Section V OPERATION LIMITATIONS

PURPOSE.

This section includes limitations for the aircraft, engine and auxiliary flight equipment for normal operation. These limitations must be observed at all times to prevent possible damage to equipment through excessive loads. Particular attention must be given to the instrument marking pages in this section, as this data is not repeated elsewhere in the text. For complete restrictions, carefully read this entire section including the instrument marking page.

You would do well to study this section until it is memorized; however, it is not recommended that you rely on memory alone for the limitations of the aircraft.

MINIMUM CREW.

While there is a provision for both a pilot and copilot, the airplane may be flown easily and safely by one pilot under any conditions. The minimum crew, therefore, will be a pilot in the left seat. Additional crew members as required will be added at the direction of the Commanding Officer.

ENGINE LIMITATIONS.

The engine limitations as set up by the instrument markings are based on grade 91/96 fuel. Should grade 91/96 fuel not be available, the next higher grade may be used with the same limitations. Grade 87 fuel may be used if no other is available.

In the event an engine overspeeds, any speed in excess of 2900 rpm requires that the engine be inspected. A speed of 3000 rpm necessitates removal of the engine. In either event, the degree of overspeed, the length of time the engine operated at that speed and, if possible, the cause, should be noted and reported.

ELECTRICAL SYSTEM.

Do not operate landing gear and flaps simultaneously, or with landing lights on. Such operations will considerably overload the electrical system. Refer to Section VII for power requirements.

LANDING LIGHTS.

The landing lights shall not be extended at speeds in excess of 110 mph IAS (95 knots). Extension at greater speeds can cause structural failure in the light mechanism.

PROHIBITED MANEUVERS.

All acrobatic maneuvers, including spins, are prohibited. However, should an accidental spin occur, follow normal spin recovery procedure, detailed in Section VI.

WEIGHT AND BALANCE LIMITATIONS.

The lavatory compartment is restricted against occupancy during take-off and landing.

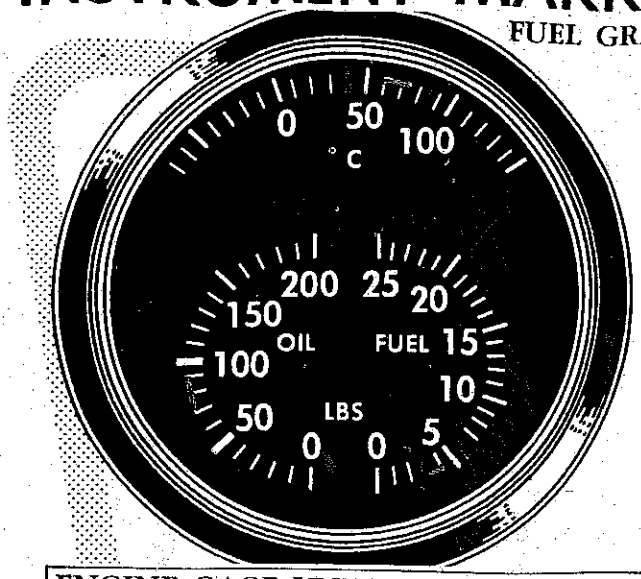
The forward CG limit of the aircraft is 107 inches, the rear limit 118.8 inches.

OPERATING WEIGHT LIMITATIONS.

In flight planning, the pilot is often confronted with this question: "What is the maximum weight at which this aircraft may be operated?" Due to certain weight controlling criteria, there is no single answer to this question. Since these criteria can be set at various optimums to accommodate varying conditions, it becomes apparent that the maximum weight of an aircraft is a varying quantity. Following are some of the controlling criteria with illustrations of how they can vary.

INSTRUMENT MARKINGS

FUEL GRADE 91/96

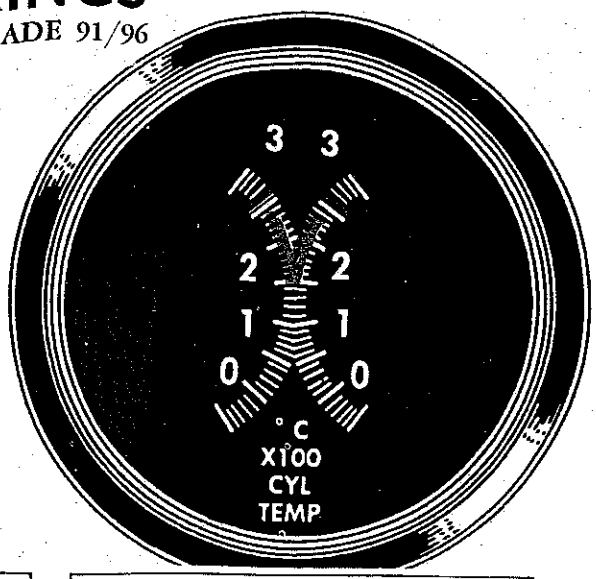


ENGINE GAGE UNIT

	OIL TEMP	OIL PRESS	
	40° C	50 PSI	MINIMUM
	60° TO 75° C	70 TO 90 PSI	NORMAL
	85° C	100 PSI	MAXIMUM

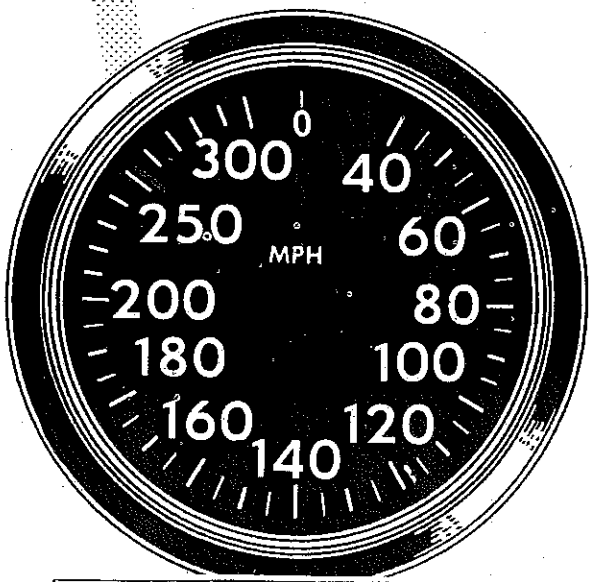
FUEL PRESS

- 3 PSI MIN FOR FLIGHT
- 3 TO 4 PSI NORMAL
- 6 PSI MAXIMUM



CYLINDER HEAD TEMP

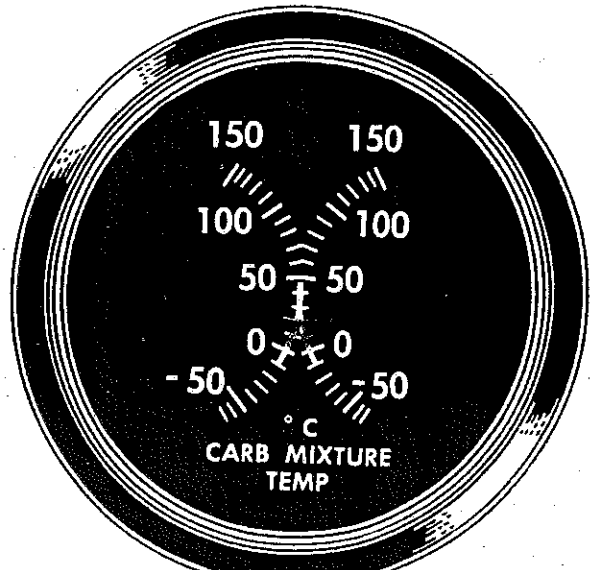
- 150° TO 232° C NORMAL
- 260° C MAXIMUM DURING TAKE-OFF



AIRSPEED INDICATOR

MPH

- 117 MAXIMUM FOR FLAPS (LANDING GEAR 125)
- 253 MAXIMUM ALLOWABLE (STILL AIR)



CARB MIXTURE TEMP

- − 10° TO + 3° C ICING ZONE
- 3° TO 20° C NORMAL
- 20° C DANGER OF DETONATION

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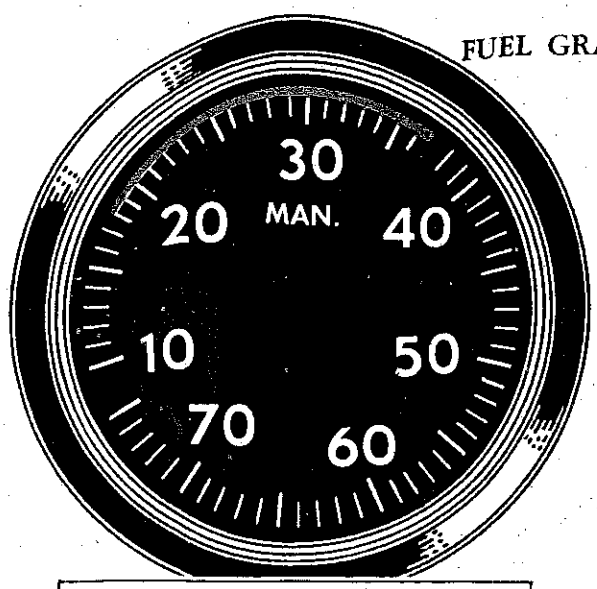
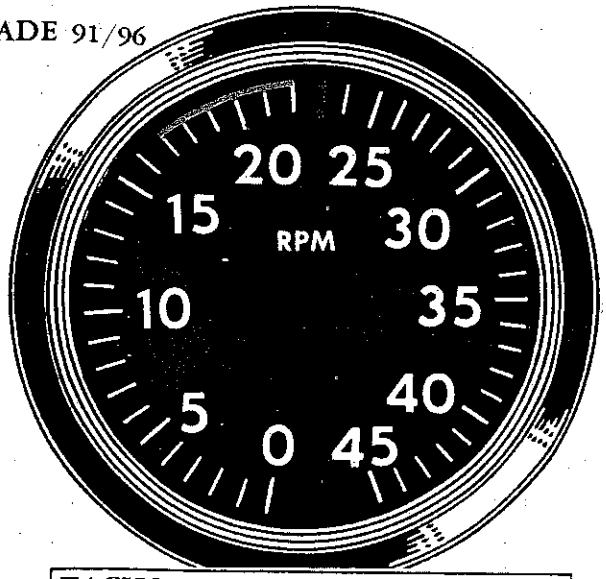
Figure 5-1. (Sheet 1 of 2)

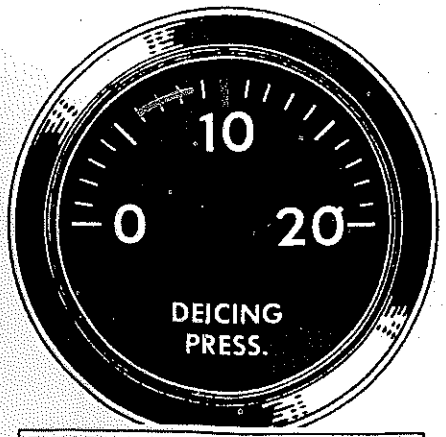
FUEL GRADE 91/96



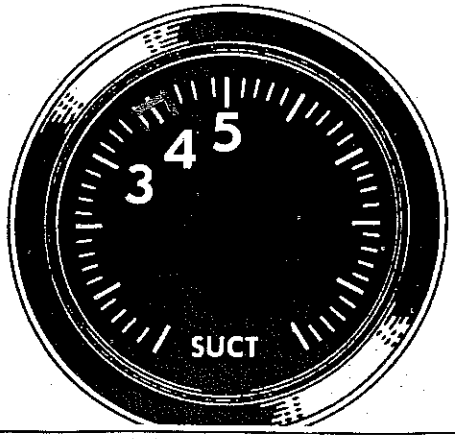
MANIFOLD PRESSURE (DUAL)
INCHES HG
18 TO 37
FULL RICH REQUIRED
37 TAKE-OFF



TACHOMETER (DUAL)
RPM
1700 TO 2200
FULL RICH REQUIRED
2300 TAKE-OFF
MAXIMUM CONTINUOUS



DEICING PRESSURE
6 TO 8.5 PSI NORMAL
10 PSI MAXIMUM



SUCTION GAGE
3.75 IN HG MINIMUM
3.75 TO 4.25 IN HG NORMAL
4.25 IN HG MAXIMUM

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Figure 1-5. (Sheet 2 of 2)

OPERATING WEIGHT.

The weight limitations chart for the aircraft is based on an operating weight of 6520 pounds. This is an approximate weight including the aircraft (basic weight) with standard crew and full oil. Since individual airplane basic weights vary, it will be necessary to adjust the chart for specific aircraft. The intersection of the cargo (ordinate) with wing fuel (abscissa) at "0" represents the airplane operating weight of 6520 pounds.

GROSS WEIGHT.

Diagonal lines on the chart indicate the gross weights of the loaded aircraft.

DISTRIBUTION OF LOAD.

The maximum load that an aircraft can carry is dependent on the way that load is distributed throughout the aircraft. Since the wings support the weight of an aircraft in flight, the greater the load carried in the fuselage, the greater will be the bending moment on the wings. This means that an aircraft might safely carry 10,000 pounds if 6000 pounds were carried in the fuselage and 4000 pounds were in the wings. The same 10,000 pounds might become an unsafe load if 8000 pounds were carried in the fuselage and 2000 pounds in the wings. The unsafe condition would result from the excessive bending moment imposed on the wings by the 8000 pounds in the fuselage. It is to be noted that this is merely an example and does not apply to this aircraft.

SPACE CAPACITY.

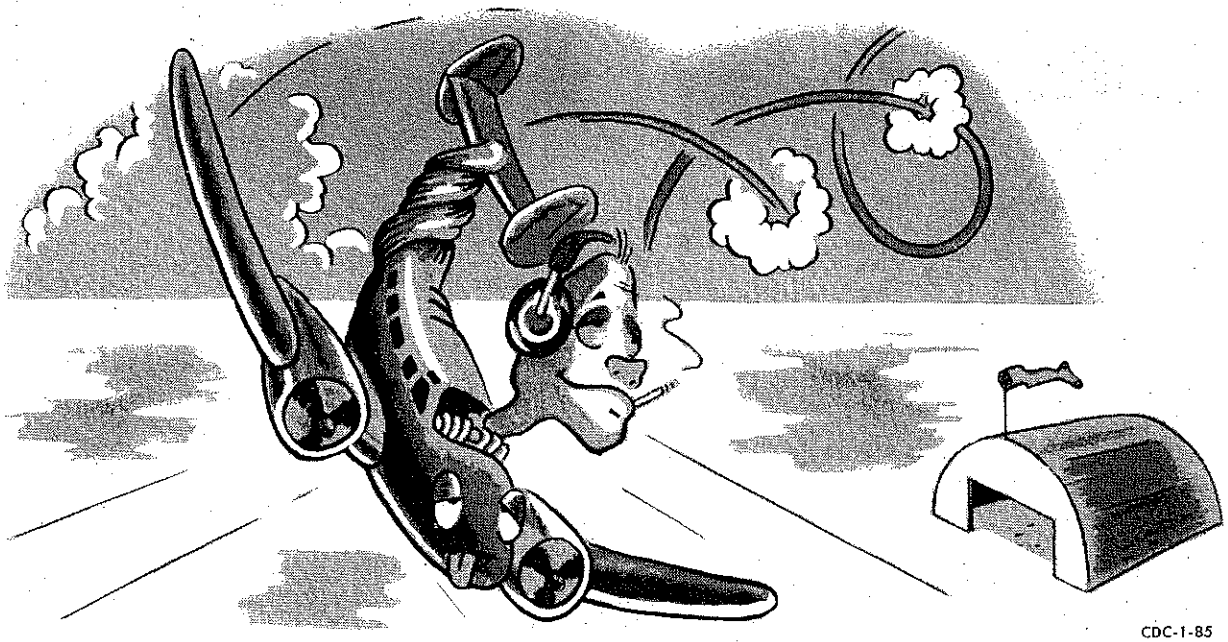
The space available may limit the load that can be carried in an aircraft. This does not normally apply to cargo aircraft.

MARGIN OF SAFETY AND LOAD FACTORS.

Ability to withstand shocks or additional loads resulting from maneuvers becomes increasingly less, as the aircraft structure is loaded to higher weights. The amount of shock or additional load that the structure will sustain before failure occurs is the margin of safety. In planning a mission, it must be understood that the "maximum" permissible weight may depend on the margin of safety desired for the various supporting structures (wings, landing gear, etc.). Should the mission require excessive maneuvering or flight through turbulent air, it would be advisable to maintain a greater margin of safety for the wing structure and, as pointed out, the greater the margin of safety, the lower the "maximum" permissible weight. Regarding aircraft, load factors are used as an indication of the margin of safety available. The structural margin of safety of the wing, for example, will be equal to the difference between the load factor the wing is capable of making good and the load factor the wing is sustaining at that moment. Example: Should the aircraft be loaded so that the wing is capable of making good a load factor of 2.6 and during the flight, load factors of 2.0, 2.3 and 1.5 are imposed on the wing, the margins of safety during these phases of flight will be 0.6, 0.3 and 1.1 load factors, respectively. The above shows how important it is to anticipate the maximum load factors that will be encountered during a mission, so that the aircraft will be loaded such that the load factors it can make good will never be exceeded during any part of the flight. Experience has shown that it is difficult to accomplish a mission, even under ideal conditions, during which the aircraft will not be subjected to load factors of at least 2.0.

WING LIMITATIONS.

Lines showing wing strength in terms of aircraft load factors for combinations of fuel and payload are shown for 2.0g, 2.5g and 3.36g. The 3.36g is the load which the aircraft structure will sustain at the de-



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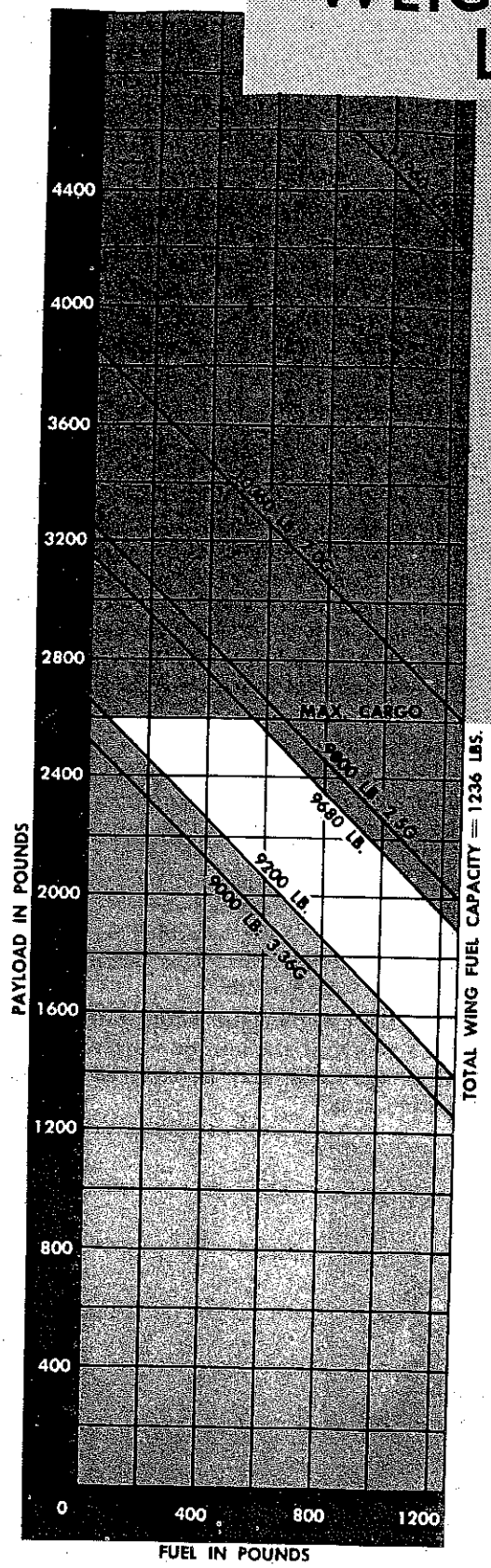
WEIGHT LIMITATIONS



WEIGHT LIMITATIONS CHART

6520 LB	Operating Weight
9000 LB	Design Landing Gross Weight at 10 FPS Contact Sinking Speed — Landing Load Factor = 3.0 Flight Load Factor 3.36
9200 LB	100 FPM Rate of Climb — Sea Level — Hot Day One Engine Inoperative — Prop Feathered Take-Off Power 450 BHP — Gear and Flaps Up
9680 LB	100 FPM Rate of Climb — Sea Level — Standard Day One Engine Inoperative — Prop Feathered Take-Off Power 450 BHP — Gear and Flaps Up
9800 LB	Design Gross Weight for Take Off, Landing, and Flight for 2.5 g's Maneuver Load Factor. Tail Wheel and Tire become Critical above this Weight because there is a possibility of the Tire and Tube blowing out upon Rough Landings, or Taxiing over Extremely Rough Ground.
10360 LB	Maximum Fuel and Maximum Body Weight Based on Compartment Loading Limitations — See Chart "E" T.O. 01-90CDB-5 Flight Load Factor = 2.0
11960 LB	Maximum Landing Gross Weight at 8 FPS Sinking Speed

Max. Cargo is the maximum load for compartments in accordance with Chart "E" of T.O. 01-90CDB-5.

NOTE: Fuel located in the fuselage is considered as cargo.

RED — NOT RECOMMENDED
YELLOW — CAUTIONARY
GREEN — RECOMMENDED

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sign gross weight of 9000 pounds. Combinations of payload and fuel, for which the aircraft structure is good for less than 3.36g's, should be flown with caution, especially when making turns and pullouts. THE AIRCRAFT WILL NOT BE LOADED WITH ANY COMBINATION OF PAYLOAD AND FUEL WHICH EXTENDS BEYOND THE 2.0g LINE BECAUSE STRUCTURAL DAMAGE TO THE WING MAY OCCUR.

The wing structure is designed for landing during routine operation at a gross weight of 9000 pounds at a maximum contact sinking speed of 10 feet per second limit. Based on stress of the landing gear carry-through structures located in the wings of the aircraft, the maximum recommended landing weight is 9,800 pounds.

Figure 5-2

LANDING GEAR LIMITATIONS.

The landing gear structure is designed for landing during routing operation at a gross weight of 9000 pounds at a maximum contact sinking speed of 10 feet per second limit. This is the maximum recommended landing weight for normal operation. The maximum recommended landing weight under emergency conditions is 9800 pounds at a landing load factor of 2.5. This weight is based upon the fact that the tail wheel and tire become critical above this weight, because there is a possibility of the tire and tube blowing out during a rough landing or when taxiing over extremely rough ground. Therefore, when landing at weights in excess of 9000 pounds, the tail down attitude should be avoided if at all possible. The maximum permissible landing gross weight is 11,960 pounds based upon a sinking speed of 8 feet per second limit.

PERFORMANCE LIMITATIONS.

Unsatisfactory performance at higher weights may limit the maximum permissible weight of the aircraft. Maximum take-off weight must necessarily be limited by the ability of the aircraft to take-off within the available runway length, its ability to clear any obstacles and its ability to fly with partial power failure. Two performance limitations lines are shown. The explanation of the performance limits is stated in the notes which appear on the chart.

EXPLANATION OF THE CHART.

The red area represents loadings which are not recommended. Under conditions of extreme emergency when safety of flight is of secondary importance, the Commanding Officer will determine whether the degree of risk warrants operation of the aircraft in the red zone.

The yellow area represents loadings of progressively increasing risk as the red area is approached. The structural strength becomes marginal in the landing configuration and the performance becomes marginal depending upon aircraft configuration, take-off altitude and ambient air temperature. Therefore, adequate care must be exercised when operating in the yellow area.

The green area represents the loading conditions that present no particular problem in regard to strength or preformance of the aircraft. This weight should not be exceeded unless dictated by the requirements of the mission.

NOTE

Operating weight should never exceed that required by the mission, since unnecessary risk and equipment wear will result. The take-off weight must also be considered in light of available runways and their altitude, surrounding terrain and atmospheric temperatures.

USE OF THE CHART.

For illustration purposes, two sample problems follow:

1. Assume that a C-45H aircraft calls for an 800 pound payload and 1000 pounds of fuel. Starting with the operating weight of 6520 pounds at "0", proceed along the vertical axis to 800 pounds; this increases the gross weight to 7320 pounds. Next proceed along the horizontal axis to 1000 pounds and project a line vertically to intersect the horizontal projection of the 800 pound line. By interpolation, the intersection will indicate a gross weight of 8,320 pounds.

2. Another example to demonstrate a problem where the operating weight of the aircraft is greater than that shown on the chart: assume an operating weight of 6720 pounds instead of 6520 pounds, or a difference of 200 pounds. Using the same requirements as in the previous example and proceeding as before, the gross weight will be found at 8320 pounds. To this value, 200 pounds must be added to correct the chart for the heavier aircraft. This increases the total gross weight to 8520 pounds.

In the event that the gross weight would fall within the red area as a result of the mission requirements, either the fuel or the cargo may be reduced to fall within the caution area.

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