKER BEACON RECEIVER

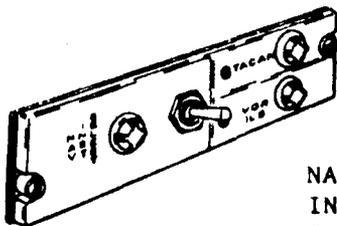
indication of position. The marker beacon audio signal may be monitored by use of the associated audio selector. The marker beacon receiver is automatically turned on anytime power is applied to the DC bus.

TACAN AN/ARN-21

TACAN is a radio navigation aid operating in the UHF frequency band, designed to operate in conjunction with a surface navigation beacon. The airborne and surface equipment form a radio navigation system which enables an aircraft to obtain continuous indications of its distance and bearing from any selected surface beacon located within a line-of-sight distance from the aircraft up to 195 nautical miles. The bearing information is displayed on the RMI and Course Indicator.



The equipment is so installed that the Course Indicator and RMIs used with OMNI are utilized by TACAN. A manual instrument changeover switch on the control pedestal makes this possible. TACAN is so designed that, when the



NAVIGATION
INSTRUMENT
SELECTOR PANEL*

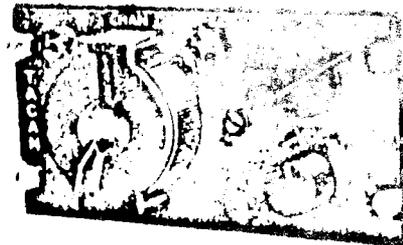
* Located on Pilot's instrument panel on 51-176 series.

correct bearing and distance information cannot be determined, the indicators will rotate rapidly so the operator will be unable to derive proper information from them.

Operation

Positioning the function selector to REC turns the equipment on and after a 90 second delay relative course indicator and RMI information should be displayed. By positioning the function selector to TWR, Course Indicator and Range Indicator information will be displayed.

Frequency selection is made automatically by selecting the appropriate channel number (01-20).



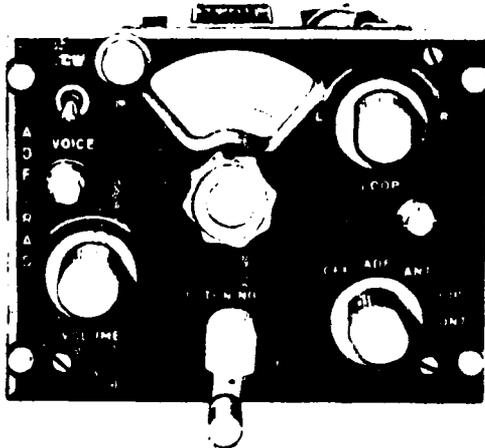
REMOTE CONTROL

Radio Compassing Aid

The ARN-26 function selector is a radio receiver which operates in the range of 100 kc to 1750 kc. It is used for radio compassing aid and for following navigation.

1. Automatic visual indication of bearings between the aircraft and the transmitting station by means of a RMI.

2. Aural Null Homing, using a loop antenna.
3. Radio reception, using a non-directional sense antenna.



CONTROL PANEL

Tuning is accomplished through four remote control heads, two on the control pedestal and two at the navigator's station. Voltage requirements are 24-28 Volts DC for the receiver, 115 Volts AC (100 cycles) for the loop motor and 26 Volts AC (400 cycles) for the indicator system. A circuit breaker is located on the radio rack.

Operation

1. DC Power and Inverter - ON
2. Turn Function Selector to either compass, antenna or loop position.
3. Turn tuning crank until desired frequency is indicated.
4. Tune the frequency for maximum audio.
5. CW/Voice switch in appropriate position.
6. Adjust volume control for the desired level.

Loop operation is governed by a loop left/right switch on each control. The speed of rotation (fast or slow) is dependent upon the degree of turn (left or right) that the switch is moved. Transfer of control is accomplished with the function switch.

Trouble Shooting

The power for the loop motor is supplied by a vibrator located in the receiver. Should the vibrator become inoperative, the loop cannot be rotated. To determine if the vibrator is operative, place the function selector to the loop position and actuate the left/right switch. If signal intensity does not change in the headset, the loop is not turning. A spare vibrator is located under the receiver cover. Replacing the inoperative vibrator with the spare will correct the malfunction.

Pilot's Radio Altimeter AN/APN-22

The APN-22 is a low range absolute radar altimeter. The operating range is 0 to 10,000 feet over land, and 0 to 20,000 feet over water. The receiver transmitter and antenna are one component, flush mounted on the underside of the fuselage aft of the rear cargo loading door. All operating controls are positioned on the indicator.

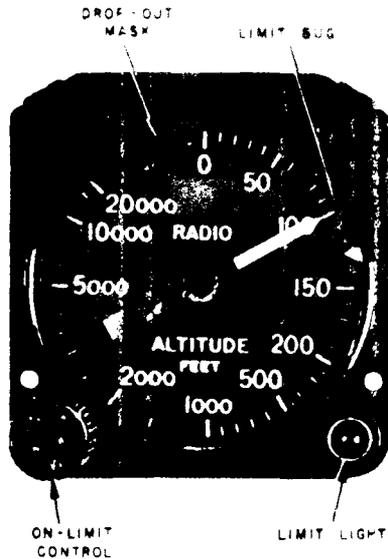
Operation

1. AC and DC power ON
2. Turn the ON-LIMIT knob clockwise to position the Limit Bug at the lowest desired flight altitude.

Note: When the ON-LIMIT knob is turned on, the red light will come on.

3. During aircraft ground movement the altitude needle will fluctuate, but will settle down after takeoff.

4. After passing the preset altitude the red light will go out and remain out until the aircraft is again flying at or below the preset altitude.
5. The black area painted on the face of the indicator is referred to, as the drop-out mask. The altitude needle will position itself under the drop-out mask anytime the information received is unreliable.



HEIGHT INDICATOR

Nav. Radar Altimeter SCR-718

The SCR-718 altimeter is a high range absolute altimeter. It sends out pulses and times their return. The altimeter is accurate within plus or minus one tenth of one percent, with a maximum error of 50 feet at 50,000 feet.

A toggle switch on the indicator is marked "Times Ten" and "Times One." When set on "Times One," the indications are from 0 to 5,000 Feet. When

set on "Times Ten," they are from 0 to 50,000 Feet.

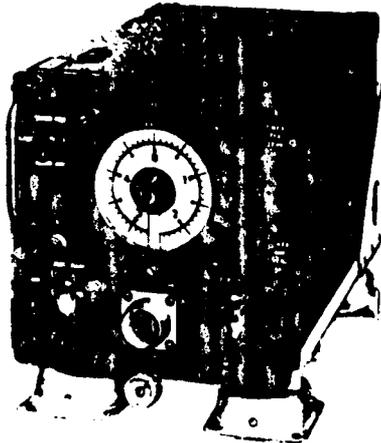
Operation

1. Turn receiver gain switch "ON" before takeoff and allow 3 minutes for warmup.
2. After warmup, turn receiver gain control until the green circle appears on the indicator tube.
3. Set receiver gain control so that the circle size is just that the circle is barely visible as a luminous ring at the outer edge of the black calibration mask.
4. Adjust "Receiver Gain Adj" so that a pulse approximately 1/4 inch high appears on the scale at 0 on the scale. This is the reference pulse or tone.
5. Set to "Times Ten." The circle will be smaller than 1/4 inch inside of the black scale.
6. Adjust "Times Ten Zero Adj" until the reference pulse is at 0. Use the counterclockwise edges of the pulses.
7. Set on "Times One" and adjust "Times One Zero Adj" so that the reference pulse is at 0. This should be done in the daylight.

As the aircraft descends, the reflected pulses will appear on the reference pulse scale. The leading edge indicates the altitude.

On "Times One" the scale goes all the way around and the reference pulse at 1,000 feet is at 1,000 Ft when the instrument is at 6,000 Ft. For each 1/10th of an encirclement takes place. When the scale switch on "Times One" changes from 0 to 1000

the number of revolutions the pulse has made. For each revolution of the pulse 5,000 Ft must be added to the reading. Calibrations are spaced so that readings can be estimated to the nearest 25 Ft.



NAV. RADAR ALTIMETER

On "Times Ten," it is possible to read to within 500 Ft. The switch should be left in this position especially at high altitudes. When greater accuracy is required, read the reflected pulse position on the small circle "Times Ten" position to the next lower 5,000 foot mark and then switch to "Times One" and add the readings

Radar altimeter SCR-718 is not designed for use as an extremely low altitude altimeter. As the height of the aircraft above the ground decreases to less than 1,000 Ft., the gain must be reduced to prevent the reflected pulse from becoming too broad and more than 1/4 inch high.

The indicator and control are located at the navigator's station. The altimeter operates on 115 volts 400 cycles AC from the main inverter.

When operating over mountainous terrain, several altitude lobes appear

because of numerous reflections. Over water the reflections should be steady. At altitudes of 5,000 Ft and multiples thereof, with the scale switch at "Times One" position, the reflected pulse coincides with the reference pulse and causes a blind spot. (Improper operation will make the indicator circle become oval in shape).

AN/APX-25 Radar Identification Equipment (IFF, SIF)

The purpose of this equipment is to identify the aircraft as friendly when correctly challenged by friendly radar. The equipment provides positive control and surface tracking of the aircraft by the radar station.

The APX-25 is a transponder. A transponder must receive and interrogate the proper signal before it will trigger the transmitter to make a reply.

Note: The only means to determine that the equipment is operating properly is to check with the ground radar control by radio.

Operation

1. Before takeoff set the master control to the "stand by" position. There is an automatic time delay of approximately one minute when the master control is moved from the "off" position. In the "stand by" position the equipment is ready, but not transmitting.
2. After takeoff turn the master control until "normal" appears under the index. This is MODE 1 operation.
3. The "emergency" position should be utilized when the aircraft is experiencing an emergency. The emergency stop release button must be depressed to position "emergency" under the index.

4. MODE 2 and MODE 3 operations are controlled by the respective two way toggle switches. "Low" or "Normal" must be selected on the master control before MODE 2 or MODE 3 toggle switches are moved to the "up" or "on" position. These toggle switches should be in the OUT position unless directed to reply using that MODE.
5. "Low" should be selected only when directed. To select "low," turn the master control until "low" is positioned under the index. This is MODE 1 low. MODE 2 low and MODE 3 low are other possible selections.
6. The I/P-OUT-MIC toggle switch is used to identify the aircraft from other aircraft on the radar scope. When the switch is held in the I/P position for a few seconds, the equipment will automatically send

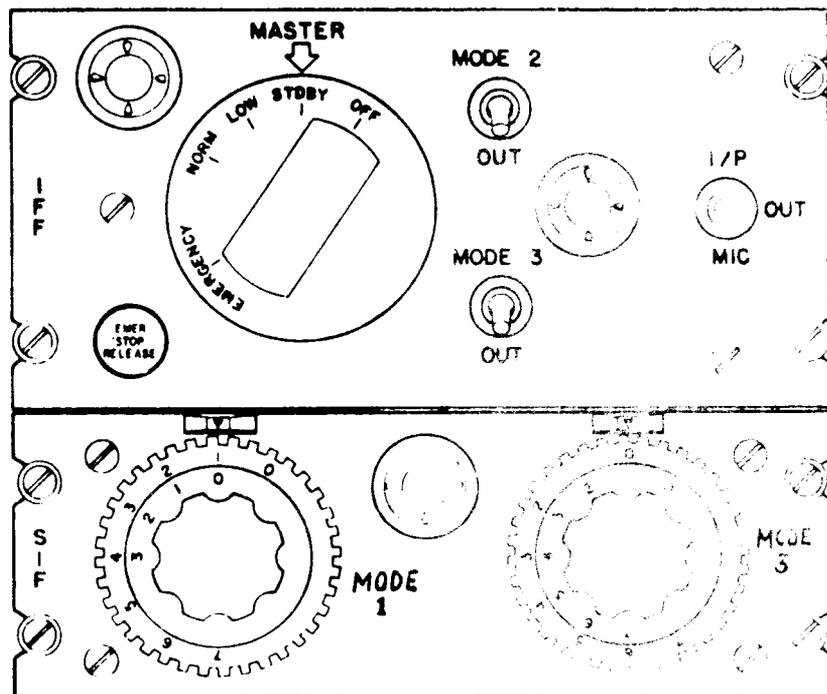
a double reply for thirty seconds. The I/P position is spring loaded to the OUT position.

The MIC position is not normally used in C-118 installations.

Note: To select the proper "code number," the proper MODE must first be selected.

7. MODE 1 codes and MODE 3 codes are selected by the large dials. The left dial is used to select MODE 1 codes, the right dial for MODE 3 codes. MODE 1 has thirty-two possible codes and MODE 3 has sixty-four possible codes. The codes are selected by turning the inner and outer knobs until the desired code is read under the index. The codes must be read from the outer scale to the inner scale.

TRANSPONDER
REMOTE CONTROL



KEYER GROUP
REMOTE CONTROL

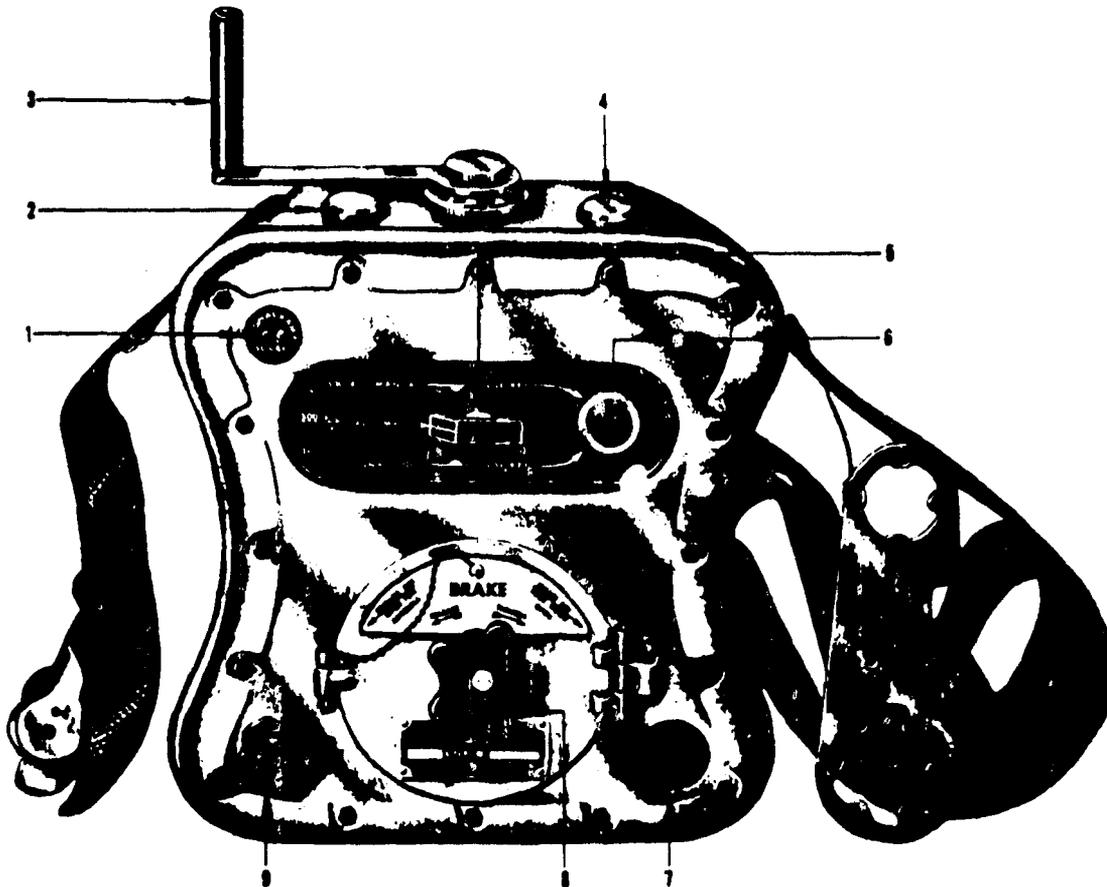
Chapter 4

EMERGENCY EQUIPMENT

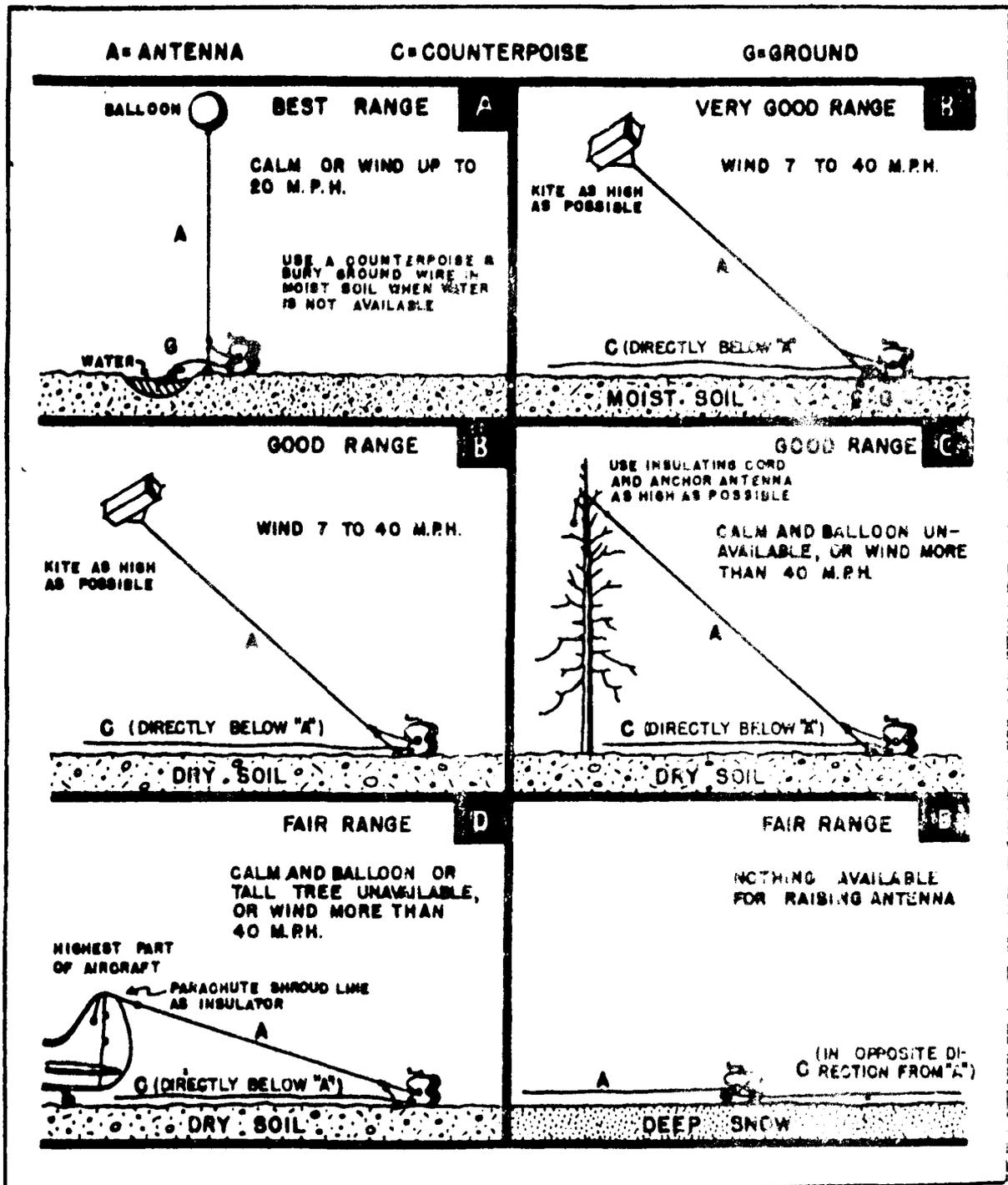
The CRT-3 (Gibson Girl) is a portable transmitter. The unit is complete with power supply, antenna and accessories. The yellow container housing the Gibson Girl also contains a signal lamp, kite, two hydrogen generators, two ballons and two spare reels of antenna. This radio operates on the 500 kc International Distress or 8364 kc Military Emergency frequencies.

A selector switch is provided for Manual, Automatic, or Signal Lamp operation.

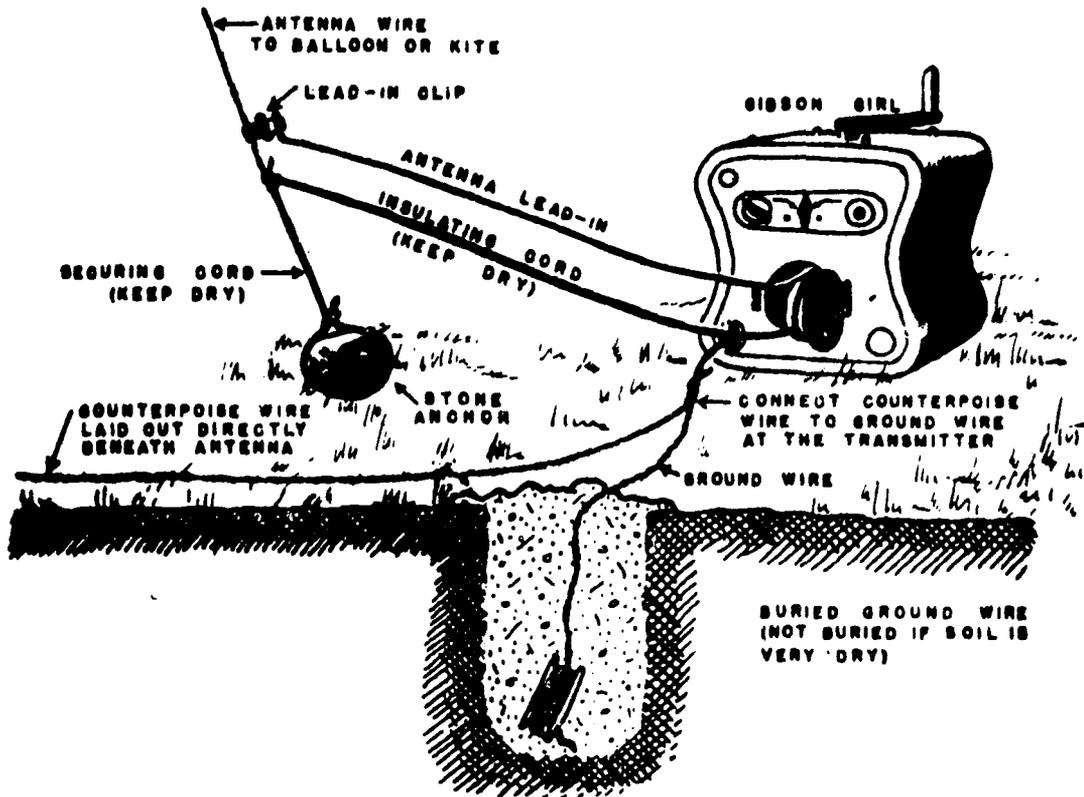
In MANUAL position, the set must be keyed manually and operates on 500 kcs only. In AUTOMATIC, the set will transmit a series of six SOS's followed by a twenty second dash. This sequence will be transmitted on 500 kcs and 8364 kcs alternately. In the SIGNAL LAMP position, the set can be manually keyed to send blinker signals with no radio output. The range on 500 kcs is approximately 300 miles. Signals on 8364 kcs can be heard approximately 1,500 miles.



- | | |
|--------------------------|--------------------|
| 1. SIGNAL LAMP SOCKET | 5. SELECTOR SWITCH |
| 2. RADIO OUTPUT LAMP | 6. KEY |
| 3. HAND CRANK | 7. DESICCATOR CAP |
| 4. SPEED INDICATOR LIGHT | 8. ANTENNA REEL |
| | 9. GROUND LEAD |



METHODS OF SETTING-UP THE CRT-3



Proper Set-up on Land

SAFETY NOTICE

Do not raise the antenna during severe electrical storms. Observe this rule to prevent death or serious injury.

Observe the following precautions when using the hydrogen generator:

Permit no flames, coals, or sparks near the balloon or opened hydrogen generator, since hydrogen gas is explosive.

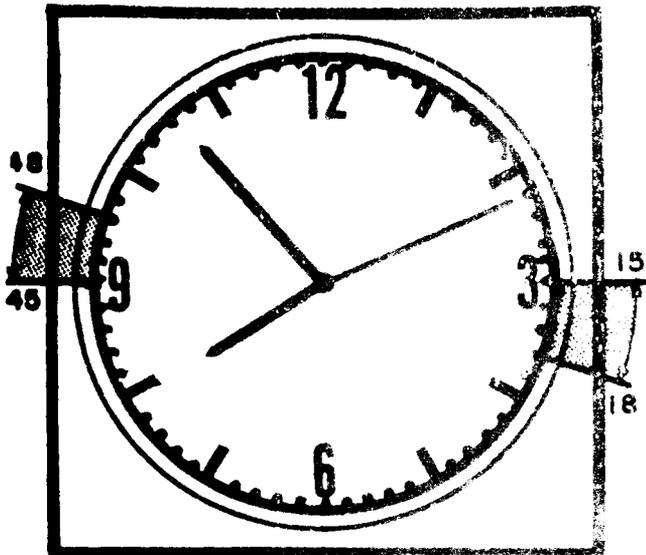
Do not allow the residue in the can to come in contact with the body or clothing, since it is caustic and will cause burns. Immediately wash in water any part of the body that is burned. Throw the hydrogen generator away immediately after use.

Do not touch the hydrogen generator while it is in use, since it generates large amounts of heat.

Power is supplied by a hand-cranked generator. There are two indicators on the top of the transmitter. One indicates the correct cranking speed, the other indicates the sequence of the coded signals into the antenna.

Both of the operating frequencies are tuned to 306 feet of antenna. The antenna is wound on a special antenna and is attached to the face of the transmitter. It is important to use the entire length of antenna to insure maximum range. The use of more than one antenna is not recommended. A life raft or a hydrogen gas inflated balloon can be used to raise the antenna.

When operating in emergency mode, it is important to know the international silence periods; 15 to 18 minutes past the hour and 45 to 48 minutes past the hour. Ships at sea and shore stations monitor the distress frequencies. Distress signals should be sent for a minimum of five minutes.



INTERNATIONAL SILENCE PERIODS

VHF/UHF Emergency Transceiver URC-4

The URC-4 radio set is a portable unit for two way voice communication and tone modulated signals. It is crystal controlled and will transmit and receive on any preset frequency within 120 mcs to 130 mcs VHF and 240 mcs to 260 mcs UHF. The equipment is preset to the VHF emergency frequency 121.5 mcs and the UHF emergency frequency 241.8 mcs.

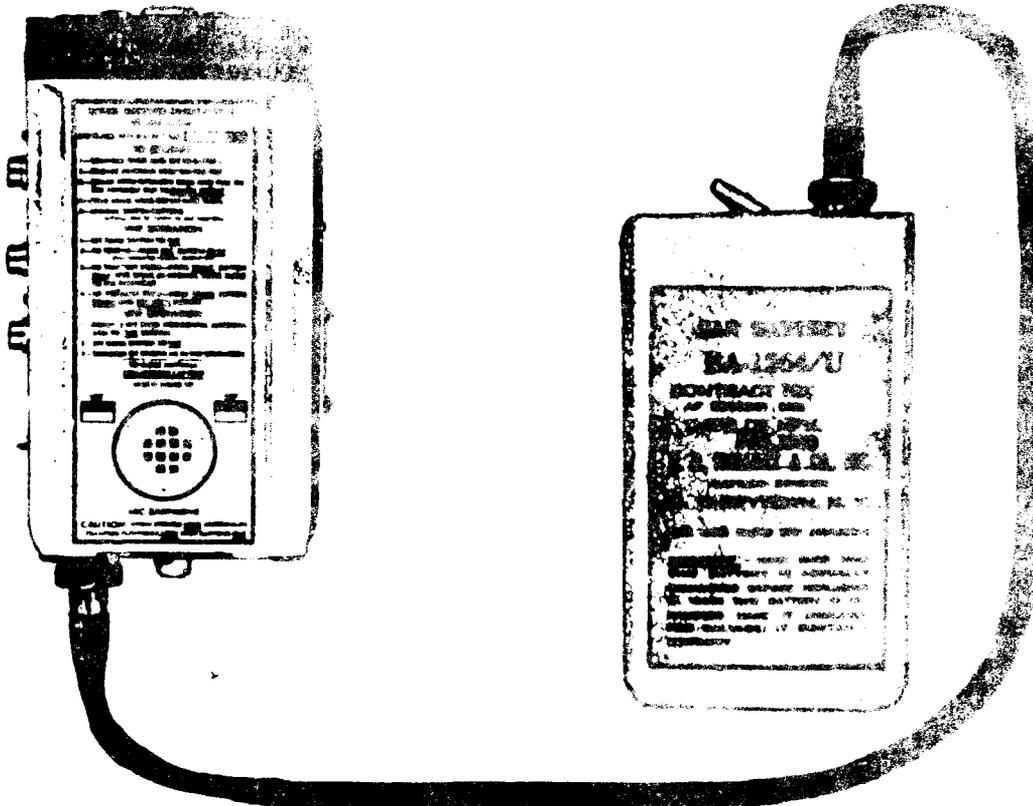
The purpose of this equipment is to facilitate emergency use. It can also be used as a auxiliary communications device between ship members as an intercom. The URC-4 is battery operated. The range of the set is limited by weather conditions and atmospheric conditions will be a detriment on the range. The normal complement is one URC-4 per crew member and one per life raft.

Operation

1. Connect the battery pack to the transceiver with the power cord supplied.
2. To extend the antenna, push thumb switch located on top of the set and the di-pole antenna will pop up. Manually extend the antenna vertically and horizontally to the fullest extent for VHF operation. Collapse the horizontal antenna to one layer for UHF operation.
3. Select VHF or UHF operation with the switch provided on the side of the set.
4. A sliding control plate for the Tone Transmitter and Receiver buttons is

located on the side of the set. Make certain the slide control is down (unlocked position).

5. Push the button marked Transmit and talk into the unit marked MIC-EARPHONE.
6. Release the Transmit button and depress the Receive button and listen with the ear positioned close to the unit marked MIC-EARPHONE.
7. To transmit a Tone modulated signal (D/F), depress the Transmit and Tone buttons simultaneously.
8. For transmissions of long duration, the sliding control lock may be used to hold the Transmit button down. To prevent battery drain, the control should be unlocked when not in use.
9. For receiving signals of long duration, the sliding control lock may be used to hold the Receiver button down.
10. For transmitting Tone for a long duration, the sliding control lock may be used to depress the Transmit and Tone buttons simultaneously.
11. The battery should be recharged whenever possible. (See max. use)
12. Battery performance will be reduced in extreme cold conditions. Try hear with inside maximum operation.



Chapter 5

INFLIGHT VOICE COMMUNICATIONS

The information contained in this chapter is extracted from ACP 125B-1 (USAF AIR/TROOP RADIO TELEPHONE PROCEDURES) and apply to all flights operated by, for or under the operational control of MATS.

During flight, aircraft stations will maintain continuous watch and will operate on the appropriate radio frequency. Aircraft stations will not cease watch except for reasons of safety, without informing the appropriate aeronautical station. All aeronautical stations will maintain continuous operation on all assigned aeronautical frequencies unless otherwise published in pertinent NOTAM message and Radio Facility Charts.

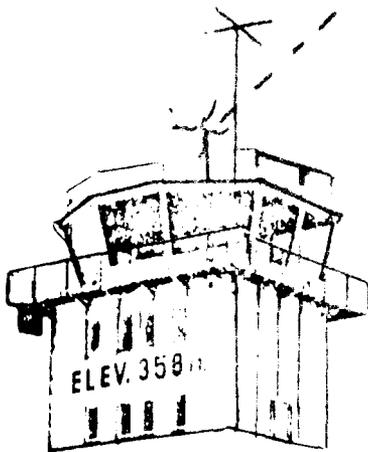
ALL MATS aircraft utilizing high frequency voice communication will use the prefix "MATS" followed by the last five digits of the aircraft serial number.



Aeronautical stations will be identified by the geographical name of the station or aerodrome location, TOKYO, GUAM, TRAVIS, ANDREWS, etc.

The following words will be used after the aeronautical station identification to indicate the service required:

APPROACH	- Approach Control Office
CONTROL	- Approach Control Center
GCA	- Ground Control Approach
HOMER	- Home Base Station
INFORMATION	- Flight Information Center
RADAR	- Surveillance Radar
RADIO	- Aeronautical Station
TOWER	- Aerodrome Control Tower



All aeronautical stations operating on a common family of frequencies are a member of a radio telephone network. Every member of the network is guarding a flight; however, for best organized operation one station has primary guard, another has secondary guard, and the remaining stations have standby responsibilities.

The aeronautical station which accepts responsibility for exercising communications control of an aircraft during any part of an overwater flight will be considered the primary (air-ground control radio station) for that aircraft until the communications control is transferred or relinquished. A primary station normally will be the station of departure. When an aeronautical station is not located at the particular point of departure, the nearest aeronautical station most directly located on the proposed route will be designated the primary station.

A secondary station will be the first station after the primary station located on the proposed air route. The secondary station will assume the primary role and the original primary station will then become the secondary station as the flight progresses. The remaining stations in the system will be standby stations.

The primary guard normally transfers at approximately the half-way point to the station ahead; however, the primary guard may, and should, change whenever improvements in communications can be effected. Guard should not necessarily change because aircraft has reached a geographical point. The criteria for guard change will be established when the secondary (or standby) station can provide equal or better two-way communications than the primary station.

The change in primary guard should be effected by one or more of the follow-

ing means, preferably in the order listed:

1. The current primary station requests the secondary station to assume primary guard responsibilities.
2. The secondary station requests assumption of the primary guard from the current primary station.
3. The aircraft calls the primary station and requests guard change.
4. The aircraft calls the secondary or one of the standby stations and requests that station to take over the primary guard.
5. Any one of the standby stations, noting the situation wherein neither the primary nor the secondary station can provide satisfactory guard, calls the aircraft and volunteers to assume primary guard.

The listing above is in the order of preference only. In general, aeronautical stations are instructed not to allow the aircraft to continue under the primary guard of a station or be shifted to a new guard station which cannot communicate satisfactorily with the aircraft.

Whenever primary guard shifts to another station, the new primary station will announce acceptance of such responsibility to the aircraft and the new secondary station, and specify the primary and secondary frequencies to be used. In any event, both air and ground stations should assure satisfactory communications are established prior to making any change.

To enable the aeronautical station operator to determine the

calling frequency, stations will identify the HF calling frequency on the initial call-up. (5840 kcs would be "Five Eight").

Before transmitting, every station will listen for a period long enough to satisfy itself that it will not cause harmful interference.

The call-up and subsequent transmission between aeronautical stations and aircraft will always be brief and concise, consistent with clarity and accuracy of the information to be conveyed. It is always assumed that communications are good and neither the call-up nor the message information will be repeated unless communications are difficult. Messages will not be repeated unless repetition is requested.

A standard call-up between aircraft and aeronautical stations will utilize the following procedure:

1. Identification of the called station(s)
2. Proword THIS IS.
3. Identification of the calling station.
4. Identification of frequency being used.
5. Proword OVER

EXAMPLE: ANDREWS - THIS IS MATS TWO EIGHT SIX SEVEN FOUR ON FIVE EIGHT - OVER

The reply to an initial call-up will be as follows:

1. Identification of the called station.
2. Proword THIS IS.
3. Identification of the calling sta-

tion.

4. Instructions as to whether to go ahead (GO AHEAD) or to wait (STAND BY).

EXAMPLE: MATS TWO EIGHT SIX SEVEN FOUR-- THIS IS ANDREWS -- GO AHEAD.

Communications will commence with a call and a reply when it is desired to establish contact. When it is certain that the called station will receive the call, the calling station may transmit the message, without waiting for reply.

After contact has been established continuous two-way communications will be permitted until termination of the contact without further identification or call if no mistake in identity is likely to occur.

When no confusion is likely to arise, a shortened form of procedure will be permitted. For example, prowords OVER, THIS IS, ROGER, and other similar prowords may be omitted at the discretion of the operators after initial contact has been established.

When messages do not require relay, the called station shall serve as the addressee, and the calling station shall serve as the message originator.

EXAMPLE: Call -- WESTOVER -- THIS IS MATS FOUR EIGHT TWO ZERO ZERO ON THREE FIVE --

Text -- REQUEST PRIMARY GUARD CHANGE FROM THREE FIVE TO FIVE EIGHT --

Ending -- OVER

When an aircraft originates a message that requires a specific address and/or retransmission over the point-to-point circuits, the message address shall be preferably the pro-

word "FOR" and comprise the following parts in the order stated:

EXAMPLE: Call -- ANDREWS -- THIS IS
MATS FOUR EIGHT TWO ZERO
ZERO ON FIVE EIGHT --

Address - FOR BOLLING OPERATIONS

Text----- REQUEST AMBULANCE AND DOCTOR
UPON ARRIVAL -- TWO PASSENGERS
SERIOUSLY ILL --

Ending -- OVER

When In-Flight Command Communications Procedures have been waived in some areas due to inadequate circuitry to meet ATC requirements, the following will apply:

1. Advise the guarding military airways station of entry into the area and that changeover to ICAO primary guard is being made.
2. Comply with all ICAO communications requirements while in the area.
3. Continue to report to military ground/air station if equipment and circumstances permit. In areas where primary HF reporting must be made direct to ICAO Agencies, reporting to military ground/air stations is highly desirable but not required for aircraft equipped with one HF receiver. Dual HF equipped aircraft will make reports to both ICAO and Military Ground/Air stations.
4. When leaving the area resume communications with the appropriate Military Ground/Air station. Give first position in accordance with position reporting procedures in the Radio Facility Chart.
5. VHF/UHF Air Traffic Control reporting, where required, will be accomplished in addition to HF reporting.

Position Reporting

Before takeoff obtain the Primary and Secondary frequencies for the overwater route to be flown from Base OPS and verify.

Ramp check will be brief.

EXAMPLE: Call --"ANDREWS - MATS
THREE TWO EIGHT SIX SEVEN
ON SIX FOUR - RAMP CHECK".

Airways operator will answer: "SIX
SEVEN-ANDREW" "REAL" "SIX
FIVE".

Pilot or Copilot will make all voice POMAR REPORTS

AWS Form 29B, dated July 21, will be the voice reporting form to be used until replaced by a new ICAO Form.

All entries on the Form AWS 29B will be completed by the air crew in-flight.

Example of a normal voice POMAR Report using the columns indicated.

1. Aircraft identification (use last five digits or aircraft serial number)
MATS NINE FOUR FIVE TWO SIX.
2. Position of aircraft - POSITION -
FOUR SIX FIVE NORTH - THREE ZERO SEVEN
WEST.
3. Time, hour and minutes, GCT - "ONE
TWO ZERO ZERO".
4. Altitude of aircraft in hundreds
of feet, "ALTITUDE SIX ZERO".
6. Flight conditions, "IN CLOUDS".
7. Estimation (point) at (time)
GCT., (ESTIMATE OBOE ZEBRA ROGER AT
ONE FIVE ZERO ZERO".

9. Remaining fuel in hundreds of Lbs.
"FUEL ONE FIVE ZERO".

10. Temperature, degrees Centigrade,
minus or plus with corrections applied,
"TEMPERATURE MINUS ONE".

12. Wind at flight altitude, degrees
true and knots, "WIND THREE ZERO ZERO
AT THREE FIVE".

14. D-Factor, Plus or Minus Feet, (D-
Factor is obtained by subtracting the
pressure altimeter reading 29.92 from
the height given by the radio altim-
eter) "MINUS ONE TWO ZERO".

Additional information will be sent
when indicated on POMAR Form AWS 29B.

Example Position Report: "ANDREWS -
MATS THREE TWO EIGHT SIX SEVEN - ON
SIX FOUR - POSITION REPORT - OVER".

Airways operator will answer: "THREE
TWO EIGHT SIX SEVEN - TWO NINE SIX
NORTH - FOUR ZERO FIVE WEST - ONE FIVE
- ETC".

To receipt for the message the airways
will answer: "ANDREWS".

The aircraft may receipt for a message
with "THREE TWO EIGHT SIX SEVEN" or
"SIX SEVEN".

The Operation Normal Report will
be given thirty minutes after the
hourly POMAR and will be transmitted
with or without a slot time allocated.

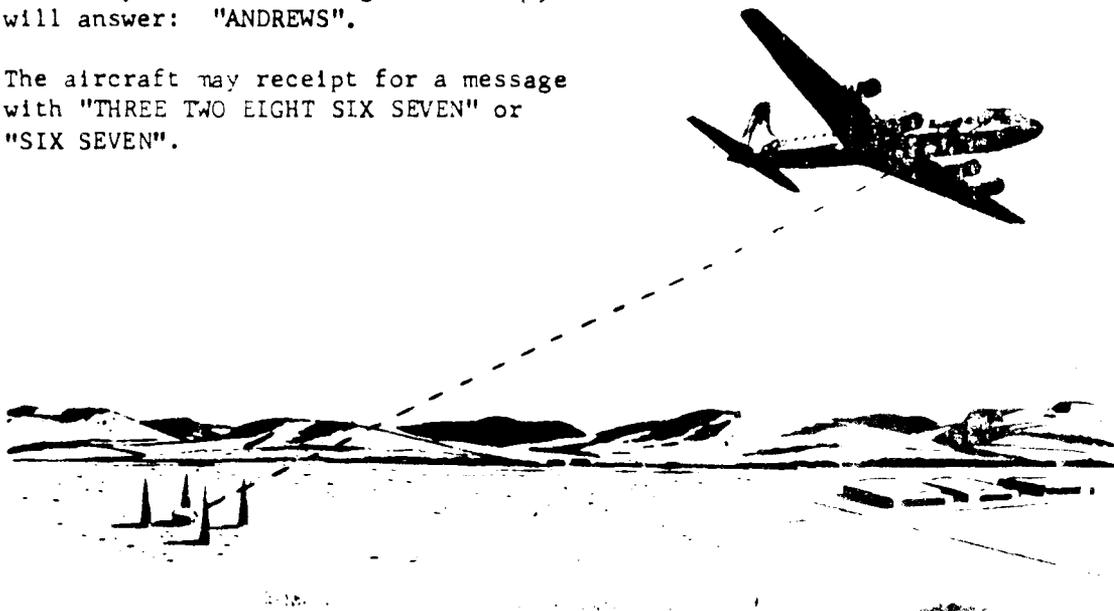
EXAMPLE: "ANDREWS-MATS THREE TWO EIGHT
SIX SEVEN-ON SIX FOUR-OPERATIONS NOR-
MAL AT THREE FIVE".

Reply: "THREE TWO EIGHT SIX SEVEN -
ANDREWS OPERATIONS NORMAL AT THREE
FIVE".

Operational Normal Reports will
not be sent on routes with fixed
mandatory reporting points.

For Position Reports other than
scheduled POMARS, the short form con-
tained in the Radio Facility Chart is
used.

Load messages will not be trans-
mitted from the aircraft except by
specific request of the military
ground/air station. Load messages
are normally sent over point to point
radio, preceding the arrival of the
aircraft.



1

2

3

STUDY GUIDE SUPPLEMENT

1951 SERIES AIRCRAFT

VERSUS

1953 SERIES AIRCRAFT

1. COLLINS 101-VHF

- a. Control panel on the pedestal.
- b. Antenna is mast type located on bottom of fuselage aft of battery well.

2. BENDIX Nr. 2 VHF

Control panel located forward of propeller control box or aft of co-pilot's throttles on pedestal.

3. Nr 1 - Nr 2 CONTROL TRANSFER SWITCH

- a. Located on seat behind pilot's right shoulder or on the BENDIX control panel.
- b. BENDIX NR 2 control over co-pilot's head (Some aircraft)

4. ARC-27A UHF (20 Channel)

- a. One control panel in cockpit.
- b. Mast type antenna located on bottom of fuselage forward.
- c. UHF-VHF transmitter switch on pilot's instrument panel or on left side of control pedestal.

5. ART-13 HF TRANSMITTER (1 or 2)

- a. Control at radio operator's station.
- b. Can be keyed from any position.

6. ARR-15 HF RECEIVER (1 or 2)

Controlled at radio operator's station.

7. HF TRANSCEIVER

- a. On some aircraft this is the 618S-1 and on others the 618S-1/MC. If either is installed, delete the number of ART-13s and ARR-15s by one.

1. COLLINS 101-VHF

- a. Control panel on the pedestal.
- b. Antenna is mast type located on top of fuselage over cockpit.

2. No comparable equipment.

3. No comparable equipment.

4. ARC-27A UHF (20 Channel)

- a. One control panel in cockpit.
- b. Mast type antenna located bottom of fuselage, aft.

5. No comparable equipment.

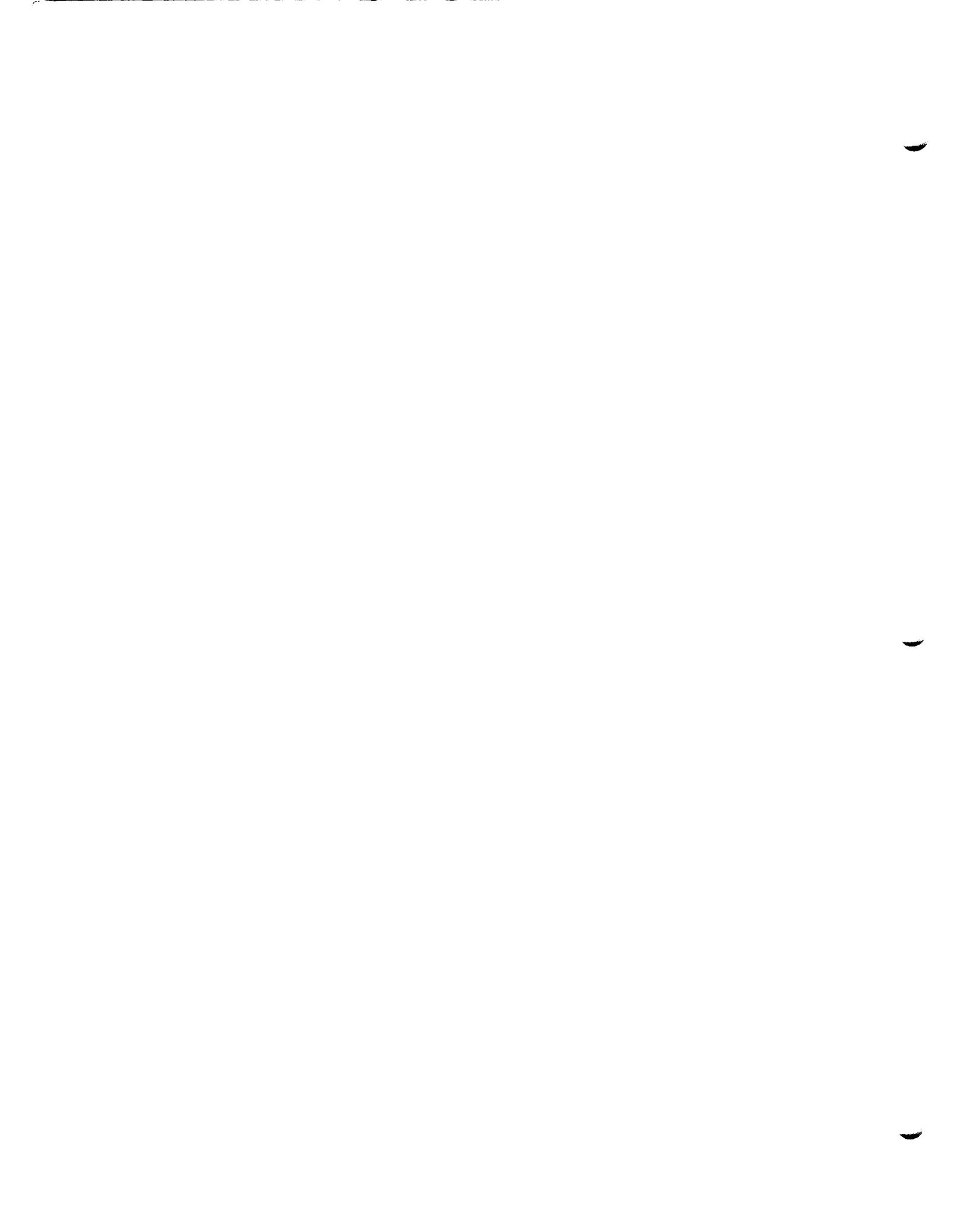
6. No comparable equipment.

7. HF TRANSCEIVER

- a. Each aircraft has one 618S-1 and one 618S-1/MC.

- b. Control panel at radio operator's station.
8. ARN-6 ADF (2)
Tuning meter normally located in control box.
9. R23A/ARC-5 LF RECEIVER
a. Control panel located on pedestal or at pilot's audio console.
b. Uses HF antenna.
10. ARN-14 OMNI and LOCALIZER RECEIVER
a. Deer Horn type antenna located on top of fuselage over cockpit.
b. Gear located in main radio rack.
11. ARN-18 GLIDE SLOPE RECEIVER
12. ARN-12 MARKER BEACON RECEIVER
High-Lo switch, 31-38 series
13. APN-1 LOW RANGE RADIO ALTIMETER
a. Dual range: 0' - 400' and 0' - 4000'.
b. Range knob on indicator.
c. Low limit switch located on pedestal.
14. SCR-718 HIGH RANGE ALTIMETER
Gear located aft of pressure dome, right hand side.
15. APX-25
a. Control panel in cockpit at pilot's audio console.
b. Gear located aft of pressure dome, left hand side.
16. APS-42 RADAR
Radar operates from radar inverter.
- b. Both control panels on pedestal.
8. ARN-6 ADF (2)
Single switch selected tuning meter for both ADF's.
9. No comparable equipment.
10. ARN-14 OMNI and LOCALIZER RECEIVER
a. Flush mounted antenna in vertical stabilizer.
b. Gear located in auxiliary radio rack.
11. ARN-18 GLIDE SLOPE RECEIVER
12. ARN-12 MARKER BEACON RECEIVER
No Switch
13. APN-22 LOW RANGE RADIO ALTIMETER
a. Single range: 0' - 20000'.
b. One indicator on pilot's and one indicator on copilot's instrument panels.
c. Limit control on indicator.
d. Gear located in auxiliary radio rack.
e. Antenna is flush mounted.
14. SCR-718 HIGH RANGE ALTIMETER
Gear located on auxiliary radio rack.
15. APX-25
a. Control panel at the navigator's station.
b. Gear located in auxiliary radio rack.
16. APS-42 RADAR
Radar operates from radar inverter or standby inverter.

- | | |
|--|--|
| <p>17. <u>APN-70 LORAN</u></p> <p>18. <u>MI-36A PUBLIC ADDRESS SYSTEM AMPLIFIER</u></p> <p style="margin-left: 2em;">a. Control panel on aft side of pedestal below autopilot controller.</p> <p style="margin-left: 2em;">b. Handphone input only.</p> <p style="margin-left: 2em;">c. No cockpit speaker.</p> <p style="margin-left: 2em;">d. Foot operated mike switch by navigator's position.</p> <p>19. <u>LA-17 HANDPHONE AMPLIFIER</u></p> <p style="margin-left: 2em;">a. Three handphones carried on aircraft, with jacks available throughout all accessible spaces.</p> <p style="margin-left: 2em;">b. Handphone mounted in cockpit at passenger entrance door and in nose wheel well.</p> <p>20. <u>AIC-58 ICS AMPLIFIER</u></p> <p style="margin-left: 2em;">a. Eight audio switches.</p> <p style="margin-left: 2em;">b. AM40A/ADC used for navigator's audio control in conjunction with AIC-5B.</p> <p>21. <u>LM-18 FREQUENCY GENERATOR</u></p> <p>22. <u>C-1 COMPASS AMPLIFIER</u></p> <p>23. No comparable equipment.</p> <p>24. <u>ARN-21 TACAN</u></p> | <p>17. <u>APN-70 LORAN</u></p> <p>18. <u>MI-36A PUBLIC ADDRESS SYSTEM AMPLIFIER</u></p> <p style="margin-left: 2em;">a. Control panel located at pilot's audio console.</p> <p style="margin-left: 2em;">b. Incorporated with ICS system.</p> <p style="margin-left: 2em;">c. Speaker behind cockpit with On-Off switch on right hand side of cockpit.</p> <p>19. No comparable equipment.</p> <p>20. <u>AIC-10 ICS AMPLIFIER</u></p> <p style="margin-left: 2em;">a. Ten audio switches.</p> <p style="margin-left: 2em;">b. None</p> <p>21. No comparable equipment.</p> <p>22. <u>C-1 COMPASS AMPLIFIER</u></p> <p>23. <u>ARA-25 UHF HOMER</u></p> <p>24. <u>ARN-21 TACAN</u></p> |
|--|--|



PILOT FAMILIARIZATION

RADAR SET AN/APS-42

Hail

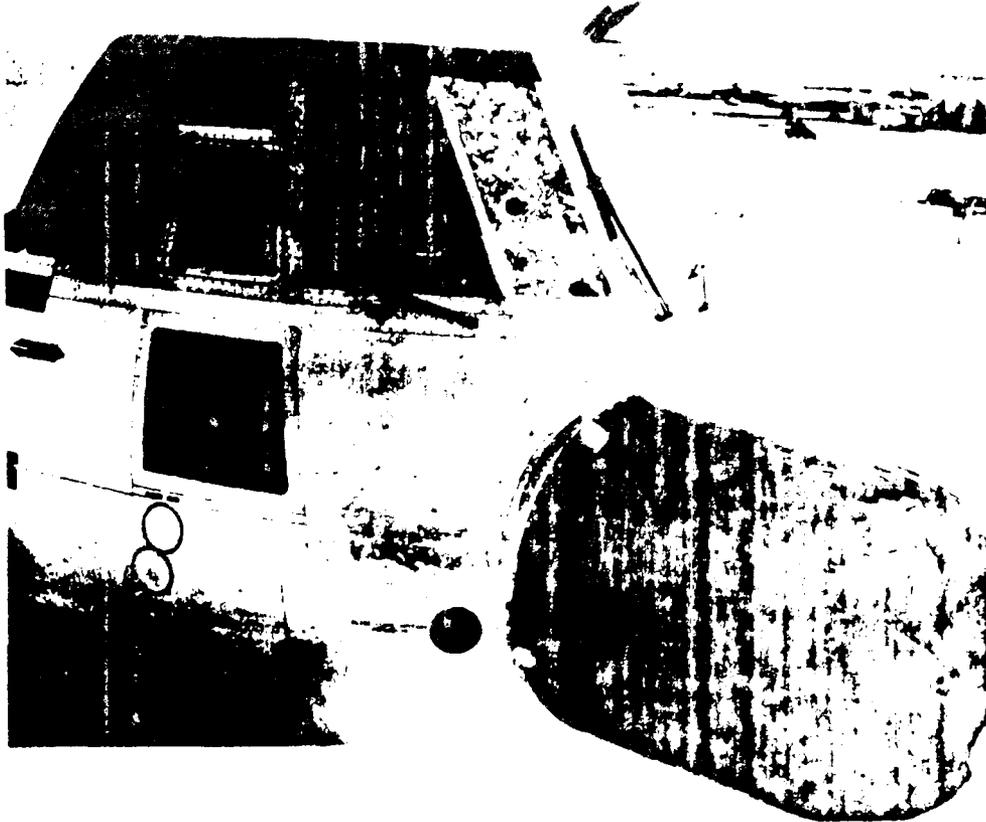
Ever wonder what would happen if a plane flew into a sky full of baseballs? The picture on this page gives the answer.

How long did it take for these ice baseballs to severely batter this plane? . . . Just a few seconds.

How long will it take to fix this airplane so that it will fly again?

Estimates ran well over ten thousand man hours.

What's it like to hit two and one-half inch hail? Here is the description given by the aircraft commander. The first indication was a ticking noise similar to a metal object being tapped against the wall. This was probably caused by isolated hail stones hitting the aircraft. This was followed by a loud explosion similar to the discharge of a gun, or someone dropping a heavy



A brief encounter with two and one-half inch hail did this to a MATS C-135.

box two or three feet. At this time, I realized the right hand center panel of the windshield was completely shattered and had holes in it, all windshields broken and the leading edge of the wings were almost flat and had holes in them.

Is hail avoidance possible? One of the Major Airlines reports it has never had a radar equipped airplane damaged by hail.

How is hail avoidance accomplished?

1. By knowing the limitations and capabilities of the radar equipment.
2. By proper operation of the radar set.
3. By knowledge of echo interpretation on the scope.
4. By always following avoidance techniques.

Limitations and Capabilities

Proper operation of the APS-42 radar set and proper interpretation of the scope make these functions possible.

Drift Angle Regardless of weather conditions, you can compute your drift angle from radar intelligence without leaving your course.

Ground Painting By showing coastline and recognizable ground features, the APS-42 can help you make a landfall at the desired point when visibility is poor. Get used to operating in contact weather. Then you will be ready.

Ground Speed The APS-42 makes it possible to follow your track through darkness or undercast and compute your ground speed.

Wind Data From the ground speed and drift information you can check the

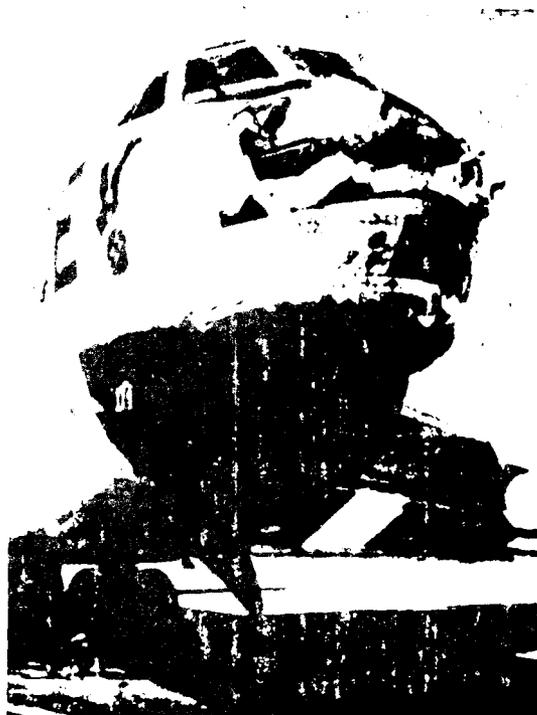
wind velocity and direction. It is not necessary to leave your course to do it.

Beacon Homing The APS-42 is equipped to give you range and bearing to a beacon. You can home or navigate by coded beacon signals anywhere within reception range.

Missiles from Ground The very nature of radar makes it possible to interpolate the distance to the ground (the distance to the nearest echo).

Weather Interpretation and Avoidance The APS-42 is an excellent device for determining turbulence, hail, and other adverse weather conditions which might affect the safe operation of the aircraft.

Spotting a Fix Many of the navigation functions that are possible with visible fixes may now be accomplished through use of the radar even through 10/10 clouds and at night.



SAC bomber that fell victim to hail stones.

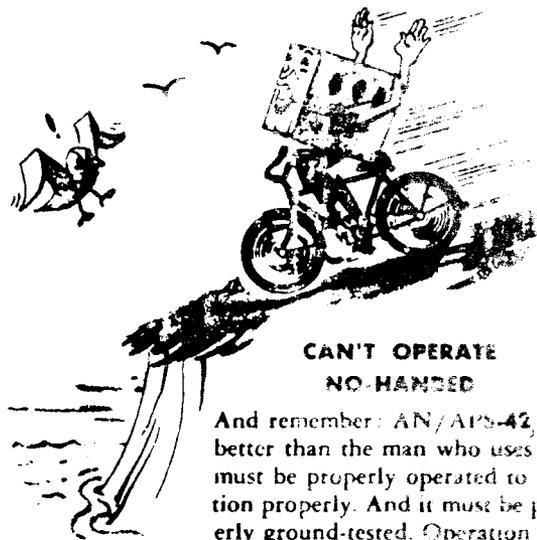
LIMITATIONS

If you understand the limitations of AN/APB-42 you'll make better use of its capabilities.



CAN'T SEPARATE OBJECTS CLOSE TO EACH OTHER

AN/APB-42 cannot give separate indications for more than one target, if they are too near each other. Two or more ships may look like one large one. Two islands may appear to join into one.



CAN'T OPERATE NO-HANDED

And remember: AN/APB-42 is no better than the man who uses it. It must be properly operated to function properly. And it must be properly ground-tested. Operation is up to you.



CAN'T SEE AROUND CORNERS

Remember: Radar signals travel practically in a straight line. It can't look over the horizon. Radar ranges may be better at greater ranges.



CAN'T REPLACE STANDARD EQUIPMENT

AN/APB-42 is an addition rather than a replacement. Use it as a supplement and to get *additional* data. It doesn't use the same equipment you have learned to use.



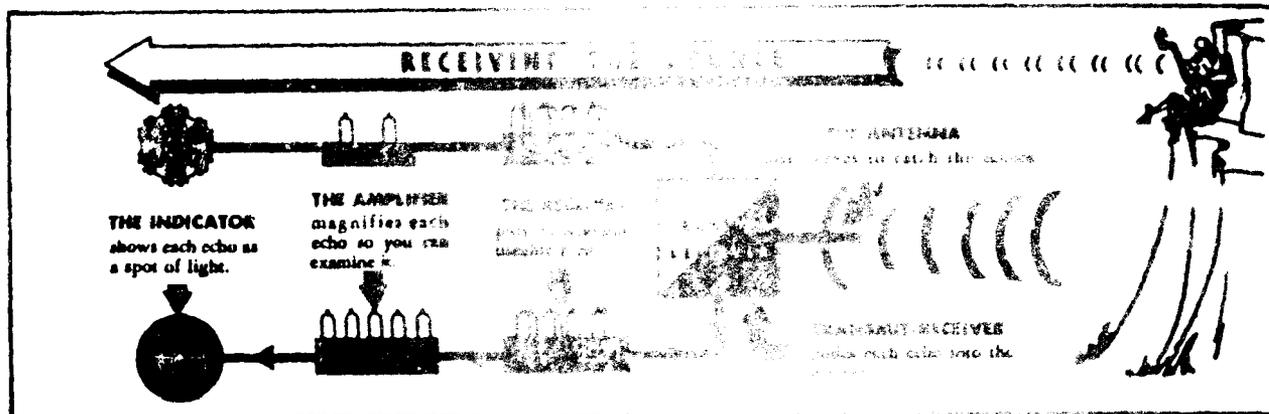
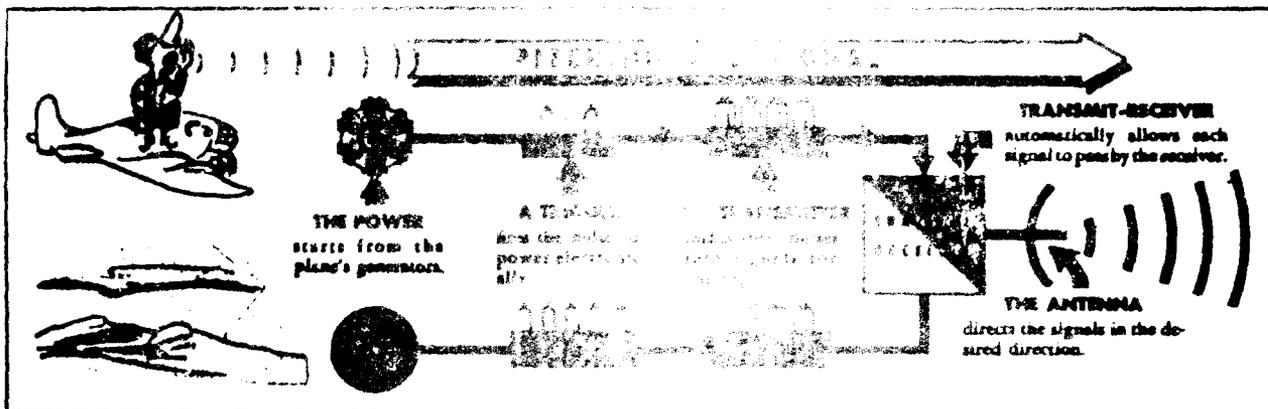
CAN'T LOCATE OBJECTS UNDER WATER

Radar signals do not travel through water. They are absorbed by it and reflected from its surface. Objects are on the surface, AN/APB-42 won't see them.



WHISTLE BOUNCING — Sometimes a skipper is uncertain of the position of a ship in fog or fog. He has learned to blow his whistle *wooo!* for the echo from shore. He can tell how far off shore he is by the time the echo returns to him.

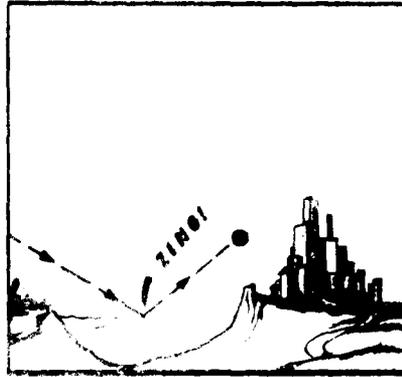
WHISTLE BOUNCING — Radar is like that. Only instead of a whistle it sends out an electronic signal and each echo is received accurately and automatically. The signal is like the whistle — Radar uses the echo that bounces back.



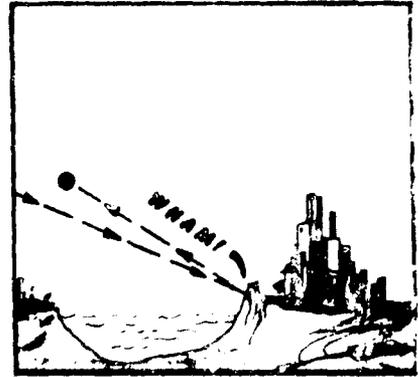
WHAT MAKES RADAR ECHOES



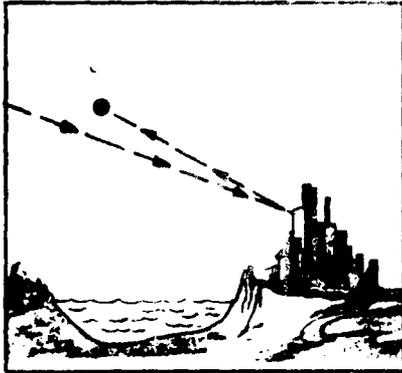
1. THE PITCH — If you could look at *part* of a signal — it would be like this. You pitch it with Radar.



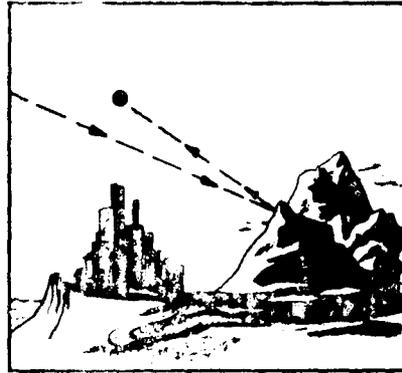
2. NO RETURN — Suppose your signal hits flat water. The angle is such that it glances off and is gone.



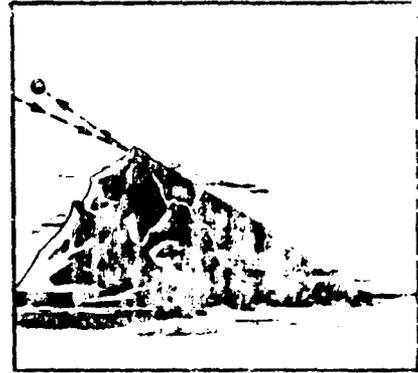
3. A BOUNCE — But suppose your signal hits the shore, beyond the water. It can bounce right back.



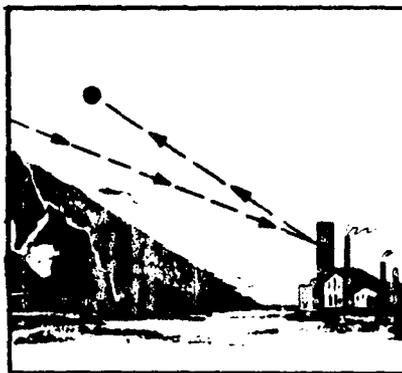
4. MORE BOUNCE — Or if it hits the building in a city — you can expect a healthy bounce back at you.



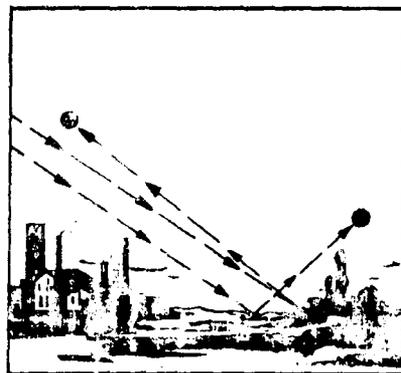
5. A MOUNTAIN — Any slope that's steep enough will bounce back an echo. The steeper the slope, the better the bounce.



6. BARE OVER THE MOUNTAIN — Your signal travels in a straight line. So you can't get echoes from the valley.



7. SIGNALS BEYOND THE SHADOW — But you may pitch a signal *over* the top and get echoes from objects beyond.

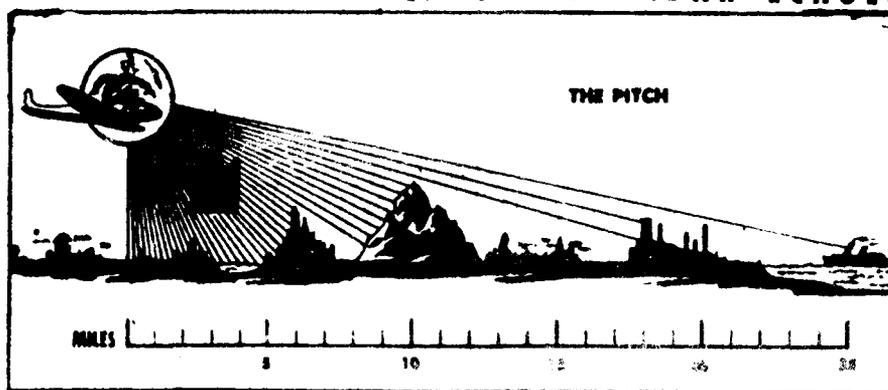


8. GROUND RETURN — Ground isn't perfectly flat. So you are apt to get little echoes from almost any land.



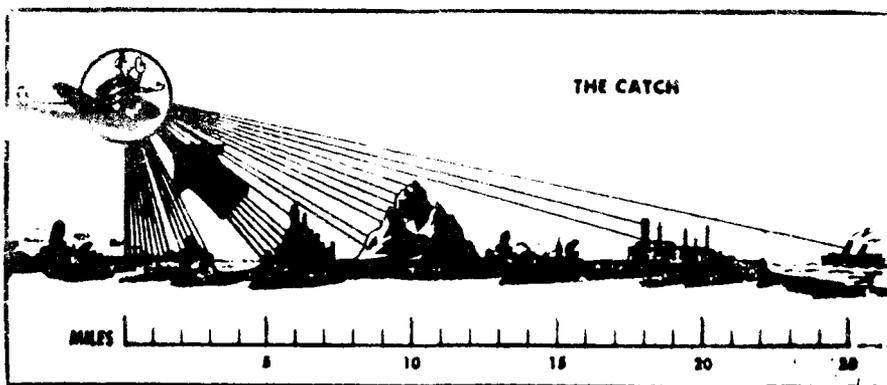
9. ALTITUDE SIGNAL — No matter what's directly below you — you can bounce signals and expect echoes.

CATCHING RADAR ECHOES



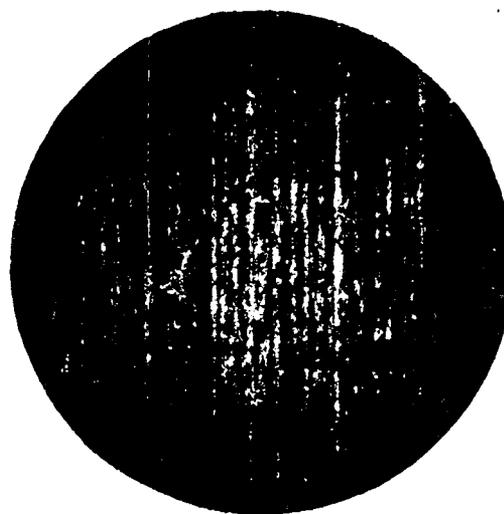
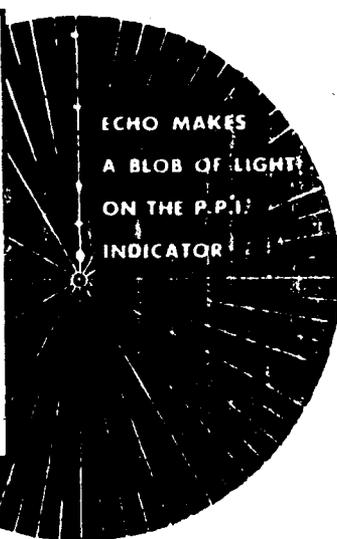
TRANSMIT — When a Radar signal is actually sent from the plane, it behaves more like this. Imagine pitching an infinite number of balls all at once. They travel to earth in straight lines. They hit whatever is within range of the Radar set. Some are sure to bounce back and some will not. The picture below shows how the echoes depend on what is below.

RECEIVE — The echoes return like this. They depend on what the signal hits. You get strong returns from right under the plane, from the cities, mountains, and ship. Weak echoes come from the ground between them. And no echoes return from the lake or the valley beyond the mountain, or the ocean. The strength of each echo and the distance it travels are both important.



TIME THE BOUNCE

Radar waves travel at a constant speed (about 186,000 miles per second). So the time it takes for signal and echo to go and come is in direct proportion to the range or distance. By plotting the time you can read the distance in miles.

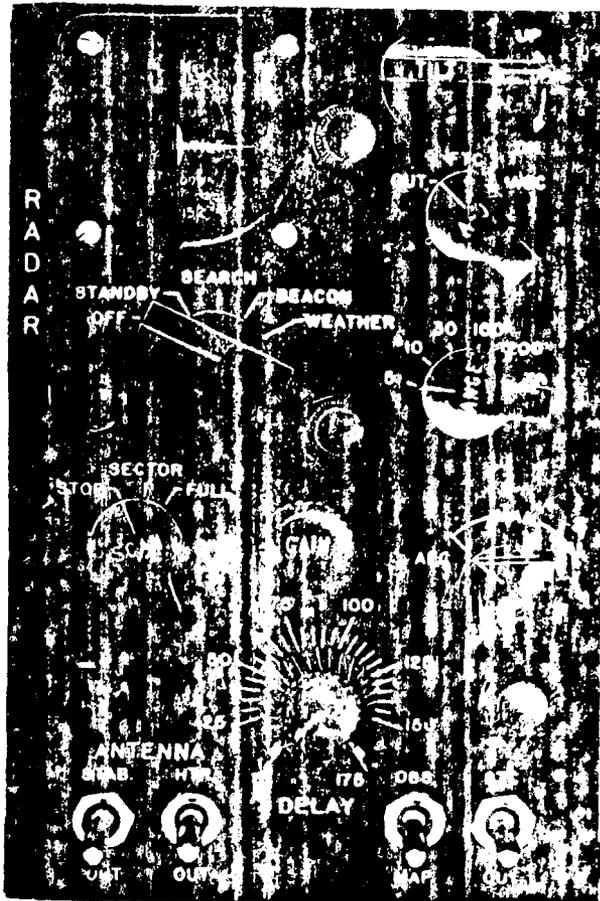


MEASURING THE DISTANCE — Echoes are plotted on this sweep line of the P.P.I. (Plan Position Indicator.) Prominence varies with the strength of the echo. Range (or time) is read from the center (which corresponds to your position) to the outside. The location of the sweep line depends on what way the antenna is pointing at that instant. The top (0°) is straight ahead, or the direction of the plane's heading.

IT LOOKS LIKE THIS — As the Antenna revolves, this sweep line repeats hundreds of times per second around the P.P.I. (indicator). It paints in all the echoes around you. You can see the ship, the shoreline, the cities, the valley, the mountains, and the lake. The P.P.I. is made so that it will "hold" these marks as the sweep travels clockwise around the P.P.I. It becomes a kind of map or plan with you in the center.

Operation

The key to successful radar operation and interpretation comes from correct use of the antenna tilt and the proper setting of the gain control. While there is no normal setting for either of these controls, there is a best setting for any specific target or type interpretation. This section will stress the settings of these controls as used for weather avoidance, but the operator must realize that they are not a magic formula for all radar targets and will vary for terrain, beacon displays, etc.



APS/42 RADAR CONTROL

Operation for Weather Avoidance

1. Turn all controls counterclockwise or DOWN.
2. Place Function switch to STANDBY and wait three minutes.

NOTE: The antenna tilt meter will respond when the set is sufficiently warmed up for operation.

3. Rotate the INTENSITY control on the scope clockwise until the sweep trace line is just barely visible.
4. Adjust the FOCUS control on the scope for a sharp and clear sweep Trace Line.

5. Set the FUNCTION switch to either SEARCH, BEACON or WEATHER, as desired.

NOTE: When using the 5, 10, or 30 mile ranges, a better weather return is usually obtained on the SEARCH position. For weather displays on the 100 and 200 mile ranges, the WEATHER position should be used.

6. Place Beam Selector switch to the OBS position for weather, MAP for terrain. Reference: Figure 2 and 3.

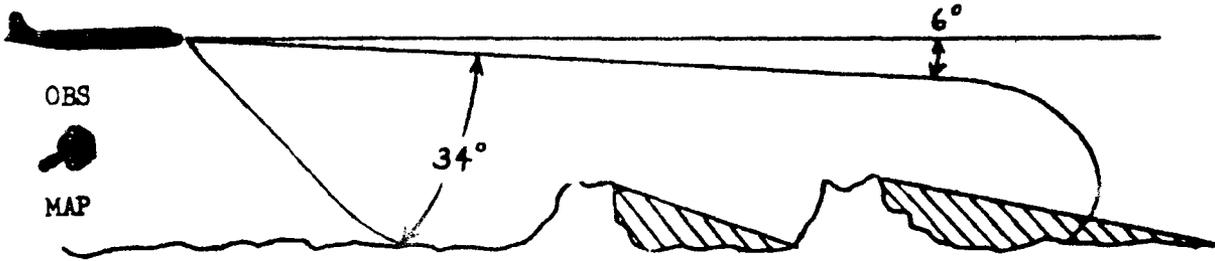
NOTE: Use SECTOR SCAN any time it is desired. The Scan will be 120 degrees on Sector and 240 degrees on Full. For this reason observation of specific targets in the direction of the aircraft heading are slightly improved by using SECTOR SCAN.

7. Place the SCAN switch to either SECTOR or Full.

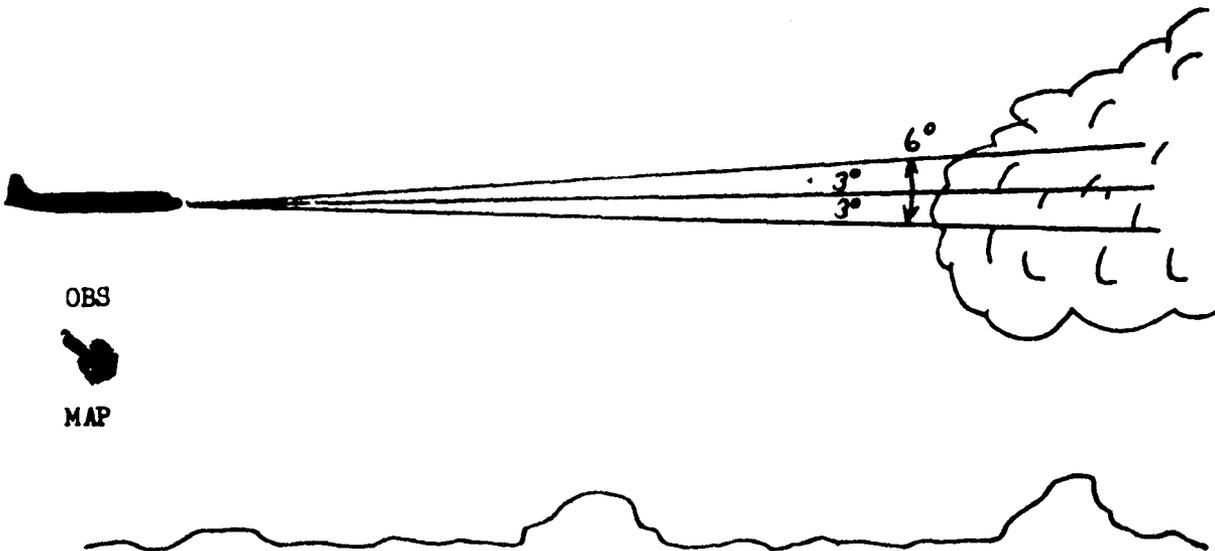
8. Rotate the GAIN control clockwise until the scope is covered with heavy yellow salt-like noise returns (Fig. 1-A). Knob should then be turned counterclockwise until a very faint trace of salty flecks still remain. (Fig 1-B).

BEAM PATTERNS

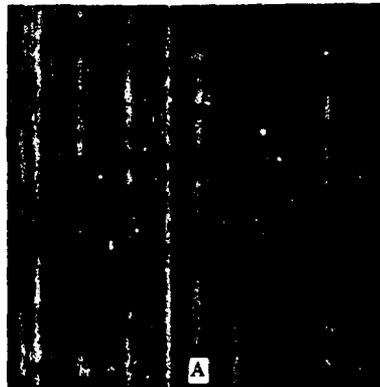
0° Antenna Tilt



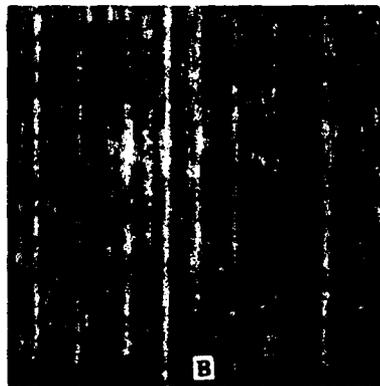
MAP BEAM, SHOWING SHADOWS BEHIND PROMINENT TERRAIN FEATURES



OBS BEAM, AS USED FOR AVOIDANCE OF THUNDERSTORMS AND TERRAIN COLLISIONS



GAIN TOO HIGH



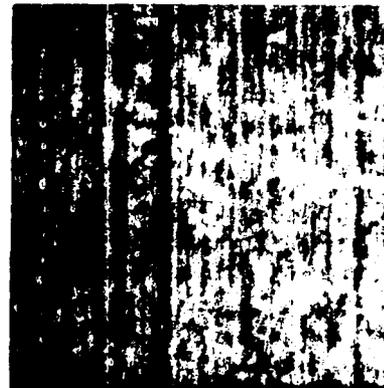
PROPER GAIN SETTING

Figure 1.

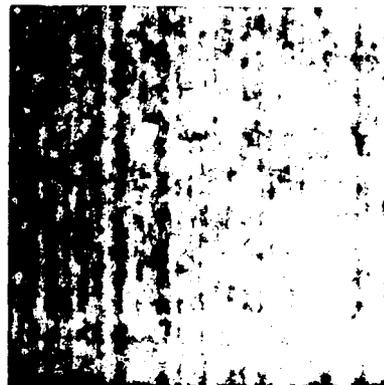
in the antenna unit will compensate the antenna for both pitch and roll.



TILT TOO LOW



TILT COULD BE TOO HIGH
(No ground clutter reference)



PROPER TILT

Figure 2

9. Range Selector - As desired, usually no greater than 30.

10. Set the Antenna Tilt.

NOTE: Setting the antenna tilt correctly is very important for weather interpretation. A good rule of thumb is to run the tilt up until ground clutter is just visible at the outer edge of the scope. This will allow readable pickup of all storm echos. (Figure 2) Occasionally, when flying through storm areas, it will be desirable to run the tilt up momentarily to estimate the height of the storm.

11. Set the Stab control as desired. When placed to the STB position, a gyro

The above controls are all that are generally used for weather interpretation. However, in many cases the other

controls will prove helpful and may be used and, for that reason, a brief explanation of each is given below.

HTR (Heater) This switch is on all APS-42 controls, however, it is important only to the older model antennas. In the later models, the antennas have no need for heaters and therefore are not installed. The switch is left on the newer models to satisfy interchangeability requirements. In the older models there are two heaters, one of 75 Watts, and the other 375 Watts. The 75 Watt heater is thermostatically controlled and is usually sufficient. In extreme temperatures the 75 Watt heater is insufficient and, in this event, the 375 Watt heater may be turned on to pre-heat the antenna by placing the HTR switch to the HTR position (Use it only as a PREHEATER).

A-J Control The Anti-Jam control is normally left in the OUT position. Turn it to the Fast Time Constant or Instantaneous Automatic Gain Control (FTC or IAGC) position enables the operator to reduce the clutter on the scope for the entire range of the set. Use the setting that gives the best results and re-adjust the gain, if necessary.

NOTE: The A-J switch should not be used unless definite improvements are noted as the overall sensitivity of the set is reduced.

STC Switch This control is similar to the A-J control in many respects as it also reduces clutter. In addition, it will reduce the return from targets up to a maximum of ten miles. Occasionally, a nearby city or rough sea will appear too bright on the scope and can be diminished by using this control.

Tune Control This control has two positions AFC (Automatic Frequency Control) and MANUAL. Use the AFC position in all normal operation. Manual tuning is used only when the automatic is in-

operative. This will be indicated by severe spoking on the scope or loss of all returns.

Delay Control and TD (Target Discrimination) feature of the Range Selector. On the TD feature of the Range switch the display on the scope is delayed from 5-175 miles as indicated by the delay control; and only a 30 mile area is amplified.

Example of TD Operation Assume a target that you want to scrutinize is 150 miles out. First, place the range switch to 200 and observe the target on the sixth range mark. (25 mile range marks at this setting). Rotate the delay control until the delay (variable) marker is just below the target in question. Switch to TD and the area from where the delay marker appeared plus 30 miles will be displayed.

Echo Interpretation

A radar scope does not picture turbulence, hail, or tornadoes. Insofar as weather displays are concerned, it pictures only moisture. There is no differentiation between moisture in the form of rain or hail, but from the moisture return we attempt to identify degrees of turbulence and probable hail areas.

Turbulence

Turbulence is caused by sheer. Sheer occurs when wind flow in adjacent areas varies in direction or speed, or both. The degree of turbulence is in proportion to the difference in wind flow speed, angular change of flow direction, or both. Turbulence is extreme in thunderstorms because vertical currents of air are flowing in opposite directions at high rates of speed. Schematically, these updrafts and water-loaded downdrafts are shown in Fig. 3.

The degree of turbulence encountered

during flight through any such area is dependent upon how fast the aircraft passes through the shear zone. To a degree, the pilot has some control over this by slowing down when storms are penetrated, but this slight control is not nearly as effective as picking an area of more gradual sheer gradient.

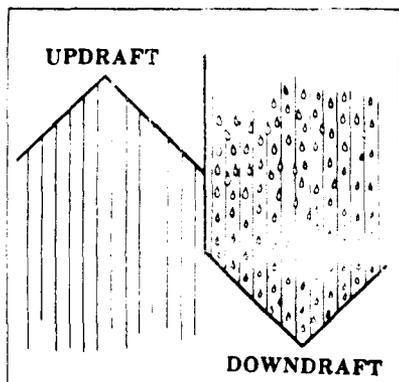


Figure 3.

Radar enables a pilot to "see" and avoid areas of maximum sheer (turbulence). If his set is equipped with contouring circuitry (iso-echo), he can choose a flight path through areas of most gradual sheer gradient. Contour circuitry (iso-echo) is presently being installed in some MATS APS/42 equipped aircraft.

Since radar echos shown on the scope picture moisture content, this can be pictured as in Fig. 4.

Contouring circuitry blanks out returns above a fixed degree of brightness. With this feature the storm echo depicted in Figure 4 would appear as shown in Figure 5.

Frequently two storms that appear approximately equal in size and intensity without iso-echo (Fig. 6) are found to be of considerably different intensity when viewed with iso-echo (Fig. 7).

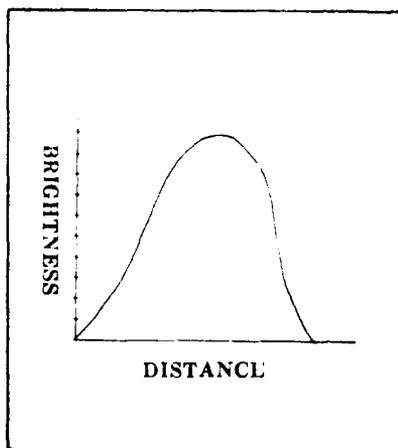


Figure 4.

Immediately we know that storm 1 has sharp sheer and heavy turbulence.

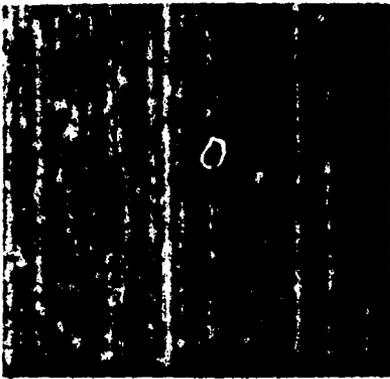
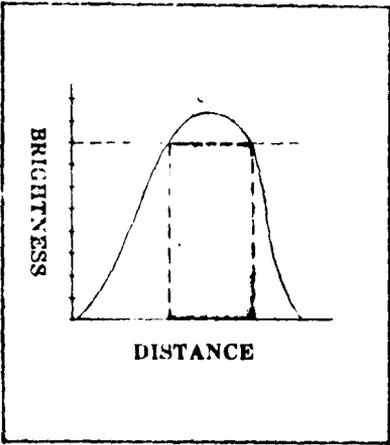
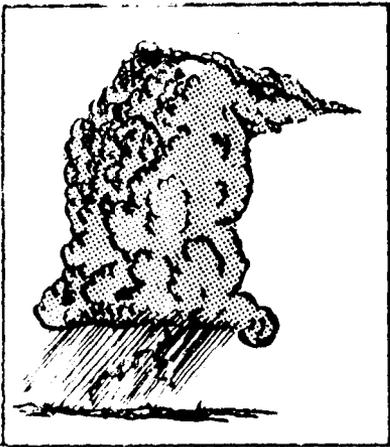
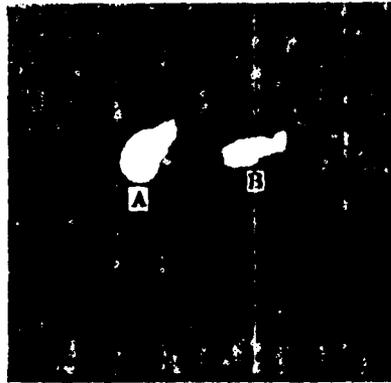


Figure 5.



WITHOUT ISO-ECHO

Figure 6.



WITH ISO-ECHO

Figure 7.

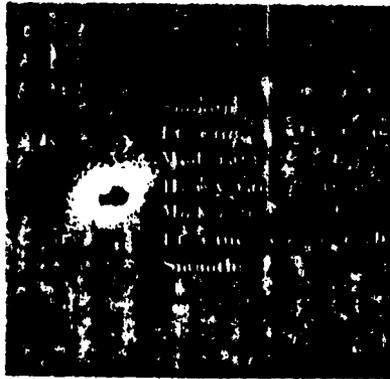
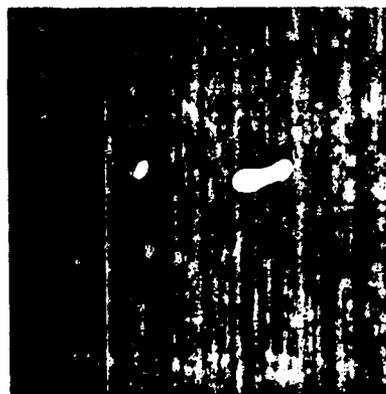


Figure 8.

Actually, were we to fly through storm A, we would probably encounter conditions as in Fig. 8.

In storm B (Fig 6 and Fig 7) however, the gradient is much sharper, therefore, applying the rule that turbulence is proportionate to the speed of passage through sheer, we know that storm B should be avoided.

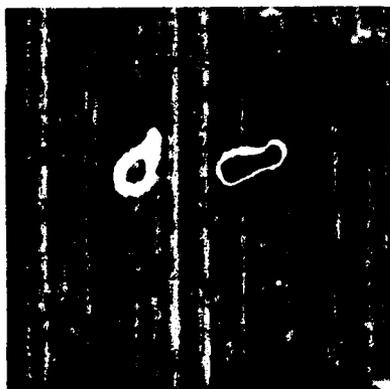
Is there any way comparative severity of storms can be determined without iso-echo? Yes, to some degree. By decreasing gain on the set, the target will grow smaller. Those which decrease the most are the least intense. This gives an approximation of iso-echo, as illustrated in Fig. 9.



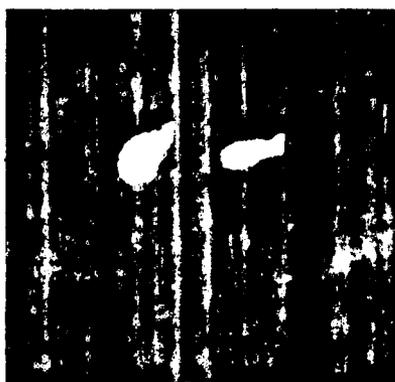
LOW GAIN

Figure 9.

Use of low gain as a means of determining storm intensity cannot be considered as accurate as iso-echo, but may help on occasions when all storms cannot be circumnavigated.



WITH ISO-ECHO



WITHOUT ISO-ECHO

Figure 9.

If the "low gain" technique is practiced, the following procedure is suggested: Mark the normal gain setting in order to return to this exact setting. Decrease gain to obtain some target fade and mark this setting. (Fig. 10). Any time a check is made for storm intensity, ALWAYS decrease the gain control to the exact low setting mark; then ALWAYS return it to the normal gain setting mark. In this way the comparative pictures will always be in the same relative proportion. Any other setting will give the operator an erroneous impression of storm intensity.

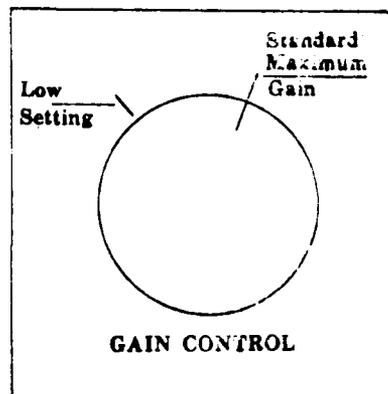


Figure 10.

Hail

A good procedure for radar identification of probable hail is to watch for, identify, and avoid the following echo patterns:

Pointing Fingers
Hooked Fingers
Scalloped Edges

Hail shafts appear to form quickly in active thunderstorms and constant scope monitoring is mandatory during flight near such storms. Any time a storm is changing shape fairly rapidly, chances of hail shafts are excellent.

Fig. 11 shows scope presentations of fingers and scalloped edges as typical hail shaft echoes.



Figure 11.

Avoidance

Shafts of hail normally fall from the thunderstorms rather than from the inner heavy rain core. Winds often carry these hail shafts well out into clear areas adjacent to the storm. In the Severe Weather Warning Center's hail summary, it was pointed out that hail encounters below 10,000 Feet were predominately within two miles or less of the storm. Between 10,000 and 20,000 Feet hail encounters ranged up to six

miles from the storm.

All hail echo and heavy turbulence type returns should be avoided by five miles or more below the freezing level and ten miles or more above the freezing level. By using the 30 mile range, you should be able to fly the inner circle between the storms and above the freezing level you should be able to push the second circle between the storms. (Fig 12)



Figure 12.

NOTE

Any time a "Figure 6" echo is noted, it should be given wide berth as there is some evidence to indicate that this echo pattern is representative of tornadoes.

Turbulence and Hail Avoidance
Tips - When you MUST Fly Through
Storm Areas

- * Set the gain correctly then never change it.
- * If your set is iso-echo equipped, use it.
- * If your set has no iso-echo feature and a low gain setting is being used in an attempt to simulate iso-echo information, always use the same low gain settings.
- * Tilt setting should be adjusted until ground return is visible toward the outer range.
- * Sharp rainfall gradients are indicative of sharp sheer areas(turbulence).

* Watch for and avoid hail echos:

- Hooked Fingers
- Pointing Fingers
- Scalloped Edges

* Fly at least five miles from storms below the freezing level, and at least

ten miles from storms above the freezing level.

- * Monitor the scope constantly, if possible, when in storm areas.
- * Fly well clear of rapidly developing storm echos.
- * Never fly under an overhanging thunderstorm cloud - you are asking to be hit by hail.
- * Watch for turbulence visually and by running radar occasionally. A protuberance over a rain cell can fall rapidly. It is not necessary to fly into a shaft of hail - equal damage can result when hail suddenly drops on your aircraft as you fly through a clear corridor.

* A thirty mile range setting is ideal for close up detail and hail detection, but switch to the one hundred mile setting occasionally to keep from flying into a "blind alley".

* Don't use radar to find out if it's rough - use it to avoid areas where it may be rough.





AIRCRAFT PERFORMANCE

Section 8

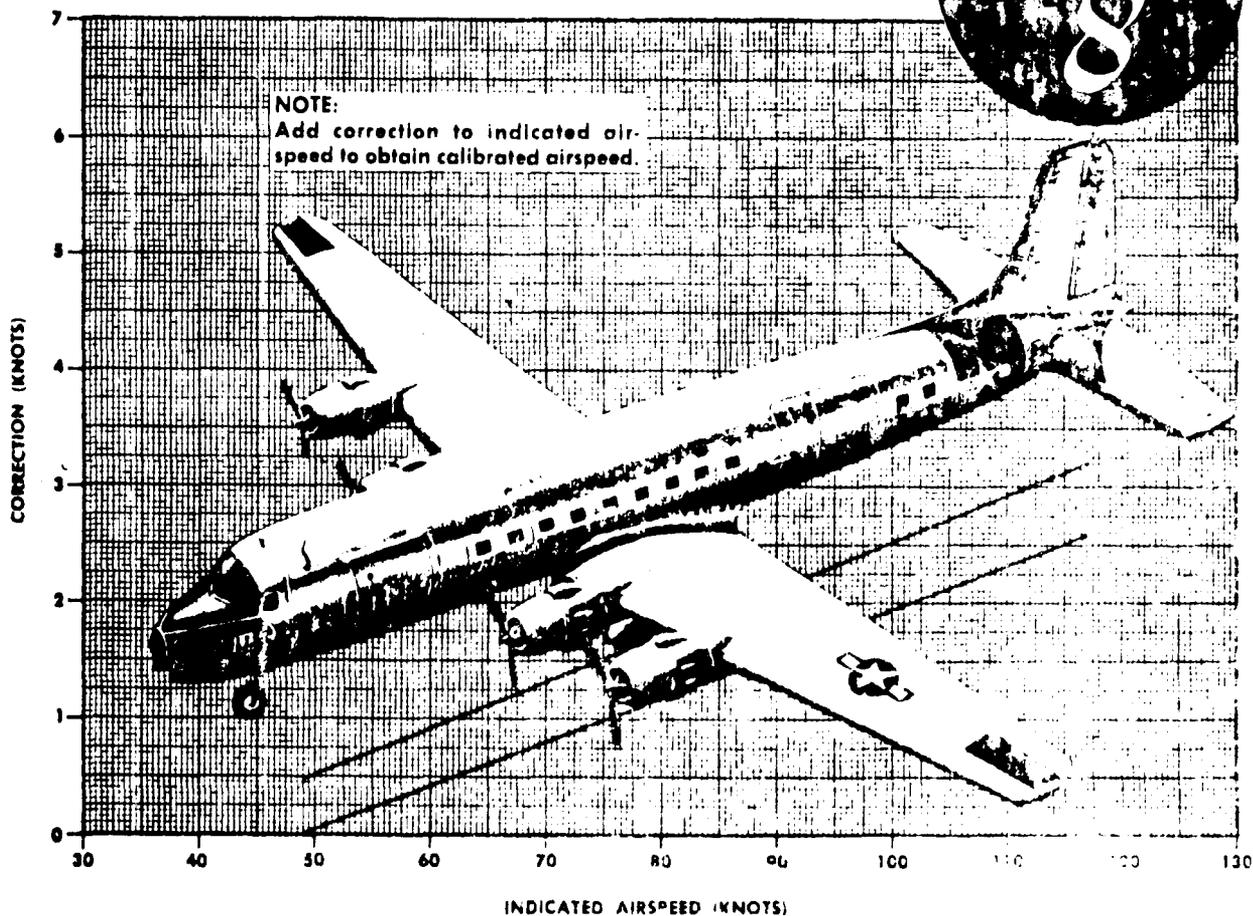


TABLE OF CONTENTS

Chapter	1	Introduction -----	8-2
Chapter	2	Terms and Symbols -----	8-3
Chapter	3	The Computer -----	8-4
Chapter	4	Atmosphere -----	8-10
Chapter	5	Engine Performance (Takeoff) -----	8-14
Chapter	6	Aircraft Performance (Takeoff) -----	8-21
Chapter	7	Recinded -----	
Chapter	8	Climb -----	8-24
Chapter	9	Cruise Control -----	8-25
Chapter	10	Descent -----	8-29
Chapter	11	Flight Planning -----	8-30
Chapter	12	MATS Form 52 -----	8-34
Chapter	13	Aerodynamic Characteristics -----	8-36
Chapter	14	Bibliography -----	8-36

Chapter 1

INTRODUCTION

General

Aircraft Performance, once labeled "Cruise Control" is a general term which describes the overall function and efficient operation of an aircraft. This study includes flight planning, takeoff planning, power predictions and, of course, cruise control.

The Computer or a slide rule is a necessary part of aircraft performance calculation and will be one of your most valuable time savers. With it, you can solve complex aircraft performance problems rapidly and accurately. These, however, are only as accurate as the individual operating them. You will benefit greatly by developing skill with these "Tools of the Trade."

Takeoff is perhaps the most critical part of flight operation. Modern aircraft, such as the C-118A, are designed as high performance machines, but you must be able to determine the performance capabilities of your aircraft under all conditions so that you can recognize the danger signals exhibited by an aircraft which is less than perfect. Takeoff planning will insure that your aircraft operating weight is within the limits set up by aviation authorities to be safe margins under any operating conditions.

Climb data will include such facts as fuel predictions, power requirements, airspeed computations, and distance predictions.

Cruise Control will include finding and setting power with five different methods:

- Maximum Range
- Long Range
- Maximum Endurance

Constant Brake Horse Power
Constant True Airspeed

Each of these methods has its own application, and each is indispensable for its own reasons.

Flight Planning, while often the function of the navigation and briefing department in cooperation with the crew navigator, is still the concern of the entire crew. The flight plan information will include fuel load, time factors, and speeds.

The Engineer's Flight Log, MATS Form 52, is the complete record of the entire flight, as far as aircraft and engine performance is concerned. Requirements for its use are set forth in MATS Regulation 55-26. This running account of flight performance may be used to detect possible future failure of components, errors in operating techniques, discrepancies in weight and balance figures, and aerodynamic correction factors.

The study of aircraft performance is like the purchase of an insurance policy, except there are no premiums to pay and the policy-holder is the real beneficiary. Your reward for proper use is a longer life, a safer flying career, and a professional position in the aviation field.

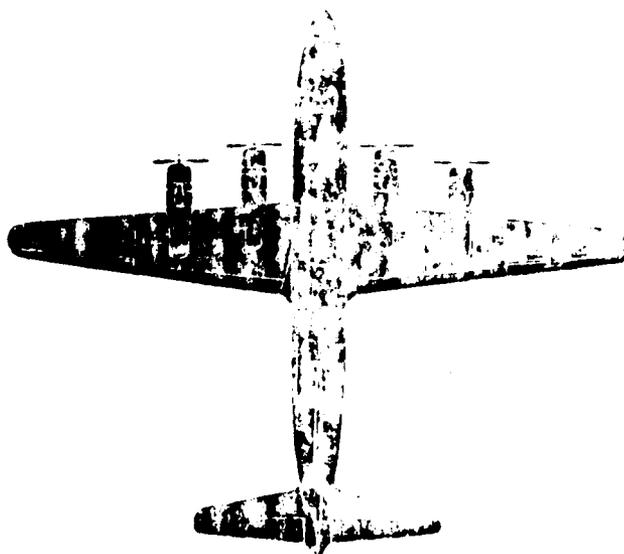


Chapter 2

TERMS AND SYMBOLS

In order that you may recognize the terms and symbols required in this study, we will list them in the general order of their appearance. Refer to this list often, for recognition of the terms involved is a large factor in performance accuracy.

H_p	- Pressure altitude with setting of 29.92	$V_{l/d}$	- Velocity for maximum lift versus drag
H_d	- Density altitude, H_p corrected for OAT_c	V_s	- Stalling Speed (Zero thrust)
OAT_c	- Outside air temperature, corrected for compressibility	V_{ng}	- Go-no-go Speed
OAT_i	- Outside air temperature, indicated	V_{ac}	- Acceleration Check Speed
$\frac{1}{\rho}$	- SMOE - An air density reciprocal	V_r	- Refusal Speed
IAS	- Indicated Airspeed	V_{to}	- Takeoff Speed
BAS	- Basic Airspeed (IAS corrected for mechanical error)	V_{mc}	- Minimum Control Speed
CAS	- Calibrated Airspeed (BAS corrected for position error)	V_{max}	- Maximum Speed (redline)
EAS	- Equivalent Airspeed (CAS corrected for compressibility)	NM/LB	- Nautical miles per pound of fuel
TAS_k	- True Airspeed Knots (EAS corrected for H_d)	FF	- Fuel Flow (pounds per engine per hour)
Δ	- Greek sign "DELTA" = Error Factor	D	- Distance (usually in nautical miles)
K	- Engine power constant (283)	F	- Fuel in pounds
CAT	- Carburetor Air Temp ($OAT + 50^\circ C$)	η	- Greek ETA - Propeller efficiency (85%)
BHP	- Brake Horsepower	R/D	- Rate of Descent in feet per minute
BHP_p	- Brake Horsepower predicted	MAP	- Manifold Absolute Pressure
BHP_r	- Brake Horsepower reject	CFL	- The distance represented by the liftoff or stopping point with engine failure.
BHP_c	- Brake Horsepower correction	GW	- The "scale" weight of the aircraft
BMEP	- Brake Mean Effective Pressure		
$BMEP_p$	- Predicted		
$BMEP_r$	- Reject		
$BMEP_o$	- Observed		
DP	- Dew Point		
AWF	- Average Wind Factor		
RWY	- Runway		



THE COMPUTER

The Computer is a circular slide rule to which two supplementary scales have been added; airspeed correction and altitude correction. Using the computer, we can solve mathematical problems and airspeed and altitude computations quickly and easily. The outer scale is calibrated in miles and the inner scale in minutes. In the inner scale, a shaded triangle called the speed index is placed at the one hour position. Also, the face of the computer is so calibrated that any rela-

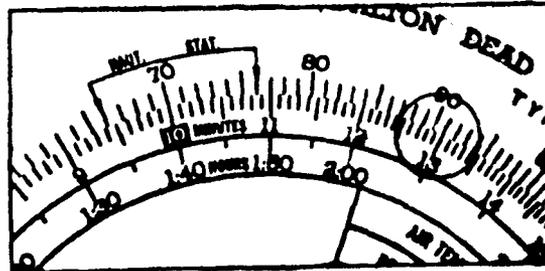
tionship between two numbers, one on the outer scale and one on the inner scale, will hold true for all other numbers on the two scales. Thus, if 20 on the inner scale is placed opposite 10 on the outer scale, all numbers on the inner scale will be double those on the outer scale. This feature of the computer permits one to solve for the fourth term in any mathematical problem in proportion. The following examples are presented as a guide in using the Computer.

Multiplication

Problem: 7×13

Solution: Set index 10 on "inner" scale opposite number multiplying by, (7). Read opposite number to be multiplied (13) on "inner" scale, to find answer on "outer" scale.

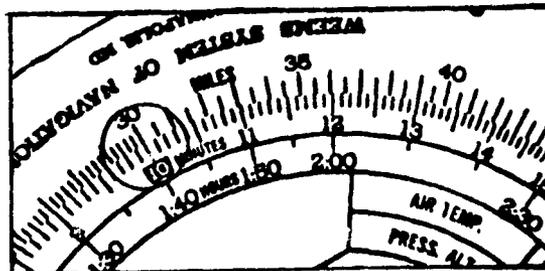
Answer: 91.

Division

Problem: $39 \div 13$

Solution: Set number dividing by (13) on "inner" scale opposite number to be divided (39) on "outer" scale. Read answer on "outer" scale above "inner" scale index 10.

Answer: 3.

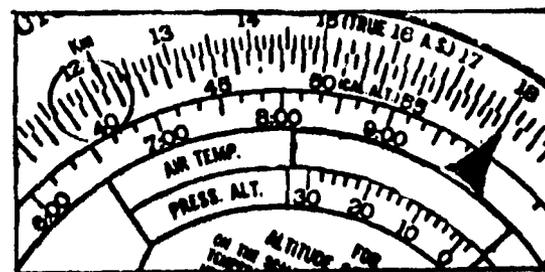
Time and Rate

Given: TASK 180, time in-flight, 40 min.

Find: Distance traveled.

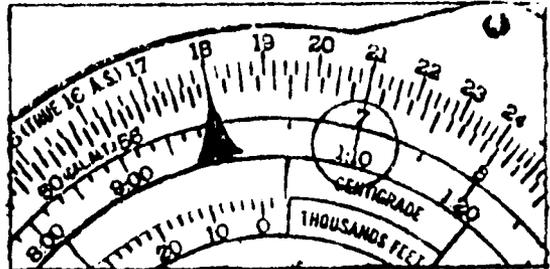
Solution: Set the speed index (triangle shaped mark on "inner" scale) opposite 180 TASK (18) on "outer" scale. Opposite 40 min. on "inner" scale read the distance traveled on "outer" scale.

Answer: 120 Nautical Miles

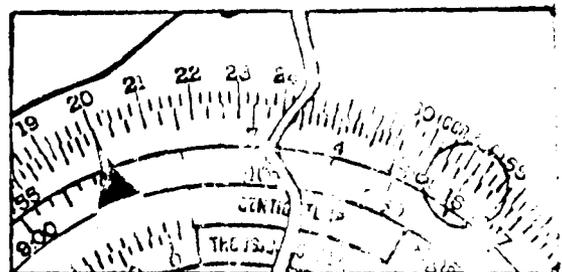
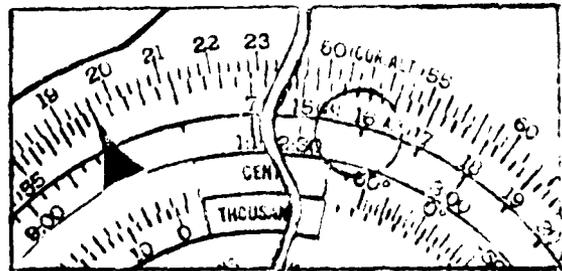


Time and Rate

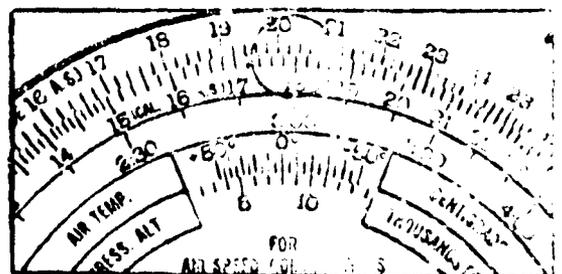
Given: TASK 180. Distance to travel
210 Nautical Miles.
Find: Time required to fly distance.
Solution: Set speed index (heavy tri-
angle-shaped mark on "inner"
scale) opposite 180 TASK (18)
on "outer" scale. Opposite
210 (21) miles on "outer"
scale, read 70 (7) minutes on
"inner" scale, or 1:10 on
innermost scale.
Answer: 70 minutes or 1:10.

Fuel and Time and Rate

Given: Fuel flow 2,000 lbs per hour
TASK 196. Distance to travel
525 Nautical Miles.
Find: Fuel required.
Solution: Set speed index opposite 196
TASK "outer" scale, read be-
low 525 Nautical Miles "outer"
scale for time required for
flight 2:40. Reset speed index
opposite 2,000 lbs. per hour
fuel flow on "outer" scale.
Above required flight time on
"innermost" scale, read fuel
required on "outer" scale.
Answer: 5,350 lbs.

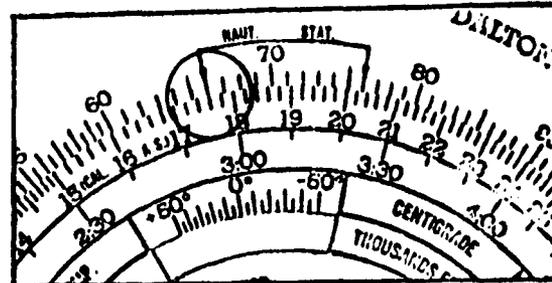
Convert EAS to TAS

Given: Equivalent airspeed - 180 MPH
Pressure altitude 9,000 Ft.
Temperature - 10°C.
Find: TAS
Solution: Using Airspeed Computation
Window, adjust rotating disk
to bring the temperature
-10°C. opposite the figure 9
(9,000 Ft pressure altitude).
Opposite 180 MPH (18) on
"inner" scale, read the true
airspeed on "outer" scale.
Answer: True Airspeed - 203 MPH.



Convert TAS to TASK

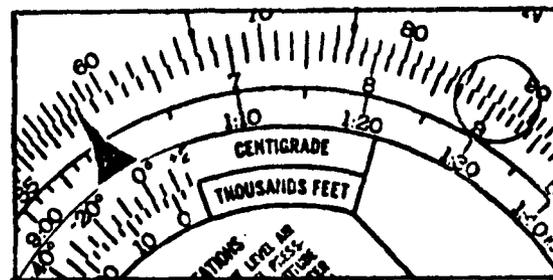
Given: True Airspeed 203 MPH.
 Find: True airspeed Nautical Miles.
 Solution: Set 203 miles on rotating disk opposite index marked "stat". Opposite index marked "NAUT"., read Nautical Miles.
 Answer: 176 Nautical Miles per Hour.



NOTE: A third index arrow marked KM will show the equivalent distance in kilometers.

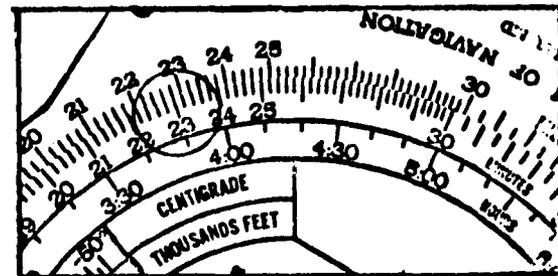
Find True Altitude

Given: Indicated altitude 9,000 Ft.
 OAT -10°C .
 Find: True altitude
 Solution: Using altitude computation window, adjust rotating disk to bring the temperature -10°C opposite the indicated altitude 9,000 Ft. Opposite 9 (9,000 Ft) on "inner" scale, read true altitude 8,780 Ft on "outer" scale.
 Answer: 8,780 Feet.



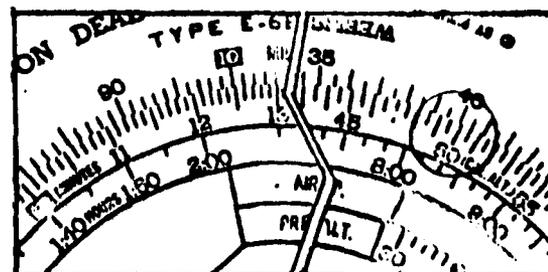
Find BHP

Given: K-283, RPM-2800, EMEP-230.
 Find: BHP.
 Solution: Align K Constant 283 on "inner" scale with engine RPM 2800 on "outer" scale. Read BHP on "outer" scale above EMEP 230 on "inner" scale.
 Answer: 2280.



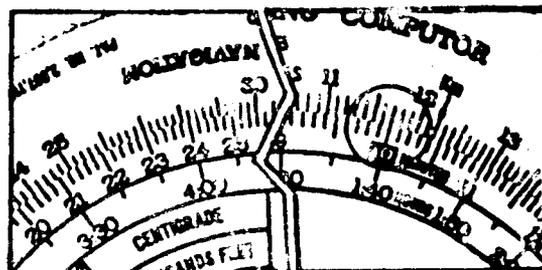
Find BHP Gain in Descent

Given: K-112,200, Gr.Wt. 90,000, R/D 500 Ft/Min.
 Find: BHP Gain in Descent.
 Solution: Above 112,200 on "inner" scale, align aircraft gross weight 90,000 Lbs at start of descent. Above rate-of-descent 500 Ft/Min. on "inner" scale, read BHP gain on "outer" scale.
 Answer: 401.

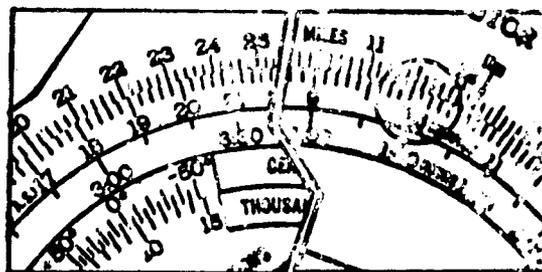


Find Nautical Miles per Pound

Given: NM-270, Fuel used 2300 Lbs.
 Find: Nautical Miles per Pound.
 Solution: Align distance covered in NM 270 on "outer" scale above fuel used in Lb. 2300 on "inner" scale. Above index 10 on "inner" scale read NM/LB .117.
 Answer: .117

Find $\frac{1}{\text{SMOE}}$ (SMOE Factor)

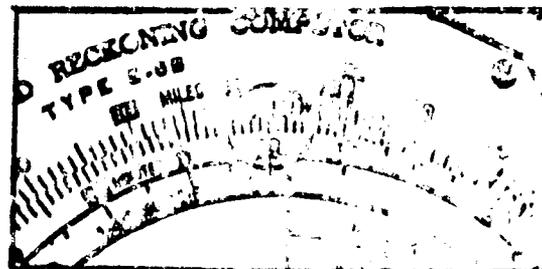
Given: Temp. -5°C ., Hp 10,000 Ft.
 Find: $\frac{1}{\text{SMOE}}$ (SMOE Factor)
 Solution: Using airspeed computation window, align corrected outside air temperature -5°C . with pressure altitude 10,000 Ft. Above index 10 on "inner" scale, read:
 $\frac{1}{\text{SMOE}} = 1.1637$



Answer: 1.1637.

Find BHP Required at Hd

Given: Charted BHP 1100, $\frac{1}{\text{SMOE}} = 1.1637$ (standard), $\frac{1}{\text{SMOE}} = 1.20$ (actual)
 Find: BHP Required at Hd.
 Solution: From specific range curve align charted BHP 1100 on "outer" scale above $\frac{1}{\text{SMOE}} = 1.1637$ (at standard conditions) on "inner" scale. Above actual $\frac{1}{\text{SMOE}} = 1.20$ (Found on Hd Chart) on "inner" scale, read required BHP on "outer" scale.
 Answer: 1135 BHP.



PRACTICE PROBLEMS

Multiplication

- 1. 192×1.1637 ■ _____
- 2. 3190×5.81 ■ _____
- 3. $3750 \times .0761$ ■ _____
- 4. 1150×1.4 ■ _____
- 5. $1905 \times .1175$ ■ _____
- 6. $11 \times .17$ ■ _____
- 7. $1790 \times .1150$ ■ _____
- 8. 201×1.2901 ■ _____
- 9. 4400×5.72 ■ _____
- 10. $2260 \times .1090$ ■ _____
- 11. 900×1.6 ■ _____
- 12. $16 \times .35$ ■ _____
- 13. $21,950 \times .1255$ ■ _____
- 14. 5404×5.85 ■ _____
- 15. $1905 \times .1175$ ■ _____
- 16. 188×1.3866 ■ _____
- 17. $1890 \times .1355$ ■ _____
- 18. 1050×1.4 ■ _____
- 19. $19,600 \times .1035$ ■ _____
- 20. 210×1.0921 ■ _____

- 31. $199 \div 2010$ ■ _____
- 32. $245 \div .1135$ ■ _____
- 33. $1,909 \div 18,720$ ■ _____
- 34. $22,140 \div 5.88$ ■ _____
- 35. $1,695 \div 16,970$ ■ _____
- 36. $2,550 \div 29,140$ ■ _____
- 37. $229 \div 1.1637$ ■ _____
- 38. $235 \div 2,260$ ■ _____
- 39. $2,080 \div .1250$ ■ _____
- 40. $30,900 \div 5.71$ ■ _____

Percentage

- 41. 95% of 247 ■ _____
- 42. 9.64% of 2,470 ■ _____
- 43. 5.68% of 2,150 ■ _____
- 44. 76% of 2,500 ■ _____
- 45. 160% of 2,050 ■ _____
- 46. 140% of 1,650 ■ _____
- 47. 6.49% of 2,200 ■ _____
- 48. 95% of 218 ■ _____
- 49. 25% of 1,920 ■ _____
- 50. 4.09% of 2,130 ■ _____

Division

- 21. $29,170 \div 5.91$ ■ _____
- 22. $210 \div .1075$ ■ _____
- 23. $2100 \div 21,000$ ■ _____
- 24. $172 \div 3540$ ■ _____
- 25. $300 \div 30,000$ ■ _____
- 26. $230 \div 1.0921$ ■ _____
- 27. $17,000 \div 5.95$ ■ _____
- 28. $2550 \div 29,140$ ■ _____
- 29. $199 \div .1355$ ■ _____
- 30. $2,020 \div 4$ ■ _____

Time and Rate

	Time	Dist	TAS _r
51.	_____	2,290	241
52.	$6 \div 35$	_____	192
53.	$10 \div 10$	2,090	_____
54.	_____	1,160	250
55.	$16 \div 00$	_____	211
56.	$0 \div 35$	90	_____
57.	_____	765	199

Approximate Values
Estimated

Multiplicities

- 1. 20,000
- 2. 20,000
- 3. 20,000
- 4. 1,000
- 5. 22,000
- 6. 1,000
- 7. 20,000
- 8. 20,000
- 9. 20,000
- 10. 20,000
- 11. 20,000
- 12. 20,000
- 13. 20,000
- 14. 20,000
- 15. 20,000
- 16. 260 photo
- 17. 256 IM
- 18. 1,470 ft runway
- 19. 2,030 NM
- 20. 229...

Division

- 21. 4,900
- 22. 1,950
- 23. .1000
- 24. .0486
- 25. .01
- 26. 210
- 27. 2,257
- 28. .0875
- 29. 1,468
- 30. 505

- 21. 10000 NM/LB
- 22. 255 lbs fuel
- 23. 10000 NM/LB
- 24. 10000 gals
- 25. 10000 NM/LB
- 26. 10000 NM/LB
- 27. 10000 NM/LB
- 28. 10000 NM/LB
- 29. 10000 lbs fuel
- 30. 10000 lbs fuel
- 31. 10000
- 32. 10000
- 33. 10000
- 34. 10000
- 35. 10000
- 36. 10000
- 37. 10000
- 38. 10000
- 39. 10000
- 40. 10000

CHAPTER 4

ATMOSPHERE

Since the atmosphere, as it affects the aircraft, is the primary factor in its performance; and since density, pressure and outside air temperature are variable; it became necessary to set standards of flight performance and make adjustments with altitude to aircraft performance. These standards are:

- Sea level pressure (SLP)
- Sea level temperature (SLT)

...representing
North latitude 45° North
As altitude increases, which means density decreases, which means temperature decreases, to show a change in temperature at a "normal lapse rate" of approximately 2°C per 1000 feet of altitude. Thus at 9000 feet, the standard temperature would be:

$$15^{\circ}\text{C (S.L.)} - (9 \times 2) \\ = 15 - 18 = -3^{\circ}\text{C}$$

Density altitude is a value based on pressure altitude (Pb) and outside air temperature (OAT) and may be thought of as "density altitude" so far as aircraft performance is concerned.

Outside air temperature indicated (OATc) may be found by adding a compressibility correction to the outside temperature indication on the true air temperature gage. This correction is charted on the Al-18 curve. Temperature correction to compressibility is the density altitude then may be determined by reading Al-20 "Density Altitude Chart."

For Example:

Hp - 10000
OAT_i - 8°C
CAS - 185

On the Al-18 curve, enter with CAS 185. Proceed vertically to the Hp 10000. Read temperature correction to the left as 30.

OAT_c = OAT_i + 30 minus (-) 30 = 8°C

OAT_c > OAT_i = 30
30 - 8 = 22

Now enter the Al-20 Curve with the 22. Proceed vertically to the Hp 10000. Now proceed horizontally to the left and read 11,000.

The SMOE factor ($\frac{1}{\sqrt{\sigma}}$) is the reciprocal of the relative air density and is a mathematical term which varies directly as Hd. The SMOE factor ($\frac{1}{\sqrt{\sigma}}$) for any Hd may be found from figure number Al-21. The SMOE factor may be used to compute true airspeed:

$$\text{TASK} = \frac{1}{\sqrt{\sigma}} \times \text{EAS}$$

or it may be used to compute power requirements at varied altitudes.

Airspeed symbols and corrections have become important to the aircrew even though the corrections seem small because accurate aircraft performance figures are possible only when the readings used are accurate.

The standard airspeed terms are:

IAS - Indicated airspeed
BAS - Basic airspeed
CAS - Calibrated airspeed
EAS - Equivalent airspeed
TASK - True Airspeed (Knots)

IAS, corrected for instrument error
= BAS

EAS, corrected for position error
 = CAS
 CAS, corrected for position error
 = EAS
 EAS $\times \sqrt{\frac{\rho_0}{\rho}}$

EAS = 204
 204 $\times \frac{1}{\sqrt{1.1822}}$ at Hd 11000 = 211
 (1.1822) TASk

For example:

IAS, corrected for position error
 plus
 Instrument error
 correction
 EAS
 Position error correction
 curve
 CAS
 Corrected
 Altitude

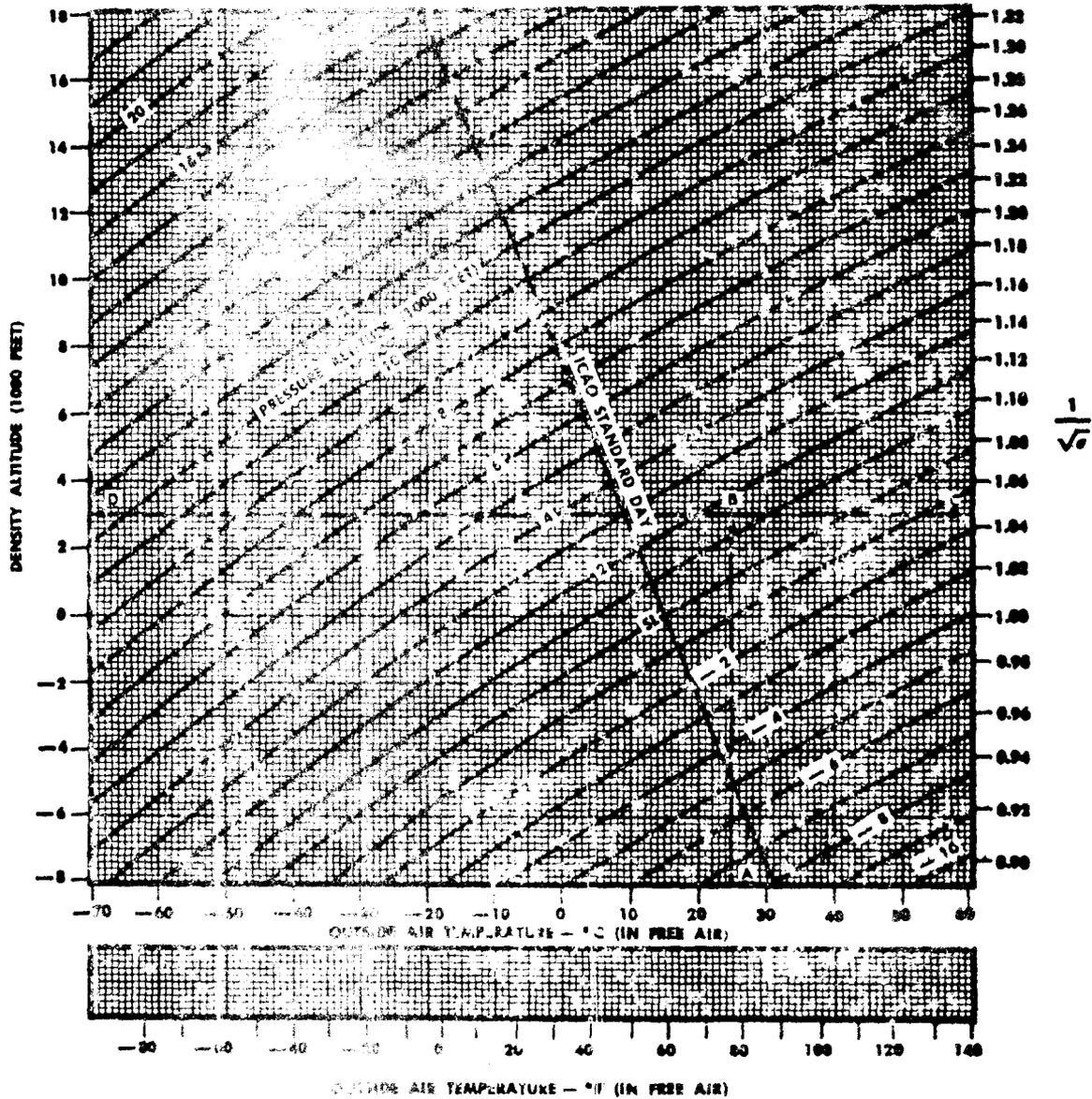
As can be seen, then, that the altitude as it affects the aircraft's performance, varies by pressure (Hp) and by temperature (OATs). These two factors, when properly corrected, will give us a density altitude (DA), which in turn gives us an air density reciprocal (AD) commonly called SMOL. This reciprocal when applied to airspeed will give TASk, which is the most important indicator of actual aircraft performance.



DENSITY ALTITUDE CHART

SAMPLE PROBLEM:

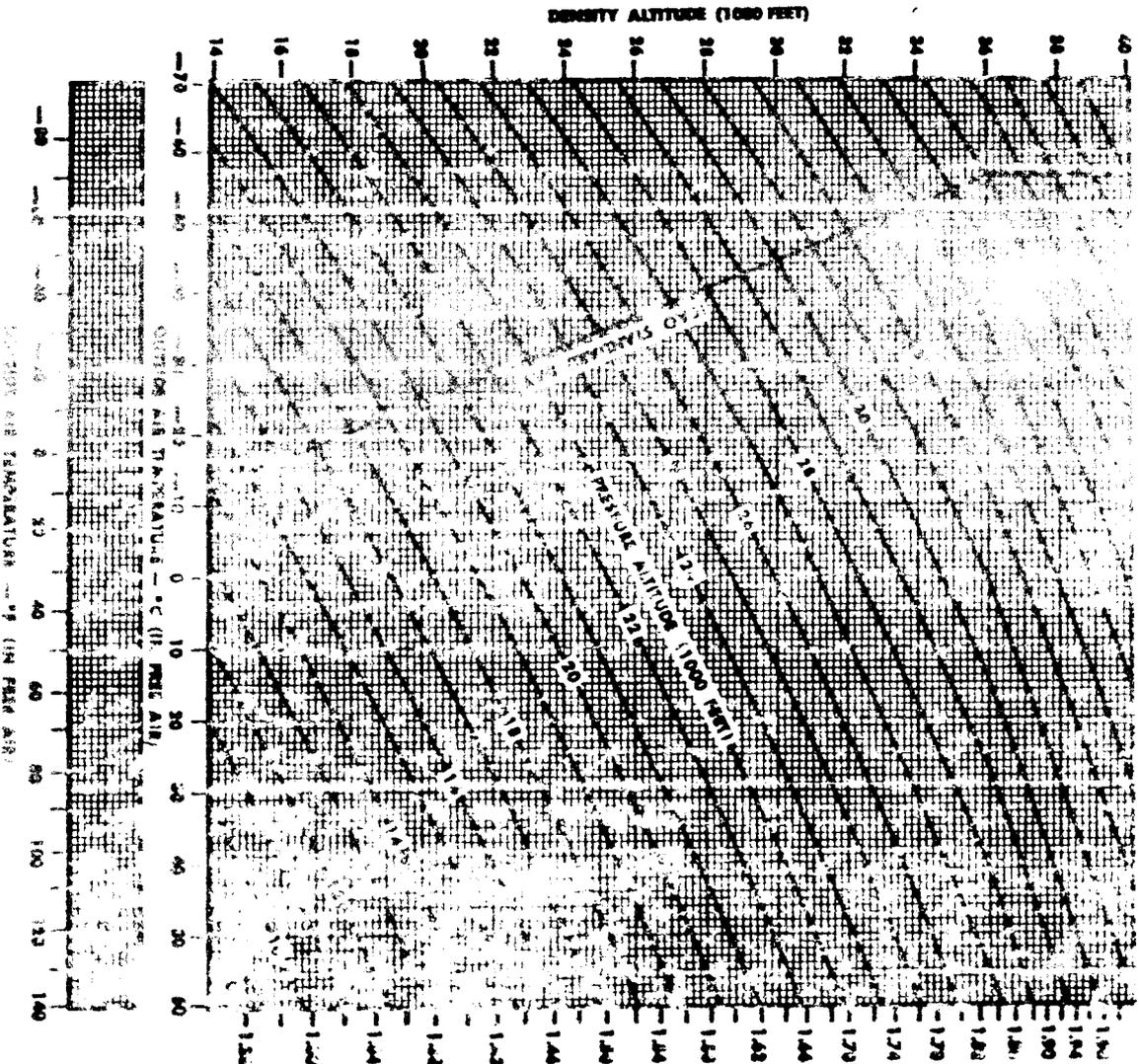
- A. OUTSIDE AIR TEMPERATURE = 25°
- B. PRESSURE ALTITUDE = 1500 FEET
- C. $\frac{1}{\sigma} = 1.045$
- D. DENSITY ALTITUDE = 1000 FEET



AE-20 Density Altitude Chart

Sheet 1

DENSITY ALTITUDE CHART



60 20 Density Altitude Chart

Sheet 2

Chapter 5

ENGINE PERFORMANCE (TAKEOFF)

The power plant, which not only provides propulsion power, but also delivers power to drive accessories, can, with complex instrument and mechanical systems, be controlled completely. The potential power output can be predicted in some instances by the observation of some of the warning signals displayed by these instruments.

In order that an engine may serve its expected time in service, some operating limits must be observed.

A. Cylinder pressure must be restricted under all conditions (Max BMEP).

B. Rotation speeds must be held below speeds which result in excessive centrifugal forces (Max RPM).

C. Time periods for higher power operation must be observed as engines would necessarily be heavier if unrestricted (Max Time at Max Power).

D. Temperatures must be closely monitored to prevent premature failure (Max CAT & Max CHT).

E. Input pressures must be restricted (Max MAP).

Engine power output, however, is effected by the same forces which effect an airplane in flight, plus others peculiar only to the engine:

- A. Pressure (H_p) of the atmosphere
- B. Temperature (OAT) or (RWT)
- C. BHP deficiency from mechanical causes

D. Humidity, where combustion supporting air is replaced by water.

Let's look at these factors one at a time:

First, pressure below standard sea level 29.92 will result in input pressure drops and eventually a condition where the throttle has been advanced as far as possible and from this point on an increase in Hp will result in a loss in BHP. This power loss is plotted on the A2-9 operating limits curve. Conversion lines exist for take-off power (Max PWR) wet & dry and for normal rated (METO) power. It can readily be seen that we are in part throttle WET to 2600 ft. at part throttle DRY to 4500 feet and at part throttle METO to 7,000 ft.

Our second computation entry should be mechanical brake horsepower deficiency, which is often called installation effect. This value will be posted in the aircraft by the Squadron performance engineer, if it exists. It is loss of power caused by conditions within the engine, and should never exceed 150 BHP/ENG average.

The third "power reducer" is temperature, OAT or RWT. Temperatures above standard result in a lower air density, which results in less combustion support. This power loss may be computed as:

Part throttle: .17% loss per °C
Full throttle: .35% loss per °C

NOTE: Degrees centigrade means hotter than standard. Increases in loss rate at full throttle is common with all reciprocating engines.

The fourth computable loss is caused by humidity, as moisture replaces dry air, and the moisture, being about 5/8 as heavy as dry air, causes enriched mixture. This enrichment will result in a percentage power loss which may be plotted as shown on the A2-3 curve.

Brake horsepower available for take-off may be found from plots on the A2-4 curve for "wet" power and the A2-5 curve for "dry" power.

Note: For alternate grade fuel, use A2-6 and A2-7 curves.

Begin with a coordinate point on the graph with pressure altitude (Hp) and carburetor air temperature. Proceed to the right to the base line for humidity then curve parallel to these guide lines to where your "chase" line intersects a vertical line from an altitude corrected dew point.

Next, to the next base line, where, if we are at "part throttle" we may add manifold pressure to the value shown on the small pressure scale at the lower right of the page. At this point, after adding the allowed vapor pressure, read your predicted BHP from the graph scale at the right. Subtract from this the BHP deficiency (mechanical defect) and you have determined the correct predicted BHP for your takeoff.

The only instruments, however, which give us a BHP indication, are the tachometer and BMEP indicator. Therefore, we must convert our BHP available to a BMEP value to give us an instantly recognized standard. This is done with the formula:

$$BHP = \frac{BMEP \times RPM}{K}$$

where: $K = 283$

$$\text{or: } \frac{BHP}{BMEP} = \frac{RPM}{K(283)} \quad (2800 \text{ at T.O.})$$

This BMEP resultant is predicted BMEP (BMEP_p). Regulations allow us to accept 95% of this and still complete the takeoff. Therefore, BMEP_p x .95 = BMEP_r. If less than BMEP_r is observed on any BMEP gage, the engineer will call ABORT (This is subject to the discretion of the aircraft commander) if V_R is less than V_{T0}. Further this 95% power will be used to compute the aircraft performance figures which will be guides during the take-off run.

Now, let's try finding a power prediction for a takeoff, using the following conditions:

Hp	Sea Level
OAT	82° F
DP	78
BHP Deficiency	100

First, we change OAT to °C by using the A1-23 curve. 82°F = 28°C. Since our engines use carburetor air, we must convert this OAT to CAT.

$$\begin{aligned} OAT + 5^{\circ}C &= CAT \\ 28 + 5 &= 33^{\circ}C. \end{aligned}$$

Now, on the A2-4 Curve, we find first, the intersection of Hp and CAT. Next, move to the humidity section, and following the guide lines, move to the humidity value of 78°F. Next, move right, to the MAP increase base line and, since we are at part throttles (we reach full throttle wet at 2500') guide up to the pressure value as shown by this graph (1.0"Hg). Read the predicted BHP here as 2300. Subtract the 100 BHP deficiency, and our prediction becomes 2000.

$$\frac{BHP (2200)}{BMEP} = \frac{RPM (2800)}{K (283)}$$

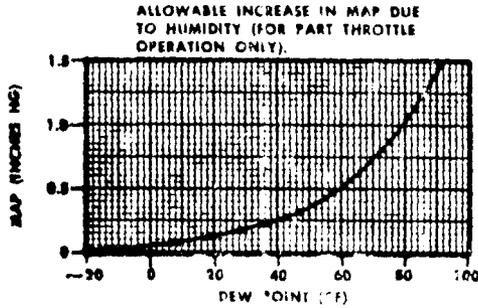
$$BMEP_p = 222$$

Since BMEP_r = 95% BMEP_p, we find this factor to be 211 BMEP, and our 95% BHP consequently, is 2090.

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

**BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF —
STANDARD FUEL GRADE — WET**
2400 RPM

ENGINES: (4) R2000-SSW
FUEL GRADE: 115/140



NOTES:
1. Assume that the carburetor air temperature (CAT) is 5°C above the outside air temperature (OAT).

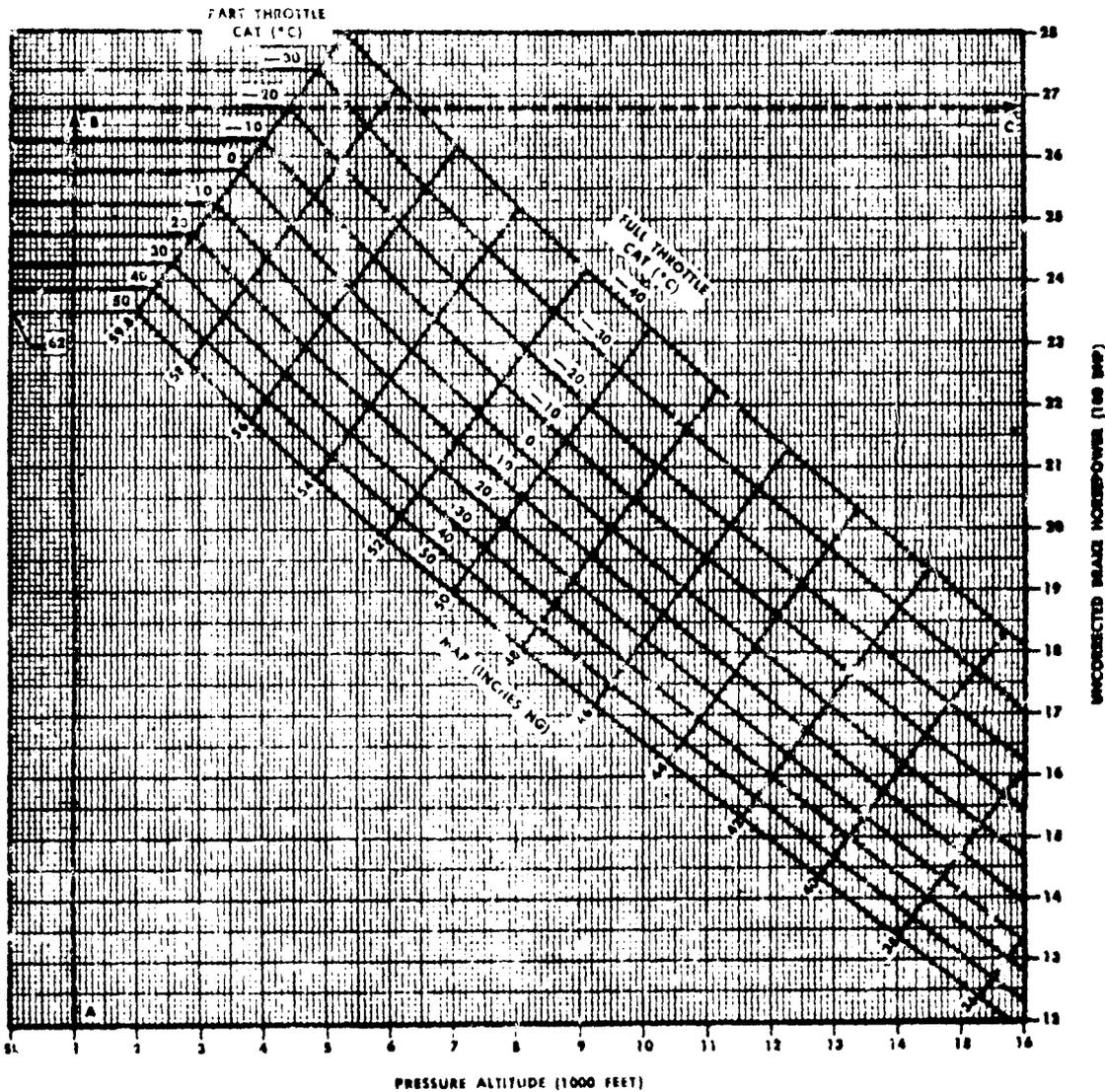


Figure A2-4
Brake Horsepower Available for Takeoff-Standard Fuel Grade-Wet
(Sheet 1 of 2)

C-118

BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF
STANDARD FUEL GRADE - WET
1500 RPM

Section 8

MODEL: C-118A
DATA AS OF: 6-15-43
DATA BASIS: FLIGHT TEST

ENGINE: (4) R2800-52W
FUEL GRADE: 115/145

SAMPLE PROBLEM

- A. Pressure altitude = 10000 feet
- B. CAT = -20°C (5° above OAT of -25°C)
- C. Uncorrected brake horsepower = 2680
- D. No correction for humidity because dew point is -20°C.
- E. Predicted power per engine = 2500 BHP
- F. Map reduction for low CAI = 2.5 inch. HG (MAP for takeoff = 62 inch. HG - 3.6 inch. HG, or 58.4 inch. HG).
- G. Predicted BMEP = 253 PSI
- H. 95 percent predicted BMEP = 240 PSI

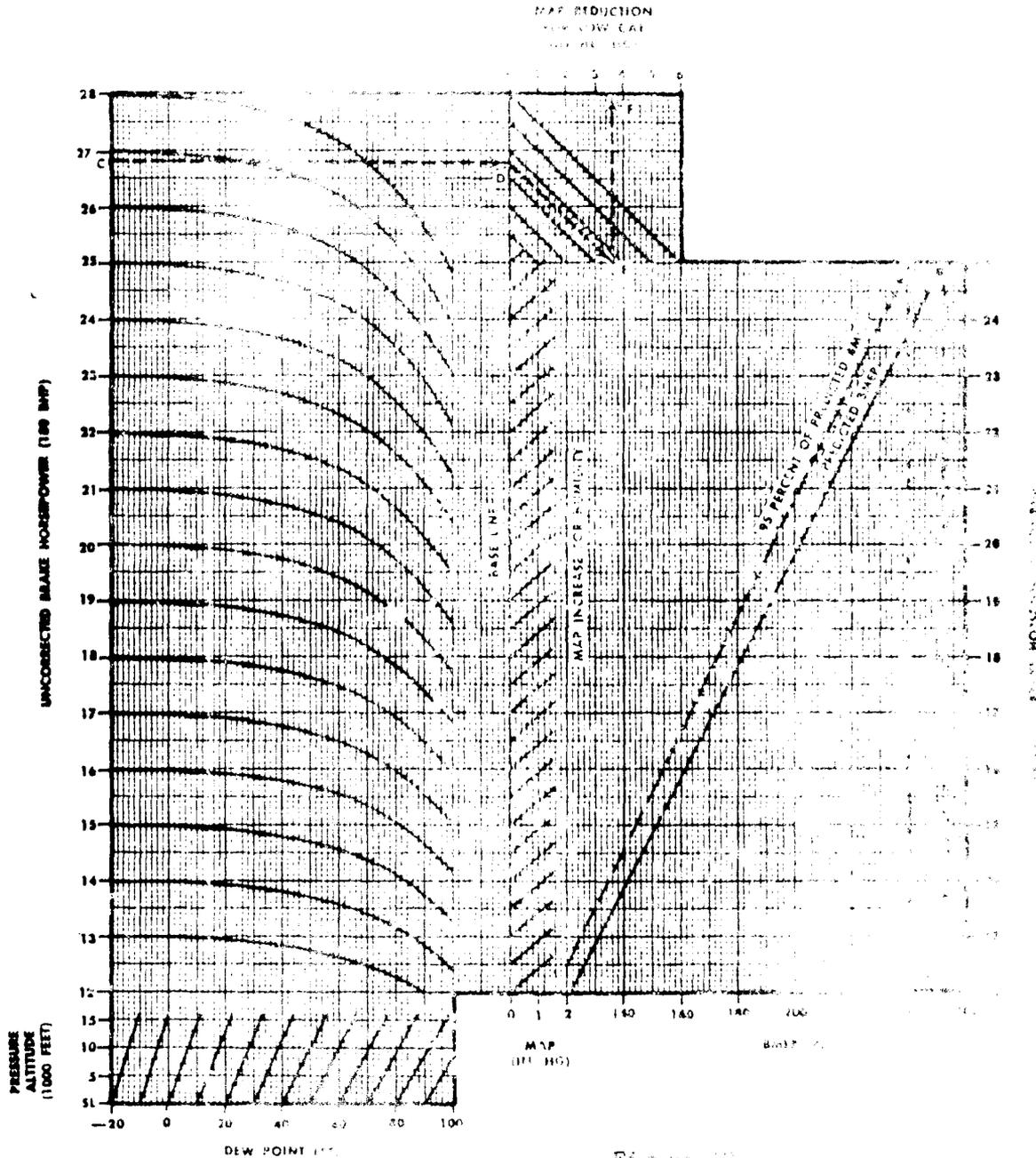


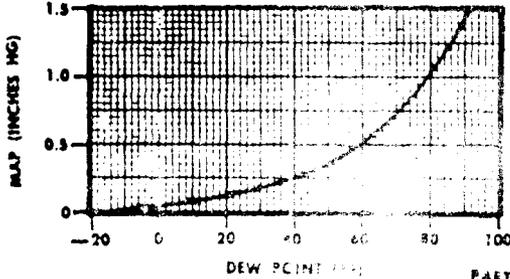
Figure 118
Brake Horsepower Available for Takeoff
(Standard)

**BRAKE HORSEPOWER AVAILABLE FOR TAKEOFF -
STANDARD FUEL GRADE - DRY
2800 RPM**

MODEL: C-118A
DATA AS OF: 4-15-62
DATA BASIS: FLIGHT TEST

ENGINES: (4) R2800-82W
FUEL GRADE: 110/140

ALLOWABLE INCREASE IN MAP DUE
TO HUMIDITY (FOR PART THROTTLE
OPERATION ONLY).



NOTE

Assume that the carburetor air temperature (CAT) is 3°C above the outside air temperature (OAT).

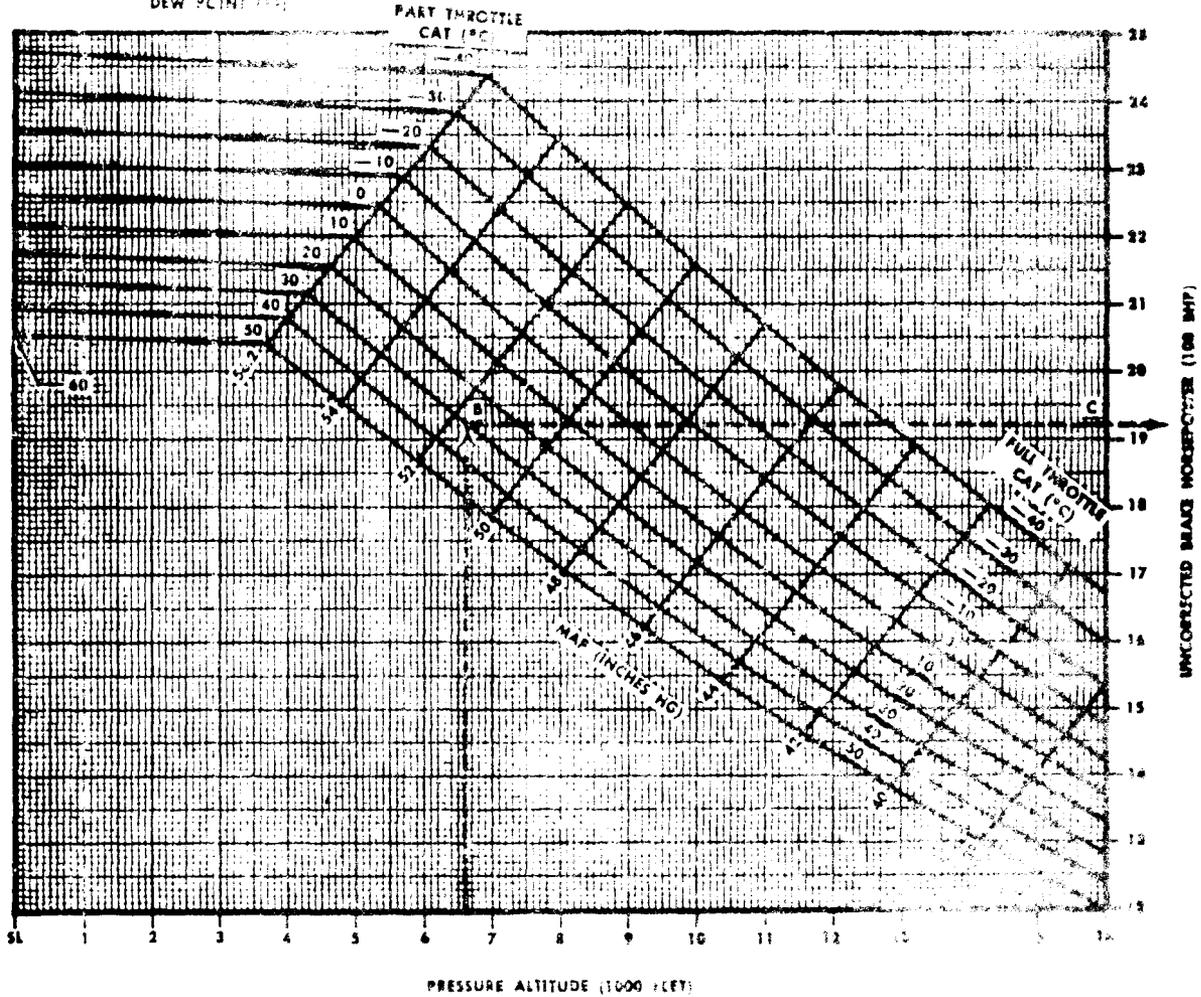


Figure A2-5
Brake Horsepower Available for Takeoff-Standard Fuel
(Sheet 1 of 2)

MODEL: C-118A
DATA AS OF: 6-15-62
DATA BASIS: FLIGHT TEST

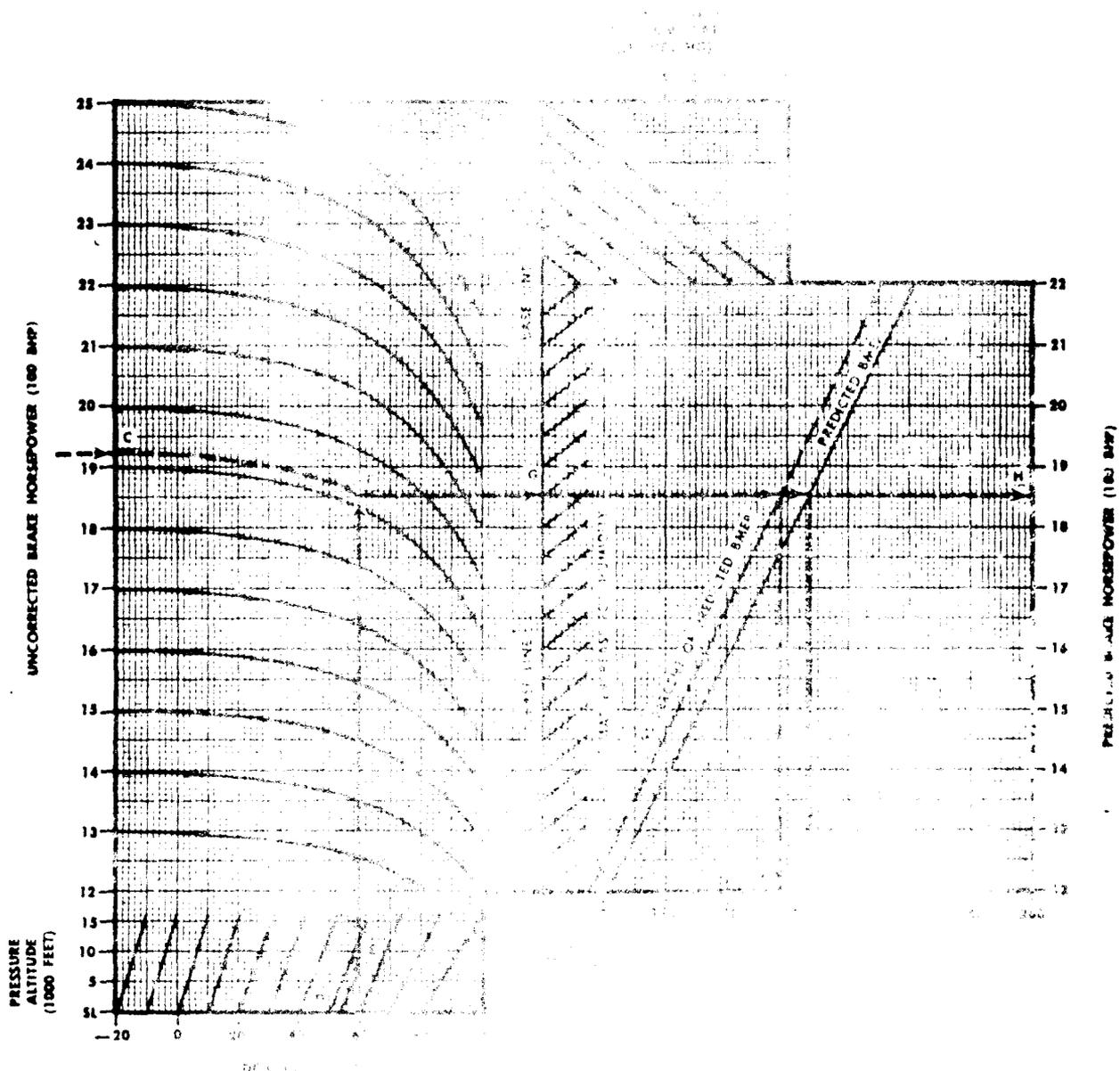
ENGINES: (4) R2800-82W
FUEL GRADE: 115/145

SAMPLE PROBLEMS

- A. Pressure altitude = 6000 ft.
- B. CAT = 37°C.
- C. Uncorrected brake horsepower = 1922 BHP
- D. Dew point = 54°F.
- E. Pressure altitude = 6000 ft.
- F. Power correction factor =

- G. No increase in MAP for humidity because full throttle operation is required (see point E)
- H. Total power per engine = 1898 BHP

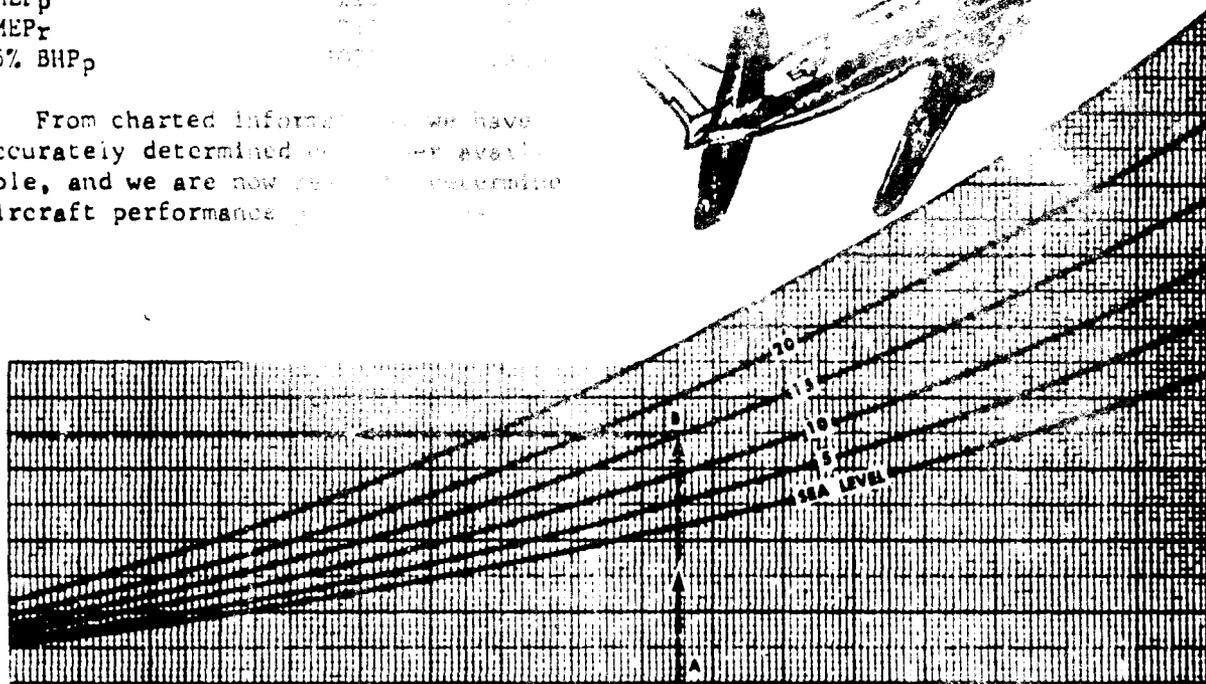
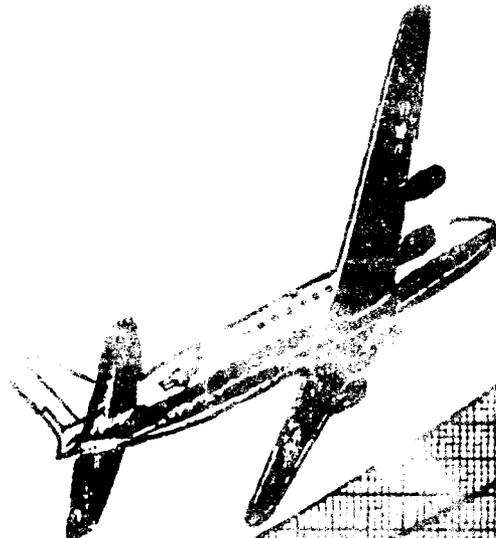
- I. Predicted Brake = 1975 BHP



Using the same methods in the A2-D chart, the entire group of engine performance figures may be plotted as follows:

	WET	DRY
MAP Pressure Increase	1.0	1.0
BHP Chart	2300	2020
BHP Deficiency	100	100
BHP Predicted	2200	1920
BMEP _p	230	200
BMEP _r	210	180
95% BHP _p	1970	1710

From charted information we have accurately determined engine performance available, and we are now proceeding to determine aircraft performance.



CHAPTER 6

AIRCRAFT PERFORMANCE (TAKEOFF)

In the interest of the safe conduct of a flight in any aircraft, certain rules have been set up as minimum requirements in the takeoff performance and landing operation of aircraft.

These takeoff performance and minimums have been set by USAF and NATO and are as follows:

- Max T.O. (3 engines) 10000'
- Zero Fuel Weight 10000 lbs
- Max Landing Weight 10000 lbs
- Max CFL 10000 lbs
- Max Vd 100 Kts
- Min for Vd 100 Kts
- Min R/C (3 engines) 100 FPM
- Max crosswind 30 Kts 90°

Our first concern with aircraft performance on takeoff is to be sure the gross weight does not exceed structural limitations, while at the same time CFL is at or less than RMY (runway length) and GW will allow a 100 FPM rate of climb on three engines. Also that the GW will allow for obstacle clearance in the takeoff corridor when on three engines. (Reference: 121 55-6)

Note: Required three engine rate of climb is based on gear up, flaps twenty degrees and propeller on inoperative engine feathered (see paragraph 12.25 in NATM Manual 55-1).

Two factors in takeoff prediction may be found on one chart. These factors are:

- Allowable Gross Weight
- Critical Field Length

Let us continue takeoff predictions under the conditions enumerated in Chapter 5:

H₀ - Sea Level - CAT 28°C

Q₀ - 1013 mb

95% Available Power

Runway Length 5000'

Runway 1000'

Normally, minimum acceptable BrP will be used as a basis for takeoff planning. Plans will be made for a wet or a dry takeoff, but allowable T.O. GW will be based on wet power (ADI).

First, we must determine the wind effect on our takeoff. Enter the A3-19 chart with the 40° wind at 20 knots. Read the crosswind component at 13 knots (within limits) and the runway wind component as +15 knots (15 knot headwind).

Now compute a takeoff factor from 95% MEP corrected for density altitude.

Enter the A3-6 chart with the takeoff factor. Move horizontally to the gross weight. From this point, move vertically down to the zero line. Following the guide lines down in 500' of the AWP. Moving down to the bottom of the chart, you read the takeoff factor for a wet takeoff condition. The takeoff factor is computed in the same manner as the dry takeoff factor.

Note: This chart does not apply at or under 10000' altitude. It must be reduced to meet the 10000' requirements.

Next, check the A3-8 chart to determine that we can still maintain a 100 FPM rate of climb. The chart factors with maximum gross weight and flaps set at 20 degrees. The maximum gross weight at which this rate of climb is still possible is 125,500 lbs. A sample problem is shown in A-111A-1.

Since our GW is 107,000 lbs, it is clear that we will be able to proceed on our takeoff. We will now check our performance.

Continue by finding V_{R0} on the A3-8 chart, the ground run required for takeoff by using the chart factor.

From the same chart, determine takeoff speed (V_{R0}) on the copilot's indicator.

Next, we determine fuel speed, using wet and dry takeoff factors. This information is plotted on the A3-8 chart. Enter with the takeoff factor, proceed horizontally to RWY length, then vertically down to GW. At this point, move horizontally to wind, passing through slope as it is zero, and follow the guide lines for 50% of AWF. Read the V_R at the left.

Note: Refusal speed (V_R) may not exceed takeoff, or liftoff speed (V_{to}).

Now, we move to the A3-10 chart to determine an acceleration check point for speed and time. As is shown in the sample in the C-118A-1, begin your plot with the coordinates of the ground run (3500') and V_{to} minus 50% AWF (111-7½). Guide down the contour line to V_R minus 50% AWF (104-7½), and continue on down the contour line to a marker. This marker will have to be more than 500' and less than 1500' from refusal point. This marker number is our acceleration check point.

From this check point, proceed vertically to wind line, adding back the 50% of AWF (77+7½).

From this same check point, proceed diagonally along the time line and find time in seconds (29).

If the aircraft has not accelerated to 100 knots in 29 seconds, the copilot must abort the takeoff and the takeoff must be rejected.

We must also work on the same acceleration check point for speed and time based on dry takeoff data.

Note: The 50% AWF is used only for the acceleration check. (Reference: A-111A-1)

Prior to our takeoff, we must compute the speed required for approach and the runway required for a landing with and without reverse. These figures will be based on takeoff gross weight, even though we may be able to dump fuel to get our weight down to 88,200 lbs, the maximum allowable for landing.

Approach speeds may be found on the A6-6 chart of the flight handbook, and are based on full flaps for landing. 130% V_S must be maintained until the aircraft is over the approach end of the runway at a height of 50 feet. 120% V_S is the velocity at which the wheels should contact the landing surface. Chart A6-6 gives these speeds, for 107,000 lbs gross weight.

130% = 117 Knots
120% = 108 Knots

Landing runway length requirements may be found on the A6-4 and A6-5 charts. Using the following example: 3000', gross weight 107,000 lbs, 10 mph wind and 50% AWF, we find that, without re-

verse, the landing clearance from a 50 foot height is 1520 feet and the landing ground clearance is 1520 feet.

The only other information which is required on takeoff is the time required to dump enough fuel after takeoff to get the aircraft weight down to 88,200 lbs. for a return to base. This time requirement is 7 minutes.

Our takeoff weight is 100,000 lbs. as weight is low enough for safe

climb on three engines, and the critical field length is less than the runway available. On our takeoff run we will encounter no trouble if we have accelerated to 92 knots in 29 seconds. We can stop the takeoff at any speed up to V_T and safe three engine climb may be established when we reach V_{TO} of 117 Knots.

You must instruct your crew, and especially the passengers to properly and accurately predict the takeoff data, and to heed every warning signal during the critical takeoff run.

SPECIAL NOTICE

Chapter 7 has been intentionally omitted from this Study Guide.

CHAPTER 8

Climb performance restrictions are important for two reasons. First, you must have a "charted" reading of airspeed. You may compare the actual results with the chart for evaluation. Second, we must know the gross weight at the top of climb and the cruise power requirements dictated.

Charts are available for 1400 BHP climb, 1500 BHP climb, and 1500 BHP cruise. They depend on the engine type.

- 1400 BHP at 10000 ft
- 1500 BHP at 10000 ft

The distance and time charts (A4-1 and A4-2) are used to find time, distance, and fuel used in climb, as well as the gross weight predicted for the top of climb.

BHP requirements for climbing may be found on the A4-13 and A4-16 charts. MAP will be reset each time used during climb on the basis of CAT value.

True airspeed is necessary for TAS/LE computation. It is found

with the following formula:

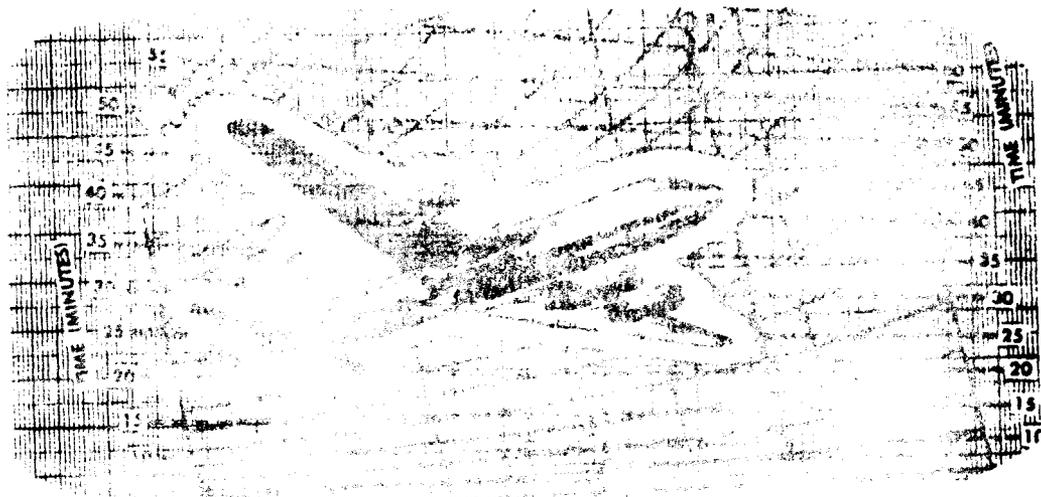
$$TAS = CAS \times \sqrt{\frac{1}{\sigma}}$$

where TAS is true airspeed for climb, CAS is calibrated airspeed, and σ is the density ratio indicated on the chart.

Average SMOE may be computed by dividing the average TAS by climb:

$$SMOE = \frac{TAS}{\text{climb}} + Hd_1$$

Fuel flows in climb are a matter of concern for the crew also. Because of the high rate of climb of the C-118A, a faulty automatic mixture control valve may cause mixtures to lean below minimum values. This condition may be followed by detonation, preignition and a subsequent loss of all power. The charted minimum fuel flows may be found on the A2-13 chart. Flow rates as much as 50 lbs/hr below minimum may be tolerated if CAT and CHT are steady and within limits, but with high CHT and low fuel flow we must reduce the BHP on the affected engine until the flows are within limits. It is recommended that reduction be made to 150 BHP increments.



Chapter 9

CRUISE CONTROL

General

Cruise control is the prediction of the level flight performance of an aircraft, and the various mixture, supercharger settings required to obtain the performance as predicted. The performance is also the prediction of finding the degree of mixture of an aircraft from normal operation.

There are five cruise control operation, each with its own supercharger and each with its own mixture.

- A. Long Range Cruise
- B. Maximum Range Cruise
- C. Constant Speed Supercharger Cruise
- D. Maximum Endurance Cruise
- E. Constant Thrust Superpower Cruise

Cruise power charts and all cruise information includes the following assumptions:

- A. RAM will be used in selecting RPM
- B. Low blower is used when possible
- C. Manual mixture adjustment is Normal
- D. Fuel flows are for normal operation
- E. MAP includes head and cabin supercharging
- F. Airspeeds are based on CPA of -2° (cowl flap angle)
- G. Fuel in color, viz. 115/145 (purple) or 130/130 (orange) or 100/130 (green)
- H. The BMEP DR is 1.0 and the mixture is assumed to be 1.0 but maximum endurance cruise and some three engine cruises

Long Range Cruise

These cruise control charts are

found on the Nautical Mile Per Pound charts, Figures A5-1, through A5-12. Long range speeds are 110% V L/D. This recommended long range speed line is shown on the charts, which are plotted for four, three and two engines. BHP requirements may be found at the intersection of gross weight and the speed line. The NM/LB value and the expected calibrated airspeeds may be found to the left and beneath the intersection point respectively.

Gross weight and BHP may be read in any increment by interpolation. RPM and MAP may be found on the A2-16, A2-17, A2-18 and A2-19 curves. Fuel requirements and fuel flows may be computed with the following ratio and proportion formula.

$$\star \frac{FF}{25\%} = \frac{TASK}{NM/LB} = \frac{FUEL (1 Hr)}{10}$$

* The 25% reading for fuel flow is correct only if you are cruising on four engines. Factors for three and two engines would be 33 1/3% and 50% respectively.

The lines on the NM/LB charts labeled 110% of speed for maximum range are information lines and should not be used for finding power settings.

Maximum Range Cruise

As these cruise readings are obtained from the same charts as long range cruise, we need only to follow the gross weight lines to the ends. A maximum range speed line may be drawn in by correcting the ends of these lines. Maximum range RPM, MAP, FF, fuel and CAS may be found in the same way that they were found for long range cruise.

Constant True Airspeed Cruise

These may be plotted on the same curves through the expedient of entering with the EAS or TAS needed and proceeding vertically to the gross weight.

NB/LB curves are plotted for every 1000' level from Sea Level to 20,000' for four engine operation. For three and two engine operation, at intermediate altitudes other than 10-15000', the BHP may be found by the formula:

$$\frac{\sqrt{V}}{BHP \text{ Charted}} = \frac{\sqrt{V}}{BHP \text{ Actual}}$$

When finding BHP for rates other than charted increments of altitude the CAS and NM/LB will be as charted, Hd must be used, and the nearest altitude nearest the actual altitude must be used so as to include exhaust back-pressure effect.

Maximum Endurance Cruise

The power for maximum endurance cruise may be found on the A5-16, 17 and 18 charts. Power requirements are based on gross weight. Power requirements change as the gross weight diminishes, and the BHP must be corrected to allow for this change. Power should be reset at least each hour when flying long range, maximum range, maximum endurance, or constant airspeed cruise control.

Constant Brake Horsepower Cruise

This is a method whereby we operate at one power setting for long periods of time. The aircraft manufacturer does not recommend operation below 110% V L/D, so CBHP cruise should be flown at or over this speed. Power charts are available for 700 to 1240 BHP in 100 BHP increments (except for 1240), but normal operation is at 900, 1000, 1100 or 1200. The lowest BHP allowing

operation at or over 110% V L/D should be used. The CBHP charts will be found as Charts A5-30 through A5-43.

Note: In finding TASK and IAS on the ODD NUMBER charts, stay outside the shaded areas, for instability of operation results when we operate below 110% V L/D.

Details of Cruise Control

We have covered the methods of cruise control for the C-118 A. Now let us see when each type should be applied.

Maximum range cruise gives optimum mileage. NM/LB ratings are highest here, so this is best when distance requirements are high. If a head wind of over 50 Knots is encountered, while at gross weights of under 85000 lbs, the NM/LB-Ground should be closely monitored while flying maximum range cruise.

Long range cruise sacrifices a small amount of mileage to gain a good increase in speed. Maintenance time and utilization gains offset the small cost in fuel requirements. The headwind problem disappears at long range cruise. This is the best overall method.

Constant true airspeed cruise is needed when "door-open" times must be met or when flight scheduled arrivals are required. This method in general, is the most costly in terms of dollars per ton/passenger mile.

Maximum endurance cruise control should be applied only when maximum time is needed in the air. The lowered airspeeds make for less than ideal stability, and too, the NM/LB rating falls below other methods. Its application then, would be for the holding pattern, when getting naviga-

tional fixes needed because the aircraft is lost, or when a runway is closed to clear obstructions.

Constant brake horsepower has its application too. More costly than long range or maximum range, it is, however, somewhat easier to use. This method is not recommended for use by MATS.

Cruise performance is the real indication of the dynamic condition of the aircraft. Stated values may not be met due to increased drag, or weight errors. If the aircraft does not deliver planned performance, re-enter the NM/LB curve with the actual EAS, move

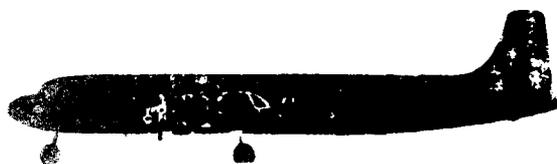
up to the BHP setting, and at this intersection, read the "apparent" or "performance" gross weight. The difference between performance gross weight and logged gross weight is referred to as Δ GW. It may be plus or minus. Power should not be re-computed to include this correction factor.

Cruise control then, is not just a means of getting an aircraft from one part of the globe to another, but it is the scientific application of proven values to the performance of the aircraft so it may be moved between those two spots safely, and with optimum efficiency.

Sample Cruise Power Readings

		Hd GW CAT	10,000 FT 100,000 LBS +10 °C			
	<u>LR</u>	<u>MR</u>	<u>*CTAS</u>	<u>ME</u>	<u>CBHP</u>	
BHP	1075	1000	1110	890	1100	
RPM	1990	1870	2050	1780	2100	
BMEP	153	151	153	142	148	
EAS	195	182	197	144	196	
TASK	227	212	230	168	228	
FUEL (HR)	1972	1733	2044	1600	1960	
FF	493	434	512	400	495	
NM/LB	.1150	.1165	.1125	.1050	.1151	
CAT	10	10	10	10	10	
MAP	33.2	32.7	33.6	N/A	32.9	

* REQUIRED TASK = 230



MODEL: C-118A

DATA AS OF: 2-19-59

BASED ON: LEAN-FLIGHT TEST

RICH-CALCULATED: 9504

NAUTICAL MILES PER POUND OF FUEL—FOUR-ENGINE

10,000 FEET STANDARD DAY

LOW BLOWER

$W/V = 1.1637$

ENGINES: R2000-S2W

FUEL GRADE: 115/148

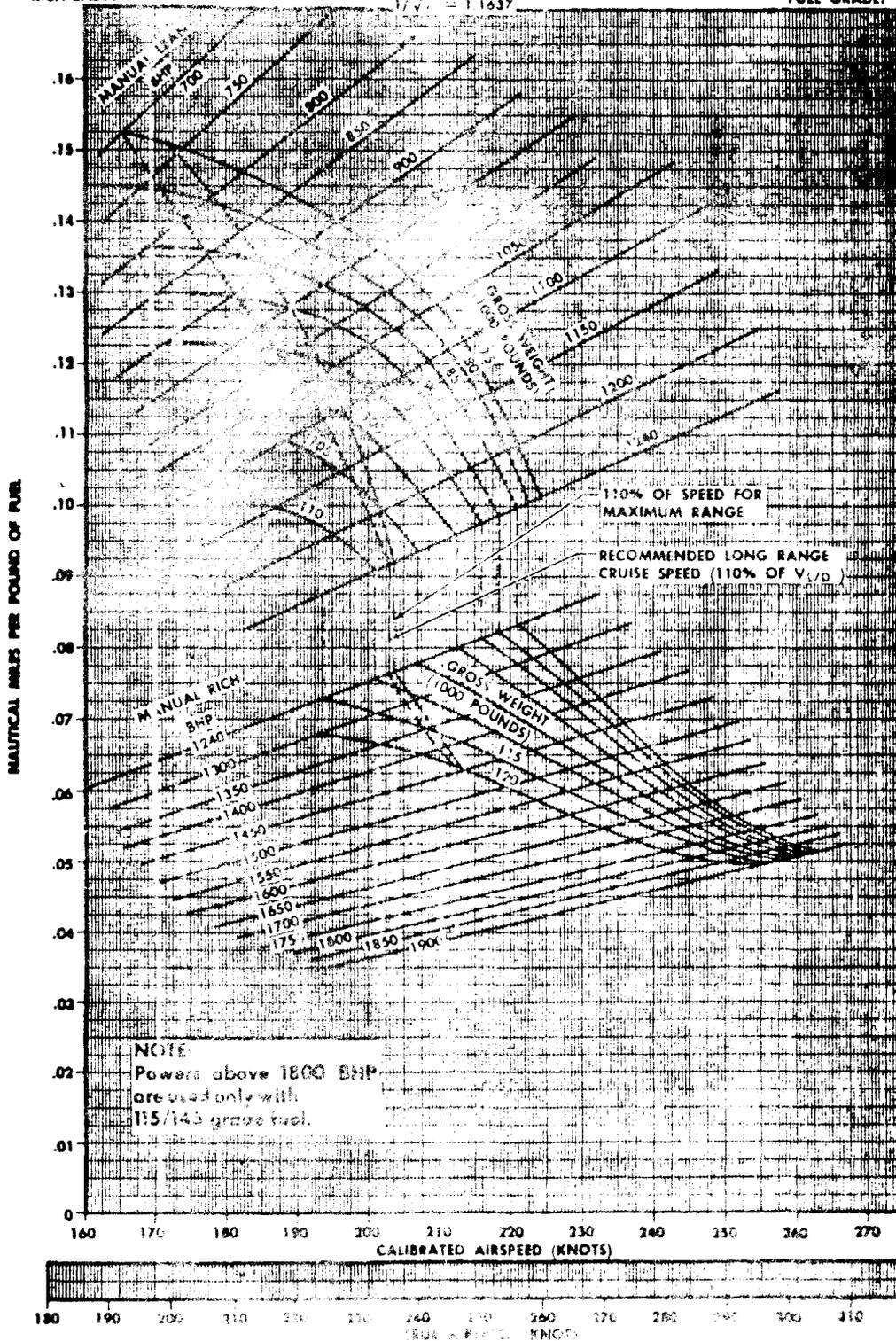


Figure 4-1. Nautical Miles Per Pound of Fuel—Four-Engine—C-118A Data

Chapter 10

DESCENT

A "controlled descent" is desirable to give more efficient aircraft operation. The proper power will result in higher RPM, less spark plug fouling, lower EGT and lower cooling straining. Power requirements in descent may be determined by computing "BHP Gain", or the amount of power increase we experience due to the increase in gross weight over lift.

This gain is computed as follows:

$$\text{BHP gain} = \frac{GW \times RD}{33000 \times \eta}$$

Where

- RD = rate of descent (Normal 300 FPM)
- η = propeller efficiency (85%)
- 33000 = Foot pounds of work per minute per horsepower.
- N = Number of engines operating.

For four engine descent, this formula would read:

$$\text{BHP gain} = \frac{GW \times RD}{112,200}$$

or

$$\frac{\text{Gain}}{RD} = \frac{GW}{112,200}$$

This gain, subtracted from last cruise BHP will result in BHP required in descent.

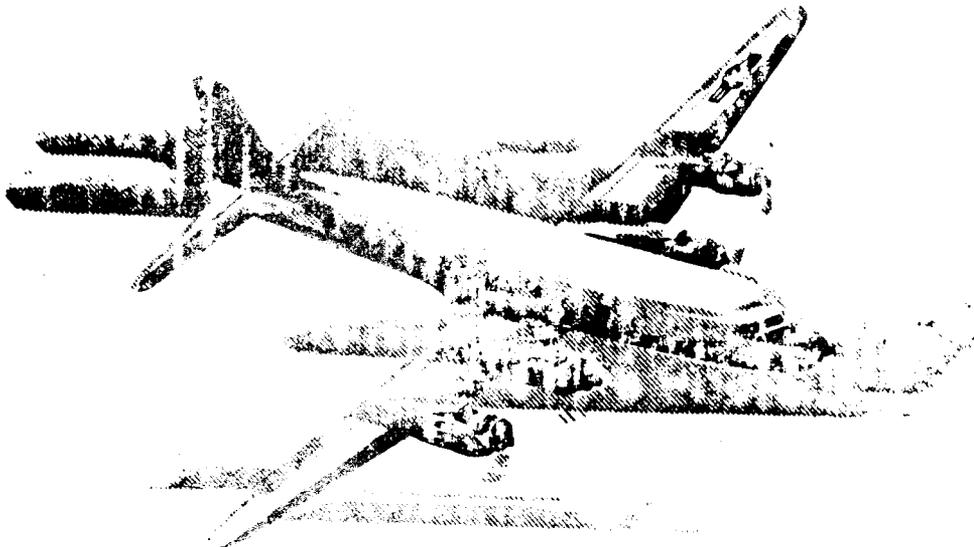
Descent is computed to traffic pattern altitude only.

True airspeed in descent may be computed with the formulas:

$$\text{TAS} = \sqrt{\frac{1}{\sigma}} \times \text{EAS}$$

$$\sqrt{\frac{1}{\sigma}} = \text{Hd}$$

$$\text{Hd} = \left[\frac{1}{2} (\text{hd}_1 - \text{hd}_2) \right] + \text{hd}_2$$



Chapter 11

FLIGHT PLANNING

Four engine flight planning for the C-118A is done quickly and accurately with MATS Manual 55-9. This set of Charts will give flight information in its entirety for many density altitudes and many gross weights.

A sample problem might give:

T.O. GW 25,000 lbs.
 ME 15,000 ft.
 AWF 120 Knots.
 Distance 1,000 NM

Enter chart with density altitude at AWF and then to bottom of chart. As vertical line crosses the fuel consumed reference, read fuel consumed as 24650 lbs. Now as you cross the dashed line labeled "Avg. TAS" read the average true airspeed as 229 Knots. Now at bottom, read the estimated time enroute as 11 + 18.

Fuel load will be as follows:

Flight plan fuel	24200
10% enroute reserve	2420
Alternate airport (*)	1350
Holding (**)	2100
Warm up, Taxi, & T.O.	1075
Descent	600
Wing Heaters (***)	75
Cabin Heaters (***)	250
Blower Shift (****)	75
Added BHP under icing WX (*****)	410
	32595

(*) if alternate is required

(**) 1 + 15 with alternate

1 + 45 if no alternate

1 + 45 if north of 52° N.

1 + 45 if Alaska or Aleutians

(***) 25 lbs/heater/hour

(****) 25 lbs per each two hours of flight

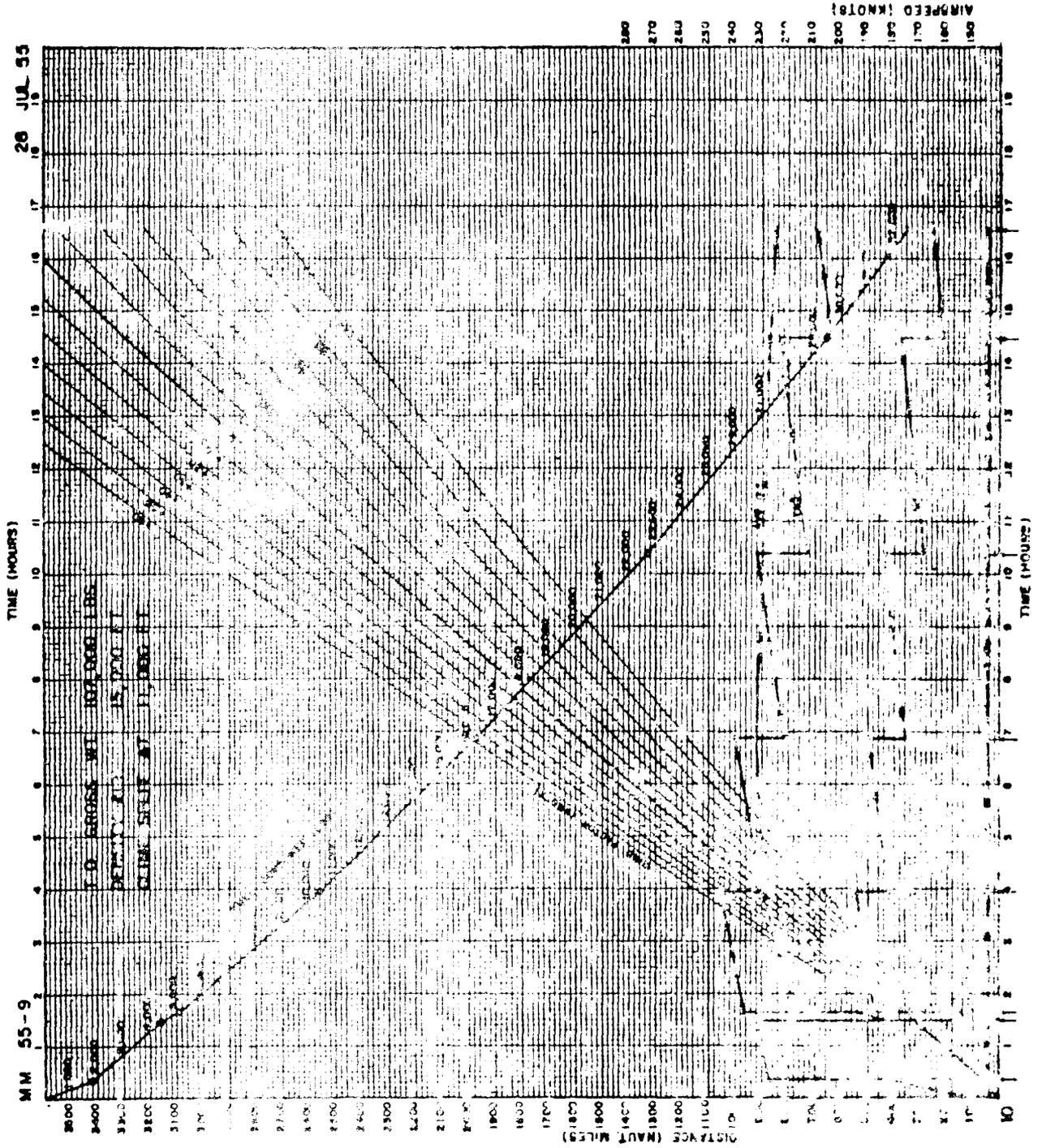
(*****) 400 lbs per hour for anticipated icing in excess of "light".

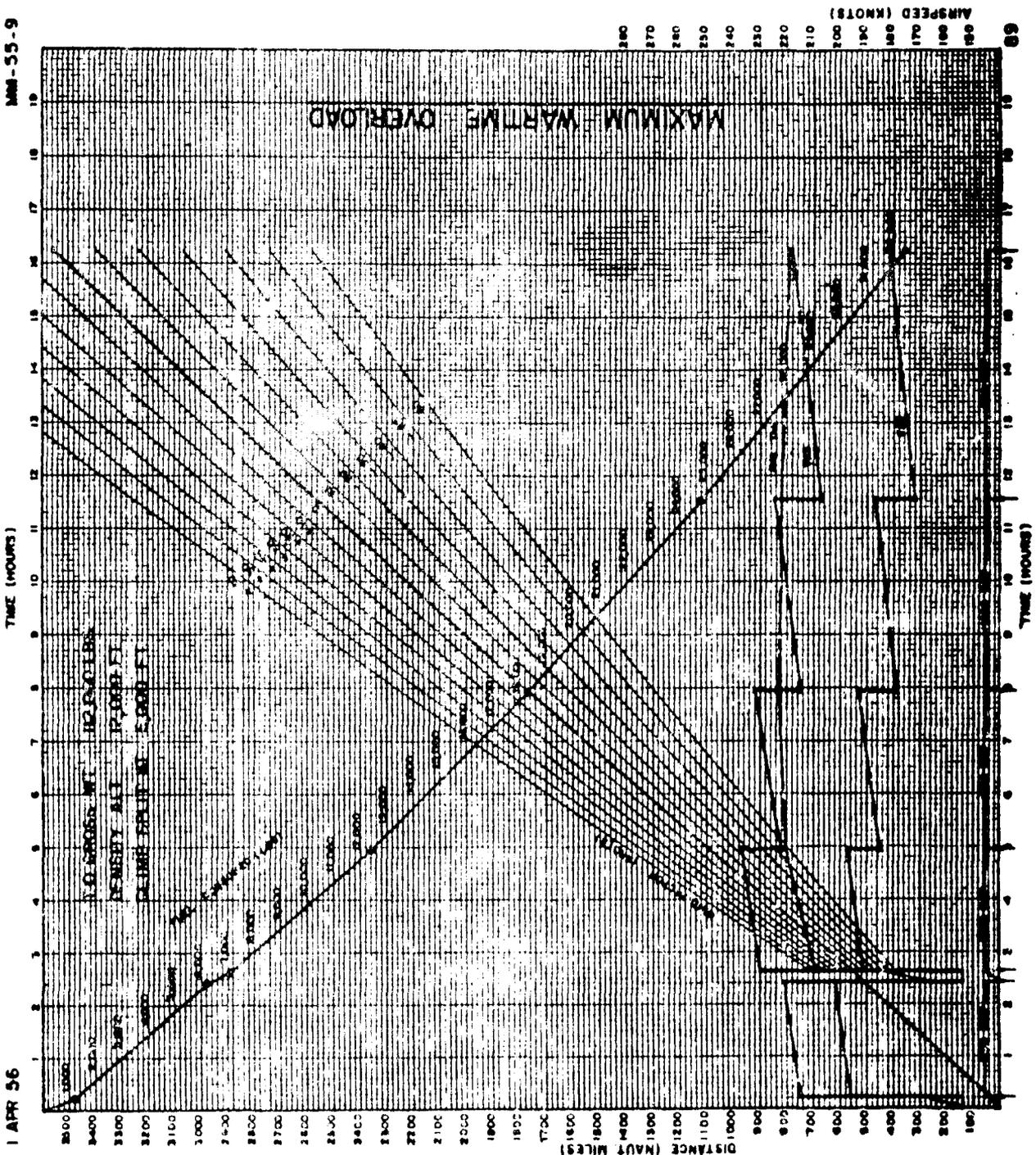
We may also plan our flight for Long Range Cruise by finding climb predictions from the A4-1 and A4-2 charts, then determining cruise predictions from the A5-22, 23 and 24 charts.

Now suppose the Nr. 1 engine fails enroute. We now need a quick and accurate reading on three-engine cruise operation. Charts A5-25, 26 and 27 will give this information. Also included are two-engine planning charts.

These flight planning documents MUST NEVER be used as cruise control guides. MM 55-9 is based on CBHP cruise and the 4, 3 and 2 engine long range predictions may be made good through power settings (changed each hour) for the NM/LE curves.







FLIGHT PLANNING CHART FOR CRUISE CONDITION - THREE ENGINES

RECOMMENDED LONG RANGE SPEED - 15,000 FEET DENSITY ALTITUDE

MODEL: C-118A

DATA AS OF: 2-15-59

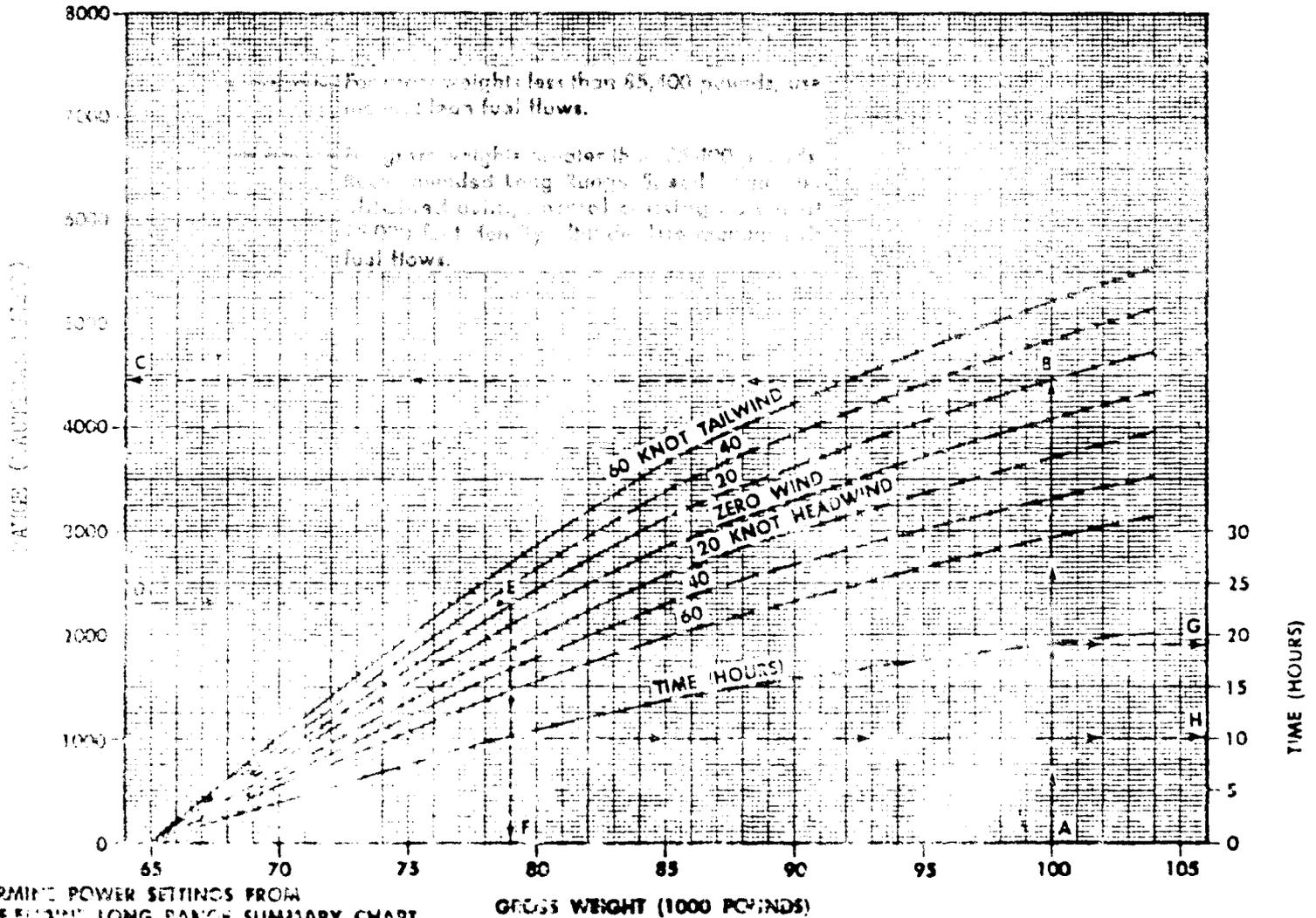
BASED ON: LEAN-FLIGHT TEST

RICH-CALCULATED DATA

ENGINE(S): R2800-52W

FUEL GRADE: 115/145

ALTERNATE FUEL GRADE: 100/130



C-118

Section 8

Figure 15-11 is a flight planning chart for cruise condition for gross weight 3-33

Chapter 12

AIRCRAFT PERFORMANCE LOG AND ANALYSIS

During actual operation of an aircraft, many conditions will cause the actual performance to vary from the charted and predicted value. These variations may be caused by such conditions as poor weight and balance, dirty aircraft exterior, icing conditions and engine malfunctions. The resulting performance may affect speed, power, weight and fuel consumption. Therefore, from the standpoint of safety and efficiency, it is necessary to know what variations exist during aircraft flown.

Inflight and postflight analysis, is the necessary procedure required to determine how an aircraft actually performs in relation to the charted data. We cannot place too much emphasis on the value of maintaining an accurate Flight Log and its Performance Data Section, for these factors will govern the further predictions and operation of the aircraft.

MATS Form 52

MATS Form 52 is the Aircraft Performance Log for Reciprocating Aircraft. Details of MATS Form 52 are contained in MATS Regulation 55-26. In the following paragraphs of this Study Guide, you will find the necessary information on how to fill out the MATS Form 52.

Description

MATS Form 52 is designed to present a simplified method of recording aircraft performance data pertaining to a specific flight. Part I, Predeparture Data, contains information to be determined prior to flight. Part II, Flight Performance, contains information determined during inflight operation. Part III contains the analysis

Section. Part IV, Instrument Readings, contains data recorded from aircraft instruments during the flight. As issued, MATS Form 52 will be folded accordion style with the Part IV attached. The log may be folded as each section is completed to afford ready accessibility to both the flight and instrument reading sections eliminating the need to return to a section already completed.

This is accomplished as follows:

Step 1. After completing Part I, Predeparture Data, fold the page back on the heavy black line just below the dotted line of Part II. This exposes Part II, Flight Performance. There is space on this side for 12 flight condition entries including takeoff. Immediately behind this page is the first page of Part IV, Instrument Readings, containing sufficient line entries to correspond with the flight condition entries.

Step 2. After completing the last entry on this page, fold on dotted line and turn log over from the bottom up. The last Flight Performance entry now appears at the top of the page. The second page of the engine instrument readings will be directly beneath and accessible by folding the first Flight Performance page out and up so the Predeparture page will face the blank page.

Step 3. After completion of trip, turn completed MATS Form 52 into squadron performance engineer.

Instruction

Blocks are identified by number. All blocks not applicable to a specific

aircraft will be left blank. All other blocks will be completed unless otherwise indicated hereafter.

Part I - Predeparture

Blocks 1 through 12 - Entries are self-explanatory.

Block 13 - Fuel

Tank numbers: List tanks in sequence from left to right. Identify the alternate and auxiliary tanks with the letter "A." Identify wing tanks with the letter "W."

Gage: Enter fuel tank quantity gage readings for individual tanks.

Corrected: Enter the dipstick reading or known amount of fuel in tanks if different from the gage reading. (Note: One corrected gage reading will require a "C" in each block in this column indicating the gage, dipstick or other quantity of fuel, whichever provides the correct fuel quantity.)

Total: Totals of the GAGE column and the CORRECTED column.

Required: Enter fuel required for the mission including reserves, warmup, taxi and takeoff fuel. This will be entered under the CMIC column unless a correction is indicated. If a correction is indicated, the figure will be entered under the CORRECTED column.

Extra: Subtract fuel required from the column representing the actual fuel aboard.

Block 14 - Reserve Fuel

Gage column, corrected column and total. Same instructions as Block 13.

Total Used: Subtract the figure which represents the actual total fuel remaining aboard, from the actual fuel aboard prior to departure.

Block 15 - Weight and Balance

Enter items as extracted from the Form 365F. Note: The fuel (ramp) value entered must be identical to the fuel total reflected in Block 13 total value.

Block 16 - Auxiliary Systems

Oxygen Pressure:

Pilot - Pressure of pilot's oxygen system.

Crew - Pressure of crew oxygen system.

Other - Pressure of oxygen systems other than crew and pilot.

ADI Fluid: Enter quantity of ADI fluid in the appropriate blocks.

Alcohol: Enter quantities of carburetor alcohol and windshield alcohol. Identify carburetor alcohol with a "C" and windshield alcohol with a "W."

Hydraulic Fluid: Enter a check (✓) in the FULL block to indicate a full system. Enter the number of extra gallons of hydraulic fluid aboard the aircraft in the EXTRA block.

Block 17 - Power

Pressure Altitude: Pressure altitude of the field from which the takeoff is being made.

DP or VP: Enter the dew point or vapor pressure as predicted by the weather office for the time of takeoff.

Temp. °C (P): Runway temperature

in degrees centigrade as predicted by the weather office for the time of takeoff. If runway temperature is not available, use OAT + 100 if OAT is standard or above. Use actual OAT if OAT is below standard.

Temp. °C (A): Actual temperature as noted at time of takeoff. Note: If using CAT for prediction and recording horsepower, enter the initials CAT to the right of Temp. °C and Temp (A). Add the figure printed in the applicable Dash One Flight Handbook to the runway or corrected OAT and enter the result as indicated. Enter actual OAT in Temp. °C.

Predicted: Enter actual or torque value as predicted at the time of takeoff.

Min. Perf: Minimum engine torque, BMEP or torque value as predicted for time of takeoff (see section 7).

Wet or Dry Block: Circle applicable block indicating moisture at takeoff being made.

Actual: Enter, for each engine, the actual BMEP or torque value obtained at time of takeoff.

BHP Diff: Compute and enter BHP difference between predicted and actual takeoff BHP.

Block 18 - Remark:

Enter all discrepancies which affect aircraft performance during flight. Also, any log entries which cannot be made due to instrument failure will be fully explained in this section.

Part II - Flight Performance

Block 19 - Engine Start: Enter time (GMT) the first engine was started.

Block 20 - Cond: Enter symbol indicating flight condition. WU/TAX/TO indicates the ground operating condition. 1 ↗ indicates climb, 2 → indicates cruise, 1 ↘ indicates descent, L/T indicates land and taxi. Enter number of the condition above or to the left of arrow. All climb readings will be taken at 2/3 pressure altitude.

Block 21 - End: Enter time for end of condition.

Block 22 - Set: Enter increment time duration of the condition.

For WU/TAX/TO condition all WU/TAX time will be entered in the circle of the set block. Two minutes for takeoff time will be entered in the total time block. Note: Cruise entries will normally be of not more than one hour duration. However, the cruise immediately prior to enroute climb and/or the last cruise prior to descent may be extended to a maximum of one hour and twenty-nine minutes.

Block 23 - Total: Enter accumulative total of SET times including two minutes for takeoff, land and taxi time but excluding encircled time for WU/TAX.

Block 24 - OAT1: Enter indicated outside air temperature reading.

Block 25 - OATc: Enter indicated outside air temperature corrected for compressibility.

Block 26 - HP: Enter pressure altitude as read from altimeter with barometric scale set at 29.92.

Block 27 - Hd: Density altitude, as computed from density altitude chart in the Dash One Flight Handbook.

Block 28 - IAS: Enter actual indi-

cated airspeed average for the increment. Note: All airspeed indicators will be checked for accuracy with the pilot's indicator.

Block 29 - EAS: Enter equivalent airspeed, as determined by applying position error and compressibility correction factor, from the appropriate flight manual, to the IAS reading. Note: On aircraft where the nautical mile per pound charts show CAS rather than EAS, divide 1.154 block from upper right to lower left and enter CAS in left side and EAS in right side.

Block 30 - $\frac{1}{\sqrt{1.154}}$

Enter smoe (σ) as computed from chart in appropriate flight manual for that increment of flight.

Block 31 - TAS: Enter true airspeed as computed by multiplying EAS x SMOE. When EAS is in MPH.

TASK = $\frac{\text{EAS (MPH)} \times \frac{1}{\sqrt{1.154}}}{1.154}$

Block 32

CAT: Enter actual average carburetor air temperature.

RPM: Enter average of RPMs being used.

MP: Enter corrected maximum allowable manifold pressure for the horsepower being used.

TOR/BMEP: Enter actual average torque or BMEP being used.

Block 33 - BHP Chart: (Cruise Only) - Enter the charted brake horsepower as picked off of the appropriate curve or chart in the Dash One Flight

Handbook. Use the actual average gross weight for the cruise period. Smoe the horsepower to the actual density altitude being flown.

Block 34 - BHP Req: Enter actual average brake horsepower being used.

Block 35 - Chart Fuel Flow: (Cruises only) - Enter charted fuel flow total for period for the actual average horsepower being used.

Block 36 - Total: Enter flight total of the charted fuel flows.

Block 37 - Instrument Fuel Flow/ LBS/HR: Enter actual observed fuel flow instrument readings for individual engines.

Block 38 - Total: Enter total of engine instrument readings.

Fuel: Note: Standard fuel used values for the C-118 are as follows:

Warmup, Taxi and Takeoff	450 lbs for 15 minutes and 15 lbs/min thereafter
Climb	Instrument Fuel Flow
Descent	2000 lbs/hr
Land and Taxi	15 lbs/min

FUEL USED

Block 39 - Period: Enter total fuel used for the period as computed using the fuel flow readings corrected by any known fuel flow correction factor.

Block 40 Extra: Enter any additional fuel used for heater, prime, defouling, etc.

Block 41 - Total: Enter accumulative total of fuel used.

FUEL REMAINING

Block 42 - Period: Enter total fuel used for period, by adding period fuel used to extra fuel used. See Blocks 39 and 40.

Block 43 - Total CALC: Subtract total period fuel used to obtain a running total of fuel remaining.

Block 44 - Ramp CALC fuel: Enter Ramp Calculated Fuel aboard as obtained from the total of the corrected fuel column in Block 13.

Block 45 - Period: Enter the gage difference between the sum of fuel quantity gage readings at the beginning and end of each condition.

Block 46 - Total Gage: Enter total gage fuel remaining at end of SET conditions as indicated on quantity gages.

Block 47 - Ramp Gage Fuel: Enter ramp gage fuel aboard as obtained from the total of the gage fuel column in Block 13.

Block 48 - Fuel Flow Corri: Enter known fuel flow correction factor percentage.

Block 49 - Fuel Used: Enter same value as entered in Block 42 for the condition.

Block 50 - Gross Weight: Enter delta gross weight as computed. This figure is computed as follows:

(1) Smoe the actual average horsepower to the nautical mile per pound chart nearest the actual density altitude being flown.

(2) Using this horsepower and the

average EAS (or CAS, if applicable) for that period, go into the nautical mile per pound chart nearest the density altitude being flown. Where the EAS (or CAS, if applicable) line and the horsepower intersect, note gross weight.

(3) If the gross weight in Step 2 is higher than the actual average gross weight, subtract the actual average gross weight from it and the resulting figure will be a plus (+) weight correction. If the gross weight in Step 2 is lower than the actual average gross weight, subtract it from the actual average gross weight and the resulting figure will be a minus (-) weight correction. Note: The actual average gross weight is found by subtracting half of the corrected fuel flow for the period from the weight at the beginning of the cruise.

Block 51 - End Gross Weight: Enter result of subtracting period fuel used from previous gross weight entry.

Block 52 - Enter total weight (Ramp) from Block 15.

Block 53 - Enter increment fuel used for WU/TAX/TO from Block 41.

Part III - Analysis

Block 54 - Fuel Flow Correction: Enter cruise fuel used during cruises on top line. Enter extra fuel used during this same period on second line. Subtract extra fuel used from gage fuel used and enter result as actual fuel used, line three. Enter total of fuel flows uncorrected for the same cruise periods below actual fuel used figure. Divide actual fuel used by fuel flow total (uncorrected) and enter this figure. Multiply this figure by 100 to obtain fuel flow correction factor.

Block 55 - Engine Performance Factor: Enter total fuel flow times fuel

flow correction factor on line opposite total fuel flow corrected. Enter total charted fuel used for this same period opposite total chart fuel flow. Divide total fuel flows corrected by total chart fuel flow and enter this figure. Multiply this figure by 100 to obtain engine performance factor.

Block 56 - Aircraft Performance Factor: Add all the delta gross weights computed for each stable cruise and enter on the line opposite total gross weights. Enter the number of stable cruises. Divide total delta gross weights by the number of stable cruises to obtain aircraft performance factor.

Block 57 - Log Checked By: Signature of squadron engineer or his designated representative, signifying that log has been checked for accuracy.

Block 58 - Date Checked: Enter date log was checked for accuracy.

Part IV - Instrument Readings

a. Part IV is divided into two sections, hourly and periodic instrument readings.

b. The Hourly Instrument Readings will be made once each hour. The initial readings will be made during the first climb period. The Hourly Instrument Readings will be made halfway through each cruise.

c. Enter the static readings in the heading blocks for manifold pressures, torque or BMEP value, CAT, CHT and oil quantity. Note: Oil quantity will be corrected reading (dipstick or known) if different from gage reading.

d. The Periodic Instrument Readings will be made in conjunction with the first climb period and every third cruise thereafter. Exception: Whenever indications or conditions dictate

the need for more frequent readings, they may be made once each hour. (i.e., one generator beginning to hog the load.) Under this condition it would be wise to log the generator loads each hour. Recording of one such reading each hour does not necessarily mean all other readings must be recorded.

HOURLY INSTRUMENT READINGS

Block 59 - Condition: Enter condition of flight corresponding to the condition entered in the flight performance section.

Block 60 - Time Increment: Enter amount of time for power condition. Same as Block 22. Note: First entry will be engine ground time from start engines to takeoff.

Block 61 - Density Altitude: Same as Block 27.

Block 62 - RPM: Enter RPM of engines.

Block 63 - MAP: Enter actual manifold pressure reading for each engine.

Block 64 - Torque/BMEP: Enter Torque or BMEP value, whichever is applicable, as read from the torque or BMEP gages for each engine.

Block 65 - Eng. Inst. F/F: Enter actual fuel flow reading for each engine.

Block 66 - Mixture Position: Enter position of mixture control lever. Indicate full rich position with the letter "R;" normal detent with the letter "N;" auto lean detent with the letter "L." For manual leaning mixture positions for either retard or advance spark timing, enter symbols as designated by the applicable flight manual.

Block 67 - CAT: Enter carburetor air temperature reading for each engine.

Block 68 - CHT: Enter cylinder head temperature reading for each engine. Those aircraft with two CHT indications for each engine, split the block from upper right to lower left. Enter front or lowest cylinder number indications in left side and rear or highest number cylinder on right side.

Block 69 - Cowl Flaps: Enter cowl flaps setting for each engine.

Block 70 - Oil Quantity: Enter actual oil quantity gage readings.

Block 71 - Oil Temp: Inlet: Enter oil inlet temperature for each engine. Outlet: Enter oil outlet temperature for each engine if applicable.

Block 72 - Pressure: Oil: Enter oil pressure readings for each engine. Fuel: Enter fuel pressure readings for each engine.

PERIODIC INSTRUMENT READINGS

Electrical

Block 73 - DC: Enter essential bus direct current voltage reading.

Block 74 - 10: Enter single-phase AC voltage reading.

Block 75 - 30: Enter three-phase AC voltage reading.

Block 76 - Load: Enter each generator load reading in amperes or percent of load. Indicate % or AMPS in block heading as applicable. For those engines having more than one generator, split the appropriate block from upper right to lower left and enter the load reading of the outboard generators in the left side and inboard generators in the right side.

Supercharger

Block 77 and 78 - Oil Temp: Enter

oil temperature readings for each cabin supercharger.

Block 79 and 80 - Oil Press: Enter oil pressure readings for each cabin supercharger.

Block 81 and 82 - Bearing: Enter cabin supercharger driveshaft rear bearing temperature for each cabin supercharger.

Block 83 - Cabin Diff: Enter cabin differential pressure reading.

Block 84 - C. Alt: Enter cabin altitude reading.

Blocks 85 and 86 - Dis Press: Enter cabin supercharger discharge pressure reading for each cabin supercharger.

Blocks 87 - Total Flight Time: Enter time for flight as recorded in Form 781-1.

Block 88 - Oil Transferred: Enter amount of oil transferred into each tank.

Block 89 - Oil Consumed: Enter actual oil consumed per engine during flight.

Block 90 - BHP DIFF: (T.O.): Compute and enter BHP difference between predicted and actual takeoff BHP.

Block 91 - Engine Time: Enter total engine time at start of flight, from Form 781-2.

Block 92 - Signature: Signature of flight engineer responsible for the log.

Blocks 93 through 97 - Entries are self explanatory.

Block 98 - Remarks: Enter any remarks pertaining to instrument readings that are not normal, or that

would be of help to maintenance analysis.

Flights Within Continental United States

For flights within the continental United States only the following portions of MATS Form 52 need be completed:

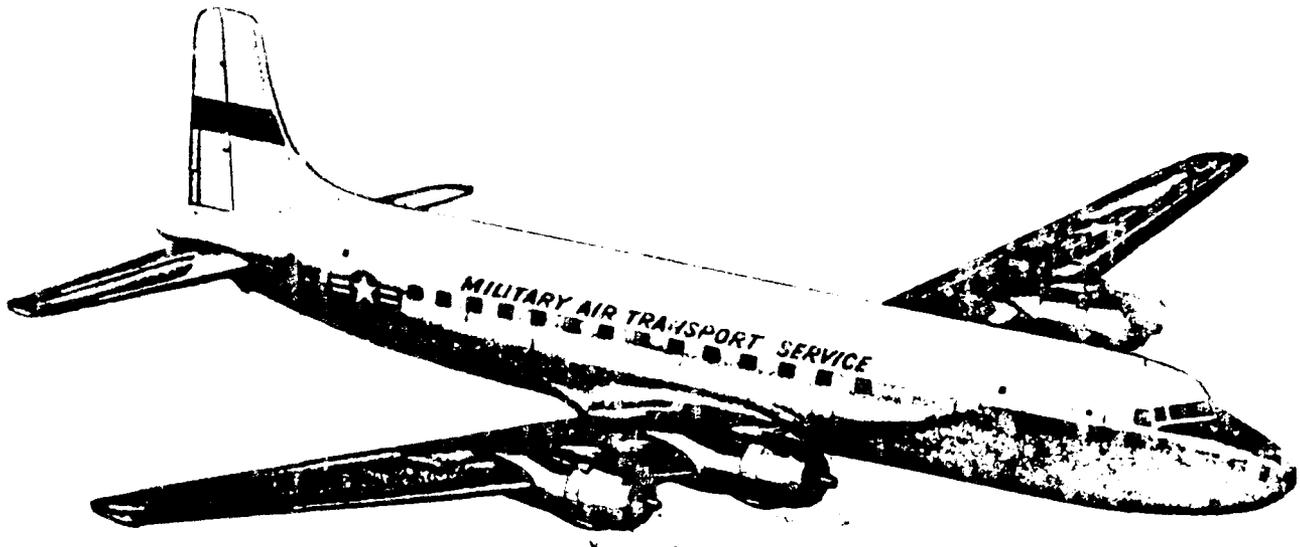
(1) All of Part I, Predeparture; Blocks 1 through 18.

(2) Part II, Flight Performance; Blocks:

32	42
34	43
37	44
38	49
39	51
40	52
41	53

(3) None of Part III, Analysis.

(4) All of Part IV, Instrument Readings; Blocks 59 through 98.



Chapter 13

AERODYNAMIC CHARACTERISTICS

Stability

The aircraft is dynamically stable, and will, if oscillation is induced about the roll, pitch, or yaw axis, damp out. The aircraft is statically stable in pitch, and if displaced longitudinally, will return to the trim condition. The spiral stability is neutral. If trimmed for a standard rate turn the aircraft will tend to remain in the same turn.

Drag

Drag is given in square feet of equivalent flat plate area:

<u>Item</u>	<u>Drag</u>
Basic aircraft	27.3 sq. ft.
Landing gear	38.6 sq. ft.
20° Flaps	26.8 sq. ft.
Full Flaps	83.6 sq. ft.

Wing Flaps

Wing flaps are double slotted. At the 20° to 25° angles, they are primarily a lift device, but at larger angles, become a lift AND drag device. Flap effectivity is as follows:

<u>Angle</u>	<u>Drag Area</u>	<u>Lift Increase</u>
20°	26.9 sq. ft.	26.7 %
30°	46.3 sq. ft.	46.1 %
Full	83.6 sq. ft.	64.5 %

Stall

Stall characteristics are excellent. The aircraft is controllable up to a full stall and buffeting on approach to the stall is unmistakable. The nose will pitch forward at the stall point and stall recovery is easily effected with the application of maximum power. Stall speed is not affected by gear position, with over 25° flaps. Flap effect is as follows:

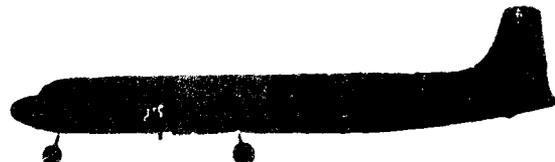
<u>Flap</u>	<u>Stall Speed</u>
0°	106 Knots
20°	94 Knots
30°	88 Knots
50°	83 Knots

(Based on GW 88,200)

Note also, as regards to stalling speeds, that gust loads (acceleration) will increase stalling speeds. "Power on" stalling speeds, however, will be lower than those listed above. As a matter of fact, stall speeds are 5-10 knots slower at approach power, and 10-15 knots slower at maximum power.

Bank effect increases stalling speed, in a 60° bank, stalling speed may be as much as 32 knots higher than in level flight.

In short, aerodynamic and flight handling characteristics are excellent and it may be true that the C-118A is the Air Force's "Transport Cadillac."

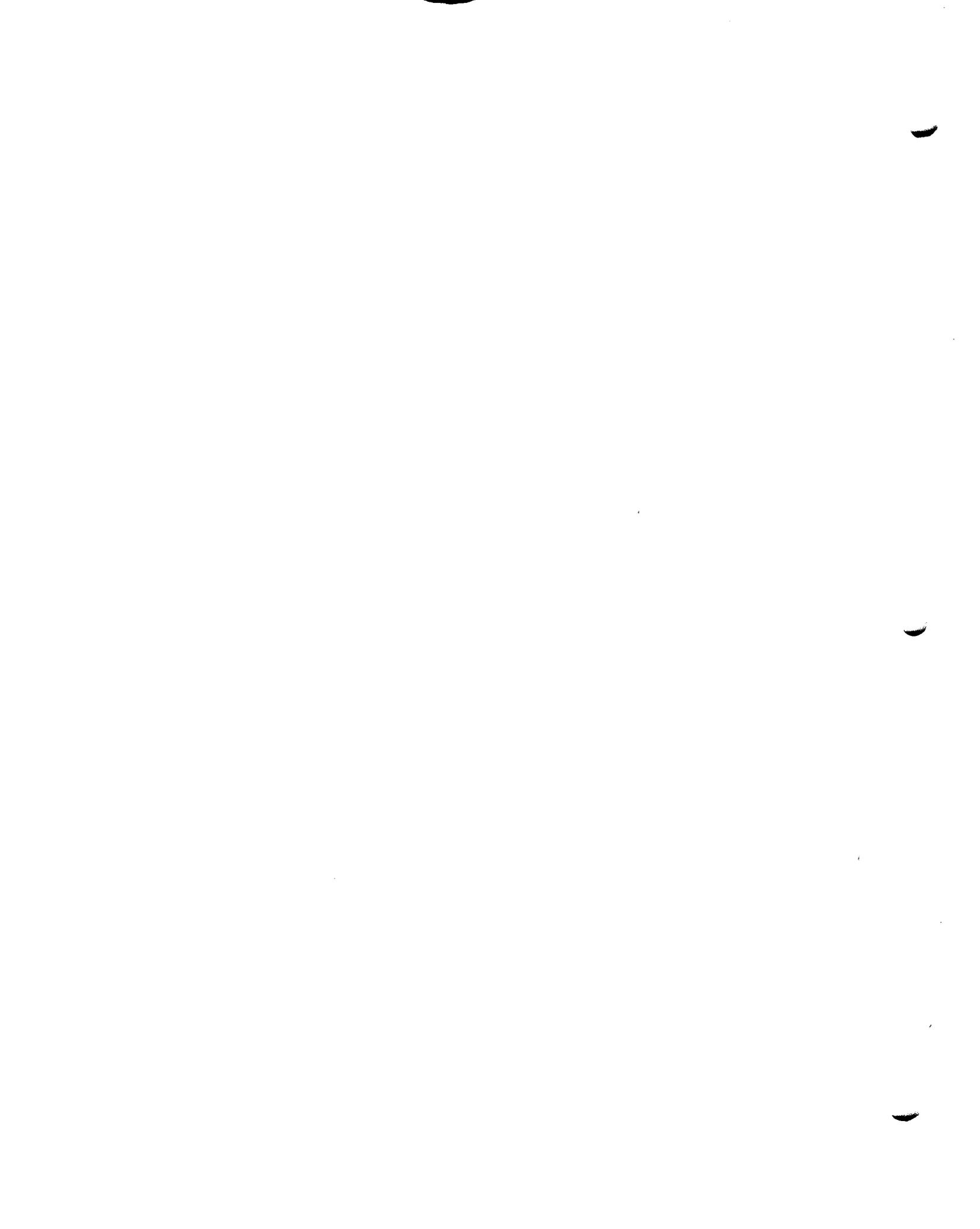


Chapter 14

BIBLIOGRAPHY

MATS MANUAL	55-1	Transport Operations Manual
MATS MANUAL	55-9	Flight Planning Instructions
MATS REGULATION	55-6	Aircraft Performance Data
MATS REGULATION	55-26	MATS Form 52
AF MANUAL	51-9	Aircraft Performance Engineering
AF MANUAL	51-12	Power Plant Maintenance
AF MANUAL	51-42	Aircraft Engineering
TECHNICAL ORDER	10-118A-1	Flight Handbook
OJT MANUAL	JA43174	Flight Engineer Technician
DC6B Flight Study Guide		Douglas Aircraft Corporation





WEIGHT & BALANCE

TABLE OF CONTENTS

Chapter 1	Introduction	9-1
Chapter 2	Directives	9-3
Chapter 3	Terms & Principles	9-4
Chapter 4	Charts	9-5
Chapter 5	Form F	9-16
Chapter 6	Cargo	9-19
Chapter 7	Bibliography	9-19

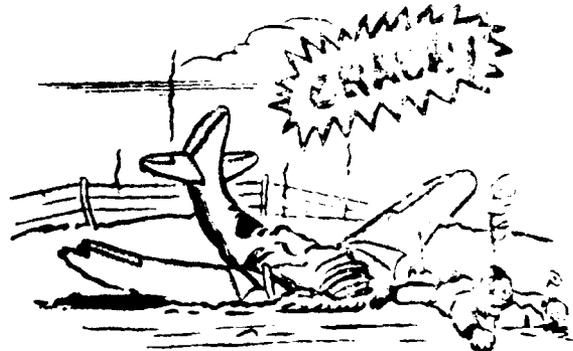
Chapter 1

INTRODUCTION

Weight and balance deals with the amount and location of a load within the aircraft. With small capacity short range aircraft this study was of lesser importance than some other considerations, but with larger aircraft, such as the C-118 and C-118A, the problem has become literally a life or death matter. Improper loading of the airplane can result in a marked reduction in efficiency and safety of the flight, and if severe, can cause disaster at takeoff or landing.

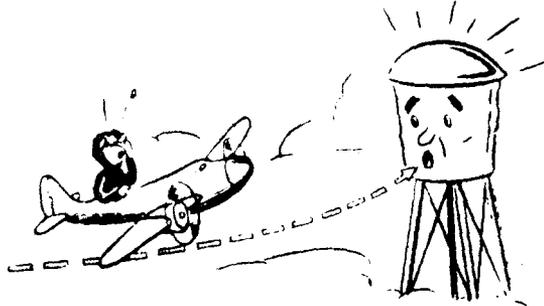
Improper loading of the aircraft can result in an increase in take-off distance to such a degree that with a small loss in engine power the air-

craft will fail to safely complete the takeoff. This is especially true if runway distances are less than 6000 feet.



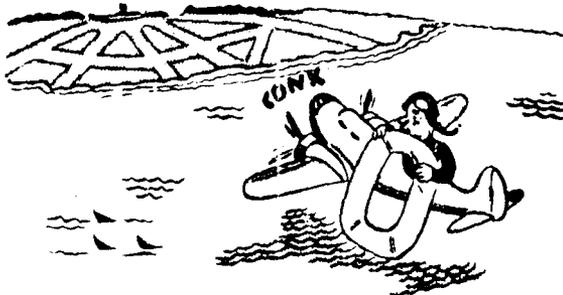
Increase in take-off distance

Excess weight can cause a decrease in rate of climb which may result in a failure of the aircraft to clear flight path obstacles, or at least result in a decrease in the safety factor during the takeoff and climb portion of the flight



Decrease in rate of climb

Overweight and unbalanced aircraft may fly at speeds lower than charted or require higher powers than were predicted. This can result in reduced range of the aircraft possibly enough to preclude the safe arrival at the destination airport.



Decrease in range

An aircraft loaded out of balance may end up with undesirable flight characteristics such as increased or even reversed control forces.



Increase in pilot's control forces

The most concern in the weight and balance study may be the decrease in structural safety factors which will result when the aircraft is overloaded. This concern has caused loading limits to be established for each aircraft.

The weight limits for the C-118A are:

	<u>Normal</u>	<u>Mil Overload</u>
Max for takeoff:	107,000	112,000
Max for landing	88,200	107,000*
Zero fuel weight	83,200	89,900

*At a gross weight of 107,000 lbs for landing the rate of sink at touchdown is restricted to 300 FPM Maximum.



Decrease in structural safety factors

Other effects of improper loading are:

- Increased stalling speeds.
- Decreased "engine out" performance.
- Decreased stability.
- Decreased maneuverability.

Weight and balance information in MATS is computed by specialists assigned to space control, air freight or transport control sections, but the aircraft commander is responsible when his name is placed on the weight and balance limitations and observe the restrictions placed on your aircraft.

Chapter 2

DIRECTIVES

Each phase of aircraft operation is for control and standardization, carefully and judiciously governed by directives. Weight and Balance is regulated by several types of publications.

T. O. 1-1B-41, lists computer (load adjustor) plate numbers for all military aircraft. Plate number for all the C-118 is E1015, and for the C-118A is E1027. The plate number is a required entry on the Form F.

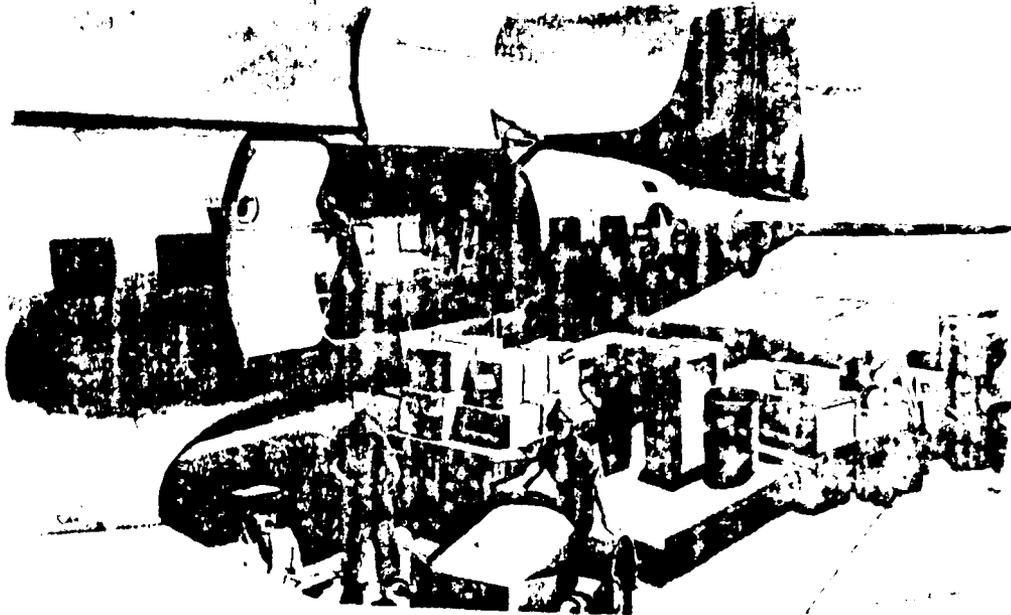
T. O. 1-1B-43, lists weight and balance classifications of aircraft. The C-118 and C-118A fall into Class 2.

T. O. 1-1B-50, the basic weight and balance handbook gives methods applicable to all aircraft.

T. O. 1-1B-52, indicates when class 2 aircraft will be weighed. The C-118 type will be weighed after major modification or repairs, when W/B information is suspected to be in error, when the aircrew reports unsatisfactory flight conditions and at least once each 2 yrs.

T. O. 1-1B-40, includes DD 365 Series Charts, Chart E and blank Form F's. This T.O. should be on board the aircraft for all trips.

T. O. 1C-118A-9 gives specific information on the C-118A concerning cargo handling instructions.



Chapter 3

TERMS AND PRINCIPLES

Weight is the force placed on an object of gravity. It is expressed in pounds when used on W/D forms.

Balance gives the center of gravity of the aircraft. It is normally expressed in percent of M.A.C.

M.A.C. means Mean Aerodynamic Chord the average distance between the leading and trailing edge of the wing.

Reference datum is an imaginary line from which all horizontal distances are measured. On the C-118A it is located 77.0 inches aft of the nose of the aircraft. Station 0 for weight and balance purposes.

Arm is the distance in inches from reference datum at which an item is located in the aircraft.

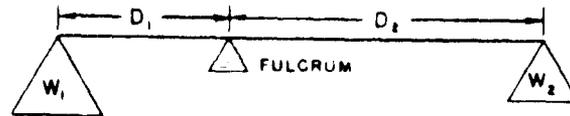
Centroid is the average arm of a compartment. It may be used to compute the moment for weight that is distributed in a compartment.

Moment is the produce of the weight multiplied by the arm expressed in pounds. It is usually simplified by dividing it by 1000.

Balance readings are computed along the longitudinal axis of the aircraft.

Lateral moments are too small normally to have any effect on the aircraft. Balance is computed through application of the laws of leverage.

$$W_1 D_1 = W_2 D_2$$



Where D=Arm, W=Weight, and the Fulcrum can be called the center of gravity.

$$D_1 \times W_1 = \text{Moment } (M_1)$$

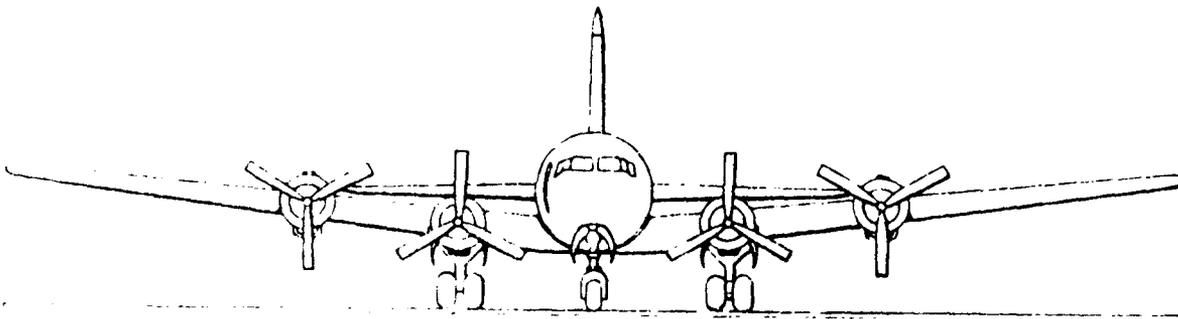
$$D_2 \times W_2 = \text{Moment } (M_2)$$

$$\frac{M_1 + M_2}{W_1 + W_2} = \text{CG}$$

Percent M.A.C. can be found by applying the formula:

$$\% \text{ MAC} = \frac{\text{CG} - \text{LEMAC}}{\text{MAC}} \times 100$$

When CG and LEMAC (leading edge of the MAC), and MAC (from leading to trailing edge) are both expressed in inches.



Chapter 4

CHARTS

Weight and Balance control requires the use of Standard DD Forms of the 365 Series. They are to be found in T.O. 1-1B-40 and are:

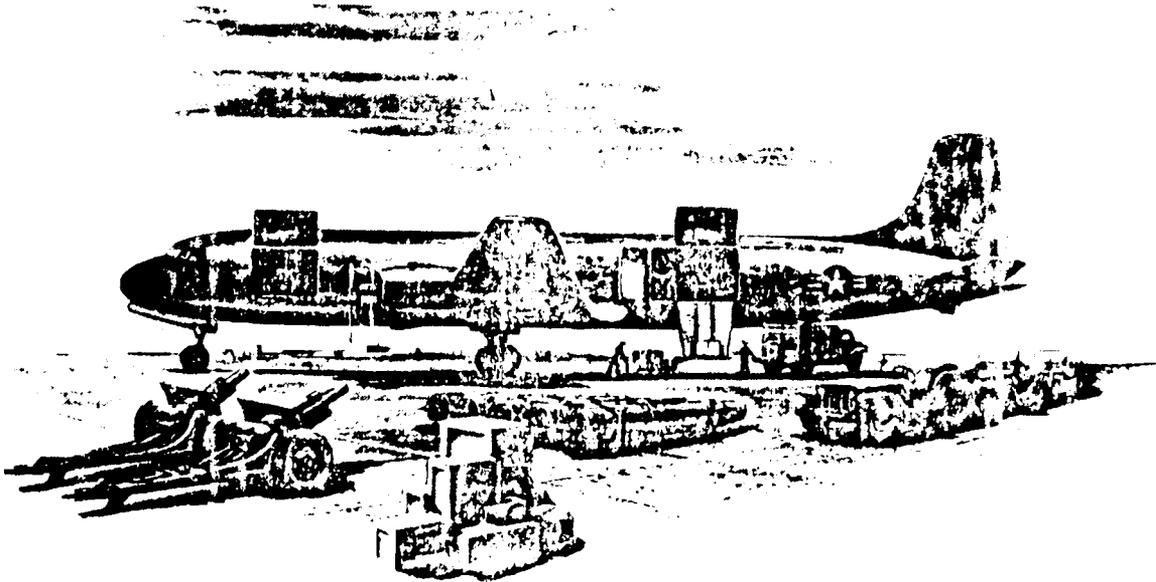
- DD365 Record of weight and balance personnel (Signature sheet).
- DD365A Basic weight check list, an inventory sheet checked at each weighing.
- DD365B Airplane weighing record to be accomplished by weighing personnel at each weighing.
- DD365C Basic weight and balance record, a continuous history of the basic weight, moment resulting from structural and equipment changes in service.

Last weight and moment is the current weight and balance status of the aircraft.

DD365F Weight and Balance clearance form to be filed prior to take-off. A three-nation agreement with Canada (RCAF) and British (RAF) prevents changes in this form without unanimous consent.

Of these forms, the 365C and 365F are most important to the aircrew, so these will be treated in the following chapter.

Chart E: Airplane loading charts are found in the Douglas Manual. These charts allow easy W/B computations without the load adjustor computer.



T. O. 1-1B-40
AN 01-1B-40

HANDBOOK

WEIGHT AND BALANCE DATA

MODEL C-118 A AIRPLANE

SERIAL NO. 51-3821A

This publication replaces AN 01-1B-40 dated 22 June 1951, existing stock of which will be used until exhausted

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE AND THE CHIEF OF THE BUREAU OF AERONAUTICS AND APPROVED BY THE AERONAUTICAL STANDARDS GROUP

Amendment or revision of this publication must be approved by the Aeronautical Standards Group

AIRPLANE WEIGHING RECORD

FOR USE IN T.O. 1
1B 40 & AN 01 1B 43

DATE WEIGHED: 12 DEC 52 MODEL: C118-A SERIAL NUMBER: 51-3821A

PLACE WEIGHED: D.A.C. SANTA MONICA WEIGHING PERSONNEL: HERB W. HOAG - A-950

REACTION (Wheels, Jackpoints, etc.)	SCALE READING	TARE	NET WEIGHT	ARM	MOMENT
LEFT MAIN	25,217	-5	25,212		
RIGHT MAIN	25,175	+10	25,185		
SUB-TOTAL (Both Main)	50,392	+5	50,397	^E 504.0	25,400,000
NOSE OR TAIL	8,711	-15	8,696	^F 69.0	600,000
TOTAL (As Weighed)	60,010	-10	60,000	^H 435.0	26,000,000

MEASUREMENTS

$B = 15.7$ the distance from the jig point, to the center line of the main reactions. Obtain by measurement.

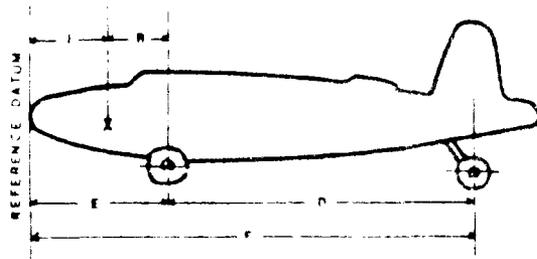
$I = 459.3$ the distance from the reference datum to the jig point of the airplane, from which a plumb bob can be dropped to the ground. Obtain from the airplane diagram in Chart B.

$E = 504.0$ // the distance from the reference datum to the center line of the main reactions.
 $E = I + B$
 $E = I - B$ (If the jig point is aft of the center line of the main reactions.)

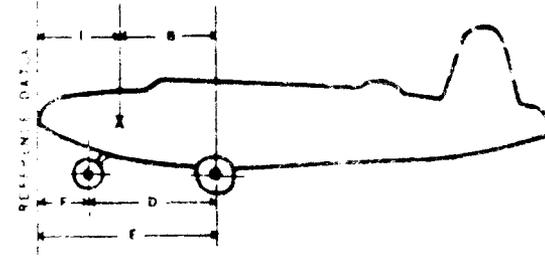
$D = 435.0$ the wheel base (or the distance between fore and aft reactions.) Obtain by measurement.

$F = 69.0$ // the distance from the reference datum to the center line of the nose or tail reaction.
 $F = I - D$ (For nose wheel type aircraft)
 $F = E - D$ (For tail wheel type aircraft)

TAIL WHEEL AIRPLANE



NOSE WHEEL AIRPLANE



DIAGRAMS FOR MEASURING VARIOUS TYPES OF AIRPLANES TO DETERMINE ARM OF SUPPORT POINTS.

// Check dimensions E and F against approximate dimensions listed on Chart C.

PASSENGER TABLE

Location or Row No.	Compt	1 Pass /Compt. 170 lb.	2 Pass /Compt. 340 lb.	3 Pass /Compt. 510 lb.	4 Pass /Compt. 680 lb.	5 Pass /Compt. 850 lb.	6 Pass /Compt. 1020 lb.	7 Pass /Compt. 1190 lb.	8 Pass /Compt. 1360 lb.	9 Pass /Compt. 1530 lb.	10 Pass /Compt. 1700 lb.
		M/1000	M/1000	M/1000	M/1000	M/1000	M/1000	M/1000	M/1000	M/1000	M/1000
Crew	A	11	22	33	44	-	-	-	-	-	-
Crew, 1, 2	B	22	58	87	116	145	-	-	-	-	-
3	C	43	85	128	171	213	-	-	-	-	-
4, 5	D	53	106	159	211	264	317	370	423	476	529
6	E	63	127	190	254	317	-	-	-	-	-
7, 8	F	74	149	223	298	372	446	521	595	669	744
9	G	85	171	256	342	427	-	-	-	-	-
10, 11	H	96	193	289	386	482	579	675	772	868	965
12, 13	J	108	216	323	431	539	647	754	862	-	-
14	K	119	238	356	475	-	-	-	-	-	-
15, 16	L	129	259	388	517	647	776	906	-	-	-
17, 18	M	141	282	423	564	705	846	986	1127	-	-

OIL & WATER INJECTION FLUID TABLES

Nacelle Oil		
35.0 gal/Nacelle		
Gal.	Wt.	Mom. 1000
5	37.5	14
10	75.0	27
15	112.5	41
20	150.0	55
25	137.5	68
30	225.0	82
35	262.5	96
40	300.0	109
45	337.5	123
50	375.0	137
55	412.5	150
60	450.0	164
65	487.5	177
70	525.0	191
75	562.5	205
80	600.0	218
85	637.0	232
90	674.0	246
95	712.5	259
100	750.0	273
105	787.5	287
110	825.0	300
115	862.5	314
120	900.0	328
125	937.5	341
130	975.0	355
135	1012.5	369
140	1050.0	382

Center of Gravity
at Sta. 364.0

Fillet Oil		
Capacity 26 gal.		
*50% oil, 50% Gas.		
Gal.	Wt.	Mom. 1000
2	13.5	7.6
4	27.1	15.3
6	40.6	22.9
8	54.2	30.6
10	67.7	38.3
12	81.2	45.9
14	94.8	53.6
16	108.3	61.2
18	121.9	68.9
20	135.4	76.5
22	148.9	84.1
24	162.5	91.8
26	176.0	99.4

*Based on a Unit
Wt. of 6.77 lb/gal.

Center of Gravity
at Sta. 565.0

Anti-icing alcohol
is listed on Chart A

Water Injection Fluid		
Capacity 38.8 gal.		
7.5 lb/gal.		
Gal.	Wt.	Mom. 1000
2	15	7
4	30	13
6	45	20
8	60	26
10	75	33
12	90	39
14	105	46
16	120	52
18	135	59
20	150	65
22	165	72
24	180	78
26	195	85
28	210	91
30	225	98
32	240	104
34	255	111
36	270	117
38	285	124
38.8	291	127

Center of Gravity
at Sta. 435.0

Chart E

FUEL TABLES

Model C-118A

Main Fuel Tanks			
No. 1 and No. 4		No. 2 and No. 3	
Cap. 695 Gal. Ea.		Cap. 719 Gal. Ea.	
C.G. Sta. 460.0		C.G. Sta. 450.8	
Undumpable Fuel 116.0 Gal. Ea.		Undumpable Fuel 108 Gal. Ea.	
Weight (lb)	Mom. 1000	Weight (lb)	Mom. 1000
5	2.3	5	2.3
10	4.6	10	4.5
15	6.9	15	6.8
20	9.2	20	9.0
30	13.8	30	13.5
40	18.4	40	18.0
50	23.0	50	22.5
100	46.0	100	45.1
200	92.0	200	90.2
300	138.0	300	135.2
400	184.0	400	180.3
500	230.0	500	225.4
600	276.0	600	270.5
700	322.0	700	315.6
800	368.0	800	360.6
900	414.0	900	405.7
1000	460.0	1000	450.8
1200	552.0	1200	541.0
1400	644.0	1400	631.1
1600	736.0	1600	721.3
1800	828.0	1800	811.4
2000	920.0	2000	901.6
2200	1012.0	2200	991.8
2400	1104.0	2400	1081.9
2600	1196.0	2600	1172.1
2800	1288.0	2800	1262.2
3000	1380.0	3000	1352.4
3200	1472.0	3200	1442.6
3400	1564.0	3400	1532.7
3600	1656.0	3600	1622.9
3800	1748.0	3800	1713.0
4000	1840.0	4000	1803.2
4200	1932.0	4200	1893.4
4400	2024.0	4400	1983.5
4600	2116.0	4600	2073.7
4800	2208.0	4800	2163.8
5000	2300.0	5000	2254.0
5200	2392.0	5200	2344.2
5400	2484.0	5400	2434.3
5600	2576.0	5600	2524.5
5800	2668.0	5800	2614.6
6000	2760.0	6000	2704.8
6200	2852.0	6200	2795.0
6400	2944.0	6400	2885.1
6600	3036.0	6600	2975.3
6800	3128.0	6800	3065.4
7000	3220.0	7000	3155.6
7200	3312.0	7200	3245.8
7400	3404.0	7400	3335.9
7600	3496.0	7600	3426.1
7800	3588.0	7800	3516.2
8000	3680.0	8000	3606.4
8200	3772.0	8200	3696.6
*8340	3836.4	8400	3786.7
8400	3864.0	8600	3876.9
8600	3956.0	*8628	3889.5
		8800	3967.0
		9000	4057.2

Alternate Tanks			
No. 1 and No. 4		No. 2 and No. 3	
Cap. 526 Gal. Ea.		Cap. 762 Gal. Ea.	
C.G. Sta. 467.9		C.G. Sta. 448.9	
Undumpable Fuel 0 Gal. Ea.		Undumpable Fuel 54 Gal. Ea.	
Weight (lb)	Mom. 1000	Weight (lb)	Mom. 1000
5	2.2	5	2.3
10	4.5	10	4.7
15	6.7	15	7.0
20	9.0	20	9.4
30	13.5	30	14.0
40	18.0	40	18.7
50	22.4	50	23.4
100	44.9	100	46.8
200	89.8	200	93.6
300	134.7	300	140.4
400	179.6	400	187.2
500	224.5	500	234.0
600	269.3	600	280.7
700	314.2	700	327.5
800	359.1	800	374.3
900	404.0	900	421.1
1000	448.9	1000	467.9
1200	538.7	1200	561.5
1400	628.5	1400	655.1
1600	718.2	1600	748.0
1800	808.0	1800	842.2
2000	897.8	2000	935.8
2200	987.6	2200	1029.4
2400	1077.4	2400	1123.0
2600	1167.1	2600	1216.5
2800	1256.9	2800	1310.1
3000	1346.7	3000	1403.7
3200	1436.5	3200	1497.3
3400	1526.3	3400	1590.9
3600	1616.0	3600	1684.4
3800	1705.8	3800	1778.0
4000	1795.6	4000	1871.6
4200	1885.4	4200	1965.2
4400	1975.2	4400	2058.8
4600	2064.9	4600	2152.3
4800	2154.7	4800	2245.9
5000	2244.5	5000	2339.5
5200	2334.3	5200	2433.1
5400	2424.1	5400	2526.7
5600	2513.8	5600	2620.2
5800	2603.6	5800	2713.8
6000	2693.4	6000	2807.4
6200	2783.2	6200	2901.0
*6312	2833.5	6400	2994.6
6400	2873.0	6600	3088.1
6600	2962.7	6800	3181.7
		7000	3275.3
		7200	3368.9
		7400	3462.5
		7600	3556.0
		7800	3649.6
		8000	3743.2
		8200	3836.8
		8400	3930.4
		8600	4023.9
		8800	4117.5
		9000	4211.1
		*9122	4298.5
		9200	4304.7
		9400	4398.3

*Approximate weights and moments for full fuel tanks under standard conditions (60°F) based on 6.0 lb/gal.

CARGO COMPARTMENT TABLES													
CABIN CARGO COMPARTMENT													
Compt.	B	C	D	E	F	G	H	I	J	K	L	M	N
Arm	171.0	251.0	311.0	373.0	437.5	502.5	567.5	632.5	699.0	761.0	829.0	891.0	910.0
Cargo Wt. (lb.)	Moment/1000												
5	1	1	2	2	2	3	3	3	4	4	4	5	
10	2	3	3	4	4	5	6	6	7	8	8	9	
20	3	5	6	8	9	10	11	13	14	15	17	18	
30	5	8	9	11	13	15	17	19	21	23	25	27	
40	7	10	12	15	18	20	23	25	28	30	33	36	
50	9	13	16	19	22	25	28	32	35	38	42	46	
100	17	25	31	37	44	50	57	63	70	76	83	91	
200	34	50	62	75	88	101	114	127	140	152	166	182	
300	51	75	93	112	131	151	170	190	210	228	249	273	
400	68	100	124	149	175	201	227	254	280	304	332	364	
500	86	126	156	187	219	251	284	317	350	381	415	455	
1000	171	251	311	373	438	503	568	634	699	761	829	910	
1500	257	377	467	560	656	754	851	951	1049	1142	1244	1365	
2000	342	502	622	746	875	1005	1135	1268	1398	1522	1658	1820	
2500	428	628	778	933	1094	1256	1419	1585	1748	1903	2073	2275	
2960	506	743	921	1104	1295	1487	1680	1877	2069	2253	2454	2694	
3000	513	753	933	1119	1313	1508	1703	1902	2097	2283		2730	
3130	535	786	973	1167	1369	1573	1776	1984	2188	2382		2848	
3500	599	879	1089	1306	1531	1759	1986	2219	2447	2664			
3720	636	934	1157	1388	1628	1869	2111	2359	2600	2831			
4000	683	1004	1244	1492	1750	2010	2270	2536					
4500	770	1130	1400	1679	1969	2261	2554	2853					
4800	821	1205	1493	1790	2100	2412	2724	3043					
5000	857			1865	2188	2513	2838	3170					
5120	876			1910	2240	2573	2906	3246					
5200	887				2275	2613	2951	3297					
5300	910							3449					

CENTER OF GRAVITY TABLE

Gross Weight lb.	Moment/1000					
	*Mod. Limit	15%	20%	25%	30%	33%
60,000	25,014	25,182	25,674	26,166	26,658	26,952
200	25,091	25,266	25,760	26,253	26,747	27,042
400	25,169	25,350	25,845	26,340	26,836	27,132
600	25,246	25,434	25,931	26,428	26,925	27,222
800	25,323	25,518	26,016	26,515	27,013	27,311
61,000	25,400	25,602	26,101	26,602	27,102	27,401
200	25,478	25,686	26,187	26,689	27,191	27,491
400	25,554	25,770	26,273	26,777	27,280	27,581
600	25,632	25,854	26,359	26,864	27,369	27,671
800	25,709	25,937	26,444	26,951	27,458	27,761
62,000	25,786	26,021	26,530	27,038	27,547	27,850
200	25,863	26,105	26,615	27,125	27,635	27,940
400	25,941	26,189	26,701	27,213	27,724	28,030
600	26,017	26,273	26,787	27,300	27,813	28,120
800	26,093	26,357	26,874	27,387	27,902	28,210
63,000	26,170	26,441	26,952	27,474	27,991	28,300
200	26,248	26,525	27,035	27,561	28,080	28,389
400	26,327	26,609	27,129	27,649	28,169	28,479
600	26,404	26,693	27,214	27,736	28,257	28,569
800	26,479	26,777	27,300	27,824	28,346	28,659
64,000	26,557	26,861	27,388	27,910	28,435	28,749
200	26,624	26,945	27,471	27,998	28,524	28,839
400	26,700	27,029	27,557	28,085	28,613	28,928
600	26,777	27,123	27,642	28,172	28,702	29,018
800	26,853	27,197	27,728	28,259	28,791	29,108
65,000	26,930	27,281	27,814	28,347	28,880	29,198
200	27,006	27,364	27,899	28,434	28,968	29,288
400	27,082	27,448	27,985	28,521	29,057	29,378
600	27,158	27,532	28,070	28,608	29,146	29,468
800	27,235	27,618	28,156	28,695	29,235	29,557
66,000	27,311	27,700	28,247	28,783	29,324	29,647
200	27,387	27,784	28,327	28,870	29,413	29,737
400	27,463	27,868	28,413	28,957	29,502	29,827
600	27,539	27,952	28,498	29,044	29,590	29,917
800	27,615	28,036	28,584	29,131	29,679	30,007
67,000	27,691	28,126	28,669	29,219	29,768	30,096
200	27,767	28,204	28,755	29,306	29,857	30,186
400	27,843	28,288	28,840	29,393	29,946	30,276
600	27,919	28,372	28,926	29,480	30,035	30,366
800	28,005	28,456	29,012	29,568	30,124	30,456
68,000	28,081	28,540	29,097	29,655	30,212	30,546
200	28,158	28,624	29,183	29,742	30,301	30,635
400	28,234	28,707	29,268	29,829	30,390	30,725
600	28,310	28,791	29,354	29,916	30,479	30,815
800	28,387	28,875	29,440	30,004	30,568	30,905
69,000	28,463	28,959	29,525	30,091	30,657	30,995
200	28,540	29,043	29,611	30,178	30,746	31,085
400	28,616	29,127	29,696	30,265	30,834	31,174
600	28,692	29,211	29,782	30,353	30,923	31,264
800	28,769	29,295	29,867	30,440	31,012	31,354
70,000	28,845	29,379	29,953	30,527	31,101	31,444
200	28,922	29,463	30,039	30,614	31,190	31,534
400	29,000	29,547	30,124	30,701	31,279	31,624
600	29,077	29,631	30,210	30,789	31,368	31,714
800	29,154	29,715	30,295	30,876	31,456	31,803
71,000	29,231	29,799	30,381	30,963	31,545	31,893
200	29,308	29,883	30,466	31,050	31,634	31,983
400	29,385	29,967	30,552	31,138	31,723	32,073
600	29,462	30,050	30,638	31,225	31,812	32,163
800	29,539	30,134	30,723	31,312	31,901	32,253
72,000	29,616	30,218	30,809	31,399	31,990	32,343
200	29,693	30,302	30,894	31,486	32,078	32,432
400	29,770	30,386	30,980	31,574	32,167	32,522
600	29,847	30,470	31,066	31,662	32,256	32,612
800	29,924	30,554	31,151	31,748	32,345	32,702
73,000	30,001	30,638	31,237	31,835	32,434	32,792
200	30,078	30,722	31,322	31,923	32,523	32,881
400	30,155	30,806	31,408	32,010	32,612	32,971
600	30,232	30,890	31,493	32,097	32,700	33,061
800	30,309	30,974	31,579	32,184	32,789	33,151
74,000	30,386	31,058	31,664	32,271	32,878	33,241
200	30,463	31,142	31,750	32,358	32,967	33,331
400	30,540	31,226	31,836	32,446	33,056	33,420
600	30,617	31,310	31,921	32,533	33,145	33,510
800	30,694	31,394	32,007	32,620	33,234	33,600
75,000	30,771	31,478	32,092	32,708	33,323	33,690
200	30,848	31,561	32,178	32,795	33,411	33,780
400	30,925	31,645	32,264	32,883	33,500	33,870
600	31,002	31,729	32,349	32,970	33,589	33,960
800	31,079	31,813	32,435	33,056	33,678	34,050

Gross Weight lb.	Moment/1000					
	*Mod. Limit	15%	20%	25%	30%	33%
76,000	31,403	31,897	32,520	33,144	33,767	34,139
200	31,486	31,981	32,606	33,231	33,856	34,229
400	31,568	32,065	32,692	33,318	33,945	34,319
600	31,651	32,149	32,777	33,405	34,033	34,409
800	31,734	32,233	32,863	33,492	34,122	34,499
77,000	31,816	32,317	32,948	33,580	34,211	34,588
200	31,899	32,401	33,034	33,667	34,300	34,678
400	31,982	32,485	33,119	33,754	34,389	34,768
600	32,064	32,569	33,205	33,841	34,478	34,858
800	32,147	32,653	33,291	33,929	34,567	34,948
78,000	32,230	32,737	33,376	34,016	34,657	35,038
200	32,312	32,821	33,462	34,103	34,744	35,127
400	32,395	32,904	33,547	34,190	34,833	35,217
600	32,478	32,988	33,633	34,277	34,922	35,307
800	32,560	33,072	33,719	34,364	35,011	35,397
79,000	32,643	33,156	33,804	34,452	35,100	35,487
200	32,725	33,240	33,890	34,539	35,189	35,577
400	32,808	33,324	33,975	34,626	35,277	35,666
600	32,891	33,408	34,061	34,714	35,366	35,756
800	32,973	33,492	34,146	34,801	35,455	35,846
80,000	33,056	33,576	34,232	34,888	35,544	35,936
200	33,139	33,660	34,318	34,975	35,633	36,026
400	33,221	33,744	34,403	35,062	35,722	36,116
600	33,303	33,828	34,489	35,150	35,811	36,206
800	33,387	33,912	34,574	35,237	35,899	36,295
81,000	33,469	33,996	34,660	35,324	35,988	36,385
200	33,551	34,080	34,745	35,411	36,077	36,475
400	33,634	34,164	34,831	35,499	36,166	36,565
600	33,717	34,248	34,917	35,586	36,255	36,655
800	33,800	34,331	35,002	35,673	36,344	36,745
82,000	33,882	34,415	35,088	35,760	36,431	36,834
200	33,965	34,499	35,173	35,847	36,521	36,924
400	34,048	34,583	35,259	35,935	36,610	37,014
600	34,130	34,667	35,345	36,022	36,699	37,104
800	34,213	34,751	35,430	36,109	36,788	37,194
83,000	34,296	34,835	35,516	36,196	36,877	37,284
200	34,378	34,919	35,610	36,284	36,966	37,373
400	34,460	35,003	35,697	36,371	37,055	37,463
600	34,544	35,087	35,772	36,458	37,143	37,553
800	34,626	35,170	35,858	36,545	37,232	37,642
84,000	34,709	35,255	35,944	36,631	37,321	37,732
200	34,791	35,339	36,029	36,720	37,410	37,823
400	34,874	35,423	36,115	36,807	37,499	37,912
600	34,957	35,507	36,200	36,894	37,588	38,002
800	35,039	35,591	36,286	36,981	37,677	38,092
85,000	35,122	35,675	36,371	37,069	37,766	38,182
200	35,205	35,758	36,457	37,156	37,854	38,272
400	35,287	35,842	36,543	37,242	37,943	38,362
600	35,370	35,926	36,628	37,330	38,032	38,452
800	35,453	36,010	36,714	37,417	38,121	38,541
86,000	35,537	36,094	36,799	37,505	38,210	38,631
200	35,619	36,178	36,885	37,592	38,299	38,721
400	35,702	36,262	36,971	37,679	38,388	38,811
600	35,784	36,346	37,056	37,766	38,476	38,901
800	35,867	36,430	37,142	37,853	38,565	38,991
87,000	35,950	36,514	37,227	37,941	38,654	39,081
200	36,032	36,598	37,313	38,028	38,743	39,170
400	36,115	36,682	37,398	38,115	38,832	39,260
600	36,198	36,766	37,484	38,202	38,921	39,350
800	36,280	36,850	37,570	38,290	39,010	39,440
88,000	36,363	36,934	37,655	38,377	39,098	39,530
200	36,445	37,018	37,741	38,464	39,187	39,619
400	36,528	37,101	37,826	38,551	39,276	39,709
600	36,610	37,185	37,912	38,638	39,365	39,799
800	36,693	37,269	37,998	38,726	39,454	39,889
89,000	36,775	37,353	38,083	38,813	39,543	39,979
200	36,857	37,437	38,169	38,900	39,632	40,069
400	37,045	37,521	38,254	38,987	39,720	40,158
600	37,133	37,605	38,340	39,075	39,809	40,248
800	37,221	37,689	38,425	39,162	39,898	40,338
90,000	37,310	37,773	38,511			

CENTER OF GRAVITY TABLES
(CONT.)

Gross Weight lb.	Moment/1000					
	* Fwd. Limit	15% 419.7	20% 427.9	25% 436.1	30% 444.3	33% 449.2
92,000	38,195	38,612	39,367	40,121	40,876	41,326
200	38,283	38,696	39,452	40,208	40,964	41,416
400	38,372	38,780	39,538	40,296	41,053	41,506
600	38,460	38,864	39,624	40,382	41,142	41,596
800	38,549	38,948	39,709	40,470	41,231	41,686
93,000	38,638	39,032	39,795	40,557	41,320	41,776
200	38,726	39,116	39,880	40,645	41,409	41,865
400	38,815	39,200	39,966	40,732	41,498	41,955
600	38,904	39,284	40,051	40,819	41,586	42,045
800	38,994	39,368	40,137	40,906	41,675	42,135
94,000	39,082	39,452	40,223	40,993	41,764	42,224
200	39,171	39,536	40,308	41,080	41,853	42,315
400	39,261	39,620	40,394	41,168	41,942	42,404
600	39,349	39,704	40,479	41,255	42,031	42,494
800	39,438	39,788	40,565	41,342	42,120	42,584
95,000	39,527	39,872	40,651	41,430	42,209	42,674
200	39,616	39,955	40,736	41,517	42,297	42,763
400	39,704	40,039	40,822	41,604	42,386	42,853
600	39,793	40,123	40,907	41,691	42,475	42,944
800	39,882	40,207	40,993	41,778	42,564	43,033
96,000	39,971	40,291	41,078	41,866	42,653	43,123
200	40,060	40,375	41,164	41,953	42,742	43,213
400	40,149	40,459	41,250	42,040	42,831	43,303
600	40,239	40,543	41,335	42,127	42,919	43,393
800	40,329	40,627	41,421	42,214	43,008	43,483
97,000	40,418	40,710	41,506	42,302	43,097	43,572
200	40,507	40,794	41,592	42,389	43,186	43,662
400	40,596	40,879	41,677	42,476	43,275	43,752
600	40,686	40,963	41,763	42,563	43,364	43,842
800	40,775	41,047	41,849	42,651	43,453	43,932
98,000	40,864	41,130	41,934	42,738	43,541	44,022
200	40,954	41,215	42,020	42,825	43,630	44,111
400	41,044	41,298	42,106	42,912	43,719	44,201
600	41,133	41,382	42,192	42,999	43,808	44,291
800	41,221	41,466	42,277	43,087	43,896	44,381
99,000	41,311	41,550	42,362	43,174	43,986	44,470
200	41,400	41,634	42,448	43,261	44,075	44,561
400	41,490	41,718	42,533	43,348	44,163	44,650
600	41,579	41,802	42,619	43,436	44,252	44,740
800	41,669	41,886	42,704	43,523	44,341	44,830
100,000	41,760	41,970	42,790	43,610	44,430	44,920
200	41,850	42,054	42,876	43,697	44,519	45,010
400	41,939	42,138	42,961	43,784	44,608	45,100
600	42,029	42,222	43,047	43,872	44,697	45,190
800	42,118	42,306	43,132	43,959	44,785	45,279
101,000	42,208	42,390	43,218	44,046	44,874	45,369
200	42,298	42,474	43,303	44,133	44,963	45,459
400	42,367	42,578	43,389	44,221	45,052	45,549
600	42,477	42,642	43,475	44,308	45,141	45,639
800	42,567	42,725	43,560	44,395	45,230	45,729

CENTER OF GRAVITY TABLES
(CONT.)

Gross Weight lb.	Moment/1000					
	*Fwd. Limit	15%	20%	25%	30%	33%
		419.7	427.9	436.1	444.3	449.2
102,000	42,656	42,809	43,646	44,482	45,319	45,818
200	42,746	42,893	43,731	44,569	45,407	45,908
400	42,845	42,977	43,817	44,657	45,496	45,998
600	42,948	43,661	43,903	44,744	45,585	46,088
800	43,053	43,145	43,988	44,831	45,674	46,178
103,000	43,157	43,234	44,074	44,913	45,763	46,273
200	43,261	43,313	44,159	45,006	45,842	46,357
400	43,366	43,397	44,245	45,093	45,941	46,447
600	43,471	43,481	44,330	45,180	46,029	46,537
800	43,481		44,416	45,267	46,118	46,627
104,000	43,680		44,502	45,354	46,207	46,717
200	43,785		44,587	45,441	46,296	46,807
400	43,890		44,673	45,529	46,385	46,896
600	43,994		44,758	45,616	46,474	46,986
800	44,100		44,844	45,703	46,563	47,076
105,000	44,205		44,930	45,791	46,652	47,166
200	44,310		45,015	45,878	46,740	47,256
400	44,416		45,100	45,965	46,829	47,346
600	44,521		45,186	46,052	46,918	47,436
800	44,626		45,272	46,139	47,006	47,525
106,000	44,732		45,357	46,227	47,095	47,615
200	44,838		45,443	46,314	47,185	47,705
400	44,943		45,529	46,401	47,274	47,795
600	43,049		45,614	46,488	47,362	47,885
800	45,144		45,700	46,575	47,451	47,975
107,000	45,250		45,785	46,663	47,540	48,064
200	45,356		45,871	46,750	47,629	48,154
400	45,462		45,966	46,837	47,718	48,244
600	45,569		46,042	46,924	47,807	48,334
800	45,675		46,128	47,012	47,896	48,424
108,000	45,781		46,213	47,099	47,984	48,514
200	45,888		46,299	47,186	48,073	48,603
400	45,994		46,384	47,273	48,162	48,693
600	46,101		46,470	47,360	48,251	48,783
800	46,207		46,555	47,448	48,340	48,873
109,000	46,314		46,641	47,535	48,429	48,963
200	46,421		46,727	47,622	48,518	49,053
400	46,528		46,812	47,709	48,606	49,142
600	46,653		46,898	47,796	48,695	49,232
800	46,742		46,983	47,884	48,784	49,322
110,000	46,849		47,069	47,971	48,875	49,412
200	46,956		47,155	48,058	48,962	49,502
400	47,064		47,240	48,145	49,051	49,592
600	47,171		47,326	48,233	49,140	49,682
800	47,267		47,411	48,320	49,228	49,771
111,000	47,375		47,497	48,407	49,317	49,861
200	47,482		47,582	48,496	49,406	49,951
400	47,590		47,668	48,582	49,495	50,041
600	47,798		47,754	48,669	49,584	50,131
800	47,806		47,839	48,756	49,673	50,220
112,000	47,914		47,925	48,843	49,762	50,310

SEE FORWARD LIST

Chapter 5

FORM F

The Form F summarizes the aircraft weight and balance for a particular flight. It will list, locate, and compute balance resultant for everything loaded on the aircraft. This form may be computed and filled out with longhand methods, chart E figures, or with the weight and balance computer (Load Adjuster). You should use a load adjuster with your airplane on every trip. Forms F are supplied in expendable pads, and are made out in duplicate. One copy is kept with the aircraft filed papers (Form 119, etc) and the other copy remains in the booklet folder.

Sample copies of Form F are included in this Study Guide to show the different methods used in computing it. One uses a chart and the other uses index (Load Adjuster) for the computation. Some of the rules to be followed are:

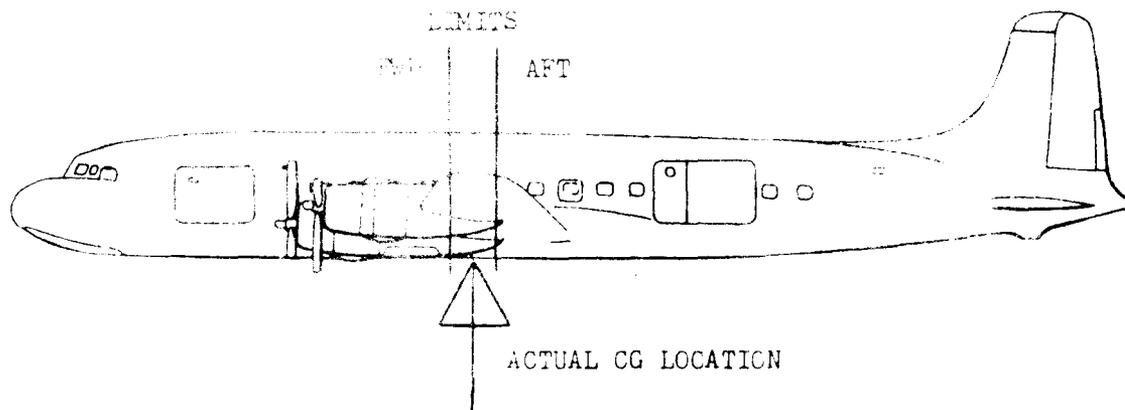
1. Basic weight must come from Chart C.
2. Limitation on cargo load and:

Max takeoff wt	100,000*
Max landing	88,200*
Zero fuel	83,200*

 *Normal Operation

3. Maximum permissible CG for takeoff and landing is 16.3% to 33% MAC.
4. Fuel will be itemized in the remarks block.
5. Landing fuel weight from flight plan.
6. Lower compartments match upper compartments but are double lettered. Example: D (upper) D-D (lower).
7. Use actual passenger weights but 170 lb. average for crew.
8. Computer plate number must be entered in proper space.
9. Weight and Balance clearance Form F must be properly signed before the aircraft is allowed to depart.

Weight and Balance computation in MATS is taken care of by experts in this field who are assigned permanently to this duty. The Aircraft Commander is, however, responsible after he or his representative sign accepting the Form F.



WEIGHT AND BALANCE CLEARANCE FORM F TRANSPORT (USE REVERSE FOR TACTICAL MISSIONS)				Cross Reference NAF Form 2678 RCAP Form F, 118 U MAY 6-61 (879)		FOR USE IN T.O. 1-18-40 & AN 01-18-40	
DATE 10 JAN 53		AIRPLANE TYPE C-118A		FROM NORTON AFB		HOME STATION WESTOVER AFB	
MISSION/TRIP/LIGHT/NO. FERRY		SERIAL NO. 51-3821A		TO WESTOVER AFB		PILOT MAJ OLSEN	
LIMITATIONS				REF	ITEM	WEIGHT	CORRECTION MOM/1000
CONDITION	TAKEOFF	LANDING	LIMITING WING FULL				
1 ALLOWABLE GROSS WEIGHT	107000	88200	83200	1	BASIC AIRPLANE (STW (BOP C))	59915	25915
TOTAL AIRPLANE WEIGHT (Ref. 1)	94500			2	OIL (140+26 Gal.)	1226	482
OPERATING WEIGHT PLUS ESTIMATED LANDING FUEL WEIGHT		78209		3	CREW (No.) 4 "A" CAPT	680	42
OPERATING WEIGHT (Ref. 4)			62609	4	CREW'S BAGGAGE "D" CAPT	488	156
ALLOWABLE LOAD (Ref. 18) (use 3A1ALLEST Apply)	12500	9991	20591	5	STEWARDS EQUIPMENT		
PERMISSIBLE C.G. TAKEOFF	FROM 16.3	TO (% M.A.C. 33.0)		6	EMERGENCY EQUIPMENT	300	190
PERMISSIBLE C.G. LANDING	FROM 16.3	TO (% M.A.C. 33.0)		7	EXTRA EQUIPMENT "J" CAPT		
				8	OPERATING WEIGHT	62609	26705
				9	TAKEOFF FUEL (5404 Gal.)	31600	14498
				10	WATER MW FLUID (38.8 Gal.)	291	127
				11	TOTAL AIRPLANE WEIGHT	94500	41410
12 DISTRIBUTION OF ALLOWABLE LOAD (PAYLOAD)							
LANDING FULL WEIGHT		11600					
REMARKS		COMPT		UPPER COMPARTMENTS		LOWER COMPARTMENTS	
TAKEOFF FUEL		NO. WEIGHT		PASSENGERS		PASSENGERS	
124 MAIN 8100 LBS				CARGO		MAIL	
223 MAIN 8400 LBS							
124 ALT 6140 LBS							
223 ALT 8960 LBS				3000		3000 933	
LANDING FUEL							
124 MAIN 5800 LBS				5000		5000 2838	
223 MAIN 5800 LBS							
TOTAL FLIGHT		8000		KK		500 500 350	
TOTAL MAIL		500				8500	
COMPUTER PLATE NUMBER (if used)							
1 Enter constant used							
2 Enter values from current applicable T.O.							
3 Applicable to gross weight (Ref. 13)							
4 Applicable to gross weight (Ref. 18)							
5 Ref. 4 minus Ref. 17.							
CORRECTIONS (Ref. 14)				13 TAKEOFF CONDITION (Uncorrected)		103000 45531	
				14 CORRECTIONS (if required)			
				15 TAKEOFF CONDITION (Corrected)			
				16 TAKEOFF C.G. IN % M.A.C.		28.0%	
				17 LESS FULL		20000 - 9216	
				18 LESS AIR SUPPLY LOAD DROPPED			
				19 MISC. VARIABLES			
				20 ESTIMATED LANDING CONDITION		83000 36318	
				21 ESTIMATED LANDING C.G. IN % M.A.C.		26.0%	
				COMPUTED BY			
				Edward A. Lester DAFC			
TOTAL WEIGHT REMOVED				WEIGHT AND BALANCE AUTHORITY			
TOTAL WEIGHT ADDED				Sgt R.M. Moore			
NET DIFFERENCE (Ref. 14)				PILOT			
				Lloyd A. Olsen USAF			

NOT - THIS TRANSPORT CLEARANCE FORM HAS RESULTED FROM TRIPARTITE AGREEMENT AND NO FURTHER CHANGES MAY BE MADE TO IT WITHOUT PRIOR CONSIDERATION BY TRIPARTITE AUTHORITIES.

DD FORM 1 SEPT 54 365F