

The L-20A Airplane



Figure 1-1

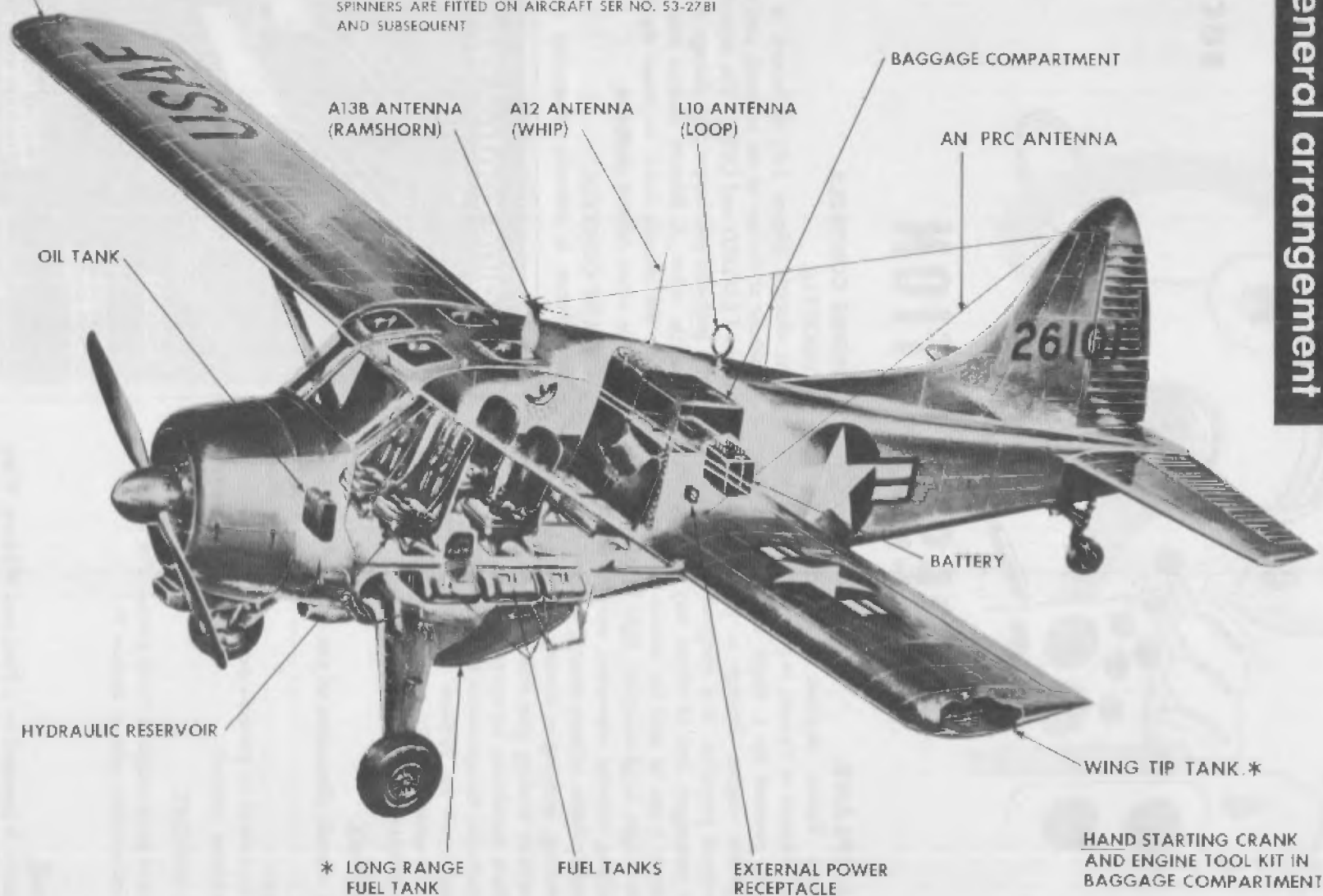
general arrangement

general arrangement

* WING TIP TANK

* EXTERNAL LONG RANGE FUEL TANK INSTALLATION IS FITTED ON AIRCRAFT UP TO BUT NOT INCLUDING SER NO. 53-2781. ARMY L-20A AIRCRAFT SER NO. 53-2781 AND SUBSEQUENT ARE FITTED WITH WING TIP TANK INSTALLATIONS.

SPINNERS ARE FITTED ON AIRCRAFT SER NO. 53-2781 AND SUBSEQUENT



OIL TANK

A13B ANTENNA
(RAMSHORN)

A12 ANTENNA
(WHIP)

L10 ANTENNA
(LOOP)

BAGGAGE COMPARTMENT

AN PRC ANTENNA

2610

BATTERY

HYDRAULIC RESERVOIR

WING TIP TANK *

* LONG RANGE
FUEL TANK

FUEL TANKS

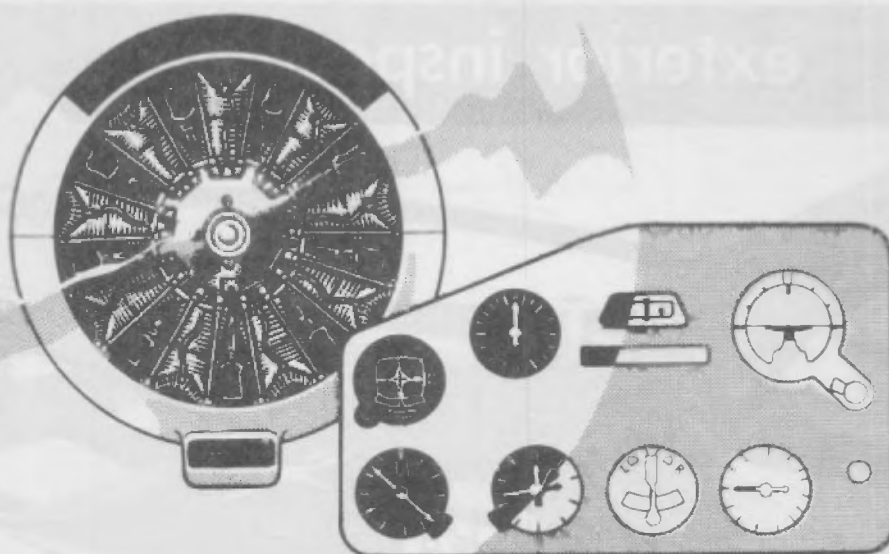
EXTERNAL POWER
RECEPTACLE

HAND STARTING CRANK
AND ENGINE TOOL KIT IN
BAGGAGE COMPARTMENT

Figure 1-3

section

11



NORMAL PROCEDURES

STATUS OF THE AIRPLANE. FLIGHT RESTRICTIONS.

It is essential that the airplane is operated within the limitations set out in Section V.

FLIGHT PLANNING.

Determine the required fuel load, power setting, altitude, and all necessary information to complete the proposed flight, by using the operating data in the Appendix.

WEIGHT AND BALANCE.

Obtain take-off gross weight. Check that the intended payload has been loaded into the airplane and check that the loading is within the weight limitations in Section V. Refer also to the Handbook of Weight and Balance, AN 01-1B-40. Insure that Form F is completed.

ENTRANCE.

Entrance to the pilot's and co-pilot's seat is made through the two cockpit doors. Steps on the landing gear struts facilitate access.

BEFORE EXTERIOR INSPECTION.

1. Consult DD Form 781 to determine the status of the airplane.

2. Check ignition switch OFF.

EXTERIOR INSPECTION.

Carry out the inspection checks called for in figure 2-1.

ON ENTERING THE AIRPLANE.

INTERIOR CHECK FOR ALL FLIGHTS.

1. Check that there are no fuel fumes in the fuselage

compartment. Any condition found involving leakage, or fumes as a result of leakage, must be corrected prior to flight.

2. Check that the hand-operated fire extinguisher is securely stowed.

3. Check that first aid kits are stowed.

4. If a parachute is not worn, check that seat cushion is installed in pilot's seat.

5. If necessary, adjust pilot's seat.

6. Unlock flight controls and check for free, full, and correct movement of all flight controls.

CAUTION

(A)

When making this check on early airplanes (A) which have not been modified in accordance with T.O. 11-20A-510, do not pull the control column fully back while checking the rudder pedals for full movement. Also, make certain to centralize the rudder pedals when checking the control column for fully aft movement. These precautions will prevent the rudder and elevator from coming in contact with each other at their positions of extreme travel.

7. Insure that control column throw-over lock is securely engaged.

8. Fasten safety belt and shoulder harness.

9. All switches OFF except generator switch.

exterior inspection



Starting at the pilot's cockpit, make the following checks

While making exterior inspection, check that all ice and snow accumulations have been removed. Check all surfaces including control surfaces and hinges for cracks, distortion, loose rivets and indications of damage. Check all access doors for security. Check fuel for leakage.

- 1 Check security of fuel filler caps and access panel. Check that airplane has been serviced with required quantities of fuel, oil and hydraulic fluid.

- 2 Check that wheels are chocked. Check security of landing gear, fairings, tires for cuts, bruises and slippage. Check tire pressures and wheel brakes hose and pipes for oil leaks.

- 3 Check that carburetor and oil cooler intakes are clear.

- 4 Check propeller for nicks and oil leaks. Check cowl and panels for dents, scratches and for security.

- 5 Check tailwheel tire for cuts, bruises and slippage. Check tire pressure.

- 6 Check that pitot head cover is removed.

Figure 2-1

10. Battery master switch OFF (ON if external power is not used. This is considered an emergency operation).

11. External power connected.

12. FUEL CONT. gage switch on.

13. Check fuel quantity.

14. Fuel selector valve to fullest tank.

15. Fuel transfer valve OFF.

16. Check fuel and oil emergency shut-off lever in OPEN position and safety-wired.

17. Wing flaps CRUISE.

18. Set altimeter.

19. Set clock.

20. Test communications equipment from external power supply. If external power is not available, make this test after the engine is started.

21. Check flashlight.

22. Post the fire guard.

23. Throttle $\frac{1}{4}$ in. to $\frac{1}{2}$ in. open.

24. Propeller control lever HIGH PITCH.

25. Mixture control IDLE CUT-OFF.

26. Carburetor hot air control lever COLD.

27. Carburetor filtered air control handle out if dusty conditions prevail.

28. Check ignition switch OFF.

29. Set parking brakes.

CAUTION

The parking brake will not hold the aircraft at engine speeds of more than 1900 rpm, if only normal toe pressure was applied before locking the brake system.

30. Have ground crew turn propeller four revolutions to check for hydraulic lock. Alternatively, if ground crew is not available, the check for hydraulic lock may be made by engaging the starter, then intermittently energizing the starter, and watching for a tendency for the engine to stall during the rotation of the propeller.

CAUTION

If an hydraulic lock is indicated, do not attempt to clear the hydraulic lock by rocking the propeller either manually or by the starter, since this might cause damage to the engine. Have spark plugs removed from lower cylinders to permit fluid drainage.

ADDITIONAL CHECKS FOR NIGHT FLIGHTS.

Before night flights, check the following:

31. Instrument lights.

32. Map lights.

33. Cabin light.

34. Landing light.

35. Navigation lights.

36. Anchor lights (seaplane only).

37. Rotating anti-collision light.

STARTING ENGINE.

ELECTRICAL STARTING.

1. Check that propeller is clear.

2. Mixture control FULL RICH.

Note

Operation of the hand wobble pump will not be necessary during the start unless the aircraft has been standing in storage for a period of time with resultant evaporation of fuel in the float chamber, or the hand primer will not lift the fuel from the fuel tank to the primer piston. In these cases, use of the hand wobble pump may be necessary; however, it is not necessary to maintain any prescribed pressure.

3. Starter energize switch ENERGIZE.

4. Starter energize switch OFF when pitch of starter whine ceases to rise; simultaneously move engage switch to ENGAGE and boost coil switch to BOOST COIL position.

Note

When starting a hot engine, use the energize and engage switches together.

5. After propeller has turned approximately two revolutions, turn the ignition switch to BOTH.

6. Operate hand primer pump in slow even strokes until the engine starts firing. As soon as the engine starts firing, operation of the hand primer may be discontinued.

7. When engine fires, release starter engage and boost coil switches.

CAUTION

- Do not pump the throttle or engine backfiring may cause damage to the induction system and/or an engine fire.

- Check oil pressure; if no oil pressure is indicated within approximately 30 seconds, switch off engine immediately and investigate.

8. Have external power supply disconnected.

9. Battery master switch ON.
10. If the engine fails to start due to the starter running down:
 - a. Ignition switch OFF.
 - b. Disengage clutch, if engaged, by rocking propeller by hand between $\frac{1}{4}$ and $\frac{1}{2}$ revolution.
 - c. Attempt another start.
11. If engine fails to start due to over-priming:
 - a. Ignition switch OFF.
 - b. Throttle OPEN.
 - c. Clear excess fuel from induction system by turning propeller forward by hand for 4 or 5 revolutions.

CAUTION

Insure that propeller is turned in a *forward* direction. Turning the engine backwards will return the excess fuel into the induction system which will hamper starting and become a fire hazard.

HAND CRANKING.

1. Ignition switch OFF.
2. Battery master switch ON.
3. All other switches OFF.
4. Starter brush release control at HAND TURNING.
5. Turn propeller by hand 3 or 4 revolutions.
6. Operate hand primer pump to fill priming lines with fuel. Give 6 or 7 further strokes and simultaneously turn propeller by hand.
7. Throttle $\frac{1}{4}$ in. open.
8. Propeller control lever HIGH PITCH.
9. Mixture control FULL RICH.
10. Carburetor hot air control lever COLD.
11. Insert starter handcrank and rotate starter to maximum possible speed.

Note

When not in use, the handcrank is stowed in the baggage compartment aft of the cabin partition.

12. Ignition switch BOTH.
13. Pull out starter clutch handle and hold.
14. Boost coil switch to BOOST COIL position.
15. As soon as engine fires, release starter clutch handle.
16. Actuate hand primer pump until carburetor takes over.
17. When engine runs smoothly, fuel contents switch to FUEL CONT. position.

Note

Before attempting an electrical start, after handcranking, move the starter brush release lever to ELECTRIC in order to move the starter commutator brushes into contact with the commutator.

SEAPLANE ENGINE STARTING.

Whether or not the engine is started prior to casting off from a mooring buoy or jetty is dependent upon the prevailing wind strength, direction and general weather conditions, and when the seaplane is moored to an off-shore buoy, upon the proximity of the shore. If it is intended to start the engine before casting off from a buoy, it is essential that the mooring rope knot is untied, before starting the engine, and the rope slipped around the forward spreader bar between the floats. Pull the seaplane forward, by pulling on the rope, until the buoy, which must be of the flagless type to allow it to clear the spreader bar when taxiing away, is behind the propeller and near the spreader bar. The engine may then be started and the mooring rope slipped for taxiing away.

ENGINE FIRE.

See Section III for instructions for extinguishing engine fire on the ground.

ENGINE GROUND OPERATION.

LANDPLANE OPERATION.

1. Start warm up at 1000 rpm. After the oil temperature increases to 40°C. adjust throttle to the smoothest speed between 1200 to 1600 rpm.
2. Move the propeller control lever fully forward to INCREASE RPM as soon as oil pressure reaches 50 psi.

SEAPLANE OPERATION.

Use warm-up procedure as above for landplane. Under calm weather conditions, the before-take-off aircraft and engine checks may be performed when moored to a jetty, after insuring that the mooring ropes are sufficiently strong and securely attached to substantial fixtures on the jetty. If this is impractical the checks must be made while taxiing away from moorings. The checks must be performed as quickly as possible to prevent excessive water spraying on the propeller and to prevent engine over-heating. The engine check may be performed on the actual take-off if there is unlimited take-off distance ahead. In calm weather conditions, it is also possible to perform a full engine check by securing a rope bridle to the float's rear support struts and connecting the bridle by a suitably strong rope to a substantial tree or similar fixture on the bank, removing the bridle and rope when the engine checks have been completed.

GROUND TESTS.

While the engine is warming up, make the following tests:

1. Fuel system—Check that all tanks feed properly by rotating fuel selector valve.
2. Electrical system—Check ammeter to insure that generator cuts in for charging between 1300-1400 rpm.
3. Instruments—Check that readings are in the correct ranges.
4. Hold manifold pressure gage purge button depressed for 3 seconds to clear vapor or moisture from lines.

5. Communications equipment—Check for correct functioning if not already checked.

TAXIING.

Make certain that the area is clear for taxiing.

LANDPLANE TAXIING.

1. Mixture control FULL RICH.
2. Propeller control lever full INCREASE RPM.
3. Check ignition switch by setting throttle at 700

rpm and turning ignition switch OFF momentarily. Check that engine stops firing completely. Conduct this check as rapidly as possible to prevent severe backfiring when the ignition switch is turned to BOTH again.

WARNING

If the engine does not stop firing completely, shut down the engine. Warn all personnel to keep clear of the propeller until corrective action is taken. The switch may be defective or a magneto ground lead may be open.

4. Release parking brakes, have chocks removed.
5. Throttle as required.
6. As soon as airplane rolls forward, apply brakes evenly and firmly to test for correct functioning.

CAUTION

Never allow the speed to increase excessively without testing the brakes.

7. The steerable tailwheel will steer the airplane when the rudder pedals are operated. For turns in excess of twenty-five degrees, use the brakes.

8. Whenever you stop the airplane while taxiing, run the engine at the smoothest speed between 1200 to 1600 rpm to help prevent plug fouling and to obtain adequate propeller slipstream for engine cooling.

SEAPLANE TAXIING.

1. Wing flaps at CRUISE, except for on-step taxiing when flaps should be at TAKE-OFF.
2. Cast-off.
3. Taxi clear of all mooring buoys and obstructions and head into wind, using the water rudders for steering.

SKIPLANE TAXIING.

When taxiing the skiplane, insure that flaps are in the CRUISE position. Skiplane taxiing is assisted through the tail ski which is steerable by means of the tail wheel steering mechanism.

CAUTION

Before take-off, move the wing flaps to TAKE-OFF.

BEFORE TAKE-OFF. PRE-FLIGHT ENGINE CHECK.

1. Parking brakes set.

CAUTION

- The parking brake will not hold the aircraft at engine speeds of more than 1900 rpm, if only normal toe pressure was applied before locking the brake system.
- On airplanes which have not been modified in accordance with T.O. 1L-20A-511 (formerly T.O. 1L-20-36), toe brakes must be used for all ground operations, instead of the parking brake.

WARNING

If the brake toe pedals are operated when the parking brake is on, make sure the parking brake system has not become disengaged, otherwise it must be re-set.

Before each flight, conduct the following engine checks:

1. Insure that fuel selector valve is to the fullest tank.
2. Cruising fuel air mixture check.
3. Propeller check:
 - a. Propeller control lever HIGH PITCH. and then to INCREASE RPM. During this check the manifold pressure should not exceed 29 in. Hg.
4. Power check:
 - a. Control column fully back and parking brakes on.
 - b. Open throttle to 1750 rpm.
 - c. Check manifold pressure 23 in. Hg.
5. Ignition system check:
 - a. Check magnetos by switching to L and R alternatively. The drop in rpm when running on one magneto should not exceed 100 rpm. Return the ignition switch to BOTH between checks to allow the engine to regain its normal rpm.

CAUTION

Conduct this check as quickly as possible to prevent severe backfiring when the ignition switch is returned to the BOTH position.

6. Acceleration and deceleration check:
 - a. Control column fully back and parking brakes on.
 - b. Advance throttle from idle to 2000 rpm to insure that engine accelerates rapidly and smoothly without any tendency to backfire or falter.
 - c. Throttle back to 500-600 rpm and check for smooth deceleration.

7. Idle speed check:
- a. Check idling at 450 rpm.
8. Instruments—Check for desired ranges.
9. Insure that generator switch is ON.
10. Insure that fuel contents gage switch is on.

PRE-FLIGHT AIRCRAFT CHECK.

Before each flight, conduct the following aircraft checks:

1. Check flight controls for free, full, and correct movement.
2. Elevator trim indicator at 0.
3. Rudder trim indicator between 0 and one quarter RIGHT.
4. Wing flaps at TAKE-OFF.
5. Check all doors fully closed.
6. Directional gyro and flight gyro uncaged and set.
7. All instruments in the correct ranges.
8. In cold weather, or when icing conditions are expected, pitot head heater on.
9. Check shoulder harness control unlocked.

TAKE-OFF.

LANDPLANE TAKE-OFF.

Visually check for other aircraft in the vicinity and check with control tower for take-off signals. Release brakes and taxi into take-off position with the airplane lined up with the runway.

Make sure that the tailwheel steering mechanism is engaged.

Note

Re-engagement of the tailwheel steering mechanism after sharp turns is achieved automatically through taxiing forward and actuating the rudder pedals at the same time in order to align the steering mechanism for re-engagement. The re-engaged steering mechanism will give increased resistance to rudder pedal movement.

To obtain the take-off performance shown in figure A-2, proceed as follows:

1. Adjust the throttle, mixture and propeller friction control knobs to prevent creep.
2. Open the throttle rapidly and smoothly to take-off power.
3. Counteract any tendency to swing to the left by using the rudder.
4. The airplane will unstick in a tail-down attitude between 55 and 61 knots IAS.

Note

For action to be taken in the event of engine failure during take-off, see Section III.

TAKE-OFF SURFACE REQUIREMENTS.

Take-offs may be made from hard-surface runways or long-grass fields within the field altitudes and airplane weight limitations shown in figure A-2.

MINIMUM-RUN TAKE-OFF.

A minimum-run take-off necessitates thorough familiar-

ity with slow-flying the airplane. Consequently you must be experienced in this type of maneuver before attempting to make a minimum-run take-off. When it is necessary to perform a minimum-run take-off, proceed as follows:

1. Complete the ground tests and before-take-off checks.
2. Elevator trim indicator at 0.
3. Rudder trim indicator one quarter RIGHT to counteract torque.
4. Wing flaps at TAKE-OFF.
5. Line up the airplane facing into wind and with the maximum length of take-off area ahead.
6. Apply wheel brakes.
7. Open throttle to take-off power.
8. Release wheel brakes. Correct tendency to swing by use of steerable tailwheel or by lightly braking on one side.

9. Raise tail slightly as soon as sufficient speed is attained. At approximately 47 knots IAS pull back gently on the control column to unstick. Maintain 73 knots IAS for initial climb.

10. When at least 500 feet above ground, and at approximately 73 knots IAS, move wing flaps to CLIMB.

11. At a safe altitude, move wing flaps to CRUISE.

CROSS-WIND TAKE-OFF.

Due to the low take-off speed of this airplane, unless you are thoroughly experienced in flying the airplane, it is not recommended that a cross-wind take-off be attempted if the lateral component of the wind velocity is more than 13 knots. When it is necessary to take-off cross-wind, proceed as follows:

1. Complete the ground tests and before-take-off checks.
2. Elevator trim indicator at 0.
3. Rudder trim indicator between 0 and one quarter RIGHT.
4. Wing flaps at TAKE-OFF.

Note

If the grass surface between runways is suitable, and if space between runways permits, the effects of a cross-wind on the runway can be overcome by taking-off into wind from the grass. If this procedure is adopted, ensure that there are no other aircraft in the vicinity, and that the runways are clear.

5. Open throttle slowly to take-off power.
6. Hold tail down so that directional control can be maintained with the steerable tailwheel until the rudder becomes effective.
7. Keep the airplane on the runway until a speed of 47 knots IAS is reached.

SEAPLANE TAKE-OFF.

Cover applicable steps as under LANDPLANE TAKE-OFF. Visually check for other aircraft and surface craft in the vicinity and insure that there are no obstructions or flotsam in the water in the take-off path. To obtain

the take-off performance shown in figure A-3, proceed as follows:

1. Adjust the throttle, mixture, and propeller friction control knobs to prevent creep.
2. Retract the water-rudders as necessary.

Note

When operating from large areas of water, and after taxiing into take-off position, the pilot should lift the water rudders and wait until the aircraft "weathercocks" into wind before taking off.

If operating from one of the channel lakes, rivers or under cross wind condition, it is advisable to keep the water rudders down during take-off when the pilot can pull them up after he is safely in the air, and at his leisure.

3. Holding the control column back of neutral, open the throttle rapidly and smoothly to full take-off power. The seaplane will immediately rise on the step with no tendency to porpoise, even in rough water. On smooth water the aircraft will unstick at approximately 59 knots IAS. On rough water the aircraft will fly itself off at approximately 55 knots IAS.

SKIPLANE TAKE-OFF.

The take-off procedure and performance for the skiplane are almost exactly as for the landplane fitted with wheels, with the exception that the skiplane cannot be braked on the ground. To turn on the ground, make careful use of the throttle and rudder, keeping the control column forward. Use rudders for tail ski steering.

CLIMB

LANDPLANE.

To obtain the climb performance shown in figure A-4, proceed as follows:

1. At altitude of 500 feet move wing flaps to CLIMB.
2. Climb at 81 knots IAS.
3. Use power as required.
4. Check instruments for desired ranges.
5. At a safe altitude, wing flaps to CRUISE.

SEAPLANE.

The climb control settings for the seaplane are the same as for the landplane with the exception that, for a prolonged climb, a slightly increased rate of climb will result if the flaps are moved to CRUISE shortly after take-off, provided there are no obstacles ahead.

FLIGHT CHARACTERISTICS.

For flight characteristics, see Section VI.

SYSTEMS OPERATION.

For additional information regarding the operation of

the various systems, see Section VII.

DESCENT.

1. Reduce airspeed to 100 knots IAS.
2. Propeller control lever full INCREASE RPM.
3. Mixture control FULL RICH.
4. Check instruments for desired ranges.
5. Clear engine periodically during descent.

PRE-TRAFFIC PATTERN CHECK.

Before entering the traffic pattern, check the following:

1. Fuel selector valve to fullest tank.
2. On airplanes without the fully-filtered air induction system, pull the carburetor filtered air control handle out to the OUT-FILTER position, if dusty conditions prevail.
3. All instruments in the correct ranges.
4. Check shoulder harness control unlocked.
5. Enter the traffic pattern as soon as permission is given from control tower.

TRAFFIC PATTERN CHECK.

Traffic pattern checks and landing procedures are shown in figure 2-2.

Note

See Section V for landing weight and CG limitations.

LANDING.

LANDPLANE LANDING.

To obtain the normal landing performance shown on figure A-6, proceed as follows:

1. Maintain a final approach airspeed of 70 knots IAS.
2. Level off.
3. With power off, a distinct nose-down attitude will result. Pull back gently on the control column and make a three-point touchdown.
4. As soon as the airplane is firmly on the ground and rolling forward, pull the control column fully back.
5. Use the rudder and steerable tailwheel to maintain a straight path. Apply wheel brakes gently and gradually.

Note

For procedure in case of an emergency landing, see Section III.

MINIMUM-RUN LANDING.

To perform a minimum-run landing, proceed as follows:

1. Wing flaps to LANDING.
2. Maintain a final approach airspeed of 55-60 knots IAS.
3. Level off.
4. With power off, make a three-point touch-down. Airspeed will be approximately 48 knots IAS.
5. As soon as possible, pull control column fully back and apply brakes.

CROSS-WIND LANDING.

Due to the low landing speed of this airplane, unless you are thoroughly experienced in flying the airplane, it is not recommended that a cross-wind landing be attempted if the lateral component of the wind velocity is more than 13 knots because it is only at or below this figure that the drift can be cancelled out by yaw or bank.

1. Wing flaps to **LANDING**.
2. Maintain a final approach airspeed of 70 knots **IAS**.
3. Level off.
4. As soon as the airplane is firmly on the ground and rolling, pull the control column fully back and raise flaps to **CRUISE**. The airplane will tend to weather-cock; as the forward speed decreases, use the rudder and steerable tailwheel to ease the airplane back to a straight path. Apply wheel brakes gently and gradually.

Note

If the grass surface between runways is suitable, and if space between runways permits, the effects of a cross-wind on the runway can be overcome by landing into wind on the grass. If this procedure is adopted, insure that there are no other aircraft in the vicinity, and that the runways are clear.

NIGHT LANDING.

When performing a night landing, switch on the landing light as you turn into the final approach. It will be necessary to make a power-on landing at approximately 1400 rpm so that, in the event of a misjudgment of height, a go-around will be facilitated.

CAUTION

(A)

On certain groups of airplanes (A) do not operate the landing light until all radio navigation equipment has been turned off, because the presently installed 50 ampere generator cannot handle the combined current requirements. The radio navigation equipment which must be turned off includes the AN/ARN-12 marker beacon receiver, the AN/ARN-30A VHF navigation omnirange equipment, and the AN/ARN-42, AN/ARN-54, or AN/ARN-59 radio compasses. Failure to comply with this instruction will result in overloading the electrical system.

SEAPLANE LANDING.

The procedure for landing the seaplane is similar to that for the landplane, but there are certain additional considerations which must be taken into account. Before attempting any seaplane landing, the landing area should be checked from the air to make certain that there are no floating or slightly submerged objects on the actual landing path. Seaplane landings should be made tail low. See figure A-7 for seaplane landing performance. If at all possible, do not attempt to land on rough water. For a landing area, select a cove on the lee side of a point, or an area to the lee side of a dock or a large boat, having the smoothest available water surface. This will prevent heavy impact loads from being imposed on the floats. Avoid landing on an absolutely smooth (glassy) water surface, however, because of the extreme danger involved in judging altitude. If necessity demands a smooth-water landing, land near the shore, or near a buoy or boat or other objects which will provide a water line to aid in judging altitude. Keep eyes on these objects rather than on the glassy water surface ahead of the aircraft.

WARNING

If a landing must be accomplished on a large open area of glassy water, do not attempt to glide down lower than 50 feet above the water. Settle the seaplane through the remaining 50 feet with the nose up, and increased power.

CAUTION

When landing, do not lower the water rudders until the seaplane has stopped planing, in order to prevent the water rudders from being damaged.

SKIPLANE LANDING.

Before landing the skiplane, try to determine the nature of the snow or ice on which it is proposed to land. Remember that snow-covered rough ground sometimes deceptively appears, from the air, as a suitable landing area. In the case of frozen lakes, blue ice is generally quite thick and white ice nearly always thin; white ice

(A) U.S. Army 54-1666 thru 55-708 } AFTER installation of AN/ARC-44 FM Radio
 55-4589 thru 55-4612 }
 56-351 thru 57-2578 (except 56-4397), and 57-6137 thru 57-6153 }

is often close to open water. Ice is usually thinner in narrow inlets and on fast-flowing rivers which have become frozen.

When landing on unmarked snow on a dull day, use a power approach with a controlled rate of descent.

Do not attempt to turn at low altitudes.

GO-AROUND.

Decide as early as possible whether it is necessary to go-around.

1. Throttle fully OPEN.
2. Emergency air handle (A) OPEN only if necessary.
3. Trim elevator.
4. As soon as a safe airspeed and altitude is reached, wing flaps to CLIMB.

AFTER LANDING.

Immediately after turning off the runway:

1. Wing flaps to CRUISE.

POST FLIGHT ENGINE CHECK.

1. Set parking brakes.
2. Check ignition switch by setting throttle at 700 rpm and turning ignition switch OFF momentarily. Check that engine stops firing completely. Conduct this check as rapidly as possible to prevent severe backfiring when the ignition switch is turned to BOTH again.

WARNING

If the engine does not stop firing completely, shut down the engine. Warn all personnel to keep clear of the propeller until corrective action is taken. The switch may be defective or a magneto ground lead may be open.

CAUTION

The usual ignition system check will be unreliable when magneto ground trouble exists.

3. Cruising fuel air mixture check:
 - a. Throttle 1700 rpm.
 - b. Mixture control FULL RICH.
 - c. After engine speed and instruments have stabilized, slowly move mixture control into the manual lean range until approximately 100 rpm drop is noted, then return to FULL RICH.
 - d. If a change of over 25 rpm increase occurs as a result of this mixture, it indicates an excessively rich carburetor.
4. Power check:
 - a. Control column fully back.
 - b. Open throttle to 1750 rpm.

approach and landing procedure

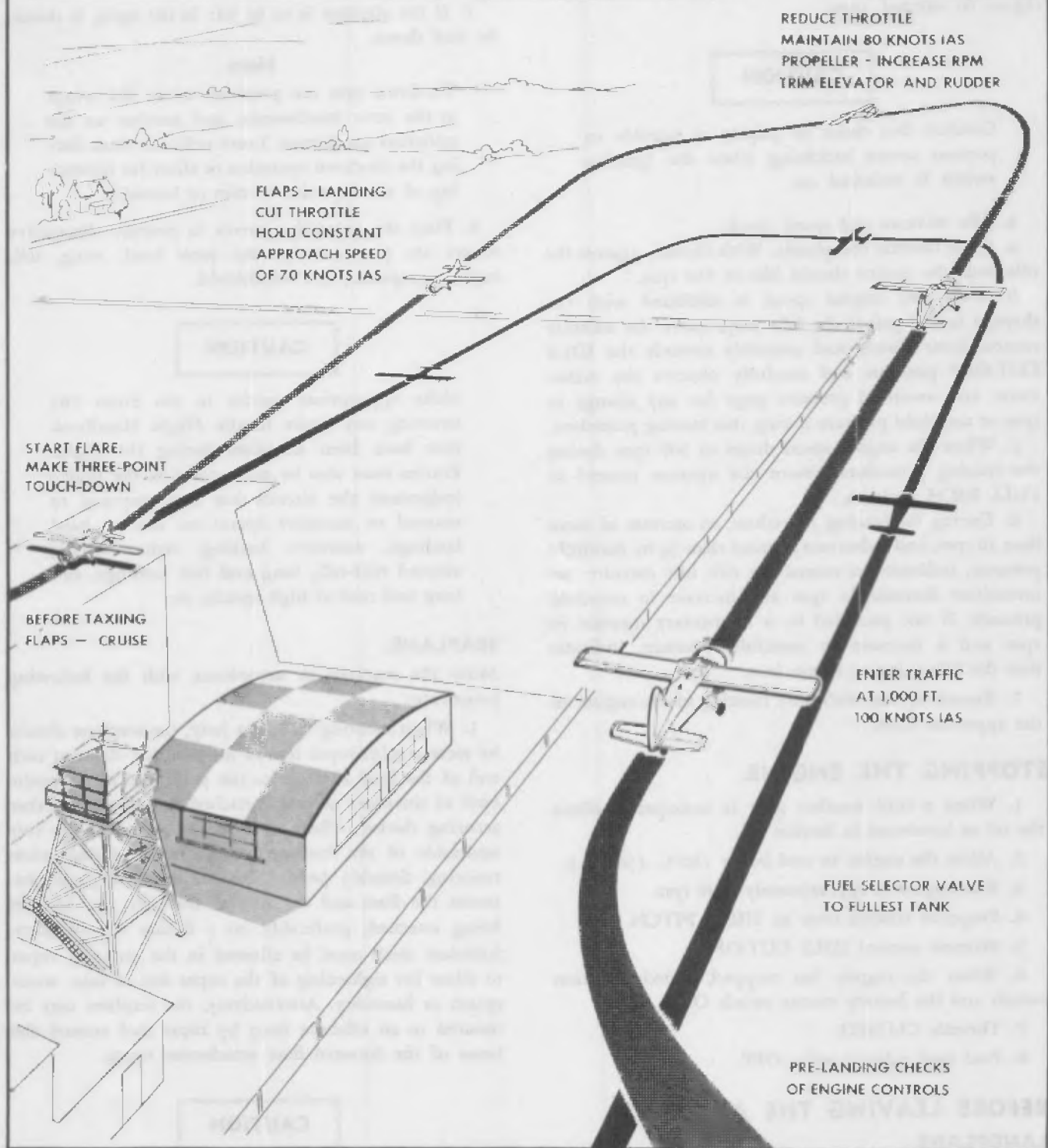


Figure 2-2

- c. Check manifold pressure 23 in. Hg.
5. Ignition system check:
 - a. Check magnetos by switching to L and R alternately. The drop in rpm when running on one magneto should not exceed 100 rpm. Return the ignition switch to BOTH between checks to allow the engine to regain its normal rpm.

CAUTION

Conduct this check as quickly as possible to prevent severe backfiring when the ignition switch is switched on.

6. Idle mixture and speed check:
 - a. Close throttle completely. With throttle against the idle stop, the engine should idle at 450 rpm.
 - b. When the engine speed is stabilized with the throttle lever against the idle stop, move the mixture control lever slowly and smoothly towards the IDLE CUT-OFF position and carefully observe the tachometer and manifold pressure gage for any change in rpm or manifold pressure during this leaning procedure.
 - c. When the engine speed drops to 300 rpm during the leaning procedure, return the mixture control to FULL RICH position.
 - d. During the leaning procedure, an increase of more than 10 rpm, and a decrease of more than $\frac{1}{4}$ in. manifold pressure, indicates an excessively rich idle mixture: an immediate decrease in rpm and increase in manifold pressure, if not preceded by a momentary increase in rpm and a decrease in manifold pressure, indicates that the idle mixture is too lean.
7. Report any unsatisfactory running of the engine on the approved form.

STOPPING THE ENGINE.

1. When a cold weather start is anticipated, dilute the oil as instructed in Section IX.
2. Allow the engine to cool below 150°C. (302°F.).
3. Run engine at approximately 1200 rpm.
4. Propeller control lever to HIGH PITCH.
5. Mixture control IDLE CUT-OFF.
6. When the engine has stopped, switch ignition switch and the battery master switch OFF.
7. Throttle CLOSED.
8. Fuel tank selector valve OFF.

BEFORE LEAVING THE AIRPLANE. LANDPLANE.

1. Have wheels chocked before releasing parking brakes.

2. Lock the flight controls.
3. Check that starter brush release control is at ELECTRIC.
4. All switches OFF, except generator switch.
5. Carburetor hot air control lever COLD.
6. Elevator trim tabs at zero.
7. If the airplane is to be left in the open, it should be tied down.

Note

Tie-down eyes are provided under the wings at the strut attachments, and another on the tailwheel attachment. Leave sufficient slack during the tie-down operation to allow for tightening of the rope due to rain or humidity.

8. Place the protective covers in position. Protective covers are provided for the pitot head, wing, tail, engine, propeller, and windshield.

CAUTION

Make appropriate entries in the Form 781 covering any limits in the Flight Handbook that have been exceeded during the flight. Entries must also be made when in the pilot's judgement the aircraft has been exposed to unusual or excessive operations such as hard landings, excessive braking action during aborted take-offs, long and fast landings, and long taxi runs at high speeds, etc.

SEAPLANE.

Moor the seaplane in accordance with the following procedure:

1. When mooring against a jetty, the seaplane should be secured with ropes tied to the mooring cleats at each end of the float adjacent to the jetty, and the opposite ends of the ropes securely attached to bollards or other securing devices. There is a handling bar at the rear underside of the fuselage to facilitate handling when mooring. Suitably padded fenders must be placed between the float and the side of the jetty, the fenders being attached, preferably, to a fixture on the jetty. Sufficient slack must be allowed in the mooring ropes to allow for tightening of the ropes due to rain, water splash or humidity. Alternatively, the seaplane may be moored to an offshore buoy by ropes tied around the bases of the forward float attachment struts.

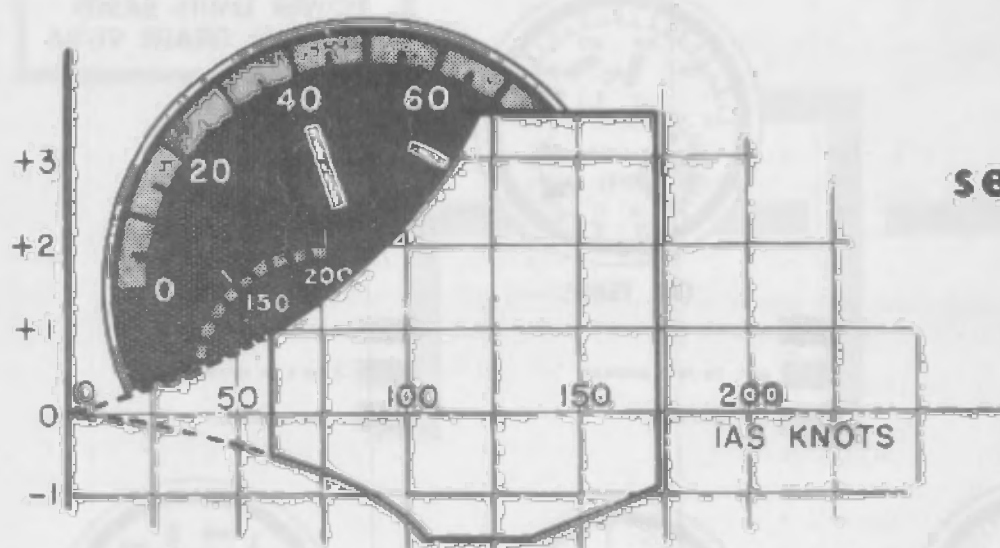
CAUTION

Always tie the mooring rope around both struts; never between the struts.

2. Lock flight controls.
3. Check that starter brush release control is at ELECTRIC.
4. All switches OFF except generator switch.
5. Carburetor hot air control lever COLD.
6. Elevator trim tabs at zero.

7. If the seaplane is moored to an offshore buoy at night, switch the anchor lights ON if required by prevailing regulations.

8. Place the protective covers in position. Protective covers are provided for the pitor head, wing, tail, engine, propeller, and windshield.



section

V

OPERATING LIMITATIONS

GENERAL.

This section includes the engine and the airplane limitations that must be observed during normal operation.

Instrument markings showing the various operating limitations are illustrated in Figure 5-1.

Operating limitations which are not indicated on the instruments, are discussed in the following paragraphs.

MINIMUM CREW.

The minimum crew required to fly the airplane under normal non-tactical missions, consists of one pilot in the left front seat. Additional crew members as required will be added at the discretion of the Commanding Officer.

INSTRUMENT LIMITATION MARKINGS.

The instrument limitation markings illustrated in Figure 5-1 must be given close attention since they represent limitations that are not necessarily repeated or explained in the text. However, when further explanation is given in the text, it will be found under the appropriate heading, such as Engine Limitations, Airspeed Limitations, etc.

ENGINE LIMITATIONS.

All normal engine limitations are shown in Figure 5-1,

WARNING

Whenever engine speed exceeds the operating

limits, the airplane should be landed at the nearest base. The reason for the overspeed (if known), the duration and the maximum rpm should be entered in Form 1.

Overspeed between 2900 and 3000 rpm calls for an inspection of the engine before further flight. If engine overspeed exceeds 3000 rpm, the engine must be changed.

PROPELLER LIMITATIONS.

Provided that the engine is operated within the engine limitations, the propeller will operate within safe limits.

AIRSPEED LIMITATIONS.

For the landplane, seaplane and skiplane versions, the airspeed limitations for the gross weight of 5100 lb are:

Minimum Control Speed..... 59 knots IAS

PROHIBITED MANEUVERS.

All acrobatic maneuvers, including spins, are prohibited. The maximum lateral component of wind for which cross wind take-offs and landings are approved, is 13 knots.

Steep sideslips on floats without ventral fin are not recommended, as some difficulty may be experienced in keeping a steady airspeed and direction, especially with glassy water.

ACCELERATION LIMITATIONS.

An operating flight strength diagram (V-G diagram) for a gross weight of 5100 lb is presented in Figure 5-2. Its boundary lines show airspeeds and load factors which must not be exceeded under any circumstances.

**POWER LIMITS BASED
ON FUEL GRADE 91/96**

OIL PRESS.

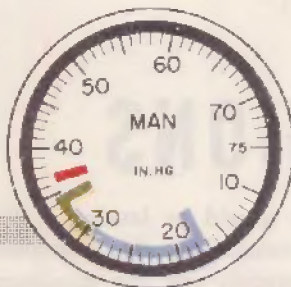
- 30 PSI MIN FOR FLIGHT
- 70 TO 90 PSI NORMAL
- 100 PSI MAXIMUM

OIL TEMP.

- 40°C MIN FOR FLIGHT
- 60°C TO 75°C NORMAL
- 85°C MAXIMUM

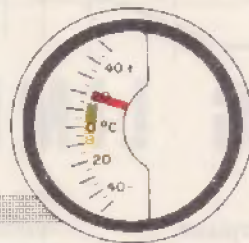
FUEL PRESS.

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



MANIFOLD PRESS.

- 18 IN. HG MIN FOR FLIGHT
- 18 IN. TO 30 IN. HG MANUAL LEAN PERMITTED
- 30 IN. TO 34.5 IN. HG FULL RICH REQUIRED
- 34.5 IN. HG MAX CONTINUOUS (OPERATION ABOVE THIS PRESSURE WILL BE LIMITED TO 5 MINUTES)
- 37 IN. HG TAKE-OFF



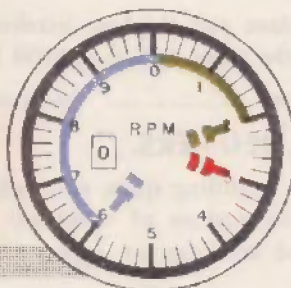
CARB. MIXTURE TEMP.

- 10°C TO +3°C DANGER OF ICING
- +3°C TO +15°C CONTINUOUS OPERATION
- +20°C MAX - DANGER OF DETONATION



CYLINDER HEAD TEMP.

- 150°C TO 232°C MANUAL LEAN PERMITTED
- 232°C TO 260°C FULL RICH REQUIRED
- 260°C MAXIMUM



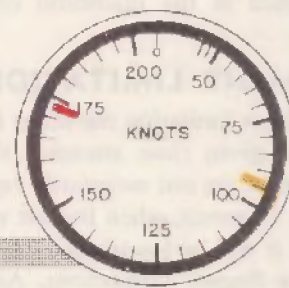
TACHOMETER

- 1600-2000 RPM MANUAL LEAN PERMITTED
- 2000-2200 RPM FULL RICH REQUIRED
- 2200 RPM MAXIMUM CONTINUOUS (OPERATION ABOVE THIS RPM WILL BE LIMITED TO 5 MINUTES)
- 2300 RPM MAXIMUM



SUCTION

- 3.75 IN. HG MINIMUM
- 3.75-4.25 IN. HG NORMAL
- 4.25 IN. HG MAXIMUM



AIRSPEED

- 96 KNOTS - FULL FLAPS
- 173 KNOTS - MAXIMUM DIVING

Figure 5-1—Instrument Limitation Markings

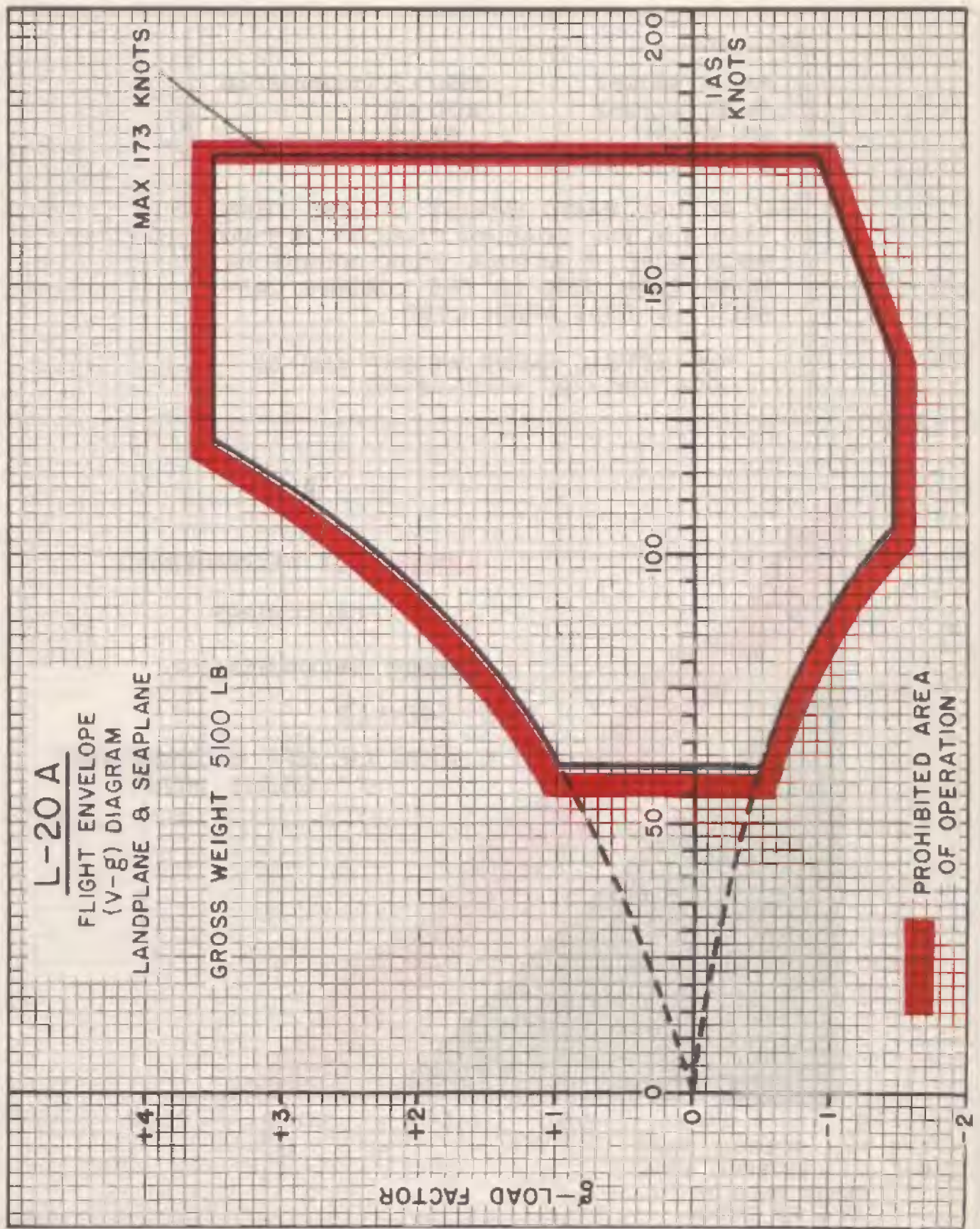


Figure 5-2—Operating Flight-Strength Diagram

BASIC WEIGHT	3330 LB (ASSUMED)*
PILOT WEIGHT	200 LB
OIL WEIGHT	47 LB
OPERATING WEIGHT	<u>3577 LB</u>

* IF ACTUAL BASIC WEIGHT IS LESS THAN 3330 LB, THE LOADING CAPACITY IS THAT MUCH MORE; IF ACTUAL BASIC WEIGHT IS MORE THAN 3330 LB THE LOADING CAPACITY IS THAT MUCH LESS.

FOR ACTUAL BASIC WEIGHT AND CG LOCATION, USE AN OI-IB-40

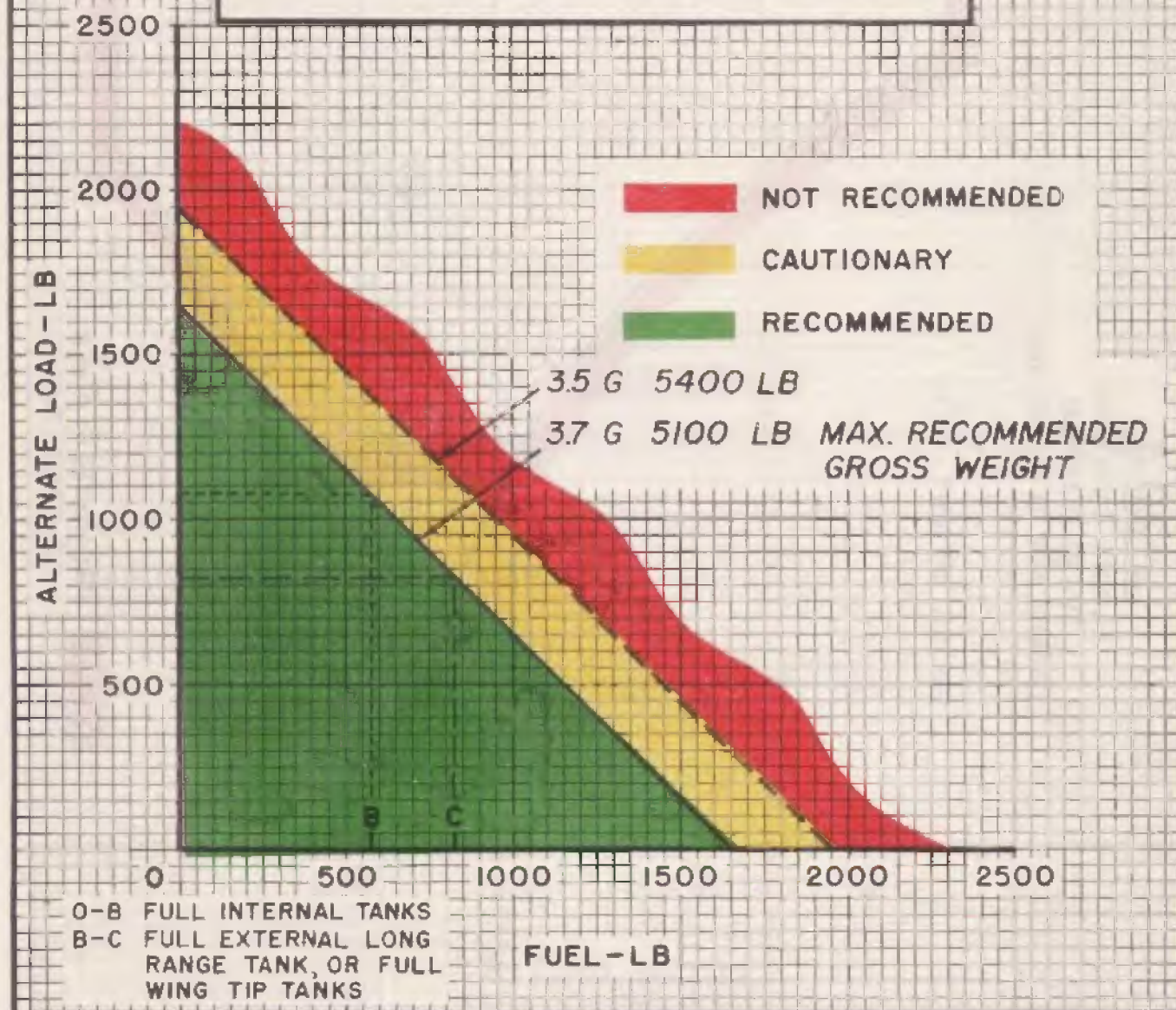


Figure 5-3—Operational Weight Limitations—Landplane, Seaplane and Skiplane

The flight loads are conveniently expressed as a multiple of the gross weight. The number by which the gross weight is multiplied to derive the flight load is known as the load factor.

Limit load factors are the maximum values to which the airframe may safely be subjected in flight. The boundary lines, with red outlines, in the operating flight strength diagram (figure 5-2) represent the limit load factors, for a gross weight of 5,100 lb. resulting from maneuvers initiated by the pilot. The load factors corresponding to normal turns at various angles of bank and the associated stalling speeds are shown below.

Angle of Bank	Load Factor	Stalling Speed (Knots IAS)
0°	1.0	59
48°	1.5	79
60°	2.0	93
66°	2.5	105
70°	3.0	113
73°	3.5	123

Flight loads of considerable magnitude may also result, even in steady level flight, from atmospheric gusts. The procedures outlined in Section IX under the heading **FLIGHT IN TURBULENCE AND THUNDER-STORMS** should be followed.

CENTER OF GRAVITY LIMITATIONS.

The center of gravity must always be maintained within the prescribed limits through the use of the Weight and Balance Handbook AN 01-1B-40.

The effect of forward or aft C.G. on taxiing, take-off, stability and control is negligible. In landing, however, more elevator control is required for the flare out with the C.G. forward than with C.G. aft.

WEIGHT LIMITATIONS.

GENERAL.

The maximum permissible weight at which an airplane can be operated, varies within broad limits. Following are some of the controlling criteria, on which the maximum permissible weight is dependent under various conditions.

BASIC OPERATING WEIGHT.

The basic operating weight on which the Weight Limitation Chart is based, is 3,330 lb. This assumed value is an approximate weight which includes the average landplane basic weight plus pilot and full oil capacity. Since individual airplane basic weights vary, it will be necessary to adjust the chart for specific airplanes as shown in sample problems and chart.

GROSS WEIGHT.

The maximum recommended gross weight of the airplane is 5,100 lbs. This is indicated on the Operational Weight Limitations Chart (figure 5-3) by the diagonal upper border of the green area. At this weight all air-

worthiness requirements are satisfied. Take-off at any gross weight greater than the maximum recommended gross weight will require authorization from the Commanding Officer. Refer to the yellow and red areas of figure 5-3.

CAUTION

Landplanes operating at the maximum recommended gross weight, or greater, must be fitted with 8.50 x 10 tires on the main wheels.

Note

All seaplanes, including those flying at low gross weights, must be fitted with a ventral fin for directional stability, in accordance with T.O. 1L-20A-210.

DISTRIBUTION OF LOAD.

The maximum load that the airplane can carry is dependent on the way in which that load is distributed.

INTERNAL LOAD.

Maximum Static Distributed Floor

Load 100 lb. per sq. ft.

Maximum Static Concentrated Floor

Load 200 lb. per sq. ft.
(Surrounding Floor Unloaded)

EXTERNAL LOAD.

Bomb Racks, Static Load, each..... 250 lb.
i.e. per Wing..... 500 lb.
i.e. per Aircraft..... 1000 lb.

To stay within C.G. limits, use T.O. AN01-1B-40.

MARGIN OF SAFETY AND LOAD FACTORS.

It is readily understandable that as a structure is loaded to higher weights, its ability to withstand shocks or additional loads resulting from maneuvers, becomes increasingly less. The amount of shock or additional load that the structure will sustain before failure occurs, is the margin of safety. Should the mission require excessive maneuvering or flight through turbulent air, it would be advisable to maintain a larger margin of safety. Load factors are used as an indication of the margin of safety that is available.

WING LIMITATIONS.

Lines showing wing strength in terms of aircraft load factors for combinations of fuel and alternate load are shown for 3.5 g, 3.7 g, and 3.9 g.

The 3.9 g line encompasses the load combinations which the aircraft structure will sustain at the design gross weight of 5,100 lb. Combinations of alternate load and fuel for which the airplane structure is good for less than 3.9 g, should be flown with caution, especially when making turns and pullouts.

THE AIRPLANE WILL NOT NORMALLY BE LOADED WITH ANY COMBINATION OF ALTER-

NATE LOAD AND FUEL WHICH EXTENDS BEYOND THE 3.5 g LINE, BECAUSE STRUCTURAL DAMAGE TO THE WING MAY OCCUR.

LANDING GEAR LIMITATIONS.

The landing gear structure is designed for landing at a contact sinking speed of 8.5 ft. per second.

When on floats, and loaded to 5,400 lb., the reserve buoyancy is 75%.

PERFORMANCE LIMITATIONS.

In some instances, it will be found necessary to limit the maximum permissible weight of the airplane, not because of structural considerations but because of reduced performance due to higher weights. Maximum Take-Off Weight must necessarily be limited by the ability of the of the aircraft to take-off within the available runway length, and its ability to clear any obstacles.

Refer to Take-Off and Landing Charts in Appendix.

EXPLANATION OF THE CHART.

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

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

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

Note

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

To arrive at the weight of fuel and alternate loads, subtract Operating Weight from relevant weight, as shown

in sample below.

Normal Weight.....	4820 lb
Operating Weight consisting of:	
Basic Weight (assumed).....	3200 lb
Pilot	200 lb
Oil (full)	47 lb

Fuel plus Alternate Load..... 1373 lb

Thus, as long as any combination of fuel and alternate weights does not exceed the 1373 lb, of the sample, the aircraft is loaded within the normal weight. Similarly the weight of Fuel plus Alternate Load for the overload weight and for the emergency overload weight may be calculated.

However, since the actual Basic Weight of each aircraft as given on Chart C of AN 01-1B-40 varies with the assumed basic weight of 3200 lb above and in the Weight Limitations Chart, it will be necessary to adjust the result as read from the chart accordingly. If the actual basic weight is less than 3200 lb, the aircraft can carry that amount more; if the actual basic weight is more than 3200 lb, the aircraft can only carry that amount less.

The C.G. of the combined Fuel, Alternate and Operating Weights should be within limits. Use AN 01-1B-40.

SAMPLE PROBLEMS.

1. What is the maximum alternate load that can be carried under normal conditions with full internal fuel tanks if actual Basic Weight is 3165 lb?

Referring to Figure 5-3, maximum internal fuel load is at point B on horizontal scale. Project vertical line upwards to intersect the "4820 lb normal" line. Project horizontally to Alternate Load scale and read 785 lb. Since actual Basic Weight is $3200 - 3165 = 35$ lb less than assumed, the final alternate load that can be carried is $785 + 35 = 820$ lb.

C.G. must be checked in accordance with Weight and Balance Handbook AN 01-1B-40.

2. What is the maximum fuel load that can be carried by a seaplane whose Basic Weight is 3450 lb for a payload of 1100 lb under overload conditions?

Since a gross weight of 5100 lb will be used, the ventral fin must be fitted and the Basic Weight increased by the weight of the fin from 3450 lb to 3456 lb. From the 1100 lb point on the Alternate Load scale project horizontally to the "5100 lb overload" diagonal line, and then vertically down to the fuel load scale and read 550 lb. Since the actual Basic Weight is $3456 - 3200 = 256$ lb greater than assumed, the final fuel load that can be carried under these conditions is $550 - 256 = 294$ lb.

The C.G. must be checked in accordance with Weight and Balance Handbook AN 01-1B-40.

ELECTRICAL SYSTEM LIMITATIONS. (A)

All airplanes are at present equipped with a 50 ampere generator which, on certain groups of airplanes (A), cannot produce enough current to supply all the electrical and electronic equipment at one time. For this reason the following limitations are imposed:

1. On recent airplanes (B) do not operate the AN/ARC-44 FM liaison radio and the AN/ARC-55 command radio simultaneously for any longer than is necessary.

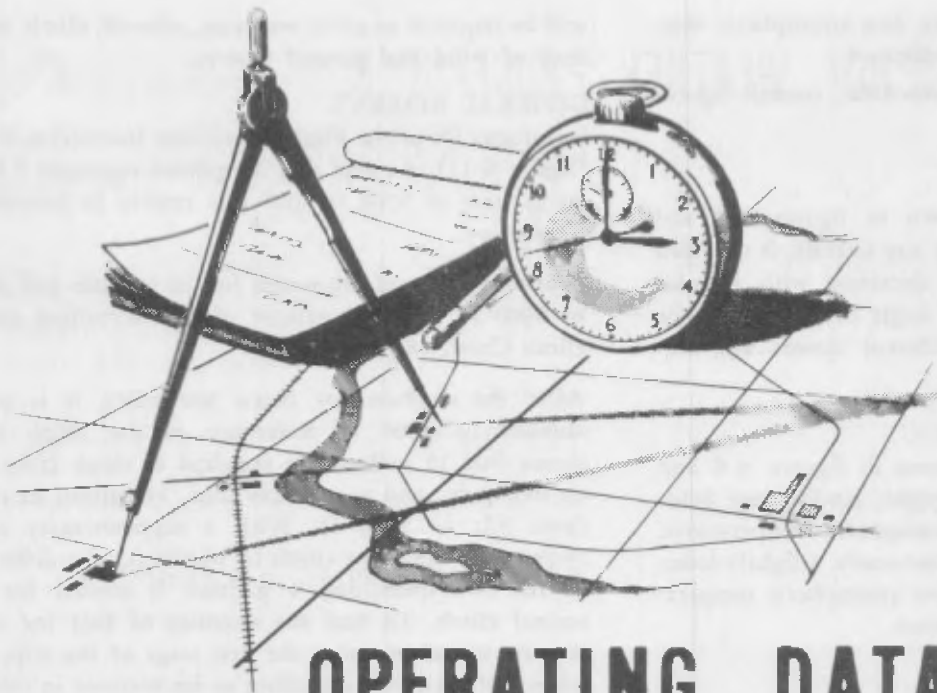
2. On earlier airplanes (C), when equipped with FM liaison radio, do not operate the AN/ARC-44 FM liaison radio and the ARC-12 VHF communication equipment simultaneously for any longer than is necessary. Refer to the paragraph entitled VHF Command Transmitters T-11A and T-13, in Section IV, for information on the VHF equipment covered by the ARC-12 designation.

3. On all airplanes (A) to which the foregoing limitations apply, do not operate the landing light until all radio navigation equipment has been turned off. The radio navigation equipment which must be turned off is listed as follows:

- a. AN/ARN-12 marker beacon receiver.
- b. AN/ARN-30A VHF navigation omnirange equipment. (Turn off VHF Navigation Receiver R-13B).
- c. AN/ARN-42, AN/ARN-54, or AN/ARN-59 radio compass.

Failure to comply with these limitations will result in overloading the electrical system which, if prolonged, could result in a total failure of the system.

-
- | | | | |
|-----|-----------|---|--|
| (A) | U.S. Army | 54-1666 thru 55-708
55-4589 thru 55-4612
56-351 thru 57-2578 (except 56-4397), and 57-6137 thru 57-6153 | } AFTER installation of AN/ARC-44 FM Radio |
| (B) | U.S. Army | 56-351 thru 57-2578 (except 56-4397), and 57-6137 thru 57-6153 | |
| (C) | U.S. Army | 54-1666 thru 55-708
55-4589 thru 55-4612 | } AFTER installation of AN/ARC-44 FM Radio |
| | | | |



appendix

I

OPERATING DATA

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Introduction

The correct method to perform a mission can be determined from the information presented in the charts on the following pages. They are easy to interpret and enable you to fly a greater distance at a better cruising speed, and to arrive at your destination with more reserve fuel. Two sample problems are also included.

AIRSPEED INSTALLATION CORRECTION.

An airspeed installation correction table is shown in figure A-1 for computing calibrated airspeed (CAS) from indicated airspeed (IAS).

Indicated airspeed is the airspeed indicator reading corrected for instrument error.

Calibrated airspeed is indicated airspeed corrected for installation error. Equivalent airspeed (EAS) is calibrated airspeed corrected for compressibility error.

Within the airspeed range of this aircraft the compressibility error is negligible, and $CAS = EAS$. True airspeed (TAS) is equivalent airspeed corrected for atmospheric density.

TAKE-OFF DISTANCES.

Take-off characteristics are shown in figures A-2 and A-3. An increase in gross weight, taking off from fields at high altitudes in high atmospheric temperatures, increase the take-off distance. Conversely, a lightly

laden aircraft, sea-level take-offs, low atmospheric temperatures, decrease the take-off distance.

When take-off conditions are doubtful, consult figures A-2 and A-3.

CLIMB.

Climb characteristics are shown in figures A-4 and A-5. The best rate of climb, for any aircraft, is obtained at one specified speed which decreases with increase in altitude. However, the best angle of climb and the best rate of climb require different speeds and flap settings.

LANDING DISTANCES.

Landing characteristics are shown in figures A-6 and A-7. An increase in gross weight, landing on fields at high altitudes in high atmospheric temperatures, increase the landing distance. Conversely, a lightly laden aircraft, landing at sea-level, low atmospheric temperatures, decrease the landing distance.

SAMPLE PROBLEMS.

The following sample problems employ actual chart values and show how the charts should be used:

Problem 1. It is required that the airplane, as land-plane, be flown to a base 550 miles away.

The first 300 miles of the flight will be carried out at 5000 ft. At this point, a climb will be made to 9000 ft. to fly over mountainous terrain and the flight will be completed at this altitude.

First the conditions of the problem must be established.

Required range..... 550 miles

Weather CAVU

Winds

At home field, 25 mph effective head wind at 5000 ft. At 300 miles out, 15 mph effective tail wind at 9000 ft.

Aircraft basic weight (with specified equipment) 3195 lbs.

Oil 6.25 U.S. gal..... 47 lbs.

Fuel, front tank 35 U.S. gal.	}	138 gal.	828 lbs.
center tank 35 U.S. gal.			
rear tank 25 U.S. gal.			
external tank 43 U.S. gal.			

Crew (1)..... 200 lbs.

Passengers (2) + Baggage 550 lbs.

Gross Weight 4820 lbs.

Now it is necessary to establish the flight plan.

As the charts give only *cruise* ranges under no wind conditions, and do not include any reserves, it is necessary to compute first all allowances and reserves which

will be required to cover warm-up, take-off, climb, influence of wind and general reserve.

GENERAL RESERVE.

In column IV of the Flight Operation Instruction Chart (figure A-11), we find that 20 gallons represent 1 hour flying time at 5000 ft. and this reserve is considered satisfactory.

Warm-up, take-off allowance for 10 minutes and climb to 5000 ft. need 11 gallons of fuel according to the climb Chart, (figure A-4).

After the airplane has flown 300 miles, it is to be climbed to 9000 ft. Reference to the climb chart shows that 15 gallons are required to climb from S.L. to 10,000 ft., and as we have seen, 11 gallons to climb from S.L. to 5000 ft. With a supplementary small reserve, assuming the climb to 10,000 ft., the difference of the two quantities, 4 gallons, is needed for the second climb. To find the quantity of fuel for wind reserve, we assume that the first stage of the trip, 300 miles, will be flown according to instructions in column IV (Flight Operation Instruction chart, figure A-11).

The true airspeed will be 122 mph (opposite to 5000 ft.—Column IV, figure A-11). Therefore, 'no wind time' of the first stage will be

300 = 2.46 hrs., with 25 mph of head wind time

122

300 = 3.1 hrs.

122-25

The additional fuel required to account for the head wind at an hourly consumption of 20 gph (column IV, figure A-11), is the increase in time, due to the wind, multiplied by the consumption per hour . . .

(3.1 — 2.46) x 20 = 12.8 gallons

As normally tail winds are treated as no wind condition, the wind reserve for the second stage = 0 gallons.

Collecting all the required allowances:

General reserve for unexpected difficulties	20
Warm-up, take-off and climb to 5000 ft.....	11
Climb from 5000 to 9000 ft.	4
Wind reserve (first stage).....	13
Wind reserve (second stage).....	0
Total Fuel Allowance	48 gallons

Subtracting this from the total fuel of 138 gallons, we have the fuel available for cruising:

138

48

90 gallons for cruising

Consulting the Flight Operation Instruction chart, it may be seen that with the power setting of Column IV, with 90 gallons, 564 miles can be covered.

Problem 2. Suppose that upon arrival over the destination at the completion of Problem 1, it is found that the field is closed because of bad weather and an alternate field 100 miles farther on must be used.

Suppose the general reserve is available. Reference to the Flight Operation Instruction chart (figure A-11) shows that the required range may be found in column

IV or V as desired. If column IV is used, TAS at 9000 ft. will be 131 mph.

Under no wind conditions, time for the flight will be

$$100 = 0.77 \text{ hrs.}$$

$$131$$

Fuel required will be $21 \text{ gph} \times 0.77 = 16 \text{ gallons}$.
Fuel left in the tanks upon arrival at the alternate field will be

$$20 - 16 = 4 \text{ gallons}$$

AIRSPEED INSTALLATION CORRECTION TABLE (All Configurations and Loading Conditions)

MODEL: L-20A

ENGINE: R-985-AN-1 or AN-3

FLAPS UP Add Correction to Instrument Reading to Obtain CAS		FLAPS DOWN 'CLIMB' OR 'LANDING' Add Correction to Instrument Reading to Obtain CAS	
IAS (KNOTS)	CORRECTION (KNOTS)	IAS (KNOTS)	CORRECTION (KNOTS)
50	—3	50	—4
100	—3	105	—4
150	—3		
175	—3		

REMARKS:

DATA AS OF: 15 SEPT. 1951

DATA BASIS: FLIGHT TEST

Figure A-1 Airspeed Installation Correction Table

TAKE-OFF DISTANCES — FEET

FLAPS,

"TAKE-OFF"

HARD SURFACE RUNWAY

MODEL (S): L-20A (LAND PLANE)

ENGINE(S): (1) R-985-AN-1 or AN-3

CONFIGURATION AND GROSS WEIGHT LB.	PRESSURE ALTITUDE	-5 DEG. CENT.				+15 DEG. CENT.				+35 DEG. CENT.				+55 DEG. CENT.			
		ZERO WIND		30 KNOT WIND		ZERO WIND		30 KNOT WIND		ZERO WIND		30 KNOT WIND		ZERO WIND		30 KNOT WIND	
		GROUND RUN	CLEAR 50'	GROUND RUN	CLEAR 50'	GROUND RUN	CLEAR 50'	GROUND RUN	CLEAR 50'	GROUND RUN	CLEAR 50'	GROUND RUN	CLEAR 50'	GROUND RUN	CLEAR 50'	GROUND RUN	CLEAR 50'
4820 (WITH LONG RANGE TANK)	SL	455	790	125	340	504	880	140	380	605	1060	170	455	655	1145	185	495
	1,000	470	820	130	355	520	910	145	395	625	1090	175	470	675	1175	190	515
	2,000	480	840	135	365	535	935	150	405	645	1120	180	485	695	1215	195	525
	3,000	495	870	140	375	550	965	155	415	660	1160	185	500	715	1255	205	540
	4,000	520	920	145	390	580	1020	160	440	695	1220	195	525	755	1325	210	570
	5,000	565	990	160	425	630	1100	175	475	755	1320	210	565	820	1430	225	615
4400 (WITH LONG RANGE TANK)	SL	380	665	100	290	420	740	113	320	505	890	135	385	545	960	145	415
	1,000	390	690	105	295	435	765	117	330	520	920	140	395	565	995	150	430
	2,000	400	705	110	305	445	785	120	340	535	945	145	405	580	1020	155	345
	3,000	415	730	115	315	460	810	125	350	555	975	150	420	600	1050	165	455
	4,000	435	770	120	330	485	855	130	365	580	1020	160	440	630	1110	170	475
	5,000	475	835	130	360	525	925	145	400	630	1110	170	480	680	1200	190	520
4000 (WITH LONG RANGE TANK)	SL	310	575	75	250	345	640	85	280	415	770	103	340	450	830	110	365
	1,000	320	595	80	260	355	660	90	290	430	780	107	350	460	860	115	375
	2,000	330	610	84	270	365	680	92	300	440	815	110	360	475	885	120	390
	3,000	340	630	86	280	380	700	95	310	455	840	113	370	495	910	125	405
	4,000	360	665	90	295	400	740	100	325	480	890	119	390	520	960	130	425
	5,000	390	720	100	320	435	800	108	355	520	960	130	425	565	1040	140	460
5100 (WITH LONG RANGE TANK)	SL	500	905	140	390	555	1000	155	430	650	1190	185	510	710	1290	200	570
	1,000	510	920	145	400	570	1030	160	440	670	1220	190	530	730	1330	205	580
	2,000	520	950	150	410	585	1060	165	455	690	1255	195	550	770	1400	215	590
	3,000	540	985	155	420	605	1100	170	470	720	1305	200	570	790	1440	225	610
	4,000	580	1050	160	440	640	1160	180	500	760	1385	215	590	830	1505	240	645
	5,000	620	1120	170	480	690	1255	195	535	820	1485	230	630	880	1602	260	685

REMARKS: TAKE-OFF DISTANCES ARE AIRPLANE REQUIREMENTS
UNDER NORMAL SERVICE CONDITIONS

DATA AS OF: 1 DEC. 1957
DATA BASIS: FLIGHT TEST

FUEL GRADE: 91/96
FUEL DENSITY: 6 LB./GAL.

SEAPLANE TAKE-OFF CHART

MODEL(S): L-20A (SEAPLANE)

FLAPS,

"TAKE-OFF"

WATER

ENGINE (S): (1) R-985-AN-1 or AN-3

CONFIGURATION AND GROSS WEIGHT LB.	-5 DEG. CENT.				+15 DEG. CENT.				+35 DEG. CENT.				+55 DEG. CENT.			
	ZERO WIND		30 KNOT WIND		ZERO WIND		30 KNOT WIND		ZERO WIND		30 KNOT WIND		ZERO WIND		30 KNOT WIND	
	TIME (SEC.)	DIST. (FEET)	TIME (SEC.)	DIST. (FEET)	TIME (SEC.)	DIST. (FEET)	TIME (SEC.)	DIST. (FEET)	TIME (SEC.)	DIST. (FEET)	TIME (SEC.)	DIST. (FEET)	TIME (SEC.)	DIST. (FEET)	TIME (SEC.)	DIST. (FEET)
4820 (WITH LONG RANGE TANK)	16	720	8.5	210	17	800	9.0	230	18.5	960	10	280	19	1040	10	300
4400 (WITH LONG RANGE TANK)	15	615	8	180	16	680	8.5	200	17.5	815	9.5	240	18	885	10	260
4000 (WITH LONG RANGE TANK)	14	525	7.5	155	15	585	8.0	170	16	700	9	205	17	760	9	225
5100 (WITH LONG RANGE TANK)	17	800	9.0	230	18	890	9.5	250	19	1070	10.5	310	20	1160	10.5	330

REMARKS: TAKE-OFF TIMES AND DISTANCES ARE AIRPLANE
REQUIREMENTS UNDER NORMAL SERVICE CONDITIONS
(TIME FIGURES ARE APPROXIMATE).

DATA AS OF: 1 DEC. 1957
DATA BASIS: FLIGHT TEST

FUEL GRADE: 91/96
FUEL DENSITY: 6 LB./GAL.

CLIMB CHART FOR NORMAL POWER

STANDARD DAY

MODEL(S): L-20A (LAND PLANE)

ENGINE(S): 1 R-985-AN-1 or AN-3

CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4820 LBS.CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4400 LBS.

APPROXIMATE				M.P.	CAS	PRESSURE ALTITUDE FEET	CAS	M.P.	APPROXIMATE			RATE OF CLIMB
RATE OF CLIMB	FROM SEA LEVEL			IN.	KNOTS		IN.	FROM SEA LEVEL				
	DIST.	TIME	FUEL	H.G.			KNOTS	H.G.	FUEL	TIME	DIST.	
920			7(1)	33.5	81	S.L.	81	33.5	7(1)			1090
875	7	6	11	32.0	77	5,000	77	32.0	10	5	6	1055
625	16	12	15	F. T.	74	10,000	74	F. T.	14	10	14	760
365	31	22	20	F. T.	69	15,000	69	F. T.	17	18	25	465
100	59	44	27	F. T.		20,000						
						21,200			24	37	50	100

REMARKS:

(1) WARM-UP AND TAKE-OFF ALLOWANCE

RATE OF CLIMB: FEET PER MINUTE
 DISTANCE NAUTICAL MILES
 TIME: MINUTES
 FUEL: GALLONS
 CAS: CALIBRATED AIRSPEED
 F.T. FULL THROTTLE
 M.P. MANIFOLD PRESSURE

DATA AS OF: 1 NOV. 1951
 DATA BASIS: FLIGHT TEST

FUEL GRADE: 91/96
 FUEL DENSITY: 6 LB./GAL.

CLIMB CHART FOR NORMAL POWER

STANDARD DAY

MODEL(S): L-20A (LAND PLANE)

ENGINE(S): (1) R-985-AN-1 or AN-3

CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4000 LBS.CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 5100 LBS.

APPROXIMATE				M.P. IN. H.G.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS	M.P. IN. H.G.	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST.	TIME	FUEL						FUEL	TIME	DIST.	
1255			7(1)	33.5	77	S.L.	82	33.5	7(1)			822
1220	5	4	10	32.0	73	5,000	78	32.0	12	7	8	775
920	11	9	13	F. T.	70	10,000	74	F. T.	17	15	18	525
605	20	15	16	F. T.	65	15,000	70	F. T.	22	28	34	260
						18,000		F. T.	29	49	57	100
300	34	26	20	F. T.	61	20,000						
100	54	42	24			23,200						

REMARKS:

(1) WARM-UP AND TAKE-OFF ALLOWANCE

RATE OF CLIMB: FEET PER MINUTE
 DISTANCE: NAUT. MILES
 TIME: MINUTES
 FUEL: GALLONS
 CAS: CALIBRATED AIRSPEED
 F.T. FULL THROTTLE
 M.P. MANIFOLD PRESSURE

DATA AS OF: 1 DEC. 1957
 DATA BASIS: FLIGHT TEST

FUEL GRADE: 91/96
 FUEL DENSITY: 6 LB./GAL.

WADC Form 241J
 (11 Jun 51)

Figure A-4 (Sheet 2 of 2 sheets) Climb Chart for Normal Power—Landplane

CLIMB CHART FOR NORMAL POWER

STANDARD DAY

MODEL(S): L-20A (SEAPLANE)

ENGINE(S): (1) R-985-AN-1 or AN-3

CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4820 LBS.CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4400 LBS.

APPROXIMATE				M.P. IN. H.G.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	M.P. IN. H.G.	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST.	TIME	FUEL						FUEL	TIME	DIST.	
805			7(1)	33.5	78	S.L.	78	33.5	7(1)			985
755	8	6	11	32.0	74	5,000	74	32.0	11	5	7	930
495	19	14	16	F. T.	68	10,000	68	F. T.	15	12	15	615
230	36	28	23	F. T.	62	15,000	62	F. T.	20	22	29	305
100	57	44	29			17,600						
						18,300			26	39	50	100

REMARKS:

(1) WARM-UP AND TAKE-OFF ALLOWANCE

RATE OF CLIMB: FEET PER MINUTE
 DISTANCE: NAUT. MILES
 TIME: MINUTES
 FUEL: GALLONS
 CAS: CALIBRATED AIRSPEED
 F.T. FULL THROTTLE
 M.P. MANIFOLD PRESSURE

DATA AS OF: 1 NOV. 1951
 DATA BASIS: ESTIMATED

FUEL GRADE: 91/96
 FUEL DENSITY: 6 LB./GAL.

CLIMB CHART FOR NORMAL POWER

STANDARD DAY

MODEL(S): L-20A (SEAPLANE)

ENGINE(S): (1) R-985-AN-1 or AN-3

CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4000 LBS.CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 5100 LB.

APPROXIMATE				M.P. IN. H.G.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS	M.P. IN. H.G.	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST.	TIME	FUEL						FUEL	TIME	DIST.	
1165			7(1)	33.5	74	S.L.	79	33.5	7(1)			700
1120	5	4	10	32.0	70	5,000	75	32.0	13	8	10	650
795	12	10	13	F. T.	64	10,000	69	F. T.	18	18	22	380
460	22	18	17	F. T.	58	15,000	63	F. T.	25	38.5	41	110
						15,300		F. T.	27	45	46	100
						20,500						

REMARKS:

(1) WARM-UP AND TAKE-OFF ALLOWANCE

RATE OF CLIMB: FEET PER MINUTE
 DISTANCE: NAUT. MILES
 TIME: MINUTES
 FUEL: GALLONS
 CAS: CALIBRATED AIRSPEED
 F.T. FULL THROTTLE
 M.P. MANIFOLD PRESSURE

DATA AS OF: 1 DEC. 1957
 DATA BASIS:

FUEL GRADE: 91/96
 FUEL DENSITY: 6 LB./GAL.

WADC Form 241J
 (11 Jun 51)

Figure A-5 (Sheet 2 of 2 sheets) Climb Chart for Normal Power—Seaplane

LANDING DISTANCE - FEET

STANDARD DAY

MODEL(S): L-20A (LAND PLANE)

ENGINE(S) (1) R-985-AN-1 or AN-3

GROSS WEIGHT LB	BEST TAS FOR APPROACH		'LANDING' FLAPS - HARD SURFACE - NO WIND							
	POWER OFF	POWER ON	AT SEA LEVEL		AT 2000 FT		AT 4000 FT		AT 6000 FT	
			GROUND ROLL	CLEAR 50'	GROUND ROLL	CLEAR 50'	GROUND ROLL	CLEAR 50'	GROUND ROLL	CLEAR 50'
4820 (WITH LONG RANGE TANK)	70		500	975	530	1040	565	1100	600	1170
4400 (WITH LONG RANGE TANK)	60		455	910	485	965	510	1020	545	1090
4000 WITH LONG RANGE TANK	56		420	870	445	925	475	980	505	1040
3600 (WITH LONG RANGE TANK)	52		360	790	385	840	405	890	435	945
5100 (WITH LONG RANGE TANK)	75		555	1050	580	1105	610	1165	655	1240

REMARKS. LANDING DISTANCES ARE AIRPLANE REQUIREMENTS
UNDER NORMAL SERVICE CONDITIONS

DATA AS OF: 1 DEC. 1957
DATA BASIS: FLIGHT TEST

FUEL GRADE: 91/96
FUEL DENSITY: 6 LB./GAL.

WADC Form 241Q
(11 Jun 51)

Figure A-6 Landing Distances—Landplane

LANDING DISTANCE - FEET

STANDARD DAY

MODEL (S): L-20A (SEAPLANE)

ENGINE (S): R-985-AH-1 or AH-3

GROSS WEIGHT LB	BEST TAS FOR APPROACH		'LANDING' DEGREE FLAPS - HARD SURFACE - NO WIND							
	POWER OFF	POWER ON	AT SEA LEVEL		AT 2000 FT		AT 4000 FT		AT 6000 FT	
			WATER RUN	CLEAR 50'	WATER RUN	CLEAR 50'	WATER RUN	CLEAR 50'	WATER RUN	CLEAR 50'
4820 (WITH LONG RANGE TANK)	70		725	1200	770	1275	815	1350	870	1440
4400 (WITH LONG RANGE TANK)	60		660	1115	700	1185	745	1255	790	1335
4000 (WITH LONG RANGE TANK)	56		610	1060	650	1125	685	1190	730	1270
3600 (WITH LONG RANGE TANK)	52		515	945	550	1000	580	1060	615	1130
5100 (WITH LONG RANGE TANK)	75		780	1285	830	1370	870	1450	935	1550
DATA AS OF: 1 DEC 1957 DATA BASIS: ESTIMATED										
FUEL GRADE: 91/96 FUEL DENSITY: 6 LB./GAL.										

WADC Form 241Q
(11 Jun 51)

Figure A-7 Landing Distances—Seaplane

MAXIMUM ENDURANCE

STANDARD DAY

MODEL (5) L-20A (LAND PLANE)

ENGINE(S): (1) R-985-AN-1 or AN-3

CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4820 LBS.CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4400 LB.

APPROXIMATE				CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE			
LBS/HR	MIX.	RPM	M.P. IN. Hg				M.P. IN. Hg	RPM	MIX.	LBS/HR
77		1600	22.5	71	S.L.	68	21.5	1600	M.L.	71.0
83		1600	22.0	71	5,000	68	21.0	1600	M.L.	75.0
89		1600	22.0	71	10,000	68	20.5	1600	M.L.	80.0

CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4000 LB.CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 5100 LB.

64.0	M. L.	1600	20.0	64	S. L.	74	23.0	1600	M. L.	85
68.0	M. L.	1600	19.5	64	5000	74	23.0	1600	M. L.	93
71.0	M. L.	1600	19.0	64	10,000	74	22.5	1600	M. L.	100

REMARKS:

LBS/HR: FUEL FLOW
CAS: CALIBRATED AIRSPEED
M.P.: MANIFOLD PRESSURE
MIX: MIXTURE
M.L. MANUAL LEAN

DATA AS OF: 1 DEC. 1957
DATA BASIS: FLIGHT TEST

FUEL GRADE: 91/96
FUEL DENSITY: 6 LB./GAL.

MAXIMUM ENDURANCE

STANDARD DAY

MODEL (S) L-20A (SEAPLANE)

ENGINE(S): (1) R-985.AN.1 or AN.3

CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4820 LB.CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4400 LBS.

APPROXIMATE				CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE			
LBS/HR	MIX.	RPM	M.P. IN. Hg				M.P. IN. Hg	RPM	MIX.	LBS/HR
89	M.L.	1600	24.50	70	S.L.	66	22.75	1600	M.L.	79
95	M.L.	1600	24.25	70	5,000	66	22.25	1600	M.L.	84
103	M.L.	1600	24.0	70	10,000	66	22.0	1600	M.L.	89

CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 4000 LB.CONFIGURATION: WITH LONG RANGE TANK
WEIGHT: 5100 LB.

70	M. L.	1600	21.25		S. L.	72	25.5	1600	M. L.	98
73	M. L.	1600	21.0		5000	72	25.25	1600	M. L.	106
78	M. L.	1600	20.5		10,000	72	24.75	1600	M. L.	114

REMARKS:

LBS/HR: FUEL FLOW
CAS: CALIBRATED AIRSPEED
M.P.: MANIFOLD PRESSURE
MIX: MIXTURE
M.L: MANUAL LEAN

DATA AS OF: 1 DEC. 1957
DATA BASIS:

FUEL GRADE: 91/96
FUEL DENSITY: 6 LB./GAL.

WADC Form 241U
(11 Jun 51)

Figure A-9. Maximum Endurance—Seaplane

COMBAT ALLOWANCE CHART

MILITARY POWER

STANDARD DAY

MODEL L-20A

ENGINE: R-985-AN-1 or AN-3

PRESS. ALT. FT.	R.P.M.	M.P. INCHES HG.	MIXTURE	TIME LIMIT MIN.	LIMIT CYL. HD. TEMP. °C.	FUEL FLOW LB./MIN.
S.L.	2300	35.5	M R	5	260	5.7
2,000	2300	35.0	M R	5	260	5.7
4,000	2300	F. T.	M R	5	260	5.6
6,000	2300	F. T.	M R	5	260	5.2
8,000	2300	F. T.	M R	5	260	4.9
10,000	2300	F. T.	M R	5	260	4.5
12,000	2300	F. T.	M R	5	260	4.2
14,000	2300	F. T.	M R	5	260	3.8
16,000	2300	F. T.	M R	5	260	3.5
18,000	2300	F. T.	M R	5	260	3.2
20,000	2300	F. T.	M R	5	260	2.9

REMARKS:

DATA AS OF: 1 NOV. 1951

DATA BASIS: PRATT AND WHITNEY

FUEL GRADE: 91/96

FUEL DENSITY: 6 LB./GAL.

Figure A-10 Combat Allowance Chart

AIRCRAFT MODEL (S): L-20A (LANDPLANE)		FLIGHT OPERATION INSTRUCTION CHART STANDARD DAY								EXTERNAL LOAD ITEMS: LONG RANGE TANK																									
ENGINE (S): 1 R-985-AN-1 or AN-3		CHART WEIGHT LIMITS: 5100				TO 4820		POUNDS		NUMBER OF ENGINES OPERATING: 1																									
INSTRUCTIONS FOR USING CHART: Select figure in FUEL column equal to or less than amount of fuel to be used for cruising move horizontally to right or left and select RANGE value equal to or greater than the statute or nautical air miles to be flown. Vertically below and opposite values nearest desired cruising altitude (ALT.) read R.P.M., manifold pressure (M.P.) and MIXTURE setting required. Refer to corresponding column and altitude for new power settings when gross weight falls below limits of this chart.										NOTES: Column I is for emergency high speed cruising only. Columns II, III, IV and V give progressive increase in range at a sacrifice in speed. Air miles per Gal. (M.Gal.) (no wind), gals. per hr. (G.P.H.) and true airspeed (T.A.S.) are approximate values for reference. Range values are for an average airplane flying alone (no wind).																									
COLUMN I		FUEL ⁽¹⁾ GAL.	COLUMN II		COLUMN III		COLUMN IV		FUEL ⁽¹⁾ GAL.	COLUMN V																									
RANGE IN AIRMILES			RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES			RANGE IN AIRMILES																									
STATUTE	NAUTICAL		STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL																								
SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)																																			
475	413	138	642	559	718	624	800	695	138	884	768																								
447	389	130	604	525	676	588	754	646	130	832	723																								
413	359	120	557	485	624	542	696	605	120	768	667																								
378	329	110	510	444	572	497	638	554	110	704	611																								
344	299	100	463	403	520	452	580	504	100	640	556																								
310	270	90	416	362	468	407	522	454	90	576	500																								
275	239	80	369	321	416	362	464	403	80	512	445																								
241	210	70	322	280	364	316	406	353	70	448	389																								
206	179	60	274	238	312	271	348	302	60	384	334																								
172	150	50	230	200	260	226	290	252	50	320	278																								
137	119	40	184	160	208	181	232	202	40	256	222																								
103	90	30	138	120	156	136	174	151	30	192	167																								
69	60	20	92	80	104	90	116	101	20	128	111																								
3.44 MAXIMUM CONTINUOUS		PRESS ALT. FEET	4.6 STAT. 4.0 NAUT. MI./GAL.		5.2 STAT. 4.5 NAUT. MI./GAL.		5.8 STAT. 5.0 NAUT. MI./GAL.		PRESS ALT. FEET	6.4 STAT. 5.5 NAUT. MI./GAL.																									
R.P.M.	M.P. INCHES		MIX- TURE	APPROX.		R.P.M.	M.P. INCHES	MIX- TURE		APPROX.		R.P.M.	M.P. INCHES	MIX- TURE	APPROX.																				
			TOT GAL/HR	T.A.S. MPH KN				TOT GAL/HR	T.A.S. MPH KN				TOT GAL/HR	T.A.S. MPH KN																					
		40000																																	
		35000																																	
		30000																																	
		25000																																	
		20000																																	
		15000																																	
2200	27.00	F.R.	44	148	139	10000	2200	27.00	F.R.	32	148	129	2000	26.25	F.R.	27	140	122	1800	26.00	M.L.	23	133	116	10000	1600	27.00	M.L.	22	121	105				
2200	33.00	F.R.	44	151	131	5000	2100	28.50	F.R.	31	140	122	1900	28.00	F.R.	26	133	116	1600	29.00	M.L.	22	125	109	5000	1600	25.75	M.L.	18	112	97				
2200	33.50	F.R.	42	145	126	S.L.	2050	30.00	F.R.	29	132	115	1900	29.00	F.R.	24	125	109	1600	29.50	M.L.	20	117	102	S.L.	1600	26.00	M.L.	16	104	90				
REMARKS:												EXAMPLE												LEGEND											
1 Make allowance for warm-up, take-off and climb (see fig. A-4) plus allowances for wind, reserve and combat as required.												At 5100 lb. gross weight with 120 of fuel (after deducting total allowances of 18) to fly 620 statute air miles at 5000 ft. altitude maintain 1900 rpm and 27-25 in. manifold pressure with mixture set: Full Rich when weight decreases below 4820 lb. refer to next weight chart, 4820 to 4400 lb under col. III to 5000 ft.												ALT.: Pressure Altitude M.P.: Manifold Pressure G.P.H.: Fuel flow per hour T.A.S.: True Airspeed KN.: Knots S.L.: Sea Level F.R.: Full Rich A.R.: Auto Rich A.L.: Auto Lean C.L.: Cruising Lean M.L.: Manual Lean F.T.: Full Throttle											
DATA AS OF: 1 DEC. 1957 BASED ON: Flight Test												FUEL GRADE: 91/96												FUEL DENSITY: 6 LB. GAL.											

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Appendix

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Appendix

AIRCRAFT MODEL (S): L-20A (SEAPLANE)		FLIGHT OPERATION INSTRUCTION CHART STANDARD DAY						EXTERNAL LOAD ITEMS: LONG RANGE TANK				
ENGINE (S)(1) R-985-AN-1 or AN-3		CHART WEIGHT LIMITS:		5100	TO 4820		POUNDS		NUMBER OF ENGINES OPERATING: 1			
INSTRUCTIONS FOR USING CHART: Select figure in FUEL column equal to or less than amount of fuel to be used for cruising move horizontally to right or left and select RANGE value equal to or greater than the statute or nautical air miles to be flown. Vertically below and opposite values nearest desired cruising altitude (ALT.) read RPM, manifold pressure (M.P.) and MIXTURE setting required. Refer to corresponding column and altitude for new power settings when gross weight falls below limits of this chart.								NOTES: Column I is for emergency high speed cruising only. Columns II, III, IV and V give progressive increase in range at a sacrifice in speed. Air miles per gal. (MPGAL.) (no wind), gals. per hr. (G.P.H.) and true airspeed (T.A.S.) are approximate values for reference. Range values are for an average airplane flying alone (no wind).				

COLUMN I		FUEL ⁽¹⁾ GAL.	COLUMN II		COLUMN III		COLUMN IV		FUEL ⁽¹⁾ GAL.	COLUMN V	
RANGE IN AIRMILES			RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES			RANGE IN AIRMILES	
STATUTE	NAUTICAL		STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL
427	371	138	580	504	642	558	697	597	138	757	657
403	350	130	546	475	605	526	655	569	130	713	619
372	323	120	504	438	558	485	606	526	120	658	571
341	296	110	462	402	512	445	555	482	110	603	524
310	270	100	420	365	465	404	505	538	100	548	476
279	242	90	378	328	418	363	455	395	90	493	428
248	216	80	336	292	372	323	404	351	80	438	380
217	189	70	294	256	326	283	354	308	70	384	334
186	162	60	219	291	279	242	303	263	60	329	286
155	135	50	210	183	233	202	253	220	50	274	238
124	108	40	168	166	186	162	202	176	40	219	190
93	81	30	126	110	140	122	152	132	30	165	143
62	54	20	84	73	93	81	101	88	20	110	96

3.1 MAXIMUM CONTINUOUS										PRESS		4.2 STAT. 3.65 NAUT. MI./GAL.										4.65 STAT. 4.04 NAUT. MI./GAL.		5.05 STAT. 4.39 NAUT. MI./GAL.										PRESS		5.48 STAT. 4.76 NAUT. MI./GAL.															
APPROX.										ALT. FEET	APPROX.										APPROX.										APPROX.										ALT. FEET	APPROX.									
TOT T.A.S.											TOT T.A.S.										TOT T.A.S.										TOT T.A.S.																				
R.P.M.	M.P.	MIX.	TOT	T.A.S.		R.P.M.	M.P.	MIX.	TOT	T.A.S.		R.P.M.	M.P.	MIX.	TOT	T.A.S.		R.P.M.	M.P.	MIX.	TOT	T.A.S.		R.P.M.	M.P.	MIX.	TOT	T.A.S.		R.P.M.	M.P.	MIX.	TOT	T.A.S.																	
			GM/HR	MPH	KN																																														
2200	27.00	F.R.	44	137	118	10000	2200	27.00	F.R.	32	136	118	2050	26.30	F.R.	28	131	114	1950	25.75	F.R.	25	126	110	10000	1800	24.75	M.L.	21	116	101																				
2200	32.00	F.R.	44	138	120	5000	2100	28.50	F.R.	30	128	111	1900	28.50	F.R.	26	123	107	1800	28.00	M.L.	24	119	103	5000	1600	28.00	M.L.	20	111	96																				
2200	33.50	F.R.	42	131	114	S.L.	2050	29.50	F.R.	29	120	104	1900	29.25	F.R.	25	115	100	1600	30.75	M.L.	22	110	96	S.L.	1600	27.50	M.L.	18	100	87																				

REMARKS: 1 Make allowance for warm-up, take-off and climb (see fig. A-4) plus allowances for wind, reserve and combat as required.	EXAMPLE At <u>5100</u> lb. gross weight with <u>120</u> of fuel (after deducting total allowances of <u>18</u>) to fly <u>606</u> statute air miles at <u>5000</u> ft. altitude maintain <u>1800</u> rpm and <u>24</u> in. manifold pressure with mixture set: <u>Manual Lean</u> when weight decreases below <u>4820</u> lb. refer to next weight chart, <u>4820</u> to <u>4400</u> lb under col. IV to <u>5000</u> ft.	LEGEND ALT.: Pressure Altitude M.P.: Manifold Pressure G.P.H.: Fuel flow per hour TAS: True Airspeed KN.: Knots S.L.: Sea Level F.R.: Full Rich A.R.: Auto Rich A.L.: Auto Lean C.L.: Cruising Lean M.L.: Manual Lean F.T.: Full Throttle
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DATA AS OF: 1 DEC. 1957 BASED ON: ESTIMATED	FUEL GRADE: 91/96 FUEL DENSITY: 6 LB. GAL.
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AIRCRAFT MODEL (S): L-20A (SEAPLANE)		FLIGHT OPERATION INSTRUCTION CHART STANDARD DAY								EXTERNAL LOAD ITEMS: LONG RANGE TANK																									
ENGINE (S):(1) R-985-AN-1 or AN-3		CHART WEIGHT LIMITS: 4820				TO 4400				POUNDS																									
INSTRUCTIONS FOR USING CHART: Select figure in FUEL column equal to or less than amount of fuel to be used for cruising move horizontally to right or left and select RANGE value equal to or greater than the statute or nautical air miles to be flown. Vertically below and opposite values nearest desired cruising altitude (ALT.) read R.P.M., manifold pressure (M.P.) and MIXTURE setting required. Refer to corresponding column and altitude for power settings when gross weight falls below limits of this chart.												NOTES: Column I is for emergency high speed cruising only. Columns II, III, IV and V give progressive increase in range at a sacrifice in speed. Air miles per gal. (M.G.) (no wind), gals. per hr. (G.P.H.) and true airspeed (T.A.S.) are approximate values for reference. Range values are for an average airplane flying alone (no wind).																							
COLUMN I		FUEL ⁽¹⁾ GAL.	COLUMN II		COLUMN III		COLUMN IV		FUEL ⁽¹⁾ GAL.	COLUMN V																									
RANGE IN AIRMILES			RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES			RANGE IN AIRMILES																									
STATUTE	NAUTICAL		STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL																								
SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)																																			
427	371	138	580	504	679	590	762	662	138	839	729																								
403	350	130	546	475	639	555	716	622	130	788	685																								
372	323	120	504	438	589	511	659	572	120	725	630																								
341	296	110	462	402	539	468	602	524	110	661	575																								
310	270	100	420	365	489	425	545	474	100	597	519																								
279	242	90	378	328	439	381	488	424	90	534	464																								
248	216	80	336	292	389	338	431	375	80	471	410																								
217	189	70	294	256	339	295	374	325	70	407	354																								
186	162	60	219	291	291	253	320	278	60	349	303																								
155	135	50	210	183	242	210	267	232	50	291	253																								
124	108	40	168	186	194	169	214	186	40	233	203																								
93	81	30	126	110	145	126	160	139	30	175	152																								
62	54	20	84	73	97	84	107	93	20	116	101																								
3.1 MAXIMUM CONTINUOUS		PRESS ALT. FEET	4.2 STAT. 3.65 NAUT. M.G./GAL.			4.85 STAT. 4.22 NAUT. M.G./GAL.			5.34 STAT. 4.64 NAUT. M.G./GAL.			PRESS ALT. FEET	5.82 STAT. 5.06 NAUT. M.G./GAL.																						
R.P.M. SEACHM. MIX- TURE APPROX. TOT G/H/HR MPH KN			R.P.M. M.P. INCHES MIX- TURE APPROX. TOT G/H/HR MPH KN			R.P.M. M.P. INCHES MIX- TURE APPROX. TOT G/H/HR MPH KN			R.P.M. M.P. INCHES MIX- TURE APPROX. TOT G/H/HR MPH KN				R.P.M. M.P. INCHES MIX- TURE APPROX. TOT G/H/HR MPH KN																						
T.A.S.			T.A.S.			T.A.S.			T.A.S.				T.A.S.																						
		40000										40000																							
		35000										35000																							
		30000										30000																							
		25000										25000																							
		20000										20000																							
		15000										15000																							
2200	27.00	F.R.	44	137	119	10000	2200	27.00	F.R.	33	137	119	2000	26.25	F.R.	27	130	113	1850	25.50	F.R.	23	123	107	10000	1700	24.50	M.L.	19	112	98				
2200	32.00	F.R.	44	138	120	5000	2100	28.50	F.R.	31	129	112	1900	27.25	F.R.	25	121	105	1800	26.50	M.L.	22	116	101	5000	1600	26.50	M.L.	19	109	95				
2200	33.50	F.R.	42	131	114	S.L.	2050	30.00	F.R.	29	121	105	1900	28.00	F.R.	23	114	99	1600	29.50	M.L.	20	108	94	S.L.	1600	26.75	M.L.	18	102	89				
REMARKS:												EXAMPLE												LEGEND											
1 Make allowance for warm-up, take-off and climb (see fig A-5) plus allowances for wind, reserve and combat as required.												At 4820 lb. gross weight with <u>120</u> of fuel (after deducting total allowances of <u>18</u>) to fly <u>580</u> statute air miles at <u>5000</u> ft. altitude maintain <u>1900</u> rpm and <u>27-25</u> in. manifold pressure with mixture set: Full Rich when weight decreases below <u>4400</u> lb. refer to next weight chart, <u>4400</u> to <u>4000</u> lb under col. III to <u>5000</u> ft.												ALT.: Pressure Altitude M.P.: Manifold Pressure G.P.H.: Fuel flow per hour TAS: True Airspeed KN.: Knots S.L.: Sea Level F.R.: Full Rich A.R.: Auto Rich A.L.: Auto Lean C.L.: Cruising Lean M.L.: Manual Lean F.T.: Full Throttle											
DATA AS OF: 15 FEB. 1952 BASED ON. ESTIMATED												FUEL GRADE: 91/96 FUEL DENSITY: 6 LB. GAL.																							

AIRCRAFT MODEL (S): L-20A (SEAPLANE)		FLIGHT OPERATION INSTRUCTION CHART STANDARD DAY								EXTERNAL LOAD ITEMS: LONG RANGE TANK																					
ENGINE (S): (1) R-985-AN-1 or AN-3		CHART WEIGHT LIMITS:		4400		TO 4000		POUNDS		NUMBER OF ENGINES OPERATING: 1																					
INSTRUCTIONS FOR USING CHART: Select figure in FUEL column equal to or less than amount of fuel to be used for cruising move horizontally to right or left and select RANGE value equal to or greater than the statute or nautical air miles to be flown. Vertically below and opposite values nearest desired cruising altitude (ALT.) read R.P.M., manifold pressure (M.P.) and MIXTURE setting required. Refer to corresponding column and altitude for new power settings when gross weight falls below limits of this chart.								NOTES: Column I is for emergency high speed cruising only. Columns II, III, IV and V give progressive increase in range at a sacrifice in speed. Air miles per gal. (M.Gal.) (no wind), gals. per hr. (G.P.H.) and true airspeed (T.A.S.) are approximate values for reference. Range values are for an average airplane flying alone (no wind).																							
COLUMN I		FUEL (1) GAL.	COLUMN II		COLUMN III		COLUMN IV		FUEL (1) GAL.	COLUMN V																					
RANGE IN AIRMILES			RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES			RANGE IN AIRMILES																					
STATUTE	NAUTICAL		STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL																				
SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)																															
427	371	138	580	504	700	608	814	706	138	920	800																				
403	350	130	546	475	659	572	765	665	130	864	750																				
372	323	120	504	438	608	529	704	611	120	794	690																				
341	296	110	462	402	556	484	643	559	110	724	629																				
310	270	100	420	365	504	438	582	506	100	654	568																				
279	242	90	378	328	453	394	521	453	90	584	507																				
248	216	80	336	292	402	350	460	400	80	514	446																				
217	189	70	294	256	350	304	399	347	70	444	386																				
186	162	60	252	219	300	261	342	297	60	381	331																				
155	135	50	210	183	250	217	285	248	50	317	276																				
124	108	40	168	146	200	174	220	198	40	254	221																				
93	81	30	126	110	150	130	171	149	30	190	165																				
62	54	20	84	73	100	87	114	99	20	127	111																				
3.1 MAXIMUM CONTINUOUS		PRESS ALT. FEET	4.2 STAT. 3.65 NAUT. MI./GAL.		5.0 STAT. 4.35 NAUT. MI./GAL.		5.7 STAT. 4.95 NAUT. MI./GAL.		PRESS ALT. FEET	6.35 STAT. 5.51 NAUT. MI./GAL.																					
R.P.M.	M.P. INCHES		MIX- TURE	APPROX.			R.P.M.	M.P. INCHES		MIX- TURE	APPROX.			R.P.M.	M.P. INCHES	MIX- TURE	APPROX.			R.P.M.	M.P. INCHES	MIX- TURE	APPROX.								
				TOT GAL/HR	T.A.S. MPH	KN					TOT GAL/HR	T.A.S. MPH	KN				TOT GAL/HR	T.A.S. MPH	KN				TOT GAL/HR	T.A.S. MPH	KN						
		40000							40000									40000													
		35000							35000									35000													
		30000							30000									30000													
		25000							25000									25000													
		20000							20000									20000													
		15000							15000									15000													
2200	27.00	F.R.	44	138	120	10000	2200	27.00	F.R.	33	138	120	2000	25.75	F.R.	26	130	113	1800	25.25	M.L.	22	123	107	10000	1650	24.00	M.L.	18	114	99
2200	32.00	F.R.	44	138	120	5000	2100	29.00	F.R.	31	130	113	1950	27.25	F.R.	25	123	107	1700	26.50	M.L.	20	115	100	5000	1600	24.25	M.L.	16	101	88
2200	33.50	F.R.	43	132	115	S.L.	2050	30.00	F.R.	29	122	106	1900	28.25	F.R.	23	115	100	1600	28.50	M.L.	19	107	93	S.L.	1600	25.00	M.L.	15	97	84

REMARKS:

1 Make allowance for warm-up, take-off and climb (see fig. 5.) plus allowances for wind, reserve and combat as required.

EXAMPLE

At 4400 lb. gross weight with 120 of fuel (after deducting total allowances of 18) to fly 600 statute air miles at 5000 ft. altitude maintain 1950 rpm and 27.25 in. manifold pressure with mixture set: Full Rich when weight decreases below 4000 lb. refer to next weight chart, 4000 to 3600 lb under col. III to 5000 ft.

LEGEND

ALT.: Pressure Altitude
M.P.: Manifold Pressure
G.P.H.: Fuel flow per hour
TAS: True Airspeed
KN.: Knots
S.L.: Sea Level

F.R.: Full Rich
A.R.: Auto Rich
A.L.: Auto Lean
C.L.: Cruising Lean
M.L.: Manual Lean
F.T.: Full Throttle

FUEL GRADE: 91/96
FUEL DENSITY: 6 LB. GAL.

DATA AS OF: 15 FEB. 1952 BASED ON: Estimated

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(11 Jun 51)