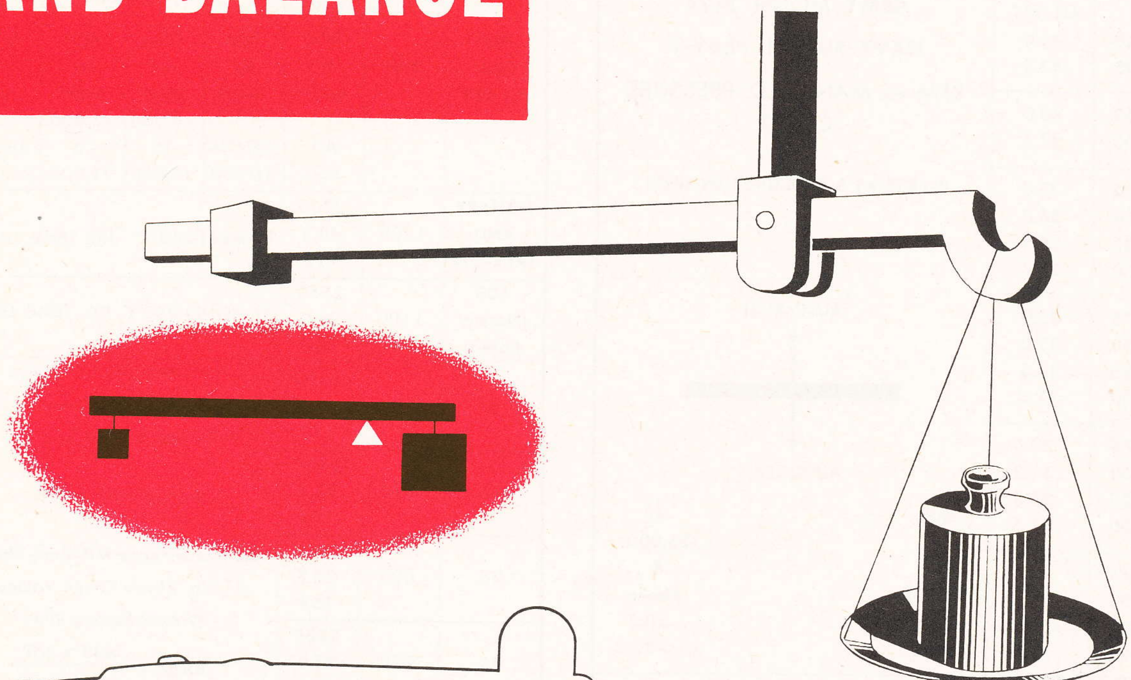
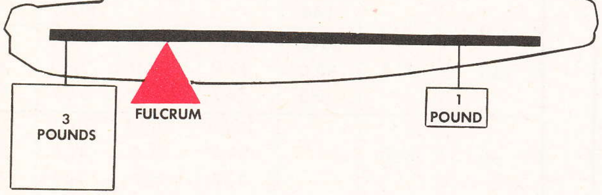
RESTRICTED

WEIGHT AND BALANCE





PRINCIPLES OF BALANCE

The theory of aircraft weight and balance is extremely simple. It is that of the old familiar steelyard scale which is in equilibrium or balance when it rests on the fulcrum in a level position. It is apparent that the influence of weight is directly dependent on its distance from the fulcrum and that the weight must be distributed so that the turning effect is the same on one side of the fulcrum as on the other. A heavy weight near the fulcrum has the same effect as a lighter weight farther out on the bar. The distance of any object from the fulcrum is called its arm. This distance, or arm, multiplied by the weight of the object, is its turning effect, or moment, exerted about the fulcrum.

Similarly, an airplane is balanced when it remains level if suspended at a certain definite point or ideal center of gravity (CG) location. It is not necessary that an airplane balance so that it is perfectly level, but it must be reasonably close to it. This allowable variation is called the CG range and the exact location, which is always near the forward part of the wing, is specified for each airplane model. Obtaining this balance is simply a matter of placing loads so that the center of gravity falls within the allowable range. Heavy loads near the wing location can be balanced by much lighter loads at the nose or tail of the airplane.

If the CG falls within the CG limits, forward and aft, the loading is satisfactory. If not, the load must be shifted until the CG does fall within the limits.

For flight, since the wing supports the airplane's weight, it is obvious that the CG must remain within safe allowable limits; otherwise, the tail surfaces could not properly control the path of flight. Limits are usually expressed as a percentage of the mean aerodynamic chord of the wing (% MAC). The MAC is simply the width of a theoretical rectangular wing which has the same aerodynamic characteristics as the regular wing.

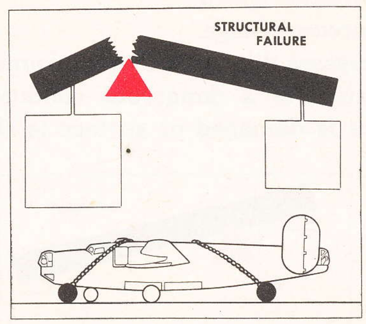
To obtain the gross weight and the CG location of the loaded airplane, it is necessary first to know the basic weight and the CG location of the airplane. This weighing should be with the airplane in its basic condition; that is, with fixed normal equipment which is actually present in the airplane, less fuel.

When the weight, arm, and moment of the basic airplane are known, it is not a difficult matter to compute the effect of fuel, crew, cargo, armament, and expendable weight as they are added. This is done by adding all the moments of these additional items to the total moment found by weighing the airplane and dividing by the sum of the basic weight and the weight of these additional items. This gives the CG for the newly loaded airplane. This calculation can be performed by arithmetic, by loading graphs, or by a balance computer.

EFFECTS OF IMPROPER LOADING

Overloading

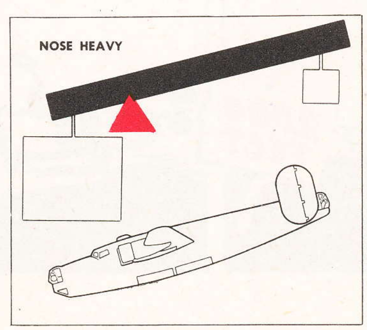
1. Causes a higher stalling speed.
2. Always results in lowering of airplane structural safety factors which may be critical during rough air or takeoffs from poor fields.
3. Reduces maneuverability.
4. Increases takeoff run.



5. Lowers angle and rate of climb.
6. Decreases ceiling.
7. Increases fuel consumption for given speed (decrease in miles per gallon).
8. Decreases range.
9. Lowers tire factors.

CG Too Far Forward

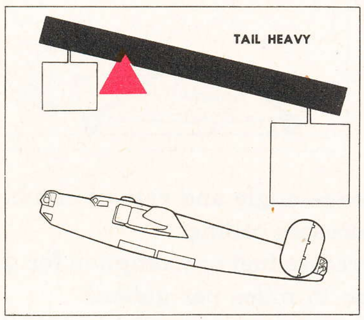
1. Increases fuel consumption (less range); decreases maneuverability.
2. Increases power for given speed.
3. Oscillating tendency—increased strain on pilot during instrument flying.
4. Tends to increase dive beyond control.
5. Might cause critical condition during flap operation.



6. Increases difficulty in getting nose up during landing.
7. Overstresses nose wheel.
8. Results in dangerous condition if tail structure is damaged or surface is shot away.

CG Too Far Aft

1. Creates unstable condition.
2. Increases stall tendency.
3. Definitely limits low power; might affect long-range optimum speed adversely.
4. Decreases speed.
5. Decreases range.
6. Increases pilot strain in instrument flying.
7. Results in a dangerous condition if tail structure is damaged or surface is shot away.



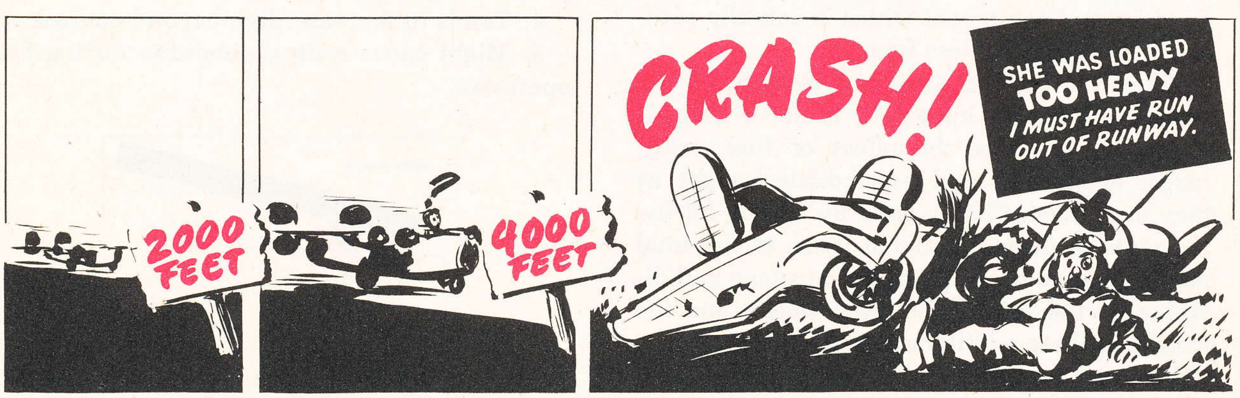
8. A sudden upgust or downgust may cause stall before recovery is possible. The reason is that the elevator is trimmed to keep the nose down. Each bump throws the nose up. In case of a severe bump there is little elevator travel left to bring the nose down, making a recovery difficult.

PROPER LOADING OF THE B-24

The day is past when the pilot makes decisions by the seat of his pants, and the loading of aircraft is no exception. Especially is this true in the B-24. Here is a high performance airplane if properly loaded. But you can't expect normal performance if you hang a ball and chain on the tail, put a ring in the nose with hundreds of pounds hanging from it, or suspend an anchor from one wing. Improper loading at best cuts down the efficiency of the airplane and at worst can cause a crash.

In transition, pilots learning to fly the B-24 sometimes get in the habit of overlooking weight and balance because there are often only a few individuals aboard, no bombs, no ammunition and the distribution of weight is of less importance. Bear in mind that the tactical Air Force you join will expect you to **know** weight and balance when you arrive. Any B-24 airplane commander worth his salt will take time to master the relatively simple operation of the load adjuster.

Note: There is a load adjuster for every airplane. On the back of its case are blank spaces for 4 items: 1. AF No.........; 2. Model ....; 3. Basic Wt........; 4. Index........ Fields will refuse to clear you for departure unless these items are filled out and unless you can complete a Form F (weight and balance clearance) for the flight as required by AAF regulations.



INSTRUCTIONS FOR OPERATION OF THE B-24 LOAD ADJUSTER

The load adjuster is the calculator used in conjunction with the **Weight and Balance Handbook.** Proficiency in its operation will save the time and effort of tracking down the elusive CG by means of mathematical calculations. Its use in conjunction with the charts and forms contained in the handbook insures a safe loading and provides a means of checking exactly how the balance position will be affected by each item of load which is added or expended.

The colored top strip is the guide to a safe loading. The actual loading range is the area between the yellow sections. The yellow area restricts these limits further for certain conditions. These conditions vary with each airplane. On B-24D, E, G, H, and J load adjusters a restriction is imposed when fuel is carried in the forward bomb bay. This caution is noted so that the allowable rear limit will not be exceeded as the balance position moves aft with the consumption of this fuel. When there is no forward bomb bay fuel aboard, this yellow section may be disregarded.

The sloping lines indicate the limits of the loading range for the gross weights to which the airplane is to be loaded. Examination of the top strip will show that at high gross weights the forward section of the loading range increases but diminishes at the rear limit. Comparison of the top strip with the center of gravity grid will explain the reason for these sloping limits.

The movement of the hairline indicator translates the change in balance position as load is added or expended in terms of the index scale which appears on the bottom of the rule. This index is merely a simple reference that is mathematically related to the center of gravity grid which appears on the inside of the load adjuster.

The center of gravity grid on the inside of the rule is the basis of the load adjuster's design. The forward and aft red sections show the CG limits in terms of % MAC, and it is from these limits that the top strip of the load adjuster is derived. The dotted lines show the fuel travel and determine the yellow caution areas for this airplane.

The CG position in terms of % MAC and inches from the reference datum may be read directly from this grid. The crosswise lines represent the weight and the diagonal, downward lines represent the percent. To convert an index reading to % MAC, note the point at which the indicator hairline and the gross weight line intersect and the % MAC is estimated at that intersection. The marks across the top of the grid are in inches from the reference datum. The position in inches is read in the same manner as the % MAC since, had the lines for inches been extended downward, they would follow the trend of the percent lines.

The fuselage diagram on the back of the load adjuster will be of great assistance in deciding where to place load items. It also provides information concerning leveling lugs, jig points, etc., to assist you in the actual weighing of the airplane. The loading scales on the front of the load adjuster are lettered to correspond with the compartment letters on the diagram on the back of the load adjuster.

The basic weight and moment scales on the inner side of the load adjuster slide determine for you in a few simple operations the basic index which is the starting point of all loading calculations. All that you need do to arrive at a basic index is set the indicator hairline at "0" on the index scale. Then, move the slide until the basic weight is under the hairline. Follow that up with a quick slide of the indicator to the basic moment/1000 and the basic index is right there under the hairline staring you in the face. If the basic moment/1000 should happen to be on a scale other than that containing the basic weight, don't be alarmed. Just set your basic weight as above: move the indicator to the final moment/1000 mark at the end of the scale containing the basic weight; then move the slide again until the same moment/1000 mark at the beginning of the next scale is under the hairline. Move the indicator to the moment/1000 figure you were looking for in the first place and the problem is solved.

Operation of the Load Adjuster

All loading calculations start with the hairline of the hairline indicator over the basic index.

From there on it requires only 2 operations to lead each of the totals shown on Form F.

The first step is to slide the slide until the "0" vertical starting line of the scale involved is under the hairline.

The next step is to move the hairline indicator until the hairline is over the weight that is to be added. The new index is then read under the hairline on the index scale at the bottom of the rule.

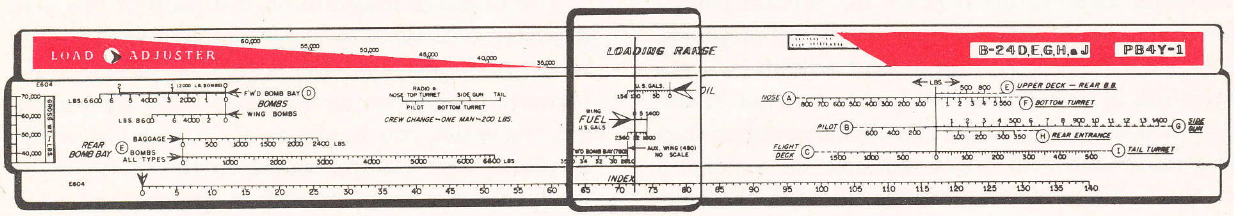
That's all there is to it. These two operations are repeated for each loading total that appears on Form F. The computations are made in the order that the items appear in the form and the resulting index reading is entered in the index column.

When you're sliding the slide, make sure that you don't move the hairline indicator, and when you move the hairline indicator, see that the slide remains in position.

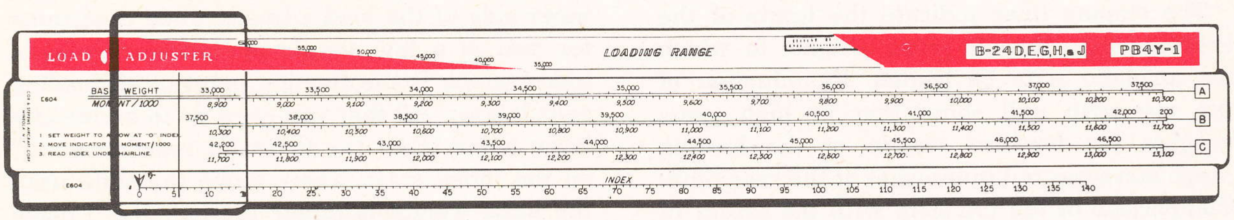
Following these two steps, work out a simple problem. Don't base any of your field problems on the data given. This is just to help you to operate your load adjuster.

Suppose the card in the load adjuster case in agreement with chart C in the handbook in your airplane shows a basic weight of 36,767 lb. and a basic index of 63.8.

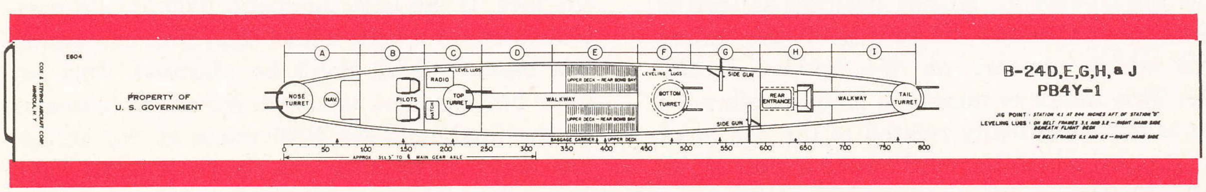
The index readings for each of the compartments are shown so that you can start working



LOAD ADJUSTER SHOWING LOADING SCALE



LOAD ADJUSTER SHOWING BASIC WEIGHT AND MOMENT SCALE



LOAD ADJUSTER SHOWING FUSELAGE DIAGRAM

your load adjuster, and check your answers with the index readings given.

Now, get a B-24 load adjuster and get your copilot and your engineer. If you can't get hold of a load adjuster any other way, get permission to go sit in an airplane. Then work out the following problem using the basic index given in the problem. You'll use the actual basic index for the airplane after you have learned to use the load adjuster. Have a Form F and fill it out as you go along. As soon as you have mastered this problem, teach it to your copilot and then to your engineer. Whenever a weight and balance clearance is necessary, you, the airplane commander, must either figure it and have it checked by copilot or engineer or have one of them figure it and you check it.

Set the indicator hairline over the basic index of 63.8 and begin.

1. Slide the slide until the "0" vertical starting line of the compartment scales is under the hairline.
2. Move the indicator until the hairline is over 260 lb. on Nose Scale A. This adds the moment of the 260 lb. in that compartment and produces a new index reading of 57.4.
3. With the hairline over the new index of 57.4 slide the slide until the "0" starting line of the compartment loads scale is again under the hairline.
4. Move the indicator to the 400-lb. mark on scale B and read the new index of 51.2.

Following the above steps, work out the other compartment loadings by yourself. You should not need any further illustration. Each new addition is made with the indicator hairline over the index determined from the previous operation.

Minimum Landing Check

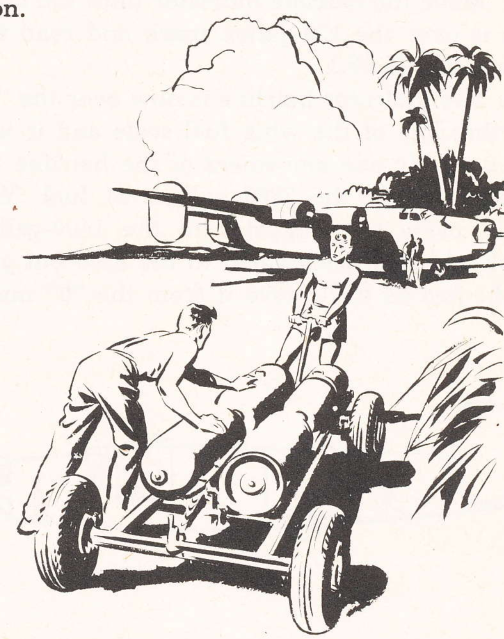
Having added all the items of non-expendable load you have now arrived at the minimum landing check. The hairline of the indicator is well within the white section and the CG is, therefore, within the loading limits.

Unless there is a most unusual loading condition, when the balance position at "Minimum Landing Gross Weight" and at takeoff is within the loading limits, no adjustments will be necessary during flight to keep plane in balance.

If the indicator hairline is, at this point, in either the forward or aft red section, readjust your cargo or provide necessary ballast (gross weight limits permitting), so that the minimum landing check will show a balance position within the loading range.

Loading Expendable Items

In order to complete calculations, now add the so-called expendable load. In this problem ammunition, bombs, oil, and fuel have to be considered. They are added in the same manner as the compartment totals but separate scales are provided for the bombs, oil and fuel. The compartment scales are used for the ammunition.



1. With the indicator hairline over the minimum landing index of 65.8, slide the slide until the "0" starting line of compartment scales is under the hairline.
2. Move the indicator until the hairline is over the 240-lb. mark on nose scale A. This adds the 800 rounds of .50-cal. ammunition in compartment A. The new index reading is 59.9.
3. Repeat these operations for each of the compartment ammunition loadings using the scales in the same manner as they were used for the addition of the non-expendable items in the compartment sections.

4. For the addition of the bombs a separate set of scales is provided. Therefore, with the indicator hairline over the last index determined from the ammunition loadings, 79.1, slide the slide until the "0" starting line of the forward bomb bay scale is under the hairline.

5. Move the indicator until the hairline is over the 6400-lb. mark on the forward bomb scale, thus adding the four 1600-lb. bombs in the forward bomb bay and providing a new index reading of 61.1.

6. Using the rear bomb bay scales, repeat the same operation for the bombs in the rear bay for a new index of 83.2.

7. Slide the slide until the vertical starting line of the oil scale is under the hairline.

8. Move the hairline indicator until the hairline is over the 130-gallon mark and read the new index of 78.1

9. The indicator hairline is now over the "0" starting line of the wing fuel scale and it will require only one movement of the hairline indicator to add the 2360 gallons of fuel. You could move the indicator to the 1400-gallon mark and then back again to the 2360 but you might just as well move it from the "0" mark right to the 2360 and let it go at that for a final index reading of 77.0.

Crew Change Scale

Since the Form F was filled out considering the crew members at battle stations, you had best put the tail gunner and the side gunner in the spots where they will be for landing and takeoff, just to make sure that the balance position will be satisfactory. You will find that the crew change scale takes care of this problem very easily.

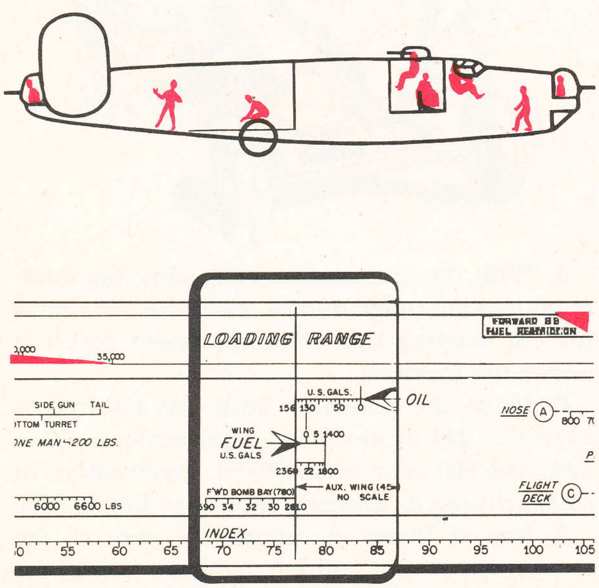
1. Set the slide so that the mark for the tail gunner on the crew change scale is under the hairline.

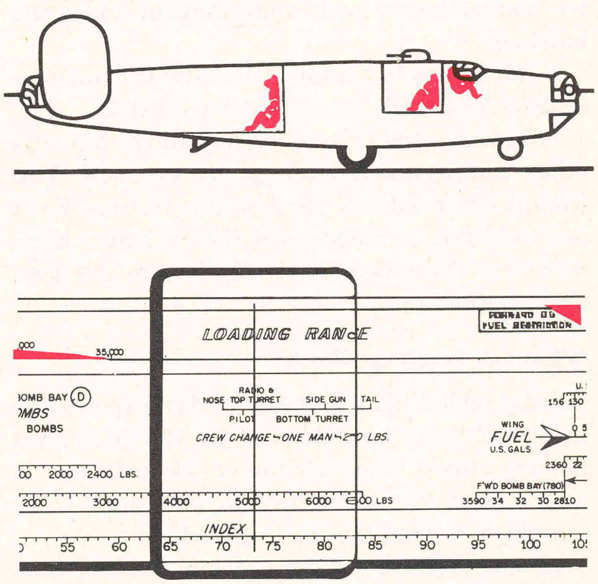
2. Move the hairline indicator so that the hairline is over the bottom turret position since that is where he will be at takeoff.

3. Slide the slide again until the mark for the side gun on the crew change scale is under the hairline.

4. Move the hairline indicator until the hairline is over the bottom turret mark.

5. Now slide the slide until the mark for the nose on the crew change scale is under the hairline.





6. Move the hairline indicator until the hairline is over the radio and top turret mark.

These operations have produced an index of 73.2 and placed your crew in the takeoff position. This is your final takeoff index.

You will find the indicator hairline right in the middle of the loading range, so you are now assured that your balance position is perfectly safe.

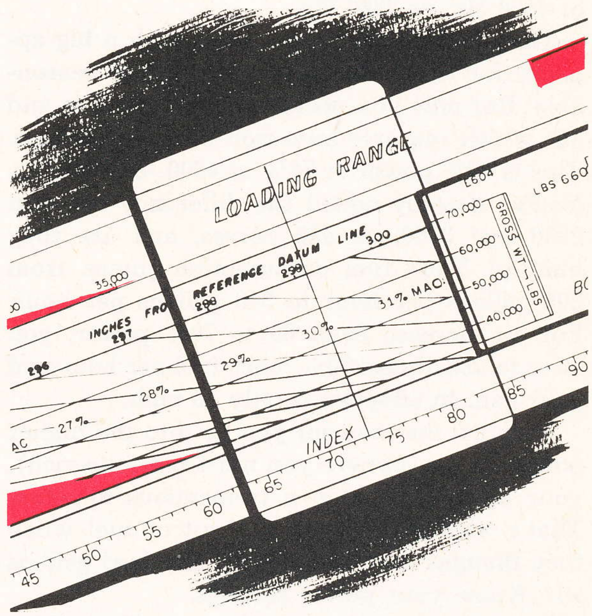
Use of Expendable Items

Since both the minimum landing check and the takeoff index have been within the limits, you can be reasonably certain that all will be well during flight. However, it might be well to see what will happen to your balance position after you have dropped that bomb load, burned the fuel or maybe caught a Jerry or two with the ammunition you had aboard. By checking your balance without these expendable items you can be equally sure of a safe CG when you come in for a landing.

You can check this CG change as load decreases either by adding to the minimum landing index or subtracting from the takeoff index. To accomplish the former, set the indicator hairline over the minimum landing index and use the load adjuster scales to add whatever part of the expendable load is still aboard at landing, always adding full oil first since it is almost impossible to estimate the oil consumption. Then add whatever you have left in the way of expendable items. If the meters show that you still have 200 rounds of nose ammunition, load 200 rounds of ammunition on scale A. If the fuel gauge registers 500 gallons of wing fuel, use the wing fuel scale and add that. Always be sure to check your landing CG. Balance alters with the use of expendable load, so don't rely on your takeoff index to make you land safely.

This computation may also be made by using the load adjuster scales in reverse. This method starts with the indicator hairline over the takeoff index. Set the slide so that the original amount loaded on any one scale is under the hairline and then move the indicator to what you have left.

You may like the first method better because it doesn't require so much mental arithmetic. However, you ought to know about this "taking out" process because it comes in handy when you find in the course of a loading calculation that re-adjustment of load is going to be necessary. By setting the indicator hairline over the index reading at which the adjustment should be made and by moving the slide to the amount originally loaded on the applicable compartment scale, you can take out whatever you like and then re-load it in some other section where it will improve your balance position. This often saves re-working an entire calculation since the index readings on Form F can be corrected accordingly if not too much re-adjustment of load is involved.



Reading CG Position From Grid

To check on reading % MAC and inches from the center of gravity grid, convert your loaded index. Set the hairline of the indicator at the takeoff index of 73.2 and slide the slide so that the gross weight figures on its left-hand end will be conveniently close to the indicator hairline. The intersection of the hairline and the line representing the 65,000 lb., which is the closest to the takeoff gross weight of 64,437 lb., occurs about 1/5 of the way between the 31 and 32% MAC lines. Therefore, the % MAC may be estimated at approximately 31.2% or, expressed in inches, between 299 and 300 inch marks as approximately 299.1.

FLIGHT CONTROL CHARTS

The average pilot doesn't realize how many horses he is controlling with his throttle hand. Twelve hundred horsepower per engine is a lot. Multiply this by 4 and it's a hell of a lot.

Normally you'll cruise auto-lean at, say 2000 rpm and 30″ (181 gallons per hour) or 2050 rpm and 31″ (205 gallons per hour), thus using 55 to 60% power—i.e., you are using about 60% of 4800 Hp, or 2880 Hp.

These 2880 horses don't have such a big appetite for fuel—200 gallons an hour is reasonable. But now you decide to use 2250 rpm and 35″ which requires auto-rich mixture settings. This is 70% power or 70% of 4800—or 3360 Hp. You've thereby added the difference between 2880 and 3360, or 480 horses, and are they hungry! Your fuel consumption jumps from 205 gallons per hour to 348 gallons per hour. For an increase from 60 to 70% power, you have to use almost 70% more fuel per hour and your gain in airspeed is only 10 mph.

In short, the moment you go into the higher power ranges (where you must use auto-rich), your engines develop a tremendous appetite. That's why pilots have run out of fuel when they **thought** they had several hundred gallons left. Know your power settings.

Remember there is a minimum efficient flying speed. The B-24 has to be up on the step to fly efficiently. This varies with weight. The moment you drop your bombs, this airspeed changes and must be recalculated. You don't conserve gas by mushing along at too low a power setting and airspeed.

The only way to ascertain the proper power settings and airspeeds for various flight conditions is to use the flight control charts or tables.

Don't Feather to Go Farther in the B-24

It works on some airplanes with light wing loadings, but it won't work on the B-24. To go the same distance, you'll use more fuel with 2 engines feathered than if you use all 4 engines properly.

For example: With a 45,000-lb. weight, cruising at density altitude of 15,000 feet, best power setting is 1700 rpm, 28.3″ of manifold pressure. You are getting approximately 490 brake Hp per engine or a total of 1960 Hp to maintain efficient airspeed with minimum fuel consumption of 150 gallons per hour.

Now suppose you feathered 2 engines. The remaining 2 engines still have to produce at least 1960 Hp for them to deliver enough thrust to give you your minimum efficient true airspeed of 153 mph. There's no way to get around that. To do this each of the engines must produce 980 Hp. This will require approximately 90% power or 2490 rpm and 41.5″ (in auto-rich). At this setting you will use 254 gallons per hour compared with 150 gallons per hour using all 4 engines. No allowance was made here for loss of efficiency because of the drag of feathered propellers.

Remember there is a big difference between maximum economy and maximum range. If you want to stay in the air as long as possible, you want maximum economy—as in a case where you want to hang around near the field until a ground fog clears.

But maximum economy flying usually means the airplane is in a semi-mushing attitude. It will stay in the air but it won't go any place and it won't get you the most miles per gallon for fuel available. The airplane **must** be flying efficiently to get the most miles per gallon.

The charts on the following pages are for instructional use only. For planning actual flights, you will find simplified tables in your G file for the plane you are flying. Such tables are replacing the graph charts, from which they are derived.

Use of the graph charts in your spare time will give you a fuller understanding of the use of the simplified tables. The charts presented serve only as examples of the full series.

EFFECTS OF POWER SETTINGS ON GAS CONSUMPTION AND AIRSPEED

(Based on 50,000 pound weight cruising at density altitude of 5,000 feet, no wind; see Cruise Control Chart)

POWER SETTING rpm	Manifold Pressure	Brake Horse Power	Gals. Per Hour	Hours and Minutes of Fuel H	M	Indicated Airspeed	True Airspeed	Range in Miles*	What the Table Shows
Auto-Lean									
1500	26″	35%	126	15	52	132	142	2254	Airplane won't cruise at 35% power
1600	28″	40%	134	14	55	152	163	2234	Low fuel consumption. But maximum range would be approx. 42.5% power.
1650	30″	45%	146	13	42	165	178	2438	12 GPH more fuel = gain 15 mph TAS.
1750	31″	50%	161	12	25	173	186	2311	15 GPH more fuel = gain 8 mph TAS.
1900	31″	55%	180	11	07	183	196	2178	19 GPH more fuel = gain 10 mph TAS.
									Increase in gas consumption of 46 GPH gives increase of 33 MPH TAS.
2050	31″	60%	205	9	45	190	205	2000	25 GPH more fuel = gain 9 mph TAS.
2200	32″	65%	250	8	00	197	212	1696	45 GPH more fuel = gain 7 mph TAS.
Auto-Rich									
2200	32″	65%	306	6	32	197	212	1386	56 GPH more fuel = gain NO mph TAS.
2250	35″	70%	348	5	45	203	218	1252	42 GPH more fuel = gain 6 mph TAS.
2325	35.5″	75%	390	5	08	208	224	1149	42 GPH more fuel = gain 6 mph TAS.
									Increase in gas consumption of 140 GPH gives increase of 12 mph TAS.
2400	37.5″	80%	428	4	40	213	230	1075	38 GPH more fuel = gain 6 mph TAS.
2490	41.5″	90%	508	3	56	222	238	937	80 GPH more fuel = gain 8 mph TAS.
2550	46″	95%	581	3	27	228	246	847	73 GPH more fuel = gain 8 mph TAS.

These are roughly interpolated figures to give you an idea of the effect of power settings. Note what a change in rpm alone will do. Note what happens when you go into auto-rich—Zoom goes the gas consumption! But remember these figures are for only one weight of airplane at one altitude. Different figures apply for different weights at different altitudes.

*Based on 2000 gallons of fuel, cruising in level flight.

HIGH PERFORMANCE TAKEOFF CHART

Normally it will not be necessary to compute takeoff distances when operating from airfields constructed for 4-engine aircraft. However, for heavy loads and for takeoffs from strange and shorter fields it is imperative that you check the length of run required.

In effect a field is a different length every day. Wind will make a field longer, hot weather will make it shorter, air density changes its effective length. The weight of your airplane can shorten or lengthen the field. It will measure the same distance in feet but so far as the B-24 is concerned these elastic takeoff strips stretch and contract with the weather. This means that just because Joe Doakes took off from some field last Tuesday is no reason that you can do it this Saturday. The difference between a warm afternoon and a cold morning can mean as much as 500 feet difference in takeoff run. Variation in wind alone can easily make as much as 1000 feet difference in the length of your ground run. The field elevation and runway surface must also be considered. Before a doubtful takeoff always consult the high performance takeoff chart.

To get the pressure altitude you can ask the weather office or you can set the barometric pressure scale on the altimeter to 29.92 (standard sea level pressure). This will give a reading of the pressure altitude of the airplane above sea level. If this pressure altitude reading is higher than field elevation, the air is less dense than the standard for the elevation (requiring a longer takeoff run than usual), if the pressure altitude reading is lower than field elevation, the air is more dense than standard and takeoff distance should be less than normal.

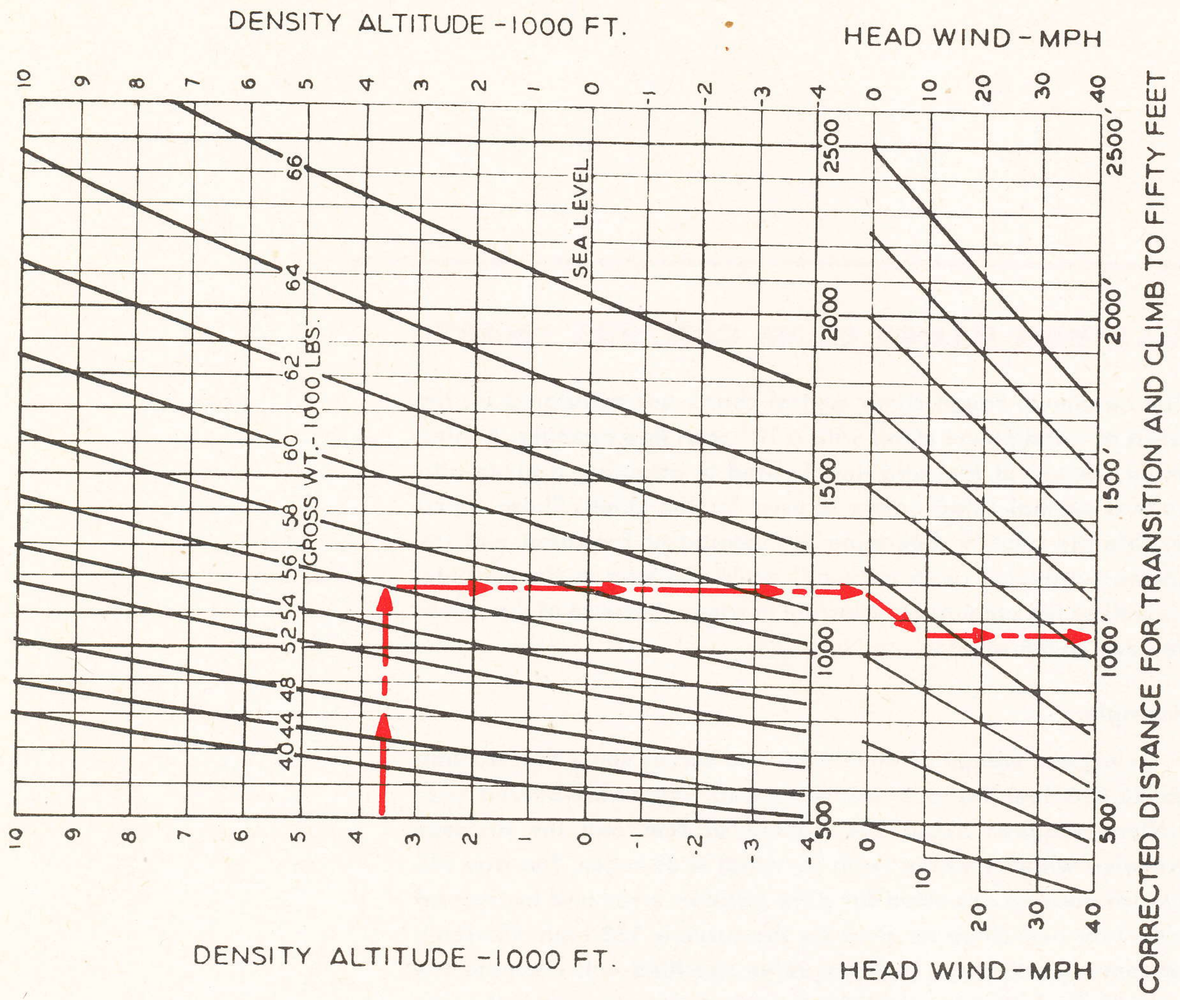
EXAMPLE: (Illustrated on chart with red line)

Given: Temperature = 25°C.
Gross Weight = 56,000 lb.
Field Condition = soft turf.
Headwind = 10 mph.
Pressure Altitude = 2000 feet.

Solution:

Density Altitude = 3550 feet.
Ground run—concrete runway—no wind = 2980 feet.
Ground run corrected for ground condition (soft turf) = 4200 feet.
Ground run corrected for ground condition plus a 10 mph headwind = 3550 feet.
Distance for transition and climb to 50 feet (no wind) = 1180 feet (same density altitude used as determined from the ground-run chart).
Distance for transition and climb to 50 feet corrected for 10 mph headwind = 1050 feet.

Total distance to clear a 50-foot obstacle = 3550 + 1050 = 4600 feet.



HORIZONTAL DISTANCE FOR TRANSITION AND CLIMB TO FIFTY FEET ONLY

GROUND RUN ONLY

NOTE: THIS CHART IS BASED ON THE FOLLOWING:

WING FLAPS —20°, COWL FLAPS —5°, TAKE-OFF POWER—4800 BHP

NOTE: THE TAKE-OFF DISTANCES SHOWN ON THIS CHART ARE *HIGH PERFORMANCE* AND CAN ONLY BE ATTAINED BY FOLLOWING THE PROCEDURE GIVEN BELOW. FOR NORMAL TAKE-OFF CONDITIONS WHERE HIGH PERFORMANCE IS NOT REQUIRED (AIRLINE PROCEDURE) ADD APPROX. 200 FT. TO THE GROUND RUN AND 600 FT. TO THE TOTAL DISTANCE TO CLEAR A 50 FT. OBSTACLE AND INCREASE THE TAKE-OFF VELOCITIES 10 MPH.

TAKE-OFF PROCEDURE

1. AFTER WARM-UP, RUN UP EACH ENGINE SEPARATELY TO 2700 RPM AND 47" Hg MP (THIS SETTING ALLOWS FOR A 1½" Hg INCREASE IN MP DUE TO RAM) TO OBTAIN TURBO REGULATOR SETTING.

2. PRIOR TO TAKE-OFF, MAINTAIN TURBO REGULATOR SETTINGS DETERMINED IN ITEM 1 AND REGULATE THE POWER BY MEANS OF THROTTLE ONLY.

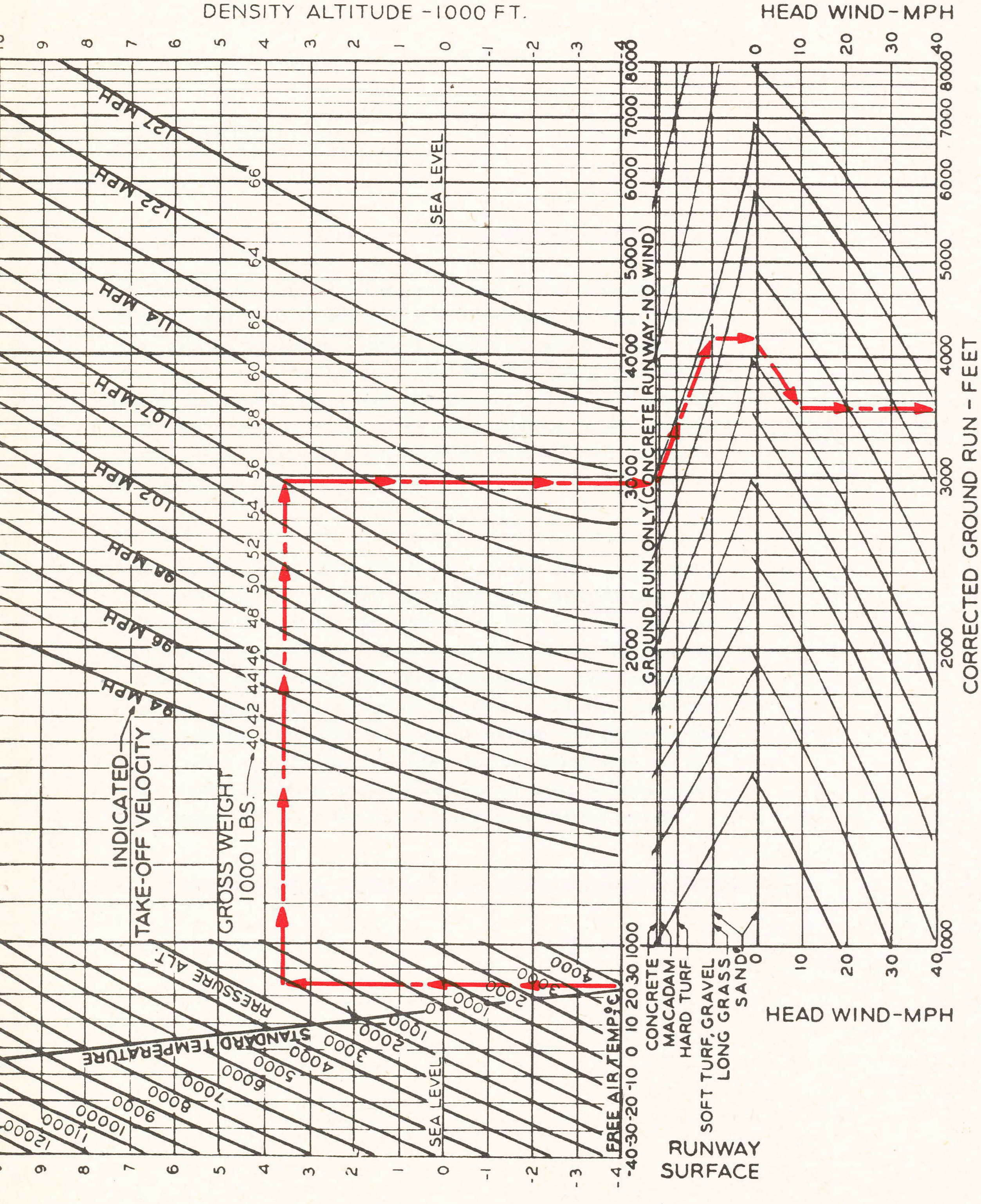
3. SET WING FLAPS TO 20° AND COWL FLAPS TO 5°.

4. ON TAKE-OFF DO NOT RELEASE BRAKES UNTIL MP HAS REACHED 35" Hg.

5. UPON RELEASING BRAKES, INCREASE THROTTLE SETTING TO FULL OPEN POSITION AS RAPIDLY AS POSSIBLE.

6. TAKE OFF AT THE INDICATED VELOCITY SPECIFIED ON THE CHART FOR GROUND RUN DISTANCES.

TAKE-OFF CHART (B-24D)



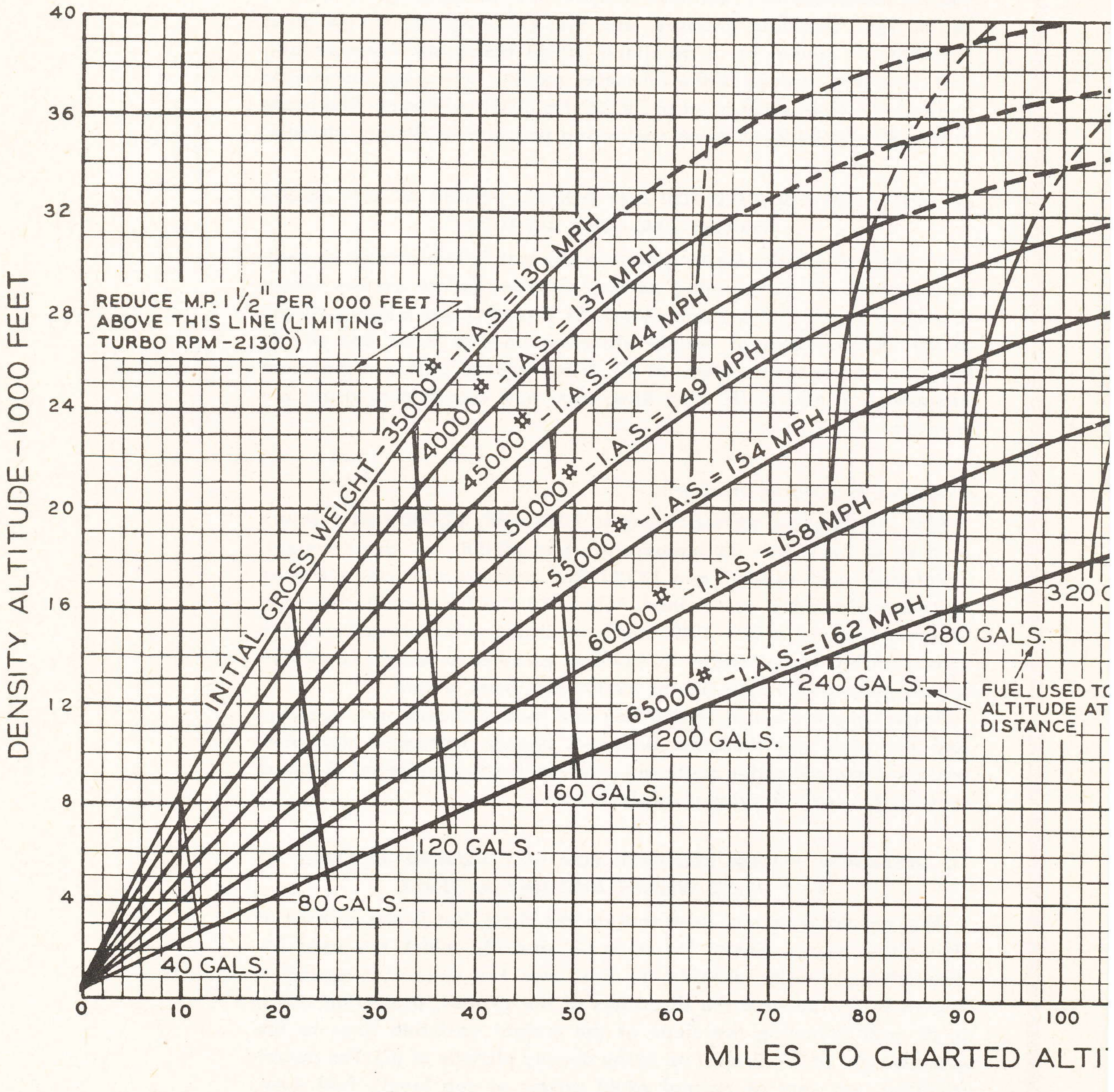
MAXIMUM RANGE CLIMB CONTROL CHARTS

The maximum range climb control charts are calculated on the basis of rated power climb with a 10° cowl flap opening. A minimum amount of fuel and time is used in attaining a given altitude if normal rated power is used for the climb. These charts enable the pilot to determine the amount of fuel used and the distance traveled (with no wind) while climbing to the altitude, as well as the amount of reduction in range (because of the climb) for any given mission.

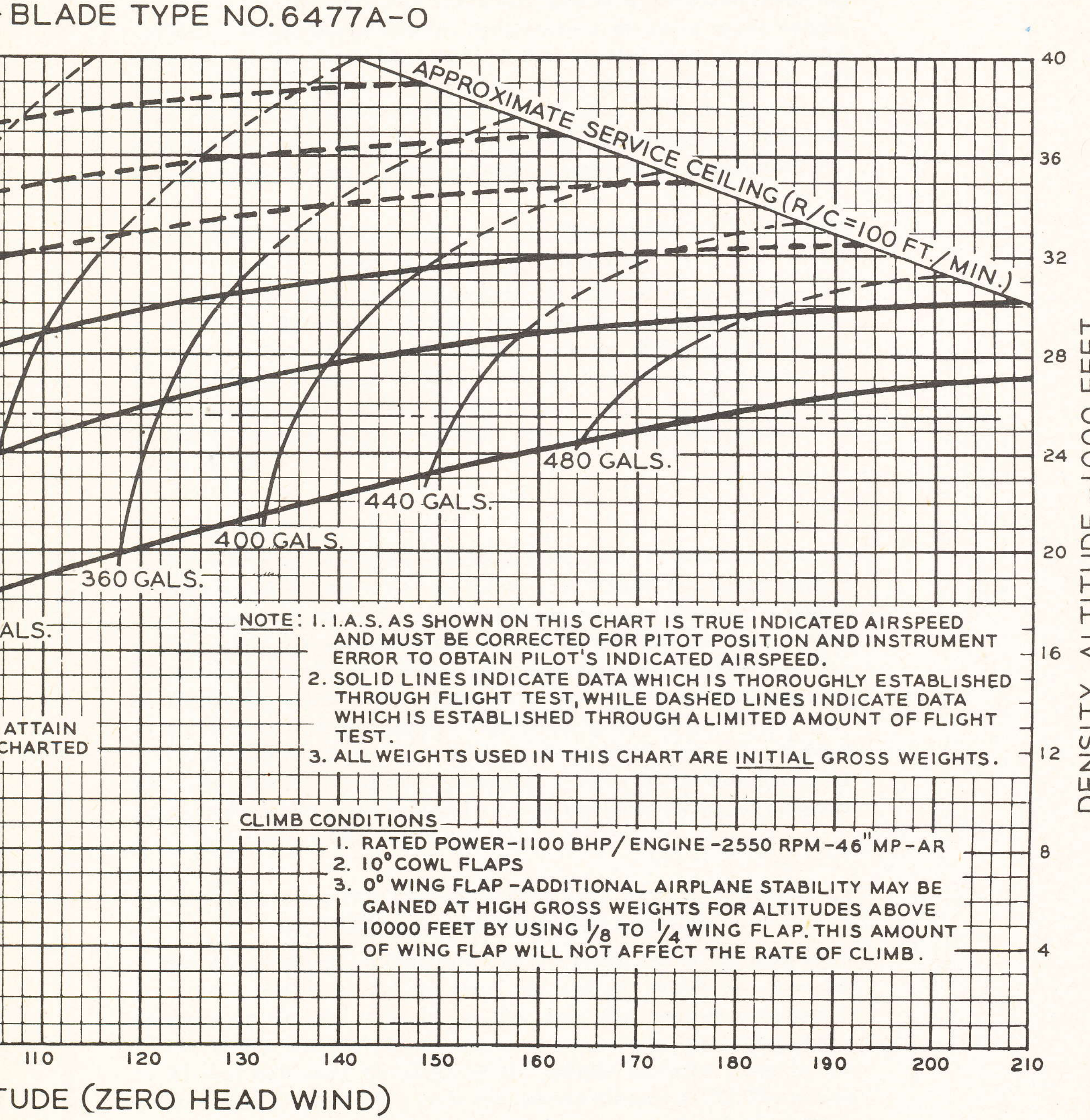
Example:

At a gross weight of 60,000 lb., the curves show that a climb to 20,000 feet for a B-24D equipped with wide-bladed propellers, requires about 258 gallons of fuel and the distance traveled while climbing (with no wind) is 82 miles. The true IAS (which must be corrected for pitot position error and instrument error) for best climb as given by the curve is 158 mph. Climbing at some speed faster than the value specified will decrease the rate of climb and increase the total fuel consumed and the distance traveled during climb. Climbing at powers lower than rated power will have the same effects as increased speed.

WIDE BLADE PROPELLERS-



MAXIMUM RANGE CLIMB CONTROL (B-24D)



THE CRUISE CONTROL CHART

Use of this chart allows quick and direct solution of problems involving various combinations of altitude, temperature, airspeed, gross weight, engine rpm, manifold pressure, and fuel consumption. It also gives approximate speeds for a maximum range operation. Pressure altitude: Pressure altitude is the altimeter reading when the barometric scale on the instrument is set to 29.92" Hg (1013 millibars). This scale setting should be used when converting pressure to density altitude.

TO DETERMINE AIR SPEED FOR ANY DESIRED POWER AT ANY GROSS WEIGHT AND ANY ALTITUDE

Enter chart at outside air temperature (A) and follow arrows to pressure altitude (B) determining density altitude. Follow arrows across to desired or selected per cent power (C). Project down to gross weight at (D). Follow slope of weight variation lines to base line at (E). Project up to density altitude at (F). True airspeed and true indicated airspeed are read at (F). Fuel flow, rpm, and manifold pressure are found at (C).

EXAMPLE (illustrated on chart):

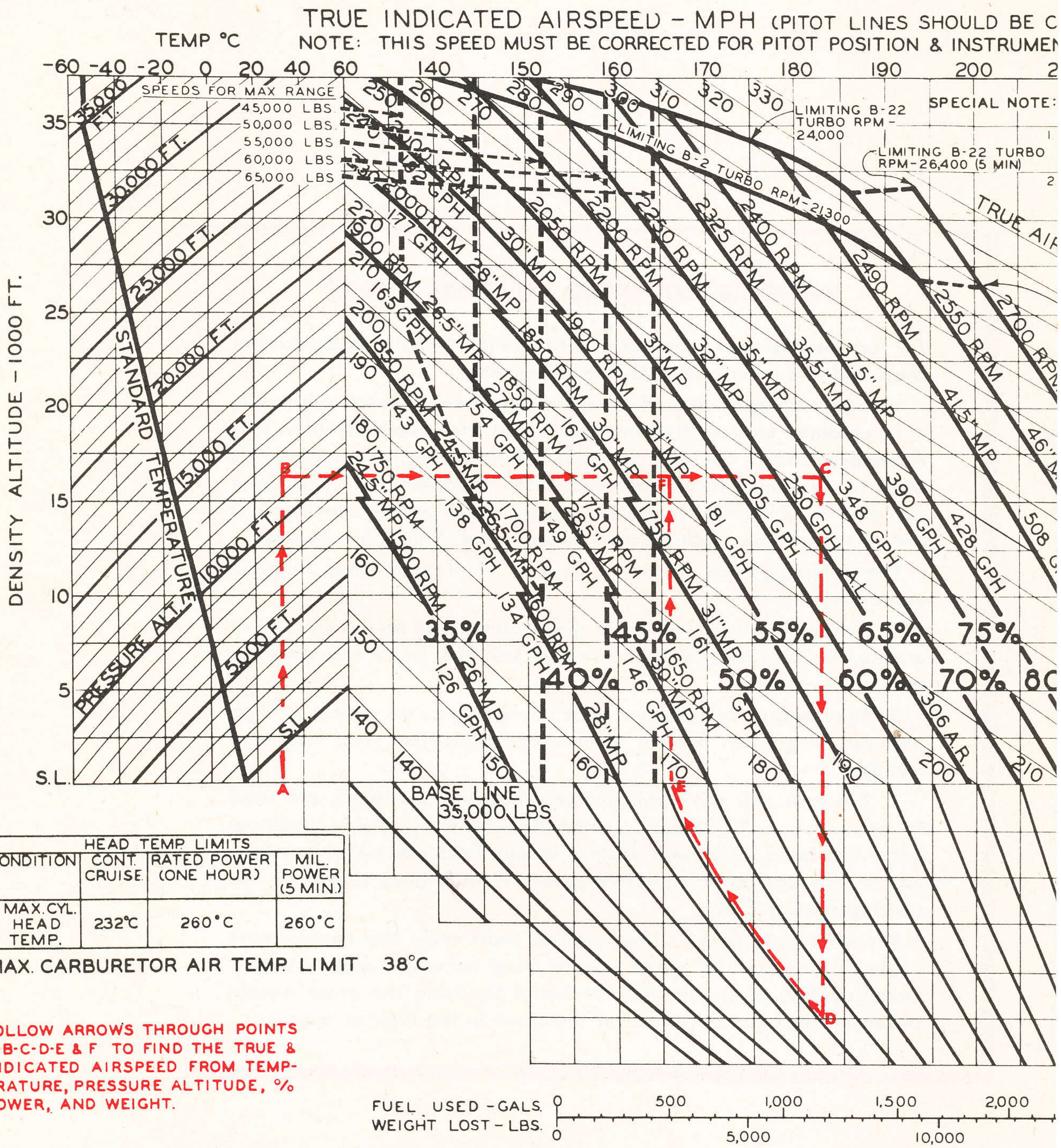
Find the airspeed corresponding to 70% BHP, 12,000 feet pressure altitude at 32°C free air temperature and 60,000 lbs. gross weight.

Entering chart at 32°C and 12,000 feet pressure altitude, a density altitude of 16,500 is determined. Follow 16,500 foot line horizontally to intersection with 70% BHP, and project this point vertically to line of 60,000 lbs. gross weight. Follow line parallel to weight correction to intersection with base line of 35,000 lbs. gross weight.

Project intersection to 16,500 feet and read 215 mph true airspeed and 166 mph true indicated airspeed. (Apply instrument and pitot position error correction to obtain pilot's corrected indicated airspeed reading for each individual airplane.)

TO DETERMINE POWER REQUIRED FOR ANY DESIRED AIRSPEED AT ANY GROSS WEIGHT AND ANY ALTITUDE

This procedure is not illustrated on the chart, but is the reverse of that given above, except for steps (A) and (B), which are used for determining density altitude. In this case the desired airspeed is known at (F). Reverse the directions of the arrows, projecting down to (E) and following the slope of the weight variation lines to the gross weight at (D). Project up to the density altitude at (C). The power required (per cent of normal rated power at sea level), fuel flow, rpm, and manifold pressure are found at (C).



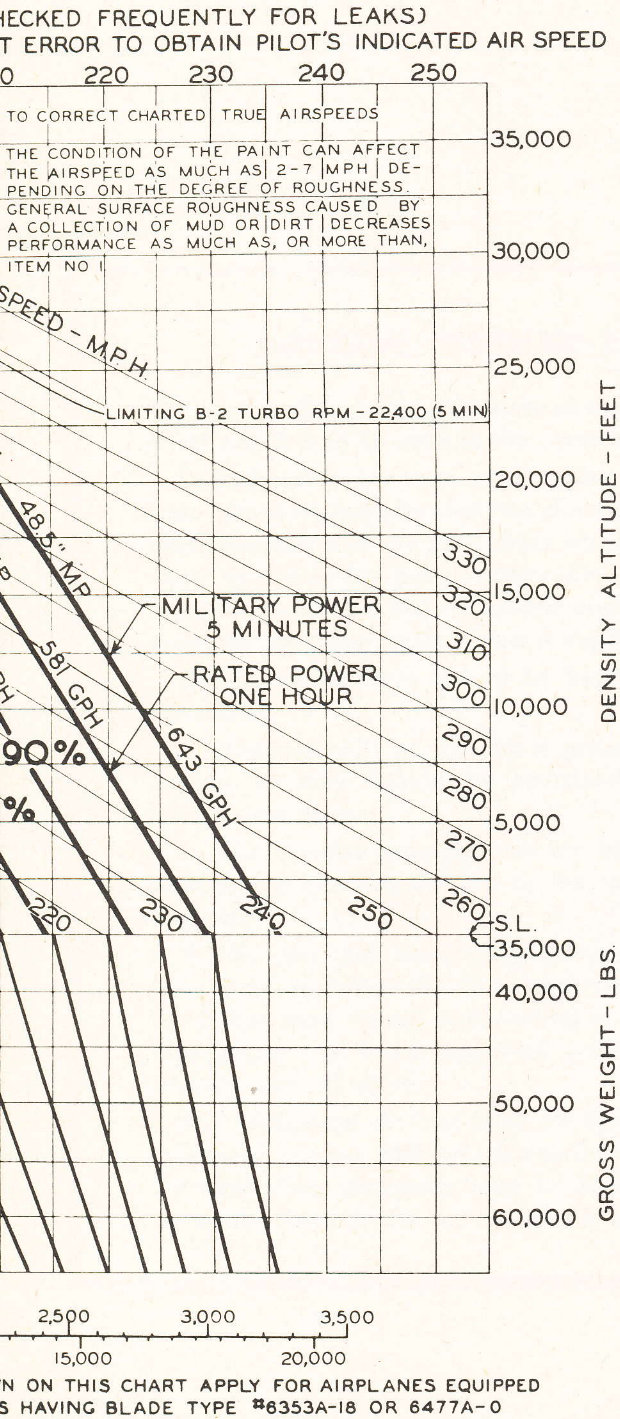
HEAD TEMP. LIMITS			
CONDITION	CONT. CRUISE	RATED POWER (ONE HOUR)	MIL. POWER (5 MIN.)
MAX. CYL. HEAD TEMP.	232°C	260°C	260°C

MAX. CARBURETOR AIR TEMP. LIMIT 38°C

FOLLOW ARROWS THROUGH POINTS A-B-C-D-E & F TO FIND THE TRUE & INDICATED AIRSPEED FROM TEMPERATURE, PRESSURE ALTITUDE, % POWER, AND WEIGHT.

TO OBTAIN G. W. AT ANY POINT DURING FLIGHT SUBTRACT WT. OF FUEL USED FROM INITIAL G.W.

NOTE: THE SPEEDS SHOW
WITH PROPELLER



CRUISING CONTROL CHART
MODELS B-24G,H & J
NAVY PB4Y-1

(WITHOUT RADAR)

R-1830-43 ENGINE

(BENDIX-STROMBERG CARBURETOR)

AUTO RICH FOR 65% POWER AND ABOVE - AUTO LEAN BELOW 65%

100% HP=4X1100 HP (NORMAL RATED)

TAKE OFF - AUTO RICH, 2700/48.5"

FOR USE IN CRUISING FLIGHT-

1. DETERMINE DENSITY ALTITUDE. SET MAN. PRESS. AND RPM TO CHARTED VALUES, AS REQUIRED, TO GIVE SPEED OR RANGE DESIRED.
2. IN HOT WEATHER INDICATED AIRSPEED WILL BE LOW, IN COLD, HIGH WHEN COMPARED TO CHARTED VALUES. CHANGE MAN. PRESS. AS REQUIRED TO OBTAIN CHARTED INDICATED AIRSPEED. (THIS WILL ESTABLISH POWER EXACTLY. FUEL FLOW WILL THEREBY BE ESTABLISHED.)
3. <u>DO NOT INCREASE MAN. PRESS. MORE THAN 2" ABOVE CHARTED VALUES WITHOUT RAISING RPM.</u>
4. AFTER FINDING SPEED FOR BEST RANGE, USE WEIGHT CORRECTION IN DETERMINING POWER SETTING REQUIRED.
5. FOR STEADY CRUISING IT SHOULD NOT BE NECESSARY TO RE-SET POWER OFTENER THAN EACH HOUR. EVERY 3 HOURS WILL PROBABLY BE SATISFACTORY.
6. <u>DO NOT EXCEED</u> 32" MAN. PRESS. AND 2200 RPM FOR AUTO LEAN OR 35.5" MAN. PRESS. AND 2325 RPM FOR AUTO RICH FOR CONTINUOUS CRUISING.
7. AT AN ALTITUDE WHERE A CHANGE OF RPM IS SHOWN USE LOWER RPM.
8. WEIGHT OF FUEL TAKEN AS 5.89 LBS./GAL. (USING STANDARD TEMPERATURE CORRECTION)
9. FUEL FLOW VARIATION IS APPROX. 1% INCREASE FOR EACH 6000' INCREASE IN ALTITUDE. FUEL FLOWS GIVEN ON CHART ARE QUOTED FOR 12500' FOR POWERS RANGING FROM 60% POWER TO MILITARY POWER. AT POWER CONDITIONS BELOW 60%, THE FUEL FLOW FIGURES ARE QUOTED FOR THE AVERAGE ALTITUDE, THROUGH THE ALTITUDE RANGES IN WHICH RPM IS HELD CONSTANT WITH THE GIVEN POWER CONDITION. FUEL FLOW FIGURES ARE FOR BENDIX STROMBERG CARBURETOR SETTINGS PD-12F2-14, PD-12F5-14.

3-ENGINE CRUISING CONTROL CHART

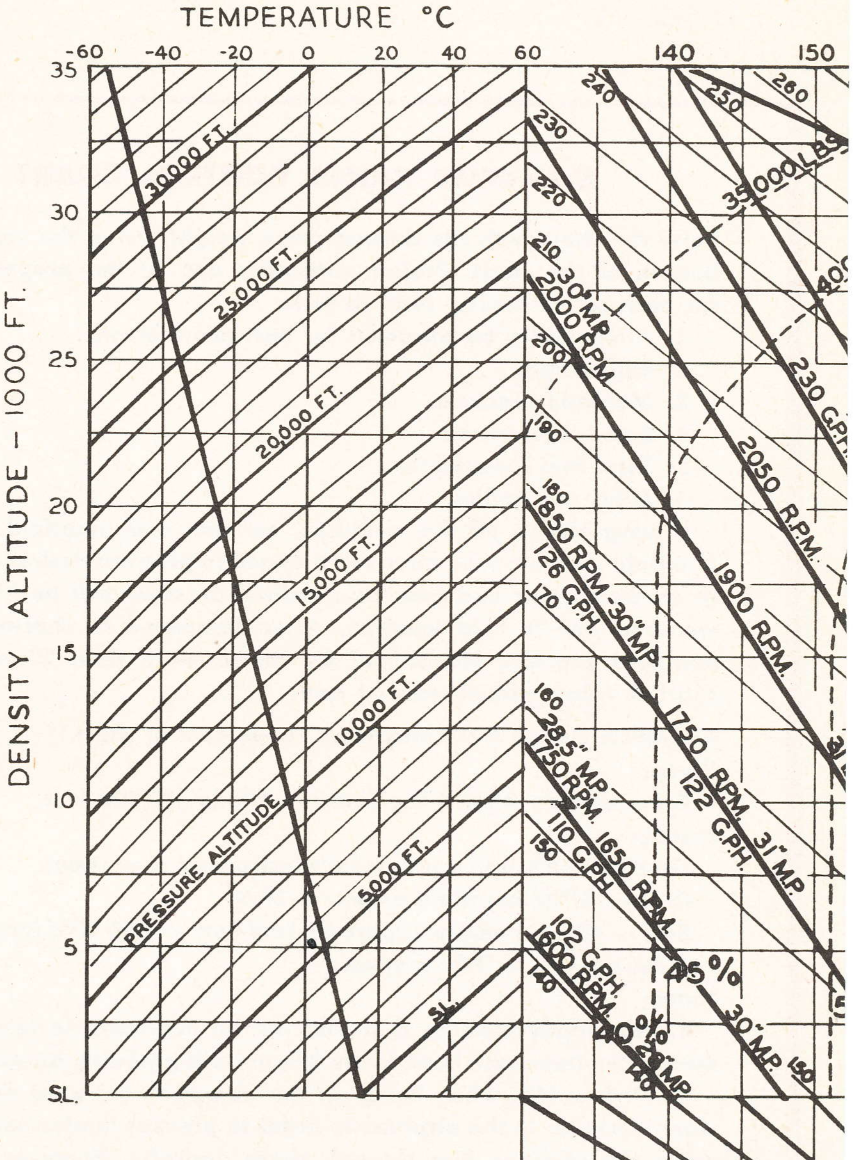
The form on this chart is the same as that of the 4-engine cruise control chart and it is to be used in the same manner.

Though extensive tests of 3-engine performance were not made, data obtained indicate that the chart gives conservative values. It is recommended that the pilot check his individual airplane against this chart to determine how conservative the chart may be. The worst 3-engine condition (left outboard engine dead) as well as the best 3-engine condition (right inboard engine dead) should be checked.

The following facts should be kept in mind concerning 3-engine operation:

1. Airspeed will be less for a given amount of power from each engine, so care should be exercised lest the head temperatures become excessive.
2. Since engine temperatures are likely to become critical at high altitudes, a gradual descent to the lowest practical level is recommended.
3. The rpm and manifold pressure combinations which are used for normal operation should be satisfactory for the 3-engine condition; but it has been found that cooling is improved somewhat by using higher rpm and lower manifold pressure than those shown on the cruising control chart.

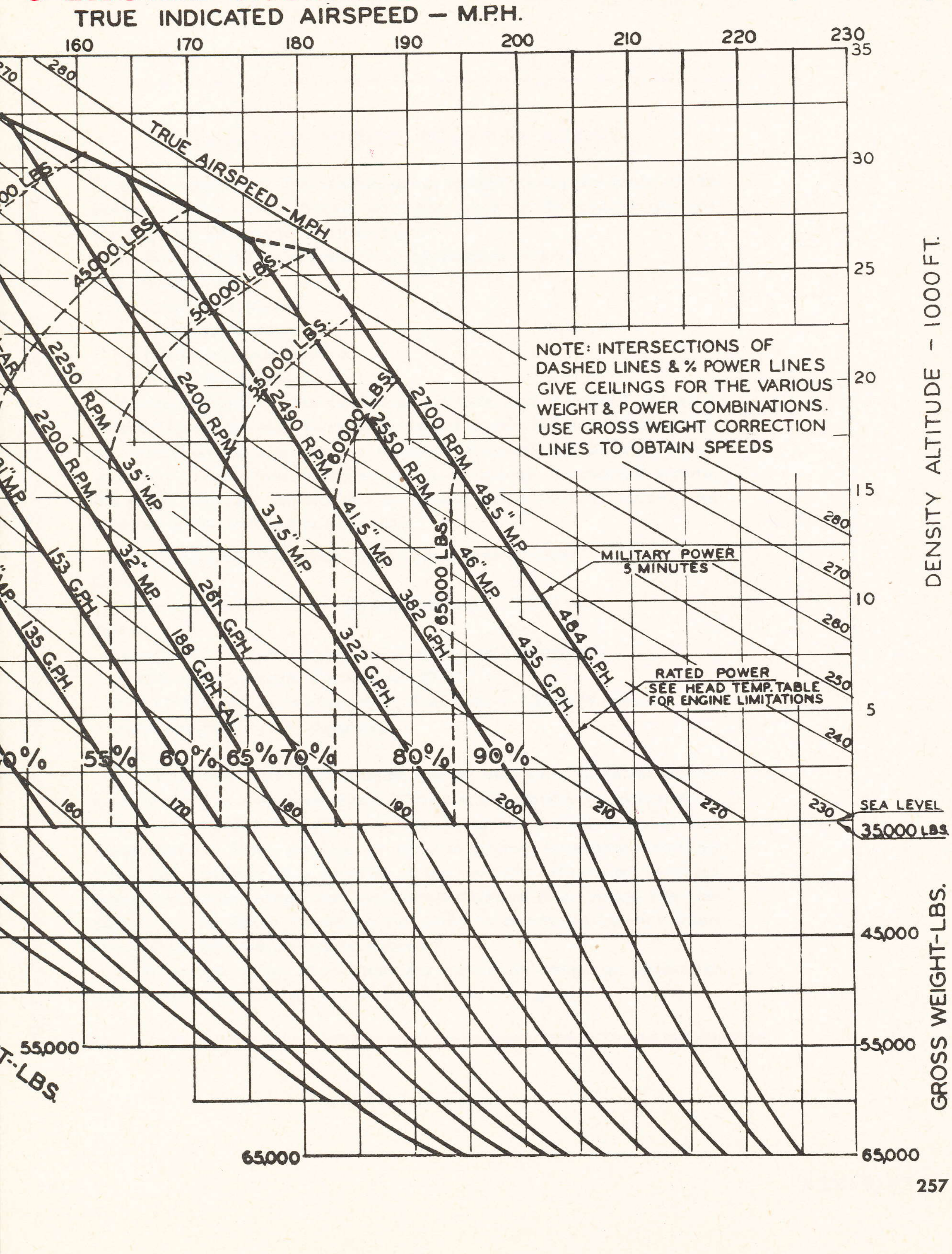
The additional dashed lines on this chart show the approximate minimum percent BHP which can be used for given gross weights. Corresponding airspeeds may be found by using the gross weight correction lines at the bottom of the chart in the regular manner.



HEAD TEMPERATURE LIMITS			
CONDITION	CONTINUOUS CRUISING	RATED POWER	MILITARY POWER (5 MINUTES)
MAXIMUM CYLINDER HEAD TEMP.	232°C	232°C (CONTINUOUS) 260°C (ONE HOUR)	260°C

MAX. CARBURETOR AIR TEMP. LIMIT – 38°C

3-ENGINE CRUISING CONTROL CHART (B-24D)



MAXIMUM RANGE CONTROL CHART

Enter the chart with the desired gross weight, using the scale at the bottom of the chart. Project vertically, and at the proper altitude for each set of curves, read in turn:

1. Airspeed (to be corrected for instrument error).
2. Engine rpm.
3. Manifold pressure.
4. Brake horsepower.
5. Total fuel consumption.
6. Miles per gallon.

Having picked off the condition, set rpm and manifold pressure. Manifold pressure may have to be varied to give the desired airspeed. At charted speed and rpm the manifold pressure will be high in hot weather, low in cold weather, when compared to charted values. Manifold pressure should not be raised more than 2″ above the charted value without raising rpm.

EXAMPLE: (Taken from maximum range control chart.)

Given:

Gross weight—45,000 lb.; Density altitude—15,000 feet.

Results:

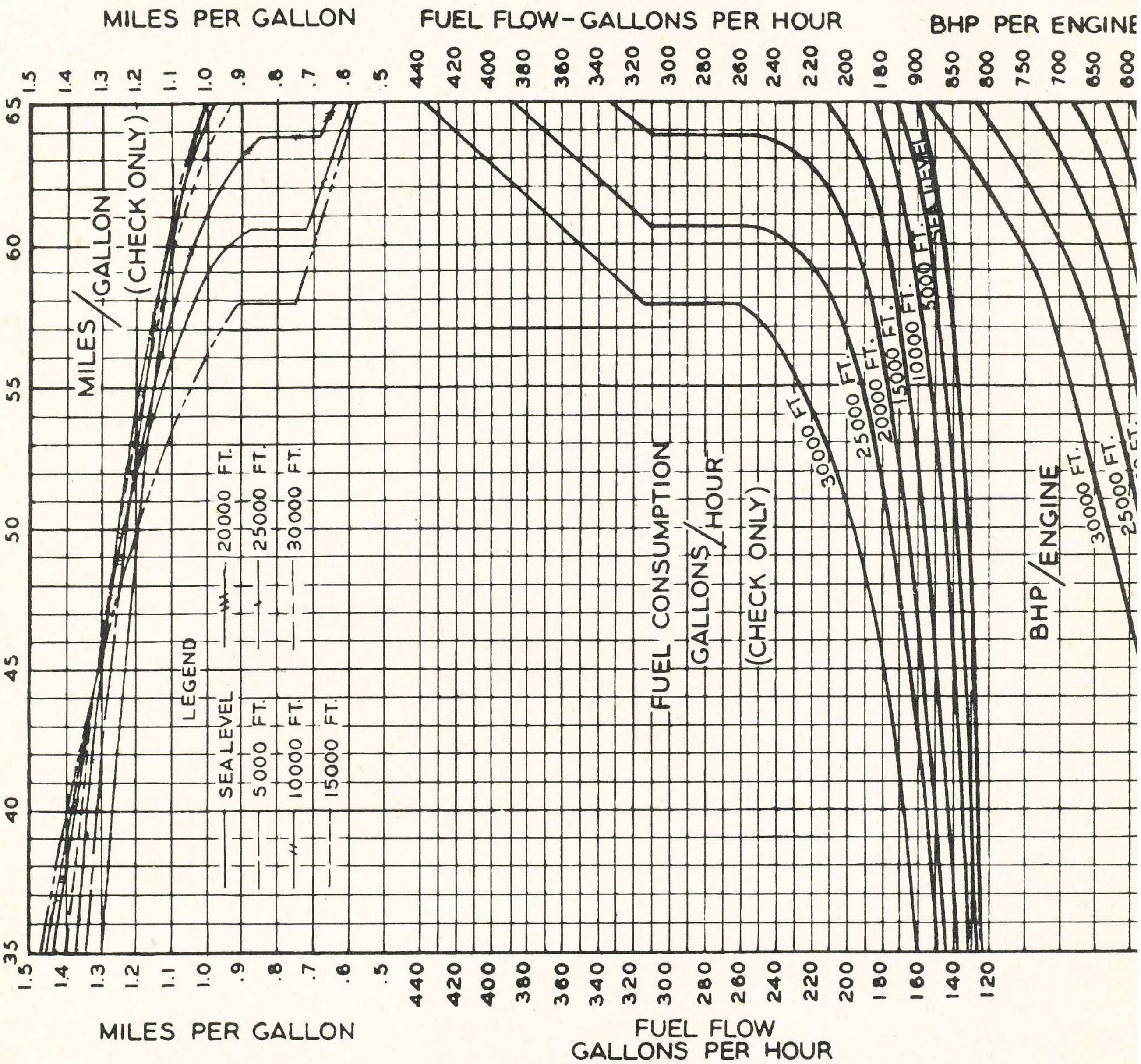
True IAS—153 mph (apply pilot's instrument correction).
RPM = 1720; manifold pressure—28.3
BHP = 490 per engine (approx.). Fuel flow = 150 GPH (approx.)
Miles per gal. = 1.31 (approx.)

Notes:

1. For steady cruising it should not be necessary to re-set power more often than each hour. Every 3 hours will probably be satisfactory.

2. At low IAS, when flying on the autopilot, the pilot should pay close attention to the airplane in order to prevent inadvertent stalling when the airplane flies through sharp updrafts. However, in cases where maximum range and endurance demand low speeds, the airplane may be flown manually, returning to automatic control when the low speeds are no longer required.

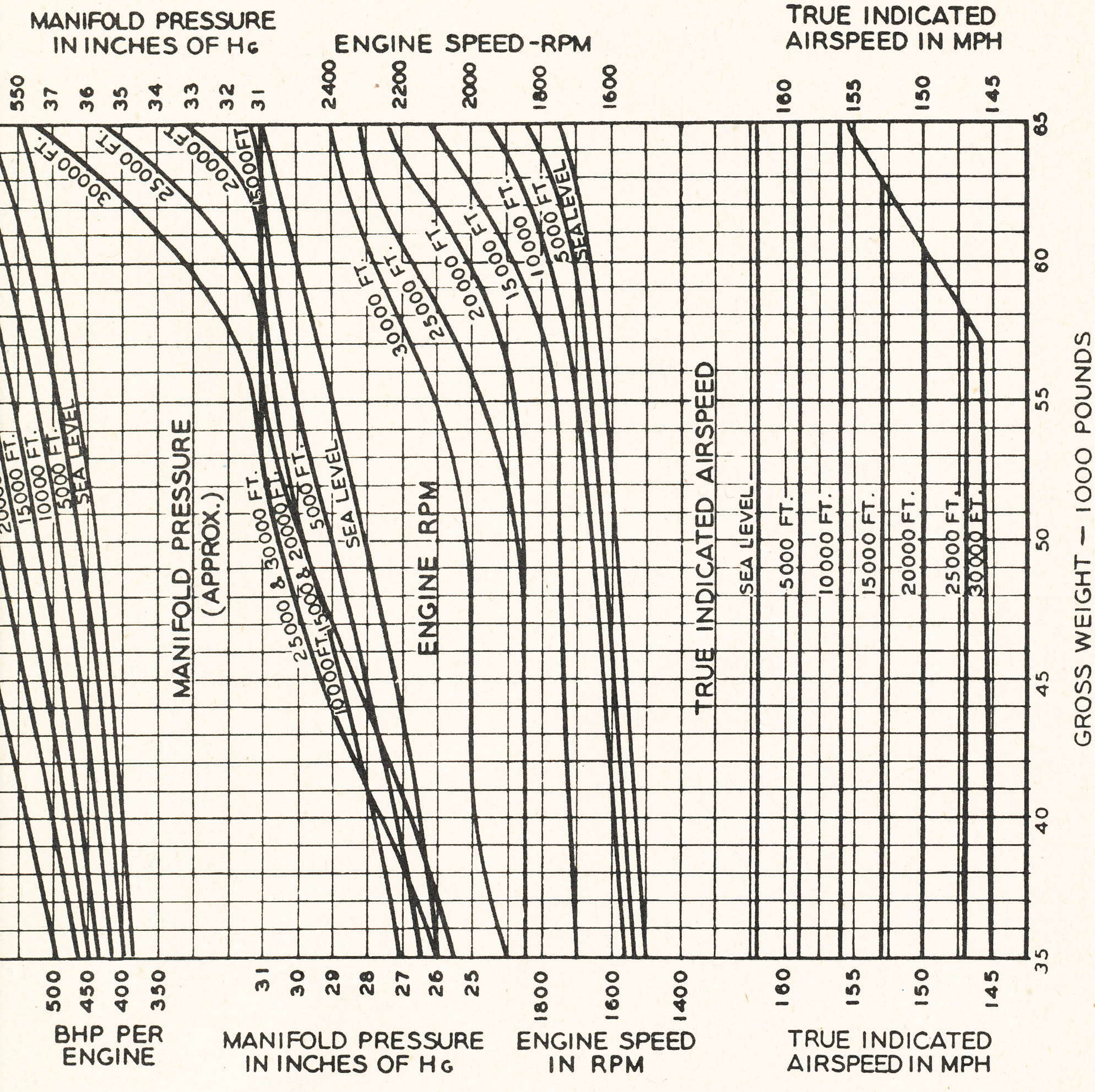
3. At speeds other than those for maximum range or maximum endurance, the cruising control chart is used as a guide.



PROCEDURE:
ENTER CHART AT GIVEN GROSS WEIGHT. PROJECT VERTICALLY AND OBTAIN SETTING FOR TRUE INDICATED AIRSPEED, ENGINE RPM AND APPROX. MANIFOLD PRESSURE AT ANY GIVEN ALTITUDE.

NOTE
1. TRUE INDICATED AIRSPEED MUST BE CORRECTED TO PILOTS INDICATED.
2. FUEL CONSUMPTION AND MILES/GALLON OF FUEL ARE FOR CHECK PURPOSES ONLY. BHP IS APPROX. FOR A GIVEN ENGINE RPM AND MANIFOLD PRESSURE.

MAXIMUM RANGE CONTROL CHART (B-24D)



SPECIAL NOTE: THE LOSS IN TRUE AIRSPEED DUE TO:

1. THREE NOSE GUNS IS 2 MPH.
2. ROUGH PAINT IS 2-7 MPH DEPENDING ON THE DEGREE OF ROUGHNESS.
3. GENERAL SURFACE ROUGHNESS CAUSED BY A COLLECTION OF MUD OR DIRT IS AS MUCH AS ITEM NO. 2.

QUESTIONS AND ANSWERS

1. Q. Is it proper to decrease rpm before manifold pressure?

A. No. Decrease manifold pressure first, then the rpm.

2. Q. What is the proper method to increase rpm and power settings?

A. Increase the rpm first, then the manifold pressure.

3. Q. When flying on instruments, name some of the conditions you may encounter that are not prevalent in contact flight?

A. Wing icing. Propeller icing. Pitot tube icing. Carburetor icing.

4. Q. How would you combat the conditions in question No. 3?

A. Operation of wing and tail group deicer boots if conditions warrant it. Operation of propeller anti-icer system—should be put in operation before icing conditions exist. Turning on pitot tube heaters before flying on instruments. Closing the intercoolers and opening throttles when drop of manifold pressure or engine roughness occurs.

Note: Intercoolers should not be used for longer periods than necessary.

5. Q. Are there any restrictions on the use of the landing lights?

A. Yes. Due to the lack of rapid air circulation required to cool the lights, they should not be used longer than 3 minutes at a time while on the ground. Otherwise, light-bulb failure is likely. Use alternately while taxiing.

6. Q. When do you use the carburetor air filters?

A. When dusty air conditions are encountered on the ground or in the air.

7. Q. If you had hot gasoline (because of hot weather or a hot engine) with possible vapor lock trouble in flight, how would you remedy the situation?

A. By using the electric booster pump.

8. Q. In the event of a gasoline stoppage to an engine, what is the first indication on the instrument panel?

A. Fuel pressure drop.

9. Q. What is maximum allowable rpm and manifold pressure for using "AUTO-LEAN"?

A. 32" manifold pressure, 2200 rpm (grade 100 fuel) and 30" manifold pressure, 2100 rpm with grade 91 fuel.

10. Q. When do you use "FULL (EMERGENCY) RICH"?

A. At such time as the "AUTO-RICH" setting becomes faulty.

11. Q. If you were climbing at 35" manifold pressure and 2300 rpm and you reduced rpm to 2000, what would happen to the manifold pressure?

A. An increase of manifold pressure will occur with a resultant increase in BMEP.

12. Q. What is the desirable continuous operation head temperature?

A. 200° to 232°C. **Desirable 205°.**

13. Q. What is the maximum one-hour continuous operation head temperature?

A. Not to exceed 260°. Must be in "AUTO-RICH."

14. Q. At what rpm should Engine 3 be running to operate the hydraulic system normally?

A. Approximately 1000 rpm is required to operate the hydraulic system efficiently.

15. Q. If the propeller on Engine 3 is allowed

to windmill, is the rpm sufficient to operate the hydraulic system?

A. The hydraulic pumps on Engine 3 will operate and supply pressure for the hydraulic system at all times when the engine is turning over. However, at low rpm the volume of oil supplied will be small; therefore, the action of any unit that is operated will be very slow.

16. Q. What should I do if a tire blew out on landing?

A. Put the nosewheel firmly on the ground. Use the engines on the side the tire is blown on, concentrating preferably on the outboard, and use sufficient brake on the good tire to keep the airplane rolling straight.

17. Q. What is the allowable range of brake accumulator pressures?

A. 850 to 1250 lb.

18. Q. What is the landing gear kick-out pressure?

A. Landing gear down—850 lb.
Landing gear up—1100 lb.

19. Q. Explain the different methods of lowering the flaps.

A. (a) Move the flap handle to "DOWN";

(b) If engine-driven hydraulic pump fails, or No. 3 engine is feathered, open emergency hydraulic (star) valve, turn on auxiliary hydraulic pump and place flap handle in "DOWN" position;

(c) Move the flap handle to "DOWN." Close forward valve and open rear valve and hand-pump flaps down. Use this procedure when engine pump and auxiliary hydraulic pump are not working.

20. Q. How long will it take to bleed the shuttle valve for flap operation after the flaps have been lowered by means of the hand pump?

A. The time required will vary according to the temperature. At times it may take as long as 20 minutes. Normal operation would probably be 3 to 5 minutes. On cold days the aluminum cylinder will contract more than the steel piston and it may be necessary to tap the valve very lightly to jar the piston loose so that it will return to the normal operating position.

21. Q. Is it possible, under emergency conditions, to raise the flaps after they have been lowered by means of the hand pump?

A. Yes. First, open both valves, located on top of the hand pump, to bleed off the pressure on the shuttle valve and allow the piston to return to the normal operating position.

Second, close the aft valve, leaving the forward valve open.

Third, place the flap selector valve in the "UP" position.

Fourth, operate the hand pump to supply hydraulic pressure through the open center system to operate the flaps.

22. Q. What should be done in case of a vapor lock in the hydraulic system?

A. This means there is air in the system. The selector valves should be operated back and forth, forcing the hydraulic pressure first one way and then the other, forcing the air into the reservoir until the system operates normally.

23. Q. What would happen if one accumulator was shot away?

A. One half of the braking action on each wheel would be lost. It would be impossible to operate the open center system until the broken line was sealed (or repaired).

24. Q. Why is the landing gear lever put in the "DOWN" position when parking the airplane?

A. With the landing gear lever in the "DOWN" position any increase of pressure in the system will be exerted on the down gear mechanism. This will hold the latches in the down position. An increase of pressure in the system could be caused by expansion of the fluid due to heat or changes in temperature.

25. Q. On the new airplanes, without the old de-boosters, the brake action is slow and then it grabs suddenly when it takes hold. What causes this?

A. The metering valve may not be properly adjusted and/or there may be dirt under the valve seat.

26. Q. What pressures are required to operate the bomb doors?

A. Bomb doors open—600 lb.
Bomb doors closed—1000 lb.

27. Q. Why does it take more pressure to close the bomb doors than it does to open them?

A. To compensate for the difference in force required on the top and bottom of the piston due to loss of area on the bottom of the piston on account of the connecting rod area.

28. Q. Why is the flap selector valve set to kick out at 450 lb. in the "DOWN" position and 750 lb. in the "UP" position?

A. To allow for the different operating forces required on the up and down operation, as well as to compensate for the loss of area on the bottom of the piston due to the connecting rod area.

29. Q. How can we determine when the air pressure in the accumulators is low?

A. When use of the brakes causes the accumulator pressure to drop rapidly, by chattering of the unloading valve when the accumulator is charged, or by frequent cutting in of the auxiliary hydraulic pump when this facility is in use.

30. Q. Can the air pressure in the accumulators be checked without removing the oil in the system?

A. No. The hydraulic fluid must be removed from the accumulator before the air pressure can be measured. If this were not done the gage would register the combined oil and air pressure.

31. Q. How often should the air pressure in the accumulators be checked?

A. During extreme cold conditions, the accumulators should be checked daily. Sluggish brake action usually indicates low air pressure in the accumulators.

32. Q. If a brake expander tube were ruptured, could the system be repaired so that the hydraulic fluid would not be lost when the brakes were operated?

A. Yes. By disconnecting the line at the brake valve and sealing the opening, or by breaking the line to the brake expander affected, and pinching or sealing the end.

33. Q. Is it possible to operate the flaps with accumulator pressure?

A. Yes. The procedure is as follows:

1. With the bomb doors closed, place the utility valve in the bomb door closed position.

2. Place the bombardier's bomb door selector valve in the bomb door open position.

3. The pressure from the accumulator is then routed from the accumulator through the pressure line to the utility valve, out of the valve through the bomb door closed line to the operating cylinders at the bomb doors. Since the bomb doors are closed, the pressure backs up through the line to the bombardiers' bomb door selector valve. When the selector valve is in the bomb door open position, the bomb door closed line is the return, therefore, the pressure enters the open center system. By operating the flap or landing gear selector valve either unit will operate from the accumulator pressure provided there is sufficient pressure in the accumulator.

34. Q. Explain in detail all the methods of lowering the landing gear.

A. a. Lowering the gear through the regular method of hydraulic pressure created by No. 3 engine hydraulic pump.

b. Lowering the gear by hydraulic pressure created by the electric auxiliary system.

c. Lowering by hydraulic pressure created by the hand hydraulic pump on the copilot's side of the cockpit.

d. Lowering the gear manually by the hand crank mounted on the forward spar, requiring between 28 to 32 turns. **Caution:** This crank must be wound back to its original position before raising the gear hydraulically.

On late model airplanes the nosewheel can be extended manually in this manner. Pry open up-latch and depress drag strut to hold lock open, then disconnect lock mechanism with quick disconnect pin. Gear can be pushed overboard by lifting up and forward on the top of oleo cylinder. Gear will fall out and lock down.

35. Q. When the landing gear is lowered, under what condition is the selector valve first placed in the "UP" position, and why?

A. To insure a full supply of fluid on the up side of the piston and lines which will cushion the shock produced by dropping the main gear and relieve up locks of full weight of gear before they are unlatched. This is an advisable operation when lowering gear after flights of long duration. (Over 2 hours.)

36. Q. Is it possible to lower the tailskid when the landing gear is lowered by emergency methods?

A. The tailskid is not lowered when the landing gear is lowered with the emergency hand crank. It is lowered by hydraulic pressure only.

37. Q. Is it necessary in emergency landing gear operation to unwind the cables on the drum before raising the gear?

A. Yes. If this is not done, the gear will not lock up.

38. Q. Why is it necessary to put the selector valve in the "DOWN" position when using emergency manual cable system for lowering the landing gear?

A. To relieve the hydraulic pressure on the up side of the operating cylinder, otherwise a hydraulic lock would be formed.

39. Q. Why must the utility valve be held open until the bomb doors are fully open?

A. Hydraulic pressure is supplied to the bomb door operating cylinders only when the valve is held in the open or closed position. When released, the utility valve returns to the neutral position which shuts off the hydraulic pressure.

40. Q. Is there a manual operation for lowering the flaps?

A. No.

41. Q. What should be done if the hydraulic suction line between the reservoir and No. 3 engine pump is broken?

A. Open the emergency hydraulic (star) valve and operate the auxiliary hydraulic pump to supply pressure for the open center system taking oil from the bottom of the reservoir. The check valve automatically shuts off the broken suction line.

42. Q. What should be done if the pressure line from engine No. 3 is broken?

A. Break the suction line to prevent loss of reserve oil and open the 3-way suction valve to take oil from the bottom of the reservoir. Open the emergency hydraulic star valve and turn on the auxiliary hydraulic pump to supply pressure through the open center system.

43. Q. Should the airplane be taxied with the inboard or outboard engines?

A. Taxiing with the outboard engines gives better control; therefore, they should be used. However, do not allow inboards to foul up.

44. Q. a. If, with the gear down, the throttle horn blows and the light does not come on, where would you look for the trouble?

b. Would you land with the horns blowing and no light?

A. a. The trouble usually occurs in the micro-switches sticking on the main landing gear. This trouble cannot be remedied from the cockpit. The light and the horns are on the same electric circuit. The micro-switch on the nosewheel locking mechanism can be checked and should be checked to see if it is the cause. If this switch is not at fault, there is nothing that can be done to remedy the matter while in the air.

b. Yes. If a visual check absolutely indicated that the gear was down and locked.

45. Q. When starting an engine how would you know if it is under-primed? Over-primed?

A. Usually an under-primed engine fails to give an indication of wanting to start or there may be a weak explosion occasionally while the engine is being turned over by the starter. An over-primed engine is usually one where the mixture is so rich and the explosions are so weak they will not keep the engine running; also white vapor coming out of the exhaust pipe is an indication, under some conditions, of an over-primed engine. **Note:** It is practically impossible to write all the causes or combinations of causes and remedies for the above. It is up to the pilot to learn the symptoms himself and apply the proper remedy.

46. Q. With a flooded engine, where would you place the throttle while starting?

A. Place the throttle in the open position.

47. Q. What is liable to happen if you take off in "AUTO-LEAN?"

A. If the carburetor mixture is in proper adjustment, possibly nothing would happen because the fuel mixture curve in "AUTO-LEAN" is almost the same as "AUTO-RICH" at maximum power output. However, the danger is that the fuel mixture curve drops rapidly to a leaner mixture upon slight reduction of power. This will cause detonation and possible engine failure.

48. Q. How would you determine whether the artificial horizon air screen is dirty?

A. By observing the speed with which the instrument erects when the engine driving the instrument vacuum pump is started.

49. Q. Would you cage and set your artificial horizon in a climbing turn? Why?

A. No. Because it would give erroneous readings and it would take several minutes for it to seek its proper position again.

50. Q. What are the maximum allowable precession limits on the directional gyro?

A. Precession shall not exceed 3° in either direction for any 15-minute period on any heading, except that a maximum of 5° precession is permitted on one heading when the total precession on 4 headings 90° apart from each other does not exceed 12° and the precession does not exceed 3° on any of the other 3 headings.

51. Q. What is a spilled gyro instrument and how is this accomplished?

A. A spilled gyro is a gyro which has exceeded its stop limits. Occurs during acrobatics or banks steeper than the stop limits of the instrument.

52. Q. How do you know when the engines are warm enough to taxi?

A. When the oil pressure has returned to its operating pressure, approximately 80-100 lb.; when the oil temperature reaches a minimum of 40°C; when the head temperature is 120°C.

53. Q. Is there any reason why you should not taxi through mud with the wing flaps down?

A. Yes. You are likely to throw mud into the exposed flap tracks, thus impairing the operation of the flaps.

54. Q. When taking a bearing on a radio station with the loop antenna using the aural null, does the needle always point toward the station?

A. No. It will point either at the station or exactly 180° away from the station.

55. Q. What receiver and antenna combination would you use when flying in an overcast where reception is poor?

A. The radio compass receiver and the loop antenna, with the radio compass adjusted 90° to the station; or rotate the loop until you get maximum signal strength.

56. Q. How do you tune the radio compass to a station?

A. With the radio receiver on the antenna setting identify the desired station and get a clear signal by use of maximum tuning indicator, then put the receiver on the compass setting.

57. Q. Does the radio compass, properly tuned to a station, always lead you straight to the station?

A. It will if you have absolutely no drift. However, with a drift condition, you will fly in an arc reaching your station.

58. Q. How many radio receivers is the B-24 airplane equipped with which will receive radio range signals?

A. Three receivers: the command set, the radio compass set, and the liaison set.

59. Q. In the event No. 4 engine was on fire in flight, explain what you would do in sequence.

A. Turn off the electric booster pump, turn the gasoline selector valve supplying fuel to this engine to the "OFF" position, close the cowl flaps, feather the engine and put mixture in "IDLE CUT-OFF" when fuel in lines has been used and fuel pressure has dropped to zero. In event the plane is equipped with a Lux fire extinguisher, turn its selector handle to No. 4 engine and operate the system. In this case, close cowl flaps to confine CO_2 in nacelle.

60. Q. Referring to question No. 59, is the condition the same on No. 1, 2, and 3 engines? If not, explain.

A. The procedure would be the same, with the exception of No. 1 or No. 2 Check which engine was driving the gyro instruments. Also check No. 3 engine before coming in to land and be sure the auxiliary electric hydraulic system is in operation.

61. Q. How would you reduce the BMEP in an engine?

A. By increasing the rpm or reducing the manifold pressure.

62. Q. If you knew the nosewheel was not lined up straight before landing, what would you do?

A. This is generally one indication that the shimmy damper is not working. On accumulator-type damper, align wheel with shimmy damper locks. On Houdaille shimmy damper where no lock is available, make a nose high landing as you would do for a damaged nosewheel.

63. Q. In the event No. 2 engine gasoline cells became faulty, how would you bypass these cells and keep No. 2 engine running? Does this procedure hold true on any of the other engines?

A. Turn No. 2 engine selector valve to crossfeed to engine. Turn selector valve of fullest tank to tank to engine and crossfeed. Turn on fuel booster pump of fullest tank. This holds true on all engines.

64. Q. What precautions would you take before transferring fuel from the bomb bay tanks?

A. Because of possible gas fumes prevalent during this operation, see that all the radio receivers and transmitters are off and permit no smoking. Unless necessary, see that the fuel booster pumps are off. Operation of any electrical unit which might create a spark should be avoided until the operation is completed, and any cabin heater in operation should be off. Crack bomb doors 6 to 8 inches and place observer in bomb bay to note any possible leakage and any abnormal function during transfer. Do not remove bomb bay tank caps while transfer pump is in operation.

65. Which engine has the instrument vacuum pump on and which has the wing boot pump?

A. No. 1 and 2 engines drive the vacuum pumps actuating the instruments and wing boots. When the selector valve has No. 1 engine driving the instruments, No. 2 engine is automatically driving the wing boots, or vice-versa.

66. Q. What is your overshoot procedure?

A. Procedure: First, apply power. Second, reduce flap setting to ½ or to 20°. Third, raise the gear. The cowl flaps should be adjusted immediately after power is applied. The flaps should be completely raised when safe to do so after the gear is up.

67. Q. How do you ascertain the main gear latch is locked on the visual inspection?

A. By seeing that the yellow latch locks are in the lower position in the slot. This can only be seen from waist gun windows when flaps are in the upper position.

68. Q. If you were taking off into a low ceiling where you would immediately go on instruments, what precautionary measures would you take before takeoff?

A. Ascertain that all gyro instruments are working properly. Taxi, making S turns to determine that bank and turn instrument is operating. Check de-icer boots for operation and propeller anti-icer fluid operation. Also, immediately off the ground, turn on pitot heaters. The pitot tube heaters should be checked by feel on the ground and then turned off because continual use on ground may damage element.

69. Q. What will result from excessive cowl flap opening?

A. Will result in tail buffeting and lazy aileron action. Flap opening of from 10° to 20° is the range where usually the highest buffeting condition occurs. If permissible, a wide-open cowl flap setting is better if required for engine cooling rather than a flap setting in the range between 10° and 20°. However, the wide-open cowl flap setting will cut down the performance of the aircraft considerably.

70. Q. If oil dilution is over-used, what is the danger?

A. The over-use of this system dilutes the oil to such a light viscosity that the high gasoline content in the oil allows the gas fumes to come out the engine breather and into the combustion chambers, constituting a fire hazard.

71. Q. What would you do if your airspeed indicator failed because of stoppage in the passage?

A. Ask the bombardier to call airspeed over the interphone.

72. Q. In the event No. 3 engine was feathered and you were coming in for a landing, what would you do?

A. Be sure that the electric auxiliary

hydraulic system was functioning and in operation, and open star valve to lower the gear and flaps.

73. Q. Is it necessary to use the fuel booster pumps after takeoff?

A. After takeoff, when 1000 feet above the ground, they are not required again until an altitude of 10,000 feet has been reached or when a drop of 2 lb. on the fuel pressure occurs.

74. Q. What is likely to happen if an engine backfires with the turbo waste gate closed?

A. It is liable to damage the waste gate turbo mechanism and exhaust system.

75. Q. What will happen if you take off or land with the wing de-icer boots inflated?

A. It will disturb the air flow over the wings, causing the aircraft to act in an abnormal way and increase the stalling speed.

76. Q. How do you approach your cruising altitude, from below or from the top?

A. From about 500 feet on top.

77. Q. What is meant by flying on the step?

A. By flying the airplane in a minimum-angle-of-attack attitude.

78. Q. If you set your turbos for 47″ manifold pressure for takeoff at San Diego, would this same setting give you 47″ for takeoff at Salt Lake City, Utah? If not, why?

A. No. Because of higher altitude at Salt Lake City, if the turbo lever were set at the same position as San Diego, you would have about 4½″ higher manifold pressure at Salt Lake City.

79. Q. What is the trend of the mechanically driven internal supercharger in regard to manifold pressure drop or increase in relation to increase in altitude?

A. The trend is for the manifold pressure to decrease with increase of altitude.

80. Q. Is the exhaust-driven turbo-supercharger's trend in regard to increase in altitude the same as the engine-driven supercharger?

A. No. The turbo-supercharger increases manifold pressure with increase in altitude because of the density of the air decreasing with altitude, allowing the exhaust gases to escape more readily through the bucket wheel.

81. Q. What would the result be if you took off with the intercoolers closed?

A. Probably detonation.

82. Q. What is the purpose of the intercoolers?

A. To cool the air compressed through the turbo-supercharger.

83. Q. When would you close the intercooler shutters?

A. When flying in icing conditions to control carburetor air temperature.

84. Q. How much load will the tailskid support?

A. A very small amount. Heavy loads on the tailskid should at all times be avoided. Care must be taken any time the airplane is being towed backwards that the tailskid never touches the ground.

85. Q. In the event you encountered highly turbulent rough air conditions how would you fly the airplane?

A. Slow the airplane to 150 mph and use a partial wing flap setting for additional lift and stability. The landing gear may be lowered to avoid too great a decrease in power.

86. Q. In slow flight, such as traffic pattern flying, what is the best wing flap setting? Why?

A. 10°. This increases stability of the airplane and also lowers the stalling speed.

87. Q. What is likely to occur if excessive airspeed is allowed with a full flap setting?

A. Possible springing of the flap tracks or other structural failure would result. The bleed-back valve which is supposed to allow the flaps to retract at excessive airspeeds would not allow the flaps to retract soon enough if the airplane was suddenly allowed to attain an excessive airspeed.

88. Q. How tight do you have your copilot snub the throttles on takeoff?

A. Tight enough to hold the throttles in position but not so tight that throttles cannot readily be moved in case of emergency.

89. Q. When spinning the turbo bucket wheel by hand, what do you look for?

A. Warped bucket wheel, proper bucket wheel clearance, noisy bearings, and freedom of movement.

90. Q. Leaking fluid on the outside of landing gear wheel indicates what?

A. Indicates a leak in brake line or fractured brake expander bladder.

91. Q. If a wheel wobbles during taxiing, what's wrong?

A. Probably a cracked wheel flange.

92. Q. If you smelled burning rubber while retracting the landing gear, what is the probable cause?

A. Nosewheel not lined straight fore and aft, allowing it to rub on structural members of the airplane during retraction.

93. Q. What is the function of the master bar switch?

A. It cuts all the magnetos off as well as all electric current unless the generators or auxiliary power unit (APU) are in operation. If they are in operation, you will still have electric power but no magnetos.

94. Q. When are the engines ready to run up?

A. When the head temperature is 150°C, oil pressure within the operating limit and the oil temperature above 40°C.

95. Q. What is the maximum allowable magneto rpm drop or engine run-up?

A. 100 rpm if the engine is smooth.

96. Q. What is the MAC or mean aerodynamic chord?

A. MAC is the average chord or width of a tapered wing.

97. Q. Is there a rule-of-thumb method by which the CG of an airplane can be determined without the use of the load adjuster?

A. There is no rule-of-thumb method accurate enough to warrant its use.

98. Q. What is the root chord of a wing?

A. The root chord is the distance from the leading edge to the trailing edge at the largest section of a tapered wing.

99. Q. What percent of the MAC is the most forward limit of the CG?

23%.

100. Q. What percent of the MAC is the most aft limit of the CG?

A. 23%.

101. Q. How was the CG range determined?

A. The forward and aft CG limit in percent of the MAC from the leading edge of the MAC is determined by means of flight tests.

102. Q. What is the effect of overloading an airplane?

A. Overloading causes higher stalling speeds, results in lowering of the airplane structural safety factors, lowers the angle and rate of climb, decreases ceiling, increases fuel consumption and lowers the general tire factor of safety.

103. Q. What happens when the CG is too far aft?

A. If the CG is too far aft it creates unstable conditions, thereby increasing the tendency to stall. It definitely limits low power and might very easily affect long-range optimum speed adversely. In the extreme condition it may even cause a stall during an up-gust.

104. Q. What happens when the CG is too far forward?

A. Fuel consumption is increased, greater power is required for the same speed and there is an increased tendency to oscillate as well as to increase dive beyond control. It may cause a critical condition during flap operation. It definitely increases the difficulty in getting the nose up during landing.

105. Q. What is meant by moment?

A. Moment is the turning effect exerted by a force or weight about a fulcrum point and is equal to the weight times the distance from the fulcrum to the weight.

106. Q. If on the final approach with throttles back you accidentally put the propellers in low rpm, what would happen when you applied power?

A. Absence of usual propeller noise, very slow response in airspeed increase because of absence of power, much lower rpm than customary. This condition can prove disastrous if the airplane is being dragged in on the approach or in the event of an overshoot. Do not do it!

Index