TECHNICAL MANUAL

FLIGHT HANDBOOK
USAF SERIES H-21B, ARMY SERIES H-21C
HELICOPTERS

TM 1-1H-21B-1
CHANGES No. 1

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *26 November 1957*

Note. These changes replace AF TO 1H-21B-1, revision of 15 June 1957, for use within the Department of the Army.

TM 1-1H-21B-1, 25 July 1957, is changed as follows:

Remove pages A, i-iv, 2-9-2-26A, 3-5-3-8, 5-6A-5-8, 7-4A-7-6, and IN-1-IN-5; insert revised pages numbered the same.

Add new page 2-26A in its proper sequence.

By Order of *Wilber M. Brucker*, Secretary of the Army:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:
HERBERT M. JONES,
Major General, United States Army,
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NG: State AG; units—same as Active Army.
USAR: None.
For explanation of abbreviations used, see AR 320-50.

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NOTE: The portion of the text affected by the current revision is indicated by a vertical line in the outer margin of the page.

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TABLE OF CONTENTS

Section

SCOPE. This handbook contains all the information necessary for safe and efficient operation of the H-21B or H-21C Helicopter. These instructions do not teach basic flight principles, but are designed to provide you with a general knowledge of the helicopter, its flight characteristics, and specific normal and emergency operation procedures. Your flying experience is recognized, and elementary instructions have been avoided.

SOUND JUDGMENT. The instructions in this handbook are designed to provide for the needs of a crew inexperienced in the operation of this helicopter. This book provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures contained herein.

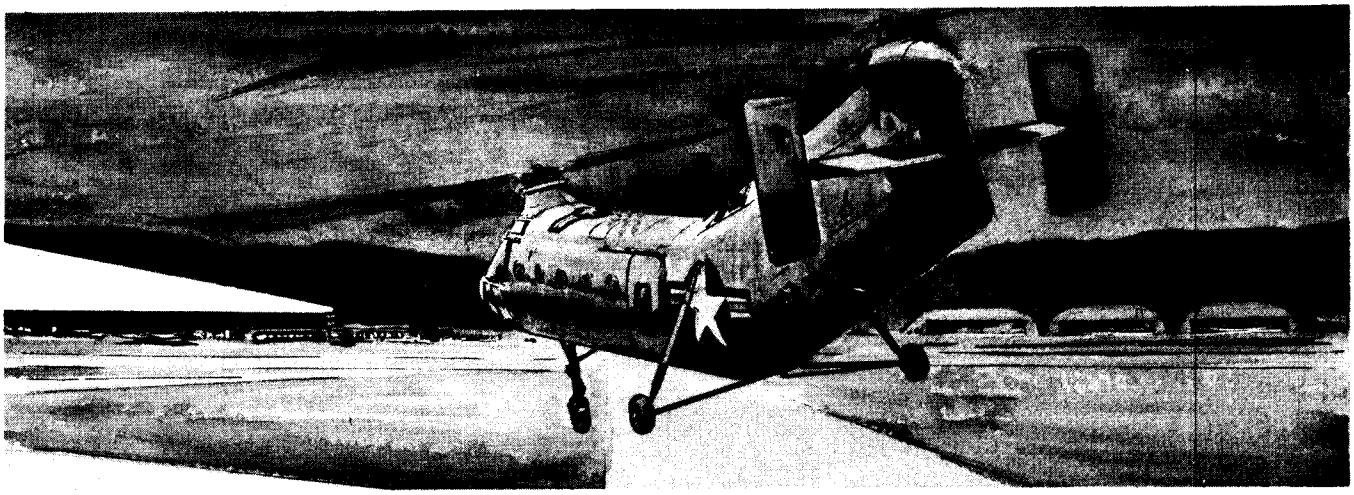
PERMISSIBLE OPERATIONS. The Flight Handbook takes a "positive approach" and normally tells you only what you can do. Any unusual operation or configuration (such as asymmetrical loading) is prohibited unless specifically covered in the Flight Handbook. Clearance must be obtained from ARDC before any questionable operation is attempted which is not specifically covered in the Flight Handbook.

STANDARDIZATION. Once you have learned to use one Flight Handbook, you will know how to use them all—closely guarded standardization assures that the scope and arrangement of all Flight Handbooks are identical.

ARRANGEMENT. The handbook has been divided into 10 fairly independent sections, each with its own table of contents. The objective of this subdivision is to make it easy both to read the book straight through when it is first received and thereafter to use it as a reference manual. The independence of these sections also makes it possible for the user to rearrange the book to satisfy his personal taste and requirements. The first 3 sections cover the minimum information required to safely get the helicopter into the air and back down again. Before flying any new helicopter these 3 sections must be read thoroughly and fully understood. Section IV covers all equipment not essential to flight but which permits the helicopter to perform special functions. Sections V and VI are obvious. Section VII covers lengthy discussions on any technique or theory of operation which may be applicable to the particular helicopter in question. The experienced pilot will probably not need to read this section but he should check it for any possible new information. The contents of the remaining sections are fairly obvious.

YOUR RESPONSIBILITY. These Flight Handbooks are constantly maintained current through an extremely active revision program. Frequent conferences with operating personnel and constant review of UR's, accident reports, flight test reports, etc, assure inclusion of the latest data in these handbooks. In this regard, it is essential that you do your part! If you find anything you don't like about the book, let us know right away. We cannot correct an error whose existence is unknown to us.

PERSONAL COPIES, TABS AND BINDERS. In accordance with the provisions of AFR 5-13, flight crewmembers are entitled to have personal copies of the Flight Handbooks. Flexible, loose leaf tabs and binders have been provided to hold your personal copy of the Flight Handbook. These good-looking, simulated-leather binders will make it much easier for you to revise your handbook as well as to keep it in good shape. These tabs and binders are secured through your local materiel staff and contracting officers.



HOW TO GET COPIES. If you want to be sure of getting your handbooks on time, order them before you need them. Early ordering will assure that enough copies are printed to cover your requirements. Technical Order 0-5-2 explains how to order Flight Handbooks so that you automatically will get all revisions, reissues, and Safety of Flight Supplements. Basically, all you have to do is order the required quantities in the Publication Requirements Table (T.O. 0-3-1). Talk to your Senior Materiel Staff Officer—it is his job to fulfill your Technical Order requests. Make sure to establish some system that will rapidly get the books and Safety of Flight Supplements to the flight crews once they are received on the base.

SAFETY OF FLIGHT SUPPLEMENTS. Safety of Flight Supplements are used to get information to you in a hurry. Safety of Flight Supplements use the same number as your Flight Handbook, except for the addition of a suffix letter. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in 10 days. You can determine the status of Safety of Flight Supplements by referring to the Index of Technical Publications (T.O. 0-1-1) and the Weekly Supplemental Index (T.O. 0-1-1A). This is the only way you can determine whether a supplement has been rescinded. The title page of the Flight Handbook and title block of each Safety of Flight Supplement should also be checked to determine the effect that these publications may have on existing Safety of Flight Supplements. It is critically important that you remain constantly aware of the status of all supplements—you must comply with all existing supplements but there is no point in restricting the operation of your helicopter by complying with a supplement that has been replaced or rescinded. If you have ordered your Flight Handbook on the Publications Requirements Table, you automatically will receive all supplements pertaining to your helicopter. Technical Order 0-5-1 covers some additional information regarding these supplements.

WARNINGS, CAUTIONS, AND NOTES. For your information, the following definitions apply to the "Warnings," "Cautions," and "Notes" found throughout the handbook:

WARNING — Operating procedures, practices, etc, which will result in personal injury or loss of life if not carefully followed.

CAUTION—Operating procedures, practices, etc, which, if not strictly observed, will result in damage to equipment.

NOTE—An operating procedure, condition, etc, which it is essential to emphasize.

COMMENTS AND QUESTIONS. Comments and questions regarding any phase of the Flight Handbook program are invited and should be forwarded through your Command Headquarters to:

Commander, Detachment No. 1
Headquarters, Air Research & Development Command
Wright-Patterson Air Force Base, Ohio
Attention: RDZSPH.

H-21 B&C Helicopters

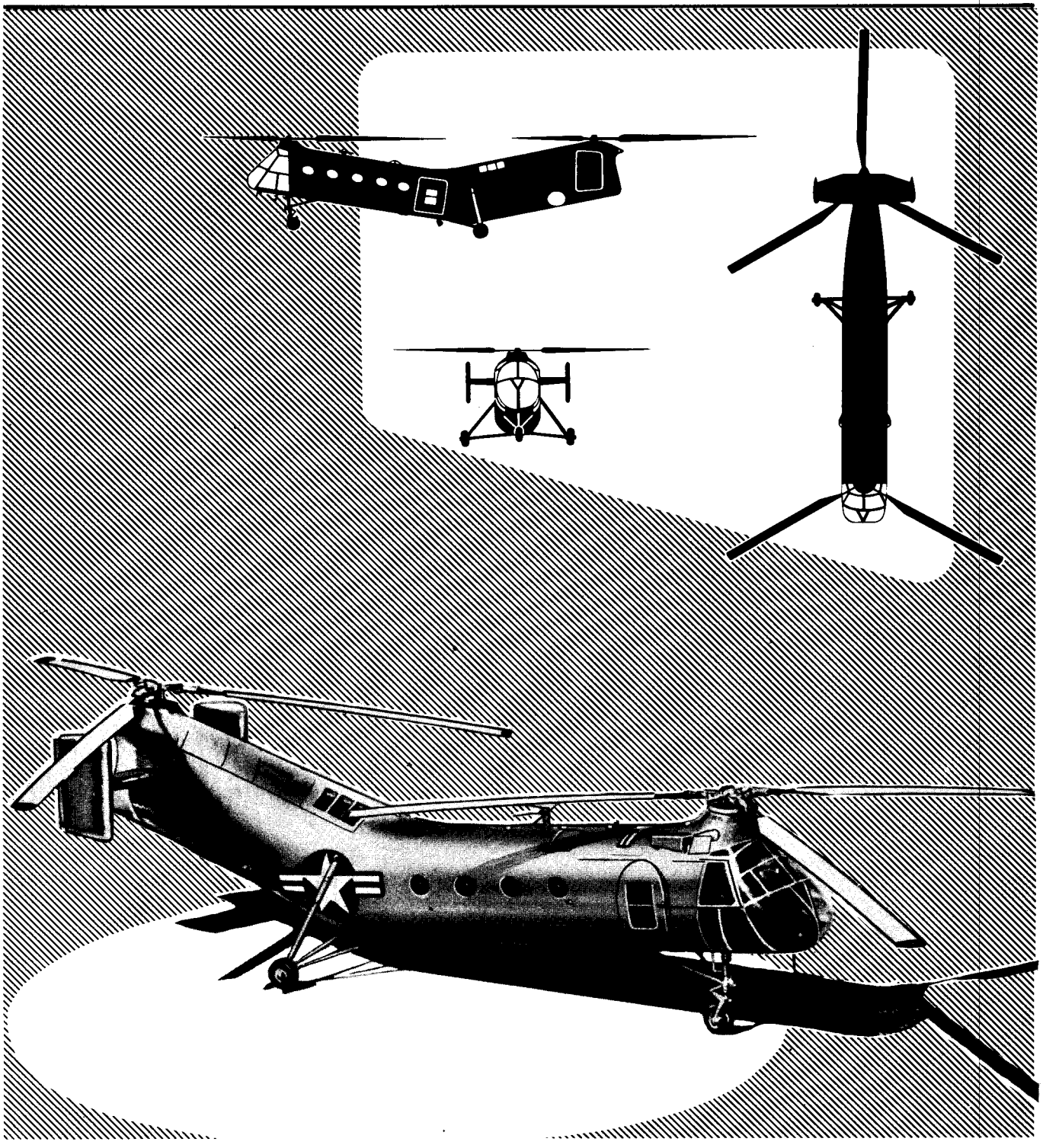


Figure 1-1

Before Taxiing (continued)

19. Carburetor air temperature gage—Check desired temperature.

20. Dual tachometer—Check. (Engine and rotor needles should coincide. Spread of the needles, unless clutch is over-running, indicates a faulty instrument and should be checked before take-off.)

Note

Engine instruments should respond correctly through various ranges of power and be free from undue fluctuation.

21. Radio switches—ON. (Check squelch and sensitivity. Check controls for optimum operation. See Section IV.)

22. Compass—Check. (Readings should be consistent with heading of the helicopter.)

TAXIING.

The thrust which is supplied to the helicopter by the rotor system is used to provide taxiing control. Directing this thrust by means of the cyclic stick can move the helicopter forward or rearward; use of the pedals provides directional control. Wheel brakes may be used to assist in taxiing or turning; however, their primary function is as a parking brake.

PROCEDURE.

1. Throttle—2000–2300 engine rpm.
2. Nose wheel lock handle—Recheck, DOWN.
3. Wheel parking brake knob—Recheck. Turn counterclockwise and PUSH DOWN.
4. Collective pitch lever—Increase to obtain 20–23 inches Hg manifold pressure so that helicopter is light on wheels. To stop taxiing increase collective pitch simultaneously with rotor rpm and aft cyclic stick.
5. Cyclic stick—Displace forward to start taxiing. (Use pitch control and cyclic stick displacement to control speed.)

CAUTION

It is possible for the rotor blades to hit the droop stops while taxiing if the controls are displaced excessively during high rotor rpm and low collective pitch conditions. This can be recognized by a heavy thumping noise.

6. Directional pedals—As required. When the helicopter stops, return cyclic stick to neutral and reduce collective pitch and engine rpm.

Note

When taxiing or turning in strong crosswinds, caution must be used because should a rolling-over tendency be noticed, the helicopter must be air-borne immediately. The best practice is to keep the cyclic stick into the wind and maintain a high rotor rpm in order that take-off power may be applied more rapidly.

7. Flight Instruments—Check attitude indicator, turn and slip indicator, compasses and directional indicator, etc, for correct operation while taxiing.

CAUTION

To taxi straight back, lock the nose wheel in its forward trail position. To be certain that the nose wheel is locked, taxi the helicopter straight forward several feet and place the nose wheel locking handle in the UP (LOCKED) position. Taxi rearward very slowly to prevent nose wheel shimmy.

TAKE-OFF.

BEFORE TAKE-OFF.

1. Attitude indicator—SET.
2. Gyro magnetic compass switch—Desired position.
3. Altimeter—SET.
4. Crew and passengers—Alerted for take-off.
5. Longitudinal stick positioner wheel and indicator—ZERO.
6. Collective pitch lever—UNLOCKED.

Note

It is recommended that sufficient collective pitch friction be applied before take-off so that no sudden movement of the collective pitch lever will occur if released.

7. Flight controls—CHECK for freedom and full movement.
8. Supercharger switch—LOW.
9. Fuel booster pump switch—HIGH or ON.
10. Mixture lever—RICH.
11. Carburetor heat lever—COLD.

WARNING

Take-offs and landings must be made at all times with the carburetor heat lever in the COLD position to avoid dangerous loss of engine power due to excessive carburetor heat. The short period of time

Before Take-Off (continued on Page 2-10)

required for take-offs and landings will not present a hazard from icing in the carburetor.

12. Nose wheel lock handle—Desired position.

13. Wheel parking brake knob—DOWN.

14. Shoulder harness inertia reel lock handle—FORWARD (locked).

Note

The automatic locking safety feature of the inertia reel cannot function satisfactorily under all potential helicopter take-off conditions with the reel lock handle in RELEASE position. Therefore, the lock handle should be positioned in LOCKED before take-off, after all necessary switches and controls whch may be difficult to reach have been placed in the proper positions.

15. Area—CHECK clear for take-off.

TAKE-OFF.

Due to the versatility of the helicopter and the diverse missions it is called on to perform, the type of take-off chosen by the pilot is dependent only upon consideration of terrain, gross weight, and atmospheric conditions existing at the time of take-off. The following paragraphs discuss some of the salient factors involved in the various types of take-offs.

Hovering Take-Off.

This type of take-off provides a considerable margin of safety, as the helicopter is raised vertically until the wheels are approximately 10 feet off the ground, then hovered briefly while the pilot performs a power check and a control forces check, before committing himself to continuing the take-off.

Note

A wheel clearance of 10 feet permits the pilot to perform the power check, while in ground effect, at approximately the field elevation. This is also sufficient altitude to allow the helicopter to accelerate into forward flight with little danger of the nose wheel striking the ground.

This type of take-off can be made regardless of the roughness of the terrain, as there is no ground roll. A relatively large open area is required, however, as the helicopter is accelerated into forward flight close to the ground until sufficient airspeed is attained to perform the best rate of climb. Take-offs of this type may be successfully performed at weights up to the Maximum Overload Gross Weight, depending upon atmospheric conditions. Refer to figure A-5 in Appendix I.

Note

Careful attention must be paid to control of engine rpm during take-off, particularly when operating at higher gross weights. As the helicopter is comparatively slow to accelerate, there is a pronounced tendency for the pilot to increase collective pitch as the helicopter moves into translational lift. Caution should be exercised to maintain take-off rpm while accelerating through the translational lift area, as a loss of take-off rpm at a high gross weight will cause the helicopter to return to the ground.

The following procedure will produce the results stated in Appendix I:

1. Collective pitch lever—DOWN.

2. Throttle—Increase to take-off rpm (2500–2700 rpm).

3. Collective pitch lever — Increase pitch steadily until airborne.

4. Rise vertically until wheels are approximately 10 feet off ground; then hover.

5. Cyclic stick and directional pedals—As required to maintain attitude.

6. Throttle—Maintain take-off rpm.

7. Control forces—Check as presented in Section VI.

8. Power check—Perform in accordance with figure A-5.

9. Instruments—Check for correct indications.

10. Cyclic stick—Displace slightly toward desired flight direction. Maintain desired conditions of attitude and direction as helicopter accelerates and translational lift is attained.

11. Throttle—Maintain take-off rpm until desired climb speed is attained.

Note

Operation within the transitional flight region (10–40 knots) must be held to a minimum due to airframe vibration. If it is mandatory to operate within these speed ranges, vibration may be reduced by yawing the helicopter approximately 45 degrees to the relative wind.

Rolling Take-Off.

Under certain operating situations of high gross weight and adverse atmospheric conditions there may not be sufficient power available to accomplish a hovering take-off. Under these conditions it is necessary to use speed developed during a ground roll to attain sufficient lift to become airborne. This type of take-off will require a larger available open area than any other, as the distance

Rolling Take-Off (continued on Page 2-11)

Rolling Take-Off (continued)

covered during ground roll and initial climb may be excessive. It should only be attempted from a smooth, prepared surface such as a hard-surfaced runway or road, or a well-graded field.

Note

When operating from an unfamiliar area, it is recommended that the pilot physically examine the surface for any irregularities that might cause excessive airframe vibration or landing gear damage during a ground roll.

The following procedure will produce the results stated in Appendix I:

1. Collective pitch lever—DOWN.
2. Throttle—Increase to maximum available power.
3. Cyclic stick—Displace FORWARD during ground roll, then AFT at 50 knots IAS for take-off.
4. Collective pitch lever—Increase until helicopter is airborne.
5. Throttle—Maintain take-off rpm until desired climb speed is attained.

Vertical Take-Off.

This take-off is necessary when operating from a restricted area, where it is not possible to accelerate to the desired best climb speed either by forward flight while close to the ground, or by a ground roll. In this type of take-off the helicopter is lifted vertically, without hovering, until clear of all surrounding obstacles. Transition into forward flight is then made as smoothly and rapidly as possible. Since this take-off requires the maximum in performance, the pilot should carefully evaluate the factors of gross weight, density altitude and free air temperature, steady wind velocity and direction, size of the available area, and distance and height of all obstacles before attempting a take-off. The following procedure will produce the results stated in Appendix I:

1. Collective pitch lever—DOWN.
2. Throttle—Increase to take-off rpm.
3. Collective pitch lever — Increase pitch steadily until airborne.
4. Rise vertically until clear of all surrounding obstacles.
5. Cyclic stick—Displace forward to accelerate into forward flight while establishing a climb.

Note

A safe autorotative airspeed and altitude should be attained as quickly as possible. Refer to figure 3-1.

6. Maintain take-off power with throttle and collective pitch lever until the desired best climb speed is attained.

AFTER TAKE-OFF—CLIMB.

After accelerating through the translational lift area and attaining the desired best climb speed, the following procedure may be followed for a climb at normal gross weights:

Note

For climb data see Climb Chart in Appendix.

1. Throttle—2500 engine rpm. Coordinate with subsequent steps 2 and 3.
2. Collective pitch lever—46.5 inches Hg manifold pressure. Establish required vertical speed.
3. Cyclic stick—As required to establish 60 knots IAS.
4. Mixture lever—NORMAL. Use RICH if cylinder head temperature is high.
5. Cylinder head temperature gage—Check within limits.

Note

In executing a climb, it is desirable to increase airspeed to 40 knots before exceeding 15 feet altitude, then attain best climb speed and climb to a cruise altitude. During climb and forward flight, observe that the cylinder head temperature does not exceed the maximum limits. If the temperature is increasing too rapidly, decrease the vertical speed and increase forward speed. The use of RICH mixture will also reduce cylinder head temperature.

CRUISE.

The following procedure may be used to trim the helicopter for cruise:

1. Cyclic stick—Displace to obtain desired conditions of airspeed, attitude, and direction; then neutralize.

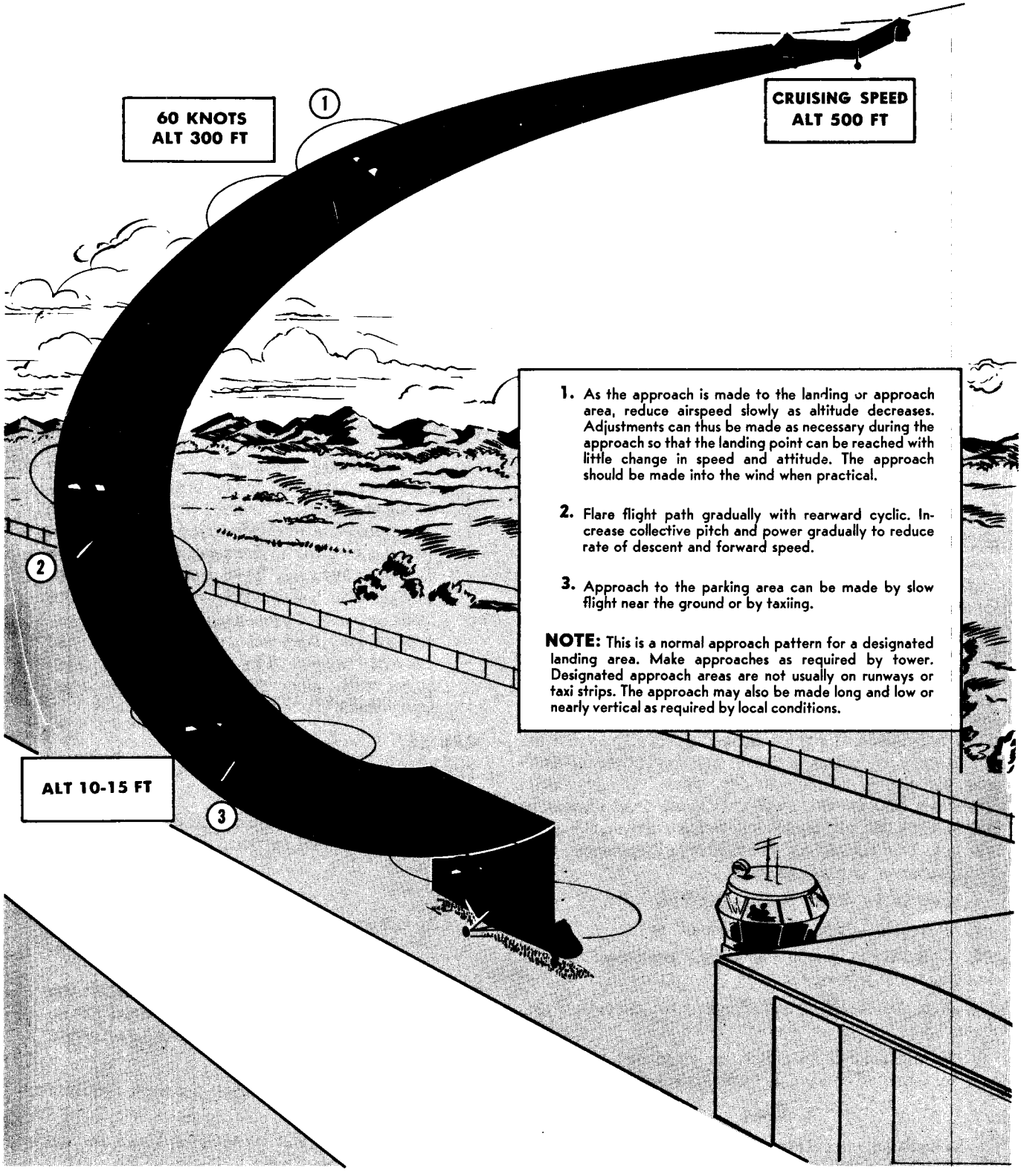
Note

It is recommended that the helicopter be climbed to slightly above the desired cruising altitude, then dived slightly to the cruising altitude. This will permit the helicopter to maintain the desired cruising speed and attitude with the minimum use of power.

2. Longitudinal stick position indicator—CHECK position.
3. Stick positioner wheel—Adjust to desired position of cyclic stick.

Cruise (continued on Page 2-12A)

NORMAL APPROACH AND HOVERING LANDING POWER ON



1. As the approach is made to the landing or approach area, reduce airspeed slowly as altitude decreases. Adjustments can thus be made as necessary during the approach so that the landing point can be reached with little change in speed and attitude. The approach should be made into the wind when practical.

2. Flare flight path gradually with rearward cyclic. Increase collective pitch and power gradually to reduce rate of descent and forward speed.

3. Approach to the parking area can be made by slow flight near the ground or by taxiing.

NOTE: This is a normal approach pattern for a designated landing area. Make approaches as required by tower. Designated approach areas are not usually on runways or taxi strips. The approach may also be made long and low or nearly vertical as required by local conditions.

Figure 2-3

Cruise (continued)

4. Centering device release switch—DEPRESS, then release. (When controls are positioned for cruise.)

5. Supercharger—Desludge. (Refer to Section VII.)

Forward Flight.

Forward flight may be conducted at any speed from zero to the red line on the airspeed indicator. (See Section V.)

CAUTION

When in high speed forward flight, the rotor blades may hit the droop stops. This condition may be eliminated by adjusting the stick positioner wheel to attain a more nose-up attitude. If this brings the longitudinal stick too far forward, the airspeed should be reduced.

Sideward Flight.

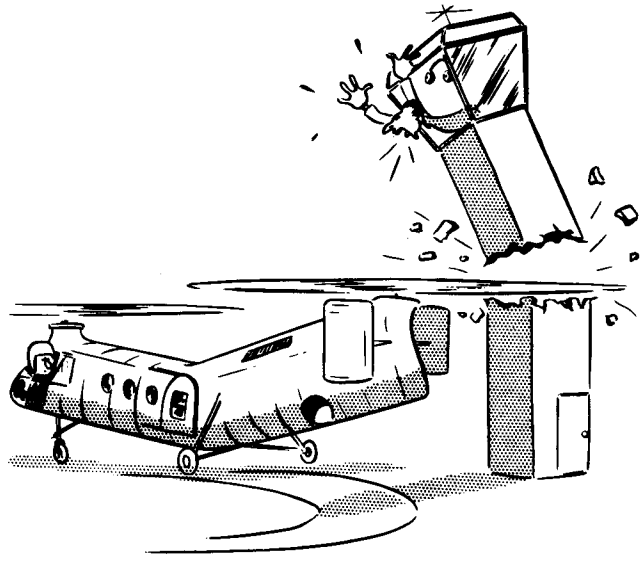
Sideward flight can be accomplished up to 40 knots without loss of control.

Note

Orientation of the pitot static head is such that it functions accurately only in forward flight. It is of no value for determining rearward or sideward airspeed.

Rearward Flight.

Care must be exercised to prevent loss of altitude as airspeed increases. Rearward flight should be limited to 20 knots airspeed because of the impaired visibility to the rear.



CAUTION

There is 65 feet of helicopter behind you. Check the area thoroughly before attempting rearward or sideward flight.

Cruise Control.

Refer to Appendix for recommended procedure.

Flight Characteristics.

Refer to Section VI.

Systems Operation.

Refer to Section VII.

LANDING.

DESCENT.

The following procedures, described for most descents, approaches, and landings (figure 2-3), are normally used at established airports or at a place where the terrain or situation warrants.

Descent From Altitude.

Two methods of descent are power-on and autorotative descent. Power-on descent provides a slower, more easily controlled descent; autorotative descent provides a maximum rate of descent without exceeding the airspeed limitations.

Vertical Descent.

Vertical descent at zero airspeed may be accomplished. Vertical descent in autorotation is smoother than vertical descent with partial power. Refer to Section VI for Flight Characteristics.

BEFORE LANDING.

Before entering the traffic pattern prior to landing, make the following check:

1. Crew and passengers—Alerted for landing.
2. Rescue boom and cable—Secured.
3. Altimeter—SET as desired.
4. Supercharger switch—LOW.
5. Fuel booster pump switch—HIGH or ON.
6. Mixture lever—RICH.
7. Fuel tanks selector switches—CHECK desired positioning.
8. Hydraulic boost pressure gage—CHECK within limits.
9. Wheel parking brake knob—As required.
10. Nose wheel lock handle—As required.
11. Landing area—CHECK, clear.
12. Landing light or search light switches—As desired.
13. Shoulder harness inertia reel lock handle—FORWARD.
14. Airspeed—60 knots IAS.
15. Carburetor heat lever—COLD.

Whenever it is practical make the approach into the wind, coming in either long and low or nearly vertical as the terrain and situation dictates. Reduce airspeed slowly as altitude decreases so that

Before Landing (continued on Page 2-13)

the landing point can be reached without making any abrupt change in attitude.

Normal Approach (Straight-In).

1. Altitude—500 feet above the ground.
2. Airspeed—60 knots IAS.
3. Throttle—2400 engine rpm.
4. Collective pitch lever—20–25 inches Hg. Perform simultaneously with step 3.

Note

The manifold pressure will be determined by the distance from the landing spot. The nearer the spot that entry is made, the lower the manifold pressure. It will seldom be necessary to use less than 20 inches or more than 25 inches Hg.

5. Cyclic flare—Initiate at 100–150 feet above the ground. Reduce forward speed to 10–15 knots and vertical speed to 1500-0 feet per minute.

Slow, Steep Approach.

CAUTION

This type of approach is more critical because of the use of low airspeed at altitudes above 10 feet, and is used only in confined areas.

1. Throttle—2500 engine rpm at 500 feet above the ground.
2. Airspeed—Establish 40 knots IAS.
3. Collective pitch lever—Down (as necessary when desired approach angle is established for vertical speed).

Note

Center attention on rate of descent rather than airspeed. As the ground is approached, enough collective pitch is added to come to a hover or to cushion the landing, whichever is desired.

180-Degree Down-Wind Approach.

1. Altitude 500 FEET above ground when 180-degrees downwind from intended landing spot.
2. Airspeed—80 knots IAS.
3. Throttle—2400 engine rpm.
4. Collective pitch lever—20–25 inches Hg.

Note

The manifold pressure will be determined by the distance from the landing spot. The nearer the spot that entry is made, the lower the manifold pressure. It will seldom be necessary to use less than 20 inches Hg manifold pressure or more than 25 inches.

5. Airspeed—60 knots IAS.
6. Cyclic flare—Accomplish 100–150 feet above the ground.

Fast, Shallow Approach.

At 200 feet above the ground, establish airspeed so as to touchdown as described under RUNNING LANDINGS.

Transition From Approach To Hovering.

1. Throttle—Gradually increase engine rpm to 2500–2700, as required by gross weight and atmospheric conditions.
2. Collective pitch lever—Adjust to obtain manifold pressure as necessary to prevent settling of the helicopter as forward speed is decreased.

CAUTION

Make the transition from approach to hovering at least 10 feet above the ground. Refer to Section VI.

Descent From Hovering Position To The Ground.

1. Throttle—Maintain 2500–2700 engine rpm as required.
2. Collective pitch lever—Decrease slightly.

Note

Establish stabilized hovering position before contacting the ground.

3. Collective pitch lever—Full DOWN at ground contact. (Nose wheel completely settled.)

Note

When a landing is made with no forward or rearward motion, the tires tend to "roll-under". It is desirable to roll forward (approximately six feet) to avoid this.

Cross-Wind And Down-Wind Landings.

Cross-wind and down-wind landings may be effected. Exercise care to prevent drift by applying cyclic control against the wind and increasing power if necessary. After touchdown, continue to hold the cyclic stick slightly into the wind until rotor rpm has decreased.

Slope Landings.

Landings on uneven terrain may be safely accomplished if a careful approach is made and the touchdown is accomplished Up Slope or Cross Slope.

Slope Landings (continued on Page 2-14)

Slope Landings (continued)

CAUTION

Down-slope landings are to be avoided because of the danger of striking the ground with the tail surfaces when reducing altitude. The maximum slope angle for landings is 20°. (See figure 5-4, Section V.)

Up-Slope Landings. Perform as follows:

1. Nose wheel lock handle—UP to lock nose wheel.
2. Toe brakes—DEPRESS and LOCK with wheel parking brake knob.
3. Throttle—2500 engine rpm. Simultaneously decrease collective pitch and displace cyclic stick forward for touchdown.

Note

On up-slope landings the nose wheel will touch the ground first. Maintain 2500 engine rpm until the landing is completed in case a recovery is necessary.

Cross-Slope Landings. Perform as follows:

Note

Do not displace the cyclic stick down slope at any time while landing or taking off, as the helicopter may roll over.

1. Nose wheel lock handle—UP.
2. Toe brakes—DEPRESS and LOCK with wheel parking brake knob.

On Cross Slope landings the wheel on the high side will touch the ground first. From this point the landing is effected as follows:

3. Throttle—2500 engine rpm. Perform simultaneously with subsequent steps 4 and 5.
4. Cyclic Stick—Toward high side of slope.
5. Collective pitch lever—DOWN slowly until firmly on ground.
6. Centering device release button—PRESS. Neutralize stick in proper up-slope position for next take-off.

Note

Take-off from an up-slope or cross-slope position is easily accomplished by slowly applying power to bring the helicopter to a level attitude before breaking clear of the ground on all sides.

Running Landing (Tactical).

A running landing may be used to land troops and equipment when the situation and the terrain permit. Bear in mind that the lower the landing speed the shorter the landing roll required.

1. Nose wheel lock handle—UNLOCKED.
2. Cyclic stick—Slowly rearward, at 75–100 feet.

Note

This causes the flight path to flatten. A gradual reduction in airspeed will accompany this maneuver. Establish landing attitude at 10–15 feet.

3. Throttle—2500 rpm.
4. Collective pitch lever—UP smoothly. Reduce vertical speed to zero at touchdown.

Note

Running landings are not recommended at speeds above 40 knots IAS, because of possible damage to landing gear.

5. Cyclic stick—Rearward (as power is applied) to stop the helicopter.

CAUTION

If the helicopter should begin to swerve or roll, immediately add power as necessary to maintain control.

Landing On Unfamiliar Terrain.

Helicopter landings in unprepared areas are hazardous and should be planned and carried out with the utmost caution to prevent the possibility of blade damage caused by debris striking the rotors. Circle the intended landing spot at a safe altitude, but sufficiently low, to permit detection of obstacles, debris or loose gear prior to landing. If there is any doubt of the nature of the terrain, hover the helicopter and lower a crewmember to the ground to inspect the terrain and to give signals for a safe landing.

CAUTION

Exercise extreme care in approaching landing areas which have been marked by strips of cloth or other temporary markings not firmly held down.

GO-AROUND.

If excessive drift or swinging is evident as the helicopter touches down, apply power to lift the helicopter free of the ground, stabilize it by counteracting undesirable movement with cyclic control, and attempt a new landing. If the situation requires a go-around during an approach, add power smoothly and rapidly to minimize further loss of altitude. Level off or climb to execute the go-around in accordance with local conditions and practice.

AFTER LANDING.

1. Throttle—2300–2500 engine rpm.
2. Collective pitch lever—As desired for taxiing.
3. Nose wheel lock handle—DOWN (for taxiing).

POSTFLIGHT ENGINE CHECK.

Postflight engine and transmission check is to be made after each flight. Note all discrepancies in DD Form 781. Check items as follows:

1. Toe brakes—DEPRESS pedals and SET with wheel parking brake knob.
2. Transmission oil pressure and temperature gages—Check within specified ranges.
3. Ignition system—Check.
   a. Collective pitch lever—25 inches Hg manifold pressure at 2300 engine rpm.
   b. Ignition switch—"L" observe rpm drop.
   c. Ignition switch—Return to BOTH. Stabilize engine rpm.
   d. Ignition switch—"R" observe rpm drop.
   e. Ignition switch—Return to BOTH. A drop of 50–75 rpm is normal while a maximum drop of 100 rpm is permissible when operating on one magneto, providing there is no engine roughness.
4. Collective pitch lever—DOWN and LOCKED.
5. Throttle—CLOSE to split dual tachometer needles.
6. Friction clutch switch—DISENGAGE (while rotors are overrunning the jaw clutch).
7. Idle mixture—Check.

Note

While making the idle mixture adjustment check, be certain that the cylinder head temperature is at least 150°C. If the temperature is lower, engage rotors and operate the engine at 2300 rpm and 25 inches Hg for a short warm-up. Disengage rotors and continue idle check.

With primer—

   a. Mixture lever—RICH.
   b. Throttle—1000 engine rpm. LOCK.
   c. Primer switch — Flick and note any changes in manifold pressure and rpm.

Note

A momentary decrease in manifold pressure accompanied by a corresponding increase in rpm indicates that the mixture is too lean. If the idling mixture is either correct (i. e., at best power) or too rich, a momentary decrease in rpm and increase in manifold pressure will occur.

To determine if mixture is too rich or at best power, check without primer as follows—

   a. Cylinder head temperature gage—150°C minimum. Warm up engine if necessary.
   b. Mixture lever—RICH.
   c. Throttle—1000 engine rpm. LOCK.
   d. Mixture lever—Retard to NORMAL and then advance from NORMAL to RICH, and note that there is no change in manifold pressure or engine rpm.
   e. Mixture lever—Retard towards IDLE CUT-OFF until a change in engine rpm and manifold pressure occurs.

Note

A decrease in manifold pressure with an increase in rpm indicates that the mixture is too rich. If a decrease in rpm and an increase in manifold pressure occur, then mixture is at best setting.

8. Ignition system—Check.
   a. Ignition switch—BOTH.
   b. Throttle—Closed (index marks opposite one another).
   c. Ignition switch—OFF, momentarily (Observe that engine stops firing).
   d. Ignition switch—BOTH.

CAUTION

Make this check, with the rotors disengaged, as quickly as possible to prevent engine backfire when switch is returned to BOTH. If violent backfiring occurs during ground run of engine, a shutdown must be made to inspect the engine, induction, and accessory system.

9. Oil dilution—Check. (When stopping the engine, and it is anticipated that the next start will be made in low temperatures, dilute the engine oil. Refer to oil dilution table, Section IX.)

CAUTION

Do not dilute oil when oil temperature is above 50°C as it will cause partial evaporation of fuel and result in improper dilution.

STOPPING OF ENGINE AND ROTORS.

If the engine is warm, idle until the cylinder head temperature drops to a maximum of 150°C (300°F) or to a value consistent with existing atmospheric temperature.

Stopping of Engine and Rotors (continued on Page 2-16)

Stopping of Engine and Rotors (continued)

Note

Idle the engine with closed throttle for a minimum of 30 seconds prior to shutdown to insure maximum oil scavenging and to preclude liquid lock, plug fouling, and smoky starts.

1. Mixture lever—IDLE CUT-OFF.
2. Ignition switch—OFF.
3. Friction clutch switch—ENGAGE if desired. (Wait until rotors have slowed to 100 rpm or less. Refer to Section VII for procedure.)

BEFORE EXIT FROM THE HELICOPTER.

INTERIOR CHECK.

1. Friction clutch switch—ENGAGE. Return to DISENGAGE.
2. All other switches—OFF.

WARNING

Due to the automatic action of the fan overrun thermal switch, the heater switch must be placed in the OFF position at least five minutes before the battery switch is placed in the OFF position, or before the external power supply is disconnected. Failure to observe this precaution will result in a dangerous accumulation of explosive fuel vapor in the heater combustion chamber.

3. Radio switches—OFF.
4. Wheel parking brake knob—Turn counterclockwise, push DOWN (after wheels are chocked).
5. Nose wheel lock handle—As required.
6. DD Form 781—Check (enter all discrepancies discovered in flight).

AFTER EXIT FROM THE HELICOPTER.

Make an exterior walk-around inspection and enter all discrepancies in DD Form 781.

HELICOPTER TIE-DOWN UNDER VARIOUS WIND CONDITIONS.

For proper tie-down procedure under various wind conditions, refer to Section IX.

CONDENSED CHECK LISTS.

Condensed check lists are located on pages 2-17 through 2-26A inclusive.

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H-21B & H-21C
CONDENSED CHECK LIST

BEFORE EXTERIOR INSPECTION.

1. DD Form 781—CHECK.

EXTERIOR INSPECTION.

A. GENERAL.

1. Blade covers—REMOVED.
2. Blades—PHASED.
3. Tie downs—REMOVED.
4. Wheels—CHOCKED.
5. Fuel, oil or hydraulic leaks—CHECK.
6. Aircraft—CLEAN.
7. Area—CLEAR.

B. ENTRANCE DOOR.

1. Condition—CHECK.
2. Operation and closing—CHECK.

C. LEFT FORWARD FUSELAGE.

1. Cargo sling—STOWED.
2. Auxiliary fuel tank—CHECK.
3. Fuselage skin—INSPECT.
4. Radio antennas—CHECK.

D. FORWARD ROTOR.

1. Rotor and blades—INSPECT.
2. Top of fuselage—INSPECT.
3. Work platform—STOWED.

E. NOSE SECTION.

1. Shock strut—CHECK.
2. Tire—CHECK.
3. Nose enclosure—INSPECT.
   a. No cracks.
   b. No hydraulic leaks.
   c. Secure.
   d. Clean.

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4. Pitot cover—REMOVED.
5. Tie-down—REMOVED.

F. RESCUE DOOR & RIGHT FWD FUSELAGE.

1. Condition of door—CHECK.
2. Hoist boom and stowage—CHECKED.
3. Fuselage skin—INSPECT.
4. Auxiliary fuel tank—CHECK.

G. RIGHT AFT FUSELAGE.

1. Air inlet screen—CHECK.
2. Fuel quantity and cap—CHECK.
3. Shock strut—CHECK.
4. Braking disc and tire—INSPECT.
5. Tie-down—REMOVED.
6. Fan Section—CHECK.
7. Structural door—CHECK.
8. Exhaust shroud—CHECK.

H. ENGINE COMPARTMENT.

1. Throttle and mixture control rods—SECURE.
2. Engine accessory section—CHECK.
3. Flight controls—CHECK.

I. AFT ROTOR & EMPENNAGE.

1. Oil tank, hopper and cap—CHECK.
2. Rotor and blades—INSPECT.
3. Fuselage skin—INSPECT.
4. Dorsal fairing—SECURE.
5. Aft transmission—CHECK.
6. Horizontal and vertical stabilizers—
   a. SECURE.
   b. NO DAMAGE.

J. LEFT AFT FUSELAGE.

1. Exhaust shroud—CHECK.
2. Structural door—SECURE.
3. Fan section—CHECK.
4. Tie-down—REMOVED.
5. Braking disc and tire—INSPECT.
6. Shock strut—CHECK.
7. Air inlet screen—CHECK.

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INTERIOR INSPECTION (ALL FLIGHTS).

FUEL CELL COMPARTMENT.

1. Battery—CHECK.
2. Vapor return line manual selector valve—CHECK.
3. Circuit breakers—IN.
4. Mid transmission—CHECK.
5. Auxiliary power plant—CONNECT.
6. Drive shaft couplings—CHECK.
7. Mid transmission area—CHECK.
8. Control cable pulleys—PROPERLY TRACKED.
9. Auxiliary equipment—SECURED.
10. Clutch—CHECK CYCLING AND OIL LEVEL.

CARGO-PASSENGER COMPARTMENT.

1. Dome light switch—AS REQUIRED.
2. Heat duct valve lever—CHECK.
3. Fire extinguisher—CHECK.
4. Litter attendant's radio controls—NORMAL.
5. Main entrance door jettison handle—SECURE.
6. Litter light switches—AS REQUIRED.
7. Interior of the helicopter—INSPECT.
8. First aid kits—STOWED.
9. Anemostats—OPEN.
10. Emergency exits—CHECK.
11. Cargo-passenger compartment lights switch—AS REQUIRED.
12. Forward cargo-passenger compartment radio controls—NORMAL or OFF.
13. Electronic and radio equipment—SECURED.
14. Rescue door emergency release—SECURE.
15. Rescue hoist—
    a. Cable cutter—SECURED.
    b. Hoist boom handle—STOWED.

COCKPIT CHECK.

1. Seat and rudder pedals—ADJUST.
2. Safety belt and shoulder harness—SECURE.
3. Window jettison handles—CHECK.
4. First aid kit—CHECK.
5. Flight controls—CHECK (with collective pitch lever UP).
6. Collective pitch lever—DOWN and LOCKED.
7. Throttle and friction locknut—CLOSED and SET.
8. Landing and search light switches—OFF.

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CUT ON BLACK LINE

9. Wheel parking brakes—ON.
10. Nose wheel lock handle—UP.
11. Fire extinguisher—PRESSURE and SECURED.
12. Hydraulic boost valve and pressure—OFF and ZERO.
13. Radio controls—AS DESIRED.
14. Stick positioner wheel and indicator—CHECK.
15. Mixture lever—IDLE CUT-OFF.
16. Carburetor heat lever—COLD.
17. Oil dilution switch—OFF.
18. Fuel booster pump switch—OFF.
19. Supercharger switch—LOW.
20. Ignition switch—OFF.
21. Friction clutch switch—DISENGAGE.
22. Radio-switch—OFF.
23. Autopilot switches—OFF.
24. Circuit breakers—IN.
25. Clock—SET.
26. Altimeter—SET.
27. Compass slaving switch (gyro)—IN.
28. Magnetic compass—FREE OF BUBBLES.
29. Auxiliary fuel tanks switch—OFF.
30. Main tank fuel selector switch—AS DESIRED.
31. External tanks fuel selector switch—AS DESIRED.
32. Fuel quantity check switch—CHECK.
33. Radio compass switch—OFF.
34. Search light control switches—AS DESIRED.
35. Engine fluids switch—NORMAL.
36. Navigation and formation light switches—OFF.
37. Anti-collision light switches—OFF.
38. Cargo sling release switch—OFF.
39. Hoist switch—OFF.
40. Windshield wiper switch—OFF.
41. Heater switch—OFF.
42. Blower switch—OFF.
43. Pitot heat switch—OFF.
44. Dome light switch—OFF.
45. Panel light switch—OFF.
46. Instrument light switch—OFF.
47. Battery switch—OFF.
48. Generator switch—ON.
49. Inverter switch—OFF.
50. Cockpit map light—OFF.

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INTERIOR INSPECTION (NIGHT FLIGHTS).

1. Instrument lights—CHECK.
2. Navigation lights—CHECK.
3. Landing lights—CHECK.
4. Retracting and rotating search light—CHECK.
5. Personal equipment—CHECK.
   a. Flashlight.

BEFORE STARTING ENGINE.

1. Auxiliary power plant—CONNECTED.
2. Battery switch—OFF.
3. Attitude indicator—CAGE.
4. Inverter switch—MAIN.
5. Generator warning light—ON.
6. Fire warning light case—PRESS TO TEST.
7. Fire warning test switch—TEST.
8. Fuel and transmission warning lights—TEST.
9. Clutch warning light—PRESS.
10. Friction clutch switch—DISENGAGE.
11. Fuel booster pump switch—HIGH.
12. Fire guard—ALERTED.

STARTING ENGINE.

1. Throttle and friction lock nut—RECHECK.
2. Starter button—PRESS.
3. Ignition switch—BOTH.
4. Primer switch—AS REQUIRED.
5. Mixture lever—RICH.
6. Engine oil pressure and temperature gages—CHECK.
7. Throttle—1250–1400 ENGINE RPM.
8. Manifold pressure purge button—PRESS.
9. Voltmeter—CHECK.
10. Inverter switch—SPARE-OFF-MAIN.
11. Fuel quantity test switch—AS REQUIRED.
12. Carburetor heat lever—HOT then COLD.

ENGINE WARM-UP.

1. Throttle—1250–1400 ENGINE RPM.

IGNITION SWITCH CHECK.

1. Ignition switch—BOTH.
2. Throttle—CLOSED.

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3. Ignition switch—OFF—momentarily.
4. Ignition switch—BOTH.

ENGINE DRIVEN FUEL PUMP CHECK.

1. Fuel booster pump switch—OFF.
2. Fuel pressure gage—CHECK.
3. Fuel booster pump switch—HIGH or ON.

ENGINE IDLE SPEED CHECK.

1. Throttle—CLOSE.

STARTING ROTORS.

1. Throttle—1200 ENGINE RPM.
2. Collective pitch—DOWN and LOCKED.
3. Cyclic stick and directional pedals—NEUTRAL.
4. Rotors—ENGAGE.
5. Transmission oil pressure gages—CHECK.
6. Hydraulic boost valve lever—A/P OFF/BOOST ON.
7. Auxiliary power plant—DISCONNECTED.
8. Battery switch—ON.
9. Radio switches—ON.

BEFORE TAXIING.

1. Personnel—IN POSITION.
2. Chocks—REMOVED.
3. Wheel parking brake knob—PUSH DOWN.
4. Nose wheel lock handle—DOWN.
5. Area—ALL CLEAR.
6. Voltmeter—CHECK.
7. Battery switch—EMERG then ON.
8. Carburetor air temperature gage—CHECK.
9. Supercharger control operation—CHECK.
   a. Throttle—1600 ENGINE RPM.
   b. Supercharger switch—HIGH.
   c. Collective pitch lever and throttle—25 inches Hg at 2300 rpm.
   d. Supercharger switch—LOW.
10. Ignition system—CHECK.
    a. Ignition switch—"L" observe rpm.
    b. Ignition switch—BOTH.
    c. Ignition switch—"R" observe rpm.
    d. Ignition switch—BOTH.
11. Transmission oil temperature gages—CHECK.
12. Transmission oil pressure gages—CHECK.
13. Overrunning clutch—CHECK.

CUT ON BLACK LINE

CUT ON BLACK LINE

14. Fuel pressure gage—CHECK.
15. Engine oil pressure gage—CHECK.
16. Engine oil temperature gage—CHECK.
17. Cylinder head temperature gage—CHECK.
18. Carburetor air temperature gage—CHECK.
19. Dual tachometer—CHECK.
20. Radio switches—ON and CHECK.
21. Compass—CHECK.

TAXIING.

1. Throttle—2000–2300 ENGINE RPM.
2. Nose wheel lock handle—RECHECK.
3. Wheel parking brake knob—RECHECK.
4. Collective pitch lever—AS REQUIRED to move or stop.
5. Cyclic stick.
   a. FORWARD to start.
   b. REARWARD to stop.
6. Directional pedals—AS REQUIRED.
7. Flight instruments—CHECK.

TAKE-OFF.

BEFORE TAKE-OFF.

1. Attitude indicator—SET.
2. Gyro magnetic compass switch—AS DESIRED.
3. Altimeter—SET.
4. Crew and passengers—ALERTED.
5. Longitudinal stick positioner wheel and indicator—ZERO.
6. Collective pitch lever—UNLOCKED.
7. Flight controls—CHECK.
8. Supercharger switch—LOW.
9. Fuel booster pump switch—HIGH or ON.
10. Mixture lever—RICH.
11. Carburetor heat lever—COLD.
12. Nose wheel lock handle—AS DESIRED.
13. Wheel parking brake knob—DOWN.
14. Shoulder harness inertia reel lock handle—FORWARD.
15. Area—CHECK.

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Hovering Take-Off.

1. Collective pitch lever—DOWN.
2. Throttle—2500–2700 ENGINE RPM.
3. Collective pitch lever—INCREASE.
4. Hovering altitude—WHEELS 10 FEET OFF GROUND.
5. Cyclic stick and directional pedals—AS REQUIRED.
6. Throttle—MAINTAIN TAKE-OFF RPM.
7. Control forces—CHECK.
8. Power check—CHECK.
9. Instruments—CHECK.
10. Cyclic stick—DISPLACE.
11. Throttle—MAINTAIN TAKE-OFF RPM.

Rolling Take-Off.

1. Collective pitch lever—DOWN.
2. Throttle—MAXIMUM AVAILABLE POWER.
3. Cyclic stick—FORWARD to accelerate; AFT at 50 knots.
4. Collective pitch lever—INCREASE.
5. Throttle—MAINTAIN TAKE-OFF RPM.

Vertical Take-Off.

1. Collective pitch lever—DOWN.
2. Throttle—2500–2700 ENGINE RPM.
3. Collective pitch lever—INCREASE.
4. Rise vertically—CLEAR OF OBSTACLES.
5. Cyclic stick—DISPLACE.
6. Throttle and collective pitch lever—MAINTAIN TAKE-OFF POWER.

AFTER TAKE-OFF—CLIMB.

1. Throttle—2500 ENGINE RPM.
2. Collective pitch lever—46.5 INCHES HG.
3. Cyclic stick—AS REQUIRED.
4. Mixture lever—NORMAL.
5. Cylinder head temperature gage—CHECK.

CRUISE.

1. Cyclic stick—DISPLACE.
2. Longitudinal stick position indicator—CHECK.
3. Stick positioner wheel—ADJUST.
4. Centering device release switch—DEPRESS, then RELEASE.
5. Supercharger—DESLUDGE.

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LANDING.

BEFORE LANDING.

1. Crew and passengers—ALERTED.
2. Rescue boom and cable—SECURED.
3. Altimeter—SET.
4. Supercharger switch—LOW.
5. Fuel booster pump switch—HIGH or ON.
6. Mixture lever—RICH.
7. Fuel tanks selector switches—CHECK.
8. Hydraulic boost pressure gage—CHECK.
9. Wheel parking brake knob—AS REQUIRED.
10. Nose wheel lock handle—AS REQUIRED.
11. Landing area—CHECK.
12. Landing light or search light switches—AS DESIRED.
13. Shoulder harness inertia reel lock handle—FORWARD.
14. Airspeed—60 KNOTS IAS.
15. Carburetor heat lever—COLD.

Normal Approach (Straight In).

1. Altitude—500 feet.
2. Airspeed—60 KNOTS IAS.
3. Throttle—2400 ENGINE RPM.
   a. IAS—60 Knots.
4. Collective pitch—Maintain 20–25 inches Hg.
5. Cyclic flare—100–150 feet.

Slow, Steep, Approach.

1. Throttle—2500 ENGINE RPM (500 feet).
2. Airspeed—40 KNOTS IAS.
3. Collective pitch—DOWN.

180-Degree Approach.

1. Altitude—500 FEET (180 degrees downwind).
2. Airspeed—80 KNOTS IAS.
3. Throttle—2400 ENGINE RPM.
4. Collective pitch lever—20–25 INCHES HG.
5. Airspeed—60 KNOTS IAS.
6. Cyclic flare—100–150 feet.

Transition From Approach To Hovering.

1. Throttle—2500–2700 ENGINE RPM.
2. Collective pitch lever—ADJUST.

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Up-Slope Landing.

1. Nose wheel lock handle—UP.
2. Toe brakes—DEPRESS and LOCK.
3. Throttle—2500 ENGINE RPM.

Cross-Slope Landings.

1. Nose wheel lock handle—UP.
2. Toe brakes—DEPRESS and LOCK.
3. Throttle—2500 ENGINE RPM.
4. Cyclic stick—DISPLACED towards slope.
5. Collective pitch lever—DOWN.
6. Centering device release button—PRESS.

Running Landing (Tactical).

1. Nose wheel lock handles—DOWN.
2. Cyclic stick—REARWARD slowly (75–100 feet).
3. Flight controls—POSITION for landing attitude (10–15 feet).
4. Throttle—2500 ENGINE RPM.
5. Collective pitch lever—UP SMOOTHLY.
6. Cyclic stick—REARWARD (as power is applied).

GO-AROUND.

1. Flight controls and throttle—AS REQUIRED.

AFTER LANDING.

1. Throttle—2300–2500 ENGINE RPM.
2. Collective pitch lever—AS DESIRED.
3. Nose wheel lock handle—DOWN.

POSTFLIGHT ENGINE CHECK.

1. Toe brakes—DEPRESS and SET.
2. Transmission oil pressure and temperature gages—CHECK.
3. Ignition system—CHECK.
4. Collective pitch lever—DOWN and LOCKED.
5. Throttle—CLOSE.
6. Friction clutch switch—DISENGAGE.
7. Idle mixture—CHECK (with primer).
   a. Mixture lever—RICH.
   b. Throttle—1000 ENGINE RPM.
   c. Primer switch—FLICK.

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8. Without primer—CHECK.
   a. Cylinder head temperature gage—150°C Minimum.
   b. Mixture lever—RICH.
   c. Throttle—1000 ENGINE RPM.
   d. Mixture lever—NORMAL to RICH.
   e. Mixture lever—RETARD.
9. Ignition switch—CHECK.
10. Oil dilution—CHECK.

STOPPING OF ENGINE AND ROTORS.

1. Mixture lever—IDLE CUT-OFF.
2. Ignition switch—OFF.
3. Friction clutch switch—ENGAGE (if desired).

BEFORE EXIT FROM HELICOPTER.

INTERIOR CHECK.

1. Friction clutch switch—ENGAGE, OFF.
2. All other switches—OFF.
3. Radio switches—OFF.
4. Wheel parking brake knob—PUSH DOWN.
5. Nose wheel lock handle—AS REQUIRED.
6. DD Form 781—CHECK.

AFTER EXIT FROM HELICOPTER.

1. Exterior inspection—COMPLETE.
2. Discrepancies—Enter in DD Form 781.

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APPROACH & LANDING POWER-OFF

1. Approach: Establish an airspeed of 50 knots for weights up to 12,000 pounds and 60 knots for weights over 12,000 pounds. The rotor speed just prior to the flare should be 300 rpm (when sufficient time and altitude are available).

2. Flare: Make flare primarily with the cyclic control, starting at an altitude of approximately 80 feet for smooth terrain and 150 feet for rough terrain. Execute the flare in such a manner that as little as possible collective pitch is used.

3. Touch down airspeed: Maintain so that airspeed at point of touch down is 25 to 35 knots on smooth terrain (little or no forward roll on rough terrain).

4. After touch down of the main wheels: Do not apply any additional collective pitch and use little or no aft cyclic control until the nose wheel is safely on the ground.

5. Stopping: Use rearward cyclic whenever possible to bring the helicopter to a stop. Use toe brakes.

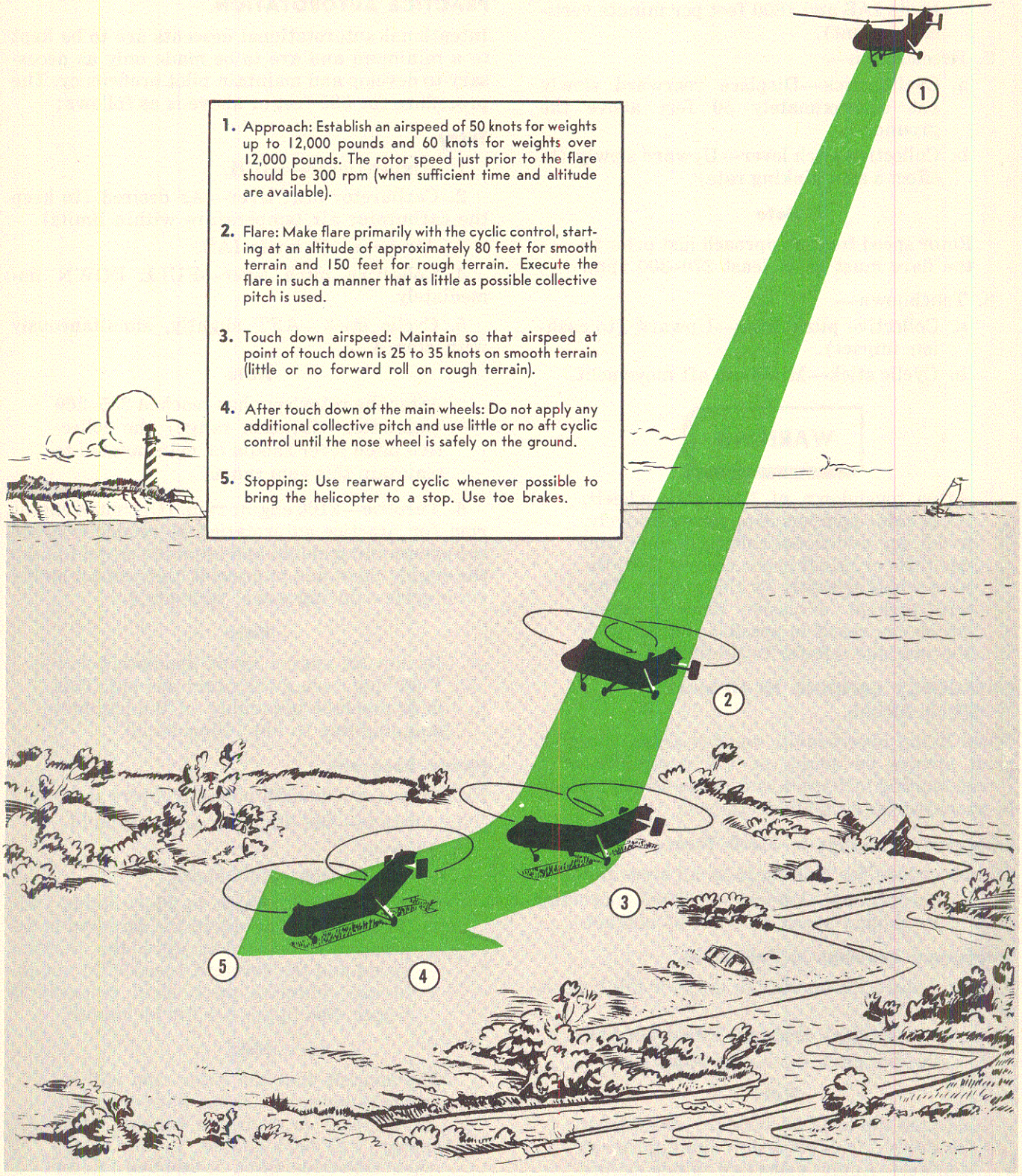


Figure 3-3

Autorotative Landing (continued)

1. Approach—
   a. Collective pitch lever—As required (to maintain 270–300 rotor rpm).
   b. Cyclic stick—As required (to maintain 60 knots IAS and 1800 feet per minute vertical descent).
2. Deceleration—
   a. Cyclic stick—Displace rearward slowly (at approximately 50 feet above the ground).
   b. Collective pitch lever—Upward slowly (to effect a slow sinking rate).

Note

Rotor speed for the approach just prior to the flare must be at least 270–300 rpm.

3. Touchdown—
   a. Collective pitch lever—Upward (to cushion impact).
   b. Cyclic stick—Minimum aft movement.

WARNING

After touchdown of the main wheels, when rotor rpm has dropped excessively, avoid any additional collective pitch and use little or no aft cyclic control until the nose wheel is safely on the ground. This will prevent excessive blade flapping which can result in possible contact with the fuselage. (Refer to Section VI.)

EMERGENCY LANDING IN HEAVILY WOODED AREAS.

When flying over heavily wooded areas, the pilot must always be aware of the possibility of a forced landing into trees, and, consequently, should be prepared for such an emergency.

Emergency Landings in Small Trees.

The procedure for landing in small trees follows:

1. Autorotational landing — Effect normally with zero ground speed at point of contact.

Emergency Landings in Tall Trees.

The procedure for landing in large or tall trees is as follows:

1. Autorotational descent—Effect normally.
2. Collective pitch lever—As required.

Note

At tree top level all forward speed must be stopped to effect a slow sinking rate at contact. Apply collective pitch before contact.

3. Ignition switch—OFF.
4. Battery switch—OFF.
5. Engine fluids switch—OFF.
6. Throttle—CLOSED.

PRACTICE AUTOROTATION.

Intentional autorotational descents are to be kept to a minimum and are to be made only as necessary to develop and maintain pilot proficiency. The procedure for 500 feet or above is as follows:

Entry.

1. Mixture lever—RICH.
2. Carburetor heat lever—As desired (to keep the carburetor air temperature within limits).
3. Airspeed—60 knots IAS.
4. Collective pitch lever—FULL DOWN immediately.
5. Cyclic stick—AFT slightly, simultaneously with step 4.

Note

After the rotor rpm has reached 235–260 (minimum vibration range) the collective pitch lever should be manipulated to maintain this rpm range.

6. Throttle—2100 engine rpm. (Optimum engine rpm for practice autorotation to reduce wear on the overrunning clutch and adjacent parts, to keep the engine clear, and to prevent high impact on the rotor system during power recovery.)

Note

Do not let engine speed decrease below 1500 rpm during voluntary descent. This is to preclude possibility of the engine's stopping due to low idling speed.

Power Recovery.

Procedure for a smooth power recovery is:

1. Altitude—100–150 feet above ground.
2. Flare—
   a. Cyclic stick—AFT slowly.
   b. Airspeed—Diminish to 20–30 knots IAS. (The altitude at which the airspeed is decreased is dependent upon the vertical speed and the forward speed.) Do not increase collective pitch until recovery is begun. See figure 3-4 for technique.

Note

The amount that the rotor rpm will increase is dependent on the flare executed. An increase is desirable because more energy will be available to the rotors when collective pitch is applied. Refer to Appendix for detailed information.

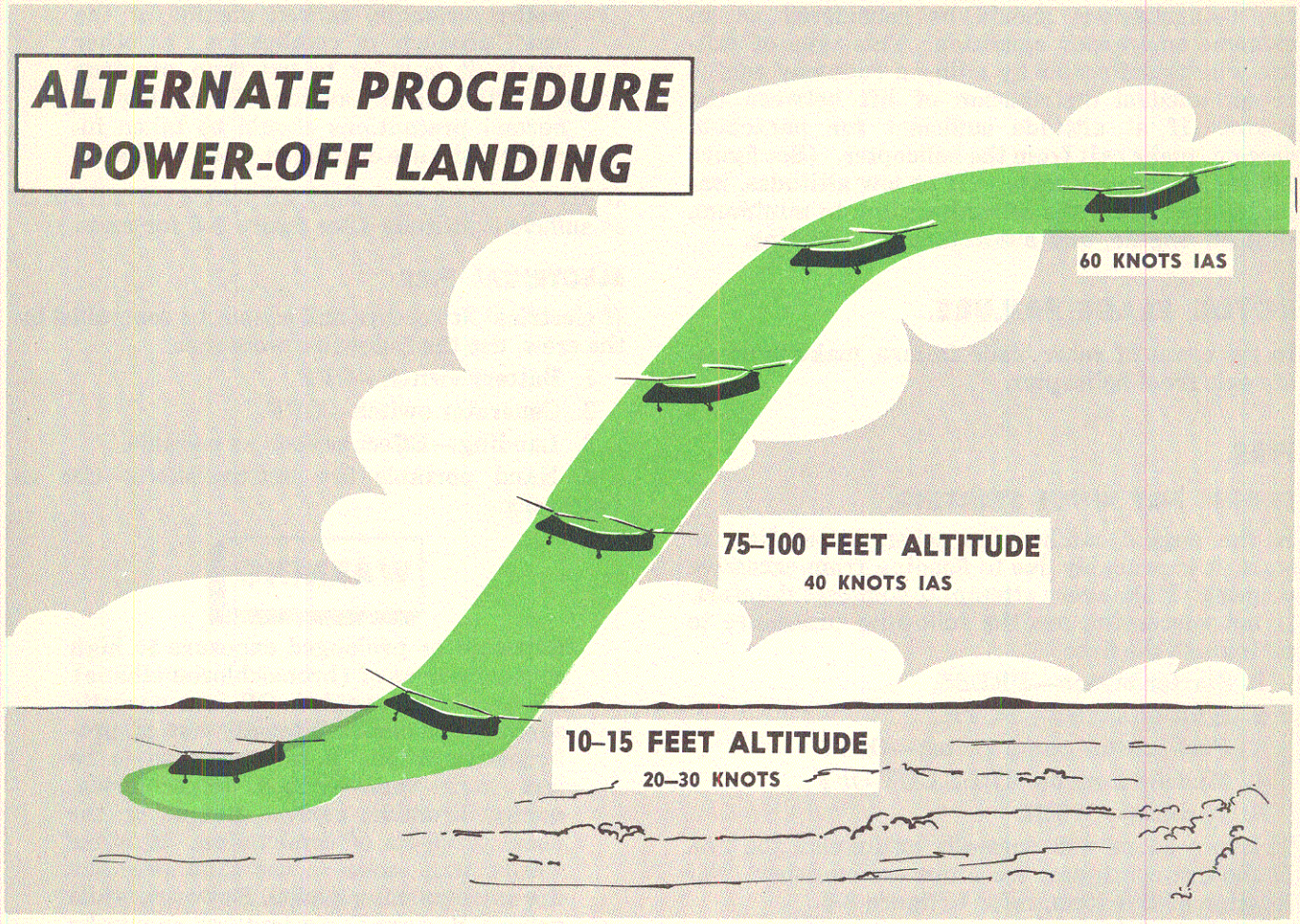


Figure 3-4

3. Collective pitch lever—UP (at the end of the flare when the helicopter is no higher than 10 feet above the ground to bring the rotor rpm back to the normal operating range). A noticeable decrease in lift and a settling of the helicopter will be evident as energy from the flare is lost.

4. Throttle—Increase slowly (until the engine and rotor rpm are synchronized, but not until rotor speed is within the operating range of the engine).

CAUTION

Extreme care must be taken in handling the engine controls during power recovery from autorotation. Incorrect application of throttle can cause overspeed and require replacement of the engine.

Execution of power recovery as outlined prevents engine overspeed and extreme shock loads to the rotor system. In addition, the pilot becomes familiar with the effect of collective pitch required for emergency power-off landings.

Touchdown.

This maneuver is executed the same for Autorotative Landing with Minimum Forward Speed.

TRANSMISSION FAILURE.

Trouble developing in the forward, mid or aft transmission can be identified by excessively high oil temperature or excessively high or low oil pressure, as indicated by the instruments and warning lights. Should these indicators warn of difficulty, land as soon as possible with minimum use of power. Should a warning occur while over water or unlandable terrain, attempt to reach the closest landable area at minimum altitude, 10–25 feet, and slow airspeed, 20–40 knots IAS. This will lessen the chance of injury to personnel or damage to the helicopter in event of complete failure. The decision to land or continue flight is left to the pilot.

DRIVE SYSTEM FAILURE.

Failure of the rotor drive system resulting in the severance of the interconnecting shafts between

the transmissions should be considered as an extreme emergency condition. This type of failure will be noticeable by either a runaway engine or an unequal distribution of lift between the rotors. If at altitude sufficient for parachute descent, make exit from the helicopter. (See figure 3-5 for emergency exits.) If at low altitudes, immediately reduce the collective pitch to minimum, shut off engine, and autorotate to a landing.

ROTOR BLADE FAILURE.

In the event of rotor blade failure, make immediate exit from helicopter.

FIRE.

ENGINE FIRE WHEN STARTING.

If the engine catches fire when attempting to start, it is probably due to flooding from excessive priming. Make every attempt to complete the start. If not successful, use the following procedure to extinguish the fire:

1. Starter button—PRESS.
2. Ignition switch—BOTH.
3. Fuel booster pump switch—OFF.
4. Mixture control—IDLE CUT-OFF.
5. Throttle—OPEN.

This procedure will normally extinguish the fire. If the fire continues, use a fire extinguisher. For location of this item, refer to figure 3-6.

ENGINE FIRE DURING FLIGHT.

If engine catches fire during flight, proceed as follows:

1. Collective pitch lever—Reduce to autorotative position.
2. Throttle—CLOSED.
3. Mixture lever—IDLE CUT-OFF.
4. Engine fluids switch—SHUT-OFF.
5. Ignition switch—OFF.

The choice to autorotate to a landing or bail out is left to the pilot's discretion. (See figure 3-5 for emergency exits.)

FUSELAGE FIRE.

1. Fire extinguishers—Use as necessary.

WARNING

Repeated or prolonged exposure to high concentrations of (bromochloromethane) CB should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, carbon dioxide or the usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. While using CB, normal precautions should be taken including the use of oxygen when available.

If fire cannot be controlled, all personnel bail out if at sufficient altitude (See figure 3-5 for exits.)

ELECTRICAL FIRE.

If electrical fire occurs and cannot be controlled by the crew, use the following procedure:

1. Battery switch—OFF.
2. Generator switch—OFF.
3. Landing—Effect as soon as possible.
4. Hand portable fire extinguishers—Use as necessary.

WARNING

Repeated or prolonged exposure to high concentrations of (bromochloromethane) CB should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, carbon dioxide or the usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. However, while using CB, normal precautions should be taken including the use of oxygen when available.

SMOKE ELIMINATION.

1. Cockpit Windows—OPEN (after the fire is extinguished).
2. Rescue and main entrance doors—OPEN.

Note

Yaw helicopter to left to create air flow out the main entrance door.

3. Window snap vents—OPEN (to increase ventilation if desired).

OPERATION WITH FLAT TIRES.

DURING OR PRIOR TO LANDING.

In the event that a tire becomes deflated during flight or on touchdown, use extreme care while landing. Do not attempt a roll-on landing.

Note

Land on sod or dirt, whenever possible, to prevent damage to wheel castings.

NEW ENGINE LIMITATIONS.

Note

Discussion with the helicopter engine manufacturer reveals that each new engine is subjected to 5–15 hours of test operation prior to release of this engine to the field. Factory overhauled engines also receive similar treatment. It is believed, therefore, that although the recommendations below are desirable when time and conditions permit, there is no positive necessity for this procedure.

The following limitations should be followed for the first 10 hours after a new or overhauled engine has been installed in a helicopter:

1. Operate at minimum gross weight.
2. Conduct all flight operations at 2350 engine rpm.
3. Use the minimum manifold pressure required to take-off and to perform initial hovering. Take-off slowly. A rapid take-off requires excessive power.
4. Eliminate all unnecessary hovering.
5. Climb at reduced power.

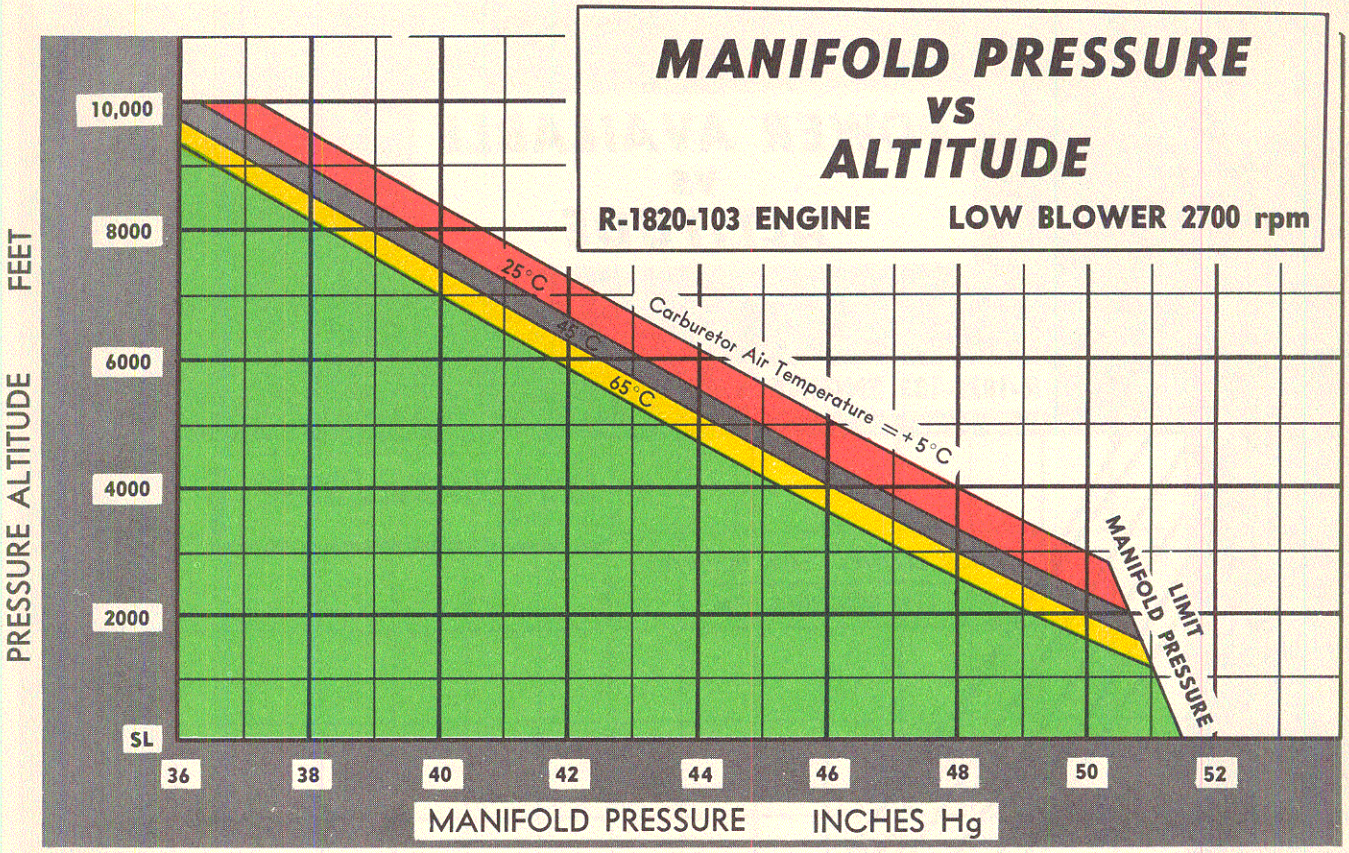


Figure 5-3

6. Avoid the following maneuvers:
   a. Autorotation.
   b. High speed flight.
   c. Quick starts.
   d. Quick stops.

These flight maneuvers require rapid changes in power and high power settings, both of which are detrimental to new engine operation.

7. Conduct cruising flight at 70 knots TAS to permit the use of minimum power.

By complying with the above recommendations, maximum engine life should be realized.

ROTOR LIMITATIONS.

In powered flight, do not operate rotors at less than 235 rpm. This figure represents the minimum rpm for safely entering autorotation in the event of sudden power failure. During transition from powered to autorotative flight, the rotor speed may temporarily drop to as low as 210 rpm. However, continuous operation at rotor speeds below the green line range on the rotor tachometer is prohibited. Refer to figure 5-1 for limitations and to Section VI for flight characteristics in autorotation.

Note

If the engine stops and cuts in again during flight, the blades should be given thorough postflight inspection for cracks.

AIRSPEED LIMITATIONS.

The maximum forward speed of the helicopter is restricted to 100 knots.

PROHIBITED MANEUVERS.

Aerobatics are prohibited in the helicopter.

FLIGHT RESTRICTIONS.

See Section IX for restricted flight under IFR conditions and in heavy rain.

FLIGHT CONTROL LIMITATIONS.

Under certain extreme control conditions, it has been found possible to excite large blade flapping

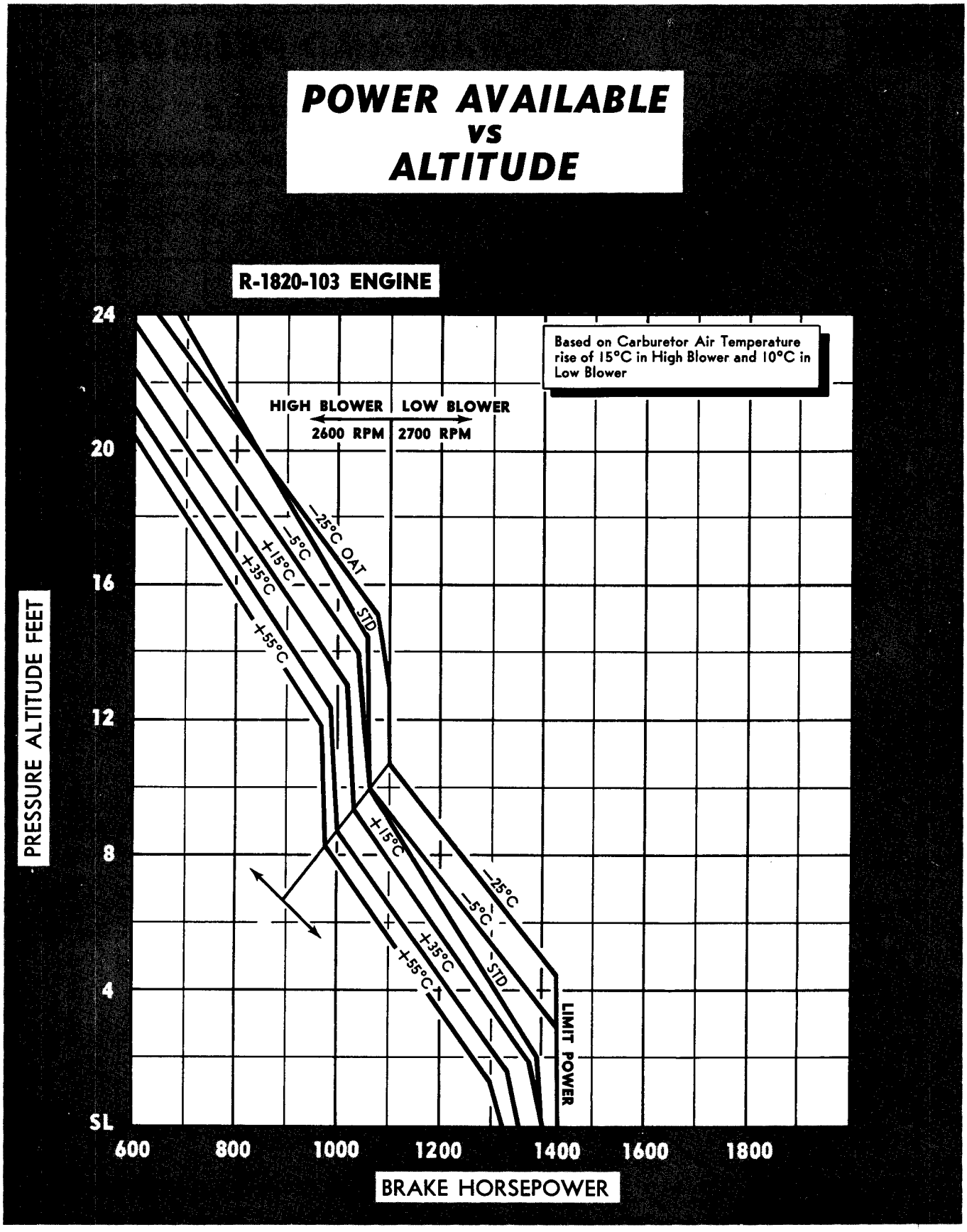

POWER AVAILABLE
VS
ALTITUDE
R-1820-103 ENGINE
Based on Carburetor Air Temperature rise of 15°C in High Blower and 10°C in Low Blower
HIGH BLOWER
2600 RPM
LOW BLOWER
2700 RPM
PRESSURE ALTITUDE FEET
24
20
16
12
8
4
SL
600
800
1000
1200
1400
1600
1800
BRAKE HORSEPOWER
-25°C OAT
-5°C
+15°C
+35°C
+55°C
STD
LIMIT POWER

Figure 5-3A

lector switch should be stopped in the BOTH position for at least 10 seconds to ensure uninterrupted fuel flow.

Normal Operation—Main and External Tanks.

1. Carburetor vapor return line selector valve—MAIN TANK.
2. Main booster pump switch—ON.
3. Main tank fuel selector switch—ON.

Note

When operating with fuel in main and both external fuel tanks, the first 20 minutes of flight must be on MAIN tank only to avoid overflow of fuel from main tank due to carburetor vapor return.

4. External tanks fuel selector switch—OFF.
5. Fuel quantity check switch—Check RIGHT tank, check LEFT tank. (With main tanks fuel selector switch ON and external tanks fuel selector switch OFF, fuel quantity gage will register fuel quantity in main tank.)
6. External tanks jettison switch—NORMAL.
7. Engine fluids switch—NORMAL.

FUEL TANK SELECTION PROCEDURE.

With main and both external fuel tanks fully serviced, the following procedure is suggested for switching from main fuel tank to either left or right external fuel tank:

1. Carburetor vapor return line manual selector valve—MAIN TANK.
2. Main booster pump switch—ON.
3. Main tank fuel selector switch—ON.
4. External tanks fuel selector switch—BOTH.

Note

When switching from main to external fuel tanks, the main tank and the external tanks fuel selector switches must both be in operation for at least 10 seconds to ensure an uninterrupted fuel flow at the carburetor.

5. Main tank fuel selector switch—OFF.
6. Main booster pump switch—OFF.
7. External tanks fuel selector switch—LEFT or RIGHT as desired.

TRANSMISSIONS.

TRANSMISSION OIL TEMPERATURE.

There is no minimum. The transmission oil will be warm enough for take-off by the time the engine is warmed up. Normal operating temperature of the transmissions is 65–75°C. However, the operating temperatures vary with the outside temperature and it is permissible to operate at a stabilized temperature to the limit of the red line (maximum) on the temperature gage.

TRANSMISSION OIL PRESSURE.

The oil pressure of the forward, mid and aft transmissions will normally be observed at 55–65 psi. However, the pressure will vary with conditions and it is permissible to operate at a stabilized pressure within the range of the red lines on the pressure gage. The transmission oil pressure warning light on the instrument panel will light if the pressures are less than or more than the red line markings on the pressure gage. The warning light may function during the warming up or idling periods due to reduced oil pressures at low rpm. The light may also illuminate when the engine oil has been exposed to low temperatures. Cold oil will probably cause high oil pressure after starting because it is thick. The red warning light will remain on until the oil is heated to normal consistency.

Note

During autorotative landing with high rotor rpm, the transmission oil pressures can build up as high as 100 psi. Under these conditions the warning light will come on. This is not an indication of a malfunction and is normal, provided that:

1. Warning light was not on prior to autorotation.
2. Warning light goes out when normal rotor rpm is resumed.

TRANSMISSION WARNING LIGHTS.

Transmission temperature and pressure warning lights can be actuated by any one of the following:

1. Oil pressure below the low limit.
2. Oil pressure above the high limit.
3. Oil temperature above the high limit.
4. Malfunction of the warning light system.

In the event that a warning light illuminates but the temperature and pressure remain normal (stabilized at or within the red line limits), the pilot can continue his flight and investigate the cause upon landing. Refer to Section III.

BEFORE STABILIZATION.

It is permissible to take off with excessive transmission pressure and the red warning light on, since the indicated pressure may exceed the maximum continuous operating pressure when the oil temperature is low and take-off rpm is applied. However, during flight the temperature and pressure must be checked for stabilization within the normal operating range. If stabilization is not obtained in 15 minutes, land as soon as possible.

AFTER STABILIZATION.

During normal flight, the temperature and pressure will be stabilized within the limits shown on the indicator. Illumination of a warning light, confirmed by reference to the appropriate indicator, dictates the urgency of landing as soon as possible. Refer to Section III.

ROTOR CLUTCH.

CLUTCH ACTUATOR CHECK.

The friction and jaw clutch switches should be placed on, in proper sequence, to check the actuator cycle. This test should be made twice by the pilot, while a crewmember watches the actuator arm from the left side of the mid transmission.

This is necessary since too much torque can be applied to the clutch actuator motor and cause it to slip. This slippage will be apparent (with the clutch switch in the DISENGAGE position) by continued illumination of the clutch warning light on the console. This condition permits the clutch actuator to move the clutch engaging mechanism directly into the jaw position thereby damaging the rotor system.

The arm is upright when both clutches are disengaged. It moves aft for friction clutch engagement and down at 45 degrees for jaw clutch engagement. This visual check will show that the actuator arm is working through its full range of travel and stopping at its designated points to minimize the possibility of damage to the helicopter resulting from actuator failure.

Preflight Check Procedure.

This detailed check procedure shall be performed prior to each starting of the engine. A qualified crewmember, perhaps a co-pilot or mechanic, should stand in the cargo-passenger compartment adjacent to the clutch, where he can observe the clutch actuator.

Pilot	Crewmember
1. Friction clutch switch—ENGAGE.	Observe that desired action takes place and signal confirmation to the pilot.
2. Jaw clutch switch—ENGAGE.	
3. Friction clutch switch—DISENGAGE.	

CLUTCH ENGAGING LIGHT CHECK.

This check should be made simultaneously with the Clutch Actuator Check. The amber jaw clutch light on the console is operated by two interdependent microswitches. One is mechanically actuated, and the other is actuated by oil pressure. The mechanically actuated switch is set to break the light circuit when the jaw clutch is in full engagement position. This will cause the light to go out (provided there is oil pressure in the mid transmission). If the light does not go out after the visual Clutch Actuator Check has been made and when there is pressure in the mid trans-

mission, it is probable that the limit switches in the clutch actuator are malfunctioning. This warrants shut-down and inspection for adjustment or repair except when flight is absolutely necessary. The procedure to follow in an emergency to determine engagement status is to perform the Functional Engagement Check presented under Rotor Clutch Engagement.

ROTOR CLUTCH ENGAGEMENT.

CAUTION

Rotor engagement must not be attempted when the clutch warning light is already on. Under this condition the clutch will travel immediately into the jaw position instead of starting friction engagement. The resultant damage to the rotor system will be the same as during any other premature jaw clutch engagement.

To engage the rotors, first throttle the engine to indicate 1200 rpm. Lift the guard from the friction clutch switch, and place the switch in the FRICTION position. Lock switch in this position with the guard. Maintain constant throttle setting until the engine tachometer indicates approximately 900 rpm. This throttle setting may then be maintained until engine and rotor rpm are synchronized. Engine and rotors should synchronize in 8–15 seconds. An adjustment of the friction clutch may be required if engagement requires more or less time than aforementioned. Do not permit engine speed to drop below 800 rpm during engagement.

Note

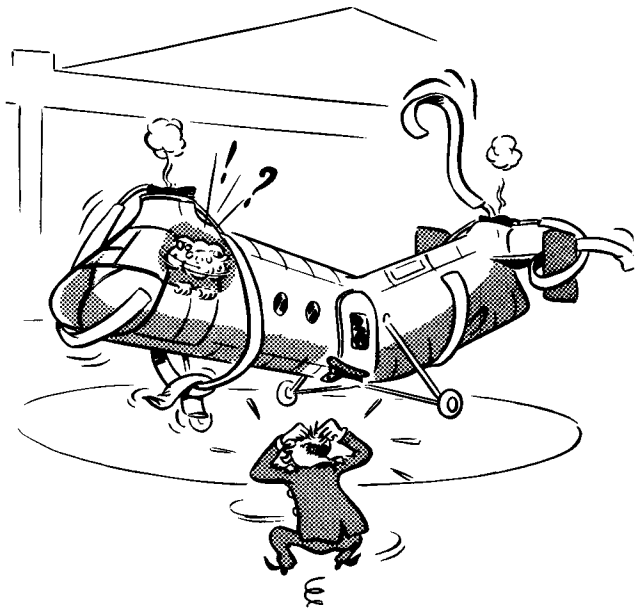
If, while engaging the clutch, the engine speed is allowed to drop below 800 rpm, and it is necessary to disengage the clutch to prevent stalling the engine, the clutch actuator need not be cycled before re-engagement; provided the clutch has not been operated beyond the FRICTION position.

The jaw clutch may be engaged only when the tachometer needles are synchronized. Synchronization of the needles is essential during the entire time required for jaw clutch engagement. The jaw clutch light will go out when clutch is fully engaged. Release the jaw clutch spring-loaded switch; it will return to the OFF position. The friction switch must remain in the FRICTION position until the clutch is to be disengaged.

CAUTION

In the event the jaw switch is actuated before synchronization of engine and rotor rpm, shut down immediately and inspect rotor and drive system for damage.

Disengage clutch immediately if oil pressures are not indicated in the forward, mid, and aft transmissions within approximately two minutes.



CAUTION

Make certain the rotor and engine tachometer needles are synchronized before engaging jaw clutch.

FAILURE OF JAW CLUTCH TO ENGAGE.

It is possible that the clutch actuator will satisfactorily engage the friction clutch but will fail to engage the jaw clutch. This condition generally results from low battery voltage, but it may also be the result of defective actuator wiring or a high slip clutch torque setting which causes the actuator motor to stall. To determine if the condition is merely the result of low battery voltage, the following procedure is recommended:

1. With friction clutch engaged and engine and rotor rpm synchronized, slowly increase engine rpm to a point where the voltmeter indicates the generator is charging (approximately 1300–1500 engine rpm).

CAUTION

Do not increase engine rpm unless needles are synchronized, as this may result in damage to the friction clutch due to excessive heat from slippage.

2. When the generator is charging, the jaw clutch switch may be placed in the ENGAGE position.

CAUTION

Do not run up engine when friction clutch only is engaged. Such action warps the bronze friction plates and discolors the steel plates due to the extreme heat generated when the clutch plates slip.

If the actuator still fails to engage the jaw clutch, the actuator is defective and must be replaced.

3. If an auxiliary power unit is available, a jaw clutch engagement should be attempted with the APU plugged in and the battery switch turned OFF.

CAUTION

If an APU is used, make certain that it is disconnected immediately after the jaw clutch is engaged to prevent a possible take-off with the APU still attached to the helicopter.

MANUAL CLUTCH ENGAGEMENT.

Should the electric clutch actuator fail, it is possible to engage the clutch manually by using the clutch manual engagement wrench.

Note

This method of engagement is to be used as an emergency measure only. The circuit breakers and connections should be checked before resorting to manual engagement.

The following procedure must be followed with the pilot and an assistant acting in close coordination:

1. The clutch actuator linkage must be disconnected.

2. The manual engagement wrench is placed over the clip on the operating mechanism so that the large plug engages the hole in the operating cam, and the pin guide engages the slot in the jaw clutch cam.

3. The holes in the clip and the retainer in the wrench are aligned. Insert the pin attached to the wrench and lock in place with the hook.

4. After the wrench is installed and locked in place, and before the engine is started, several practice engagements and disengagements should be made to ensure that the installation is correct and that the wrench stops at the correct positions.

5. After the engine is started, the crewmember must wear earphones in order to clearly understand the pilot's instructions.

6. After the pilot has stabilized the engine rpm at 1200 he will instruct the crewmember to "engage friction." The crewmember will then rotate the wrench in a counterclockwise direction until the pin hits the jaw clutch cam follower bearing. At this position the friction clutch is fully engaged.

7. The crewmember will maintain the first stop position until the pilot instructs him to "engage jaw." The pilot must not ask for jaw engagement until engine and rotor rpm are synchronized and steady. Upon the pilot's signal, the crewmember will depress the lever on the side of the wrench handle. This raises the pin and allows the pin guide to pass over the jaw clutch cam follower bearing. The wrench may then be rotated counterclockwise until the jaw clutch is fully engaged. The crewmember will then notify the pilot that full engagement is completed. The wrench will remain attached while the actuator is inoperative.

8. To accomplish disengagement the crewmember, upon being alerted by the pilot, will take his station by the clutch. When the clutch is in an override condition, and upon the order "disengage," he will move the wrench to the fully disengaged position.

CAUTION

During manual engagement and disengagement the crewmember must wait at all times for verbal instructions from the pilot to perform each step of the procedure.

FUNCTIONAL ENGAGEMENT CHECK.

Check the clutch for proper functioning at 2300 engine rpm. While increasing throttle, watch to see that the tachometer needles stay together and show no tendency to split. Any tendency to split while increasing throttle would indicate slippage; therefore, it would be obvious that the jaw clutch was not engaged. At 2300 engine rpm, close the throttle rapidly so that the jaw coupling will override. If the needles split, indicating override, the clutch is functioning properly. If the needles should fail to split when throttle is decreased rapidly, the indication is that the friction clutch is engaged and the jaw clutch is not engaged. If the needles do not split, move the friction clutch switch to DISENGAGE. The needles should then split, and it is safe to stop the engine.

Note

In cold weather, it may be necessary to engage at a higher rpm but the engine speed should not exceed 1500 rpm nor fall below 800 rpm.

ROTOR CLUTCH DISENGAGEMENT.

In order to disengage the clutch system, it is necessary to take advantage of the overrunning action between the driver jaw (connected to the

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