

## TAKEOFF

Takeoffs are easy and smooth in the B-24 provided there is plenty of room and you use proper technique. Tricycle gear improves both the takeoff and landing characteristics. Be sure before you leave the line that the runway is long enough (considering altitude, temperature, etc.—see takeoff chart) and be sure there are no obstructions in your line of flight.

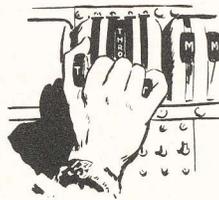
### Taxiing Into Position

Get your clearance from the tower to line up on the runway. Take a good look for aircraft and taxi out in a wide sweep using a minimum of runway for straightening the nosewheel. Stop the airplane lined up straight ahead, hold your position with the brakes, and set all throttles at 1000 rpm. Both pilot and copilot should make a final quick check on all instruments.

Then copilot obtains a radio clearance for takeoff and you are ready for the takeoff run.

### The Takeoff Run

1. Release the brakes and slowly but steadily advance all throttles together. Learn to apply power at the speed engines can readily take it. Never jam or stiff-arm the throttles.



2. If you start to move to the left of the middle of the runway lead the throttles on the left, and vice versa. Don't stop the opposite set of throttles, but instead lead all throttles progressively. In this manner you can build up speed rapidly and obtain rudder control quickly. **Don't ever** attempt to control direction on takeoff by the use of brakes.

3. As soon as you have rudder control, use it! Come in with lots of rudder to hold your line down the runway, rather than using excessive and unnecessary build-up of power on one side.

4. Copilot follows throttles through with his left hand, and as soon as they are against the stops he sets the friction lock to prevent throttles from creeping but so they still can be easily moved. **Note:** Pilot's hand should be on the throttles throughout the takeoff except when necessary to trim the plane or signal the copilot. Whenever pilot's hand leaves the throttles, copilot should hold them. Copilot should closely observe all instruments (particularly manifold pressure and rpm). Use full throttle on takeoff. This shortens the run and minimizes wear and tear on tires and gear. Manifold pressure should not exceed 49" for Grade 100 fuel or 42.7" for Grade 91 fuel and propellers should not exceed 2700 rpm. Power reduction necessary to keep within manifold pressure limits should be made with the throttles and not with the turbo regulators.

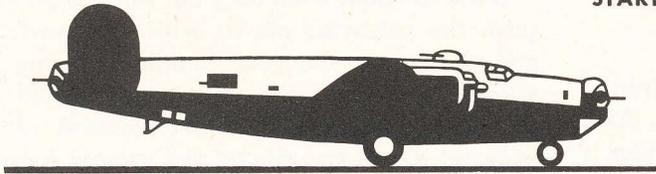
5. As your speed increases to 70 or 80 mph so that you have elevator control, ease back on the control column just enough to relieve the nose-

wheel of its weight. When full weight is on the nosewheel, the wing is at a negative angle of attack; lifting the weight puts the wing in the desired slightly positive angle.

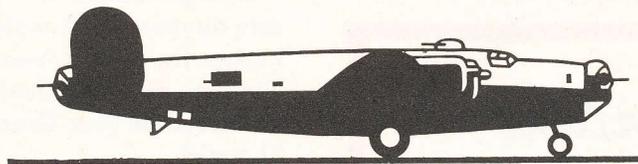
6. Hold this attitude straight down the runway, and the airplane will fly itself off the ground at 120 to 130 mph, depending on the gross weight. Don't haul it off, however, and be sure the attitude is correct. If you apply too much back pressure, pulling the nose too far up, you establish too great an angle of attack, which creates more lift and puts the plane into the air at a lower airspeed—110 mph, for example. Then, if you lower the nose to pick up airspeed, you decrease the angle of attack and therefore decrease the lift. The airplane cannot accelerate fast enough to compensate for this changed angle, and the result will be that you settle back on the ground. So don't try to make the airplane fly—let it fly itself. Once it does, increase the back pressure just enough to establish a shallow positive climb, and **hold it**.

**Note:** Even if you have to get the airplane into the air at a low airspeed (in a short-field takeoff, for instance), don't lower the nose; hold

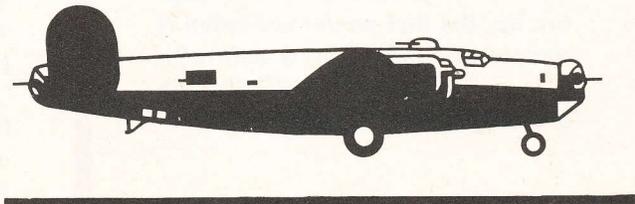
#### START YOUR TAKEOFF RUN



#### RELIEVE NOSE WHEEL OF ITS WEIGHT



#### AIRPLANE WILL FLY ITSELF OFF



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your angle of attack and let the airspeed build up gradually.

7. Don't become over-anxious about building up climbing speed. It takes time for the power of the propeller thrust to overcome the inertia of a heavy airplane. Beware of lowering the nose below level flight to build up airspeed. Always make all changes of attitude gradually, a little at a time. Make frequent small changes rather than large ones. As your airspeed increases, relieve heavy fore or aft control pressure by trimming.

If you set artificial horizon properly before takeoff, with the miniature airplane slightly below the horizon bar, you can hold the proper angle of climb after leaving the runway by keeping the miniature airplane approximately  $\frac{1}{8}$ -inch above the horizon bar. Establish and hold proper attitudes in the B-24 by reference to flight instruments rather than to outside objects. It's an instrument plane.

8. Attain a minimum airspeed of 140 mph and a safe altitude above all objects before your first power reduction.

## AFTER-TAKEOFF CHECK

### Amplified Checklist

1. **Wheels.** Copilot raises gear on signal from the pilot, (usually thumb jerked upward). As soon as the gear handle is in the "UP" position, pilot stops the wheels with smooth, firm application of brakes. This reduces the strain on the

## Important

The copilot reads the after-takeoff checklist when the gear and flaps are up, the first power reduction is completed, and when a safe altitude and an airspeed of 150 mph are reached.

main gear suspension assemblies caused by the gyroscopic action of rapidly rotating wheels. Rough application of brakes puts undue strain on the gear fittings and may rupture an expander tube.

**Caution:** There is no hurry about raising the wheels. Be sure you have plenty of airspeed and altitude before you start them up.



### Press the Button

When the copilot raises the gear, he should be sure to press down the safety button located on top of the gear handle to unlock it. Forcing the handle against the lock will injure the locking pin.

If the solenoid latch does not release, you can push the releasing pin in with a screwdriver and then raise the gear handle to bring the wheels up. The latch is located behind the pilot's instrument panel just forward of the pedestal. **Don't try this on the ground because you will retract the gear and the airplane will crash down on its belly.**

2. **Superchargers.** When the airplane attains safe airspeed (140 mph) and altitude, the pilot makes the first power reduction with superchargers and sets them for normal climb (not to exceed 46" for Grade 100 or 38" for Grade 91 fuels).

**Power Reduction With Electronic Turbo Control:** Turn the turbo control dial back toward zero until you reach the desired manifold pressure.

3. **Throttles.** If manifold pressure remains higher than desired for climb after superchargers are all the way off, then retard the throttle to obtain climbing manifold pressure.

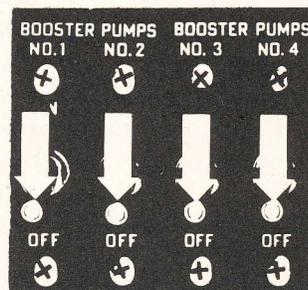
4. **Propellers.** Copilot reduces rpm to 2550 when requested by the pilot.

5. **Wing Flaps.** Copilot raises them when directed by the pilot. Don't raise the flaps before you have altitude of 500 feet and an airspeed of 140 mph. Remember that changes in flaps change the lift effect of the wing. As you raise the flaps, raise the nose of the airplane to correct for change in attitude. Use enough back pressure to maintain altitude and the airplane will rapidly accelerate to 150 mph. Don't lower the nose to gain this speed because this will result in unnecessary loss of altitude. Add nose-up elevator trim to help maintain your altitude.

In heavily loaded aircraft, it is advisable to raise the flaps from 20° to full up in two or three stages.

**Warning:** Don't be in a hurry. Get a safe air-

speed and a safe altitude before you raise the flaps. But don't let airspeed exceed 155 mph with flaps down.



6. **Booster Pumps.** Copilot switches them off one at a time above 1000 feet and notes any drop in pressure.

7. **Cowl Flaps.** Will normally be at trail for the climb, checked and set by the copilot.



## RUNNING TAKEOFF

### Procedure

1. Bring the airplane down to a normal 2-point, nose-high landing.

2. When speed has decreased to 80 mph (about  $\frac{1}{3}$  distance of a normal landing roll), gently lower the nose to a normal 3-point position.

3. Be sure you have ample runway left in which to re-accelerate and take off.

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4. At command of the pilot, the copilot raises the flaps from 40° to 20° and trims for normal takeoff as the pilot smoothly applies normal takeoff power. Remember that the airplane is already moving fast, and don't advance throttles too rapidly.

5. Speed permits the pilot to maintain directional control entirely with rudder. It isn't necessary to apply power unevenly or to use brakes.

6. Lift the weight off the nosewheel as soon as throttles are full forward.

7. Avoid a tendency to pull the airplane off the ground at low speed and at a high angle of attack. Build up adequate airspeed and break contact as in a normal takeoff.

8. In other respects, proceed exactly as in a normal takeoff.

**Caution:** On running takeoffs watch cylinder-head temperatures and open cowl flaps to trail if necessary.

**Warning:** Don't hit the gear handle when you mean to raise the flaps. Remember you have full flaps down as you roll along the runway and are bringing flaps to 20° to re-establish normal takeoff settings.

Copilots have been known to reach for the flap handle and unintentionally hit the gear handle from force of habit while wheels are still on the ground. Normally when the weight of the airplane is on the gear, gear handle cannot be moved to the up position. In a running takeoff, however, enough weight may be off the gear while wheels are still on the concrete to allow oleo to extend far enough to close safety micro switch in the left main gear and allow the gear to unlatch and collapse.

Don't let flaps come all the way up. The Davis wing needs 20° of flaps for additional lift.

Don't raise the gear until you are safely clear of the ground. This is deceiving on running takeoffs.

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## CROSSWIND TAKEOFF



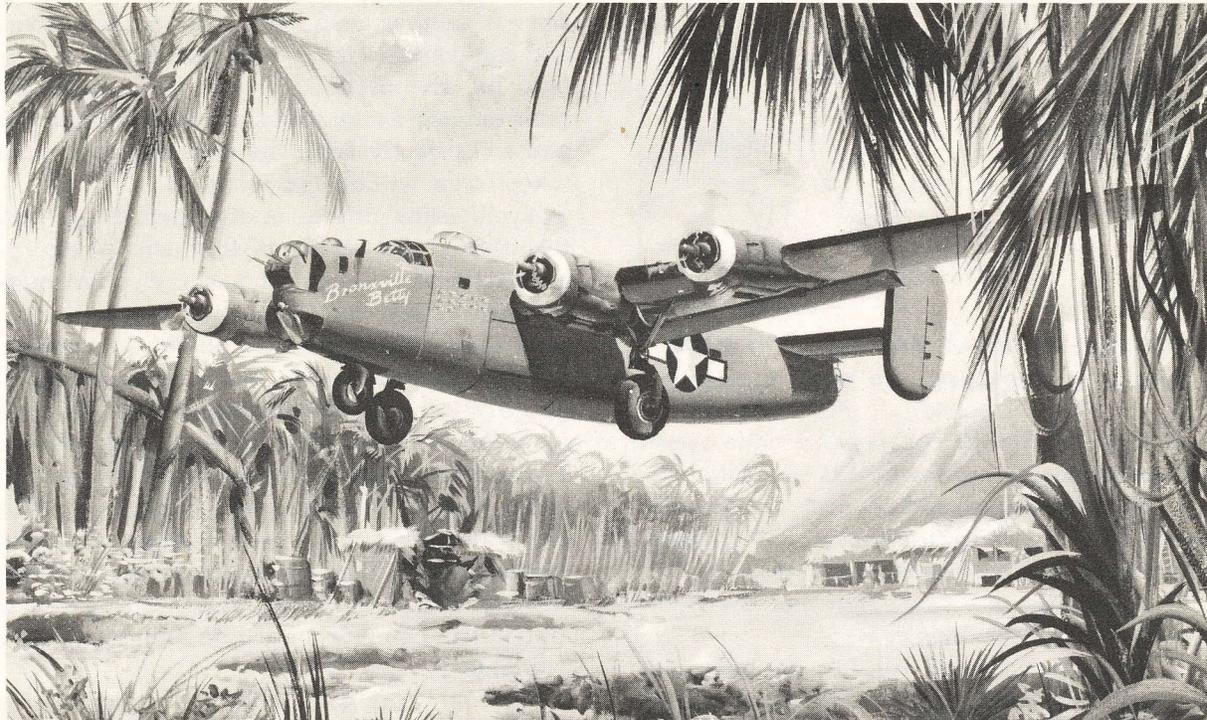
You will experience no difficulty with a B-24 in crosswind takeoffs. Proper leading of throttles and use of rudder pressure will hold the airplane straight down the runway.

Inherent directional stability of the tricycle landing gear tends to keep the airplane straight on its roll as long as the nosewheel is on the ground. There is no tendency to weathercock.

Be sure, especially on bumpy runways, to

build up ample flying speed before leaving the ground. Otherwise the airplane may settle back down as it starts to drift and place severe strain on the landing gear.

As soon as you are clear of the ground, hold the wings level and establish a crab with rudder to continue down the runway path. Don't drop a wing, because this reduces your lift. Continue as in a normal takeoff.



## HIGH-PERFORMANCE TAKEOFFS

Where it is necessary to take off in as short a distance as possible, execute a high-performance takeoff. This, on an average, reduces your ground run approximately 200 feet and reduces the total distance necessary to clear a 50-foot obstacle by approximately 600 feet.

Be sure you have proper authority and are going to succeed before you attempt a high-performance takeoff. Several variables must be considered: Pressure altitude, free air temperature, model and weight of the airplane, wind, and type of runway surface. Don't take a chance. Taking all these variables into consideration, precalculate the answers to 3 questions before you attempt a takeoff:

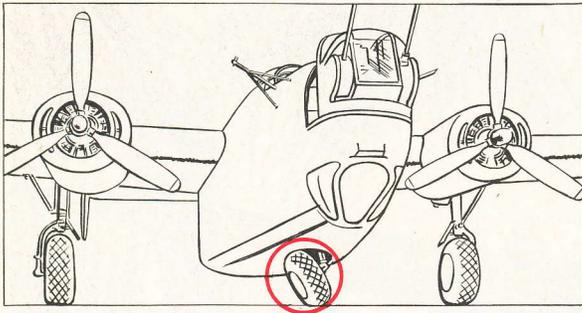
1. What ground run will be required?
2. What will the takeoff airspeed be?

3. What distance will be required to clear a 50-foot obstacle?

Use the high-performance takeoff chart in this manual (if suitable) or in the technical order for the model of airplane you are flying to answer these questions. Calculate carefully and double-check your answers. When you are satisfied that the high-performance takeoff can be safely made, use the following procedure.

### Procedure (Based on Grade 100 fuel)

1. Complete the before-takeoff check. Run up each engine separately to 2700 rpm and 47" manifold pressure. (This setting allows for a 1½" increase in manifold pressure due to ram.)
2. Set wing flaps at 20° as for a normal takeoff. Set cowl flaps at 5° to reduce drag.



**EXAMPLE OF WHAT MAY OCCUR IF NOSE WHEEL IS NOT LINED UP WITH RUNWAY**

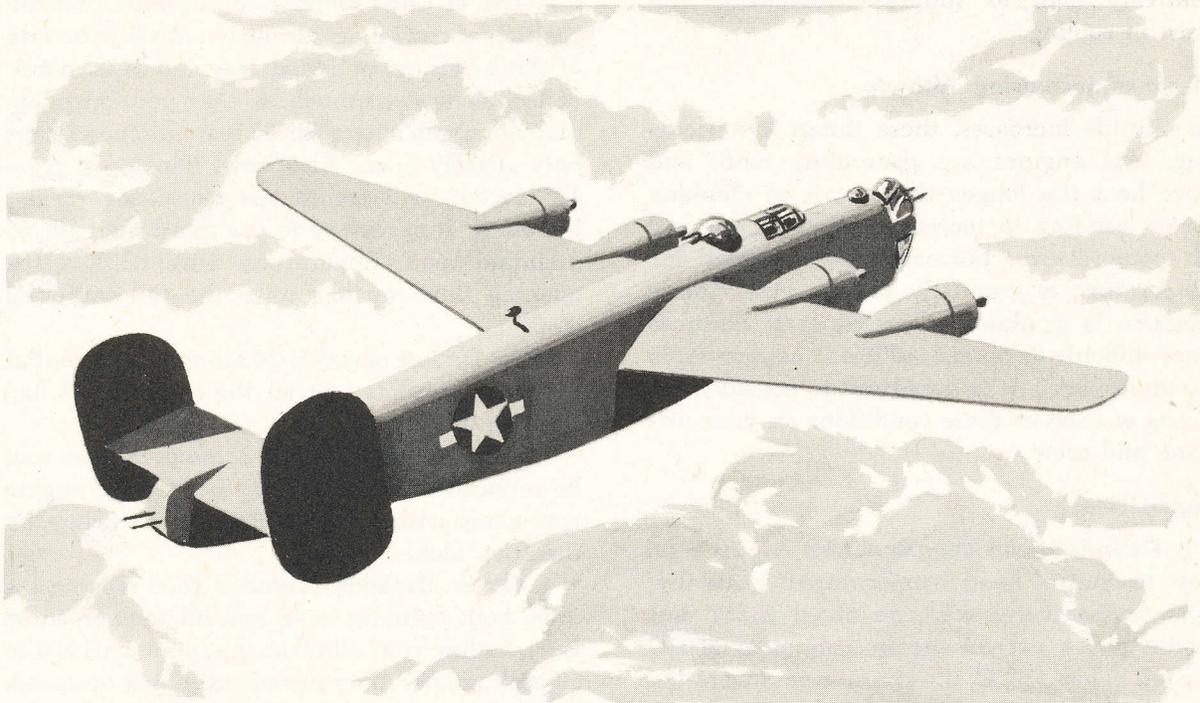
3. Line up with the runway and make a positive check that the nosewheel is straight.
4. Hold the brakes and advance the throttles smoothly and evenly to establish 35" of manifold pressure. Then release the brakes.
5. As rapidly as possible, advance the throttles to full open position.
6. Make your takeoff run in a normal manner until you reach your precalculated takeoff speed! Then use sufficient back pressure to break contact and gradually establish the desired angle of climb. Some margin of safety is necessarily sacrificed by this procedure.

**Another Good Method**

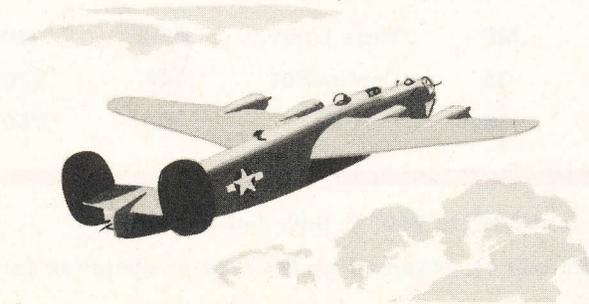
Here is another good method if you have room and can continue your roll from the taxi strip onto the end of the runway. Execute in the same manner as the first procedure, except that you roll directly from the taxi strip into your takeoff run without stopping.

Avoid using brakes in the turn. Lead with throttles on the outside of the turn. When you have sufficient momentum to carry you through the turn, retard that set of throttles, and as the nose approaches the center line of the runway, advance throttles on the inside of the turn sufficiently to check the turning action. Immediately follow up with the other set and advance all throttles progressively as rapidly as possible to the desired takeoff manifold pressure. This procedure gives you the advantage of having the mass weight of the airplane in motion at the extreme end of the runway, permitting you to take full advantage of every foot of runway available.

**Caution:** You gain nothing by having too much speed in executing the turn. You are likely to roll a tire or damage the gear. The main thing is to have the weight in motion at the extreme end of the runway.



## THE CLIMB



You will judge the proper angle of climb by obstacles to be cleared, airspeed and the flight indicator. The best average airspeed for the climb after completing the after-takeoff check (wheels up, flaps up, etc.) is 150 to 160 mph.

Pilot should relieve control pressures by proper trimming and copilot should synchronize propellers as soon as convenient after wheels and flaps are up. Both pilot and copilot should keep a roving eye on all instruments to see that power, temperatures and pressures all stay within limits.

### **Auto-rich for All Climbs**

Throughout all climbs mixture controls should be in "AUTO-RICH," for at high power it is

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necessary for the proportion of fuel to air to be relatively high to suppress detonation and assist in cooling.

### Effects of Increasing Altitude

As altitude increases, these things are occurring: The engines are generating more and more heat the longer they work at climbing power, tending to increase cylinder-head and oil temperatures; normally the indicated air temperature is gradually falling; atmospheric pressure is gradually decreasing; it becomes more difficult to obtain sufficient oxygen from the atmosphere. It is important to consider the effects of each of these conditions on your airplane and crew.

### Engine Heat

1. **Cylinder-head Temperatures:** Adjust cowl flaps to control head temperatures. Normally, head temperatures will run about 232°C but should never exceed the maximum of 260°C nor fall below 150°C, the operating limits of the

engine during the climb.

2. **Use of Cowl Flaps:** Keep in mind that the position of cowl flaps seriously affects your rate of climb because of added drag and disturbance of the airflow—so much so that your airplane may not climb above 23,000 feet with cowl flaps only slightly open. Also, cowl flaps open from 10° to 20° will sometimes cause severe tail buffeting. If necessary to use more than 10° to maintain head temperatures within limits, try opening them farther until the tail buffeting stops.

**Note:** On late series B-24 aircraft, differential cowl flap settings restrict the upper cowl flap opening to 12¼°.

3. **Oil Temperatures:** Oil temperatures can be reduced more quickly by decreasing engine rpm along with throttles than by reducing the throttles alone.

4. **Other Methods:** Another good way to reduce both cylinder-head and oil temperatures is to shallow your climb so that your IAS is 5 to 10 mph greater than normal climbing airspeed.

## CLIMBING POWER SETTINGS

### GRADE 100 FUEL—SPECIFICATION ANF-28

Operation	Setting	Mixture	RPM	MP	Time Limit	BMEP	HP
Climb	Desired	Auto-rich	2550	41	Continuous	167	990
Climb	Max.	Auto-rich	2550	46	Continuous*	186	1100

### GRADE 91 FUEL—SPECIFICATION ANF-26

Operation	Setting	Mixture	RPM	MP	Time Limit	BMEP	HP
Climb	Desired	Auto-rich	2550	35	Continuous	147	870
Climb	Max.	Auto-rich	2550	38	1 Hr.	160	950

\*Cyl. head temp. not to exceed 232° C. For temperatures of 232° to 260° C, time limit is 1 hour.

The above are normal limits. Variations within limits will be governed by the type of operation for a particular organization.

This will not cause much loss in your rate of climb.

In case of extreme cylinder-head and oil temperatures, use **emergency** "FULL RICH" mixture (with Bendix-Stromberg carburetors). This will dissipate the heat very rapidly but will also cause a loss of power and excessive gas consumption. Use only long enough to reduce temperatures. Excessive temperatures are sometimes caused by failure of the automatic feature of "AUTO-RICH." "FULL RICH" corrects this because it gives a fixed mixture.

### Decreasing Air Temperature

1. **Carburetor Air Temperature:** On an extended climb when the relative humidity is high, check regularly to be sure your carburetor air temperature is either above or below the icing range ( $-5^{\circ}\text{C}$  to  $+15^{\circ}\text{C}$ ). You can get carburetor ice with little or no warning.

2. **Intercooler Shutters:** Hot compressed air is coming to your carburetor from the supercharger through the intercoolers. Intercooler shutters are kept in the **open** position to cool this compressed air. It is practically never necessary to close intercooler shutters except in very severe carburetor icing conditions. (See Carburetor Icing.) If you do close them, keep a close watch to see that both carburetor air temperatures and cylinder-head temperatures don't suddenly rise beyond limits. Intercooler shutters should always be used with utmost caution to avoid overheating.

3. **Heater:** Remember that there are crew members all over the airplane who may be getting cold. Ask them if they want some heat. The longer you can keep them warm the more effective they will be with their headwork, their bombs, and their guns. Crew comfort is important to crew efficiency.

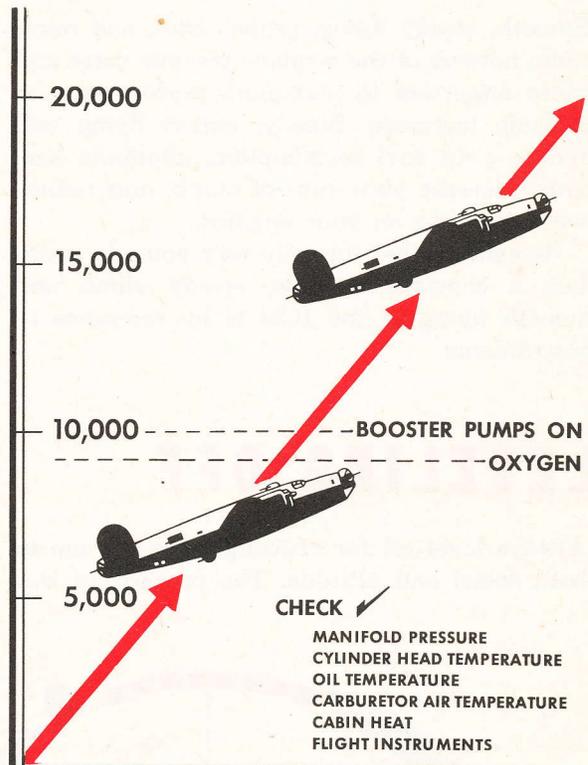


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### Decreasing Atmospheric Pressure

1. **Airspeed Indicator:** Decreasing atmospheric pressure causes your airspeed indicator to show an airspeed lower than your true one.

2. **Manifold Pressure:** The density and pressure of the outside air is decreasing as altitude increases. At sea level normal atmospheric pressure will, on some engines, be sufficient to maintain the desired manifold pressure. As altitude increases, and full throttle fails to give sufficient manifold pressure, you add boost with the turbo-superchargers.



**Note:** With oil-type turbo regulator, when climbing at a given throttle setting, rpm, and turbo regulator setting, the manifold pressure will increase slightly as altitude increases because the atmosphere has less back-pressure effect in relation to the constant exhaust pressure. This results in a steady increase in turbo wheel speed and thus increased manifold pressure.

3. **Booster Pumps On at 10,000 Feet:** As you climb and the atmospheric pressure decreases,

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there is more and more tendency for a vapor lock to form and for suction from your engine-driven fuel pump to collapse the rubber fuel lines. Booster pumps put 8 lb. additional pressure in the lines to help support them. Turn the booster pumps on at 10,000 feet and keep them on until you descend below that altitude.

4. **Crew:** As altitude increases, your crew is becoming less efficient. Their ears tend to bother them. Head congestion may cause severe pain. They are getting insufficient oxygen. Always use oxygen above 10,000 feet.

### The Importance of Smooth Flying

Smooth, steady flying, proper trim, and minimum horsing of the airplane become more and more important to maximum performance as altitude increases. Steady, expert flying will reduce your fuel consumption, eliminate hazards, increase your rate of climb, and reduce wear and tear on your engines.

Remember that the only way you can maintain a constant attitude, steady climb and smooth flying in the B-24 is by reference to instruments.

## LEVELING OFF

Always level off for cruising **from the top** in both speed and altitude. The purpose of this

is to let the airplane build up full momentum for cruising. If you go directly from a climb to level flight with a B-24, and reduce power, it will mush along at a high angle of attack and in a high drag attitude while trying to gain speed. It will fly sluggishly and inefficiently. The heavier your load, the more important it is to level off properly.

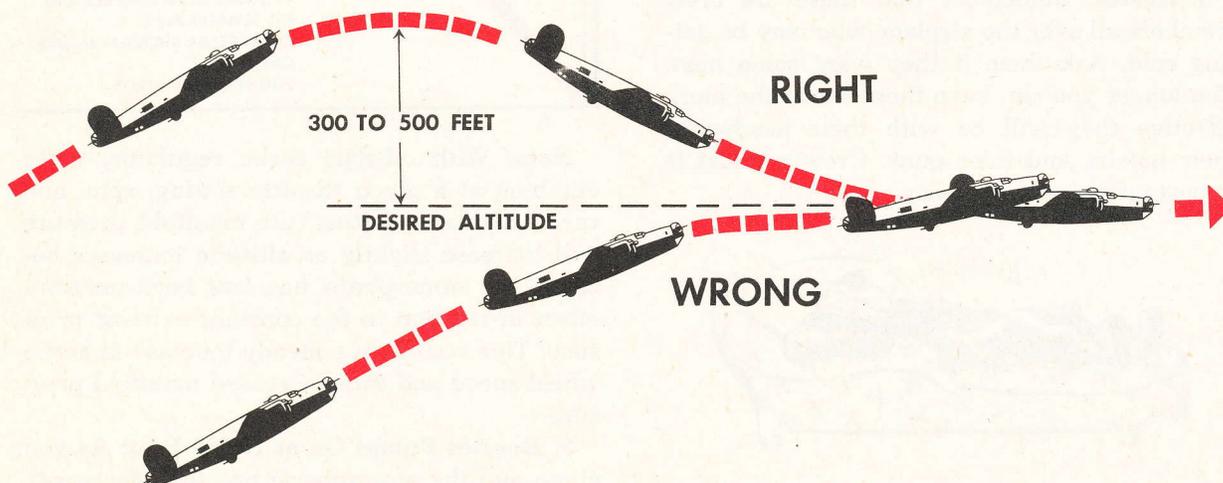
### Leveling-off Procedure

1. Continue your climb 300 to 500 feet above the desired cruising altitude.
2. Level off, drop the nose slightly to get on the step and pick up speed.
3. Reduce power to cruising setting and gradually descend to your cruising altitude.
4. Synchronize propellers and trim the airplane.

### Cool Off the Engines

Remember that throughout the climb the engines have been generating heat. Give them a chance to cool down somewhat below desired cruising temperatures before you change to "AUTO-LEAN" mixture settings. This allows cylinders, blower and rear sections to dissipate heat. A well-cooled engine is less likely to detonate when the mixture is leaned than a hot engine.

To aid cooling, don't close the cowl flaps immediately upon completing the climb. Instead, close them progressively as airspeed builds up.



## HOW TO SYNCHRONIZE PROPELLERS

The copilot brings propellers to the desired tachometer setting with the propeller governor control switches. Although rpm readings are identical for all 4 engines, propellers may not be perfectly synchronized because of slight variations in tachometers. To synchronize, copilot should follow this procedure:

1. **No. 1 and No. 2 Propellers:** Leave No. 2 (inboard) as it is. Note the rotating shadow around the top half of No. 1 propeller. If the shadow is rotating away from you, the propeller is too slow and should be increased; if the shadow is rotating toward you, the propeller is too fast and should be decreased.

2. **No. 3 and No. 4 Propellers:** Leave No. 3 (inboard) as it is. Note the rotating shadow around the top half of No. 4 propeller. Here the procedure is reversed. If the shadow is rotating away from you, the propeller is too fast and should be decreased; if the shadow is rotating toward you, the propeller is too slow and should be increased.

**Note:** An easy way to keep this straight is by remembering that all propellers in the B-24 rotate to the right. Thus, from the cockpit, No. 1 propeller is turning toward you and No. 4 going away from you. If the shadow is rotating with the propeller, then the propeller is too fast; if the shadow is rotating backward (against the propeller rotations), then the propeller is too slow.

3. Increase or decrease rpm by a split-second flick of the toggle switch and at the same time check the effect on the shadow. The shadow will disappear when propellers are synchronized.

4. If the shadows have disappeared and the engines still sound unsynchronized (engine beat or pulsation), then No. 1 and No. 2 are not synchronized with No. 3 and No. 4.

5. To synchronize the left pair of engines with the right pair, check the tachometers to see if one pair is indicating less than the de-

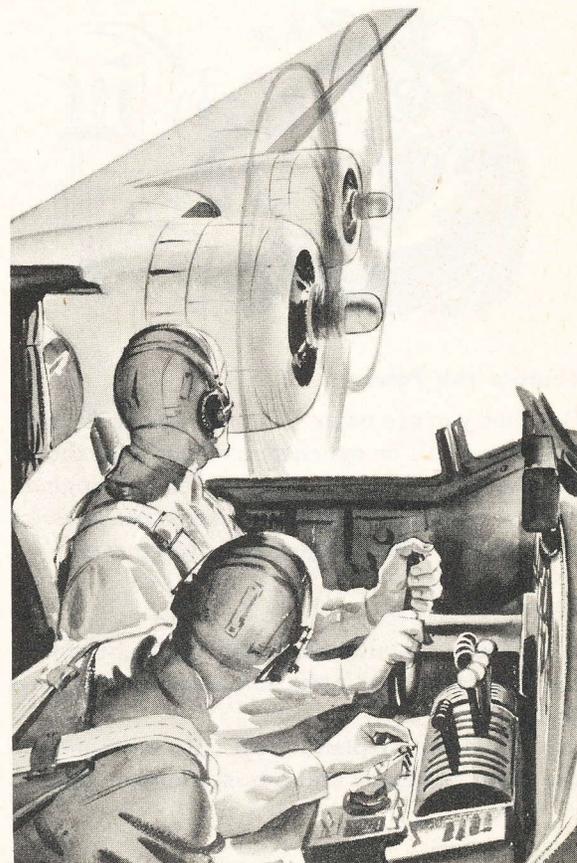
sired rpm. If so, flick both switches for that pair forward at the same time and back to neutral quickly. Repeat until you eliminate the beat and get a steady drone. If the beat gets worse, decrease rpm instead of increasing.

6. Now all 4 propellers should be synchronized. However, the propeller governors for the propellers that were changed as a pair may respond unevenly. If so, re-synchronize them.

**Note:** The difference in needle travel on the tachometers will tell you which propeller governors are fast and which are slow. With practice you will be able to lead with the toggle switches for slow-acting governors to bring all propellers to the desired rpm at the same time.

### At Night

Use your landing lights or a flashlight to see which way the shadows are turning. With experience it is possible to synchronize propellers by sound



## TRIMMING

Trimming the B-24 is a routine procedure but tremendously important to the easy and proper operation of the airplane. Brawny, 200-lb. pilots have exhausted themselves in an hour's flying because they failed to trim properly and frequently enough. Poor trim cuts down the airspeed, increases fuel consumption, lowers the speed and ceiling of a climb, and decreases the efficiency of the airplane and the pilot. Formation flying is a nightmare if the airplane is poorly trimmed.

Trim the B-24 by instruments—not by visual reference to outside objects. But keep a sharp lookout for other traffic at all times.

Following is the easy, sure way to properly trim the airplane for straight and level flight.



### Balance the Power

See that you are using balanced power. Propellers should all be synchronized and you should have equal manifold pressure on all engines. **This is important!** Manifold pressures must be equalized to a hair to give balanced power.

### Elevators

1. Check the altimeter with the flight indicator and reset the latter if necessary for level flight.

2. Hold the airplane level with reference to the flight indicator and adjust elevator trim to

relieve any fore and aft pressure required to hold the nose level.

### Rudders

1. Hold the wings level with the ailerons by reference to the flight indicator and remove all rudder pressure.

2. Watch the directional gyro to see if the airplane is turning. Gradually correct with rudder trim until the directional gyro holds a steady course straight ahead.

### Ailerons

1. Level the wings, hold a gyro heading with rudder, and release the wheel.

2. If the flight indicator shows a wing is dropping, correct with aileron trim.

### Double-check

Finally, check the directional gyro, flight indicator and needle and ball with hands and feet off controls to make sure of proper trim. Once the airplane is properly trimmed, small adjustments will usually keep it there. Trimming should become automatic.

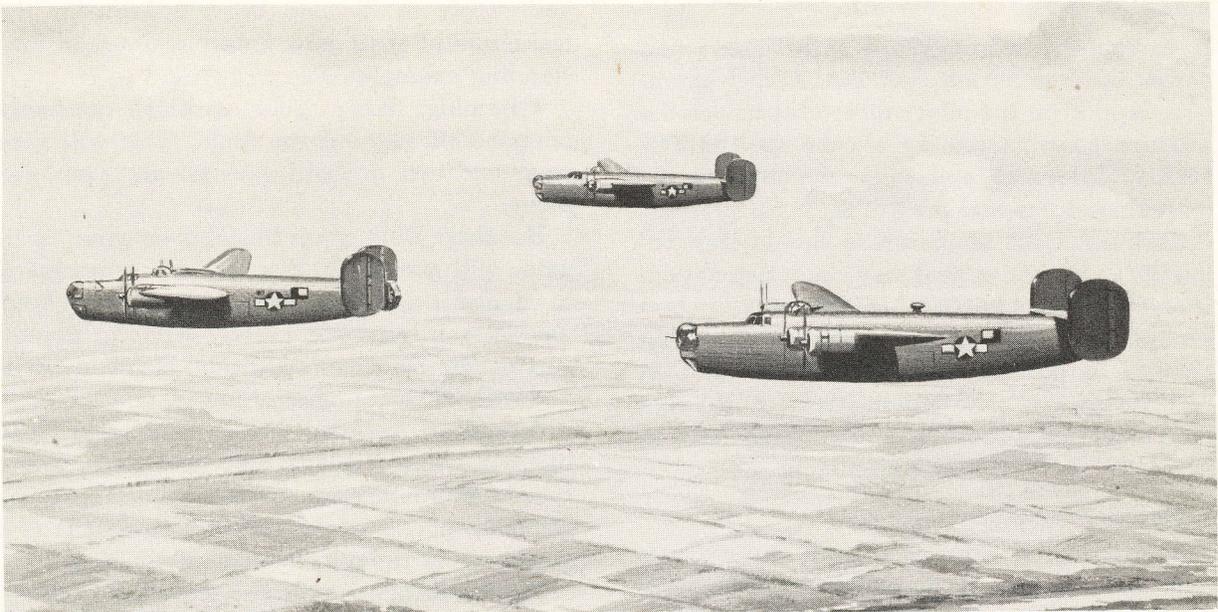
### When to Trim

Trim at the first sign of excessive control pressure. You will want to trim for climbs, descent, gear down or up, flaps down or up, when the crew changes positions, as the fuel is used up, when your bombs are dropped, in case of engine failure, etc.

### Relationship of Load and Trim

If the airplane is perfectly loaded, it is possible to fly it hands off with one or two degrees of tab setting. On long flights tab settings become extremely important. A loss of 3 to 4 mph in airspeed can result from 1° of tabs on one control surface. Thus, if your ship is improperly loaded and you have to use a lot of trim, it is worth while to shift cargo to establish better balance.

Don't kid yourself by holding pressures manually instead of using trim.



## CRUISING

As soon as you have leveled off, synchronized propellers, trimmed the airplane, and let the engines cool down, check all instruments preparatory to going into auto-lean.

### Normal Automatic Lean Pressures and Temperatures

1. Cylinder Temperature: 232° C maximum.  
205° C desired.
2. Oil Temperatures: 100° C maximum.  
75° C desired.
3. Oil Pressures: 65 to 100 lb. sq. in.
4. Fuel Pressures: 16 to 18 lb. sq. in.

## CRUISING POWER SETTINGS

### GRADE 91 FUEL—SPECIFICATION ANF-26

Operation	Setting	Mixtures	RPM	MP	Time Limit	BMEP	HP
Cruise	Normal	Auto-lean	1650-2100	30	Continuous	—	—
Cruise	Local	Auto-lean	2000	30	Continuous	131	610

### GRADE 100 FUEL—SPECIFICATION ANF-28

Operation	Setting	Mixtures	RPM	MP	Time Limit	BMEP	HP
Cruise	Maximum	Auto-rich	2325	35	Continuous	150	820
Cruise	Maximum	Auto-lean	2200	32	Continuous	140	715
Cruise	Desired	Auto-lean	2000	30	Continuous	131	610
Cruise	Maximum Range: See Cruise Control Charts.						

**Automatic Lean**

If instrument readings are satisfactory, and power settings permit "AUTO-LEAN" operation, copilot (at the pilot's direction) moves the mixture controls one at a time to "AUTO-LEAN." Pilot and copilot note the effect of this on temperatures and pressures.

Carburetor air temperature should stay below 35°C. Excessive heat may cause detonation. If an engine gets hot in "AUTO-LEAN" (a less cooling mixture), go to "AUTO-RICH" long enough to cool it down. If it stays hot in "AUTO-LEAN," the automatic feature may not be operating properly and you may have to use "AUTO-RICH" for that engine.

**Superchargers**

Low altitude: If cruising at low altitude you may have sufficient manifold pressure with superchargers completely off. (Watch for icing, however. If there is danger of icing, close intercoolers and operate as close to full throttle as possible. See Carburetor Icing.)

Above 20,000 feet: Superchargers won't function properly at less than 1800 rpm above 20,000 feet because in less dense air there is insufficient exhaust gas to operate the turbo wheel properly. Don't suspect turbo regulator trouble until you have checked rpm.

**Cowl Flaps**

Regulate cylinder-head temperatures with cowl flaps. The closed position reduces drag and increases speed, but also increases engine temperatures.

**Directional Gyro**

Check and correct for precessing at least every 15 minutes or as necessary.

**NOTE**

Although pilot and copilot will be checking instruments regularly, it is a good idea to call for a complete check and report by the copilot at stated intervals.

**Flying the Airplane**

Take pride in your ability to fly the airplane perfectly. You can't expect your copilot or

your crew to develop keen interest in the technique of their jobs unless you set an outstanding example.

**Trimming:** Keep your airplane perfectly trimmed throughout the flight. This will save wear and tear on both yourself and your airplane.

**Heading:** Hold your heading or your navigator will give up in disgust. If you are going to change headings or dive or climb, warn your navigator in advance exactly what to expect.

**Altitude:** Hold your altitude. Don't be satisfied with 200 feet higher or lower.

**Airspeed:** As time passes and your load lightens, your airplane will tend to gain airspeed. Maintain your predetermined IAS by reducing power every 1 to 3 hours. This is a good rule of thumb for efficient cruising.

**Fly the airplane as if you expected to use it in a combat mission tomorrow.**

**Flight Performance Record**

It is the copilot's duty, with the assistance of the engineer, to keep a flight performance record of every mission. Entries should be made every 30 minutes. Properly kept this form will:

1. Warn you of excessive gas consumption.
2. Give a running picture of the performance of engines.
3. Provide a check on how efficiently you are flying the airplane.

**Engineer's Hourly Visual Check**

Require the engineer to make a visual check once an hour of turbo, cowl flaps, nacelles, fuel cell areas, etc. Many items will have to be checked from the rear of the airplane. When on oxygen, check can be conducted with the use of a walk-around bottle.

**Oxygen**

When on oxygen, require the copilot to check crew stations at least once every 15 minutes by interphone to ascertain that crew members are all right and have an adequate supply of oxygen on hand.

# GENERAL FLIGHT CHARACTERISTICS

The flight characteristics of the B-24 are outstanding without exception if the airplane is properly loaded. It has no abnormal or bad characteristics. The tremendous power plant will carry huge loads great distances at high speeds with ease.

## Inherent Directional Stability

The airplane has inherent directional stability which may be maintained for long periods by slight adjustments in trim. However, controls are normally heavy, as they should be in a heavy airplane, and the pilot who fails to maintain proper trim is in for an exhausting workout. Properly trimmed, the airplane will fly the desired heading true as an arrow with comfortable control pressures.

## Longitudinal Stability

Longitudinal stability is excellent over a wide range of center of gravity locations. Under normal loadings the airplane will return to normal flight when released from a stall or other abnormal positions. However, when fully loaded, the airplane increases its weight by  $\frac{1}{2}$  to  $\frac{3}{4}$ . If the center of gravity moves too far forward or too far aft, it is easily possible to develop limit load factors. Exercise care in using controls smoothly and gradually when operating near these limits, especially when the center of gravity is in extreme aft positions, because it is easy to develop excessive strain on the tail assembly with sudden heavy elevator pressure.

## Characteristics in Rough Air

The intelligent pilot will avoid violent turbulence because the forces of some storms are incalculable in their intensity. There is nothing critical in ordinary rough-air operation with the Liberator. It will maintain stable flight. It is a waste of effort to fight every slight deviation from level flight. Use pressures to maintain generally level flight and the airplane

will hold its own. Inherent stability will tend to return the airplane to level flight. In a heavy airplane like the B-24, this action is comparatively slow, so give the airplane time to settle down.

In extremely turbulent air slow down to 150 mph. For additional drag and to avoid too great a decrease in power, extend the landing gear but bear in mind that this will have a serious effect on your rate of fuel consumption.

## Don't Fly Contact

The B-24 is strictly an instrument airplane. You must fly by reference to instruments by day and by night, fair weather or foul, if you expect to get the most out of your airplane. The only reason they put windows in the airplane is to permit you to see other aircraft and mountains — so don't fly contact! Remember, however, that it is easy to control the attitude of the airplane by reference to instruments and still keep a sharp lookout. Don't let the instrument panel hypnotize you. Even when the sky seems empty, be heads-up for traffic. Remember what you learned in flying school about the swivel head and the rubber neck. You still need them. Keep crew members on the alert as lookouts, too, as an additional safeguard while you work at the double job of flying by instruments and watching the air around you.

## FLIGHT INSTRUCTIONS

At no time will the following maneuvers be attempted:

LOOP  
ROLL SPIN  
INVERTED FLIGHT  
IMMELMANN  
VERTICAL BANK

# Always

- Always follow all items on checklist.
- Always check fuel before takeoff and regularly during flight.
- Always check nosewheel accumulator—if provided.
- Always open intercoolers for starting.
- Always use battery cart when available.
- Always check generator switches "OFF" when starting.
- Always use "AUTO-RICH" except when cruising.
- Always check de-icers "OFF" before takeoff or landing.
- Always use outboard engines for steering when taxiing.
- Always turn "OFF" auxiliary hydraulic pump before takeoff.
- Always check gear latches engaged before landing.
- Always check the automatic pilot "OFF" before takeoff or landing.

# Never

- Never execute prohibited maneuvers.
- Never exceed airspeed restrictions.
- Never start engines before pulling props through.
- Never start with low batteries.
- Never start with auxiliary power unit alone.
- Never start with superchargers "ON."
- Never use starter for direct starting. Inertia flywheel must be energized before meshing.
- Never attempt to use intermediate positions on mixture control.
- Never turn on ground too sharply. It will damage landing gear and tires.
- Never attempt to take off with props in low rpm.
- Never transfer fuel with radio "ON."
- Never apply brakes with nosewheel off ground
- Never land with brakes locked.

# AIRPEED LIMITATIONS

Limiting Factor	Maximum Indicated Airspeed
40° Flaps .....	155 mph
10° Flaps .....	180 mph
Lowering Landing Gear.....	155 mph
41,000 lb. Gross Weight.....	355 mph
56,000 lb. Gross Weight.....	275 mph

**Automatic Pilot:** Do not operate the automatic pilot when flying at less than an indicated airspeed of 155 mph or when flying in extremely turbulent air.

**Extremely Turbulent Air:** Slow down to IAS of 150 mph.

**Maximum Gross Weight of 56,000 lbs.:** Do not attempt other than normal flight. Permissible flight factor—2.67; permissible landing factor—2.25.

**Emergency Maximum Gross Weight of 64,000 lb.:** Do not attempt other than normal flight. Permissible flight factor—2.3; permissible landing factor—2.0. Operate only from smooth fields and do not exceed cruising speeds until load has been expended to 56,000 lb.

# STALLS

The B-24 has no unusual stall characteristics. It has sufficient reserves of power; there is no excuse for getting into a stalled condition if the airplane is operated normally.

## Various Factors Affecting Stalling Speeds

Wheels down will increase the stalling speed of the airplane from 3 to 5 mph. The operation of de-icer boots will have a serious effect on the stalling speed. The degree of cowl flap opening will reduce airspeed and affect stalling speeds accordingly.

A feathered propeller is much less of a drag on the airplane than a windmilling propeller. An engine operating at 11" manifold pressure is the equivalent of a feathered propeller.

## COMPARISON OF STALLING SPEEDS

	Gross Weight Lbs.	Wing Flaps and L.G. Retracted IAS	Wing Flaps 40° L.G. Extended IAS
<b>NO POWER</b>	45,000	110	91
	56,000	123	101
	64,000	132	109
<b>40% POWER</b>	45,000	103	71
	56,000	114	80
	64,000	123	85

**Caution:** All stalling speeds given in this manual have been test flown but speeds will vary slightly from airplane to airplane, of the same weight and series. Speeds given serve as a basic guide only.

**Warning of Stalls:** Usually there is clear warning of an approaching stall. Controls will loosen somewhat and airspeed will be falling off. You will observe a shuddering of the tail and a slight pitching action.

**The Stall:** In the approach to a stall (the usual practice maneuver) the nose will have an increasing tendency to drop. In a complete stall, the airplane will tend to fall off to either side without any inherent tendency to spin.

**Recovery From Stalls:** The stall recovery in the B-24 is like that in almost any other airplane for the most part:

1. Lower the nose to regain flying speed. Because of its aerodynamically clean design, the B-24 will lose a great deal of altitude and pick up speed rapidly.

2. If the stall occurs with decreased power, don't increase power until you have lowered the nose. The purpose is to establish airspeed and prevent rolling action caused by torque.

3. If a wing drops and airplane is turning, correct with rudder. **Don't use ailerons.** Ailerons increase the drag, aggravate the stall and

prolong recovery. You can stop the turn and level the wings with rudder alone.

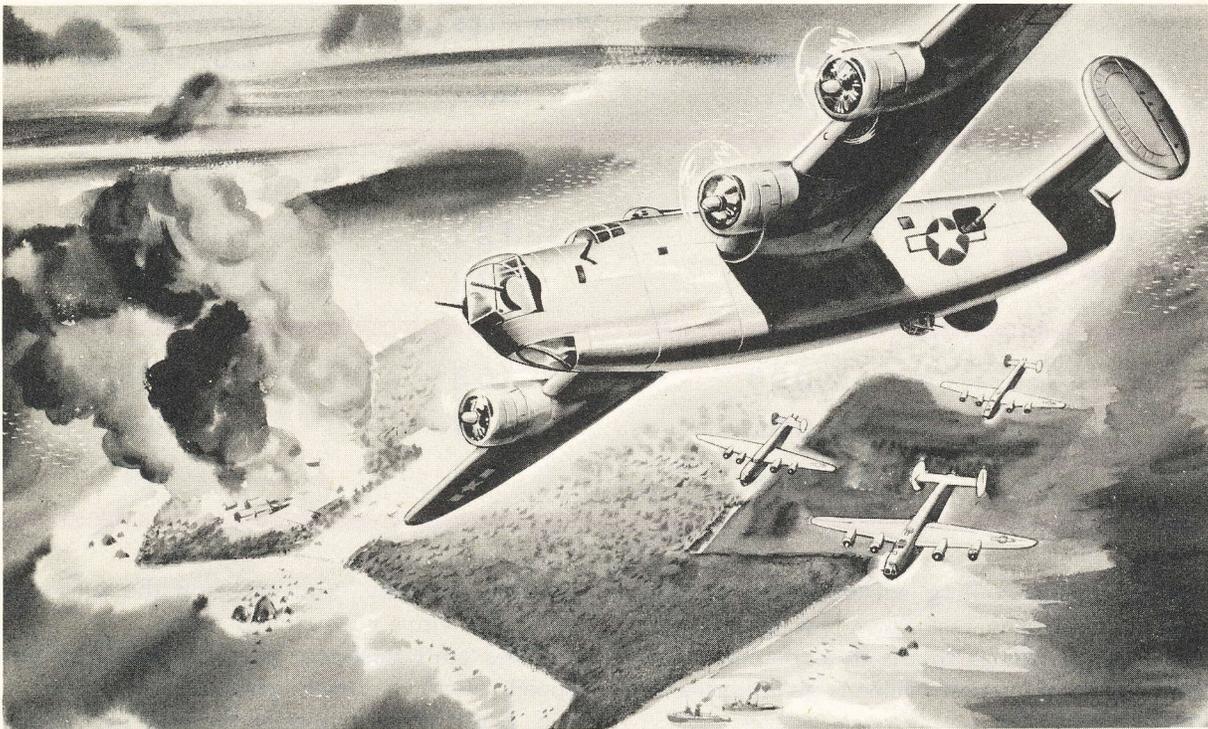
4. As your nose-low attitude builds up airspeed, blend in power gradually.

5. Don't attempt to raise the nose too rapidly before you regain speed or it is possible to cause a secondary stall more violent than the original one.

6. Properly executed, you will blend in power and raise the nose to level flight so that as you level off you will have established cruising airspeed and normal power settings.

### WARNING CONCERNING APPLICATION OF POWER

Never attempt recovery from a stalled condition by immediate application of power. Those wings are a platform with thousands of horsepower waiting to be lashed into action. When you are in a stalled condition, the platform loses its stability and, if you jam on power, torque may violently roll the airplane to the left. Always lower the nose, straighten with rudder, and blend in power with your gain in airspeed.



## URNS

Turns in the B-24 should be made by reference to the flight indicator, the directional gyro, needle and ball, altimeter and airspeed indicator. One-needle-width turns are normal and will vary in degrees of bank from approximately  $20^\circ$  for 150 miles an hour up to  $25^\circ$  for 200 miles an hour. Except in emergency, it is recommended that banks not exceed  $45^\circ$  because the load factor at  $60^\circ$  is 2 G's or twice that of level flight. In turbulent air a  $60^\circ$  bank might impose loads far in excess of 2 G's. Steeper banks very rapidly increase this load factor to an unsafe degree. In moderately loaded airplanes banks up to  $60^\circ$  can be made easily and safely, but with heavy loads aboard safety is sacrificed as banks are steepened.

Since rough or turbulent air constantly changes load factors, it is wise to limit banks

to one-needle-width turns in rough air and to reduce airspeed to 150 mph.

### How to Enter the Turn

Drop a wing with aileron pressure to enter a turn, coordinating necessary rudder and back pressure on the elevators. Only slight rudder is necessary. Control resistance is heavy and the response of the airplane is slow and gradual. Don't stop short of the desired degree of bank and then expect the wing to keep dropping. Bring it all the way down to the desired degree of bank and then stop it. It will be necessary to hold aileron against the bank to keep it from getting steeper. The amount of aileron will vary with the degree of bank.

### Difference in Turns

In a left turn, torque gives the B-24 a slight tendency to lose altitude, so it is necessary to come in early with back pressure to keep the nose from dropping.

In a right turn, torque causes the airplane to want to climb as you start the turn and the airplane holds its altitude slightly longer, so you delay the use of back pressure accordingly.

### Rolling Out of the Turn

Keep in mind that you are controlling a large mass of weight on a platform that stretches 55 feet out on each side of you. Establishing a turn and rolling out of it take time. To roll out of a 30° bank on a heading, give your roll-out about 15° of lead. Your roll-out will require smooth, solid application of controls, and as in rolling in, it is necessary to roll all the way out to level flight. Don't relax ailerons until you are level by the flight indicator. Proportion of aileron used is much greater than rudder on both entry and recovery compared with other planes. The common tendency of most pilots on the B-24

is to overcontrol with rudder, throwing ball off center.

Make allowances for torque again in the roll-out. You'll have to use more back pressure in a left turn than in a right turn and will need some forward pressure in the roll-out from a right turn to keep from climbing as you near level flight.

### Stalls in Turns

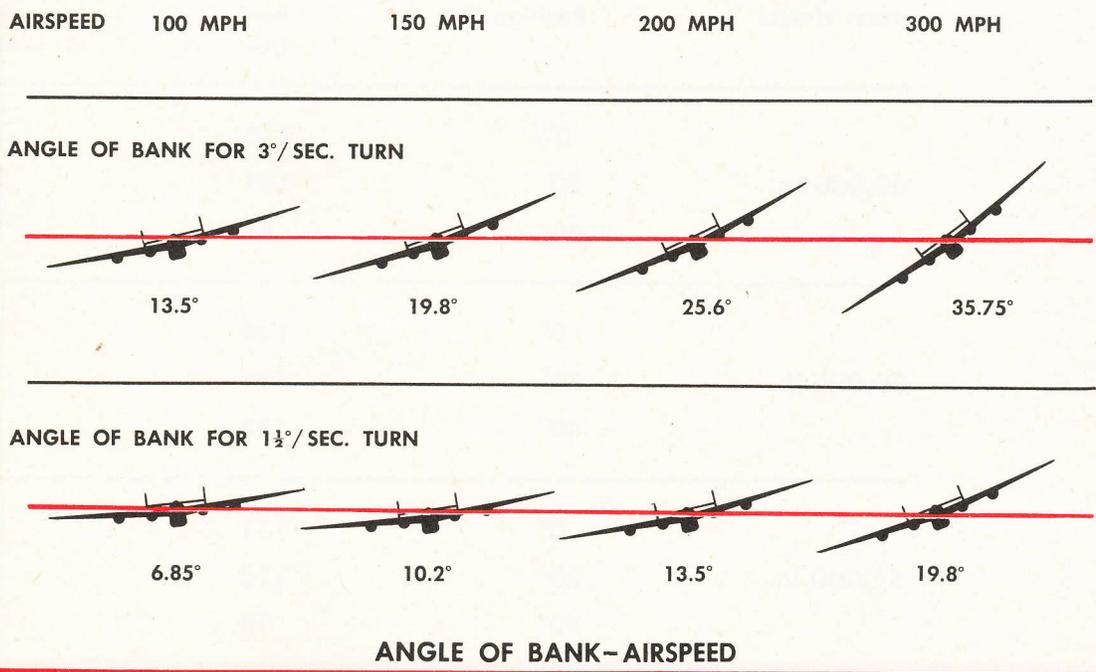
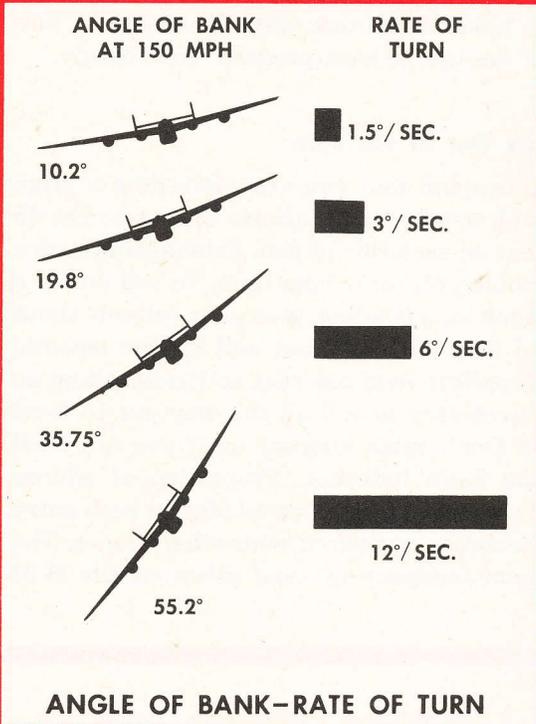
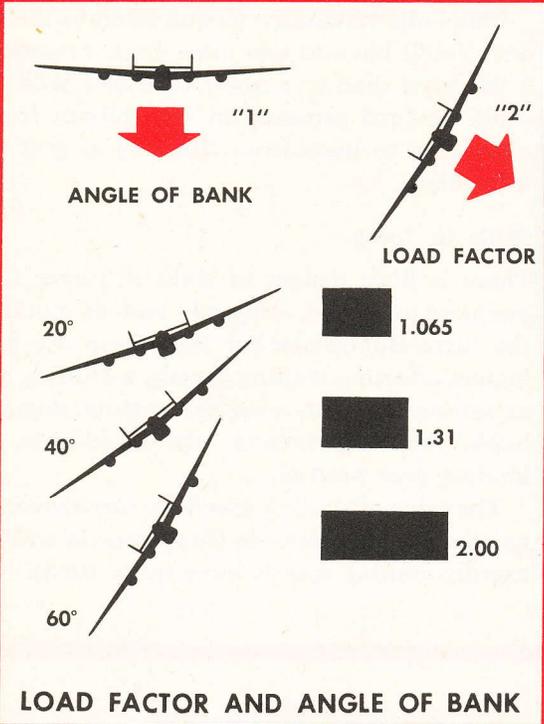
There is little danger of stalls in turns if you maintain required airspeeds and do not force the turn. But remember that there are many factors affecting stalling speeds, including power settings, weight, wing flap setting, degree of bank, cowl flap setting, use of de-icers, and landing gear position.

The table of stalling speeds in turns gives you an idea of how variable this factor is and how rapidly stalling speeds increase in turns.

## HOW STALLING SPEEDS INCREASE IN TURNS

Gross Weight	Wing Flap Position	30° Bank IAS	60° Bank IAS
43,000 lb.	0°	115	152
	20°	101	133
	40°	86	113
50,000 lb.	0°	124	163
	20°	109	143
	40°	93	122
56,000 lb.	0°	131	173
	20°	115	152
	40°	98	129

NOTE: Excessive back pressure in any of these turns will cause the stalling speeds to be much higher.



# DIVES

## Diving Speed Limits

41,000 lb. ....	355 IAS
47,174 lb. ....	325 IAS
56,000 lb. ....	275 IAS

Never violently dive the B-24. Under normal flying conditions you will never have occasion to exceed 250 mph in a dive. The airplane can take it up to certain limits but these limits vary greatly with the amount and position of loading. Air loads build up rapidly in a large airplane so avoid abrupt movements of controls.

In any normal dive always keep the airplane trimmed by use of trim tabs. If you attempt to hold forward elevator pressure without the use of trim tabs or against opposite trim, sudden relaxing of this pressure may, because of the extreme leverage action, cause buckling of the fuselage. It is better to trim slightly nose-heavy rather than tail-heavy. If trimmed tail-heavy in a dive, the inherent tendency of the airplane to pull up makes application of up-elevator easier and more abrupt, creating large loads.

In an extended dive when airspeed tends to build up too much, reduce power as necessary but don't pull it entirely off longer than necessary. This would allow the engines to cool down too much.

## Recovery From Dives

For dive recoveries the airplane requires plenty of altitude. In contrast with maintaining a dive, always pull out of dives by manual pressure without the use of trim tabs so that you can feel the amount of pressure you are using. Otherwise you can build up tremendous elevator strain too fast by trimming out of the dive with possible structural failure. It takes a lot of space and a lot of pressure to change the direction of 25 tons of airplane hurtling downward at 200 to 250 mph.

Wait until you have re-established level flight, and then re-trim and advance power to the desired airspeed.

**Combat Emergency:** If, in combat, your elevator control cables were shot away and you were thrown into a dive, you could trim your way out with elevator tabs. Apply trim gradually, because you are using great leverage.

## AIR-SPEED CORRECTION TABLE

TYPE D-1 PITOT STATIC TUBES.

IAS Instrument Reading MPH	IAS CORRECTED MPH		
	Wing Flaps Retracted	Wing Flaps Extended 20° Down	Wing Flaps Extended Full Down
90	---	---	85
100	---	---	96
110	---	105	107
120	---	116	118
130	127	127	130
140	137	142	139
150	147	150	148
160	158	161	---
170	169	---	---
180	179	---	---
190	190	---	---
200	200	---	---
210	211	---	---
220	221	---	---
230	---	---	---
240	---	---	---
250	---	---	---

TYPE G-2 PITOT HEADS AND FLUSH-TYPE STATIC HEADS.

IAS Instrument Reading	IAS CORRECTED MPH		
	Wing Flaps Retracted	Wing Flaps Extended 20°	Wing Flaps Full Down
90	---	---	80
100	---	---	95
110	---	109	108
120	---	118	119
130	127	128	129
140	138	139	140
150	148	149	150
160	158	159	---
170	168	---	---
180	179	---	---
190	189	---	---
200	199	---	---
210	209	---	---
220	219	---	---
230	230	---	---
240	240	---	---

# LANDINGS

## DESCENT TO THE LANDING AREA

The B-24 is built for long missions at high altitudes. Just as in climbing or cruising, the descent from altitude can be sloppy or skillful depending on the knowledge and foresight of the pilot.

### Normal Cruising Descent

It saves time, fuel and maintains engine performance to plan your descent ahead. Two factors govern a normal descent: distance from the landing area, and desired rate of descent.

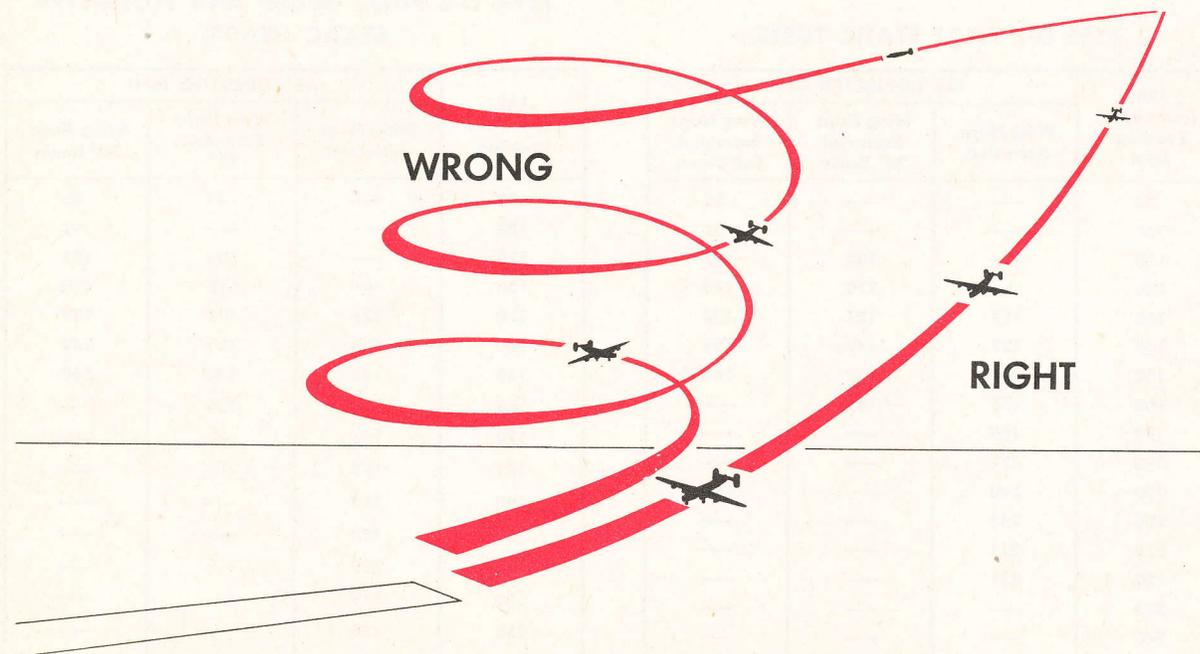
In a normal cruising descent the object is to come down at the rate of approximately 200 feet a minute, using normal cruising power settings, so that you will arrive at an altitude 500 to 1000 feet above traffic as you near the landing area. It is poor planning and wastes fuel to arrive above the field 6000 to 10,000 feet high and then chop power and come down like an elevator. You waste time over the field and cool the engines too rapidly.

### Good Procedure

1. Plan your descent. To come down 10,000 feet at 200 feet a minute would require 50 minutes. In that case you would start your descent about an hour out from the field. From 20,000 feet you would start descending 1 hour and 40 minutes out.

2. Lower the nose to establish the desired rate of descent. It isn't advisable to exceed 200 miles an hour.

3. Trim to maintain a steady, constant rate of descent. To increase the rate of descent, reduce power. This avoids building up excessive airspeed. With this procedure you are getting greater efficiency from fuel, saving time, and placing minimum strain on the airplane.



### Reminders

1. **Oxygen.** Stay on oxygen until you get below 10,000 feet.

2. **Booster Pumps.** Turn off below 10,000 feet to prevent overheating and to increase their life.

3. **Cowl Flaps.** The increased airspeed will tend to lower the cylinder-head temperatures so you should be able to close cowl flaps if they were open during cruising.

4. **Intercooler Shutters.** Make sure they are open. (See Carburetor Icing.)

5. **Manifold Pressure.** You may want to reduce power when descending. In a cruising descent, however, you would maintain a constant manifold pressure during the descent. If equipped with manually operated turbos and if you have some boost on, it will be necessary to slightly advance turbo controls to maintain manifold pressure while descending until you arrive at an altitude where your internal blower will provide sufficient manifold pressure. At this point, turbos may be pulled all the way off. After that, you'll get a rise in manifold pressure as altitude decreases and will control it by reduction of the throttles.

If equipped with electronic turbo controls, the manifold pressure will be automatically maintained down to an altitude where increase in atmospheric pressure allows internal blower to provide sufficient manifold pressure. At this

point turbo control may be dialed back to zero and power controlled from then on by throttles.

6. **Airway Traffic Control Rules.** Keep them in mind during your descent.

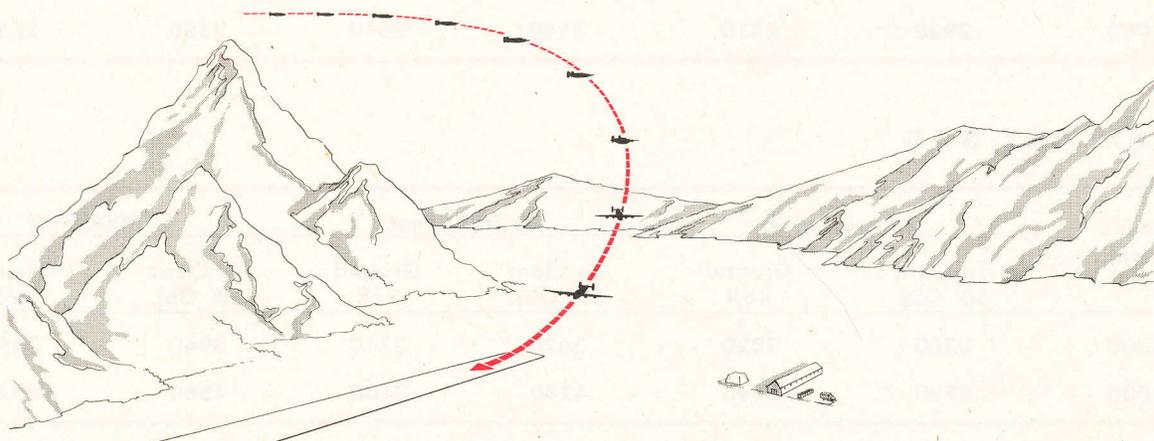
### Quick Descent Without Exceeding Airspeed

When it is necessary to make a quick descent, don't point the nose down and dive at excessive airspeeds. A good method is to reduce manifold pressure to 18" or 20" and bring the indicated airspeed down to 160 mph before lowering the nose. Don't lower the nose before you have dissipated airspeed or the inertia of the B-24 will keep you moving at high forward speed. Hold approximately 160 mph.

If you want a faster rate of descent, maintain this airspeed and further reduce power. For a slower rate of descent, increase power and maintain the same airspeed. Control your airspeed by raising or lowering the nose. Trim to maintain attitude with ease. This gives you a descent controlled by power which will prove valuable in instrument approaches. It gives you lower forward speed, better control, reduces the turning radius and relieves control pressures.

**Cold:** In cold weather, after you reduce manifold pressure, increase rpm to approximately 2400. This will keep the engines warm.

**Warning:** Never make a long power-off descent. This cools the engines too quickly and may result in turbo warping, or in possible engine failure when you resume power.



QUICK DESCENT WITHOUT EXCEEDING AIRSPEED

## RESTRICTED

### Approaching the Landing Area

When your descent is completed and you are in the vicinity of the landing area, restore normal rpm and manifold pressure unless you are going directly into the traffic pattern. Notify the tower of your position and obtain altimeter setting and landing instructions.

### Strange Fields

When clearing for strange fields you, of course, ascertain in advance that runways are of suitable length and condition to accommodate a B-24, and that you can obtain the type of fuel and service necessary. However, weather or emergencies may force a change of flight plan to a strange field. Check carefully with the tower before you land as to the length of runways and the type of surface. A difference in the surface alone can lengthen your landing roll as much as 1000 feet (see Landing Table). It may be better to ask permission to use a runway that is quartering or crosswind rather than

a shorter runway into the wind. At a strange field it is a good idea to fly over the field 500 feet above traffic to look it over and note obstructions.

## TABLE OF DISTANCES

This table is useful both for reference and comparisons. Figures used are average based on no wind and standard temperatures. **Example:** To land a 50,000-lb. airplane on a hard surface runway with a field elevation of 3000 feet over a 50-foot obstacle, you should have a ground roll of 2610 feet and a total distance of 3140 feet between the obstacle and the end of the ground roll, with moderate braking from point of contact.

## LANDING DISTANCE (In Feet) B-24, D, E, G, H, & J

### HARD DRY SURFACE

Gross Weight in Lb.	At Sea Level		At 3000 Feet		At 6000 Feet	
	To Clear 50' Obj.	Ground Roll	To Clear 50' Obj.	Ground Roll	To Clear 50' Obj.	Ground Roll
40,000	2365	1885	2640	2250	2960	2470
50,000	2940	2410	3140	2610	3380	2850

### FIRM DRY SOD

Gross Weight in Lb.	At Sea Level		At 3000 Feet		At 6000 Feet	
	To Clear 50' Obj.	Ground Roll	To Clear 50' Obj.	Ground Roll	To Clear 50' Obj.	Ground Roll
40,000	3300	2820	3620	3140	3940	3460
50,000	3920	3490	4240	3700	4560	4040

NOTE: For ground temperatures above 35° C (95° F), increase approach IAS 10% and allow 20% increase in ground roll.

**Comparison:** It requires 500 to 600 feet more ground run at a 6000-foot field to land the same weight airplane on the same kind of surface. Everything else being equal, you may need as much as 1200 feet more ground roll on sod than on concrete. A difference of 10,000 lb. in weight alone can increase your ground roll as much as 400 to 600 feet. These are average figures based on no wind and will vary with wind and air density. However, they show the

importance of considering every factor before deciding to try to land at a strange field.

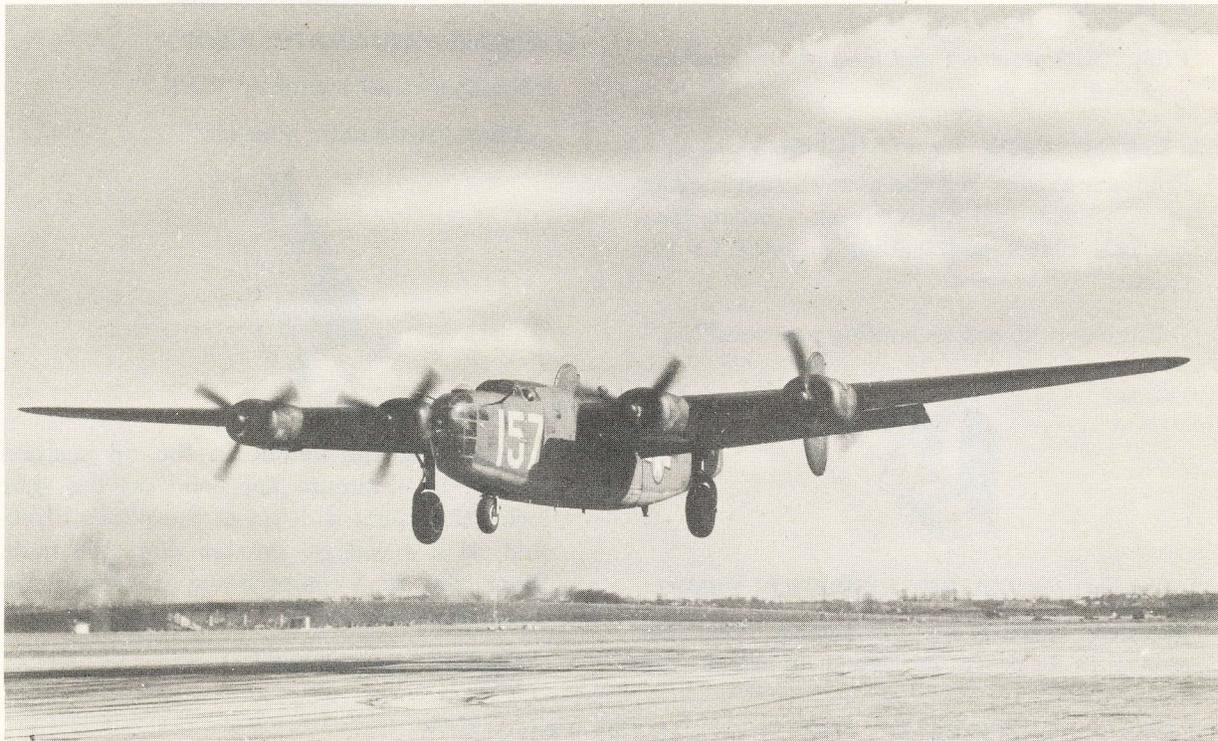
**Caution:** Just because you or somebody else got into a field last week doesn't mean you can do it today. How much did the airplane weigh, what was the direction and velocity of the wind, and what was the air density compared to conditions today? One serious variation can make hundreds of feet of difference in distance required.

## LANDING CHECKS AND TECHNIQUES

Consistently good landings in a B-24 require a combination of good judgment, good technique and good timing. Although there are quite a few things to do on a landing, you can time your cockpit operations so that you are free at the right moments to concentrate on flying the airplane.

Bear down on your technique and keep it sharp. When you get your own plane and crew,

you'll want to grease every landing to keep the old bus in good shape for the next flight. The key to good landings regardless of the weight of the airplane is "control with power." A heavy airplane is not a floating or gliding type. Power takes you off and it's the proper use of power that will let you down easy at reasonable speed. **Don't forget that!** It applies to every type of B-24 landing.



## RESTRICTED

### Location of Downwind Leg

Establish your downwind leg 1 to 3 miles out from and parallel to the landing runway. Fly a reciprocal gyro heading. In strong winds it is usually desirable to set the downwind leg closer to the field; this will shorten the base leg and prevent excessive drift.

## BEFORE LANDING

### Amplified Checklist

Reduce your indicated airspeed to 160 mph as you enter traffic. Start your before-landing check early enough to complete it by the time you are opposite the tower on your downwind leg.



#### 1. Copilot: "ALTIMETER SETTING?"

Before you enter traffic, copilot calls the tower for altimeter setting and landing instructions.

Pilot: "Altimeter set and landing instructions received!"

#### \*2. Copilot: "CREW TO STATIONS?"

Engineer checks that the nose section is clear of passengers and crew. He also directs that the ball turret and trailing antenna be retracted.

Engineer: "Crew in landing positions!"

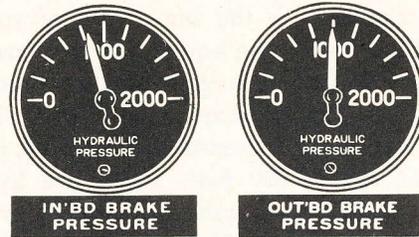


#### \*3. Copilot: "AUXILIARY HYDRAULIC PUMP?"

Engineer turns it on and signals "On." He continues back to the waist to check the

\*ITEMS WITH ASTERISK FOR SUBSEQUENT LANDINGS.

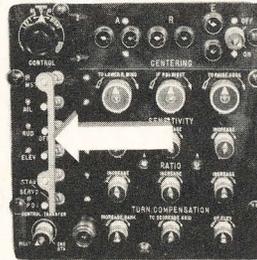
main gear down and locked when it comes down.



#### \*4. Copilot: "BRAKE PRESSURE AND PARKING BRAKE?"

Pilot presses pedals, notes pressure, and checks parking brake handle in "OFF" position.

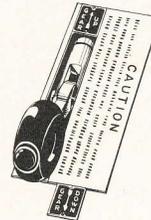
Pilot: "Brake pressure checked and parking brake off!"



#### 5. Copilot: "AUTOMATIC PILOT?"

Pilot checks all switches "OFF."

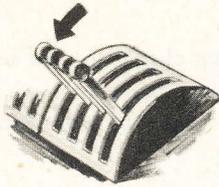
Pilot: "Automatic pilot off."



#### \*6. Copilot: "GEAR?"

Copilot puts the handle in the up position briefly, to eliminate any load on the gear locks, then puts it down at the pilot's direction, at a speed no greater than 160 mph. When the gear comes down it usually reduces airspeed about 5 mph.

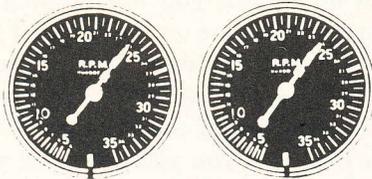
Copilot: "Gear down!"



**\*7. Copilot: "MIXTURES?"**

Copilot (at the direction of pilot) puts them in "AUTO-RICH" positions.

**Copilot: "Mixtures in auto-rich!"**

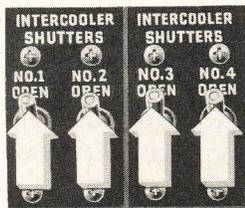


**\*8. Copilot: "PROPELLERS?"**

Copilot increases rpm to 2400 to permit greater flexibility of power range if required.

**Copilot: "2400 rpm!"**

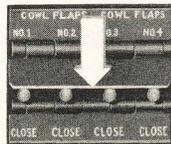
Increase in rpm will cause a drop in manifold pressure. Pilot should be ready to increase throttles, as manifold pressure drops, to maintain power.



**9. Copilot: "INTERCOOLERS?"**

Copilot checks them open.

**Copilot: "Intercoolers open!"**

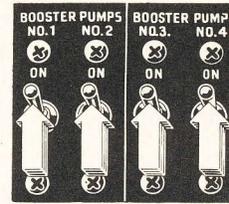


**\*10. Copilot: "COWL FLAPS?"**

Copilot checks them for required position.

**Copilot: "Cowl flaps closed (or as required)!"**

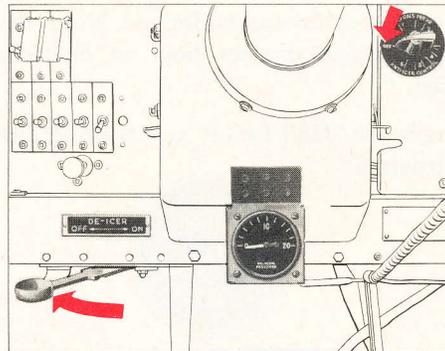
**\*ITEMS WITH ASTERISK FOR SUBSEQUENT LANDINGS.**



**\*11. Copilot: "BOOSTER PUMPS?"**

Copilot turns them all on to assure adequate fuel pressure during landing.

**Copilot: "Booster pumps on!"**

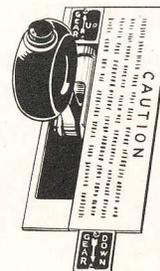


**12. Copilot: "WING DE-ICERS?"**

Copilot checks to make sure they are off. **Never land with de-icers on!**

(See note on exhaust heat anti-icing.)

**Copilot: "De-icers off!"**



**\*13. Copilot: "WHEELS?"**

Pilot and copilot look out to see if they each have a wheel, Pilot: "Wheel left!"; Copilot: "Wheel right!" Pilot checks and reports, "Light on, handle in neutral."

**Engineer: "Gear down and locked!"**

Warning Horn: On final approach, when throttles are retarded to 15" manifold pres-

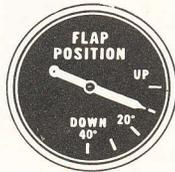
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sure or less, the horn will blow to warn you the gear is not fully down or not locked. But remember that some of the later series aircraft do not have horns.

**14. Copilot: "BALL TURRET AND TRAILING ANTENNA?"**

After the engineer has checked the main gear through the waist gun windows, he proceeds forward to check the ball turret and trailing antenna to be sure they are retracted and the nose gear down and locked. Note: Be sure your engineer **knows how** to check gears locked.

**Engineer: "Ball turret and trailing antenna retracted!"**



**\*15. Copilot: "WING FLAPS?"**

Copilot lowers them 10°. This increases drag very little at 150 mph but increases lift materially and gives the plane a more level attitude, better visibility and a lower stalling speed.

**Copilot: "10° of flaps!"**

**Airspeed:** Be sure your airspeed is 155 mph or less before lowering flaps.

**Before-landing check** should be completed by the time you pass the tower on the downwind leg to leave you free to get ready for the turn on the base leg.

**Get on the Step**

Get up on the step just as soon as your wing flaps are down 10°. Remember: Control airspeed with attitude and control ascent and descent with power. If airspeed starts to drop, lower the nose until you are holding the desired airspeed and ease on more power to maintain your desired altitude. Don't jockey your attitude and power so that one correction throws the other off. If the airplane is mushing with nose high and you add power, it will keep right on mushing with only slow gain in airspeed. To regain airspeed and eliminate the mushing effect with the least possible delay, the nose should be lowered slightly as the power is added.

**Time Your Distance Out**

You are flying a reciprocal gyro heading parallel to the landing runway. As you pass a point opposite the end of the runway, start timing yourself. Usually you will fly 20 to 30 seconds and then start a standard rate (one needle-width) turn into your base leg. The turn will carry you about 3/4 mile farther out from end of the runway this will put your base leg approximately 2 3/4 miles from the edge of the field. Your heading and turns are controlled



**\*ITEMS WITH ASTERISK FOR SUBSEQUENT LANDINGS.**

entirely with reference to instruments. Watch your time, and turn on your base leg to make good a gyro heading perpendicular to the landing runway.

### Base Leg

If you have followed approved procedure, you will be free on the base leg to fly your gyro heading, observe traffic ahead, and look over the approaches to the landing strip. This gives you a chance to judge your distance out from the end of the runway in relation to your altitude. The success or failure of a landing depends largely on a good entry into your final approach.

### Turning On Final Approach

When to start your turn on final approach is important. The common tendency is to wait too long. Lead your standard-rate turn, approximately  $\frac{3}{4}$  of a mile. Then your rollout will bring you into final approach in line with the runway.

**Half Flaps:** Pilot calls for half flaps just before starting the turn into final approach, and copilot lowers them to 20° position.

**Power Reductions:** As the flaps come down, pilot reduces his power. Pilot should hold a level turn until 20° flaps and reduced power bring airspeed down to 135 mph.

### Line Up With the Runway

Be sure you are lined up with the runway. If not, rudder over at once before you get too close to the field. You may roll out to the right or left of the runway and you can usually correct this with rudder and little or no bank if you start far enough back.

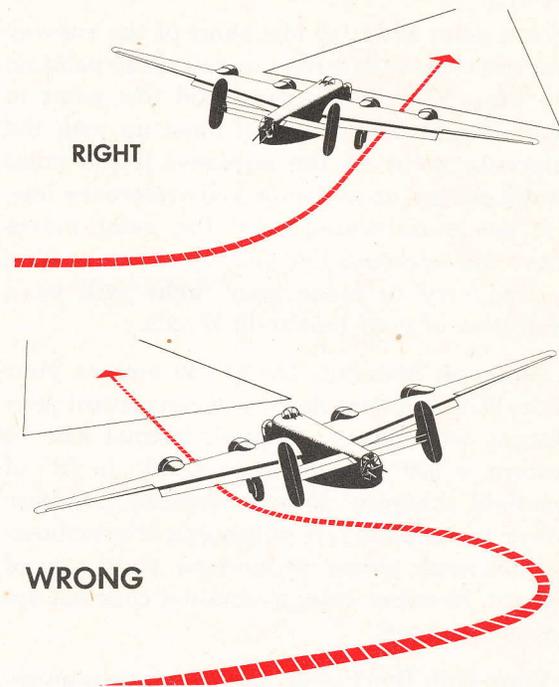
## FINAL APPROACH

### Amplified Checklist

As you roll out of your turn lined up with the runway, start your checklist procedure.

**Warning:** Be sure your feet are flat on the rudder pedals and down off the brakes. It takes very little brake pressure to blow your tires when the wheels touch.

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### 1. Copilot: "PROPELLERS?"

Pilot has reduced power below 25" manifold pressure and now calls for high rpm. Copilot sets propellers in high rpm.

**Copilot: "High rpm!"**

### 2. Copilot: "SUPERCHARGERS?"

Pilot sets superchargers at takeoff manifold pressure so that full power will be available if needed.

**Pilot: "Superchargers set and locked."**

### 3. Copilot: "FULL FLAPS?"

Pilot calls for full flaps (airspeed 135 mph) and copilot lowers them. This will bring the airspeed down to 125 to 130 mph for the glide.

**Copilot: "Full flaps down!"**

### 4. Copilot: "AIRSPEED."

Copilot calls out airspeed every few seconds throughout landing to assist pilot in maintaining proper attitude.

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### Make Good a Point

Pick a point about 10 feet short of the runway and line it up with a rivet or reference point on the nose. You are making good this point in your descent if you keep it lined up with the reference point on the airplane. If the point on the ground drops below your reference line, you are overshooting it; if the point moves above the reference line you are undershooting it. Don't try to judge your flight path by a projection of your longitudinal axis.

**Airspeed:** Maintain 125 to 130 mph in your glide. With full flaps down you can control your descent with power. A good, normal rate of descent is 500 feet a minute at 15" to 18" of manifold pressure. If undershooting, increase power to cut your rate of descent; if overshooting, decrease power to increase your rate of descent. In either case, maintain a constant approach airspeed.

**Flare-Out:** Start your flare-out high enough, about 150 feet up. It takes time to change the direction of a 4-engine bomber. Your airspeed will decrease gradually as you gradually raise the nose and reduce power.

### Coordination of Power and Attitude

Your flare-out and reduction of power should be perfectly coordinated. If too high, reduce power; don't steepen your gliding angle and build up excessive airspeed. If you are coming in just right, power should be blended off in

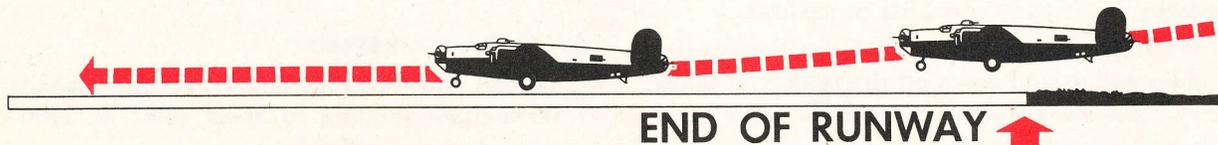
almost perfect coordination with your round-out. If you are flaring out short, let your power lag behind the flare-out to carry you farther in; if you are too high, bring power off a little faster to ease the airplane to the ground more quickly. Properly executed, the flare-out will bring the airplane in just above the runway surface at 105 to 110 mph in a definitely nose-up attitude, sinking at a rate that will grease it into the runway. Power keeps down your rate of descent and prevents the airplane from hitting the runway with a heavy jolt.

### *Avoid these errors*

**Undershooting:** There is a tendency to undershoot because in a normal landing the flight path is much steeper than it seems. Although the nose may be pointed well down the runway, the airplane may be sinking toward a point short of the runway. Pick a point to make good and establish a reference line by which to judge your glide path.

**Dropping In:** The B-24 is not a glider. Don't make the mistake of chopping off all power in the flare-out before your airplane is on the concrete. Let down to the runway with smooth, gradual reduction of power. Otherwise the heavy drag of wings, flaps, and windmilling propellers will cause a sudden loss of airspeed and will drop you in.

**Flying Onto the Concrete:** What you want is power control, not excessive airspeed. If you



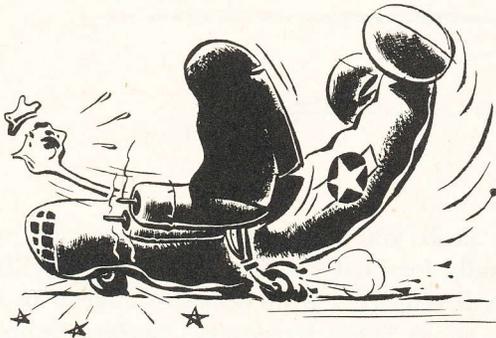
come in too fast, you'll have to fly onto the concrete with the nose gear as low as the main gear to get the airplane to stay on the runway. Then, with power off, if you try to kill speed by bringing the nose up, you will take off again, rapidly lose airspeed, stall and drop in from several feet above the ground.

Get the nose up and airspeed down during the flare-out, and control your sink with power. Use correct airspeed, attitude and power control and you've got a good landing.

### Landing Roll

Hold the nose up with the elevators and maintain directional control with the rudders. In a nose-high attitude the drag of the wings and flaps reduces speed rapidly.

Keep the nose high until it tends to want to come down—usually at 70 to 75 mph. Then lower the nosewheel smoothly to the runway. When the nosewheel is solidly on the ground (and not before), raise your feet into braking position.



### Brakes

Feel out the brakes early so you will know what to expect of them. If you have plenty of room, use it and save your brakes, but remember it is better to use brakes too early than too late. Get the airplane slowed down with a reasonable amount of room to spare. Use brakes progressively. Apply them and then release them. Don't sock them on and leave them. And don't leave the weight of your toes on the brakes when not applying them, because the heat generated may crack a drum or burst an expander tube.

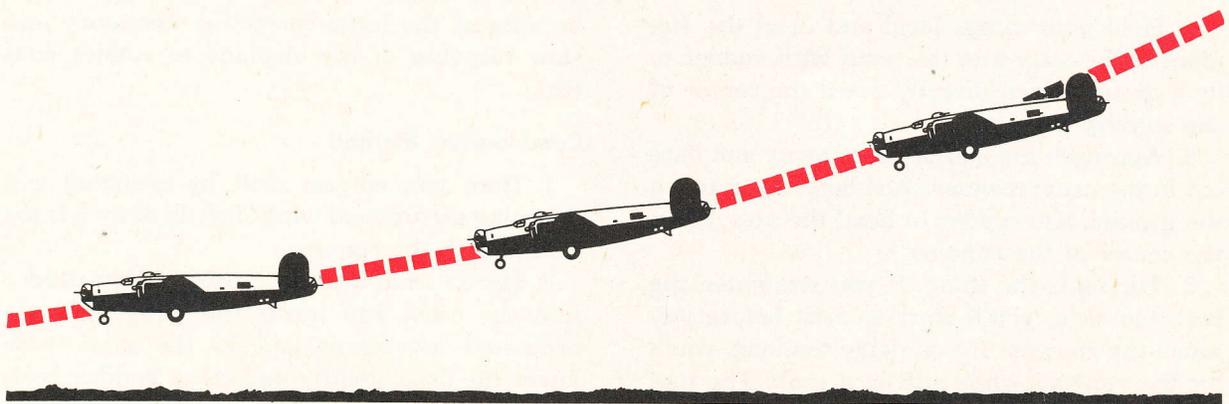
### Clear the Runway

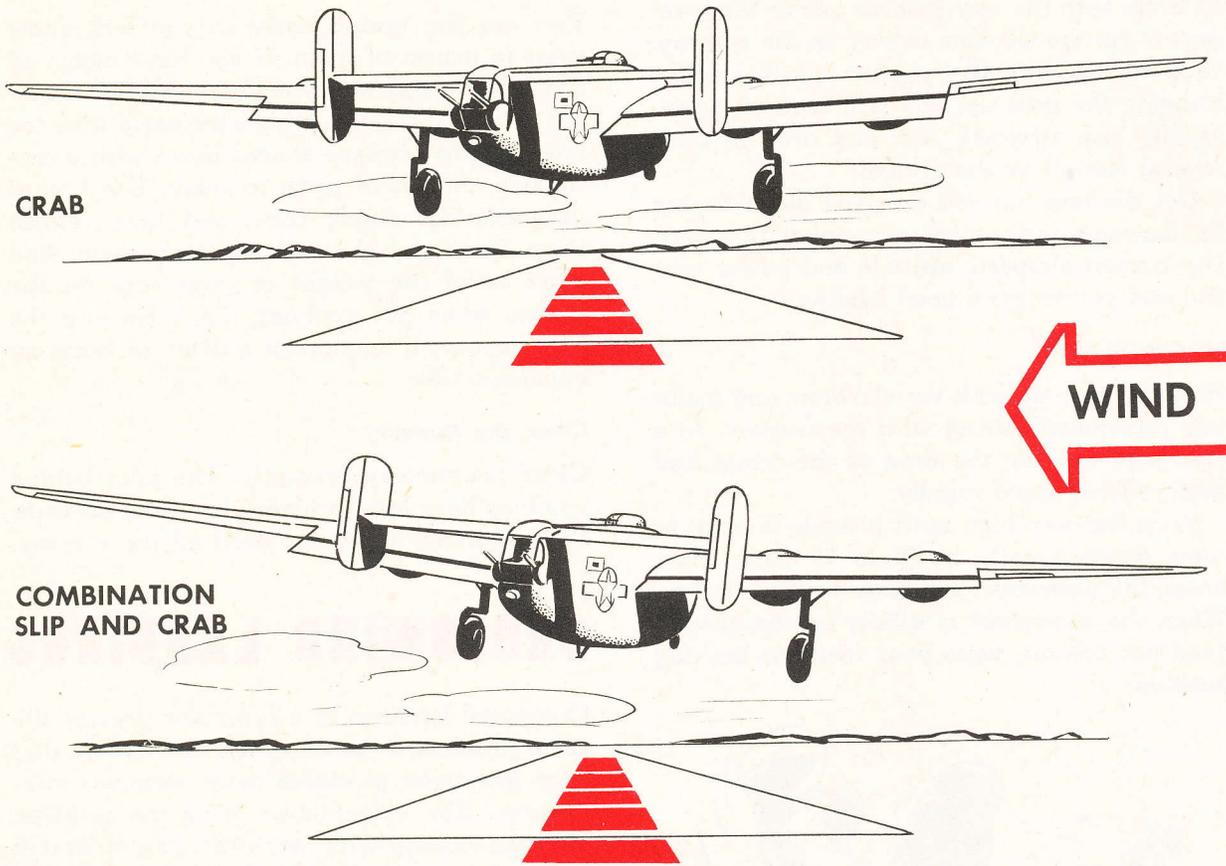
Clear the runway promptly. The pilot behind you may have lost his hydraulic brake pressure and not know it, or may need all the runway.

## CROSSWIND LANDINGS

Crosswind landings in a Liberator present the same problem as in other aircraft except that poor technique produces more serious consequences. The object is to bring the airplane onto the runway with zero drift. Any drift will place a heavy side load on the gear and can result in blown tires or landing gear failure.

In a crosswind landing, fly the pattern just the same as in a normal landing. Line up with your runway on final approach and note your drift. There are 2 approved methods of correct-





ing for drift, namely: Full crab with wings level, or combination of crab with the upwind wing slightly down.

**Full Crab Correction**

1. Hold your wings level and head the airplane sufficiently into the wind with rudder to fly a ground track directly down the center of the runway path.
2. Approach the end of the runway and flare out in the usual manner. Just before you touch the ground, use rudder to head the nose down the center of the runway.
3. Timing is the thing. If you straighten the crab too soon, you'll start to drift before you touch the runway. If you delay too long, you'll hit the runway while still in a crab. The moment you touch the runway is the crucial one.
4. Remember that when you rudder out of

the crab you are moving the upwind wing rapidly forward, tending to increase its lift, so it will require a little opposite aileron to hold the wings level. It requires perfect timing to execute this type of crosswind landing properly because of the large correction necessary and slow response of the airplane to rudder control.

**Combination Method**

1. Here you correct drift by crabbing and dropping the upwind wing slightly to fly a track in line with the runway.
2. Here's what actually happens. You rudder into the crab, and lower the wing in a coordinated movement and at the same time lower the nose slightly and relax rudder pressure. The result is a crab and a mild slip into the wind. For that reason it is important not to

drop the wing too much because you lose lift rapidly in an uncoordinated bank.

Again be sure your airplane is not drifting as you contact the runway. Usually you can correct the crab and lift the wing almost entirely with rudder, because the forward movement of the upwind wing as it swings out of the crab will lift it. Use no more ailerons than necessary, because ailerons create burble at low flying speeds.

**Warning:** If you see you have taken out the crab too soon and are starting to drift, you have 2 choices: Apply enough power to keep the airplane off the runway and re-establish a non-drifting ground track; or, if that is not possible, apply full power smoothly to go around and try again. Don't take a chance on hitting the runway while you are drifting sideways. The combination type of crosswind landing is most commonly used.

#### **Crosswind Landing Roll**

In either the full crab or combination methods it is a good idea to touch the ground with the nose slightly lower than normal but with the nosewheel definitely clear of the concrete. Bring the nosewheel firmly to the ground as soon as possible.

#### **Tricycle Gear Fights a Groundloop**

The inherent directional stability of the tricycle landing gear overcomes the weathervaning effect of the crosswind on the airplane. Reason: The center of gravity is between the main gear and the nose gear. The force of inertia (or moving weight) is straight ahead, down the center of the runway, and tends to pull the nosewheel back to this line if it starts to veer. Thus inertia fights against a groundloop. In conventional airplanes with the center of gravity aft of the main gear, inertia tends to swing the tail around and aggravate a groundloop.

You can hold the plane straight ahead with rudder control until speed drops down to 70 or

75 mph. As you lose rudder control, a little extra throttle on the upwind outboard engine or slight brake pressure on the downwind side will hold the plane straight on the runway.

Keep flying the airplane. A successful crosswind landing is not completed until the airplane is safely parked on the hangar line.

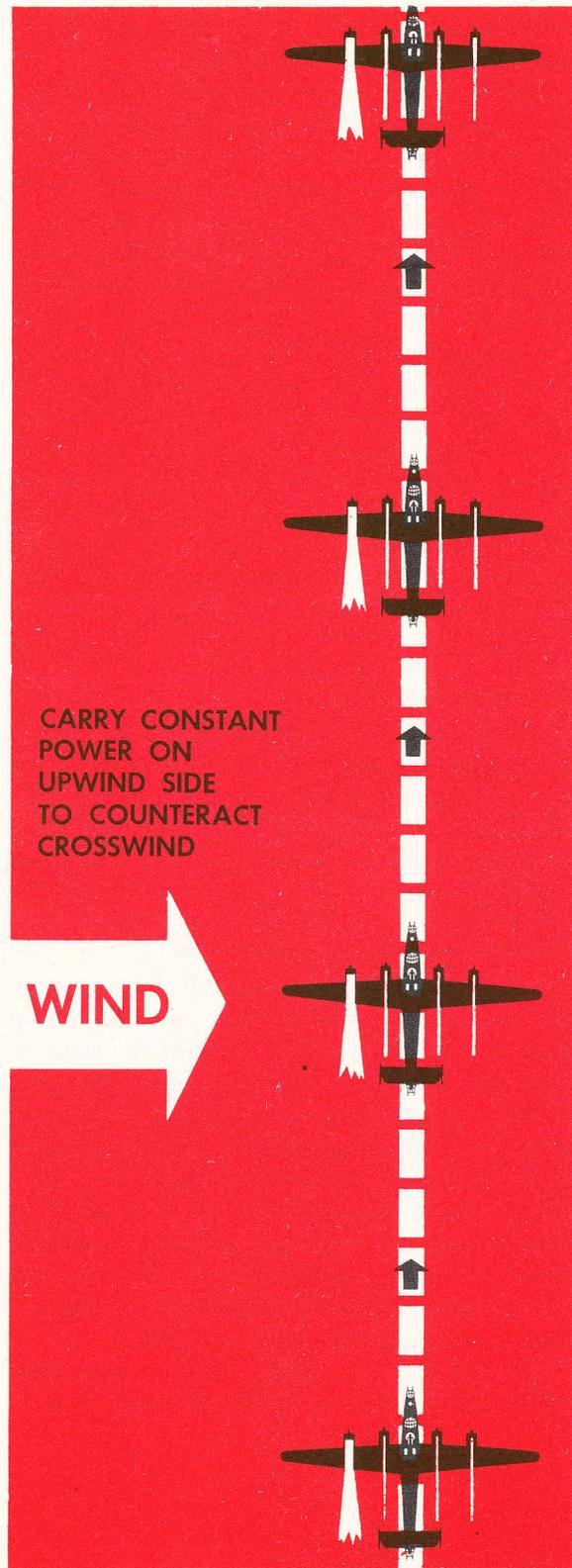
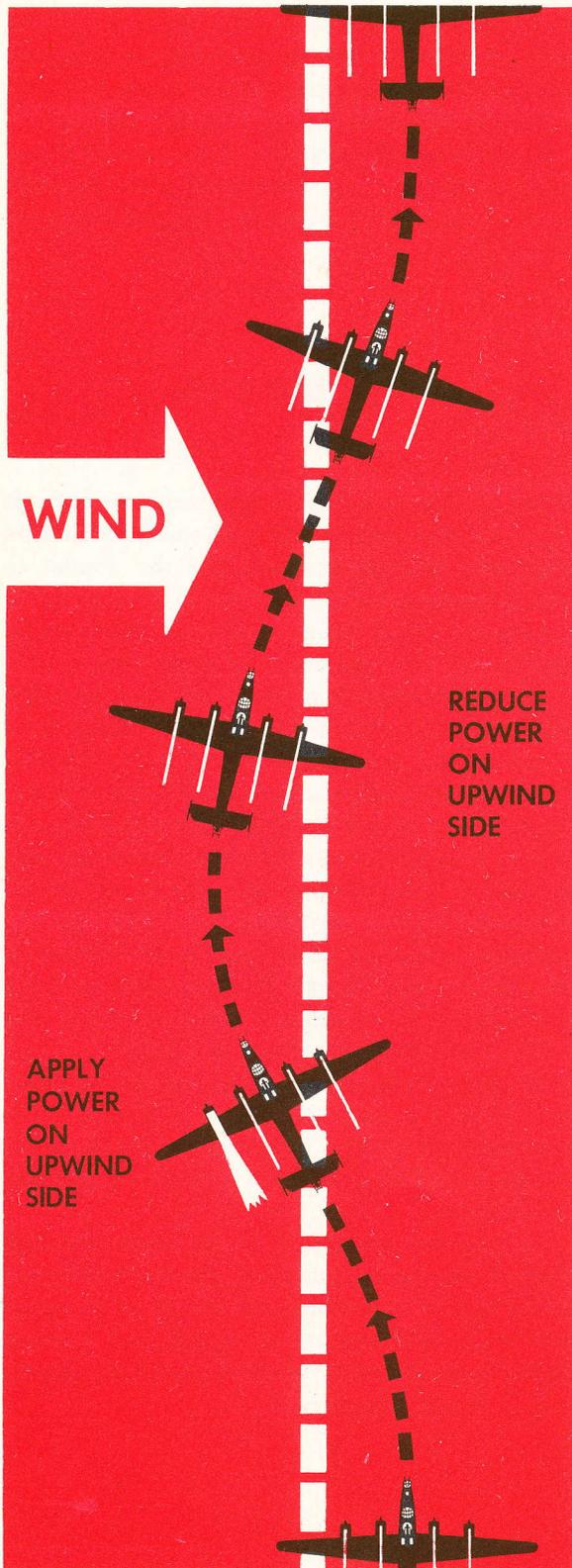
## **CROSSWIND TAXIING**

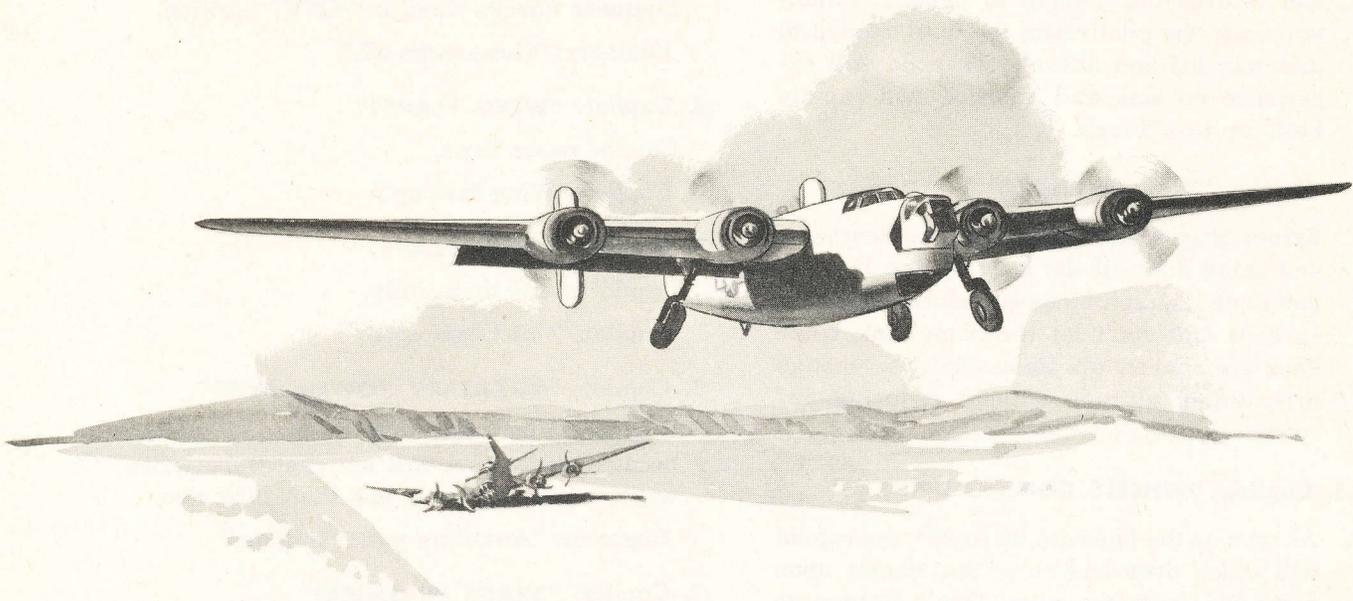
When taxiing in a high crosswind, it is difficult to hold rudder neutral. In that case, it will save wear and tear on yourself and the copilot to relock controls before starting to taxi. If so, be sure you unlock them before takeoff. Usually the copilot can hold controls in neutral.

On the average taxi strip you can keep the airplane down the center of the runway in a crosswind by proper manipulation of throttles. When the airplane starts to nose into the wind, apply power smoothly on the upwind outboard engine long enough so the nose will swing past the center line; then pull the throttle off. Meanwhile hold other throttles back. Then let the airplane gradually nose back to the center of the runway and repeat. This produces an S-ing track but permits control without brakes and without building up excessive speed.

Another method is to carry enough constant power on the upwind side to counteract the crosswind. However, this tends to build up excessive speed and requires more frequent use of brakes.

In a severe crosswind or on a narrow taxi strip, it may be necessary to use the downwind brake to hold a straight-ahead path. If so, apply the brake and release it, apply and release. There is danger of destructive heat if you maintain a steady pressure.





## GO-AROUND

Be ready, on every landing, to go around if necessary. Without warning, it may be necessary for the tower to send you around again because of an accident on the runway, misunderstanding of traffic instructions by another pilot, or other emergency. You may choose to go around because you find yourself too close behind another airplane, because you are overshooting or have made a bad landing. Don't wait too long. The minute you see the need, decide to go around. If you aren't on the ground in the first  $\frac{1}{3}$  of the runway, call for the go-around procedure. Notify your copilot so he knows immediately what you intend to do.

### Amplified Checklist

#### 1. Copilot: "POWER."

As he announces the go-around procedure, the pilot opens throttles to takeoff manifold pressure and re-trims airplane.

**Avoid Jamming:** Don't stiff-arm the throttles. Advance power smoothly and rapidly but no faster than propellers can take it. If you jam power on too fast, it speeds up blades faster

than propeller governors can change pitch so that there is danger of a runaway propeller.

**Trimming:** Re-trim elevators for climb as you increase power. You were trimmed for landing and for reduced power. Increased power will make the airplane tail-heavy until re-trimmed.

**Climb:** You are trying to build up airspeed with full flaps down, so hold a near level-flight attitude with very shallow climb.



#### 2. Copilot: "AIRSPEED."

Copilot watches the airspeed and calls it out to the pilot every few seconds.

#### 3. Copilot: "WING FLAPS."

After the airplane has reached a safe speed (approximately 120 mph) copilot when di-

rected by the pilot, brings the flaps up to 20° and returns flap handle to neutral. Simultaneously the pilot raises the nose enough to maintain lift and altitude. Then he will experience no sink and airspeed will rapidly build up to 135 mph.

**Copilot: "Wing flaps at 20°."**

**Errors:** Stop at half flaps! Don't be distracted and bring flaps all the way up yet. Be sure you have 120 mph airspeed before calling for ½ flaps and don't let the plane sink while flaps are coming up. Raise the nose enough to maintain altitude without reducing airspeed.

#### 4. Copilot: "WHEELS COMING UP."

As soon as the flaps are up to 20°, the copilot will reach over and raise the wheels upon command from the pilot. Don't attempt to raise the wheels until you return the flap handle to neutral. The hydraulic system is designed to perform only one major operation at a time.

**Error:** Don't pull gear up before bringing the flaps to 20° or you'll have to wait the 25 to 30 seconds it takes the gear to retract before you can raise the flaps. Then you would have the drag of full flaps when you could be gaining forward speed and climbing. Thirty seconds is a long time at this point.

#### Check

After you have a safe airspeed, check temperatures and put cowl flaps at trail, if closed. Don't change cowl flaps until you have 135 mph.

## END OF LANDING ROLL

#### 1. Copilot: "SUPERCHARGERS?"

Pilot closes them while taxiing.

**Pilot: "Superchargers off."**

#### 2. Copilot: "BOOSTER PUMPS?"

Copilot switches them off.

**Copilot: "Booster pumps off."**

#### 3. Copilot: "GENERATORS?"

Engineer checks them in "OFF" position.

**Engineer: "Generators off."**

#### 4. Copilot: "WING FLAPS?"

Copilot raises flaps.

**Copilot: "Wing flaps up."**

#### 5. Copilot: "COWL FLAPS?"

Copilot opens them fully.

**Copilot: "Cowl flaps open."**

#### 6. Copilot: "AUXILIARY POWER UNIT?"

Engineer turns this unit on during taxiing because generators will not charge batteries when engines produce less than 1700 rpm.

**Engineer: "Auxiliary power unit on."**

#### 7. Copilot: "BRAKE PRESSURE?"

Copilot checks brake pressure and continues to check it frequently until the airplane is parked. If at any time brake pressure falls below 800 lb., pilot will bring the airplane to a stop and not move it again until brake pressure is re-established or until engineering personnel come to tow the airplane in.

### TAXIING IN

As soon as your landing roll is completed, clear the runway and keep moving, because other aircraft may also want to clear immediately. At strange fields ask the tower for taxiing information. Don't proceed blindly. Tower personnel are there to help you. Ask for clearance before crossing runways. Some fields use 2 runways at the same time. Don't forget to post an observer.

### PARKING THE AIRPLANE

There isn't any hurry. Wait for directions if not fully familiar with the parking area. Get a ground man out in front and one on each wingtip. Remember that you are the airplane commander, and if the ground crew rams you into another airplane or tries to put you into a space that's too small, you'll get the blame. If in doubt as to clearance, stop the airplane in its tracks.

Don't let a ground-crew man mess up your airplane. Let them put it away with a tug.

After completing the turn into the parking space, roll at least 5 feet forward to avoid parking with the nosewheel at an angle.

Caution: When the airplane is parked don't let any of the crew or passengers leave until the engines are stopped. Issue special instructions to this effect if anyone has been ill during the flight. **Never let anyone walk through the propellers at any time.**

## TO SECURE THE AIRPLANE

### Amplified Checklist

#### 1. Copilot: "ENGINES."

Pilot opens throttles until propellers reach 1000 rpm. Copilot puts mixture controls in "IDLE CUT-OFF"; then pilot opens throttles slowly, leaving them fully open.

**Copilot: "Mixtures in idle cut-off."**

**Pilot: "Throttles fully open."**

#### 2. Copilot: "SWITCHES."

Copilot closes all switches after propellers have stopped, first magnetos and radio; then, when autosyn instruments such as oil, fuel, etc., have returned to neutral, he turns off AC power, lights, battery selectors and main line. Don't cut battery selectors and main line until all electrical switches are "OFF."

**Copilot: "Switches off."**

#### 3. Copilot: "WHEEL CHOCKS?"

Pilot checks left wheel chock and copilot checks right wheel chock in place so brakes may be released, because heat continues to expand the expander tubes. Brakes should be left unlocked until they are cooled off and the crew chief locks them later.

**Pilot: "Wheel chock in place left."**

**Copilot: "Wheel chock in place right."**

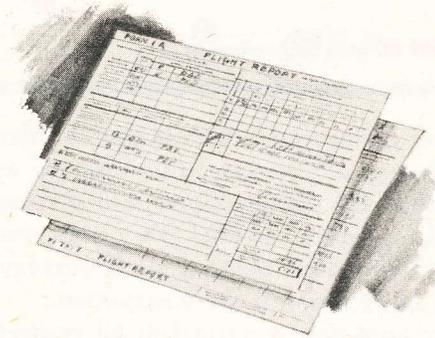
#### 4. Copilot: "GEAR HANDLE?"

Copilot puts landing gear handle down so that any hydraulic expansion will tend to close the gear lock rather than to open it.

**Copilot: "Gear handle down."**

#### 5. Copilot: "FLIGHT CONTROLS."

Copilot locks flight controls while pilot loosens the locking strap. Use the following sequence for locking controls: First lock rudder by holding rudder near neutral and slowly moving either way while applying slight tension to the locking handle. Next lock the elevators by moving the wheel to the white line and then slowly back and forth until the locking pin drops in; lock ailerons by moving wheel slightly from side to side until the aileron pin drops in. **Do not force the locking handle.** Then place the hook in the handle and draw the strap up.



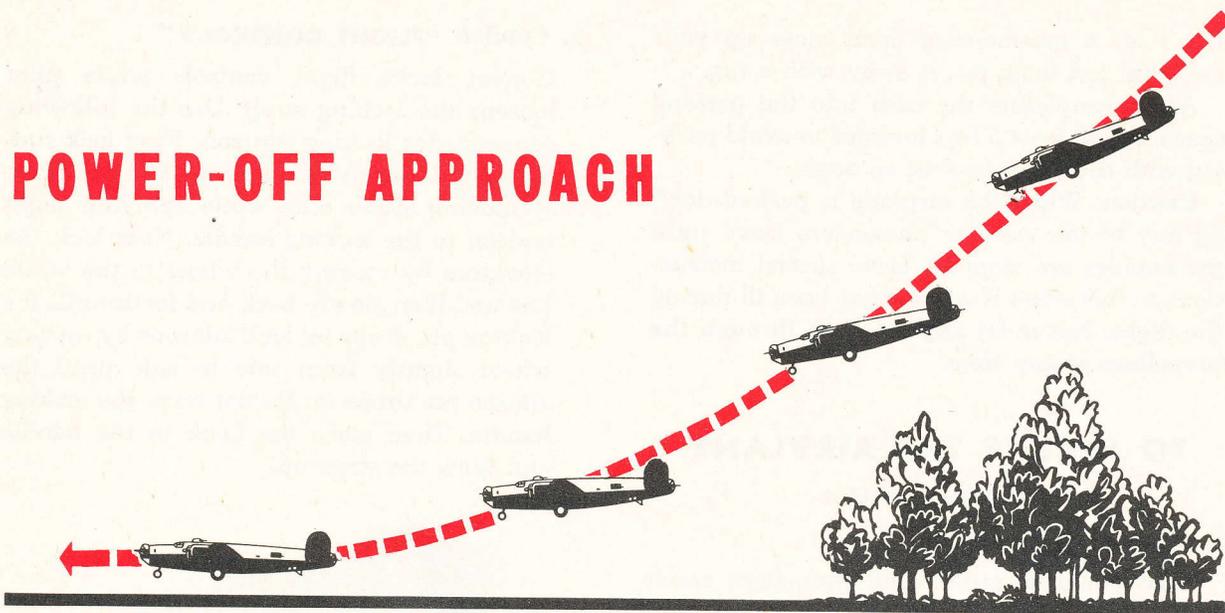
Fill out Form 1 and 1A before leaving the airplane and give the engineer full instructions as to servicing.

#### Parking at Strange Fields

Airplane and crew are the airplane commander's responsibility. You can delegate duties but you cannot delegate responsibility. You must arrange for proper servicing, securing and mooring of the airplane. The airplane should be locked and a guard should be posted if there is not regular guard protection, even if you have to hire a civil guard.

Think of your crew's comfort before you think of your own. See that they have a place to eat and sleep; check transportation; arrange for passes to get them in and out of the field, and notify them as to probable takeoff time so they will know when to have the airplane ready. Fair-minded consideration for your crew will build loyalty and crew spirit.

## POWER-OFF APPROACH



A power-off approach proves useful when you see that you are coming in too high or when—in combat, for instance—you find it necessary to make a quick descent over high trees or other obstructions on to a short runway that begins fairly close to the obstruction.

Your approach is normal in all respects except that you pull in toward the field under power, high enough to make certain you will clear the obstacle when you start your glide.

### Glide

From a relatively high position in relation to the end of the runway, retard throttles completely and lower the nose to maintain an air-speed of 125 mph. This will bring you down at a relatively steep angle of glide. Trim to ease fore and aft pressure but avoid over-trimming, or the airplane will have a strong nose-high tendency when you advance throttles.

### Flare-out

Start your flare-out 100 to 150 feet above the ground and at the same time increase throttles to 12" to 14" of manifold pressure to stop the descent and change the direction from down to forward. Remember, you must overcome the tendency of a heavy body to continue moving in the same direction. Coordinate power with your flare-out, first building up power to change

the attitude and direction of the airplane and then, as you near contact with the runway, reduce power to hold forward speed down to 105 to 110 mph. Don't completely reduce power until you make contact with the runway.

Although you are making a power-off approach, you are making a power-controlled landing. Don't try this without power to aid in your flare-out, or you'll keep right on sinking.

## EMERGENCY SHORT-FIELD LANDINGS

Never land a B-24 on a short runway except in absolute emergencies. However, it is important to know the proper technique if an unexpected emergency arises. In combat anything can happen and often does.

### Procedure

1. Execute downwind and base leg in the normal manner.
2. Come in toward the field in a normal manner but shoot for a point several hundred feet short of the runway.

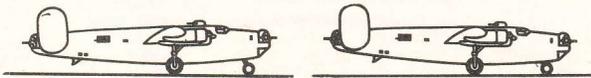
3. Flare out as if you were going to land short of the field but add power as you increase your angle of attack so that the airplane is dragging in 50 or 60 feet up at 105 to 110 mph. Control sink by addition or reduction of power.

4. Reduce power to lower the airplane in a nose-high attitude at a point as near the end of the runway as possible. Pull power completely off as soon as wheels touch, but **not before**. Remember that the only thing which keeps you flying is the thrust from your propellers.

**Error:** Don't build up airspeed by lowering the nose, or the airplane will tend to have excessive forward speed and float, using up too much runway. This defeats the purpose of a short-field landing. The object is to reduce forward speed but maintain control with power.

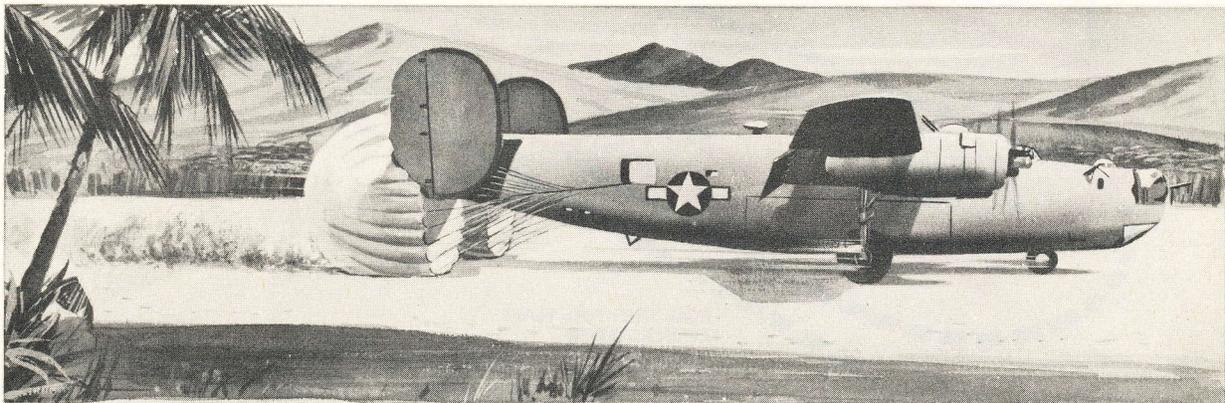
5. The moment the main gear is on the concrete get the nosewheel down smoothly but quickly and hold positive forward pressure on the wheel to depress the oleo strut fully so braking won't injure the nose gear assembly. There is risk of excessive strain on the nosewheel, so build up forward wheel pressure smoothly and gradually.

6. Immediately start to feel out the brakes, and then use them strongly and intermittently—not continuously unless absolutely necessary.



GET NOSEGEAR DOWN  
SMOOTHLY BUT QUICKLY

USE BRAKES STRONGLY  
AND INTERMITTENTLY



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### Advantages

This technique brings the airplane to the concrete as near the end of the runway as possible, at minimum forward speed, and permits the use of brakes quickly. It helps you get maximum benefit from every inch of runway.

**Errors:** If overshooting, go around and come in for another try. If you have slowed down too much to have room to go around, but are running off the end of the runway because the brakes won't hold, you'll have to use quick judgment of what is best to do. Here are 2 possible courses of action:

1. As you roll from the end of the runway, get off the brakes and pull as much weight as possible off the nosewheel. Otherwise it may dig into soft dirt and collapse.

2. If there are obstructions or a drop-off ahead, you may choose to bear down hard on one brake and use a little opposite power to groundloop the airplane.

Don't get yourself in a spot where you have to make a choice of this kind.

### Parachute Brakes

If you ever have to land on a short runway without brakes or flaps, a trick devised in combat theaters may come in handy. Several times B-24's have been landed safely with parachutes slung from the waist gun mounts to provide drag. The procedure has varied, but the general method is to fasten the parachute harness to the gun mounts. As soon as the airplane touches down, the pilot signals crew members—by interphone or by a pre-arranged alarm bell signal—to pull the ripcords. The point of

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drag is far enough aft so that you don't need to worry about a groundloop even if one parachute fails to open, but some pilots have had two parachutes fastened on each side, the second being used if the first doesn't open. Still another variation calls for two parachutes on each side to be opened simultaneously. It's all improvisation, so work out whatever procedure seems best; better still, find some one who has seen it done and learn from him.

# LOW VISIBILITY OR CLOSE-IN APPROACH

This approach may be used in case it is necessary to land in a condition of low visibility when the normal traffic pattern would carry you out of sight of the field, when there are no directional radio aids to aid you in making an instrument approach, or in case of radio failure. Also see Low Visibility Approach in T.O. 30-100B-1.

### Procedure

1. Approach the field in the direction you are going to land at traffic altitude or as high as visibility will permit.

2. Check in with the tower, know the exact conditions regarding other traffic, and check your knowledge of the location and altitudes of all obstructions in the vicinity of the field. Complete your checklist, get your gear down and checked, and have an airspeed of 150 mph by the time you reach the field.

3. Fly upwind along the landing runway to the opposite end.

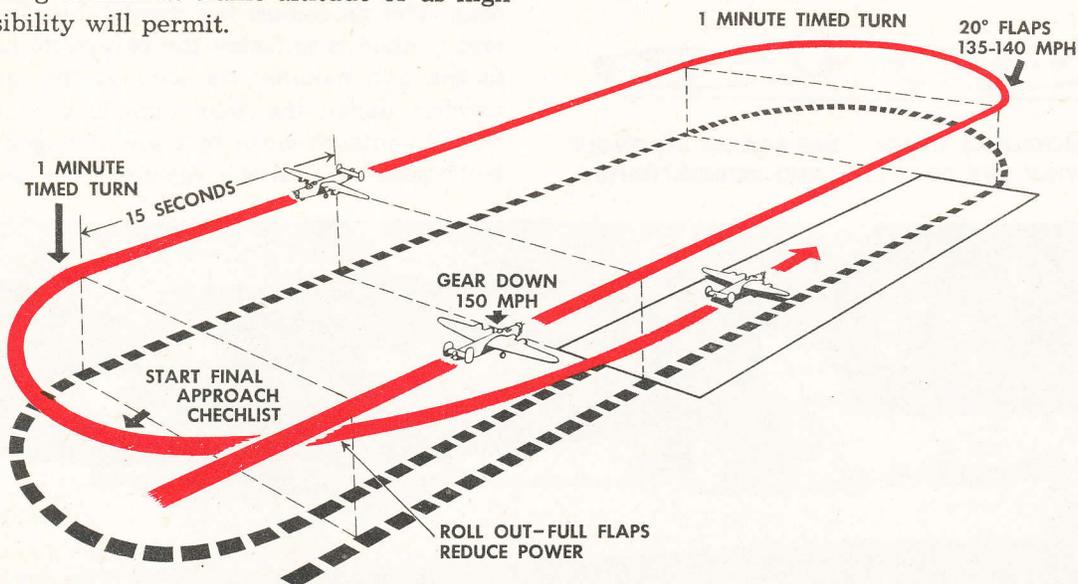
4. Lower the flaps to 20° and reduce airspeed to 135 mph to 140 mph and execute a one-minute timed turn.

5. Fly back on the reciprocal heading and, opposite the approach end of the runway, start timing and fly out for 15 seconds.

6. Reduce power at the end of 15 seconds and start a 1-minute timed turn, descending at the rate of 200 to 500 feet a minute depending upon your altitude. Power reduction will be in proportion to desired rate of descent. Start your final approach checklist halfway through the turn to obtain proper settings of propellers, superchargers, etc.

7. Roll out in line with runway, lower full flaps, and reduce power as necessary.

8. Procedures are the same as a normal landing in all other respects.



# FORCED LANDINGS

Of necessity, the problem of forced landings not on airports will vary with every situation, and procedure must be left to the judgment and resourcefulness of the pilot. Following are practical suggestions:

1. Radio your position to the nearest facility at the first indication of an emergency.
2. Always drop bombs over uninhabited areas or in enemy territory, and secure loose equipment which might cause injury.
3. Always warn the crew immediately of the emergency by interphone so they will have time to get ready to bail out or to take stations and get braced for a crash landing.
4. Have the engineer turn off fuel sight gage valves and wing compartment drain line valves located in forward bomb bay compartment on lower wing surface near the booster pumps.
5. Bleed the oxygen system if there is time.
6. Retract the ball turret.
7. Have fire extinguishers and first-aid kits handy to facilitate removal after landing.
8. Do not turn auxiliary hydraulic pump on if No. 3 engine is operating. If No. 3 is not operating, use auxiliary hydraulic pump to lower gear and flaps and charge brake accumulators. Then turn it off before contact to reduce fire hazard in case the wing tanks are fractured and leak gas into bomb bays, in vicinity of the open-brush motor.
9. Bail out in preference to making a forced landing at night.

## Positions For Bracing

Flight Deck: Pilot and copilot with safety belts and shoulder harness securely fastened. Others

on flight deck lying down with feet braced against step as much out of the way of the turret as possible.

Half Deck: As many men as possible squeezed on half deck, feet braced against forward part of ship. Remaining men in crash harness or braced near Station 6.

## To Land or Not to Land?

If you have a choice, don't attempt a forced landing unless you are reasonably certain of success.

Over rocky, rough, or excessively soft terrain, always bail out if altitude permits.

It is sometimes possible to make a forced landing on a road or on a long, level, dry, cultivated field.

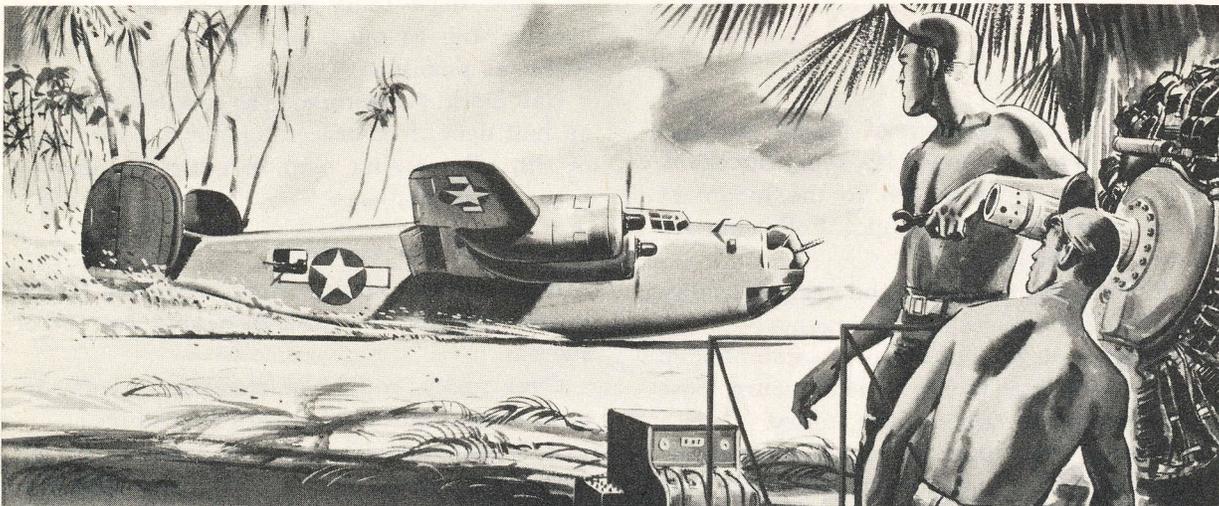
## Procedure After Landing

1. Remove fire extinguishers and first-aid kits when leaving airplane.
2. Get out as quickly as possible.
3. Count noses and rescue trapped personnel, check injuries and give first aid if needed.
4. Inspect aircraft for fire hazards. Forbid smoking in vicinity of aircraft. Post guard and send word by nearest telephone in accordance with instructions in your flight envelope.

## ALWAYS BAIL OUT THE CREW IF ALTITUDE PERMITS

On any landing where there is serious danger of over-running a short runway or where other circumstances make the landing hazardous, bail out all the crew except the engineer, copilot and pilot if altitude permits. Before doing so, make certain that each crew member understands how to leave the airplane and how to use the parachute. (See Bailout.) It is the positive duty of the airplane commander to hold

**ALWAYS LOWER AND LOCK THE LANDING GEAR,  
IF POSSIBLE, FOR A FORCED LANDING**



ground drills in the airplane on bailout procedures and emergency bailout signals. Never leave it up to the crew to decide whether they will bail out or not.

#### How to Make a Belly Landing

If all emergency procedures fail to lower the gear, then it is necessary to make a belly landing. Should you land on or off the runway? Experience has shown that with heavy bombardment aircraft such a landing should be made on the runway. The reason is that dirt and sod roll up into balls, fracturing the plane's skin; then the bottom surfaces serve as a scoop.

Fear of fire has caused pilots to dislike the idea of belly landings on concrete. If the gas system is intact and not leaking, such fears are largely groundless. Moreover, the airplane will stop as quickly or more quickly on concrete than on sod.

#### Procedure

1. Bail out all crew members except the engineer, copilot and pilot.
2. At the earliest moment notify the tower of your position, that it may be necessary to make a belly landing on the runway, how much longer you intend to remain aloft and approximately where and when crew members will bail out.

Pilot and copilot should securely fasten safety belts and shoulder harness to avoid being

thrown forward on the wheel on impact and thus forcing the nose down. Warn the engineer to brace himself in a position clear of the top turret in case it should fall on impact.

3. When you are sure you must make a belly landing, release bombs in "safe" position over uninhabited areas at not less than 500 feet.

4. Have the engineer turn off the fuel sight gage valves and wing compartment drain line valves located in forward bomb bay compartment on lower wing surface near booster pumps; drain the lines through the bomb bay drain valves.

6. Have the engineer check auxiliary hydraulic pump "OFF." Open the flight deck escape hatch, and also open the waist window hatches to permit easy access to the rear of the airplane after landing.

7. Make a normal approach in all respects.

8. Use a normal flare-out and hold your sink to a minimum with power, contacting the runway at 105 to 110 mph. Brace against the impact so you won't shove the wheel forward. Bring the control column back as far as possible and hold it there.

9. Simultaneously on impact copilot should put all mixture controls in "IDLE CUT-OFF" and turn master switch "OFF." This cuts off all switches, batteries, etc.

10. When the airplane stops get everyone out as quickly as possible. Have the engineer bring fire extinguishers along.

## NO-FLAP LANDINGS

This becomes necessary if flaps can not be lowered because of mechanical failure or as a result of enemy fire. The important thing to remember is that no flaps reduce lift greatly and increase the stalling speeds in level flight, in turns, and during flare-out.

### Procedure

1. Maintain an airspeed of 150 to 155 mph approaching the field and in traffic, and use the longest runway wind permits.

2. Make shallow turns because of higher stalling speeds with no flaps.

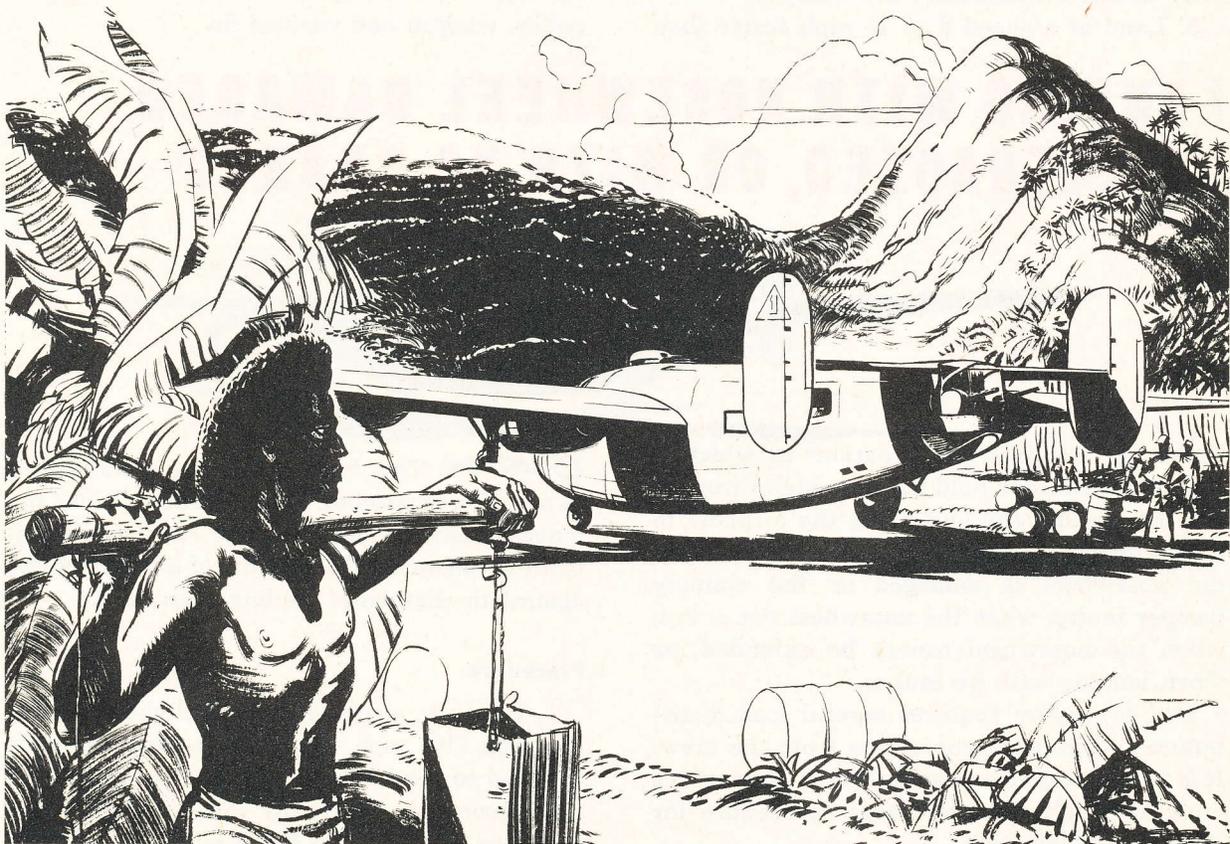
3. Fly the final approach descent flatter so there is less change of attitude in the flare-out.

Avoid a steep angle of glide. But don't get so low you have to use excess power and build up too high an airspeed in order to drag in.

4. Hold an airspeed of 150 mph on final approach, reducing to 140 mph (for normal load) during the flare-out. Maintain airspeed 15 to 20 mph faster than known stalling speed for the load carried.

5. Plan contact as near the end of the runway as possible. When you are low over the runway, start raising the nose and reducing power very gradually. Carry enough power to keep sink to a minimum, and don't raise the nose to stop sink. Contact the ground at 135 to 140 mph and immediately bring throttles full back.

6. If there is ample runway, raise the nose to slow airplane down. If the runway is short for your speed, immediately lower the nose so that you can start using the brakes.



## LANDING WITH ONE MAIN WHEEL UP, OTHER MAIN AND NOSEWHEEL DOWN

If this landing is executed properly, there is much less damage to the airplane and chance of injury to personnel than in a belly landing. Know and try all emergency means to lower the main gear. If you have plenty of gas aboard, ask the tower to call an expert to tell you how to get the gear down. If you can't get it down, use this procedure:

### Procedure

1. Bail out all crew members except the engineer, copilot and pilot.
2. Choose a runway on which you can groundloop without running into a hangar or parked aircraft, or going over a cliff.
3. Make a normal power approach and trim for a normal landing.
4. Be sure auxiliary hydraulic pump is off after brake accumulators are charged.
5. Land at a speed 5 to 10 mph faster than

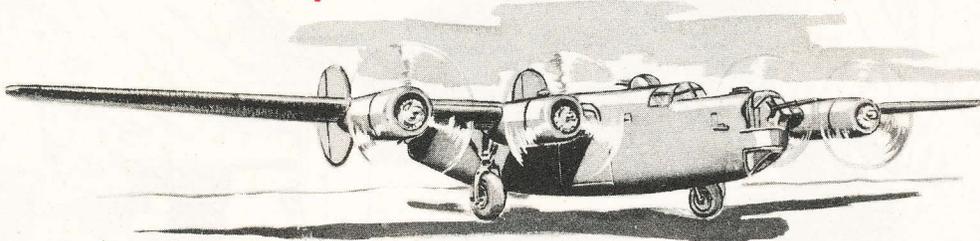
usual and use power to keep sink to a minimum. Grease 'er on.

6. Land with the wing on the side of the faulty gear slightly high, and immediately after contact raise this wing still higher and feather the outboard engine on the bad-gear side to reduce drag.

7. As soon as the main gear is solidly on the ground, raise the nose to a high angle of attack to get maximum lift and to reduce speed as rapidly as possible.

8. As lift decreases, the wing on the faulty-gear side and the nose gear will tend to drop. Hold the wing up with ailerons as long as possible; when the wing starts down and touches, use brake on the good-gear side to stop the groundloop, which will seldom exceed 45°. Damage is usually limited to the outboard propeller, wingtip and vertical fin.

## LANDING WITH NOSEWHEEL DAMAGED OR RETRACTED, OR WITH NO BRAKES



There are a number of situations in which it will be desirable to hold the nose high throughout the landing roll and bring the airplane to a stop resting on the tailskid. Examples: When the nosewheel is damaged or the shimmy damper faulty; when the nosewheel tire is flat; when the nosewheel cannot be extended, or when landing with no brakes.

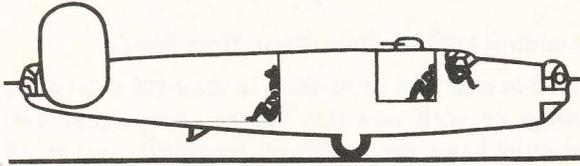
This procedure requires careful load distribution and precise cooperation from the crew. It is the airplane commander's duty to brief his crew thoroughly on the proper procedure for a landing of this kind.

**Caution** This type of landing is hazardous in a strong crosswind. It is desirable to use the longest runway, but the pilot must use judgment in balancing the benefits of a long runway against the hazard of landing crosswind.

### Procedure

1. Hold the airplane in level flight at 150 to 155 mph (160 mph with nose turret) and shift the load so the airplane will fly level with 1½° nose-down trim. Normally this requires 7 men stationed between the No. 6 bulkhead and the

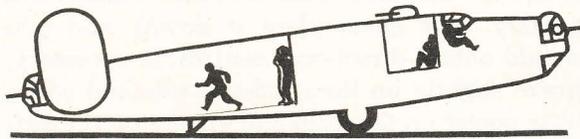
waist windows. Advise crew in advance exactly what they are to do on landing.



2. Get permission from the tower for an emergency landing. Request the alert crew to stand by and notify tower you will come to a full stop on the runway.

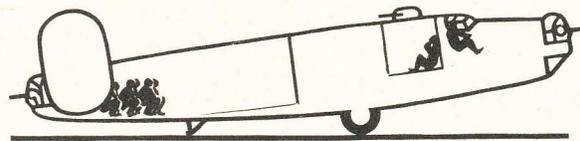
3. On final approach see that crew are all at the predetermined stations in the rear compartment. Carry out the checklist as usual and trim for a normal landing.

4. Land on the main gear at the slowest safe airspeed, controlling sink with power, as near the approach end of the runway as possible. Keep the nose slightly higher than normal but do not land on the tailskid.



5. Hold throttles all the way back, open cowl flaps, and put inboard mixtures in "IDLE CUT-OFF" immediately after landing to get full propeller braking action. If necessary, use outboard engines for directional control or as a last resort for groundlooping if running out of runway.

6. Immediately after contact, raise the nose as high as possible to ease the tailskid down until it is dragging. Trim tail-heavy to hold the tailskid on the ground.



7. The moment the tailskid starts to drag, one crew member will move to the extreme rear of the airplane. Thereafter one additional crew member should move aft for each signal

on the alarm bell. Five or 6 men should be aft when the landing roll has decreased to approximately 20 mph. Send the 6th and 7th men back as the airplane comes to rest.

## *Important*

Emphatically tell men that they are to stay in the extreme rear until specifically ordered out. Several landings of this kind have been successfully made, and as soon as the airplane stopped the crew rushed forward, banging the nose into the ground and doing as much damage as a bad landing.

In case the nosewheel is extended but you have a flat tire, faulty shimmy damper or no brakes, you can lower the nose by calling one man forward at a time from the rear of the airplane to let the nosewheel settle gently to the ground.

## TIRE TROUBLE

Blown tires seldom occur unless the airplane is handled improperly. Then the great weight of a large airplane and the extreme heat generated by improper use of brakes may blow a tire. If this occurs, the inherent directional stability of the tricycle gear is an important aid to the pilot. Following are the best procedures to use in case of a blown tire.

### Blowout on Takeoff

This is usually caused by having the feet up on the brakes during takeoff or braking the wheels too soon after takeoff. Then, if the airplane settles momentarily so that the tires touch, one or both tires may blow out.

If a blowout occurs early in the takeoff run and there is room enough, throttle back and stop. Use brakes with caution, or the flat tire will tear apart and throw rubber all around. Don't let the noise and vibration confuse you.

If you are going too fast to stop, continue the takeoff. With an airplane not too heavily loaded

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and good airspeed, you may be able to climb satisfactorily with wheels down. In that case, complete the takeoff procedure in the normal manner—but leave the wheels down to avoid danger of their becoming jammed in the gear wells. Keep 5° to 9° of flaps down for additional lift. You can fly traffic safely at 150 mph.

If you can't make altitude with wheels down, then raise the gear, but be sure the wheels are braked so that loose rubber won't jam in the gear wells. Notify the tower that you are going around for a flat-tire landing.

### Landing With One Main Gear Tire Blown

Repeated successful landings have been made in the B-24 with tires flat and with little or no other damage to the airplane.

#### Procedure

1. Notify the tower that you have a flat tire and that you will make a full-stop landing on the runway.
2. If possible, get permission to use a runway with the wind quartering from the good-tire side. But avoid drift or you'll blow the other tire, too.
3. Cut sink to a minimum. Control it with power.
4. Upon contact, get the nose down as soon as possible, and hold forward pressure on the nosewheel. Then the directional stability of the tricycle gear will help hold the airplane straight.
5. As the airplane slows down it will tend to turn more into the blown tire. Use a little power on the flat-tire side with light braking action on the good tire side to maintain a straight-ahead path.
6. Keep the airplane where it stops until the wheel is changed.

**Note:** Avoid using brakes on the flat-tire side; it will tear the tire up, increase vibration, and won't help in stopping.

### Landing With 2 Main Gear Tires Blown

In this case the procedure is approximately the same as with one tire blown except that you should have the auxiliary hydraulic pump off before contact and land as directly into the wind as possible. Again lower the nose as soon after contact as possible and push the wheel forward, to get the weight forward on the nose-wheel tire and to get the wing at a negative angle of attack. The airplane will vibrate, thump, shake and throw rubber, but you will have good directional control. Stay off the brakes as long as possible. If you must use them, do so sparingly. For added braking action, put inboard engines in "IDLE CUT-OFF."

### Blowout As You Land

If a tire blows out as you land, stay off the brake on that side. Ease the nosewheel down quickly (but never slam it down) and you should obtain directional control. If necessary, brake slightly on the good-tire side and add a little power on the outboard engine on the flat-tire side. The usual mistake is to slam on both brakes too soon. This jerks the nose down and rips the flat tire to pieces. The thing to remember is that you always obtain greater directional control just as soon as you get the nosewheel solidly on the ground. However, in case the flat tire balls up and locks the wheel, it may be necessary to use considerable power and brake to avoid a severe groundloop.

### Nosewheel Tire Blown

See Landing With Nosewheel Damaged or Retracted or Without Brakes.