The DC-4 Operating Manual has been prepared and is issued by the Flight Operations Department of Resort Airlines, Inc.

It is primarily for the use of Captains and First Officers assigned to C-54B-DC aircraft and is intended as a guide and reference for proper and efficient operation of the equipment involved.

Revisions and/or additions to the Manual will be forwarded via Company Mail direct to each person holding a copy, and it is requested that the attached receipts be promptly returned to the address indicated thereon.

The person to whom this Manual is loaned, and whose name and title appear below shall be responsible for its safekeeping and for insertion of all revision pages issued. This Manual must be returned to the Company upon transfer or termination.

NAME:

TITLE:

SECTION: RECORD OF REVISIONS

Rev. No.	Date Entered	Entered By		Rev. No.	Date Entered	Entered By
1				19		
2				20		
3				21		
4				22		
5				23		
6				24		
7				25		
8				26		
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10				28		
11				29		
12				30		
13				31		
14				32		
15				33		
16				34		
17				35		
18				36		

After insertion of each revision, enter date and initials after proper revision number.

This sheet will not be removed at any time.

I. Description

The DC-4 airplane is a four engine, low wing monoplane with a fully retractable tricycle landing gear. It is powered by four Wright C9HD engines, and is equipped with Hamilton Standard Hydromatic propellers.

A. Fuselage

The fuselage is of semi-Monocoque all-metal stressed skin construction, incorporating transverse frames and longitudinal stiffeners with smooth aluminum alloy sheet covering. There are ice protector strips on the sides of the fuselage in line with the plane of rotation of the inboard propellers.

The tail cone assembly is attached to the fuselage stub by means of bolts screwed into nut plates on the fuselage. The tail cone light is a part of the tail cone assembly.

B. Wing Group

The wing is of full cantilever all-metal construction. It has a center section permanently attached to the fuselage, two removable outer panels bolted to the center section, and two removable wingtips bolted to the outer panels. The engine nacelles and the wing fuel tanks are built as integral parts of the center section. The main landing wheels retract into the inboard nacelles.

NACA type wing flaps, extending from the inboard ends of the ailerons to the fuselage, are incorporated in the center wing section aft of the rear spar. The flaps, of all-metal construction, operate hydraulically.

Fabric-covered ailerons extend along the trailing edge of each outer panel. They are balanced aerodynamically and statically by weights bolted to the aluminum alloy sheet which covers the surface forward of the spar. The right aileron has a trim tab operated by dual control wheels on the control pedestal in the pilot's compartment. The ailerons move 15° up and $11\frac{1}{2}^{\circ}$ down.

C. Tail Group

The horizontal and vertical stabilizers are of all-metal (aluminum alloy) conventional type construction, attached in fixed alignment to the fuselage.

I. Description (Cont'd)

C. Tail Group (Cont'd)

The elevators and rudder are of metal frame fabric-covered construction. They are balanced aerodynamically and statically by lead weights attached to the skin. The rudder has a flying tab and each elevator has a trim tab, all controllable from the pilot's compartment. Elevator movement is 25° up and 15° down. Rudder movement is 20° each way from neutral.

D. Landing Gear

The landing gear comprises three units: two fully retractable main gears with brakes and dual wheels, a fully retractable nose gear with steerable wheel, and a faired, non-retracting, shock-supported tailskid.

The two wheels of each main gear are mounted on opposite sides of a single oleo pneumatic shock strut which is supported by two drag struts, or links. Each main gear is attached to the wing center section aft of the center of gravity of the airplane. The main wheels retract forward into wheel wells in the inboard nacelles. When the gear is fully retracted, the doors of the wells close to form the bottom contour of the nacelles.

The nose gear also operates hydraulically, retracting forward into the nose wheel well simultaneously with the main gear. The nose wheel is self-trailing and self-centering and is mounted on a fork and single shock strut which slopes forward like a bicycle fork. For normal operation stops limit the swivel of the nose wheel to 45° each side of neutral. The torque links may be disengaged to allow the nose wheel a full 360° of swivel for towing on the ground.

The nose wheel has a hydraulic steering device by which you steer the airplane while taxiing. The steering device engages automatically when the weight of the airplane is on the nose gear, disengages when the weight is removed.

The doors of the nose wheel well completely enclose the gear when it is retracted fully, completing the contour of the fuselage nose section. The nose wheel has no brake for ground operation. Retracted, however, the nose wheel fits against a strip of brake lining, which acts as a snubber to stop spinning of the wheel after take-off.

I. Description

E. Flight Controls

The flight controls in the cockpit are of conventional arrangement. Ailerons are controlled by a wheel, elevators by a control column which swings fore and aft, and the rudder by adjustable pedals. Toe pressure on the pedals operates the brakes. The First Officer has duplicate controls on his side with the exception of the rudder tab control wheel, which is in the windshield V within reach of both pilots. The wing flaps are controlled hydraulically by a handle in the center of the lower portion of the control pedestal, within reach of both pilots. The landing gear is also controlled hydraulically by a handle located on the pedestal, adjacent to flap control handle.

A cable-operated gust lock mechanically secures the rudder, elevators, and ailerons in the neutral position when the airplane is on the ground and not being operated. The lock is held in the "ON" position by a ring attached to a red tape which serves as a warning that the lock is being used. A warning light on the pilots' instrument panel also indicates when the gust lock is engaged.

Automatic pilot servo units are attached to the rudder, elevator, and aileron cable system to provide automatic control of the airplane.

Operation of the rudder controls provides automatic operation of the rudder flying tab, which gives aerodynamic boost for the rudder and reduces the load on the rudder pedals. The flying tab is also used as a trim tab, controlled by the control wheel in the flight compartment. Trim control wheels operate the conventional trim tabs on the elevators and on the right aileron.

F. Flight Compartment

The flight compartment includes stations for the Captain, First Officer, Flight Radio Operator, plus provisions for a jump seat. This jump seat is located between the Captain and First Officer. The floor contains removable panels for access to controls and various mechanical systems.

On the right side of the flight compartment, behind the First Officer's station, is an exterior door for access to the flight compartment while on the ground. The door, which includes a small Plexiglas window, is hinged on the forward edge and opens inward by operation of a conventional door handle. It has a safety light to warn the captain when the door is open.

I. Description (Cont'd)

F. Flight Compartment (Cont'd)

The flight compartment has left and right windshield assemblies, each of double glass panels, curved corner windows, and sliding side windows. The curved windows are hinged at the forward edge and open in. Rain does not enter the cockpit when these windows are opened in flight and you get no effect other than the roar of air. The side windows may also be opened in flight. The handle is aft of the window. Turn it up to unlock window. This forces the window out of its recessed position against the frame and lines it up with its slide tracks. Then push down on the knob on the forward frame and slide the window back.

Captain and First Officer have 2-way adjustable seats with conventional safety belts and shoulder harnesses. The control levers for adjustment are on the outboard sides of the seats. The upper lever controls vertical adjustment, and the lower lever controls horizontal adjustment. When you have the seat adjusted be sure that the levers are in the locked position.

If the adjustment is not locked, the seat can slip back and leave you in the embarrassing position of not being able to reach the controls.

G. Rudder Pedal Adjustment

Captain's and First Officer's rudder pedals are adjustable. There is a spring latch on the lower inside corner of each rudder pedal. By pushing the latch away from the pedal you can slide the pedal backward or forward. When you have the pedal where you want it, release the latch and the pedal locks into the nearest notch. Be sure pedals are locked into position and that the pedals are exactly equal when the rudder is in neutral.

H. Instruments

The engine, flight, and other instruments necessary for the operation of the airplane are mounted on two major panels and one auxiliary panel. The main instrument panel is at the front of the flight compartment, below the windshield. An upper panel is above the windshield V. The auxiliary instrument panel is the First Officer's control panel to the right of the First Officer's seat.

The instrument panels are constructed of non-magnetic materials and with the exception of the First Officer's control panel, are mounted

I. Description (Cont'd)

H. Instruments (Cont'd)

on Lord shock absorber units. The center section of the main panel, and the upper instrument panel are shielded with a box type structure of non-magnetic material to prevent the electrically operated instruments from interfering with radio reception and transmission.

I. Cargo Compartments

The 2 main cargo compartments of the airplane are located on the main floor level between the flight and cabin compartments. The right hand compartment begins at the front side of the forward cabin bulkhead and extends forward to a movable post located aft of the flight compartment outside door. The second main cargo compartment is located on the left side of the airplane between the buffet and radio racks. Cargo loading and unloading from both main compartments is accomplished through the flight compartment outside door. The cargo compartment has provisions for storage of crew baggage. The crew baggage rack is so arranged that loading and unloading of crew baggage may be accomplished through the forward main cargo door.

Two additional cargo compartments are located below the main floor level in the belly of the airplane. The forward and aft belly cargo compartments are separated by a hydraulic accessories compartment which extends the full width of the fuselage. Access to the forward cargo, hydraulic accessories and aft cargo compartments may be gained from the ground through a belly door for each compartment. All three doors are located on the right hand side of the airplane. Emergency entrance to the belly cargo compartments can be gained through small floor doors. The forward door is located in the galley directly between the buffet work shelf and the door to the passenger cabin. The door for the rear belly compartment is located on the floor in the main isle of the passenger cabin forward of the draft shield at the passenger entrance door. In order to locate either door, the rug must be lifted up. The doors are held in position by Dzus fasteners.

A small service door in the aft end of the right lavatory leads to the tail section, which contains the flight control mechanism and tail skid strut.

II. Dimensions and Areas

A. General

Span	117 feet, 6 inches
Length (over-all)	93 feet, 5 inches
Height	27 feet, 6 inches

B. Wing

Chord at root (NACA 23016)	19 feet, 1 inch
Chord at tip (NACA 23012)	5 feet, 10½ inches
Incidence at theoretical root	4 degrees
Incidence at theoretical tip	1 degree
Dihedral (measured on top front face of spar)	7 degrees
Sweepback at 30% chord	1 degree, 17 minutes

C. Horizontal Stabilizer

Span	39 feet, 6 inches
Maximum chord	11 feet, 3 inches
Incidence	1 degree
Dihedral	None

D. Vertical Stabilizer

Height	14 feet, 3 inches
Maximum chord	12 feet, 4 inches

E. Fuselage

Width	10 feet, 5 inches
Height	11 feet, 6 inches

F. Areas

Wings (less ailerons)	1341.6 square feet
Ailerons (including tab)	120.4 square feet
Aileron trim tab	3.3 square feet
Wing Flaps	241.6 square feet
Gross horizontal empennage surface	324.9 square feet
Elevators (aft of hinge line and including tabs)	86.5 square feet
Elevator trim tabs	6.84 " feet
Vertical empennage surfaces	179.3 square feet

II. Dimensions and Areas (Cont'd):

F. Areas (Cont'd)

Rudder (aft of hinge line and including tabs) - - 47.6 square feet
Rudder flying tab - - - - - - - - - - - - - - - - - - 4.75 square feet

G. Settings and Ranges of Movement of Control Surfaces

Ailerons - UP travel - - - -	15° ± 1 degree	or 7 5/8 ± 1/2 inches
Ailerons - DOWN travel - - -	11½° ± 1 degree	or 5 7/8 ± 1/2 inches
Wing Flaps - DOWN travel - -	45° ± 2 degrees	or 32 3/16 ± 7/16 inches
Elevators - UP travel - - - -	25° ± 1 degree	or 18 7/16 ± 3/4 inches
Elevators - DOWN travel - - -	15° ± 1 degree	or 11 3/16 ± 3/4 inches
Rudder - LEFT travel - - - -	20° ± 1 degree	or 17 13/16 ± 7/8 inches
Rudder - RIGHT travel - - - -	20° ± 1 degree	or 17 13/16 ± 7/8 inches

H. Trim Tabs

Elevator tab-UP travel - - -	15° ± 1½ degrees	or 2 1/4 ± 1/4 inches
Elevator tab-DOWN travel - -	15° ± 1½ degrees	or 2 1/4 ± 1/4 inches
Rudder tab - LEFT travel - - (rudder neutral)	20° ± 1½ degrees	or 3 7/16 ± 9/32 inches
Rudder tab - RIGHT travel - - (rudder neutral)	20° ± 1½ degrees	or 3 7/16 ± 9/32 inches
Aileron tab-UP travel - - - -	15° ± 1 degree	or 1 3/4 ± 1/4 inches
Aileron tab-DOWN travel - - -	15° ± 1 degree	or 1 3/4 ± 1/4 inches

I. Main Landing Gear

Type - - - - - - - - - - - - - -	Two individual, hydraulically-retractable, single shock strut, dual wheel units
Tread - - - - - - - - - - - - - -	27 feet, 5/8 inch (outboard wheels, center to center)
Shock strut - - - - - - - - - -	Cleveland oleopneumatic
Tires - - - - - - - - - - - - - -	15.50 x 20 12 ply rating
Wheels - - - - - - - - - - - - -	Goodyear 17.00 x 20 magnesium
Brakes - - - - - - - - - - - - -	Goodyear hydraulic disc type, 2 units per wheel

J. Nose Wheel Gear

Type - - - - - - - - - - - - - -	Steerable, hydraulically-retractable, single shock strut, single wheel unit

II. Dimensions and Areas (Cont'd)

J. Nose Wheel Gear (Cont'd)

Shock strut - - - - - - - - - - - Cleveland oleopneumatic
Wheel - - - - - - - - - - - - - - Goodyear magnesium
Tire - - - - - - - - - - - - - - - 44 inch, 10 ply rating

K. Tail Skid

Type - - - - - - - - - - - - - - - Hinged, streamlined, with single strut and telescoping fairings
Maker - - - - - - - - - - - - - - Douglas Aircraft Co., Inc.

L. Propellers

Manufacturer and type - - - - - Hamilton Standard, 23E50 hydromatic 3 blade
Hub - - - - - - - - - - - - - - - 23E50-505
Blades - - - - - - - - - - - - - - 6519A-12
Diameter - - - - - - - - - - - - - 12 feet, 1 inch
Governor - - - - - - - - - - - - - 5G8-A-30M, electric head
Pitch Settings:
- Low - - - - - - - - - - - - - - 21 degrees (maximum Range)
- High - - - - - - - - - - - - - - 93 degrees (maximum Feathering Range)
- Low - - - - - - - - - - - - - - 21 degrees (Governing Range)
- High - - - - - - - - - - - - - - 49 degrees (Governing Range)

The Operating Limitations below must be observed as such observance is required by the Civil Aeronautics Administration when operating the DC-4 airplane.

I. General Specifications

Fuel	Grade 100/130
Oil Capacity	20 Gal. in each inboard nacelle 150 lb. each 20 Gal. in each outboard nacelle 150 lb. each.
Datum	3" aft of nose
Mean Aerodynamic Chord	163.6 inches
Loading Edge of Mean Aerodynamic Chord	355.2 inches aft of datum (Station 355.2)
Leveling Means	Leveling brackets are located in the nose wheel well and aft of the rear belly cargo compartment.
C. G. Limits	Landing (Gear extended) 16% MAC (Station 381.4) and 32% MAC (Station 407.6) Flight (Gear Retracted) 50,000 lb. gross weight 13.6% MAC (Station 377.5) and 29.6% MAC 68,000 lb. gross weight 14.3% MAC (Station 378.6) and 30.3% MAC (Station 404.8) (At intermediate weights, use straight line variation)
NOTE:	Load the airplane in accordance with the approved loading schedule.
Control Surface Movement	Rudder Left or Right 20 degrees; Elevator up 25 degrees, down 15 degrees; Flaps down 45 degrees.

II. Weight Specifications

Maximum Take-off Weight (With Dump Valves)	70,000 lb.
Maximum Landing Weight	61,600 lb.

With authorized weight in excess of maximum landing weight, landing shall not be made except in accordance with CAR 61.310. Fuel shall not be dumped except in accordance with CAR 61.310 and with flaps retracted, and then only if the pilot deems it safer than landing at a weight in excess of maximum landing weight.

NOTE: The Civil Air Regulations authorize the first pilot, in emergency situations which require immediate decision and action, to resolve upon a course of action which is required by the factors and information available to him. He may, in such situations, deviate from prescribed methods, procedures, or minimums to the extent required by considerations of safety. When such emergency authority is exercised, the pilot shall, to the extent possible, keep the proper control station fully informed regarding the progress of the flight. He shall submit a written report of any such deviation to the Vice President - Operations. The Vice President - Operations shall furnish a copy of such report, with his comments, promptly to the Administrator.

III. Center of Gravity

The airplane must be loaded in accordance with approved charts and data.

A. The maximum forward center of gravity position for operation is 14 per cent of the mean aerodynamic chord, wheels up position.

B. The maximum aft center of gravity position for operation is 32 per cent of the mean aerodynamic chord, wheels up position and 32 per cent of the mean aerodynamic chord, wheels down position.

IV. Power Plant

The air-cooled radial, single-row, 9-cylinder Wright Cyclone R1820 - C9HD engines are geared down 16:9 to drive the 12-foot 1-inch Hamilton Standard Hydromatic propeller and pre-equipped with a PD-12K-10 Stromberg metering type carburetor.

IV. POWER PLANT (Cont'd)

A. General Specifications

Type	9 cylinder, single row
Bore	6.125"
Stroke	6.875"
Displacement	1823 Cu. in.
Compression Ratio	6.80:1
Supercharger Ratio	7.21:1
Impeller Diameter	11.40"
Propeller Shaft Spline Size	SAE 50
Fuel	Grade 100/130

B. Accessories

Magneto	Scintilla SF9LN-4
Carburetor	Stromberg PD-12-K10
Starter	JH6FR12

C. Ratings

CONDITION	BHP	RPM	ALTITUDE IN FEET	IN.HG MANIFOLD PRESSURE
LOW IMPELLER GEAR RATIO	7:21:1			
Take-off (5 Min.)	1425	2700	Sea Level	51.5
Normal Rated Power	1275	2500	Sea Level	46.5
Normal Rated Power	1275	2500	3500	45.5

D. Specifications

Maximum permissible cylinder head temperatures 260°C

Maximum permissible oil inlet temperatures 103°C

Fuel Pressure
Allowable Range 19-21 psi

IV. POWER PLANT (CONT'D)

D. Specifications (Cont'd)

Oil Pressure		
Maximum	75 psi	
Minimum	65 psi	
Minimum Idling	15 psi	
Oil Temperature		
Desired	85°C	
Take-off and Climb	104°C	
Maximum Continuous	103°C	
Cylinder Head Temperature	232°C	Maximum for ground operation

E. Propellers

The propellers are three-blade type Hamilton Standard Hydromatic propellers equipped with a 23E50 hub and 6519A-12 blades.

	DEGREES OF PITCH
Low Pitch Setting	21°
High Pitch Setting	93°
Constant Speed Range	21° - 49°

F. Oil

Use oil of Grade 120

V. SPEEDS

All speeds listed in this manual are true indicated airspeeds. See charts for airspeed indicator calibration.

A. Limitations (MPH Indicated)

Maximum Level Flight Speed	See Chart (Section 15.00)
Maximum Glide or Dive Speed	See Chart (Section 15.00)

V. SPEEDS (Cont'd)

Maximum speeds at which use of flaps is permissible	202 MPH-20° flaps 158 MPH-30° flaps 154 MPH-45° flaps
Maximum speed with landing gear extended	180 MPH
Maximum speed at which fuel may be dumped	220 MPH
Minimum speed at which airplane is controlable in flight with engine failure (propeller idling, other three engines at take-off power, flaps in take-off position, landing gear up) except at weight where stalling speed is higher	95 MPH
Minimum take-off climb speed (V_2)	115 to 70,000 pounds
Design Maneuvering Speed	188 to 70,000 pounds

B. Demonstration Speeds

The performance data shown in this manual is based on the following speeds:

	MPH TIAS
Climb Speed: Flaps up (maximum continuous power climb)	138
Climb Speed: Flaps in approach position (one engine inoperative, propeller feathered)	117
Climb Speed: Flaps in take-off position (one engine inoperative, propeller windmilling)	115 to 70,000 pounds
Climb Speed: Flaps in landing position (all engines operative)	101
For critical engine failure speed	See Chart (Section 15.00)

VI. Crew

A. C.A.A. approved.
   1. Minimum
      a. Pilot
      b. Co-Pilot

B. RESORT [redacted] Air Lines INC.
   1. Captain (Pilot)
   2. First Officer (Co-Pilot)

VII. Flaps

The performance shown in this manual is based on the following flap positions:

Take-off	15°
Approach	30°
Landing	45°
Enroute Operation	0°

These positions were used regardless of gross weight or altitude.

VIII. Taxiing

There are no special limitations on taxiing this airplane, with the exception that sharp turns at high speeds should be avoided to prevent fuel spillage through vents. Brakes should not be used for taxiing.

IX. Critical Cross-Wind Operation

The airplane was demonstrated to be satisfactory for landings and take-offs in direct cross-winds up to 30 mph where wind speeds were measured at the control tower, which was 50 feet above field level.

X. Instrument Limit Markings

Green arc - - - - - - - - - - - - - - - - - Normal operating range.

Red radial line - - - - - - - - - - - - - - Maximum or minimum limits.

White arc - - - - - - - - - - - - - - - - - Index mark on flap operating range.

Yellow - - - - - - - - - - - - - - - - - - Cautionary range.

XI. Explanation & Use of the Speed & Load Factor Chart

These curves are cross plots of five variables:

1. Airplane gross weight
2. Permissible indicated level flight speed
3. Permissible indicated gliding speed
4. Weight of fuel in the wing tanks
5. Ultimate wing load factor

They are so arranged that if any two of these quantities are known, the other three may be readily determined.

These curves are based on the following system of fuel loading:

1. All fuel will be loaded symmetrically about the airplane centerline.
2. In loading any fuel weight less than 11,772 lbs. (1,962 gals.), it may be distributed between the inboard and outboard main tanks.
3. In loading any fuel weight over 11,772 lbs. (1,962 gals.), it may be distributed between the inboard and outboard auxiliary tanks in any manner desired.
4. The fuel must be used symmetrically about the centerline of the airplane and in an order the reverse of that given above for loading.

The boundary conditions, or limiting operating conditions, of the speed and load factor chart, noted in a clockwise direction are as follows:

1. Zero wing fuel.
2. Maximum level flight speed.
3. Maximum allowable gross weight under operational limitations.
4. The airplane must be so loaded and handled that it may be able, at all times, to satisfactorily withstand an ultimate wing load factor of at least 3.75.

XII. Explanation of the Term "Load Factor"

When an airplane is accelerated in any direction, all parts of the plane experience inertia forces in the opposite direction. The "load factor" expresses the ratio of these inertia loads to the normal pull of gravity. For example, a load factor of 3.0 means that the airplane and its parts have inertia forces acting on them equal to three times their normal weights; or a 100-lb. object actually weighs 300 lbs. under a 3.0 load factor. The "maximum load factor made good" is the maximum value which the airplane can safely withstand under given loading conditions. The "absolute maximum load factor" is the largest value which the airplane can safely withstand under any conditions.

The "limit load factor" is, in all cases, the maximum value at which the airplane can safely operate under the conditions stipulated without parts of the structure yielding; i.e., stretching so far that they will not come back to their original shape after the load is reduced to normal. The "ultimate load factor" is that value which, if exceeded, will cause parts of the airplane to actually break; it is by definition 1.50 times the limit value.

In the chart prepared for this purpose all values of load factor are ultimate values; and they all refer to vertical acceleration in which the airplane accelerates upward and the inertia loads act down.

The following examples demonstrate specific applications of the chart:

Example 1 - The gross weight at take-off is predetermined. What is the minimum amount of fuel required in the wing tanks and the maximum speeds permissible with this amount of fuel?

For a take-off gross weight of 64,000, the origin is at point (A). Enter the chart at this point and rise vertically to intersect the 3.75 load factor line. The minimum weight of wing fuel required is 6,000 lbs. (approx. 1,000 gallons). Proceed horizontally to the speed scales, the maximum permissible level flight speed is 228 mph and the maximum permissible gliding speed is 274 mph.

Example 2 - The amount of fuel required for a particular flight is known; what are the maximum take-off gross weight and flight speeds permissible?

The fuel required is, for example, 3,000 lbs. In accordance with the loading instructions, the origin is now point (B). Descend vertically to the G.W. Scale and horizontally to the speed scales. The maximum T.O. gross weight is 61,000 lbs.; the maximum permissible level flight and glide speeds are 218 and 262 mph, respectively.

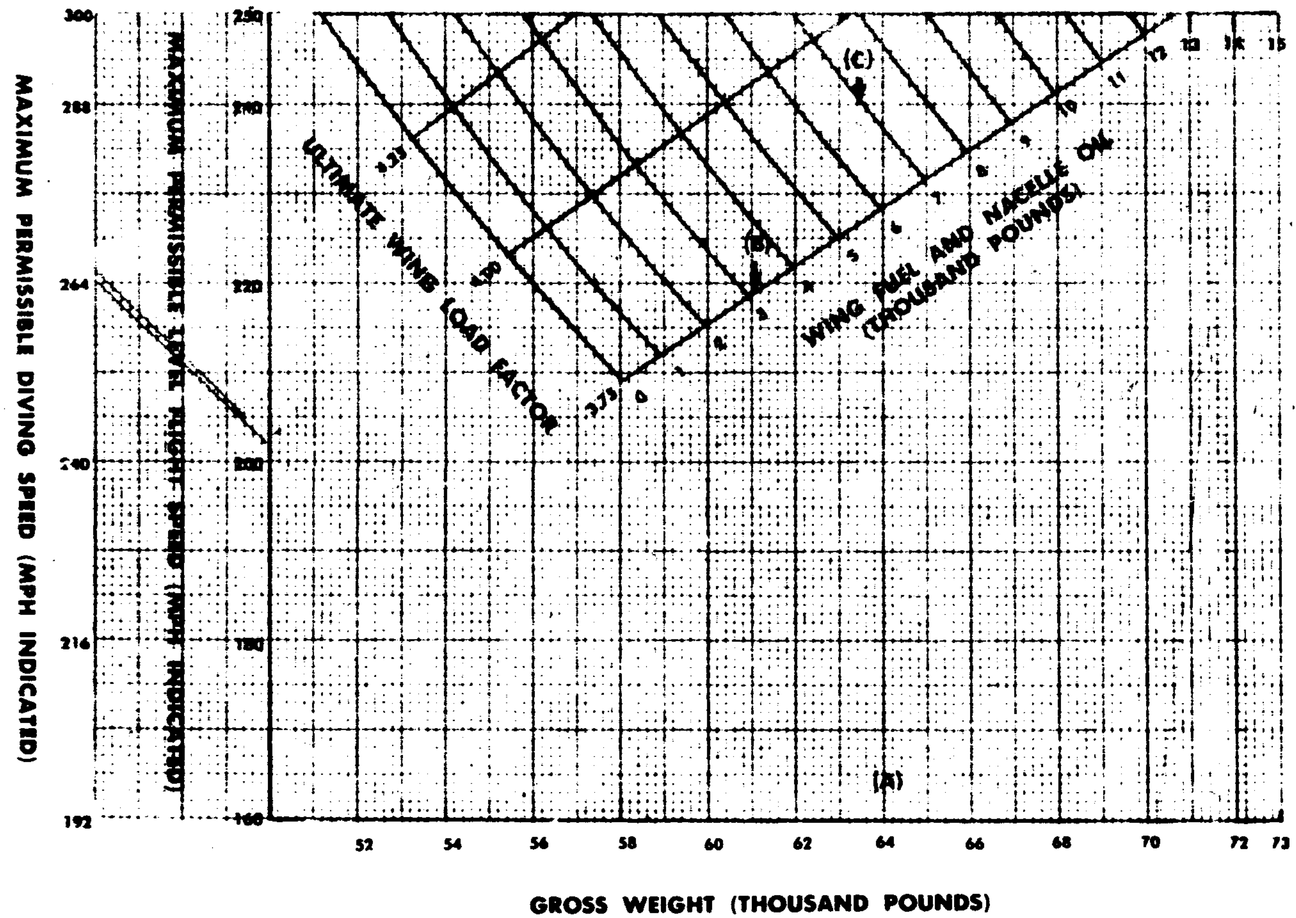
XII. Explanation of the Term "Load Factor" (Cont'd)

Example 3 - Having determined the minimum wing fuel or maximum T.O. gross weight in accordance with Examples 1 or 2; what are the maximum permissible speeds at any instant during flight, and what maximum ultimate load factor may the airplane be expected to withstand at this instant? First, it is necessary to determine the instantaneous gross weight. This may be computed by the following formula:

Inst. G.W. = G.W. at T.O. - total fuel in airplane at T.O. + total fuel remaining in airplane.
(For conversion, 1 gallon = 6 lbs.)

For instantaneous G.W. of 63,500 lbs. and 7,000 lbs. of fuel in the wing tanks, the origin is point (C). The maximum permissible speeds are 240 and 288 mph for level flight and gliding, respectively. The ultimate load factor is approximately 3.85.

Attention is called to the fact that as fuel is used from the wing tanks, the permissible top speed decreases, following a constant load factor line.

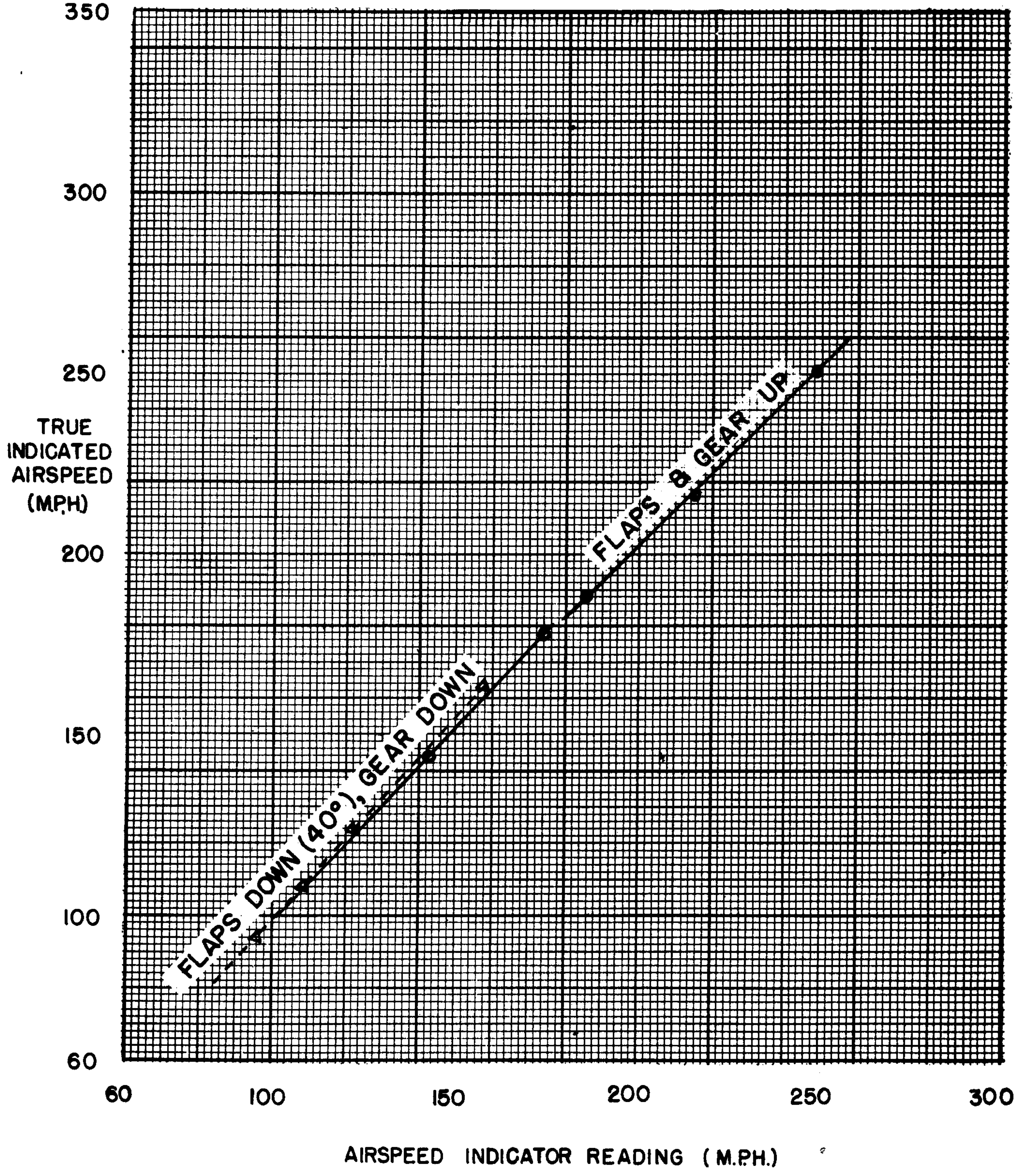


Notes:

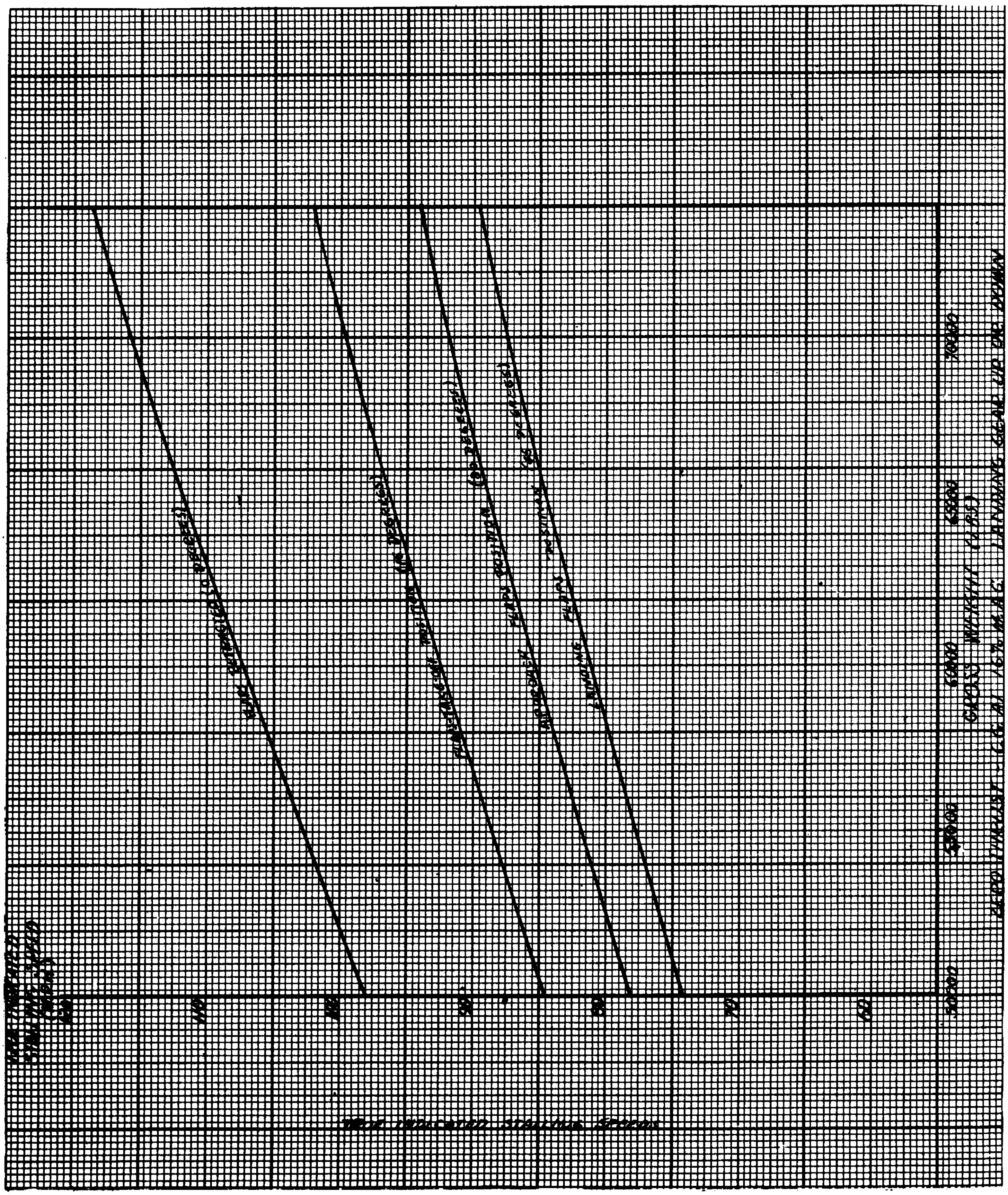
1. All weight in excess of 58,000 pounds must consist of fuel and usable nacelle tank oil (at 20 gallons per tank).
2. All fuel will be loaded symmetrically about the airplane center line.
3. In loading any fuel of less than 12,036 pounds (2006 gallons) in weight, it will be equally distributed between the inboard and outboard main tanks.
4. In loading any fuel over 12,036 pounds (2006 gallons) in weight, fill the outboard auxiliaries to capacity first, then fill the inboard auxiliaries with balance of fuel.*
5. The fuel must be used symmetrically about the center line of the airplane, emptying the auxiliaries first in any sequence, then emptying all 4 main tanks simultaneously.

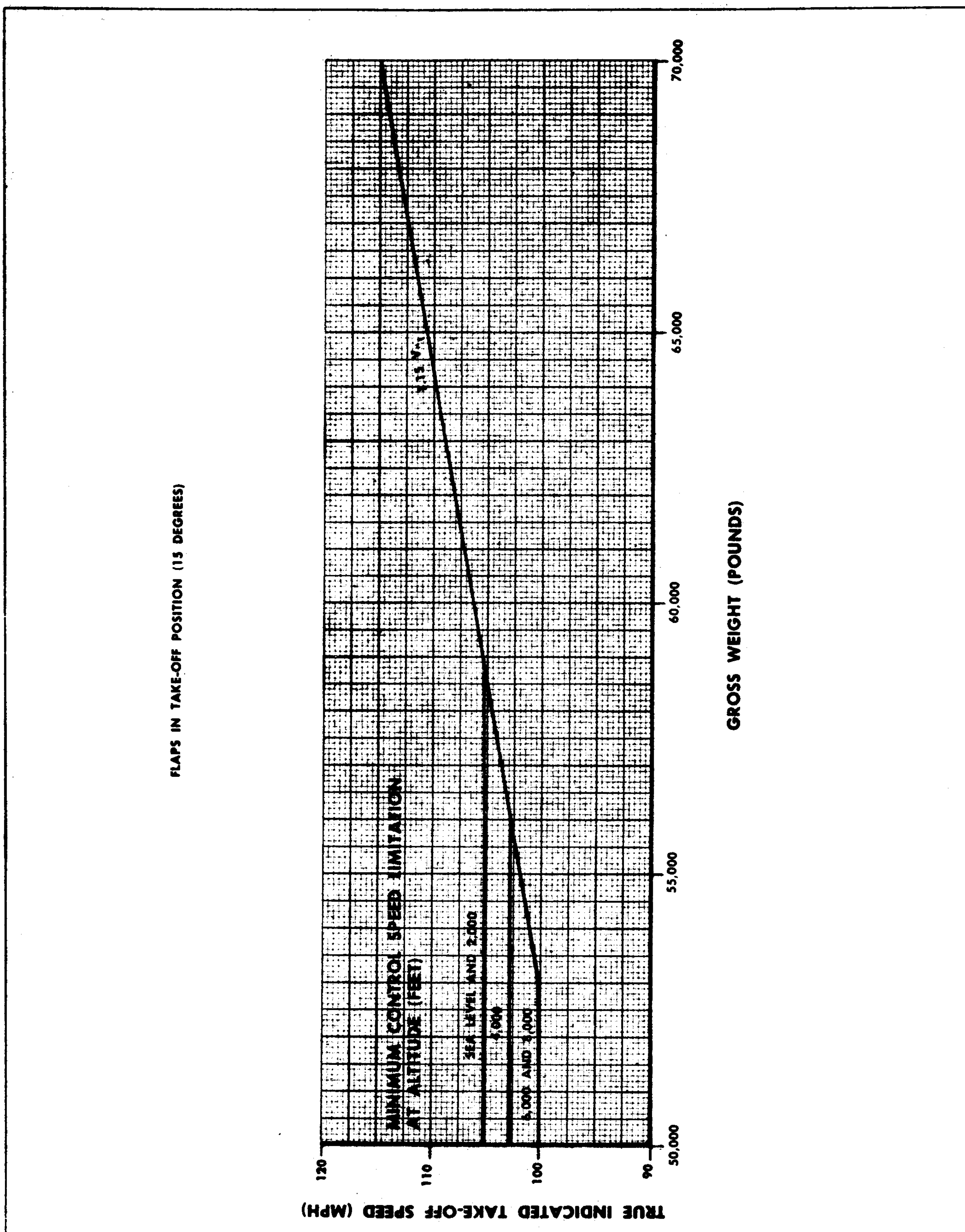
*If, for any reason, it is desired to fuel the inboard auxiliary tanks before the outboard auxiliaries, it is permissible to do so. However, the gross weight of the airplane may be increased above 58,000 pounds by *only* the weight of fuel in the main tanks and the outboard auxiliaries and the nacelle oil tanks (up to a maximum gross weight of 70,000 pounds). Any fuel in the inboard auxiliary tanks must be considered to be the same as cabin load; that is, its weight must be included in the zero fuel and nacelle tank oil weight.

Figure 1 – Speed and Load Factor Chart – Curve III

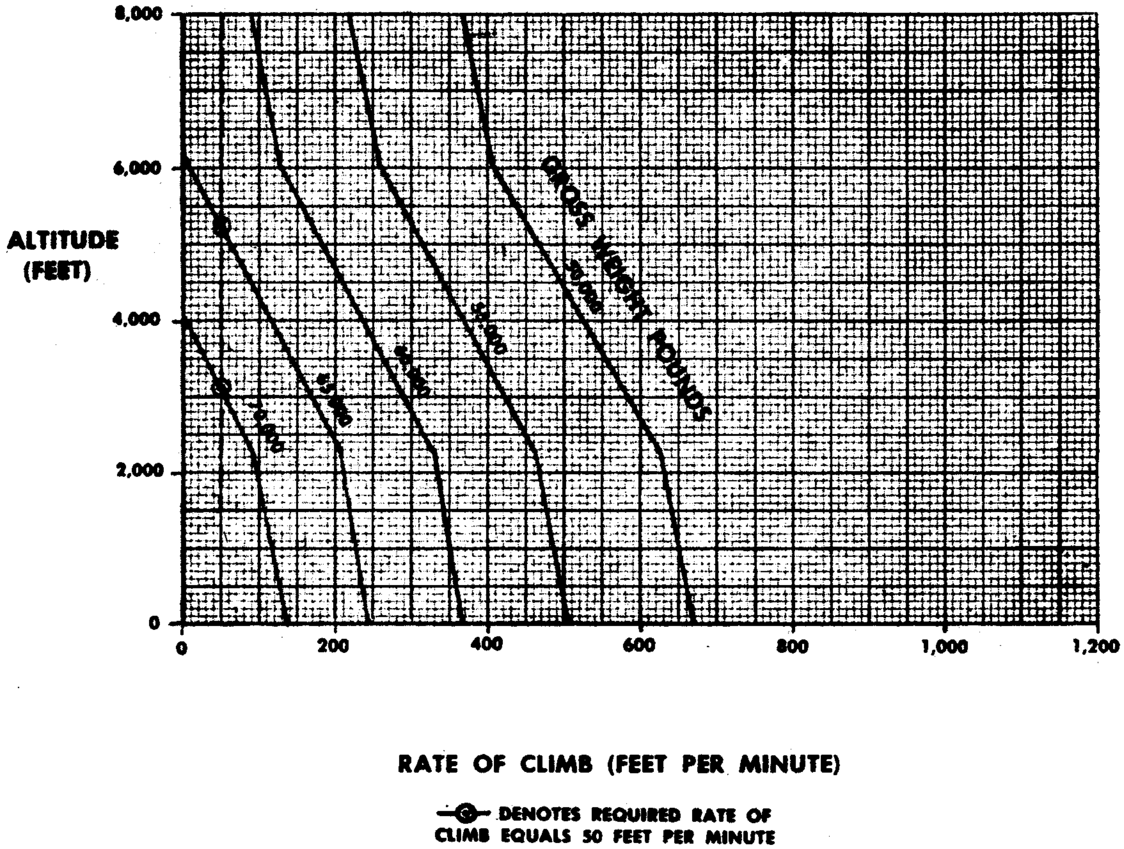


AIRSPEED CALIBRATION


GROSS WEIGHT (LBS)
TRUE INDICATED STALLING SPEEDS



True Indicated Take-Off Speed



TRUE INDICATED AIRSPEED EQUALS 1.15 V_{S_1}, OR 1.10 V_{MC}, WHICHEVER IS LARGER

LANDING GEAR EXTENDED

WING FLAPS IN TAKE-OFF POSITION (15 DEGREES)

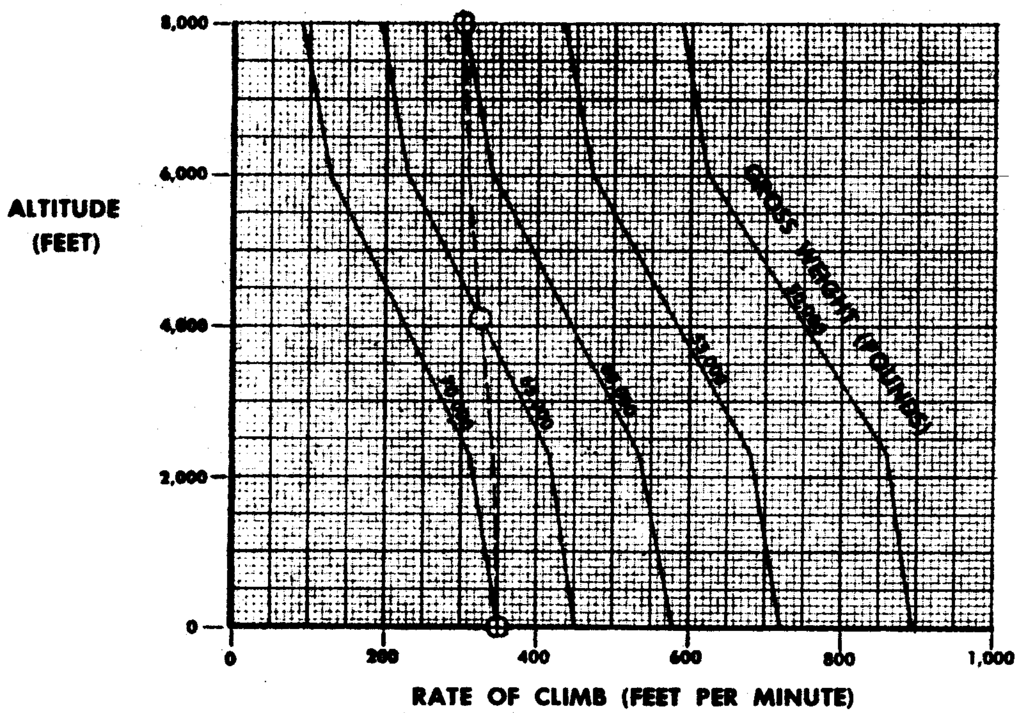
1 ENGINE INOPERATIVE, PROPELLER WINDMILLING IN LOW PITCH

3 ENGINES OPERATING AT TAKE-OFF POWER,

ALL COWL FLAPS OPEN 2 DEGREES

STANDAR' ATMOSPHERIC CONDITIONS

Climb Performance — First Segment Take-Off Configuration



—⊙— DENOTES REQUIRED RATE OF CLIMB EQUALS .035 $V^2_{S_1}$

TRUE INDICATED AIRSPEED EQUALS 1.15 V_{S_1}, OR 1.10 V_{MC}, WHICHEVER IS LARGER

LANDING GEAR EXTENDED

WING FLAPS IN TAKE-OFF POSITION (15 DEGREES)

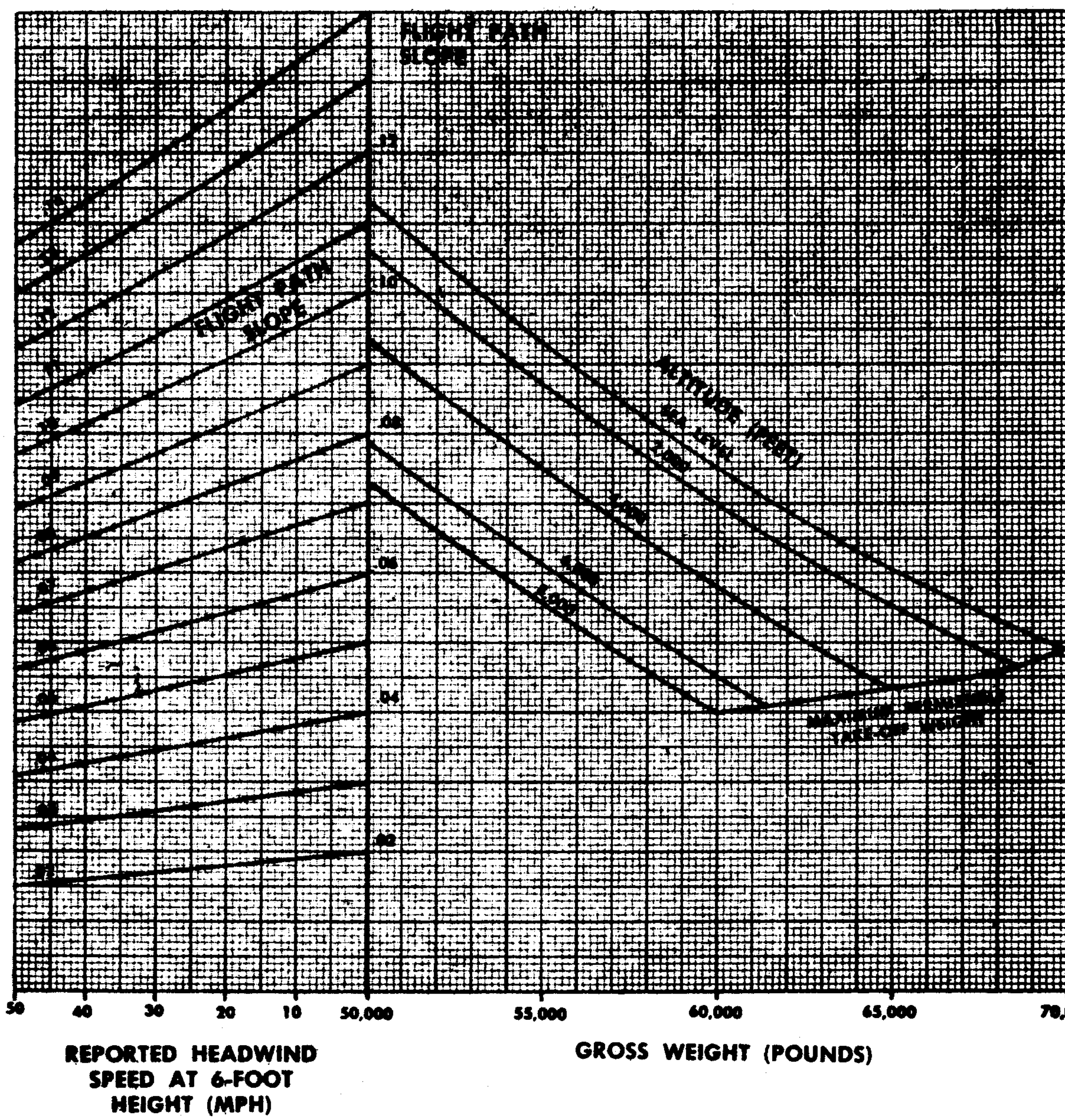
1 ENGINE INOPERATIVE, PROPELLER WINDMILLING IN LOW PITCH

3 ENGINES OPERATING AT TAKE-OFF POWER,

ALL COWL FLAPS OPEN 2 DEGREES

STANDARD ATMOSPHERIC CONDITIONS

Climb Performance — Second Segment Take-Off Configuration



TRUE INDICATED AIRSPEED EQUAL 1.15 V_{s1}
OR 1.10 V_{MC}, WHICHEVER IS LARGER

LANDING GEAR RETRACTED

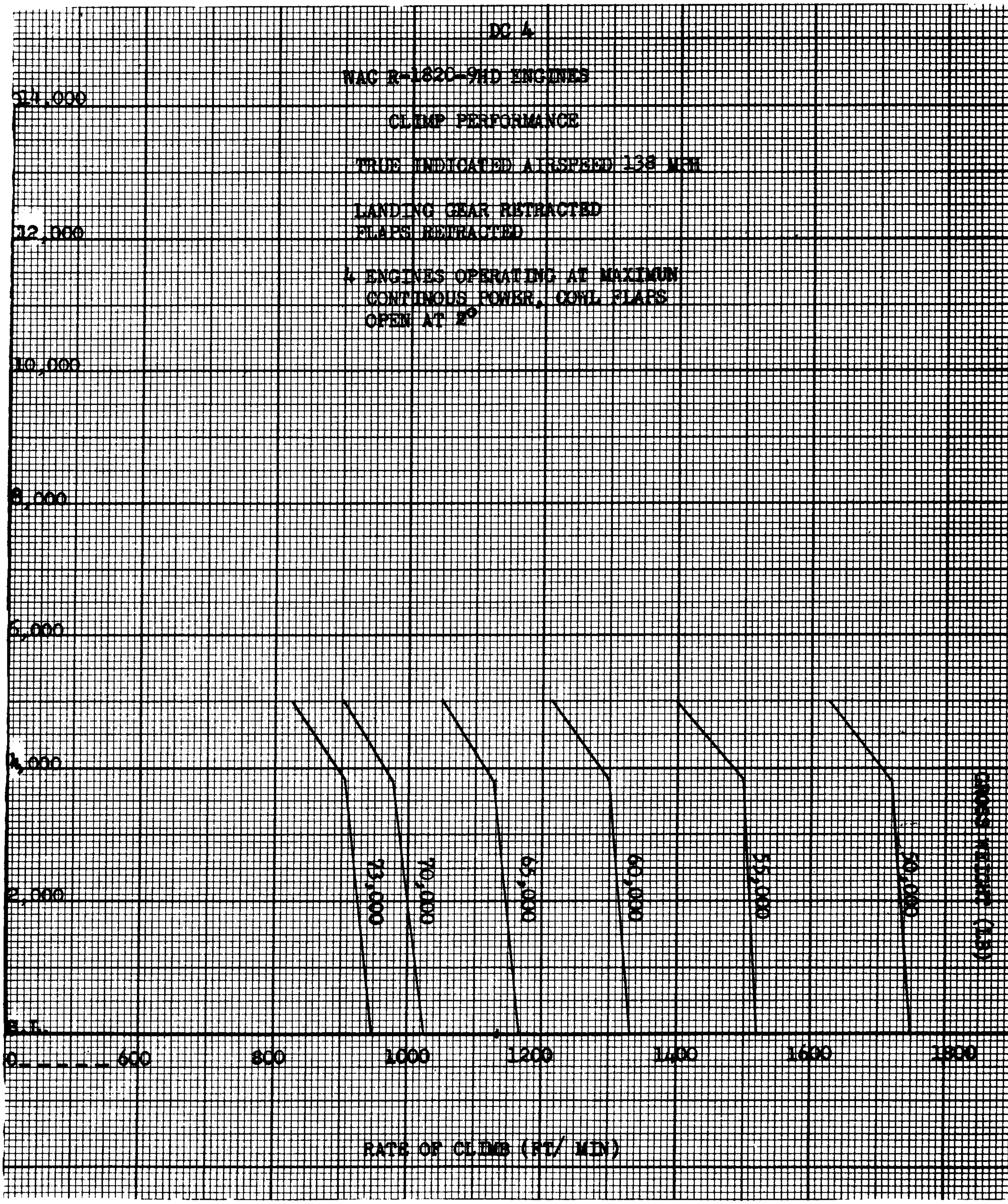
WING FLAPS IN TAKE-OFF POSITION (15 DEGREES)

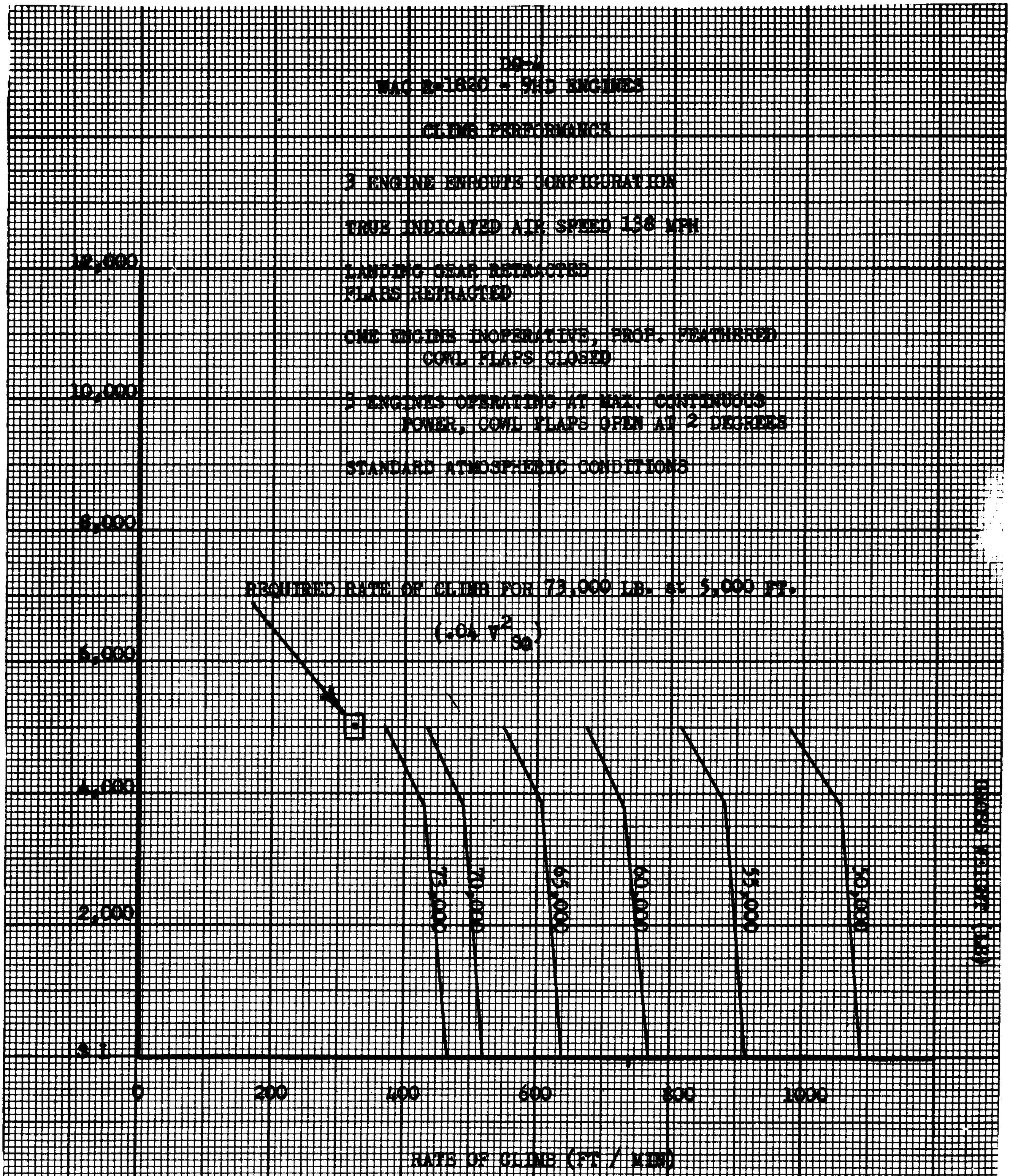
1 ENGINE INOPERATIVE, PROPELLER FEATHERED,
COWL FLAPS CLOSED

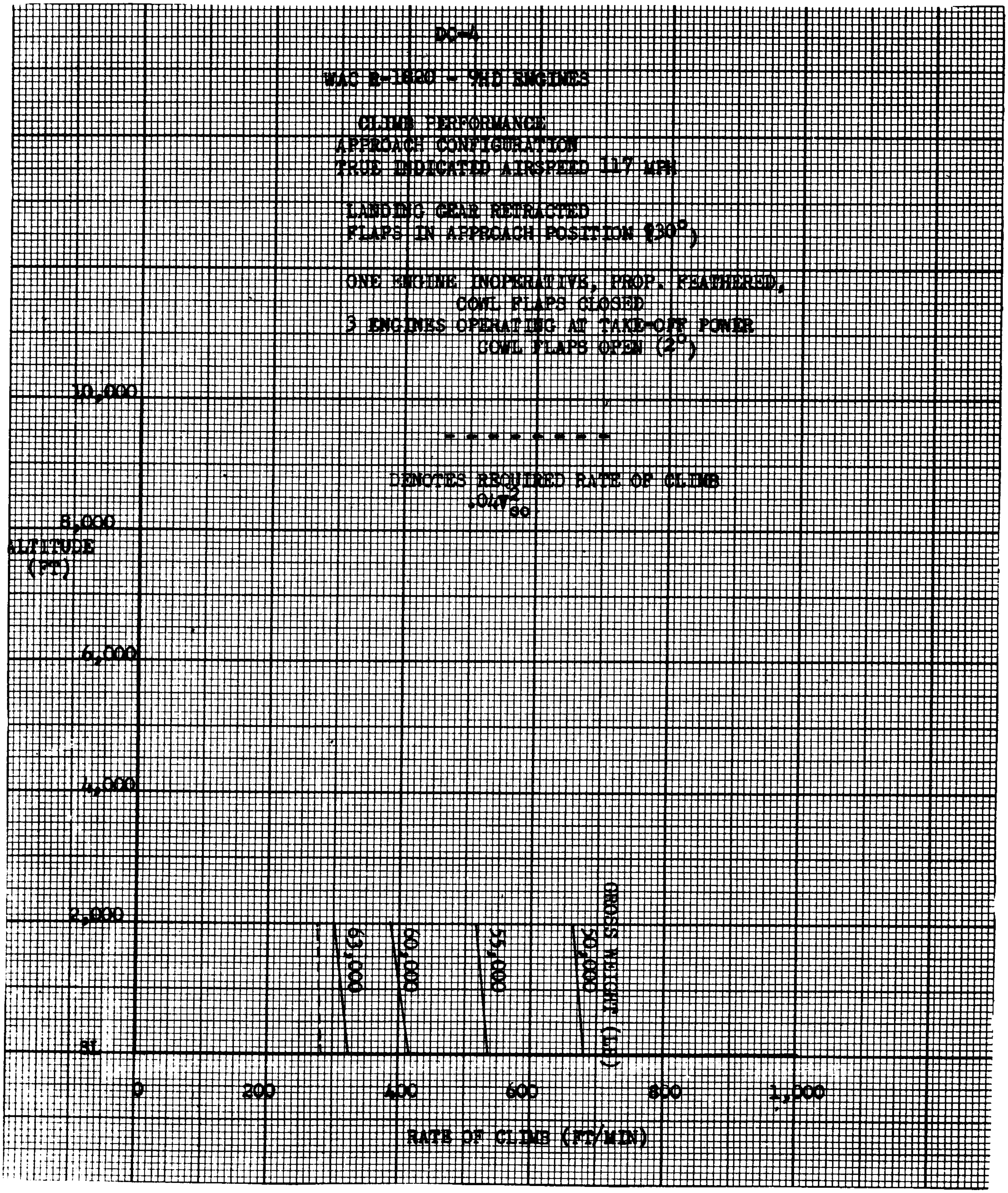
3 ENGINES OPERATING AT TAKE-OFF POWER,
COWL FLAPS OPEN 2 DEGREES

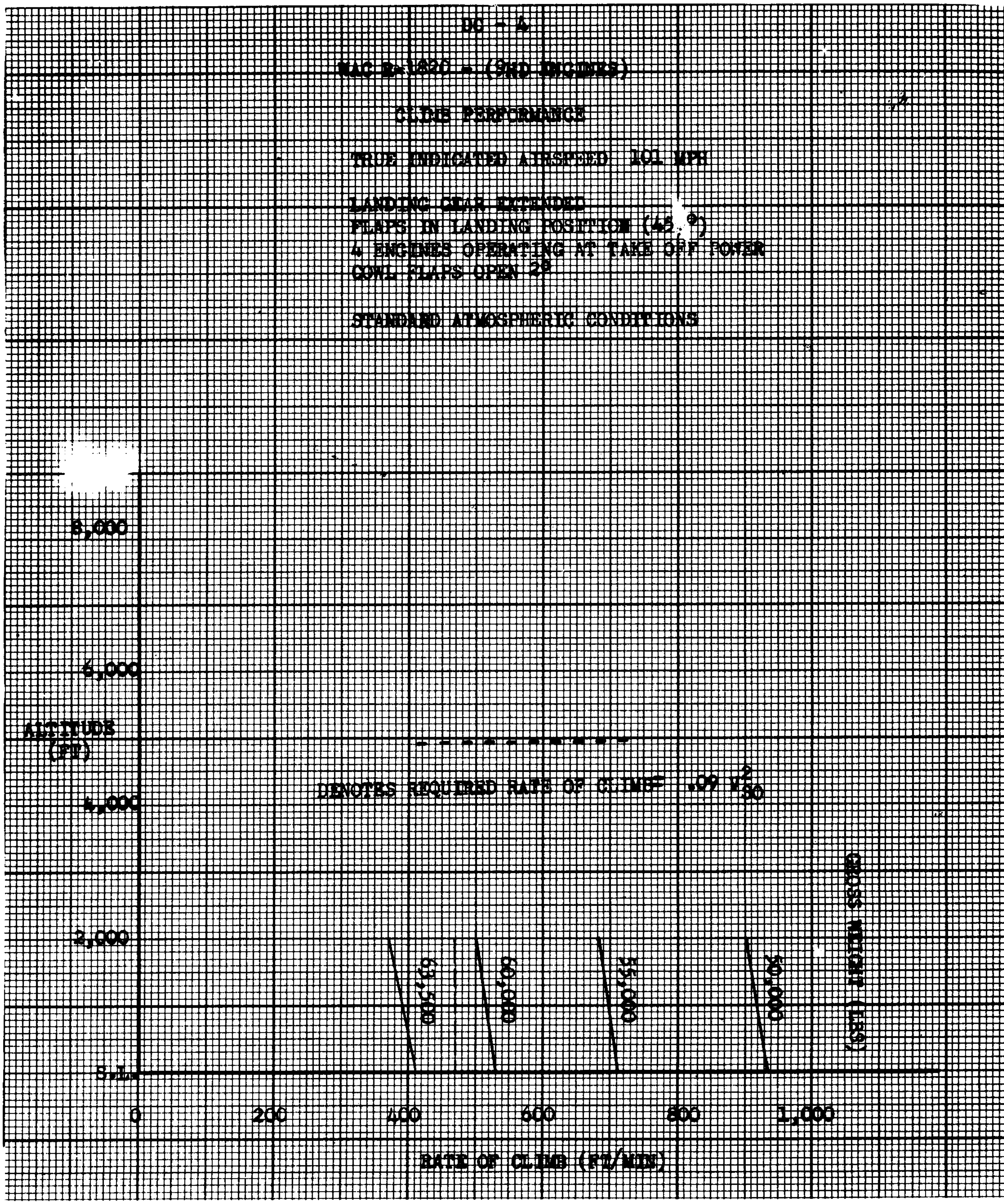
STANDARD ATMOSPHERIC CONDITIONS

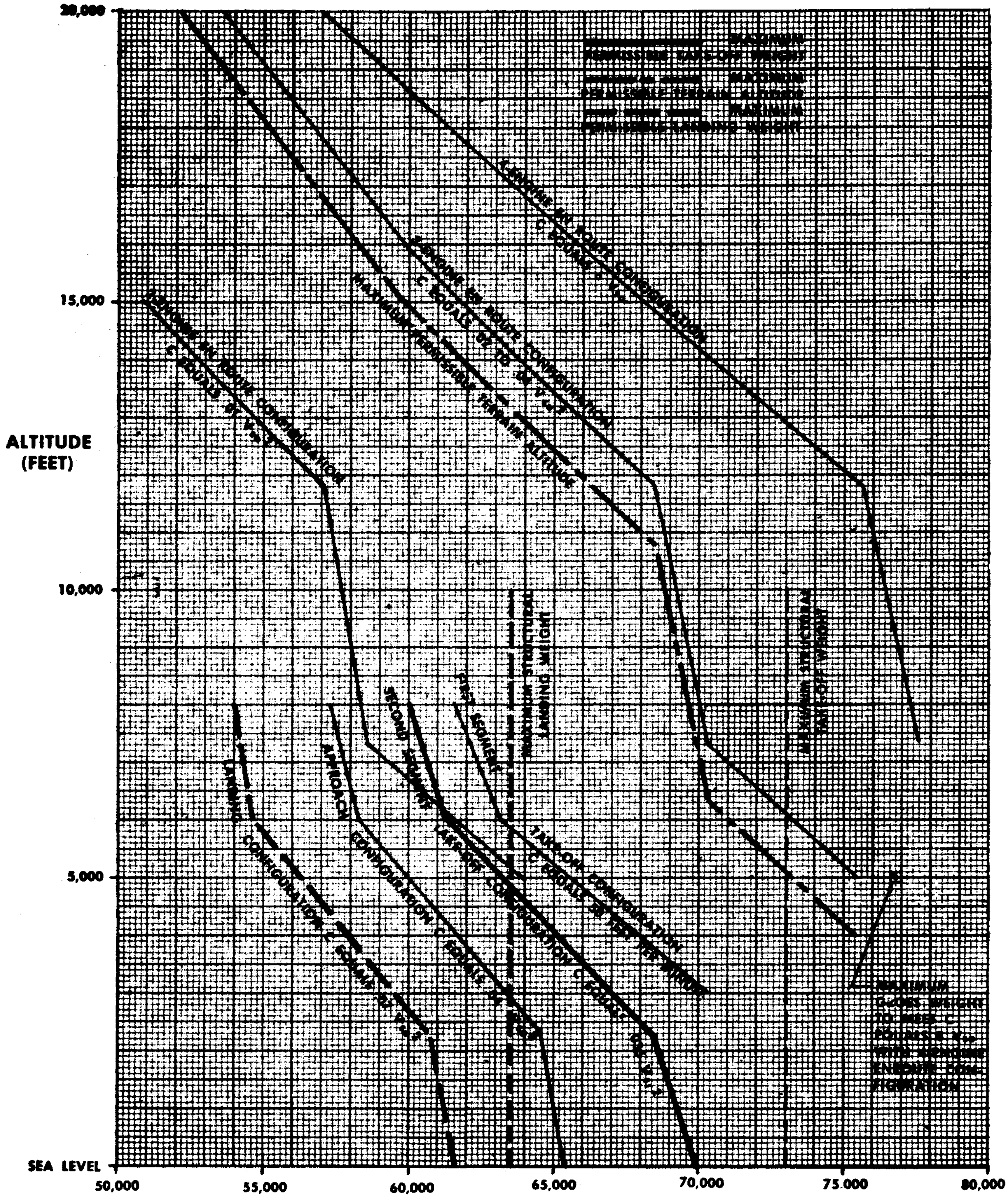
Take-Off Performance — Third Segment Take-Off Flight Path Slope


DC 4
WAC R-1820-9HD ENGINES
CLIMP PERFORMANCE
TRUE INDICATED AIRSPEED 138 MPH
LANDING GEAR RETRACTED
FLAPS RETRACTED
4 ENGINES OPERATING AT MAXIMUN CONTINOUS POWER, COWL FLAPS OPEN AT 2°
14,000
12,000
10,000
8,000
6,000
4,000
2,000
S.L.
0
600
800
1000
1200
1400
1600
1800
73,000
70,000
65,000
60,000
55,000
50,000
GROSS WEIGHT (LB)
RATE OF CLIMB (FT/ MIN)


DC-4
WAC R-1820 - 9HD ENGINES
CLIMB PERFORMANCE
3 ENGINE ENROUTE CONFIGURATION
TRUE INDICATED AIR SPEED 138 MPH
LANDING GEAR RETRACTED
FLAPS RETRACTED
ONE ENGINE INOPERATIVE, PROP. FEATHERED
COWL FLAPS CLOSED
3 ENGINES OPERATING AT MAX. CONTINUOUS
POWER, COWL FLAPS OPEN AT 2 DEGREES
STANDARD ATMOSPHERIC CONDITIONS
REQUIRED RATE OF CLIMB FOR 73,000 LB. at 5,000 FT.
(.04 V^2_{S0})
12,000
10,000
8,000
6,000
4,000
2,000
S.L.
0
200
400
600
800
1000
73,000
70,000
65,000
60,000
55,000
50,000
RATE OF CLIMB (FT / MIN)


DC-4
WAC R-1820 - 9HD ENGINES
CLIMB PERFORMANCE
APPROACH CONFIGURATION
TRUE INDICATED AIRSPEED 117 MPH
LANDING GEAR RETRACTED
FLAPS IN APPROACH POSITION (30°)
ONE ENGINE INOPERATIVE, PROP. FEATHERED, COWL FLAPS CLOSED
3 ENGINES OPERATING AT TAKE-OFF POWER COWL FLAPS OPEN (2°)
DENOTES REQUIRED RATE OF CLIMB
.04V²so
ALTITUDE (FT)
10,000
8,000
6,000
4,000
2,000
SL
63,000
60,000
55,000
50,000
GROSS WEIGHT (LB)
0
200
400
600
800
1,000
RATE OF CLIMB (FT/MIN)


DC - 4
CLIMB PERFORMANCE
TRUE INDICATED AIRSPEED 101 MPH
LANDING GEAR EXTENDED
FLAPS IN LANDING POSITION (45 °)
4 ENGINES OPERATING AT TAKE OFF POWER
COWL FLAPS OPEN 2°
STANDARD ATMOSPHERIC CONDITIONS
8,000
6,000
ALTITUDE (FT)
4,000
2,000
S.L.
DENOTES REQUIRED RATE OF CLIMB= .09 V_{50}^2
63,500
60,000
55,000
50,000
GROSS WEIGHT (LBS)
0
200
400
600
800
1,000
RATE OF CLIMB (FT/MIN)



Climb Performance — Maximum Permissible Operational Weights

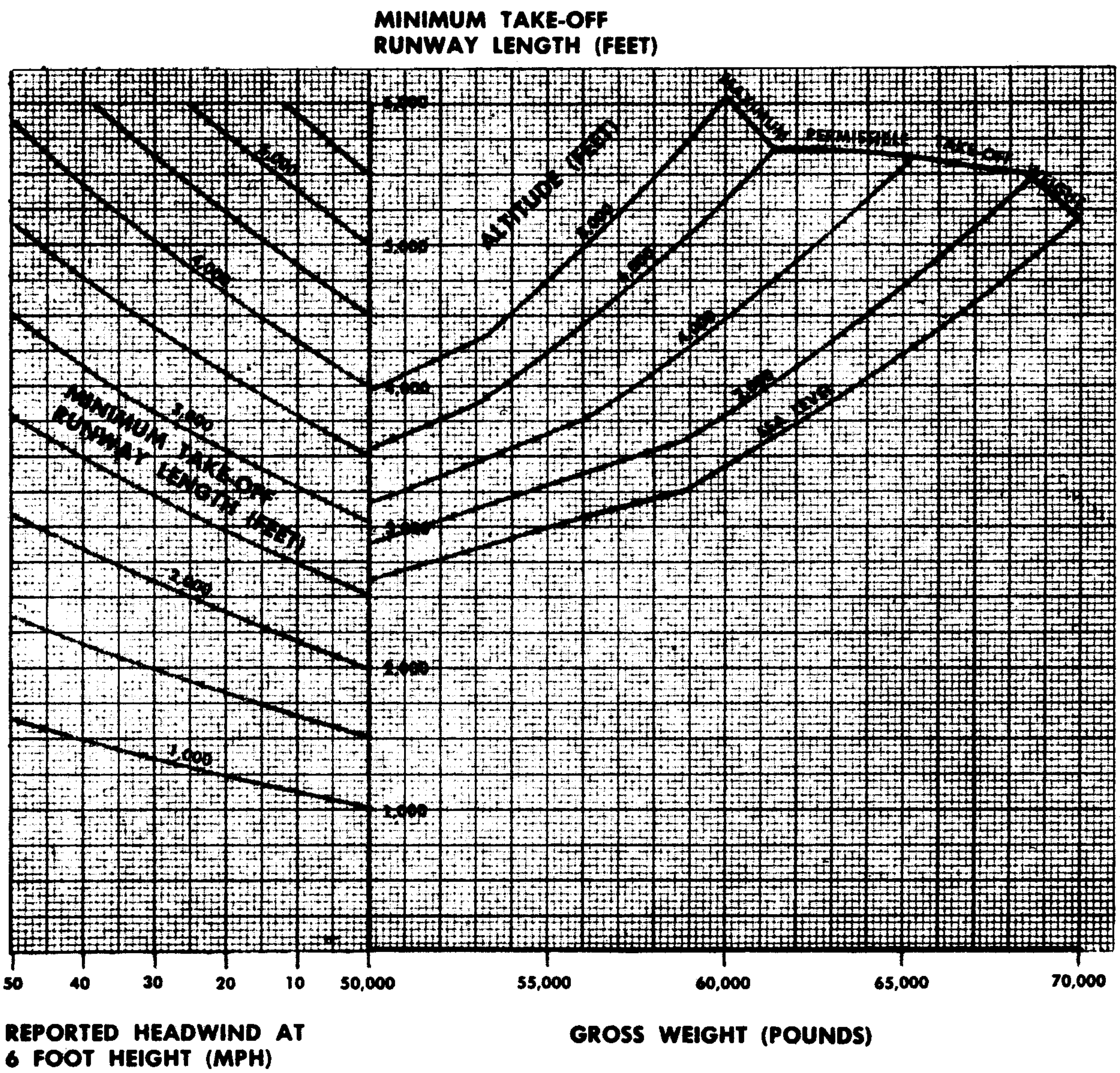
HARD SURFACE RUNWAY

NO RUNWAY SLOPE

NO OBSTACLE AT END OF RUNWAY

FLAPS IN TAKE-OFF POSITION (15 DEGREES)

STANDARD ATMOSPHERIC CONDITIONS



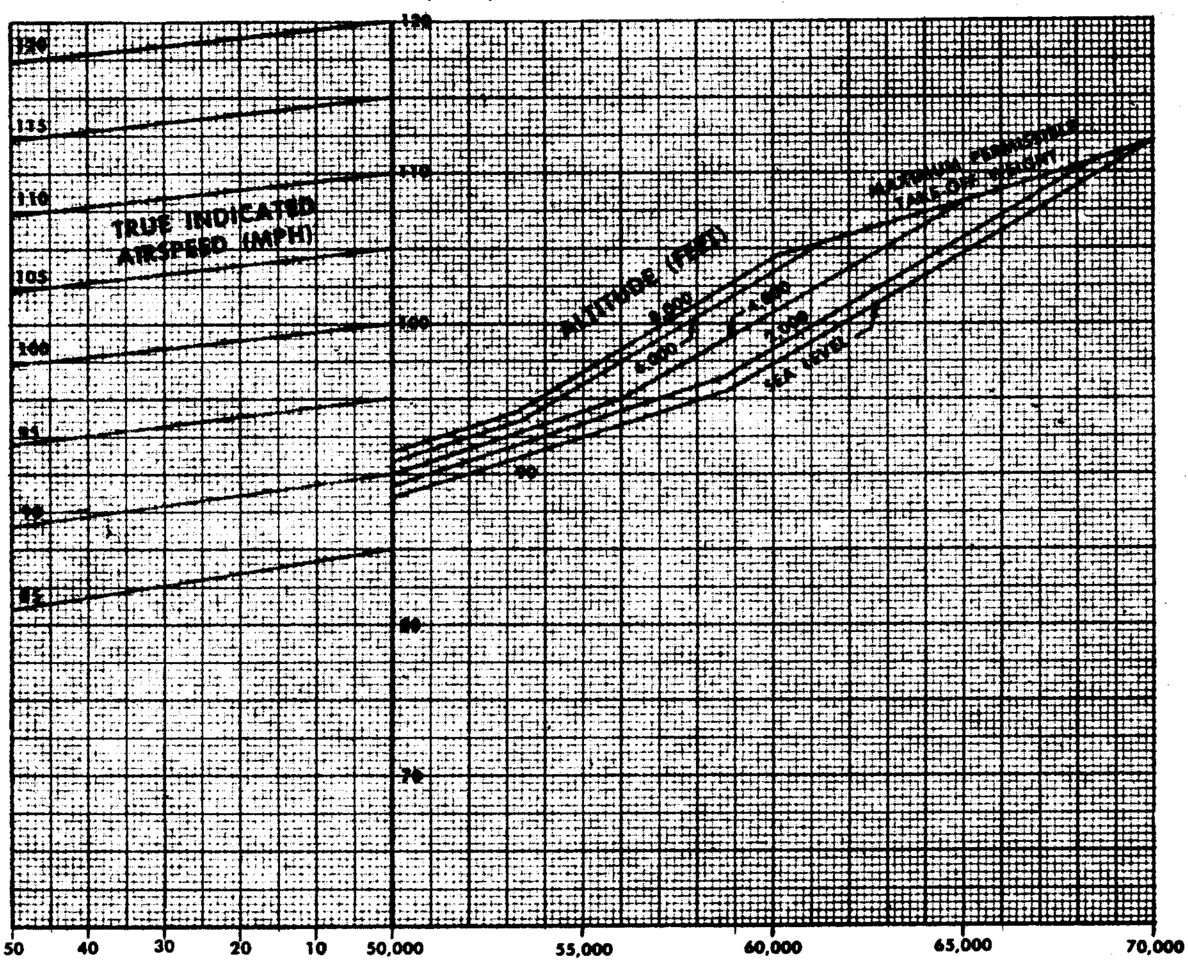
Ref. CAR 61.7122 (c)
The favorable wind used in the construction of this chart equals 50% of the reported headwind speed.

Note:

If one engine fails at critical engine failure speed, distance to stop is equal to distance to continue to 50-foot height.

Take-Off Performance — Minimum Take-Off Runway Length

TRUE INDICATED
AIRSPEED (MPH)



REPORTED HEADWIND
SPEED AT 6-FOOT
HEIGHT (MPH)

GROSS WEIGHT (POUNDS)

Note:

If one engine fails at critical engine failure speed, distance to stop is equal to distance to continue to 50-foot height.

Ref. CAR 61.7122 (c)
The favorable wind used in the construction of this chart equals 50% of the reported headwind speed.

HARD SURFACE RUNWAY

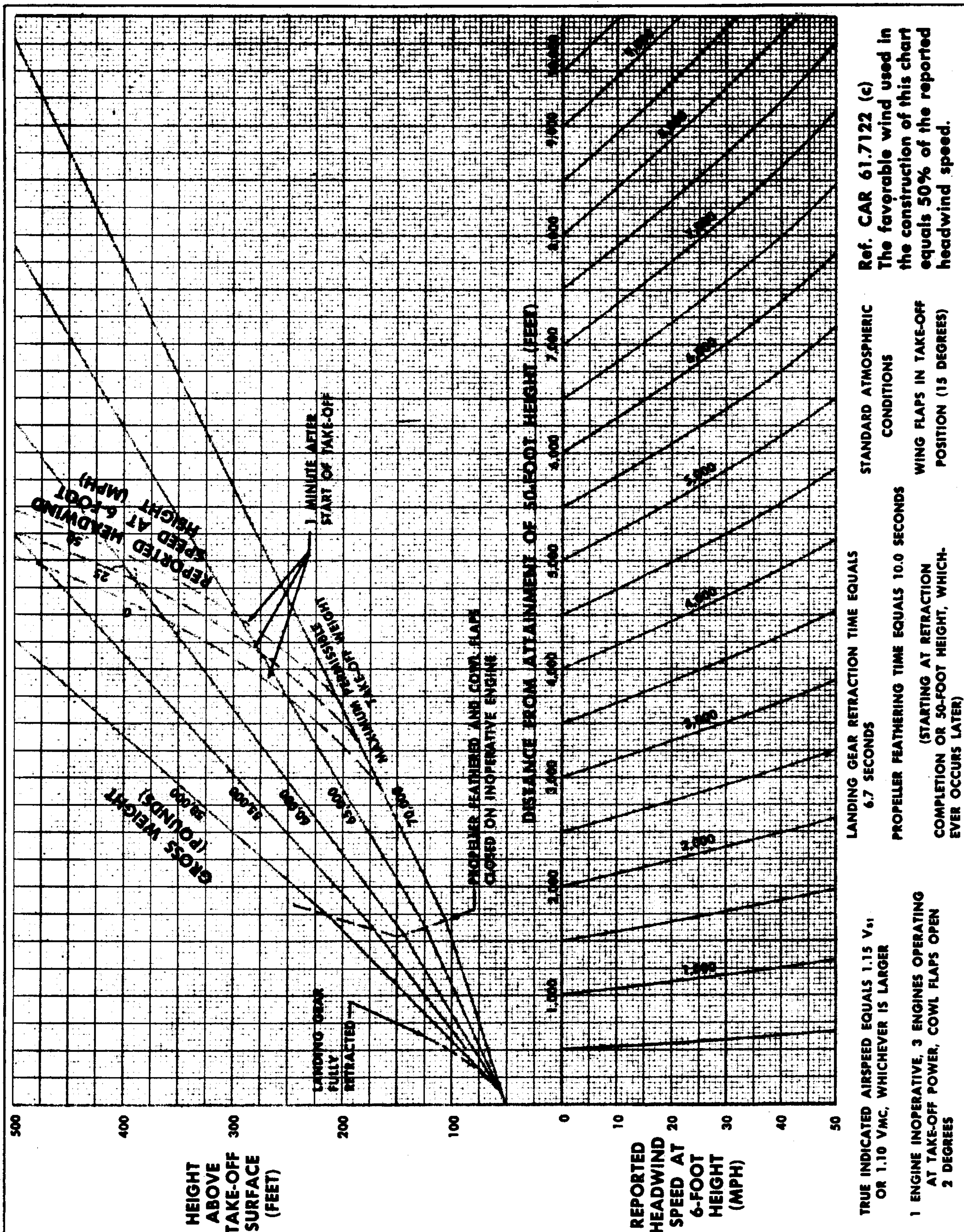
NO RUNWAY SLOPE

NO OBSTACLE AT END OF RUNWAY

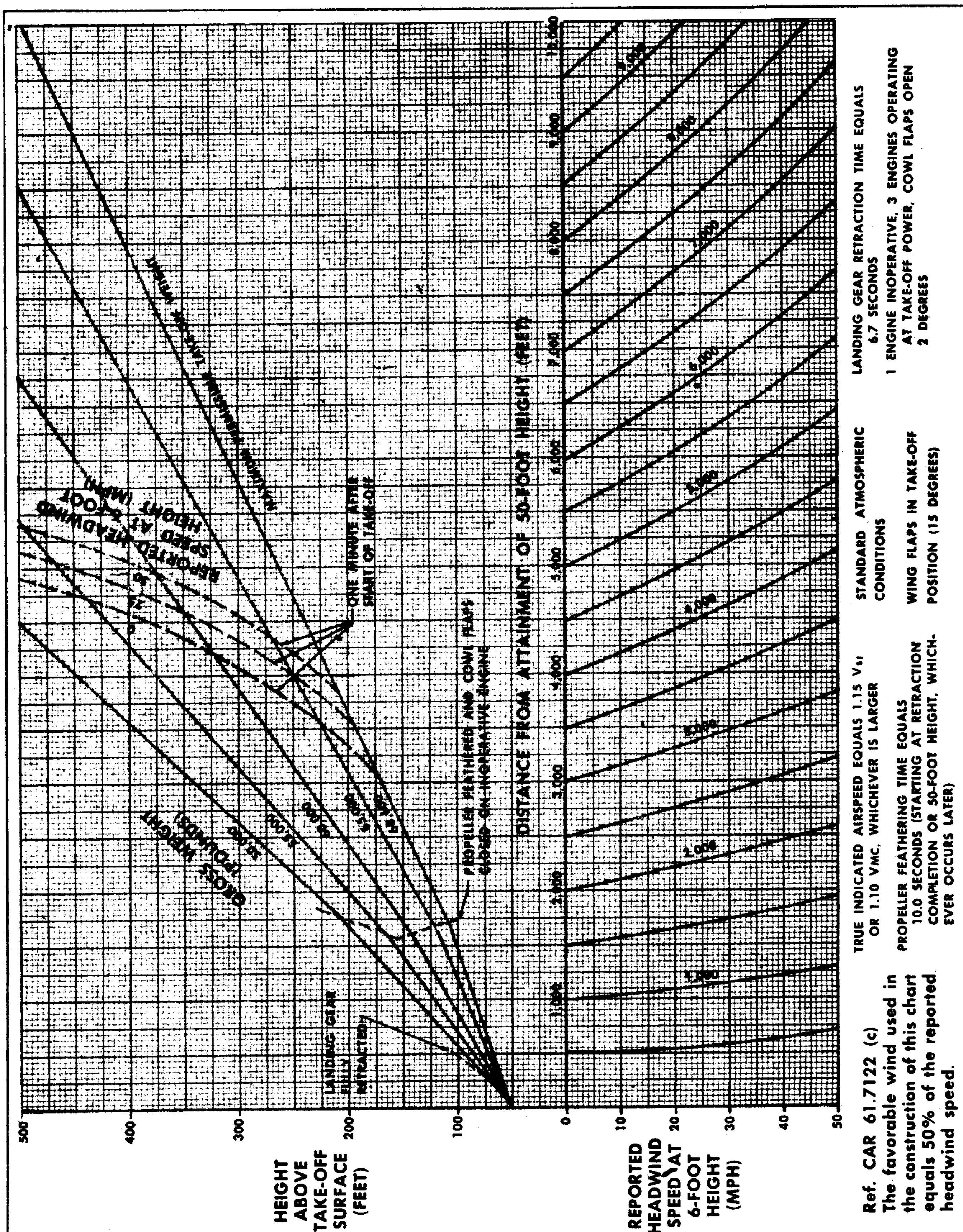
FLAPS IN TAKE-OFF POSITION (15 DEGREES)

STANDARD ATMOSPHERIC CONDITIONS

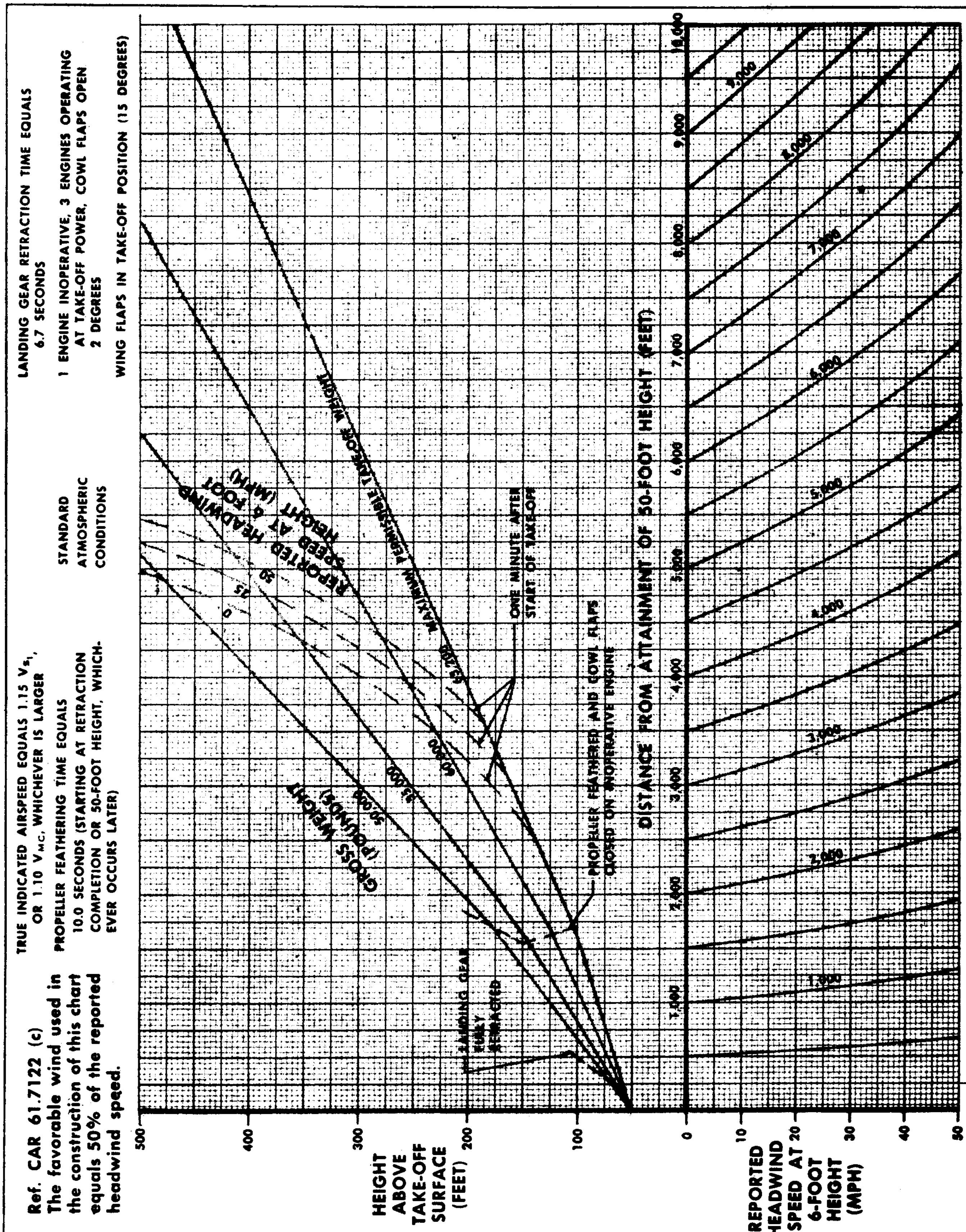
Take-Off Performance — Critical Engine Failure Speed



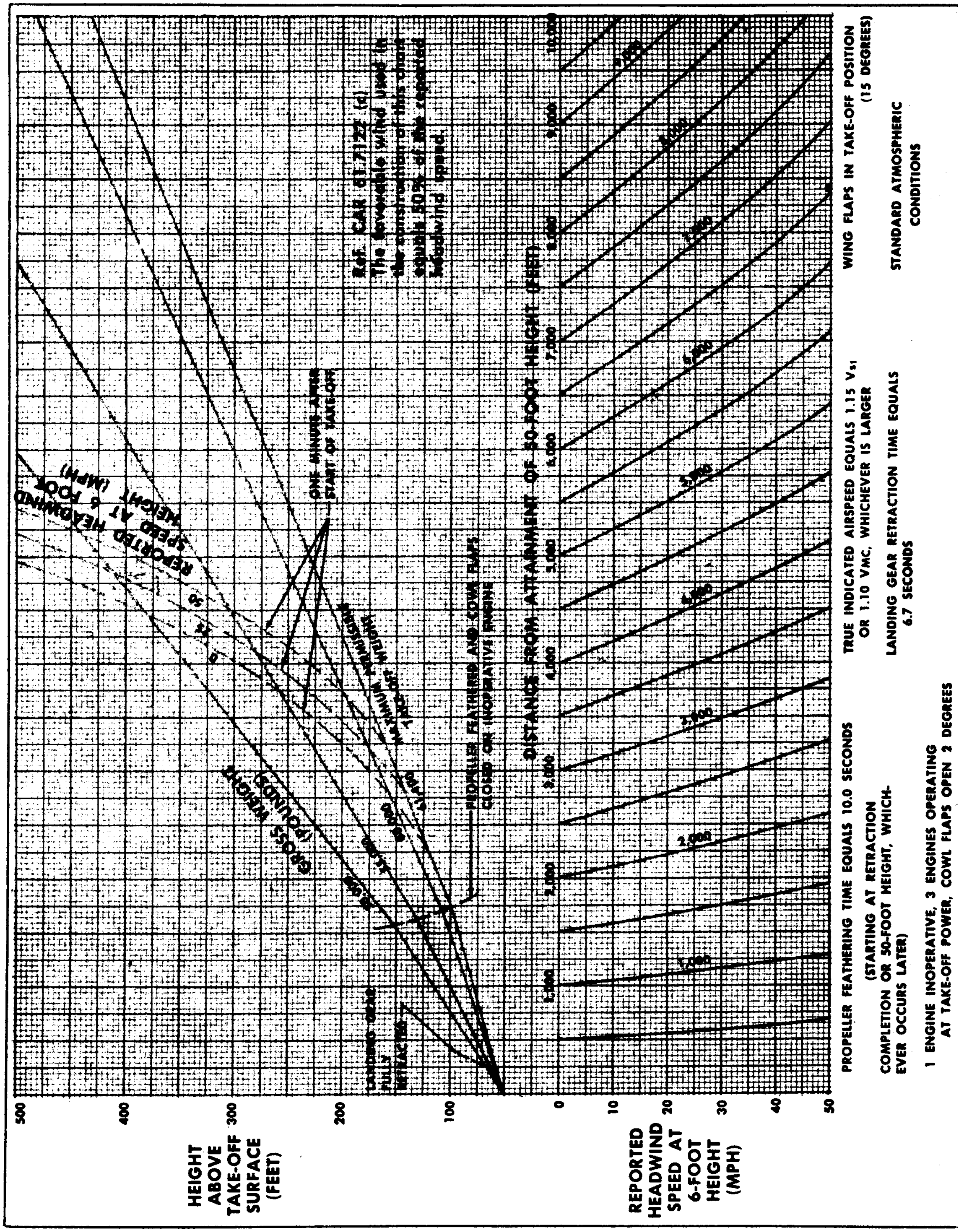
Take-Off Performance — Take-Off Flight Paths (Altitude Sea Level)



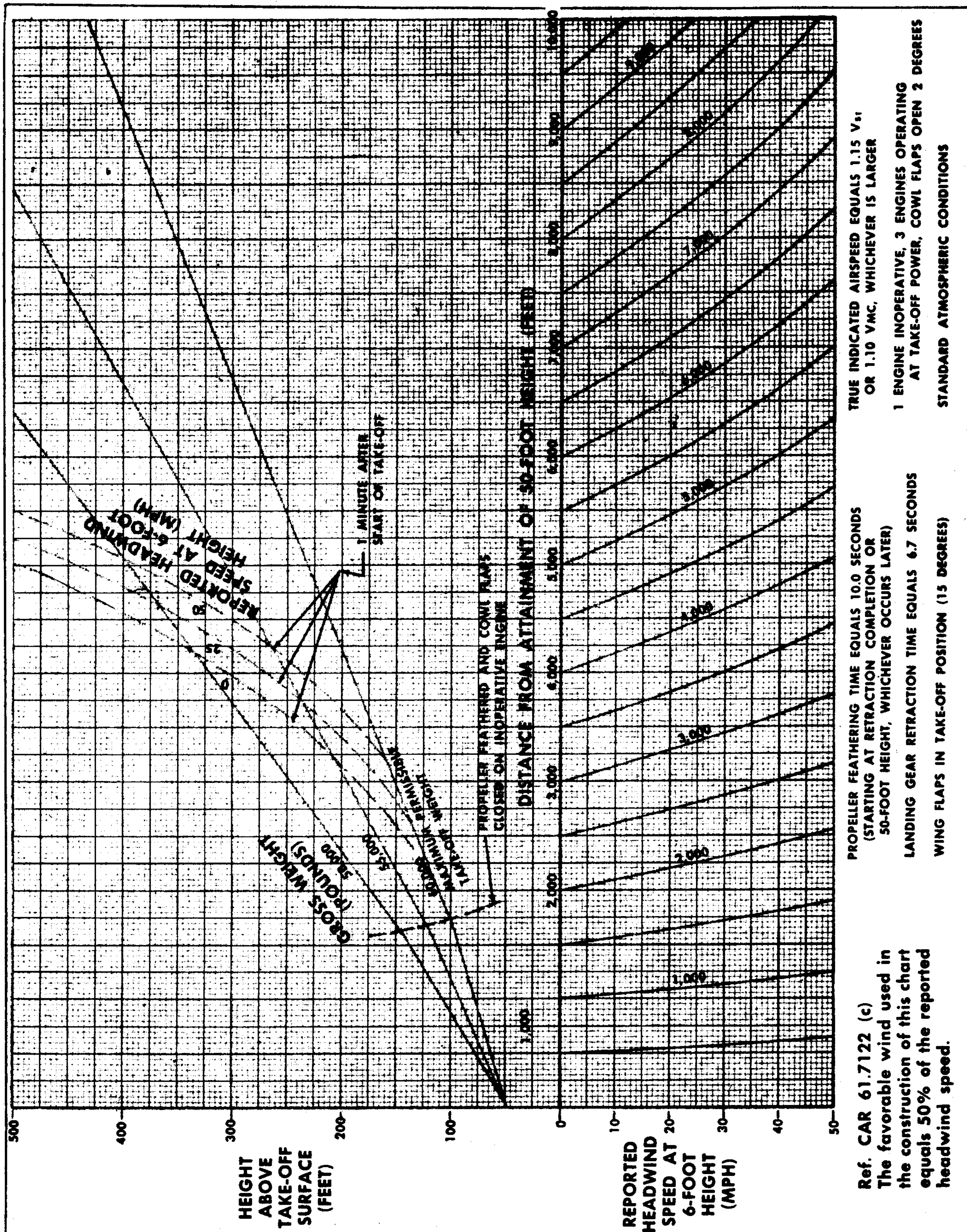
Take-Off Performance — Take-Off Flight Paths (Altitude 2,000 Feet)



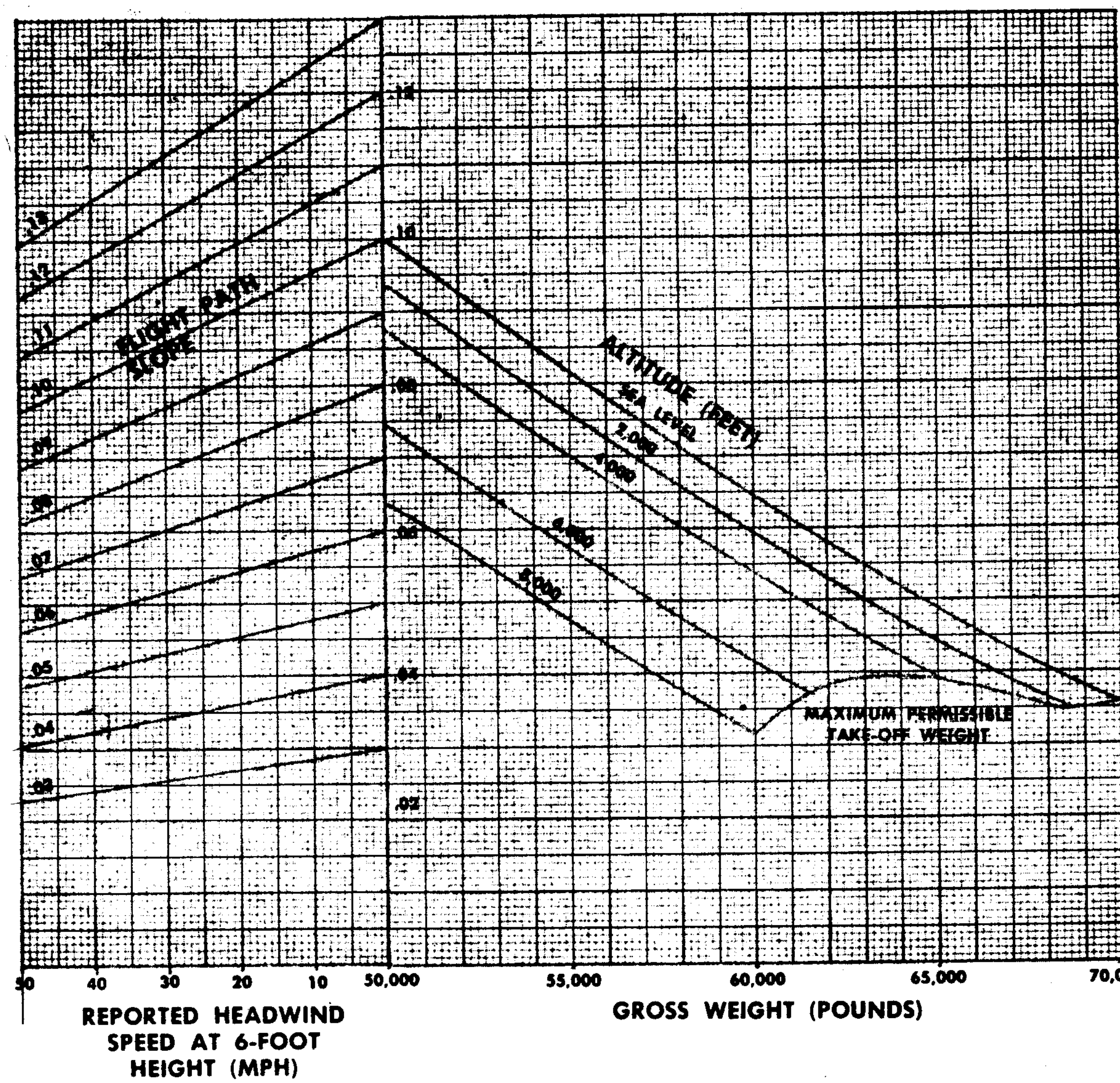
Take-Off Performance — Take-Off Flight Paths (Altitude 4,000 Feet)



Take-Off Performance — Take-Off Flight Paths (Altitude 6,000 Feet)



Take-Off Performance — Take-Off Flight Paths (Altitude 8,000 Feet)



TRUE INDICATED AIRSPEED EQUAL 1.15 V_{s1} OR 1.10 V_{MC}, WHICHEVER IS LARGER

LANDING GEAR RETRACTED

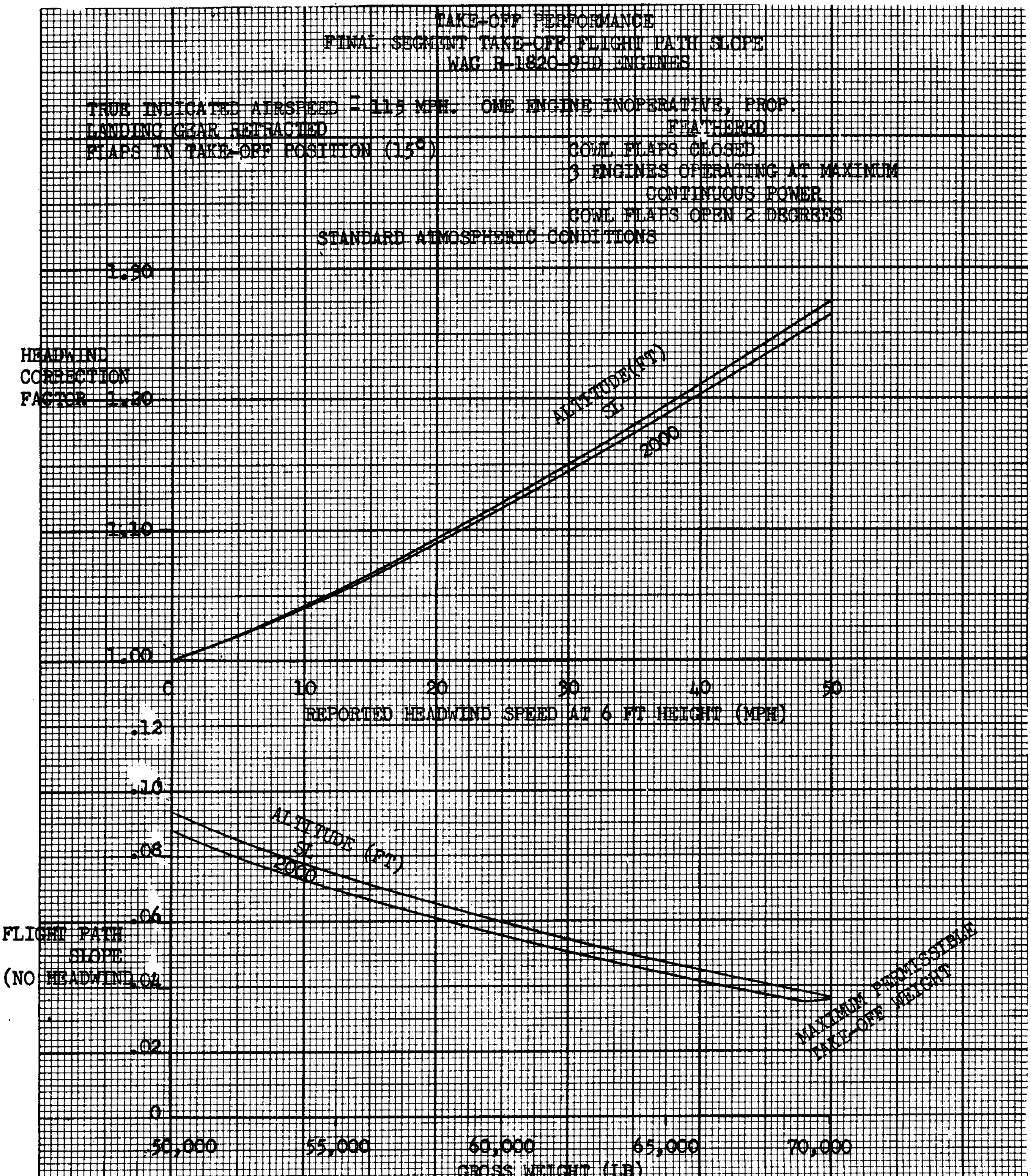
WING FLAPS IN TAKE-OFF POSITION (15 DEGREES)

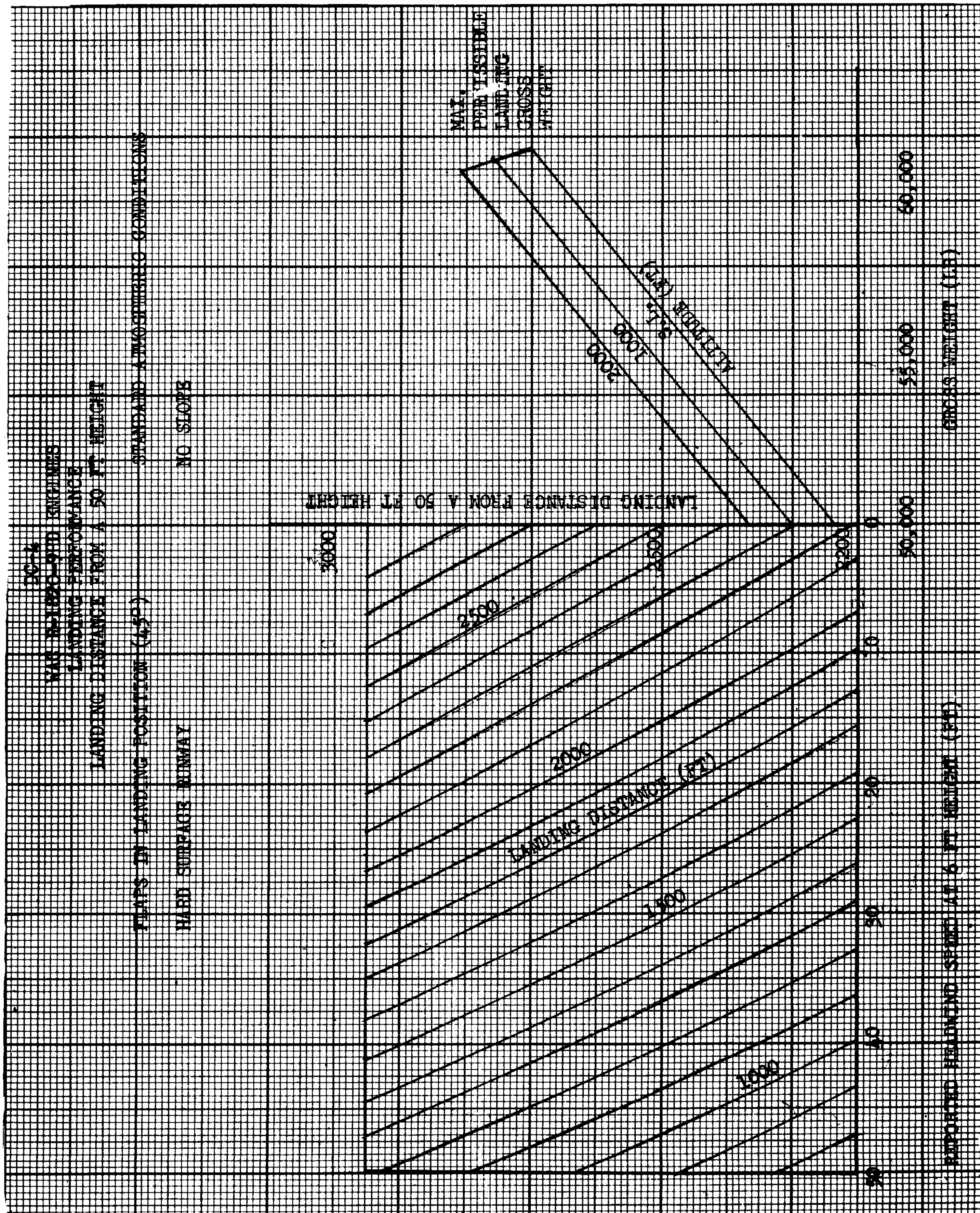
1 ENGINE INOPERATIVE, PROPELLER FEATHERED, COWL FLAPS CLOSED

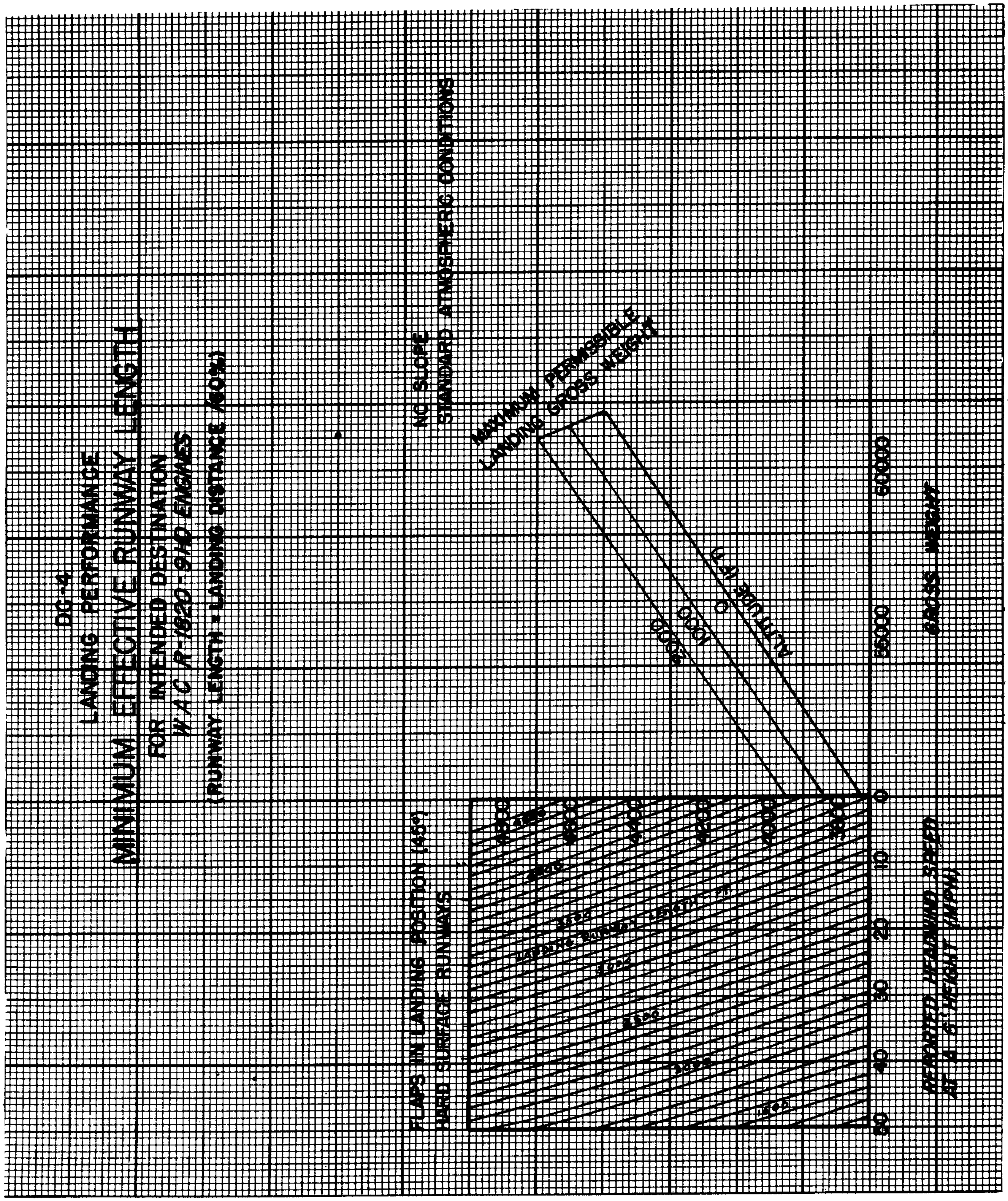
3 ENGINES OPERATING AT TAKE-OFF POWER, COWL FLAPS OPEN 2 DEGREES

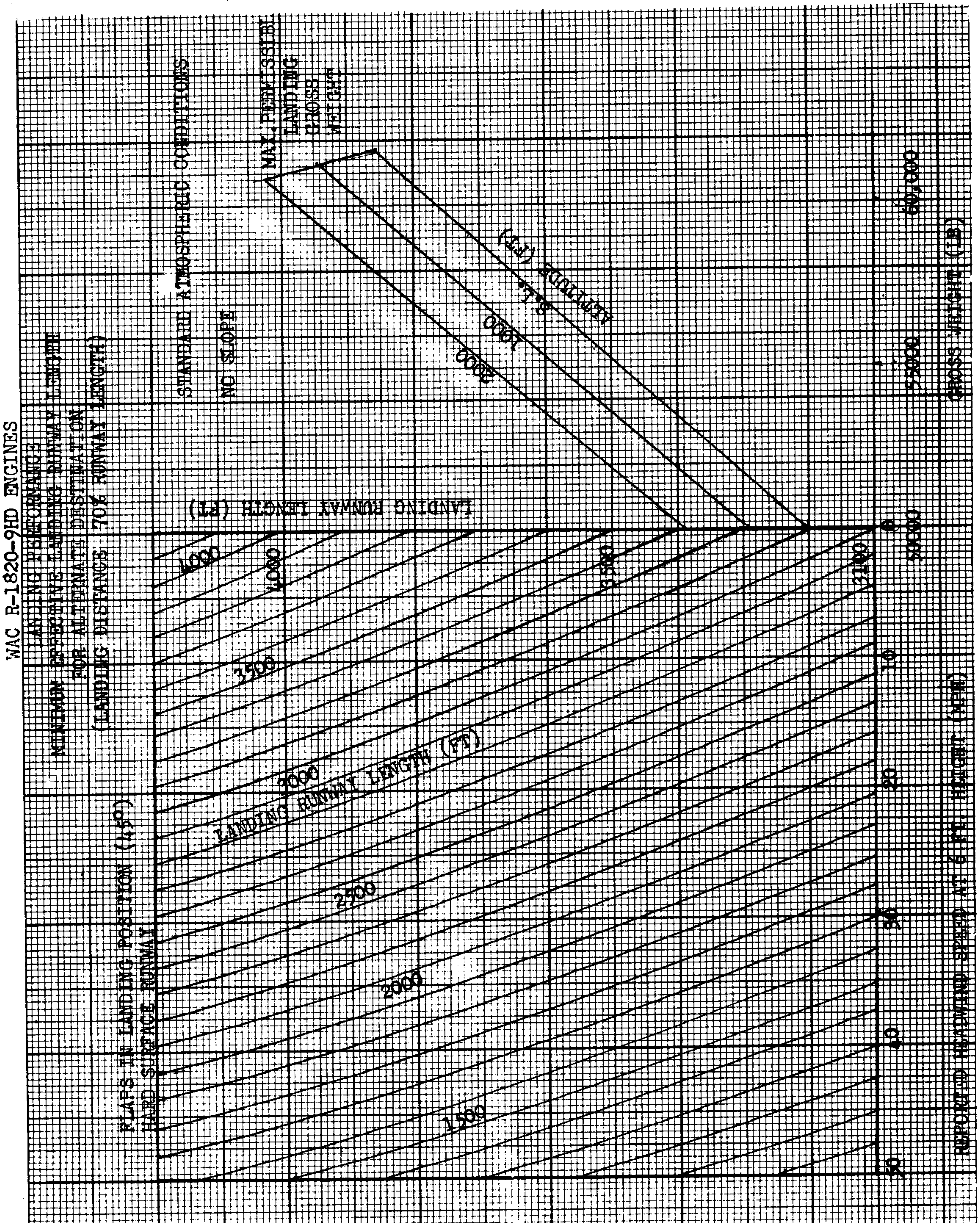
STANDARD ATMOSPHERIC CONDITIONS

Take-Off Performance — Final Segment Take-Off Flight Path Slope

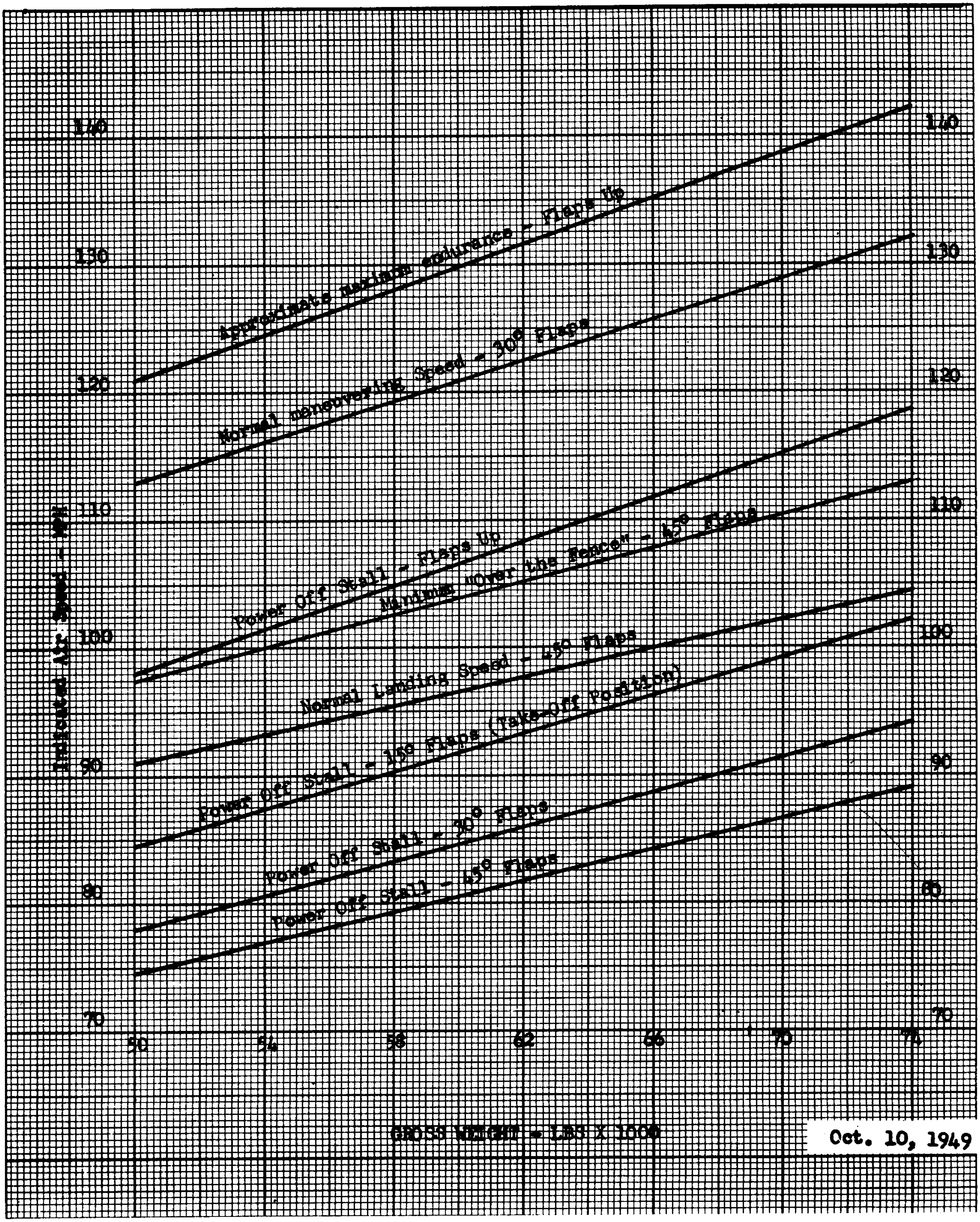

TAKE-OFF PERFORMANCE
FINAL SEGMENT TAKE-OFF FLIGHT PATH SLOPE
WAG R-1820-9HD ENGINES
TRUE INDICATED AIRSPEED = 115 MPH. ONE ENGINE INOPERATIVE, PROP. FEATHERED
LANDING GEAR RETRACTED
FLAPS IN TAKE-OFF POSITION (15°)
COWL FLAPS CLOSED
3 ENGINES OPERATING AT MAXIMUM CONTINUOUS POWER
COWL FLAPS OPEN 2 DEGREES
STANDARD ATMOSPHERIC CONDITIONS
HEADWIND CORRECTION FACTOR
1.30
1.20
1.10
1.00
ALTITUDE (FT)
SL
2000
0
10
20
30
40
50
REPORTED HEADWIND SPEED AT 6 FT HEIGHT (MPH)
.12
.10
.08
.06
.04
.02
0
FLIGHT PATH SLOPE (NO HEADWIND)
ALTITUDE (FT)
SL
2000
MAXIMUM PERMISSIBLE TAKE-OFF WEIGHT
50,000
55,000
60,000
65,000
70,000
GROSS WEIGHT (LB)


DC-4
LANDING PERFORMANCE
LANDING DISTANCE FROM A 50 FT. HEIGHT
FLAPS IN LANDING POSITION (45°)
STANDARD ATMOSPHERIC CONDITIONS
HARD SURFACE RUNWAY
NO SLOPE
MAX. PERMISSIBLE LANDING GROSS WEIGHT
ALTITUDE (FT)
S.L.
1000
2000
LANDING DISTANCE FROM A 50 FT HEIGHT
3000
2500
2000
1500
1000
LANDING DISTANCE (FT)
50,000
55,000
60,000
GROSS WEIGHT (LB)
0
10
20
30
40
50
REPORTED HEADWIND SPEED AT 6 FT HEIGHT


DC-4
LANDING PERFORMANCE
MINIMUM EFFECTIVE RUNWAY LENGTH
FOR INTENDED DESTINATION
W A C R-1820-9HD ENGINES
(RUNWAY LENGTH = LANDING DISTANCE /60%)
NO SLOPE
STANDARD ATMOSPHERIC CONDITIONS
FLAPS IN LANDING POSITION (45°)
HARD SURFACE RUNWAYS
MAXIMUM PERMISSIBLE LANDING GROSS WEIGHT
ALTITUDE IN FT
0
1000
2000
60000
GROSS WEIGHT
0
10
20
30
40
50
REPORTED HEADWIND SPEED AT A 6' HEIGHT (MPH)

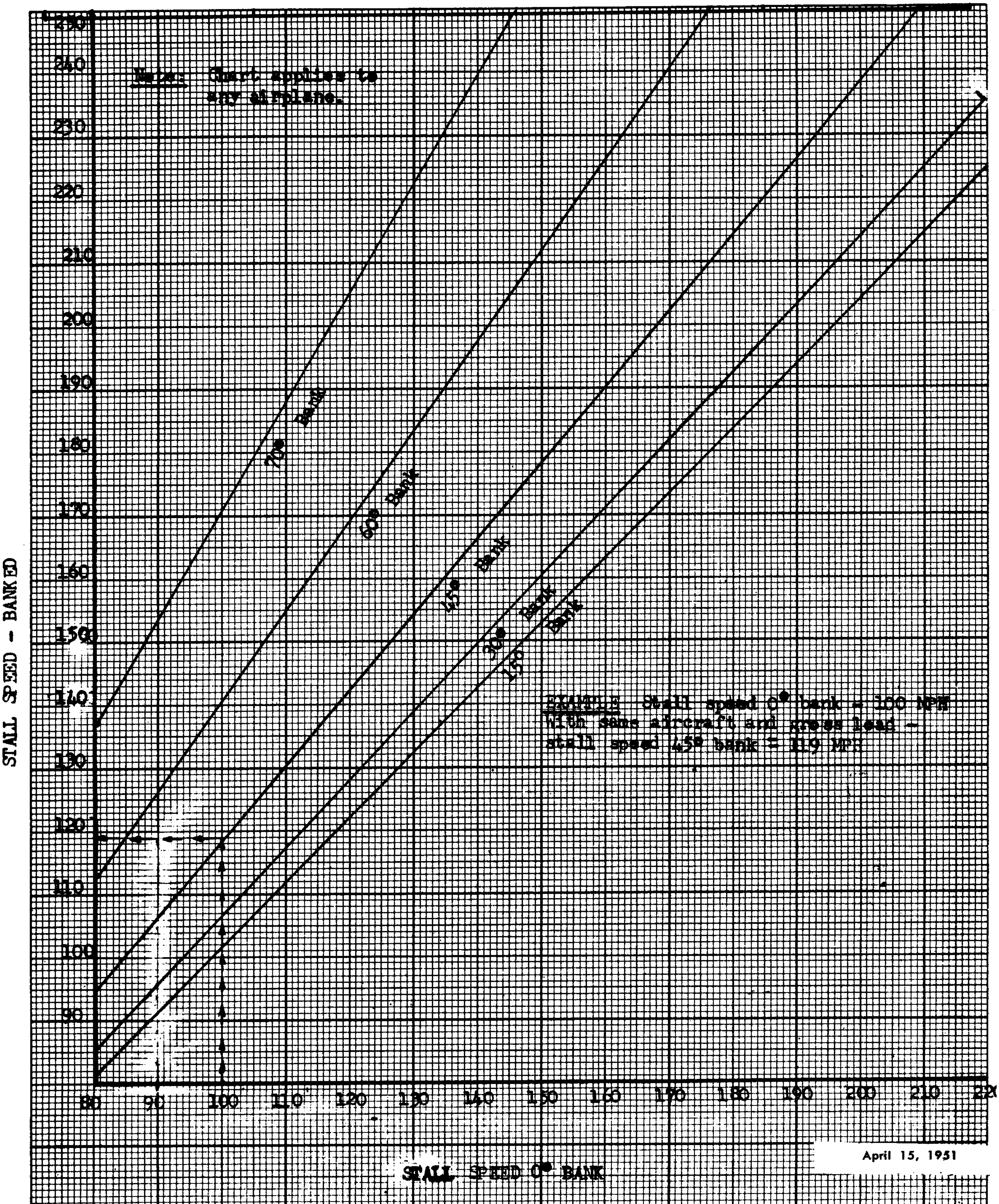

DC-4
WAC R-1820-9HD ENGINES
LANDING PERFORMANCE
MINIMUM EFFECTIVE LANDING RUNWAY LENGTH
FOR ALTERNATE DESTINATION
(LANDING DISTANCE 70% RUNWAY LENGTH)
STANDARD ATMOSPHERIC CONDITIONS
NO SLOPE
MAX. PERMISSIBLE LANDING GROSS WEIGHT
ALTITUDE (FT)
S.L.
1000
2000
LANDING RUNWAY LENGTH (FT)
4000
4000
3500
3500
3000
LANDING RUNWAY LENGTH (FT)
2500
2000
1500
2100
FLAPS IN LANDING POSITION (45°)
HARD SURFACE RUNWAY
60,000
55000
50000
GROSS WEIGHT (LB)
0
10
20
30
40
50
REPORTED HEADWIND SPEED AT 6 FT HEIGHT (MPH)

HERE'S HOW! DC-4



Oct. 10, 1949

CORRECTION CHART FOR STALL SPEED WITH AIRPLANE IN A BANKED CONDITION



I. COCKPIT CHECK:

A. Before Entering Cockpit:

Landing Gear Safety Blocks - Installed
Nose Wheel Safety Pin - Installed
Nose Wheel Links and Pins - Engaged
Up Latch Positions - Unlatched
Tail Support - Chocked

B. Before Starting Engines

Gross Weight and Take-Off Limitations - - - - - - - - - - - - - - - Checked
Battery Cart - On
Generators - Off
Wing De-icer - Off
Running & Warning Lights - As Applicable
Heaters - Check
Fire Detector System - Check
Seat Belt & No Smoking Sign - - - - - - - - - - - - - - - - - - - On
Ignition - Off
Cowl Flaps - Open
Trim Tabs (Check for 5° Travel) - - - - - - - - - - - - - - - - - Set
Props - Low Pitch
Cross Feed Fuel Valves - Off
Carburetor Heat - Cold
Fuel Selector Valves - On
Parking Brake - On
Auto Pilot - Off
Mixtures - Idle Cut Off
Gear - Down
Flaps - Up
Aux. Fuel Valves - Off
Hyd. By-pass Valve - Down
Fuel & Oil Quantity - Check
Hyd. Quantity - Check
Hyd. & Air Pressure - - - - - - - - - - - - - - - - - - Checked (1800 & 1000)
Prop De-icers - Off
Alcohol Quantity - Check
Radio, Altitimeters, Clock - On & Set

C. Start Engines:

D. Electrical Check:

Ships Battery - On
Generators - On
Inverter - On
(One or More Engines 800 RPM AC Volts-105-125 Frequency 360-440)

I. COCKPIT CHECK (Cont'd)

E. Run-Up:

(1) Run up both outboards followed by both inboards to 30" & Check:

Magnetoes	Check
Generators	Charging
RPM	2300 (Approx.)
Oil Pressure	70 Lbs.
Fuel Pressure	20 Lbs.
Oil Temp.	Check
Head Temp.	Check
Carburetor Heat	Off
Hyd. Pressure	Check
(2) Cowl Flaps	Trail
(3) Wing Flaps	15°
(4) Recheck Fuel Selector Valves	
(5) Mixtures	Auto Rich
(6) Gyros	Uncaged
(7) Gust Lock - Off - Controls	Free

F. Take-Off and Climb:

51.5" HG (sea level)	2700 RPM
Landing Gear	Up
46.5" HG (sea level)	2500 RPM
Wing Flaps	Up
36.1" HG to 34.5" HG	2300 RPM
Mixture	Auto Rich
Cowl Flaps	Adjust
Landing Gear Handle	Neutral
Hydraulic By-Pass	Up

G. Before Landing:

Landing Gross Weight	Check
Seat Belt & No Smoking Sign	On
Ignition	Check
Fuel Selector Valves Main Tanks	On
Aux. Tanks	Off
Cross Feed Fuel Valves	Off
Altimiters	Set
De-icers	Off
Heaters	Check
Mixtures	Auto Rich
Hyd. By Pass	Down
Props	2300
Land Gear (Light)	Down
Brake Pressure	Up
Hyd. Pressure	Up
Flaps	Down

I. COCKPIT CHECK (Cont'd)

H. After Landing:

Wing Flaps - Up
Cowl Flaps - Open
Engines 1 & 4 - Off
Horizons - Caged
Gust Lock - On

I. After Parking:

Parking Brakes - On
Inverter - Off
Mixtures -Idle Cut Off
Ignition - Off
Radio - Off
Heaters - Off
Ships Battery - Off

J. Normal Feathering Procedure:

Gear and Flaps - - - follow procedure, comply with minimum air speed requirements at various flap settings

Minimum Climb Speeds with Maximum Gross Load -

45° Flaps - 101 MPH
30° Flaps - 117 MPH
15° Flaps - 115 MPH
0° Flaps - 135 MPH

Throttle - Closed
Mixture Control -Idle Cut Off
Feather Button - Push
Fire Wall Shut Off - Pull
Fire Extinguisher (If Needed) - - - - - - - - - - - - - - - - Pull
Power on Good Engines - As Required
Mixture - Auto Rich
Cowl Flaps - Adjusted
Fuel Tank, Cross Feed, Booster Pump - - - - - - - - - - -Off (Bad Engine)

K. Unfeathering Procedures:

Fire Wall Shut Off - Push
Ignition - On
Tank Selector - On
Mixture - Auto Rich
Feathering Button - Hold to 900 RPM
Warm Up - Until Oil Pressure Stabilizes

NOTE: Cowl Flap Switches Should Be Off Except When Operating Cowl Flaps. When Either Horizon Is Caged, Auto Pilot Gyros Are Caged.

II. COCKPIT PROCEDURES

It is the responsibility of the Captain to check all items of the preceding Check Lists (a copy is carried in each airplane).

The purpose of the Check Lists is to assure that items essential for proper starting and for a safe take-off, landing, or engine out check have definitely been carried out. In using these Check Lists, the First Officer will call the challenge, the Captain will perform the required operation and then reply. Where the position of a control makes it desirable for the First Officer to perform the operation, the First Officer will read the challenge, perform the item, and then make the reply.

1. Before Entering Cockpit:

   See Check List (A) (Self explanatory).

2. Before Starting Engines:

   See Check List (B) (Self explanatory).

3. Starting Engines:

   The following engine starting procedure is to be used at all times when starting C9HD engines:

   Starting order 3-4-2-1

   a. Check the fuel and oil supply
   b. Examine engine controls for smooth movement and full travel
   c. Fire guard - - - - - - - - - - - - - - Posted, Engine clear
   d. Fuel supply valve - - - - - - - - - - On
   e. Throttles - - - - - - - - - - - - - - - One quarter open
   f. Mixture controls - - - - - - - - - - Idle cut off
   g. Fuel booster pump - - - - - - - - - On (low)
   h. Engage starter and apply primer as required.
   i. After Engine Has Turned Over at Least Two Complete Turns, Turn the Ignition Switch to "Both"
   j. Operate the booster ignition. Should the engine fail to start after engaging starter for 30 seconds, allow starter to cool for 1½ minutes, then repeat starting procedure.
   k. When the engine is firing evenly, place mixture control in the auto rich position. The priming system on the DC-4 will operate engine at 1000 RPM with mixture control in idle cut off; therefore there is no need for great haste in getting into auto rich.

II. COCKPIT PROCEDURES (Cont'd)

3. Starting Engines (Cont'd):

Caution - If engine starts and runs for a short time, then stops, immediately return mixture control to idle cut off to shut off fuel supply and prevent fire.

Operate primer intermittently as necessary and leave fuel boost pumps on until engine driven pump is supplying adequate pressure. Do not pump throttle to obtain smooth operation, as this practice is ineffective and causes a wide, rapid variation of fuel air ratio and may result in serious backfire.

l. Observe oil pressure
m. Hydraulic pressure - - - - - - - - - 2700-3000 PSI (After starting #3)
n. Fuel booster pump - - - - - - - - - - OFF
o. Battery switch - - - - - - - - - - - Ships battery
p. Inverter - - - - - - - - - - - - - - On (One or more engines 800 RPM) (AC volts 105-125, frequency 360-440)

When the signal is received for the #3 engine to be started, the First Officer shall inform the Captain that #3 is clear and upon verbal order from the Captain proceed to start #3. The Captain shall handle the throttles, mixture control, and switches for #3 and #4 engines. The Captain shall handle starters on #2 and #1 engines, and the First Officer shall handle the throttles, mixture controls, and switches for these engines.

4. Electrical Check:

See Check Lists (D) (Self explanatory).

5. Prior to Taxiing:

a. Seat, rudder pedals, seat belts - - CHECKED
b. Ground crew clearance - - - - - - - - ALL CLEAR - LANDING GEAR LOCKS OFF - TAIL POST REMOVED
c. Door warning light - - - - - - - - - OUT
d. Parking brake - - - - - - - - - - - - OFF
e. Tower clearance - - - - - - - - - - - CLEAR TO TAXI

II. COCKPIT PROCEDURES (Cont'd):

5. Prior to Taxiing (Cont'd):

NOTE: When the signal is received to depart from the ramp, the Captain shall check with a ground crew member and observe from the cockpit the ground gear locks, as assurance of their removal prior to taxiing. The First Officer shall then check the door warning light before the Captain starts to taxi.

6. Run-Up:

See Check Lists (E):
Drop off on a single magneto should not exceed 100 RPM. During run-up the First Officer will observe all instruments closely and promptly notify the Captain of any irregularities in the performance of engines and instruments.

During cold weather the propeller controls should be moved through one or two cycles to insure getting warm oil into the prpeller dome. If there is reason to suspect the malfunctioning of carburetor heat controls, they should be checked on the run-up.

The First Officer will lower the wing flaps to 15° and place the cowl flaps in "Trail". The Captain will check all flight controls to the limits of travel immediately prior to take-off.

7. Take-Off and Climb:

See Check Lists (F)

During the take-off, the First Officer will steady the control wheel until the Captain takes over. In addition, he shall observe all instruments closely and report promptly any irregularities. As the manifold pressure reaches take-off limits, the First Officer shall take over the throttles and adjust the manifold pressure, making certain that the take-off limits are not exceeded. The First Officer adjusts throttle tension, and shall guard the throttles throughout the take-off to prevent them from slipping or creeping.

After leaving the ground and when the Captain is positive the airplane will remain off the ground, the Captain shall ease on the brakes to stop rotation of the wheels. He shall then signal to the First Officer to retract the landing gear by placing his hand, palm upward, in the

II. COCKPIT PROCEDURES (Cont'd):

7. Take-Off and Climb (Cont'd):

First Officer's view and making an upward motion, at the same time verbally ordering "Gear Up". In no case shall the First Officer attempt to retract the gear until receiving the proper signal from the Captain.

When reaching an airspeed of at least 135 and all immediate obstructions have been cleared, the flaps shall be retracted. This will normally be done by the Captain or, upon receipt of verbal orders from the Captain, the First Officer will perform this operation. The throttles and RPM will be reduced in accordance with the power reduction sequence, always reducing manifold pressure before RPM. The landing gear shall not be allowed to remain down at airspeeds in excess of 145 MPH.

During the climb, boost and RPM will be adjusted by the First Officer. Normal cruising climb will be made at 145 to 155 MPH, IAS. (For best rate of climb airspeed, refer to charts in Section 15.00.) During the climb, observe all engine instruments for proper reading and correct functioning of all units. The cowl flaps should be left in trail or adjusted to prevent exceeding the maximum temperature (232° C).

If blowers have been turned on for the nose or cabin heater, they should be turned off at airspeeds over 120 MPH. The seat belt and no smoking sign should be turned off above 1000 feet and at Captain's discretion. Landing lights should be retracted and turned "Off". The hydraulic by-pass should be turned off and only turned on when it is necessary to actuate a hydraulic unit.

8. Cruise:

When cruising altitude has been reached, the climb horsepower shall be reduced to conform with established cruise control procedures for airplane gross weights and conditions. The First Officer shall close the cowl flaps, set the manifold pressure, the cruising RPM, and return the mixtures to the "Automatic Lean" position, after cylinder head temperatures are in the desired temperature range. The Captain will trim the airplane after the cruise power setting has been made. Propeller synchronization shall be accomplished and maintained throughout the flight, insuring minimum fatigue for both pilots and passengers. The hydraulic by-pass valve shall be kept in the "Open" (Up) position during all periods of cruising to relieve the load on the engine hydraulic pumps.

II. COCKPIT PROCEDURES (Cont'd):

8. Cruise (Cont'd):

If auxiliary fuel is on board, switch to the auxiliary fuel source. (See SECTION 50.00 FUEL SYSTEM, for procedure to be followed.)

9. Before Landing:

See Check List (G) (Self explanatory)

10. Over Shooting:

If it is decided to proceed around before the wheels have touched the ground, apply METO power. If maneuvering flap position is being used, raise the gear first and then flaps as needed. If landing flap position is being used, raise flaps first to maneuvering position and then raise the gear.

Study and become familiar with the speeds necessary to maintain climb with various flap settings. These speeds are shown in pages 15.01 through 15.30 on the charts. A study of this material will show that it is possible to create a stall condition by raising the flaps at airspeeds below those necessary to maintain flight for reduced flap extension.

11. After Landing:

See Check Lists (H)

After landing, engines #1 and #4 shall normally be cut for taxiing. However, they may be used for taxiing at the discretion of the Captain, under conditions of ice and snow or at any other time when field conditions resist turning the airplane by nose wheel steering. Engines #2 and #3 should not be cut at any time during taxiing, as the hydraulic pumps which provide pressure for braking are mounted on these engines. Loss hydraulic pressure would result in the subsequent loss of steering and braking action.

12. Taxiing - Use of Brakes - Parking:

a. The First Officer shall guard (hold) the control wheel at any time when the Captain is using the steering wheel and the surface controls are unlocked. Forward pressure should be held on the control wheel to facilitate nose wheel steering.

II. COCKPIT PROCEDURES (Cont'd):

12. Taxiing - Use of Brakes - Parking (Cont'd):

b. Adequate thrust for taxiing is usually obtained, on hard surface runways, by using 600-800 RPM on each engine. Use as little power as possible to avoid dragging the brakes.

c. Use the left hand on the nose wheel steering wheel. To change the airplane's direction, turn the nose steering wheel slowly and steadily as this will avoid jerky operation of the nose wheel. Avoid turns at high taxiing speeds to prevent spilling gasoline overboard through wing tip fuel vents.

d. Avoid excessive movement of the nose wheel at high taxiing speeds. The rolling inertia of the airplane resists turning and may cause sidewise skipping of the nose wheel.

e. Braking is recommended only for slowing the speed of taxiing or stopping the airplane. A sharper turn than that made possible with the steerable nose wheel (45^{o} from center) cannot be made without dragging the nose wheel.

WARNING: Brake pedal pressures are fairly light. DO NOT ABUSE.

f. Refer to the hydraulic pressure guage to insure adequate braking pressure. (1800 psi minimum). In case of loss of hydraulic pressure and brakes, the emergency air brake can be used. This applies the brakes and is independent of the action of the hydraulic toe brakes.

WARNING: It is impossible to steer the airplane with hydraulic pressure 1800 psi or less.

13. After Parking:

See Check List (I)

If a landing is made at other than a scheduled stop, the First Officer shall install the gear locks which are carried on board the airplane for emergency purposes only.

14. Engine Failure Procedures:

See Check Lists (J and K).

NOTE: If an engine has been feathered and no fire exists, do not leave the fire wall shut-off valve closed if it is intended to restart the engine in flight. The valves have a tendency to freeze in cold weather, making it impossible to reopen them.

II. COCKPIT PROCEDURES (Cont'd):

14. Engine Failure Procedures (Cont'd):

A. When engine malfunctioning is experienced, observe the engine instruments closely. Engine instruments most often tell the best story as to which engine is bad, frequently giving a good indication of the cause and severity of the trouble. Although rudder pedal pressures caused by an engine out are fairly light, they may be used as a guide in determining on which side the engine trouble exists.

B. Throttling an engine or reducing engine speed may reduce vibration or cutting out and possibly restore normal engine operation.

C. In case of a loss of fuel or oil pressure due to line failure, or in the case of an extremely rough engine, it will be necessary to shut down that engine by immediately cutting the mixture and feathering the propeller. This protects the engine against damage, the airplane against fire, and gives the airplane better engine-out flight characteristics.

The previous procedures apply to any engine failure or loss in power that might occur during take-off, climb, cruise or landing. In all cases of engine failure, there are three steps that should be given attention as soon as possible to relieve drag on the airplane and improve flight performance. They are as follows:

1. Gear and Wing Flaps --
Give consideration to the existing conditions before arbitrarily retracting the gear and "dumping" the flaps. Should one engine fail on or shortly after take-off with the gear down and flaps extended 15 degrees, the gear should be retracted as quickly as possible; however, the retraction of the flaps should depend on the altitude to be gained and the distance to the obstacles to be cleared. The 15 degree (Take-off position) flap setting is very near the best lift/drag ratio. This degree of flap extension increases the lifting area to the maximum with a minimum increase of drag. Therefore, 15 degrees of flap setting with its required slower airspeed for climb would result in more altitude gained for ground distance covered than could be obtained with flaps retracted.

II. COCKPIT PROCEDURES (Cont'd):

14. Engine Failure Procedures (Cont'd):

C.1. Gear and wing flaps (Cont'd):
If an engine failure should occur with gear down and flaps extended 30 degrees (approach position), if necessary, the gear should be retracted first, then retract the flaps to either 15 degrees or up position, whichever is desired, if or as soon as the air speed is equal to the minimum required for climb for the particular flap position.

Should the engine failure occur with the gear down and the flaps extended 45 degrees (Landing Position), it would be necessary to retract the flaps first, either to 30 or 15 degrees as the air speed permits, before retracting the gear. Full flap extension creates considerable more drag than the gear; and the primary purpose of gear and flap retraction, in this case, is to relieve the aircraft of the most drag in the least time to assure continued flight with a minimum loss of altitude and, in addition, establish a condition which will provide a maximum gain in altitude for distance traveled.

2. The propeller on the inoperative engine should be placed in "High Pitch" and then "Feathered". Feathering is often done first instead of placing the propeller in high pitch. However, some consider it better practice to place the propeller in high pitch as a safety check, to assure cutting power off on the correct engine and reduce considerably the drag on the windmilling propeller. This action does not materially slow down the feathering procedure.

3. The cowl flaps on the inoperative engine should be closed to relieve drag and as a precautionary act in case the fire extinguisher system must be used.

In addition to relieving the drag, it is equally important to apply sufficient power to maintain flight on the good engines.

II. COCKPIT PROCEDURES (Cont'd):

14. Engine Failure Procedures (Cont'd):

Take-Off:

Should an engine fail during the take-off ground run below the critical engine-out speed, there should be sufficient runway left to chop the power off all four engines and stop on the runway. Should an engine fail above the critical engine-out speed and there be insufficient runway left to stop, the flight can continue take-off and climb out on three engines. Take-off power will already be set on the good engines and it will be necessary only to carry out the remaining items on the "Engine-Out" check list. The gear should be retracted as soon as possible to relieve drag. The inoperative propeller should be placed in high pitch and later feathered. As soon as air speed is above 125 MPH, the wing flaps should be slowly retracted to give less drag. This should be followed by carrying out the remaining items on the cockpit "Engine-Out" check list. The airplane should be trimmed to relieve the drag on the side of the dead engine. Raising the wing on the side of the dead engine will also relieve drag and lighten rudder forces, making the airplane easier to control.

Climb:

Should an engine fail after power has been reduced to climb power, or at any time after take-off, set the power on the good engines to "Rated Power" or "Take-Off Power", if necessary. After the power setting has been made, the "Engine-Out" check should be completed.

Cruise:

If an engine fails during normal cruise conditions, the gear and flaps will be in the "UP" position. Additional power will not be immediately necessary to maintain cruising altitude. Proceed with the items on the "Engine-Out" check list, continuing to use maximum cruise power on the remaining engines. If flight is at high altitudes, it may be necessary to increase the power setting on the remaining engines.

II. Cockpit Procedures (Cont'd):

14. Engine Failure Procedures (Cont'd):

Two Engines Out:

Refer to the Performance Chart for two engine out performance. Two engines out should be handled as previously outlined for one engine out. At weights above 65,000 pounds, there is no climb performance with either gear or flaps "down" and marginal climb with both gear and flaps "UP". If the failure occurs during "Take-Off" or initial "Climb", the drag from the gear and flaps should be eliminated as soon as practicable. "Take-Off" power should be used on the good engines, followed by placing the propellers on the bad engines in "High Pitch". If the failure occurs at altitude while climbing or cruising, it will be necessary to use "Rated" or possibly "Take-Off" power to maintain altitude, depending on gross load, altitude and atmospheric conditions.

Propeller Unfeathering:

When restarting an engine in flight, the First Officer will turn "ON" the fuel selector valve, "OPEN" the firewall shut-off valve, turn "ON" the ignition switch, place the throttle in the $\frac{1}{4}$ open position, set the propeller to "HIGH PITCH" and place the mixture in the "AUTOMATIC RICH" position. Push in the feathering button and hold until the RPM reaches 800-1000, then release. The engine should be operated at low boost and low RPM until the engine oil and head temperatures reach 40°C and then the manifold pressure and RPM may be increased slowly to the desired power setting. The generator should be turned "ON" after the engine cruise power setting has been made.

I. LANDINGS:

The formula for safe handling of emergency landings is the same as that for any emergency: Knowledge. There is no emergency landing in which there isn't something you can do to help. Safe procedure requires a cool head. The ability to think straight and operate calmly requires knowledge of what to do. Every emergency situation is different. Supplement these general instructions with any specific information you can add from your experience or that of other pilots.

When you approach the field for an emergency landing, always call the tower and Company as soon as possible and inform the operators of the situation. Keep them posted on your progress so that they can give you full assistance.

A. Ice on Wings:

If it is necessary to land the airplane with an ice formation on the wings, the landing speed should be kept higher than usual to prevent stalling the airplane. When ice forms on the wings of an airplane, the stalling speed may be greatly increased.

B. Emergency Field - Short Runway:

If a landing must be made on a short runway, less than 3500 feet with no wind, the following suggestions may be found helpful.

1. Make a normal downwind leg and base leg pattern.

2. Come in toward the field in the normal manner, but shoot for a point near the end of the runway.

3. Come in the last 100 yards, maintaining minimum flying speed. (See Chart - Section 15.00)

4. Get the nose wheel down fast and use brakes as needed. If the runway surface conditions are good for braking, spill the flaps to put more weight on the wheels for better braking. If the runway surface conditions are bad (slippery), the flaps should be left down to act as air brakes to aid in slowing down the airplane.

5. Use the air brakes - if necessary. But not until full weight is on the wheels. Air may be metered by pulling the valve until the desired braking is obtained. Pulling the valve all the way out applies the full air and brake pressure.

NOTE: RELEASE FLARES BEFORE ANY EMERGENCY LANDING, AS THEY ARE A POTENTIAL FIRE HAZARD.

I. LANDINGS (Cont'd):

C. Engine Out:

Landing with any one engine out may be made in the same manner as a normal landing with all engines operating, as the three engine performance of this airplane is good. When landing with any two engines out, exceptional care must be taken to:

1. Extend the landing gear at such point that the drag will not cause undershooting. Approximately 10 seconds will be required to get the gear down.

2. Approach the field in the normal manner, taking care to avoid lowering the flaps past 20 degrees and causing drag which might result in undershooting.

3. Hold the air speed at approximately 125 to 135 mph, on the approach, with power on, depending on the wind conditions.

4. Relieve the rudder tab if desired. When in such a position that it is certain a landing may be made, the rudder tab may be relieved to reduce the rudder pedal pressure on landing. (After all power has been pulled off.)

D. Wheels Up:

The impact of the smoothest belly landing is severe. There are usually two separate shocks, one when the tail makes contact and the second, more severe, when the belly contacts the ground. Take every precaution for protection of passengers and crew. Land on smooth soft turf whenever possible. Land so the aircraft will not cross a runway at high speed while ploughing through the sod. Striking the sharp shoulder of the edge of the runway may result in a very severe shock. Land, if possible, so when the aircraft comes to a stop, mobile fire fighting equipment will be able to reach the airplane and not become bogged down in soft ground.

1. Be sure there is no loose equipment. Secure flight kits, cargo, etc.

2. Captain and First Officer will secure seat belts and shoulder harnesses.

3. Stewardesses will:
   (a) Secure loose buffet equipment.
   (b) Remove the emergency exit handle covers, preparing the exits to be opened when the aircraft comes to rest on the ground.
   (c) Secure all passengers' seat belts, placing a pillow between the seat belt and the passenger's body to minimize the possibility of injuries to the passengers from the seat belts.

I. LANDINGS (Cont'd):

D. Wheels Up (Cont'd):

(d) Place the blankets - folded - on the back of each seat to minimize the possibility of head injuries to the passengers, should they be thrown forward.

(e) Advise all passengers to remove eye glasses and loosen tight clothing.

4. Dump excess fuel prior to landing.

5. Use full flaps.

6. Land into the wind, if possible.

7. When it is known that the landing will be made, it is suggested that when practical the following items be carried out prior to contacting the ground:

a. Master electrical switch "OFF".
b. Gas tank selectors "OFF".

If unable to carry out these items prior to ground contact, take care of them as soon thereafter as practical.

8. Get all passengers and crew out and away from the airplane as soon as possible.

E. Nose Wheel Up - Main Gears Down:

1. Retract the down gears and make a "Wheels Up" (Belly) landing if possible. (Refer to previous outline on "Wheels Up" for procedures.)

2. If unable to retract the down gears, proceed as follows:

(a) Dump excess fuel prior to landing.

(b) Transfer passenger weight aft as far as possible to help keep the nose off the ground. Stewardesses will follow same procedure as in previous outline on "Wheels Up" landing with this exception.

(1) Remove center arm rests of seats to be used.

(2) Seat three passengers (a male passenger in the center if possible) in each double seat.

(3) Secure the seat belt for the passenger on the right over the center passenger's right leg, and the seat belt for the passenger on the left over the center passenger's left leg.

I. LANDINGS (Cont'd):

E. Nose Wheel Up - Main Gears Down (Cont'd):

2. (b) (3) Place a pillow between the center passenger's legs and the seat belt. In this manner, 3 passengers to a double seat will have safety belts. The load then may be far enough aft to keep nose off the ground when the airplane comes to rest.

(c) Keep the tail low on landing and throughout the landing roll, or as long as possible. Drag the tail skid if possible.

(d) Land with full flaps. If runway length is sufficient, raise the flaps on the landing roll or when it is evident the retraction of the flaps will help to maintain a tail low position.

(e) Cut off all engines, mixtures and ignition switches, after contacting the ground. While easing the wheel back to hold the nose in the desired position, care should be taken to avoid running out of elevator control. This is necessary to prevent the nose from falling hard to the ground. The nose should be eased to the ground smoothly while there is still sufficient elevator control (before the wheel is full back).

(f) Cut off all gas tanks and prepare to abandon the airplane through the front cargo door.

(g) WARNING: If the transfer of passengers, as outlined above, moves the C/G AFT far enough that the aircraft comes to a stop with the tail on the ground, use extreme care in evacuating the passengers. If possible, passengers should remain in their seats until the nose can be blocked up.

F. One Main Gear Up - One Main and Nose Gear Down:

1. Retract the "Down" gears and make a "Wheels Up" (Belly) landing if possible. (Refer to previous outline on "Wheels Up" for procedures.)

2. If unable to retract the down gears, proceed as follows:

(a) Dump excess fuel prior to landing.

(b) Touch down slightly faster than normal and try to land on the good main gear, turning after touching down to keep the good main gear on the outside of the turn, holding this as long as possible and practical.

II. NOSE WHEEL COLLAPSE DURING LANDING. TAKE-OFF OR GROUND OPERATION

General

Nose impact with the ground, caused by a collapse of the nose gear during landing or take-off speed, is usually not severe; however, quick action is necessary as it is desired to evacuate all passengers from the airplane in the shortest possible time. It is possible during such an accident as a nose wheel collapse that fire under the airplane may develop through the contact of hot metal and sparks with broken hydraulic lines, etc., in the nose section.

Recommended Crew Duties and Passenger Evacuation

A. Usual Procedures - No Fire

1. Captain will lower 45° flaps (Full Down) as soon as conscious of nose wheel failure. With nose on the ground, full flaps give a sliding surface for passengers to use to the ground with only an approximate drop of six feet.

2. First Officer, after airplane comes to rest, will unfasten his safety belt, place the fifth crew member's seat in the upright position should it be down, and open the right front entrance door.

3. First Officer, after opening the doors and clearing the cockpit area passageway, will proceed to the cabin (opening the doors between the cockpit and cabin on rear-loading airplanes) and direct all passengers to follow him from the airplane out the front entrance door. Once out of the airplane, the First Officer will take a position at the right of the door to assist passengers from the airplane to the ground.

4. Captain will, after placing all controls and electrical switches in their correct position for the condition, leave the airplane with the CO_2 Fire Extinguisher (5 lb. Bottle), inspect the airplane for fires, and assist any passengers from the wing who may be leaving the airplane via the emergency exits rather than from the entrance door as directed.

5. First Stewardess will remain in the rear of the cabin and stand in front of the rear entrance door to block the door from being opened and passengers from attempting to leave the airplane via this exit.

6. Second Stewardess will proceed to the front of the cabin and from a side position in front of seat 1A, in order not to be forced through the door, direct passengers to follow the First Officer from the airplane. When passengers are underway, the Second Stewardess will proceed to remove all usable emergency exits; in only extreme emergencies should the rear exits be removed, as passengers can be injured attempting to leave the airplane via them.

II. NOSE WHEEL COLLAPSE DURING LANDING, TAKE-OFF OR GROUND OPERATION (Cont'd)

B. Procedure in Case of Fire

Should a fire develop in the vicinity of the front entrance door, thus eliminating this door as an exit for passengers, it is recommended the cabin emergency exits be used to evacuate all passengers and that with this procedure the duties will be as follows:

1. Captain will lower 45° flaps (Full Down) as soon as conscious of nose wheel failure.

2. First Officer after airplane comes to rest, will unfasten his safety belt, leave the airplane via the cockpit door or side windows, and take a position at the trailing edge of the right wing to assist passengers sliding over the flap from the trailing edge of the wing to the ground.

3. Captain will, after placing all controls and electrical switches in their correct position for the condition, leave the airplane with CO_2 Fire Extinguisher (5 lb. Bottle), andfight the existing fire. When all CO_2 is exhausted, he will determine the advisability of securing additional extinguishers from the airplane or, if best to assist passengers, he will take a position near the leading edge of the left wing to assist passengers from the wing to the ground.

4. Second Stewardess will proceed to the front of the cabin, remove (or direct passengers in the removal of) usable emergency exits, and direct passengers through them. Only in extreme emergencies should the rear exits be removed, as passengers can be injured attempting to leave the airplane via them.

5. First Stewardess will remain in the rear of the cabin, standing in front of the rear entrance door to block the door from being opened and passengers from attempting to leave the airplane via this exit.

6. First and Second Stewardesses will leave the airplane via the emergency exit after the last passenger has left the airplane.

Usually several minutes elapse before the fire is intense enough to cause structural failure or ignite the first gasoline tank. With coordinated action, fifty (50) passengers should be evacuated with crew aid in approximately two (2) minutes.

III. FIRES IN FLIGHT:

A. Gasoline Heater

In the event of a nose heater fire, the Captain and First Officer will proceed as follows:

1. Turn "OFF" blower and nose heater switches.
2. Close all cockpit hot air outlets.
3. Pull fire extinguishers selector for the nose compartment and either left or right CO_2 bottles, if necessary.
4. The First Officer will stand by to send a distress message if so directed by the Captain.

In the event of a cabin heater fire, proceed as follows:

First Officer
Will turn off heater switches on heater panel.

Captain
Will release CO_2 by pulling cabin heater CO_2 release.

First Officer
Will open cabin heater excess doors and if necessary use CO_2 hand bottle or pyrene extinguisher to assist extinguishing the fire.

Captain
Will send distress message if necessary.

B. Baggage Compartment

Captain
1. Will turn the selector switch to theproper compartment and pull the CO_2 release.
2. Will place the nose heater switch and blower in the "OFF" position.
3. Will send distress signal if necessary.

First Officer
1. Will turn off cabin heater switches.
2. Will proceed to the scene of the fire to aid in extinguishing.
3. Will obtain CO_2 or carbon tet. fire extinguisher, and direct it at the base of the flame.

WARNING: When using a carbon tet. extinguisher in a confined area, avoid breathing any of the fumes given off as the carbon tet. hits the fire. These fumes are very toxic if inhaled. If possible, the area should be thoroughly ventilated after the fire has been put out.

IV. GROUND FIRES:

A. Engine Nacelle and Fuselage:

In the case of a fire in an engine nacelle or in any fuselage compartment, the Captain and First Officer will perform the duties as listed below:

1. Captain:

   a. Upon knowledge of an existing fire, the Captain will notify the other crew members of its location. (If the airplane is on an operating runway, taxi to the first suitable area, using the other three engines. Head the airplane with the tail into the wind to keep the fire away from the passenger door. This action to be simultaneous with fighting the fire.) He will, after ascertaining that the cowl flaps are "CLOSED", the booster pumps "OFF", wing tank selector is "OFF", and the engine is stopped, pull the correct fire extinguisher selector and either the left or right CO_2 bottle.

   b. Will apply parking brakes as soon as the plane is located in the desired position.

   c. Will place the wing tank selectors and crossfeed valves in the "OFF" position.

   d. Will turn the nose heater and blower switches "OFF" if either unit is operating.

   e. Will turn the master battery switch "OFF" if the airplane is to be abandoned and after all persons have left the plane.

      NOTE: No lights will remain on under these conditions. Flashlights must be kept on hand at all times during night flights.

   f. Will direct the other crew members in their duties.

2. First Officer:

   a. Will close the cowl flaps of the engine on fire.

   b. Will immediately notify the field tower of the fire by radio.

   c. Will first stop the engine reported on fire and then the remaining engines when ordered to do so by the Captain by placing the mixture in "IDLE CUT OFF". He will check that all ignition switches are "OFF".

IV. GROUND FIRES (Cont'd):

2. First Officer (Cont'd):

d. Will check and make certain that the fuel booster pumps are "OFF".

e. When the Captain deems it advisable, will release the remaining tank of CO_2 bottles, the control for which is located in front of him.

f. Will make available and ready for use all hand fire extinguishers in the cockpit.

g. Will open the cabin door and drop the emergency rope and ladder for use.

h. Will open the front cargo door and drop emergency rope, if necessary.

Engine Nacelle Fire Zones

Zone 1 is the section of the engine ahead of the heat baffle. This consists chiefly of the nose case, power section, and exhaust collector.

Zone 2 is the section of the engine behind the heat baffle and ahead of the firewall. This includes the engine rear case and accessories.

Zone 3 is the section of the nacelle behind the firewall and ahead of the front spar.

Fire Detection

DC-4 aircraft are equipped with fire detectors and cockpit indicators for Zones 1, 2, and 3. Zone 2 and 3 detectors are both wired to the same indicator light in the cockpit. Zone 1 detectors have a separate indicator light.

CO_2

DC-4 aircraft have CO_2 plumbed to Zones 2 and 3. Both zones receive CO_2 when the engine selector valve and bottles are pulled.

Procedure for fire in Zone 1

1. Feather propeller.
2. Pull firewall shut-off valve.
3. Open cowl flaps.
4. Increase speed (by diving, if necessary).
5. Complete engine-out check list.

IV. GROUND FIRES (Cont'd):

A. Engine Nacelle and Fuselage (Cont'd)

Procedure for fire in Zone 2:

1. Feather propeller.
2. Pull firewall shut-off valve and CO_2 selector.
3. Close cowl flaps.
4. Release CO_2.
5. Complete engine-out check list.

B. Baggage Compartment Fires:

In case of baggage compartment fires, the First Officer will leave the airplane by either exit and proceed to the door of the compartment on fire. If both airplane CO_2 bottles have been used, good judgment should be exercised to determine if all possible value has been obtained from the CO_2 discharged prior to opening the compartment door and further fighting the fire with the hand extinguishers.

The Captain will drop the emergency rope and ladder for use, if necessary.

NOTE: The Captain and First Officer will stand by to assist ground personnel in fighting the fire in any way possible.

V. PROCEDURE TO BE FOLLOWED IN THE EVENT OF A RUNAWAY PROPELLER:

While a runaway propeller is an infrequent occurance, it is well to review the considerations involved in coping with the situation. Based on a general analysis, the following procedure appears to be a sound sequence of steps to take:

At the first evidence of a runaway propeller --

First: Pull up airplane and retard throttles so as to reduce forward speed.

Second: Determine which engine is overspeeding.

Third: Place mixture in idle cutoff, and cut ignition switch on runaway engine.

Fourth: Feather propeller. If cause of propeller malfunctioning is of such a nature as to prevent feathering, continue flight at an airspeed sufficiently low to hold engine speed within reasonable limits.

Fifth: Adjust throttles on remaining engines to hold necessary airspeed.

V. PROCEDURE TO BE FOLLOWED IN THE EVENT OF A RUNAWAY PROPELLER (Cont'd):

There is no mistaking the evidence of a sustained overspeed and the immediate possibility of damage is so great that the pilot should, without hesitation, take action to reduce this possibility. The correct procedure is to reduce the airplane speed to the practical minimum so that windmilling rpm is held down. ONLY WHEN THE RPM IS REDUCED SHOULD THE PROPELLER BE FEATHERED.

WARNING
Prior to unfeathering in flight, the airspeed should be reduced to approximately the practical minimum for level flight.

As it takes considerable time to lower the speed of modern airplanes, the second and third steps can be taken during this period. The danger of fire in the event of mechanical failure is lessened by cutting the mixture and turning off the ignition.

While it would be almost an instinctive act to hit the feathering button as soon as trouble asserts itself, a little study will show that the delay in feathering as outlined is more sound. In all probability the cause of the runaway is malfunctioning of the pitch increase system. Feathering is accomplished by boosting pressure in this same system and is more likely to be completed if the loads opposing a return to high pitch are reduced. These opposing loads are the results of the dynamic forces acting on the blades and they increase with the square of the rpm. At runaway speeds, the dynamic forces are of such high magnitude that the malfunctioning system probably cannot hold the increased loads and the reserve of feathering power will be dissipated futilely. By reducing the rpm, and consequently the dynamic forces, the chances of feathering are increased as the load is then more probably within the holding capacity of the malfunctioning system.

Experience has proved that quick action in lowering the airplane speed will be effective in bringing the engine rpm under control. The delay caused by a futile attempt at feathering exposes the engine to loads which may be destructive.

By following the procedure outlined, the pilot will be taking the action which will most probably permit feathering and thus allow a continuation of the flight on the remaining engines unhampered by a windmilling propeller. If a procedure is taken which results in inability to feather, the remainder of the flight must be flown at a undesirably low speed hampered by the drag of the windmilling propeller.

VI. THREE-ENGINE FERRY FLIGHTS:

1. Operating Limitations:

a. Maximum take-off weight is 51,000 pounds. To find the basic empty weight of the aircraft for this condition, subtract from the basic empty weight (domestic) the weight of the following items--if removed from the aircraft:

Stewardess (2) @ 130 lb.	260 lb.
Propeller	446
Oil (if drained from inoperative engine tank) - 20 gal. at 7.5	150
Water - 8 gal. @ 8 lb.	64
Long Range Radio Equipment	
ART - 13 transmitters (2) @ 67	134
ART - 13 Dynamotors (2) @ 30	60
ART - 348 Receivers (2) @ 35.5	71
Buffet Equipment	
Beverage Jugs (4) @ 10.5	42
Casserole Carriers (10) @ 13.5	135
Tray Carriers (8) @ 20	160
Cabin Equipment	
Blankets (50) @ 2 lb. 3 oz.	108
Pillows (50) @ 2 lb.	100
Stewardess Kit	11

b. Center of gravity limits - same as for normal operation.

c. Minimum take-off climb speed is 111 mph TIAS.

d. Only crew members essential to the purpose of the flight are to be carried. This is interpreted to mean the Captain, First Officer, and mechanic, if, in the opinion of the Captain, the presence of a mechanic will add to the safety of the flight.

e. No passengers or cargo are to be transported.

VI. THREE-ENGINE FERRY FLIGHTS (Cont'd):

2. Operating Procedures for All Three-Engine Take-Offs:

a. AFTER COMPLETION OF NORMAL RUN-UP OF OPERATING ENGINES, THE FOLLOWING STEPS WILL BE TAKEN PRIOR TO ENTRY TO THE TAKE-OFF RUNWAY:

(1) Inoperative engine propeller feathered or removed.
(2) Tank selector valve for inoperative engine "OFF".
(3) Cross-feed valve for inoperative engine "OFF".
(4) Ignition switch for inoperative engine "OFF".
(5) Cowl flaps for inoperative engine "CLOSED".
(6) Electric fuel booster pump for inoperative engine "OFF".
(7) Generator switch for inoperative engine "OFF".
(8) Vacuum selector valve "ON" for operating engine, if inoperative engine is either inboard engine.
(9) Rudder trim tab setting:
  (a) Outboard engine inoperative - $3\frac{1}{2}$ to maximum of 5° toward full power side.
  (b) Inboard engine inoperative - zero tab setting at start of take-off. Corrective tab to be applied by pilot as needed.

b. Take-Off

(1) Hold brakes.
(2) Advance balanced power to maximum for take-off on the two symetrical engines.
(3) Advance third engine power to approximately 30 In. Hg.
(4) Release brakes.
(5) Maintain directional control by positive forward pressure on control yoke, thus holding nose wheel firmly on runway.
(6) As aircraft accelerates, increase power on third engine slowly. Power application at this point to be dependent upon directional control.

VI. THREE-ENGINE FERRY FLIGHTS (Cont'd):

b. Take-Off (Cont'd):

(7) Hold nose wheel on runway until a minimum of 100 mph, TIAS is attained.

(8) Upon reaching the above airspeed, lift the nose wheel off the runway. Full take-off power should be attained on the third engine at this speed. The tendency of the airplane to yaw toward the dead engine will reach its maximum at this speed. Application of partial rudder will correct this tendency, and directional control can be consistently maintained. During this portion of the take-off run, the main wheels are still on the ground but acceleration is appreciably increased by raising the nose wheel. Fly, do not "pull" the airplane off the ground. The acceleration between the time that the nose wheel is raised and correction for induced yaw has been applied and the time that the airplane is flown off the ground will be such as to provide adequate rudder control when airborne. The tendency described above is distinctly noticeable if either outboard engine is inoperative. This tendency is extremely short-lived due to the rapid increase in airspeed after the main landing gear leaves the runway. No difficulty in maintaining directional control is evident when TIAS of 115 mph, or above, has been attained.

(9) Initial climb to 50 feet should be made at not less than 111 mph, TIAS.

(10) Flap retraction should be normal as in four-engine take-offs.

(11) As the No. 1 engine is critical, controllability is improved when No. 4 engine is inoperative.

(12) When either of the inboard engines is inoperative, the yawing effect is reduced to a minimum. The only appreciable difference from a normal four-engine take-off is a slower rate of acceleration.

VII. Smoke Evacuation Procedures

In conjunction with smoke evacuation procedures, it must be remembered that in combating and control of smoke in an aircraft, sound judgment and team work are absolute necessities. The merits of removal of smoke versus the possibility of fanning the fire must be given the proper evaluation. The possibility of smoke asphyxiation of passengers and crew while attempting to smother the fire and control it with fire extinguishers must be considered.

Flight Procedure

Cockpit

1. Open door between cockpit and buffet compartment.
2. Open the two forward cabin emergency exit windows.
3. If necessary, open pilot's and copilot's side windows.

Cabin

1. Close door between cockpit and buffet compartment.
2. Open either the two forward emergency exit windows or the two aft emergency exit windows depending on whether the smoke source is in the forward or aft section of the cabin.

NOTE: Do not open forward and aft emergency exit windows at the same time, as this reduces the evacuation rate.

General

1. If the smoke source is the nose wheel compartment, smoke evacuation should not be attempted due to the hazard of drawing smoke into the flight compartment across pilot's face, unless smoke is already dense in the cockpit.
2. With smoke in the forward or rear belly compartments, practically no smoke will penetrate the cockpit or cabin unless a smoke evacuation procedure is carried out; therefore, no smoke evacuation procedure should be initiated under these circumstances.
3. Smoke in the lavatories can be quickly eliminated by opening the aft bulkhead maintenance service door.
4. The effect of opening the pilot's entrance door is undesirable. It creates a turbulent condition which seems to hold smoke around the pilot's head. In the case of smoke, opening this door draws the smoke into the cockpit.

General (Cont'd)

5. Opening the pilot's and copilot's clear view windows in conjunction with the two forward cabin emergency exit windows is very effective when the smoke source is in the cabin or flight compartment. In this case the cockpit to buffet door must be open. This procedure is not satisfactory if the smoke source is in the nose compartment or belly bins as the smoke would be drawn across the pilots' faces.

I. LOCATION OF BASIC COMPONENTS OF EQUIPMENT:

A. Equipment in Rack:

1.	One RTA-1B	HF Communications Unit
2.	One ARC-1	VHF Communications Unit
3.	One MN53	Marker Receiver
4.	Two MN26	ADF Compass Receivers
5.	One 89 ARN5	Glide Path Receiver
6.	One RC 103	Localizer Receiver
7.	One MI32	Interphone Amplifier
8.	All	Circuit Breakers
9.	One	Paging Amplifier (after rack)

B. Equipment on Pedestal:

1. One control assembly consisting of two sections MS-114A and MS-115A

C. Equipment in Cockpit Overhead:

1. One MR15 crank for MN54 manual loop.

D. Equipment located on Instrument Panel:

1.	Two	Double Pointer Azimuth Indicators (ADF)
2.	Two I-101C	Localizer & Glide Path Indicators
3.	Two	Set Marker Lights

E. Equipment at Captain's, First Officer's, and Observer's Position:

1.	One MS92C	Audio Control Box
2.	One 631B	Microphone
3.	One 1019A	Headset
4.	One	Jack Box for Paging System

All circuit breakers are accessible from cockpit and are located just aft of Captain's position.

F. Equipment at Stewardess' Position:

1. One CSR 407 Stewardess Call Station

I. LOCATION OF BASIC COMPONENTS OF EQUIPMENT (Cont'd):

G. Antennae:

1. Main Transmitting Antenna for RTA-1B Communications unit runs from the tip of the rudder to a position above the radio rack and is approximately 70 feet long.
2. Sense Antennae for the MN26 units are located on the belly of the airplane to the left and to the right of the center line from approximately the nose wheel position on back to the forward belly cargo door.
3. Loop Antennae for each MN26 ADF unit are located along the center line of the airplane on the belly, aft of the storage batteries.
4. Manual Loop Antennae for the Captain's MN26 RED ADF unit is located on top of the airplane above the cockpit enclosure.
5. Localizer and Glide Path Antennae is located on top of the airplane along the center line, just over the observer's position.
6. VHF Antennae is located on bottom center line aft of battery compartments and forward of loops.
7. Marker Antennae is located on the belly of the airplane directly aft of the loop antennae.

II. DESCRIPTION OF EQUIPMENT:

A. Control Assembly

The pedestal control assembly combines all the operating controls for all radio units. This assembly is mounted on the control pedestal, and its functions are shown in the accompanying illustration. This control panel is most versatile, enabling the Captain or First Officer to select at will any radio unit desired. ADF knobs are colored to correspond with their group operation. All controls and their functions are described in the following paragraphs. Starting from left to right these are:

Section No.	Fig. No.	Color	Use
MS-114-A	1	Red	ADF Captains, beat oscillator on OFF switch, automatic compass band change switch, tuning control, ADF volume control, loop rotator, function switch.

II. DESCRIPTION OF EQUIPMENT (Cont'd):

A. Control Assembly (Cont'd):

Section No.	Fig. No.	Color	Use
MS-114-A	2	Black	H.F. Communications volume control and frequency selector.
MS-114-A	3	Black	Instrument approach channel selector and volume control localizer and glide path.
MS-115-A	4	Green	ADF First Officers, Beat Oscillator on Off Switch; automatic compass band change switch, tuning control, ADF volume control, loop rotator, function switch.
MS-115-A	5	Black	VHF communications volume control, channel selector, guard channel selector.
MS-115-A	6	Black	Marker Sensitivity Selector.

B. Operation of Control Assembly:

Turn on the master circuit breaker. Operation of the various equipment controls is described in following paragraphs covering the operation of individual units.

1. Circuit Breaker Panel - The master circuit breaker turns on all radio equipment. All circuit breakers are of the lever "trip free" type. "Trip free" means that during an electric overload, the circuit breaker cannot be held on by holding the lever up.

2. Operation of Circuit Breakers - All circuit breakers should be in the "ON" position. Should a circuit breaker trip off, indicating an electrical short-circuit in that particular circuit, allow 30 seconds for the breaker to cool off, then push lever to "ON" position and if the overload circuit has been eliminated, the lever will stay on. If desired, a circuit breaker may be used as a switch by manually pulling the breaker lever down to "OFF" position.

III. MS 92C JACK BOX:

A. Description:

This unit of equipment permits selection of any or all receiver outputs by operating the toggle switches on the lower part of the jack box. Adjustment of receiver audio level is made by proper setting of sensitivity controls at the pedestal control assembly; the whole is then adjusted over limits by adjustment of the audio control located on the MS 92C jack box. This control will not provide complete or even partial cut-off of audio, and its function is not to be construed as an audio output control. It is merely a level adjustment to compensate for different levels of hearing. A microphone selector permits selection of "VHF" communications, "HF" communications, "Cockpit Interphone" and "Cabin Interphone". When the switch is in the "Cockpit" or "Phone" position, closing the microphone button energizes a relay which disconnects and grounds all inputs to the amplifier, excepting the interphone and permits amplification of microphone voltage through to the headsets. When the microphone selector switch is held in call position, this signals the stewardess by operating the cabin buzzers; one of which is located on the stewardess' radio panel and the other in the buffet position.

In addition, a filter switch is provided to permit filtering for either ADF receiver. When "range" or "voice" position is used on Red ADF, the Green ADF will be on "both". When Green ADF is in "range" or "voice", the Red ADF will be on "both".

If failure of an output box should occur, flip the guard back on the "Auxiliary" "Normal" switch and move the switch to "Auxiliary" position. This permits reception of only one receiver at a time, and toggle switches for all other receivers should be turned off.

B. Operation of Jack Box:

In operating this jack box, the pilot usually sets his filter selector to "both" unless filter action is desired. The microphone selector is set to either "HF Comm" or "VHF Comm", depending on which transmitter is required. Select output of any receiver by snapping "ON" the respective receiver toggle switch. Any receivers not required for that particular function should have their switches left in the "OFF" position. The isolation provided by these selector boxes is complete, and any selection combination of one box does not in any way interfere with the functioning of another. The audio level control is to adjust for different levels of hearing and should be set for optimum level.

IV. STEWARDESS CALL AND INTERPHONE POSITION:

A. The stewardess call and phone system depends upon the MS 92C audio control box and an interphone amplifier for its operation. The stewardess equipment consists of a hand set with a push button, a selector switch, a buzzer and an additional buzzer located in the buffet compartment.

B. Operation of Equipment - The Captain or First Officer may signal intent of communication by holding the microphone selector switch in call position. The call switch turns on a light on the jack box and sounds the buzzers in the cabin compartment. The stewardess will acknowledge the call by conventional use of the hand set. The Captain, First Officer, or observer may then talk with the stewardess by turning on the toggle switch marked "Inter" and setting his microphone selector switch to "phone", pressing his microphone button and speaking. The stewardess must press the button located on the neck of her handset in order to talk. Upon completion of the call, the microphone selector switch should be returned to "Cockpit" or "Transmit" position. If the stewardess wishes to call the Captain or First Officer, she picks up her handset and presses the button on this set. Upon noting the call light, the Captain or First Officer should, if not busy on the radio, turn his microphone selector switch to "Phone" and verbally acknowledge the call.

V. RTA-1B COMMUNICATIONS UNIT:

A. Description:

This unit is a crystal controlled transmitter-receiver capable of 10 channel operation on any frequency determined by the setting of the "HF Chan" selector. Frequency selection is obtained by setting the selector marked "HF Chan" to the proper channel. Volume adjustment is obtained by variation of the control marked "HF VOL". Both controls are located on the Control Assembly.

B. Operation of RTA-1B:

1. Turn unit on by operating channel selector marked "HF Chan" to desired channel (Control Assembly).
2. Turn switch marked "HF Comm" to "ON" position (MS-92C Jack Box).
3. Turn Volume control marked "HF VOL" until background noise or signal is heard (Control Assembly).

V. RTA-1B COMMUNICATIONS UNIT (Cont'd):

B. Operation of RTA-1B (Cont'd):

4. Set microphone selector to "HF Comm" (MS-92C Jack Box).

5. Press microphone button and talk for transmission.

6. Release microphone button for reception.

VI. ARC-1 VHF COMMUNICATIONS UNIT:

This unit is a transmitter-receiver equipped for 20 channels of crystal controlled frequencies. In addition, one channel "Guard Channel" is provided as a common frequency for communication between any airplane of any airline. (Presently the guard channel is not in effect.) The transmitter section is capable of operating on any pre-set frequency from 100 to 150 megacycles. It is unique in that the same crystals that controlled the frequency for transmission are also used for reception.

In normal operation no background noise will be heard from this receiver. This is due to the action of the squelch, which renders the audio circuit inoperative unless a signal of sufficient strength is available. When this signal passes through the receiver, its volume may be controlled by manipulation of the "VHF Volume" control. Frequency selection is obtained through settings of the "VHF Comm" channel selector.

A. ARC-1 Description:

Line-of-sight communications is normally necessary for satisfactory performance of the radio set; therefore, any metal object between the transmitting and receiving antennae may make communication difficult or impossible due to low strength or garbled reception. This is the result not of faulty operation but of the characteristics of radio waves at the frequencies used.

The following table lists the approximate range to be expected, assuming that communication is taking place between an airplane and ground station over level country:

Absolute Altitude of Airplane Above Terrain	Approximate Range
250 feet	20 miles
1,000 feet	40 miles
3,000 feet	70 miles
5,000 feet	90 miles
10,000 feet	120 miles
15,000 feet	150 miles

VI. ARC-1 VHF COMMUNICATIONS UNIT (Cont'd):

B. Operation of ARC-1:

1. Turn unit on by setting selector switch marked "VHF Communications Channel Selector" to desired channel. (MS-115A Control Panel)

2. Turn switch marked "VHF Comm" to "ON" position (MS-92C Jack Box).

3. Set microphone selector to "VHF Comm." (MS-92C Jack Box).

4. Adjust "VHF COMM.VOL." to approximately 3/4 full on position. (MS-115A Control Panel)

5. Press microphone button and talk for transmission.

6. Release microphone button for reception.

VII. ARN-5 GLIDE PATH RECEIVER:

A. Description:

This receiver provides visual indication of the position of the airplane with respect to the radio glide path, such indications being displayed on the horizontal needle of the cross-pointer indicators located on the instrument panel in front of the Captain and First Officer. The receiver is crystal controlled and operates on one of three frequencies from which selection may be made simultaneously with the localizer receiver. The table below shows the glide path frequencies in relation to localizer selector channels:

CHANNEL	GLIDE PATH FREQUENCY (MCS)	LOCALIZER FREQUENCY (MCS)
U		108.3
V		108.7
W		109.1
X	332.6	109.5
Y	333.8	109.9
Z	335.0	110.3

VII. ARN-5 GLIDE PATH RECEIVER (Cont'd):

A. Description (Cont'd):

No audio output is available for the glide path receiver and operational controls are kept at a minimum. The only indications of operation are movements of the horizontal needle and the flag alarm on the cross-pointer instruments located on the instrument panel. Unreliable indications are noted when the red glide path flag marked "OFF" appears. This indicates either faulty ground or airborne equipment or that the airplane is too far from the station to receive a reliable signal.

B. Operation of ARN-5 Glide Path:

This unit is turned on when the localizer channel selector marked "INST APP" is turned to any of the six marked positions.

Operation is indicated by movement of the horizontal needle or flag on the cross-pointer indicators.

VIII. RC-103 LOCALIZER:

A. Description:

This receiver is a six channel crystal controlled superhetrodyne receiver. The output of this unit is both visual and aural. The visual indication is displayed on the cross-pointer indicators by deflections of the vertical needle. The audio output is fed to the Jack Box (MS-92C).

B. Operation of RC-103 Localizer:

1. Turn unit on by turning channel selector marked "INST. APP. CHAN." desired channel. (MS-114A Control Panel) Consult Airways chart for proper channel at the field from which you are operating.
2. To monitor signal, turn switch marked "INST. APP." on MS-92C Jack Box to "ON" position.
3. Adjust audio volume level by setting control marked "INST.APP.VOL." (MS-114A Control Panel). Settings of this audio control <u>do not</u> affect cross-pointer indications.
4. Vertical needle should move left or right according to location of the aircraft in respect to the yellow or blue area. (Instrument Panel)
5. Unreliable indications are noted when the red localizer flag marked "OFF" appears. This indicates either faulty ground or airborne equipment or that the airplane is too far from the station to receive a reliable signal.

IX. MN53 MARKER RECEIVER:

A. Description:

This receiver is a crystal controlled superhetrodyne receiver operating on 75 megacycles and providing aural and visual indication of passage over "Z" markers, Fan Markers, Inner and Outer Markers. Choice of sensitivities is provided and audio output is available for all positions. The indicator lamps are located on instrument panel in front of the Captain and First Officer.

B. Operation of Equipment:

In order to operate this equipment, it is only necessary to have the Master Circuit Breaker in the "ON" position, turn the Marker Sensitivity selector located on the Control Assembly to "LO" or "HI" as desired. When flying at high altitudes, the "HI-LO" switch should be in the "HI" position; the reason for this is to allow the marker light to illuminate the same length of time as at lower altitudes. When flying at lower altitudes, the switch is left in "LO" position; this compensates for the increased signal strength of the marker station at low altitudes.

X. MN26 ADF COMPASS:

A. Description:

The MN26 type of ADF compass consists of a loop, sense antenna, control assembly, two autosyn indicators, and a receiver. Both 28 volts DC and 40 volts AC power are required to operate the compass.

The radio compass receiver utilizes signals transmitted from a range, commercial or standard broadcast radio station to obtain directional information. Under favorable conditions, stations up to 250 miles distance may provide the necessary signal to operate this equipment depending on the power of transmitting station. The radio compass is designated to perform the following functions:

1. Automatic direction finding of radio signals.

2. Aural reception of radio signals using the sense antenna.

3. Aural-reception of radio signals using a loop antenna reduction of precipitation static.

X. MN26 ADF COMPASS (Cont'd):

A. Description (Cont'd):

4. Aural-null (manual direction finding) of radio signals, using the loop antenna.

CW reception of signals is also possible for assisting the operator in taking aural-null bearings.

All indications of ADF readings are displayed on the dual azimuth indicators, located on instrument panel.

Continuous tuning within the bands listed below is available by manipulating the tuning crank located on the control assembly. Band selection is accomplished by settings of the band selectors mounted on the control assembly. When using compass in ADF position, do not depend on its aural signals for flying the radio range.

RED ADF		GREEN ADF	
Band	Frequency	Band	Frequency
1	200-410 KCS	1	200-410 KCS
2	410-850 KCS	2	550-1200 KCS
3	850-1750 KCS	3	2900-6000 KCS

B. Operation of MN26 ADF Receiver:

The control switch located on the control assembly marked "OFF", "COMP", "ANT", "LOOP" controls all receiver equipment identified with that particular color. Tuning and adjustment of signal level are controlled by means of a tuning crank and an audio control marked "ADF VOL". Rotation of the loop is accomplished automatically in Compass position. The loop on the Green ADF is rotated electrically by deflections of the Loop Rotator. A-MC-54 anti-static loop is located on top of the aircraft. This loop may be connected to the Red ADF by changing the toggle switch behind the pilot to manual position. Rotation of this loop is accomplished normally by the MR15 crank located above the Captain's head. Loop movement is indicated by movement of the Red ADF needle. All the controls marked RED are located on the pilot's side and control the RED ADF. All controls marked GREEN are located on the co-pilot's side and control the GREEN ADF.

X. MN26 ADF COMPASS (Cont'd):

C. Operation of MN26 ADF Compass:

1. Normal Reception (Sense Antenna)

a. Turn switch to "ANT"
b. Select desired frequency range
c. Turn "ON" the respective ADF audio switch (MS-92C)
d. Tune in station
e. Adjust "ADF VOL" for desired headset volume
f. Set desired position of RANGE FILTER (MS-92C)

2. Precipitation-static Reception (Loop)

a. Turn switch to "Loop"
b. Select desired frequency range
c. Turn "ON" the respective ADF audio switch
d. Tune in station; if signal appears weak, perform item (g)
e. Adjust "ADF VOL" for desired headset volume
f. Set desired position of RANGE FILTER
g. Rotate loop on Green ADF by deflecting "LOOP ROTATOR" for maximum output in headset (90 or 270 degrees on azimuth indicator for stations directly ahead or behind). When using the Red ADF either the MN-54 loop or the Red automatic loop. This toggle switch is located to the rear of the pilot on the radio junction box.
h. If station is to the left or right of the airplane's course occasionally adjust the azimuth control setting for maximum signal.

3. Automatic Direction Finding:

a. Turn switch to "COMP"
b. Select desired frequency range
c. Turn "ON" the respective ADF audio switch (MS-92C)
d. Tune in station
e. Adjust "ADF VOL" for desired headset volume
f. Read ADF Bearing, on MN42 indicators
g. Range filter not normally used

4. Manual Direction Finding (Aural-Null)

a. Tune in station as described in paragraph headed A. Normal Reception
b. Turn switch from "ANT" to "LOOP"

X. MN26 ADF COMPASS (Cont'd):

C. Operation of MN26 ADF Compass (Cont'd):

4. Manual Direction Finding (Aural-Null) (Cont'd):

c. Using LOOP ROTATOR on Green ADF and manual loop control MR15 on Red ADF, rotate loop through 360 degrees, two maximum and two minimum (null) signal conditions will be heard. The two nulls give a line of position, not a bearing, and one must omit the bearing indicated for 180 degree ambiguity. To improve null indication of weak signals, set CW switch to "ON" position.

d. Adjust VOL for desired headset volume.

I. POWER SUPPLY:

A. Generators:

The electrical system is of the single wire bus type in which the airplane's structure is used for the ground return except in the vicinity of the magnetic and flux gate compass, in which case the ground is away from the compass. The bus bars consist of round aluminum bars suitably insulated. The bus system runs from the main electrical system 28.5 - 24 volts D.C. current supplied by the generators and by two 12 volt batteries connected in series.

The 28.5 volt current is supplied by four type 1193-3-BC Eclipse generators. Each generator has a rated output of 200 amperes at 28.5 volts. A differential type reverse-current relay mounted in the firewall junction box of each nacelle protects the generator from damage resulting from reverse-current surges during generator operation. The relay opens when the generator voltage falls below that of the line voltage and prevents reverse-current from operating the generator as a motor. Through the reverse-current relay, an additional circuit connected to switches on the overhead electrical panel enables the pilot to cut each individual generator in or out of the main bus system. A master bar is installed on these switches and the battery switches, to enable all of these units to be simultaneously disconnected from the electrical system in an emergency.

Voltage control is achieved by a carbon pile type voltage regulator. There are four such regulators, one for each generator. They are installed in the lower section of the main cabin junction box. In this type of regulator, a carbon pile (a stack of carbon discs), is placed in series with the generator field circuit. The electrical resistance of the carbon pile <u>increases with a decrease in pressure</u> on the carbon pile and <u>decreases as the pressure increases</u>. This pressure is produced by means of a spring-loaded armature in the magnetic circuit of the regulator. When the output of the generator exceeds its critical voltage of 28.5 volts. A solenoid potential coil pulls the armature away from the carbon pile, thereby increasing the resistance of the field circuit. The increase in the generator field resistance in turn cuts down the generator output voltage. An equalizer winding in the magnetic circuit of the solenoid potential coil serves to change the resistance in the generator field circuits in such a way that the load (generator output) is evenly distributed among the generators.

I. POWER SUPPLY (Cont'd):

A. Generators (Cont'd):

Immediately after removal of the battery cart, each generator should be turned on. The Eclipse 1193-3-BC generators are wide range generators and can produce 200 amps at 1000 RPM. Therefore, it is not necessary to run the engine at high RPM for 28.5 volts on the bus system. During take-off and normal flight, no advantage is gained by having some of the switches in the "OFF" position, since the generators will still be producing the voltage. The voltage regulators are normally to be adjusted on the ground by a master voltmeter so that the generator will equalize the load properly. The voltage regulator is to be sealed, and the seal is only to be broken and the generator readjusted by a mechanic when the generators become out of balance of one another more than 20 amperes. In the event that a generator does not remain in satisfactory parallel operations (within 20 amperes of each other), it should be turned "OFF" for the remainder of the Flight.

B. Batteries:

The two 12 volt 88 ampere-hour storage batteries connected in series are located just aft of the nose wheel well and are accessible through the access doors in the lower surface of the fuselage. A ground power receptacle for external power source of 24-28 volts D.C. is located between the battery elevators. The airplane storage batteries and the external power supply are connected to the bus system through relays. The two relays, one for each source of supply, are mounted on the battery enclosure. The batteries are connected to the electrical system through a Type PR-1212 battery relay which is actuated when the master battery switch is turned to the "Ships Battery" position.

When an external power source is used, the master battery switch must be in the "Battery Cart" position. It is not possible to switch to ship's battery as long as the battery cart is plugged in.

C. Inverters:

Two 2000 volt ampere and one 250 volt ampere inverters supply AC current to the electrical instruments, auto pilot, and flux gate compass. The small inverter will operate the instruments and flux gate compass but not the auto pilot. Any of the three inverters may be selected by the use of a rotary switch on the pilot's overhead switch panel. The inverters operate on the 24 to 28 bus system and have an output of 115 volt 400 cycle AC current. This voltage and frequency is indicated by 2 meters on the pilot's upper instrument panel. The frequency should be between 360 and 440 cycles; the voltage between 110 and 125 volts AC.

I. POWER SUPPLY (Cont'd):

D. Voltmeter and Ammeter:

The D-C voltmeter is located on the pilot's upper instrument panel and may be used to read bus voltage as well as the voltage on each generator. Two dual ammeters are also located on the upper panel and are direct reading for all four generators.

E. Circuit Breakers:

Circuit breakers are installed in the main electrical junction box for individual circuit protection against faults and overloads. Two types of circuit breakers are used: the "trip-free" type and the "non-trip free" type.

The "trip-free" type utilizes a toggle bar for its operation and is used for the majority of the circuits. In the event of a fault, the toggle trips to the "OFF" position, thus opening the circuit. The circuit breaker may be reset by throwing the toggle to the "ON" position; if the fault is cleared, the toggle will remain in place; if not, the breaker will remain open although the toggle indicates "ON". Before resetting, allow the breaker to cool for approximately fifteen (15) seconds.

The "non-trip-free" type uses a toggle bar for its operation, and these breakers serve to protect the fuel pumps and the propeller feathering control circuits. These circuit breakers are grouped together on the lower right-hand side of the circuit breaker panel. A guard is installed on the toggle to prevent accidental tripping of the fuel pump breakers. No guard is provided for the propeller feathering breaker which is similar in appearance to the "trip free" breaker. In the event of a fault in one of these circuits, the associated circuit breaker trips. This is indicated by the toggle moving to the "off" position. If the fault is cleared, the toggle bar will remain in place when reset. If not, the breaker will trip again. Before resetting, allow the breaker to cool for approximately fifteen (15) seconds.

Emergency Operations:

In the event that operation of the equipment protected by "non-trip free" circuit breakers is essential to safe continuance of flight, these breakers may be manually held closed, even though a fault exists. Caution: It should be realized that damage to the equipment protected by this circuit breaker or to the airplane may result due to this emergency operation.

II. POWER PLANT SYSTEM:

General

The power plant electrical system includes the primer, booster, starter, ignition, cowl flaps, propeller feathering, propeller de-icing, and carburetor alcohol circuits. Each circuit has an identical hookup for each engine. All are protected in the main junction box, with the exception of the ignition, which is a magneto ground circuit. Control switches for all these circuits, except ignition, are located on the overhead electrical panel. The primer, booster, and starter switches are grouped together for each engine. These are momentary contact switches, and they return to the "OFF" position when released. Electric head governors and magnesyn circuits are also contained in this group.

A. Booster Coil:

An Eclipse high tension booster coil is provided to assist in starting one coil for each engine. A booster switch for each engine is grouped with the starter and primer switches.

B. Engine Starter Circuit:

A direct cranking type electric starter is mounted on each engine. Closing the starter switch closes the starter relay mounted in the firewall junction box behind each engine. This causes the starter to engage the engine and turn the crankshaft.

C. Starting Engine:

A solenoid-operated primer valve is mounted on each carburetor and by pushing the primer switch on the upper electrical panel, fuel is projected into the carburetor throat to aid in starting a cold engine. Fuel pressure must be raised by use of the electrical fuel pumps prior to using the primer. Engine starting should always be done from an external power supply when this is available, as the starter draws a maximum of 300 amperes when the engine and oil are cold. This heavy load is extremely hard on the battery, and can be drawn for only a very short period. However, once the engine has been started and run at 1500 RPM or more, its generator will assume part of the load in starting the second engine. Two engines operating will handle the engine starting load of the remaining two engines.

II. POWER PLANT SYSTEM (Cont'd):

D. Starting Engine with Electrical Starter Inoperative:

In case a starter becomes inoperative on the DC-4 airplane at an intermediate station, the scheduled operation may be continued by following the procedure outlined below:

1. With the propeller on the engine concerned in full low pitch, pencil an index mark across the hub and blade.

2. Depress feathering button until the marks are 1" apart, then pull feathering button out. The propeller blades will now be set at the proper angle to accomplish the following.

3. After plane is completely loaded except for passengers, the Captain will start all engines but the one with the defective starter.

4. Captain will then similate a take-off run using 50" Hg. and 2700 RPM on the three operating engines, but will not leave the ground. On a 5000 foot runway, the plane can reach an airspeed of 90 MPH, and on a 6000 foot runway 100 MPH safely, without excessive braking.

5. The First Officer will start the engine concerned by using the following procedure:

   a. Mixture - - - - - - - Auto Rich
   b. Ignition - - - - - - On
   c. Throttle - - - - - - Quarter Open
   d. Fuel Booster Pump - - Off

When the propeller on the dead engine starts to windmill, the primer and booster will be used.

6. After the engine has started the airplane will be returned to the ramp to load passengers, stopping all engines except the one with defective starter.

7. The airplane will be removed from service for starter replacement at the first station that has maintenance facilities or at termination of the scheduled trip.

II. POWER PLANT SYSTEM (Cont'd):

E. Propeller Feathering Circuit:

The propeller feathering circuit includes the pilot's feathering switch, feathering relay, feathering pump, "non-trip-free" circuit breaker, and pressure cutout switch.

F. Pilot's Switch and Feathering Relay:

The pilot's switch is of the push-button type and incorporates a holding coil. This coil, when its circuit is closed, holds the switch in the "ON" position against a spring which tends to return it to "OFF" as the feathering operation is completed. Pushing the switch causes the feathering relay to close and also energizes the holding coil. This circuit is protected by a "non-trip-free" circuit breaker in the main junction box.

NOTE: Do not hold the feathering switch depressed during the feathering operation. The switch button will automatically return to "OFF" when feathering is completed. Should it fail to pop out (off position), pull the button out by hand.

G. Pressure Cutout Switch:

This switch is mounted on the propeller governor-high pressure feathering line and is wired in series with the pilot's switch holding coil. The switch consists of a piston linked with a set of contacts held closed by a heavy spring. The piston is exposed to the feathering oil. When feathering has been completed, the oil pressure builds up to 400 lbs. per sq.in., and moves the piston, opening the switch. This de-energizes the holding coil which allows the pilots' switch to open and in turn opens the feathering relay and stops the pump.

H. Propeller Anti-Ice Circuit:

An electrically driven propeller anti-icer pump, located in the fuselage hydraulic compartment, is operated by means of a switch on the overhead electrical panel. This pump sends alcohol to the hubs, which in turn is distributed to the blades of each propeller. A warning light is installed adjacent to the switch to indicate when the pump is energized. Individual needle valves are located on the co-pilot's side of the cockpit. Flowmeters are installed to indicate flow to each propeller.

II. POWER PLANT SYSTEM (Cont'd):

I. Cowl Flaps:

An electric motor is installed on each engine mount to operate the cowl flaps. Current is supplied to each of these motors through a 20 amp. circuit breaker in the Nacelle junction box. Each motor is controlled by a four-position switch located under the overhead electrical panel. Two positions of this switch have momentary contacts, one to open the cowl flaps, the other to close them. When the switch is released from either of these positions, it may be returned to the "OFF" position. Limit switches installed in the motor shut off the current when the flaps reach the extreme position.

A single indicator with four pointers to indicate the position of the flaps of each engine is located on the upper instrument panel. Current for the flap position indicator is supplied through a 5 ampere circuit breaker in the main junction box. This circuit breaker also supplies current to the alcohol and hydraulic quantity indicators.

III. EQUIPMENT:

A. Electrically Driven Fuel Pumps:

Six (6) electrically driven fuel pumps are provided, one located in each tank. Each motor is controlled by an individual switch located on the overhead electrical panel. These circuits are protected by "non-trip-free" circuit breakers in the main junction box.

B. Carburetor and Windshield De-Icer Systems:

A single pump supplies alcohol for de-icing the carburetor air intake manifolds on each engine, and the front windshield in the flight compartment. Each engine circuit is controlled by a separate momentary contact switch located on the overhead electrical panel. The switch for the pump is also located on the overhead switch panel and to the right of the switch is an amber light indicating "ON" and "OFF". When the de-icer pump switch is "ON", the pump forces alcohol from the supply tank to the de-icer manifold. When any one of the induction de-icing switches is held closed, a solenoid valve in the alcohol line to the engine involved is opened.

Alcohol for windshield de-icing is controlled by a needle valve located on the co-pilot's side of the cockpit. The same pump furnishes alcohol to windshield, propellers, and carburetor.

III. EQUIPMENT (Cont'd):

C. Wing De-Icer Circuit:

An electrically driven de-icer compressed air distributing valve, located in the left hand rear section of the fuselage accessory compartment, is operated by means of a switch located on the overhead electrical panel. This motor driven valve distributes compressed air at regular intervals to the rubber de-icer boots on the leading edge of the wings and empennage. The unit is so arranged that it will continue to operate after the pilot's switch has been opened until air has been exhausted from all the de-icer boots.

IV. INSTRUMENTS:

A. Outside Air Temperature Indicator:

An outside air temperature indicator is located on the pilot's instrument panel. The indicator is connected to a temperature bulb located just to the left of the nose wheel well.

B. Carburetor and Oil Temperature Indicators:

Four dual indicators are installed on the center instrument panel and connected to temperature bulbs, one on each carburetor air scoop and one on each engine crankcase, and serve to indicate carburetor air temperatures and engine oil temperatures. Two of the dual indicators indicate the carburetor air temperature, and the other two dual indicators indicate the engine oil temperature for the four engines.

C. Pitot Heaters - Cabin Air Scoop De-Icer:

Each of the two pitot head tubes in the nose are equipped with 100 watt heaters. Current for the pitot heaters is supplied through two 10 ampere circuit breakers in the main junction box. The current controlled by single pole switches, located on the upper instrument panel also passes through a Weston ammeter located just below the switches. Current is supplied through a 20 ampere circuit breaker to the contacts of a solenoid which is actuated by the left pitot heater switch. From this solenoid, current is fed to a 350 watt heater in the cabin air scoop. Turning the left pitot heater on turns on the cabin air scoop de-icer at the same time.

IV. INSTRUMENTS (Cont'd):

D. Wing Flap Position Indicator:

A single magnesyn flap position indicator is located on the pilot's instrument panel and serves to indicate the position of the flaps. The flap-position transmitter is located in the fuselage inboard of the left flap and the actuating linkage is connected to the flap. The current for the circuit is supplied through a 5 ampere circuit breaker at the 26 volt - 400 cycles A.C. bus in the main junction box.

E. Fuel Quantity Indicators:

(Liquidometers will be used temporarily. When the magnysn system is installed, this page will be rewritten.)

Liquidometer indicators are mounted on the co-pilot's instrument panel, one for each main wing tank and a dual indicator for the two auxiliary wing tanks.

By use of "Two-Step" fuel quantity transmitters, a full range quantity indication of the fuel in the tanks is obtained without the error that would otherwise be caused by fuel in the corners of a tilted tank. Two transmitter units of the float and arm type are installed in each inboard and each outboard tank, one slightly to the side and above the other. The indicator used with the inboard tanks is calibrated from 0 to 550 gallons. The lower transmitter measures the fuel quantity from 0 to 222 gallons. At 222 gallons the upper transmitter picks up the measure by means of a transfer switch located at the end of the resistance strip in the lower transmitter unit and measures the fuel quantity to the "Full" position. The transmitter system used in the auxiliary tanks is the same as that of the inboard tanks except that the dual indicator is calibrated from 0 to 500 gallons and the transfer point of the transmitter is set at 164 gallons.

The system used with the outer wing tanks is similar to that outlined above except that, due to the extreme dihedral of the wing, it is necessary to use "Three-Step" transmitters in each outer wing tank.

F. Fuel, Oil, and Manifold Pressure Indicators:

This instrument system is composed of six dual magnesyn fuel, oil and manifold pressure indicators located on the center instrument panel. It also includes four magnesyn oil pressure, fuel pressure, and manifold pressure transmitters, one of each being located on the aft side of each engine carburetor air scoop.

IV. INSTRUMENTS (Cont'd):

F. Fuel, Oil, and Manifold Pressure Indicators (Cont'd):

Current for each dual indicator and for the corresponding fuel, oil or manifold pressure transmitters is drawn through a 5 ampere circuit breaker from the 26 volt 400 cycle A.C. bus in the main cabin junction box.

G. Alcohol Quantity Indicator:

An alcohol quantity indicator is located on the co-pilot's side of the cockpit and is actuated electrically by a transmitter unit located in the alcohol tank.

H. Hydraulic Quantity Indicator:

A hydraulic fluid quantity indicator is located on the right-hand side of the cockpit and is actuated electrically by a transmitter unit located in the hydraulic fluid tank.

I. Oil Quantity Indicator:

Two dual autosyn oil quantity indicators are located on the co-pilot's instrument panel. An autosyn oil quantity transmitter is located in the oil tank in each nacelle.

Current for each dual indicator and for the corresponding oil quantity transmitters is supplied through a 5 ampere circuit breaker from the 26 volt 400 cycle A.C. bus in the main junction box.

V. LIGHTING:

A. Warning Lights:

1. Oil Pressure Warning Light:

One of four AMBER oil pressure warning lights is illuminated whenever the oil pressure for the respective engine drops below 45 psi. The warning lights are located on the center instrument panel just below the oil pressure indicators. An oil pressure switch is located in each nacelle.

V. LIGHTING (Cont'd):

A. Warning Lights (Cont'd):

2. Fuel Pressure Warning Light:

One of four RED fuel pressure warning lights is illuminated whenever the fuel pressure for the respective engine drops below 12 psi. The warning lights are located on the center instrument panel just below the fuel pressure indicators. A fuel pressure switch is located in each nacelle.

Current for the oil and fuel pressure warning lights is supplied through a 5 ampere circuit breaker in the main junction box.

3. Landing Gear Warning System:

This circuit consists of an "UP" and "DOWN" switch on each main landing gear and on the nose wheel gear, a throttle switch, landing gear lever indicating switch, warning horn, warning lights and the necessary wiring.

The single throw "UP" switches are mounted in the wheel wells and open when the landing gear reaches its full up position.

The double throw "DOWN" switches are mounted in the middle of the main landing gear drag linkage and on the nose wheel shock absorber. They move to the unsafe position when the gear is in any position other than the full down and latched.

The double throw landing gear lever indicating switch is installed adjacent to the landing gear control lever and is actuated by the lever.

The double-pole-single-throw throttle switch closes when any or all throttles are brought to within one inch handle travel of full closed. With this switch closed, the warning horn mounted on the ceiling of the pilot's compartment will blow and the red landing gear unsafe light will come on if the landing gear is in any position other than full down and latched.

The landing gear warning lights are mounted on the lower right-hand side of the pilot's instrument panel. There are three green "safe" lights, one for each gear, and one red "unsafe" light. These dual

V. LIGHTING (Cont'd):

A. Warning Lights (Cont'd):

3. Landing Gear Warning System (Cont'd):

lights incorporate two bulbs with bayonet-type sockets as a safety feature in case of bulb burn out. They may be dimmed with the warning light dimming switch to the left of the warning lights which introduces a small resistance into each lamp circuit.

The green lights burn only when their respective units of the gear are full down and latched and the landing gear control lever is in the full down position.

If any one or all of the units of the gear are in any position between latched down and fully retracted, the red light will burn. The red light is not on with the landing gear retracted unless the throttle is closed, which also sounds the warning horn.

4. Landing Gear Control Safety Pin:

The safety pin is provided to eliminate the possibility of retracting the landing gear with the airplane on the ground. This is accomplished by a solenoid-operated pin which blocks movement of the landing gear control lever. The pin solenoid is controlled by a switch mounted on the right-hand main landing gear strut. A rod connected to the strut torque linkage keeps the switch open and the pin on until the strut moves to within one inch of full expansion, i.e., until nearly all weight is off the gear. The solenoid may be released manually through the hole below and to the right of the gear lever, should the solenoid fail to function.

5. Door Warning Lights:

A door warning light located above the gear warning lights is illuminated whenever any one of the main access doors is unlatched or open. Each door is provided with a micro-switch which is opened by a plunger actuated by the door latch. The switches are adjusted to open only when the door is fully latched.

V. LIGHTING (Cont'd):

A. Warning Lights (Cont'd):

6. Fire Warning Lights:

Red warning lights are installed just below the glare shield adjacent to their respective fire extinguisher controls.

Dual lights have been provided for engine fire detection and wired to indicate the engine and zone from which the fire warning is received.

Fire warning lights for the baggage bins and heaters are connected so both sides of the respective light indicate a bin or heater fire. Since no means have been provided for checking the heater warning lights, the dual bulbs give an increased safety factor against burned-out filaments.

7. Fire Extinguishers:

Extinguishers are operated by the manually operated control handle.

B. Exterior Lights:

1. Navigation Lights:

Six navigation lights have been installed; a red light on the left wing tip, a green light on the right wing tip, a red and white light on the tail, and a white light on the top and the bottom of the fuselage. A double throw switch installed on the left-hand side of the overhead electrical panel provides control of these lights. When this switch is placed in the "Flash" position, the wing tip lights and the red tail light are flashed alternately by means of the motor-driven flasher mechanism located in the main electrical junction box. Placing the double pole switch in the "Steady" position disconnects the flasher mechanism and turns on the wing tip lights and the white tail light with no flashing cycle.

2. Landing Lights:

The landing lights are of the retractable type, one installed on the bottom surface of each wing. The landing lights are retracted

V. LIGHTING (Cont'd):

B. Exterior Lights (Cont'd):

2. Landing Lights (Cont'd):

by means of an electric motor built into each light assembly. The motors are controlled by means of two switches, one for each landing light - located on the lower left-hand corner of the overhead electrical panel. The center position is "Off", the lower position is "Retract".

When any one of the switches is in the "Extended" position, it operates relay (located in the main junction box), which in turn energizes the landing light motor, causing the light to extend.

The landing lights are turned "On" by two single throw switches located to the right of the landing light motor switches on the overhead electrical panel. The lights may be turned "On" or "Off" while in any position.

3. Cargo Loading Light:

A light similar to the white belly navigation light has been installed forward of the front belly baggage bin to facilitate cargo handling. This light turns on with the cargo bin dome lights.

C. Cabin Lighting and Equipment:

1. Forward Cabin Lights and Equipment:

The forward cabin lights are supplied with current through a 10 ampere circuit breaker in the main junction box.

2. Rear Cabin Lights:

Illumination in the rear lavatory is provided by a ceiling light controlled by a toggle switch mounted on the inboard wall adjacent to the door. The mirror is illuminated by two lights - one on each side.

Immediately over the main cabin door a light is installed to provide illumination for the area surrounding the entrance. A switch is installed in the door frame which turns the light on whenever the door is opened. A switch is installed on the panel adjacent to the buffet to turn this light on when the door is closed.

V. LIGHTING (Cont'd):

C. Cabin Lighting and Equipment (Cont'd):

2. Rear Cabin Lights (Cont'd):

Current is supplied to the lights in the rear cabin through a 5 ampere circuit breaker located on the switch panel adjacent to the passenger entrance door.

3. Cabin Dome Lights:

A dome light is installed in each of the seven Anemostats distributed along the cabin heater duct. A switch installed on the buffet switch panel controls the brilliancy. The center position of this switch is "Off" - the up position turns the lights on "Bright", while the down position turns the lights on "Dim". Circuit protection is provided by a 10 ampere circuit breaker for the dome lights in Hostess Panel.

4. Passenger Reading Light:

Individual reading lights are provided for each seat, and are located in the hat rack. Slide button switches, mounted on the face of the reading light panels, permit separate control of each light. Three 15 ampere circuit breakers supply current to the left-hand and the right-hand cabin reading lights.

5. Passenger Warning Sign:

"No Smoking Please", and "Fasten Seat Belt" signs are mounted on the aft side of the front cabin bulkhead, the front side of the aft cabin bulkhead and the aft side of the bulkhead between the four seats and the cabin door. A switch mounted on the upper left-hand corner of the overhead electrical panel permits turning "On" the "No Smoking" sign in the up position. The "Fasten Seat Belt" sign is turned on by pressing the call button type switch which is to the right of the "No Smoking" switch.

6. Cabin Attendant Call System:

A call switch having an illuminated button is installed in each reading light panel for each row of seats, and one each in the washroom and lavatory. Hostess to pilot call is accomplished

V. LIGHTING (Cont'd):

C. Cabin Lighting and Equipment (Cont'd):

6. Cabin Attendant Call System (Cont'd):

through the handset mike switch to a light in cockpit jackboxes; Pilot to Hostess call by the call switch on cockpit jackboxes to a buzzer in the buffet and hostess panels. Turn call light out (including lavatory indicator on Hostess panel) by pulling switch out at station requiring attention.

Depressing any call button (except the Stewardess to Pilots' call button) sounds the chime, located on the rear of the forward coat-room partition, and lights the corresponding call light in the panels or Hostess junction box for lavatory call buttons. The light will be held "On" by the call button switch, until cleared by pulling out the switch button.

7. Buffet:

Electrically-heated liquid and solid food containers are installed in the buffet. Each unit is controlled by an "On-Off" switch type circuit breaker mounted on the front face of the buffet.

One light is installed above the work surface and is controlled by a switch on the buffet switch panel.

Power for the buffet equipment is supplied through a 15 ampere circuit breaker in the main junction box.

The buffet dome light is controlled by a double throw switch with a center "Off" position. Throwing the switch to the "Up" position gives full brilliancy while the "Down" position is dim.

8. Cabin Fans:

Twelve fans are located along the hat rack hand rails in the cabin and are controlled by individual switches. These fans are connected to the reading light circuit with two breakers at the Stewardess panel.

The fans may be used on the ground or in flight to give better circulation of cabin air for passenger comfort.

I. GENERAL:

The hydraulic system has been designed to operate the following:

A. Brake system
B. Wing flap system
C. Landing gear system
D. Nose wheel steering system
E. Windshield Wipers
F. Emergency fuel dump chutes

Utilization of 3000 psi pressures in place of medium high pressures on the larger type airplanes has resulted in a considerable saving in design weight. Normal operating pressures in this system range from 3000-2700 psi.

Fluid pressure is supplied by two pumps located one each on #2 and #3 engines. The pumps deliver pressure first to the regulator valve which maintains and regulates operating pressure in the system and keeps both of the main system accumulators charged. The engine driven pumps operate continuously while #2 and #3 engines are running; fluid not used for normal system operation is returned to resevoir through the regulator valve or a manually operated system by-pass valve. A system pressure gauge is tee'd into the accumulator line and is located on the right wall of the cockpit below the First Officer's side window.

The two main system accumulators serve several purposes:

A. To store hydraulic energy when the pumps are not supplying pressure to the system.

B. To store a reserve supply of pressure fluid which is instantly available if system demands exceed pump output.

C. To cushion or dampen system surges created by interrupting high pressure fluid flow through the system.

The wheel brakes are considered the most important units operated hydraulically. For this reason, fluid under pressure has been made available to the brakes at all times. Two selective relief valves, operating at 1800 psi, assure that the initial rise in system pressure from 0 - 1800 psi is at all times available to the brakes <u>only</u>. System pressures between 1800-3000 psi operate all units in the system. The use of two 1800 psi selective relief valves avoids unnecessary routing of hydraulic lines in the airplane, one of the selector relief valves serve the landing gear and wing flap systems located rearward and the second selective relief valve serves the nose wheel steering, windshield wiper and fuel dump chute systems located forward. This design offers a considerable saving in weight.

I. GENERAL (Cont'd):

A by-pass valve is provided in the system to by-pass hydraulic fluid from the pumps to the main system reservoir, when no pressure is necessary for operation of the hydraulic equipment. This valve is located in the hydraulic compartment above the main power manifold and is cable controlled by a handle in the floor to the left and rear of the First Officer's seat. It is recommended that this valve be placed in the "Open" (handle up) position at all times during normal cruising.

A KEARFOTT windshield wiper system is provided, which uses hydraulic fluid for operation. The shut-off control valve is located on the co-pilot's side of the cockpit. A single speed control valve regulates the speed of the blades up to 400 strokes per minute.

NOTE: As the windshield wiper operates off the hydraulic system, the system must be "OPERATIVE" or on, to use wiper for any length of time.

II. NOSE WHEEL STEERING SYSTEM:

A. General:

Steering is controlled by a wheel on the left side of the cockpit adjacent to the Captain's seat. Cables run from the control wheel to a differential gear unit and hydraulic control valve located in the left nose wheel tunnel. These operate two one-way actuating struts connected to a collar on the nose wheel shock absorber strut.

The steering mechanism can be operated whenever the airplane is on the ground, unless the nose shock absorber strut has been over-inflated or the center of gravity of the airplane moved so far to the rear that the shock strut is extended over 10".

When the load is removed from the nose wheel shock strut, or when the nose gear retracts, the steering mechanism will become inoperative as the piston in the shock strut reaches its extended position. When there is a load on the nose shock strut, the steering system shut-off valve is held "Open" allowing fluid to flow to the control valve; when the load is relieved, the shock strut extends, the centering cam on the strut bottoms and the shut-off "Closes". The centering cam is incorporated into the nose strut to return the nose wheel to a centered position at any time when strut extension exceeds 10". A tail heavy condition or an over-inflated nose strut may cause nose strut extension in excess of 10", resulting in a loss of nose wheel steering. Normally, for ground operation, the nose wheel may be turned 45° either side of center.

II. NOSE WHEEL STEERING SYSTEM (Cont'd):

B. Operation:

Pressure supply of hydraulic fluid to the slide type selector valve is controlled by the shut-off valve. Under normal conditions with no steering required and with the selector valve in "Neutral", the 3000 psi system pressure is closed off from the two nose wheel steering cylinders. The steering cylinders are then connected to the accumulator and the 150# pressure relief valve. Snubbing action of the nose gear is accomplished by an orifice check valve located back of each steering strut which restricts the flow from one cylinder to the other. Additional snubbing is accomplished by the 150 psi pressure maintained in the steering system.

When steering is required and the slide piston is moved either in one direction or the other by the nose wheel steering wheel, 3000 psi pressure is ported to the cylinder which is to be actuated to get the desired steering, while the other cylinder will be forcing fluid back to return through the 150 psi relief valve.

III. LANDING GEAR NORMAL OPERATION:

A. To Retract Landing Gear:

1. Apply brakes smoothly to stop rotation of wheels.

NOTE: The emergency extension valve located to the right of the pedestal just above the floor level must be in the "Closed" or forward position for normal retraction of the gear, or up line pressure will be open to return. To move the by-pass to the closed position, push the lever in and it will tend to drop to the "Closed" position.

2. Move the landing gear handle to the "Full Up" position. The three green lights (one representing each gear) will have been on during all ground and take-off operations. As the gear handle starts its movement to the "Up" position, the three green lights will go out, indicating that the gear micro switch has been tripped. Immediately the red light will go "On", showing the gear to be in the upward or unsafe position.

   When the complete warning light system shows no lights, green or red, the gear is then in the "Up" position and latched.

III. LANDING GEAR NORMAL OPERATION (Cont'd):

A. To Retract Landing Gear (Cont'd):

The gear handle should then be returned to its "Neutral" position. The gear will drop on the mechanical latches, since the up line of the hydraulic system will be open to return.

NOTE: During ground taxi operations, the gear handle must be kept in the full "Down" position at all times. A micro switch installed in the lower portion of the gear handle slot and connected into the gear warning circuit immediately warns the pilots if the gear handle is moved from the full "Down" position. Such movement will cause all three green lights to go "Out", the red light will come "On", and the warning horn will sound. Replacing the handle to its full "Down" position will restore the circuit to normal.

B. Extending Landing Gear:

1. Reduce I.A.S. to 144 mph.

2. Move the landing gear control handle to full "Down" position. The red "Unsafe" gear warning light will come on and remain on until the gear is fully extended and latched.

   The three green lights then come on, showing gear to be down and latched in a safe position for landing.

C. Check Before Landing:

1. Three green lights on - to assure that all landing gears are locked in "Down" position.

2. If doubtful that gear is "Down", a visual check of main gear may be made from rear cabin windows. The nose gear may be checked through a small window located in the flare handle compartment.

   NOTE: The red warning light will come on and the horn will blow if the gear is "Up" and any throttle is closed to approximately $\frac{1}{4}$ open position.

D. Emergency Operation of Landing Gear:

With landing gear retracted and gear handle in "Neutral" position, the gear is resting on the up-latches. In case of hydraulic system failure, the gear may be lowered by opening the emergency extension

III. LANDING GEAR NORMAL OPERATION (Cont'd):

D. Emergency Operation of Landing Gear (Cont'd):

valve and placing the landing gear control handle in full "Down" position. This will allow the gear to drop freely by its own weight and lock in a safe landing position as indicated by the three green lights.

In the event the landing gear uplatches fail to release, shear pins in the uplatch can be sheared by jerking the plane upward suddenly. This added stress should shear the pins.

IV. WING FLAP SYSTEM:

A. Operation of Wing Flap System:

The center wing section aft of the rear spar incorporates trailing edge wing flaps of the N.A.C.A. slotted type which extend from the sides of the fuselage to the inboard end of the ailerons.

The wing flaps are operated by four hydraulic struts, two on each side of the airplane. The two inboard struts are interconnected by a mechanical bus cable mechanism to insure flap synchronization at all times. Each wing flap is hinged at four points and is so arranged that it has an outward and downward movement. When the flaps are in the "Full Up" position, the gap between the trailing edge of the wing and the flap is enclosed by the wing flap doors on the lower side face of the wing. With the wing flaps extended, the wing flap doors bend up, forming a smooth slot for the air to flow through.

A handle on the control pedestal operates, by means of a cable control, the flap selector valve which is located in the fuselage on the rear side of the rear spar.

The flap travel may be regulated as required by returning the flap control handle back to "Neutral" at the time the flaps reach the desired position; this effectively locks the flaps in that position.

B. Hydraulic Fluid Flow Through the Flap System:

Hydraulic fluid from the power manifold, in the hydraulic accessory compartment, is directed to the slide piston type flap selector valve which controls the flow of fluid to the wing flap operating struts.

IV. WING FLAP SYSTEM (Cont'd):

B. Hydraulic Fluid Flow Through the Flap System (Cont'd):

A pressure operated check valve is installed in the up lines to insure no back flow from the up lines when the control handle is returned to "Neutral". Thus the solid column of fluid between the pressure operated check valve and the struts keep the flaps up and any leakage through the pressure operated check valve will cause the flaps to droop.

When the flaps are to be lowered, hydraulic pressure in the down lines open the pressure operated check valve and allows the uplines to be ported to return.

V. BRAKE SYSTEM:

A. General:

Each of the four main landing gear wheels is equipped with two Goodyear multiple disc type brakes.

When brakes are applied, hydraulic pressure acts on an annular ring piston to press the discs together, causing high friction between rotating and fixed discs.

When brakes are released, fluid flows back to reservoir and internal springs back off the piston.

3 to 1 debooster cylinders on each main landing gear multiply the volume and reduce the pressure of hydraulic fluid operating at the brakes. (Hydraulic pressure at the brakes will never exceed 410 psi.)

B. Parking Brakes:

A lever on the Captain's side of the control pedestal locks the brakes in "On" position for parking. To lock brakes, both pedals must be depressed fully, parking brake handle pulled "Back and Up", and pedals released.

To release, both brake pedals must be depressed sharply, causing braking lever to automatically return to "Off" or "Forward" position. It is not possible to lock or unlock brakes on each wheel separately.

V. BRAKE SYSTEM (Cont'd):

C. Operation of Power Brake Valves:

The power brake valves are operated by toe pressure on the rudder (brake) pedals. When the pedals are depressed, motion is transmitted by means of a leverage mechanism and a tuning fork to actuate a ball valve. This permits fluid to flow into the top chamber of the brake valve and out to the brake debooster cylinders.

System pressure is reduced to 1200 psi (max.) after going through the power brake valve. However, the actual amount of pressure going to the brakes is dependent of the amount of foot pressure on the brake pedals.

VI. EMERGENCY PROCEDURES:

A. Hydraulic System Failure:

If complete hydraulic system failure occurs under cruising conditions proceed as follows:

1. Place all hydraulically operated unit controls in the "Off" or "Neutral" position.

NOTE: If the leakage occurs when only one of the hydraulic controls is being used, the leak is in that particular sub-system. Return the faulty system control to the "Off" or "Neutral" position and leave it there to isolate the leak. The remaining hydraulic controls may be safely used.

2. If the leakage occurs when all hydraulic controls are at "Off" or "Neutral", the leak is in the main supply, pressure and return system. Such a leak cannot be isolated during flight. The fluid in the main system reservoir will fall to the emergency reserve level.

B. Refilling the Reservoir in Flight:

If a sub-system leak is isolated, it may be advisable, if main system reservoir level is low, to refill the reservoir in flight. If the leak is known to be in the main supply, pressure and return system, there is little reason to refill the reservoir, unless the leak is a very slow one, in which case it is recommended that the reservoir not be refilled until just prior to landing.

VI. EMERGENCY PROCEDURES (Cont'd):

B. Refilling the Reservoir in Flight (Cont'd):

The auxiliary hydraulic reservoir is located behind the First Officer. To fill the main system reservoir, open air vent valve, and wait until reservoir supercharging air pressure is relieved. Then open main valve, and fill main system reservoir to the desired level. Normally these two valves will be safetied in the "Off" position. After filling, return both valves to the "Closed" position.

C. Emergency Operation of the Hydraulic System:

1. Use of Flaps:

When the destination is reached, lower the flaps by use of the emergency pump. Place the flap handle in the "Down" position and operate the emergency pump to lower the flaps to the desired position, then return the flap handle to "Neutral". Do not use full flaps unless considered necessary as this will use a considerable part of the reserve fluid and may limit the amount of fluid left for normal braking.

2. Engine Out Approach:

For an "Engine Out" approach, full flaps should not be used unless absolutely necessary. In case of an overshoot, there may be insufficient hydraulic fluid remaining to raise the flaps again for rapid recovery.

Lower the landing gear by "Opening" the emergency extension valve and then putting the landing gear control handle in the "Down" position. The gear will drop of its own weight and lock in the extended position. When the landing gear is "Down" and safe, "Close" the emergency extension valve.

NOTE: If the landing gear fails to latch, try zooming the plane slightly to lock the gear down. If this fails, "Close" the landing gear emergency extension valve, leave the landing gear control at "Down" and operate the emergency hydraulic pump.

A. Through the action of the hydraulic emergency pump, pressure is supplied to the brakes first. When the system is tested in the air, toe pressure can be felt on the pedals as the emergency pump is operated.

VI. EMERGENCY PROCEDURES (Cont'd):

C. Emergency Operation of the Hydraulic System (Cont'd):

2. Engine Out Approach (Cont'd):

B. If some doubt exists in the pilot's mind concerning his ability to stop the airplane on the field, he should check the emergency air brake pressure first to insure at least 800 to 900 lbs. psi available.

C. In the event of complete hydraulic failure and the air brake is used, after the airplane has come to a stop, the airplane should be towed and not taxied. The air must be bled from the complete brake system before normal braking operations are resumed.

D. Emergency Hydraulic Pump or Hand Pump:

General:

An emergency hydraulic hand pump is located to the left and rear of co-pilot for use in case of main hydraulic system failure. This unit supplies reserve fluid under pressure to the brakes first, then to the complete system.

Pressure is at first prevented from reaching the entire system because of the two 1800# sq.in., system relief valves. Not until pressures higher than 1800# sq.in. have been reached, can the entire system be supplied.

The quantity of fluid available in the reservoir for emergency use only is 2.5 gallons. This is sufficient for lowering of the flaps and braking. However, the emergency hydraulic pump should only be used intermittently as required, and its use in connection with the wing flaps should occur only after assuring that no further leakage is present in the system.

NOTE: Before operating the emergency hydraulic pump, check the accumulator shut-off valve to insure that this valve is in the "Closed" or forward position. Place this valve in the "Open" or rearward position only when it is desired to charge the system accumulators with the emergency hydraulic pump. Prior to starting the engines, the accumulators may be charged in this manner to obtain a minimum of 1800 psi system pressure for braking action.

The accumulator shut-off valve is located on the floor at the inboard side of the First Officer's seat.

VII. EMERGENCY AIR BRAKE SYSTEM:

A. General:

This system permits rapid braking of main wheels in case of hydraulic brake line failure or loss of all hydraulic fluid.

The system consists of two control handles in the flight compartment, one for the Captain and one for the First Officer, located directly above the instrument panel, an air storage bottle of 57 cu. inches capacity at 1000 psi, a gauge, a control valve located on the left hand side in the nose wheel well, a shuttle valve at each brake to shut off air lines when the hydraulic brakes are used, and vice versa.

CAUTION: This system shall be used only in an emergency. When the emergency air brake is used, each hydraulic brake unit must be bled before the brakes will operate properly again.

B. Operation of Emergency Air Valve:

If either one or the other of the two air brake cockpit controls is pulled "Out" completely, the air brake valve will open and maximum air pressure will be supplied to the brakes.

If the handle is then immediately pushed back to "Neutral" (half way in), the flow of air will be cut off, but air already supplied will remain in the brakes and the braking action will continue.

The handle should not be pushed past "Neutral"; if it is pushed in too far, the air already supplied to the brakes will be released.

If more braking is required at any time after the control has been pushed "In", the control handle may again be pulled "Out" and the procedure repeated.

If less braking is required, push the handle "All the way in", then quickly "Return it to Neutral". This will release some of the air already supplied to the brakes.

If a quick stop is necessary, pull the handle "Out Completely" and leave it there.

CAUTION: The emergency air brake must only be used to bring the airplane to a stop. The airplane should not be taxied using the air brake system.

VIII. HYDRAULICALLY OPERATED EMERGENCY FUEL DUMP CHUTE VALVE:

The fuel dump chute selector valve is located on the lower right hand side of the pedestal. To dump fuel, turn valve handle to the full right or "Dump" position. After the fuel has been dumped, valve should be returned to the "Off" position. Returning the valve to the "Off" position shuts off fuel flow through the dump valve and allows the spring action to raise the dump chute part way, thus allowing drainage of the lines.

In an emergency, the selector valve may be left in the "Off" position, but if it is desired to raise the chute completely, the selector valve should be turned to the full left or "Raise" position, then returned to the "Off" position. An over center mechanism keeps the chute from dropping when the valve is in the "Off" position.

In the "Off" position, both cylinder ports are connected to return, and the pressure port is closed. This is a precautionary measure to safeguard against possible leakage from the pressure piston when the valve is in the "Off" position.

Stand pipes in the #1 and #4 tanks allow for a reserve of 70 gallons in each tank after dumping.

In the left and right auxiliary tanks, stand pipes allow for a 40 gallon reserve in each tank after dumping.

Tanks #2 and #3 cannot be dumped.

I. GENERAL DESCRIPTION:

The system has been designed to assure controlled heat and ventilation for passenger and pilot's comfort, at all altitudes and under variable conditions of temperature and weather.

Two Surface Combustion heaters, having a thermal output of 100,000 B.T.U.'s, each are mounted in the ceiling just above the crew compartment companionway. These units supply heat to the cabin and lavatories and also act as an auxiliary source of heat for the buffet compartment.

One Surface Combustion heater having a thermal output of 40,000 B.T.U.'s is mounted in the nose wheel well to supply heat to the cockpit for comfort and windshield defrosting and de-icing.

The ventilating system of both cabin and cockpit have been designed to supply air for cooling the airplane when operating in regions of extremely high outside air temperatures. An auxiliary air conditioning unit must be used to supply air for ventilating during ground operations of the cabin system. All three heating units are gasoline fired and obtain raw fuel from the engine fuel system. Heater combustion occurs within a sealed chamber and affords full protection against fire or escape of combustion gases. Exhaust gases from the heater units are spilled overboard. Stainless steel doubler plates are mounted in the fuselage at all exhaust discharge points.

Electrical supply for heater operation is taken from the airplane bus system in the main electrical junction box. All circuits are protected against shorts or overload by circuit breakers located in the main electrical panel.

II. HEATER FUEL SYSTEM:

The sources of fuel for both cabin and cockpit heaters are fuel pressure fittings on number one and number two engine carburetors. Fuel lines from these two carburetors are joined with a tee fitting in number two nacelle. From this tee fitting a single line runs a short distance to another tee fitting. From this fitting two fuel lines, one for the cockpit and one for the cabin heaters, run inboard through two solenoid shutoff valves to the fuselage hydraulic compartment. This arrangement provides fuel source for all heaters even in the event one engine is feathered.

II. HEATER FUEL SYSTEM (Cont'd):

From the fuselage hydraulic compartment the two lines run forward, one continuing to the nose heater, the other turning up to the cabin heaters. In the nose compartment the fuel is routed to a sealed steel chamber. In this chamber the fuel is routed through a filter, solenoid valve and fuel pressure regulator. From this chamber the fuel is routed to the heater combustion chamber where it is discharged in a spray from a special atomizing nozzle.

The cabin fuel line enters a sealed steel chamber mounted above the companionway. In this chamber the fuel is routed through a filter, solenoid valve, and a fuel pressure regulator. From this chamber, the fuel passes to a tee and then to both cabin heater combustion chambers, where it is discharged as in the cockpit heater.

The fuel pressure regulators are designed to vary the rate of fuel flow into the heater in response to combustion air differential. Combustion air inlet pressure is applied to the top of a diaphragm, and static pressure is applied to the bottom side of the same diaphragm. The net result of the two pressures regulates fuel flow to the heater by means of a metering valve acting in response to diaphragm movement.

Within the heater compartments all fuel line fittings are completely enclosed in a shroud which is drained overboard.

III. IGNITION SYSTEM:

A. Cabin Heaters:

Ignition for the two main cabin heaters is supplied by a special "Quick Fix" unit mounted in the ceiling to the right of the cabin heaters. The unit consists of one dual type vibrating unit which supplies interrupted 28 volt direct current to two independent spark coils. The entire unit is housed in a shielded metal container to prevent radio interference from the vibrator and high tension current. In addition, the circuit is further protected by a series of filters and condensers.

High tension ignition is routed from the individual coil units to each heater by means of shielded ignition leads. A single electrode shielded type plug is installed in each heater. This circuit is completed by a ground electrode which is mounted in the combustion chamber to form a spark gap for the single electrode plug. Ignition is continuous during all periods of heater operation.

III. IGNITION SYSTEM (Cont'd):

A. Cabin Heaters (Cont'd):

NOTE: Failure of the vibrating unit, located in the "Quick Fix" ignition box may result in a loss of one or both cabin heaters. To replace the vibrator, remove the ceiling access panel to the heaters, open the coil box which is secured by a series of dzus fasteners and lift out the vibrating unit. The vibrator is connected into the circuit by means of a cannon type mount. (Turn heaters "OFF" before replacing the coil.)

B. Nose Heater:

Ignition for the nose heater is supplied by the same type of "Quick Fix" unit described in the cabin heating system. This unit, however, houses only a single coil. The complete unit is mounted on a beam which supports the nose heater blower and is accessible only through the nose wheel well.

IV. VENTILATING DUCT SYSTEM:

A. Cabin Heater and Cabin:

A main outside air scoop, located on top of the fuselage forward of the heaters, supplies combustion and ventilating air to the cabin heaters. This source is utilized only when the airplane is in flight resulting in a ram effect into the outside air scoop. The main air scoop houses a smaller one which picks up air and directs it to each heater combustion chamber. The leading edge of the main air scoop is fitted with an electrical heating element which may be used to clear any ice formation that tend to shut off air flow. The heater air scoop circuit is connected into the Captain's pitot static electrical circuit and operates from a common cockpit switch.

A second source of ventilating and combustion air is provided by two blowers which are located in the ventilating air duct and combustion air ducts respectively, forward of the heaters. This source provides air while the airplane is on the ground or when the indicated air speed falls below 120 miles per hour. A ram air switch is wired so as to automatically operate the blowers and heaters when the indicated air speed is 120 miles per hour or less.

IV. VENTILATING DUCT SYSTEM (Cont'd):

A. Cabin Heater and Cabin (Cont'd):

A single duct leads from the outside air scoop back and inward to the two main cabin heaters. Prior to entering the heaters, this duct splits into a "Y" formation, directing air through each cabin heater. A splitter type damper is mounted in the "Y" duct forward of the two heaters. This damper is normally positioned midway of the "Y" duct and directs an equal quantity of air to both heaters. If either of the two heaters should fail, the damper may be swung either right or left to block airflow through the bad heater. This should only be done by maintenance crews when it is necessary to dispatch a ship with one heater out.

Aft of the heaters, the discharge air ducts from each unit are routed inward to a "Y" formation where they are again split and a duct leads down along each side of the cabin to beneath the floor. The right-hand duct terminates in the lavatories at the rear of the cabin. The left-hand duct terminates at the last two seats at the rear of the cabin. There is an outlet under each set of seats from the right and left ducts respectively.

Another duct leads from the "Y" aft of the heaters and runs the full length of the cabin ceiling. This duct has been closed off at the "Y" and is only used for ground air conditioning.

Just forward of center of the cabin ceiling duct, two smaller ducts lead downward along the right-hand side of the cabin wall into a single duct which has two connections to outside. These connections are used to attach the ground air conditioner.

A fireproof spun glass insulation surrounds the center overhead duct to act as a fire preventative and conserve heat. Seven anemostats serve as outlets for cabin distribution of ventilating air.

The cabin heating and ventilating system has been further utilized to serve as an auxiliary source of heat to the buffet compartment. A duct, leading forward, is connected to the main heating source just aft of the rear heater "Y". An anemostat mounted in the ceiling of the buffet compartment supplies air to this section of the airplane.

Air circulation is provided in the main cabin by outlets in the cabin side walls above the floor line. Overboard air ducts are designed into the belly of the airplane to siphon air from the area underneath the cabin floor. This creates a low pressure area in the baggage, hydraulic and tail compartments of the airplane eliminating all dangers of fumes collecting in this area as a result of leaking fuel, hydraulic oil or alcohol lines. Air enters the area under the floor through the side wall openings along the cabin side wall.

IV. VENTILATING DUCT SYSTEM (Cont'd):

B. Nose Heater and Cockpit:

The cockpit heater receives both its combustion and ventilating air supply through an opening in the nose of the airplane. A metal duct system routes the cold air into the heater. Air is discharged from the rear of the heater through three independent duct systems, one leading to the left side of the airplane, one to the right and a third duct system supplies the Captain's foot warmer and large side window. The foot warmer is located on the side wall of the cockpit near the rudder pedals and is fitted with a foot type "Shut-Off" control. The side window is equipped with a slide type hand "Shut-Off" located on the cockpit side wall just forward of the seat. The right duct system of the heater supplies air to the First Officer's side of the cockpit by means of a duplicate system of that described. The air duct leading to the windshield vee provides air for the two sections of the main windshield, plus Captain's and First Officer's curved side windows. Air enters the windshield forward of the vee and flows between the double panel glass. After passing through the main windshield, a portion of the air is spilled out into the interior of the airplane. The remainder of the air passes through a duct leading to the small curved side windows. A control damper is mounted in the duct leading to the windshield vee. The cockpit control for windshield ventilation is located on the glare shield forward of the First Officer.

A blower unit provides an auxiliary source of air available to the nose heater for ground operation and may be utilized should the nose duct ice over in flight. The blower unit is mounted in the nose of the airplane below and forward of the nose heater. Air is taken from the nose wheel well, passes through the blower and enters the heater through a "Y" duct located immediately forward of the heating unit. Two damper controls, one in the blower air duct and the other in the ram air duct, select the source of heater air. A blower switch, located on the top of the cockpit glare shield and forward of the Captain's position, controls the two dampers. Moving the cockpit blower switch from the "OFF" to the "BLOWER" position will shut off the damper in the ram air duct and open the one in the blower duct. As the ram air damper opens, it trips a micro switch which operates a control relay to set the blower in motion. The main cockpit heater switch must be used in conjunction with the blower to obtain heat output from the unit.

V. OPERATION OF HEATER UNITS:

A. Cabin Heaters:

1. Heating:

Operation of the cabin heating system is ordinarily controlled automatically by a Minneapolis-Honeywell cabin temperature control System which maintains closely regulated temperatures within the cabin without attention. This system is primarily controlled by a cabinstat located on the bulkhead just inside the passenger entrance door. To anticipate a change in cabin temperature before it actually occurs, two compensators are used to maintain uniform temperatures throughout the airplane. These are the outside air compensator (cold air ductstat), which is a temperature sensitive resistance unit located in the air inlet "Y", just forward of the heaters, and a discharge air compensator (hot air ductstat), which is a temperature sensitive resistance unit located in the heater discharge duct. The cold and hot air ductstats are wired in series and connect into the heater amplifier unit. A combination switch and rheostat control connect in series with the rear cabinstat to form the second circuit leading to the amplifier control.

The combination switch and rheostat control is mounted on the heater control panel on the main electrical junction box and serves as the main control switch for heater operations. Turning the rheostat control clockwise from the full "OFF" position will start the heaters in operation. Continuing to turn the control in a clockwise direction will increase heater output, resulting in a higher cabin air temperature. A setting of approximately 75°F will normally be found preferable. Once a desirable cabin air temperature has been established, the automatic control unit will cut the heaters "ON" and "OFF" to maintain the selected temperature setting. A dual type temperature indicator is mounted on the heater control panel. This indicator is wired to thermocouples mounted in the discharge air duct of each heater and shows output temperature for each unit. Normal temperature output for each heater unit should range up to 148°C (300°F). Temperature output above 176°C (350°F) will cause the thermal overheat switches to open and temporarily cut off heater operation.

The rheostat type switch also controls two additional circuits connected on the rear of the same shaft. One circuit supplies 115 volt alternating current to operate the heater amplifier unit and the second circuit provides 28 volt direct current for all other heater electrical units. When the heater switch is turned "ON", current will flow immediately through the heater overheat

V. OPERATION OF HEATER UNITS (Cont'd):

A. Cabin Heaters (Cont'd):

1. Heating (Cont'd):

and complete the circuit to open the solenoid fuel valves. However, heater operation will not begin until the air ram switch (described below) - or blower switch is closed to provide ignition and fuel to each heater. A "Manual-Automatic" selector switch is also provided on the heater control panel. Normally this switch is kept in the "Automatic" position. Heater operation is then fully automatic and operates as previously described. Failure of the automatic control unit would result in loss of both cabin heaters. In this event the selector switch should be placed in the "Manual" position to by-pass the automatic unit. The rheostat or main heater control switch must be used in conjunction with the "Manual-Automatic" switch when operating the heaters in the "Manual" position. This operation is necessary since the rheostat when placed in the full "OFF" position, cuts off the electrical source to the heater units. An air ram switch, located in the ceiling near the heaters, is wired so as to automatically operate the air ram blower and heaters when the indicated air speed is 120 MPH or less. The combustion air blower is also wired so as to operate when the heaters are operating at an indicated air speed of 120 MPH or less.

Both heaters are protected by installation of an overheat switch in each heating unit. These switches are wired in series and connect into the 28 volt heater electrical source. Should the output of either heater reach a danger point of 176° (350°F), the overheat switches will open and break the electrical circuit to cut off heater ignition and fuel supply. After heating units have cooled sufficiently, the overheat switches will close, restoring fuel flow and ignition for normal heater operation.

To operate the main cabin heaters, the following may be accomplished before take-off.

1. Place "Manual-Automatic" switch to "Automatic" position.
2. Turn on main heater switch and set to desired heat position. The heaters will start operating when the airspeed reaches 120 MPH.

V. OPERATION OF HEATER UNITS (Cont'd):

A. Cabin Heaters (Cont'd):

2. Ground Operation:

To operate cabin heaters on the ground:

a. Mixture Controls "IDLE CUT-OFF".
b. Turn on No. 1 or No. 2 engine fuel boost pump.
c. Turn on cabin blower switch located on upper electrical panel.
d. Turn on cabin heater switch located in companionway.
e. Heater switch should be turned off before turning blower off.

B. Cockpit Heater:

1. Flight Operation:

During normal periods of operation the cockpit heater may be controlled by means of an "ON-OFF" switch located on the overhead panel. A second control on this panel allows the Captain to adjust the heater cycling switch and select a desired temperature for cockpit comfort. Placing the heater switch in the "ON" position energizes the heater fuel control solenoid and the heater ignition system. Heater operation will continue until the heat output opens the cycling switch to hold the cockpit temperature at the heat level selected. The cycling switch will automatically close as heater output begins to drop off. An automatic overheat switch is installed in the circuit to protect the heating unit in the event heat output should exceed the safe operating range. The normal heater output temperatures range from 27° - $138^{\circ}C$ (80° - $280^{\circ}F$).

To start cockpit heater:

a. "Open" desired cockpit outlets.
b. Place heater switch to the "On" position.
c. Select the desired cockpit temperature by means of cycling switch control.

V. OPERATION OF HEATER UNITS (Cont'd):

B. Cockpit Heater (Cont'd):

2. Ground Operation:

To operate cockpit heater on the ground:

a. Mixture controls "IDLE CUT-OFF".
b. Turn on No. 1 or No. 2 engine fuel boost pump.
c. Turn on cockpit heater blower switch located on glare shield, wait 30 seconds.
d. Turn on cockpit heater switch located on upper electrical panel.
e. Adjust temperature with control knob located on left side of cockpit adjacent to pilot's knee.
f. Cockpit heater switch must be turned off 30 seconds before turning blower off.

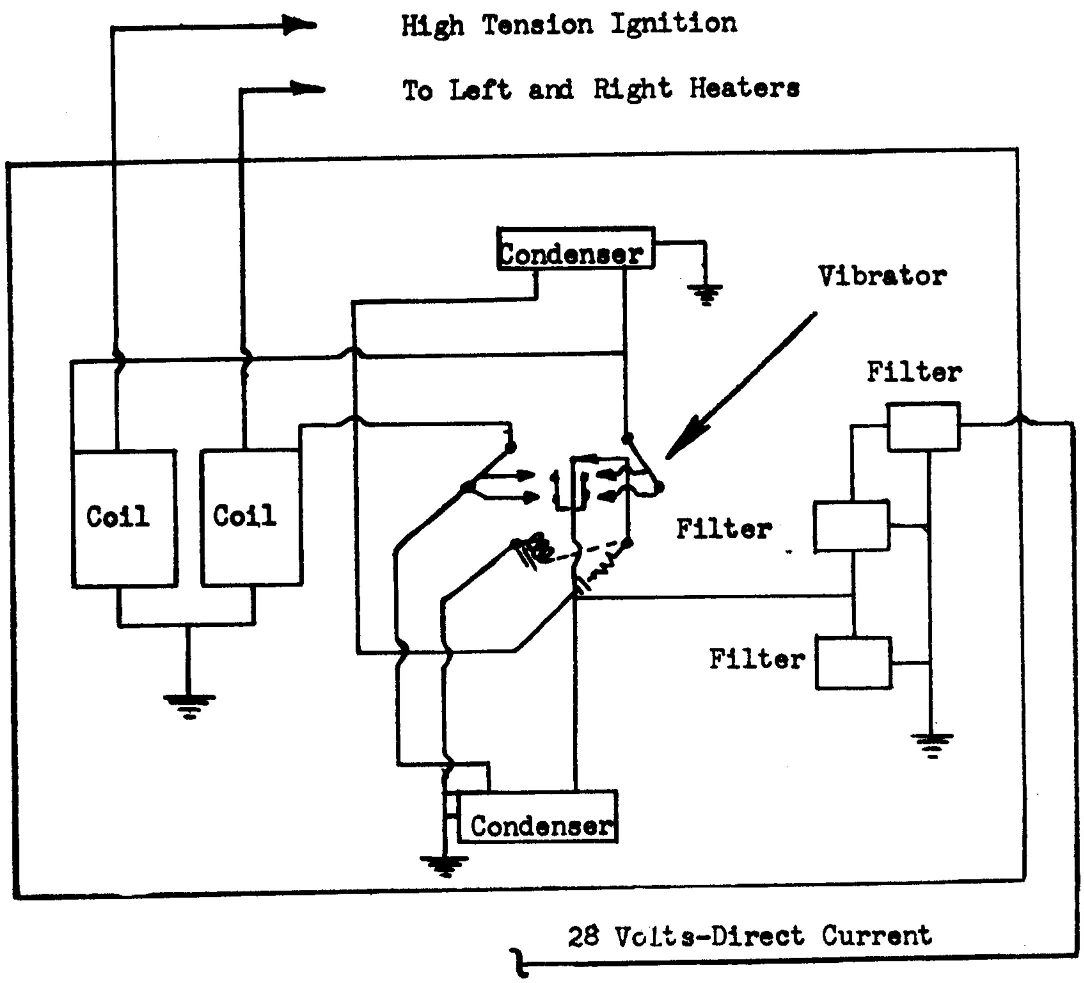
The nose blower system may be utilized for either heating or ventilating the cockpit. The blower electrical circuit consists of a micro switch which is operated by the blower damper, an electrical junction box and the blower motor. When the cockpit blower control is placed in the "Blower" position, the blower damper is opened and simultaneously trips the micro switch. The micro switch closes a relay which energizes the blower motor.

CAUTION: DO NOT OPERATE nose heater with blower off below an indicated air speed of 120 MPH. If this procedure is not followed, backfiring may result.

VI. CHECKS AND TROUBLE SHOOTING:

HEATER CHECKS AND TROUBLE SHOOTING CHART

SYMPTOM	PROB. CAUSE	REMEDY	EXPLANATION
1. Nose Heater Inoperative Flying thru Icing Condition	Nose Cap Iced Over	Operate Nose Heater Blower	This utilizes nose wheel well as source of supply of air
2. Nose or Cabin Heater Inoperat-ive	Circuit Breaker Open	Check all circuit breakers	
3. Nose Heater Insufficient	Heat Control Set Too Low	Raise heat control setting	
4. One Cabin Heater Inoperative	Splitter Damper cutting off one heater	Remove ceiling access panel in companionway and center splitter damper	
5. One or Both Cabin Heaters Inoperat-ive	Spark Vibrator defective	Remove ceiling access panel companionway, open spark coil box, remove and replace vibrator	One set of points may fail, resulting in one heater failure
6. Heat Output Too Low	Auto control out of adjustment	Raise temperature setting	
7. Both Cabin Heaters Inoperative	Failure of auto control system	Set auto-manual sele-ctor switch to manual	Caution--Turn blower switch on, on landing.
8. Both Cabin Heaters Inoperative	Cause unknown or unable to correct in flight	Turn "OFF" heaters	



CABIN HEATER IGNITION SYSTEM

I. GENERAL:

Fuel is supplied to the engines from six wing tanks (four main and two auxiliary) integrally built into the center and outer wing structures. Each engine is directly served by one main tank. Various tank-to-engine combinations may be obtained by proper positioning of the selector and crossfeed valves located on the forward side of the control pedestal and the auxiliary tank selectors located under the floor panel immediately aft of the pedestal. An emergency firewall shut-off valve controlled from the cockpit and a strainer are installed in the supply line between each tank selector valve and its respective engine. Engine-driven pumps furnish the fuel pressure required for normal cruising conditions. A fuel pressure transmitter, mounted in each nacelle, relays the fuel pressure delivered at the carburetor to the cockpit indicator. Dump chutes are installed so that fuel in the two outboard mains and the two auxiliary tanks may be dumped. The dump chutes are actuated hydraulically and the selector valves are located on the lower aft section of the pedestal.

II. DESCRIPTION OF SYSTEM (See Diagram on Page 8):

A. Fuel Tanks and Capacities:

Tanks	No. of Tanks	Fuel Capacity for Tank	Total Usable Fuel Capacity
Outboard Main #1-#4	2	482 gallons	964 gallons
Auxiliaries	2	415 gallons*	830 gallons
Inboard Main #2-#3	2	499 gallons	998 gallons
		Total----	2792 gallons

Total fuel capacity (usable) for Flight Planning is 2792 gallons. Weight figures for the airplane include residual (unusable) fuel and need not be considered in Flight Planning.

Each tank contains a Thompson electrically-driven centrifugal booster pump located at the bottom of the tank, a tank drain valve for "defueling", a pump drain for the draining of water and sediment, and a manually operated shut-off valve to permit the removal of lines, selector valve and strainer without tank drainage.

Vapor vent return lines are connected to each engine carburetor and are routed back to the engine's respective main tank. The vapor vent system returns to the main fuel tank any vapor (plus a small amount of fuel) that normally collects in the carburetor.

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*Auxiliary tanks are placarded to fill to a maximum of 219 gal. on normal operation. This quantity was obtained from a 30 to 1 oil fuel ratio. It is permissible to fill auxiliary tanks to their capacity provided the oil consumption is not more than one gal. per hour on any engine. Should oil consumption records show high oil consumption, airplane will be restricted by flight control to 219 gal. in each auxiliary tank.

II. DESCRIPTION OF SYSTEM (Cont'd):

B. Crossfeed System:

The crossfeed system provides a link between all fuel tanks and all engines. The wing tank system consists essentially of four independent main tank systems, with auxiliary tanks connecting into the main crossfeed line. Each engine is directly connected through a selector valve to a main tank. Fuel may be drawn from the auxiliary tanks through the auxiliary tank selector valve and crossfeed lines. The various tank to engine combinations may be obtained by positioning the four selector valve controls, the four crossfeed valve controls and two auxiliary tank selector valve controls. The valves are controlled by cables operated from the cockpit.

C. Dump Chutes and Their Use:

Fuel dumping facilities are provided for the emergency jettisoning of fuel. Dump valves are located in the outboard main and auxiliary tanks and positioned so that when all fuel possible is dumped in level flight, sufficient fuel will remain in the main tanks for 45 minutes at 75% of rated power. The fuel dumping lines from each dump valve are teed together at a common outlet and jettisoned out of an extendible chute at the rear of each outboard nacelle. With chutes extended and valves fully open, the dumping rate is approximately 395 gallons (2370 lbs.) per minute - 197 gallons (1182 lbs.) per chute per valve located under a cover door on the lower aft part of the control pedestal. A spring-loaded hydraulic strut in each nacelle actuates a bell crank linkage which lowers the chutes when the valve is moved to "Dump". Control cables from the chute to the dump valves operate simultaneously. Normally the dump chutes are retracted into #1 and #4 nacelles, the dump valves are closed and the selector valve in the cockpit is in the "Off" position.

1. Fuel dumping may be resorted to, at the discretion of the Captain, in order to decrease the weight of the airplane in the following circumstances:

   a. When the Captain considers dumping fuel to be safer than landing at a weight in excess of the normal maximum landing gross weight.

   b. When it is necessary to attain or maintain altitude, and because of improper engine operation or reduced airplane performance, it is impossible to reach or hold the necessary altitude with the existing weight of the airplane.

II. DESCRIPTION OF SYSTEM (Cont'd):

B. Crossfeed System:

The crossfeed system provides a link between all fuel tanks and all engines. The wing tank system consists essentially of four independent main tank systems, with auxiliary tanks connecting into the main crossfeed line. Each engine is directly connected through a selector valve to a main tank. Fuel may be drawn from the auxiliary tanks through the auxiliary tank selector valve and crossfeed lines. The various tank to engine combinations may be obtained by positioning the four selector valve controls, the four crossfeed valve controls and two auxiliary tank selector valve controls. The valves are controlled by cables operated from the cockpit.

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   b. When it is necessary to attain or maintain altitude, and because of improper engine operation or reduced airplane performance, it is impossible to reach or hold the necessary altitude with the existing weight of the airplane.

II. DESCRIPTION OF SYSTEM (Cont'd):

D. Fuel Dumping Procedures (Cont'd):

6. The dump valves may be closed at any time during or after dumping is completed, by turning the cockpit valve to the "Off" position. This relieves the hydraulic pressure on the dump struts and allows a spring in the nacelle to move the dump chutes to a drain position in which the dump chutes remain in an extended position so that dripping fuel will not spatter on the underside of the wing.

7. After about 30 seconds (permitting the lines to drain), the chutes may be retracted by turning the valve to the "Raise" position. When the chutes are fully retracted, return the valve to "Off" to relieve the hydraulic pressure on the struts. The chutes will remain locked in the "Up" position.

8. Before permitting smoking in the cabin and before moving any electric switch, an inspection of the cabin should be made to make certain that gasoline fumes are not present in the fuselage.

9. After the next landing, the dump valve in the cockpit should be re-safetied in the "Off" position with .012 copper wire.

E. Fuel Pressure and Quantity Indicators:

Two dual pressure indicators are mounted on the main instrument panel. Red warning lights located beneath the pressure indicators illuminate when the fuel pressure at any carburetor falls below 13 psi.

Four fuel quantity indicators for main tanks and one dual indicator for auxiliary fuel quantity are located on main instrument panel. These indicators are calibrated in gallons of fuel.

F. Filling and Draining:

Fuel tanks shall be filled in the following order:

Main Tanks (#1, #2, #3, #4), dividing fuel and filling evenly.
Auxiliary Tanks (L/H and R/H), dividing fuel and filling evenly.

II. DESCRIPTION OF SYSTEM (Cont'd):

G. Normal Operation:

1. For normal operation, including take-offs and landings, use individual selection, that is #1, #2, #3 and #4 main tanks feeding to their respective engines; crossfeed and auxiliary tank controls "Off".

2. For long range operation, where fuel is carried in auxiliary tanks, use the fuel as follows:

   a. After the top of the climb is reached and cruising power established, place #1 and #2 engines on the left auxiliary tank, #3 engine on #3 main, and #4 engine on #4 main, OR #3 and #4 engines on the right auxiliary, #1 engine on #1 main, and #2 engine on #2 main.

   b. Use auxiliary tanks until approximately 25 gallons remain in any one auxiliary tank; and if it is necessary to use the 25 gallons remaining in any one auxiliary, return one engine to its main tank and run the auxiliary tank dry on one engine only, returning selector to main tank when draining is completed.

   c. Do not transfer fuel in flight except in an emergency.

   d. If it is necessary to transfer fuel on the ground, the filler cap of tanks into which gasoline is being transferred must be off.

      (1) Turn the tank selector "On" at the tank that fuel is to be transferred to. Booster pump on this tank is "Off".

      (2) Turn the tank selector "On" to the tank that fuel is to be transferred from. Turn Booster Pump on this tank to "High".

      (3) Turn "On" the crossfeed between the tanks. The rate of transfer is approximately 10 to 12 gallons per minute.

H. Precaution:

1. In order to avoid the possibility of air entering the system tank selectors and crossfeed valves must be "off", except when fuel flow is desired through them.

II. DESCRIPTION OF SYSTEM (Cont'd):

H. Precaution (Cont'd):

2. Open valves to a new source of fuel supply before closing off the old source unless the old source of fuel has previously been run dry.

3. It should be noted that there are no check valves in the line leading from the tank. Booster pumps are submerged in the tanks; therefore, on the ground it is possible, by proper use of cross-feeds and tank selector valves, to flow fuel from any wing tank to any other wing tank. In flight, care must be taken to close off any tank from which fuel is not being drawn or being transferred to; otherwise, spillage might occur through the tank vents.

4. "Low Speed" on the electric booster pumps should be used for starting. "High Speed" or "Low Speed" may be used as required for high altitude flight, or in case of loss of fuel pressure. Flight tests have proven that "Low Speed" will provide adequate fuel pressure to service ceilings with 42°C (110°F) fuel in the tanks. Booster pumps should normally be left "Off" during take-offs and landings unless engine pump does not furnish desired fuel pressure.

   Note: If use of fuel booster pump does not restore pressure in case of loss of fuel pressure, leave booster pump "Off" as loss may be due to a broken line.

5. Crossfeed valves must be off when airplane is parked, as fuel will gravity feed into lower tanks, causing them to overflow.

I. Loading Precaution:

1. Fuel consumption should be controlled so that loading will be symmetrical about the center line of the airplane. If more fuel is used from one wing tank than from the opposite wing tank, a condition of lateral unbalance will exist. At lower airspeeds response to aileron throw will be slightly reduced.

2. In order that the wing landing stresses will not be excessive, it is necessary to limit the maximum fuel allowable on landings to 395 gallons in each outboard main and auxiliary combined. Maximum in each main No. 2 and 3 tank is 395 gals.

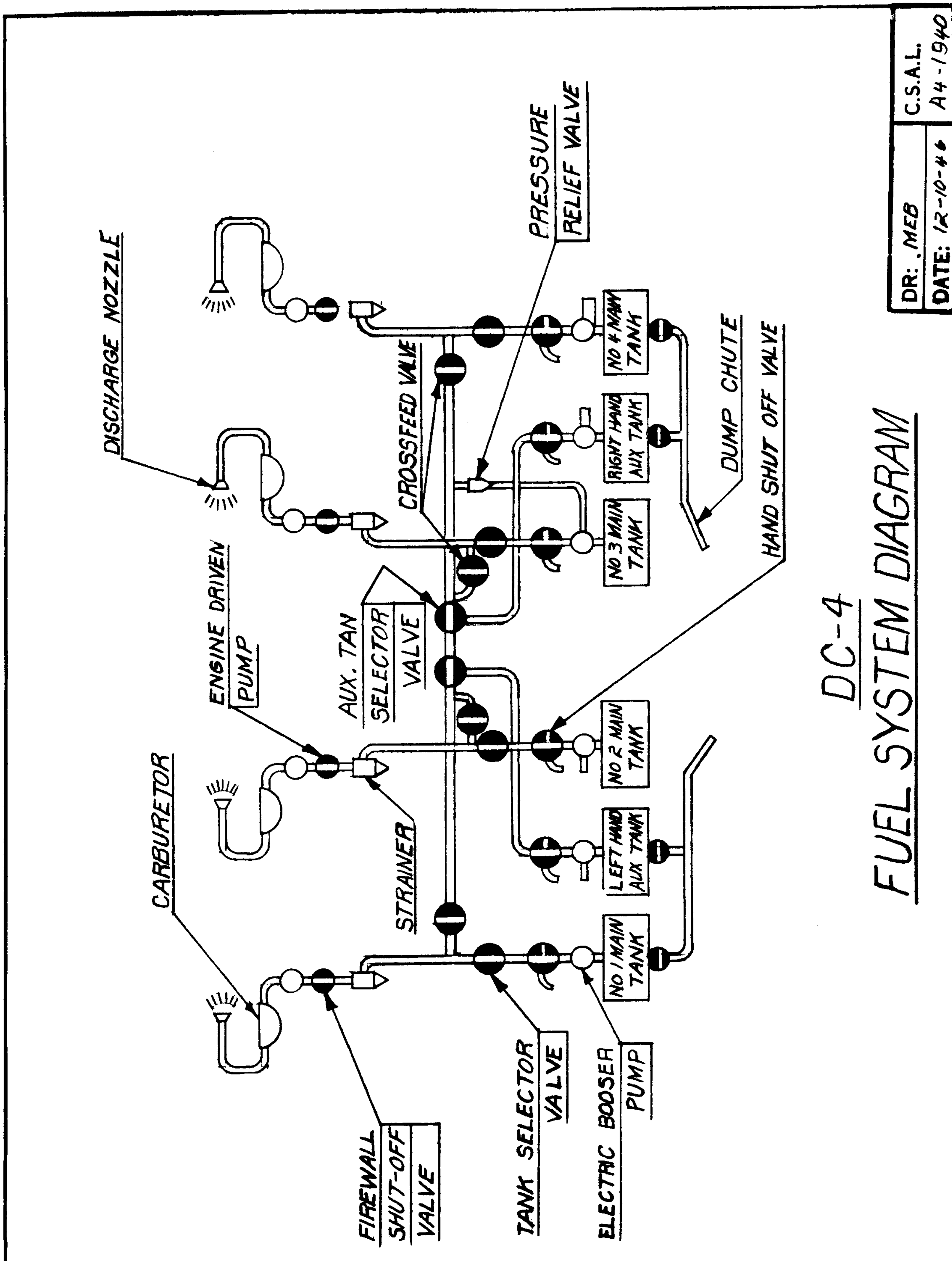
II. DESCRIPTION OF SYSTEM (Cont'd):

I. Loading Precaution (Cont'd):

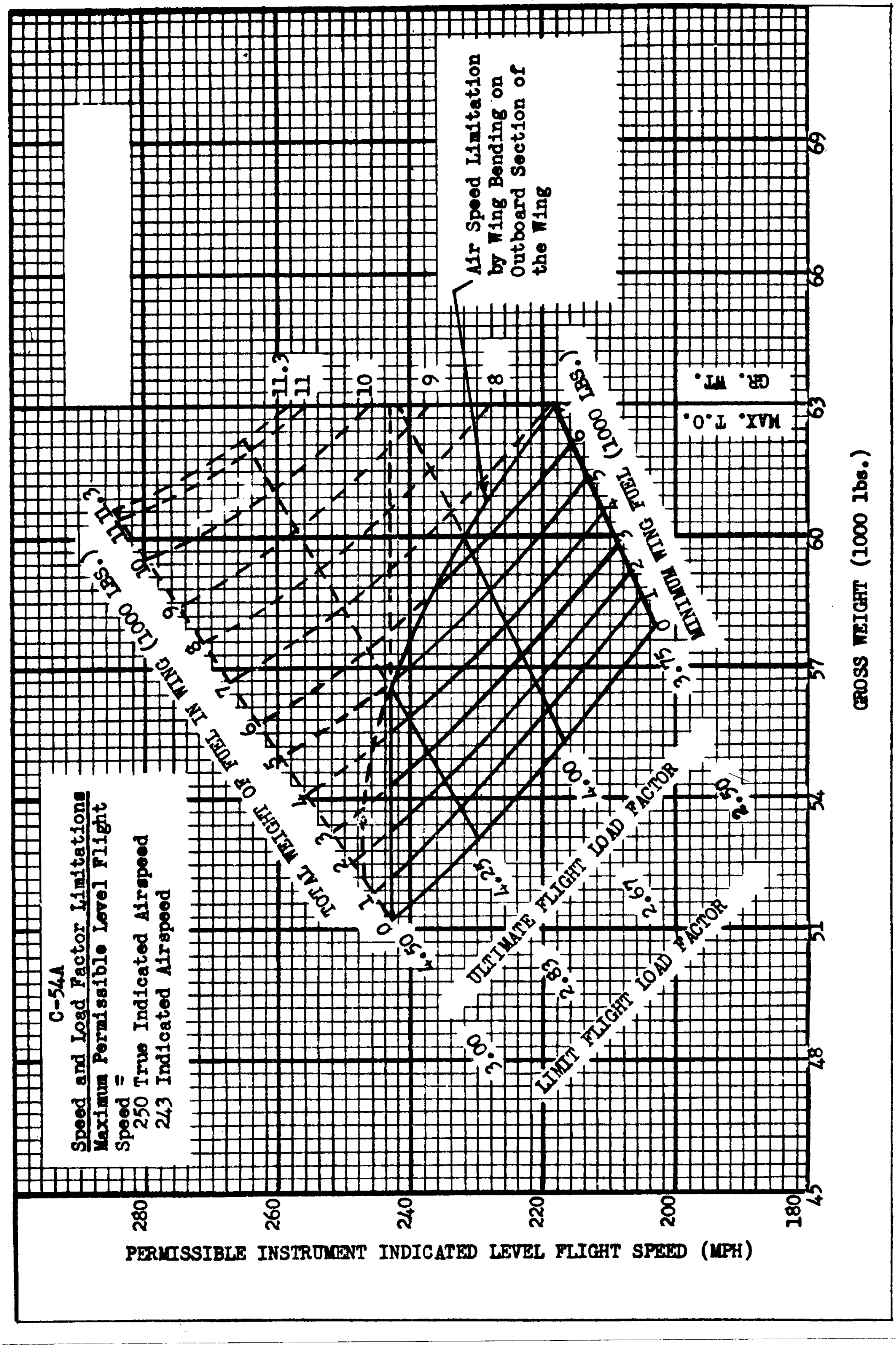
3. When landing is imminent with wing tanks nearly full, fuel must be dumped to reduce the quantity to not more than 395 gallons (outboard and auxiliary combined); or if the pilot elects to land without dumping any fuel, care should be exercised to maintain the lowest possible landing load factors.

J. Minimum Fuel:

No [redacted] RESORT DC-4 type aircraft will take off with less than 1000 gals. of fuel aboard.


DC-4
FUEL SYSTEM DIAGRAM
DR: MEB
DATE: 12-10-46
C.S.A.L.
A4-1940
DISCHARGE NOZZLE
PRESSURE RELIEF VALVE
CROSSFEED VALVE
DUMP CHUTE
HAND SHUT OFF VALVE
ENGINE DRIVEN PUMP
AUX. TAN SELECTOR VALVE
CARBURETOR
STRAINER
FIREWALL SHUT-OFF VALVE
TANK SELECTOR VALVE
ELECTRIC BOOSER PUMP
NO 4 MAIN TANK
RIGHT HAND AUX TANK
NO 3 MAIN TANK
NO 2 MAIN TANK
LEFT HAND AUX TANK
NO 1 MAIN TANK

This curve to be used only when airplane is operated in accordance with procedures for leaking fuel tank



FUEL TANK FILLING SEQUENCE DC-4

#1 MAIN 482 GALS	LH AUX 415 GALS	#2 MAIN 499 GALS	#3 MAIN 499 GALS	RH AUX 415 GALS	#4 MAIN 482 GALS

Fuel Load Gallons	#1 Main 482	LH Aux 415	#2 Main 499	#3 Main 499	RH Aux 415	#4 Main 482
500 to 1962	(Evenly distributed in all four main tanks until full)	Empty			Empty	
1962 to 2792	Full	(Evenly distributed in both auxiliaries)	Full	Full		Full
NOTE: Use Fuel in Opposite Sequence						

OIL TANKS - GALLONS REQUIRED

#1	#2	#3	#4
20 gal.	20 gal.	20 gal.	20 gal.

III. PROCEDURE WITH LEAKING FUEL TANK

A. General

In the event a fuel tank develops a leak discovered at some intermediate point on a scheduled flight, the airplane may continue on schedule to a major repair base where adequate repair facilities are available and repair can be made, providing the following procedure is complied with.

The leakage shall be evaluated in accordance with Douglas Service Bulletin DC-4 #37 or reference [redacted] C-54B-DC Manual page 27311. If leakage is in excess of that outlined in the pertinent service bulletin, flight must not be continued unless location of the leak is definitely established by careful inspection to be at the upper level of the vertical walls or in the upper surface of the tank in order that the vapor vent return fuel will not run over the leak.

B. Differential Limits

Fuel load shall be within the following differential limits (left wing to right wing) when aircraft is dispatched on all flights.

1. Number 1 and 4 main tanks shall contain within 100 gallons ± 10 gallons of the same amount.
2. Left and right auxiliary tanks shall contain within 150 gallons ± 10 gallons of the same amount.
3. Number 2 and 3 main tanks shall contain within 230 gallons ± 20 gallons.

Only one of the above conditions is permissable on an aircraft. All other tanks must be loaded symmetrically with a gross weight not to exceed 63,000 lbs.

In the event that one of the main fuel tanks is leaking and not to be used in the emergency operation, the vapor vent line from the respective engine must be temporarily re-routed to auxiliary tank. The auxiliary tank would then be used as a main tank. Auxiliary tank selector valve should be properly positioned, main tank selector valve for tank which is not to be used should be "off", crossfeed valve to engine using fuel from auxiliary "on", and fuel booster pump on "low" during take-off and landing. The use of the booster pump is necessary due to the added plumbing involved in using the auxiliary as a main tank.

III. PROCEDURE WITH LEAKING FUEL TANK (Cont'd):

B. Differential Limits (Cont'd):

A maximum gross take-off weight of 63,000 pounds can be calculated as follows:

Sample	#1 Main	0
	L.H. Aux.	415
	#2 Main	499
	#3 Main	499
	R.H. Aux.	415
	#4 Main	110
		1939 gallons total

By using speed-gross weight chart, the fuel weight should total twice the weight on the light side.

914 gallons of fuel on light side - 5484 pounds
Double 5484 - 10,968 pounds of fuel permissable

Maximum gross weight with an outboard tank empty is 63,000 lbs. Fuel weight is 10,968 lbs., the maximum gross weight less fuel for take-off would be 52,032 lbs.

When the gas load desired is such it can be distributed within the auxiliary and main tanks not including the tank leaking and the respective tank on the opposite wing, the fuel load should be the same in respective auxiliary and main tank. In this case, two engines would feed from an emergency system. It is not necessary to re-route the vapor vent line from the tank not leaking, but it will be necessary to keep fuel to minimum in this tank by using it in flight.

I. OIL TANKS:

Lubricating oil is supplied to each engine from an independent nacelle oil tank. Each tank has a capacity of 20 U.S. gallons.

Each oil tank has a standpipe in the main oil supply line, which provides 1.4 gallons of oil for propeller feathering. The minimum oil required for safe engine operation is 6.6 gallons.

II. OIL TEMPERATURE AND PRESSURE GAUGES:

Oil temperature gauges (2 dual gauges) are located on the left side of the center instrument panel directly below the warning lights. The oil pressure gauges (2 dual gauges) are located on the left side of the center instrument panel directly above the warning lights. These gauges are electrically operated from transmitter units located in each engine nacelle.

III. OIL TEMPERATURE:

No minimum oil temperature is specified for take-off; however, it is necessary to assure proper circulation of the oil before using take-off power. When the oil temperature has risen at least 8°C above the pre-starting temperature and the oil pressure has stabilized, it is permissible to take-off. Do not take off with an oil temperature higher than 140°C.

IV. OIL PRESSURE:

The oil pressure should be between 65 and 75 pounds per square inch, with oil temperature of 85°C. The minimum oil pressure for idling is 15 pounds per square inch. The oil pressure warning lights are set at 45 psi.

V. OIL COOLING:

The lubricating oil is cooled after leaving the engine by a 13" aluminum radiator. The oil temperature is controlled, within desired limits, by a thermostatically operated valve on the radiator which routes oil through radiator cores or around outer shell, depending on temperature of oil. During normal operation, this thermostatic control is completely satisfactory. However, in the event of malfunctioning of thermostat or unusual operating conditions, a door is located on the scoop that can be used to regulate the volume of air passing through the radiator core. This door is electrically actuated and is operated by individual switches on the right side of the overhead switch panel.

V. OIL COOLING (Cont'd):

The door on the radiator scoop is placed in a "Neutral" position or flush with scoop contour for normal operation. The switch will rarely have to be moved except on designated inspections. This neutral position is set on the ground by having an observer at scoop door relay signal to cockpit. Guards are to be installed over the switches so that they will not be inadvertently moved.

VI. COLD WEATHER OPERATION:

In cold weather, if a rise in oil temperature is observed while the oil radiator air door is open beyond "Neutral", and the temperature continues to rise, it is a good sign of congealed oil in the radiator. If such a condition is encountered, the air door should be closed for a short period of time in order to warm congealed oil and allow it to flow from the radiator. The radiator air door should then be opened to maintain normal oil temperature.

I. GENERAL:

The oxygen system in the DC-4 consists of 2 each, 1800 pound bottles located directly behind the co-pilot's seat, mounted on a special rack above the cargo bin. The two bottles have separate outlet lines which connect into a tee fitting which carries the oxygen from both bottles in one common line to a Puritan type regulator and gauge. This regulator will supply an adequate amount of oxygen for use between 10,000 and 14,000 ft. From the regulator the line is plumbed into a second tee which makes it possible to run one line to the cockpit and one line to the cabin.

II. CREW SUPPLY:

A shut off valve in the cabin supply line is located on the floor accessible to the co-pilot. There are three (3) outlets in the cockpit: pilot's, co-pilot's and observers. The co-pilot's outlet is located on the floor of the cockpit, to the right of the co-pilot's seat. The pilot's outlet is located on the floor and to his left, the observer's outlet is located on the radio rack post, just behind the pilot's right shoulder, accessible to the observer when he is riding the "Jump" seat.

III. PASSENGER SUPPLY:

The oxygen directed to the cabin for passenger use is accessible from outlets on the cabin wall just above the floor and to the side of each row of seats. A total of twenty-five (25) outlets are installed in each C-54-B aircraft. Six (6) masks are stored in the upper right hand buffet ahead of the first set of seats. The two (2) kits, containing three (3) masks each, are safetied shut and immediately available should they be needed.

I. DESCRIPTION:

A. Pitot and Static Pressure Supplies:

Two pitot tubes are mounted side by side in the nose of the airplane. The pitot pressure line from the left hand pitot tube connects to the Captain's airspeed indicator. The pitot pressure line from the right hand pitot tube connects to the First Officer's airspeed indicator.

The static pressure for both the Captain's and First Officer's airspeed and other static instruments is supplied by flush type static fittings mounted in the sides of the nose of the airplane. The two static lines are connected to a common static selector valve mounted on the Captain's side of the main instrument panel. The static selector valve enables the flight crew to choose an alternate static source, should the primary static source become defective in flight.

An emergency source of static pressure is available through the static selector valve, should both the primary and secondary static sources become defective. This emergency static source is located in the tail cone of the airplane.

B. Static Selector Valve:

The Captain's and First Officer's airspeed indicators, altimeters, and rate of climb indicators receive their static pressure through manifold blocks located behind the respective instrument panels. The manifolds in turn are connected to the static selector valve mentioned in paragraph "A", above. The static selector valve is connected to the primary, secondary, and emergency static sources.

C. Pitot Tube Electric Heaters:

Each of the two pitot tubes in the nose are equipped with 100 watt electric heaters. Current for the pitot heaters is supplied through two 10 ampere circuit breakers in the main electrical junction box. The current controlled by single pole switches located on the upper instrument panel also passes through a Weston ammeter located just below the switches.

Current is supplied through a 20 ampere circuit breaker to the contacts of a solenoid which is actuated by the left pitot heater switch. From this solenoid, current is fed to a 350 watt heater in the inlet scoop for the cabin heater. Turning the left pitot heater on turns on the cabin heater air scoop de-icer at the same time.

II. OPERATION:

A. Use of Static Selector Valve:

Under normal operation the static selector valve should be turned to the PRIMARY source. If an airspeed indicator is operating improperly and the pitot heater does not correct the trouble, select the SECONDARY static source. It is to be noted that all statically operated instruments are operated from the same static source.

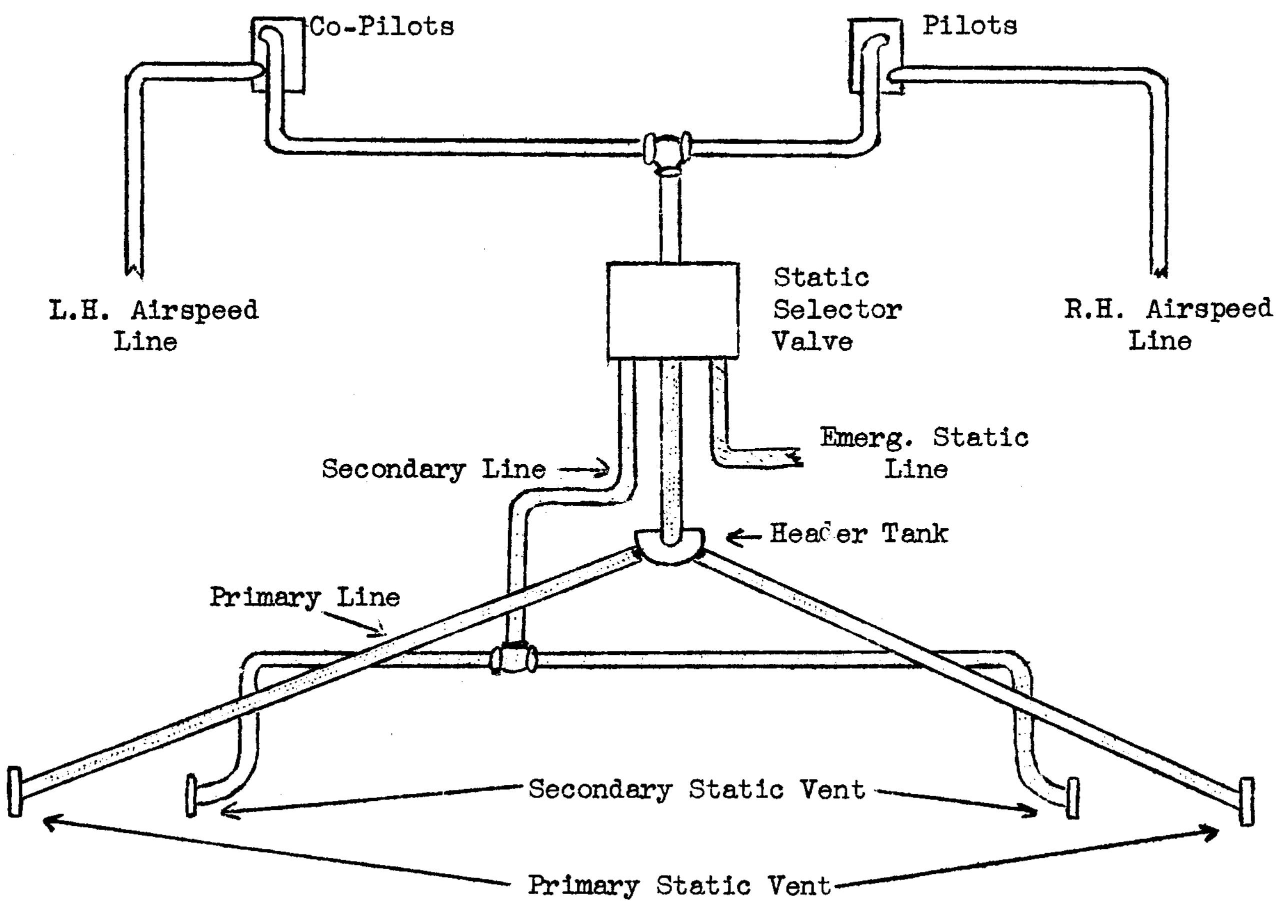
B. Use of Pitot Heaters:

Operation of the pitot heaters shall be checked by the First Officer prior to each trip. If atmospheric conditions might cause moisture to collect in the pitot heads before or immediately after departure, and if the temperature is expected to be below 4°C (40°F), the heaters shall be turned on when the plane is taxied to the take-off position. Turn the pitot heat on in rain whenever the temperature is below 4°C (40°F). Care should be taken to watch falling temperatures and turn the pitot heaters on whenever the temperature goes below 4°C (40°F).

NOTE: Due to intense heat supplied by the heating elements, heaters should be "Off" at all times on the ground, or the elements will be burned out.

Periodically during each flight, the current drawn by each heater may be checked by turning the heaters on and noting the ammeter reading for each heater. If the ammeter shows no current consumption when a heater switch is on, either a circuit breaker is open or the heater element is inoperative and in need of repair. Check the individual heater element circuit breakers and the main heater circuit breaker in the main junction box circuit breaker panel and reset any open circuit breakers. Operation of the pitot heaters slightly affects the compass reading. The compass deviation should be noted as the heaters are turned on.

STATIC LINE SYSTEM



Alcohol is supplied to the propeller blades, the carburetors, and the windshield for the prevention and removal of ice in these areas.

All components of the alcohol system are operated from the cockpit.

I. DESCRIPTION OF SYSTEM:

A. Tank:

A 40-gallon alcohol supply tank is located under the floor at the forward end of the rear belly compartment. The tank is filled through an opening near the rear of the left wing fillet. A drain valve under the tank is used for draining, shutting off, or allowing fluid flow to the distributing units. This valve is normally positioned to allow flow to the system and is safetied "Open". The tank has an alcohol quantity transmitter of the liquidometer type, that operates an indicator located in flow meter panel in cockpit.

B. Pump:

The alcohol system is pressurized by an electrically driven pump, located on the floor of the "Hell Hole" forward of the alcohol supply tank. The pump has a pressure relief valve set for 25 to 28 pounds per square inch. The pump may be energized by any one of five electric switches in the cockpit. One switch, for constant use of propeller and windshield alcohol, is located in extreme right side of overhead electrical panel. Four double poled switches, spring loaded to "Off" position, for individual operation of carburetor (induction) alcohol are located in upper electrical panel. One pole of each of these switches energizes the alcohol pump, and the other pole energizes the solenoid valve for its respective carburetor. These switches are numbered corresponding to engine position. When any one of five switches mentioned above is "On", a warning light located in right side of upper panel indicates alcohol pump operation. The alcohol coming from pump is routed to a distributor. Fluid flowing out of one side of the distributor passes through the wing and individual nacelles to solenoid type control valves mounted in #1 and #2 engine nacelles. Fluid flow in the other direction is similarily controlled by two solenoids, one for #3 carburetor and another for #4 carburetor. However, in this case both solenoids are mounted in the wheel well of the #3 engine. The one in the rear is the control solenoid for the #4 engine.

I. DESCRIPTION OF SYSTEM (Cont'd):

C. Flow Meters and Propeller System:

Four flow meters with regulating valves are mounted on the right side of the cockpit adjacent to first officer's elbow for controlling alcohol flow to propellers. Illumination of the flow meters is controlled by a switch mounted to the left of constant pressure alcohol switch. The alcohol quantity gage is located in the right side of this panel. A slinger ring is mounted at the rear barrel half of each propeller assembly. Three tubes lead from this slinger ring, one to the leading edge of each blade. Alcohol from the pump is routed from the hydraulic compartment to a "Hooked" discharge tube which empties into a groove in the rear of the slinger ring. In this manner, fluid is transferred from the stationary outlet to the revolving propeller, and from there it is thrown out the slinger ring spigots by centrifugal force. A grooved rubber boot which is cemented to the leading edge of the blades provides a channel by means of which the fluid can reach the affected area.

II. OPERATION:

A. Windshield:

First pressurize alcohol system by placing constant flow switch to "ON" position. Then open needle valve located on right side of cockpit adjacent to First Officer's knee. Rate of flow to windshield is regulated by amount of opening. Alcohol for windshield anti-icing is supplied as a supplementary method. The primary method is heat applied between panes of glass. (Refer to section 45.00.)

B. Propellers:

First pressurize alcohol system by placing constant flow switch to "ON" position. Second, turn on flow meter light and then open the needle valves for desired flow as indicated by flow meters. Normal anti-icing requirements are 2 to 3 quarts per hour. Flow should not exceed 5 quarts per hour, per propeller, as alcohol in excess of 5 quarts is wasted.

II. OPERATION (Cont'd):

C. Carburetor or Induction:

To supply alcohol to carburetor system, hold the spring loaded switch corresponding to desired engine to "ON" position.

The carburetor alcohol system is of the "Deluge" type, designed for emergency de-icing and not anti-icing. The rate of flow while switch is "ON" is between 10.5 and 11.7 gallons per hour.

The alcohol quantity is available on the basis of a supply sufficient for complete icing protection based on the outline as follows:

Two carburetors (assuming pre-heat inoperative on two engines) under most severe conditions, the operation cycle of carburetor alcohol switches being 10 seconds on and 15 off:

1. Two engines at 5.5 gallons hr/carb - - - - -	11 gals.
2. Four propellers at 5 qts. per hr/prop - - -	5 gals.
3. One windshield cleaning per hr(approx.)- - -	2 gals.
Total - - - - - - - -	18 gals.

NOTE: Provisions for alcohol on the pitot tubes are unnecessary as they are electrically heated.

I. PRINCIPLES OF OPERATION OF PB-10 AUTOMATIC PILOT

The PB-10 automatic pilot is fully electronic. The smooth, easy, comfortable action of the PB-10 automatic pilot is based on two principles: (1) Mechanical impedence between the servo and the control surface, giving coordination of servo action with the aircraft's natural recovery; (2) Use of rate gyro in axis to affect dampening, thereby eliminating aircraft's natural tendency to hunt.

PB-10 pilot is not a force pilot but uses proportional displacement signals. The servos having full torque for 3/4° displacement signal, torque increase being effectively linear from 0° to that point. Response to any deviation from the aircraft level attitude is instantaneous. This, in conjunction with proportional displacement, exerts lower forces and causes less control surface deflection than the human pilot, even in the roughest of air. Corrections are, therefore, swift, smooth and continuous.

Trim controls are provided to make minor corrections in pitch and bank after the pilot is engaged. Automatic pilot controls and indications are few and simple in operation, consisting of the following:

A. Cage or Gyro Erecting Switch

The sole purpose of this switch is to provide rapid erection of gyros to approximate level flight attitude. Operation of this switch while automatic pilot is engaged automatically disconnects the automatic pilot.

B. Clutch Switch

This is a solenoid type switch which engages the servo motor with the aircraft system whenever the switch is depressed. The gyros must be uncaged to engage the system by depressing this switch.

C. Clutch Disconnect Switch

This switch is a push button type usually mounted on the control box for convenience in disconnect. It is necessary to use the clutch switch to re-engage the automatic pilot.

D. Gyro Beacon

This is a small neon lamp, located adjacent to the controller. When the aircraft is in level flight attitude, this beacon will indicate "Gyros Erect" by flashing at 30 to 40 times per minute. This beacon will not indicate during turns.

I. PRINCIPLES OF OPERATION OF PB-10 AUTOMATIC PILOT (Cont'd):

E. Altitude Control Switch:

This switch is used to maintain the aircraft at a desired altitude. The switch is normally "OFF" until aircraft has attained a desired altitude and then engaged. This control will then maintain that altitude within reasonable limits, despite passenger movement, fuel consumption or localized pressure conditions. When changing altitude the switch should be in "OFF" position; however, the control cannot be damaged if the switch is in the "ON" position, providing rate of change is not in excess of 500 ft. per minute.

F. Pitch Trim Indicator:

This indicator provides a visual indication of load being carried by the elevator. Thus, with change of CG, due to fuel consumption, etc., it is possible to manually trim the aircraft, with the trim tab, without disengaging the automatic pilot.

G. Controller:

This controller was developed to give simplified operation of the automatic pilot using one hand. Climb and dive and bank trim are readily adjusted by finger tip control. Coordinated turns can be made by merely turning the pistol grip in the direction desired. Minute adjustments of direction, such as used on the last leg of approach, can be made by depressing the trigger of the pistol grip and turning it until desired correction is made.

H. Manual Servo Disconnect:

This disconnect system is provided to manually disconnect the servos from the aircraft control system. The manual disconnect control is located accessible to the pilot to allow for quick disconnect.

To re-engage the servos after mechanical disconnect, it is only necessary to release the manual disconnect control. This control is located on the floor to the left of the Captain's seat.

II. THE FLUX GATE COMPASS:

This system is a gyro stabilized compass. It is used as a direction control for the automatic pilot, and also replaces the directional gyros on the flight panel. The gyro in the system is erected with the automatic pilot erecting switch.

II. THE FLUX GATE COMPASS (Cont'd):

WARNING: Action of the auto pilot servos is transmitted to main flight control cables and does not tie in with trim tabs. Pilots should relieve all auto pilot pressure on elevators prior to dis-engaging auto pilot.

III. OPERATION PROCEDURE:

A. Inverter switch "ON". This supplies power to automatic pilot.

B. Caging switch in "Cage" position, altitude switch in "OFF" position.

Before engine run up, caging switch in "uncaged" position, gyro beacon should be flashing 30 to 40 times a minute.

C. Align indices of pitch and bank controls; center pistol grip control. This is to assure equal travel, of each control, in each direction after the automatic pilot is engaged.

D. Trim aircraft to attitude of flight. This may be during climb, or level flight. To engage automatic pilot depress clutch switch. Any further trimming may be accomplished by the automatic pilot trim controls. Heading corrections may be made by turning of the pistol grip as previously described.

E. If pilot was engaged in a climbing attitude, rotate pitch trim down to attain level flight when desired.

F. After the ship has been leveled off at desired altitude, throw altitude switch "ON".

G. If an out-of-trim condition is indicated on pitch trim indicator, center indicator pointer using elevator trim tab. With pitch trim indicator centered, the automatic pilot may be disengaged at any time, placing the aircraft on manual control without change in attitude.

H. Disengaging the automatic pilot may be accomplished by:

1. Pressing clutch disconnect switch momentarily, or

2. Pulling clutch switch, or

3. Pulling manual disconnect.

In the event of an engine failure on a multi-engine aircraft, it is not necessary to disengage the automatic pilot. The PB-10 system will automatically adjust for this condition, and maintain the aircraft on the desired heading. However, it may be advisable to make a small rudder trim tab adjustment.

I. LOCATION AND OPERATION:

Two parachute flares, of 300,000 to 400,000 candle power each, are mounted in the racks in the left wing fillet of the airplane. The flares rest on release cover slides which restrain the flares from dropping through holes in the wing. The flares are released when the release slides are pulled out by means of release cables attached to two flare release handles located on the floor aft of the pilot's control pedestal. The flares are mounted in tandem, the rear flare release being attached to the release handle labled "Flare #1" and the forward release being attached to the release handle labeled "Flare #2". Use flare #1, then flare #2.

II. PURPOSE:

The purpose of the parachute flares is to provide sufficient illumination over a sufficiently large area of ground to allow the pilot to select an emergency landing area at night. Factors affecting the visibility from the aircraft or ground objects lighted only by flares are:

1. Candle power of the flare and number of flares used.
2. Height from which flare is released.
3. Nature of terrain reflecting the flare light.
4. Condition of the atmosphere (haze, clouds, etc.).

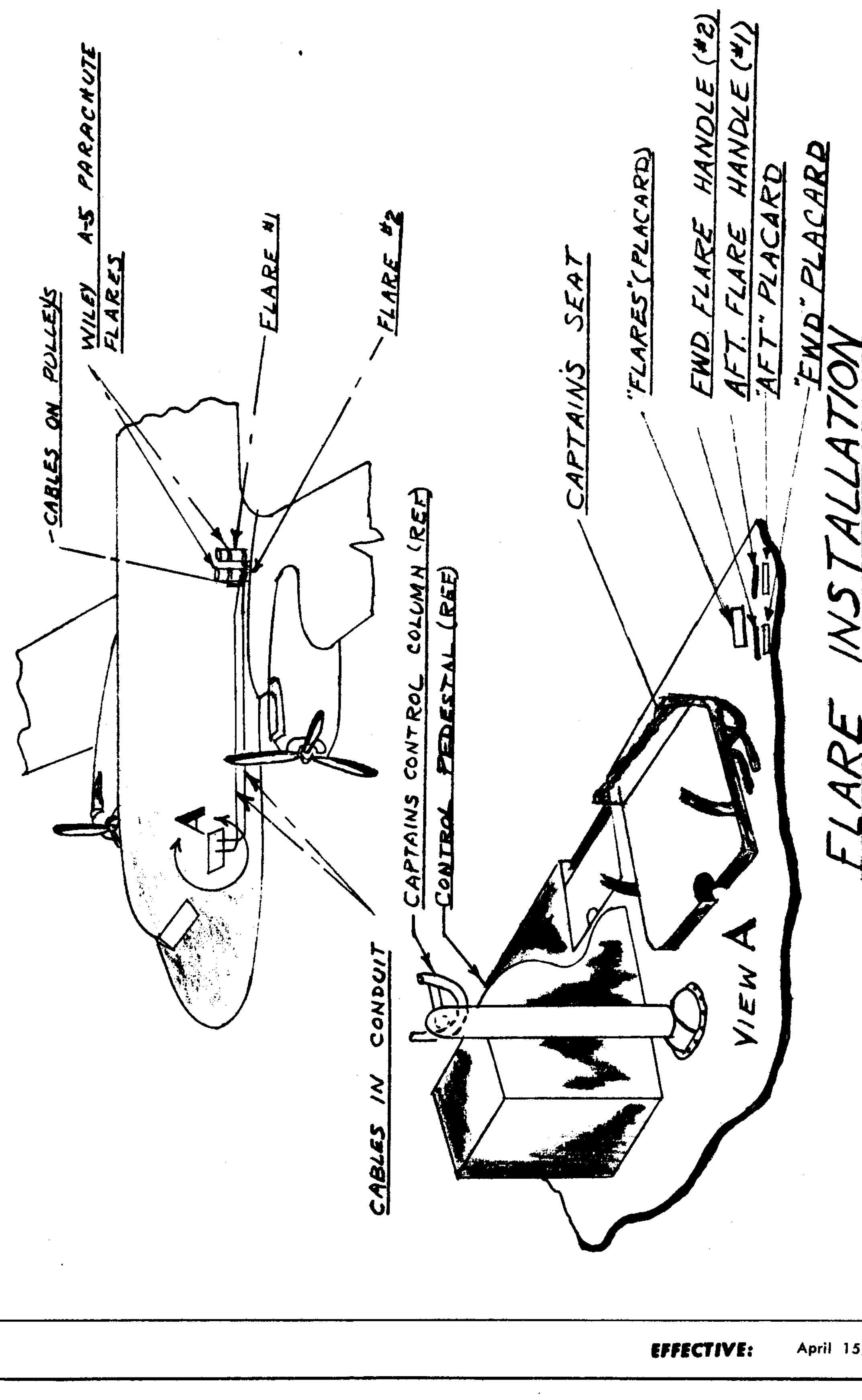
III. ILLUMINATION:

Ground illumination may be anticipated six seconds after the flare has been pulled. The rate of descent of the flare is approximately 360 feet per minute and the flare burns from 3 to 3½ minutes.

The maximum intensity and area of ground illumination is obtained if the flare is released between 1000 and 2000 feet above the ground. When dropped from a height of 2500 feet above the ground, a flare will illuminate a circular area approximately one and one-half miles in diameter. The flare may be safely released at an altitude of 1200 feet above the ground without danger to life or property beneath it.

IV. DROPPING FLARES:

When it becomes necessary to use the flares, the airplane's speed should be reduced to 140-150 mph. At the greater speeds, the flare's parachute may be ripped upon release. The flare release handle labeled "Flare #1" should be pulled first, with a strong sharp pull, as far as it will go. If the use of a second flare is necessary, the release handle labeled "Flare #2" should be pulled. The #2 release handle is connected to the forward flare and should always be pulled last to eliminate the possibility of its "Hand-wire" (which remains attached to the airplane) interfering with the release of the rear flare. Wing flaps should be in "Up" position when a flare is being released.


CABLES ON PULLEYS
WILEY A-5 PARACHUTE FLARES
FLARE #1
FLARE #2
CABLES IN CONDUIT
A
CAPTAINS CONTROL COLUMN (REF)
CONTROL PEDESTAL (REF)
CAPTAIN'S SEAT
"FLARES" (PLACARD)
FWD. FLARE HANDLE (#2)
AFT. FLARE HANDLE (#1)
"AFT" PLACARD
"FWD" PLACARD
VIEW A
FLARE INSTALLATION

I. GENERAL:

In order that the airplane be properly balanced at all times, it is necessary to determine the correct distribution of cargo and passengers prior to each departure. To avoid delay and improve the efficiency of the operation, a weight distribution schedule providing for every combination of cargo and passengers is prepared in advance. The distribution schedule provides for the proper balancing of the airplane within the prescribed limits of 16% M.A.C. to 32% M.A.C.

II. DEVELOPMENT OF WEIGHT DISTRIBUTION CHART:

The weight distribution chart has been developed to provide a ready means of keeping the airplane within its balance limits. In computing this chart, due consideration was given all variable load items by considering the maximum effect on balance and restricting the C.G. limits accordingly. Variable items affecting the forward C.G. limit are: Food service - 80 or 90 lbs., and one check pilot - 170 lbs. Variable items affecting the rear C.G. limit are: One forward passenger moving to the lavatory - 165 lbs. One pilot moving to the lavatory - 170 lbs. As passengers and crew are prohibited from being in lavatories during take-off and landing, the effect of gear retraction is taken into consideration with those variable items affecting the rear C.G. limit. Gear retraction will not affect the forward C.G. limit, as this is 14% with gear up. (14% with gear down.)

III. USE OF THE WEIGHT DISTRIBUTION CHART:

The weight distribution form used with the DC-4 is similar to the forms used on DC-3 type airplane. This form has one additional column adjoining the minimum and maximum rear cargo valves. The column designates those seats which are to be blocked. Under certain loading conditions, seat blocking is necessary due to the additional seating capacity in [redacted] RESORT DC-4's. Original Douglas design had 44 seats. It is the responsibility of the Station Agent to determine from the charts which seats are to be blocked. This information will be given to the Stewardess, and seat occupied cards will be placed accordingly.

INSTRUCTIONS

The minimum and maximum figures shown on the loading charts apply to the weight of cargo in the FORWARD COMPARTMENTS: i.e., the weight of cargo in the Deck Compartments plus the weight of cargo in the Forward Belly Compartments; Forward compartments must be loaded first. Cargo in excess of the minimum figure may be loaded in the Rear Belly Compartment.

5th MEMBER

When check pilot's seat is utilized, add 170 lb. to groos. His weight is not included in the cargo weight. Do not consider his weight in working with weight and balance figures.

FOOD

When a meal is placed aboard, add 80 lb. to gross for domestic flights; 90 lb. for international flights. This weight is not included in the cargo weight and and is not to be considered in working with weight and balance figures.

BLOCKING SEATS

On this chart, the figure shown above the maximum allowable weight indicates the number of forward or aft seats to be blocked for the existing condition. When blocking aft seats the most rearward seats excluding those in the private compartment are to be blocked first. When blocking forward seats the most forward seats are to be blocked first.

CARGO IN THE CABIN

If the maximum allowable cargo in the forward compartments plus the maximum capacity of the rear belly compartment (2120) is less than the total cargo, load the remainder in the forward cabin seats. Each 170 lb. or fraction thereof of cabin cargo is considered as one passenger in using this chart.

BASIC WEIGHT

Basic weights for international flights include the following:

Domestic Basic Weight
+

3 life rafts with equipment and water	450 lb.
55 life vests (56 with radio operator)	110 or 112
Emergency Transmitter	29
Radio Operator and baggage (when applicable)	200

NOTE: Loading charts are carried aboard each airplane and are available at each station.

RESORT
[redacted] AIR LINES, INC.

DOUGLAS DC-4

CARGO DISTRIBUTION TO FRONT CARGO BINS

Basic Empty Weight 44.294 lbs.

Basic C.G. Sta. 386 or 19.12% M.A.C.

PSG ↓ / TOTAL CARGO →	0 TO 250	251 TO 500	501 TO 750	751 TO 1000	1001 TO 1250	1251 TO 1500	1501 TO 1750	1751 TO 2000	2001 TO 2250	2251 TO 2500	2501 TO 2750	2751 TO 3000	3001 TO 3250	3251 TO 3500
0 TO 4 BLOCK MAX MIN	0 250 0	0 500 0	0 727 0	0 756 0	0 891 0	0 1030 0	0 1168 0	0 1307 0	0 1445 0	0 1584 0	0 1723 0	0 1861 0	0 2000 80	0 2138 203
5 TO 9 BLOCK MAX MIN	0 250 0	0 500 0	0 674 0	0 726 0	0 865 0	0 1003 25	0 1142 148	0 1280 271	0 1419 394	0 1558 517	0 1696 640	0 1835 763	0 1973 886	0 2112 1009
10 TO 19 BLOCK MAX MIN	6 aft 250 0	5 aft 500 123	4 aft 580 425	4 aft 685 548	4 aft 817 671	4 aft 956 794	4 aft 1094 917	3 aft 1233 1132	3 aft 1371 1255	3 aft 1509 1378	3 aft 1648 1501	3 aft 1787 1624	2 aft 1925 1823	2 aft 2064 1946
20 TO 30 BLOCK MAX MIN	10 aft 250 0	10 aft 500 98	8 aft 750 465	7 aft 1000 680	6 aft 1250 925	5 aft 1336 1175	5 aft 1432 1298	5 aft 1571 1421	5 aft 1709 1544	5 aft 1848 1667	5 aft 1986 1790	5 aft 2125 1913	5 aft 2264 2036	4 aft 2402 2290
31 TO 40 BLOCK MAX MIN	10 aft 250 0	10 aft 500 90	8 aft 750 445	7 aft 1000 700	6 aft 1250 955	5 aft 1500 1220	4 aft 1750 1495	4 aft 2002 1618	3 aft 2250 1903	2 aft 2500 2200	1 aft 2750 2500	1 aft 3000 2623	0 3127 2928	0 3202 3051
41 TO 44 BLOCK MAX MIN	6 aft * 400	6 aft * 396	6 aft 750 392	6 aft 1000 515	5 aft 1250 988	5 aft 1500 1111	4 aft 1750 1408	3 aft 2000 1737	3 aft 2250 1860	2 aft 2500 2153	1 aft 2750 2480	1 aft 3000 2603	0 3250 2913	0 3500 3036
45 TO 46 BLOCK MAX MIN	4 aft * 800	4 aft * 796	4 aft * 792	4 aft 1000 788*	4 aft 1250 784	4 aft 1500 1140	3 aft 1750 1475	3 aft 2000 1598	2 aft 2250 1923	2 aft 2500 2046	1 aft 2750 2473	0 3000 2720	0 3250 2843	0 3500 2966
47 BLOCK MAX MIN	3 aft * 1040	3 aft * 1036	3 aft * 1032	3 aft * 1028	3 aft 1250 1024*	3 aft 1500 1020	3 aft 1750 1383	2 aft 2000 1735	2 aft 2250 1858	1 aft 2500 2238	1 aft 2750 2361	0 3000 2663	0 3250 2786	0 3500 2909
48 BLOCK MAX MIN	2 aft * 1360	2 aft * 1356	2 aft * 1352	2 aft * 1348	2 aft * 1344	2 aft 1500 1340*	2 aft 1750 1336	2 aft 2000 1666	2 aft 2250 1789	1 aft 2500 2163	0 2750 2490	0 3000 2613	0 3250 2736	0 3500 2859
49 BLOCK MAX MIN	1 aft * 1756	1 aft * 1752	1 aft * 1748	1 aft * 1744	1 aft * 1740	1 aft * 1736	1 aft 1750 1732*	1 aft 2000 1728	1 aft 2250 1987	1 aft 2500 2110	0 2750 2463	0 3000 2586	0 3250 2709	0 3500 2832
50 MAX MIN	* 2090	* 2086	* 2082	* 2078	* 2074	* 2070	* 2066	* 2062	2250 2058*	2500 2290	2750 2411	3000 2532	3250 2655	3500 2778

* ADD BALLAST UNTIL CARGO WEIGHT IN FORWARD COMPARTMENTS AGREES WITH THE FIGURE SHOWN

RESORT

[redacted]N AIR LINES, INC.

DOUGLAS DC-4

CARGO DISTRIBUTION TO FRONT CARGO BINS

Basic Empty Weight 44,294 lbs.

Basic C.G. Sta. 386 or 19.12% M.A.

PSG ↓ TOTAL CARGO →		3501 TO 3750	3751 TO 4000	4001 TO 4250	4251 TO 4500	4501 TO 4750	4751 TO 5000	5001 TO 5250	5251 TO 5500	5501 TO 5750	5751 TO 6000	6001 TO 6250	6251 TO 6500
0 TO 4	BLOCK MAX MIN	0 2277 326	0 2416 449	0 2560 572	0 2693 695	0 2831 818	0 2970 941	2 fwd 3165 1064	6 fwd 3390 1190				
5 TO 9	BLOCK MAX MIN	0 2251 1132	0 2389 1255	0 2528 1378	0 2666 1501	0 2805 1624	0 2944 1747	2 fwd 3165 1870	6 fwd 3400 1993	10 fwd 3630 2116	18 fwd 3935 2239		
10 TO 19	BLOCK MAX MIN	2 aft 2203 2069	2 aft 2341 2192	2 aft 2480 2315	2 aft 2619 2438	2 aft 2757 2561	2 fwd 3046 2910	2 fwd 3185 3033	6 fwd 3520 3156	6 fwd 3659 3279	10 fwd 3950 3402	14 fwd 4250 3525	18 fwd 4575 3648
20 TO 30	BLOCK MAX MIN	4 aft 2541 2413	4 aft 2679 2536	4 aft 2818 2659	4 aft 2957 2782	4 aft 3095 2905	4 aft 3234 3028	4 aft 3372 3151	4 aft 3511 3274	3 aft 3650 3543	6 fwd 4336 4100	6 fwd 4475 4223	6 fwd 4614 4346
31 TO 40	BLOCK MAX MIN	0 3341 3174	0 3479 3297	0 3618 3420	0 3756 3543	0 3895 3666	0 4034 3789	0 4172 3912	0 4311 4035	0 4449 4158	0 4588 4281	0 4727 4404	0 4865 4527
41 TO 44	BLOCK MAX MIN	0 3750 3159	0 4000 3282	0 4250 3405	0 4500 3528	0 4750 3651	0 5000 3774	0 5250 3897	0 5500 4020	0 5720 4143	0 5720 4266	0 5720 4389	0 5720 4512
45 TO 46	BLOCK MAX MIN	0 3750 3089	0 4000 3212	0 4250 3335	0 4500 3458	0 4750 3581	0 5000 3704	0 5250 3827	0 5500 3950	0 5720 4073	0 5720 4196	0 5720 4319	0 5720 4442
47	BLOCK MAX MIN	0 3750 3032	0 4000 3155	0 4250 3278	0 4500 3401	0 4750 3542	0 5000 3647	0 5250 3770	0 5500 3893	0 5720 4016	0 5720 4139	0 5720 4262	0 5720 4385
48	BLOCK MAX MIN	0 3750 2982	0 4000 3105	0 4250 3228	0 4500 3351	0 4750 3474	0 5000 3597	0 5250 3720	0 5500 3843	0 5720 3966	0 5720 4089	0 5720 4212	0 5720 4335
49	BLOCK MAX MIN	0 3750 2955	0 4000 3078	0 4250 3201	0 4500 3324	0 4750 3447	0 5000 3570	0 5250 3693	0 5500 3816	0 5720 3939	0 5720 4062	0 5720 4185	0 5720 4308
50	MAX MIN	3750 2901	4000 3024	4250 3147	4500 3270	4750 3393	5000 3516	5250 3639	5500 3762	5720 3885	5720 4008	5720 4131	5720 4254