SECTION IX—ALL WEATHER OPERATION

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INSTRUMENT FLIGHT PROCEDURES.

INTRODUCTION.

Except when repetition is necessary for emphasis, clarity, or continuity of thought, this section contains only those procedures that differ from normal operating instructions covered in Section II.

NOTE

> This section is designed to correlate the flight characteristics and capabilities of the aircraft with standard U.S. Air Force instrument flight procedures. The procedures presented here are considered practical and safe for most circumstances. However, a pilot must always use his best judgment in coping with the multitude of circumstances which cannot be foreseen and dealt with in this section.

The aircraft has good stability and flight characteristics that make possible long-range flights under sustained instrument operation with minimum pilot fatigue. Each pilot's instrument panel is arranged with a complete set of flight instruments, and an automatic pilot is incorporated in the flight control system to relieve the pilot of manual control. Instrument lighting and radio remote controls are provided within easy reach of either pilot.

INSTRUMENT TAKEOFF (ITO)

1. PREPARING FOR THE ITO – During the interior preflight, the pilot will insure that an operational check of all flight and navigational instruments is performed and that current applicable publications are available in the cockpit. Select the appropriate navigational aids to be used for the departure and set the navigational instruments and switches as required. The Air Traffic Control clearance and departure procedures must be thoroughly understood before takeoff. It is a good operating practice to have the appropriate instrument approach charts available in the event an instrument approach is necessary immediately after takeoff.

2. PERFORMING THE ITO – The ITO is accomplished by combined outside visual reference and the flight instruments. The amount of attention given to each varies with the individual and the weather. When cleared into position for takeoff, align the aircraft with the runway centerline and recheck the heading indicator and attitude indicator for possible precession errors induced by turning while taxiing on to the runway. Select the assigned departure frequency as directed and monitor "Guard" frequency during takeoff. When cleared for takeoff, release wheel brakes simultaneously to minimize initial directional control difficulties. Directional control immediately following brake release should be accomplished predominantly with the aid of outside visual references. As the takeoff progresses, the pilot's crosscheck should transition from outside references to the heading indicator, airspeed indicator, and attitude indicator. The rate of transition is directly proportional to the rate at which the outside references deteriorate. It is extremely important for this cross-check to be "in-progress" before losing complete outside reference during takeoff roll and/or subsequent departure.

The takeoff attitude should be established on the attitude indicator at the point of rotation or just prior to reaching takeoff airspeed. The pilot should make it a special point to know the specific attitude indicator "picture" required for takeoff. This pitch attitude and a wings level attitude should be held constant as the aircraft leaves the ground. Cross-check the vertical velocity indicator for positive climb indications and that the warning light on the radar altimeter (if operative) is out before retracting the landing gear. While the gear is being retracted, maintain or adjust the pitch attitude as necessary to insure the desired climb.

CAUTION

Some attitude indicators are susceptible to precession errors caused by aircraft acceleration. This phenomenon causes the horizon bar to lower slightly and appears as a higher than actual pitch attitude. To avoid lowering the nose prematurely, the pilot must cross-check the vertical velocity and altimeter throughout this phase of flight to insure proper climb performance.

After the gear is up control the pitch attitude to provide a reasonable increase in both airspeed and altitude until attaining 150 KIAS. Call for AFTER TAKEOFF CHECKLIST and continue acceleration to climb speed while continuing the departure.

INSTRUMENT CRUISING FLIGHT.

It is recommended that the pitot heaters be kept ON at all times during instrument operation to minimize the accumulation of moisture in the pitot heads. Frequent checks of the carburetor air temperature indicator should be made, and carburetor heat applied as required. The automatic pilot may be engaged to relieve the pilot during extended instrument operation.

DESCENT.

Cylinder head and oil-in temperature should be kept sufficiently warm to supply carburetor heat to insure proper operation of oil. If airways approach clearance requires extended holding, the aircraft should be trimmed and power settings adjusted to the best fuel economy range. An adjusted fuel consumption rate also should be established so that maximum holding time can be determined, and allowances be made for proceeding to an alternate airport.

HOLDING PROCEDURE.

If it is necessary to hold, request an expected approach time and set up power necessary to maintain 140 knots, flaps extended to 60 percent. It is permissible to use the automatic pilot during extended holding. If fuel is critical, set up maximum endurance power, flaps up. If icing and turbulence are encountered during holding, retract flaps, set aircraft deck angle at 3 degrees or less, and increase airspeed to maintain this deck angle. If ice is suspected in the wing flap wells, do not raise the flaps beyond the 10 percent position. Since the Descent checklist requires going to landing tanks, do not accomplish the checklist until cleared for the approach so that the fuel which may be in the other tanks can be used.

INSTRUMENT APPROACHES.

The general qualities and capabilities of the aircraft during instrument approaches are considered to be excellent and no special technique is required. Instrument let-downs from holding patterns normally do not require extensive retrimming of the aircraft to establish the approach speeds. Letdown from cruising altitudes without holding procedures can be made in the clean configuration, or with the gear and flaps extended. Pilot's discretion is important in determining the particular choice of action when icing or turbulence is anticipated. Pilots should acquaint themselves with suitable alternate airfields within range of their destination. A careful study of the approach plate for the approach to be made is mandatory prior to commencing the approach. Minimum altitudes, courses, times, and missed approach headings should be fixed in the pilot's mind. The approach plate should be kept readily available for reference during the approach. Weather minimums for each station are contained in current publications. These minimums must be adhered to.

Make standard turns during an instrument approach except when correcting for wind drift as in holding, or when making corrections during final approach.

If an accurate ETA to the initial approach fix (IAF) is known and no delay is expected, or approach clearance has already been granted, approximately 3 minutes prior to ETA, the Descent Checklist should be accomplished. The aircraft should be slowed to 140 KIAS, 60% flaps extended, and RPM increased to 2200. If ETA is not known the Descent Checklist will not be accomplished until position is established close in or over the IAF. The radar altimeter will be set for the appropriate minimum altitude for the instrument approach. The pilot will maintain 140 KIAS during holding and procedure turns, and 130 KIAS will be maintained during final approach and descent with gear and flaps extended. After holding, and when over the IAF starting the approach, the Descent Checklist will be accomplished. After completing procedure turn the pilot will call for the Before Landing Checklist. The final aircraft configuration and final approach airspeed will be established prior to the final approach fix (FAF) for non-precision approaches and prior to intercepting glide slope for precision approaches.

On crossing the FAF an immediate descent to minimum altitude should be initiated for non-precision approaches. Glide path information will be utilized for precision approaches.

To maintain a glide path, any adjustments to the rate of descent must be immediate and positive. When airspeed is off more than 5 knots and altitude is off more than 50 feet or more than one dot deflection, a return to glide path can best be accomplished by altering the attitude of the aircraft combined with a slight change in MAP. Normally, a 200 FPM variation in the rate of descent will bring the aircraft back to glide path.

Heading correction must be initiated promptly, but overcontrolling must be avoided. A good practice on final approach is not to exceed in angle of bank the number of degrees to be corrected in heading. Normally a maximum bank of 10 degrees is sufficient. The use of rudder to start and stop turns will reduce heading drift. Although only one heading indicator may be used as the primary indicator for heading control, all compass systems should be cross-checked so that a malfunctioning primary system may be detected immediately.

Both the pressure and the radar altimeter must be referred to constantly during the approach.

Upon completion of the Before Landing Checklist the copilot will advise the pilot. The copilot or the flight engineer can maintain airspeed during descent with throttles, at the pilot's request. The copilot will advise the pilot 100 feet above a minimum altitude, when reaching a minimum altitude, when airspeed varies 10 knots from desired and when the field is in sight.

Do Not Descend Below the Prescribed Minimums.

During approaches with minimum weather conditions, it is recommended that the wing flap setting not be changed after breaking out.

Missed Approach

Perform the missed approach when the missed approach point or decision height is reached and the runway environment is not in sight, when the pilot is unable to make a safe landing, or when directed by the controlling agency. Specific missed approach instructions are contained in current publications or will be issued by the controlling agency.

CAUTION

> Pilots are cautioned to allow for possible settling of the aircraft during pullup at minimums. Heavily loaded aircraft may settle as much as 100 feet before pullup power takes effect.

APPROACH PROCEDURES.

Complete the Descent Checklist prior to the IAF if ETA is known or an approach clearance has been received.

For Precision Approach procedures, refer to figure 9-2 and 9-3. For Non-precision Approach procedures, refer to figure 9-1.

ALL NORMAL NON-PRECISION STRAIGHT IN APPROACHES.

1. Four Engine

IAF to Procedure Turn - 140 Kts, 220 RPM, Flaps 60%, gear up.

Procedure Turn to FAF - 130 Kts, 2400 RPM, Flaps 60%, gear down; and Before Landing Checklist complete.

2. Three Engine

IAF to FAF - Same as four engine approach except 2600 RPM will be set while accomplishing the Descent Checklist.

3. Two Engine

IAF to FAF - Maintain 150 Kts (Minimum), 2600 RPM, gear and flaps up.

At the FAF - Flaps 60%, 2900 RPM, maintain 140 Kts (minimum). Gear down and flaps to desired position when safe landing is assured.

NOTE

> The failure of two engines will affect the manner in which some aircraft systems function due to the manner they are integrated with various engines (i.e., hydraulics, electrics, etc.). Less than optimum operation of these systems must be understood and anticipated when executing a two-engine approach.

CIRCLING APPROACHES.

Circling approaches should be conducted in strict observance of circling approach minimums, keeping the runway in sight at all times while maneuvering to land. (See AFM 51-37 Instrument Flying.) If a straight in approach is impossible or impractical, it may be necessary to make a visua circling maneuver in order to line up with the runway. If it can be determined prior to passing the final approach fix that a circling approach will be required, the gear should remain up, flaps at 60%, RPM 2400, 140 Kts. Lower the gear and complete the Before Landing Checklist upon turning base leg. If the gear is down and airspeed is below 140 Kts when arriving over the field and a decision is made to make a circling approach, add sufficient power to increase to 140 Kts. Complete the approach with the gear down. Due to the low altitude of this maneuver it is advisable not to exceed 30 degrees of bank. If Before Landing Checklist has not been accomplished, complete it upon turning base leg.

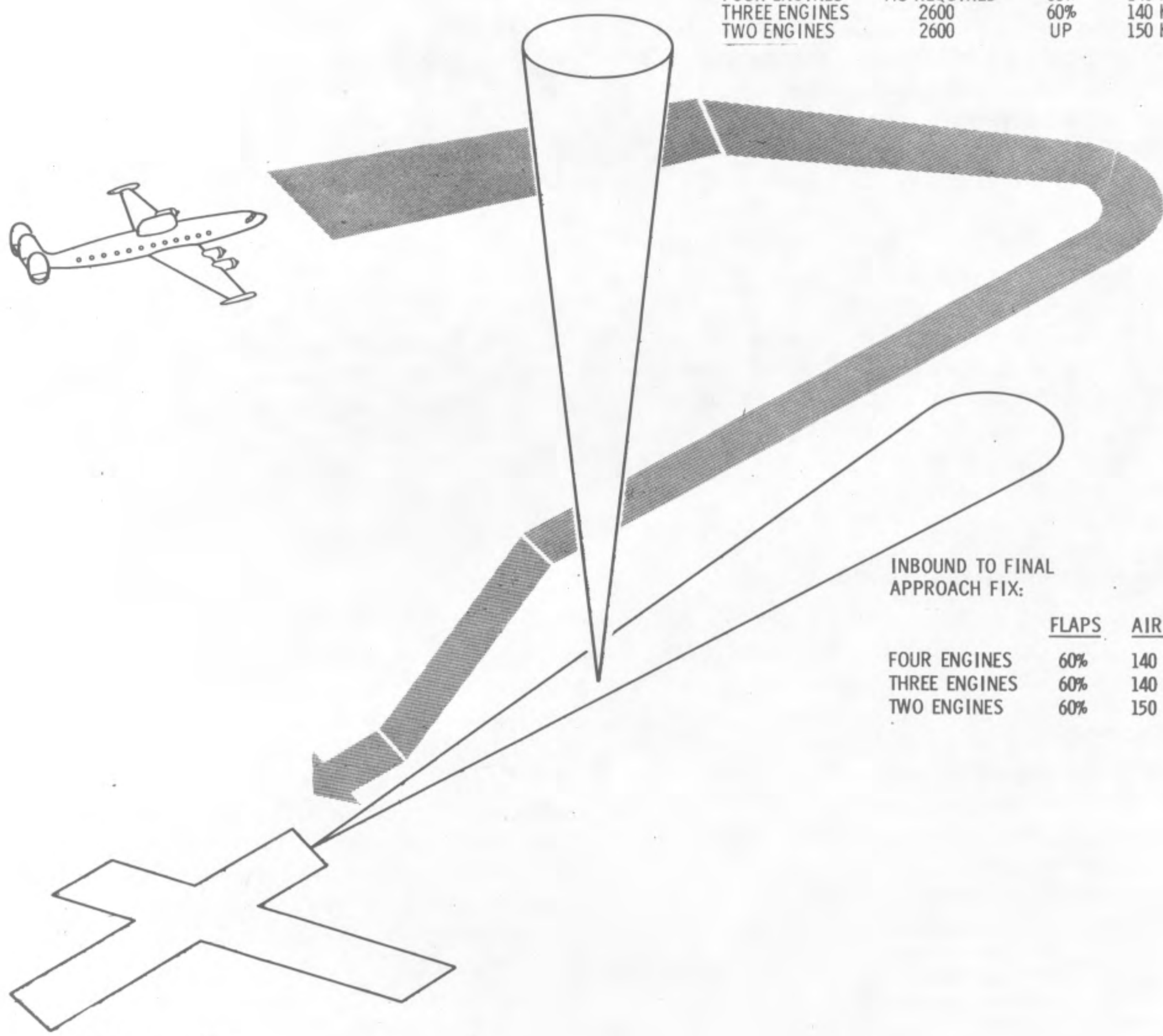
CIRCLING PROCEDURE WITH ONE ENGINE OUT

Same as a three engine straight in approach except that the gear remains up until turning on base leg. Set 2600 RPM when the gear is lowered and maintain 140 Kts until final approach.

NON-PRECISION APPROACH (TYPICAL)

INITIAL APPROACH FIX:

	RPM	FLAPS	AIRSPEED
FOUR ENGINES	AS REQUIRED	60%	140 KIAS
THREE ENGINES	2600	60%	140 KIAS
TWO ENGINES	2600	UP	150 KIAS



INBOUND TO FINAL APPROACH FIX:

	FLAPS	AIRSPEED
FOUR ENGINES	60%	140 KIAS
THREE ENGINES	60%	140 KIAS
TWO ENGINES	60%	150 KIAS

FINAL APPROACH:

	RPM	GEAR	AIRSPEED
FOUR ENGINES	AS REQUIRED	DOWN	130 KIAS
THREE ENGINES	2600	DOWN	130 KIAS
TWO ENGINES	2900	DOWN (LANDING ASSURED)	140 KIAS (MIN)

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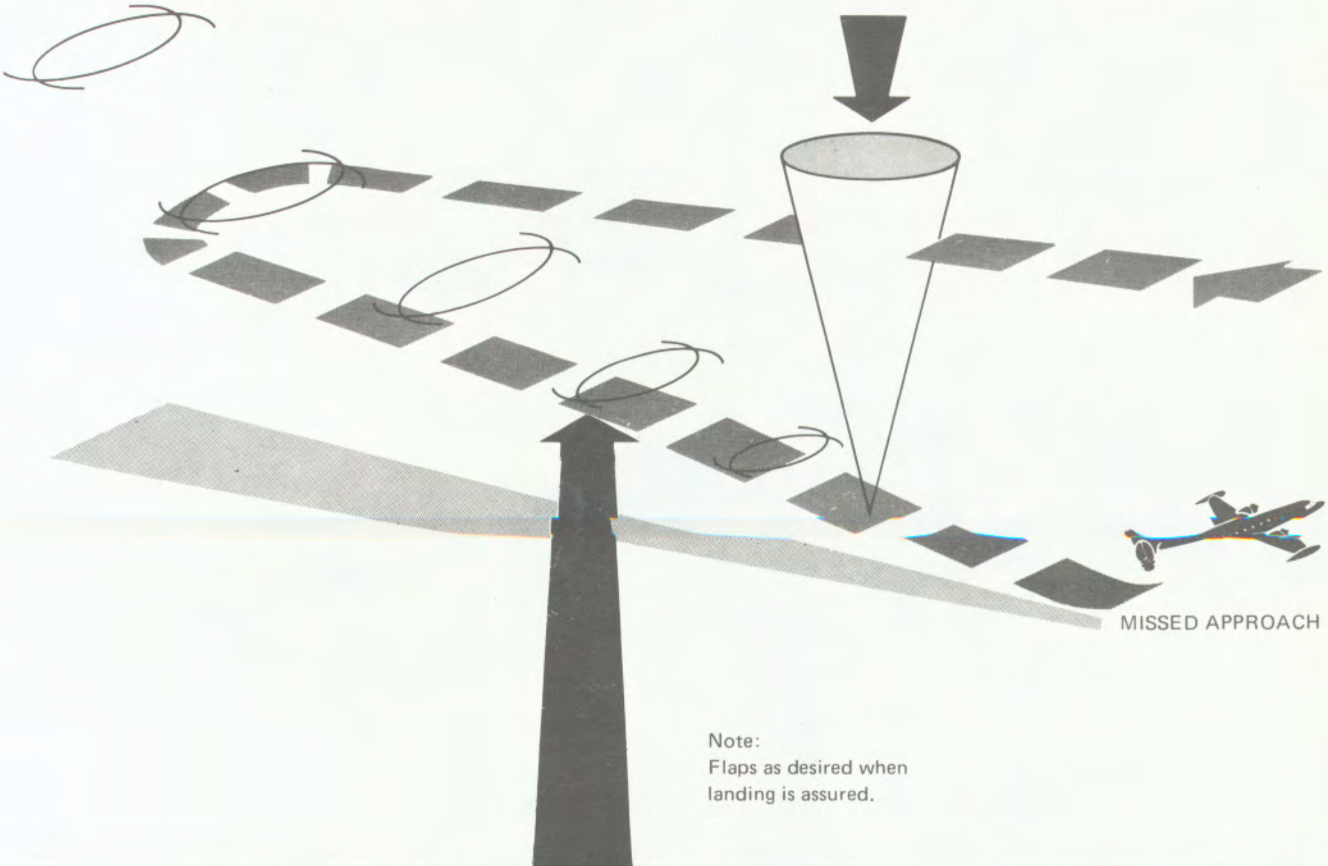
Figure 9-1

RADAR APPROACH PROCEDURES

WHEN OVER RADIO FIX ON DOWNWIND

	POWER	FLAPS	AIRSPEED	CHECK LIST
FOUR ENGINES	AS REQUIRED	60%	140 KNOTS	DESCENT
THREE ENGINES	2600	60%	140 KNOTS	DESCENT
TWO ENGINES	2600	UP	150 KNOTS	DESCENT



Note:
Flaps as desired when landing is assured.

PRIOR TO INTERCEPTING GLIDE PATH

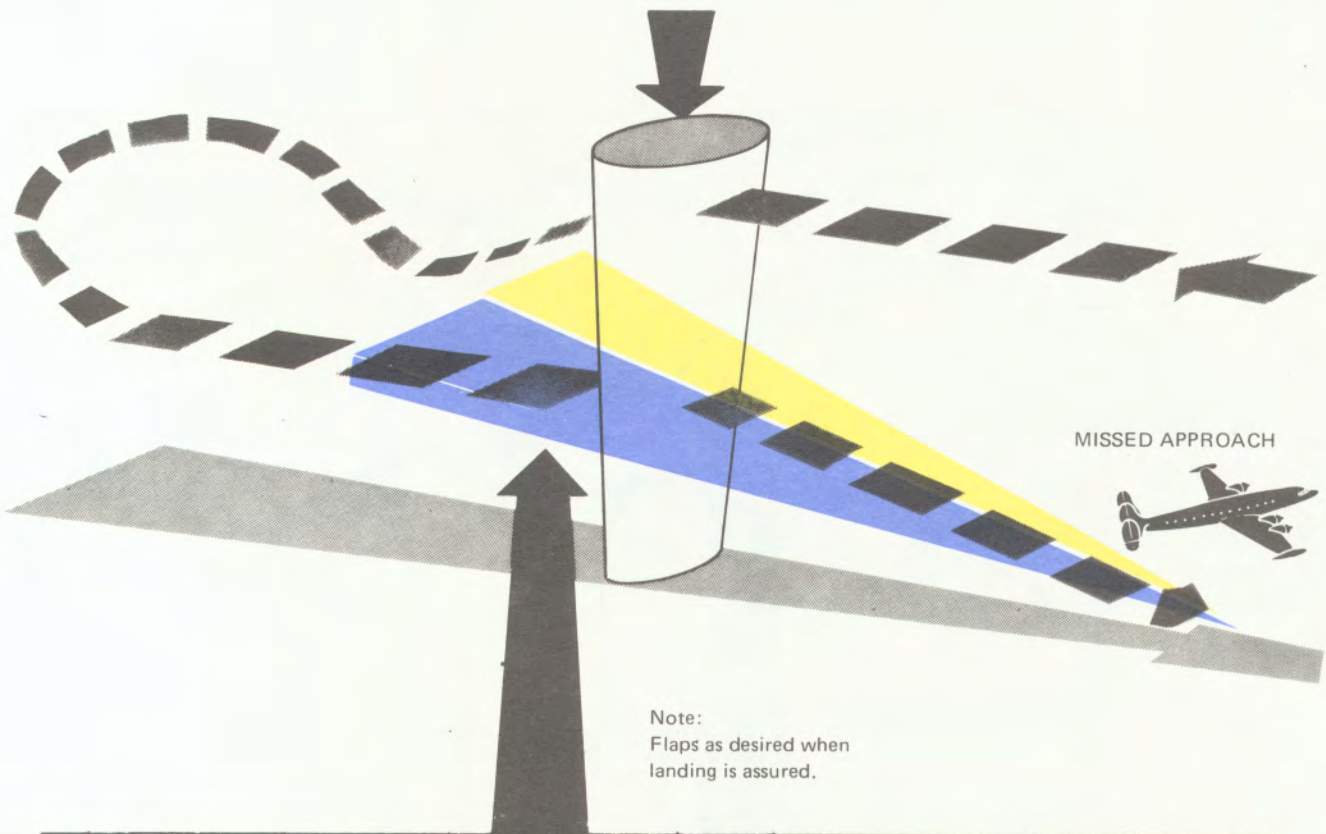
	POWER	FLAPS	GEAR	CHECK LIST	AIRSPEED
FOUR ENGINES	AS REQUIRED	60%	DOWN	BEFORE LANDING (COMPLETED)	130 KNOTS
THREE ENGINES	2600	60%	DOWN	BEFORE LANDING (COMPLETED)	130 KNOTS
TWO ENGINES	2900	AS REQUIRED	DOWN (WHEN LANDING IS ASSURED)	BEFORE LANDING (COMPLETED)	140 KNOTS (MIN)

Figure 9-2

ILS PROCEDURES

WHEN OVER RADIO FIX

	POWER	FLAPS	AIRSPEED	CHECK LIST
FOUR ENGINES	AS REQUIRED	60%	140 KNOTS	DESCENT
THREE ENGINES	2600	60%	140 KNOTS	DESCENT
TWO ENGINES	2600	UP	150 KNOTS	DESCENT



Note:
Flaps as desired when landing is assured.

PRIOR TO INTERCEPTING GLIDE PATH

	POWER	FLAP	GEAR	CHECK LIST	AIRSPEED
FOUR ENGINES	2600	60%	DOWN	BEFORE LANDING (COMPLETED)	130 KNOTS
THREE ENGINES	2600	60%	DOWN	BEFORE LANDING (COMPLETED)	130 KNOTS
TWO ENGINES	2900	AS REQUIRED	DOWN (WHEN LANDING IS ASSURED)	BEFORE LANDING (COMPLETED)	140 KNOTS (MIN)

Figure 9-3

CIRCLING PROCEDURE WITH TWO ENGINES OUT

Same as two engine straight in to the FAF; at the FAF 2900 RPM, if necessary and maintain 140 Kts (minimum). Sufficient time must be allowed to insure that the landing gear and flaps are lowered prior to turning final approach. However, the landing gear must not be lowered until a safe landing is assured.

NOTE

The failure of two engines will affect the manner in which some aircraft systems function due to the manner they are integrated with various engines (i.e., hydraulics, electrics, etc.). Less than optimum operation of these systems must be understood and anticipated when executing a two engine approach.

PRECISION APPROACHES.

The descent Checklist will be completed prior to being cleared for the approach. On downwind leg or crossing the IAF, set 2200 RPM, flaps 60%, gear up, airspeed 140 Kts. Turn to base leg as directed by Approach Control or accomplish a procedure turn (ILS), maintaining 140 Kts. The Before Landing Checklist should be initiated prior to intercepting the glide path. As the aircraft turns final, reduce airspeed to 130 Kts. Upon intercepting the glide path, lower the landing gear and complete the Before Landing Checklist. The additional drag of the landing gear, when lowered, will normally give the desired rate of descent with only minor MAP adjustments. Do not attempt to use the vertical velocity until gear extension is complete.

PRECISION APPROACH WITH ONE ENGINE OUT.

Same as for three engine non-precision approach.

PRECISION APPROACH WITH TWO ENGINES OUT.

Same as two engine non-precision approach.

MISSED APPROACH.

A missed approach should be executed in accordance with published procedures or as directed by the controlling agency.

CAUTION

Pilots are cautioned to allow for possible settling of the aircraft during pullup at minimums. Heavily loaded aircraft may settle as much as 100 feet before pullup power takes effect.

ICE AND RAIN.

WARNING

Takeoff should not be attempted with ice accumulations on the wing surfaces, or during heavy freezing rain conditions.

Proper technique in the use of anti-icing and deicing equipment is essential when instrument flight is conducted through rain and icing conditions. The various types of icing encountered at low altitudes may present greatest problems during instrument approaches. When visible moisture is encountered it is better not to close the cowl flaps because closing them disturbs the flow of air past the engine and moisture will accumulate more rapidly in the engine section. It is better to keep the cowl flaps in the faired position.

No appreciable reduction in performance will be experienced when the deicer boots are in operation. Flight in moderate icing conditions without the deicer boots in operation can be accomplished for short periods at airspeeds of 180 knots or more. No significant losses in airspeed will result for approximately 15 minutes. Operating the deicer boots and maintaining power settings will partially rectify speed losses, and an airspeed of approximately 155 knots can be maintained. If the deicer boot system is inoperative, it is unsafe to enter other than light icing conditions.

If the mission profile of 4 1/2 degrees angle of attack is to be maintained, flight in other than light icing conditions should be avoided.

Apply propeller deicing fluid and carburetor heat as required. Icing conditions and ice formation can vary in intensity. Ice can form during extensive cruising flight and have many different effects upon aircraft performance. Ice deposits increase the stall speed of the aircraft, which will occur at a smaller angle of attack. This means that increased dependence must be placed on the airspeed indicator, and landings must be made at airspeeds well above the normal landing speed. Efforts should be made to constantly maintain a smaller angle of attack during climb to minimize the development of ice deposits on the underside of the wing. During light icing, the aircraft can be flown for long periods, provided the anti-icing and deicing equipment is handled properly. When icing reaches a moderate degree of intensity, the flight plan should be altered to avoid remaining in that condition. When icing is encountered, the wing and empennage deicers should not be operated until ice has formed on the boots. If the deicers are operated before entering the icing area, or if they are operated continuously, it is possible that a bridge of ice will form over the deicer boots, thereby rendering the inflation cycle ineffective.

TURBULENCE AND THUNDERSTORMS.

Penetration of known thunderstorms should be avoided if possible; however, during instrument flight at night, such areas may be difficult to detect. Severe vertical air currents, heavy icing, and hail can be expected in thunderstorms, and all precautionary methods should be taken to prepare the aircraft prior to entering known thunderstorm areas. The automatic pilot may be engaged during light turbulence provided the altitude control is OFF. Maintain pitch attitude with the pitch control. A power setting should be made prior to entering a known thunderstorm area that will provide an airspeed of 60 knots above the stall speed for the weight, altitude, and configuration being flown. (Refer to the Stall Speed chart, figure 6-1.) The aircraft should be maintained in the clean configuration (gear and flaps retracted) during turbulent air conditions. Prepare the aircraft for entry as follows:

1. Pitot heaters ON
2. Gyro instruments set properly
3. All seat belts tight
4. All radio equipment that is affected by static, turned off
5. Cockpit lights turned on to minimize blinding by lightning.

THUNDERSTORM PENETRATION.

1. Maintain power and propeller pitch settings established before entry. Hold these and the attitude constant, and airspeed will be constant regardless of erratic airspeed indicator readings.

CAUTION

If the reduction of airspeed is carried to an extreme the danger of stalling because of gusts is increased. It is necessary therefore, that the optimum penetration speed be maintained at 60 knots above the stall speed.

2. Devote attention to flying the aircraft by reference to the attitude indicator. Maintain a level attitude.

NOTE

The altimeter is unreliable in severe turbulence because of differential barometric pressures.

3. Use as little elevator control as possible in maintaining attitude in order to minimize the stresses imposed on the aircraft.

CAUTION

Do not attempt to alter the aircraft attitude by reference to the airspeed indicator. Heavy rain may partially block the pitot heads and cause erratic readings.

COLD WEATHER OPERATION.

The success of arctic operations depends upon the preparations that were made during engine shutdown and postflight procedures of the previous flight. Advance planning in the use of ground heating, wing and empennage covers, and other shelter facilities will help in assuring successful operations. If external heat will not be available for starting, the oil should be drained into clean containers and stored in a sheltered location where the temperature will not be lower than freezing. Where warm storage space is not available, the oil must be heated until free-flowing and poured into the oil tanks immediately before starting engines.

CAUTION

Never consider preheating adequate until fluid oil will flow from the Y-drain. Do not attempt to start the engine if you cannot obtain oil flow from the Y-drain.

BEFORE ENTERING THE AIRCRAFT.

Problems of congealed oil in the engine and attendant system of plumbing and accessories require considerable attention with regard to adequate preheating. Whenever outside air temperatures are low enough to warrant preheating engine oil systems, cabin supercharger units should also be preheated to ensure that initial torque load on the unit and shaft is held to a minimum. Engines which have been parked in warm hangars will accumulate considerable condensation within the cylinders when moved out on the ramp. They must be started as soon as possible to avoid starting difficulties from such condensation. Ascertain that auxiliary power is adequate for starting an engine at the first attempt to reduce time for condensation to form and avoid loading-up effects.

Ice, snow, and frost must be removed from the aircraft prior to takeoff. Under extremely cold conditions, it will be impossible to drain water from the fuel sumps, since any water will have turned to ice in the bottom of the fuel tanks. If the airplane is later flown into areas with above-freezing temperatures, the ice will thaw into water again. The above conditions indicate the need for water checks before entering very cold areas.

Whenever there is a possibility of ice in the fuel crossfeed system, the operation of each engine should be checked on this system. Particular attention should be given to the pitot tubes to assure that they are free from ice and the heating element is working satisfactorily. Check the entire landing gear assemblies for undesirable presence of chunks of frozen mud or ice, which might prevent satisfactory operation of switch and latches. Wing flap undersurfaces must be inspected since they might be damaged by chunks of ice kicked up by the wheels.

It is suggested that when a shock strut is flat and there is evidence of excessive hydraulic leakage, the strut be partially warmed up with an air conditioner before reservicing. Check that tires are not frozen to the ground or to the wheel chocks. Direct that ground heaters be used to thaw as necessary.

CAUTION

- Do not attempt to move the aircraft until the tires are free.
- Make certain that tire pressure is reduced to normal limits if over-inflation was used to help free tires that were frozen to the ground.

CAUTION

Care must be taken when the aircraft is towed in snow or slush to avoid excessive strain on the nosewheel strut. Jerky or rocking starts should be avoided at all times.

The gyro instruments in airplanes parked for more than twenty-four hours in subzero conditions will be very sluggish when they first start operating. Low temperature may react on the bearings to cause noise. Usually, bearing noise will disappear after use of the air conditioner to warm up the instruments, but if noise persists, the particular instrument may be detected easily by using the microphone as a stethoscope, i.e., with the headset on, the radio turned to INTERPHONE, and mike button depressed, place the mike against the face of each gyro instrument in turn until the problem instrument is discovered. (Gyro instrument problems may also be encountered during long flights in subzero conditions without cockpit heat.)

During engine warmup in extremely cold weather, pilots should operate all flight control surfaces, control tabs, and flaps through two or three cycles to check freedom of movement. Shift to manual elevator control two or three times. Check the operation of the windshield and propeller anti-icers, windshield wiper, pitot heaters, and deicer boots. Note that static electricity is sometimes more prevalent in cold, crisp weather; be governed accordingly.

ON ENTERING THE AIRCRAFT.

1. Check that ground heating procedures as outlined in Section IV have been followed to ensure warming of cabin and flight station, radio and electrical equipment, and the instrument panels.

2. Direct that engine protective shields, nacelle covers, and propeller blade covers be removed. This should be the last operation before starting engines.

STARTING ENGINE.

Flight crews are cautioned against the ineffectiveness of wheel chocks or blocks when runup is contemplated on icy surfaces. Sandbags are the best wheel chocks to use under this condition.

Use of minimum throttle position is most effective in cold weather starts, as Wright engines are not easily loaded up under these conditions. Primers should aid in getting better starts. Cold weather starts are sometimes aided by first turning the engine through with mixtures in FULL RICH prior to ignition, thus ensuring presence of sufficient fuel in the cylinders. Unfortunately, however, if condensation is present before an attempted start, this latter suggestion might merely aggravate the situation. The importance of doing everything to get the engine to fire on the first attempt is of utmost importance. After an engine has fired and indicates extreme instability, application of full carburetor heat in the initial stages of firing should help to vaporize fuel and even out power impulses. Carburetor heat will aid in heating the master control when difficulty is encountered in changing from primer operation to normal mixture during extreme temperature conditions. Caution is advised against leaving full carburetor heat on after carburetor air temperature rises to approximately 30°C. The engine should be started with as low an rpm as possible to avoid undue stresses to the cabin supercharger unit and drive shafts, until engine oil temperatures have started to warm up. Due to possible extensive use of primers and possible leaking alcohol solenoids, cold weather engine starting may result in backfiring. This subjects the engine to considerable strain and may even result in blowing off carburetor air scoops. It is possible for power plants to ice up during runup. Therefore, whenever power plant malfunctioning is indicated during the runup period, every means must be exhausted to eliminate the possibility of icing.

High oil pressures, if actually encountered, can split oil pressure lines and blow off hose connections. An indication of high oil pressure can be caused by faulty instrumentation which must be adjudged accordingly to individual circumstances. Some cases of high BMEP have been encountered wherein the indication did not change, thus indicating congealing of oil in the BMEP line or frozen condensed moisture. The starting engines procedure will be as follows:

Follow normal engine starting procedures outlined in Section II when the temperature is 10°F or above.

a. Open the throttle approximately one knob width.

b. Move the mixture to AUTO RICH when the propeller starts turning.

c. When the propeller has turned six blades, call for ignition switch ON.

d. Apply steady prime until the engine starts to fire, then release the primer.

e. If the engine does not start within 10 seconds, change from steady to intermittent prime.

NOTE

Discontinue cranking if the engine does not start firing within 30 seconds.

CAUTION

- Close coordination with the ground crew is required when using the above procedure, because fuel will run from the blower drain increasing the fire hazard.
- Avoid priming when the engine is not turning. If the engine is primed prematurely, the gasoline will not vaporize but will run down into the lower cylinders. This will result in bent connecting rods and cracked cylinder heads when the piston contacts the cylinder full of fluid gasoline.
- If there is no oil pressure after 20 seconds of operation, immediately stop the engine and investigate.
- The oil pressure will be abnormally high immediately after starting. In extreme conditions the pressure will gradually drop from the high reading to approximately 20 psi. In either case rising oil temperature will correct the condition. Do not increase engine speed above 1200 rpm until oil pressure is normal.

ENGINE WARMUP.

1. Reserve oil system heater switch–ON
2. Nesa power and pitot heater switches–ON
3. Use ice-free area or firmly anchored wheel chocks for all engine runups. Make sure no personnel, ground installations, or other aircraft are in the propeller wash.
4. Warm up engine. Do not make performance checks until oil temperature and pressure and cylinder head temperatures are within desired limits.
5. Check wing flap operation.

TAXIING.

1. Avoid sharp turns during taxiing. Use as asymmetrical power for steering in icy areas and avoid excessive use of brakes.

NOTE

Avoid deep snow, mud, and slush-covered areas as much as possible. Do not stop in deep snow. Watch out for obstacles hidden by freshly fallen snow.

In cold weather, make sure all instruments have warmed up sufficiently to ensure normal operation. Check for sluggish instruments during taxiing.

ENGINE RUNUP.

NOTE

The following cold weather operational procedures prior to takeoff are recommended to flush the propeller and the auxiliary pump line of oil that may have congealed while the airplane was idle. This action is necessary so that bleeds, which are provided to keep the oil in the propeller and auxiliary pump line warm, will function properly in flight. The following check prior to takeoff should be conducted during engine runup after engine oil has reached the recommended operating temperature of 40°C.

1. Set the master propeller pitch lever to full INC RPM position, and adjust throttles to obtain approximately 1700 rpm.
2. Move master propeller pitch lever toward DEC RPM until minimum rpm position is obtained. RPM should drop to minimum setting.

3. Set the master propeller pitch lever toward INC RPM until engine speed increases to the value established in step 1.

4. Repeat Steps 2 and 3 three or four times.

5. Readjust throttle setting if desired and conduct a feathering check. Push the feathering button for each engine individually and observe a drop of 200 to 300 rpm. Pull feathering button out to neutral. RPM should return to the initial setting. Complete standard runup procedure listed in Section II.

BEFORE TAKEOFF.

1. Follow normal operating procedures as outlined in Section II.

NOTE

If flight is to be made during precipitation, removal of wing and empennage covers may be delayed until just prior to takeoff.

2. Check all heating, anti-icing and deicing systems for proper operation.

3. Carburetor heat--OFF

4. Recheck trim tabs and controls for freedom of operation.

TAKEOFF.

WARNING

Do not attempt to take off with ice or snow on the wings. Even loose snow may not blow off. Loss of lift and treacherous stalling characteristics may result.

1. During crosswind takeoff on icy runways, use asymmetrical power for directional control until rudder control becomes effective. It may be necessary to lift the nosewheel earlier than normal during the takeoff run to lessen the possibility of snow or icy slush being thrown into the nosewheel well.

WARNING

The use of asymmetrical power for directional control may appreciably lengthen the takeoff run.

ICING DURING FLIGHT.

Wing ice during cruise can become critical if the proper procedure is not followed. Since long-range cruise involves flying only slightly faster than the speed for maximum L/D, any loss of airspeed due to wing ice will mean flying in an unstable speed range on the nautical-mile-per-pound fuel chart. (In other words, airspeed will vary over quite a range with changes in attitude caused by turbulence or crew movement, even though a constant power setting is maintained.) In this unstable speed range, the aircraft is quick to lose speed, but slow to recover it. The result is a further lowering of the average airspeed. This necessitates an increase in the angle of attack to maintain altitude. This increased angle of attack will allow ice to accumulate on the bottom of the leading edge where it cannot be removed by the boots. This slows the aircraft still further and increases the stall speed considerably. If this cycle is allowed to continue, a very dangerous situation will quickly develop.

When encountering wing ice in cruise, watch the angle of attack as shown by the inclinometer. It should not be allowed to exceed 3 degrees. If necessary, go to maximum cruise power for as long as is necessary to keep the angle of attack below the recommended maximum limit for operating in icing conditions. If unable to maintain an angle of attack of less than 3 degrees with maximum cruise power, a change of altitude should be requested. As ice forms on the vertical and horizontal stabilizers, an increased tendency to yaw will be noted.

Propeller icing may occur under the same conditions as surface icing. Propeller ice is especially dangerous because it decreases propeller efficiency by altering the blade profile and increasing the blade thickness. (Refer to Section IV for alcohol maximum flow.)

Failure of the airspeed indicator may result from freezing of the pitot head or the static line. Use pitot heater or alternate static source as necessary.

Refer to Carburetor Icing in Section VII, and Normal Operating Procedures for Deicer Boots in Section IV for information on these systems.

DESCENTS AND APPROACHES.

During descents and approaches, maintain power settings sufficient to prevent overcooling of the engines. Use carburetor heat as explained in Section VII and cowl flaps as necessary.

NOTE

It may be desirable to lower wheels and use partial flaps well in advance of the actual approach to check that they function correctly while sufficient altitude remains for emergency procedure.

LANDING.

When landing a heavily iced aircraft, approach and landing speeds should be considerably higher than normal depending upon the amount of icing.

NOTE

A slow touchdown speed is desirable, consistent with safe control. The brakes should be used as little as possible, and nosewheel steering used discriminately.

CAUTION

When landing on snow or slush-covered runways, use of reverse thrust can cause serious impairment of pilots' visibility. Turn on windshield wipers prior to using reverse thrust. During the landing rollout, snow and slush may be carried into the wing flap well and onto the top surface of the wing flaps. Upon retraction of the wing flaps, the packed snow may cause damage to the wing trailing edge and the flap mechanism. Under these circumstances, the flaps should not be retracted beyond the 30 percent extended position until the flap area and mechanism can be inspected and cleaned, if necessary.

STOPPING ENGINES.

When parking on ice, after having taxied through slush, or when the temperature alternates between freezing and thawing, roll the aircraft onto a layer of some type of protective material to prevent the tires from freezing to the surface.

NOTE

Oil dilution is not recommended.

BEFORE LEAVING THE AIRCRAFT.

1. Install all necessary protective covers if shelter for the aircraft is not available.

CAUTION

The protective covers should not be installed until the engines have cooled sufficiently to preclude the possibility of condensation forming inside.

2. Position ram/alternate air doors to alternate air position (CLOSED).

2. Position ram/alternate air doors to alternate air position (CLOSED).

3. If a long layover is anticipated, and if external heat will not be available for starting, or if oil dilution cannot be accomplished, the oil should be drained into clean containers and stored in a sheltered location where the temperature will not be lower than freezing.

4. If extremely low temperatures are expected, the aircraft batteries should be removed and stored in a warm location.

5. Release the brakes and chock the wheels. If the brakes are left on, the formation of ice may lock the wheels.

6. Drain water tanks if there is a possibility of freezing.

7. Drain oil tank sumps, Y-drains, and fuel drains of condensate approximately 30 minutes after stopping engines.

8. Leave some aperture, such as a side window, partly open to help prevent the formation of frost on the inside of the windows.

9. Direct that any snow, slush, or mud picked up in nosewheel well or nacelles, or on landing gear mechanism, be cleaned off before it freezes.

HOT WEATHER PROCEDURES.

TROPIC OR DESERT OPERATIONS.

Before Entering the Aircraft.

1. During exterior and interior inspections, be particularly observant for corrosion, growth of fungi, or excessive accumulations of sand and dust.

2. If sand or dust is blowing, do not direct the removal of covers from engines, nacelles, propellers, and pitot tubes until just prior to starting engines.

On Entering the Aircraft.

NOTE

The instruments should be preheated prior to flight to eliminate possible fungus growths.

Engine Warmup.

1. Conduct ground operations in a minimum amount of time, and be careful not to overheat engines.

CAUTION

Longer takeoff runs are required than are necessary in ordinary temperatures.

2. Avoid taking off in the wake of another aircraft if ground is sandy or dusty.

Stopping Engines.

Follow normal operating procedures as outlined in Section II, except that cylinder head temperatures should be stabilized at the lowest temperature possible before shutting down.

Before Leaving Aircraft.

1. As soon as engines have cooled, install all protective covers.

2. If a sand or dust storm is anticipated, close all doors, windows, and hatches.