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This revised edition supersedes the 2nd edition (brown cover) Pilot Training Manual for the Superfortress. All copies of this and other editions are rescinded.

B-29

Headquarters Army Air Forces
Washington, 15 December 1945

The use and authentication of this manual are governed by the provisions of AAF Regulation 50-17.

BY COMMAND OF GENERAL ARNOLD

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RESTRICTED

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PILOTS' AND FLIGHT ENGINEERS' TRAINING MANUAL FOR THE SUPERFORTRESS

INTRODUCTION

This manual is the text for your training as a B-29 airplane commander or flight engineer.

The Air Forces' most experienced training and supervisory personnel have collaborated to make it a complete exposition of what your duties are, how each duty will be performed, and why it must be performed in the manner prescribed.

The techniques and procedures described in this book are standard and mandatory. In this respect the manual serves the dual purpose of a training checklist and a working handbook. Use it to make sure that you learn everything described herein. Use it to study and review the essential facts concerning everything taught. Such additional self-study and review will not only advance your training, but will alleviate the burden of your already overburdened instructors.

This training manual does not replace the Technical Orders for the airplane, which will always be your primary source of information concerning the B-29 so long as you fly it. This is essentially the textbook of the B-29. Used properly, it will enable you to utilize the pertinent Technical Orders to even greater advantage.

Commanding General, Army Air Forces

YOUR DUTIES AND RESPONSIBILITIES AS

Airplane Commander

The B-29 is a teamwork airplane, and you are the captain of that team. Your success in combat, and the safety of your crew and the airplane, depend on how well you organize your team and how well you lead it.

You are no longer just a pilot—you hold a command post and all the responsibilities that go with it. You are flying an 11-man weapon. It is your airplane and your crew, not only when you are flying, but for the full 24 hours of every day.

Your crew is made up of specialists, every one an expert in his line. Each one contributes an important part to the whole. Know their capabilities as well as their shortcomings. Know them as men as well as specialists. Know their background, their personalities, their individual problems, their needs for specific training.

You can't fly the B-29 alone. You need the full cooperation of your crew and you can get that cooperation only if the morale of your crew is good. You can help build that morale by taking the trouble to know just a little more than usual about your crew members. Find out who they were, where they lived, and what they did before the war. It gives a man considerable lift to have his commanding officer say something casually now and then about the town where he lived, his family, or the work that he once did. Make a point of showing genuine interest in your men; it will pay big dividends in morale.

Make each crew member feel that he is an important part of the team. Make a point of letting each man take a short turn at the controls during practice missions while you or the copilot stand by on dual. Make a tour of all stations at least once during every practice flight. Talk to the men, ask them questions about their duties, try to clear up any questions they may have. Make them want to have the best team in their squadron.

As airplane commander, you are responsible for the daily welfare of your crew. See that they are properly quartered, clothed, and fed. See that they are paid when they should be paid. Away from your home station, carry your interest to the point of financing them yourself, if necessary. You are the commander of a combat force all your own—a small but specialized army—and morale is one of the biggest problems in any army, large or small.

DURING TRAINING

Train your crew as a team. Make teamwork their byword. Keep abreast of their training. It won't be possible for you to attend all courses of instruction with the members of your crew, but you should check their progress and their records constantly. Get to know each man's duties and help him to devise means for performing them quickly and efficiently. If knowledge is lacking on some specific point, supply it.

Pair off your crew members and have them check and train each other. Simulate combat conditions and emergency situations and have each crew member describe his duties. Ask them what they would do under the following and similar conditions:

1. A designated crew member is seriously wounded.
2. A designated turret is out of commission.
3. Gasoline or oil is leaking from a designated part of the airplane.
4. The airplane must be abandoned.
5. Bombs fail to drop.
6. Bomb bay doors fail to open.
7. Landing gear fails to operate.
8. You are forced to land in enemy territory.
9. You are forced to land on water.
10. Fire occurs in some part of the airplane.

A B-29 crew consists of airplane commander, copilot, flight engineer, bombardier, navigator, radar observer, radio operator, central fire control specialist gunner, left gunner, right gunner, and tail gunner.

As airplane commander you must:

1. Know your airplane and how it operates.
2. Be able to take off and land under adverse conditions.
3. Be able to fly under instrument conditions either with or without radio aids.
4. Be able to use blind-landing systems.
5. Be able to navigate and locate your position with the various radio and radar aids available.
6. Be proficient at formation flying, including the proper performance of evasive tactics at various speeds and altitudes.
7. Be able to get the most out of your airplane under all conditions.
8. Know your crew.
9. Know yourself.

COPILOT

Your copilot is your assistant—the executive officer of your command post. He must be able to do everything that you can do so that he can assume full command should the occasion arise. You and he should be virtually interchangeable. Let him handle the controls at least 30% of the time. **Remember that your copilot is a potential airplane commander.**

NAVIGATOR

Your navigator must:

1. Be proficient in pilotage, dead reckoning, radio, and celestial navigation.
2. Be familiar with all radar aids to navigation.
3. Understand thoroughly the use of drift meter, sextant and flux gate compass.
4. Be able to perform minor maintenance on all equipment incidental to the performance of his duties.
5. Know the proper use of the flare chute, flare gun, and other identification signals.

BOMBARDIER

Your bombardier must:

1. Understand the bombsight, radar equipment, and automatic pilot insofar as they pertain to bombing.
2. Understand the normal and emergency operation of bombs, bomb racks, switches, controls, releases, doors, etc.

3. Understand and be able to operate the computing RCT sight.

4. Be proficient at pilotage and dead reckoning.

5. Be proficient at target identification.

RADAR OBSERVER

Your radar observer must:

1. Be proficient at pilotage and dead reckoning.

2. Understand the operation of, and be able to use, all available radio and radar equipment for navigation and bombing.

3. Be able to perform minor maintenance on all radar equipment.

4. Be proficient at target identification.

FLIGHT ENGINEER

Your flight engineer is an important member of your B-29 combat team. He runs your airplane while you and your copilot fly it. In actual flight, he relieves you and your copilot of many duties and responsibilities. On the ground, he is your chief liaison with ground crew maintenance. Check your flight engineer frequently to make sure he is on the job. He must:

1. Understand the operation and maintenance of all mechanical equipment.

2. Be thoroughly familiar with the engines and the fuel, oil, and electrical systems.

3. Be thoroughly familiar with the cruise control charts, weights and balance, and all operating procedures.

4. Be thoroughly familiar with the pressurized cabin system.

5. Be thoroughly familiar with the putt-putt and auxiliary electrical system.

6. Be thoroughly familiar with the oxygen system.

7. Be thoroughly familiar with all emergency procedures.

RADIO OPERATOR

Your radio operator must:

1. Be thoroughly familiar with the operation and maintenance of all radio equipment aboard the airplane.

2. Be thoroughly familiar with the use of all radio navigational aids.

3. Be proficient in transmitting and receiving.

4. Be thoroughly familiar with IFF procedures and equipment.

5. Understand the operation and care of the radio compass.

6. Be thoroughly familiar with AAF instrument approach procedures and the signal operation instructions (radio authentication, special codes for the day, weather codes, blinker codes, radio call signs).

CENTRAL FIRE CONTROL SPECIALIST GUNNER

Your central fire control specialist gunner should:

1. Be thoroughly familiar with the care, maintenance, and operation of the entire central fire control system.

2. Be thoroughly familiar with the loading and servicing of the turrets.

3. Be proficient in aircraft identification.

CAREER GUNNERS

Your career gunners must:

1. Know how to operate the computing sight.

2. Be thoroughly familiar with the central fire control system.

3. Know how to load and repair turrets.

CREW DISCIPLINE

Your success as the airplane commander will depend in a large measure on the respect, confidence, and trust which the crew feels for you. It will depend also on how well you maintain crew discipline.

Your position commands obedience and respect. This does not mean that you have to be stiff-necked, overbearing, or aloof. Such characteristics certainly will defeat your purpose.

Be friendly, understanding, but firm. Know your job, and, by the way you perform your duties daily, impress upon the crew that you do know your job. Make fair decisions after due consideration of all the facts involved, but make them in such a way as to impress upon your crew that your decisions are made to stick.

Crew discipline is vitally important, but it is not as difficult a problem as it sounds. Good discipline in an air crew breeds comradeship and high morale. And the combination is unbeatable.

You can be a good CO and still be a regular guy. You can command respect from your men, and still be one of them.

"To associate discipline with informality, comradeship, a leveling of rank, and at times a shift in actual command away from the leader, may be paradoxical," says a former combat group commander. "Certainly, it isn't down the military groove. But it is discipline just the same—and the kind of discipline that brings success in the air."

The way each crew member performs his duties will reflect favorably—or unfavorably—on your ability as airplane commander.

What about your navigator? You can't do his job for him throughout training in the States and then expect him to guide you safely over a thousand miles of water to a speck on the map. Remember that there aren't any check points on the ocean. You have to rely on your navigator. Now is the time to make certain that he knows his job.

Your bombs miss the target. Long hours of flying wasted. Why? It may be because the bombsight gyro was not turned on long enough in advance or because the bombsight was not kept warm by means of the heater so that when the bombardier put his warm face to the eyepiece, it fogged up and was unusable. Who is the culprit? The bombardier, of course, is primarily at fault, but fundamentally your lack of leadership, guidance and inspiration is to blame.

Remember—**NO AIR CREW IS EVER MORE ON THE BALL THAN ITS AIRPLANE COMMANDER**

ENFORCE THESE Rules ON EVERY FLIGHT

SMOKING

a. No smoking in airplane at an altitude of less than 1000 feet.

b. No smoking during fuel transfer.

c. Never attempt to throw a lighted cigarette from the airplane. Put it out first.

d. No smoking in tail gunner's compartment.

e. No smoking while on oxygen.

PARACHUTES

a. All persons aboard will wear parachute harness at all times from takeoff to landing.

b. Each person aboard will have a parachute on every flight.

c. Have an extra parachute in front and rear pressurized compartments.

PROPELLERS

a. No person will walk through the propellers at any time.

b. No person will leave the airplane when propellers are turning unless personally ordered to do so by the airplane commander.

OXYGEN MASKS

Oxygen masks will be carried on all day flights where altitude may exceed 8000 feet for more than 4 hours, and on all night flights.

TRAINING

a. Tell your crew the purpose of each mission and what you expect each member to accomplish.

b. Keep the crew busy throughout the flight. Get position reports from the navigator; send them out through the radio operator. Put the engineer to work on the cruise control and maximum range charts and require him to keep a record of engine performance. Give every crew member a workout. Encourage each to use his skill. A team is an active outfit. Make the most of every practice mission.

c. Practice all emergency procedures at least once a week—bailout, ditching and fire drill.

INSPECTIONS

a. Check your airplane with reference to the particular mission you are undertaking. Check everything.

b. Check your crew for equipment, preparedness and understanding.

INTERPHONE

a. Keep the crew on interphone. Require them to give immediate reports of all aircraft, trains, and ships sighted, with proper identification, just as you would in combat.

b. Require interphone reports every 15 minutes from all crew members in rear of airplane.

General Description

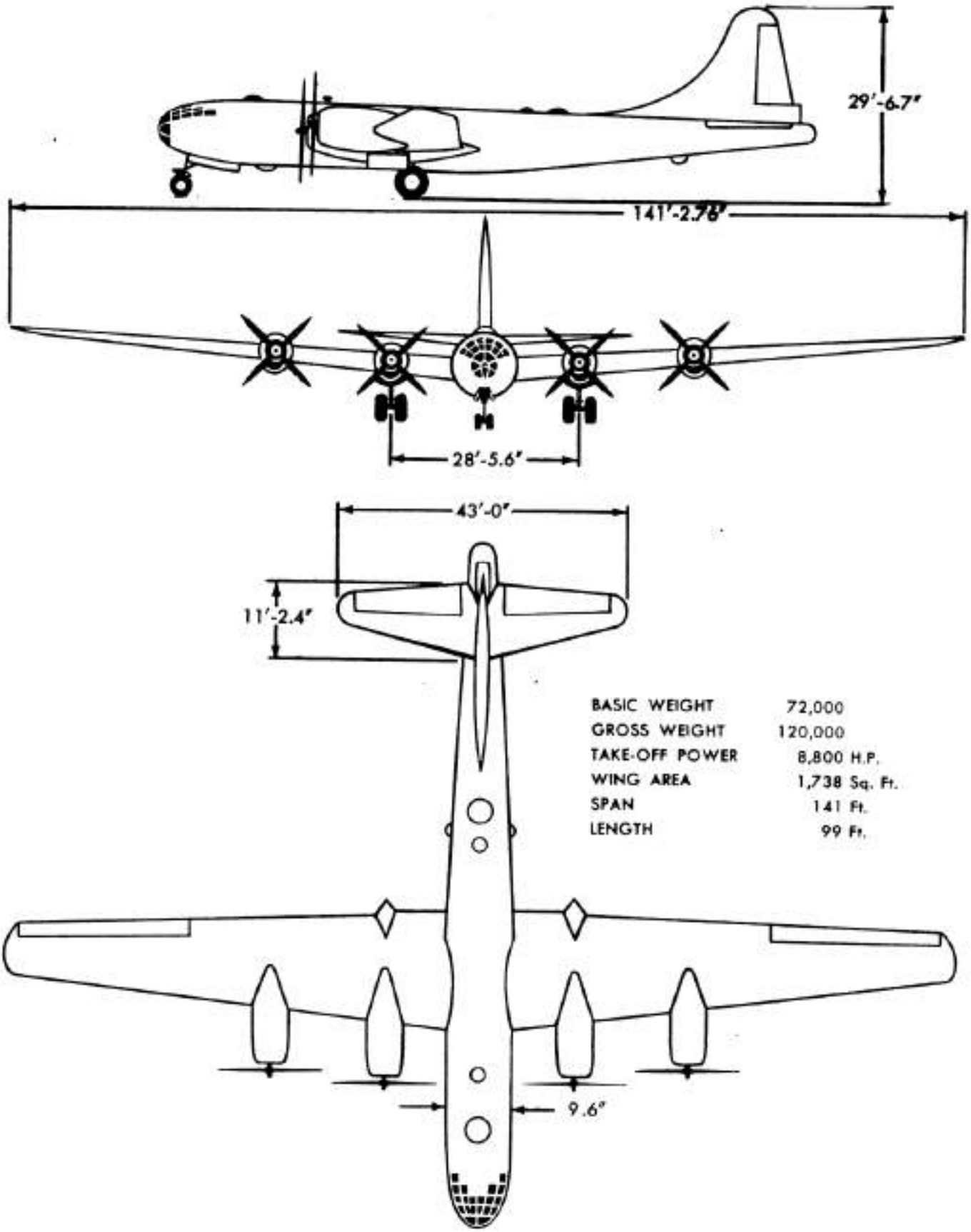
POWER PLANTS

Your B-29 Superfortress has four 18-cylinder, twin-row R-3350 Wright radial engines, each capable of delivering more than 2200 Hp. The 4-bladed propellers, reduction-geared to the crankshaft and rotating clockwise when viewed from the rear, are Hamilton Standard constant-speed, full-feathering, hydromatic. Constant-speed control is maintained by governors which are operated from the airplane commander's aisle stand. (See also **Curtiss Electric Propeller System.**)

Each engine has two exhaust-driven turbo-superchargers mounted vertically at the sides of the nacelle. The turbo boost on all four engines is controlled simultaneously by a Minneapolis-Honeywell electronic turbo-supercharger control system operated by a single manual control knob on the airplane commander's aisle stand.

Engines may have either conventional carburetors or fuel injection systems.

Vacuum pumps, one on each engine, provide vacuum for the cameras, de-icer boots, and instruments, and pressure for inflating the de-icer boots. Either inboard vacuum pump may be used for vacuum; the other three pumps provide pressure for the de-icer boots.

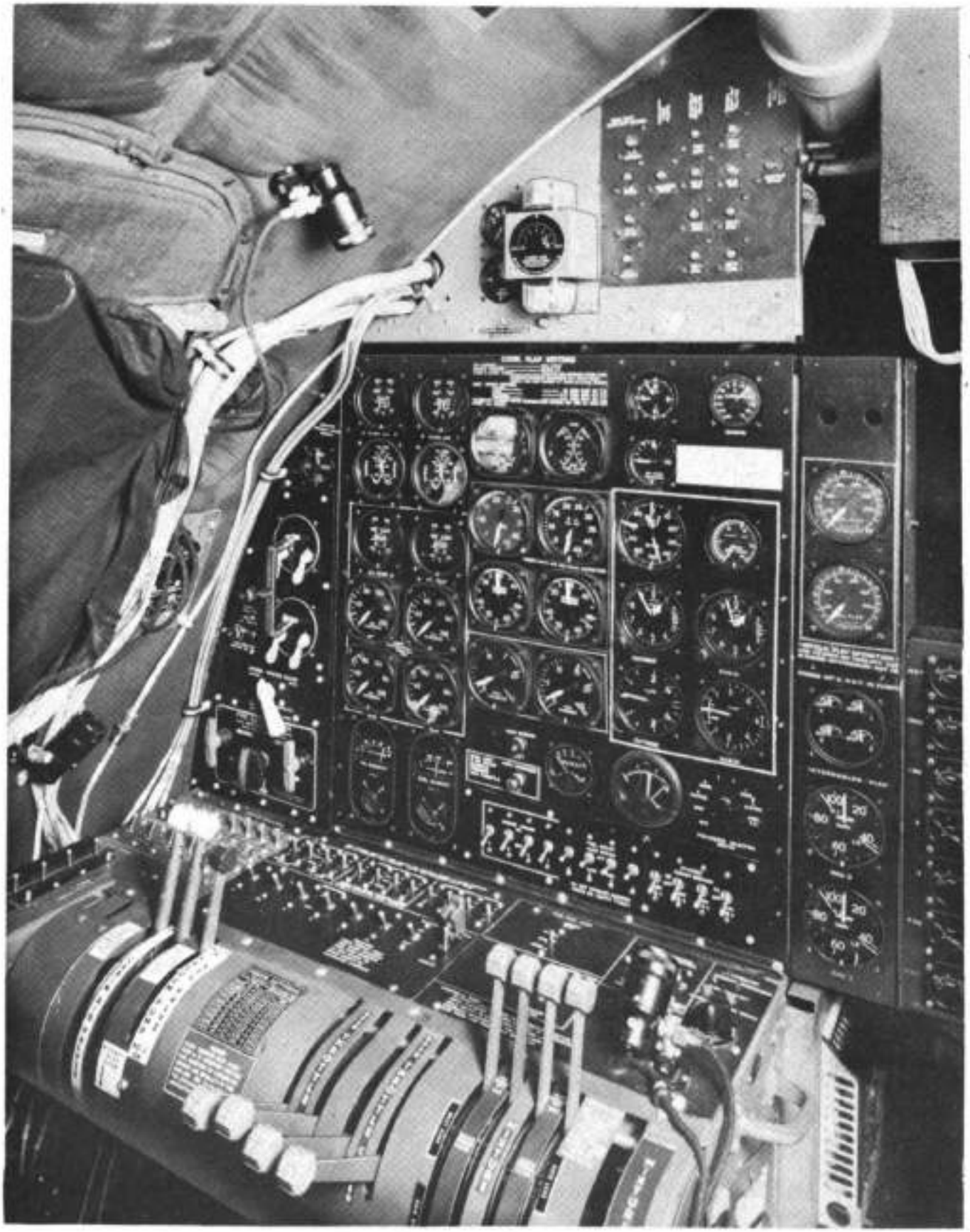


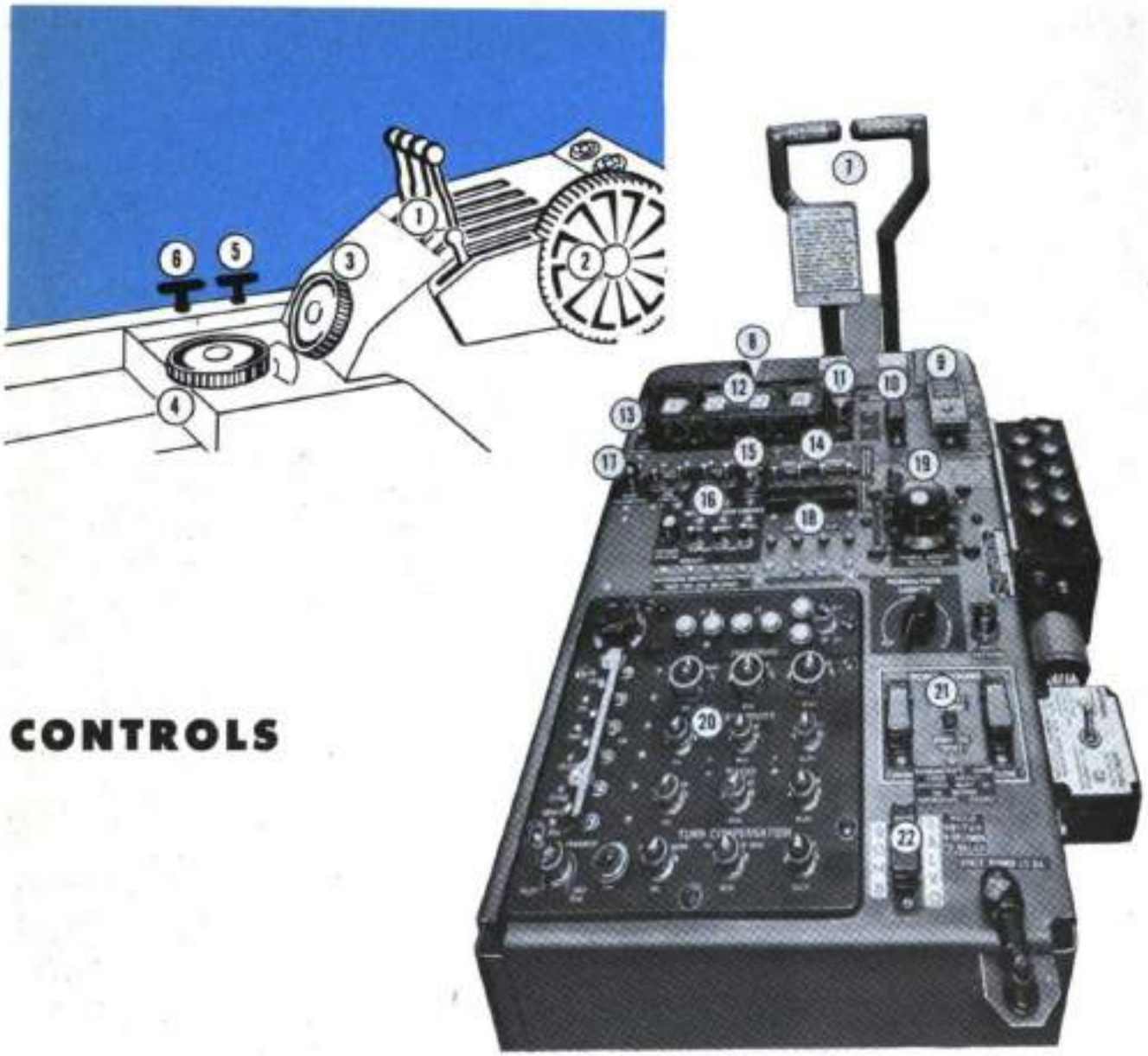
BASIC WEIGHT	72,000
GROSS WEIGHT	120,000
TAKE-OFF POWER	8,800 H.P.
WING AREA	1,738 Sq. Ft.
SPAN	141 Ft.
LENGTH	99 Ft.

FLIGHT ENGINEER'S PANEL

Besides throttles and mixture controls the flight engineer's panel mounts the following engine controls and gages:

1. Cowl flap switches and indicators
2. Intercooler switches and indicators
3. Oil dilution switches
4. Starter switches
5. Oil cooler switches
6. Prop anti-icer and de-icer switches
7. Main tank shut-off valve switches
8. Engine shut-off valve switches
9. Manifold shut-off valve switches
10. Generator switches
11. Battery switch
12. Inverter switch
13. Fuel tank valve (center wing)
14. Booster pumps switch (manifold transfer)
15. Pitot heater switches
16. Inverter switch circuit breakers
17. Hydraulic pump over-ride switch
18. Engine fire extinguisher controls and selector valve
19. Ignition switches
20. Putt-putt ignition switch and light
21. Engine primer switches
22. Fuel booster pump switches
23. Starter circuit breaker switches
24. Cabin air rate-of-flow gages (2)
25. Generator ammeters
26. Fuel flow meters (2)
27. Two rate-of-climb indicators (outside and cabin)
28. Two altimeters (outside and cabin)
29. Airspeed indicator
30. Cabin differential pressure gage
31. All engine, fuel, and oil gages
32. Clock
33. Cabin air temperature gage
34. Cabin air temperature rheostat
35. Suction gage
36. Circuit breakers for manifold transfer system
37. Main and emergency hydraulic system pressure gages
38. Emergency hydraulic system filler valve
39. Cabin air conditioning switches
40. Cabin pressure warning horn switch
41. Wheel well light switch
42. Fluorescent light rheostats
43. Free air temperature gage
44. Cabin air valve levers
45. Vacuum pump selector lever





CONTROLS

From the airplane commander's and copilot's viewpoint, the controls on the B-29 have been simplified. The majority of the power plant controls and most of the basic electrical and mechanical system controls are on the flight engineer's stand directly in back of the copilot.

Both airplane commander and copilot have control stands (see illustration) on which throttles (1), elevator trim tab (2), aileron trim tab (3), and rudder trim tab (4) are mounted. The emergency cabin pressure (5) and emergency bomb door (6) releases are at the rear of the airplane commander's control stand.

The emergency brake levers (7), control surface lock (8), landing gear switch (9), emergency wing flap control switch (10), normal wing flap control switch (11), propeller feathering switches (12), alarm bell switch (13), propeller increase and decrease rpm switches (14), phone-call signal light switch (15), light switches (16), propeller feathering circuit breaker re-set switch (17), propeller governor circuit breaker re-sets (18), turbo boost selector (19), C-1 automatic pilot controls (20), pneumatic bomb door switches (21), bomb salvo switch (22) are on the aisle stand to the right of the airplane commander's seat.

AIRPLANE COMMANDER'S PANEL

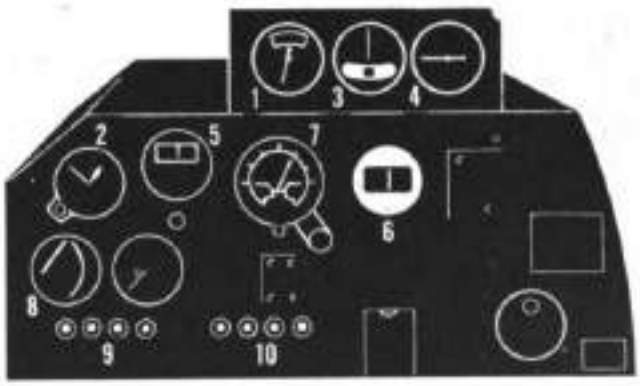
Except for manifold pressure gages and tachometers, the instruments on the airplane commander's panel are all flight instruments:

1. Airspeed indicator
2. Altimeter
3. Bank-and-turn indicator
4. Rate-of-climb indicator
5. Turn indicator
6. Gyro-horizon
7. Pilot direction indicator (PDI)
8. Radio compass
9. Flux gate compass
10. Manifold pressure gages
11. Tachometers
12. Blind-landing indicator
13. Clock
14. Turret warning lights
15. Bomb release indicator light
16. Vacuum warning light
17. Inverter warning lights

COPILOT'S INSTRUMENT PANEL

The instruments mounted on the copilot's instrument panel are:

1. Airspeed indicator
2. Altimeter
3. Bank-and-turn indicator
4. Rate-of-climb indicator
5. Turn indicator
6. Magnetic compass
7. Gyro-horizon
8. Flap position indicator
9. Propeller rpm limit indicator lights
10. Landing gear indicator lights



FLIGHT CONTROLS

The flight controls are conventional and the forces necessary to move them are light, even at high speeds—a surprising fact to most pilots the first time they fly the B-29. The elevators are similar to those on the B-17. The ailerons, although considerably larger than those on the B-17, are so rigged that they can be easily moved 18° up or down. The rudder gives maximum possible control and yet can be moved easily without the use of power boosts.

Wing flaps and tricycle landing gear are lowered and raised by reversible electric motors. The Fowler-type wing flaps travel on track and roller mechanisms in such a manner that they project beyond the trailing edge of the wing when they are extended. Under normal operation the landing gear can be lowered in 40 seconds.

AIRPLANE COMMANDER'S Exterior Visual Inspection

You make this exterior visual inspection for the purpose of assuring yourself that all preflight maintenance, service, and inspection procedures have been accomplished and the airplane is ready to fly.

In your early training, make the checks listed below carefully and completely. Omit nothing. Follow the route shown in the diagram.

As your training and familiarization with the airplane progress you will be able to condense and speed up this inspection so that it does not hold up your preparation for flight, but still accomplishes its purpose: **a careful re-check of the engineer's preflight, to be sure that he has missed nothing.**

1. Place parachutes and personal equipment on ramp to left of nose section. (This will prevent confusion when airplane commander calls for crew inspection.)

2. Master, battery and magneto switches OFF. Airplane commander enters forward pressurized compartment and checks master, battery and magneto switches OFF. He then informs the crew, permitting them to check for liquid locks.

3. Test for liquid lock. When the airplane commander informs the crew that the switches are OFF, each prop will be pulled through four blades to test for liquid lock. (Do not pull blades in reverse in an attempt to break a lock. This is merely a preliminary inspection and does not replace procedure of pulling props through 12 blades before starting.) Look in air scoops—free from foreign objects.

4. Form 1A and loading list. Check the Form 1A and sign (if necessary) the exceptional release. Fill out and sign the loading list.

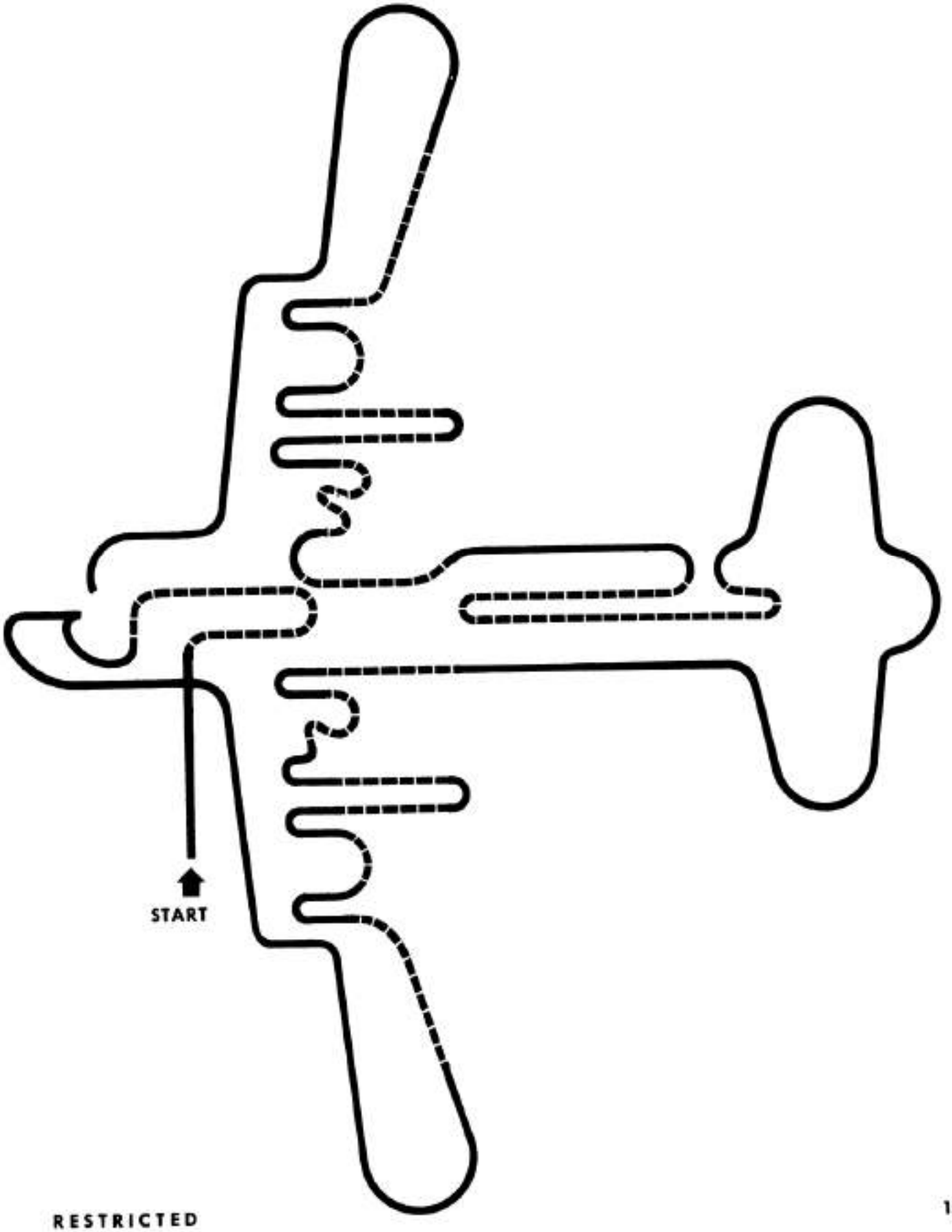
5. Internal inspection of forward pressurized compartment. Check general condition and proper stowage of all equipment.

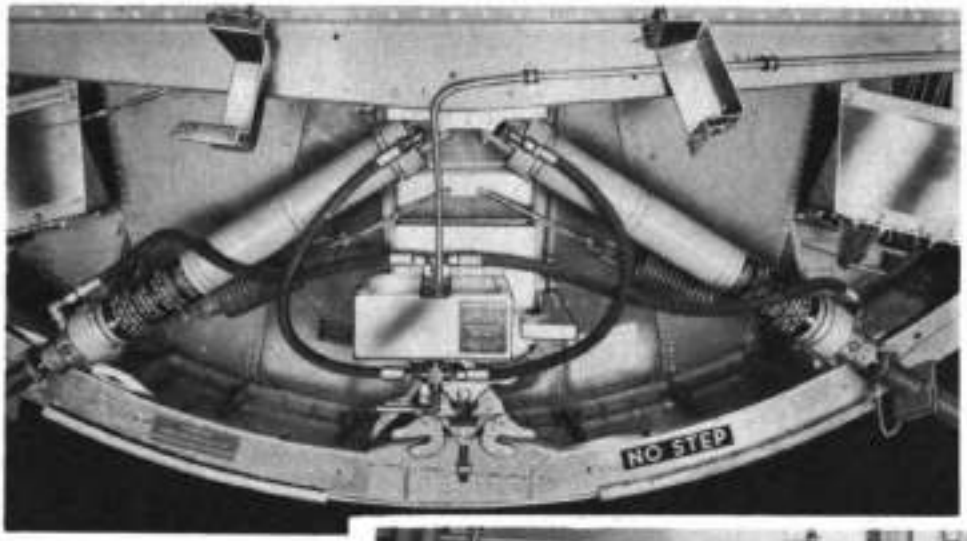
a. Fire extinguisher—securely mounted and actuating valve safetied.

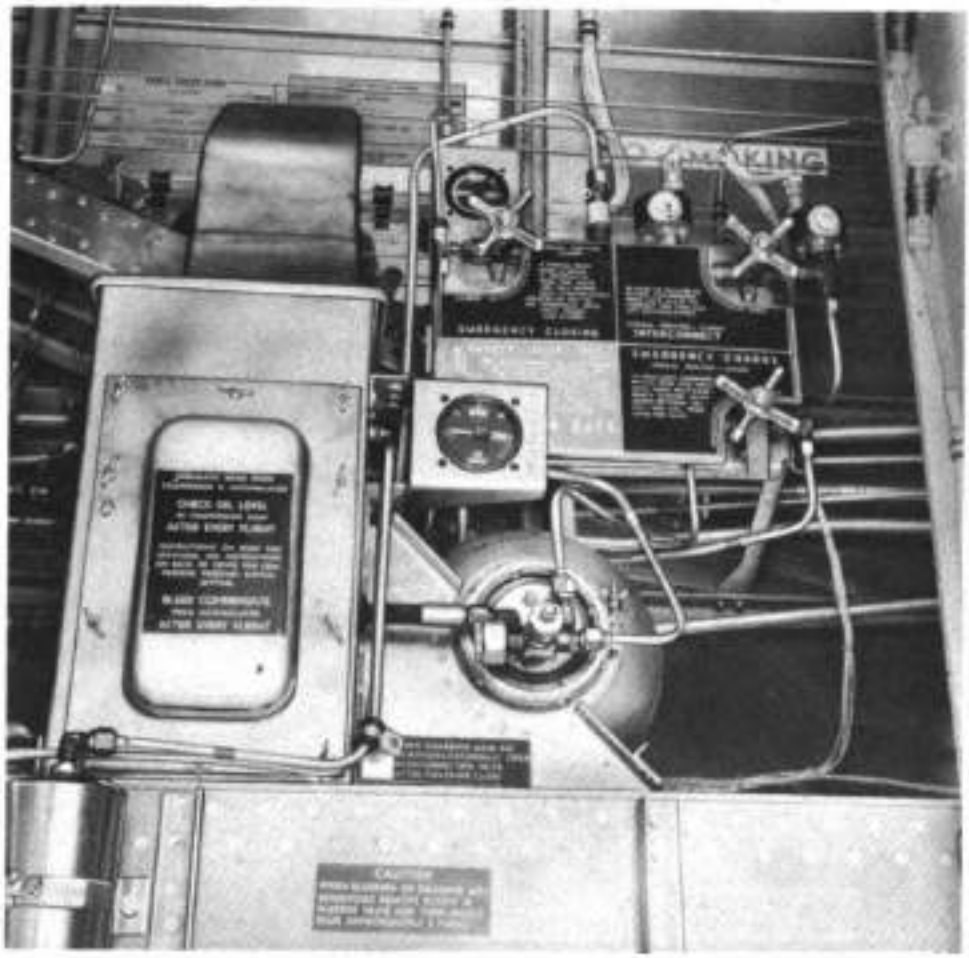
b. Ditching braces—stowed.

c. Compressor circuit breakers—ON.

d. Pressure bulkhead door (Sta. 218)—check movement and closed position for warpage.







6. Forward bomb bay.

a. Ditching braces—stowed.

b. Bomb door safety down lock—in place.

c. Emergency release cables—check tension, wear and freedom from foreign objects.

d. Tank safety switch—ON.

e. Bomb door safety valves—OFF.

f. Accumulator pressure—1200-1500 psi.

g. Control cables—check tension, wear and freedom from objects.

h. Loading—visually check loading and number of bombs.

7. Nosewheel well.

a. Nosewheel crank—stowed.

b. Engine fire extinguishers—check red disc at end of line running down each bottle.

If discs are not present, or if safety wire is broken or missing, new CO_2 cylinders should be installed before flight. They should be safetied with fine brass wire. If the wire is too heavy, engineer will be unable to pull the handle.

c. Nosewheel well light—bulb okay and securely socketed. Check operation if contemplating night flight.

d. Nosewheel solenoid shield securely mounted.

e. Cannon plug—all cannon plugs should be tight and taped as an added precaution. If the rotating collar is not screwed tightly, engine vibration can shake loose the cannon plug connections.

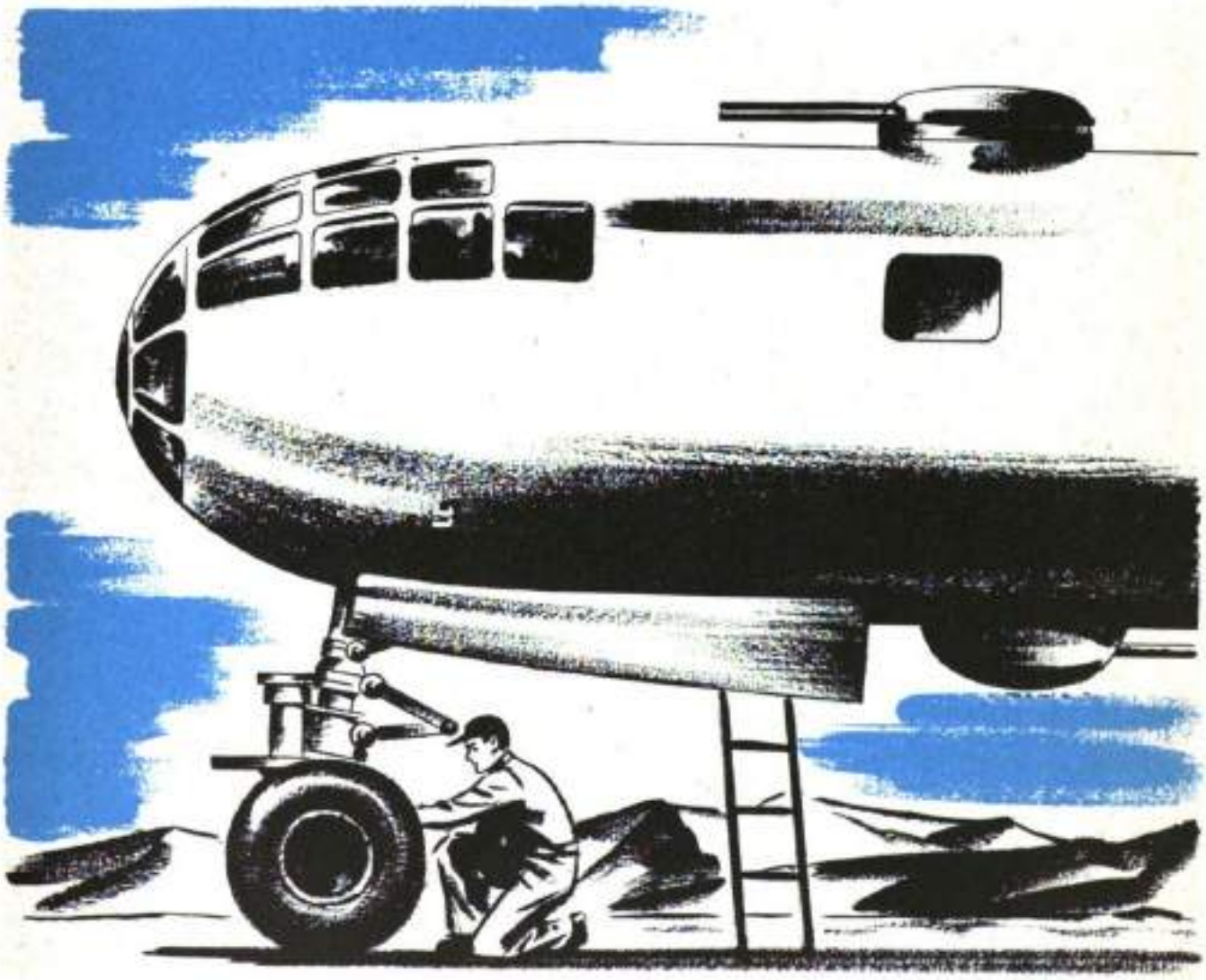
f. Nosewheel well doors and hinges—check: condition and security of attachment of doors; latch spring on actuating mechanism for tension or distortion; control cables for tension, wear, and freedom of movement.

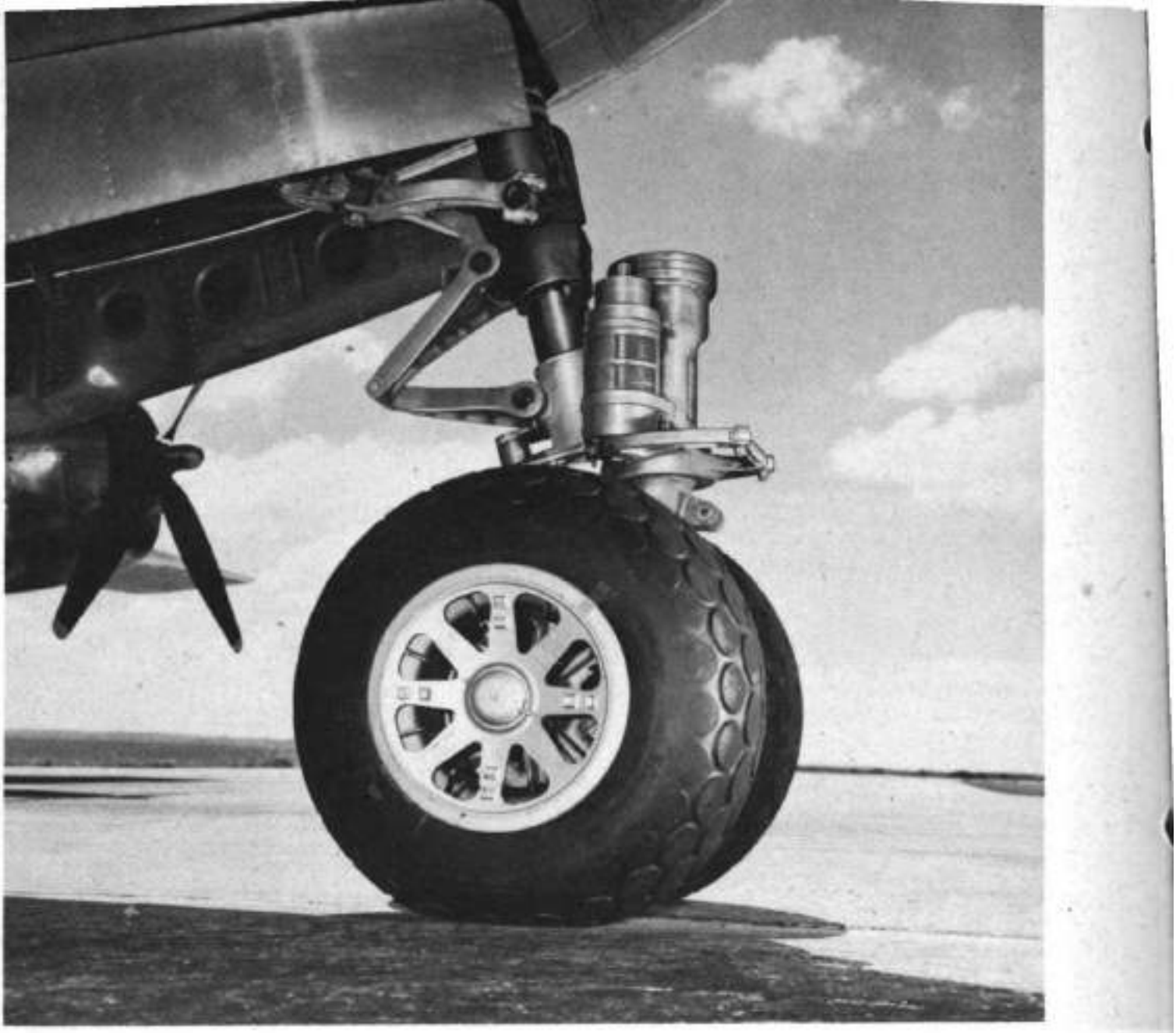
g. Nosegear limit switches—access doors to limit switches tight and screws safetied.

h. Electrical or manual emergency system—check cables for tension, wear and freedom from objects.

i. External power plug-in box—socket clean and box secure.

j. Nosewheel inspection window—cleanliness and condition.





8. Nosewheel

a. Down lock–in place.

b. Torsion links–alignment of pins and signs of failure.

c. Micro-safety switch–check for damage.

d. Shimmy damper–check oil level. (The top of the pin should be even with groove–plus or minus 3/16".)

e. Strut inflation–10" between pin centers (tolerance is +½" and —1"). Check for dirt on oleo and for leaks at filler valves and main packing nut.

f. Wheels–inspect for: mud, grass, ice, etc.; distorted rim flanges and ribs; security and presence of nuts, bolts and cotter pins.

g. Tires–check: proper and even inflation; excessive oil or grease; cuts, blisters, slippage, pulling away from rim, and chafing.

h. Centering device–security of mount.

9. Nose section.

a. Greenhouse–check cleanliness and condition.

b. Pitot tubes–covers off and tubes open.

c. A.P.I. vent–open.

d. Schwien regulator vent–open.

e. Static sources–open.

f. Forward turrets–stowed, domes and gun enclosures on and locked, and access doors closed.

g. Fuel tank vents–open.

10. Leading edge of wing between fuselage and No. 2 nacelle:

a. Inspect for cracks, corrosion, wrinkles and loose or missing rivets.

b. Aftercooler vent—open.

11. Front of No. 2 engine nacelle.

a. Prop blades—check for nicks, cracks and bends.

b. Thrust bearing and prop dome—check general condition.

c. Prop governor—check for oil leaks.

d. Cylinders—check for damaged or broken fins.

e. Bonding—check connections.

f. Sparkplug leads—check all visible leads for condition.

g. Nose cowling—check: rigidity, loose rivets or dzus fasteners, and dents which may hamper the airflow.

12. Leading edge of wing between No. 1 and No. 2 engine nacelle—inspect for cracks, corrosion, wrinkles and loose or missing rivets.

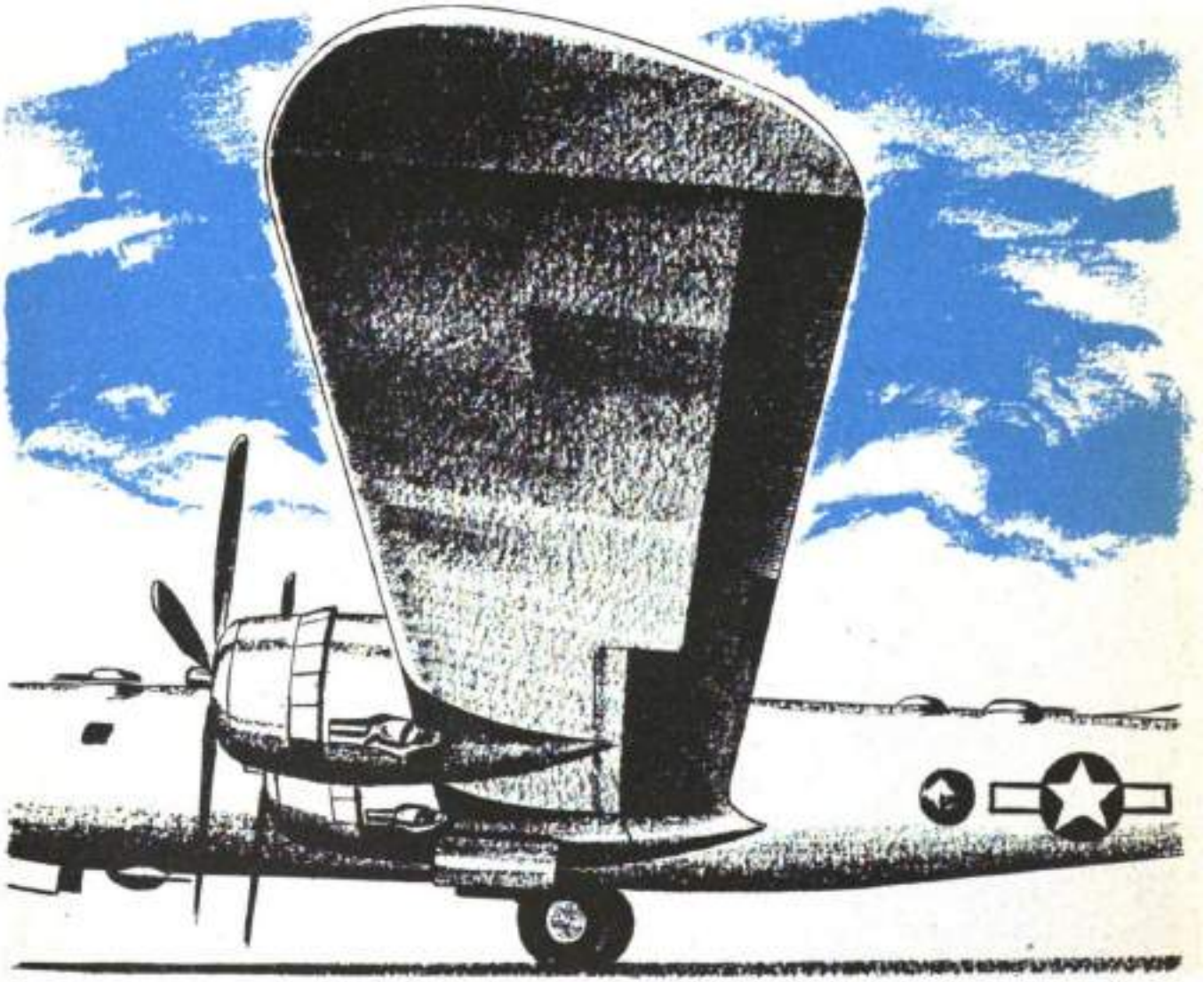
13. Front of No. 1 engine nacelle. Same as No. 11.

14. Leading edge of outboard wing. Same as No. 12.

15. Left wingtip—check for dents, cracks and loose or missing rivets.

a. Left navigation light – general condition (check operation if anticipating night flight).

b. Static discharge wicks—normally three on a wingtip.



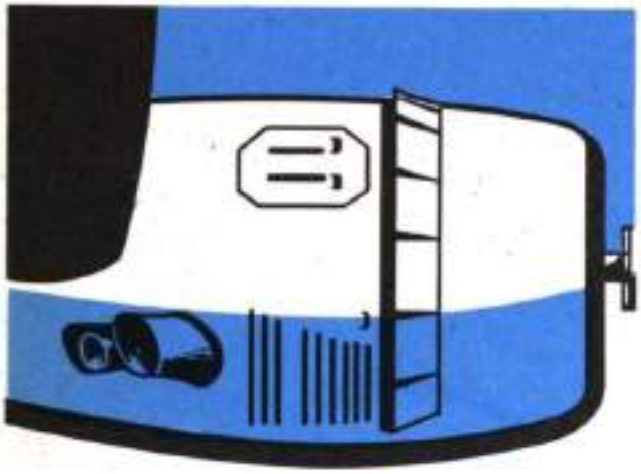
16. Left outer wing panel—check for: wrinkles, holes, dents, loose or missing rivets, fuel leaking from seams, loose fasteners on inspection plates.

a. Aileron—check for holes, wrinkles, cracks, and loose or missing rivets.

b. Trim tab—check condition and position of trim tab and re-check trim tab indicator.

c. Hinge pin retainers—check for presence.

d. Landing light—check cleanliness and condition. If anticipating night flight, check operation.



17. No. 1 nacelle (left side)—check for excessive oil or grease which is a definite fire hazard.

a. Cowling—check for dents, loose rivets, and security of mounting.

b. Cowl flaps—check for cracks, dents, and security. Inspect all flexible shafts for kinks and chafing.

c. Bonding, sparkplug leads, and cooling fins—check condition and security.

d. Intake pipes—check for rigidity and signs of failure, also leaks denoted by bluish dye color.

e. Fuel booster pump drain—open.

f. Exhaust stacks and turbo flight hood—check for broken lugs, studs, and bolts, cracked connections, and rigidity. Check exhaust expansion collar.

g. Top turbo head deflector in top of turbo wall—check for signs of failure.

h. Position of waste gate—open.

i. Oil coolers—open.

18. No. 1 nacelle (right side).

a. Waste gate—open.

b. Top turbo head deflector—same as No. 17g.

c. Intake stacks—same as No. 17d.

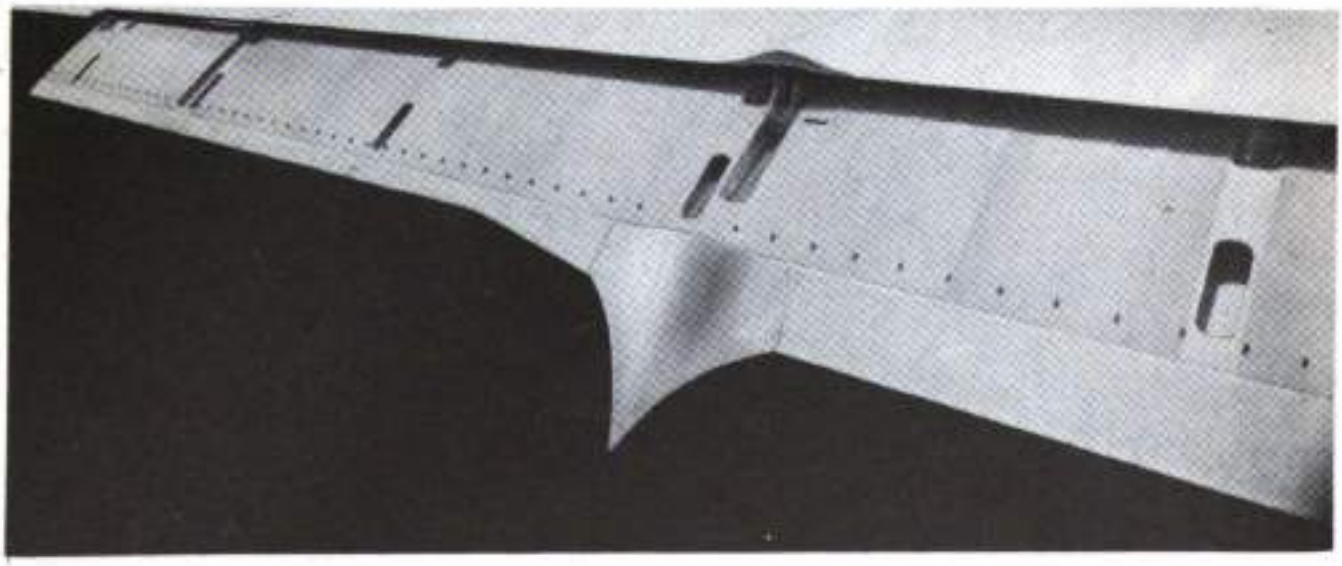
d. Exhaust stacks and turbo flight hood—same as No. 17f.

e. Cowl flaps—same as No. 17b.

f. Cowling—same as No. 17a.

19. Left inboard wing panel — check for: wrinkles, holes, dents, and loose or missing rivets; inspection plates for loose fasteners, and seams for fuel leaks.

a. Flaps—check for dents, cracks, loose or missing rivets, warpage and play (tolerance 9/10" up); check alignment in up position.



20. No. 2 nacelle (left side)—same as No. 17.

21. Left main gear and wheel well.

a. Left well door—check: condition and security of attachment, control cables for freedom of movement, tension and wear, and latch spring on actuating mechanism for tension.

b. Down lock—in place.

c. Gear motors (emergency and normal)—check cannon plugs for looseness and taping. Check connections, security of mounting and general condition of motors.

d. Well light—check bulb for condition and tightness. If night flight, check operation.

e. Emergency door releases—check for tension, wear and freedom of movement.

f. Relay switch—check security of mounting.

g. Fluid leaks in upper aft of nacelle—check fuel and hydraulic lines for leaks and chafing. This includes a check of the debooster valves.

h. Hydraulic swivel lines between wheels—check for loose connections and leaks.

i. Drag strut—check for alignment and signs of failure.

j. Torsion links—check for alignment of pins and signs of failure.

k. Left wheel and tire—check wheel for freedom from mud, grass, ice, etc., distorted rim flanges and ribs, security and presence of nuts, bolts and cotter pins. Check tire for proper and even inflation, excessive oil or grease, cuts, blisters, slippage, and pulling away from rims.

l. Outboard and inboard brakes—check the bottom of the wheel for signs of leaks in the expander tubes.

m. Main gear torsion link—check for alignment and signs of failure.

n. Ground wire — securely attached and grounded.

o. Micro-safety switch—check for damage.

p. Strut inflation—13¼" between pin centers (tolerance +½" and —1").

q. Right tire and wheel—same as No. 21k.

r. Outboard and inboard brakes — same as No. 21l.

s. Right well door—same as No. 21a.

22. No. 2 nacelle (right side)—same as No. 18.

23. Absolute altimeter antenna—check condition and security of mounting.

24. Left wing surfaces—check for loose rivets, unfastened inspection plates, cracks, wrinkles, and signs of excessive oil leaks from the engines.

25. Left blister—check for cleanliness and condition.

26. Upper turret—same as No. 9f.

27. Camera doors—in place.

28. Auxiliary power plant exhaust—open.

29. Lower rear turret—same as No. 9f.

30. Marker beacon antenna—check condition and security of mount.

31. Tailskid—check for leaks on strut and signs of failure.

32. Left horizontal stabilizer and elevator—inspect for corrosion, wrinkles, cracks, dents, and loose or missing rivets.

a. Static discharge wicks—check presence of two on each stabilizer and three on rudder.

b. Trim tab—check condition and position and re-check position later with indicator in the cockpit.

c. Hinge pin retainers—check presence.

33. Tail turret—gun stowed and access covers on.

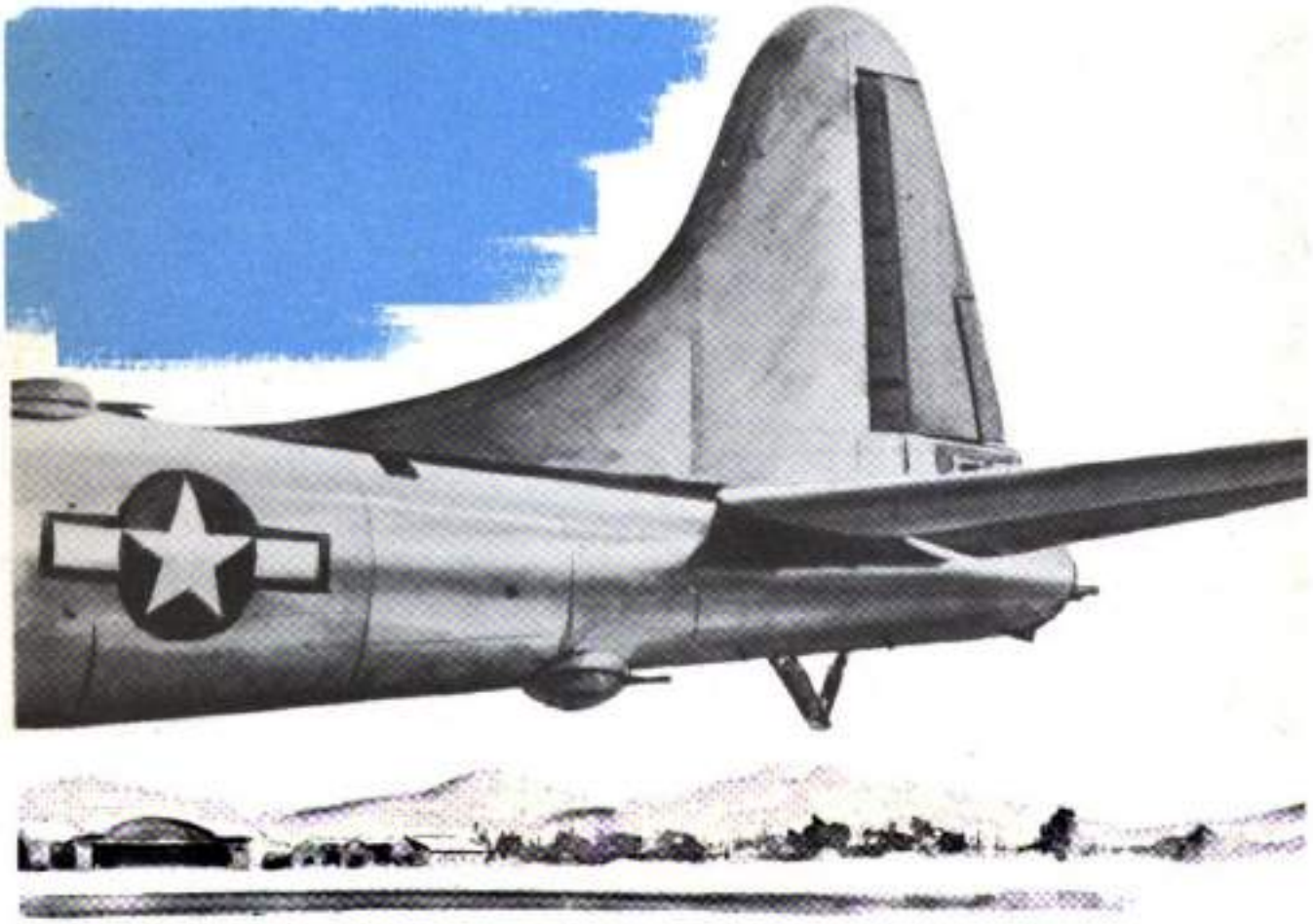
34. Condition of lights—check condition of all lights visible. If anticipating night flight, check operation.

35. Vertical stabilizer and rudder—inspect for corrosion, wrinkles, cracks, dents, and loose or missing rivets.

a. Trim tab—check condition and position and re-check position later with indicators in cockpit.

36. Right horizontal stabilizer — same as No. 32.

37. Command and liaison antenna—check for security, corrosion, and condition of leads.



38. Interior of rear unpressurized compartment—check for proper stowage of equipment, loose rags, and general condition.

a. Starter crank—stowed.

b. Fire extinguisher—same as No. 5a.

c. Putt-putt and battery – examine exterior for loose parts, leaks, and loose electrical connections. Check the oil level with the gage. (Should be up to F mark.) Check fuel. Fuel cap tight.

d. Rope for starting putt-putt—stowed.

e. Control cables – check for tension, wear, and freedom from foreign objects.

39. Rear pressurized compartment.

a. Emergency cabin pressure relief valve—check seating and security.

b. Vacuum relief valve—check for position, seal, and freedom of movement.

c. Pressure bulkhead door (Sta. 834)—check for movement and closed position for warpage.

d. Fire extinguisher—same as No. 5a.

e. Aldis lamp—OK.

f. Electric salvo switch—circuit breakers ON.

g. VHF and IFF switches—ON.

h. Pressure regulators—check general condition and rigidity of both regulators. (Knurled knobs should be screwed down tightly.)

i. Emergency cabin pressure release—check seating security and general condition of latching mechanism.

j. Manual salvo T-handle – in place with guard down.

k. Pressure bulkhead door (Sta. 646)—check movement and closed position for warpage.

l. Ditching braces—stowed.

m. CFC dome—cleanliness and condition.

40. Rear bomb bay.

a. Bomb door safety down lock—in place.

b. Bomb bay tank safety switch—ON.

c. Emergency main gear hand cranks – stowed.

d. Emergency landing gear T-handle – in place. Hand crank gear boxes – sockets free from dirt and foreign matter.

e. Portable motor – check condition and security.

f. Bomb door safety valves—OFF.

g. Accumulator pressure—1200-1500 psi.

h. Loading—visually check loading and number of bombs.

i. Control cables – check for tension, wear, and freedom from foreign objects.

41. Right blister—cleanliness and condition.

42. Right wing surfaces—same as No. 24.

43. Rear bomb bay tank vent—open.

44. Rear bomb bay doors and salvo releases—check for dents and warpage. Check cables for tension, wear, and freedom of movement.

45. Rear bomb bay compressor air intake and exhaust—open.

46. Midwing section.

a. Radar dome—retracted. Eagle wing—check for dents, cracks, wrinkles, and loose or missing rivets.

b. Midwing tank—check fuel load (gage) and filler cap in place.

c. Fuel lines—check for leaks, loose connections, and chafing.

d. Transfer pumps—check for leaks, rigidity, and general condition.

e. C-1—test connection.

47. Front bomb bay doors and salvo release—same as No. 44. The preflight from this point progresses as shown in the diagram on page 17. Consult the method of inspection of the various parts of the left side of the airplane for reference in inspecting similar parts of the right side.

WEIGHT AND CG CHECKED

Flight engineer will hand the airplane commander for approval and signature the weight and balance sheet (Form F). Airplane commander will see that CG is between limits (minimum between 18% and 24%, maximum at 34%).

CREW INSPECTION COMPLETED

Airplane commander will enter the airplane, see that all ignition switches are turned off and signal the other crew members or the ground crew to pull the props through, provided the engines have been cut more than 30 minutes. Props should be pulled through at least 12 blades, with not more than two men to a blade. If prop seems to stick, remove plugs from bottom cylinders, pull the prop through to remove excess oil from the cylinders, install clean plugs and pull the prop through 12 blades. (Do not attempt to relieve a liquid lock by applying pressure or by pulling the prop backwards.)

Airplane commander will then have crew line up to the left of the airplane's nose in the following order: copilot, bombardier, navigator, flight engineer, radar observer, radio operator, gunners, and passengers. Crew will then be inspected for physical condition and equipment, including oxygen masks, parachutes, flying clothing, and identification tags. (If dirty ramp conditions exist, crew members may place parachutes and other flying equipment in the airplane during preflight. However, parachutes will be worn and all other flying equipment will be carried at crew inspection. It is definitely the airplane commander's responsibility to inspect the crew and all their equipment before flight.)

Airplane commander will see that each crew member is familiar with his duties and with emergency procedures. After completing this inspection, crew members will enter the airplane and begin checklists for their stations.

NOTE

Prompt discovery of a liquid lock may prevent a late takeoff. The first crew members to reach the airplane will (after checking all ignition and battery switches OFF) pull each prop through four blades. This is merely a preliminary inspection and does not replace the procedure explained above. Each prop will be pulled through 12 blades immediately before crew inspection.

Pilots' Checklist

BEFORE STARTING

	AIRPLANE COMMANDER	COPILOT
1. PILOTS' PREFLIGHT	COMPLETED	
2. FORM 1A, LOADING LIST WEIGHT AND BALANCE	CHECKED	
3. CREW INSPECTION	COMPLETED	
4. LANDING GEAR DOWN LOCK BOMB BAY DOOR LOCK	REMOVED REMOVED	
5. PARACHUTES	CHECKED	CHECKED
6. CLOTHING	CHECKED	CHECKED
7. LIFE PRESERVERS	CHECKED	CHECKED
8. SEATS AND PEDALS	ADJUSTED	ADJUSTED
9. PARKING BRAKES AND CHOCKS	SET AND IN PLACE, LEFT	IN PLACE, RIGHT
10. SAFETY BELTS	ADJUSTED AND FASTENED	ADJUSTED AND FASTENED
11. EMERGENCY LANDING GEAR DOOR RELEASE	IN PLACE	
12. EMERGENCY BOMB RELEASE	IN PLACE	
13. EMERGENCY CABIN PRESSURE RELEASE	IN PLACE	
14. LANDING GEAR TRANSFER SWITCH	NORMAL	
15. OVERCONTROL	ENGAGED	
16. LANDING GEAR SWITCH AND FUSE		SWITCH DOWN, FUSE CHECKED
17. BATTERY SWITCH		ON
18. HYDRAULIC PRESSURE		_____PSI
19. FLIGHT CONTROLS		CHECKED
20. RADIO	CHECKED	CHECKED
21. ALTIMETERS	SET	SET
22. TURRETS	STOWED	
23. LIGHTS	CHECKED	CHECKED
24. OXYGEN PRESSURE	_____PSI	_____PSI
25. PROPELLERS	HIGH RPM	
26. TURBOS	OFF	
27. FLIGHT ENGINEER'S REPORT		ENGINEER'S REPORT
28. STAND CLEAR—FIRE GUARD	CLEAR LEFT	CLEAR RIGHT

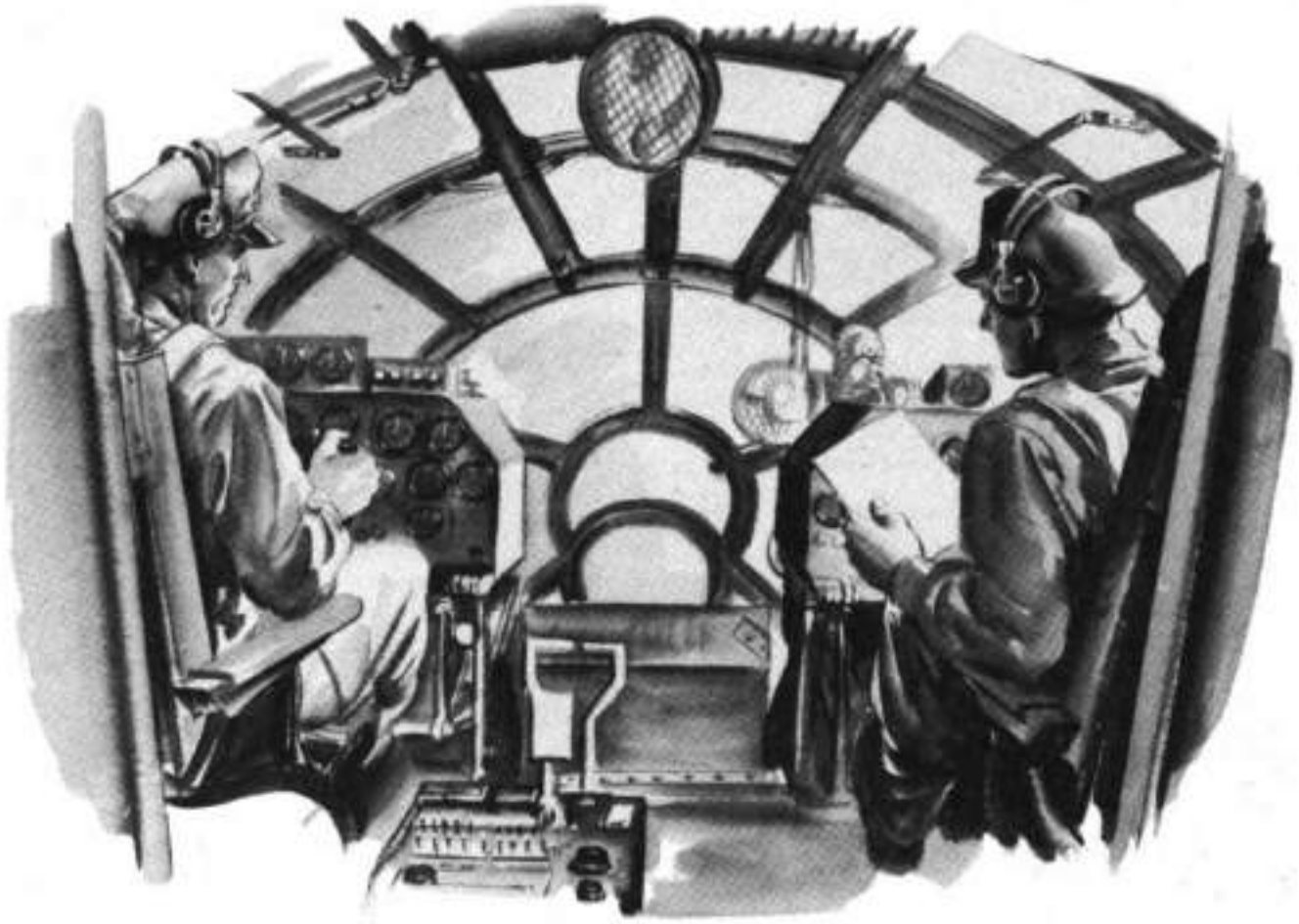
BEFORE TAXIING

1. VACUUM		CHECKED
2. GYROS	UNCAGED	UNCAGED
3. INSTRUMENTS	CHECKED	CHECKED
4. ALARM BELL 5. PHONE CALL—SIGNAL LIGHT 6. COMBAT STATION REPORT	.....	CHECKED
7. CHOCKS	OUT LEFT	OUT RIGHT
8. BOMB BAY DOORS		CLOSED
9. PARKING BRAKES	OFF	OFF—READY TO TAXI
10. EMERGENCY BRAKES	CHECKED	

	AIRPLANE COMMANDER	COPILOT
BEFORE TAKEOFF		
1. NOSEWHEEL		STRAIGHT
2. ENGINE RUN-UP		
3. WING FLAPS		SET TO 25°
4. TRIM TABS	NEUTRAL	
5. AUTOPILOT	OFF	
6. WINDOWS AND HATCHES	CLOSED	CLOSED
7. TURBOS		SET FOR TAKEOFF
8. PROPELLERS		HIGH RPM
9. CREW		READY FOR TAKEOFF
10. RADIO CALL	COMPLETED	
11. THROTTLE BRAKE	ADJUSTED	
12. FLIGHT CONTROLS	CHECKED	
BEFORE LANDING		
1. CREW		PREPARE FOR LANDING
2. RADIO CALL	COMPLETED	
3. ALTIMETER	SET	SET
4. AUTOPILOT	OFF	
5. TURRETS	STOWED	
6. HYDRAULIC PRESSURE		_____PSI
7. PROPELLERS		2400 RPM
8. LANDING GEAR		DOWN, GREEN LIGHTS ON
9. ENGINEER'S REPORT		GROSS WEIGHT ____LBS, PUTT-PUTT ON LINE READY TO LAND
10. STALLING SPEED		_____MPH
11. WING FLAPS		AS REQUESTED
12. TURBOS		SET
AFTER LANDING		
1. HYDRAULIC PRESSURE		OK
2. TURBOS		OFF
3. PROPELLERS		HIGH RPM
4. WING FLAPS		UP WHEN REQUESTED
5. PARKING BRAKES	SET	
6. BOMB BAY DOORS		OPEN
7. ENGINES		RUN-UP AND CUT
8. RADIO	OFF	OFF
9. CONTROLS	LOCKED	
10. CHOCKS	IN PLACE LEFT	IN PLACE RIGHT
11. BRAKES	OFF	
12. FORMS 1 AND 1A	ACCOMPLISHED	
13. CREW INSPECTION		

Before Starting

1-3. When you have completed your visual check (items 1 to 3 on your checklist) and have climbed into your seat beside your co-pilot, you are ready for the rest of the Before Starting Checklist.



4. Landing Gear Down Lock and Bomb Bay Door Locks Removed

5. Parachutes Checked

Airplane commander and copilot put on parachutes at this time, and check for location of their seat-type dinghies if the airplane carries them.

6. Clothing Checked

Airplane commander and copilot check for proper clothing for mission to be performed. Adjust helmet, throat microphone, and attach oxygen mask to left side of helmet.

7. Life Preservers Checked

On all over-water flights, airplane commander and copilot check to see that their life vests are fitted with cartridges. Wear parachute harness over life vest.

8. Seats and Pedals Adjusted

9. Parking Brakes in Place and Chocks Set

Airplane commander depresses rudder pedals and pulls out the parking brake lever. He and the copilot look out the windows on their respective sides to see that chocks are in place.

10. Safety Belts Adjusted and Fastened

11. Emergency Landing Gear Door Release in Place

T-handle on airplane commander's control stand should be down and safetied with light wire. Pulling this handle releases the nacelle doors only. (Installed only in earlier series.)

12. Emergency Bomb Door Release in Place

T-handle on airplane commander's control stand should be down and **safetied** with light wire.

13. Emergency Cabin Pressure Release in Place

T-handle on airplane commander's control stand should be down and **safetied** with light wire.

14. Landing Gear Transfer Switch NORMAL

Airplane commander sees that switch (airplane commander's control stand) is in the NORMAL position. In this position, the main landing gear and nosewheel are operated by the landing gear switch on the aisle stand. When the landing gear transfer switch is in the EMERGENCY position, power from the engine-driven generators goes to the emergency bus and the emergency landing gear motors can be actuated by the emergency landing gear switches. (Installed in earlier series only.)

15. Overcontrol ENGAGED

Airplane commander sees that the lever on airplane commander's control stand (eliminated in later series) is in the ENGAGED position (full forward). This engages the flight engineer's throttles.

16. Landing Gear Switch DOWN and Fuse Checked

Switch (airplane commander's aisle stand) should be down. Check to see that fuse in airplane commander's aisle stand is in place and not burned out.

17. Battery Switch ON

Copilot calls on interphone: **"Battery switch."** Flight engineer flips battery switch ON and notifies the copilot.

18. Hydraulic Pressure

The copilot asks the flight engineer to check the emergency hydraulic pressure on the engineer's panel (900-1075 psi). Copilot then checks the normal hydraulic pressure by depressing and releasing the brake pedals until the gage on his control stand indicates 800 ± 25 psi. The hydraulic pump should then cut in and build the pressure up to 1000 ± 25 psi.

19. Flight Controls Checked

Airplane commander pushes down locking lever located at forward end of airplane commander's aisle stand. This also unlocks the throttles, which are held in closed position by a lock bar when the control lock is on. This lock bar is linked to the control lock in such a way that strong forward pressure on the throttles forces the control lock off and eliminates the possibility of locked controls on takeoff. (**Note:** Make sure that the control lock lever is pushed all the way down and fixed securely in the unlocked position.) The copilot makes the control check. In making the check, the copilot announces over the interphone: **"Copilot to gunners; stand by to check flight controls."** He then pulls the control column back and says on interphone: **"Check elevators."** Left

gunner answers: **"Left elevator up, sir."** Right gunner answers: **"Right elevator up, sir."** The copilot then pushes the column forward and completes his check on the elevators. Ailerons and rudder are checked in the same manner.

20. Radios Checked

While the copilot is checking flight controls, the airplane commander turns on his radio and requests and receives taxi information. Copilot, after checking controls, turns on radio compass and checks for proper operation. He then turns radio compass off and stands by on the interphone so that he can be in continuous contact with the crew.

21. Altimeters Set

Airplane commander and copilot set their altimeters by the tower altimeter setting. Check the altitude reading against the known field elevation. If the altimeter setting given by the tower indicates an altitude different from the known field elevation, check the setting again and note the difference in elevation so you can use it in correcting the reading when landing.

22. Turrets Stowed

Airplane commander checks all turret warning lights on his instrument panel to see that all turrets are properly stowed. Turret lights should be out.

23. Lights Checked

If any night operation is contemplated on the flight, check all lights—fluorescent lights, identification lights, landing lights, and position lights (switches on control and aisle stands). A member of the ground crew should be instructed to check the landing lights and position lights. Wing position lights are not visible from the airplane in flight. They can be inspected at night from inside the airplane only by checking the reflection on the ground.

24. Oxygen_____PSI

Airplane commander and copilot check their oxygen pressure gages and their walk-around bottles for proper pressure (400 to 425 psi). Auto mix should be on ON, emergency valve OFF.

25. Propellers High Rpm

The airplane commander pushes the propeller switches (on the aisle stand) to INCREASE RPM (forward) and holds them there until the propeller limit lights on copilot's instrument panel flash on. The propeller governors then will be in high rpm. (**Note:** Always grasp both gang plates when making propeller adjustments. This insures action of all four toggle switches and prevents any possibility of their sticking.

26. Turbos Off

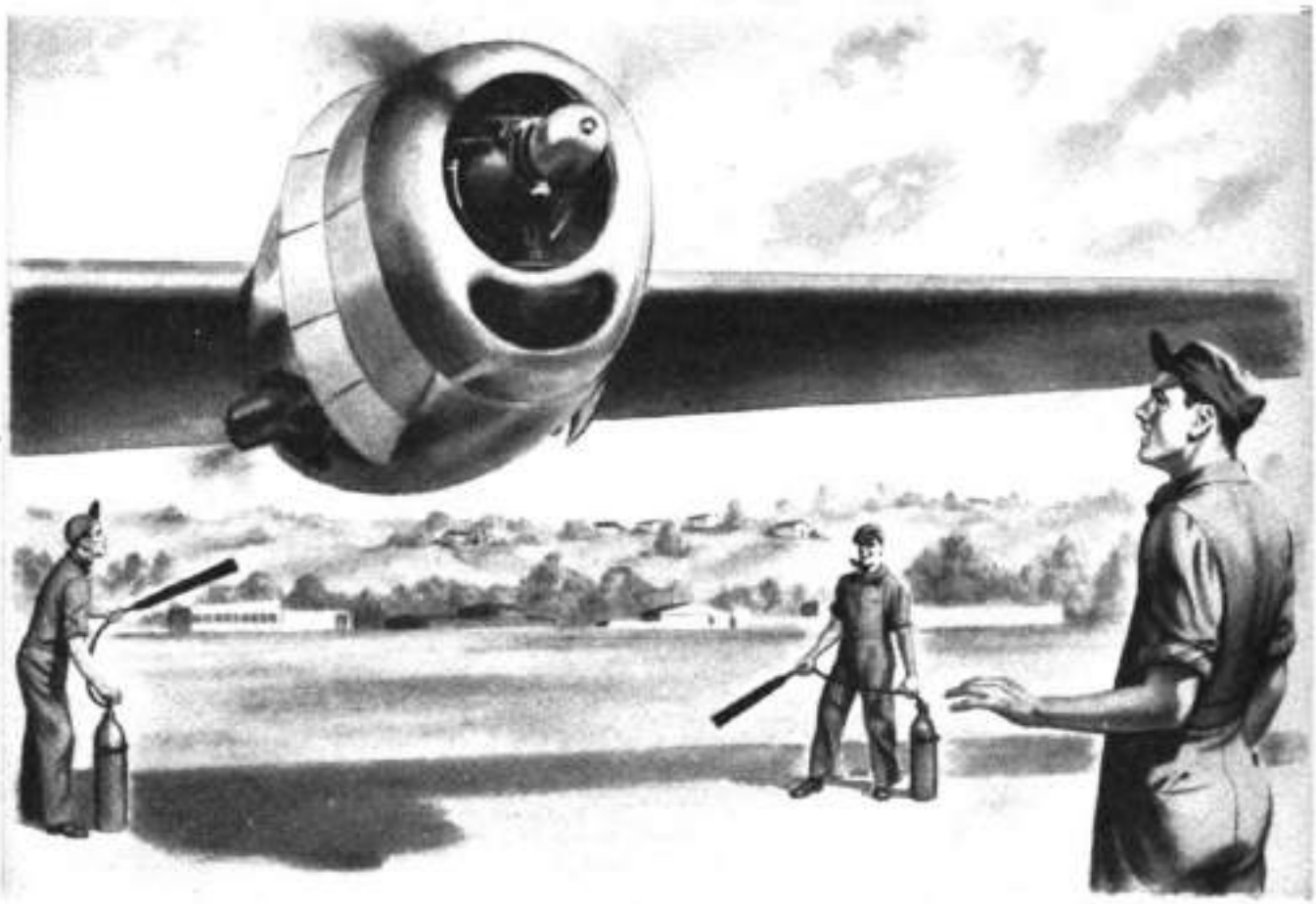
Airplane commander checks to see that the turbo selector dial is set at 0. Turbo-supercharger regulators are ready for instant operation at any time since amplifier tubes remain on even with selector dial at 0.

27. Flight Engineer's Report

The copilot calls on the interphone: **"Engineer's report."** The flight engineer responds: **"Ready to start engines."** (At this point, if the flight engineer has not completed his checklist, the airplane commander waits before giving the command to start engines.)

28. Stand Clear—Fire Guard—Clear Left—Clear Right

When ready to start the engines both the airplane commander and the copilot give the command **"Stand clear"** to the ground crew (clear right, clear left). When the fire guard is ready, copilot says on interphone: **"Stand by to start engines."**



Starting the Engines

The engines are started in 1, 2, 3, 4 order. The airplane commander signifies to the ground crew that No. 1 engine is ready to be started, and then tells the flight engineer to start No. 1 engine. The number of fingers held up by the airplane commander and copilot indicates the number of the engine to be started.

When the engine starts, the flight engineer ordinarily reports: **"Engine operating normally."** Then he announces: **"Ready to start No. 2 engine."** Follow a similar procedure for the other engines.

The flight engineer handles the throttles throughout the starting procedure, keeping the rpm between 1000 and 1200. When an engine is running smoothly, the flight engineer sets the throttle at 700-1000 (1000 rpm if oil temperature is below 40°C). Thereafter, the airplane commander will control the throttles except when asking for engine-driven generators and during the engine run-up. If any crew member sees that an engine is loading up (black smoke, or rpm drop, or both) he informs the copilot on interphone. In the event of engine fire, place jackbox in CALL position and make necessary report.

DO NOT IDLE ENGINES BELOW 700 RPM

STARTING DON'TS

1. Don't start the engines until the Before Starting Checklist has been covered item by item.

2. Don't start the engines until the propellers have been pulled through to eliminate any possibility of liquid locks.

3. Don't jam throttles forward at any time, especially during the starting procedure.

4. Don't start your engines until a fire guard is posted.

5. Don't continue to run an engine if the nose oil pressure and rear oil pressure do not build up within 30 seconds after starting.

Before Taxiing

1. Vacuum Checked

The copilot tells the flight engineer on interphone: **"Check vacuum."** The flight engineer, after checking the vacuum reading for both pumps (gage on engineer's panel should read 3.8" to 4.2" Hg.), reports this check to the copilot on interphone.

If the vacuum selector valve is stopped between the two ON positions the light on the airplane commander's instrument panel will flash on.

2. Gyros Uncaged

Airplane commander and copilot check their gyro instruments to make sure that they are uncaged and operating correctly. At this time, set the directional gyros to agree with the magnetic compass reading.

3. Instruments Checked

Airplane commander and copilot check their respective instrument panels for proper readings and operation of all instruments.

On One Interphone Call Check

4. Alarm Bell

5. Phone Call Signal Light

6. Combat Station Report

Airplane commander switches on alarm bell (aisle stand) and phone call signal light (aisle stand), then calls for combat station report. Copilot repeats this command on interphone saying, **"Combat station report,"** and receives acknowledgment in the following manner: bombardier, flight engineer, navigator, radio operator, top gunner, left gunner, right gunner, radar observer, and tail gunner (in that order) acknowledge that they have completed a check of their stations by saying, for example: **"Flight engineer O.K."; "Alarm bell O.K., light O.K., top gunner O.K."; "Left (or right) gunner O.K."; "Light O.K. (radar compartment), tail gunner O.K."**

7. Chocks Out

Airplane commander and copilot check to see that chocks have been pulled.

8. Bomb Bay Doors Closed

Copilot calls for bomb bay doors closed. Copilot says on interphone: **"Bomb bay doors closing."** Flight engineer sets throttle on coolest engine to 1500 rpm and places generator on the line. The radio operator and one of the gunners check through the pressure doors and report to the copilot when the doors are closed. Flight engineer then returns throttles to 700 rpm and turns all generators off. (Generator procedure is unnecessary with pneumatic bomb bay doors.)

When bomb bay doors are of the pneumatic type.

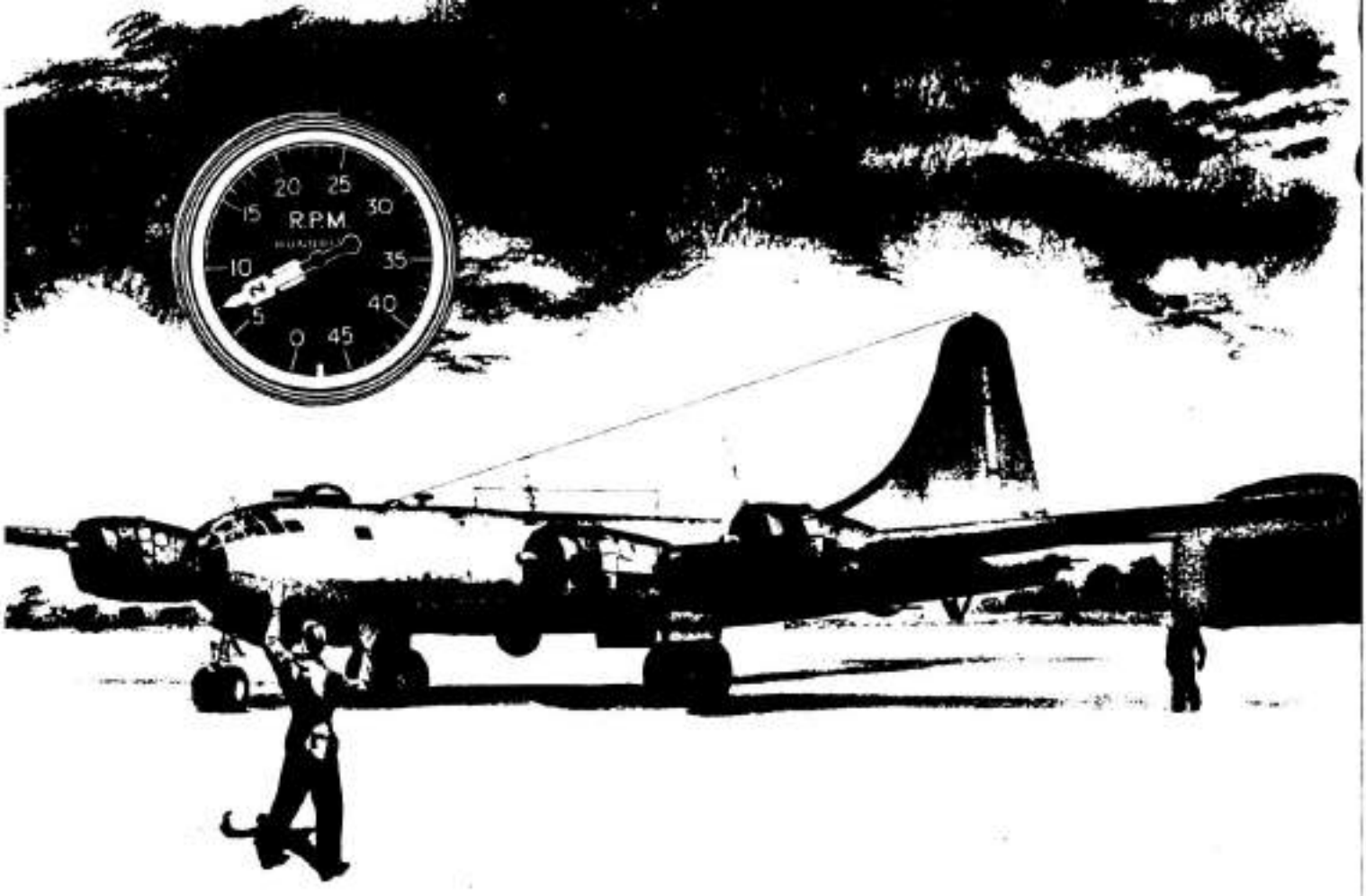
Radio operator and scanner open the bomb bay door safety shut-off valve, check the bomb bay safety switches for the "can salvo" (ON) position, and then report: **"Bomb bay doors closed, safety valves open."**

9. Parking Brakes Off, Ready to Taxi

After releasing the parking brakes, the airplane commander gives the command: **"Parking brakes off, ready to taxi."** The copilot repeats the command over the interphone.

10. Emergency Brakes Checked

After parking brakes are released, when starting to taxi, the copilot says: **"Emergency brakes."** Airplane commander then pulls the emergency brake hand metering levers (aisle stand) to see that emergency brakes are operating properly on both sides. Copilot then tells flight engineer to recharge the emergency system. Normal brakes may be used safely while recharging the emergency system since the electric hydraulic pump recharges both systems with the hydraulic servicing valve on emergency.



TAXIING PROCEDURE

Like all tricycle-landing-gear aircraft, the B-29 taxis easily. The brakes are good and have four expander tubes per wheel. Remember, however, that the B-29 is big and heavy. It gains momentum rapidly and, because of its size, you have to depend on your side and top gunners to act as observers to warn you of obstacles.

For all ground operations, set the props at 700-1000 rpm and the mixture in AUTO RICH. **Never use AUTO LEAN for taxiing.** If the carburetors are adjusted properly the engines idle as low as 550 rpm without loading up.

When taxiing uphill or in hot weather, 700 rpm may not keep the airplane rolling. Under these conditions, increase all throttle settings, but not more than necessary to continue taxiing. Always return throttles to 700 rpm when parked.

For maximum cooling and prevention of backfires, control both the speed and direction with brakes alone. Entering a taxi turn with outside throttle doesn't save your brakes, in the long run, because the speed of the airplane accelerates quickly with this extra power and you must use the brakes to slow down. If you gain too much speed, bring the airplane almost to a stop, straight ahead, then stay off the brakes as long as possible to let them cool.

Don't Ride Your Brakes

BEFORE TAKEOFF

1. Nosewheel Straight

Before engine run-up, copilot checks through cockpit floor observation window to make sure the nosewheel is straight.

2. Engine Run-up

The airplane commander gives the command: **"Stand by for engine run-up,"** and the copilot repeats the command over the interphone. The engine run-up for first takeoff should be accomplished in the following manner (for subsequent takeoffs items a. through g. may be eliminated):

a. Airplane commander increases all throttles to 1500 rpm and commands: **"Check generators."** Copilot starts flaps down (switch on aisle stand) and tells flight engineer (on interphone) to check generators. Copilot holds switch DOWN until flaps have reached 25°, pauses for 10 seconds, and then brings flaps to full UP position.

Note: Flaps are run down at this time in order to have an electrical load on the normal bus so the flight engineer can properly check the generators. Gunners check the lowering of the flaps by reporting: **"Left flap down 25°,"** and **"Right flap down 25°."**

b. Airplane commander operates all four propeller switches to full decrease then to full increase (from limit warning light to limit warning light) to test the propeller governors. At full decrease rpm, before returning switches to increase rpm, check tachometers for stable, uniform readings of 1200-1300 rpm. When propellers are again returned to high rpm, tachometers should all read 1500 as before. Any propeller overshooting the original setting is not being properly governed and this must be corrected before takeoff. (See section on **Curtiss Electric Propeller System** for engine run-up of airplanes equipped with these props.)

c. When propellers and generators are checked, airplane commander pulls No. 2, 3, and 4 throttles back to 700-1000 rpm and tells flight engineer to check magnetos.

d. Flight engineer advances No. 1 throttle to 2200 rpm, reports manifold pressure to copilot, checks magnetos, and calls out, **"Right, both, left, both."** Flight engineer then returns throttle to 700 rpm. (If desired, a full-power, no-boost run-up may be made.) At sea level, approximately 32" is normal manifold pressure for 2200 rpm. Above sea level, subtract one inch for each thousand feet of altitude. Changes in temperature will vary these settings, but the variation will be the same for all engines. Excessive manifold pressure on one engine is an indication of a bad cylinder, a bad valve, or some other engine malfunction.

e. Magneto check is made for each engine. Allowable drop at 2200 rpm is 100.

f. If rpm drop on any engine is more than 100 (caused by fouled plugs) proceed with full-power check for that engine. Then check magnetos (turbos off) on bad engine again. If rpm drop is still above 100, return airplane to the line.

g. After magnetos are checked, airplane commander sets turbo selector to takeoff position and advances throttles one at a time full open to check manifold pressure and rpm. For this ground check gages should read between 2500 and 2600 rpm and 46½" and 47½" manifold pressure. Deduct ½" manifold pressure for each 50 rpm below maximum governed speed. (For certain types of engines, gages should read 2700-2800 rpm and 48"-49" Hg.)

WARNING

Do not check magnetos with turbos on. A backfire at this time (with turbos on) can damage turbo and waste gate assembly.

If possible head the airplane into the wind for maximum cooling during engine run-up.

3. Wing Flaps Set to 25°

Lower wing flaps to 25° and have gunners report: **"Left flap down 25°," "Right flap down 25°."**

4. Trim Tabs Neutral

The airplane commander checks to see that all trim tab controls are in the neutral position.

5. Autopilot OFF

The airplane commander makes sure that all autopilot switches (airplane commander's aisle stand) are off.

6. Windows and Hatches Closed

As the airplane commander closes and secures his window, the copilot closes his, checks to see that the forward compartment entrance hatch is closed, and checks over the interphone saying: **"Close rear entrance door and escape hatch"** to the tail gunner to make sure that the rear entrance door and rear escape hatch are closed.

7. Turbos Set for Takeoff

On most airplanes takeoff setting on TBS will be position No. 8. Some airplanes are equipped with the Type B-7 control on the TBS to provide for water injection. On these airplanes the takeoff setting is marked at 3¾ on the TBS.

8. Propellers High RPM

The copilot pushes the propeller switches (on aisle stand) to INCREASE RPM (forward) and holds them there until propeller limit lights on his panel flash on.

9. Crew Ready for Takeoff

The copilot says on interphone: **"Prepare for takeoff,"** then notifies the airplane commander.

10. Radio Call Completed

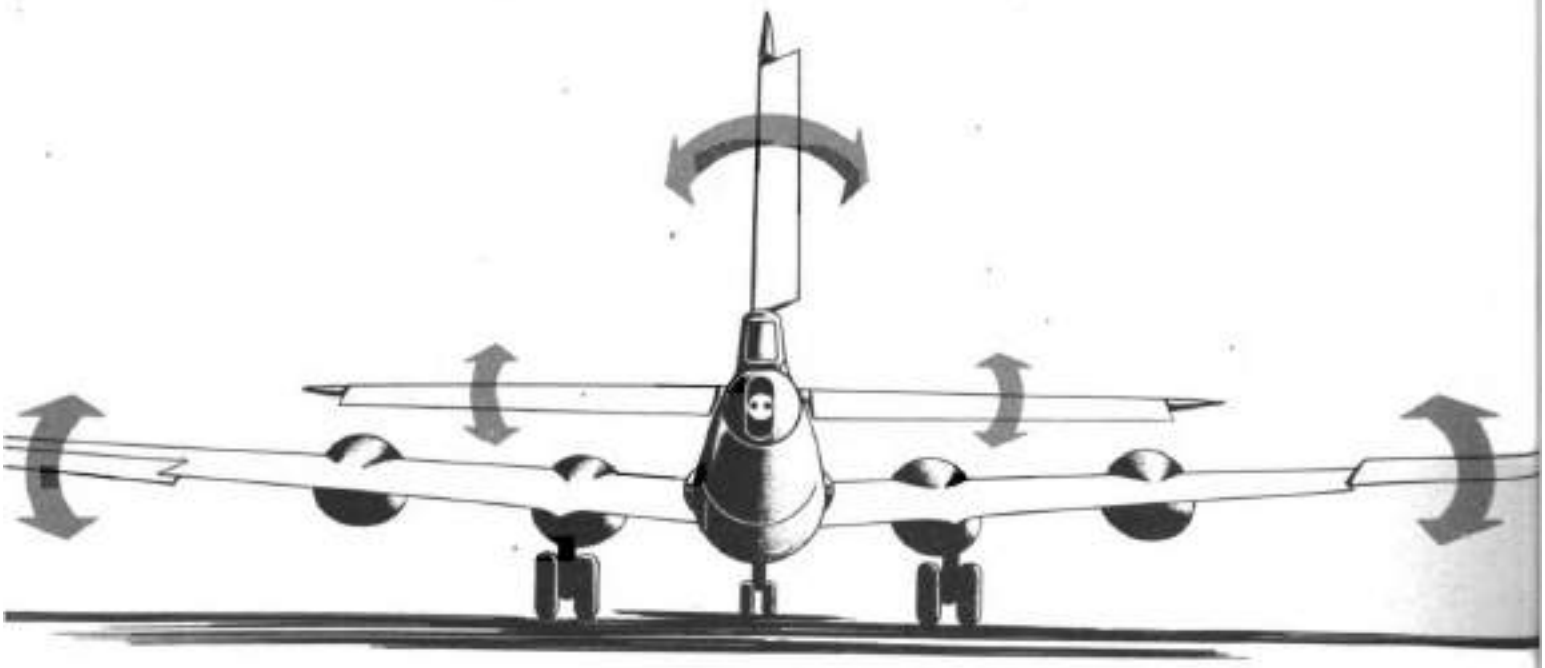
Airplane commander calls tower and requests permission to take off.

11. Throttle Brake Adjusted

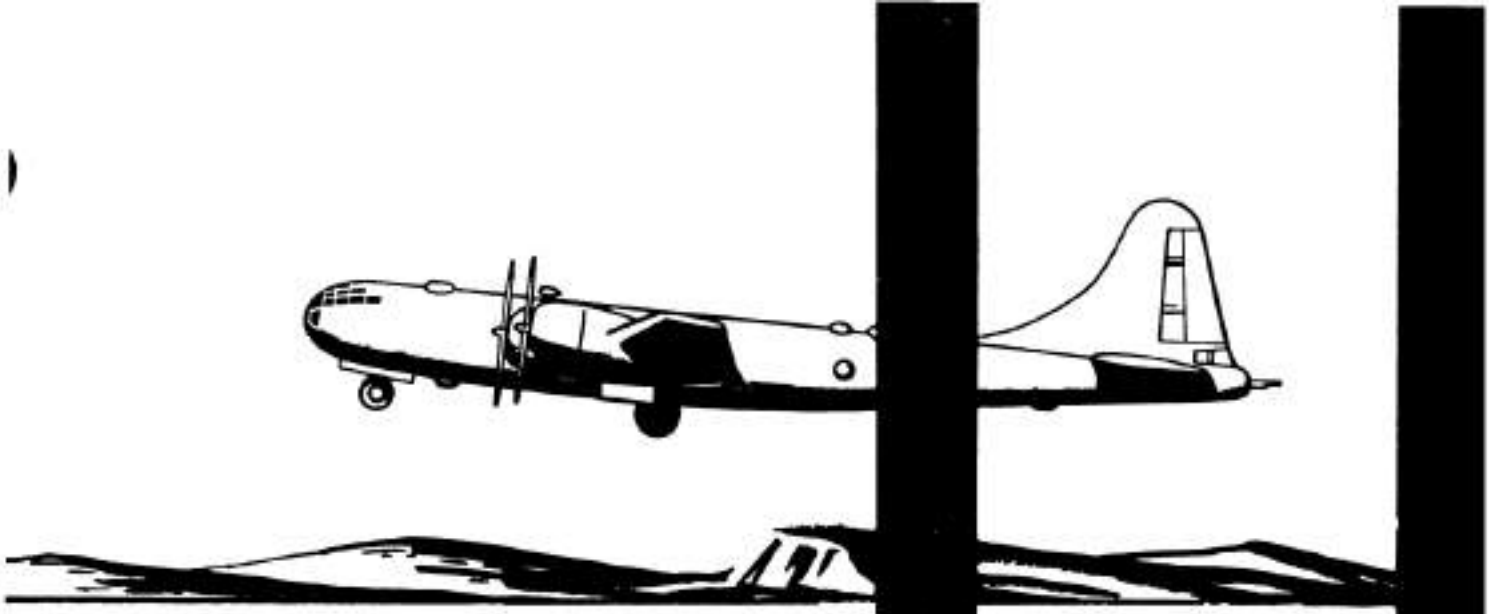
Airplane commander adjusts his throttle brake for desired friction to prevent slipping.

12. Flight Controls Checked

Check controls for freedom of movement. Airplane commander, as he turns onto runway, notifies flight engineer:



"Stand by for takeoff"



Keep the cylinder-head temperatures (CHT) at a minimum before takeoff. Never take off with any CHT above 220°C.

Use the minimum of brakes and throttles to line up on runway. Then, as the airplane starts to roll, advance the throttles slowly. The rudder begins to be effective at approximately 70 mph. In this way, you can maintain directional control first with throttles, then with rudder.

Don't use the brakes to hold the airplane straight on the runway, except in emergencies, since this increases the takeoff distance and wears out the brakes and tires. If you are careful not to use brakes, the airplane will gain speed continuously from the point of run-up to the point where the wheels leave the ground.

If you advance the throttles too quickly at the beginning of the roll, you won't have the reserve power necessary to hold the airplane straight with throttles and until the airplane picks up speed you may have to use brakes to stay on the runway. This increases the time required to get rudder control, and lengthens the takeoff roll.

The copilot follows through on throttles, making a continuous power check as the throttles are advanced during the initial takeoff roll. Full power should be obtained during the roll down the first third of the runway. If any unusual power conditions are noted, the copilot notifies the airplane commander, who still has time to cut throttles if he decides that takeoff is inadvisable.

Never attempt takeoff with less than full takeoff power. Full-power takeoffs are not harmful to the engines as long as the CHT's stay within their limits. Takeoffs with reduced power prolong the time required to reach 195 mph—the minimum speed at which adequate engine cooling can be obtained during the initial climb.

When adjusting propeller rpm immediately after takeoff, **make sure that none of the propeller rpm switches sticks in the decrease rpm position. TO BE SURE, ALWAYS USE BOTH GANG PLATES WHEN OPERATING THE SWITCHES.**

At 90 mph, relieve pressure on the nosewheel oleo by easing the control column back. As soon as the ship is safely off, airplane commander brakes wheels and calls for gear up.

Note: Don't pull the nosewheel off the ground. Just relieve pressure so as to lengthen the oleo strut. For the ideal takeoff the nosewheel will not be more than one inch from the ground during any part of the takeoff roll. The airplane will become airborne in a good safe flight attitude which will facilitate a steady climb and a rapidly accelerating airspeed.

Power Condition Two

At a minimum of 140 IAS the airplane commander calls for Power Condition 2 (43½" and 2400).

At 150 mph, the airplane commander calls for flaps up easy. A recommended procedure is to have the copilot retract flaps to 10° at which time he notifies the airplane commander and then completes the retraction.

CAUTION: As the flaps come up to last 10° there is a noticeable change in lift and the airplane commander should be alert to compensate for this change in lift by back pressure on the control column. Gear and flaps pull a total of 965 amperes and may be safely raised together provided the switches are not tripped simultaneously.

Copilot receives reports from side gunners and tail gunner on operation of gear, flaps, and tailskid.

With gear and flaps full up, the airplane commander calls for power reduction. Reduce the manifold pressure with the turbo selector dial until turbos are off, at which time copilot announces to flight engineer, "**Turbos off.**" Make subsequent manifold pressure reductions with the throttles.

Cowl flaps, which are 15° open as the airplane takes the runway, are closed to 7½° or less (depending on cylinder-head temperatures) by the time the airplane leaves the ground. This setting permits rapid increase of airspeed and should keep all cylinder-head temperatures below 260°C.

If cylinder-head temperatures rise above 260°C on takeoff, or stay above 248°C after the second power reduction, the flight engineer informs the airplane commander. The airplane commander can then order cowl flaps on the hot engine opened to a maximum of 10°. (Never open cowl flaps more than 10° in flight. Larger openings provide little, if any, additional cooling and reduce cruising ranges considerably.) Or, the airplane commander can pull back the throttle on the hot engine to about 25". A slight reduction of manifold pressure is often sufficient to reduce cylinder-head temperature to within operating limits. The throttle should not be pulled back unless the airplane has reached 170 mph.

Cowl flaps should be set at the smallest opening which keeps cylinder-head temperatures below the required maximum (260° for takeoff, 248° for climb, 232° for cruising—continuous).

NOTE

On all takeoffs, first climb to 500 feet above the terrain with a minimum airspeed of 160 mph. Then, before continuing the climb, level off until reaching climbing airspeed (195 to 205, depending on weight) and until CHT's fall below 248°C.

TAKEOFF EMERGENCIES

Just remember these points if an engine fails on takeoff:

1. Get directional control first, using rudder and minimum aileron. Then pick up airspeed before trying to climb.

Because of the large flap area on the B-29, the total or partial loss of an engine on one side creates an unbalanced blast against the flaps which tends to raise one wing and lower the other. Ailerons may not be effective enough to counteract this tendency to roll unless power is balanced. However, if one engine has been retarded to balance power, restore power as soon as the airplane is under control.

2. Drag with gear and flaps down is excessive, so raise gear immediately and bring up flaps at 150 mph, even if gear is not all the way up.

3. If you use turbo position No. 10, reduce power as soon as possible.

4. Determine which engine has failed and whether it is delivering some power or should be feathered.

5. If two engines fail on takeoff, be prepared to crash-land straight ahead.

6. If possible avoid climbing below 170 mph.

Runaway Propeller

1. **Throttle back** to bring rpm and manifold pressure within limits: 2200 rpm and 35" Hg.

2. If throttle does not control rpm, use the feathering button intermittently. Feather propeller completely as soon as a safe altitude is reached.

Don't confuse normal overspeeding of the propellers up to 3150 rpm, caused by a power surge, with a runaway propeller. The governor normally returns an overspeeding propeller to the set speed within a few seconds. Sometimes, after the feathering button has been used to return the propeller to normal rpm, the governor controls the propeller, if the airplane commander is careful not to apply sudden power to the engine. In this case, do not feather the propeller. Just handle the throttles carefully and come in for a landing as soon as possible.

If propeller continues to overspeed beyond 3150 rpm, **throttle back** to control rpm. **Do not try to control a runaway propeller by holding the propeller toggle switch in the decrease rpm position.**

Runaway Turbo

1. **Throttle back** to bring manifold pressure within limits.

2. Change amplifier (amplifiers mounted forward of navigator's seat).

Climb

If all cylinder-head temperatures run high during a sustained climb, hold the climbing power setting and level off until the cylinder-head temperatures return to normal, then start climbing again.

Climb at rated power, regardless of the gross weight. Rated-power climbs use less fuel, provided the cylinder-head temperatures can be maintained within limits during a sustained climb.

UNDER NO CONDITIONS ATTEMPT A TURN UNTIL YOU HAVE DIRECTIONAL CONTROL AND A SAFE FLYING SPEED. IF THERE IS NO ALTERNATIVE, CRASH-LAND STRAIGHT AHEAD.

Cruising

Efficient cruising of the B-29 requires the maintenance of a constant recommended airspeed. The recommended airspeeds are obtained from the cruise control charts. Maintain the desired airspeed by use of the elevators and vary power settings slightly to maintain altitude. Do not allow the airspeed to drop; if you are unable to maintain altitude with given airspeed, add power as necessary.

In order to use minimum power for any given cruising speed, you must reduce the drag as much as possible. Use the smallest possible cowl flap and intercooler door openings which will keep cylinder-head temperatures at or below maximum and carburetor air temperatures within desired limits. Trim the airplane properly. Use related manifold pressures and rpm as given in the BMEP Power Schedule in Appendix I-A of AN 01-20EJA-1.

It is recommended that the following procedures be used in order to establish cruising conditions from climb.

1. **If cylinder-head temperatures are not excessive** level off at the desired altitude and continue to use rated power until desired airspeed is obtained. Hold the desired airspeed with the elevators and adjust power to maintain zero rate of climb.

2. **If cylinder-head temperatures are excessive** climb above the desired altitude and hold rated power at zero rate of climb until 210 mph CAS is obtained. Set predetermined cruising power setting, open cowl flaps to 10°, and descend to desired altitude at 210 mph CAS. Level off at desired altitude, close cowl flaps to predicted setting, and use elevators to hold desired cruising airspeed. Vary power settings slightly to maintain altitude. After desired airspeed has been established and cylinder-head temperatures have stabilized, cowl flaps may be opened or closed individually to maintain proper cylinder-head temperatures. This procedure is necessary only when excessive cylinder-head temperatures are encountered.

TRIMMING

Rudder

Hold wings level and center ball with rudder trim tab.

Ailerons

Hold wings level with ailerons and remove control pressure with aileron trim tab.

Elevators

Hold the desired airspeed with elevators and remove control pressure with elevator trim tab.

Note: If possible, make no turns with unbalanced power until after the airplane is trimmed for the condition. When using unbalanced power, make all speed and power changes smoothly and make appropriate change in trim immediately.

MAXIMUM ENDURANCE

The way to stay in the air the longest possible time is to fly the airplane at the speed where the engines use fuel at the lowest possible rate. That condition exists when you use the smallest amount of engine power to keep the airplane flying.

Actually the B-29 endurance speed is much higher than the B-17 long-range cruising speed. To get good performance, fly the airplane at a constant calibrated airspeed (CAS). This means that you must adjust the power to maintain altitude.

The less the airplane weighs and the lower the altitude flown, the longer the airplane stays in the air.

Note: For power settings, refer to the charts in Appendix I-A of AN 01-20EJA-1.

MAXIMUM RANGE

The B-29 is built to do one particular job well —to fly a long way with a big load of bombs. It has excellent abilities to fly fast and high, but its outstanding tactical ability is long-range bombing.

Maximum range is flown at the speed and altitude that give the greatest mileage from each gallon of gasoline consumed. This is a higher speed than that for maximum endurance. Adding a little more power to the minimum power needed to stay in the air (which also increases fuel flow) produces a fairly large increase in speed and therefore an increase in miles traveled for each gallon of fuel used.

If you fly the airplane at optimum speed, you obtain maximum range. A headwind decreases the range by its mph value for every hour the airplane flies. You obtain a greater range when flying at the given speed for the headwind. (This is true up to 75 mph headwinds.) The weight of the airplane and the altitude materially affect the speed.

When flying for maximum range, hold the recommended airspeed.

To obtain maximum range it is necessary to control the airplane's drag and weight. **For each 6 lbs. added to the empty weight of the airplane, it is necessary to add one gallon of fuel to get the same range. This increases the gross weight 12 lbs. Every degree of cowl flap opening used above that required to cool the engines increases the fuel used by at least 15 gallons per hour.** The airplane is clean and added drag affects it considerably. Everything added to the outside of the airplane, whether it is streamlined or not, adds drag and decreases the range and maximum speed.

If you have difficulty keeping up with the others, it is probably because of extra drag or extra weight.

To extend the maximum range, make descents at the recommended long-range cruising speeds and the lowest recommended power setting at the end of a long-range flight.

★ KEEP YOUR AIRPLANE CLEAN AND LIGHT.

★ KEEP THE COWL FLAPS AS NEARLY CLOSED AS POSSIBLE AND USE AUTO LEAN IF ENGINE POWERS AND CYLINDER-HEAD TEMPERATURES PERMIT.

★ USE RECOMMENDED AIRPLANE SPEEDS AND ENGINE POWERS.

★ ADJUST POWER TO MAINTAIN ALTITUDE.

★ MAINTAIN AIRSPEED WITH ELEVATORS.

★ REFER TO POWER SCHEDULE FOR RELATED POWER SETTINGS.

ENGINE MALFUNCTION IN FLIGHT

Low Nose or Rear Oil Pressure

When nose oil pressure drops below 20 psi, or when rear oil pressure drops below 50 psi, it is desirable to feather the propeller on that engine to prevent overspeeding and freezing of the engine bearing surfaces.

High Oil Temperature

If oil temperature goes above 90°C, throttle back and open oil cooler shutters manually to their limit.

If oil temperature goes above 100°C after the engine has been throttled back to less than 20" Hg and oil cooler doors have been opened, feather the propeller on that engine.

Engine Backfiring on Takeoff

If engine backfiring occurs during takeoff **and sufficient runway is available for a landing,** land the airplane and return to the line.

However, if you are already committed to the takeoff, throttle back the backfiring engine as much as is consistent with a safe takeoff. If the engine continues to backfire after throttle has been reduced, feather that engine **as soon safe altitude and airspeed have been reached.**

Engine Backfiring During Cruise

If engine backfiring occurs during cruise, place mixture in AUTO RICH, and throttle back to 20" Hg. if necessary. Increase throttle gradually. If backfiring recurs at normal cruise power settings, feather the propeller on that engine.

Remember: backfiring is to be expected when in AUTO LEAN at power conditions below 25" Hg and 2000 rpm. **Place mixture in AUTO RICH when these power conditions are likely to occur.**

High Cylinder-Head Temperature

To reduce high cylinder-head temperature in flight:

1. Open cowl flaps to not more than 10°.
2. Increase airspeed.
3. Place mixture controls in AUTO RICH.
4. Reduce manifold pressure.
5. Reduce carburetor air temperature.

It is advisable to reduce power on the particular engine as much as is consistent with safe airspeed.

High cylinder-head temperature may be caused by improperly installed orange peel cowling and cylinder baffles, improperly timed magnetos and ignition distributors, dirty cylinder cooling fins, and exhaust gases flashing over the thermocouple at the cylinder head.

Mission should be aborted if, **after corrective measures have been attempted,** cylinder-head temperature remains at or above 232°C at 70% power, or 248°C at 90% power.

Flight Characteristics

Even with its large size and weight, the B-29 has just about the same flying qualities as smaller aircraft. Large aircraft are usually slower in responding to the pilot's controls because of their greater inertia. But the control forces on the B-29 are light, and even at low flying speeds the combination of light forces with the high inertia of the airplane seldom gives the pilot any impression of sluggishness or lack of control. Just after taking off, and again during the short interval of time while landing, the rudder and the aileron control response is slow but it is still positive. The controls are as good and in many ways better than those of many small aircraft.

Elevators

The elevator control is almost exactly like that on the B-17. The size of the horizontal tail is the same except that the B-29 elevators have a little more balance and the nose of the tail airfoil section is turned up so that the tail does not stall when making a power-on approach to a landing with the flaps full down. Elevator trim tab is extremely sensitive in high-speed dives, and you must be careful not to over-control the airplane when flying with the trim tab.

Ailerons

The ailerons are large and have a full throw of 18° up or down, so that the pilot has good control. The control wheel travel is greater than that of the B-17. This extra control is valuable if an engine fails just after takeoff or when, for some reason, fuel is used on one side of the airplane only and the other wing gets heavy. The effect of unbalanced amounts of fuel in the two sides is noticeable in the aileron control when flying straight and level. If you allow the speed to approach stalling, the amount of aileron needed to offset uneven wing weights increases rapidly. Don't attempt a landing when this unevenness exists until you check the aileron control in flight at the landing speed.

The aileron trim tabs are geared to move when the ailerons move. The shape of the wing airfoil is such that the part covered by the ailerons has a hollow on top and is full on the bottom. If the control cables are out during combat, the ailerons would ordinarily trim down because of this shape. To avoid this, the trim tabs are rigged down 1½ inches at the trailing edge to trim the ailerons more nearly neutral if a cable is cut or broken.

Rudder

The rudder gives the maximum possible control and stability, yet it can be moved without the help of power boosts. The diamond shape of the rudder is the result of studies made to find a rudder which behaves normally under all flight conditions. A good rudder is one that can be moved with a small amount of effort when an engine fails at any speed and does not become overbalanced or locked. Don't be confused by the light B-29 rudder forces—they do not tell you what the rudder is doing to the airplane. In landing approach conditions, it is possible to get an appreciable amount of skid with slight effort. Remember, it takes a certain amount of time to skid a large airplane and also to stop the skid.

Trim the rudder to center the ball.

Stability

The longitudinal stability of the B-29 is normal for all conditions. For good flying characteristics, however, the center of gravity (CG) must be kept within the allowable limits. The forward center of gravity limits are fixed by structural strength, and the elevator control for these forward limits is good for all normal operations. The most rearward center of gravity limit is determined by the longitudinal instability which occurs at climbing power. Going aft of this limit makes the airplane difficult to fly and decreases safety in flight.

Make every possible effort to keep the center of gravity within the design limits and to keep the gross weight of the airplane to the absolute minimum for the mission to be performed. Use a weight-and-balance slide rule before and during every flight.

STALLS

The stall characteristics of the B-29 airplane are entirely normal. In practicing the approach to the stall (complete stalls are not practiced) use not more than 15" Hg. As the airplane approaches the stall, a noticeable lightening of the elevator loads occurs. It is necessary to move the controls an appreciable amount to get a response from the airplane. Remember that in a stall you lose aileron control before you lose rudder and elevator control. Just before the full stall is reached, a shuddering and buffeting of the airplane occurs. The airplane recovers from the stall normally and has no excessive tendency to drop off on one wing when the stalls are properly controlled. Power reduces the stalling speed, but in general has no great effect upon the stall.

Never fly below the power-off stalling speed, since any loss in power when flying below this speed is likely to put the airplane into a violent stall. On all landing approaches, be extremely careful not to allow the speed to fall below the power-off stalling speed. Try power-off approaches whenever possible in order to become familiar with the airplane under emergency conditions. Never use power to reduce your landing speed.

When the airplane stalls, always recover by first nosing the airplane down and then increasing the power. Never apply power in the stall without first dropping the nose. In most aircraft, it is possible to obtain a high rate of descent by applying power during the power-off stall without dropping the nose. Avoid these conditions in the B-29.

POWER-OFF STALLING SPEEDS

INDICATED STALLING SPEEDS

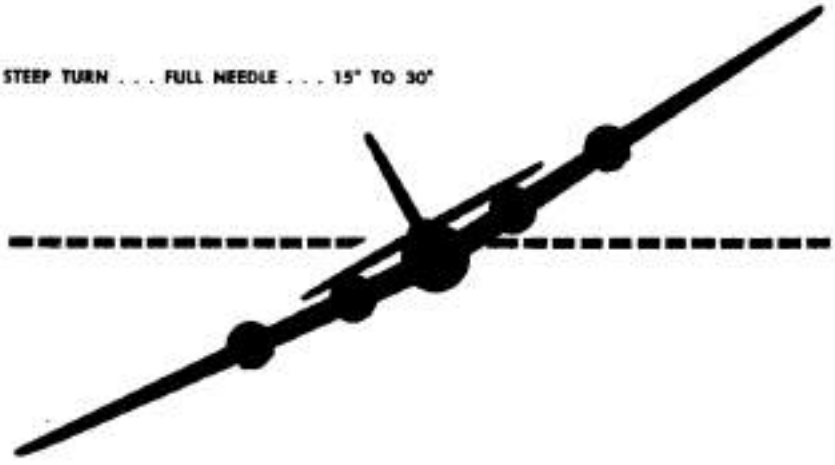
Gross Weight	Flaps Up	Flaps 25°	Flaps Full
140,000 pounds	145 mph	131 mph	119 mph
130,000	140	125	114
120,000	135	121	110
110,000	129	115	105
100,000	123	110	100
90,000	117	104	95
80,000	110	98	89
70,000	103	92	84

Warning: **Do not practice the approach to the stall with the cowl flaps open more than 10°**

TURNS

In spite of its size and weight, the B-29 has good maneuverability. It controls easily and turns easily:

SHALLOW TURN . . . ½ NEEDLE . . . 12° TO 15°



STEEP TURN . . . FULL NEEDLE . . . 15° TO 30°

DIVES

The B-29 is limited in its allowable diving speed by both strength limitations and control characteristics. Again, remember that this is a big, heavy airplane. As the speed increases, the loads carried by nearly every part of the airplane increase rapidly. This is especially true of the horizontal tail surfaces.

The maximum diving speed at any time or any altitude is 300 mph IAS. This speed is sufficiently above the level-flight top speed of the airplane to cover most diving needs.

DEAD-ENGINE CHARACTERISTICS

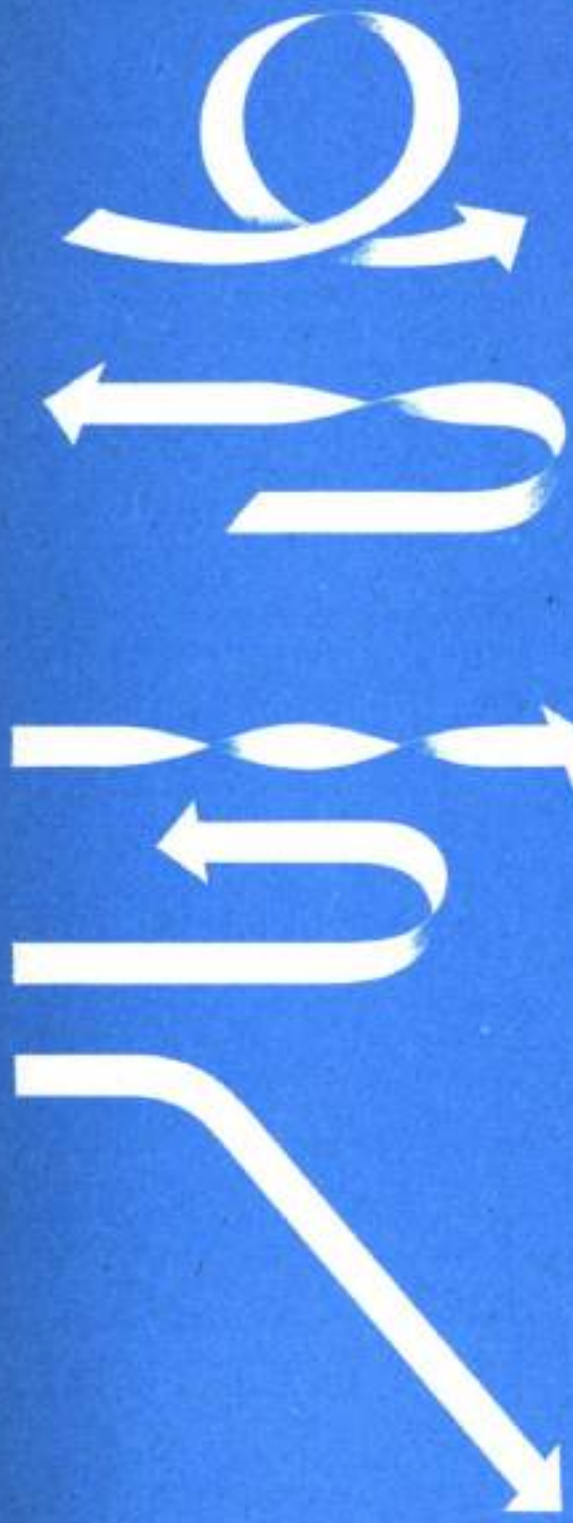
In straight and level flight, normal power, with one engine feathered and power balanced, the flight characteristics of the B-29 differ little from those of normal 4-engine operation. When turning into a dead engine maintain a speed of at least 160 mph IAS.

If two engines on the same side are out, the airplane has a tendency to roll and yaw. To keep lateral trim, apply rudder first and then aileron as needed. If turns are made into two dead engines, maintain a minimum airspeed of 160 mph indicated. At low weights it is possible to fly with two dead engines with good control at speeds down to 150 mph. However, at slower speeds full rudder is necessary to control the crab. In general, always stay at least 10 mph indicated above the power-off stalling speed. Keep the drag of the airplane as small as possible. At 100,000 lbs. gross weight it is just possible to maintain level flight on two engines with two propellers feathered and with the landing gear down and 25° flaps.

★ **Avoid making steep turns**

★ **Trim the airplane**

PROHIBITED MANEUVERS



LOOP

SPIN

IMMELMANN

INVERTED FLIGHT

ROLL

VERTICAL BANK

DIVE

(IN EXCESS OF **RED-LINE SPEED**)

Don't fly the airplane with the center of gravity (CG) aft of 34% of the mean aerodynamic chord (MAC) at any time, and don't fly with it ahead of 24% except at low gross weights (120,000 lbs.).

Before Landing

1. Notify Crew—Prepare For Landing

The before-landing check starts on aircraft returning from a mission about 8 to 10 minutes before landing. For transition missions, take-offs can be spaced 10 minutes apart so that the airplane will not have to leave the traffic pattern. The airplane commander announces: **"Prepare for landing."** Copilot repeats the command over the interphone: **"Prepare for landing,"** at which time the flight engineer orders the tail gunner to start the putt-putt. Crew members acknowledge in the following order: bombardier, flight engineer, navigator, radio operator, top gunner, left gunner, right gunner, radar observer, and tail gunner.

2. Radio Call Completed

The airplane commander calls the tower for landing information.

3. Altimeters Set

Airplane commander and copilot set their altimeters to the altimeter setting given by the tower.

4. Autopilot OFF

Airplane commander sees that all switches for the autopilot (on aisle stand) are off.

5. Turrets Stowed

Airplane commander checks to see that the turret warning lights on his instrument panel are out.

6. Hydraulic Pressure___PSI

The copilot checks to see that pressure is 1000 psi. Any difference in final pressure should be reported to the flight engineer. Copilot asks flight engineer to check emergency hydraulic pressure.

7. Propellers 2400 RPM

The copilot adjust propellers to 2400 rpm at airplane commander's request.

8. Landing Gear Down, Green Lights On

The copilot, on command of the airplane commander, lowers the landing gear and says over the interphone: **"Gear is coming down."** The side gunners check the main gear and announce in order: **"Left gear coming down, sir,"** and **"Right gear coming down, sir."** When the gear is completely down the gunners announce again: **"Left gear is down and locked,"** and **"Right gear is down and locked."** (For all night operation the gunners will use the Aldis lamp for checking the gear down.) The copilot checks the nosewheel through the observation window in the floor of the cockpit and checks the landing gear warning lights on his instrument panel. After receiving copilot's report that gear is down, airplane commander will check to see that the red light is off, and the three green lights are on.

The gear switch will be left in DOWN position until airplane is parked.

Note: The indicated airspeed must be less than 180 mph before the gear is lowered.

Visual check by the gunners and the copilot is most important. The red warning light and the green down and locked lights (and the landing gear warning horn, on some series) all operate from the gear motor limit switches. Remember this—the lights and the horn are **not** position indicators except in late series airplanes. They mean only that the limit switches have stopped the operation of the gear motors. If the switches open the circuit too soon, the gear will be only partially down and warning of this danger can come only from the visual check. The gear will support the weight of the airplane if the retracting screw is not more than 4 inches from the full down position (the screw itself retracts as the gear lowers). The

gear is not designed to support the airplane if the screw is extended more than 4 inches.

Have the putt-putt operator report when the tailskid is down.

9. Flight Engineer's Report

The copilot, on the interphone, calls for **"Engineer's report."** The flight engineer reports: **"Gross weight ... lbs.; putt-putt on the line; ready to land."**

10. Stalling Speed

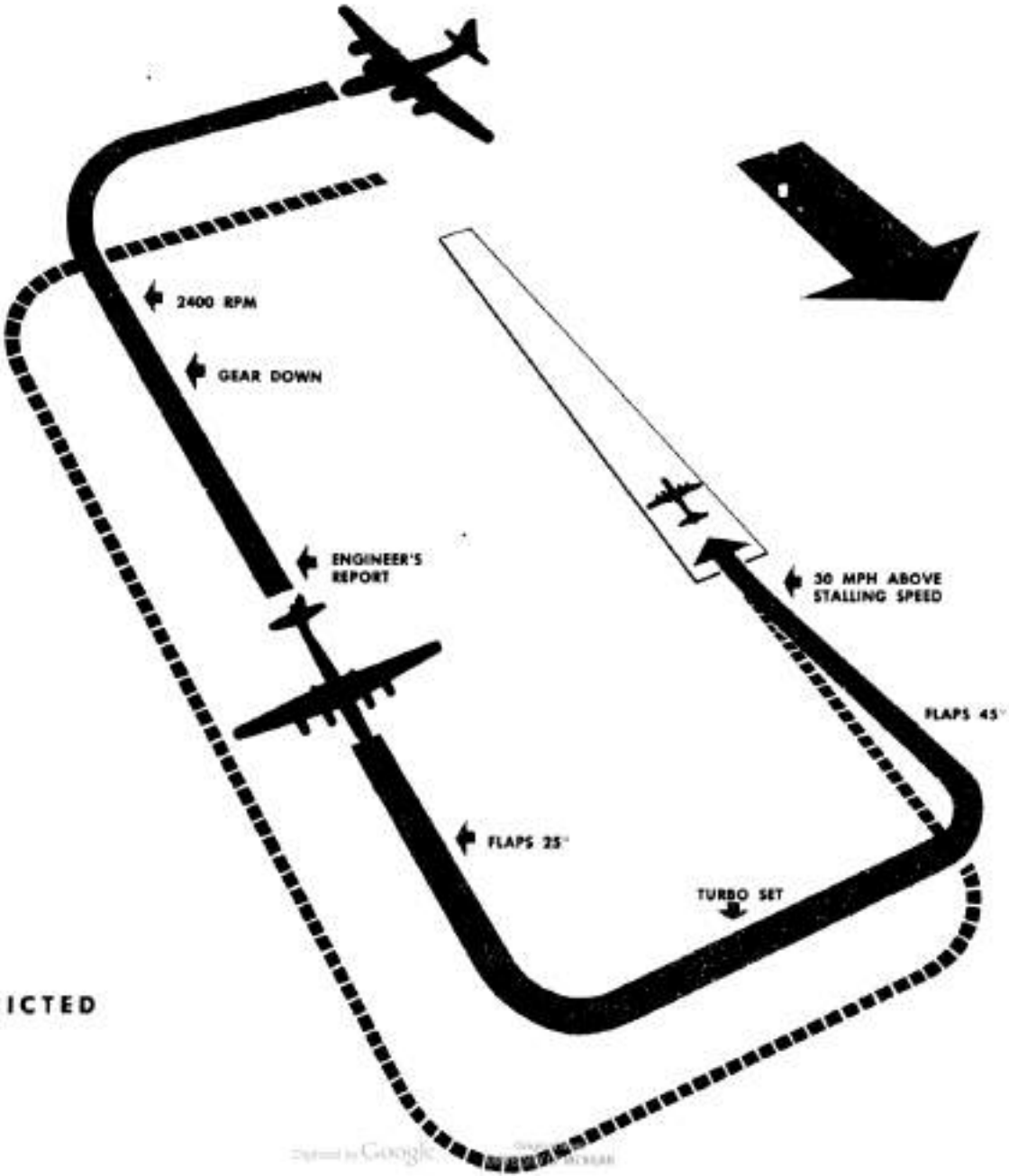
The copilot finds the stalling speed based on the weight by referring to the table mounted on his instrument panel and informs the airplane commander.

11. Wing Flaps

At the airplane commander's order, the copilot extends the wing flaps 25° just before turning into the base leg. Later, on the final approach and at the airplane commander's order, he extends full flaps, at which point the airplane commander retrims the elevators. The side gunners check position of flaps and inform the copilot over the interphone. **Don't lower flaps above 180 mph indicated.** (Note yellow line on airspeed indicator.)

12. Turbos Set

Airplane commander calls for turbos on base leg. Copilot announces: **"Turbos on"** to flight engineer and turns selector dial to 8. (Some airplanes are equipped with Type B-7 control for TBS to provide for water injection. On these airplanes the takeoff setting is marked at 3¾ on the TBS.)



Landing Procedure

Don't put down full flaps until you are lined up with runway and sure of making the field. Go-arounds are difficult only when full flaps are down. After putting down full flaps, maintain an airspeed of 30 mph, indicated, above the power-off stalling speed. Don't chop the power at any point on the approach. Long approaches are unnecessary, even for narrow runways.

Crosswind Landings

When turning on the approach in a crosswind, be careful not to allow the wind to force you off your approach to a degree where it is impossible to align with the runway.

There are three possible ways of making a crosswind approach and landing: (1) holding the airplane straight toward the runway, dropping one wing into the wind with just enough top rudder to counteract drift; (2) heading the airplane into the wind (crabbing) just enough to keep a straight ground path; and (3) a combination of the first two methods.

The combination of methods is preferred, because it eliminates the possibility of dropping the wing too low, or of crabbing too much, and decreases the amount of correction needed to straighten out and level off during the roundout.

Landing Roll

Don't use your brakes more than necessary after the wheels touch the ground. On a long runway, let the airplane roll until it loses speed. Lower the nose gently at 90 mph, and when nearing end of the roll, apply brakes evenly and smoothly.

AFTER LANDING

1. Hydraulic Pressure OK

Copilot checks normal pressure gage for reading between 800 and 1000 psi.

2. Turbos Off

Toward the end of the landing roll, copilot turns TBS to 0.

3. Propellers in High RPM

Copilot checks to see that propellers are in high rpm position.

4. Wing Flaps Up

At the airplane commander's command, near the end of the landing roll, copilot raises flaps (all the way, if this is the last landing; to 25° if planning to make another takeoff). Side gunners report on position of wing flaps.

At night, after turning off the runway, stop the airplane, and run up the coolest engine to supply power to raise flaps. The power available from the putt-putt is not sufficient to carry the load of the landing lights, radio, and wing flaps.

5. Parking Brakes Set

6. Bomb Bay Doors Open

Copilot calls for bomb bay doors open. Copilot says on interphone: "**Bomb bay doors opening.**" Flight engineer sets throttle on coolest engine to 1500 rpm. The radio operator and one of the gunners check through the pressure doors and report to copilot that doors are open. Flight engineer then returns throttle to 700 rpm and turns all generators off. (Generator procedure unnecessary with pneumatic bomb bay doors.) Radio operator and scanner will close the bomb bay door safety shut-off valve, check bomb bay safety switches for the "can't salvo" (OFF) position and then report: "**Bomb bay doors open, safety valve closed.**"

7. Engines Run-up and Cut

The airplane commander says: "**Run-up and cut engines.**" The copilot repeats the command on interphone. The flight engineer follows the procedure outlined in his checklist and reports to copilot when it is completed.

8. Radios Off

The airplane commander turns off the command set and the copilot switches off the radio compass.

9. Controls Locked

The airplane commander pulls the lock handle on the aisle stand to the up position and sees that the flight controls are securely locked.

10. Wheel Chocks in Place

Airplane commander and copilot see that chocks are in place.

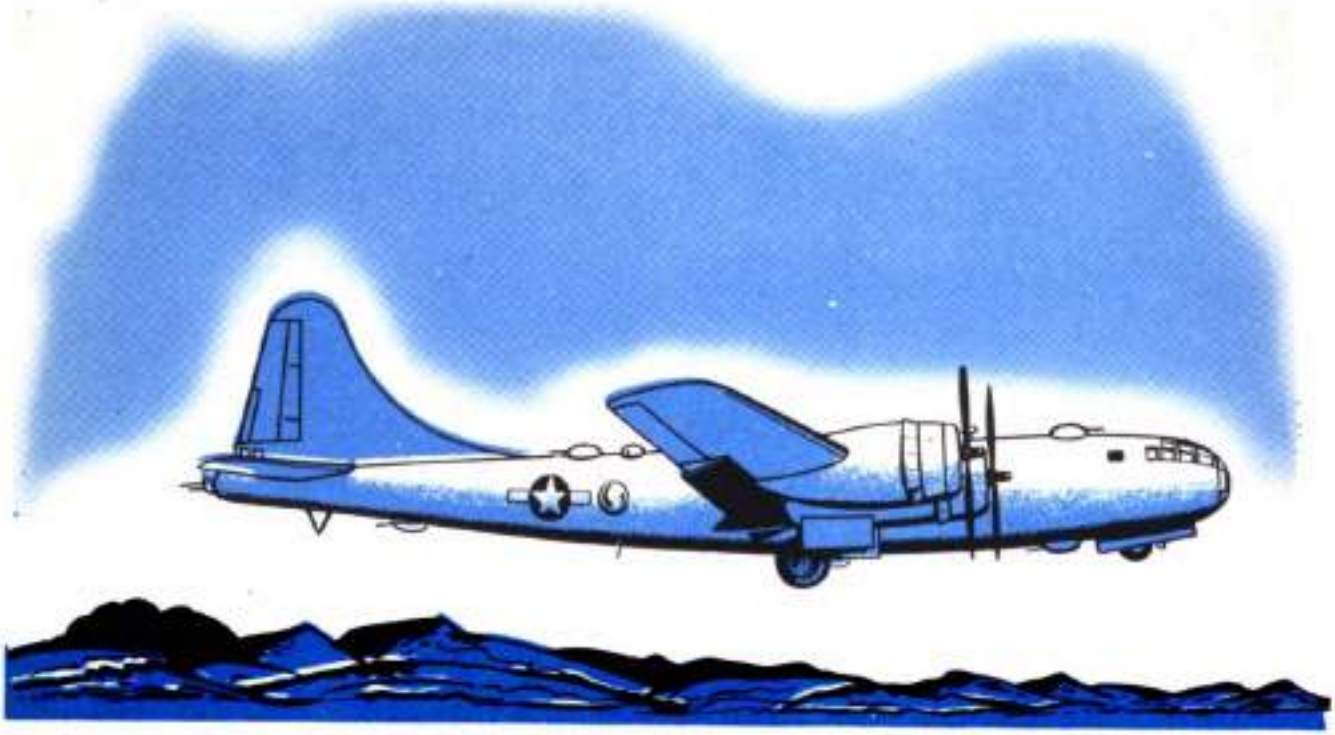
11. Brakes Off

12. Forms 1 and 1A Accomplished

The flight engineer completes Forms 1 and 1A and presents them to the airplane commander for check.

13. Crew Inspection

Crew members leave the airplane and line up as before flight to be checked by the airplane commander. At this time, defects in the airplane not already noted are reported to the flight engineer.



GO-AROUND

The procedure for a normal go-around is not complicated. Raise the flaps from the full-down position to 25° as power is applied and continue on the same approach angle until safe flying speed is reached. Then raise the gear as soon as you are sure that the runway will not be touched, and start the climb. Raising the flaps all in one movement to 25° is important. Don't wait for a safe flying speed—with flaps full down, you cannot attain a safe flying speed because of the high full-flap drag and reduced acceleration. Follow this procedure:

1. Notify flight engineer that you are going around.
2. Apply throttle gradually as needed.
3. Raise flaps to 25°.
4. Set full high rpm.
5. Don't try to climb until you reach a safe flying speed.
6. Raise gear when safely clear of the ground.
7. Proceed as in a normal takeoff.
8. If needed apply emergency power by advancing the TBS to emergency power marking.

GO-AROUNDS WITH LESS THAN FOUR ENGINES OPERATING ARE NOT RECOMMENDED

EMERGENCY LANDINGS

Wheels Up

The B-29 can be crash-landed with a minimum of injury to the crew. Whenever possible land on a hard surface in preference to sod or dirt. Do not feather props unless engine trouble requires feathering.

With wheels up, drag is reduced considerably, so plan your approach to land short. **Land the B-29 with as many wheels extended as possible unless only the nose gear will go down.** The damage sustained on a crash landing is greatly minimized if any of the main gear are down. If only the nose gear will go down, land the airplane wheels up, as the fuselage will probably buckle from the weight of the wing and engines. However, remember, in an emergency, extend any of the main gear that will go down. **Note:** Terrain conditions in the theater of operations may dictate variations of this procedure.

When you are positive that an emergency landing is inevitable, contact the control tower and continue to circle the field until the immediate area is cleared of all other traffic, and an ambulance, crash truck, and fire truck are ready on the flying line. If feasible, circle until the remaining fuel supply is 200 gallons per engine. If it is found inadvisable to land at your home base, proceed to the prescribed alternate and observe the same precautions.

It is the prerogative of airplane commanders to allow any crew member not essential to the emergency landing operation to jump from a safe altitude over the airport if he desires. If the crew member decides to stay with the airplane, he must prepare for a crash landing and then take up his prescribed crash-landing position. Crew members should stay clear of the lower turret areas and nose gear door because the turrets may tear loose and be forced up into the cabin. To prepare for the crash landing,

drop all bombs, auxiliary bomb bay tanks, and flares; open all emergency hatches except the bomb bay doors; and if time permits drain oxygen system. Proceed in the following order:

1. Close the nacelle wheel well doors of any retracted gear, if possible.
2. Make a normal approach sufficiently far back from the field and high enough to allow remaining crew members to perform the following last-minute preparations at the command of the airplane commander.
3. Lower full flaps for landing.
4. See that flight engineer is ready to set engine nacelle fire extinguisher selector.
5. Stop putt-putt.
6. Shut off fuel boost.
7. Close fuel shut-off valves on final approach when certain of making the field. (Approximately 10 to 15 seconds of fuel, at low power, remain in the lines after closing the fuel shut-off valves.)
8. Just before contact with the ground, throttle the engines back and place mixture control in FUEL CUT-OFF, when committed to land.
9. Turn the master ignition switch off, then turn the individual ignition switches and battery switch off.
10. Warn the crew members just before ground contact, then land by sliding airplane in on its belly.

Both Main Gear Down, Nosewheel Partially or Completely Up

1. Check with the operations control tower and stand by in the air until an ambulance, crash, and fire truck are ready on the flying line. If it is found inadvisable to land on the home base, proceed to alternate base directed and observe the same precautions.
2. Check with the operations control tower to be sure all air traffic is clear of the proposed landing zone.
3. Drop all bombs or auxiliary bomb bay fuel tanks and flares in a safe zone; if time permits drain oxygen system.
4. Allow all crew members not essential to the landing operation, who wish it, to jump from a safe altitude over the field. Otherwise, they are to help prepare for a crash landing and take their positions.
5. Open all emergency escape hatches to avoid jamming, with the exception of the bomb bay doors and the nose gear hatch. If the nose gear hatch is open and the nosewheel collapses, gears or parts of gear may be forced through hatch.
6. Shift disposable load and crew, if necessary, to the after compartments to shift the CG as far back as possible.
7. Make a normal approach to land on runway with full flaps.
8. See that the flight engineer is ready to set engine nacelle fire extinguisher selector.
9. Stop putt-putt.
10. Shut off fuel boost.
11. Close fuel shut-off valves on final approach, when certain of making the runway, and just prior to throttling engines for landing. Approximately 10 to 15 seconds of fuel, at a low power setting, remain in the fuel lines and carburetor after shutting off these valves.
12. Just before contact, throttle the engines and place the mixture controls in FUEL CUT-OFF position.
13. Turn master ignition switch off, then turn individual ignition switches and battery switch off.
14. After the main wheels touch the ground, hold the nose of the airplane in the air as long as possible with the elevators and then lower it gently until it strikes the runway.
15. After the nose of the airplane strikes the runway, apply brakes as necessary to bring airplane to a stop.

One Main Wheel Up, Nosewheel and One Main Wheel Down

1. Check with the control tower and stand by in the air until an ambulance, crash truck and fire truck are ready on the flying line. If it is not advisable to land on the home base, proceed to the alternate base directed and observe the same precautions.

2. Check with control tower to be sure all air traffic is clear of the proposed landing zone.

3. Drop all bombs or auxiliary bomb bay fuel tanks and flares in a safe zone; if time permits drain oxygen system.

4. Allow all crew members not essential to the landing operation, who wish it, to jump from a safe altitude over the field. Otherwise, they are to help prepare for a crash landing and take their positions.

5. Open all emergency escape hatches to avoid their jamming, with the exception of the bomb bay doors.

6. Make a normal approach to land on runway.

7. See that the flight engineer is ready to set engine nacelle fire extinguisher selector.

8. Stop putt-putt.

9. Shut off fuel boost.

10. Close fuel shut-off valves on final approach, when certain of making the field, and just before throttling engines for landing. (Approximately 10 to 15 seconds of fuel, at a low power setting, remain in fuel lines and carburetor after shutting off these valves.)

11. Just before contact, throttle the engines and place the mixture controls in FUEL CUT-OFF position.

12. Turn master ignition switch off, then turn individual ignition switches and battery switch off.

13. With full flaps, make normal landing on good wheel with the wingtip slightly low on the good-wheel side.

14. Hold the wing on bad-wheel side up as long as possible with ailerons.

15. Be prepared for groundloop in the direction of the crippled wheel when wingtip and nacelle dig into runway. Use brakes to minimize groundloop.

One Main Wheel Down, Nosewheel and One Main Wheel Up

Follow the foregoing procedure up to and including item No. 11, then continue as follows:

12. With full flaps, make landing on the good wheel.

13. Hold nose of the airplane up and hold up the wingtip on the damaged main wheel side with elevator and aileron as long as possible.

LANDING WITH LESS THAN FOUR ENGINES

Three-engine Landing

With one engine dead and the propeller feathered, the B-29 can be flown without difficulty. A three-engine landing can be accomplished easily if you **plan your actions and follow the correct procedures.**

Remember these points:

1. Notify the control tower of your position and difficulty so that crash equipment can be alerted and the traffic pattern cleared.

2. Turns can be made into the dead engine **if you maintain airspeed and keep the airplane trimmed properly.**

3. Make your traffic pattern as nearly normal as is practicable, conserving altitude for a high final approach.

4. Don't lower the landing gear too soon, or it will be necessary to draw more power from the three operating engines.

5. Partial flaps may be lowered, but wait until you are sure of making the field before putting down full flaps.

6. Remember that the airplane has been trimmed to offset the loss of power of one engine, and be ready to correct for the "off trim" (i.e., trim to neutral) when the throttles are retarded for landing. A feathered propeller creates less drag than a propeller on an idling engine. Thus, in addition to the trim, you must compensate for this off-balance condition.

Two-engine Landing

When contemplating a two-engine landing, bear in mind all the points mentioned above. But remember also that the necessity for smooth, well-coordinated turns and flying is even greater than in three-engine operation.

The necessary trim change will be greater if power is not balanced. (Not much trim change will be necessary if two outboards or two inboards are dead. If the remaining power is to be delivered by an outboard on one side and an inboard on the other, however, the trim required will be substantially greater.)

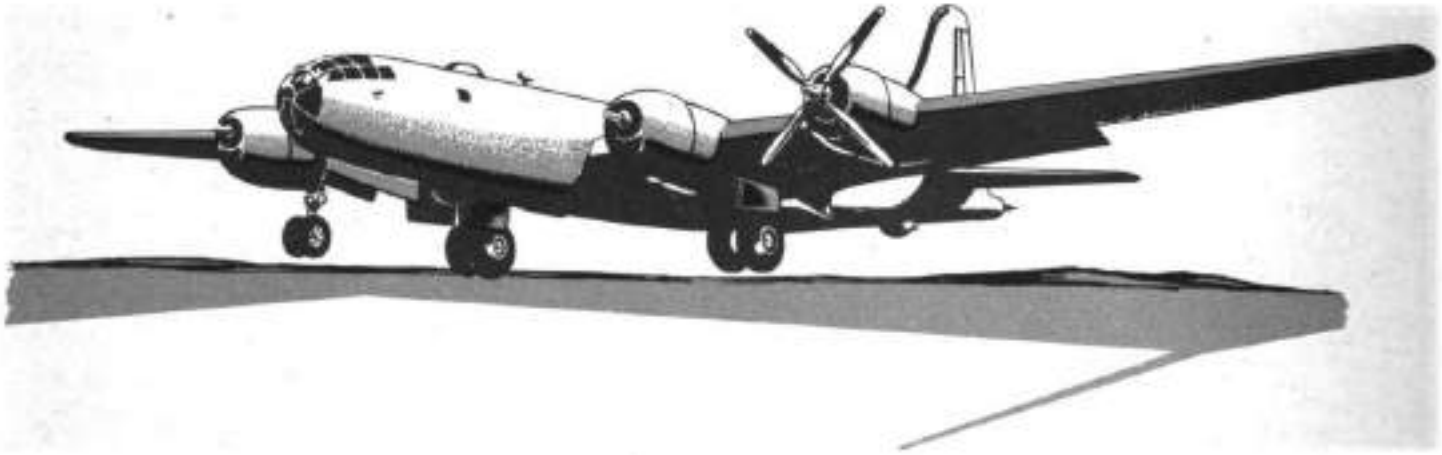
Be prepared for the change in trim necessary when power is reduced for landing.

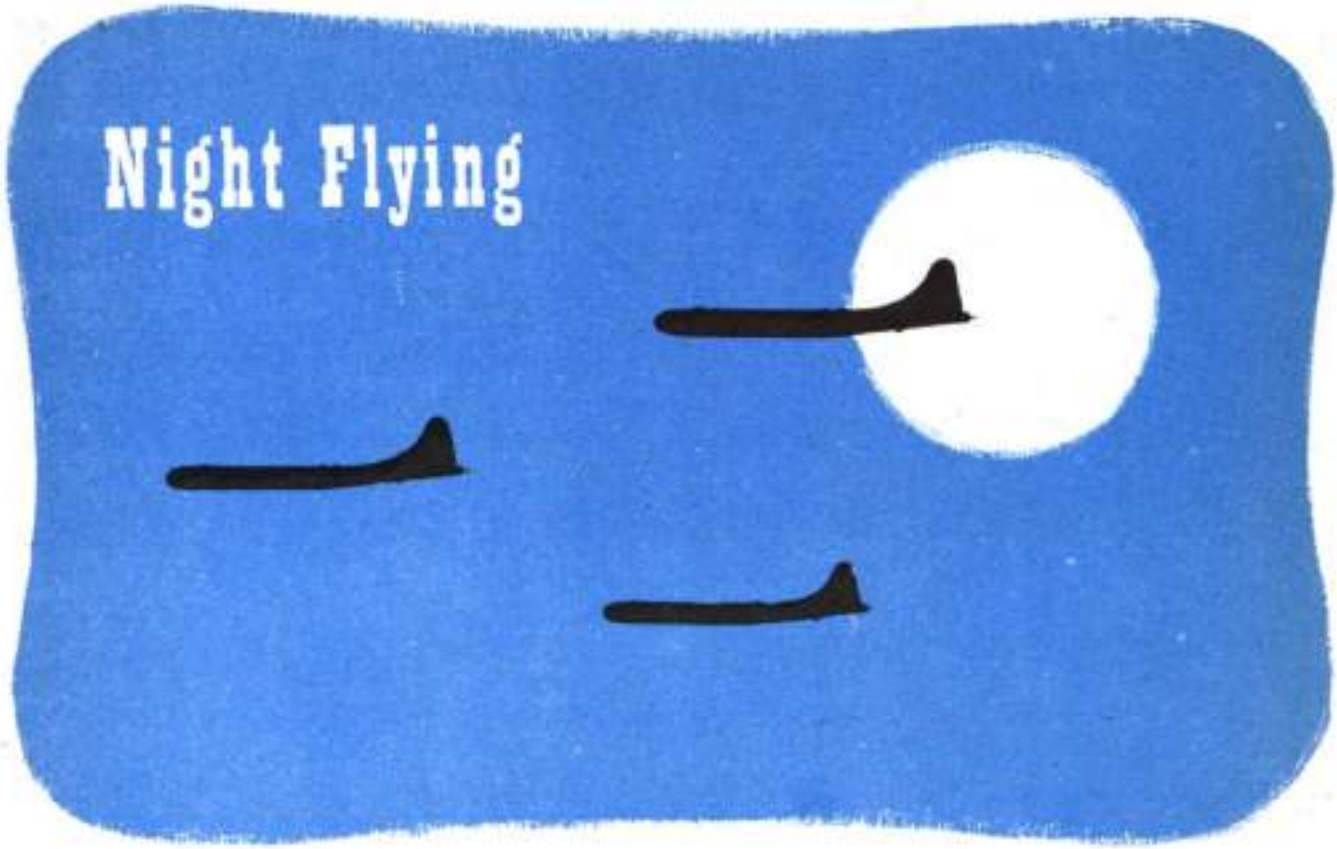
With two engines dead, and their propellers feathered, you will float farther than with all four engines operating because the two feathered propellers create less drag.

Remember: Go-arounds are impossible with two engines out and gear and flaps down.

Single-engine Landing

At gross weights of 110,000 lbs. and less, and with three engines dead and their propellers feathered, it is possible to maintain a descent of 500 feet per minute at 170 mph IAS and rated power.





1. Before flight don't subject your eyes to any bright lights: brightly lighted rooms, wing-light beams, bright cockpit lights, etc.

2. Turn out all unnecessary cockpit lights, and dim instrument panel lights. Read instruments, maps, and charts rapidly, then look away.

Night Takeoffs

1. On all night takeoffs climb to 500 feet above the terrain before leveling off to build up airspeed.

2. Obtain clearance from the tower before taxiing to the runway. Line up in the center of the runway and select a distant light as a reference point.

3. If visibility is poor and no horizon is visible, prepare to take off on instruments.

4. Maintain proper airspeed and a constant heading. It is imperative to hold a constant heading until you reach sufficient altitude for the turn.

5. Top and side gunners should warn you if you are turning into the path of other aircraft.

Night Taxiing

1. When taxiing use the landing lights alternately as needed. This reduces the load on the electrical system imposed by both lights. Continuous ground operation of the lights burns them out quickly. However, don't hesitate to use both lights if necessary.

2. Make frequent checks of wheels and tires.

3. Check for signs of engine roughness.

4. When taxiing close to obstructions or parked aircraft, see that members of the ground crew walk ahead of each wing and direct taxiing by means of light signals.

5. Be particularly careful in judging distance from other taxiing aircraft. Sudden closure of distance is difficult to notice at night.

6. In case of failure or weakening of brakes, stop immediately and have the airplane towed to the line. Faulty brakes are always hazardous. They are certain to cause accidents when taxiing at night.

General

1. Be sure that goggles, side windows, and wind screens are kept scrupulously clean. Scattered light on unclean surfaces reduces the contrast between faint lights and their background.

2. Be sure that all fluorescent lights, winglights, navigation lights, passing light, cockpit light, and individual instrument lights are in operating order.

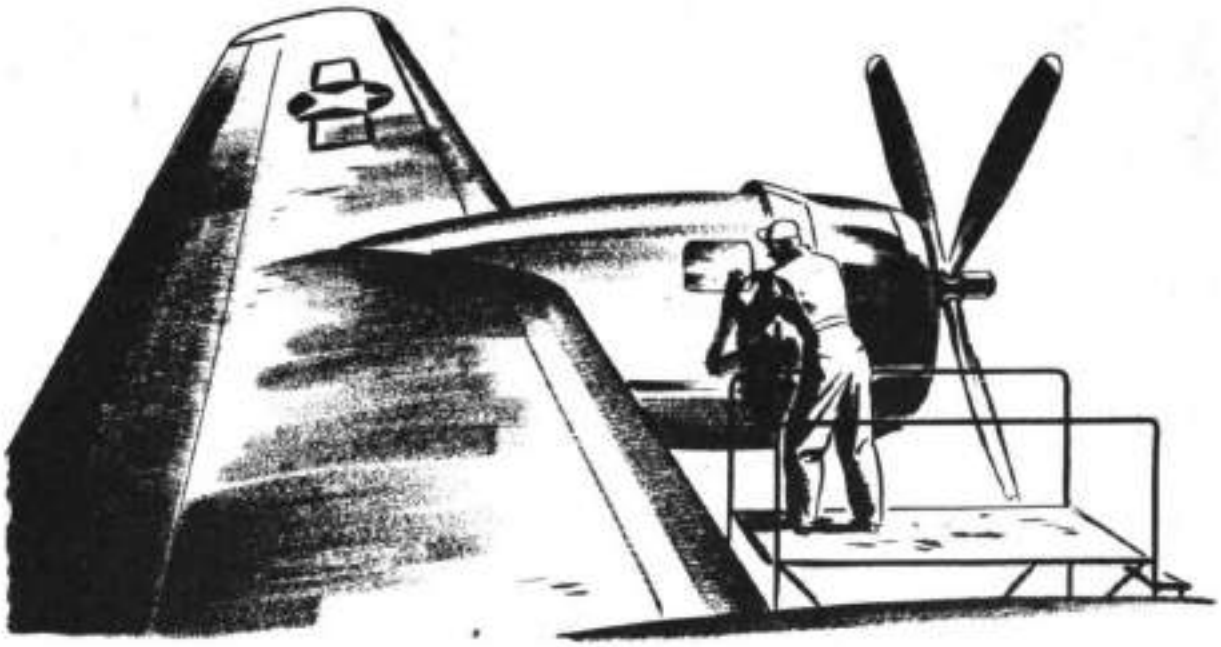
3. Be sure that you, your copilot, and your flight engineer have individual flashlights.

4. Check radio operation and set proper frequencies. You need your radio, especially at night.

5. Know your field layout, the proper relationship of taxi strips to runways, etc. It is easy to become confused at night.

FLIGHT ENGINEER'S PREFLIGHT INSPECTION AND CHECKLIST

Flight Engineer's Preflight Inspection



Your preflight inspection is a heavy responsibility which you cannot afford to slight. Remember that the safety of the crew and the success of the whole mission depend in some respect on this preflight inspection of yours. Never assume that maintenance is perfect, or that the checks of others can substitute for your own careful inspection.

You are expected to know the B-29. You are expected also to know the condition of the particular B-29 which you are about to operate. Only by a thorough, professional, complete preflight inspection can you be sure that your airplane is ready to fly and that every necessary item of service and maintenance has been accomplished so that your airplane and crew can go to work with a minimum of delay and a maximum of efficiency.

The procedures given here comprise an inspection route and a sequence of checks which is arranged to accomplish the preflight with greatest efficiency in a minimum time. However, different facilities and different routines of your own organization may force you to modify this procedure. Regardless of the order in which you perform your preflight check, be sure to include all of the following items and check them in the manner prescribed. These are the minimum checks; others may be added where local conditions require.

Note: **First check Form 1A for the status of the airplane, so that you know what things to give particular attention to in your preflight inspection. Check entries, inspections due, engine and airplane hours, and fuel and oil servicing.**

Outboard Wing Panel

1. Position lights: unbroken.
2. Static drains: installed.
3. Skin on underside of wing: no wrinkles, holes, missing rivets, or fuel leaks.
4. Aileron: no wrinkles or holes.
5. Trim tabs: proper droop 1½".
6. Landing light: fully retracted, lens unbroken.
7. De-icer boots: no holes or tears.

Outboard Engine

Note: Be sure ignition switches are OFF.

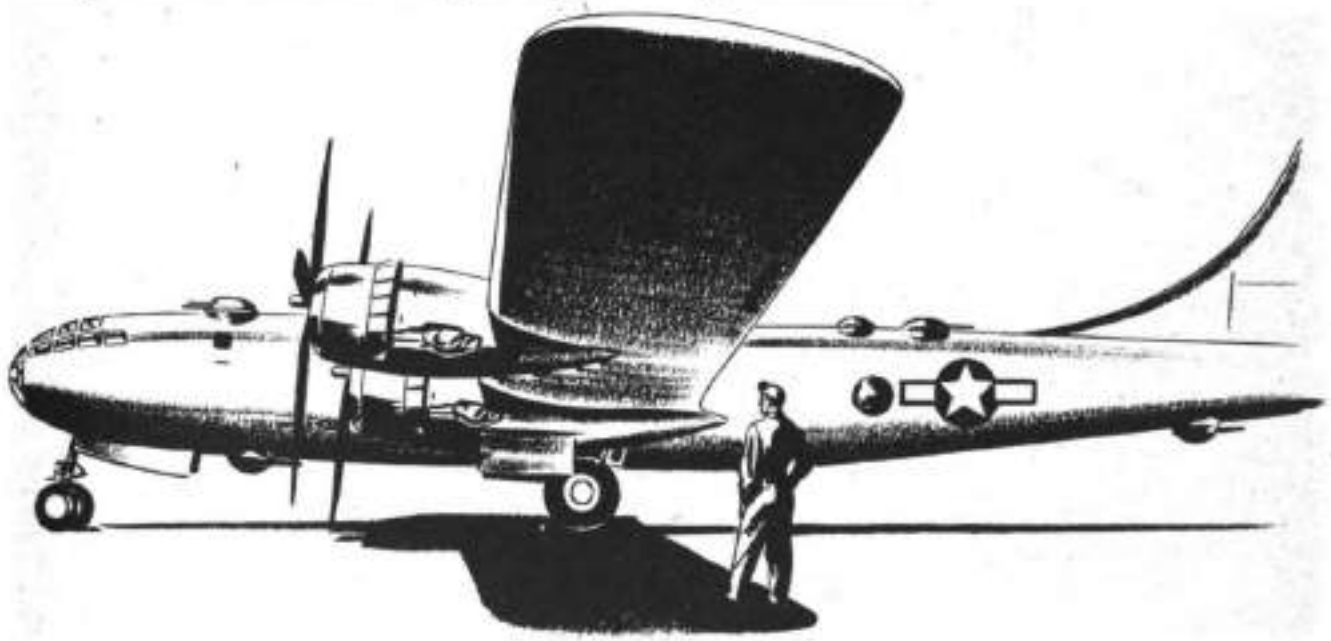
1. Propeller: pull through four blades (no more than two men to a blade). Check each blade and the propeller dome for freedom from nicks and cracks. As each blade is pulled through listen for blow-by or valve leakage. If there is a liquid lock it can be corrected now, preventing the delay in takeoff which will occur if it is not discovered until later. This procedure, however, does not replace pulling the prop through 12 blades before starting the engine. Don't pull the prop through until the engine has cooled for at least 30 minutes after the last operation.

In case of a liquid lock, you can locate the cylinder containing the liquid by the following method: count the lobes on the magneto cam, starting with the red dotted lobe (No. 1 cylinder). The lobe on which the breaker points are riding indicates the cylinder containing the liquid lock. Determine this cylinder from the number of lobes and the firing order. When you find the lock, remove the spark plug, drain the liquid, and install a clean sparkplug.

Never attempt to relieve a liquid lock by applying pressure or by pulling the prop backwards.

2. Engine nose section: clean, no cracks, cylinders free from broken fins, no loose baffles, no loose high tension leads or foreign material in air scoop. See that nose oil sump plug is safetied.
3. Drain lines or vents (Y drain, blower drain, oil separator drain, etc.): open.
4. Air lock fasteners, cowling and panel: secure.
5. Flight hoods, exhaust stacks, shroud covers: secure, no cracks, waste gates open and not binding, free movement of turbo wheels, no buckets missing.
6. Engine oil tank: serviced, cap secure.
7. Turbo oil tank: serviced, cap secure.
8. Feathering oil tank: serviced, cap secure.
9. Engine accessory section: clean, tight lines, rear sump plug safetied, pressure transmitters in proper condition.

Note: Inspection of oil coolers, cowl flaps, intercoolers, and aftercoolers is included in the operational check.



Inboard Engine

Make same inspection that you made on outboard engine.

Landing Gear

1. Doors and retraction units: proper condition.
2. Tires: proper inflation and condition, slip marks aligned (rolling radius 23.3"—axle to ground).
3. Brake assemblies: proper clearance (.010" minimum) and no hydraulic leaks.
4. Strut: proper condition and inflation (13¼" between torsion link pin centers desired).
5. Down locks, wheel chocks (2" from tires), static groundwire: in place.
6. Hydraulic equipment (lines, deboost valves, shuttle valves): proper condition, no leaks.
7. Fuel cross-over lines: proper condition.
8. Electrical cannon plugs, limit switches: properly installed, safetied.
9. Mechanical wheel retraction system: proper condition.

Wing Section

1. Fuel drain access panels: installed.
2. Wing flaps: no fuel leaks, skin in proper condition.
3. Fuel vent: open.
4. Aftercooler air intake: open.

Nose—Left Side

1. Front bomb bay doors: proper condition, no holes.
2. Fuel vents: open.
3. Fuselage skin: proper condition, no wrinkles or holes.
4. Navigator's temperature bulb: not broken or bent.
5. Static holes: clear.
6. Turret cover: secure.
7. Fire extinguisher red rupture disc: intact.
8. Pitot head: not clogged.
9. Windows: clean and unbroken.
10. Bombardier's temperature bulb: not broken or bent.
11. Nosewheel door: proper condition.

Nose Gear and Well

1. Tires: proper inflation (rolling radius: 15.3"—axle to ground), proper condition, slip marks aligned.
2. Wheels: no cracks.

3. Shimmy damper: proper oil level.
4. Oleo strut: proper inflation (10" between torsion link pin centers desired), proper condition.
5. Wheel well door actuating spool: secure.
6. Retraction unit and door actuators: proper condition, no cracks.
7. Cannon plugs: secure and taped.
8. Limit switches: safetied.
9. Gear retraction motor: clutch engaged.
10. CO_2 fire extinguisher bottles: properly installed.
11. Nose gear hand crank: installed on under side of hatch.

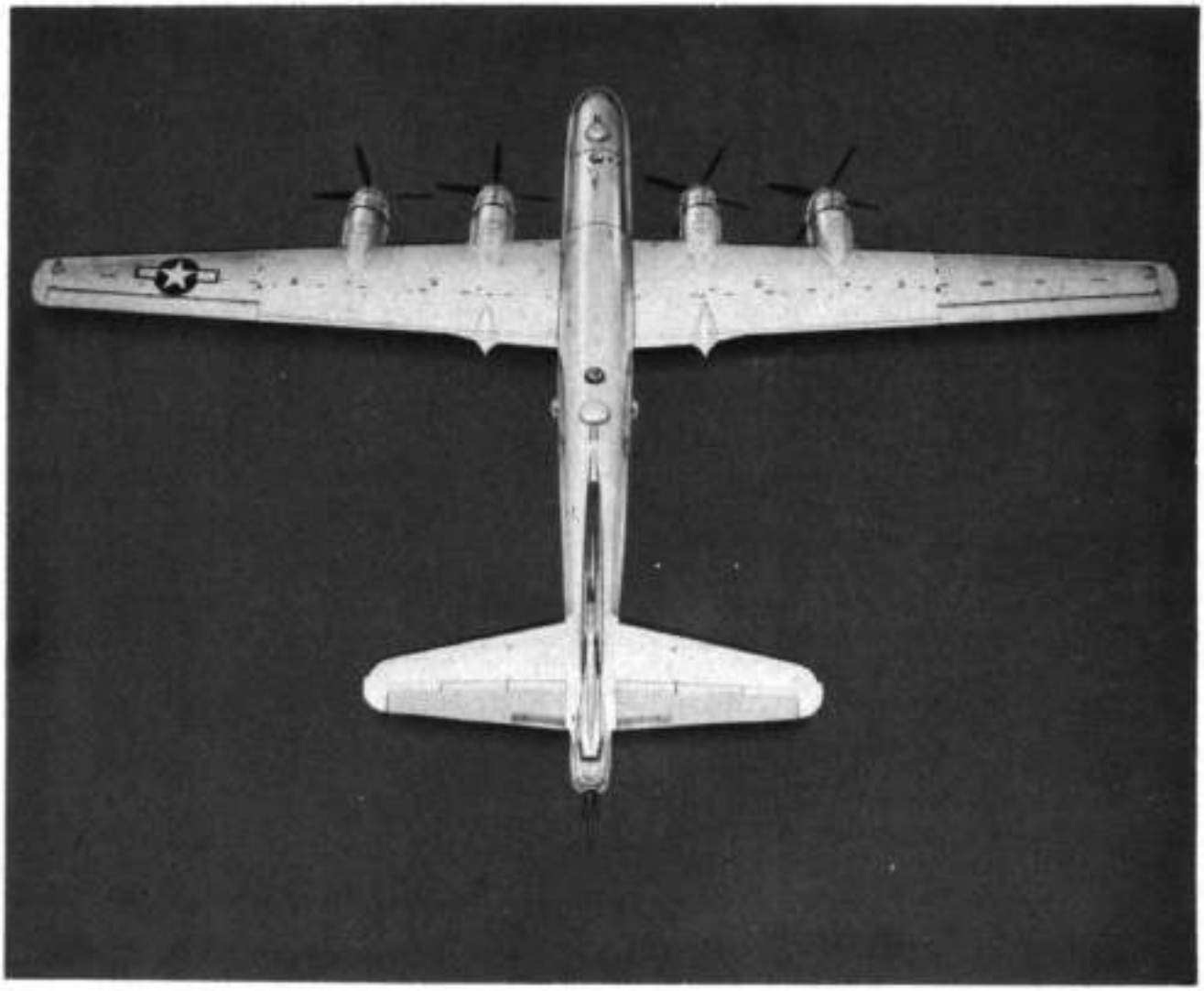
Nose—Right Side

1. Nosewheel door: proper condition.
2. Fuselage skin: proper condition, no wrinkles or holes.
3. Windows: clean and unbroken.
4. Pitot head: not clogged.
5. Engineer's temperature bulb: not broken or bent.
6. Static holes: clear.
7. Right front bomb bay door: proper condition, no holes.
8. Fuel vents: open.
9. Radome: no holes.
10. Vents (around radome): open.

Note: from this point proceed to wing and make same inspection of wing, two engines, and landing gear which you completed on the other side.

Aft Fuselage

1. Fuselage skin (sides and bottom): general condition, no wrinkles, holes, or popped rivets.
2. Bomb bay fuel vent: open.
3. Scanning blister: clean, not cracked.
4. Camera doors: closed.
5. Turret cover: secure.
6. Tailskid: proper condition.
7. Tail turret fairing: secure.
8. Tail gunner's window: clean, unbroken.
9. Skin, vertical and horizontal stabilizer: proper general condition, no wrinkles, holes or popped rivets.
10. Rudder and elevators: no holes or wrinkles in fabric covering, hinges in proper condition.
11. Elevator and rudder trim tabs: proper condition and position.
12. Antennas: installed, unbroken.
13. Recognition light lenses: unbroken.



Top of Wing

1. Skin: no holes, wrinkles, or popped rivets.
2. Aileron and trim tab: no wrinkles or holes, fabric coating in proper condition.
3. Formation light lenses: unbroken.
4. All access panels: secure.
5. Engines, as much as is visible from top of wing: no broken fins or loose baffles, sparkplug leads in place.
6. Intercoolers, cowl flaps: no evidence of binding.
7. Airlock fasteners and cowling: secure and in proper condition.
8. Fuel tanks: proper servicing, caps secure.

Upper Fuselage

1. Turret cover: secure.
2. Astrodome: clean, no cracks.
3. Antennas: installed, unbroken.
4. Life rafts doors: secure. Give several heavy tugs on door handles (not emergency release handles) to be sure they are securely locked. Check for presence of life raft through inspection window.
5. Formation light lenses: unbroken.
6. Skin: no holes, wrinkles, missing rivets.
7. CFC blister: clean, no cracks.
8. Upper aft turret cover: secure.
9. Upper empennage: no holes or wrinkles.

Aft Bomb Bay

1. Bomb bay door down locks: installed.

2. Bomb bay doors (inside and outside): hinges and chafing strips in proper condition.

3. Door retraction units (electrical or pneumatic): no external evidence of malfunction. Check cable release system on electrically operated doors.

4. Pneumatic unit: no leaks; air pressure: normal accumulator—1200 to 1500 psi, emergency accumulator (where present): 750 to 850 psi. **Caution: When recharging emergency accumulator open emergency recharging valve slowly until desired pressure is reached, and then close.**

Ask crew chief if condensate was removed from the accumulators during daily inspection.

5. All control valves: closed.

6. Emergency pull handle and pull cable, bomb door latch: proper condition and position.

7. Oxygen system: no leaks.

8. All visible control cables: no evidence of chafing or improper tension.

9. All lines: no evidence of leaks, deterioration, looseness.

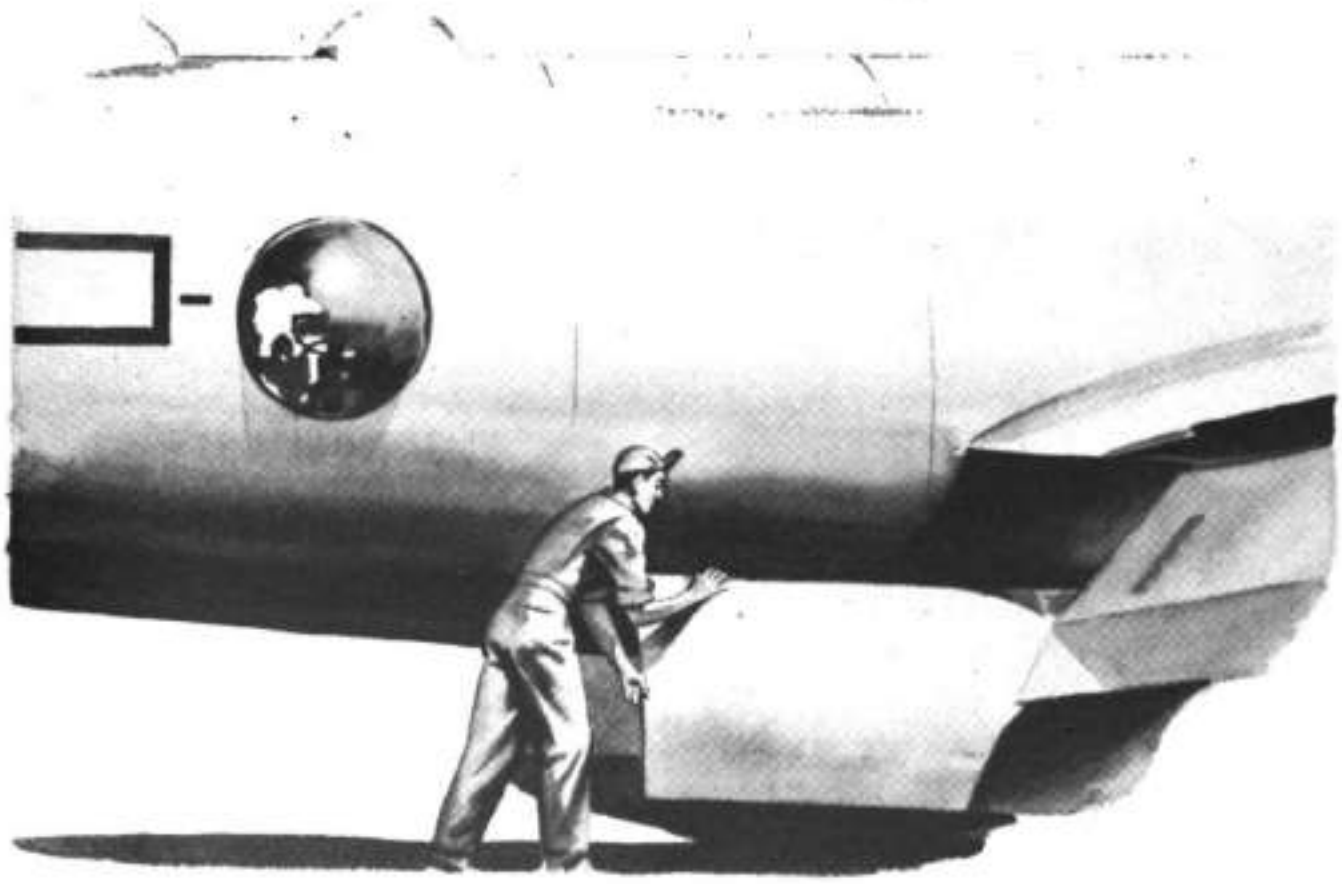
10. Portable emergency motor: properly installed in wing flap receptacle, cannon plug connected, switch OFF.

11. Life raft release dogs at center wing: fully engaged. Make detailed inspection of all life raft release cams and roller arms inside bomb bay to assure maximum meshing in fully locked position.

11. All cannon plugs: secure.

12. Landing gear cranks: stowed. Clutch handles: IN.

13. Bomb loading and racks: secure, bomb bay tank safety switch OFF. This switch must be off to prevent accidental salvo of bomb bay tanks or bombs with resulting injury to ground personnel.



Front Bomb Bay

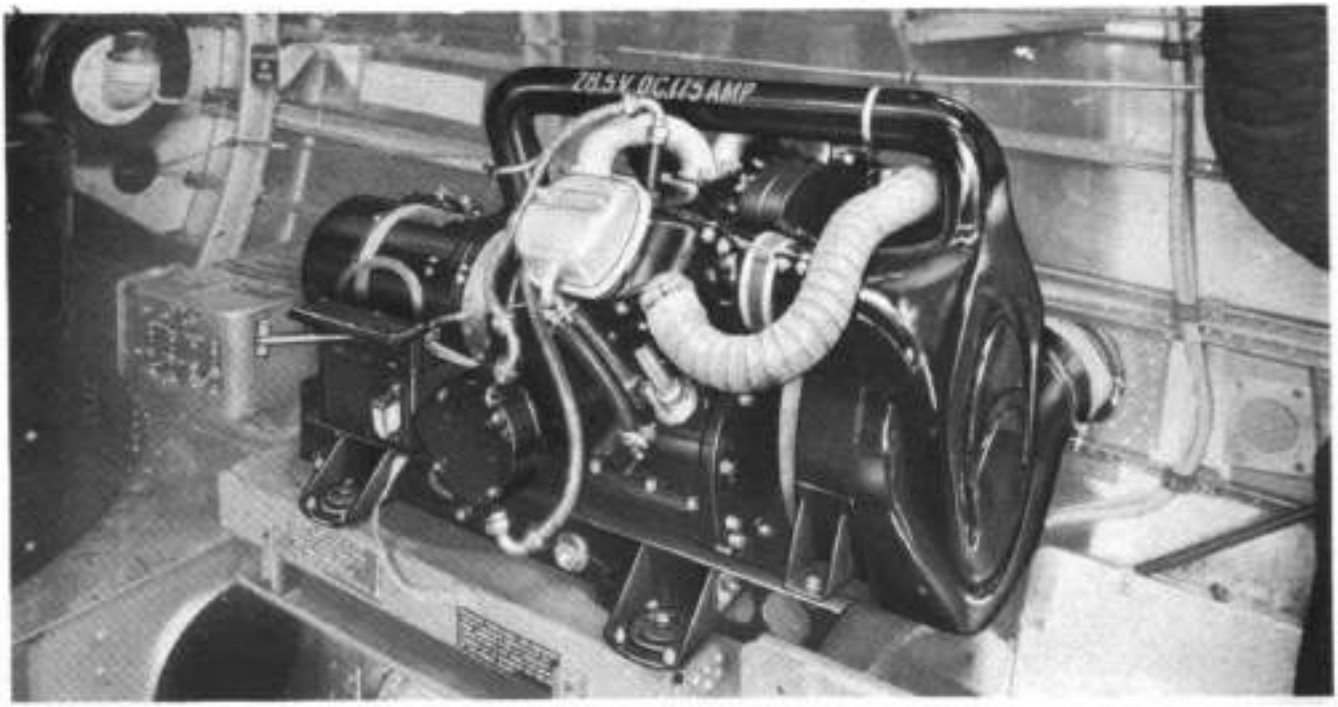
1. Bomb bay door down locks: installed.
2. Bomb bay doors (inside and outside): no holes, hinges and chafing strips in proper condition.
3. Door retraction units (electrical or pneumatic): no external evidence of malfunction. Check cable release system on electrically operated doors.
4. Pneumatic unit: no leaks; air pressure: normal accumulator—1200 to 1500 psi, emergency accumulator (where present)—750 to 850 psi. **Caution: When recharging emergency accumulator open emergency recharging valve slowly until desired pressure is reached and then close.**

Ask crew chief if condensate was removed from accumulators during daily inspection.

5. All control valves: closed.
6. Emergency pull handle and pull cable, bomb door latch: proper condition and position.
7. Oxygen system: no leaks.
8. All visible control cables: no evidence of chafing or improper tension.
9. All lines: no evidence of leaks, deterioration, or looseness.
10. Center wing tank and/or bomb bay tank: proper servicing, no fuel leaks, caps secure.
11. Bomb loading and racks: secure, bomb bay tank safety switch OFF.

Tail Compartment

1. Windows and escape hatch: secure and in proper condition.
2. Tail gun armored access panel: properly installed.
3. All electric light switches: OFF.
4. Spare bulbs: on hand.
5. Oxygen station: pressure 425 plus or minus 25 psi, emergency valve OFF, auto-mix ON (NORMAL), hose in proper condition, walk-around bottles charged to line pressure.
6. Bulkhead door seal and hinge: proper condition.
7. Oxygen bottles: no leaks.
8. Cables and lines: proper condition:
9. Camera hatch: closed.
10. Emergency equipment: stowed.
11. Putt-putt: properly serviced and in proper condition, fuel and oil filler caps secure, circuit breaker ON or bus selector switch in NORMAL position.
12. Battery: proper condition and installation, quick-disconnect in place and in proper condition.



Radar Compartment

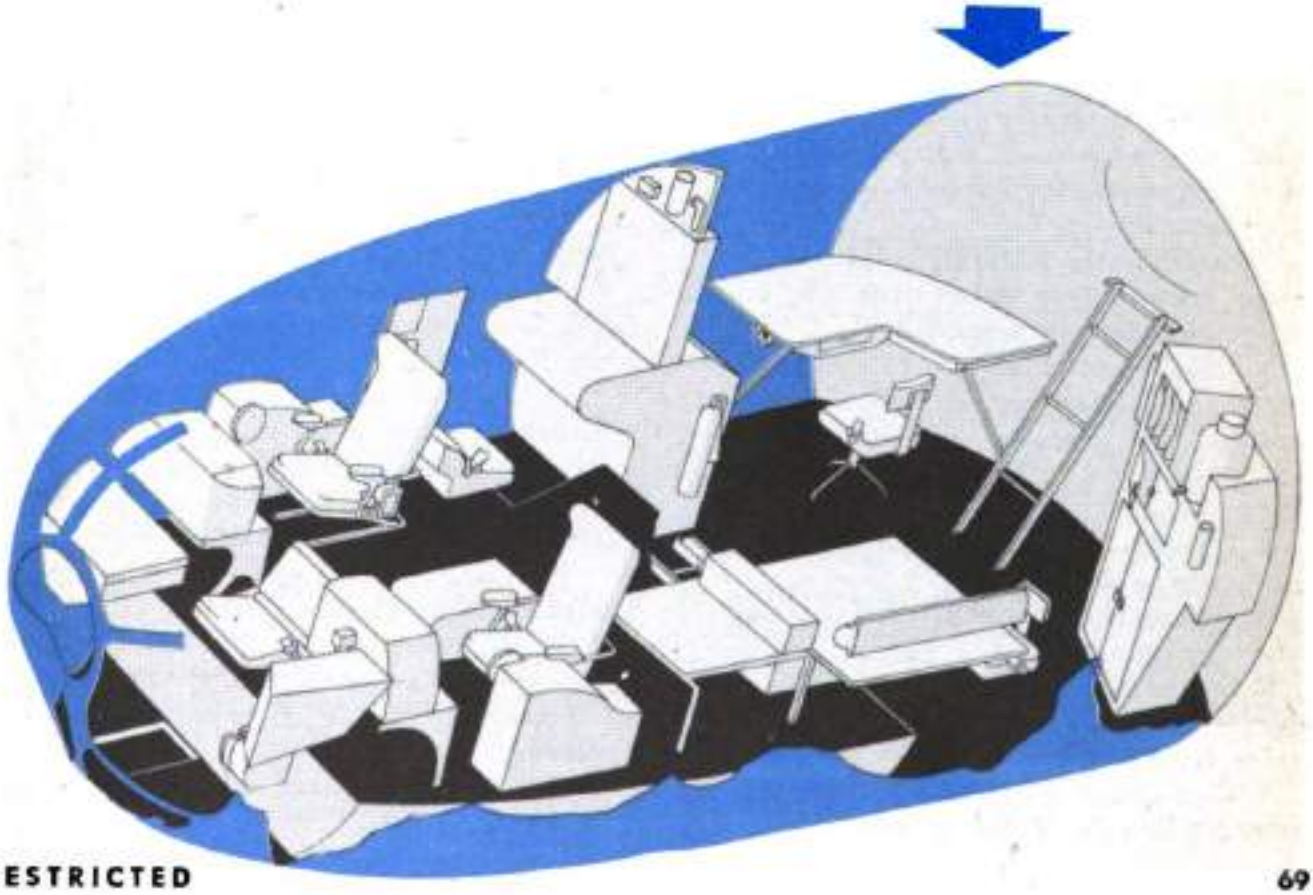
1. Bulkhead door seal and hinge: proper condition.
2. Emergency pressure relief valve: closed.
3. Vacuum pressure relief valve: free movement.
4. All electric light switches: OFF.
5. All oxygen stations: pressure 425 plus or minus 25 psi, emergency valve OFF, auto-mix ON (NORMAL), hose in proper condition, walk-around bottles charged to line pressure.
6. All emergency equipment: present and properly stowed, seals unbroken.
7. Cable controls: proper tension and condition.
8. Turret dome: properly installed.
9. Entire compartment: clean, ash trays emptied, equipment properly stowed.

Gunners' Compartment

1. Blisters: clean, unbroken, no scratches.
2. All electric light switches: OFF.
3. Defroster fans: OFF.
4. Salvo switches: OFF.
5. Air compressor circuit breaker: ON.
6. Cabin pressure regulators: unlocked.
7. Bulkhead door seal and hinge: proper condition.
8. Door braces: aboard.
9. All oxygen stations: pressure 425 plus or minus 25 psi, emergency valve OFF, auto-mix ON (NORMAL), hose in proper condition, walk-around bottles charged to line pressure.
10. Tail gunner's air supply valve: full OPEN.
11. Entire compartment: clean, ash trays emptied, equipment properly stowed.

Flight Compartment

1. Bulkhead door seal and hinge: proper condition.
2. All oxygen stations: pressure 425 plus or minus 25 psi, emergency valve OFF, auto-mix ON (NORMAL), hose in proper condition, walk-around bottles charged to line pressure.
3. Emergency kits: properly stowed, seals unbroken.
4. Hydraulic fluid quantity: approximately 2 gallons.
5. Air compressor circuit breaker: ON.



6. All voltage regulators: in place.

7. Turret covers: properly installed, ammunition doors closed.

8. Turbo amplifiers: in place. Check for spare.

9. Entrance hatch seal: proper condition.

10. All fuse panel covers: properly installed.

11. Landing gear fuse: in place.

12. All windows: clean, no cracks, airplane commander's and copilot's windows operating properly, engineer's emergency escape window properly installed.

13. Safety belts: present and in proper condition.

14. All light switches: OFF.

15. De-icing fluid: stowed (if required for mission).

16. Electrical wires and tubing: visual check for evidence of external damage. Give particular attention to tubing and wires near the tunnel entrance.

17. Entire compartment: clean, ash trays emptied, no unnecessary equipment aboard.

OPERATIONAL CHECK OF EQUIPMENT

1. Check all switches OFF, then turn on battery switch and start the putt-putt. Check the voltage output on DC voltmeter. Check the current output by momentarily flicking the hydraulic pump switch to the MANUAL position. A momentary voltage drop plus momentary decrease of putt-putt speed are indications that the unit is operating properly. As soon as the putt-putt is checked turn it off and make subsequent operational checks using an external power source.

2. Check the operation of the bomb bay doors from the bombardier's station. Be sure that the locks are removed if doors are pneumatically operated.

Note: Make the following checks at the airplane commander's station with the ground crew observing unit operations:

3. Unlock control lock. Operate rudder, elevators and ailerons noting action of copilot's controls and obtaining verification of correct external control movements from the ground crew.

4. Operate trim tabs, checking as in No. 3. Return to neutral.

5. Operate throttles, noting action of copilot's and engineer's throttles.

6. Set parking brakes and watch normal pressure for a short time for indications of hydraulic leaks. Release brakes.

7. Check emergency brakes—note emergency pressure for evidence of leaks.

8. Operate propeller electric head to both low and high limit settings noting the time required to change from the low to the high rpm setting. The time should be almost the same for all electric heads.

9. Turn the turbo boost selector to No. 10 (inverter ON) and have ground crew check for smooth operation of the waste gates to the closed position. Return TBS to zero. Waste gates should open fully.

10. Operate the wing flaps to the down and up limits and check position indicator. Have ground crew check fuel liquidometers and fuel transfer lines while flaps are down.

11. Check fluorescent instrument lights if night operation is anticipated.

12. Check all external lights if night operation is anticipated: formation, position, recognition, and landing.

13. Be sure to turn lights OFF after checking. Check instruments for broken or loose cover glasses. Make manifold pressure readings.

Note: Perform the following operational checks at the flight engineer's station:

14. Check mixture control lock. Leave unlocked. Check vacuum controls.

15. Operate fuel transfer selector handles noting detent positions. Return to OFF position. Momentarily operate fuel transfer system in all positions.

16. Check emergency cabin pressure valve and leave it open.

17. Check cowl flap operation for open and closed position and freedom from binding. Leave open. Ground crew reports operation.

18. Check intercooler door operation as in No. 17. Leave open.

19. Check oil cooler door operation as in No. 17. Leave open.

20. Check aftercooler doors as in No. 17. Leave closed.

21. Check pitot heaters. Turn ON for approximately 5 seconds and have ground crew member feel the pitot heads to determine if heaters operate. Be sure to turn OFF after checking.

22. Make the following pressure checks:

(**Note:** Three men are necessary to accomplish these checks, one working at the flight engineer's panel and one at each access door of the engine nacelle.)

Carburetor and Primer Pressure Check

a. Battery switch or external power—ON.

b. Fuel shut-off valve—CLOSED.

c. Fuel booster pump—on LOW.

d. Mixture control—cracked. There should be no indication of fuel pressure.

e. Fuel shut-off valve—OPEN. Check for fuel pressure rise.

Note: Operate fuel shut-off valve by momentary contact of switch. Prolonged energizing burns out actuating coils.

At this time men at nacelle check fuel lines and carburetor for leaks. Check especially around main fuel strainer, mixture control assembly, and fuel drain plug. You can detect small leaks more readily by smell than by sight. In addition one man checks that the mixture control lever operates smoothly with load sufficiently low so that all engines can be set with one hand. He also makes sure that the detents for AUTO LEAN and AUTO RICH mixture control positions are easily and positively located.

f. Mixture control—FUEL SHUT-OFF (Five seconds of fuel pressure indication is maximum, in order to avoid liquid lock.)

g. Toggle primer switch. Man at nacelle listens for clicking of solenoid and watches primer line connection for spray and droplets of fuel.

h. Check all safetying of carburetor, especially after 25, 50, and 100-hour inspections.

Fuel Inspection Pressure Check

a. Fire guard—posted.

b. Putt-putt or external power—ON.

c. Ignition switches—OFF.

d. Fuel shut-off valve—CLOSED.

e. Fuel booster pump — on LOW. There should be no indication of fuel pressure.

f. Fuel shut-off valve—OPEN. Check for fuel pressure indication.

g. Mixture control—AUTO RICH.

h. Throttles—FULL OPEN.

i. Rotate propeller 8 to 10 seconds (maximum 15 seconds) **by direct cranking.**

At this time men at nacelle check fuel lines, master control box, and both pumping units for leaks. In addition one man checks that mixture control lever operates smoothly with load sufficiently low so that all engines can be set with one hand. Also he makes sure that the detents for AUTO LEAN and AUTO RICH mixture control positions are easily and positively located.

Have member of the flight crew or ground crew clear propeller and give signal for direct cranking. After engine rotation, check fuel lines and fittings in front of engine.

Note: Hold this check to a minimum to prevent washing oil from cylinder walls of the engine.

23. Check normal and spare inverter output, noting airplane commander's and engineer's warning lights.

24. Check fluorescent instrument lights.

25. Check wheel well lights if night landing or takeoff is anticipated.

26. Check electrical instruments: carburetor air temperature, oil temperature, fuel and oil quantity gages, cowl flaps and inter-cooler indicators, hydraulic pressure (charge if necessary), wind and set clock, and note manifold pressure readings. The purpose of checking airplane commander's and engineer's manifold pressure gages is to find which instruments read more nearly correct. Power settings then should be made using the better set of instruments or by applying a correction factor to instruments that read incorrectly.

27. Ask crew chief if the bomb release system was checked before loading the bombs and if emergency equipment is in the life raft compartments.

28. Compute the weight and balance.

CREW INSPECTION

Flight engineer joins other crew members for crew inspection.

Following crew inspection, make the following checks before entering the airplane.

1. Pitot covers: removed.

2. Forms 1, 1A, F, loading list: completed. Give Forms 1A and F and/or loading list to the airplane commander for approval and signature.

3. Propellers: pulled through. Airplane commander checks that all ignition switches are OFF and signals to other crew members or the ground crew to pull the props through. Pull the props through at least 12 blades with not more than two men to a blade.

4. Down locks (gear and bomb door): removed.

5. Chocks: 2" in front of wheels.

Flight Engineer's Checklist

BEFORE STARTING

1. FLIGHT PLAN.....COMPLETED
2. FLIGHT ENGINEER'S PREFLIGHT....COMPLETED
3. FORMS 1, 1A, F.....ON BOARD AND SIGNED
4. PROFESSIONAL EQUIPMENT.....CHECKED AND ABOARD
5. FLIGHT LOG.....INITIATED
6. BATTERY SWITCH.....ON
7. MASTER IGNITION SWITCH.....ON
8. PUTT-PUTT.....START AND CHECK FOR ON THE LINE
9. INSTRUMENTS.....CHECKED
10. COWL FLAPS.....FULL OPEN
11. INTERCOOLERS.....OPEN TO 7½°
12. OIL COOLERS.....AUTOMATIC
13. DE-ICERS, ANTI-ICER SWITCH & RHEOSTATS.....OFF
14. BOMB BAY FUEL TANK VALVE...CLOSED
15. GENERATOR SWITCHES.....OFF
16. INVERTER.....CHECK ALTERNATE; NORMAL ON
17. FUEL TRANSFER SWITCHES AND TANK SELECTORS.....OFF
18. HYDRAULIC PRESSURES.....1000 PSI
19. EMERGENCY HYDRAULIC SYSTEM VALVE.....CLOSED
20. FUEL SHUT-OFF VALVES.....OPEN
21. STARTER CIRCUIT BREAKERS.....ON
22. PITOT HEATERS.....OFF
23. FUEL TRANSFER CIRCUIT BREAKERS.....ON
24. CABIN PRESSURE WARNING SWITCH.....ON
25. OXYGEN REGULATOR AND PRESSURE.....CHECKED
26. CABIN PRESSURE RELIEF VALVE...CLOSED
27. CABIN AIR VALVES.....CLOSED
28. THROTTLES.....SET TO START
29. MIXTURE CONTROLS.....UNLOCKED; CARBURETOR—FUEL CUT-OFF, INJECTION—AUTO RICH
30. OIL QUANTITY GAGE.....RECORD AND CHECK AGAINST DIP STICK
31. FUEL QUANTITY GAGE.....RECORD AND CHECK AGAINST DIP STICK
32. LIGHTS.....AS REQUIRED
33. FIRE EXTINGUISHERS.....SET TO ENGINE BEING STARTED
34. FUEL BOOSTER PUMPS.....ON LOW
35. FLIGHT ENGINEER'S REPORT.....READY TO START ENGINES
36. START ENGINES.....1, 2, 3, 4
37. ENGINE INSTRUMENTS.....CHECKED
38. VACUUM SELECTOR.....CHECKED
39. FLIGHT ENGINEER'S REPORT.....READY TO TAXI

1. MIXTURE CONTROL	AUTO RICH
2. GENERATORS	CHECKED AND ON
3. ENGINE RUN-UP	COMPLETED
4. INVERTER VOLTAGE	CHECKED
5. FUEL BOOSTER PUMPS	ON LOW
6. FLIGHT ENGINEER'S REPORT	MIXTURE AUTO RICH, FUEL BOOST ON, GENERATORS ON, STANDING BY ON COWL FLAPS, READY FOR TAKEOFF
7. COWL FLAPS	AT START OF TAKEOFF ROLL CLOSE FROM 15° TO 7½° OR LESS

1. GENERATORS	CHECK WHILE GEAR IS BEING RAISED
2. ENGINE CHECK	SCANNERS' REPORT
3. COWL FLAPS	AS REQUIRED
4. PUTT-PUTT	STOP AFTER GEAR AND FLAPS ARE UP
5. FUEL BOOSTER PUMPS	ON LOW
6. INTERCOOLERS	AS REQUIRED

1. MIXTURE CONTROL	AUTO RICH
2. PUTT-PUTT	START AND ON THE LINE
3. FUEL BOOSTER PUMPS	ON LOW
4. HYDRAULIC PRESSURES	1000 PSI
5. PITOT HEATERS	AS REQUIRED
6. ANTI-ICERS	AS REQUIRED
7. DE-ICERS	OFF
8. WHEEL WELL LIGHTS (NIGHT)	ON
9. GENERATORS	CHECKED WHILE GEAR IS COMING DOWN
10. COWL FLAPS	AS REQUIRED
11. INTERCOOLERS	OPEN TO 7½°
12. INVERTER VOLTAGE	CHECKED
13. FLIGHT ENGINEER'S REPORT	GROSS WEIGHT____LBS., PUTT-PUTT ON LINE, READY TO LAND

1. COWL FLAPS	FULL OPEN
2. GENERATORS	OFF
3. HYDRAULIC PRESSURES	CHECKED
4. FUEL BOOSTER PUMPS	OFF
5. ENGINE RUN-UP	COMPLETED
6. STOP ENGINES	FUEL CUT-OFF
7. ALL SWITCHES	OFF
8. PUTT-PUTT	OFF
9. WHEEL CHOCKS	IN PLACE
10. DOWN LOCKS (GEAR AND BOMB DOOR)	IN PLACE
11. PITOT COVERS	IN PLACE
12. FORMS 1, 1A, FLIGHT LOG	COMPLETED
13. GIVE CREW CHIEF REPORT OF MALFUNCTIONS	

Before Starting

1. Flight Plan Completed

2. Flight Engineer's Preflight Completed

The complete and detailed preflight inspection procedure is included in a preceding section under the heading **Flight Engineer's Preflight Inspection.**

3. Forms 1, 1A, F on Board and Signed

Check forms 1 and 1A. Advise the airplane commander of status of airplane and that forms are on board.

4. Professional Equipment Checked and Aboard

Check for proper clothing for the mission to be performed. Make the standard preflight check on your parachute. Adjust your headset and throat microphone, and attach your oxygen mask to the left side of your helmet.

For overwater missions examine your life preserver vest and check its CO_2 capsules for safetying. Wear your parachute over the vest.

Note: Stay on interphone at all times unless otherwise authorized by the airplane commander.

5. Flight Log Initiated

6. Battery Switch ON

At the copilot's call, you as flight engineer turn the battery switch on and report: **"Battery switch ON."** All electrical circuits can be energized by either battery or putt-putt, or both. Both are used for normal ground operation on loads up to 200 amperes. For additional power use an external source.

Note: Check the normal inverter switch OFF before turning the battery switch on.

7. Master Ignition Switch ON

8. Putt-putt Start and Check for ON THE LINE

Have the tail gunner start the putt-putt, warm it up and place it ON THE LINE. Check for 28 volts.

9. Instruments Checked

Check the CHT and CAT gages against OAT.

Check the tachometer, rate of climb, oil and fuel pressure gages for zero reading. Set both altimeters at 29.92" Hg. Check the MP gages for uniform readings. Flight personnel will not attempt to adjust gages.

10. Cowl Flaps Full Open

Keep the cowl flaps full open for all ground operation.

11. Intercoolers Open to 7½?

Keep the intercoolers full open for all ground operations.

12. Oil Coolers AUTOMATIC

Put the switch in AUTOMATIC. The oil cooler flaps will then adjust themselves to maintain correct oil temperatures.

13. De-icers, Anti-icer Switch and Rheostats OFF

14. Bomb Bay Fuel Tank Valve CLOSED

Close the valve to separate the two bomb bay tanks.

15. Generator Switches OFF

16. Inverter Check Alternate; NORMAL ON

Check ALTERNATE inverter and voltage reading. Allow ALTERNATE inverter to coast down, and then turn NORMAL inverter on.

17. Fuel Transfer Switches and Tank Selectors OFF

Turn the switches off to prevent inadvertent transfer or transfer by gravity.

18. Hydraulic Pressures 1000 PSI

Check both hydraulic pressures for proper readings. When the copilot asks for emergency hydraulic pressure you report: **"1000 PSI."** If the pressure is not within the normal range of 900 to 1075 psi, service the emergency accumulator.

19. Emergency Hydraulic System Valve CLOSED

20. Fuel Shut-off Valves OPEN

Open the valves to allow fuel to flow to the carburetors.

21. Starter Circuit Breakers ON

22. Pitot Heaters OFF

23. Fuel Transfer Circuit Breakers ON

24. Cabin Pressure Warning Switch ON

25. Oxygen Regulator and Pressure Checked

Check for oxygen pressure of 425 plus or minus 25 psi. Check operation of the regulator and blinker, and see that the hose collar at the regulator is screwed down tight. Auto-mix should be ON (NORMAL) and the emergency valve OFF. Check the walk-around and bailout bottles for proper pressures.

26. Cabin Pressure Relief Valve CLOSED

Close the valve only until it seats firmly. Excessive pressure tends to damage the light structure of the valve.

27. Cabin Air Valves CLOSED

Keep cabin air valves closed until after takeoff to avoid possibility of smoke being forced through the induction system into the cabin, and a slight loss of power on takeoff.

28. Throttles Set to Start

Set the throttles at 1½" open. This gives approximately 800 to 1000 rpm and prevents backfiring during starting.

29. Mixture Controls Unlocked; Carburetor—FUEL CUT-OFF, Injection—AUTO RICH

30. Oil Quantity Gage—Record and Check Against Dip Stick

31. Fuel Quantity Gage—Record and Check Against Dip Stick

32. Lights as Required

If night flight is planned, check for proper operation of the fluorescent lights and wheel well lights. For day flights turn off unnecessary lights.

33. Fire Extinguisher Set to Engine Being Started

34. Fuel Booster Pumps On LOW

Turn the fuel boost on LOW and check pressure. Fuel pressure should be approximately 9 to 12 psi.

35. Flight Engineer's Report—Ready to Start Engines

When the copilot calls for this report and if you are ready, you reply: **"Ready to start engines."**

36. Start Engines 1, 2, 3, 4.

Carburetor Type Starting Procedure:

a. Fire extinguisher—set to the engine being started.

b. Master ignition switch—ON.

c. Mixture controls—FUEL CUT-OFF.

d. Throttles—set to start: 1½" open.

e. Fuel booster pumps—on LOW.

f. Fuel shut-off valves—OPEN. When the airplane commander calls for starting No. 1 engine, you report: **"Energizing No. 1."**

g. Energize the starter 12 to 16 seconds. Report: **"Meshing No. 1."**

h. Engage the starter.

i. After one revolution of the propeller (four blades) turn the ignition switch to BOTH.

j. Prime as needed to start and when the engine is firing regularly (500 to 800 rpm) move the mixture control to AUTO RICH and release the primer. Use AUTO RICH for all ground operations.

Note: Too little prime causes backfiring; too much floods the engine.

k. Fuel booster pumps—OFF.

l. Check the starter switches for neutral positions.

m. Engine instruments—checked. Check nose and rear oil pressures, rpm, oil temperature and manifold pressure.

When No. 1 engine is running properly, report: **"Engine operating normally. Ready to start No. 2 engine."** When the airplane commander says: **"Clear on two,"** you reply: **"Starting two."**

Repeat the procedure for each engine. You, the flight engineer, will control the throttles

throughout the starting procedure, keeping rpm between 1000 and 1200 until the oil temperature is 40° C. When all engines are running set the throttles at 700 to 1000 rpm (1000 rpm if oil temperature is below 40° C). Thereafter the airplane commander controls the throttles except when calling for engine-driven generators and during engine run-up for magneto check. If you see an engine loading up (black smoke or rpm drop, or both) inform the copilot. Do not let the engines idle below 700 rpm.

Bendix Injection Type Starting Procedure:

a. Fire extinguisher—set to engine being started.

b. Master ignition switch—ON.

c. Mixture controls—AUTO RICH (AUTO RICH for all ground operations).

d. Throttles—set to start: 1½" open.

e. Fuel booster pumps—on LOW.

f. Fuel shut-off valves—OPEN. When the airplane commander calls for starting No. 1 engine, you report: **"Energizing No. 1."**

g. Energize the starter 12 to 16 seconds. Then report: **"Meshing No. 1."**

h. Engage the starter. After one revolution (four blades) turn the ignition switch to BOTH. Hold the meshing switch in until the engine begins to fire.

If the engine is warm it may be necessary to have the mixture control in FUEL CUT-OFF until the ignition switch is ON.

i. Fuel booster pumps—OFF. Check the engine-driven pumps.

j. Check the starter switches for neutral.

k. Engine instruments—checked. (See Item m. under carburetor starting procedure.)

STARTING DON'TS

a. Don't start the engines until the Before Starting Checklist has been covered item by item.

b. Don't start the engines until the propellers have been pulled through to eliminate any possibility of liquid locks. Never back up propellers on liquid locks.

c. Don't start the engines until the fire guard is posted.

d. Don't jam the throttles forward at any time.

e. Don't jockey the throttles during the starting procedure.

f. Don't continue to run an engine unless you get an oil pressure indication within 10 seconds and unless nose and oil pressures build up to normal within 30 seconds after starting.

37. Engine Instruments Checked

	MINIMUM	DESIRED	MAXIMUM
Nose oil pressure	20 psi	30-50 psi	50 psi
Rear oil pressure	60 psi	60-80 psi	80 psi
Oil temperature	40° C	50-85° C	95° C
Fuel pressure	15 psi	16-18 psi	19 psi
Vacuum		3.8"-4.2" Hg	

38. Vacuum Selector Checked

Check the vacuum gages. Vacuum should be from 3.8" to 4.2" Hg. on both No. 2 and No. 3 engines. When the copilot calls: **"Check vacuum,"** you reply **"Vacuum OK. Vacuum on No. ....."** (No. of engine on which vacuum pump is operated.)

Note: Do not move the vacuum selector valve on the engineer's control stand except in making this check. Frequent use of the valve causes unnecessary wear.

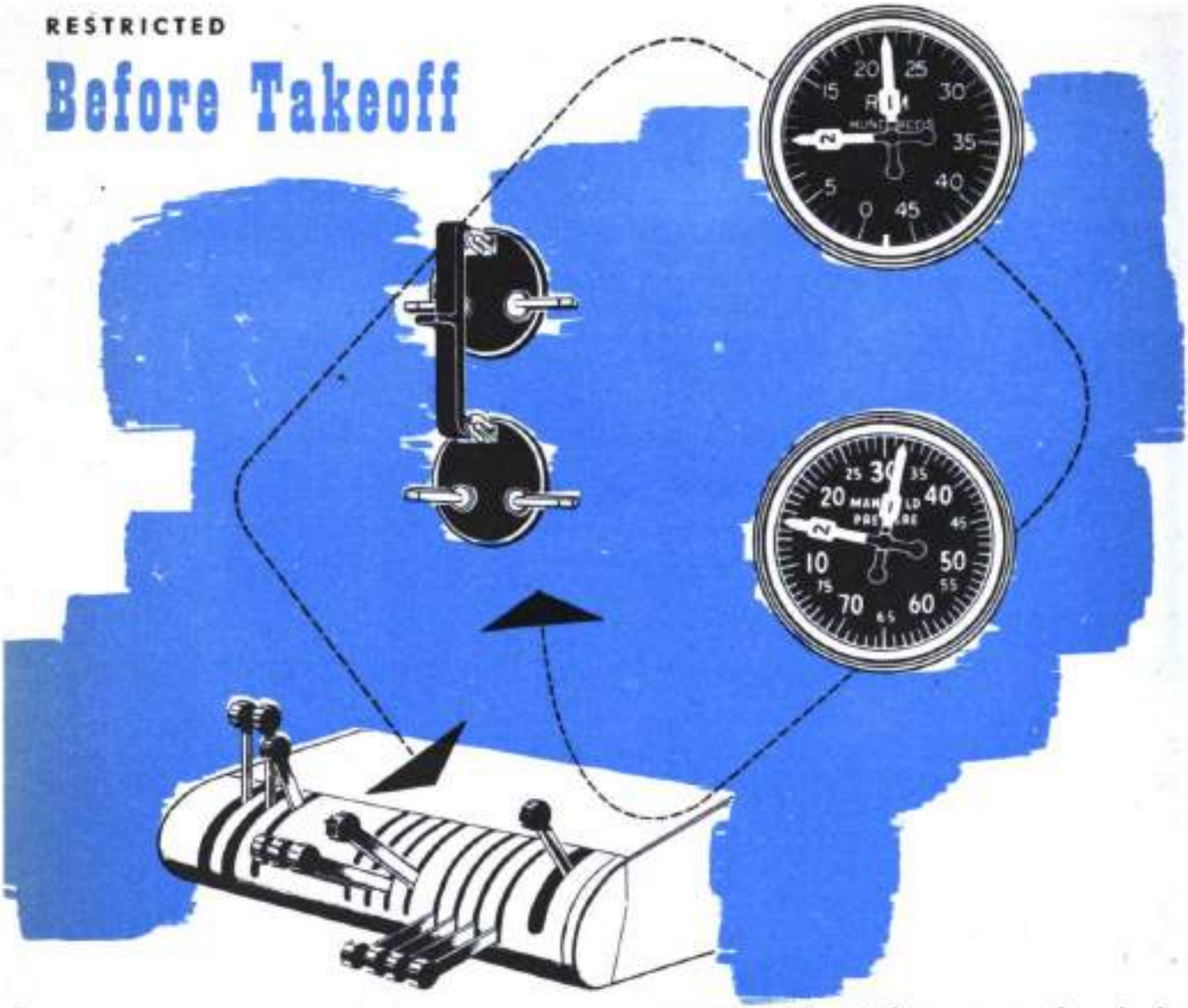
39. Flight Engineer's Report—Ready to Taxi

When the copilot calls on interphone: **"Stand by to taxi"** you reply: **"Ready to taxi,"** if engines are running properly and you are ready to go. If you are not ready to taxi, let him know.

During taxiing the copilot calls for recharging the emergency system. On this order, you service the emergency system and report: **"Emergency system recharged."**

Watch engine operation while taxiing. If an engine loads up or you detect a torching turbo notify the copilot. If an engine loads up while taxiing, make notation in Form 1.

Before Takeoff



1. Mixture Control AUTO RICH

Keep the mixture control in AUTO RICH setting for all ground operation and for takeoff.

2. Generators Checked and ON

The airplane commander gives the command: **"Stand by for engine run-up,"** and the copilot repeats the command over the interphone. The airplane commander increases all throttles to 1500 rpm and commands: **"Check generators."** The copilot starts the flaps down and tells you, the flight engineer, to check the generators. (Flaps are run to 25° position and then returned to 0°.)

Note: The flaps are run down at this time in order to have a large electrical load on the normal bus so that you can properly check the generators. The airplane commander checks props at this time.

Check the generators one at a time for amperage and voltage. After checking individually put all generators ON to check the equalizer system. Leave the generators ON for takeoff. After generator check, place the voltage selector to BUS position. Report to copilot: **"Generators OK."**

3. Engine Run-Up Completed

Advance the throttle to obtain 2200 rpm and call out the manifold pressure to the copilot. Then check the magnetos for rpm drop, calling to the copilot: **"Right, both, left, both."** Watch for rpm drop in excess of the 100 allowed. If a magneto drops 100 to 200 from bad plugs, proceed with the full power check, then return

to 2200 rpm and re-check the magnetos on the bad engine. Five seconds is the maximum allowable time for magneto check.

Note: Approximately 32" with 2200 rpm is normal manifold pressure at sea level. Above sea level subtract 1" for each 1000 feet of altitude. Changes in temperature vary these settings but the variation is the same for all engines. Excessive MP on one engine indicates a bad cylinder or some other engine malfunction. If manifold pressure differential on one or more engines exceeds normal by 2" or more, recommend to the airplane commander that he return the airplane to the line for an engine check.

If the airplane commander makes a full-power no-boost check, watch for indications of induction leaks, incorrect waste gate position, dead cylinder from bad valve, dead plugs, broken fuel injection lines, and engine roughness. A rough-running engine is a reliable indication that something is wrong. Manifold pressure of 40" is normal at sea level with the above altitude correction applying. Engine trouble reduces rpm and manifold pressure. Faulty position of the waste gate or an induction leak between turbo and carburetor may cause high manifold pressure and rpm.

At this time the airplane commander makes his full-power check with turbos set for takeoff. Check the engine instruments for proper readings.

See **Curtiss Electric Propeller System** for additional checks on that installation.

4. Inverter Voltage Checked

5. Fuel Booster Pumps On LOW

Watch fuel pressure carefully on takeoff.

6. Flight Engineer's Report

A. MIXTURE–AUTO RICH
B. FUEL BOOST–ON
C. GENERATORS–ON
D. STANDING BY ON COWL FLAPS
E. READY FOR TAKEOFF

When the airplane commander says: **"Stand by for takeoff"** you report as above. When the airplane moves into takeoff position close the cowl flaps to 15°.

7. Cowl Flaps–At Start of Takeoff Roll Close From 15° to 7½° or Less

Start closing the cowl flaps at the beginning of the takeoff roll so that when the wheels leave the ground, cowl flaps will be closed to 7½° or less.

ENGINE LIMITATIONS

Condition	RPM	MP	CHT	Time Limit
Takeoff	**2800**	**49"**	**260° C**	**5 minutes**
Climb	**2400**	**43.5"**	**248° C**	**Continuous**

During takeoff roll watch manifold pressure, rpm and engine instruments and report any irregularities to the copilot.

After Takeoff

1. Generators—Check While Gear Is Being Raised

As the gear is coming up, check the generators for amperage draw and paralleling.

2. Engine Check—Scanners' Report

Call the scanners and ask for their report on the condition of all engines. Be sure that your scanners are briefed to give an accurate report on color, type, and location of engine smoke, if it appears. See the diagram on engine fire recognition in the emergency section of this manual.

3. Cowl Flaps As Required

Adjust the cowl flaps to maintain CHT within limits (maximum opening 10°; maximum CHT 260° for takeoff, 248° for climb). If a CHT rises above 260° on takeoff or stays above 248° after the first power reduction, report the condition immediately to the copilot: "**No.____ CHT____**" and open the cowl flaps on the hot engine to a maximum of 10°. Never open the cowl flaps more than 10° in flight. If high cylinder temperature still persists, reduce manifold pressure or increase airspeed. Larger openings provide little additional cooling and decrease cruising range considerably. When you want to obtain maximum range, set the cowl flaps to the minimum opening to maintain desirable CHT. Don't exceed allowable CHT. Always report excessive CHT immediately to the copilot.

4. Putt-putt—Stop After Gear and Flaps Are Up

After flaps and gear are up have the operator stop the putt-putt.

5. Fuel Booster Pumps On LOW

6. Intercoolers As Required

Close the intercoolers when the turbos are off. When the copilot says: "**Turbos off,**" you report: "**Intercoolers closing.**"

Before Landing

1. Mixture Control—AUTO RICH

When ordered to prepare for landing place the mixture controls in AUTO RICH before increasing rpm.

Note: Place the mixture controls in AUTO RICH one at a time to avoid the possibility of inadvertently placing all four in FUEL CUT-OFF.

2. Putt-putt—Start and ON THE LINE

Ask the operator to start the putt-putt and when it is warmed up put in ON THE LINE.

3. Fuel Booster Pumps On LOW

Place the fuel booster pumps on LOW one at a time as a check on individual operation. Use the booster pumps within 1000 feet of field elevation or in the traffic pattern.

4. Hydraulic Pressures 1000 PSI

Check hydraulic pressures for proper reading. On the copilot's order check the emergency hydraulic pressure. If the pressure is not within the normal range of 900 to 1075 psi, open the emergency servicing valve. Re-service, if necessary, with the emergency over-ride switch. Report to the copilot: **"1000 psi."**

5. Pitot Heaters As Required

6. Anti-Icers As Required

7. De-Icers OFF

8. Wheel Well Lights (Night) ON

9. Generators Checked While Gear Is Coming Down

As the gear is coming down check the output of the generators to see that all of them are working, and that the load is equally distributed.

10. Cowl Flaps As Required

When the airspeed is reduced (175-180 mph) to lower the gear, set the cowl flaps as desired to maintain CHT.

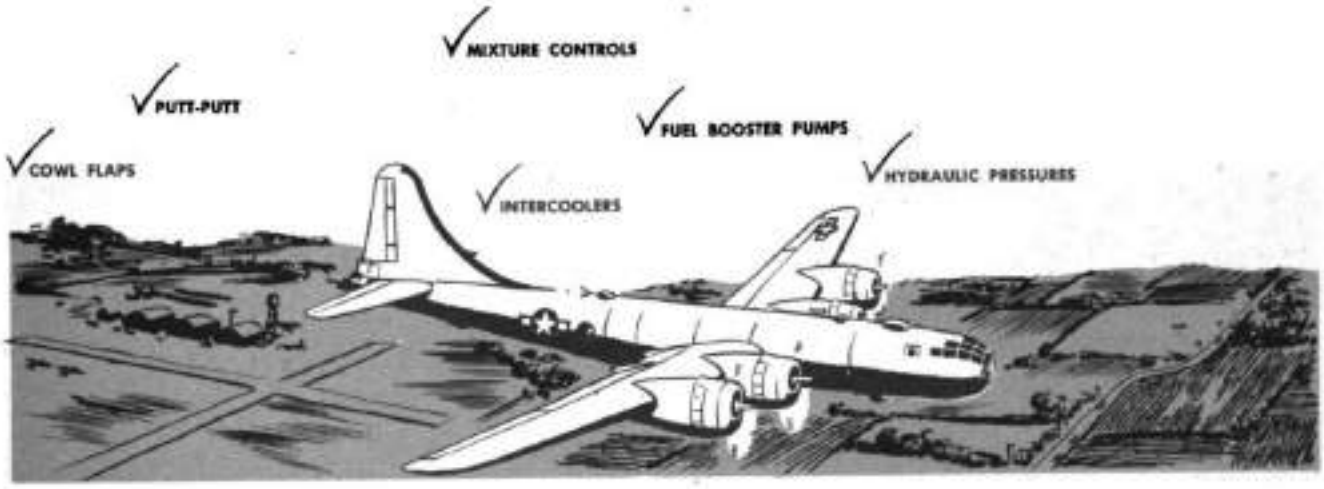
11. Intercoolers Open To 7½°

Intercoolers are full open when the indicators show 15°.

12. Inverter Voltage Checked

13. Flight Engineer's Report—Gross Weight ____ Lbs., Putt-putt ON LINE, Ready To Land.

The copilot asks for the engineer's report. When your checklist is completed report: **"Gross weight ____lbs.; putt-putt ON THE LINE; ready to land."**



After Landing

1. Cowl Flaps Full OPEN

Move the cowl flaps to full OPEN position as soon as the nosewheel touches the ground and it is apparent that the airplane will remain on the ground.

2. Generators OFF

With Curtiss Electric propellers leave the generators ON until propeller pitch returns to normal.

3. Hydraulic Pressures Checked

Immediately after the wheels contact the runway check hydraulic pressures. If either pressure is low report the reading to the copilot and service the system.

4. Fuel Booster Pumps OFF

5. Engine Run-up Completed

When the copilot calls for the magneto check set the throttle on the engine to be checked to 2200 rpm and call out the manifold pressure to the copilot. Check the magnetos and report: "**Checking magnetos, No. 1, right—both—left—both,**" etc.

6. Stop Engines—FUEL CUT-OFF

Use the following procedure to stop the engines after the airplane commander orders, "**Cut engines.**"

a. Run carburetor-type engines at 700 rpm (800 rpm on fuel-injection engines) until CHT's drop (to 190° C, if possible). While the engines are cooling move the master ignition switch to OFF position momentarily to see that all magnetos are grounded out.

b. Increase the throttle settings to 1200 rpm and run the engines (either type) for at least 15 seconds at this speed to scavenge oil from the sumps and prevent liquid locks at the next preflight. Dilute the oil at this time if necessary.

c. Move the mixture controls to FUEL CUT-OFF.

d. As the engines die, close the throttles gradually and completely. Do not open the throttles to clear the engines.

e. After the propellers stop turning cut the magneto switches.

f. On fuel-injection engines place the throttles in closed position after the propellers stop turning.

7. All Switches OFF

8. Putt-putt OFF

Order the operator to stop the putt-putt.

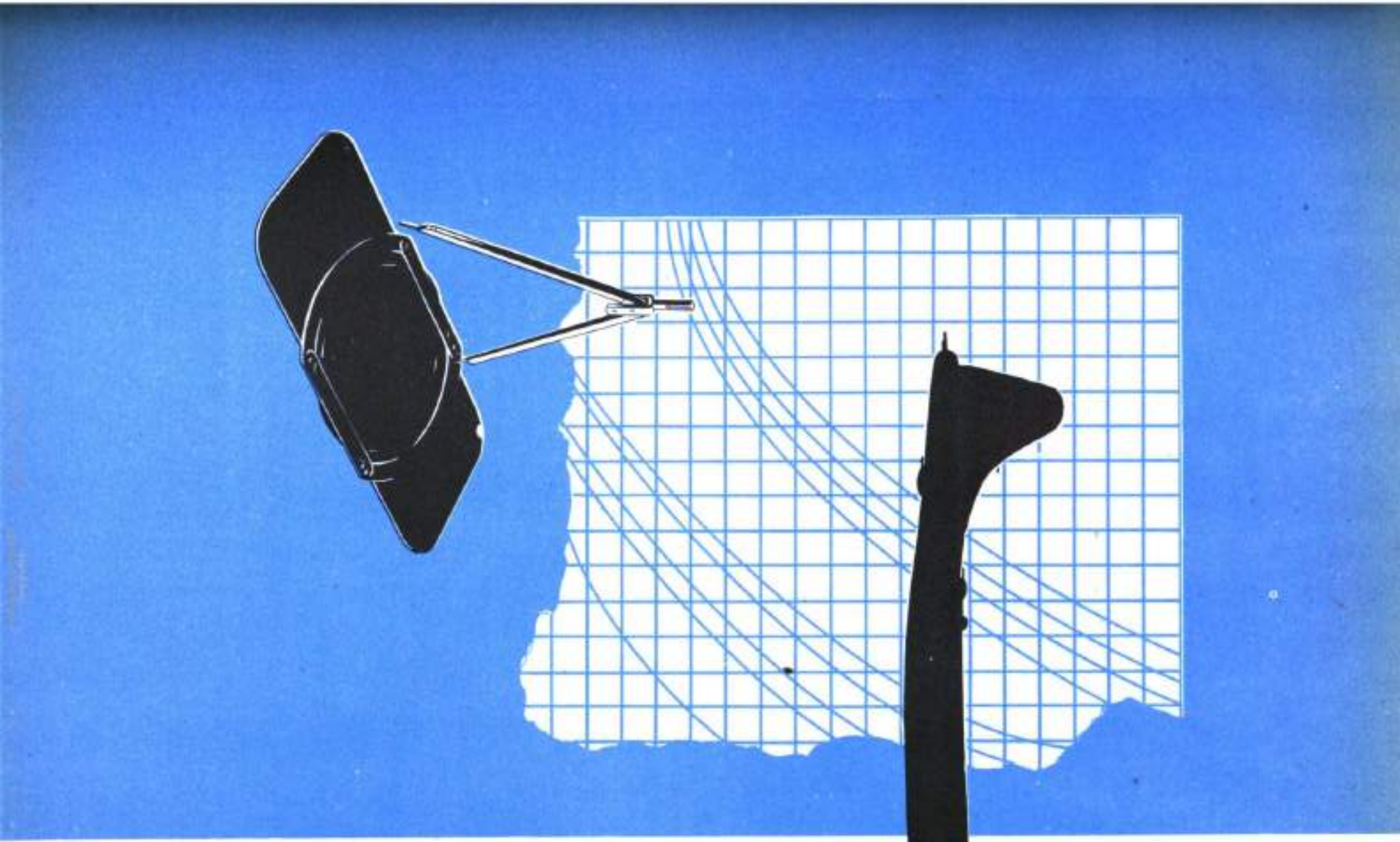
9. Wheel Chocks In Place

10. Down Locks (Gear and Bomb Door) In Place

11. Pitot Covers In Place

12. Forms 1, 1A, Flight Log Completed

13. Give Crew Chief Report Of Malfunctions



CRUISE CONTROL

Cruise control is the planned operation of aircraft before, during, and after flight. Its purpose is to obtain optimum performance from an airplane under any existing set of circumstances, due consideration being given to bomb and fuel load, length and type of mission, crew capability, winds and temperatures, and to limitations or restrictions on airframe, engines, propellers, and accessories.

As cruise control extends the range of the airplane, so does it amplify the duties and responsibilities of the flight engineer. Working closely with the airplane commander and the navigator, he must base his operations on calculations derived from a fairly complicated series of performance charts and curves. Complete proficiency in the use of the charts and curves will be attained only by understanding them and working with them. Conscientious study of the pages to follow, and of Appendix I-A of T.O. AN 01-20EJA-1 is essential.

Obviously, the term "Cruise Control" cannot be applied exclusively to any single operation. Actually, it consists of six interrelated operational steps, as follows:

1. Predicted flight progress curves;
2. Preflight planning;
3. In-flight operations;
4. In-flight replanning;
5. Operations after failure of one or more engines;
6. Post-flight analysis.

These steps are founded on a series of performance curves and charts. Since these charts, and the use of them, are basic to the other operations, they will be discussed first. However, before considering the charts and curves at length, let's have a brief explanation of calibrated airspeed, nautical miles, effect of cooling flaps, and engine operation, since doing so will make certain features of the charts and curves more readily understandable.

Calibrated Airspeed

Calibrated airspeed, that is, indicated airspeed corrected for position and instrument error, is always used on the B-29 for the following reasons:

1. In formation flying airplane speed is critically important, especially at high altitudes. Too high an airspeed makes it difficult for Tail-end Charlie to keep up; too low an airspeed causes inefficient flying. If different airplanes were to lead formations on a basis of indicated airspeed, speed of the formations would vary from day to day.

2. Rendezvous with other squadrons and with fighter groups demands close timing. This cannot be obtained if the various formations operate on indicated airspeed.

3. When operating with calibrated airspeed, all crew members concerned use the same speed in their calculations. With indicated airspeed, differences in instruments give different apparent speeds, resulting in confusion.

Nautical Miles

The nautical mile (6080 feet) rather than the statute mile (5280 feet) is used on all cruise control charts and curves in which distance is a factor. This is consistent with the use of nautical miles in all B-29 theatres of operation, and eliminates the possibility of confusion between the flight engineer and the navigator. It must be noted, though, that calibrated airspeed is read in terms of statute miles, since the instruments themselves are thus marked.

Effect Of Cooling Flaps

The drag of a B-29 does not remain constant —it is affected by altitude, speed, and several other factors. Important among the latter is the position of the cooling flaps.

The oil coolers normally operate between ¼ and ⅔ open, and do not influence drag appreciably. The intercoolers, however, cause considerable drag. When open from 0° to 7½° they reduce speed from 1 to 1½ mph; when open from 7½° to 15° they slow the airplane about 4 mph.

Cowl flaps present a serious drag problem. Opening the cowl flaps 6° reduces speed about 10 mph. During hot-day operation at altitude, large cowl flap openings are necessitated, and their drag will cause a considerable reduction in range. Consequently, the amount of cowl flap opening required (predicted cowl flap angle) must be considered in planning.

Engine Operation

For any given set of conditions, operation of the engine itself is very important. With constant speed propellers and turbo superchargers, it's possible to maintain constant power by lowering rpm and increasing manifold pressure, and vice versa. How then, is the proper setting determined?

Working pressure within the cylinders is roughly proportional to the manifold pressure. (This is the so-called brake mean effective pressure, abbreviated BMEP.) The higher the manifold pressure (and with it, higher BMEP), the lower the rpm required for the engine to develop a given amount of power. Fuel economy increases with BMEP, and so it would seem desirable to operate at the highest BMEP possible. At really high BMEP, however, engines are prone to detonate, and so a compromise must be made that will give good economy plus satisfactory engine life.

As BMEP is increased and rpm reduced at a given power, propeller efficiency at cruising speeds tends to decrease. Because of the large propellers and the high propeller-engine speed ratio on the B-29, this decrease in efficiency is comparatively unimportant. Therefore, it pays to operate at the maximum limiting BMEP.

Curves and Charts

The curves and charts illustrated and explained on the following pages are samples taken from Appendix I-A of T.O. AN 01-20EJA-1. Curves and charts of similar form, but containing somewhat different values, may be available to fit the particular climatic conditions existing in various theatres.

The complete set of the curves and charts that are actually to be used for flight purposes will be found in Appendix I and I-A of T.O. AN 01-20EJA-1.

LONG RANGE PREDICTION CURVES, TYPE A-3-4

The curves are used for preliminary flight planning, and show the relationship between change in gross weight, time and distance. More specifically, the type A-3D-4 (distance) curve relates the change in gross weight caused by consumption of fuel with the distance traveled in that time.

The type A-3T-4 (time) curve gives the same relationship between change in gross weight, caused by fuel consumption, and time required for this change. Both are based on level flight at long-range speed and power setting, as summarized on the type A-2-4 long-range summary curves.

Take a look at the sample curves. It will be seen that, if an airplane is flying at an altitude of 10,000 feet, reduction of gross weight from 100,000 to 90,000 by burning 10,000 lbs. of fuel gives the following:

Distance covered—4680 minus 3530, or 1150 miles;

Time required—22.4 minus 16.5, or 5.9 hours.

Dividers can be used to measure distance or time directly.

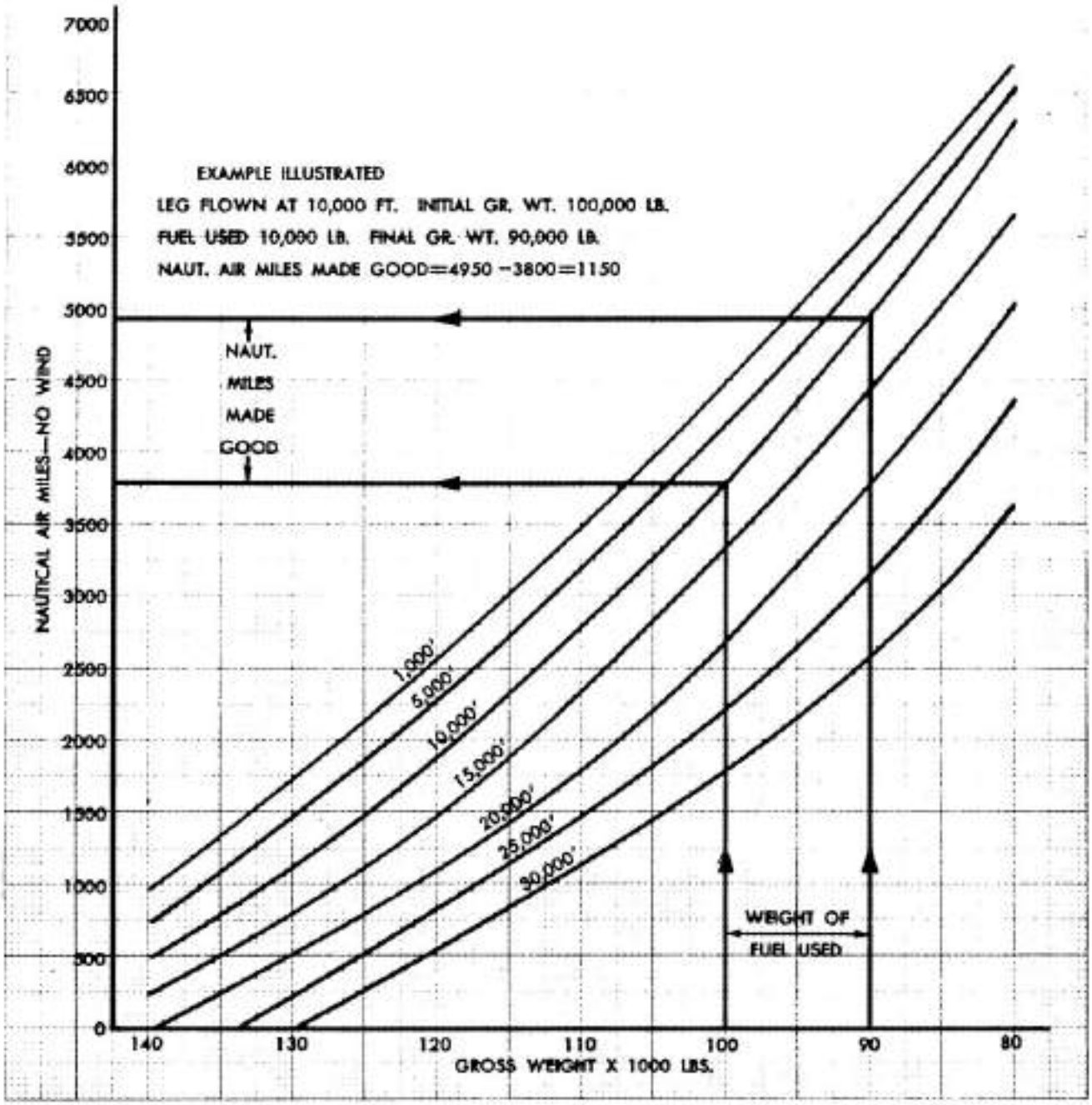
SAMPLE

LONG RANGE PREDICTION CURVE—DISTANCE

TYPE A-3D-4

4 ENG.

(CRUISING CONDITIONS PER TYPE A-2-4 CURVES)



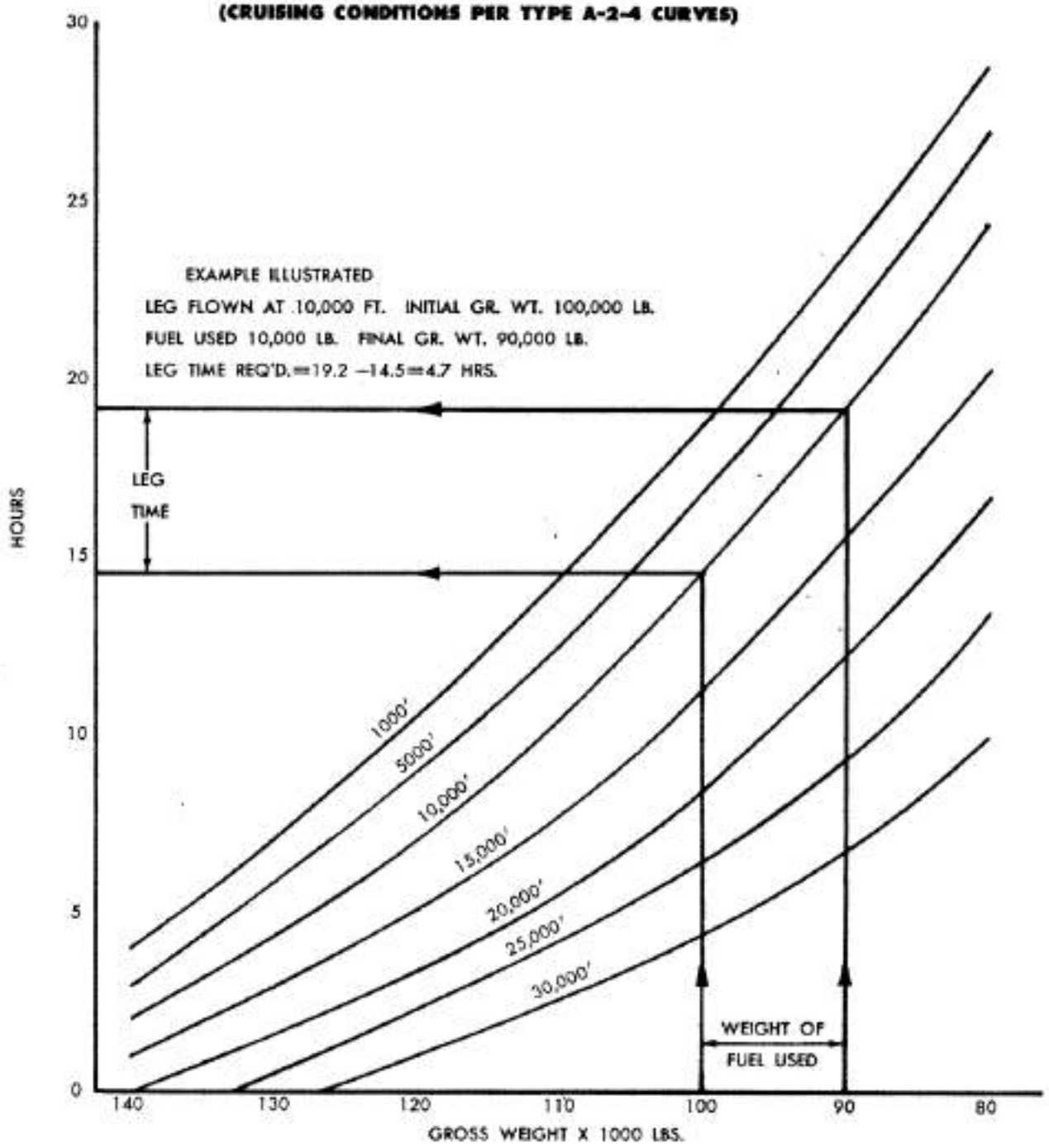
SAMPLE

LONG RANGE PREDICTION CURVE—TIME

TYPE A-3T-4

4 ENG.

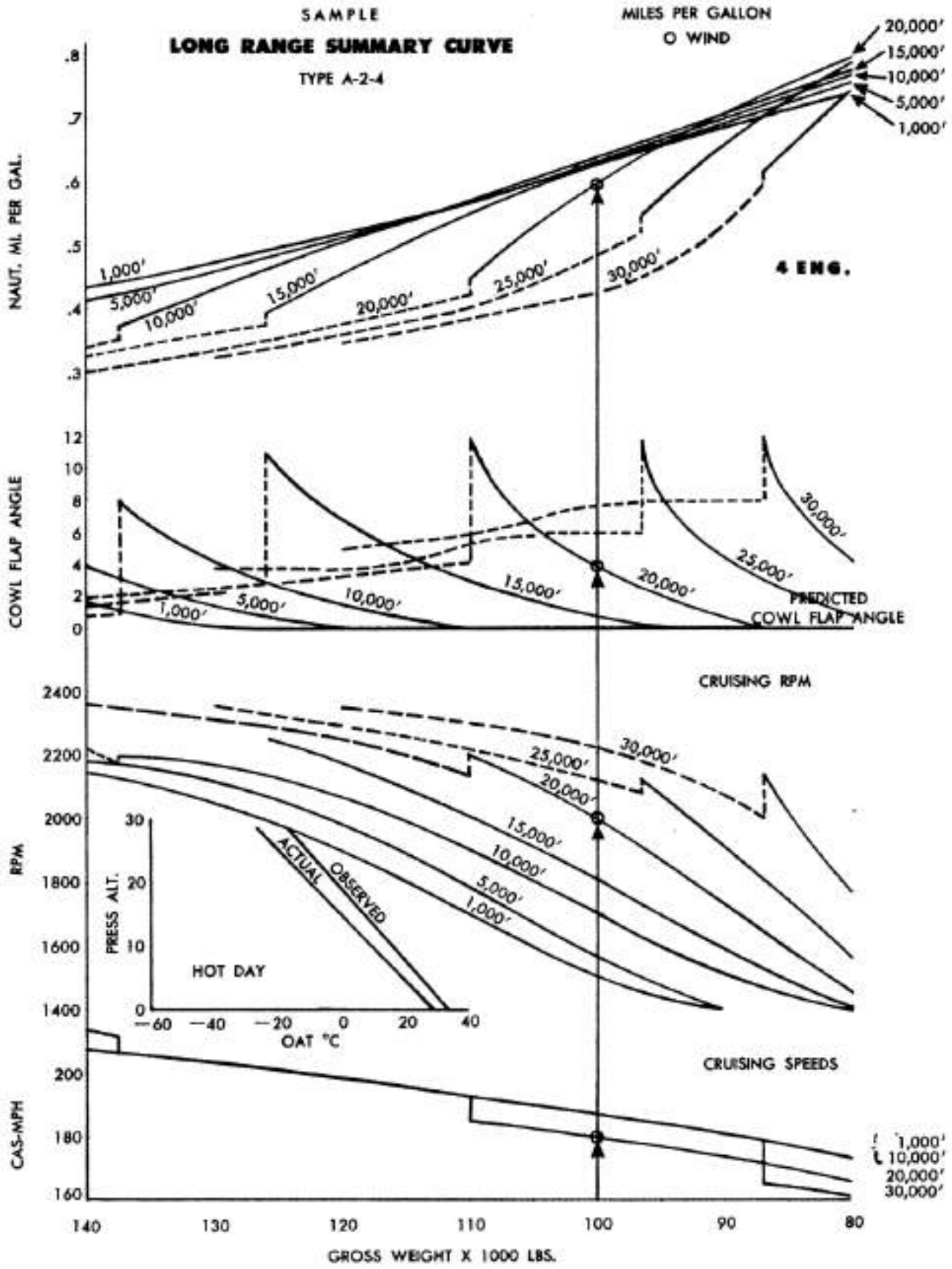
(CRUISING CONDITIONS PER TYPE A-2-4 CURVES)



LONG RANGE SUMMARY CURVE, TYPE A-2-4

Curves of this type are used for preliminary flight planning of long-range cruise. The information is summarized from the type A-1-4, miles-per-gallon curves, since most operation of the B-29 is long-range cruising. This set of curves shows the direct relationship between long-range cruising speeds, rpm, miles per gallon, and predicted cowl flap angle at various gross weights and altitudes.

For example, the curve shown indicates that if an aircraft of 100,000 lbs. gross weight is flying at 20,000 feet, its calibrated airspeed should be 180 mph, rpm should be 2000, and the predicted cowl flap angle 3½°. Solid lines indicate auto lean mixture. Approximate nautical miles per gallon for the above conditions—0.600.



EMERGENCY MAXIMUM RANGE SPEED TABLE, TYPE A-4-4

This is a supplementary table giving maximum-range calibrated airspeeds for various gross weights and altitudes, at different wind velocities. The maximum-range calibrated airspeeds derived from this table are to be used when fuel is at a premium. Remember, though, that this table does not correct for loss of range caused by headwind, but simply gives the most efficient speeds to use in various wind conditions.

By comparing this table with the Long Range Summary Curve, Type A-2-4, it will be seen that the tabulated speeds for emergency maximum-range (with zero wind) are lower than the recommended long-range cruising speeds. Range is approximately 1% greater at these lower speeds, but stability is reduced slightly and flight time is, of course, increased.

B-29 AND B-29A EMERGENCY MAXIMUM RANGE SPEED TABLE, TYPE A-4-4 • FOUR ENGINES

WEIGHT LBS.	ALTITUDE FT.	CALIBRATED AIRSPEED FOR MAXIMUM RANGE—MPH				
		HEADWIND KNOTS			TAILWIND KNOTS	
		100	50	0	50	100
120,000	30,000	197R	193R	190R	187R	186R
	20,000	200R	195R	190R	187R	185R
	10,000	202	191	186	183	181
	1,000	218	197	188	183	180
110,000	30,000	194R	190R	187R	185R	184R
	20,000	192R	189R	186R	183R	181R
	10,000	200	187	180	177	174
	1,000	216	191	182	177	173
100,000	30,000	190R	186R	183R	181R	180R
	20,000	181	176	172	168	167
	10,000	199	183	175	170	168
	1,000	214	186	175	170	166
90,000	30,000	168R	163R	160R	158R	157R
	20,000	179	171	165	161	157
	10,000	197	177	168	163	161
	1,000	211	182	172	166	162
80,000	30,000	163	156	150	150	150
	20,000	176	168	162	157	153
	10,000	195	170	160	156	154
	1,000	205	179	170	164	160

VALUES MARKED "R" REQUIRE AUTO RICH SETTINGS

BMEP POWER SCHEDULE, TYPE M-1

The purpose of this curve is to indicate the best manifold pressure to be used with different rpm settings at various altitudes and carburetor air temperatures.

The example illustrated on the curve on the opposite page shows that 32" Hg should be used at 2050 rpm, auto lean mixture, altitude 1000 feet, with a CAT of 25°C. With these settings, the BHP per engine will be 1250. The sample curve on page 95 is for use in temperate conditions.

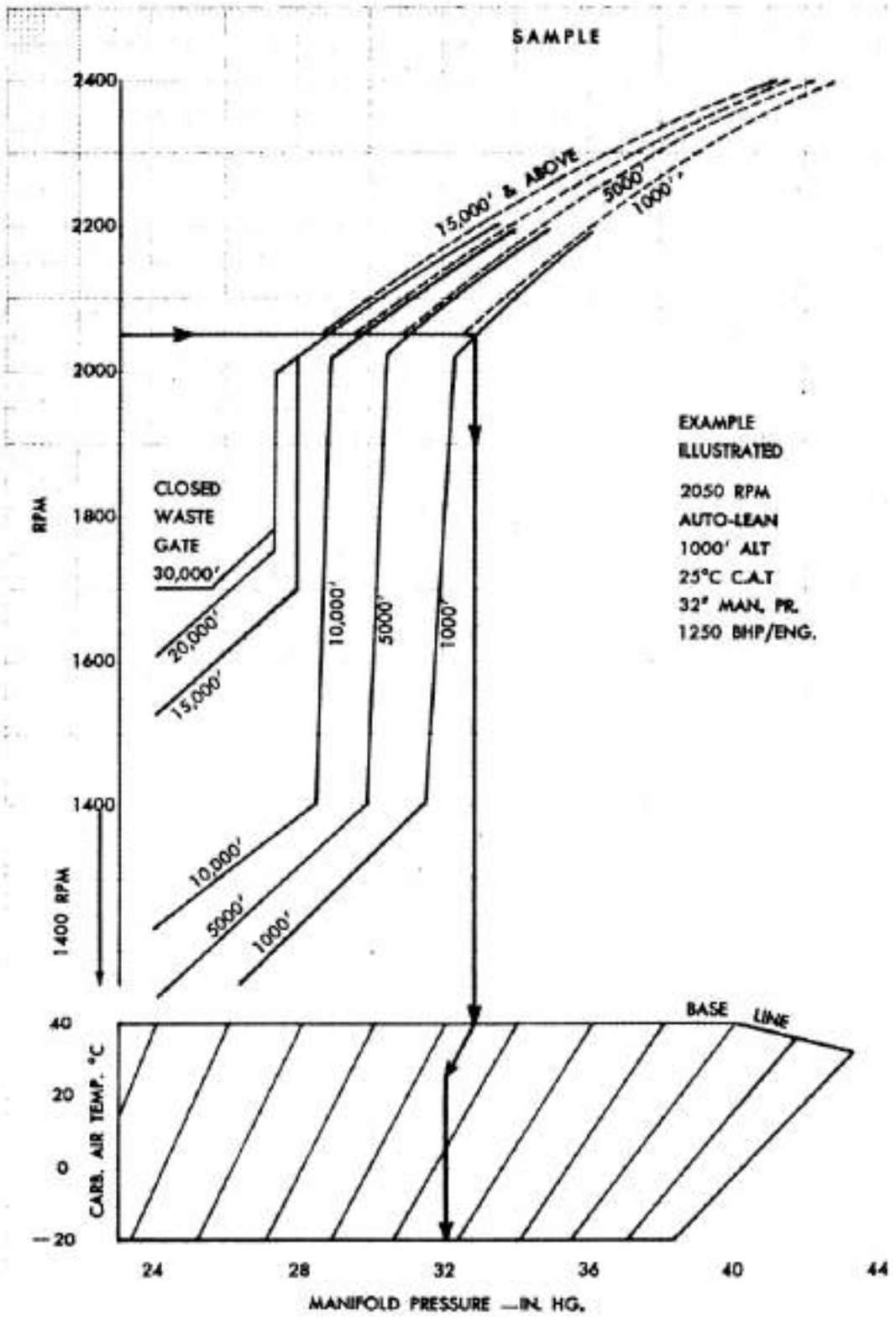
Use of manifold pressures higher than those indicated by the curve may lead to detonation and shorter engine life; lower pressures mean less efficient use of fuel. These curves express the best balance between cruising range and satisfactory engine life.

The BMEP Power Schedule Table, Type M-1, is a tabulation of the information given on the type M-1 curves, and is used in the same manner. The figures on the table are based on a CAT of 25°C.

MANIFOLD PRESSURE REQUIRED WITH ALTITUDE • 25° CAT R-3350 ENGINE AND B-31 TURBOS

RPM	*BHP	BMEP	1000′	5000′	10,000′	15,000′	20,000′	25,000′	30,000′	35,000′
2800			49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
2600			47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5
2400	2000	197	42.0	41.2	40.6	40.3	40.2	40.2	40.3	40.4
2350	1880	189	40.1	39.2	38.5	38.1	38.1	38.1	38.2	38.4
2300	1760	181	38.5	37.3	36.6	36.2	36.1	36.1	36.2	36.4
2250	1650	173	36.7	35.1	33.9	33.4	33.2	33.2	33.3	33.5
2200	1540	166	35.4	34.1	33.1	32.6	32.4	32.4	32.6	32.8
2150	1435	159	34.2	32.7	31.7	31.0	30.8	30.8	30.9	31.3
2100	1340	151	33.0	31.6	30.4	29.7	29.4	29.3	29.4	29.8
2050	1250	144	31.8	30.2	29.0	28.2	27.8	27.8	29.0	2100 28.0
2000	1190	140	31.3	29.7	28.7	27.7	27.0	26.9	27.1	2050 27.2
1900	1130	140	31.3	29.6	28.0	27.3	26.7	26.8	27.0	2050 26.0
1800	1070	140	31.2	29.6	28.0	27.3	26.6	26.7	27.0	
1700	1010	140	31.2	29.6	28.0	27.3	1750 26.2	1750 26.0	1800 25.8	
1600	950	140	31.2	29.6	27.8	1700 26.0	1700 25.6	1750 24.8	1750 25.2	
1500	890	140	31.1	29.3	27.8	1650 25.6	1650 25.0	1750 23.7	1700 24.5	
1400	830	140	30.8	29.2	27.8	1600 24.8	1600 24.1	1700 23.0	1700 23.5	
1400	770	130	29.6	28.0	26.2	1550 24.00	1600 22.8			
1400	710	120	28.2	26.6	24.6		1550 22.1			
1400	650	110	27.1	25.3	23.1	22.7	1550 21.2			
1400	590	100	25.9	24.2	21.7	21.2	20.9			

NOTE: Where RPM and MAP settings are both given, those settings are to be used to obtain the recommended power* where normal power settings will be limited by closed waste gates or surge.



B M E P—POWER SCHEDULE

(TEMPERATE CONDITIONS)

TYPE M-1

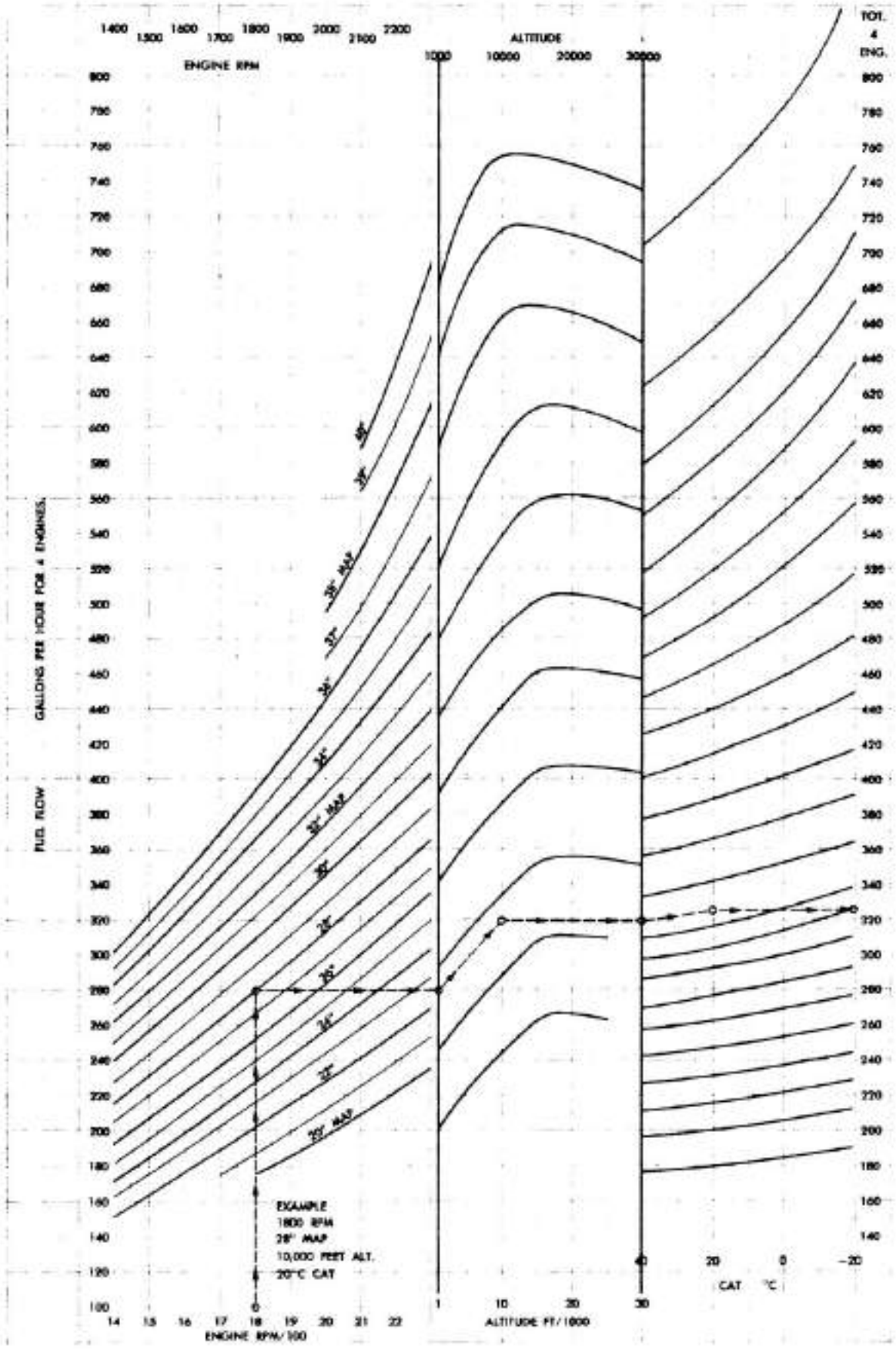
FUEL FLOW CURVES, TYPE M-2

Type M-2L — Auto Lean
Type M-2R — Auto Rich

These curves can be used to estimate 4-engine fuel flow for various conditions of rpm, manifold pressure, altitude, and CAT. They are primarily useful when a deviation is made from the BMEP Power Schedule, Type M-1, such as might occur when flying formation. They are also used in post-flight analysis.

For the sake of clarity, separate curves for auto lean and auto rich operation are presented in Appendix I-A of the T.O.

The example illustrated herewith on the type M-2L curve shows auto lean operation at 1800 rpm, manifold pressure 28" Hg, altitude 10,000 feet, and CAT 20°C. Under these conditions, it can be read from the curve that the 4-engine fuel flow will be 327 gallons per hour.



SAMPLE

FUEL FLOW CURVES

TYPE AN-2L

NAUTICAL MILES PER GALLON CURVE, TYPE A-1-4

Curves of this type present a picture of the relationship between miles per gallon, calibrated airspeed, altitude, gross weight, power settings, and predicted cowl flap angle for specified outside air temperatures. They also supply data for cruise other than long range, high speed cruise, constant speed or constant power cruise, maximum range, and maximum endurance. Similar curves have been prepared for 3- and 2-engine operation (3-engine: Type A-1-3, 2-engine: Type A-1-2).

Normal long-range cruise data taken from these curves are summarized on the Type A-2-4 Long Range Summary curves, previously discussed.

To illustrate the amount of information which may be obtained from the type A-1-4 curves, study the examples illustrated in connection with the text. An altitude of 25,000 feet, tropical conditions, and a gross weight of 90,000 lbs. are assumed. Inspection of the sample curves, at the points noted, will show:

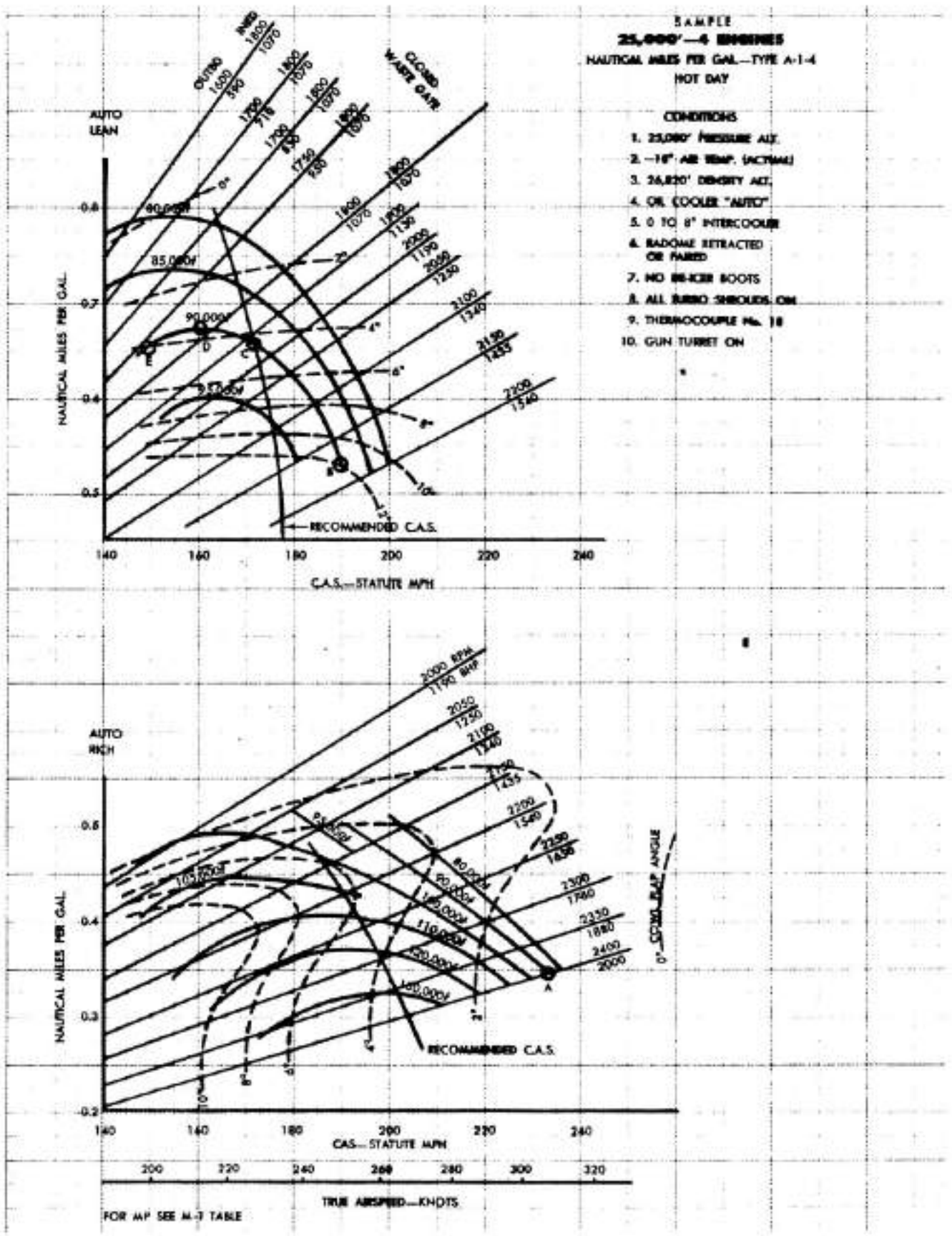
1. Speed at rated power. This is read from the lower end of the curve for each weight. For example, at point A, 2400 rpm gives 233 mph CAS, 308 knots TAS, with a fuel consumption of .34 miles per gallon.

2. Speed at maximum cruise in auto lean. It can be seen at point B that with limiting 12° cowl flap angle, operating in auto lean, rpm is 2170, CAS is 190 mph, TAS is 249 knots, and the miles per gallon value is .525.

3. Long-range cruising (about 99% maximum miles per gallon assumed). Study of the curve at point C shows the recommended long-range speed to be 172 mph CAS (228 knots TAS); obtaining this value requires 1925 rpm at a fuel consumption rate of .66 miles per gallon.

4. Emergency maximum range (no wind). From the curve at point D it may be seen that the maximum miles per gallon is .67. This requires 1780 rpm outboard and 1800 inboard, with a speed of 160 mph CAS (211 knots TAS). This speed may also be read from the type A-4-4 emergency maximum-range speed table.

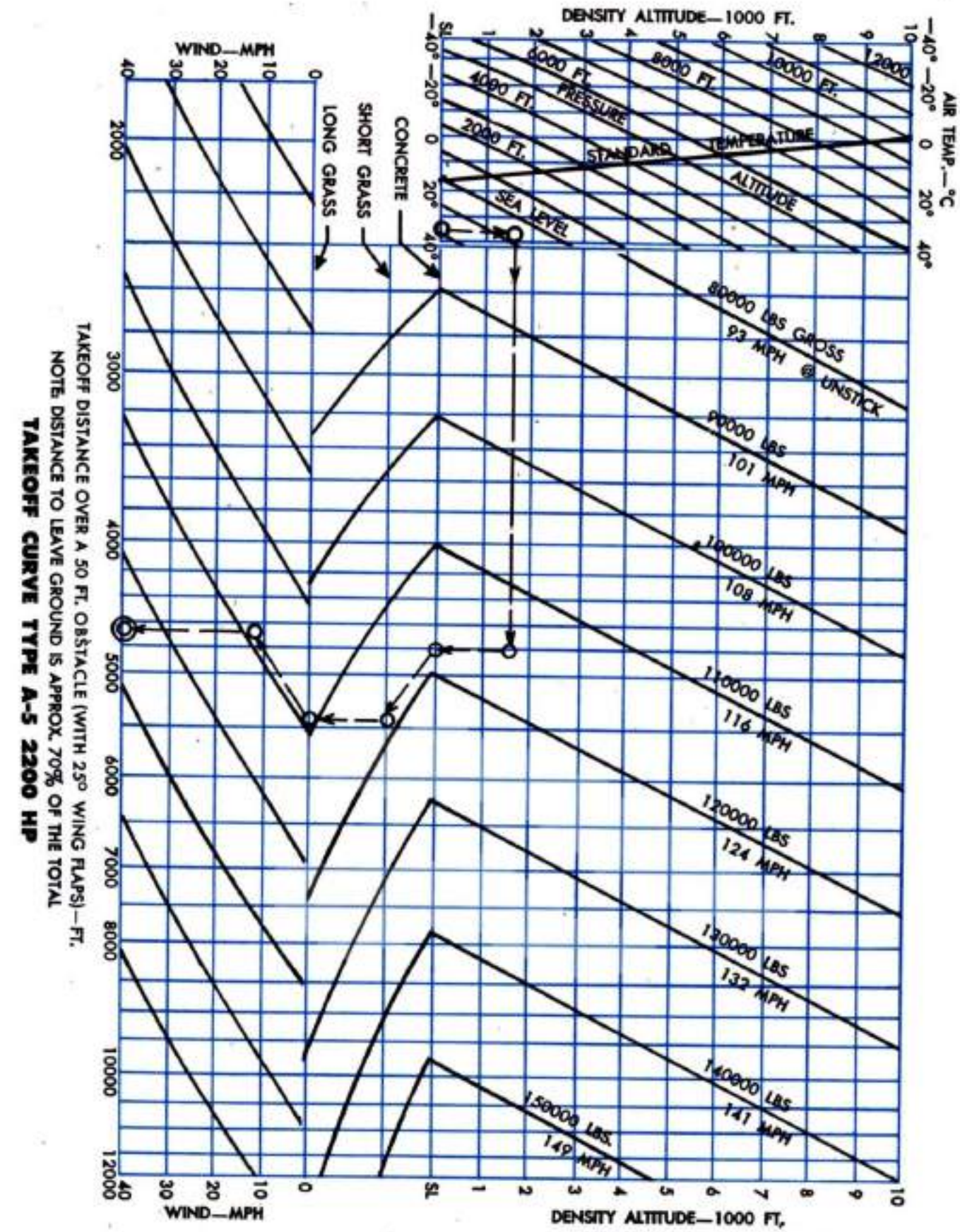
5. Maximum endurance. Conditions for maximum endurance are read from point E, where the weight curve is tangent to the sloping rpm curve. For example, maximum endurance conditions for the assumed altitude and gross weight are seen to be 1750 rpm outboard and 1800 rpm inboard, and 150 mph CAS (200 knots TAS). This setting gives a miles per gallon value of .66. It should be noted that maximum endurance gives less miles per gallon as well as less speed than either long-range cruising or emergency maximum-range settings.



TAKEOFF DISTANCE CURVE, TYPE A-5

This chart gives the minimum distance required to clear a 50-foot obstruction under various conditions of temperature, pressure altitude, weight, type of runway surface, and wind. Ground run will average about 70% of the distances read from the chart. Recommended takeoff speeds are noted on the weight lines. The example illustrated on the chart indicates that with a ground temperature of 35°C and pressure altitude of —500 feet (barometer reading 30.5"), 115,000 lbs. gross weight and 120 mph takeoff speed, runway surface of short grass and effective headwind of 12 mph, the total distance required to take off and clear a 50-foot obstacle is 4700 feet, using 25° of wing flaps. Ground run would be 70% of 4700, or about 3300 feet.

The Galcit conversion table on the chart is used to obtain density altitude from pressure altitude and observed temperature.



TAKEOFF CURVE TYPE A-5 2200 HP