12. AWAY INDICATION on WEAPON LAUNCH — CHECK.

Note

A successful launch will be indicated by the WEAPON LAUNCH going to AWAY for approximately 3 seconds. Visually confirm weapon is away.

13. WEAPONS SELECT — OFF.

Note

Selecting any new position with WEAPONS SELECT will cause MASTER ARM to go SAFE.

14. MASTER ARM — AS REQUIRED.

7.17.14.3 Mk 46 MOD 5A (SW) SLEP Torpedo Launching (With AN/ASQ-165A)

Note

Refer to NTTP 3-22.5-ASW (ASW Tactical Pocket Guide) for torpedo launch envelope and tactical employment.

1. System circuit breakers — IN.
2. Course thumbwheel — Set any position except P120.

CAUTION

Damage to presetter may occur if COURSE thumbwheel is in P120 position.

Note

The launching procedure shall be discontinued and restarted at step 1. If at any time during the presetting process, MASTER ARM is placed to SAFE, the other Weapons Station (PORT/STBD) is selected, electrical power is lost, or any steps are performed out of order.

3. MASTER ARM — ARM.
4. TORPEDO SELECT — AS REQUIRED.

WARNING

Once weapon station selection is made and the MASTER ARM pushbutton is in ARM, the torpedo will be ready for armed release. Due care shall be exercised to avoid inadvertent release.

CAUTION

To prevent damage to the ASDC and avoid improper torpedo presetting, allow a 10-second interval between depressions of the TORPEDO SELECT pushbutton.

5. STATUS READY light — CHECK ON.
6. RDY INDICATION on TORPEDO LAUNCH pushbutton — CHECK.
7. SRCH DPTH — 1,400.

Note

After 1,400 is selected, wait at least 1.2 seconds before continuing the checklist while tactical floor presetting functions are enabled.

8. MODE/CEIL — HATS.
9. Tactical floor — Course wheel set.

CAUTION

Selecting or dialing through P120 may cause presetting malfunctions/damage to presetter.

FOR TACTICAL FLOOR	SET COURSE WHEEL
125	P70
225	P35
325	0
425	S35
NO FLOOR	S70

10. SRCH DPTH — Select in accordance with normal ACIP SELECTIONS.

Note

- Do not select a search depth below the tactical floor.
- Do not reselect or allow SRCH DPTH thumbwheel to pass through 1,400 or tactical floor setting will be erased.

11. MODE/CEIL — Select in accordance with normal ACIP SELECTIONS.
12. COURSE — Select in accordance with normal ACIP SELECTIONS.

CAUTION

Selecting or dialing through P120 may cause presetting malfunctions/damage to presetter.

13. Torpedo arming — NS-TL.

Note

The launching procedure shall be discontinued and restarted at step 1. If at any time during the presetting process, MASTER ARM is placed to SAFE, the other Weapons Station (left/right) is selected, electrical power is lost, or any steps are performed out of order.

Upon capture of weapon FTP:

14. TORPEDO LAUNCH — PRESS.

CAUTION

Unless the MASTER ARM pushbutton has been set to SAFE after the TORPEDO LAUNCH pushbutton has been pressed, CAD firing and damage to BRU-14A bomb rack will occur if the torpedo launch pushbutton is again actuated when a READY INDICATION is present.

15. AWAY INDICATION on TORPEDO LAUNCH pushbutton — CHECK.

Note

AWAY will appear on the TORPEDO LAUNCH pushbutton in approximately 3 seconds, indicating a successful launch. Visually confirm weapon is away.

16. TORPEDO SELECT — SAFE.
17. TORPEDO ARM — SAFE.
18. MASTER ARM — AS REQUIRED.

7.17.14.3.1 Mk 46 MOD 5A (SW) SLEP Torpedo Launching (With AN/ASQ-198)

Note

Refer to NTTP 3-22.5-ASW (ASW Tactical Pocket Guide) for torpedo launch envelope and tactical employment.

1. System circuit breakers — IN.
2. Course thumbwheel — Set any position except 120L.

CAUTION

Damage to presetter may occur if course thumbwheel is in 120L position.

3. WEAPONS SELECT — PORT AFT, PORT FWD, or STBD AFT (as required).

Note

The launching procedure shall be discontinued and restarted at step 1. If at any time during the presetting process, MASTER ARM is placed to SAFE, WEAPONS SELECT knob is rotated out of current position, electrical power is lost, or any steps are performed out of order.

4. MASTER ARM — ARM.

WARNING

Once weapon station selection is made and the MASTER ARM pushbutton is in ARM, the torpedo will be ready for armed release. Due care shall be exercised to avoid inadvertent release.

5. Observe IFOBRL status indicator — UL.
6. TORPEDO STATUS TORP READY light — ON.
7. WEAPON LAUNCH READY light — ON.
8. SRCH DPTH — 6.

Note

After 6 is selected, wait at least 1.2 seconds before continuing checklist while tactical floor presetting functions are enabled.

9. MODE/CEIL — 3.
10. Tactical floor — Course wheel set.

CAUTION

Selecting or dialing through 120L may cause presetting malfunctions/damage to presetter.

FOR TACTICAL FLOOR	SET COURSE WHEEL
125	70L
225	35L
325	0
425	35R
NO FLOOR	70R

11. SRCH DPTH — Select in accordance with normal ACIP SELECTIONS.

Note

Do not reselect or allow SRCH DPTH thumbwheel to pass through 6 or tactical floor setting will be erased.

FOR SEARCH DEPTH	SET SEARCH DEPTH WHEEL
80	2
125	1
275	3
500	4
850	5
1400	6

Note

Do not select a search depth below the tactical floor.

12. MODE/CEIL — Select in accordance with normal ACIP SELECTIONS.

FOR MODE/CEILING	SET THUMBWHEEL
A20	1
A50	2
HATS	3
P20	4
P50	5
SNAKE	6

13. COURSE — Select in accordance with normal ACIP SELECTIONS (0 for circle search).

CAUTION

Selecting or dialing through 120L may cause presetting malfunctions/damage to presetter.

Note

The launching procedure shall be discontinued and restarted at step 1. If at any time during the presetting process, MASTER ARM is placed to SAFE, WEAPONS SELECT knob is rotated out of current position, electrical power is lost, or any steps are performed out of order.

Upon capture of weapon FTP:

14. WEAPON LAUNCH — PRESS.
15. AWAY INDICATION on WEAPON LAUNCH pushbutton — CHECK.

Note

AWAY will appear on the WEAPON LAUNCH pushbutton in approximately 3 seconds, indicating a successful launch. Visually confirm weapon is away.

16. WEAPONS SELECT — OFF (as required).
17. MASTER ARM — AS REQUIRED.

7.17.14.4 AGM-114 Hellfire Missile Launch/Training Procedure

1. System circuit breakers — IN.
2. HELLFIRE PWR — ON.
3. ACRT — Clear equipment status table faults/test (after system on for 15 seconds).

Note

- Displayed ACRT faults on the equipment status table may cause erroneous communication between AOP and the AHS, resulting in incorrect inhibits and constraints while in remote launch mode.
- Ensure VERSN 2002 is displayed in the Equipment Status Table beside ACRT/SDC prior to Hellfire launch operations. If VERSN 2002 is not displayed, initiate AOP test of the ACRT/SDC.

4. LASER CODES — ENTER/SELECT.
5. VCR — ON (tape inserted) and recording.
6. Laser eye protection (LEP) — VISORS DOWN.

For remote launch:

7. Select tactical page.
   a. Assign target.
   b. Assign remote designator.

For remote or autonomous launch:

8. FLIR main menu — SELECT.
   a. Laser code — CONFIRM.
   b. Laser select — AS REQUIRED.
9. FLIR attack page — SELECT.
   a. Launch mode —SELECT.
   b. CIG — SELECT.
   c. CCM — AS REQUIRED.
   d. Launch mode — Select REMOTE or AUTONOMOUS (as required).
   e. Priority missile/laser code — SELECT/VERIFY.

Note

- Occasionally, selection of a PIM code for an AGM-114K missile will result in failed missile symbology and an AOP "M299 Keyword Error" alert. This condition occurs when the keyword is corrupted during transmission to the M299 and is normally cleared by resetting the launcher.
- PIM codes require an installed and properly operating ACRT. Selection of a PIM code without an installed and operating ACRT will result in the LRD designating at the rangefinding PRF and weapon guidance failure.

   f. AUTO TRK mode — AS REQUIRED.

10. AVT lock on target — AS REQUIRED.
11. LASER ENABLE — AS REQUIRED.
12. WEAPON SELECT — PORT FWD.
13. MASTER ARM — ARM.
14. AOP ARM LRD cue — AS REQUIRED.
15. PWR/ARM — ON.

Note

M299 SAFE/ARM switch will move to arm position and CANNOT be reset to safe in flight.

16. MODE/JETT — AUTO.

CAUTION

Do not select MISSILE MODE/JETT-MAN unless operator intends to jettison M299 launcher.

17. Verify attack page alerts.
    a. WPN ARM.
    b. LASER ARMED — AS REQUIRED.
    c. Priority missile — SELECTED AND READY.
18. Position reticle.
19. Range find — AS REQUIRED.

After weapon release authority is obtained:

Note

For LOBL engagements, designate target prior to weapon launch.

20. RELEASE CONSENT — DEPRESS.
21. Designate target — AS REQUIRED.

WARNING

Ensure LASING alert disappears when laser trigger released. If the LASING alert remains displayed, refer to Uncommanded Lasing procedure.

Note

- The LASE NOW prompt will not appear if more than 10 seconds have elapsed since last valid range.
- Next Hellfire missile is available within 2 to 3 seconds of previous launch.

Upon completion of lasing or engagement:

22. AN/ASQ-198 WEAPON SELECT switch — OFF.
23. MASTER ARM — VERIFY SAFE.
24. PWR/ARM — OFF.
25. LASER — DISABLE.
26. VCR — OFF (as required).
27. HELLFIRE PWR — OFF.

7.17.14.5 Remote Lasing Checklist

1. System circuit breakers — IN.
2. HELLFIRE PWR — ON (if a PIM code is required).

3. ACRT — Clear EQUIPMENT STATUS TABLE FAULTS/TEST (after system on for 15 seconds).

Note

- Displayed ACRT faults on the equipment status table may cause erroneous communication between AOP and the AHS.
- Ensure VERSN 2002 is displayed in the equipment status table beside ACRT/SDC prior to Hellfire launch operations. If VERSN 2002 is not displayed, initiate AOP test of the ACRT/SDC.

4. Laser code — ENTER AND SELECT.
5. VCR — ON and recording.
6. LEP — VISORS DOWN.
7. ATO/SO FLIR — SELECT.
8. FLIR main menu select — Confirm laser code.
9. LASER — ENABLE.
10. AN/ASQ-198 WEAPON SELECT switch — NOSE.

Note

Laser will arm if the weapon select switch is in any position other than OFF.

11. MASTER ARM — ARM.
12. AOP ARM LRD cue — SELECT YES.

Note

- Certain keyset functions can interrupt live FLIR video. If the laser operator live FLIR video is interrupted, the laser will be disarmed. Thus, the MASTER ARM must be cycled (i.e., to SAFE and back to ARM) and the MPD ARM LRD cue must be selected to YES in order to rearm the laser.
- If repeat other is selected after the LRD is armed, the LRD will temporarily disarm while the operator is not viewing live FLIR video. In this case, returning to live FLIR video will automatically rearm the LRD.

13. AVT — LOCK ON TARGET.
14. Reticle — POSITION.
15. Laser status — Ensure LASER ARMED is displayed on the MPD.
16. Designate target laser trigger to 2nd detent — LASING DES alert is displayed on the MPD.

WARNING

Ensure the LASING alert disappears when the laser trigger is released. If the LASING alert remains displayed, refer to Uncommanded Lasing procedure.

Upon completion of lasing:

17. AN/ASQ-198 WEAPON SELECT switch — OFF.
18. MASTER ARM — SAFE.
19. LASER — DISABLE.
20. HELLFIRE PWR — OFF.

7.17.15 MAD Operational Checklists

7.17.15.1 MAD Deployment

CAUTION

MAD operations with FLIR pod mounted on the starboard weapons pylon are not recommended. Turbulence due to proximity of FLIR pod may impede safe recovery of magnetic anomaly detector.

1. MAGNETIC DETECTING SET PWR — ON.
2. MAD reeling machine POWER — ON.
3. Verify no fail lights, SYS READY light — ON.
4. Verify straight and level.
5. Verify airspeed 40 to 90 KIAS.
6. Verify altitude 200 feet AGL minimum.
7. Report — "READY TO DEPLOY MAD".
8. (When directed) REEL — OUT, commence timing.
9. Observe VEHICLE TRAIL light ON and report — "MARK TIME, VEHICLE TRAIL".
10. Verify CABLE LIMIT light — ON (within 61 seconds).

WARNING

If MAD bird is lost in flight, MAD cable shall be cut immediately at the reeling machine by activation of the EMER REL button.

CAUTION

MAD reeling machine power shall be secured after 61 seconds with no CABLE/MAD LIMIT light.

Note

- Some pitching and longitudinal surging of the MAD towed body can be expected within five feet of the pylon.
- If the MAD towed body stops at an intermediate position during deployment, the CABLE LIMIT light on the MAD reeling machine control panel and the MAD LIMIT light on the caution/advisory panel should flash continuously.
- If reeling machine power is lost or secured with MAD towed body deployed, MAD jettison circuits are inoperative.

11. Recenter REEL switch and report — “CABLE LIMIT”.
12. Conduct MAD operations.

7.17.15.1.1 MAD Altitude Compensation Procedure

1. Pilot — Climb to minimum of 2,000 feet.

Note

Higher altitude will produce better results due to less interference from geological sources.

2. Deploy the MAD.
3. Tune the compensator dial on the MAD amplifier for current part of the world.
4. Set the following controls to the given values:
   a. γ FS — 1.
   b. BANDPASS settings — .04 and .6.
   c. ALT COMP switch — ON.
5. Observe the displayable noise.
6. Make small adjustments to the compensator dial to attain minimum noise.
7. Pilot — Make small altitude excursion (±100 feet) to ensure no excessive noise exists.
8. Retrieve the MAD.

7.17.15.2 MAD Retrieval

1. γ FS — TST.
2. Verify straight and level.
3. Verify airspeed 40 to 90 KIAS (50 to 55 KIAS for last 12 feet).
4. REEL — IN.
5. Verify CABLE LIMIT light — OFF and report – “RETRIEVING, CABLE LIMIT LIGHT OFF”.

Note

- Some pitching and longitudinal surging of the MAD towed body can be expected within five feet of the pylon.
- If the MAD towed body stops at an intermediate position during retrieval, the CABLE LIMIT light on the reeling machine control panel and the MAD LIMIT light on the caution/advisory panel should flash continuously.

6. Verify VEHICLE TRAIL light — OFF.
7. MAD reeling machine POWER — OFF.
8. Report — “MAD STOWED, POWER SECURED”.
9. Secure from MAD operations.

7.17.16 Alternate Engine Start Procedures

7.17.16.1 Crossbleed Start

WARNING

- At 94 percent N_g, the aircraft will be light on it's wheels. Be vigilant for signs of dynamic rollover; maintain a centered cyclic and be prepared to lower collective quickly. Sideward tip path may increase possibility of dynamic rollover.
- The WOW switch may trigger, enabling AFCS functions associated with flight; keep collective trim switch depressed. Fuel Dump, Rescue Hoist shear, and Cargo Hook shear functions are enabled; keep personnel clear of the aircraft.
- For shipboard operations, request amber deck and slacken Main Landing Gear chains. Ensure chains do not become taut; dynamic instability may result.

CAUTION

- When attempting engine crossbleed starts with the engine intake cowling removed, a hot start may be experienced if the bleed air plug is not installed in the anti-ice bleed air line.
- Donor N_g less than 94 percent may result in hot starts.

Note

A full fuel load is recommended when conducting a crossbleed start to mitigate effects of a high power setting on deck.

1. Fireguard — Posted/area clear.
2. AIR SOURCE ECS/START switch — ENG.
3. ENG IGN switch — NORM.
4. Fuel Selectors — XFD/DIR (as required).
5. Collective — Increase to set minimum 94 percent N_g on operating engine.
6. Opposite Eng — START, normal procedures apply.
7. Collective — FULL DOWN.
8. PCL — FLY.
9. Fuel selectors — DIR.
10. Back up Hyd Pump — AUTO.
11. Check Torques matched within 5 percent.
12. Post Engagement — CHECKLIST PERFORM.

7.17.17 APU Turn-Up Checklist

1. Circuit breaker and switches — CHECKED AND OFF.
2. Rotor brake — ON.
3. BATT switch — ON.
4. Fire detector system — CHECK.
5. Fire guard posted, area clear.
6. Interior/Exterior/NVD lighting — AS REQUIRED.
7. APU — START.
   a. ECS — OFF.
   b. AIR SOURCE ECS/START switch — APU.
   c. FUEL PUMP switch — APU BOOST.
   d. APU CONTR switch — ON.
8. APU GENERATOR switch — ON.
9. Blade/pylon spread — AS REQUIRED.

CAUTION

- Should the blade fold system stall during spread, cycling the BLADE FOLD switch to FOLD should return the rotor blades to the folded position.
- Shut down the APU immediately if a rotor blade remains stalled in the APU exhaust.
- When the ROTOR SPREAD light is not illuminated, pressing the AFCS CONTROL panel RDR ALT pushbutton during blade fold system operations may cause failure of the system. Press this pushbutton only if flashing and after the blade spread evolution has been completed.

   a. Area — CLEAR (wing walkers positioned, as required).
   b. CMPTR PWR/RESET pushbutton — ON.
   c. BLADE FOLD MASTER switch — ON.
   d. BLADE FOLD switch — SPREAD.
   e. PYLON FLIGHT and ROTOR SPREAD lights — ILLUMINATED.

WARNING

Illumination of the ROTOR SPREAD light may not be an accurate indication of the blades being properly spread. Rotor engagement with improperly spread blades may result in catastrophic rotor failure. A head check shall be conducted any time the BLADE FOLD switch is moved from the OFF position.

   f. RDR ALT pushbutton — PRESS (if flashing).

Note

If RDR ALT pushbutton is flashing, pressing will update flight control position to AFCS.

g. BLADE FOLD switch — OFF.

h. BLADE FOLD MASTER switch — OFF.

i. IGB/TGB oil levels — Check, after pylon spread.

10. BACKUP HYD PMP switch — AS REQUIRED.

11. Conduct maintenance checks.

12. Blade fold — AS REQUIRED.

CAUTION

- Should the blade fold system stall during fold, cycling the BLADE FOLD switch to SPREAD should return the rotor blades to the spread position.
- Shut down the APU immediately if a rotor blade remains stalled in the APU exhaust.
- When the ROTOR SPREAD light is not illuminated, pressing the RDR ALT pushbutton during blade fold system operations may cause failure of the automatic system. Do not press this pushbutton during blade fold operations.
- Simultaneous folding of main rotor blades and tail pylon is prohibited.

Note

Failure to suppress the DECU numerical fault codes on the PDU will prevent the automatic blade fold from operating due to the torque signal being relayed to the AFCS. Codes can be suppressed by pressing either ENG OVSP TEST A or B button for the affected engine.

a. Area — CLEAR (wing walkers positioned, as required).

b. BACKUP HYD PMP switch — ON.

c. STABILATOR AUTO CONTROL pushbutton — OFF.

d. SAS 1 and SAS 2 pushbuttons OFF, TRIM pushbutton ON, AUTO PLT pushbutton OFF.

e. SERVO switch — 1ST OFF or 2ND OFF.

f. BLADE FOLD MASTER switch — ON.

g. BLADE FOLD switch — FOLD.

h. Rotor brake — OFF.

i. ROTOR INDEXED light — ILLUMINATED.

Note

Blades may be manually indexed if the main rotor indexer/gust lock fails. Cycling the BLADE FOLD switch OFF, pulling the RTR HD INDEX MOTOR circuit breaker (NO. 2 AC PRI, SO OVHD, ROW 3 CB 5), and cycling the BLADE FOLD switch to FOLD may disengage the indexer. Rotate the rotor system until the INDEXED light illuminates, then continue with the Blade Fold Checklist.

j. Rotor brake — APPLY.

k. BAR ALT pushbutton — FLASHING.

l. Collective, cyclic, and pedals — FREE TO POSITION.

Note

If computer is unable to null after 30 seconds, the AFCS DEGRADED caution will appear. To attempt another cycle, turn BLADE FOLD switch OFF, press any FAIL ADVISORY MODE RESET pushbutton, and repeat blade fold sequence.

m. BAR ALT pushbutton — PRESS.

Note

The following blade status panel light sequence indicates proper operation of the fold cycle: TRIM light flashing (blades positioned for pitch lock insertion) and PITCH LOCKED light illuminated (last pitch lock in). Blades will begin folding following the illumination of the PITCH LOCKED light. Should the INDEXED light flicker or extinguish during folding (indicating a loss of index), the blade fold sequence will stall. Cycling the BLADE FOLD switch to SPREAD should clear the stall. When the SPREAD light illuminates, the rotor head may be re-indexed and another fold cycle attempted.

n. ROTOR FOLDED light — ILLUMINATED.

o. BLADE FOLD switch — OFF.

p. BLADE FOLD MASTER switch — OFF.

q. SERVO switch — CENTER.

13. BACKUP HYD PMP switch — OFF.

14. Lights — OFF.

15. STABILATOR MAN SLEW switch — SLEW TO 0º (as required).

16. APU GENERATOR switch — OFF.

17. APU — SHUTDOWN.

    a. AIR SOURCE ECS/START switch — OFF.

    b. APU CONTR switch — OFF.

    c. FUEL PUMP switch — OFF.

18. BATT switch — OFF.

7.17.18 No APU Shutdown Procedures

1. TAIL WHEEL switch — LOCK.
2. Parking Brake — SET.
3. Chock(s) — IN.
4. BACKUP HYD PMP switch — ON.
5. MSN Power — OFF.

If External Power is available:

6. External Power Cord — CONNECT.
7. External Power Source — VERIFY ENERGIZED.
8. External Power Switch — RESET, THEN ON.

Note

If the external power source is energized, and the EXT PWR Switch is placed to RESET, then ON, the external power circuit will be energized, and power to the aircraft system busses will be immediately available upon securing the main generators. External Power will NOT supply power to any of the aircraft system busses while any source of airframe power is energized. The EXT PWR CONNECTED Annunciator light only verifies that an acceptable external power source is connected to the aircraft. There is no means of verifying the external power circuit is energized prior to securing main generators.

9. NO. 1 and NO. 2 GENERATOR switches — OFF.
10. Proceed with step 6. of Normal Shutdown Checklist.

If External Power is not available:

11. ECS — OFF.
12. STABILATOR MAN SLEW switch — SLEW to 0 (as required).
13. APU GENERATOR switch — OFF.
14. ENGINE IGNITION switch — OFF.
15. Flight controls — POSITION (as required)
16. Lights — AS REQUIRED.

Note

At night, consideration should be given to configuring battery-powered lighting in the cockpit before securing interior lights.

17. Area — CLEAR.
18. NO. 1 and NO. 2 GENERATOR switches — OFF.

WARNING

With no AC Power, AFCS TRIM will be lost. An unguarded cyclic will allow the rotor arc to dip as low as four feet above the ground, without droop stop pounding, prior to full control deflection. This condition is exacerbated at night by the loss of aircraft lighting to aid in tip path placement.

CAUTION

After shutdown of the second engine as N_r drops below approximately 92-97 percent, the main generators will drop off line and the VIDS will not be available to monitor for Post Shutdown Engine Fire, and engine starter will be unavailable. Personnel should be standing by with a fire extinguisher due to this possibility.

Note

During shutdown at night, the rotor head light will not be available if battery charge is below 35 percent. During shutdown, loss of hydraulic pressure will occur as N_r decreases resulting in loss of control to the rotor system. Ensure personnel are well clear prior to commencing shutdown.

19. PCLs — IDLE.
20. NO. 2 PCL and fuel selector lever — OFF.
21. Droop stops — IN.
22. NO. 1 PCL and fuel selector lever — OFF.
23. Rotor brake — ON (between 30 percent and 50 percent N_r).
24. BATT switch — OFF.

7.18 NORMAL MANEUVERS

The AFCS of the SH-60B helicopter is designed to significantly reduce pilot workload in all regimes of flight. Attitude, altitude, airspeed, and yaw control can be performed by the AFCS, when desired.

7.18.1 Taxi

With the tail wheel unlocked, place the cyclic forward of neutral and increase collective to start forward movement. Minimize forward cyclic movement to prevent droop-stop pounding. Reduce collective to the minimum required to maintain forward movement. Soft or rough terrain may require additional collective. Regulate taxi speed with collective and control heading with pedals while checking heading indicators and turn needles. Cyclic should be displaced in the direction of turns. Use brakes as required.

7.18.2 Takeoff

The pilot not at the controls (PNAC) shall monitor all systems (e.g., stabilator, engines, transmissions) during takeoff to alert the pilot at the controls (PAC) of malfunctions.

7.18.2.1 Takeoff to Hover

With cyclic slightly aft of neutral, increase collective until desired hovering altitude is reached (normally a 10-foot wheel height). Use pedals to maintain heading as collective is increased. The normal hover attitude is 4° to 5° nose up and 2° to 3° left wing down.

Perform the following checks in a hover:

1. Flight controls — NOTE CORRECT RESPONSE.
2. System and flight instruments — CHECK.
3. Power — CHECK. The power check will determine if enough power is available for the mission. It is accomplished by comparing the indicated torque required to hover with the predicted values from performance charts.

7.18.2.2 Hovering Turns

Hovering turns may be accomplished in one of two ways. The conventional flight control system may be used by applying pressure on the desired tail rotor pedal to begin the turn, using pressure and counter pressure on pedals as necessary to hold the desired rate of turn. The pilot may also turn by depressing the HDG TRIM switch in the desired direction and a turn will be effected at 3 degrees per second. In either case, coordinate cyclic and collective as required to hold desired attitude and altitude.

7.18.2.3 Sideward and Rearward Flight

From a stabilized hover, apply cyclic pressure in the desired direction of flight to begin sideward or rearward movement. Maintain desired heading with pedals and altitude with collective. To return to a stationary hover, apply cyclic pressure opposite to the direction of movement by coordinating collective and pedal. The RADALT hold and heading–hold feature of the AFCS may be used to hold desired altitude and heading.

7.18.2.4 Air Taxi

From a stabilized hover, apply forward cyclic pressure to begin forward movement. Desired heading may be retained with pedals or the HDG TRIM and altitude with collective. Changes in direction should be made primarily with pedal control or the HDG TRIM switch, and altitude with collective. Changes in direction should be made primarily with pedal control or the HDG TRIM switch to avoid excessive bank angles. To stop forward movement, apply aft cyclic pressure while coordinating collective and pedals to hold desired altitude and heading.

7.18.2.5 Normal Takeoff

Align the helicopter with the desired takeoff course in a stabilized 10–foot hover or an altitude permitting safe obstacle and terrain clearance. Smoothly apply forward cyclic pressure to begin acceleration into effective translational lift. As the helicopter transitions from hovering to forward flight, the change in direction of the main rotor thrust vector will result in a loss of lift, which tends to cause the helicopter to settle. As airspeed increases through translational lift (approximately 15 knots), the power requirements to maintain level flight will decrease and more power will be available to climb. Refer to the Height–Velocity Diagrams (Figure 4-4) for avoid areas.

7.18.2.6 Running Takeoff

Running takeoffs should be used under conditions of high–gross weight and high–density altitude where the power available may not be sufficient to make a vertical takeoff. Contingency power should be selected. Move the cyclic slightly forward of neutral and apply enough collective to start a forward roll while maintaining heading with pedals. Maintain cyclic and collective settings until passing through effective translational lift. Apply enough power for the helicopter to leave the ground. Continue to climb and accelerate, transitioning to a normal climb.

7.18.2.7 Maximum Performance Takeoffs

A takeoff that demands maximum performance from the helicopter may be necessary because of various combinations of heavy helicopter loads, restricted performance due to high density altitudes, barriers that must be cleared, and other terrain features. The decision to use the following takeoff techniques must be based on an evaluation of the conditions and helicopter performance. Contingency power may be selected if required.

7.18.2.7.1 Obstacle Clearance Takeoff

From a hover, a vertical climb is initiated using coordinated cyclic, pedals, and collective up to TGT or torque limiting. Once the desired altitude is reached, transition to forward flight/climb as desired. Maintaining clearance from obstacles is the most important aspect of this takeoff, not rapidity. Crewmen should be positioned at the cabin doors to ensure tail rotor clearance. Do not exceed TGT or torque limitations.

7.18.2.7.2 Maximum Gross Weight Takeoff

The decision to use the following takeoff technique shall be based on an evaluation of the conditions and helicopter performance. Contingency power should be selected if required. Position aircraft into the wind, and apply power smoothly by increasing collective pitch to raise the helicopter to a low hovering altitude. While slowly increasing forward cyclic, maximum power shall be smoothly applied to continue the takeoff, gradually accelerating and maintaining the low hover altitude. As translational lift is attained, adjust the nose to begin an accelerating climb. The critical period is over when translational airspeed is attained; accelerated through. However, the climbout should remain shallow until airspeed has increased to 50 knots KIAS to ensure best single–engine performance characteristics.

7.18.3 Climb Procedures

The procedures for establishing a climb will vary depending on when the climb was initiated (i.e., transition to forward flight, running takeoff, obstacle clearance). Regardless of the type of climb desired, refer to the climb charts to obtain the profile that will yield best rate-of-climb speed.

7.18.3.1 Initial Climb to Altitude

This will normally start after the helicopter has transitioned to forward flight and the desired climb speed is approached. Adjust the collective and cyclic to obtain the airspeed that will produce the best rate of climb for the specific gross weight, pressure altitude, and OAT conditions. Maintain directional control with the tail rotor pedals.

7.18.3.2 Maximum Performance Climb

The climb is usually made to gain altitude in the least amount of time, or when gross weight and density altitude prohibit a normal climb with associated power. Apply maximum power while simultaneously applying cyclic to transition to the airspeed that will produce the best rate of climb for the existing gross weight, pressure altitude, and OAT. Directional control should be maintained on all maximum performance climbs with tail rotor pedals.

7.18.3.3 Cruise Climb

This type of climb may be varied by sacrificing rate of climb for airspeed, or airspeed for rate of climb, depending on the time and horizontal distance desired before reaching the newly selected altitude. After determining the desired rate of climb and associated speed, adjust the collective and cyclic to produce the results for specific gross weight, pressure altitude, and OAT conditions.

7.18.4 Cruise

To obtain specific power settings and fuel consumption rates, refer to the cruise charts.

7.18.5 Descent

The factors governing the type of descent to be made are gross weight, pressure altitude, OAT, condition of landing site and terrain, and the amount of time desired in which to accomplish the descent.

7.18.5.1 Cruise Descent

Descents from an established to newly selected altitude are made by lowering the collective to obtain the power reduction that will produce the desired rate of descent.

7.18.5.2 Autorotative Descent

The autorotative descent is used whenever a rapid descent is desired. An autorotative descent is made by lowering the collective to minimum and entering autorotation, then using collective to control N_r. 75 KIAS will produce the minimum sink rate and 95 KIAS will produce the maximum glide distance. To recover, slowly raise the collective at approximately 200 feet above the selected altitude to resume powered flight and slow the rate of descent, then adjust the cyclic to resume desired cruise airspeed. The autorotative descent should not be used in Instrument Meteorological Conditions (IMC) except in an emergency.

Note

> A transient Np rise of up to 109 percent following entry into an autorotation is possible. This is acceptable as long as it does not exceed the Np limitations.

To obtain specific power settings and fuel consumption rates, refer to the cruise charts.

7.18.6 Night/IMC Descent Over Water

Operational Risk Management (ORM) analysis, Controlled Flight Into Terrain (CFIT) prevention efforts, and mishap data have identified low altitude night/IMC descents over water as a high-risk maneuver that demands undivided aircrew attention and precise aircrew coordination. The following procedures are recommended for all night/IMC descents over water at 1,000 ft AGL and below:

WARNING

Failure to follow night/IMC descent procedures over water may lead to a loss of situational awareness and result in water impact.

Note

- Prior to commencing night/IMC descents over water, barometric altimeters should be synced to the radar altimeter.
- Descents should be commenced and conducted in a wings-level attitude when circumstances allow.
- Altitude hold shall be used in level flight at 500 ft AGL and below.
- RAWS tones shall be verbally acknowledged by pilot and copilot.

Descent:

1. The PAC reports “ON INSTRUMENTS” and states the leaving altitude, intended altitude, and variable RAWS/LAWS index position (i.e., set below the intended altitude).
2. The PNAC acknowledges descent commencement, intended altitude, and RAWS variable index position.
3. The aircrewman acknowledges the intended altitude. (During the descent, the aircrewman should monitor the altitude via the NAV PARAMETERS table or the altitude display, to the maximum extent permitted by the tactical situation).

Level-off:

1. As the helicopter nears the intended altitude, the PNAC reports “RAWS tones,” 200 ft and 100 ft prior.
2. When level, the PAC reports “LEVEL” and “ALTITUDE HOLD ENGAGED.”

7.18.7 Approach to Landing

An approach should be a precise maneuver. Approaches should not be made so low that the PAC loses sight of the landing point nor so high that a very low power setting with a high rate of descent is required. Approach speed will depend on weight, altitude, and wind conditions. Maintain translational lift as long as possible while avoiding excessive flares and abrupt, large power inputs. The PNAC shall monitor all systems (e.g., stabilator, engines, transmission) during the approach and landing to alert the PAC of malfunctions.

CAUTION

Nose attitudes in excess of 13° nose-up at altitudes less than or equal to 15 feet will cause the tail bumper/stabilator to impact the ground.

7.18.7.1 Normal Approach

Before commencing a normal landing, ensure the Landing Checklist is complete. The landing is approached from an abeam position of approximately 500 feet AGL at an airspeed of 75 to 100 KIAS, so as to arrive at the 90° position at approximately 300 feet AGL and 60 to 80 KIAS. Continue the descent to roll wings-level into the wind with approximately 1,000 feet of straightaway at 150 to 200 feet AGL and 50 to 70 KIAS. Initiate a decelerating attitude and maintain this attitude until the airspeed decreases to 20 KIAS and 30 feet on the radar altimeter.

At 30 feet, adjust the nose attitude (15° nose-up maximum) and increase collective to achieve a hover at approximately 10 feet. Maintain heading and attitude using the tail rotor pedals and cyclic. When transition to a hover is not possible and running landings are not feasible, normal approach procedures may be used for a no hover landing.

7.18.7.2 Steep Approach

A normal approach is flown until reaching the final inbound course to the landing site. Level off at approximately 200 feet AGL, transition to approximately 40 KGS, and intercept the glide slope (approximately 20 to 30º). Reduce power to begin the descent. While descending, do not exceed 700 fpm and maintain translational lift until reaching ground effect. Should rate of descent become excessive or the approach angle become excessively steep, execute a waveoff. The approach may be flown to a hover or no-hover landing as desired. Refer to Chapter 11 for a detailed discussion on vortex-ring state and Chapter 9 for a detailed discussion on mountain and rough-terrain flying.

7.18.8 Landings

WARNING

Extreme aft cyclic in conjunction with low or decreasing collective settings may cause droop stop pounding (DSP) or contact with the ALQ-144A/205. Rapid aft cyclic movement in conjunction with low collective settings may also cause main rotor blades to strike the tail pylon, resulting in loss of tail rotor drive.

7.18.8.1 Crosswind Landing

When a crosswind approach is necessary, it is best to bring the helicopter to a hover and perform a hovering turn into the wind before landing. When this cannot be done, execute a flare and hover as though making a normal approach into the wind. Arrest all drift before touching down. In strong wind, it will be necessary to hold the helicopter in a slip using cross control to touch down first on the upwind wheel and tail wheel. After touchdown, allow the helicopter to settle on the other wheel.

7.18.8.2 Vertical Landing from a Hover

The most important consideration in making a vertical landing is arresting lateral drift. Commence a vertical descent. The aircraft will touch down tail wheel first, then left main mount, and last, right main mount due to the normal nose up, left wing down hover attitude. As the collective is lowered, the tip path will tend to move right wing down due to control mixing.

7.18.8.3 Running Landing

Running landings are usually made from a shallow approach when the helicopter cannot hover due to insufficient power available or loss of tail rotor control. Adjust collective as necessary to maintain the desired approach angle; dissipate speed gradually throughout the approach so the landing can be made while maintaining translational lift. A running landing should not be attempted on rough terrain. Establish a straight track over the ground and a shallow approach with a slow rate of descent. Use tail rotor pedals to maintain heading in the direction of track and cyclic to control drift. Eliminate all lateral drift before touchdown. As the helicopter approaches the ground, increase collective slightly to reduce rate of descent and adjust airspeed to a value compatible with gross weight. Do not exceed groundspeed limitations. As the wheels contact the ground, tail wheel first then main gear, move the cyclic to the neutral position and slowly decrease collective to minimum. Stop the helicopter with the wheel brakes. Avoid overbraking, especially at high gross weights.

CAUTION

Rapid divergent tail wheel oscillations can occur at certain ground speeds and collective combinations with a malfunctioning or unlocked tail wheel. If a running landing is required, maintain 20 KGS or less on touchdown. If oscillations occur, the aircraft should be brought into a hover or stopped with minimum collective and maximum braking.

To prevent rotor head damage and to extend dynamic component life, excessive aft cyclic should be avoided after touchdown. To avoid this during a running landing:

1. Control airspeed prior to the main wheels touching down. Avoid aerodynamic braking with cyclic.
2. Be aware of the tip path plane; excessive aft cyclic will place the tip path unusually high in the field of view.
3. Consciously reposition the cyclic forward prior to lowering collective.

7.18.8.4 No-Hover Landing

A no-hover landing is accomplished in the same manner as a normal approach to a hover. Continue descent through the hovering altitude to touchdown on the tail wheel with little or no forward roll. Maintain the landing attitude (approximately 5° nose-up) with collective and aft cyclic until all forward movement is stopped, then lower the main landing gear to the ground.

7.18.8.5 Unprepared Site Landing

This maneuver may be required under many different circumstances, regardless of the mission. The first step is a thorough study of the landing environment. Refer to Chapter 9 for a discussion of landing site evaluation.

Once it has been determined that a safe landing can be made, the PIC should decide whether or not to use a no-hover landing. Although a no-hover landing will minimize brownout/whiteout, a hover to a landing will better afford the crew the opportunity to clear the aircraft of all obstacles before touchdown. Both options should be considered.

CAUTION

The helicopter shall be continually cleared throughout the approach until collective reduction after touchdown. Helicopter damage may result after contact with foreign objects following collective reduction.

7.18.8.6 Confined Area Landing (CAL)

This maneuver is conducted to allow the helicopter to land in a Landing Zone (LZ) not accessible to a standard tactical/no-hover landing profile due to obstructions. The CAL maneuver will afford the helicopter the safest available route of approach for landing as well as the capability to safely takeoff and depart the LZ. The maneuver starts by aligning the aircraft on final approach to the confined area intended for landing. Slow the aircraft to 20 KGS or less by the time it crosses the last obstruction on the approach end of the LZ. When the aircraft is cleared to descend, simultaneously use aft cyclic and decreasing collective to stop forward motion and begin the descent. Drift in both the fore/aft and left/right directions must be controlled throughout the maneuver.

CAUTION

The helicopter shall be continually cleared throughout the approach until collective reduction after touchdown. Helicopter damage may result after contact with foreign objects following collective reduction.

7.18.9 Practice Autorotative Approach

Practice autorotations with power recovery below 500 feet AGL shall be accomplished at approved landing areas or airfields. Always plan an autorotation to an area that will permit a safe landing in the event of an actual emergency; preferably a hard, flat, smooth surface clear of approach and takeoff obstructions. Practice autorotations should not be attempted in conditions of high grossweight and critical CG loadings. Under conditions of high gross weight, the flare is very critical.

Deviations from straight-in autorotations should be practiced to ensure full utilization of the helicopter capabilities and improve pilot proficiency. These deviations include the use of 100 KIAS autorotations for maximum range and turns to establish precision maneuvering to arrive over a predetermined spot on the ground. Practice autorotations should begin at an altitude that will permit a power-off approach to the desired landing spot. The recommended altitude for practice autorotations is no lower than 500 feet AGL. After the completion of the Landing Checklist and at selected cruising speed, smoothly bottom the collective. Maintain 100 to 105 percent N_r and 80 KIAS in the descent.

Commence a flare at approximately 200 feet AGL to slow forward airspeed and stop rate of descent. The power recovery is initiated at the end of the flare no lower than 60 feet AGL by rotating the nose forward to hover attitude and subsequently increasing the collective to stop the rate of descent by 20 to 30 feet, with 15 to 20 KGS and zero drift. Avoid abrupt applications of power.

Note

- During practice autorotations, the pilot not at the controls should provide 200 feet AGL altitude calls. Recovery or waveoff shall be initiated prior to descent below 60 ft AGL.
- A transient Np rise of up to 109 percent following entry into an autorotation is possible and acceptable as long as Np limitations are not exceeded.

Simulated emergencies over unprepared surfaces may be executed wherein an autorotative state is entered; however, recovery shall be made at not less than 500 feet AGL and not less than 40 KIAS. These simulated emergencies are primarily for the purpose of developing sound judgment in the selection of the best available landing site in an emergency situation.

7.18.10 NOE Quickstop

The NOE quick stop is used to slow or stop the aircraft in the NOE flight regime. If performed properly, the quick stop effectively slows the helicopter, while balancing the need to maintain safe tail clearance against the tactical requirement to keep the aircraft masked. The maneuver is a level speed change with the point of rotation about the tail rotor, not the aircraft's aerodynamic center.

1. Maneuver description:

   a. The PAC announces intention to crew by stating, "QUICK STOP." The PAC begins the maneuver by increasing collective slightly while positively applying aft cyclic. This will induce the aircraft rotation about the tail rotor.

   b. Right gunner acknowledges with "TAIL CLEAR" as gunners scan forward and under the aircraft to aid the PAC in clearing the tail.

   c. After initial rotation, PAC reduces the collective to prevent ballooning. If power reduction is too abrupt, this will tend to build N_r and cause the engines to uncouple. It is imperative to maintain some power on the aircraft. Since uncoupled engines require time to spool up, the undesirable results can be N_r droop, degraded aircraft control, and loss of tail rotor effectiveness while attempting to maintain HOGE. If uncoupling occurs, lead the recovery with collective to re-couple the engines and prevent N_r droop.

   d. To complete the maneuver, nose attitude and collective reduction are adjusted dependent on the rate of deceleration desired.

2. Common errors include:
   a. An overly aggressive flare, causing ballooning.
   b. Failure to lead recovery from the maneuver, causing abrupt power changes or loss of N_r.
   c. Not rotating about the tail rotor, allowing the tail to come close to impacting the ground.
   d. Not maintaining altitude/allowing the aircraft to settle with a nose-up attitude.

CAUTION

The PAC shall ensure that the engines remain coupled throughout the maneuver in order to prevent excessive rotor droop resulting in altitude loss and/or loss of tail rotor effectiveness.

7.18.11 Practice Single-Engine Failure in an HOGE (Cut and Run/Cut Gun)

This maneuver shall be conducted over a prepared surface into the wind. Commence maneuver from a hover with a minimum altitude of 70 feet AGL. The PAC and PNAC must monitor nose attitude, N_r, torque, rate of descent, altitude, and airspeed until aircraft reaches safe conditions. If it appears the aircraft is going to make contact with the ground, the PAC shall take action to ensure the aircraft touches down in a level attitude with no yaw or drift.

If simulating HOGE power sufficient to execute a Cut and Run, PAC should use coordinated cyclic and collective inputs to transition to forward, descending flight while maintaining heading. The goal is to increase airspeed while descending into ground effect in order to achieve single-engine airspeed.

If simulating HOGE power not sufficient to execute a Cut and Run (Cut Gun), PAC should arrest drift and adjust collective as required to preserve N_r while descending into ground effect. This maneuver may be completed by executing a max gross weight style takeoff from the HIGE.

CHAPTER 8

Shipboard Procedures

8.1 GENERAL

This chapter highlights specific shipboard procedures and is not intended to replace procedures found within respective CV NATOPS, LHA/LHD NATOPS, and NAVAIR 00-80T-122 (Helicopter Operating Procedures for Air-Capable Ships) manuals. Aviation ships refer to aircraft carriers (CV/CVN) and amphibious assault ships (LHA/LHD). All other ship classes having the ability to support helicopter operations are referred to as air-capable ships.

8.1.1 Introduction

Shipboard procedures encompass operations involving all ships having a helicopter landing capability. Ships utilizing helicopter services normally provide a helicopter landing area, but numerous variations exist with regard to support facilities such as hangars, unprotected platforms, and nonstandard fuel and power facilities.

Pilots must refer to the CV and LHA/LHD NATOPS Manuals prior to operations involving aviation ships. Pilots must refer to the Air-capable Ships Helicopter Facilities Resume (NAEC-ENG 7576), Helicopter Operating Procedures for Air-Capable Ships (NA 00-80T-122), and Helicopter Operations from Ships other than Aircraft Carriers (HOSTAC APP 2) prior to operations involving air-capable ships. Individual ship procedures are delineated in NA 00-80T-122 and Underway Replenishment (NWP 4.01.4) series.

8.1.2 Shipboard Landing Qualification/Currency

Pilot and aircrew shipboard landing initial qualification, subsequent qualification, and currency requirements are defined in Chapter 5.

8.2 GENERAL SHIPBOARD OPERATIONS

8.2.1 Flight/Hangar Deck Procedures

8.2.1.1 Movement of Helicopter

Size, weight, and fuselage structure do not permit safe ground handling of the helicopter aboard ships where the only available method is to move the aircraft by hand. In the case of an emergency or when the appropriate mechanized means are not available it may be necessary to move the helicopter by hand while underway. In the event of a situation that requires the helicopter to be moved by hand, it shall be done IAW the procedures found in this manual and all applicable pubs (PLANE CAPTAIN MANUAL A1-H60BB-000, A1-H60BB-GAI-010, CV NATOPS NAVAIR-00-80T-105, LHA/LPH/LHD NATOPS NAVAIR-00-80T-106, and HELICOPTER OPERATING PROCEDURES FOR AIR-CAPABLE SHIPS NATOPS MANUAL NAVAIR-00-80T-122).

WARNING

Helicopter movement by hand, while underway, is inherently dangerous. Sea state, winds, and unexpected flight deck motion shall all be carefully evaluated prior to helicopter movement.

Note

If operating from a ship that does not have mechanized means available to move the helicopter, Squadrons shall coordinate with their Type Wing to ensure the equipment required to move the aircraft by hand is available.

8.2.1.2 Blade/Pylon/Stabilator Folding and Spreading

The maximum safe, non–turbulent wind relative to the helicopter for rotor folding/spreading and for tail pylon/stabilator folding/spreading is 45 knots, except in emergency situations. The safety nets shall be lowered prior to fold/spread evolution (as required).

CAUTION

- Unless external power is applied or the BATT switch is ON prior to folding the tail pylon, the tail rotor indexer will not engage after starting the pylon fold sequence and uncontrolled tail rotor windmilling may result.
- When connected to host ship's 400 Hz power only, activation of the B/U pump may cause a surge in the ship's power and cause the ship's converter box to blow its fuses and damage the helicopter's external power system.
- At any time blades are to be spread or folded aboard ship, personnel shall act as blade walkers while the blades are in motion to prevent excessive blade flapping, which could result in the blade tips striking the deck.

8.2.1.3 Engine Start and Rotor Engagement

Requirements for engine start and rotor engagement consist of the following:

1. Rotor blade restraints removed.
2. Main mount tiedowns secured with 2 to 3 inches of slack and chocks in place.
3. Flight deck area clear of unnecessary personnel.
4. Tail wheel locked, parking brake set.
5. Winds less than 45 knots.
6. Ship maintains steady course throughout engagement/disengagement.

Note

The Rotor Brake Start procedure shall be used for shipboard engine starts and rotor engagements.

8.2.1.4 General Safety Precautions

1. Secure the helicopter with two chocks and a minimum of four tiedowns. Fueling personnel shall not approach the helicopter until it is properly chocked and chained.
2. Personnel shall enter the rotor arc near the 9 and 3 o'clock positions when directed. Movements within the rotor arc shall be around the nose. Under no circumstances shall personnel work in close proximity to a turning tail rotor.
3. For air capable ships, helicopter rotors shall not be engaged/disengaged or the aircraft launched/recovered while the ship is turning.
4. For aviation ships, helicopter rotors should not be engaged/disengaged or the aircraft launched/recovered while the ship is turning.

WARNING

When the helicopter is on the flight deck with the rotors engaged, the cyclic should be held in the neutral position. Attempting to maintain the tip-path plane parallel to the horizon on a rolling, pitching deck can be hazardous to flight deck personnel and may cause droop stop pounding. Personnel shall remain outside the rotor arc during engagement/disengagement.

8.2.2 Visual Landing Aids

Signals should be in accordance with the Aviation Signals NATOPS Manual (NAVAIR 00-80T-113). Shipboard Visual Landing Aid (VLA) lighting equipment consists of a homing beacon, deck edge lights, line-up lights, floodlights and special lighting for air-capable ships (special-purpose floodlights, extended line-up lights, vertical drop-line lights, wave-off lights, Horizon Reference Systems [HRS] and a Stabilized Glide Slope Indicator [SGSI]). Whereas all VLA lighting equipment should be operative for all night operations, night operations in VMC can continue with some degradation in lighting equipment availability.

8.3 AVIATION SHIP HELICOPTER OPERATIONS

8.3.1 Aviation Ship Launch and Recovery Procedures

1. Each helicopter shall be under the positive control of a director or signalman for all flight deck evolutions. Standard helicopter signals shall be used and acknowledged.

WARNING

In crosswind conditions, relative to the ship's fore and aft axis, the indicated winds often vary from those winds actually experienced at the flight deck level. This variance will affect velocity, turbulence, and direction, all of which are critical for safe launches and recoveries.

2. Optimum wind and deck conditions should be provided. The term takeoff is defined as the action of lifting from the deck culminating in hovering, forward or sideward flight. The terms takeoff, liftoff, and launch are synonymous. The term landing is the maneuver of physically positioning the helicopter on the deck following forward or hovering flight. The terms landing and recovery are synonymous. The helicopter shall be launched and recovered within the relative wind limits. The upwind helicopter should be launched first.
3. On launching from a CV, the helicopter should be rolled forward slightly to make sure chocks/tiedowns are removed. Lift into a hover about 10 feet above the deck, and transition to forward flight. Helicopters should clear the ship expeditiously to reduce hazards to flight deck personnel.
4. Chocks and tiedowns shall not be installed upon landing without the pilot's knowledge. Normally, this will be done by an exchange of signals between the pilot and the LSE.

8.3.2 Shipboard Launch/Recovery Limitations

Wind limitations for launch and recovery operations are defined by ship class and are delineated in the NATOPS Pocket Checklists. Helicopters shall be launched and recovered within the limits of the prescribed wind envelope to preclude damage or loss.

8.3.3 Launch and Recovery Signals

Refer to the CV NATOPS, LHA/LHD/MCS NATOPS and NAVAIR 00-80T-113 AIRCRAFT HANDLING SIGNALS MANUAL for guidance.

All signals from the LSE are advisory in nature except "WAVEOFF" and "HOLD."

8.3.4 Waveoff Procedures

Compliance with a waveoff signal is mandatory at all times. Pilots must use extreme caution to avoid overflying aircraft parked or turning on deck. Reentry into the landing pattern shall be prescribed by the controlling authority.

8.3.5 Shutdown

After chocks and tiedowns have been attached, the helicopter will be shut down and folded upon signal from the LSE.

8.3.6 Night and IMC Operations

8.3.6.1 Deck Conditions

Standard deck spotting (centerline only) shall be used. Such spacing shall provide a minimum rotary wing to tail rotor clearance of 20 feet. Deck edge and centerline lights of required spacing and brilliance are required for unaided helicopter operations. Night and IMC operations from aviation ships shall be conducted from authorized spots. Aided departures are permitted from authorized spots with acceptable NVD deck lighting conditions.

Note

Before applying external power or turning the battery switch on, pilots and/or maintenance personnel shall make sure that all helicopter light switches are OFF.

8.3.6.2 Night Launches

The radar altimeter variable index should be set 10 to 15 feet above flight deck height to warn of low altitude after takeoff. Following the night takeoff, the pilot should hold cockpit functions to a minimum until the helicopter is established in level cruising flight. For CV night launches, aided sidestep departures are permitted from authorized spots with acceptable NVD deck lighting conditions. The aircraft shall slide out laterally to clear all obstacles before climbing. Helicopters shall climb straight ahead to at least 150 feet and 60 KIAS before beginning any turn. The PNAC shall ensure positive rates of climb. Altitude hold is required for all night overwater operations.

8.3.6.3 CV NIGHT APPROACHES

If NVDs are used during a flight, the NVD configuration for landing (goggles on/goggles off) shall be set at least 5 minutes before commencing the approach. Crews aided with NVDs may make a visual approach to spot rather than a Carrier Controlled Approach (CCA) provided they prebrief such an approach, are not IMC, and have sufficient illumination/visibility.

For NVD centerline visual approaches, during VMC and using NVDs, the PIC may accept a visual approach to the fantail and proceed along the centerline for landing on authorized spots. After the last fixed wing aircraft on final is identified by the Air Boss/CATCC, the helicopter will take interval and land visually.

For NVD slide-in visual approaches, at the PIC's discretion, the helicopter may slide in to a landing on authorized spots. Visual contact with the ship and NVD usage shall be required.

For mirror/optical landing system approaches, the helicopter should enter the glide path about 2 miles astern of the carrier, on the landing axis. At about 3/4 of a mile distance astern of the carrier, a speed transition should begin to arrive at the ramp in a stabilized flight condition with about 10 feet altitude above the flight deck. The helicopter may then be air-taxied to an assigned spot at a safe closure rate, with pilot reference to visual signals from LSE. Night and IMC approaches shall be conducted as published in the CV and LHA/LHD/MCS NATOPS Manuals.

8.4 AIR-CAPABLE SHIP HELICOPTER OPERATIONS

Air-capable ships are characterized by significantly smaller flight decks than aviation ships. By the nature of their size, air-capable ships are also more susceptible to pitch, roll, and turbulence created by wind interaction with the ship's superstructure. Additionally, personnel on these ships generally have less operational familiarity and receive less training than those on aviation ships. Pilot precaution is required during flight operations with air-capable ships, particularly during night and IMC.

8.4.1 Air-Capable Ship Launch and Recovery Procedures

Single-spot shipboard launches should be executed utilizing the following launch procedure to the maximum extent possible. Intentional deviation shall be thoroughly briefed and assessed utilizing ORM principles. Takeoffs should normally be performed by the pilot who is nearest the ship's superstructure, as determined by the relative winds and the desired takeoff direction.

1. The PAC lifts the aircraft into a stable hover, approximately 10-15 feet above the deck or eye level with the HARS bar while the PNAC crosschecks all performance instruments and reports good check of gauges.

CAUTION

- Initial hover height over the deck shall be sufficient to provide adequate tail clearance during heavy seas and to allow sufficient clearance to slide aft.
- During operations from a Flight II DDG, hover height at less than eye level with the HARS bar may result in a stabilator strike when sliding aft.

2. PAC maneuvers the aircraft aft as required to ensure obstacle clearance. Helicopter mainmounts should remain over the flight deck. Once the helicopter is in a stable hover, the PAC calls nose coming left or right and makes a pedal turn as required to at least approximately 45 degrees off ship's heading in direction of relative wind, and stabilizes. With commencement of pedal turn, PNAC shifts to an instrument scan. The PAC maintains an outside scan outside to ensure obstacle clearance. Once stabilized, PNAC crosschecks and reports good check of gauges.
3. PAC reports pulling power and transitions to forward flight by increasing collective. PNAC reports three rates of climb. Once a positive rate of climb is attained, and obstruction clearance is assured, PAC transitions to instrument scan and positions the nose 5 degrees below the horizon.

WARNING

- Failure to stabilize prior to power pull may result in spatial disorientation and CFIT.
- Transition from a visual scan to an instrument scan while in a dynamic flight regime can result in vertigo. The transition of scan from visual to instrument should take place after obstacle clearance is assured.
- The pilot should avoid multi-axis head movement by using peripheral vision to ensure obstacle clearance and to reduce susceptibility to vertigo.

CAUTION

On FFG-7 class ships, the takeoff should be performed in the aft part of the flight deck. A pedal turn of at least 45 is required to ensure clearance from the hangar and aft whip antennas.

4. PAC maintains departure heading until desired altitude and safe single engine airspeed is attained and RADALT hold is engaged. The crew shall not perform non-emergency checklists or other duties until level off altitude is reached and RADALT hold is verified to be engaged.

5. Once a safe flight regime is established, PAC reports “OPS NORMAL.” Both PAC and PNAC shall maintain an instrument scan until attaining pre–briefed level off altitude, at which point PAC centers the VSI and PNAC verifies RADALT is engaged.

Following takeoff, the PAC shall establish single–engine airspeed and climb to a safe operating altitude. The PNAC shall ensure positive rates of climb. During night VMC, the helicopter should climb to 150 feet AGL and 60 KIAS prior to commencing a turn. Altitude hold is required for all night over water operations.

Note

Radio transmissions by both the ship and other helicopters should be kept to a minimum when a helicopter is established in a hover over the flight deck during launch/recovery until an “OPS NORMAL” report is given or the helicopter is safely on deck.

8.4.2 Shipboard Launch/Recovery Limitations

Launch and recovery operations, signals, and procedures shall be in accordance with NAVAIR 00–80T–122 and NA 00–80T–117. Wind limitations for launch and recovery operations are defined by ship class and are delineated in the NATOPS Pocket Checklists, and NAVAIR 00–80T–122. Helicopters shall be launched and recovered within the limits of the prescribed wind envelope to preclude damage or loss.

8.4.3 Approach Procedures

There are four types of approaches for shipboard landings:

1. Visual approach.
2. Instrument approach.
3. Emergency Low Visibility Approach (ELVA) when the weather is below instrument approach minimums and the helicopter does not have adequate fuel to bingo to a GCA/CCA–equipped airfield or aviation ship.
4. Offset approach or ordnance lineup approach, when the helicopter has a hangfire or misfire missile emergency.

During day VMC approaches, the PNAC shall back up the PAC in maintaining glide path/altitude control and closure rate. Throughout all night/IMC approaches, one pilot shall be responsible for maintaining an instrument scan at all times. Both pilots shall verbally acknowledge their scan responsibility whenever it changes.

During all approaches, the PNAC and the aircrew, as briefed, shall verbally complement the scan of the PAC by providing altitude, range, lineup, and speed information while on approach. One pilot should maintain an instrument scan until able to distinguish flight deck features. Closure should be controlled via reference to flight instruments until it can be judged visually. The PAC must control closure such that when closure does become visually apparent it is slow enough that a comfortable deceleration can be maintained to arrive in a hover over the flight deck.

WARNING

- If the SGSI appears amber or green below the minimum altitude for the corresponding range, disregard the SGSI and continue the approach using standard altitude vs. range glide path control.
- If the red light on the HRS comes on, the HRS is unreliable or has failed.

Note

At night the searchlight or hover light is flashed on short final to signal the HCO to set the line–up strobes steady and reduce their intensity.

Both pilots should scan the radar altimeter for primary altitude information, even when using the SGSI or ship gunfire control radar for glide path information. The radar altimeter should be continuously crosschecked against the barometric altimeter. Rate of descent should not exceed 500 fpm throughout the approach. The PNAC should be prepared to take control of the helicopter in the event that normal altitude/range/rate of descent parameters are exceeded without sufficient response by the pilot at the controls to verbal warnings.

8.4.3.1 Visual Approach

Inbound to the ship, intercept the final approach course at approximately 200 feet and 0.5 nm to achieve 3 degree glide slope. Maintain the approach course and glide path (Figure 8-1) using the line–up line. A slow controlled closure rate is essential in order to maintain obstruction clearance. Begin a coordinated descent and deceleration maintaining glide slope. The pattern may be adjusted during day VMC to intercept the glide path commensurate with pilot proficiency and flight deck conditions or as the final part of an instrument approach.

During the visual approach phase, the approach line is maintained using the lineup lines on the ship deck as well as visual cues from the ship structure and wake. At night, the approach line is maintained using the lighted lineup and extended lineup lines, vertical dropline lights, and any other available visual cues from the ship lighting.

Note

At night, the lower anti–collision light should be secured, RAST lights on, and position lights set to dim prior to commencing approach. On those ships with SGSI, the glide path should be maintained by visual reference to the tricolor beam and cross–checked with the radar altimeter to ensure standard altitude vs. range glide path control.

8.4.3.2 Instrument Approach

An instrument approach procedure shall be utilized during IMC until sufficient visual cues are available to proceed visually (approximately 0.5 DME). The standard TACAN Instrument Approach Procedure is contained in Helicopter Operating Procedures for Air–Capable Ships NATOPS Manual (NAVAIR 00–80T–122). The Alternate Instrument Approach Procedure (Figure 8-1) reduces aircrew workload by eliminating the requirement to maintain a constant rate of descent throughout the approach.

The approach is commenced from a position at least 1.5 miles astern on BRC, at no less than 200 feet AGL and approximately 80 KIAS. When established on final approach course inbound, a descent and deceleration may be commenced to arrive at 0.5 DME (MAP) at no less than 200 feet and approximately 50 KIAS. If visual contact is not made by 0.5 DME, a missed approach shall be executed. If visual contact is established, the descent and deceleration may be continued utilizing the normal approach profile to arrive approximately 15 feet above the flight deck with a controlled rate of closure.

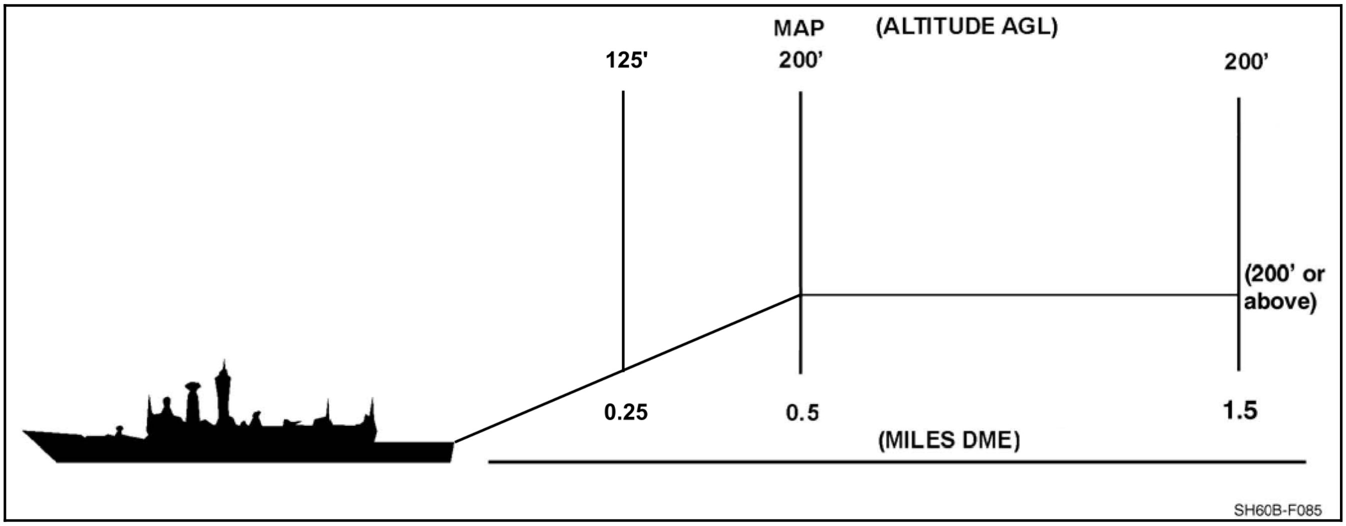


Figure 8-1. Visual and Instrument Approach Profile

8.4.3.3 Self-Contained Approach Procedures

The systems of the SH-60B enable aircrews to conduct shipboard instrument approaches independent of external aids to navigation, known as the Self-Contained Approach (SCA). The SCA is specifically for approaches to ships at night or IMC when TACAN is not available. The SCA is conducted as follows:

Note

Operations to a ship without an operable TACAN are only permitted with a visible natural horizon.

1. Establish a refined radar track on ship, ensuring ship's reported GPS true course and speed through the water are matched with helo generated track.

Note

Weather conditions permitting, a Mark On Top of vessel may provide the most accurate position for ship's track symbology.

2. Both pilots switch to Computer mode.
3. ATO establish Fly-to Point slaved to ship's track.
4. Fly to arrive 2.0 NM astern the ship at 80 KIAS and 200 feet AGL on Fox Corpen. SO make final update of radar track.
5. PAC follow course arrow to FTP. Use Range to FTP in place of TACAN DME to conduct approach.
6. SO switch MPD to Nav Parameters Table and call closure and monitor altitude for duration of approach.
7. Fly to arrive at 0.5 NM astern the ship at 50 knots at 200 feet AGL on Fox Corpen. (Missed Approach Point).
8. Begin descent and deceleration to arrive at .25NM astern the ship at 125 feet AGL on Fox Corpen with closure rate well under control.
9. Continue descent and deceleration to arrive approximately 15 feet above the flight deck with a controlled rate of closure.

WARNING

- If GPS data or aircraft symbology is suspected to be unreliable, consideration should be given to securing GPS prior to commencing approach.
- When able, the PAC must transition to visual cues for the terminal portion of the approach to landing. The range to FTP in computer mode any not be as reliable as DME if the same approach were conducted in TACAN mode.

Note

While in computer mode, the course arrow will show course to Fly-to Point in degrees true. This may differ significantly from the same approach conducted in TACAN mode.

8.4.3.4 Landing Transition

The transition from the missed approach point (0.5 DME) to landing requires deceleration below minimum power required airspeed. As the aircraft slows below minimum power required airspeed, more power is needed to maintain the glide path.

WARNING

Failure to increase power appropriately during the landing transition can result in high rates of descent at low altitude and potential water impact.

The transition from the approach phase to the landing phase begins at approximately .25 nm from the ship, with the aircraft at approximately 125 feet and closure rate well under control. The PNAC should call altitude every 10 feet and advise the pilot of adverse closure rate trends with FAST or SLOW calls.

If a waveoff is initiated during the landing phase, the PAC shall provide obstacle clearance. The PNAC shall resume a full instrument scan. A waveoff may be initiated at any time prior to landing. Compliance is mandatory. The pilot shall release the RA cable (if required) and depart the ship when “ALL CLEAR” is received.

WARNING

Activation of the waveoff lights may temporarily blind both pilots and could result in spatial disorientation and loss of helicopter. Unless there is no other method available to communicate the waveoff command, use of the waveoff lights is not recommended.

The PNAC, Aircrewman, or LSO can provide the PAC with positional information over the RSD (conning).

8.5 RAST EQUIPPED AIR-CAPABLE SHIPS

Flight deck operations on a RAST equipped ship differ from those on a non-RAST ship. RAST flight operations require an LSO, a Landing Signalman Enlisted (LSE) and two hookup men. During RAST flight deck evolutions, the LSO controls flight operations with the Helicopter Control Officer (HCO) acting as a safety observer. The LSE and the hookup men are the only personnel required on deck during the landing sequence, and only for the short time it takes to connect the messenger cable to the Recovery Assist (RA) cable. Once the aircraft lands and is secured in the RSD, the LSO will direct the LSE onto the flight deck for aircraft shutdown or personnel transfer. Chocks and chains are not required when secured in the RSD for personnel transfers, but may be considered, based upon sea state, winds, ship maneuverings, and length of time on deck. The Flight Deck Director (FDD) will assist the LSO during straightening and traversing into the hangar; the FDD and the LSO must work as a team with the FDD being the eyes on the flight deck.

CAUTION

- No maintenance shall be performed which can change the static vertical clearance between the external aux fuel tanks and the flight deck. If such maintenance is necessary, deck clearance shall be checked by appropriate maintenance personnel before continued operations.
- Pilots and LSO shall exercise due caution when conducting traversing, straightening, and launch/recovery operations with an external tank equipped H-60 aircraft in the RSD. Avoid abrupt aircraft and RSD motions to minimize potential tank/RSD contact.

8.5.1 LSO Console Preoperational Checklist

1. RSD — OFF.
2. Tail guide winch (TGW) — UNLOAD.
3. Traverse lever — TRAVERSE SELECT.
4. RA tension lever — RA SELECT.
5. Remote control (in stop position) — Obtain.

WARNING

Once remote control of the RAST system has been received, the RSD beams will respond to commands from the LSO station regardless of START/STANDBY status. Ensure that personnel keep well clear of RSD beams at all times.

6. LAMP TEST/RA METER TEST — Complete.
7. RAST machinery room — Clear of all personnel.
8. Proper RSD selected — PORT/STBD.

WARNING

Failure to ensure the proper RSD is selected can lead to activation of the wrong RSD, which can result in damage to a hangared aircraft or injury to flight deck personnel.

9. START/STANDBY — As required.

CAUTION

- Pilots and LSOs shall exercise caution when conducting launch/recovery, straightening, and traversing operations with an external auxiliary tank-equipped aircraft in the RSD. Avoid abrupt aircraft or RSD motions to minimize potential for tank/RSD contact.
- If aircraft gross weight exceeds weight at which last vertical clearance was measured, another measurement must be taken to ensure adequate tank/RSD clearance.

Note

Engagement of the START/STANDBY pushbutton is not required for operation of the RSD beams during takeoff and free deck evolutions.

10. RSD pressure light:
    a. If START/STANDBY engaged — OFF.
    b. If START/STANDBY not engaged — ON.

8.5.2 RSD Unlatched Procedure

WARNING

Toggling the RSD switch from OFF to CLOSED to OFF with the RSD beams already in the closed position may allow the beams to become unlatched, potentially resulting in aircraft rollover in heavy seas. If the beams cannot be visually confirmed latched, perform RSD Unlatched procedure and visually confirm latched condition.

1. Chocks and chains — On.
2. Beams — Open (verify by OPEN light on console).
3. RSD — CLOSED.
4. Latched condition — Visually verify beams closed conditions.

Note

Beams can be visually confirmed latched by a latched light, witnessing the RSD flags in the up position, or noting no more than a quarter inch separation at the ends of the RSD beams.

8.5.3 Traversing Checklist

WARNING

Toggling the RSD switch from OFF to CLOSED to OFF with the RSD beams already in the closed position may allow the beams to become unlatched, potentially resulting in aircraft roll over in heavy seas. If the beams cannot be visually confirmed latched, chock & chain the A/C, open the beams fully, (verify by OPEN light on console), select RSD CLOSED and visually verify beams to be closed with latch light.

Note

Beams can be visually confirmed latched by a latched light, witnessing the RSD flags in the up position, or noting no more than a quarter inch separation at the ends of the RSD beams.

1. LSO Console Preoperational Checklist — Complete.
2. FDD communication check — Complete.
3. Traverse clearance — Obtain.

WARNING

Should the ship maneuver, cease all aircraft movements, call for aircraft brakes and chains as necessary, to prevent injury to personnel and/or helicopter damage. Contact the pilot house to resolve the situation.

4. FDD — Confirm:

   a. Hangar door — Open and pinned.

   b. Track slot seals — Removed.

Note

Track slot seals should be placed in the slot whenever operationally feasible.

   c. Hangar door/deck bridge — Removed (CG).

   d. Left-handed extended pylon — Up and pinned.

   e. Hangar and flight deck gear — Stowed.

   f. RSD safety bar — Installed.

   g. RAST probe to deck clearance — Check.

   h. Tail probe — In track slot.

   i. Brakerider — In aircraft.

   j. Tail wheel — LOCKED.

   k. Blade/pylon fold restraints — In place.

   l. All access panels/cowling/LHEP — Secure.

   m. Bellmouth plug — Removed and stowed.

5. Control console — Check:

   a. Proper RSD — PORT/STBD.

   b. RSD lights — CTR, LTCH, BRKE lights on.

   c. Traverse lever — TRAVERSE SELECT position.

6. Chocks/chains — Remove.

7. Traverse — Select, check TRVS light.

8. Personnel — Clear of aircraft.

9. Aircraft brakes — Off.

WARNING

The FDD shall remain in sight of the LSO at all times while traversing the aircraft.

CAUTION

- The aircraft should be moved at slow speed when the tail wheel is within the confines of the hangar.
- Ship rolls of 16° and above will consistently generate aircraft relative roll angles of 10° when aircraft is secured only by the RSD. The aircraft will occasionally reach relative roll angles of 10° with as little as 10° of ship roll. During traversing on the FFG 7 class, these relative roll angles of 10° could result in the forward lower tail rotor blade impacting the port door frame of either hangar while the rescue hoist and outboard main rotor blade could impact the starboard door frame of either hangar. During traversing, wait to obtain a relatively quiescent period (less than 8° of ship roll) or until the ship is rolling away from the direction of possible impact before moving the MRB, hoist, or TRB areas past the hangar door frame using fast speed if required.
- Ship motion may cause the tail probe to pop out of the RAST track. If this happens, stop traversing and install chocks and tiedowns. Straightening–qualified personnel should determine appropriate actions to be taken to reseat probe in track.
- During traversing on CG 47 and class ships, traverse slowly over the elevated hangar door tracks.
- If the aircraft is to be straightened/traversed with the external power cable attached, the FDD shall assign a person to tend the power cable and keep it clear of the aircraft path to prevent damage to the cable.

Note

Sideloads can develop while traversing the helicopter, as evidenced by a lateral strain on the tires. This can result in the RSD jamming in the track slot or in excessive side forces applied to the aircraft landing gear. Reverse the direction of traversing until the sideload dissipates, then continue with normal procedures.

10. Traverse lever — Desired direction/speed.
11. FDD directions — Follow.

WARNING

Should communication or visual contact with FDD be lost, traversing shall be stopped immediately.

12. Traversing — Stop.
    a. SNUB button — Press, or
    b. Traverse lever — TRAVERSE SELECT, or
    c. START/STANDBY — Press, or
    d. STOP — Press.

Note

Traversing may be stopped before the aircraft reaches the takeoff position to permit tail pylon spread.

13. Aircraft brakes — Set.
14. Chocks/chains — As required.
15. Notify bridge — Deselect TRVS on BIDS.

8.5.4 Prelaunch Checklist

1. Communication check with HCO, bridge, and CIC — Complete.
2. FOD walkdown — Complete.
3. Deck gun mounts (if applicable) — Stowed/secured.
4. All nets — Down.
5. LSO Console Preoperational Checklist — Complete.
6. RSD/aircraft — In takeoff position.
7. RSD safety bar — Remove.
8. RSD Chock (If applicable) — Remove.
   a. Personnel — CLEAR.
   b. RSD Beams — Open.
   c. RSD Chock — Remove.
   d. Personnel — CLEAR.
   e. RSD Beams — Closed.
9. Tail probe — Manually retract.
10. HRS and SGSI — As required.
11. Night lighting — As required.
12. UHF COMM with HCO or CIC or aircraft (EMCON permitting) — Check.
13. HELO CRASH alarm — Permission from bridge and check as required.
14. HCO transfers control to LSO when flight quarters set — Complete.
    a. Deck status lights — Obtain from HCO and check.
    b. Deck status lights — Red.
    c. Helo waveoff lights — Test.

Note

During EMCON the data link hardwire or external IB may be used for deck maneuvers, in addition to deck status and aircraft lights. The LSO should use wands to communicate visually as necessary.

8.5.5 Aircraft Startup

Aircraft Startup	Deck Status
1. Spread clearance — Obtain.	
2. Relative wind — Within limits for spread.	
3. Spread sequence — Clear FDD to proceed.	
4. UHF COMM check with aircraft (EMCON permitting) — Complete	
5. Hangar doors — Fully closed.	
6. High Points and Tail Tiedowns — Verify removed with LSE.	
7. ENGINE START/ENGAGE clearance — Obtain.	Red
8. Aircraft engines started — Notify bridge.	
9. Flight deck — Clear except LSE, safety observer, and chock and chain personnel.	
10. Relative wind — Within limits for engagement.	
11. Aircraft engage (EMCON — Position lights flashing to request).	Amber
12. Engaged — Notify bridge.	Red

WARNING

Lateral cyclic displacement during high sea states may endanger deck personnel and will not maintain a level aircraft attitude.

8.5.6 Launch Procedures

Launch Procedures	Deck Status
1. Main probe — Check position in RSD, inform pilot.	
Note Ensure the main probe tip will clear the inside edges of the RSD and RSD beams when the beams are opened.	
2. Tail probe — Check up.	
3. Pass to aircraft:	
a. Altimeter.	
b. True wind.	
c. BRC.	
d. Pitch.	
e. Roll.	
f. Relative winds.	
4. Launch clearance — Obtain (EMCON — position lights steady to request).	Amber
5. Electrical/data link cords/tiedowns — Verify removed.	
6. Aircraft — Signals ready to lift.	
a. Pilot — (EMCON) Flash searchlight or hover lights.	
7. Flight deck/Airspace — Clear.	

Launch Procedures	Deck Status
8. Relative winds — Check within limits for launch.	
9. LSO (when deck is steady) RSD beams — Open.	
a. RSD red flags — Down.	
b. RSD beam position light — Open.	
c. RSD BRKE light — ON.	
10. LSO — “BEAMS OPEN, GREEN DECK, LIFT”.	Green
11. Aircraft lifts into hover:	
a. LSO — “ALL CLEAR,” or	Green
b. LSO — “AIRCRAFT FOULED.”	Amber
12. Ops normal — Received.	Red
13. Post Launch Checklist — Complete.	

8.5.7 Post Launch Checklist

1. After first launch of the day and if immediate landing not intended:
   a. Close RSD and check:
      (1) OPEN and BRKE lights — Out.
      (2) Beams — Close within 4 seconds.
      (3) LTCH light — ON.
      (4) RSD beam flags — Up.
      (5) RSD — OFF; BRKE light — ON.
   b. Open RSD and check:
      (1) LTCH and BRKE lights — Out.
      (2) Beams — Open within 4 seconds.
      (3) OPEN light — ON.
      (4) RSD beam flags — Down.
      (5) RSD — OFF; BRKE light — ON.
   c. RSD safety bar — Install if immediate landing not intended.
   d. Pull 3 to 4 feet of cable out — Complete (hold RA cable switch to OUT).
      (1) 2 FPS light — ON.
      (2) Personnel — Clear.
   e. Tension lever — RA SELECT.
   f. RA SELECT — Select:
      (1) STBY light — OUT.
      (2) RA light — ON.
      (3) Cable reels in at 2 FPS.
      (4) When seated — SEAT and STBY LIGHT ON.
   g. RSD safety bar — Install.
   h. STOP — Press, and go to local control.

8.5.8 Recovery Checklist

WARNING

Toggling the RSD switch from OFF to CLOSED to OFF with the RSD beams already in the closed position may allow the beams to become unlatched, potentially resulting in aircraft roll over in heavy seas. If the beams cannot be visually confirmed latched, chock and chain the A/C, open the beams fully, (verify by OPEN light on console), select RSD CLOSED and visually verify beams to be closed with latch light.

Note

Beams can be visually confirmed latched by a latched light, witnessing the RSD flags in the up position, or noting no more than a quarter inch separation at the ends of the RSD beams.

Recovery Checklist	Deck Status
1. Communication check with HCO, bridge, and CIC — Complete.	
2. FOD walkdown — Complete.	
3. Deck gun mounts (if applicable) — Stowed/secured.	
4. All nets — Down.	
5. LSO Console Preoperational Checklist — Complete.	
6. RSD — In landing position or clear of landing area.	
7. RA cable switch — Hold in the OUT position while 20 to 30 feet of cable is faked in a figure 8 on the inboard side of the RSD.	
8. RSD safety bar — Remove and stow.	Red
9. HRS and SGSI — As required.	
10. Night lighting — Permission from bridge and check as required.	
11. UHF communication with HCO or CIC (EMCON permitting) — Check.	
12. HELO CRASH alarm — Permission from bridge and check as required.	
13. HCO transfers control to LSO when FLT QTRS set — Complete.	
a. Deck status lights and BIDS — Obtain from HCO and check.	Red
14. RECOVERY clearance — Obtain.	

8.5.9 Recovery Assist (RA) Procedures

Note

- An RA landing can be made with or without the RSD in the landing position. Landing without the RSD utilizes the same procedure as landing with the RSD and provides increased safety over normal clear deck landings. Use clear deck wind envelopes for limitations. The RAST control panel MASTER switch is in the ON position and the main probe is locked in the down position as part of the shipboard landing checklist. The pilot should continue down the approach line and position the aircraft slightly inboard of the RSD. The aircrewman will then lower the messenger cable. After allowing some slack to compensate for ship/helicopter movement, the LSO will signal the aircraft to stop lowering. The messenger cable is grounded and attached to the RA cable. On signal from the hookup man, the LSO shall signal the aircraft to raise the messenger. The aircrewman then raises the messenger while the pilot flying maintains a steady hover. When the MESSGR CABLE IN and H'DOWN CABLE LKD indications are present on the RAST control panel, the aircrewman will inform the pilot, who will then request hover tension. The LSO will apply hover tension and inform the pilot. The pilot will inform the LSO when he/she is ready to land. The LSO, aircrewman, or pilot not at the controls will give the pilot the necessary corrections to position the aircraft over the RSD. When the deck is steady and the aircraft is over the RSD, the LSO will give the preparatory order LAND NOW, followed by the execution order DOWN, DOWN, DOWN, while simultaneously increasing tension to maximum. Once the aircraft is on deck and the main probe is in the RSD, the LSO will close the RSD beams and inform the pilot TRAPPED.
- Until the LSO begins conning, the non–flying pilot or the aircrewman will provide the pilot with conning to maintain position for hookup and establish a good position for landing.

Once the aircraft is trapped, the RA cable shall be released prior to shutdown or free deck yo–yos. The pilot will call or signal for release and the LSO will ensure zero tension and clear the pilot to release. For EMCON this may be arranged on the hardwire/external IC. It is acceptable to use the pickle signal by day (depress thumb on clenched fist). If NIGHT/EMCON or LOST COMM, alternate red/amber deck status lights.

WARNING

The RA cable is not designed to secure the aircraft to the flight deck. For RAs and free deck landings, failure to secure the aircraft with the RSD may result in the aircraft exceeding dynamic/static rollover limits during a large ship roll and allow the main rotor blades to impact the flight deck. Both pilot and LSO shall consider current and transient flight deck conditions (sea state, wind, ship pitch, and roll) to determine the necessity for securing the RSD after each recovery.

Recovery Assist (RA) Procedures	Deck Status

WARNING

When the helicopter is using NVDs on short final, to include over the deck, the waveoff lights shall not be used due to the effects of NVD blooming. The aircrew will be temporarily blinded and lose sight of the ship.

1. LSO — Green deck for RA Recovery. — Green
   a. PORT/STBD RSD.
   b. Altimeter.
   c. True wind.
   d. BRC.
   e. Pitch.
   f. Roll.
   g. Relative wind.

Note

For EMCON recoveries, this information may be passed on data link and the recovery carried out using light signals.

2. Pilot — Landing Checklist — Complete.

A Degraded Control RA recovery is a technique that may be employed when the aircraft is suffering from a flying quality degradation such as a main rotor damper system malfunction. The approach and hookup are the same as for a normal RA recovery. After receiving a report of three green, the pilot will request MINIMUM TENSION vice HOVER TENSION. The LSO uses RA Select to place 850 lb of tension on the hauldown cable. The pilot will position the aircraft over the RSD and will report READY TO LAND. The LSO steadily increases tension to 4,000 lb. The pilot should refrain from fighting against the centering action of the tensioned cable and use collective to control rate of descent. Once the aircraft is safe on deck, proceed with appropriate emergency procedures. Any time that a Degraded Control RA recovery is considered, the aircrew should weigh the relative merits of a standard clear-deck or free-deck landing.

3. Pilot — On short final, flash searchlight or hover lights (night).
4. HCO — Line-up lights steady/dim (night).
5. Pilot (crossing deck edge) — LOWER THE MESSENGER.
6. Aircrewman — LOWERING.
7. LSO — STOP LOWERING. — Amber

Recovery Assist (RA) Procedures	Deck Status

WARNING

If a STOP LOWERING command is not received from the LSO after 20 seconds, stop lowering the messenger and verify the messenger status.

8. Aircrewman — STOPPED.

9. LSO — HOOKUP MEN ON DECK.

WARNING

- One of the hookup men shall maintain eye contact with the aircraft. The other shall maintain eye contact with the LSO. If, in their opinion, the deck is unsafe or they are signaled by the LSO, they shall clear the deck immediately.
- Too much slack in the messenger cable may entangle flight deck personnel and result in serious injury.

10. LSO — PERSONNEL CLEAR, RAISE THE MESSENGER. — Green

11. Aircrewman — RAISING.

Note

If the RA cable falls away from the messenger cable, the LSO should alternate green/amber deck status lights and call the fall away. If a second attempt to hook up is possible, a steady green deck status light should be given and the procedure reverts to step 5. If the hookup is not feasible, but a safe free deck landing can be made, a steady amber deck status light should be shown and the procedures should follow step 4. of the Free Deck Landing Checklist. If an unsafe deck condition exists, a red deck should be indicated and a waveoff initiated.

12. Aircrewman — THREE GREEN.

13. Pilot — THREE GREEN, HOVER TENSION.

    a. Flash searchlight or hover lights (EMCON).

14. LSO — STANDBY:

    a. Check 2 FPS light ON.

    b. Activate RA and ensure RA selected.

Recovery Assist (RA) Procedures	Deck Status

CAUTION

To prevent the slack RA cable from becoming fouled under the RSD, the LSO should ensure the aircraft remains in a hover inboard the RSD until the cable becomes taut. Should the cable become caught under a corner of the RSD, the LSO shall place the system in standby, change deck status light to red, and have the pilot release the RA cable and move aft, and have flight deck personnel clear the cable.

Note

The use of full RA tension in a high density altitude environment may result in transient N_r drooping and excessive rates of descent.

c. Cable reels in at 2 fps to minimum tension (850 pounds).

d. Select 2,000 pounds.

15. LSO — HOVER TENSION. — Amber

16. Pilot (positions aircraft over RSD) — READY TO LAND.

a. Flash searchlight or hover lights (EMCON).

CAUTION

- The aircraft will translate slightly forward as the nose is lowered for landing following tail wheel contact during an RA landing. An aft cyclic input to arrest the perceived forward movement of the aircraft will result in droop stop pounding of the blade retention assembly and high structural loads on the rotor head assembly.
- Aircraft rolls up to 17°, in addition to the roll of the ship, can be experienced while in the RSD due to the RAST probe design.

17. LSO, PNAC, or Aircrewman — Conns aircraft into position.

a. LSO — Select 4,000 pounds. LAND, NOW, DOWN, DOWN, DOWN (until aircraft is on deck). — Green

b. Verify aircraft in the trap. For mistrap, refer to Mistrap Procedures.

c. If LTCH light fails to illuminate or RSD BEAM LTCH flags do not indicate proper latching of the RSD beams, refer to RSD Fails to Latch procedure.

d. If conducting consecutive landing practice while attached to the RA cable, refer to Consecutive Landing Practice (RA Yo-Yos or Free Deck Bounces) procedure.

e. If intentions are to shut down or release RA cable for the purpose of continuing flight operations:

Recovery Assist (RA) Procedures	Deck Status
(1) LSO — IN THE TRAP, HOOKED ON MAX TENSION.	
(2) RSD beams — CLOSE.	
(3) LTCH light — ON.	
(4) BRKE light — ON.	
(5) RSD beam flags — UP.	
18. LSO — TRAPPED.	Amber

WARNING

Failure to keep the Officer of the Deck (OOD) informed of the aircraft status may result in the ship maneuvering prior to chocks and chains being installed. Ensure the OOD is aware of whether or not the aircraft is properly secured. Deck status lights alone do not provide this information.

19. Chocks and chains — Install as required.	Red
20. Pilot — REQUEST ZERO TENSION RELEASE. (EMCON — Flash searchlight or hover lights).	
21. LSO — PREPARE RA CABLE FOR RELEASE:	
a. Minimum Tension — Select.	
b. Standby — Press. ENSURE ZERO TENSION.	
22. LSO — CLEARED FOR ZERO TENSION RELEASE (pickle signal).	Alternate Red/Amber
23. Pilot — Release RA cable by depressing RAST release button on cyclic.	
a. Aircrewman — Verify H'DOWN CABLE OUT light ON.	
b. PILOT — SHOW GOOD RELEASE.	
24. LSO — Verify cable released:	
a. Check for 2 FPS status light illumination.	
b. Select RA cable in.	
c. Check for SEAT light — On.	

CAUTION

Any time the RA cable is released with tension on the system, the machinery room shall be checked for fouled cable prior to reselecting RA.

25. LSO — Inform bridge RECOVERY COMPLETE.

8.5.9.1 Mistrap

Mistrap	Deck Status
1. Simultaneously the LSO:	Amber
a. Calls — UP, UP, UP.	
b. Minimum tension — Select.	
2. Pilot can release RA cable or return to hover while still hooked on.	
a. If pilot releases:	
(1) LSO — ALL CLEAR.	Green
b. If pilot remains hooked on:	
(1) LSO — HOOKED ON, MINIMUM TENSION.	Alternate Amber/Green
3. LSO awaits pilot request:	
a. If hooked on — For hover tension.	
b. If not hooked on — Aircraft must clear deck to fake out cable or proceed with free deck landing procedures.	

8.5.9.2 RSD Fails To Latch

RSD Fails to Latch	Deck Status
1. LSO — Maintain 4,000 pounds.	Red
2. LSO — IN THE TRAP MAXIMUM TENSION.	
3. RSD beams — CYCLE.	Green
4. If unlatched indication persists, or RSD beams cannot be closed, chocks and chains shall be applied as soon as possible.	
5. RSD — OFF.	

8.5.9.3 Airborne Release

Airborne Release	Deck Status
1. Pilot — STANDBY RELEASE, RELEASING NOW, NOW, NOW:	
a. Releases on third now.	
2. LSO, prior to third now:	
a. Minimum tension — Select.	
b. Standby — Select.	
3. LSO (aircraft clear) — ALL CLEAR.	Green
4. If release was accomplished with Tension on the cable:	
a. RAST machinery room — Check prior to further use of any RAST machinery.	

8.5.9.4 Free Deck Landing

Free Deck Landing	Deck Status
1. LSO — GREEN DECK FOR FREE DECK RECOVERY.	Green
a. PORT/STBD RSD.	
b. Altimeter.	
c. True wind.	
d. BRC.	
e. Pitch.	
f. Roll.	
g. Relative wind.	
2. Pilot — Landing Checklist — Complete.	
Note For EMCON recoveries, this information may be passed on data link and the recovery carried out using light signals.	
3. Pilot — On short final flash searchlight or hover lights (night).	
4. HCO — Lineup lights steady/dim (night).	
5. LSO — Aircraft over deck.	Amber
6. Pilot (positions aircraft over RSD) — READY TO LAND:	
a. Searchlight or hover lights — Flash (EMCON).	
7. LSO, PNAC, or Aircrewman — Conns aircraft into position:	
a. “LAND NOW, DOWN, DOWN, DOWN” (until aircraft on deck).	Green
8. LSO — IN THE TRAP.	
a. RSD beams — CLOSE.	
b. LTCH light — ON.	
c. BRKE light — ON.	
d. RSD beam flags — UP.	
9. LSO — TRAPPED.	Amber
a. For mistrap, refer to Mistrap Procedures.	

Free Deck Landing	Deck Status

WARNING

Failure to keep the Officer of the Deck (OOD) informed of the aircraft status may result in the ship maneuvering prior to chocks and chains being installed. Ensure the OOD is aware of whether or not the aircraft is properly secured. Deck status lights alone do not provide this information.

10. Once chocked and chained — Inform bridge.	Red

8.5.9.5 Consecutive Landing Practice (RA Yo-Yos or Free Deck Bounces)

Consecutive Landing Practice (RA Yo-Yos or Free Deck Bounces)	Deck Status

Note

- Clearance from the bridge to conduct yo-yos is necessary, but not for each evolution.
- EMCON yo-yos are performed using normal EMCON procedures. Preflight briefing or the data link, if available, should be used to coordinate evolutions.

1. For RA, normal procedures are used except:	
a. Aircraft does not need to be secured in the RSD after every landing; however, the RSD beams should be closed if any delay is anticipated.	
b. When not secured with the RSD, maximum tension is left applied and LSO (upon landing) calls IN THE TRAP, HOOKED ON MAXIMUM TENSION.	Amber
c. Pilot calls — READY TO LIFT, LSO ensures minimum tension selected and calls — BEAMS OPEN, GREEN DECK, LIFT.	Green
d. Upon takeoff, LSO calls ALL CLEAR. HOOKED ON, MINIMUM TENSION.	
2. For free deck, normal procedures are used. The aircraft does not need to be secured in the RSD after every landing; however, the RSD beams should be closed if any delay is anticipated.	

8.5.9.6 Post Recovery

Post Recovery	Deck Status
1. LSO — Disengagement clearance — Obtain (EMCON — Aircraft position lights flashing).	
2. LSO — Before clearing aircraft to disengage, ensure:	
a. LSE — On deck.	
b. Relative wind — Within limits.	Amber
3. LSO — Disengagement complete — Notify bridge.	Red

8.5.9.7 Straightening Checklist

CAUTION

- The aircraft shall not be straightened with the blades or pylon folded.
- Aircraft should not be refueled until straightening sequence is completed to reduce loads on the tail landing gear.
- Strong winds and high sea states may exceed tail guide winch cable authority.
- The aircraft is not to be straightened with the external power cable attached.
- If the aircraft is to be traversed with the external power cable attached, the FDD shall assign a person to tend the power cable and keep it clear of the aircraft path to prevent damage to the cable.

Note

If RAST probe slippage occurs during straightening and line-up line mark does not line up with track slot, consideration should be given to restarting the straightening procedures.

1. LSO Console Preoperational Checklist — Complete.
2. FDD communication check — Complete.
3. Safety bar (if installed) — Remove.
4. RSD beams — OPEN.
5. Main probe to deck clearance and main probe position in RSD — Check.

Note

To ensure receipt of latched light indication and proper alignment of helicopter during straightening evolutions, main probe should be centered (as indicated by yellow RSD line-up) in RSD.

If probe needs to be raised or centered in RSD:

a. RSD beams — OPEN

b. Main probe — RAISE, if necessary.

c. Traverse — SELECT, if necessary.

d. Traverse lever — Desired direction to center main probe in RSD, if necessary.

CAUTION

Under certain conditions, the aircraft main probe may contact the deck, resulting in a small amount of main probe compression. The amount of compression, if observed in the upper barrel, shall be subtracted from the 1 inch allowable on the upper barrel.

Note

If main probe to deck clearance is inadequate, the main probe can be beeped up a maximum of 1 inch as measured from the bottom of the aircraft to a point 1 inch down on the upper barrel of the main probe.

6. RSD Chock — INSTALL (if available).
7. RSD beams CLOSED — Check LTCH and BRKE lights.
   a. RSD beam flags — UP.
   b. LTCH light — ON.
   c. BRKE light — ON.

WARNING

Toggling the RSD switch from OFF to CLOSED to OFF with the RSD beams already in the closed position may allow the beams to become unlatched, potentially resulting in aircraft roll over in heavy seas. If the beams cannot be visually confirmed latched, chock and chain the A/C, open the beams fully, (verify by OPEN light on console), select RSD CLOSED and visually verify beams to be closed with latch light.

Note

Beams can be visually confirmed latched by a latched light, witnessing the RSD flags in the up position, or noting no more than a quarter inch separation at the ends of the RSD beams.

8. All nets — Down.
9. Brakerider — In aircraft.
10. Flight deck — Clear.
11. Proper RSD — PORT/STBD.
12. Straighten clearance — Obtain.

WARNING

Should the ship maneuver, cease all aircraft movements, call for aircraft brakes and chains as necessary, to prevent injury to personnel and/or helicopter damage. Contact the pilot house to resolve the situation.

13. TGW — UNLOAD.
    a. TGW cables — Install.
14. Tail probe — Verify up.
15. TGW cables — Clear.
16. TGW — AUTO.
17. Center probe in RSD — As required.

18. Tail wheel — Manually unlock.
19. Safety bar (if installed) — Remove.
20. SEAT light — ON.
21. Chocks/chains — Remove.
22. Aircraft brakes — Off.
23. If main probe is forward of bellmouth:
    a. RSD beam brakes — Release position and hold.

CAUTION

Failure to hold the RSD beam brake switch in the release position in accordance with the Straightening Checklist will result in excessive side loading of the aircraft.

    b. Traverse main probe aft of bellmouth — Complete.

WARNING

The FDD shall remain in sight of the LSO at all times when traversing the aircraft.

24. Straightening procedures — Complete.
    a. See Figure 8-2 if aircraft main landing gear is on, or starboard of, alignment line.
    b. See Figure 8-3 if aircraft main landing gear is port of alignment line.

WARNING

Ensure all flight deck personnel are clear of TGW cables to prevent injury, especially in the event of cable failure.

CAUTION

Failure to ensure all slack is removed from the tail guide winch cables prior to any twisting evolution may cause damage to the fuel dump tube.

STEP	RSD BRAKE SWITCH	TRAVERSE LEVER	TGW HANDLE	RESULT
1.	RELEASE position and hold	Fwd (Note)	Twist to Port	Move main probe to port limit (PORT light ON).
2.	ON	Aft	—	Move port aircraft alignment mark over track slot.
3.	AUTO position and hold	Fwd (Note)	Twist to STBD	Center RSD beams (CTR light ON).
		CAUTION		
	During step 3., failure to limit forward movement to six inches could result in tail guide wire hooks penetrating the aircraft skin.			
4.	ON	Fwd	—	Move tail probe over track slot.
5.	—	—	—	Aircraft brakes — ON.
6.	—	—	—	Install chocks/chains.
7.	—	—	—	Lower tail probe full down.
8.	—	—	—	Remove chocks/chains.
9.	—	—	—	Aircraft brakes — OFF.
10.	—	—	—	Complete Post Straightening checklist.

Note

Traversing provides for tail wheel caster. Limit to six inches.

Figure 8-2. Straightening Procedures, Aircraft Main Landing Gear on Alignment Line or Starboard of Line

STEP	RSD BRAKE SWITCH	TRAVERSE LEVER	TGW HANDLE	RESULT
1.	RELEASE position and hold	Fwd (Note)	Twist to STBD	Move main probe to STBD limit (STBD light ON).
2.	ON	Aft	—	Move starboard aircraft alignment mark over track slot.
3.	AUTO position and hold	Fwd (Note)	Twist to PORT	Center RSD beams (CTR light ON).
CAUTION During step 3., failure to limit forward movement to six inches could result in tail guide wire hooks penetrating the aircraft skin.				
4.	ON	Fwd	—	Move tail probe over track slot.
5.	—	—	—	Aircraft brakes — ON.
6.	—	—	—	Install chocks/chains.
7.	—	—	—	Lower tail probe full down.
8.	—	—	—	Remove chocks/chains.
9.	—	—	—	Aircraft brakes — OFF.
10.	—	—	—	Complete Post Straightening checklist.
Note Traversing provides for tail wheel caster. Limit to six inches.				

Figure 8-3. Straightening Procedures, Aircraft Main Landing Gear Port of Alignment Line

8.5.9.8 Post Straightening Checklist

1. Tail wheel — LOCK.
2. START/STANDBY — STBY.
3. Aircraft brakes — ON.
4. Chocks/chains — As required.

CAUTION

Using only the main RAST probe to secure the aircraft in high sea states may result in damage to the probe.

5. RSD safety bar — Install.
6. TGW — UNLOAD.
7. TGW cables — Remove.
8. TGW — AUTO for stow, then UNLOAD after complete.
9. STOP button — Press to obtain PRESS light.
10. Notify bridge — Straightening complete.
11. Fold blades/pylon — As required.

WARNING

Ensure external power is applied or battery switch is on prior to folding the tail pylon to ensure the tail index actuator engages immediately after starting pylon fold sequence. Uncontrolled tail rotor windmilling may result if tail index actuator is not engaged.

a. Fold clearance — Obtain.

b. Fold cycle — Complete.

CAUTION

Unsecured folded main rotor blades can flap enough in high winds or high sea states to strike the upper UHF antenna. To prevent damage to the rotor blades and antenna, blade crutches shall be applied when the blades are folded and the ambient conditions are conducive to blade flapping.

12. Notify bridge — Fold complete.

8.6 EMITTER HAZARDS

An electromagnetic interference (EMI) hazard exists to all SH-60B aircraft operating in the vicinity of CG-47 or DDG-51 class ships.

CAUTION

Due to the adverse effects of EMI on aircraft operating in the vicinity of SPY-1 radar, SH-60B aircraft should not close within 2 nm of CG-47 or DDG-51 class ships unless SPY-1 is operating at low power, the controller has broken data link, and the helicopter track has been dropped. Prior to takeoff on these class of ships, aircraft commanders should ensure that Hawk Link is in standby (following removal of the hardwire) and not placed to radiate until the aircraft is 2 nm clear of own ship.

Lot 1 SH-60B aircraft, BuNo 161553 to 161570, not incorporating ECP-3013R5 (AFC-24) shall not approach or remain within the minimum standoff distances of radiating shipboard and/or shore-based emitters as shown in Figure 8-4. Lot 1 aircraft carrying torpedoes shall remain outside the standoff distances when operating with ships, whether emitters are radiating or not. If the aircraft is on the deck, emission restrictions apply only if maintenance or preflight actions are being performed.

WARNING

Failure to maintain standoff distances may cause degradation to flight controls and/or inadvertent actuation of electroexplosive devices.

Note

Transponder MODE IV AUDIO/LIGHT/OUT control may induce static feedback in ATO and pilot headsets when set to AUDIO in an EMI environment.

EMITTER	STANDOFF	EMITTER	STANDOFF	EMITTER	STANDOFF
HF COMM	55 FT (100 FT FOR CV)	STIR	1500 FT	MK 29	1500 FT
MK 91	1500 FT	MK 92	1500 FT	CCA	2800 FT
EX 3 CWCS	2800 FT	FPN 63	2800 FT	MK X11	2800 FT
MD 15 CLWS	2800 FT	MK 24	2800 FT	MK 37	2800 FT
MK 38	2800 FT	MK 86	2800 FT	SPG 51	2800 FT
SPG 60	2800 FT	SLQ 32	2800 FT	SPN 35	2800 FT
SPN 41 ILS	2800 FT	SPN 41 T–4	2800 FT	SPN 42	2800 FT
SPN 43	2800 FT	SPN 44	2800 FT	SPQ 9	2800 FT
SPS 40	2800 FT	SPS 48	2800 FT	SPS 49	2800 FT
SPS 65	2800 FT	SPS 67	2800 FT	SPY 1A/B	2 NM

Figure 8-4. Emitter Standoff Distances (Lot 1 Aircraft)

8.7 HELICOPTER IN-FLIGHT REFUELING

8.7.1 General

Helicopter In–Flight Refueling (HIFR) is intended to extend the aircraft on–station time. It should be initiated with sufficient fuel remaining to BINGO to a suitable landing site if unsuccessful. Night HIFR operations are extremely demanding, and are only permitted for operational necessity.

CAUTION

The PIC shall ensure that the Landing Checklist is completed prior to commencing an approach, HIFR, transfer, etc., to any aviation/air–capable ship.

8.7.2 HIFR Systems

All HIFR–capable ships are equipped with one of two different rigs for helicopter inflight refueling.

8.7.2.1 Wiggins/North Island HIFR Rig

The Wiggins/North Island (NI) rig (Figure 8-5) is composed of a ship's hose (>100 feet in length) and a HIFR assembly (10–foot section of a 1.5–inch hose outfitted with a saddle for hoisting). Both ends of the HIFR assembly are equipped with female closed–circuit refueling (CCR) fittings (also referred to as Wiggins fittings). One Wiggins fitting is connected to the ship's hose and the other Wiggins fitting is connected to the male Wiggins fitting in the helicopter. A manual emergency disconnect lanyard (emergency release T–handle) is located near the Wiggins fitting, which connects to the male Wiggins fitting in the helicopter.

8.7.2.2 NATO-Compatible High Capacity HIFR Rig

The NATO–Compatible High Capacity (NHC) rig (Figure 8-6) features a 2–inch lightweight hose, unisex couplings, automatic emergency breakaway, and facilitates the use of either a Wiggins nozzle or a Parker nozzle for HIFR operations. The NHC rig is composed of two major assemblies: the 100–foot HIFR hose and the 10–foot HIFR assembly.

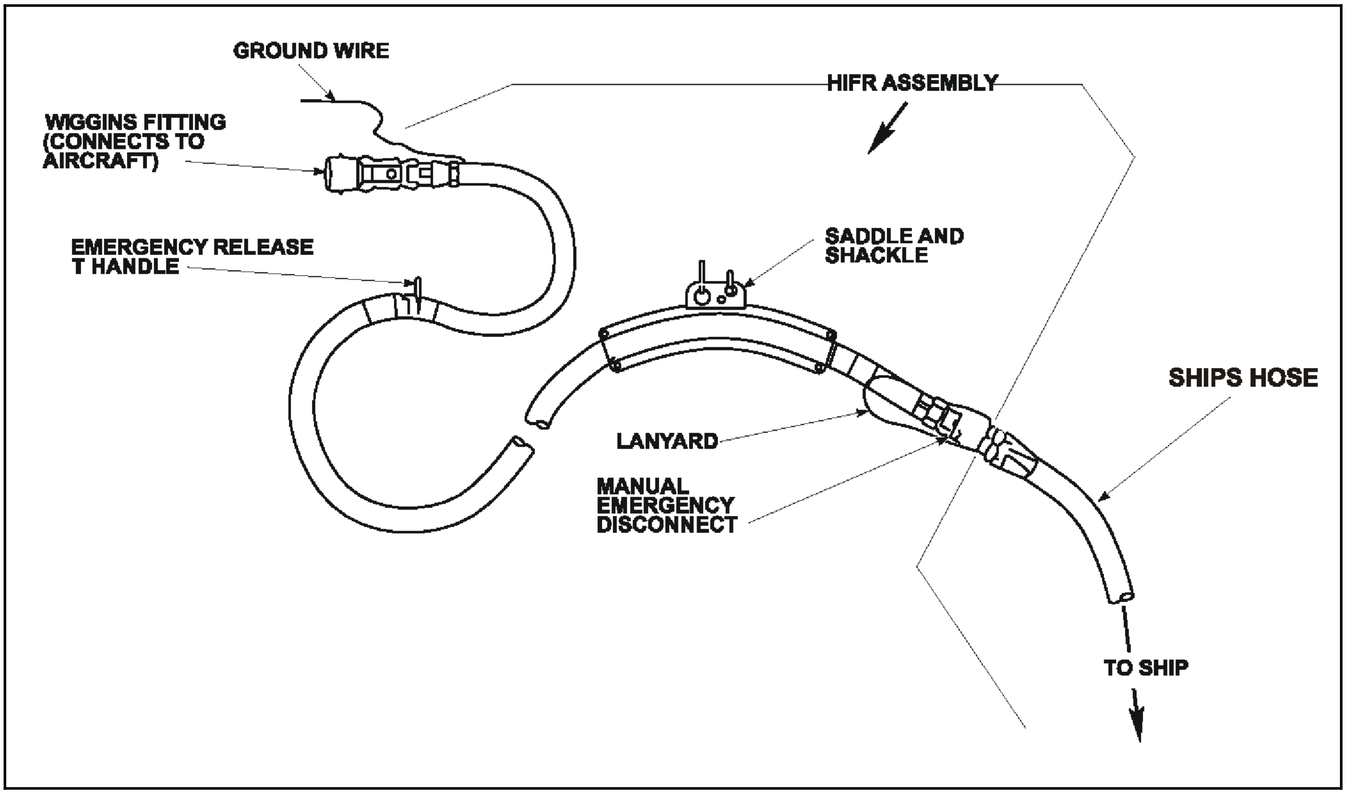


Figure 8-5. Wiggins/North Island (NI) HIFR Rig

The NHC nozzle has a built-in 45-psi pressure regulator and an on/off flow control handle. Emergency breakaway is initiated when 450 +/-50 lbs of straight tensile pull is exerted on the automatic breakaway coupling.

WARNING

When using an NHC assembly, the hose shall be secured to the deck of the ship to ensure proper functionality of the break away system.

Note

- Emergency breakaway occurs automatically as the helicopter moves away from the ship. No action by the aircrew is necessary.
- Most US helicopters are configured with a Wiggins-type connection for HIFR refueling, while all other NATO countries with HIFR capability use a Parker connection. If a US helicopter performs a HIFR with the NATO ship, it will be given a Parker nozzle. An adapter to convert the nozzle to a Wiggins type connection will be required.

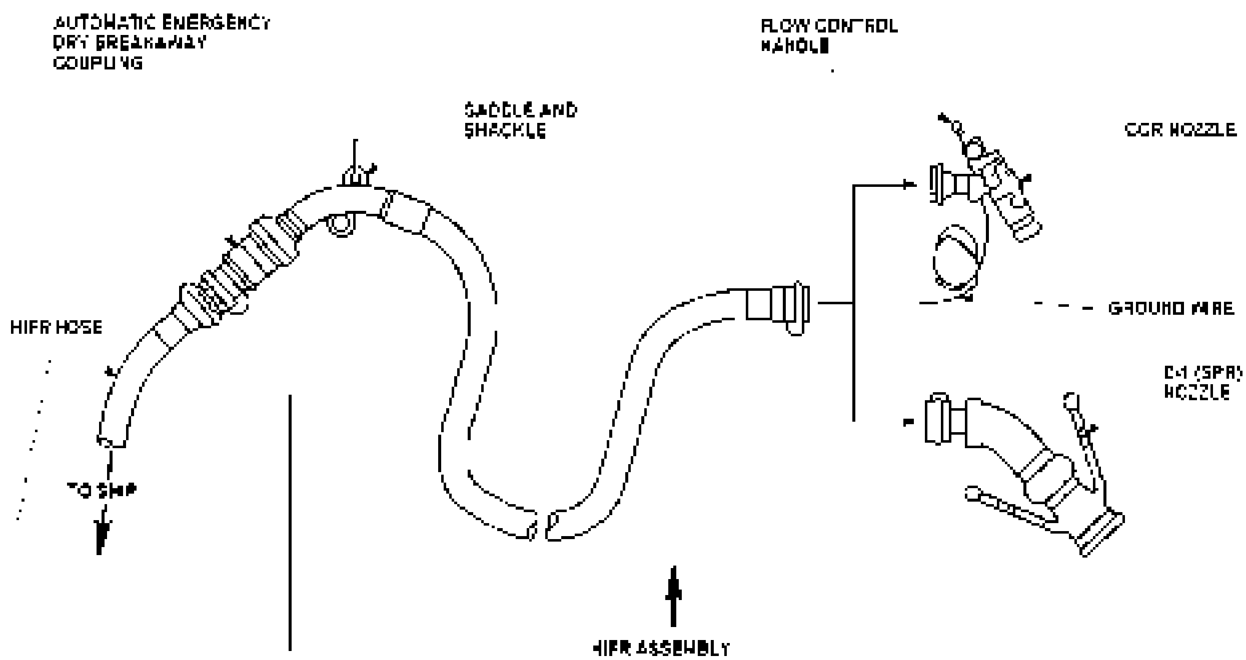


Figure 8-6. NATO High Capacity (NHC) HIFR Rig

8.7.3 Normal Operations

The ship's course and speed should be adjusted to provide relative winds from 10 to 30 knots, 300º to 360º, and minimum pitch and roll. Higher winds may be desired in high DA/gross weight/OAT conditions. The helicopter will make an approach hovering into the relative wind over the HIFR H deck marking. The fueling hose will be attached and hoisted aboard under the direction of the helicopter crewman. When the refueling hose is hoisted, the helicopter will then slide to port. The crewman shall attach the grounding wire to the airframe and the nozzle to the refueling receptacle. The helicopter will then move to a slightly lower altitude and the crewman will signal to commence pumping fuel.

CAUTION

A low hover while wind is less than 10 knots may cause excessive salt spray, which can decrease engine performance and reduce pilot field of view.

When refueling is complete, the crewman will signal for the pumping to stop and disconnect the hose. The helicopter will then be repositioned over the deck and the hose will be lowered.

8.7.3.1 HIFR Procedure

CAUTION

- Ensure HIFR assembly is grounded to aircraft before connecting hose to refueling fitting.
- The Wiggins/NI HIFR assembly can be installed backwards. The aircrewman must ensure the emergency release T-handle is located near the Wiggins fitting that attaches to the aircraft fitting. Opposite connection is possible and will force the helicopter to shear the hoist to affect an emergency breakaway.

1. Landing checklist — Complete.
2. Rescue Hoist Preoperational check — As required.
3. Lower the hoist and obtain fuel sample taken from nozzle of HIFR rig. Confirm fuel is acceptable.
4. Lower hoist cable for pickup of refueling rig.

WARNING

- Both the NHC and NI HIFR hoses shall be hoisted to the helicopter unpressurized, but full of fuel. Air in the HIFR hose will create an electrical charge on the helicopter internal fuel filter elements and may damage equipment. An NHC hose not filled with fuel poses a hazard to flight deck crew and the helicopter.
- When using an NHC assembly, the hose shall be secured to the deck of the ship to ensure proper functionality of the break away system.

5. Raise attached refueling rig to full seated position.

WARNING

- Should waveoff be required before HIFR rig is connected, the hoist cable should be cut immediately.
- The HIFR saddle must be raised as near as possible to the hoist seat position to permit proper and safe operation of the emergency breakaway on either rig.

6. Check the emergency breakaway handle for correct attachment (if applicable).
7. Connect the grounding wire.
8. Connect Wiggins nozzle (NHC rig) or the Wiggins fitting (NI rig) to the receptacle in the helicopter.
9. Signal ship to start pumping.
10. Depress locking tab on the NHC rig's SPR nozzle and slowly move the flow control handle to ON (forward) position.

Note

The Wiggins fitting (nozzle) on the NI rig does not have a flow control handle.

11. Once the hose is pressurized, direct pilot to conduct precheck.

CAUTION

- Flow of fuel when precheck valve is in precheck position indicates a shutoff system malfunction. If neither precheck switch will secure the fuel flow, fueling should be continued only if necessary. If fueling is required, proceed with caution in order to prevent rupture of the main fuel cell. One pilot shall monitor fuel quantity on the flight or mission displays.
- During HIFR if right cell fills faster than the left cell, monitor the fuel quantity gauges closely. If the difference in cell quantities persists, stop refueling before the right cell is full (approximately 1,700 pounds) to prevent rupture of the fuel cell.

Note

- Low fuel flow may be the result of low pressure from the ship's pump, aircraft altitude, or contamination in the HIFR filter canister.
- The crewman has the ability to stop fueling with the flow control handle on the NHC rig. Additionally, the SPR nozzle will automatically stop flow and the red pin behind the flow control handle will extend if pressure has exceeded 45 psi and/or the tanks are full.
- If fuel pumping rate appears to be negligible or too slow, a decrease in helicopter altitude will increase pumping rate.

12. Signal ship to stop pumping.
13. Move NHC SPR nozzle flow control handle to CLOSED (aft) position.
14. Disconnect NHC Wiggins nozzle or NI Wiggins nozzle/fitting from aircraft fuel fitting.
15. Remove grounding wire.
16. Reposition helicopter over flight deck. Lower rig once over deck.
17. Raise hoist after confirming HIFR assembly is disconnected and report, “CLEAR FOR FORWARD FLIGHT.”

Note

- The HIFR fuses in the go/no-go canister should be capable of handling approximately 10,000 pounds of fuel. The actual capacity of the fuses depends on the quality of the fuel received. If a pressure differential occurs across the fuses, fuel will not be taken and the fuse must be replaced. The HIFR filter should be replaced after each flight involving in-flight refueling.
- The Go/No-Go canister is sensitive to both water and particulate contamination.

8.7.4 Communications

Signals to start and stop pumping shall be exchanged between the helicopter crewman and the LSE, with the radios as the backup means of communication. In addition to normal hover positioning reports, standard HIFR terminology and visual signals shall be used (Figure 8-7). The visual signals will be the same at night, except a red-lens flashlight shall be used.

FROM	TO	WHEN	REPORT/VISUAL SIGNAL	RESPONSE
Hoist Operator	Pilot	HOIST IS GOING DOWN	HOIST GOING DOWN	
Hoist Operator	Pilot	HOIST IS ON THE DECK	HOIST IS ON DECK	
Hoist Operator	Pilot	HOSE CONNECTED TO HOIST	HOSE COMING UP	
Hoist Operator	Pilot	HOSE IS IN THE CABIN, CLEAR TO SLIDE LEFT	HOSE IS IN THE CABIN, CLEAR TO SLIDE LEFT	ROGER, SLIDING LEFT
Hoist Operator	Pilot	HOSE CONNECTED AND READY TO RECEIVE FUEL	HOSE CONNECTED	ROGER, COMMENCE PUMPING
Hoist Operator	Ship	DIRECT TO COMMENCE PUMPING	HOIST OPERATOR MAKES CIRCULAR MOTION WITH HAND	
Hoist Operator	Pilot	HOSE IS PRESSURIZED	READY FOR PRECHECK	
PAC	Hoist Operator	DESIRED QUANTITY OF FUEL HAS BEEN RECEIVED	STOP PUMPING	ROGER, STOP PUMPING
Hoist Operator	Ship	STOP FUELING	HOIST OPERATOR MAKES CUTTING MOTION ACROSS THROAT	
Hoist Operator	Pilot	FUELING HAS STOPPED, HOSE DISCONNECTED, CLEAR TO SLIDE RIGHT	FUELING STOPPED, HOSE DISCONNECTED, CLEAR TO SLIDE RIGHT	ROGER, SLIDING RIGHT
Hoist Operator	Pilot	READY TO LOWER HOSE	HOSE GOING DOWN	
Hoist Operator	Pilot	HOSE ON DECK	HOSE IS ON THE DECK	
Hoist Operator	Pilot	HOSE DISCONNECTED FROM HOIST AND HOIST IS BEING RAISED	HOIST CLEAR	
Hoist Operator	Pilot	SECURED AFT	CLEARED FOR FORWARD FLIGHT	

WARNING

Anyone may give the command “BREAKAWAY”. The crewman shall immediately pull the emergency disconnect lanyard (if installed) and report “HOSE CLEAR”.

Figure 8-7. HIFR Communications

8.7.5 HIFR Emergency Procedures

When an emergency condition is observed or when the command BREAKAWAY is received, the following emergency breakaway procedures should be followed (depending on the type of HIFR rig used):

Note

If emergency breakaway is necessary with either rig attached, the HIFR assembly, which includes the saddle and 10-foot section of hose, will remain attached to the helicopter.

1. NI HIFR rig. The crewman shall pull the emergency release T-handle. Allow the released HIFR hose to fall back to the ship. The PAC then flies away from the ship.
2. NHC HIFR rig. This rig incorporates an automatic emergency breakaway. Crewman action is not necessary to disconnect system. Once the NHC rig has been attached, the PAC can effect an emergency breakaway at any time by flying away from the ship.

WARNING

- All slack hose between aircraft and deck tiedown point near HIFR “H” will be pulled taut upon flyaway. Injury may result if deck crew becomes tangled in the HIFR hose.
- If either rig fails to disconnect when an emergency breakaway is attempted, it will be necessary for the crewman to quickly disengage the nozzle and grounding wire from the aircraft and cut the hoist cable.
- If the hoist cable is cut with either HIFR rig connected to the aircraft fitting, the possibility exists that the HIFR rig or aircraft fitting could rupture, causing pressurized fuel to leak into the cabin.

8.7.6 Night HIFR Procedures

WARNING

Due to the hazards associated with night operations and the increased potential for mishap, night HIFR operations shall not be conducted except for reasons of operational necessity.

Night HIFR employs the same procedures as day HIFR. Use all available navigation and reference aids (TACAN, ADF, SGSI, etc.) to execute an approach to arrive in a hover positioned into the relative wind over the HIFR H deck marking. When stabilized in a hover, conduct normal HIFR operations.

Note

- A chemical light should be connected to the hoist during night operations to provide visual reference to the hook position at all times.
- On final approach to the ship, the lower anticollision light and search/landing lights should be OFF and the position lights set to DIM to prevent temporarily blinding or disorienting the flight deck crew, LSE, or HCO.

Upon completion of the refueling evolution, make a turn to the left. After receiving a CLEAR FOR FORWARD FLIGHT report from the crewman, slide clear of the ship to port. Use standard departure procedures to climb to desired altitude.

CHAPTER 9

Special Procedures

9.1 INTRODUCTION

9.1.1 Definitions

The following definitions and general descriptions apply to Chapter 9, Special Procedures. For detailed discussion of aircrew responsibilities, see Chapter 19, Crew Resource Management.

9.2 SEARCH AND RESCUE (SAR)

The H-60 is capable of a wide variety of Search and Rescue (SAR) missions. Since each SAR mission presents a different set of circumstances, specific procedures cannot be given to cover all situations. The PIC must assess each situation and evaluate parameters such as weather, turbulence, sea state, terrain, condition of the survivor, and aircraft performance capabilities. Often there is no communication with the survivor or ground rescue party to assist in evaluating the situation. In the face of extreme pressure to complete a difficult rescue, the PIC must exercise caution and utilize sound judgment to avoid placing the aircraft and crew in an unnecessarily dangerous position.

Good lookout doctrine is mandatory for successful SAR operations. Because the pilots' primary concern is flight safety, most of the responsibility lies with the aircrewmen. The crewmen should be assigned specific lookout stations; one at each side of the aircraft.

9.2.1 SAR Equipment

A complete SAR kit must be readily available. It should be recognized that, because of the limitations imposed by space available and maximum gross weight, a SAR kit must be tailored to the environment in which the crew anticipates SAR operations. Helicopters designated as primary SAR vehicles shall carry the equipment required in NTTP 3-50.1. For specific information regarding SAR equipment refer to NTTP 3-50.1.

9.2.2 Safety Precautions

ICS directing procedures are contained in Figure 9-1. Always try to keep the cockpit informed of the pickup's position and any possible danger to the helicopter, using standard terminology and any other words that are concise and clearly understandable.

9.2.3 Rescue Precautions

WARNING

- Helicopters create static electricity which must be discharged by grounding the hoist on the surface prior to commencing a pickup. The surface in the immediate vicinity of a crash site may be covered with fuel. Avoid discharging static charge or deploying smoke markers in that zone.
- With starboard 120 gallon external fuel tank installed, hoist devices, including rescue swimmer/survivor and MEDEVAC litter, may contact the forward part of the fuel tank potentially causing equipment damage and personnel injury.
- If a parachute remains in the area of the survivor, maintain a minimum of 1 rotor diameter separation between parachute canopy and rotor downwash.

WARNING

- The rescue hoist cable must be kept clear of all parts of the aircraft and free from other external obstacles when operating the hoist. Cable abrasion during hoist operations can lead to cable failure. If cable contact or snagging occurs, suspend hoist operations and inspect the cable for damage in accordance with applicable procedures.
- Swimmer shall not be required to enter the water to affect the recovery of inanimate objects.
- There shall be a hoist operator in the cabin if a swimmer is deployed.
- Personnel hoist shall not be attempted with a damaged hoist cable.
- The hoist operator shall wear a heavy-duty glove during all rescue hoist operations.
- Any time the cabin door is open during flight, all occupants of the cabin shall wear crewman's safety harness or remain strapped in a seat. The crewman's safety harness must be thoroughly checked for secure attachment to the airframe.
- The Mk 25 shall not be launched while in hover because of valve plug possibly striking aircraft or personnel.
- The red phosphorus composition in the Mk 25/Mk 58 procedures smoke, which is highly caustic to the moist tissues of the nose and throat. Do not breathe this smoke.
- Removal of the marker pull ring from the Mk 58 exposes the battery cavity. Entrance of seawater in this cavity will immediately activate the marker. This ring shall not be removed until launching is to be accomplished.
- After the tear strip is removed from the Mk 58, use care to avoid cutting hands on the sharp edges of the can.
- Aircraft should not fly at low altitude over a burning Mk 58 marker. Ignition of the second candle can be forceful, with flame occasionally ejecting up to 50 feet.

Note

- During the pickup phase of a rescue, the PAC shall keep the survivor on the right side of the aircraft to allow the crewman to complete the pickup.
- Search and hover altitudes should be determined by existing conditions. Recommended altitude for hovering is 70 ft. Prolonged low overwater hover with little or no head-wind shall be avoided due to engine salt ingestion.
- If a lost ICS situation occurs during a SAR evolution, the COPILOT shall be notified via the cabin tunnel. All advisory hand signals shall be given via tunnel to the COPILOT/LEFT Seat Pilot.

9.2.3.1 Swimmer Deployment and Survivor Assistance

The swimmer shall enter the water and assist the survivor on all rescues except when the PIC determines that circumstances will unnecessarily expose the swimmer to danger. Conditions existing at the scene of the rescue (water temperature, sea state, condition of the survivor, proximity of other units, etc.) will dictate procedures to be followed.

Note

In sea states of three or above, it is recommended that the swimmer deploy on the hoist.

DESIRED PILOT CONTROL INPUT OR INFORMATION TO PILOT	ICS TERMINOLOGY	LOST ICS*
1. Slow rate of movement precedes basic command.	EASY	NONE REQUIRED
2. Direction of movement — STRAIGHT AHEAD.	FORWARD	ELBOW BENT 90 DEG FINGERS EXTENDED POINTING UP
3. Direction of movement — STRAIGHT BACK.	BACK	ELBOW BENT 90 DEG FINGERS EXTENDED POINTING DOWN
4. Direction of movement — RIGHT.	RIGHT	ELBOW BENT 90 DEG, FINGERS EXTENDED UP AND PERFORM WAVING MOTION
5. Direction of movement — LEFT.	LEFT	LEFT ARM EXTENDED, FINGERS EXTENDED
6. Increase helicopter altitude.	UP	PALM UP MOTIONING UP
7. Decrease helicopter altitude.	DOWN	PALM DOWN MOTIONING DOWN
8. Maintain steady hover.	STEADY	CLINCHED FIST
9. Hoist cable direction.	HOIST COMING UP/ DOWN	THUMB UP/ DOWN
10. Lost ICS communications (NOTIFY PILOT/COPILOT) VIA TUNNEL.	NONE	POINT TO MOUTH/ EAR THUMB DOWN
11. I desire crew hover.	REQUEST CREW HOVER	TAP HELMET, POINT AFT
12. Secure crew hover.	S/S CLEAR OF WATER	TAP HELMET, POINT FORWARD
13. READY FOR FORWARD FLIGHT.	S/S ABOARD/ SECURE	CIRCULAR MOTION, POINT FORWARD

Note

If a lost ICS situation occurs during a SAR evolution, the COPILOT shall be notified via the cabin tunnel. All advisory hand signals shall be given via tunnel to the COPILOT/LEFT Seat Pilot.

Figure 9-1. SAR ICS Terminology

MANUAL APPROACH AND/OR DAY/VMC PROCEDURES		
STATION	**ACTION**	**ICS CALL**
1. PAC	Signify intention to commence a manual approach to a hover.	AUTOMATIC APPROACH CHECK-LIST, CREW RIG FOR RESCUE
2. HOIST OPERATOR	Together with swimmer, prepare for rescue.	UNSTRAPPING
3. PNAC	Complete Automatic Approach checklist.	CHECKLIST COMPLETE
4. HOIST OPERATOR	Complete rescue station preparation, strap into gunners belt, ensure swimmer is also strapped in.	RESCUE STATION MANNED AND READY
5. ANY CREWMAN	Locate survivor.	SURVIVOR IN SIGHT ___O’CLOCK, ___YARDS
6. ANY CREWMAN	Direct PAC to survivor using SAR ICS terminology.	(FIGURE 9-1)
7. PAC	Commence manual approach once survivor is in sight.	SURVIVOR IN SIGHT COM-MENCING MANUAL APPROACH
8. PNAC	Report altitude and groundspeed throughout the approach.	___FEET, ___KTS
9. PAC	Continue approach to survivor, wings level on final. At 30 ft AGL, report:	STANDBY TO DEPLOY SWIMMER
WARNING Hoist operator shall maintain grasp of swimmer’s rescue harness with one hand and signal swimmer to remove gunners belt with other hand.		
10. HOIST OPERATOR	Tap swimmer once on chest.	
11. SWIMMER	Disconnect gunners belt.	
12. HOIST OPERATOR	Observe swimmer is disconnected.	SWIMMER READY
13. PAC	Confirm a 15-foot/0 KGS hover or 10-foot /10 KGS creep. If confirmed, order swimmer deployment.	JUMP, JUMP, JUMP
WARNING It is extremely difficult to accurately judge height above water; therefore, the swimmer shall not jump into the water until the PAC positively gives the JUMP command to the hoist operator.		
14. HOIST OPERATOR	Check area clear of debris, tap swimmer on shoulder three times, and release hold on swimmer.	
15. SWIMMER	After third tap, jump when clear.	

Figure 9-2. Day/VMC SAR Procedures (Manual Approach) (Sheet 1 of 3)

MANUAL APPROACH AND/OR DAY/VMC PROCEDURES (cont.)		
STATION	**ACTION**	**ICS CALL**
WARNING To assure safe swimmer deployment, the pilot shall remain at jump altitude until hoist operator reports swimmer away.		
16. HOIST OPERATOR	Observe swimmer deployment and water entry.	SWIMMER AWAY
17. PAC	Fly the helicopter to the desired hoisting altitude.	ENGAGE HOVER MODE
18. PNAC	Press APPR/HVR pushbutton, observe HVR light.	ENGAGED
19. SWIMMER	Signal condition to hoist operator.	
20. HOIST OPERATOR	Observe swimmer signal and report condition.	SWIMMER OKAY or SWIMMER IN TROUBLE
21. HOIST OPERATOR	Direct PAC left and aft to maintain visual contact with the survivor and swimmer using SAR ICS terminology.	(FIGURE 9–1)
WARNING Do not lose sight of the survivor. Keep pilot informed of swimmer's progress, cable position, debris, etc.		
22. PNAC	Conduct hover checks.	HOVER CHECKS COMPLETE
23. **If crew hover is used:**		
a. HOIST OPERATOR	Direct PAC to maintain a steady hover.	STANDING BY FOR CREW HOVER
b. PAC	maintain steady hover.	ENGAGE CREW HOVER
c. PNAC	Press CREW HVR pushbutton, and observe CREW HVR light.	ENGAGED
d. HOIST OPERATOR	Observe HOVER TRIM light illuminated on the HOVER TRIM CONTROL panel.	I HAVE A LIGHT
e. PAC	Monitor flight controls.	YOU HAVE CONTROL
f. HOIST OPERATOR	Assume control of aircraft and position helicopter over swimmer/survivor.	I HAVE CONTROL (FIGURE 9–1)
24. **If crew hover is not used:**		
a. PAC	Verbally pass directional control.	YOU HAVE VERBAL CONTROL
b. HOIST OPERATOR	Accept verbal control.	I HAVE VERBAL CONTROL
c. HOIST OPERATOR	Verbally position helicopter over swimmer/survivor.	(FIGURE 9–1)
25. HOIST OPERATOR	Lower and ground hoist.	HOIST GOING DOWN

Figure 9-2. Day/VMC SAR Procedures (Manual Approach) (Sheet 2)

MANUAL APPROACH AND/OR DAY/VMC PROCEDURES (cont.)		
STATION	**ACTION**	**ICS CALL**
26. SWIMMER	Signal ready for pickup.	
27. HOIST OPERATOR	Acknowledge swimmer's signal.	I HAVE A PICKUP SIGNAL
28. **If crew hover is used:**		
a. HOIST OPERATOR	Position helicopter over swimmer/survivor.	(FIGURE 9-1)
29. **If crew hover is not used:**		
a. HOIST OPERATOR	Verbally position helicopter over swimmer/survivor.	(FIGURE 9-1)
30. HOIST OPERATOR	Observe swimmer/survivor approaching hook and hooking up.	SWIMMER/SURVIVOR APPROACHING RESCUE HOOK /HOOKED UP
31. SWIMMER	Signal ready to be hoisted.	
32. HOIST OPERATOR	Observe swimmer/survivor giving ready to be hoisted signal.	I HAVE A HOIST SIGNAL
33. HOIST OPERATOR	Raise the swimmer/survivor.	SWIMMER/SURVIVOR CLEAR OF WATER
34. **If crew hover is used:**		
a. HOIST OPERATOR	Stabilize the aircraft and pass control to pilot.	YOU HAVE CONTROL
b. PNAC	Press CREW HVR pushbutton and observe CREW HVR light OUT.	CREW HOVER DESELECTED
c. PAC	Assume control of aircraft.	I HAVE CONTROL
35. HOIST OPERATOR	Continue the hoist evolution.	HALFWAY UP, AT THE CABIN DOOR, ABOARD
36. HOIST OPERATOR	Secure rescue station.	RESCUE STATION SECURE, CLEAR FOR FORWARD FLIGHT
37. PAC	Disengage coupled hover using DEPART pushbutton.	DEPARTING
38. PNAC	Observe DPRT light illuminated.	DEPART LIGHT
39. HOIST OPERATOR	Report survivor's injuries and treat as required.	

Figure 9-2. Day/VMC SAR Procedures (Manual Approach) (Sheet 3)

9.2.3.2 Night/IMC Search and Rescue Procedure

Commence search based on data concerning location, number, and condition of survivors. Wind must be considered while performing a search, but the pattern entry angle in relation to the wind is not critical. Selection of a rescue procedure is based on prevailing visibility, winds and sea state, crew training, aircraft systems status, and crew fatigue. The night/IMC procedure and pattern described below permits the helicopter crew to affect a rescue in minimum time with proper margins for flight safety. The altitudes and airspeeds shown are not mandatory and may be modified for the existing conditions.

NIGHT/IMC SEARCH AND RESCUE PROCEDURE		
STATION	**ACTION**	**ICS CALL**
1. PAC	Signify intention to commence an automatic approach to a hover.	AUTOMATIC APPROACH CHECK-LIST, CREW RIG FOR RESCUE
2. PNAC	Adjust landing light and searchlight as required.	
3. HOIST OPERATOR	Together with swimmer, prepare for rescue.	UNSTRAPPING
4. PNAC	Complete Automatic Approach checklist.	CHECKLIST COMPLETE
5. HOIST OPERATOR	Complete rescue station preparation (three smokes or matrix lights), strap into gunners belt, ensure swimmer is also strapped in.	RESCUE STATION MANNED AND READY
WARNING The rescue swimmer, rescue strop and rescue hook shall all be illuminated by a chemical light before lowering.		
6. ANY CREWMAN	Locate survivor.	SURVIVOR IN SIGHT ___ O'CLOCK, ___YARDS
7. ANY CREWMAN	Direct PAC over survivor using SAR ICS terminology:	(FIGURE 9-1) ON TOP, NOW, NOW, NOW
8. HOIST OPERATOR	Deploy the smokes or matrix lights.	SMOKES/MATRIX LIGHTS AWAY
9. PAC	Commence wind line rescue pattern.	(FIGURE 9-4 and 9-5)
10. PNAC/HOIST OPERATOR	Indicate survivor/marker relationship using turn rate commands.	(FIGURE 9-1)
11. PNAC	Direct PAC as helicopter approaches windline.	STANDBY TO ROLL OUT
12. PNAC	Direct PAC to roll out when lineup is achieved into the windline.	ROLL OUT
13. PNAC	Verify wings level and into the windline with less than 5° angle of bank.	STANDBY FOR AUTOMATIC APPROACH
14. PNAC	Commence automatic approach to arrive in hover just prior to the smokes/matrix lights, press APPR/HVR pushbutton, and observe APPR light. **Note** The distance to complete the approach will vary depending on altitude, ground speed, and water current	APPROACH ENGAGED
15. PNAC	After aircraft has finished the automatic approach, verify the APPR/HVR pushbutton changes to HOVER and conduct hover checks.	HOVER MODE, CONDUCTING HOVER CHECKS

Figure 9-3. Night/IMC SAR Procedure (Sheet 1 of 4)

NIGHT/IMC SEARCH AND RESCUE PROCEDURE (cont.)		
STATION	**ACTION**	**ICS CALL**
16. PAC	At approximately 50 yards downwind of survivor, establish a steady hover. Verifies hover checks are completed and aircraft is established in a steady/stable hover.	STEADY HOVER, HOVER CHECKS COMPLETE
17. HOIST OPERATOR	Ensure swimmer is in cabin door, with rescue harness on and attached to rescue hook. Perform final check of swimmer's equipment, tap swimmer on chest as signal to remove gunners belt:	SURVIVOR IN SIGHT
18. **If crew hover is used:**		
a. HOIST OPERATOR	Request crew hover.	STANDING BY FOR CREW HOVER
b. PAC	Order crew hover mode selection.	ENGAGE CREW HOVER
c. PNAC	Press CREW HVR pushbutton and observe CREW HVR light.	ENGAGED
d. HOIST OPERATOR	Observe CREW HVR TRIM light illuminated on the HOVER TRIM CONTROL.	I HAVE A LIGHT
e. PAC	Monitor flight controls while maintaining an instrument scan.	YOU HAVE CONTROL
f. HOIST OPERATOR	Assume control of aircraft and position helicopter over the swimmer/survivor.	I HAVE CONTROL (FIGURE 9-1)
19. **If crew hover is not used:**		
a. PAC	Verbally pass directional control.	YOU HAVE VERBAL CONTROL
b. HOIST OPERATOR	Accept verbal control.	I HAVE VERBAL CONTROL
c. HOIST OPERATOR	Verbally position helicopter over swimmer/survivor.	(FIGURE 9-1)
Once control is established:		
20. HOIST OPERATOR	Standby to lower swimmer.	PERMISSION TO LOWER SWIMMER
21. PAC	Ensure safe condition.	LOWER SWIMMER
22. HOIST OPERATOR	Place tension on cable and lower swimmer.	LOWERING SWIMMER, SWIMMER HALFWAY DOWN, SWIMMER IN THE WATER
23. SWIMMER	Signal condition.	
24. HOIST OPERATOR	Observe swimmer signal and report condition.	SWIMMER OK or SWIMMER IN TROUBLE

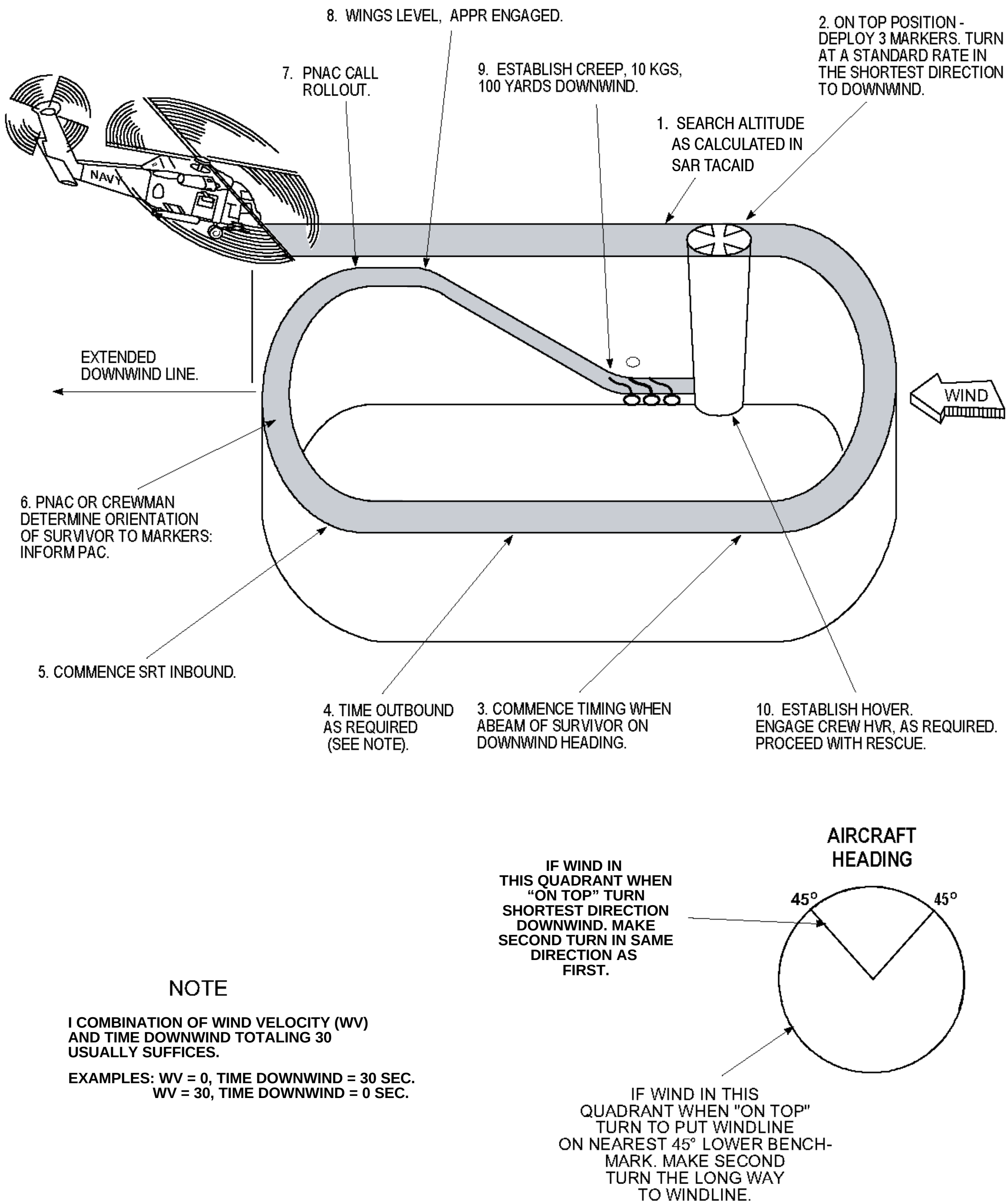
Figure 9-3. Night/IMC SAR Procedure (Sheet 2)

NIGHT/IMC SEARCH AND RESCUE PROCEDURE (cont.)		
STATION	**ACTION**	**ICS CALL**
25. HOIST OPERATOR	Verbally position helicopter so as not to interfere with swimmer while maintaining visual contact. Keep PAC advised of swimmer's progress, position, etc.	(FIGURE 9-1)
WARNING During a night rescue, selection of the FWD or OFF position on the flood/hover light will permit the hoist operator to cycle the rescue light in case of lost visual contact with the swimmer and/or survivor. **Note** In the event of loss of visual contact with swimmer, the hoist operator shall cycle the rescue light. The swimmer shall illuminate the strobe light or ignite a flare to aid in reestablishing visual contact.		
26. SWIMMER	Signal ready for pickup.	
27. HOIST OPERATOR	Acknowledge swimmer's signal.	I HAVE A PICKUP SIGNAL
28. HOIST OPERATOR	Position helicopter over swimmer/survivor (verbally or via crew hover).	(FIGURE 9-1)
29. HOIST OPERATOR	Observe swimmer/survivor approaching hook and hooking up.	SWIMMER/SURVIVOR APPROACHING RESCUE HOOK /HOOKED UP
30. SWIMMER	Signal ready to be hoisted.	
31. HOIST OPERATOR	Observe swimmer/survivor giving ready to be hoisted signal.	I HAVE A HOIST SIGNAL
32. HOIST OPERATOR	Raise the swimmer/survivor.	SWIMMER/SURVIVOR CLEAR OF WATER
33. **If crew hover is used:**		
a. HOIST OPERATOR	Stabilize the aircraft and pass control to PAC.	YOU HAVE CONTROL
b. PNAC	Press CREW HVR pushbutton and observe CREW HVR light OUT.	CREW HOVER DESELECTED
c. PAC	Assume control of aircraft.	I HAVE CONTROL
34. HOIST OPERATOR	Continue the hoist evolution.	HALFWAY UP, AT THE CABIN DOOR, ABOARD

Figure 9-3. Night/IMC SAR Procedure (Sheet 3)

NIGHT/IMC SEARCH AND RESCUE PROCEDURE (cont.)		
STATION	**ACTION**	**ICS CALL**
WARNING If cable oscillation occurs, crewman shall notify the pilots and stabilize the cable.		
35. HOIST OPERATOR	Secure rescue station.	RESCUE STATION SECURE, CLEAR FOR FORWARD FLIGHT
36. PAC	Disengage coupled hover using DEPART pushbutton.	DEPARTING
37. PNAC	Observe DPRT light illuminated and monitor the flight instruments for positive rate of climb.	DEPART LIGHT, POSITIVE RATE OF CLIMB
38. HOIST OPERATOR	Report survivor’s injuries and treat injuries as required.	

Figure 9-3. Night/IMC SAR Procedure (Sheet 4)



NOTE

I COMBINATION OF WIND VELOCITY (WV) AND TIME DOWNWIND TOTALING 30 USUALLY SUFFICES.

EXAMPLES: WV = 0, TIME DOWNWIND = 30 SEC.
WV = 30, TIME DOWNWIND = 0 SEC.

Figure 9-4. Windline (Racetrack) Rescue Pattern

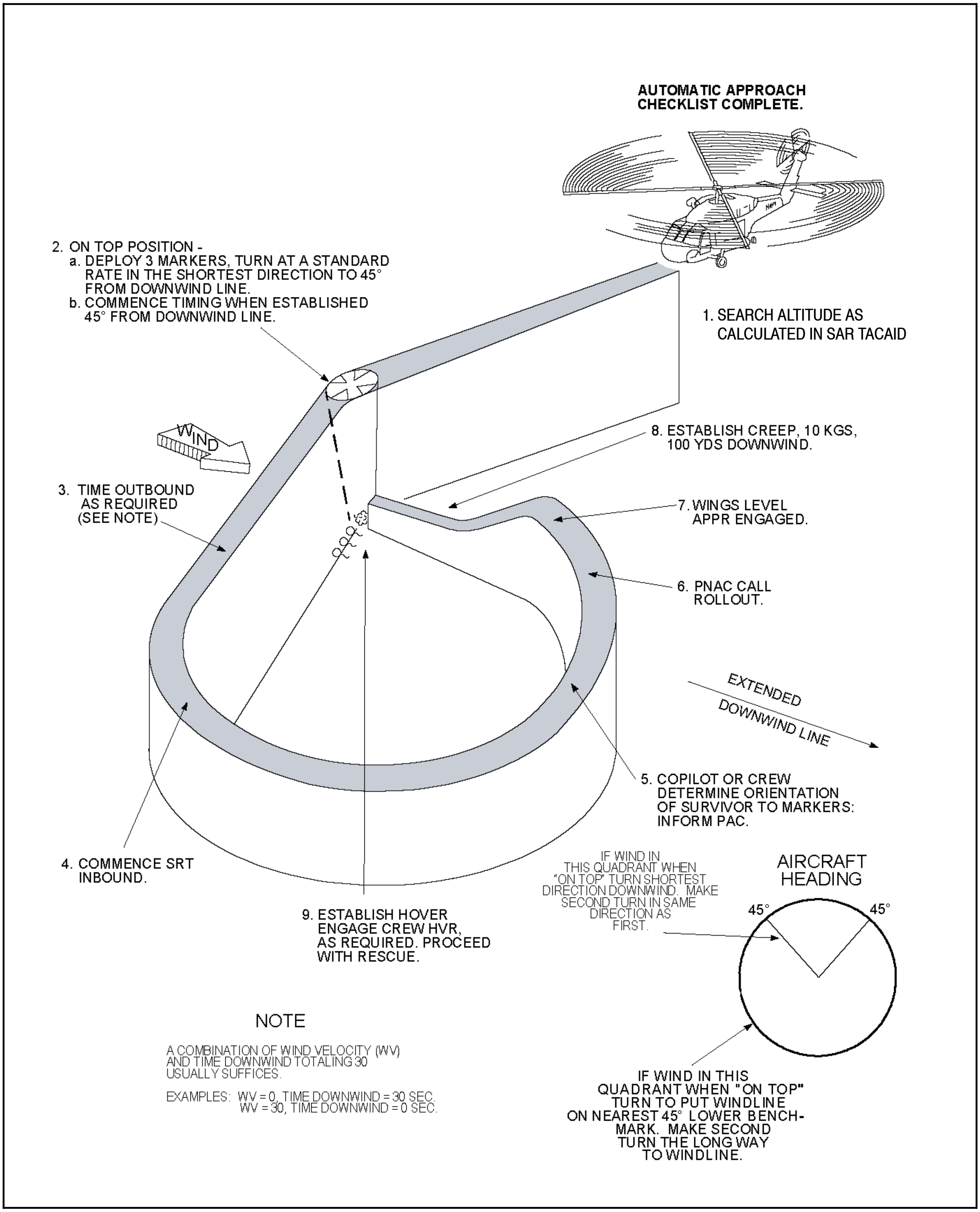


Figure 9-5. Windline (Teardrop) Rescue Pattern

9.2.4 Overland SAR

While naval SAR–capable units have traditionally operated within the maritime environment, it is becoming increasingly necessary for those units to also operate inland. Many of the procedures used in the maritime region also apply when operating inland, however, aircrew must understand and be familiar with the procedures unique to the inland environment. Prior to executing search and rescue operations in the inland environment, pilots and aircrew shall be familiar with the appropriate sections of the following documents: SH–60B NFM, NTRP 3–22.4–SH60B, NTTP 3–50.1, and OPNAV 3130.6 (series).

9.2.4.1 Rescue/Recovery Methods

There are five basic rescue methods that can be utilized in order of preference:

1. Landing to effect a rescue.
2. Rescue via one or two wheels.
3. Rescue via hoist.
4. Rappelling.
5. Direct Deployment.

WARNING

Power requirements vary significantly based upon winds, escape route and the size and slope of the landing zone. Power greater than HOGE may be required to land and takeoff. Utilize appropriate preflight planning and techniques in this chapter to ensure power margins are maintained.

CAUTION

Loss of tail rotor effectiveness is characterized by uncommanded right yaw. It is encountered when operating at high density altitudes in high power regimes. Arresting high rates of descent outside of translational lift and attempting approaches out of the wind increase the likelihood of encountering loss of tail rotor effectiveness. Immediate reduction of collective, selection of contingency power, and transition to forward flight or a right turn to drop off (if available) is required to restore directional stability.

9.2.4.2 Landing to Effect a Rescue

Landing to effect a rescue is the preferred method of rescue in the overland environment as it is more expeditious, reduces pilot/crew fatigue, and is the safest method of recovery. Prior to commencing an approach to a landing zone, pilots shall complete a SWEEP check, set up for the appropriate approach profile and announce wave off intentions. Utilize the procedures in Figure 9-6 for overland rescue. Refer to Chapter 11 for a detailed discussion of slope landing/takeoffs and dynamic rollover.

WARNING

Aft cyclic positions, in conjunction with low or decreasing collective pitch, may cause rotor blades to contact the tail pylon resulting in loss of tail rotor drive.

Note

- When landing site is a combination of cross slope and up or down slope, use the most restrictive slope landing limit. Be prepared to execute a combination of control inputs to maintain stability.
- Depending on slope and helicopter configuration, the tail wheel may touch down prior to the upslope wheel.

9.2.4.3 Rescue Via One or Two Wheels

WARNING

Due to the increased pilot workload associated with one or two wheel landings and the increased potential for mishap, one or two wheel landing operations shall not be conducted except for reasons of operational necessity.

When the landing site is not suitable for a normal landing, consideration should be given to performing a one or two wheel landing. Landing via one or two wheels significantly increases pilot workload and requires increased crew coordination. Extreme caution must be used as the aircraft is in a dynamic rollover envelope anytime a wheel is in contact with the ground. Utilize the procedures in Figure 9-6.

9.2.4.3.1 Landing Considerations for One or Two Wheel Landings

When the landing site is not suitable for a normal landing, four landing configurations may be possible. Landings may be attempted on one main mount, both main mounts, on one main mount and tail wheel, and tail wheel only. Consideration should be given to CAL, slope landing, and unprepared surface procedures as applicable.

Set the parking brake prior to making a shallow approach into the wind. Make a shallow approach to a hover over the intended landing area. From a hover, descend slowly making smooth, coordinated control inputs. Aircrewmen shall maintain sight of the landing area at all times and continuously clear and direct the helicopter for landing gear placement. The pilot shall treat the helicopter as if it were completely airborne for the entire evolution. The controls should be continually adjusted to maintain a stable attitude and position.

WARNING

- When conducting one or two wheel landings, the helicopter can develop unintentional roll rates. Constant attention by the crew is necessary to prevent dynamic roll over conditions. When landing or taking off with one or two wheels touching the ground, use smooth collective motion to maintain low roll rates. Do not allow the helicopter to drift during ground maneuvers. Dynamic rollover may result in loss of helicopter and crew.
- If there are no suitable visual references for the PAC, consideration should be given to selecting an alternate landing site or hover area. This will prevent unintentional drift into obstacles or obstructions and possible loss of the helicopter and crew.

CAUTION

Depending on the site and the helicopter position, reduced clearances may cause helicopter components to strike the ground/structure.

Note

If encountering a situation where only one wheel is in contact with the ground and a rolling moment is present, smooth reduction of the collective is the most effective corrective action the pilot can take to prevent dynamic rollover.

The departure should be a smooth, controlled liftoff to a hover followed by the appropriate departure maneuver. Throughout the evolution the aircrew shall continue clearing the helicopter until clear of all obstacles.

9.2.4.4 Rescue Via Hoist

If unable to land, rescue via the hoist is another option. Rescue via hoist is very similar to overwater rescue techniques. The aircrew must be aware of hazards and power requirements (to include the weight of the people being rescued) needed to conduct a rescue via hoisting. Prior to commencing a rescue via hoist, the HAC shall conduct a SWEEP check and announce waveoff intentions. The aircrewman shall ensure that the aircraft remains clear of all obstacles throughout the rescue. Utilize the procedures in Figure 9-7 for overland rescue via hoisting.

9.2.4.5 Rappelling

WARNING

Due to the hazards associated with rappelling and the increased potential for mishap, rappelling operations shall not be conducted except for reasons of operational necessity. Rappelling shall only be conducted by a qualified Helicopter Inland Rescue Aircrewman.

If a landing site is unavailable and the situation does not allow hoisting, consideration should be given to rappelling the rescuer into the zone. Rappelling allows the rescuer to control his rate of descent to avoid obstacles. Rappelling also allows the rescuer to quickly disconnect from the line should entanglement occur. Prior to rappelling, the HAC shall conduct a power check, site evaluation, and announce wave off intentions. The aircrewman shall ensure that the aircraft remains clear of all obstacles throughout the rescue.

Note

Rigging, ICS voice calls and terminology for Rappelling, Belay, and Overland Direct Deployment are found in the NTTP 3-50.1. Pilots and aircrew shall be intimately familiar with these procedures and properly qualified per OPNAVINST 3130.6 (series) before performing these types of rescue/recovery methods.

9.2.4.6 Direct Deployment

In certain overland situations when a landing site is unavailable, it may be advisable for the rescuer to remain connected to the hoist line throughout the rescue. Rescue operations to steep cliffs, canyon walls, towers or balconies are some examples. In these cases, the rescuer should use direct deployment techniques. The crew shall brief hoist entanglement procedures thoroughly prior to attempting direct deployment overland. The crew shall set up for the direct deployment rescue using the same procedures for rescuing via hoist.

OVERLAND PROCEDURES (LANDING)		
STATION	**ACTION**	**REPORT**
1. PAC	Signify intention to commence an overland rescue.	LANDING CHECKLIST, CREW RIG FOR RESCUE
2. PNAC	Complete Landing Checklist.	CHECKLIST COMPLETE
3. HOIST OPERATOR	Complete rescue station preparation.	RESCUE STATION MANNED AND READY
4. ANY CREWMAN	Locate survivor and landing zone.	SURVIVOR IN SIGHT, ___ O'CLOCK, ___ YARDS
5. ANY CREWMAN	Direct PAC to survivor using SAR ICS terminology.	UTILIZE TERMINOLOGY IN FIGURE 9-1.
6. PAC	After sighting survivor, mark on top survivor and begin zone evaluation.	SURVIVOR IN SIGHT.
7. PAC	After marking on top, conduct a power check, wind finding and zone evaluation (SWEEP checks).	ON TOP NOW, NOW, NOW.
8. PNAC	Compute HOGE torque.	POWER REQUIRED TO HOGE IS -________.
9. PAC	Announce type of approach, power available, wave-off torque, winds, and waveoff route.	POWER AVAILABLE IS ______, WAVE OFF TORQUE IS _______ WINDS ARE __________, AND WAVEOFF ROUTE WILL BE ___________.
10. PAC	Set up for an approach into the wind while maintaining clearance of all obstacles.	ON FINAL FOR A HOVER/NO HOVER LANDING.
11. CREWMAN	Conduct ICS check, and provide airframe clear-ance.	RIGHT'S UP/LEFT'S UP
12. PAC	Announce that the landing zone is disappearing underneath the nose of the aircraft.	NOSE IN ZONE
13. CREWMAN	Provide final clearance to land. Ensure that aircraft will remain clear of all obstacles. To direct PAC to remain clear of obstacles, utilize terminology in FIG 9-1.	CLEAR RIGHT, CLEAR LEFT, CLEAR TO LAND OR HOLD
14. PNAC	Calls torque, altitude and groundspeed.	
15. CREWMAN	Ensure aircraft is established on solid ground after touchdown	CLEAR TO REDUCE
16. PAC	Reduce collective.	REDUCING
17. CREWMAN	Embark personnel being rescued. When complete, notify PAC.	RESCUE STATION SECURE, CLEAR RIGHT, CLEAR LEFT, CLEAR TO LIFT
18. PAC	Perform final check of instruments and takeoff.	LIFTING

Figure 9-6. Overland Procedures (Landing)

OVERLAND PROCEDURES (HOIST)		
STATION	ACTION	REPORT
1. ANY CREWMAN	Locate survivor and pickup zone.	SURVIVOR IN SIGHT, ___ O'CLOCK, ___ YARDS
2. ANY CREWMAN	Complete Landing Checklist.	UTILIZE TERMINOLOGY IN FIGURE. 9–1.
3. PAC	After sighting survivor, mark on top survivor and begin zone evaluation.	ON TOP NOW, NOW, NOW.
4. PAC	After marking on top, conduct a power check, wind finding and zone evaluation (SWEEP checks).	
5. PNAC	Compute HOGE torque.	POWER REQUIRED TO HOGE IS –________.
6. PAC	Signify intention to commence an overland hoist rescue.	LANDING CHECKLIST, CREW RIG FOR RESCUE.
7. PNAC	Complete Landing Checklist. Turn on the Backup Pump and arm the Rescue Hoist, as required.	ON TOP NOW, NOW, NOW.
8. HOIST OPERATOR	Complete rescue station preparation.	RESCUE STATION MANNED AND READY.
9. PAC	Announce type of approach, power available, waveoff torque, winds, and waveoff route.	POWER AVAILABLE IS _____, WAVE OFF TORQUE IS ______ WINDS ARE ______, AND WAVEOFF ROUTE WILL BE______.
10. PAC	Set up for an approach into the wind while maintaining clearance of all obstacles.	ON FINAL FOR A ____ ft HOVER.
11. CREWMAN	Direct PAC to pickup zone and remain clear of obstacles.	UTILIZE TERMINOLOGY IN FIGURE. 9–1.
12. PAC	Establish steady hover. Confirm power required and wave-off intentions.	STEADY HOVER
13. PAC	After the steady hover and hover references has been established.	STAND BY TO HOIST RESCUER
14. HOIST OPERATOR	Connect Rescue Aircrewman to double rescue hook.	
15. CREWMAN	Disconnect gunner's belt.	
16. HOIST OPERATOR	Observe Rescue Aircrewman is clear of the gunner's belt.	RESCUER STANDING BY
17. HOIST OPERATOR	Check area clear of debris and over pickup spot.	PERMISSION TO HOIST RESCUER
18. PAC	Steady hover and instrument check.	HOIST RESCUER
19. HOIST OPERATOR	Position Rescue Aircrewman into position to be hoisted.	RESCUER OUTSIDE OF CABIN
20. HOIST OPERATOR	Lower Hoist cable/Rescuer.	HOIST/RESCUER GOING DOWN
21. HOIST OPERATOR	Hoist cable/Rescuer on deck.	HOIST/RESCUER ON DECK
22. HOIST OPERATOR	Observe ready for pickup from the rescue aircrewman and or survivor.	I HAVE A PICKUP SIGNAL
23. HOIST OPERATOR	Slack in. cable coming out.	STAND BY FOR WEIGHT ON AIRCRAFT
24. HOIST OPERATOR	Raise hoist cable.	RESCUE AIRCREWMEN/SURVIVOR CLEAR OF THE DECK, HALFWAY UP, AT CABIN DOOR, ABOARD
25. HOIST OPERATOR	Secure rescue station.	RESCUE STATION SECURE, CLEAR FOR FORWARD FLIGHT
26. PAC	Perform final check of instruments and takeoff.	DEPARTING

Figure 9-7. Overland Procedures (Hoist)

9.3 VERTICAL REPLENISHMENT (VERTREP) OPERATIONS

VERTREP involves the use of helicopters to resupply ships at sea while underway through external cargo transport. With the external cargo hook installed, the aircraft is capable of rapid transport of cargo. Approved lifting equipment and associated procedures are described in NA-80T-122, NWP 4-01.4.

The actual payload-lifting capability of the aircraft is a function of prelift gross weight, DA, and prevailing winds. Power available and maximum payload, using applicable charts, shall be completed prior to commencing external cargo transport. The crew must also be aware of the effect of the load on the moment of the aircraft. Figure 9-8 provides the cargo moments associated with weight on the cargo hook.

WARNING

Under high power-required conditions, due to flight control mixing, pedal position is not necessarily indicative of tail rotor authority remaining. In particular, under high DA and aircraft gross-weight conditions, it is possible to achieve maximum tail rotor pitch without obvious indications from pedal position (e.g., relatively neutral pedal position or no contact of left pedal stop). This condition will manifest in one of two ways: no yaw response despite left pedal input or uncommanded right yaw.

The PIC shall brief the copilot, crewmen, and, if practicable, hook-up personnel. Hook-up procedures, release procedures, and any special instructions shall be included in the brief.

WARNING

- Light or irregularly shaped external loads may swing, oscillate, or "fly" unpredictably. Should excessive load oscillations develop, an immediate reduction in airspeed is mandatory to prevent loss of control or imposing excessive loads on the helicopter. Extreme care must be exercised with such loads during pickup or delivery to avoid damage to the aircraft or damage/injury to facilities, equipment, or personnel near the drop zone. Unstable loads may have to be jettisoned in forward flight because of severe adverse effects on aircraft flight performance or if loads threaten to impact the aircraft.
- Avoid overflying buildings, personnel, livestock, vehicles, and aircraft with an external load attached due to the possibility of inadvertent load release.
- Particular care must be taken during cargo pickup/drop-off due to the increased rotor downwash and its effect on loose equipment and debris near the helicopter. Ground personnel shall wear approved eye protection and headgear.

CAUTION

- External loads may cause erratic and unreliable radar altimeter indications while in a hover and low-speed flight.
- While carrying external cargo, monitor the HOOK OPEN annunciator. If it appears, set the load down as soon as possible and discontinue the mission.

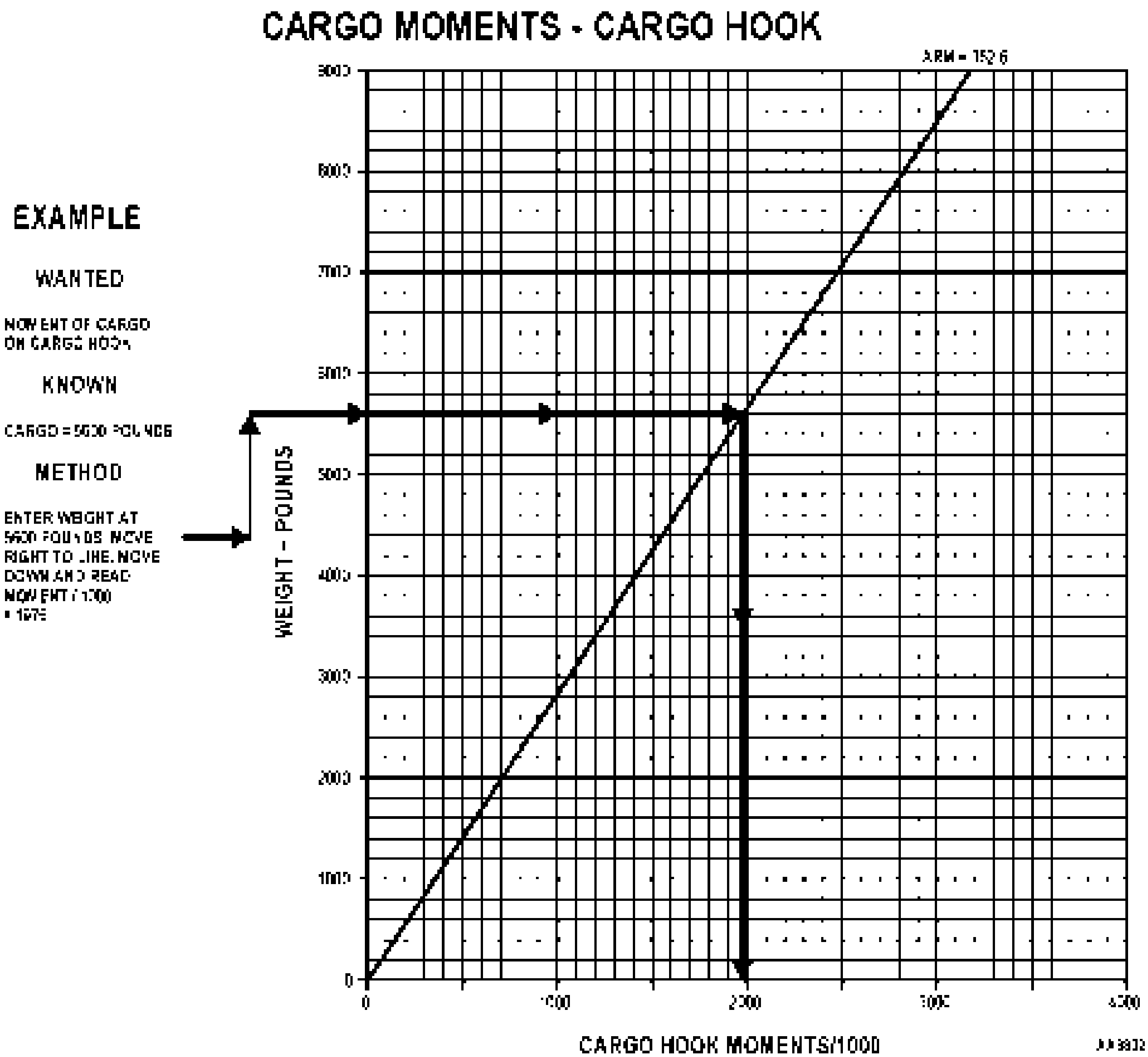


Figure 9-8. Cargo Hook Moments

9.3.1 Flight with External Loads

It is important that the PAC know the flying characteristics of various loads and associated flight control applications. All maneuvers that are made with external cargo loads should be gradual and well coordinated. Care must be taken when flying with external loads that have aerodynamic characteristics (wings, tail sections, sheet metal, plywood, etc.). The aerodynamic lift capabilities of these loads may amplify any oscillation and cause the load to contact the helicopter. Some helicopter oscillation may be noticed with low-density bulky cargo when in level flight. This oscillation can be minimized by the use of smooth control movements. When making turns at higher airspeeds, opposite lateral cyclic displacement may be necessary to prevent excessive rolling motion in the direction of turn. This tendency increases with airspeed and requires a slightly larger turning radius than would be required at the same gross weight with an internal cargo load. More than normal cyclic displacement is necessary to overcome the external cargo inertia when initiating or stopping sideward flight. Experience has shown that for any type of external cargo load, there is an airspeed best suited for that particular load. There is no one rule for flying with external loads; the combination of weight, dimension, and shape all have a direct bearing on the action of the load during flight. Increased power will be required to carry large, flat loads. If control movements are smoothly applied to preclude oscillation and airspeed is slowly increased to determine the riding characteristics of the load, external cargo can be satisfactorily flown. If high airspeeds or turbulence should cause a load to oscillate, decreasing airspeed and properly applying inputs to the flight controls can control the oscillation.

Careful attention to altitude, visual monitoring of the load by the crewman, and crew coordination are necessary to avoid load impact with obstacles or premature contact with the drop zone surface, especially when using long lifting slings.

The PAC shall be responsible for observing deck status, LSE signals, and maintaining rotor clearance. The PNAC shall monitor instruments, actively listen to the radios, and observe rotor clearance.

9.3.2 Cargo Pickup

As the aircraft proceeds inbound for a pickup, the PAC will advise the crew of load position and which pilot (seat) will be executing the pickup maneuver. The crewman will acknowledge and make the "Hook up" report.

Note

- “HOOK UP AND LOCKED” reports may be made immediately after latching/relatching or inbound prior to load pickup, according to preflight brief. In any case, “HOOK UP” checks and reports shall occur between each hook latch/relatch and the next load pickup.
- The procedures for external cargo pickup and delivery described in this manual are specified for operations where external load slings are attached directly to the cargo hook. These procedures may require modification when load slings are attached to remotely operated extensions from the cargo hook.

Check windline, helicopter weight, and power required charts prior to pickup. If necessary, a decrease in load or helicopter internal weight may be required for a safe takeoff. The height and movement to the pickup point will be determined by visual reference to the load, LSE signals, and crewman calls. The PAC can best control the approach until the aircraft is at a point (approximately 50 feet from the pickup spot) where the crewman can visually acquire the pickup spot and can begin to give directions utilizing proper voice terminology (Figure 9-9) to direct the helicopter over the load. Extreme caution must be used to avoid hitting the load.

As soon as the load is securely attached to the cargo hook, all personnel on the ground will clear the area directly beneath the helicopter. The crewman, along with the LSE, will notify the PAC that the load is ready to lift. Lift the helicopter vertically until the cargo is clear of the deck and the helicopter is in a stable hover. The PNAC will check Ng, TGT, torque, and Nr prior to transitioning to forward flight. If engines are torque limited and rotor rpm is drooping, do not attempt forward flight. When the phrase “CLEAR TO GO” is given by the crewman and signaled by the LSE, a transition to forward flight may be commenced. The PAC must ensure that safe engine limits can be maintained.

The signals received from the LSE and crewman are advisory in nature with the exceptions of “HOLD” and “WAVEOFF.” The crewman's advisories for positioning the aircraft over the load should take priority over those of the LSE. Collective and cyclic coordination is essential in maintaining position to ensure that a vertical, no-drift, no-swing pickup is accomplished.

WARNING

Extreme care shall be taken to ensure that loads are not flown over aircraft, lowered elevators, or personnel due to the possibility of inadvertent load release.

9.3.3 Cargo Delivery

The procedures for cargo delivery are similar to those used for pickup. The approach to the drop point should be higher than normal to prevent dragging the load on the deck. The PAC can best control the approach until the aircraft is at a point (approximately 50 feet from the drop spot) where the crewman can visually acquire the drop spot and can begin to give directions utilizing proper voice terminology (Figure 9-9). The helicopter should come to a hover with the load approximately 10 feet above the drop spot. A momentary hover will allow the load to stabilize and enable the crewman to direct the aircraft over the drop spot with precision and without damage to the cargo. Upon instructions from the crewman that the load is "Over the spot, easy down," reduction of power will allow the load to settle gently on the deck. Release of the load will be performed by the crewman or PAC electrically, the crewman manually, or, in case of emergency, by use of the cyclic EMER REL button.

Note

- The crewman shall notify the PAC whenever the load is spinning, swinging, or trailing aft. The PAC shall position the controls accordingly until the condition is corrected.
- After the instruction “LOAD ON DECK, HOOK CLEAR, CLEAR TO GO” is received from the crewman, forward flight may be established.

9.3.3.1 Electrical Release

Normal release of external cargo is accomplished by pressing the CARGO HOOK RELEASE button on the utility pendant or the CARGO REL button on either cyclic grip after placing the CARGO HOOK CONTR switch to the ARMED/ALL position. With the CARGO HOOK CONTR switch in the ARMED/CKPT position, only the CARGO REL button on either cyclic grip will release the cargo hook. A HOOK ARMED advisory will appear informing the pilots that electrical power is applied to the control circuit.

When the CARGO REL button is pressed and the release solenoid begins to move, a switch activates the HOOK OPEN annunciator. The load arm will swing open, releasing the cargo. When the load is released from the load beam, spring tension on the arm will cause the load beam to close and relatch. The normal release system is a one-time cycle; once the solenoid travel begins and the load arm relatches, the release cycle can again be initiated.

9.3.3.2 Manual Release

Manual release of external cargo can be accomplished from the cabin or by ground personnel. Turning the manual release control on the hook clockwise will cause the latching mechanism to release the load beam. The load beam will not open unless a downward pressure is exerted. With power applied to the helicopter and the CARGO HOOK CONTR switch in the ARMED/ALL or ARMED/CKPT position, the HOOK OPEN advisory will appear at the start of release control turning and will remain until the load beam is closed and latched.

9.3.3.3 Emergency Release

Emergency release of an external cargo load is activated by an electrically fired CAD, initiated from either cyclic EMER REL button. The emergency release is used when the electrical and manual releases are inoperative, and the load must be jettisoned. With the CARGO HOOK EMERG REL switch in the NORM position, power will be applied to the EMER REL button. Depressing the button applies 28 Vdc power to the CAD. A piston in the lock assembly, driven by high gas pressure, will release the load arm lock. The weight of the load will cause the load arm to open. Once the emergency release is used, the hook will remain open and the HOOK OPEN advisory will remain until the CAD is replaced. When the CAD is replaced, the load arm will close, the HOOK ARMED advisory will appear, and the emergency release mode is returned to operation. Power to operate the emergency release system is provided by the DC essential bus through a circuit breaker labeled CARGO HOOK EMER RELEASE.

Note

Once the emergency hook release has been activated, the cargo hook cannot be used until the CAD is replaced, because the hook load beam will not close and lock.

9.3.3.4 Cargo Hook Preflight

When external loads are to be carried, the following checks shall be performed:

1. Cargo hook — Proper installation and freedom of rotation.
2. CAD installed.
3. Manual release — Ensure no binding in the lever, load beam, or keeper.

MEANING	ICS CALL
Discontinue approach. Immediately stop all movement.	WAVEOFF** HOLD**
PICK-UP	
Pilot reports on approach.	INBOUND FOR RIGHT/LEFT SEAT PICK
Crewman rogers report and acknowledges hook has been checked up and locked.	ROGER, RIGHT/LEFT SEAT PICK; HOOK UP AND LOCKED
Pilot reports presence of HOOK ARMED annunciator	HOOK ARMED
Deck in sight, begin voice calls.	DECK IN SIGHT
Move in specific direction.	RIGHT* – LEFT* – FORWARD* – BACK*– UP* – DOWN*
Slow rate of movement. (Precedes basic command.)	EASY
Stop movement. (Precedes basic command.)	STOP
Maintain present position.	STEADY
Load is attached. Maintain present position.	LOAD HOOKED UP
Hookup man is in a safe area.	HOOKUP MAN IS CLEAR
Tension is coming on the pendant and aircraft.	WEIGHT COMING ON
Problem with the load. Maintain present position.	LOAD FOULED
Load is clear of the deck.	LOAD IS CLEAR
Load is clear of the deck and obstructions.	CLEAR TO GO
Load is not swinging, shifting, or oscillating.	LOAD RIDING WELL
Load is swinging, oscillating, spinning, or trailing aft.	LOAD UNSTABLE
Jettison immediately. Load endangering safety of flight.	PICKLE, PICKLE, PICKLE
DROP-OFF	
Pilot reports on approach.	INBOUND FOR RIGHT/LEFT SEAT DROP
Crewman Rogers report.	ROGER, RIGHT/LEFT SEAT DROP
Deck in sight, begin voice calls.	DECK IN SIGHT
Move in specific direction.	RIGHT* – LEFT* – FORWARD* – BACK* – UP*– DOWN*
Slow rate of movement. (Precedes basic command.)	EASY
Stop movement. (Precedes basic command.)	STOP
Maintain present position.	STEADY
Maintain position, slight tension on pendant.	LOAD ON DECK
Pendant clear of cargo hook.	HOOK CLEAR
Cargo not released from hook.	NO RELEASE
Pilot or copilot – release the load.	PILOT RELEASE HOOK
Aircraft cleared to depart.	CLEAR TO GO

* Give distance in feet (up 10, right 5, etc.)
** Compliance with call is mandatory

Figure 9-9. VERTREP ICS Terminology

9.3.3.5 Crewman Cargo Procedures

1. Remove cargo hatch cover and release hook from stowed position.
2. Direct PAC over the load using standard voice procedures (Figure 9-9).
3. Monitor the hookup and keep the PAC informed of the status.
4. Report when load is clear of the deck.
5. Monitor the load during transit for excessive angle or motion and keep the PAC informed of status.
6. Direct PAC over the spot for drop-off using standard voice procedures (Figure 9-9).
7. Electrically release the load and keep the PAC informed of the status.
8. Utilize manual release as required.
9. Stow cargo hook and replace cargo hatch cover.

WARNING

Gunners belts have been known to fail. Aircrew and/or passengers shall not hang feet out of cabin door except when necessitated by mission requirements. Determination if a mission requirement exists shall be the responsibility of the aircraft commander.

9.3.3.6 In-flight Procedures

When external loads are to be carried, the following checks shall be performed:

CAUTION

To prevent damage to the cargo hook keeper, the PAC should not exceed a 30° cone angle with cargo suspended from the cargo hook.

9.3.3.7 90° Sideflare Pattern

1. Once the aircraft is stabilized in a 10-foot hover over the load, the PAC shall follow the directions of the LSE and the crewman to ensure that the hook is centered directly over the load (Figure 9-10).
2. On signal from the LSE and the crewman, the collective shall be increased slowly until tension on the cargo pendant is felt. This will tend to center the aircraft over the load. At this point, smoothly increase collective to lift the load off the deck or until reaching a torque 6% less than maximum available. If the load fails to come off the deck within maximum VERTREP torque limits, maintain the hover and slowly decrease the collective until the load is on the deck. Loads should never be lifted using maximum allowable torque.
3. After clearing the deck, increase collective and place the nose 5º to 7º below the horizon. The aircraft will be placed on a climb schedule of approximately 1 foot of altitude for 1 knot of airspeed. Maintain a constant power setting, as necessary to establish the climb. This attitude should be held until the aircraft reaches approximately 60 to 80 KIAS, at which time the nose should be raised to maintain airspeed while climbing to a minimum altitude of 150 ft AGL.

4. A turn downwind shall be made with a shallow angle of bank (Figure 9-10). Abeam the drop point, commence a turn and slight descent on a racetrack pattern to intercept the final approach course into the wind (directly astern for shipboard training) at approximately 150 ft AGL and 60 to 80 KIAS.

5. The final approach is to be flown in such a manner as to position the aircraft in a hover over the drop spot. While on final approach heading, maintain a constant bearing to the intended point of pickup and position the aircraft on a glide slope approximately 500 ft horizontally from the pickup spot. Reduce collective to maintain glide slope and raise the nose above the horizon as necessary to dissipate airspeed.

6. As the aircraft reaches approximately 40 KIAS at a position 150 to 200 ft from the spot, begin to turn the aircraft and execute a 90º sideflare while maintaining a constant bearing and glide slope to the spot. This is accomplished by applying a small amount of forward and lateral cyclic in the direction of flight and opposite directional pedal. Do not exceed the 35-knot sideward flight limit. Arrive 25 to 50 ft from the spot with the aircraft perpendicular to the ship’s centerline and on glideslope. Utilize power in conjunction with lateral cyclic in order to cross the deck with the load 10 ft above deck height. Altitude in the hover will depend greatly on the length of the cargo pendant, the height of the cargo, and the height of the obstructions in the vicinity of the drop spot.

9.3.3.8 45°/135° Sideflare Pattern

This pattern is accomplished in much the same manner as the 90º sideflare; however, the approach will be flown from a wider abeam position on a final course 45º off the windline (ship's course for shipboard training) (Figure 9-11).

1. Continue the approach past the abeam position and commence a turn to arrive on final approach heading 45º off the windline at approximately 150 ft AGL and 60 to 80 KIAS. The final approach is to be flown in such a manner as to position the aircraft in a hover over the drop spot. While on final approach heading, maintain a constant bearing to the intended point of pickup and position the aircraft on a glide slope approximately 500 feet horizontally from the pickup spot. Reduce collective to maintain glide slope and raise the nose above the horizon as necessary to dissipate airspeed.

2. As the aircraft reaches approximately 40 KIAS at a position 150 to 200 feet from the spot, begin to turn the aircraft and execute a 45º or 135º sideflare while maintaining a constant bearing and glide slope to the spot. This is accomplished by applying a small amount of forward and lateral cyclic in the direction of flight and opposite directional pedal. Do not exceed 35-knot sideward flight limit. Arrive 25 to 50 feet from the spot with the aircraft perpendicular to the ship's centerline and on glideslope. Utilize power in conjunction with lateral cyclic in order to cross the deck with the load 10 feet above deck height. Altitude in the hover will depend greatly on the length of the cargo pendant, the height of the cargo, and the height of the obstructions in the vicinity of the drop spot.

9.3.4 Day VERTREP Operations

1. Once communications have been established between the receiving ships, transferring ship, and the aircraft; the receiving ships will set flight quarters as defined in NA-80T-122.

2. Prior to each approach to the flight deck for any pickup or drop-off, the following factors should be considered:

   a. Relative winds and flow characteristics around the ship with respect to turbulence and null areas.

   b. Path of ship exhaust gases that result in turbulence and warm air.

   c. Green deck status light.

   d. Appropriate LSE signals.

   e. Drop area clear of people and loose gear.

   f. Proper placement of load relative to the VERTREP/hover deck markings.

CAUTION

The aircrewman shall ensure proper placement of the load, relative to the VERTREP hover area markings.

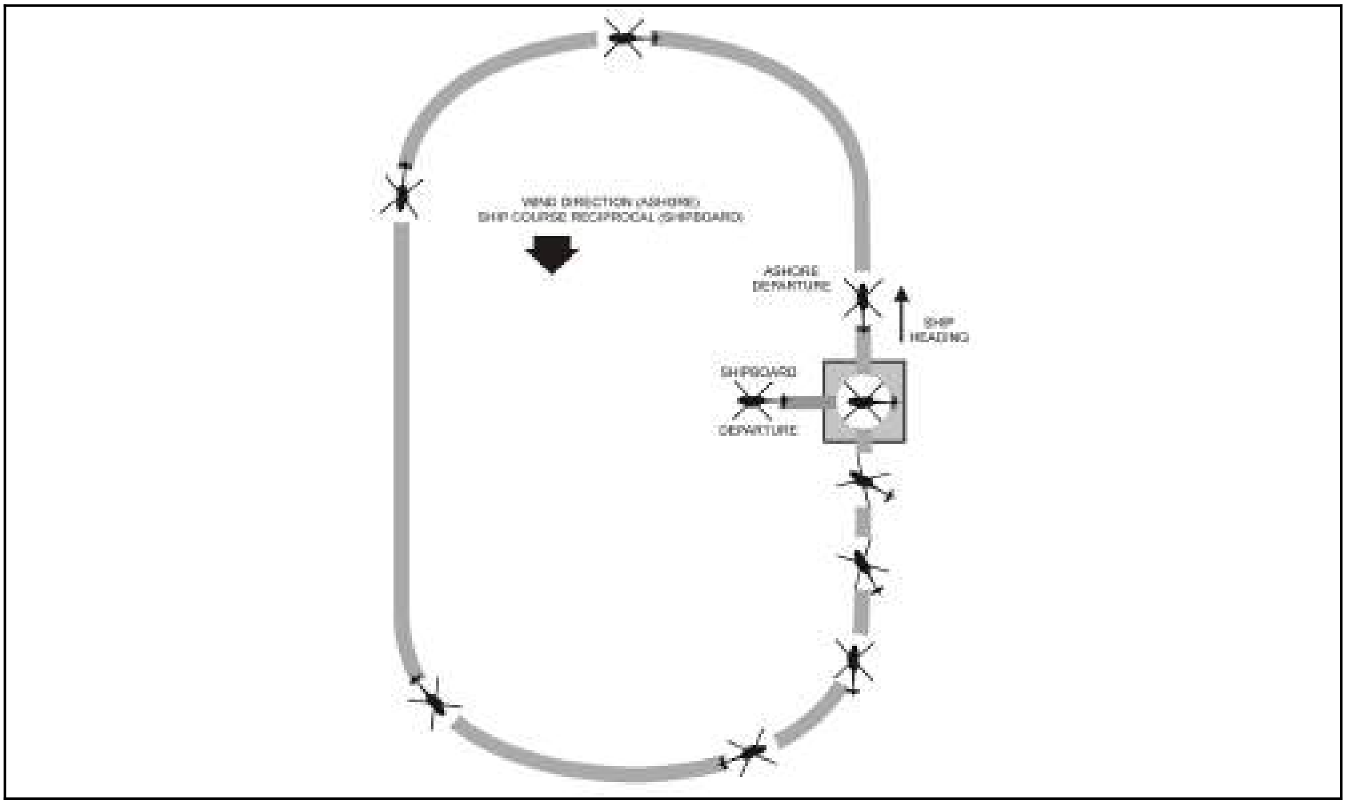


Figure 9-10. 90º Sideflare Pattern

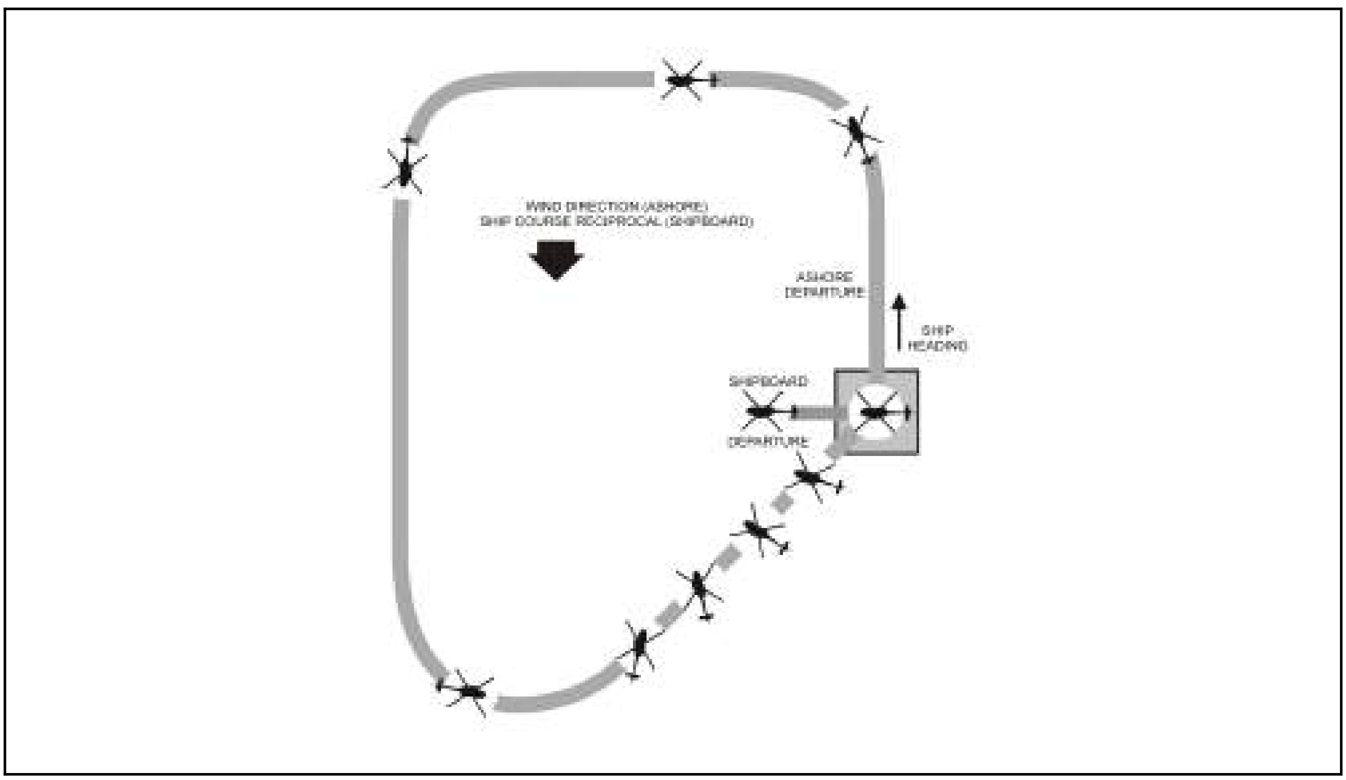


Figure 9-11. 45º/135º Sideflare Pattern

9.3.4.1 VERTREP Safety

Care must be exercised while conducting VERTREP. Various conditions such as high sea state, over-sized loads, various length lifting slings, and small drop zones may reduce available visual cues and stability/control of external loads. Reducing the maximum VERTREP torque further below the 6% margin may provide an extra measure of control and safety.

WARNING

- Prior to conducting VERTREP/external lift operations utilizing the forward TEE VERTREP/external lift line-up line markings, pilots shall verify with the ship or ships resume that the forward TEE VERTREP/external lift line-up line markings have been relocated for H-60 T/M/S operations. If the line has not been relocated, refer to VERTREP/external lift limitations as directed in NA-80T-122.
- Adequate rotor clearance does not exist to stage double stacked loads on single spot flight decks.
- There are no VERTREP fight deck markings to provide adequate obstruction clearance on a CV(N), LHA or LHD. Therefore, all hands participating in a night VERTREP evolution must be particularly alert to ensure that adequate clearance is maintained between the aircraft and obstructions in the vicinity of the flight deck. Crews should be aware that a combination of a staged flight deck, high-velocity and/or gusty winds, and ship pitch and roll may create less than adequate landing clearance for an aircraft experiencing an inflight emergency.

Note

During VERTREP, loss of visual contact with the LSE while picking up or dropping a load requires a hold until visual contact is regained.

9.3.5 Night VERTREP Operations

WARNING

Due to the hazards associated with night operations and the increased potential for mishap, night shipboard external cargo operations shall not be conducted except for reasons of operational necessity.

Night VERTREP is an inherently demanding and fatiguing evolution that requires particularly high levels of planning and coordination. One or more of the following conditions shall exist prior to conducting night VERTREP operations:

1. A natural horizon exists.
2. The ships are alongside in connected replenishment (CONREP) position.
3. The drop-off/pickup zone of the receiving/ delivery ship is clearly visible from the cockpit when over the drop-off/pickup zone of the delivery/receiving ship.

9.3.5.1 Night VERTREP Safety

Particular care must be exercised while conducting night VERTREP. Adverse environmental conditions such as fog, precipitation, sea state, horizon, and aircrew proficiency, profoundly affect the safe conduct of the mission. Altitude

SEE IC # 70

hold shall be used for all night ship flights with the exception of VERTREP operations in the CONREP position. In the shipboard landing and VERTREP pattern, altitude hold shall be turned off only after the PAC has visual reference of the landing environment/drop zone. Operational commanders must, whenever necessary, augment published operating rules with directives addressing local circumstances.

CAUTION

When carrying external loads, erratic radar altimeter indications can result in an AFCS DEGRADED caution.

9.3.5.2 Procedures

Night VERTREP patterns should be chosen based on the type of loads, the decks that they are being transferred between, and the distance that they will be carried. The normal pattern will be a racetrack type between the delivery ship and the receiving ships. Excessive maneuvering should be avoided, when able, to help avoid vertigo inducing maneuvering. Altitudes and checkpoints should be based on the type of ship being serviced, relative position of ship being worked, and maintaining safe clearance.

1. On pickup, the PNAC will monitor all instruments and note the torque. The PAC will commence lifting the load following hand signals from the LSE and voice calls from the crewman.

CAUTION

All night VERTREP climb-outs away from the immediate vicinity of the flight deck should be conducted on instruments.

2. The PAC will transition to 60 to 80 KIAS and climb to a minimum altitude of 150 ft AGL prior to turning. The PNAC shall call “POSITIVE RATE OF CLIMB”. The PNAC shall notify the PAC if more than 20º angle of bank is attained, altitude descends below 100 ft AGL, or a fast rate of descent is not corrected. If the aircraft descends through 75 ft AGL or a fast rate of descent develops, the PNAC shall assume control of the aircraft and correct the situation. Control changes should be accomplished with wings level and a positive, verbal acknowledgement. Both radar altimeters shall be set to illuminate at altitudes determined in the brief, but not less than 40 feet. Determination of radar altimeter settings should be based upon, but not limited to: type of ships, relative position of ships, and altitudes required to transition from one ship to another.

WARNING

Oscillations caused by the load and felt through the rotor blades and/or fuselage can cause vertigo at night. Should extreme oscillations and/or unsafe flight due to spatial disorientation/vertigo occur, consideration should be given to jettisoning the load immediately.

3. When the aircraft is properly positioned to commence an approach, the PNAC should inform the PAC to begin the turn. The PAC may then turn toward final and begin the descent once established on final. When the PAC has visually acquired the drop area and established that adequate visual reference exists to afford a safe approach, the approach is continued to arrive over the drop area. If the PAC has transitioned from instrument flight to visual flight, a verbal statement to the PNAC is made that there is adequate visual reference to continue the approach.

9.3.5.3 Lighting

Receiving and transferring ships shall have their decks illuminated to conform with the criteria for certification set forth by the Shipboard Aviation Facilities Resume.

Note

Night VERTREP to ships that do not conform to the minimum certification criteria set forth in the Shipboard Aviation Facilities Resume shall not be attempted.

Aircraft lighting configuration is at the discretion of the PIC, but various aspects of aircrew limitations must be taken into account to allow visual reference with the load and the deck. Additionally, care must be taken to ensure external lighting does not interfere with the LSE’s ability to see the aircraft and the load.

9.3.6 Lost Communication Procedures with a VERTREP Load

In the event of lost ICS with an external load, the following procedures are recommended:

1. The crewman operating the cargo hook will direct the aircraft via hand signals (Figure 9-12).

Note

At night, it may be necessary to turn on the cabin lights to increase visibility.

2. The PNAC will relay the direction signals to the PAC. The signals may be relayed by utilizing hand signals or by applying pressure to the PAC's shoulder or elbow in relation to the desired aircraft movement (i.e., gentle forward pressure to the back of the PAC's shoulder to indicate FORWARD, gentle pressure to the bottom of the PAC's elbow to indicate UP, and pushing or pulling on the PAC's shoulder to indicate LEFT or RIGHT).

The following is an alternate method for dropping an external load with lost ICS:

3. The crewman operating the hook will direct the aircraft via hand signals (Figure 9-12).
4. The crewman not operating the cargo hook will take a position forward between the pilot seats and relay the signals to the PAC by applying pressure to the PAC's shoulder or elbow in relation to the desired aircraft movement (i.e., gentle forward pressure to the back of the PAC’s shoulder to indicate FORWARD, gentle pressure to the bottom of the PAC's elbow to indicate UP, and pushing or pulling on the PAC's shoulder to indicate LEFT or RIGHT).
5. The PNAC will continue the normal scan for VERTREP operations.

Note

Pickups shall not be accomplished during lost ICS situations.

VOICE COMMAND	HAND SIGNAL FROM AIRCREWMAN	LOST ICS SIGNAL FROM PNAC TO PAC
WAVEOFF*	VIGOROUS CROSSING OF HANDS	VIGOROUS CROSSING OF HANDS
HOLD*	DOUBLE CLENCHED FISTS	FIRM GRASP OF SHOULDER
FORWARD	ELBOW BENT 90 DEG FINGERS EXTENDED POINTING UP	FORWARD PRESSURE
BACK	ELBOW BENT 90 DEG FINGERS EXTENDED POINTING DOWN	BACK PRESSURE
LEFT	LEFT ARM EXTENDED, FINGERS EXTENDED	LEFT PRESSURE
RIGHT	ELBOW BENT 90 DEG, FINGERS EXTENDED UP AND PERFORM WAVING MOTION	RIGHT PRESSURE
UP	PALM UP MOTIONING UP	UPWARD PRESSURE
DOWN	PALM DOWN MOTIONING DOWN	DOWNWARD PRESSURE
STEADY	CLINCHED FIST	NO PRESSURE
CLEARED TO GO	TAP HELMET, POINT FORWARD	THREE TAPS ON THE SHOULDER
HOIST GOING DOWN	CLINCHED FIST, THUMB DOWN	CLINCHED FIST, THUMB DOWN
HOIST GOING UP	CLINCHED FIST, THUMB UP	CLINCHED FIST, THUMB UP
* Mandatory		

Figure 9-12. Lost Communications Procedures

9.4 FORMATION FLYING

9.4.1 General

The following is a general discussion of safe formation flying basics.

Helicopter formation flight is conducted for the following reasons:

1. Improved operational capability. When properly executed, the flight leader can expect complete flexibility of operation within the limitations of helicopter maneuverability without danger of creating unsafe conditions within his formation (free cruise) or the encumbrance of delay while intentions are passed, via signal or radio.

2. Mutual safety and accountability. The danger of mid-air collision is greatly reduced when every flight member knows where they is supposed to be, and remains in their designated space.

Certain helicopter characteristics which should be considered in formation flight are:

1. Formation flying may be performed in a step-up position to avoid rotor-wash, improve visibility, and provide a greater safety margin between the main rotor and the helicopter ahead. By adjusting altitude to place the top of the rotor head of the helicopter in front on the horizon, a sufficient step-up will be maintained. A step-down position may provide the wingman better visual references at night over well lit populated areas.

2. At night, it is more difficult to ascertain when the lead helicopter changes direction and altitude. (Refer to NIGHT FORMATION in this chapter.)

9.4.2 Formation Composition

9.4.2.1 Section

The section will consist of two helicopters and will constitute the basic unit of a formation.

9.4.2.1.1 Parade

The wing aircraft will fly at a 45° bearing behind and on the appropriate side of the section leader. The horizontal helicopter-to-helicopter separation will be a minimum of one rotor diameter between rotor tips. The wingman's position in the parade section is fixed. (See Figure 9-13.)

9.4.2.1.2 Free Cruise

The wingman will fly approximately 60° behind the section leader. The horizontal helicopter-to-helicopter separation will be approximately two to three rotor diameters. Normally, the free-cruise wing aircraft maintains a position 60° off the axis of the lead helicopter during straight and level flight. During turns, wing crosses over from one side of the section leader to the other to maintain position with minimum changes of power. In free cruise, helicopters in the formation are not to be considered bound to a fixed position. Rather, they are assigned a segment of airspace behind lead in which they are free to move as necessary to maintain constancy of horizontal and vertical separation. Wing should avoid continued flight directly behind lead. (See Figures 9-14 and 9-15.)

9.4.2.2 Division

A division will consist of two sections. The general rules applying to section formations may be expanded to apply to divisions within the limits of safety and capability. The side of the division on which the section is placed will be known as the heavy side of the formation. When a flight consists of more than four helicopters, any amount over four will form subsequent divisions. The last division may be comprised of less than four helicopters.

9.4.2.2.1 Parade

The second section lead is the number three aircraft in the division. Parade position may be flown in echelon left/right or heavy left/right.

9.4.2.2.2 Free Cruise

The second section lead is the number three aircraft in the division. The second section lead is free to cross over the section from side to side of the division lead to maintain horizontal clearance with minimum changes of power.

9.4.3 Rendezvous

Normally, the running rendezvous will be employed. Lead will fly on course at slow cruise, and the flight will take position as briefed. When the flight is joined, the lead aircraft will proceed at cruise speed. An orbiting rendezvous may be used. The lead will fly a right or left circular pattern at normal cruise speed around a designated point until the flight is joined. In an orbiting rendezvous, helicopters will join in column formation using the free cruise principle until lead rolls out on departure heading. All rendezvous helicopters should pass across the designated point, pick up altitude separation, and join on the helicopter ahead. Any overshoot tendency should be taken to the outside of the turn. Normally, thereafter, the flight will continue to maintain free cruise formation at cruise speed, unless otherwise directed by the flight lead. Extreme caution should be exercised during night rendezvous, due to reduction of perception of relative motion.

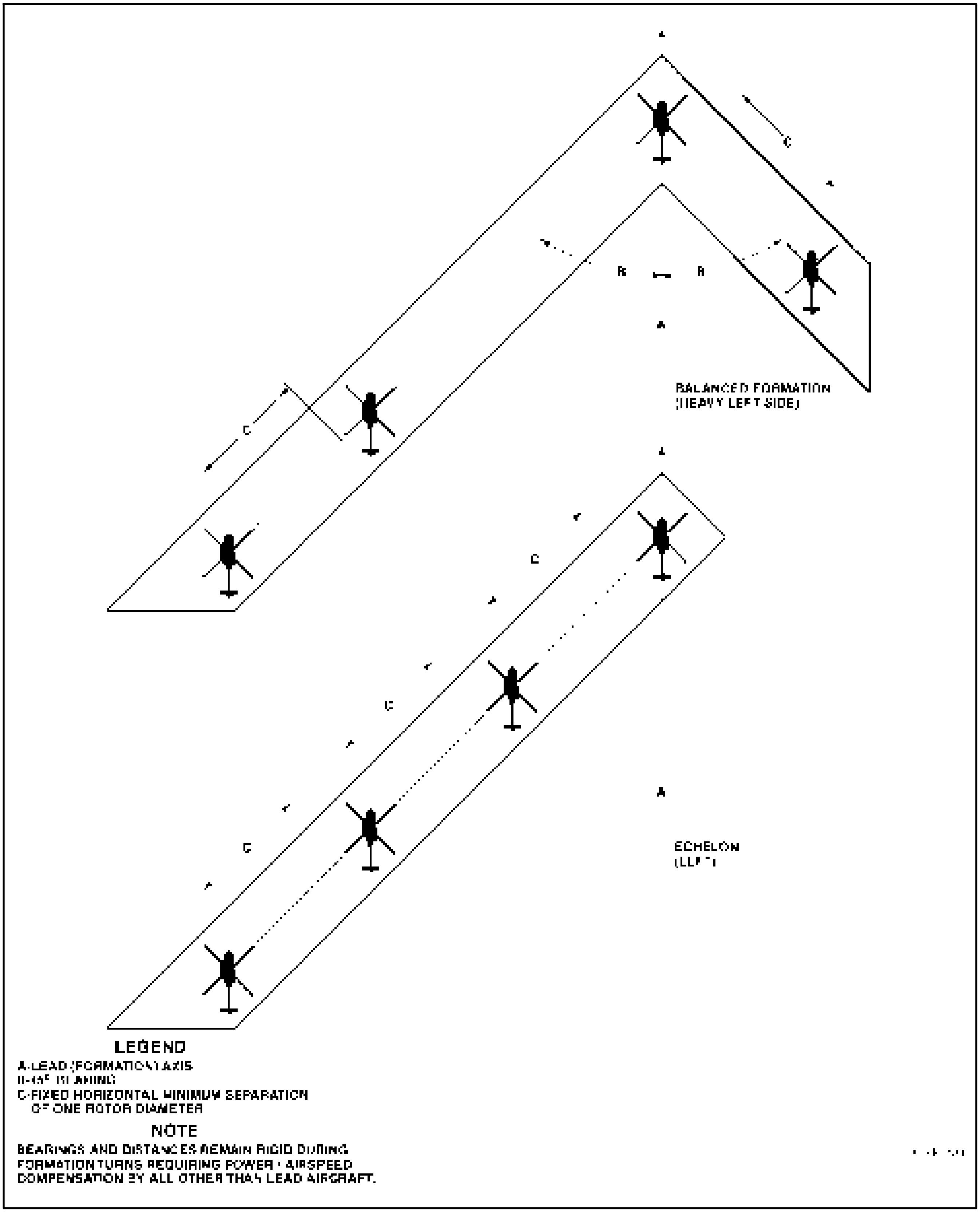


Figure 9-13. Parade

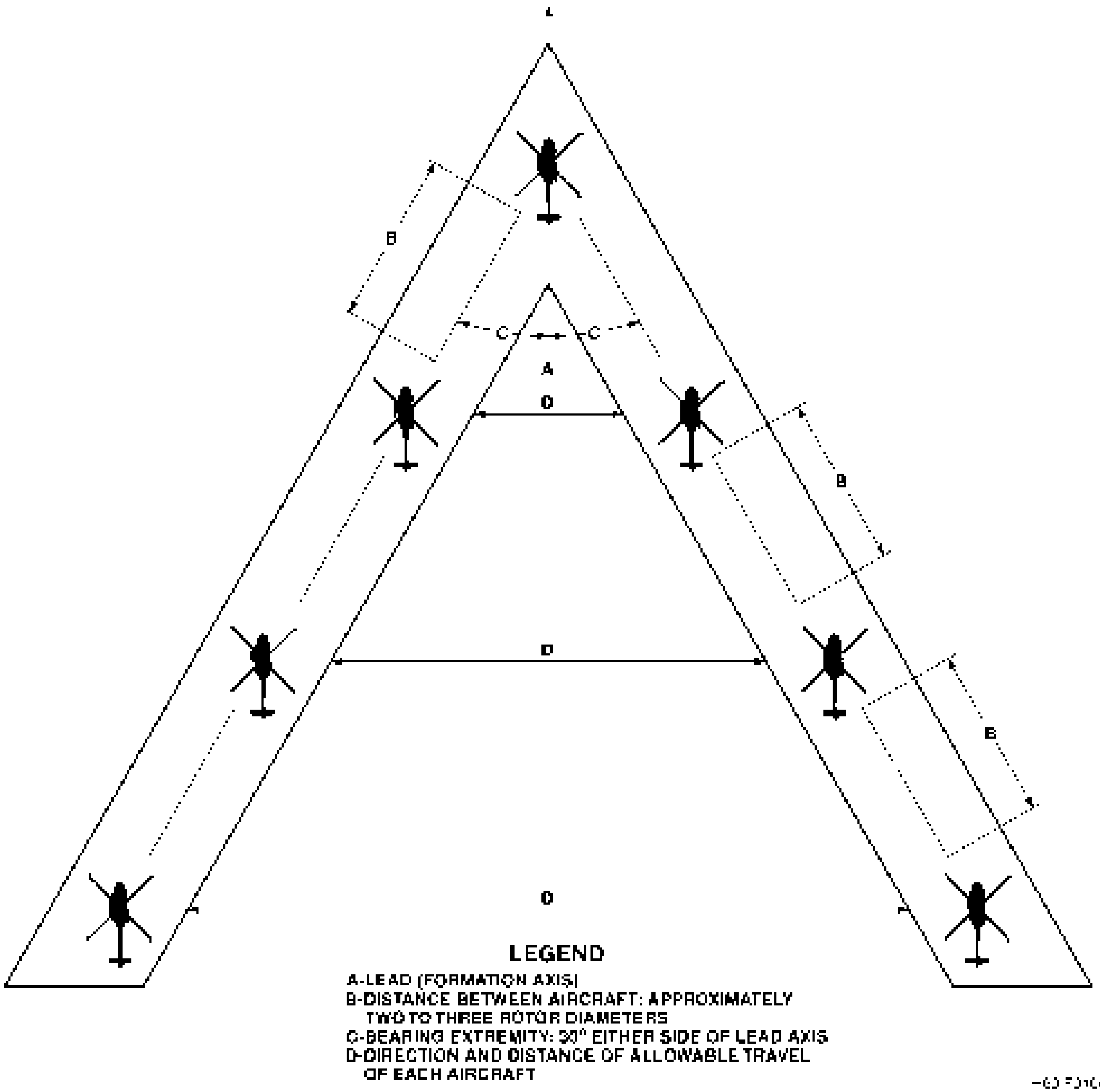


Figure 9-14. Free Cruise — Straight and Level

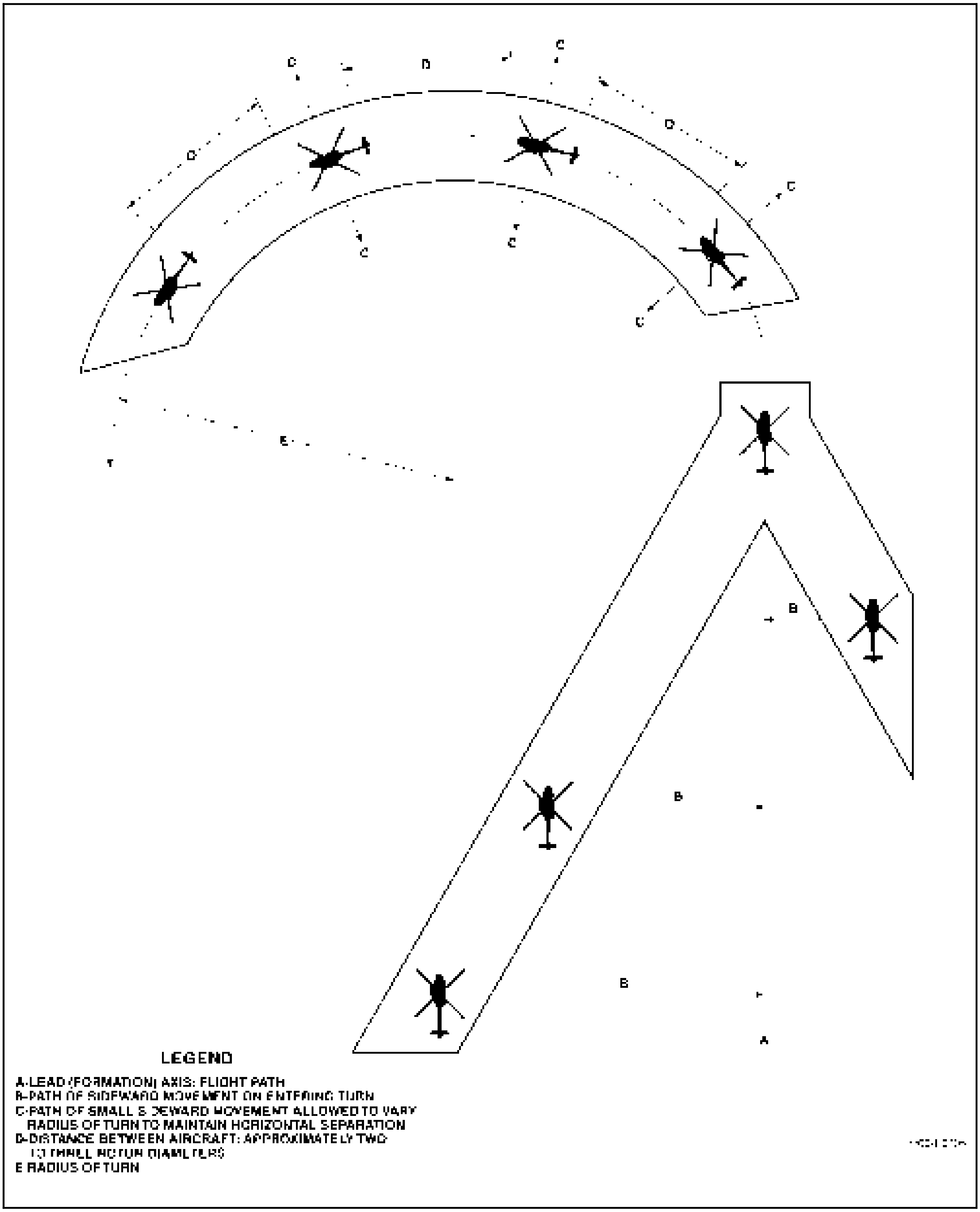


Figure 9-15. Free Cruise Turn

9.4.3.1 Breakup and Rendezvous Procedures

From a parade position, lead starts a 180° turn away from wing by executing a 30° angle of bank, maintaining altitude and airspeed. When the wing notes the lead passing through 45 relative degrees of turn, the wing will break the same direction for 180° using a 30° angle of bank turn initially and then adjusting the turn rate to arrive approximately 1,000 yards astern of the lead. The wing will then call “IN POSITION.” When the “IN POSITION” call is received, lead establishes a 10° angle of bank for 180° of turn to a parade position. This turn is conducted in the opposite direction of the initial 180° turn so that the rendezvous is not conducted by the cross-cockpit pilot. The wing establishes a 15° to 20° angle of bank turn to close the lead using radius of turn without adjusting airspeed. If the rendezvous cannot be executed in 180° of turn, wing should inform lead to keep the turn in. Cardinal headings can be used for quick reference to a 180° position.

9.4.4 Conduct of Flight

Formation flight will be practiced in accordance with this doctrine during all normal, multiple helicopter movements to improve proficiency. Free cruise formation will be used for most operations. Parade formation is normally used only for special occasions such as air shows, authorized fly-bys, etc. Nothing in this instruction shall be construed as prohibiting qualified crews from flying in tactical formation (TACFORM) or performing TACFORM maneuvers.

9.4.5 Responsibility

9.4.5.1 Flight/Form/Division Lead

The flight lead is responsible for the flight brief, formation brief, conduct, and discipline of the flight. Form lead will normally handle navigation, radio transmissions, and ATC clearances for the flight. Division leaders are responsible for the conduct of their division. All aircrew are responsible for maintaining positions as outlined. No deviation of position, such as change of lead, will be made until appropriate signals have been given and acknowledged.

9.4.5.2 Wing

Wing aircraft are responsible for safe flight separation with lead or any other aircraft. In addition, wing aircraft are responsible for maintaining formation integrity and other tasks that Lead may assign.

9.4.6 Lead Change

When changes of lead are made, the wing will increase horizontal separation to at least two rotor diameters and move forward to a position abeam the lead. The lead will then be passed by appropriate pre-briefed signal. The new wing (old lead) will then drift back to the appropriate position on the new formation. Safety will govern all actions.

9.4.7 Night Formation

Night formation should be flown only when complete visual reference between helicopters can be maintained and in the same manner as day formation. This is normally construed to mean that NVDs are required for safe night formation flight. Separation between helicopters may be adjusted as deemed prudent by members of the flight and as directed by visibility conditions. Caution should be exercised to avoid unnecessarily extending the formation to the extent of limiting its operational capability, mutual safety, or ability to maintain firm visual contact with other formation members. For wing to accurately verify distance and bearing, TACAN air to air mode, formation electro-luminescent lights, or installed IR chemical lights should be used. At any time that complete visual contact cannot be maintained between helicopters or silhouette definition is lost, discontinue the formation flight and execute pre-briefed lost contact procedures. For normal operations, the last aircraft in the formation should have anti-collision lights ON.

9.4.7.1 Lost Wingman VMC

These procedures should be commenced anytime during VMC flight when a member of the flight loses sight of the aircraft forward of them or when deemed necessary by the lead. Any member may initiate these procedures by calling “BLIND”. Lost wingman procedures shall be pre-briefed to all members of the formation and should include:

1. Lead calls base heading and wing aircraft make pre-briefed coordinated turns away from lead.
2. Lead calls base altitude and wing aircraft make pre-briefed coordinated climbs/descents away from lead’s altitude.
3. All aircraft ensure applicable sensors are operational to assist in vertical and lateral separation.
4. All aircraft make clear and concise communications as to their position, altitude, and intent during the maneuvers. If any deviations to the pre-briefed plan are made, they shall be communicated over the radio.

If VMC and able to maintain VMC both aircraft should ensure vertical and lateral separation from each other and coordinate a rendezvous. In all cases clear radio transmissions, air to air TACAN, and/or other sensors should be used to the maximum extent practicable to avoid collision.

9.4.8 Instrument Flight Conditions In Formation

Normally formation flying will not be flown when the visibility is so low that helicopters are likely to lose sight of one another. When situations can be anticipated, the leader will take such action as necessary to ensure formation integrity or safely break apart the formation for IFR flight.

9.4.8.1 Inadvertent IMC Procedures

These procedures (Figures 9-16 and 9-17) should be commenced anytime a member of the flight loses sight of the aircraft directly ahead of them due to IMC or when deemed necessary by the lead. Any member can initiate these procedures by calling “INADVERTENT IMC” and executing the pre-briefed flight profile. The following options are not a complete safety net to ensure safe flight in inadvertent IMC conditions, but are intended as a discussion of known methods to enhance safe flight in an inadvertent IMC situation. Inadvertent IMC procedures shall be pre-briefed to all members of the formation and should include:

1. Lead calls base heading and wing aircraft make pre-briefed coordinated turns away from lead.
2. Lead calls base altitude and wing aircraft make pre-briefed coordinated climbs/descents away from lead’s altitude.
3. All aircraft ensure applicable sensors are operational to assist in vertical and lateral separation.
4. All aircraft make clear and concise communications as to their position, altitude, and intent during the maneuvers. If any deviations to the pre-briefed plan are made, they shall be communicated over the radio.

If either aircraft is able to regain and maintain VMC flight during inadvertent IMC procedure they should maintain VMC and attempt coordinate Lost Wingman VMC procedures. Extreme caution shall be used when the possibility exists for IMC conditions to develop in mountains. Inadvertent IMC in mountainous environments is extremely dangerous and can develop rapidly. In mountainous terrain, it may or may not be possible to climb above the MSA. The primary concern is for all aircraft to turn away from the rising terrain and fly in a safe direction. Inadvertent IMC breakup will require lead to provide a detailed brief of procedures and all members to have a thorough understanding of the expected topography. In addition to the previous discussion on inadvertent IMC procedures, the following options may assist in safe flight for mountainous environments.

1. Lead and wing execute maximum performance climbs at pre-briefed different airspeeds. Lead should climb at a faster airspeed than wing to assist in separation.
2. Both aircraft should climb to deconflicted altitudes above the MSA if possible.
3. If the MSA is above operational parameters a detailed understanding of the topography will be required so that aircraft can execute a turn toward a safe direction that will allow for obstacle clearance.
4. If section or division aircraft are unable to regain VMC and rejoin safely, lead shall ensure all aircraft are assigned deconflicted altitudes for IFR clearances.

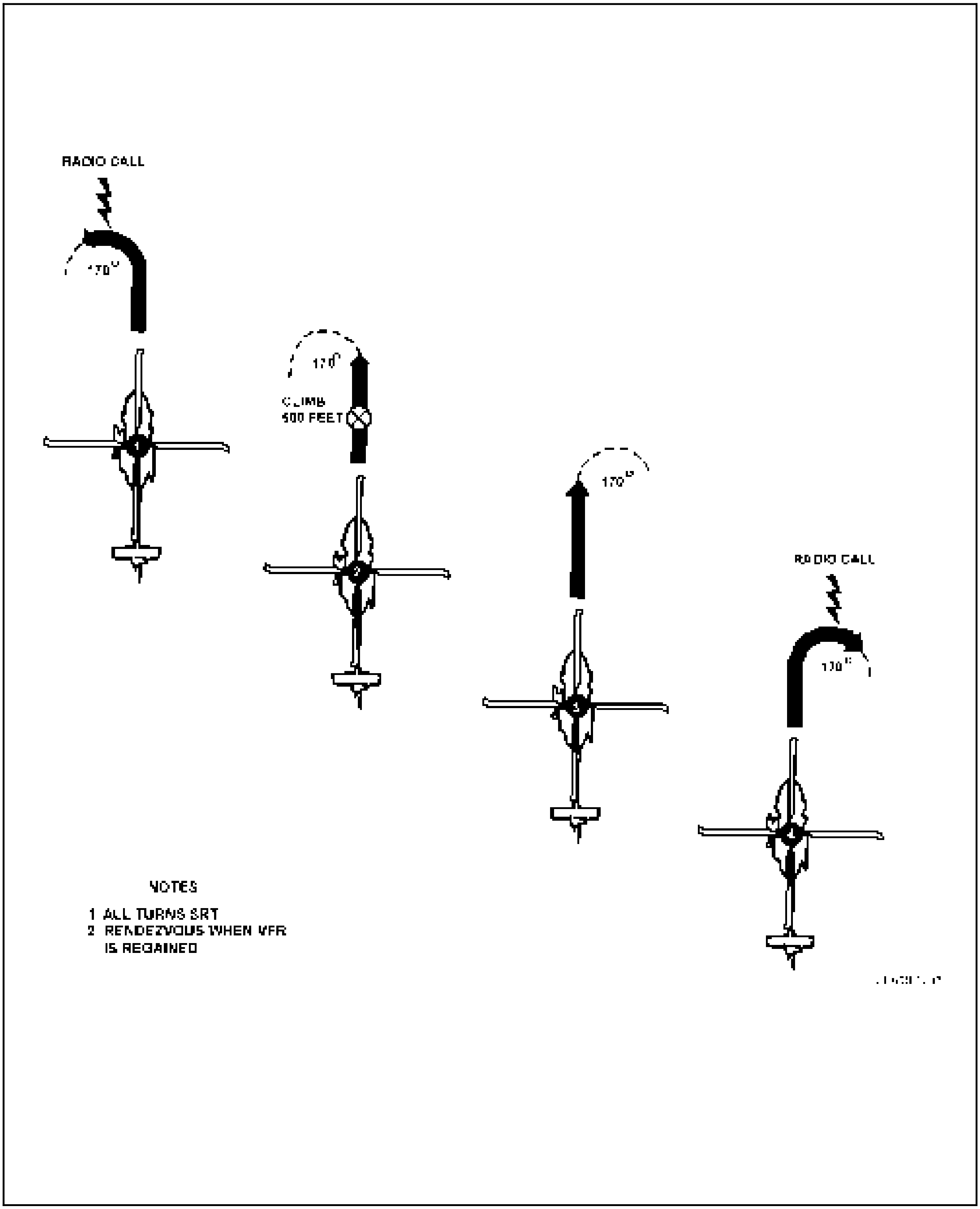


Figure 9-16. IMC Breakup Procedures (Four Plane)

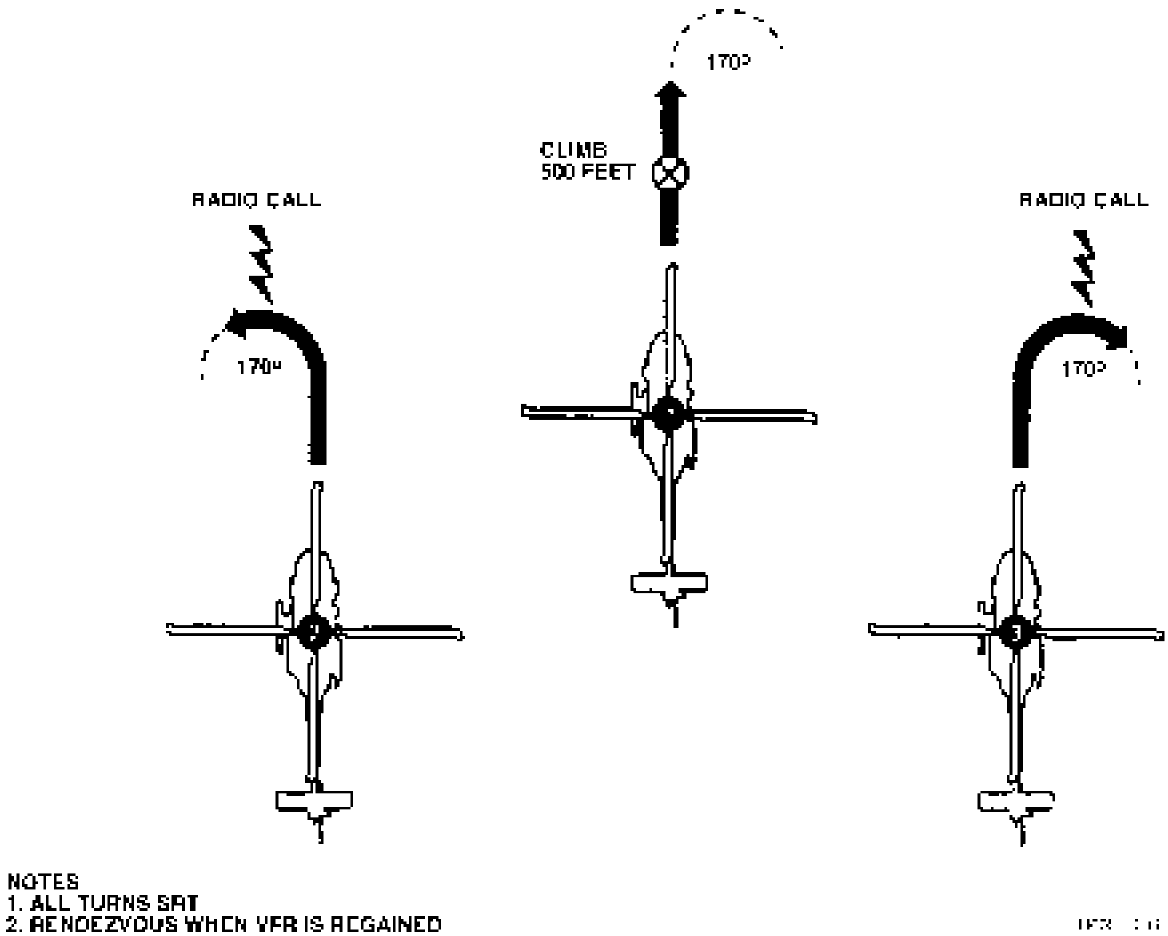


Figure 9-17. IMC Breakup Procedures (Three Plane)

9.5 TERRAIN FLYING

9.5.1 General

Consult appropriate manuals for procedures and techniques for terrain flying. The three types of terrain flying are:

1. Low level flight: Flight at a preselected altitude below 500 feet along a prescribed route, usually in straight line segments at constant airspeed.
2. Contour flight: Flight at low altitude conforming generally to the contours of the earth, with varying airspeed and altitude as vegetation and obstacles dictate.
3. Nap of the Earth (NOE) flight: Flight as close to the earth's surface as vegetation/obstacles permit. NOE is similar to contour flight but is conducted at lower altitudes and is characterized by airspeeds from a hover/air taxi to dashes of 60 to 70 Knots Ground Speed (KGS).

The close proximity to obstacles, rapid attitude adjustment, and many power changes with frequent high power demands, put a great stress on airframe and dynamic components. These same parameters demand increased attention from individual crewmembers as well as the crew as a whole. Proper crew coordination is essential. Detailed individual tasking of duties must be pre-briefed and rigidly enforced. Standard phraseology should be used to avoid confusion during critical segments of flight. Emergencies are more critical at low altitude and corrective actions must be completed expeditiously. Aircraft performance should be calculated prior to flight utilizing worst condition parameters of density altitude, gross weight and winds. The aircraft should be performance checked in flight to ensure that the calculated performance is available before terrain flying is attempted. Aircraft and pilot reaction times in all flight regimes must be considered when determining route of flight and altitude.

Note

Terrain following flights shall be accomplished only when properly scheduled, planned and briefed for that specific mission. When conducted, they should be flown no lower than is necessary to accomplish the mission.

9.6 SPECIAL WARFARE SUPPORT OPERATIONS

Special warfare support operations require maximum flexibility on the part of the aircrew. A wide variety of methods and equipment may be used to deploy and recover special warfare personnel. Therefore, it is incumbent upon the aircraft commander to ensure that all personnel are thoroughly briefed and familiar with a specific operation prior to its conduct. Although this section covers numerous operations, it is not all inclusive. Operations not addressed must be approached with maximum caution and prior planning to ensure a safe evolution. Special warfare equipment descriptions, authorizations, limitations and rigging procedures are found in NTRP 3-22.2-SH60B and NTRP 3-22.2-SH60B. Additional information concerning special warfare support operations can be found in the Air NTTP 3-22.1-SH60B/Air NTTP 3-22.1-HH60H, Naval Special Warfare Command Air Operations Manual (COMNAVSPECWARINST 3000.3) and Special Operations Infiltration/Exfiltration Operations (USSOCOM Manual 350-6), and appropriate NSAWC publications.

9.7 NIGHT VISION DEVICE (NVD) PROCEDURES

9.7.1 General

Night vision goggles provide a significant increase in visual cues and situational awareness during night operations while greatly expanding operational capabilities. The benefits of NVDs, however are only maximized through training, thorough mission planning and proper crew coordination. Competency on NVDs begins with a firm foundation in the execution of basic helicopter pilotage skills. The importance of good crew coordination cannot be overemphasized. For additional information on NVDs and their usage, refer to the MAWTS-1 USN/USMC NVD Manual or NVD operators manual.

CAUTION

Do not assume that personnel operating in and around taxiing helicopters are capable of detecting hazards with the same level of situational awareness as can be attained with NVDs.

9.7.2 NVD Physiology

Flying with NVDs has a significant impact on physiology. The most obvious visual limitation of NVDs is the reduced field of view (FOV). Compared to the 188° field of view normally available, NVD FOV is reduced to 40°. This reduction necessitates an active and aggressive scan. Additionally, a reduction in visual acuity (resolution) occurs with NVDs. As a result, the ability to perceive fine details such as electrical power lines, unlighted towers, poles, antennas, and all types of wires, is significantly degraded. Brownout/Whiteout will greatly degrade visual acuity even further. Distance estimation is significantly altered with NVDs. This is caused by the inherent reduction in visual acuity and minification, which may be the result of improper preflight focus procedures. Depth perception is not lost with NVDs. Wearing NVDs for an extended period of time can cause extreme eye fatigue. This can result in converging/diverging vision, headache and eyestrain. Proper NVD preflight and adjustment procedures are critical. Improper focus procedures will compound the adverse effects of NVDs. NVD adjustment and focus procedures shall be conducted in accordance with the MAWTS–1 USN/USMC NVD Manual or the Operators manual.

WARNING

Depth perception is adversely affected by NVDs. Weather may appear much further away than it actually is and closure rates are not immediately noticeable. Brownout/whiteout will greatly degrade visual acuity which could result in impact with ground other aircraft.

CAUTION

Flight operations involving NVDs are inherently more stressful and demanding than day flying and VMC. The resultant fatigue may have a profound physiological effect upon mission capability. Mission planners should take this physiological threat into account in making modifications to normal crew rest/crew day guidelines.

9.7.3 Lighting Considerations

NVD enhancement is inversely proportional to altitude and airspeed, i.e. the lower and slower you fly; the better your visual acuity. However, in low illumination conditions, the low/slow altitude and airspeed combinations required to adequately see may prohibit the conduct of safe NVD operations. Haze, smoke, low illumination due to overcast conditions or lack of cultural lighting can also diminish the effectiveness of NVDs.

9.7.4 NVD Operations Over Water

Procedures for operating on NVDs over water shall be the same as those for operating over water at night unaided and in accordance with applicable wing directives.

9.7.5 NVD Shipboard Operations

All NVD shipboard operations to include takeoff, goggle/degoggle procedures shall be thoroughly briefed and handled in accordance with applicable directives. When it has been decided to goggle or degoggle, it shall be completed on deck or in straight and level flight.

9.8 MOUNTAIN TERRAIN FLYING

Many helicopter missions require flight and landing in rough and mountainous terrain. A thorough knowledge of mountain flying procedure and aircraft performance parameters is essential for successful operations. Along with the adverse effects of high-density altitudes on helicopter performance, pilots must overcome severe visual illusions and operate in winds with large vertical components. Mountain winds are dramatically affected by terrain and convection cooling and heating; it is not unusual to encounter 2,000 - 5000 fpm up or downdrafts. In non-mountainous flying, the horizon is the primary spatial reference. In mountain flying, there is often no defined horizon and spatial cues are derived from vertical and sloping terrain. These two factors, wind and illusion, combined with high-density altitudes and confined landing sites, make mountain flying a demanding flight regime. Flight in mountainous terrain requires thorough preflight planning with aircraft performance parameters being carefully calculated for all segments of the flight.

Power requirements drop quickly with increased wind, especially up-flowing wind; however, local winds are difficult to predict and it is not advisable to use wind in performance calculations. Predicting winds should be used in route planning and alternate routes selected in the event adverse winds are encountered. Prior to all landings, the landing site must be evaluated and winds determined.

9.9 LANDING SITE EVALUATION BRIEF

The five major considerations that the aircrew should use when evaluating a potential landing area are summed up by the acronym SWEEP.

1. S — Size, slope, suitability, surface (grass, snow, rocks, dust, etc.).
2. W — Winds (Direction, demarcation, turbulence, loss of effect due to obstacles).
3. E — Escape routes (Dropoff, waveoff).
4. E — Elevation of LZ (PA and DA).
5. P — Power (Available vs required. Includes takeoff power after taking on additional weight.)

The transition period is the most difficult part of any approach. As helicopter performance decreases, the transition period becomes more critical, requiring a shallower, gradual approach. Therefore, as the height of obstacles increases, larger areas will be required. As wind velocity increases, so does helicopter performance. However, when the helicopter drops below an obstacle, a loss of lift generally occurs as a result of the aircraft being unable to immediately negotiate the change. This is prevalent at the upwind side of the landing zone, where a virtual null area exists. This null area extends toward the downwind side of a clearing and will become larger as the height of obstacles and wind velocity increases. In the landing phase, it is increasingly important that this null area be avoided if marginal performance capabilities are anticipated. The null area is of particular concern when performing a takeoff from a confined area. Under heavy load or limited power conditions, it is desirable to achieve forward velocity and translational lift before transitioning to a climb so that performance will be improved. If the takeoff is not commenced from the most downwind portion of the area and translational lift is not achieved before arrival in the null area, a significant loss in lift may occur during the most critical portion of the takeoff. It must also be noted that in the vicinity of the null area a nearly vertical downdraft may be encountered, which will further reduce the actual climb rate of the helicopter. It is feasible that under certain combinations of limited area, high obstacles upwind, and limited power available, the best takeoff route would be either crosswind or downwind, terrain permitting. The effects of detrimental wind flow and the requirement to climb may thus be minimized or circumvented. Although this is a departure from the cardinal rule of takeoff into the wind, it may well be the proper solution when all factors are taken into perspective. Never plan an approach to a confined area from which there is no reasonable route of departure. The terrain within the site is determined from an evaluation of vegetation, surface characteristics, and slope. Care must be taken to avoid placing the rotors in low brush or branches. Obstacles covered by grass may be located by flattening the grass with rotorwash before landing. Power should be maintained so that an immediate takeoff may be made should the helicopter begin rolling due to soft earth, a hidden hole, or a depression.

CAUTION

Cabin windows shall not be installed or removed in flight, except during actual aircraft emergencies.

Note

Consideration may be given to removing the port cabin window, drop tanks, and extended pylon for unprepared landings. This will assist in landing zone evaluation and obstacle clearance during approach and landing.

9.9.1 Illusions

Mountainous low level flight represents an unusual visual environment. The horizon may not be visible, and we are surrounded with vertical and sloping visual cues. These visual cues cause illusions that if not recognized lead to:

1. Misjudging the relative height of an LZ due to upsloping or downsloping terrain, resulting in climbing above or descending below approach glideslope.
2. Climbing and losing airspeed when flying into rising terrain.
3. Descending and accelerating when flying away from falling terrain.
4. Misjudging the relative height of ridges with higher terrain in the background.

Pilots must develop the ability to maintain an instrument scan while flying VFR at low level in rugged terrain. This skill is essential to maintaining good basic airwork, and mountain flying techniques and procedures cannot be accomplished without it.

9.9.2 Mountain Winds, Turbulence and Topography

9.9.2.1 Winds

Most pilots' understanding of wind is limited to movement over a flat surface or at altitude, unobstructed by terrain. Under these conditions, wind flows horizontally, in one direction, at a relatively constant velocity. In fact, aircraft performance charts are based on horizontal winds. Prior to each flight, preflight performance calculations are computed using the prevailing winds as the reference. Mountain winds are three–dimensional; wind not only flows across mountainous and rough terrain, it also flows up, down, and around terrain and obstacles. The vertical component can dramatically improve or reduce aircraft performance. A 30–knot wind flowing up a 45º slope can produce an updraft in excess of 1,500 fpm. Conversely, the same wind flowing down–slope can produce a downdraft in excess of 1,500 fpm. Another critical concept in mountain flying is boundary layer air. As an air mass moves across rising terrain, a blanket of vertically moving air forms a boundary layer. Mountain operations should be conducted in this boundary layer in order to optimize the performance capabilities of the helicopter. This is because airflow tends to be laminar in the boundary layer. The boundary layer normally occurs at altitudes less than 100 feet AGL, but may extend up to 200 feet AGL in higher wind velocities. An understanding of the type of winds associated with mountain operations, where the winds will most likely be encountered, and how the winds affect mountain operations, is critical to the safe completion of mountain flying. The most common winds associated with mountain and rough terrain operations are prevailing winds and local winds. Local winds are further broken down into local mountain winds, anabatic, katabatic, and land–sea breezes.

9.9.2.1.1 Prevailing

Prevailing wind is the movement of air from an area of high pressure to an area of low pressure, which is deflected by the rotation of the earth. Prevailing winds have relatively constant direction and velocity and are associated with a geographic region. When the boundary layer is formed by light prevailing winds, strong, steady gradient winds may often bend the boundary layer winds as much as 180º.

9.9.2.1.2 Local Winds

9.9.2.1.3 Local Mountain Winds

Local mountain winds are created by the formation and movement of high or low-pressure systems and frontal winds. In the northern hemisphere these systems generally move from west to east. Low-pressure winds are usually moderate to heavy and move either northeasterly or southeasterly. High-pressure winds are usually light and variable and circulate in a clockwise direction. These systems usually flow in the opposite direction in the southern hemisphere. Flying conditions, although poor in low-pressure regions, are always at their optimum when regions of high pressure are dominant.

9.9.2.1.4 Anabatic

Anabatic winds, also referred to as gradient convection winds, are created as the mountain slopes or valleys are heated by the sun. As the surface is heated, the resultant warm air rises, causing a gradient of up-flowing wind. As the heated air rises, cooler air descends and the process repeats. If the rate at which the surface air is being heated is slow, there will be pauses in the gradient winds. During periods of intense solar heating (mid-afternoon) the surface air is rapidly heated, producing steady and possibly strong gradient winds. Anabatic winds are strongest from late spring to early autumn or when a warm high-pressure system dominates a region for a long period of time.

9.9.2.1.5 Katabatic

Katabatic winds, or cool descending gradient winds, are created when cool air descends down gradients, causing cool, steady, and sometimes gusty gradient winds. Katabatic wind usually occurs during periods when solar heating has slowed, such as in the evening. It is strongest at the base of glaciers or snowfields situated on a gradient.

9.9.2.1.6 Land-Sea Breezes

Land-sea breezes are breezes that blow due to temperature differences between bodies of water and land. They affect mountain ranges that are in proximity to large bodies of water. The cooler, heavier air flows toward the warmer water, creating a land breeze. Conversely, sea breezes occur when the water is cooler than the land surface and the breeze flows from the water to the land. Sea breezes are common during the day whereas land breezes usually occur at night. Land-sea breezes will be strongest when the temperature differential is greatest.

9.9.2.2 Turbulence

Turbulence encountered during mountain operations is much different than turbulence encountered at altitude. Except for sheer-zone turbulence, the topography of mountainous regions and wind results in many different types of orographic turbulence. Determining and understanding where turbulence may exist and where smooth air separates from turbulent air, commonly referred to as the demarcation line is critical to the safe completion of mountain operations. In general, turbulence will always be present under the following conditions: down-flowing air; up-flowing air associated with mechanical, air mass, or sheer-zone turbulence; and where wind of different types/directions mix. Additionally, low-pressure systems are often turbulent and unstable. Flying techniques that will assist in determining where turbulence may exist will be discussed in the section for procedures and techniques. Orographic turbulence can be broken down into the following categories: mechanical, down-flow, air-mass, and sheer-zone turbulence.

9.9.2.2.1 Mechanical

Mechanical turbulence is formed as the wind flows over rugged terrain and obstacles. Ripples of turbulence form on the leeward side of boulders/rocks and mix with the up-flowing air. As wind velocity increases, the severity of turbulence increases.

9.9.2.2.2 Convective

Rising air currents created by uneven surface heating forms convective turbulence. Convective turbulence is normally found at a relatively low height above terrain, generally less than 2,000 feet AGL. Under certain conditions, it may reach as high as 8,000 feet AGL. It is most prevalent over barren terrain and during periods of low wind conditions. Pilots should anticipate turbulence when transitioning from these areas to terrain covered by vegetation or snow. Convective turbulence seldom gets severe enough to cause structural damage.

9.9.2.2.3 Down–Flow

Down–flow turbulence is created by the wind tumbling, once it breaks the top of the hill. As wind flows up a mountain, a region of high pressure forms across it. The leeward side is sheltered by the mountain creating an area of lower pressure. As the wind flows over the mountain, high-pressure air naturally flows toward the area of low pressure resulting in a downflow of swirling turbulence, which can be extremely dangerous to an aircraft flying in this region. Again, as wind velocity and terrain gradient increases, the severity of the turbulence increases.

9.9.2.2.4 Backlash

Backlash is similar to down–flow turbulence. It is caused by wind rushing up a steep face with an abrupt, sharp–cornered top. Backlash can exist at the top of any mountain that has a severe slope with a fairly abrupt top. In high prevailing wind (above 15 knots), severe backlash can be expected. As the wind velocity increases, the backlash will move closer to the windward edge of the ledge and its severity will increase.

9.9.2.2.5 Air–Mass

Air mass turbulence is the result of severe high– or low–pressure systems moving across mountain ranges. As the air–mass moves over the range, the prevailing wind accelerates as it moves up and down the mountains. The constant vertical movement of the mountain winds mixes with the prevailing winds at altitude, resulting in turbulence. The wind continues flowing across the mountain range and carries the turbulence created along its path. Air–mass turbulence is of concern to pilots because it can exist up to hundreds of miles downwind from a mountain range.

9.9.2.2.6 Sheer Zone

Sheer zone turbulence occurs when two or more winds meet, but are traveling in different directions. A common cause of this sheer–zone turbulence is a region of low pressure riding over a region of high pressure. A line of turbulence will exist where the two fronts overlap. The larger the pressure differential between the two regions, the more intense the turbulence. The most concerning form of sheer–zone turbulence occurs when two local air masses meet (i.e., down–flow from a slope converges with perpendicular winds traveling up a valley).

9.9.2.3 Topography

9.9.2.3.1 Ridges

Ridges are crests of mountains that normally run in a straight line parallel to a valley. Usually ridge summits are rounded, smooth, and barren. In some instances, ridges have narrow, jagged, comb–shaped tops caused by constant prevailing winds and harsh weather. Pilots can expect up sloping winds on the windward side of a ridge and down sloping winds on the leeward side. If the wind is strong and the slope is steep and sharp, turbulence can be expected immediately after the break in the crest.

9.9.2.3.2 Crowns

Crowns are the tops of a round conical hill or ridge and usually have gentle slopes. Wind tends to be up sloping on the windward side and hug the side slope to the leeward side where down slope air will be encountered.

9.9.2.3.3 Shoulders

Shoulders are protrusions usually found on sloping ridgelines and the side slopes of mountains. Small shoulders on long side slopes are commonly referred to as nubbins. Shoulders and nubbins often have gentle tapering slopes surrounding them and often present severe illusions. Winds associated with shoulders may emulate winds associated with ridges or crowns depending on topography and wind type/velocity.

9.9.2.3.4 Ledges

Ledges are very similar to shoulders in that they are protrusions found on ridges and mountains. Instead of having a gentle, tapering slope surrounding the area, ledges have a steep side leading to a nearly vertical step. Like shoulders, winds associated with ledges may emulate winds associated with ridges or crowns depending on topography and wind type/velocity.

9.9.2.3.5 Saddles

Saddles are U–shaped passes typically found between adjacent crowns in mountain formations. Saddles are usually developed through years of glacial and normal erosion. The lay of the terrain and direction of erosion create a grain, which may indicate a dominant wind direction associated with the saddle. As wind flows through a saddle it is compressed and accelerated, which may produce a venturi effect. During high wind conditions (in excess of 25 knots), the venturi effect may create a dangerous situation to aircraft flying on the leeward side of the saddle.

9.9.2.3.6 Canyons and Ravines

Canyons and ravines are long narrow valleys formed by erosion between high steep cliffs and often contain a stream or creek running through them. In addition to possible up–flowing or down–flowing local mountain winds, anabatic wind usually flows up canyons, becoming stronger as daytime heating increases. When upper level air cools or a cooler air mass passes into the region, wind will tend to flow down the canyon.

9.9.2.3.7 Alpine Meadows

Found at high altitudes, alpine meadows occur where the tree line begins thinning out. Vegetation consists of small bushes, short grass, and sporadic trees. Meadows may be fully confined, partially confined, or wide open with the terrain; they generally vary from a gentle to medium slope. Winds associated with alpine meadows are dependent upon the effects of the surrounding topography; however, pilots can usually expect a boundary layer to exist.

9.9.2.3.8 Pinnacles

Pinnacles are steep spires that usually terminate in a small plateau type summit. Pinnacles are the result of years of glacial erosion and are generally associated with high altitudes. Prevailing or local winds are usually dominant over pinnacles; however, they may be affected by anabatic wind during periods of daytime heating.

9.9.2.3.9 Cirques

Cirques are recessed, bowl–shaped regions at the head of valleys, created through years of glacial erosion. As a glacier melts, the coarse erosion causes piles of rock and gravel to remain at the base of the cirque near the headwall. Cirques are generally found in high altitudes, with bases starting at 6,500 feet and rims rising in excess of 10,000 feet. It is not uncommon to find rapid variations in wind direction in cirques, especially at the base and near the headwall where landings are expected to be made. Even in moderate winds, severe turbulence can be expected in these regions. If these conditions are present, landings are not recommended.

9.9.3 Aircraft Performance

Of all the factors to be considered when contemplating mountain/rough–terrain flight, preflight planning is the most critical. An analysis of ambient conditions at the expected operating altitudes is indispensable in determining the likelihood of success, operating envelope, and power margins a pilot can expect to encounter. The two methods for determining power available are:

1. Performance Calculations:

   a. Power required vs. Power available.

Consult the appropriate charts (Maximum Power Available, Engine Performance, Ability to Maintain Level Flight, HIGE, HOGE, and Bladestall) before flight, and then perform power checks to confirm that the power calculated is actually available. The Maximum Power Available chart determines if the performance of the engine under specified ambient conditions is acceptable. The Engine Performance illustrates the manufacturer specifications on how the engine should perform and is not based on flight test data. The Ability to Maintain Level Flight chart is used to determine the single–engine torque that can be expected at a given gross weight, temperature, airspeed, and altitude.

   b. Procedures:

      (1) Calculate density altitude at takeoff and at all expected landing elevations. If only takeoff ambient conditions are available, extrapolate high–altitude temperatures using the standard adiabatic lapse rate of –2 °C per 1,000 feet.

(2) Calculate maximum power available and engine performance for takeoff and all expected landing density altitudes.

(3) Calculate indicated torque required to hover in and out of ground effect (HIGE and HOGE) at takeoff and all expected landing density altitudes.

(4) Calculate maximum airspeed as limited by blade stall for expected operating altitudes and angles of bank.

Use no wind scenario when developing all calculations.

Power available shall be equal to or greater than HIGE power required. HOGE power required shall be less than or equal to the dual-engine torque transmission limit for the LZ.

9.9.3.1 In Flight Power Available Check

Perform In Flight Power Available Check as follows:

1. ECS/ANTI-ICE and CONTGCY PWR switches — OFF.
2. Stabilize aircraft at intended operating altitude, level the VSI, ball centered, 100 to 130 KIAS. Airspeed is dependent on environmental conditions and gross weight.
3. Gradually increase collective until N_p begins to droop on either engine or maximum dual-engine torque limits are reached. Stabilize for 5 seconds and record indicated torque.

9.9.3.2 Power Required

1. When making a landing to a surface area smaller than your rotor diameter such as a pinnacle or ridgeline, power greater than HOGE may be required to arrest descent.
2. When landing to an area where the flat surface is not at least two rotor diameters, power greater than HOGE may be required to arrest descent.
3. If the chosen path of an approach does not afford a clear escape route, HOGE plus 5 percent may be required.
4. If sufficient power is not available, either lighten the helicopter or locate a more suitable landing site.

9.9.4 Mountain Flying Procedures and Techniques

The best method to avoid terrain-generated turbulence is to acquire sufficient altitude or alter flight plans when transiting mountainous regions. If a route around or well above the region is impractical due to mission considerations, certain flying techniques must be used in order to traverse the region. Turbulence will be found near the middle and downwind side of a canyon or ravine. When a helicopter is operated at or near its service ceiling and a downdraft of more than 100 fpm is encountered, the helicopter will descend. Although the downdraft does not continue to the ground, a rate of descent may be established of such magnitude that the helicopter will continue descending and crash even though the helicopter is no longer affected by the downdraft. Therefore, the procedure for transiting a mountain pass shall be to fly close aboard that side of the pass or canyon that affords an up sloping wind. This procedure not only provides additional lift, but also provides a readily available means of exit in case of emergency.

CAUTION

- Loss of tail rotor effectiveness is characterized by uncommanded right yaw. It may be encountered when operating at high-density altitudes in high-power regimes. Arresting high rates of descent outside translational lift and attempting approaches out of the wind increase the likelihood of encountering loss of tail rotor effectiveness. Immediate reduction of collective, selection of contingency power, and transition to forward flight or a right turn to drop-off is required to restore directional stability.
- The technique of flying through the middle of a pass or canyon to avoid mountains invites disaster. This is frequently the area of greatest turbulence, and in case of emergency, the pilot has little or no opportunity to turn back because of insufficient turning space.

9.9.4.1 Wind Finding

Determining the direction of the wind is the key to safely executing an approach and landing in mountainous areas. The most reliable method is the use of smoke generators; however, hand-held day/night distress signals and smoke hand grenades are a serious fire hazard in areas covered by combustible vegetation. Observation of foliage may indicate the direction of the wind, but is of limited value in determining wind velocity. The greater the velocity, the more accurately the direction may be defined. Doppler and instantaneous hover displays in the H-60 will give an indication of wind direction, velocity, and ground speed. These winds are unreliable in contour and terrain flying due to vertical and shifting wind components and should not be used as the primary method of determining wind direction and velocity.

9.9.4.2 Contour Crawl

The contour crawl is an invaluable flight technique used to determine wind direction within the boundary layer. This flight technique is accomplished by flying as close to the mountainside as the terrain will safely permit; generally one to two rotor disks is considered optimal. Fly at a constant barometric altitude and indicated airspeed while monitoring power (torque) settings. The characteristics of the boundary layer wind are determined by comparing torque settings and observing aircraft crab angles and apparent relative groundspeed. The purpose of the contour crawl is to safely determine the characteristics of the airflow in the boundary layer for the area in which the aircraft is operating. Flight should be conducted in up-flowing air to the maximum extent possible. The contour crawl provides information about the terrain and boundary layer winds. This information is the building block for landing site reconnaissance. The five types of landing site reconnaissance are the figure eight, crossover, circle, cirque and canyon recce. It is important to note that LZs that initially appear to be workable may not be suitable for landing and an alternate LZ selection will be required.

The contour crawl is flown in the boundary layer at 60 KIAS level and balanced flight. Determine baseline torque by flying outside the boundary layer at 60 KIAS level and balanced flight at the approximate altitude you plan to work. Note the indicated torque. The baseline torque is generally between 45 and 55 percent. Begin the contour crawl by flying inside the boundary layer at 50 to 100 feet below the mountaintop, as close to the terrain as safety will permit. The boundary layer extends anywhere from one to four rotor diameters (50 to 200 feet), dependent on wind velocity and terrain. It is recommended that the PAC maintain one to two rotor diameters from terrain to accurately assess its full effect. Diligently maintain airspeed and altitude; deviations caused by poor airwork will produce erroneous power settings, making it difficult to determine wind direction. The illusions created by mountainous terrain require a frequent scan of airspeed and altitude. Compare indicated torque to baseline in order to determine if the aircraft is in up-flowing air or down-flowing air.

The characteristics of boundary layer air are:

1. UP-FLOWING.
   a. Torque settings lower than baseline.
   b. Smooth buoyant air.

c. The aircraft will have a solid feeling with airspeed easily maintained.

d. At higher wind velocities, the aircraft will crab away from the terrain in balanced flight.

2. DOWN–FLOWING AIR.

a. Torque settings higher than baseline.

b. Turbulent air.

c. At higher wind velocities, the aircraft will crab into the terrain in balanced flight.

9.9.4.3 Mountain Recce

The purpose of the mountain recce procedure is to identify and pinpoint the landing site elevation, touch down position, and to determine wind direction through torque setting, trim, and a comparison of apparent ground speed. The type of mountain recce procedure conducted is based on terrain and may require a combination of different recce passes to determine the safest approach path for the landing site and wind conditions. The standard mountain landing evolution should consist of a recce procedure, an overshoot approach, and an overshoot approach to landing.

9.9.4.4 Figure Eight Recce

The figure–eight recce is the basic LZ evaluation method. The figure–eight recce can be used to evaluate landings to ridges, crowns, shallow set saddles, shoulders, ledges, pinnacles, and alpine meadows. The contour crawl provides a general look at areas that are suitable for landing, determines up–flowing and down–flowing air, and the approximate elevation of selected zones.

The figure–eight recce consists of a minimum of two 60 KIAS passes in opposite directions with the LZ at eye level. On the basis of the information gathered in the contour crawl, set up for eye–level passes on the side of the terrain with up–flowing air and a suitable drop–off. Drop–off is the area below and away from the terrain suitable for the aircraft to descend and accelerate, returning to a safe flight regime if a power deficit is encountered for any reason. Eye–level passes must be made at constant indicated airspeed and altitude in balanced flight. Using wing–down/top rudder will disguise crosswind drift, making it difficult to assess the wind line. Gather information on groundspeed by looking straight ahead. Throughout the recce make all turns away from the terrain to allow for drop–off.

1. Eye–level pass #1.

a. Fly past the intended landing area at eye level and note the exact barometric altitude.

b. Determine the most level part of the landing area.

c. Pinpoint the LZ and identify references (i.e., trees, rock formations) to mark zone.

d. Evaluate the approach and departure path to the zone.

e. Note torque setting.

f. Note apparent groundspeed.

g. Note crab angle and drift while maintaining balanced flight.

2. Eye–level pass #2.

a. Fly a second pass parallel to the first, in the opposite direction.

b. Note torque setting and compare it to the previous pass.

c. Double check zone elevation (BAR ALT).

d. Note crab angle and drift. Compare with previous pass.

e. Note apparent ground speed relative to last pass. (This will assist in determining the horizontal wind component.)

f. Estimate the wind direction based on crab angles and apparent relative ground speed.

g. Determine precisely where you intend to place the main mounts in the zone, verbalize for crew concurrence.

3. Indications of a downwind recce or approach.
   a. Rapid decay in airspeed when deceleration attitude is set.
   b. High torque is required over the LZ.
   c. Poor airspeed recovery following an overshoot.
   d. Difficulty in maintaining basic airwork.
   e. Tail–low attitude and fishtailing.
   f. High apparent ground speed.
   g. Minimum crab angle required to maintain track.
4. Indications of an upwind recce or approach.
   a. Smooth decay of airspeed when deceleration attitude is set.
   b. Low torque is required over the LZ.
   c. Rapid airspeed recovery following an overshoot.
   d. Low apparent groundspeed.

9.9.4.5 Crossover Recce

Deep set saddles may not be suited for the figure–eight recce. The crossover recce should be used instead. Helicopters with multiple aircrewman may use the crossover recce in place of the figure–eight recce.

1. Crossover recce.
   a. Contour crawl in the area of the saddle. Determine the up-flowing and down-flowing sides of the saddle and the elevation of the LZ.
   b. Based on relative apparent ground speed, torque settings and crab angles during the contour crawl, determine the most probable direction of the wind.
   c. Fly through the saddle at 150 feet above the LZ from the upflowing side to the downflowing side. Make the crossover at an angle less than 45° while maintaining drop-off.
   d. Make multiple crossover passes until the wind direction has been confirmed by comparing ground speed, torque, and crab.

9.9.4.6 Circle Recce

The circle recce is suited for no or low wind conditions around prominent crowns, pinnacles or large confined areas away from higher terrain. Size, slope and suitability are easy to judge but will be seen only out one side of the aircraft unless the circle recce is flown in both clockwise and counterclockwise.

1. Circle recce.
   a. Maintain a 60 KIAS constant distance circle from the LZ at eye level.
   b. Wind direction is determined by noting the angle of bank required to maintain constant distance throughout the circle. The side of the circle with the highest angle of bank required is the downwind side.

Note

It is not recommended that you use the circle recce in high winds, as it may expose you to unnecessary excessive downflow.

9.9.4.7 Cirque Recce

The cirque recce is suited for cirques and confined bowl–shaped terrain where standard figure eight recce passes would not be effective.

1. Cirque recce.
   a. Fly the first pass above the ridge of the cirque checking for obstructions and down–flow conditions within the cirque.
   b. Subsequent passes will utilize modified figure eight recce passes along the sides of the cirque walls to determine up–flow and down–flow areas.
   c. Fly each additional pass by descending 150–300 feet per pass.
   d. Maintain drop–off to max extent possible. If the torque margin is minimal and up–flowing air or upwind approach conditions are not available, consideration should be given to a more suitable landing site.

9.9.4.8 Canyon Recce

When landing in canyons or narrow valleys, the canyon recce should be used. Visual horizons are severely disrupted in canyons and illusions can present a serious problem. Basic airwork and instrument scan should be emphasized. Avoid flying in the center of the crevasse so that drop–off can be maintained.

1. Canyon recce.
   a. Fly the first pass above the ridge of the canyon checking for wires, trees or other obstructions within the canyon.
   b. The second and subsequent passes will utilize modified figure eight recce passes along both sides of the canyon walls in order to determine the region of up–flow.
   c. Once the up–flow region has been determined the pilot shall fly each additional pass by descending no more than half the distance to the canyon floor until within 200 ft AGL of the canyon floor.
   d. Once the elevation of the landing site can be estimated and the wind direction determined an overshoot pass shall be conducted to determine landing site suitability and precise elevation.
   e. Maintain drop–off to the maximum extent possible. If the torque margin is minimal and up–flowing air or upwind approach conditions are not available, consideration should be given to finding a more suitable landing site.

9.9.5 Standard Mountain Approach and Landing

A flat approach with a loaded disk and minimum rate of descent is required in mountainous terrain. Power requirements are reduced by eliminating the need to arrest a high rate of descent. The mountain approach should be made to a spot in up–flowing air whenever possible. Up–flowing air in the LZ is generally found at the forward edge of the zone nearest the windward side of the terrain. Contingency power shall be on for all overshoot approaches.

1. Overshoot approach.
   a. Commence approach into the wind at 50 feet above LZ elevation as determined during recce passes with CONTGY PWR on.
   b. Fly a smooth accurate shallow approach simulating an approach to landing to 10–20 feet above LZ. Do not slow below translational lift (approximately 20 knots).
   c. Note crab angle and drift while maintaining balanced flight.
   d. Monitor torque throughout the approach.
   e. Note relative groundspeed.
   f. Ensure your flightpath takes advantage of any drop–off at the terminal stage of the approach to waveoff if necessary.
   g. Multiple overshoot passes should be flown prior to final landing.

2. Landing.

   a. Fly the overshoot approach to a 2 – 3 foot hover.

   b. From the hover the aircraft should be lowered to touchdown.

   c. Once the main mounts are on the deck, slowly reduce collective while ensuring the ability of the terrain to support the aircraft.

CAUTION

Snow landings at unfamiliar sites should be avoided unless underlying ground conditions can be determined. If a landing is attempted maintain sufficient power to remain light on the landing gear. A normal reduction of power may result in a sudden drop through the crust of the snow resulting in damage due to hidden obstacles or sloping terrain.

9.9.6 Mountain Takeoff and Departure

Mountain takeoffs should be executed with no lateral drift and minimum time spent in a hover. Takeoffs with the wind outside the forward 45° region may be attempted when it is determined that up-flowing air and drop-off will permit a crosswind or downwind take off. Establish a stable low hover ensuring the wheels are free of rocks, bushes, etc. Once power is checked, smoothly ease the cyclic forward in the desired takeoff direction. Fly the aircraft in the desired direction until translational lift is achieved. Steadily increase airspeed until maximum climb airspeed is reached. When attempting a takeoff from a confined area under a heavy load or limited power conditions, it is desirable to attain forward velocity and translational lift before transitioning to a climb so that the overall climb performance of the helicopter will be improved. Never plan an approach to a confined area from which there is no reasonable route of departure.

9.9.7 Guidelines

The following guidelines are considered to be most important for mountain terrain flying:

1. Make a continuous check of wind direction and estimated velocity.

2. Plan your approach so that an abort can be made downhill and/or into the wind without climbing.

3. If the wind is relatively calm, try to select a hill or knoll for landing in order to take full advantage of any possible wind effect.

4. The standard mountain landing evolution should consist of a recce procedure, an overshoot approach, and an overshoot approach to landing.

5. Give all cloud formations a wide berth.

6. When evaluating a landing site in non–combat operations, execute as many passes as necessary (at least one high and one low) before conducting operations into an unfamiliar landing area.

7. Fly as smoothly as possible and avoid steep turns.

8. Cross mountain peaks and ridges high enough to stay out of downdrafts on the leeward side of the crest at approximately a 45° angle.

9. Evaluate the obstacles in the landing site and consider possible null areas and routes of departure.

10. Avoid downdrafts prevalent on leeward slopes.

11. Plan your flight to take advantage of the updrafts on the windward slopes.

12. Landing site selection should not be based solely on convenience, but consideration should be given to all relevant factors.

13. Whenever possible, approaches to ridges should be along the ridge rather than perpendicular.

14. Determine ability to hover out of ground effect prior to attempting a landing.

15. Avoid high rates of descent when approaching landing sites.

16. Watch for rpm surges during turbulent conditions. Strong updrafts will cause rpm to increase, whereas downdrafts will cause rpm to decrease. When heavy turbulence is encountered, a 5 to 15 knot reduction in airspeed is recommended.

17. Know your route and conduct a thorough brief before flying in these areas. (See Figures 9-18 to 9-21.)

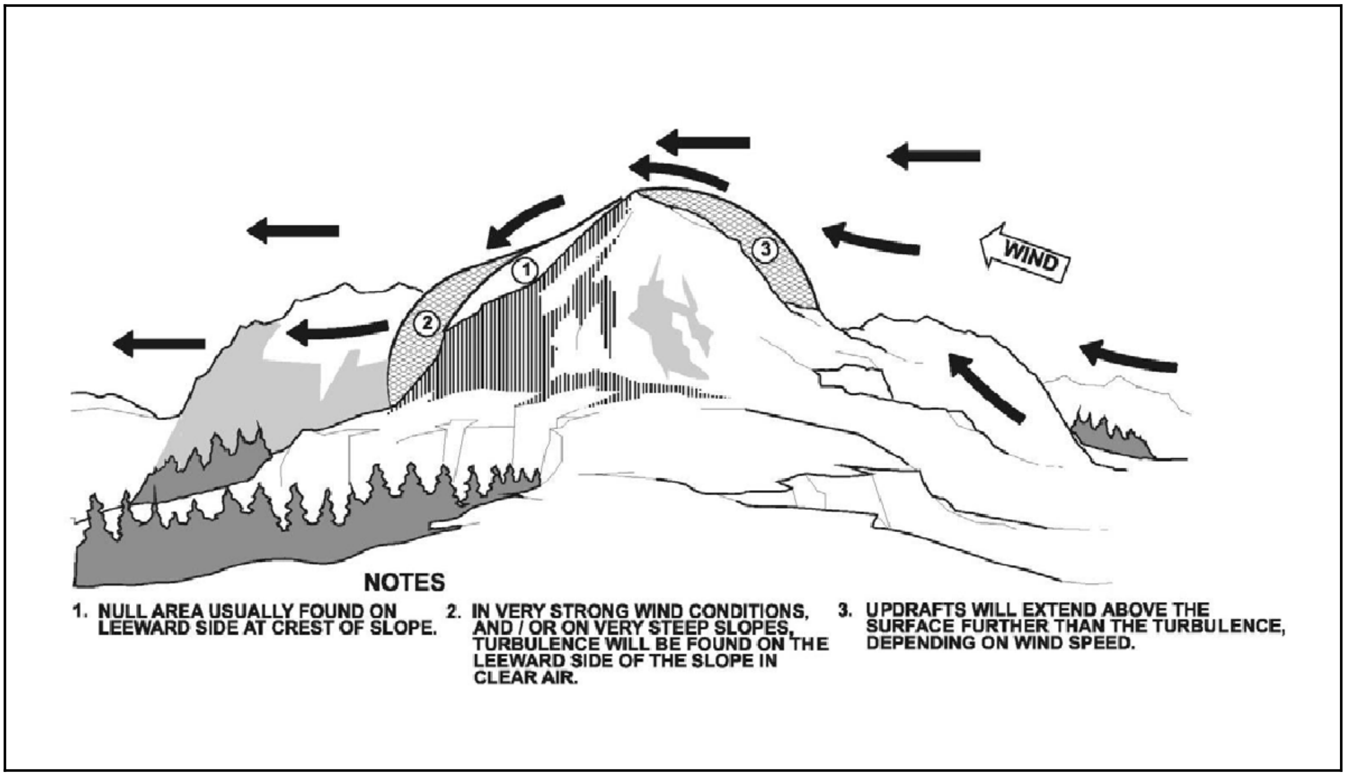


Figure 9-18. Windflow Over and Around Peaks

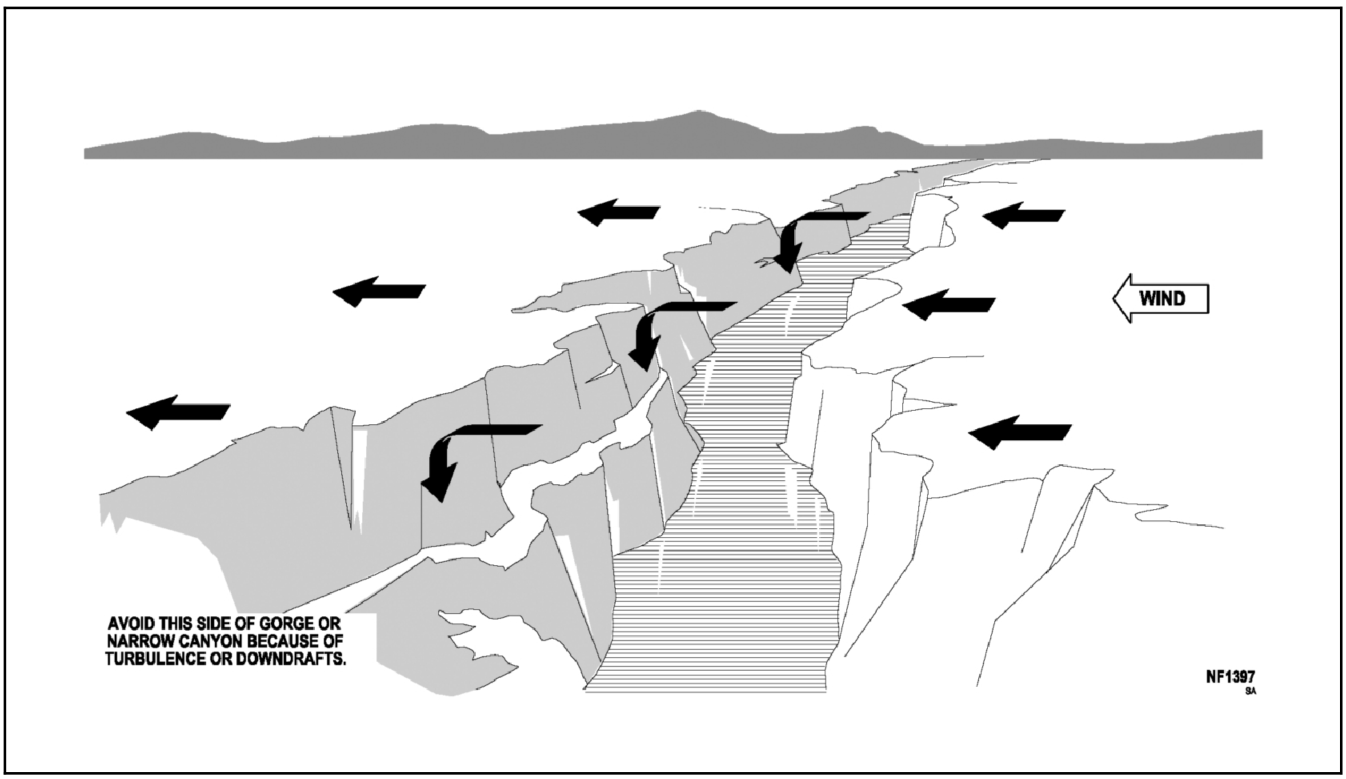


Figure 9-19. Windflow Over Gorge or Canyon

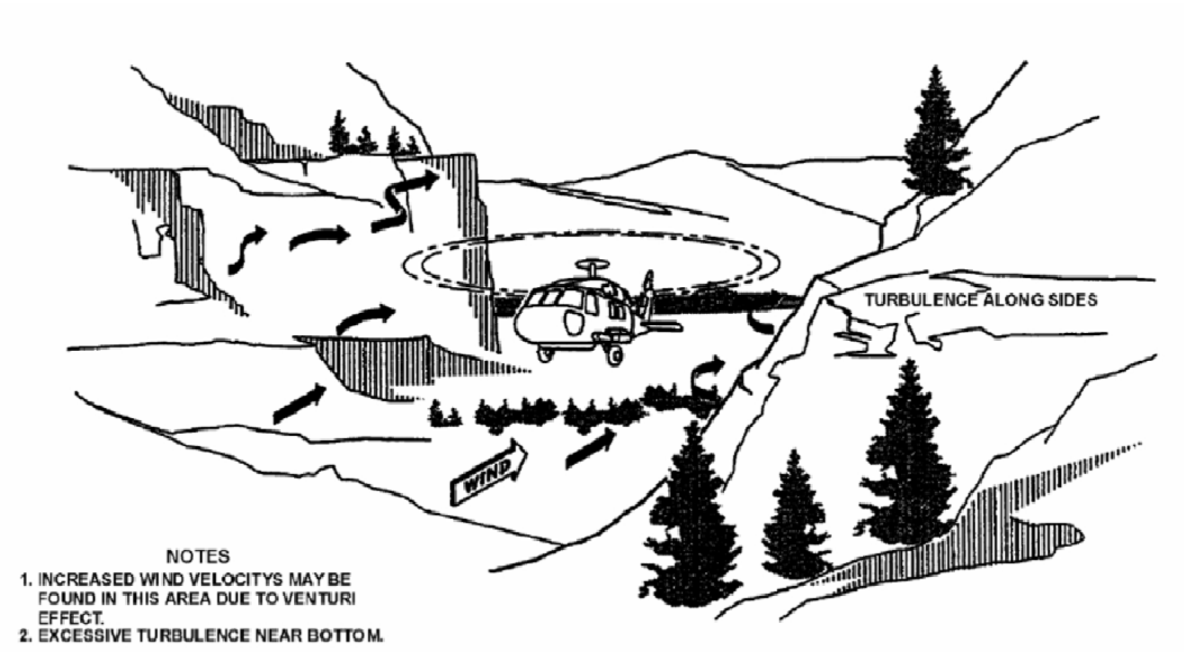


Figure 9-20. Windflow in Valley or Canyon

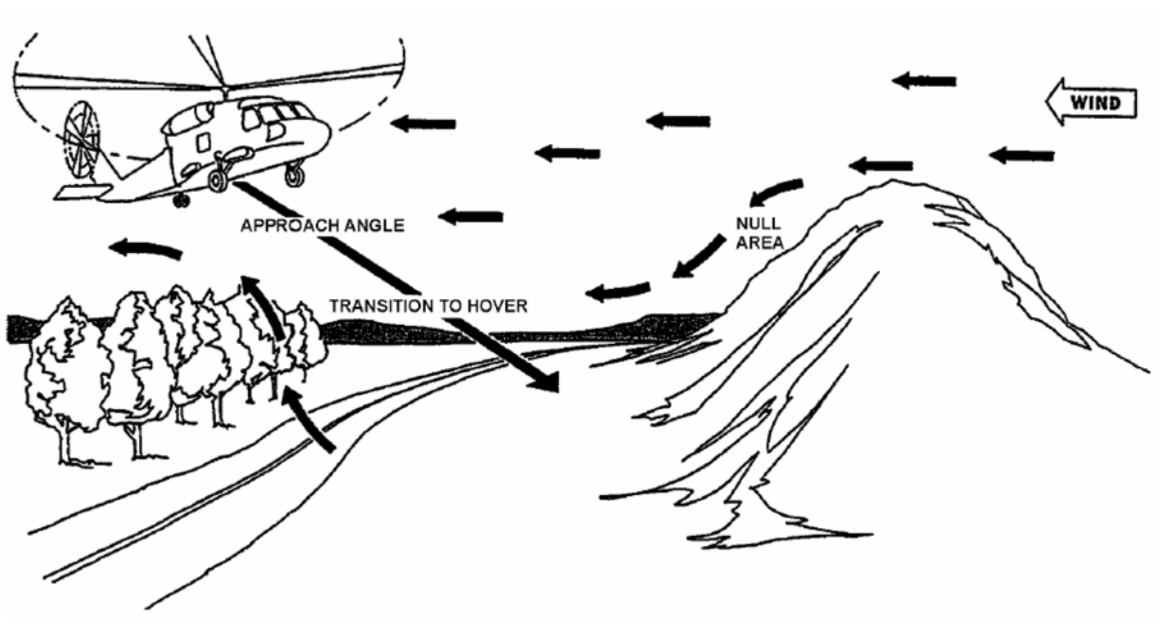


Figure 9-21. Wind Effect in a Confined Area

9.10 CREW SERVED WEAPON PROCEDURES

9.10.1 M60D/M240D Machine Gun

9.10.1.1 M60D/M240D Aircraft Preparation/Inspection

Each machine gun is air cooled, gas operated, and automatic. They each fire the standard 7.62 mm NATO cartridge from the open bolt position at firing rates of up to 550 rounds per minute (rpm) for the M60D and 650 to 950 rpm for the M240D. Barrel headspace and timing of both weapons are fixed, allowing for quick barrel changes for cooling and maintenance. The M60D incorporates a rear ring and barrel-mounted post sighting system, whereas the M240D incorporates a rear sight leaf and a barrel-mounted post sighting system. The M60D/M240D machine gun subsystems (Figure 9-22) are mounted on a pintle mounting system and are held on by a quick-release pin. The weapon mounts are on rotating arm assemblies which allow the weapons to be locked outboard in the firing position, or stowed inside the aircraft when the rotating arms are locked in the inboard position. The weapons can be removed easily from the helicopter and, if needed, may be used for ground defense. For more detail on each weapon, refer to NAVAIR 11-95M60-1 for the M60D and to NAVAIR 11-95M240D1-1 for the M240D.

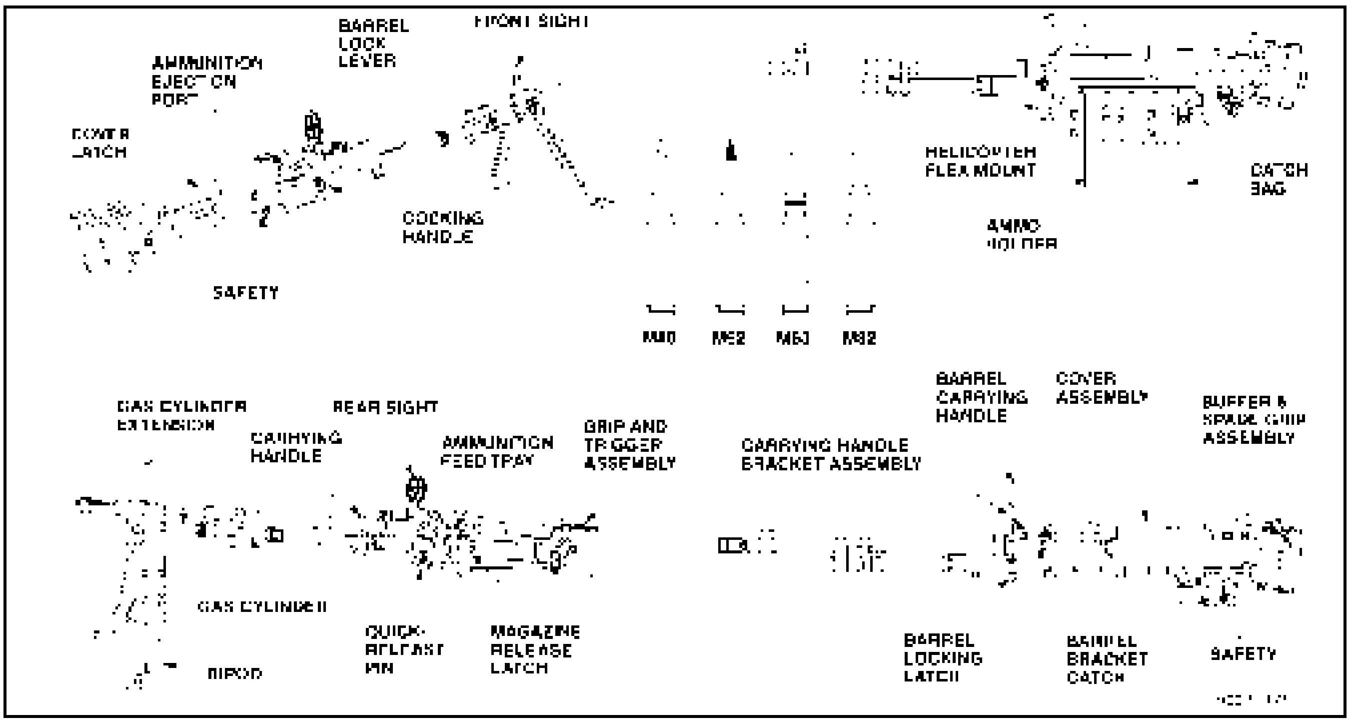


Figure 9-22. M60D/M240D Machine Gun Components

1. Gun secured to mount.

Note

In order to properly install pintle mount, attach weapon to pintle with quick-release pin. Secure with an appropriate plastic tie or 0.032 inch safety wire through the quick-release ring and around the pintle.

2. Ejector control bag installed.
3. Raise cover assembly/feed tray and verify clear of ammunition and links.
4. Place gun in the FIRE (F) position.
5. Pull charging handle rearward and return handle to forward locked position. Place gun in SAFE (S) position.
6. Visually inspect barrel chamber, ammunition feed tray, and inside of receiver. Verify ammunition is not present in the gun barrel or in position to be fed into the gun barrel.

7. Close feed tray and cover assembly.
8. Ensure gun barrel is securely attached and locked to gun receiver.
9. Check weapon for freedom of movement through azimuth, elevation, and depression positions.
10. Pull charging handle rearward, place safety in the (F) position, and ease bolt and operating rod assembly forward into the battery position.
11. Stow weapon inside cabin.
12. Report weapon status.

CAUTION

- Expended brass and links present a potential FOD hazard. Inspect lower main landing gear strut cowling and cabin door tracks for expended brass after a live fire evolution.
- No restraint is provided for 7.62 mm ammunition with the M240D feed can. When operating the M240D at maximum depression, loss of 7.62 mm ammunition from the feed will occur.

9.10.2 M60D/M240D Rigging Procedures

WARNING

Ensure barrel is positively locked into the receiver assembly before attempting to fire.

1. Cabin door — Open.
2. Pilot commands — “CLEAR TO RIG.”
3. Crewman pulls detent handle to release, swings mount to extended position, and pushes detent handle to lock weapon.

WARNING

Failure to ensure detent handle is locked will result in loss of weapon controllability.

4. Crewman removes vertical stop pin, places gun in the horizontal position, and replaces vertical stop pin.
5. Crewman reports — “WEAPON RIGGED.”

9.10.3 M60D/M240D Field of Fire Check

1. Safety switch — SAFE.
2. Pintle — OUT and LOCKED.

Note

The field of fire check should be performed with rotors engaged.

3. Position weapon in all extremes of travel — check for rotor or airframe interference.

9.10.4 M60D/M240D Lock and Load Procedures

WARNING

- The weapon shall not be loaded unless cleared by the helicopter aircraft commander (HAC) and then only in a cleared range or operational area or during a potentially hostile situation.
- Observe all safety precautions for loading ammunition in accordance with applicable directives. All loading and clearing shall be done with the weapon in the rigged position.

1. Pilot commands — “LOCK AND LOAD.”
2. Open feed cover latch and raise feed cover assembly.
3. Open the ejector control bag and pull cocking handle fully to rear.
4. Push cocking handle full forward to locked position.

WARNING

Cocking handle must be returned to full forward (locked) position before firing. Always cock the gun underhanded to preclude cutting thumb on the feed cover.

5. Press safety button to (S) position.
6. Insert link belt with open side of links down on tray assembly.
7. Close feed cover and latch in place.
8. Crewman reports — “WEAPON READY, SAFE.”

9.10.5 M60D/M240D Machine Gun Firing Procedures

WARNING

- Although stops are provided, extreme care must be taken to prevent firing the weapon into the rotor blades or airframe.
- Any crewmember may call a cease-fire in an unsafe condition.

CAUTION

Do not fire machine gun unless the ejector control bag is mounted in place with bottom zipper closed.

1. With machine gun positioned, loaded, and aimed, press safety button to firing (F) position.
2. To fire gun automatically, pull trigger fully and hold.

CAUTION

Dumping brass should be conducted while in a hover to prevent possible damage to aircraft or equipment.

Note

- The M60D/M240D low cyclic rate of fire allows firing of a single round or short bursts. The trigger must be quickly released for each shot.
- When ammunition is exhausted, the last link will remain in the tray assembly. The link assembly can be removed by hand after the feed cover assembly is opened.

9.10.6 M60D/M240D Barrel Change Procedures

1. Ensure weapon is clear of ammunition.
2. Crewman removes vertical stop pin, places gun barrel down, and replaces vertical stop pin.
3. Crewman pulls detent handle to release, swings mount inside cabin, and pushes detent handle to lock weapon.
4. Wearing asbestos gloves, grasp barrel.

WARNING

Weapon barrel will become very hot. Exercise extreme care while handling barrel.

5. Pivot barrel release lever up and remove hot barrel.
6. Insert spare barrel and lock in place by pivoting barrel release lever down.

WARNING

Ensure barrel is positively locked into the receiver assembly before attempting to fire.

9.10.7 M60D/M240D Stowing Procedures

1. Pilot commands — “STOW WEAPON.”
2. Crewman ensures weapon is clear of ammunition.
3. Crewman removes vertical stop pin, swings gun barrel down, and replaces vertical stop pin.
4. Crewman pulls detent handle to release, swings mount inside cabin, and pushes detent handle to lock weapon.
5. Crewman reports — “WEAPON CLEAR/STOWED.”

9.10.8 Voice Commands

Exact procedures may vary according to the tactical situation; however, the voice commands shown in Figure 9-23 should be used.

9.10.9 Hand Signals

In the event of ICS problems, the following hand signals may be used by the pilot to command the crewman to open fire or cease fire:

1. OPEN FIRE — The pilot extends his hand in the shape of a pistol, index finger extended, thumb pointed up.
2. CEASE FIRE — The pilot extends his hand in the shape of a pistol, index finger extended, thumb pointed down.

9.11 GAU-16/A MACHINE GUN

The GAU-16/A Airborne Machine gun is a crew-served weapon mounted in the starboard door of the helicopter. The GAU-16/A has a firing rate of 750 to 850 rounds per minute, 100-round ammunition can supply mount for a right-hand feed to the weapon, and a flash suppressor which reduces bloom out of the NVD. The GAU-16/A mount assembly is equipped with a shock absorber that significantly reduces recoil loads transferred to the aircraft. The adapter assembly allows the GAU-16/A to be placed in the inboard stow position, outboard stow position, or the firing position. The inboard stow position allows the cabin door to be closed, whereas the outboard stow position allows ease of entry and egress.

9.11.1 GAU-16/A Headspace Adjustment

9.11.1.1 Definition

Headspace for the machine gun is the distance between the front of the bolt and the rear end of the barrel. Headspace is correct when the distance is between 0.202 and 0.206 inch. Unless this distance is properly adjusted, the cartridge, when chambered, will not be properly seated against the shoulder of the chamber. No procedures for adjustment without headspace and timing gauge are authorized.

FROM	TO	WHEN	REPORT/VISUAL SIGNAL — RESPONSE
Pilot	Crewman	60 KIAS or below	CLEAR TO RIG — WEAPON RIGGED
Pilot	Crewman	Firing is imminent	LOCK AND LOAD — WEAPON READY, SAFE
Pilot	Crewman	Helicopter is steady on target bearing	ROLLING ON TARGET — ROGER
Pilot	Crewman	Permission to unsafe weapon and open fire when target within range	OPEN FIRE — ROGER, OPEN FIRE
Crewman	Pilot	Target is within range	ON TARGET — ROGER
Crewman	Pilot	Target is out of range	OFF TARGET — ROGER
Crewman	Pilot	Current ammunition can is empty	WEAPONS DRY — ROGER, RELOAD
Crewman	Pilot	All ammunition is expended	WINCHESTER — ROGER, WINCHESTER
Pilot	Crewman	Permission to fire rescinded	CEASE FIRE — ROGER, WEAPON READY, SAFE
Pilot	Crewman	Firing is no longer probable	CLEAR THE WEAPON — WEAPON CLEAR
Pilot	Crewman	60 KIAS or below	STOW THE WEAPON — WEAPON CLEAR, WEAPON STOWED

Note

The machine gun can be rigged at any airspeed. The 60 KIAS limitation pertains to the cabin door only.

Figure 9-23. Machine Gun Operations ICS Terminology

9.11.2 GAU-16/A Headspace Adjustment Checklist

WARNING

Improper headspace and timing will cause cartridge round to split and jam the weapon. Injury or death of crewman may result.

CAUTION

Headspace and timing shall be performed prior to each firing and upon completion of cleaning weapon to ensure weapon does not malfunction.

Note

No procedures for adjustment without headspace and timing gauge are authorized.

1. Weapon clear and safe.
2. Retract recoiling parts until barrel extension is separated from trunnion block.
3. Insert the GO end of the headspace gauge into the T-slot between face and bolt and breech end of the barrel. Adjust as necessary.

Note

This weapon is set up for a right-hand feed; remove the left-hand rear cartridge stop assembly for ease in screwing the barrel into the barrel extension.

4. Attempt to adjust the NO-GO end of the headspace gauge in T-slot. Adjust as necessary.
5. If NO-GO required an adjustment, repeat steps 3. and 4. until headspace adjustments are within tolerance.

CAUTION

Never release the firing pin with the headspace and timing gauge in place. Damage to the firing pin can occur.

6. Remove gauge, place the safe switch to (F) and release the firing pin.
7. Place safety back to (S).

9.11.3 GAU-16/A Timing Adjustment

Timing is the point at which the firing pin is released after the recoiling parts reach the battery position during counter recoil. This point is determined by measuring the distance between the front face of the barrel extension and the rear face of the trunnion block. The gun must fire when this distance is between 0.202 and 0.116 inch. Timing must be checked and adjusted each time headspace is checked and adjusted, and whenever incorrect timing is suspected. If the timing is early, recoil will start before the extractor is far enough forward to engage the next cartridge in the belt. In this condition, the gun will stop firing after two rounds. If the timing is late, the barrel extension will strike the trunnion block as the recoiling parts reach the battery position during counter recoil. The gun will continue to fire, but the barrel extension will be damaged as it strikes the trunnion block.

9.11.3.1 GAU-16/A Timing Adjustment Checklist

WARNING

Improper headspace and timing will cause cartridge round to split and jam the weapon. Injury or death of crewman may result.

CAUTION

Headspace and timing shall be performed prior to each firing and upon completion of cleaning weapon to ensure weapon does not malfunction.

1. Weapon clear and safe.
2. Retract recoiling parts 1/4 inch and insert NO-FIRE gauge between barrel and trunnion block.
3. Allow barrel extension to close slowly until stopped by timing gauge.
4. Pull trigger. Firing pin should not release.

If firing pin does release:

5. Make timing adjustments until firing pin does not release.

If firing pin does not release:

6. Remove gauge and allow recoiling parts to go forward to battery position.
7. Retract recoiling parts until barrel extension is about 1/4 inch from trunnion block.
8. Insert FIRE timing gauge between barrel extension and trunnion block.
9. Allow barrel extension to close slowly until stopped by contracting gauge.
10. Release trigger housing safety. Attempt to release firing pin by operating firing mechanism once. The firing pin should release with the gauge in place.

If firing pin does not release:

11. Make timing adjustments until firing pin does release.

If firing pin does release:

WARNING

Bolt shall be in the battery position before back plate is removed. Do not attempt to release firing pin or charge weapon with the back plate off.

12. Retract recoiling parts, remove the gauge, and cock the weapon.

9.11.3.2 GAU-16/A Rigging Procedures

1. Cabin door — Open.
2. Pilot commands — “CLEAR TO RIG.”
3. GAU-16/A — Rig in firing position.

4. Crewman reports — “WEAPON RIGGED.”

WARNING

The outboard stowed position is not an authorized in-flight position. It is only authorized for ingress/egress while on the ground or in a hover during hoisting evolutions.

9.11.3.3 GAU-16/A Lock and Load Procedures

1. Pilot commands — “LOCK AND LOAD.”
2. Safety — SAFE.
3. Ammunition can support lid — Open Tilt standard 100 round ammunition can forward, slide ammunition can forward under lid, and lock support lid.
4. Feed cover assembly — Open.
5. Ammunition — Insert.
6. Feed cover assembly — Close.
7. Weapon — Charge twice to load.
8. Crewman reports — “WEAPON READY, SAFE.”

WARNING

All loading and clearing shall be done with the weapon in the firing position.

9.11.3.4 GAU-16/A Firing Procedures

WARNING

The only authorized position for firing the GAU-16/A is with the crossbeam secured to both the forward and aft brackets.

1. Pilot commands — “OPEN FIRE.”
   a. As required — “CLEARED TO LASE.”
2. Crewman responds — “ROGER, OPEN FIRE.”
   a. As required — “ROGER, CLEARED TO LASE.”
3. Safety — FIRE.
4. AN/PEQ-3 laser reducer covers (if required) — Rotate off.
5. AN/PEQ-3 laser mode selector (if required) — ON.
6. AN/PEQ-3 laser deadman switch — Press and hold.
7. Trigger — Pull.

9.11.3.5 GAU-16/A Clear Weapon Procedures

WARNING

- Do not disassemble the GAU-16/A while attempting to clear weapon.
- Barrel must be pointed in a safe, uninhabited direction at all times.

1. Safety — SAFE.
2. PEQ-3 mode selector switch — OFF (if installed).
3. PEQ-3 lens covers — Rotate on (if installed).
4. Feed cover — Open.
5. Ammunition — Remove from feed tray.
6. Feed cover — Close.
7. Charging handle — Charge.
8. Feed cover — Open.

WARNING

Chamber may be hot. Use caution while inspecting T-slot.

9. Weapon — inspect T-slot/chamber, ensure weapon is clear.

WARNING

If chamber is not clear, repeat steps 4. through 7. once and remove any remaining rounds. If unable to clear weapon, execute hung ordnance procedures in accordance with local directives.

10. Weapon status — Report.

CHAPTER 10

Functional Checkflight Procedures

10.1 FUNCTIONAL CHECKFLIGHT

The purpose of an FCF is to determine if the airframe, engines, accessories, and other items of equipment are functioning in accordance with predetermined requirements while subjected to the intended operating environment. These flights should normally be conducted within autorotative distance of a landing field when feasible and during daylight hours under VMC. However, if necessary to accomplish the assigned mission, the unit commander may authorize functional checkflights under conditions other than the above, if, in the commander's opinion, the flight can be conducted with an acceptable margin of safety under the existing conditions. This authority may not be delegated. Those portions of the flight that are considered critical shall be conducted in the vicinity of a suitable landing area. At the discretion of commanding officers, or detachment officers–in–charge when deployed, functional checkflights may be performed in combination with operational flights provided the operational portion is not conducted until the flight inspection requirements have been satisfied by a designated Functional Check Pilot (FCP). The appropriate checkflight checklist shall be used. This section contains detailed checkflight procedures, sequenced in the order in which they should be done. See COMNAVAIRFORINST 4790.2 (series) for additional information.

Note

These procedures are intended for use by designated FCPs only and shall not be performed or used as troubleshooting procedures by squadron pilots. The FCP shall approach preflight inspections with diligence. Since work is being checked that directly affects safety of flight, close scrutiny must be exercised during inspections.

10.1.1 Designation of Pilots

The aircraft maintenance officer shall recommend to the commanding officer, via the operations officer, designated HACs that have completed the squadron FCP syllabus and meet all applicable OPNAV 3710.7 (series) and COMNAVAIRFORINST 4790 (series) requirements. The operations officer shall forward recommendations, with appropriate comments, to the commanding officer.

10.1.2 Ground Checks

Ground checks are defined as checks accomplished on the ground to ensure that equipment has been adjusted, reassembled, repaired, and inspected satisfactorily. These checks shall be accomplished after the helicopter system or components have been inspected following maintenance or repair operations.

10.1.3 General Information

This chapter contains detailed checkflight procedures, sequenced in the order in which they should be performed. The functional checkflight shall be conducted using the checkflight record in conjunction with normal NATOPS procedures. For the purpose of functional checkflights only, this chapter satisfies all the requirements of the Pilot's Pocket Checklist from "Interior Inspection" through "Postflight Checks." Crew requirements are specified in Chapter 5.

10.1.4 Special Instructions

1. Passengers are prohibited on FCFs.
2. Forms and records will be checked before the FCF to determine maintenance performed and the flight profile required.
3. Record information where indicated by a line ____________. Where a box ☐ is shown, use a √ for satisfactory or an X for unsatisfactory.
4. Check and go. Combination of an FCF with an operational flight is specifically prohibited when a post–depot checkflight attesting to the airworthiness of the aircraft has not been previously performed.

10.1.5 FCF Record Cards

A record card shall be used for all FCFs. When an FCF is required to determine if specific equipment or systems are operating properly, completion of only that portion of the FCF applicable to the specific equipment or systems being evaluated is required. The FCF record card may be locally reproduced. Continuation sheets may be used when necessary. Items that prove to be unsatisfactory during flight and require corrective action shall be listed in the remarks block during flight and transferred to a Visual Discrepancy System/Maintenance Action Form VIDS/MAF immediately after termination of the flight.

10.1.6 FCF Profile

The FCF altitude profile (Figure 10-1) is recommended for all checkflights.

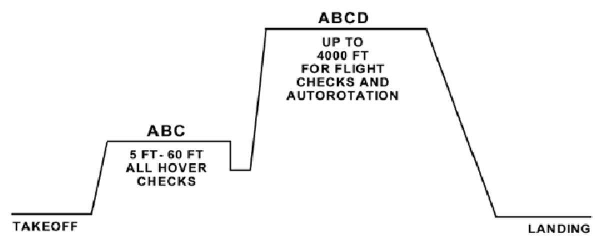


Figure 10-1. FCF Altitude Profile

A daily and turnaround inspection is required before the checkflight. Perform all normal checklist items for all checkflights. Perform applicable flight profile checks in accordance with COMNAVAIRFORINST 4790.2 (series) under the following guidelines:

1. Functional checkflights are conducted when it is not possible to determine proper operation by ground checks (e.g., aerodynamic reaction, air loading, or signal propagation).
2. Functional checkflights are not required upon the completion of phase inspections, unless the corrective action(s) resulting from a discrepancy discovered during the inspection requires a checkflight or the item inspected requires removal, disassembly, adjustment, alignment, reinstallation or reassembly of any items in the following paragraphs. The maintenance requirement cards (MRC) will indicate the phase packages requiring a partial system functional checkflight.

3. Although the following conditions requiring FCFs are minimal and mandatory, this does not preclude operational commanders from imposing additional requirements of the scope and frequency deemed necessary. Perform applicable flight profile associated checks in accordance with COMNAVAIRFORINST 4790.2 (series), NAVAIR A1-H60CA-VIB-100, H-60 (series) IETMS, and applicable Wing directives under the following checkflight conditions:

   a. A PROFILE — Full system checks.

   b. B PROFILE — Engine checks.

   c. C PROFILE — Controllability/drive train check.

   d. D PROFILE — AFCS check.

10.1.7 Limited FCF

A limited FCF is required when it is necessary to prove proper functioning of a specific item or component. Duration of the FCF need only be enough to verify performance of the item(s) being tested.

PROFILE

10.2 FUNCTIONAL CHECKFLIGHT CHECKLIST

10.2.1 Preflight Check

A B C D 1. Exterior.

A B C D 2. Interior.

A 3. Seats, belts, shoulder harnesses, and shoulder harness locks.

a. Tail rotor pedal adjustment — 6 INCHES OF TRAVEL.

b. Seat height adjustment.

c. Seat forward/aft adjustment.

d. Inertia reel check.

A 4. Compass correction cards — CURRENT AND LEGIBLE.

10.2.2 Start Checks

Note

Daggered (†) steps need not be accomplished on subsequent flights on the same day.

10.2.2.1 Prestart Checks

CAUTION

Moving flight controls without first or second-stage pressure on the primary servos may cause damage to the flight controls.

1. Seats/belts/pedals/mirrors — ADJUSTED.
2. Cockpit window emergency release handles — AFT AND SHEARWIRED.
3. Left collective — EXTENDED AND LOCKED.
4. Circuit breakers and switches — CHECKED AND OFF.

   Switches not having an OFF position should be checked as follows:

   a. RDR, DATA LINK — STBY.

   b. ATO ICS — NORM.

   c. DATA LINK MODE — AUTO.

   d. GUARD REC — ON.

   e. COMM CONTR mode select — T/R.

   f. GUST LOCK — NORM.

   g. TAIL SERVO — NORM.

   h. Pilot ICS — NORM.

PROFILE

i. CARGO HOOK ARMING — SAFE.

j. CARGO HOOK EMER RLSE — OPEN.

k. FIRE DET TEST — OPER.

l. DE-ICE MASTER — MANUAL.

m. MODE 4 AUDIO/LIGHT/OUT — AUDIO.

n. Transponder ANT — DIV.

o. COMP panel — SLAVED, LAT CHECKED.

p. FUEL MGT panel, MASTER/MODE switches — STOP FLOW/AUTO.

q. SERVO SHUTOFF SWITCH — CENTER.

5. Parking brake — RESET.

6. TAIL WHEEL — LOCK.

7. Aircrewman Prestart Checks — COMPLETE.

8. Engine T-handles — FORWARD.

9. APU T-handle — IN.

10. Rotor brake — ON.

11. BATT switch — ON. (#1/#2 CONV, AC ESS BUS OFF, STABILATOR, and AFCS DEGRADED caution, WOW and ROTOR BRAKE advisory lights — ILLUMINATE.)

12. UHF backup — SET.

13. External Power — As required, RESET then ON.

14. Fire detector system — TEST.

15. Fire guard — POSTED, AREA CLEAR.

16. Interior/exterior/NVD lighting — AS REQUIRED.

17. APU — START.

a. ECS — OFF.

b. AIR SOURCE ECS/START switch — APU.

c. FUEL PUMP switch — APU BOOST.

(1) PRIME BOOST PUMP ON advisory light — ON.

d. APU CONTROL switch — ON.

(1) APU ON advisory light — ON.

Note

Do not cycle the BATT switch or turn off the APU CONTROL switch if the APU shuts down during start or after it is running. This removes the cause of the shutdown from the APU BITE indicator.

PROFILE

18. APU GENERATOR switch — ON.
    a. APU GEN ON advisory light — ON.
19. External Power — OFF (disconnect as required).
20. ICS/RADIO — CHECK.
21. ECS — AS REQUIRED.

†22. Blade/pylon spread — AS REQUIRED.
    a. Area — CLEAR (wing walkers positioned as required).
    b. CMPTR PWR/RESET pushbutton — ON.
    c. BLADE FOLD MASTER switch — ON.
    d. BLADE FOLD switch — SPREAD.
    e. PYLON FLIGHT and ROTOR SPREAD lights — ILLUMINATED.
    f. RDR ALT pushbutton — PRESS (if flashing).
    g. BLADE FOLD switch — OFF.
    h. BLADE FOLD MASTER switch — OFF.
    i. Proceed to step 24, Head Check.

†23. Lockpins status — CHECK.
    a. BLADE FOLD MASTER switch — ON.
    b. ROTOR SPREAD and PYLON FLIGHT lights — ILLUMINATED.
    c. If ROTOR SPREAD light not illuminated:
        (1) CMPTR PWR/RESET pushbutton — OFF.
        (2) BACKUP HYD PMP switch — OFF.
        (3) BLADE FOLD switch — SPREAD (5 to 7 seconds).
    d. If rotor SPREAD light remains off:
        (1) BLADE FOLD switch — OFF.
        (2) BLADE FOLD MASTER switch — OFF.
        (3) Head check — PERFORM.
    e. If ROTOR SPREAD light illuminated:
        (1) BLADE FOLD switch — OFF.
        (2) SPREAD INCOMPLETE caution — DOES NOT APPEAR.
        (3) BLADE FOLD MASTER switch — OFF.

PROFILE

†24. Head check — AS REQUIRED.

a. Blade lock pins engaged.

b. Pitch lock pins retracted.

c. Gust lock disengaged.

†25. IGB/TGB Oil Level Check — AS REQUIRED (after Pylon Spread).

26. CMPTR PWR/RESET pushbutton — CYCLE, ON.

27. SAS/BOOST pushbutton — ON.

28. BACKUP HYD PMP switch — ON.

Note

If electrical loads are introduced (e.g., backup hydraulic pump) while operating from APU generator or external power, an AFCS power sever may occur, indicated by appearance of the AFCS DEGRADED caution. To restore AFCS computer power, press CMPTR PWR/RESET pushbutton on AFCS CONTROL panel.

10.2.3 Systems Check

†1. DIGITS — ON; CDU and PDU — TEST.

2. Fuel quantity and readouts — CHECK.

Note

The maximum difference between the fuel quantity indicators on the VIDS, and total fuel digital readout shall not be more than 200 pounds.

3. Caution/advisory/warning lights — CHECK.

a. The following caution/advisory lights should be ON:

(1) #1 and #2 GEN.

(2) #1 and #2 FUEL PRESS.

(3) #1 and #2 ENGINE OIL PRESS.

(4) #1 and #2 HYD PUMP.

(5) SAS.

(6) AFCS DEGRADED.

(7) MAIN XMSN OIL PRESS.

(8) WOW.

(9) ROTOR BRAKE.

(10) #1 and #2 ENG ANTI-ICE ON.

PROFILE

(11) APU ON.

(12) APU GEN ON.

(13) PRIME BOOST PUMP ON.

(14) BACK–UP PUMP ON.

(15) PARKING BRAKE ON.

A 4. Caution/advisory/warning lights and dimming — CHECK.

a. BRT/DIM – TEST switch — TEST.

b. All caution/advisory lights go on. All warning lights on master warning panels go on and LOW ROTOR RPM lights flash. Legends on mode selector panels go on. The AFCS control panel, FUEL MGT panel, STABILATOR panel and BLADE FOLD control panel lights go on, and RAWS tones audible.

c. BRT/DIM–TEST switch — DIM. All lights on the caution/advisory panel should decrease in intensity.

d. BRT/DIM–TEST switch — BRT. All lights on caution/advisory panel should return to normal intensity.

e. While holding BRT/DIM–TEST switch at TEST, turn INST LIGHTS PILOT FLIGHT CONTROL switch from OFF. All lights should decrease in intensity. Turn INST LIGHTS PILOT FLIGHT CONTROL switch to OFF. All lights on panel should return to normal intensity.

f. BRT/DIM-TEST switch — RELEASE. MASTER CAUTION WARNING lights should flash 16 times. Note that no transmission chip caution lights are on.

A 5. Photocell sensitivity — CHECK.

a. Lamp test buttons — PRESS AND HOLD.

b. DIM control on CDU — TURN (full clockwise).

c. All segments on CDU and PDU will go to 1/2 intensity.

d. DIM control on CDU — TURN (counterclockwise just below detent).

e. Apply light from outside source (such as utility light) to one photocell at a time. Note intensity of segments on CDU and PDU increases.

Note

If sunlight is shining on one or more photocells, covering those photocells should cause segment lights to dim.

f. DIM control — ADJUST (to desired intensity).

A 6. INTERIOR/EXTERIOR LIGHTS — CHECK. Instrument lights, secondary lights, cockpit flood, and cabin dome lights, landing/hover lights, position and anticollision lights, and controllable searchlight — CHECK. SET AS DESIRED.

7. RAD ALT, BAR ALT, clocks — SET.

8. TACAN — AS REQUIRED.

9. IFF MASTER — STBY.

PROFILE

A C D

10. Cyclic forward stop — CHECK.

    a. SAS 1 and SAS 2 pushbuttons — OFF.

    b. Move collective to midposition with full left pedal.

Note

Due to control mixing, maximum forward cyclic position is achieved with full left pedal and the collective at midposition.

    c. Move cyclic full forward and center laterally against forward stop.

    d. The cyclic should not touch the instrument panel. (Distance from instrument panel to cyclic should be approximately 3/4 to 2-1/4 inches). Cyclic may contact instrument bezel/knobs.

    e. Return cyclic to center position and collective to full down.

†11. Primary servos — CHECK.

A C D

†12. BOOST servos — CHECK.

    a. Collective and pedals — MID-POSITION and RIGHT PEDAL SLIGHTLY FORWARD OF NEUTRAL.

Note

Slight pedal control deflection may be necessary to prevent excessive collective movement.

    b. SAS/BOOST pushbutton — OFF. BOOST SERVO OFF and AFCS DEGRADED cautions appear and MASTER CAUTION lights illuminated.

    c. Move flight controls through full range of travel. Note increase in control forces (except lateral). Left/right cyclic force should be about half the fore/aft force for equal displacement.

    d. Check for not more than 1-1/2 inches of free play in controls. If free play is felt, visually inspect boost servo for failed piston link.

    e. Collective and pedals — MID-POSITION AND RIGHT PEDAL SLIGHTLY FORWARD OF NEUTRAL.

    f. SAS/BOOST pushbutton — ON. BOOST SERVO OFF caution disappears.

    g. Collective — FULL DOWN.

†13. Tail rotor servo — CHECK.

A C D

†14. AFCS ground check.

    a. SAS — CHECK.

        (1) CMPTR PWR/RESET 2-minute warm-up and SAS BOOST pushbuttons — CHECK ON.

        (2) TRIM and AUTO PLT pushbuttons — CHECK OFF.

        (3) SAS 1 pushbutton — ON for at least 10 seconds, then OFF. SAS 1 fail advisory light, SAS and AFCS DEGRADED cautions should not appear during self-test.

PROFILE

(4) SAS 1 pushbutton — ON, then OFF. No movement should occur in either main rotor blades or flight controls.

(5) Repeat step (4) for SAS 2.

(6) SAS 1 and SAS 2 pushbuttons — ON.

(7) Move controls through full range. Check for restrictions, control feedback and rotor blade chatter. If any are detected, repeat step with each SAS disengaged separately to determine in which SAS channel and axis discrepancy exists.

(8) SAS 1 and SAS 2 pushbuttons — OFF.

b. Trim — CHECK.

(1) TRIM pushbutton — ON, THEN OFF. No movement should occur in flight controls.

(2) TRIM pushbutton — ON.

(3) Cyclic Trim — CHECK.

(a) Move cyclic fore, aft, and laterally checking for symmetrical gradient force increase with control displacement.

(b) Without depressing the cyclic TRIM REL button, displace cyclic from trim position and release. Cyclic should return to trimmed position.

(c) Depress the cyclic TRIM REL button. Slowly displace cyclic fore/aft and note a resisting force. Move the cyclic fore/aft at a faster rate and note an increase in resisting force. Do the same using left/right cyclic movement. Note the force/velocity characteristics with longitudinal cyclic are twice as great as lateral cyclic.

(d) Center the pedals and place collective at midposition. Trim cyclic full aft. Using four-way TRIM switch, move cyclic full travel forward. Operation should be smooth and full travel should take 15 ±3 seconds. Repeat in opposite direction.

(e) Lower collective, trim cyclic full left. Using four-way TRIM switch, move cyclic full travel right. Full travel should take 18 ±3 seconds. Repeat in opposite direction.

(f) Pilot and copilot cyclic four-way TRIM switches — CHECK (fore/aft/lateral).

(4) Cyclic and collective trim release buttons — CHECK. Move cyclic and collective with buttons depressed to ensure proper operation.

(5) Collective trim — CHECK.

(a) Collective — TRIM TO MID-POSITION.

(b) Without pressing collective trim release switch, displace the collective full up noting increase in gradient force. Release, collective should return smoothly to mid-position.

(c) Repeat step (b) for collective full down.

(6) Yaw pedal trim — CHECK.

(a) Pedals — TRIM TO MID-POSITION.

(b) Without pressing pedal trim switch, displace one pedal full forward and release. Pedals should return smoothly to trimmed position.

PROFILE

(c) Repeat step (b) for other pedal.

(d) Move pedals back and forth at a slow constant rate and note a resisting force. Move pedals at a faster rate and note an increase in resisting force.

c. Autopilot — CHECK.

(1) SAS 1, SAS 2 and TRIM pushbuttons — ON.

(2) AUTO PLT pushbutton — ON, THEN OFF. No movement should occur in flight controls.

(3) AUTO PLT pushbutton — ON.

(4) Move flight controls through full range without depressing cyclic, collective, or pedal trim switches. Check for restrictions, control feedback, and rotor blade chatter.

Note

If any restricting control feedback or rotor blade chatter is detected, repeat step with SAS/Trim/Autopilot individually disengaged to determine the channel and axis where the discrepancy exists.

(5) Press BAR ALT pushbutton — BAR ALT hold should engage.

(6) Press RDR ALT pushbutton — RDR ALT hold should engage.

(7) Radar Altimeters — OFF. RDR ALT hold switches to BAR ALT hold, AFCS DEGRADED caution, CPLR and ALT fail advisory lights, and MASTER CAUTION lights illuminated.

(8) BAR ALT pushbutton — PRESS OFF.

(9) RDR ALT and APPR/HVR pushbuttons — PRESS. RADALT hold and hover coupler should not engage.

(10) Radar altimeters — ON.

(11) Pilot and ATO AFCS RELEASE switch — CHECK. SAS 1, SAS 2, and AUTO PLT lights OFF. SAS caution light and MASTER CAUTION WARNING lights ON.

(12) SAS 1, SAS 2, TRIM, AUTO PLT — ON.

†15. Stabilator — CHECK.

A †16. Rescue Hoist Preoperational Check — AS REQUIRED (see paragraph 7.16.2.1).

A †17. Cargo Hook Preoperational Check — AS REQUIRED (see paragraph 7.16.2.2).

A †18. Cargo hook emergency release circuit — TEST.

WARNING

Personnel shall remain clear of cargo hook during short and open circuit tests in case of inadvertent CAD firing.

PROFILE

CAUTION

To prevent unintentional discharge of the cargo hook CAD, the pilot shall call off each procedural step of the emergency release circuit test before that step is performed. The station being checked shall reply to each command.

a. CARGO HOOK EMERG REL TEST light — PRESS (light illuminates).

b. RESCUE HOIST PWR/ARMED switch — OFF.

c. EMER RELEASE HOIST CABLE SHEAR circuit breaker (DC ESNTL BUS, OVHD, ROW 2, CB 2) — PULL.

d. CARGO HOOK CONTR switch — ARMED/ALL or ARMED/COCKPIT.

e. SHORT test.

(1) CARGO HOOK EMERG REL switch — SHORT.

(2) Pilot cyclic EMER REL button — PRESS. CARGO HOOK EMERG REL TEST light illuminates.

(3) ATO EMER REL button — PRESS. CARGO HOOK EMERG REL TEST light illuminates.

f. OPEN test.

(1) CARGO HOOK EMERG REL switch — OPEN.

(2) Pilot cyclic EMER REL button — PRESS. CARGO HOOK EMERG REL TEST light illuminates.

(3) ATO cyclic EMER REL button — PRESS. CARGO HOOK EMERG REL TEST light illuminates.

g. EMER RELEASE HOIST CABLE SHEAR circuit breaker — RESET.

h. CARGO HOOK CONTR switch — SAFE.

A 19. Pitot heat system — CHECK.

a. PITOT HEAT switch — ON. Check both pitot-static tubes and static ports for increasing temperature.

b. LEFT PITOT HEAT and RIGHT PITOT HEAT cautions do not appear — CHECK.

c. Pull RIGHT PITOT HEATER (NO. 2 AC PRIMARY, CORNER, ROW 3, CB 3) and LEFT PITOT HEATER (NO. 1 AC PRI, SO's OVERHEAD, ROW 1, CB 6) circuit breakers — RIGHT PITOT HEAT and LEFT PITOT HEAT cautions appear.

d. Reset circuit breakers — cautions disappear.

e. PITOT HEAT switch — OFF.

A 20. Airspeed — Red line/slipmarked.

PROFILE

A 21. VSI — 0.

A 22. Windshield washer and wipers — CHECK.

CAUTION

To prevent scratching the windshield, do not operate the wipers on dry glass.

a. WINDSHIELD WASHER switch — ON. Note that washer provides enough water and a stream is properly directed on windshield.

b. WINDSHIELD WIPER knob — HI. Wiper blades should remain in contact with windshield over its entire sweep area.

c. WINDSHIELD WIPER knob — LOW. Wiper blades should sweep at a slower speed.

d. WINDSHIELD WASHER switch — OFF.

e. WINDSHIELD WIPER knob — PARK (CONSTANT PRESSURE REQUIRED). Wiper blades should move to windshield center posts and stop.

f. WINDSHIELD WIPER knob — OFF.

10.2.4 Starting Engines and Rotor Engagement

1. High Points and Tail Tiedowns — VERIFY REMOVED.

CAUTION

- For shore-based operations only: If the engine is started with the rotor brake on to facilitate maintenance, the PCLs should not be advanced above IDLE. If rotor engagement is required following the required maintenance checks, the engine(s) should be shut down from IDLE and restarted with the rotor brake off to avoid the possibility of engine power turbine shaft rub.
- N_p shaft rub occurs when the engines are online and the rotor brake is released. The N_p shaft impacts the N_g shaft, which causes the compressor blades to impact the compressor casing. Over time, this will cause the engine to lose power and possibly catastrophically fail. The only way to ensure N_p shaft rub will not occur is to use the No Rotor Brake Start Procedure. The No Rotor Brake Start Procedure shall be utilized for routine engine start and rotor engagement ashore.

PROFILE

Note

- After an engine installation, the initial engine start should be done against the rotor brake to check for engine leaks. During and after the run, check for oil and fuel leaks. All subsequent engine starts should be conducted with the rotor brake off.
- Engine start data collected from either the No Rotor Brake Start Procedure or the Rotor Brake Start Procedure satisfies applicable FCF requirements. It is not necessary to complete both types of starts.

10.2.4.1 No Rotor Brake Start Procedure

Note

This procedure shall be utilized for routine FCF engine start and rotor engagements ashore.

1. Fire guard posted, area clear.
2. Doors, inertia reels — LOCK.
3. SAS 1, SAS 2, TRIM and AUTO PLT pushbuttons — ON.

WARNING

When AFCS computer power is cycled, trim is disengaged. An unguarded cyclic will allow the rotor arc to dip as low as 4 feet above the ground, without droop–stop pounding, prior to full control deflection.

A B 4. Engine control quadrant — CHECK.
   a. PCLs — PULL DOWN AND PRESS FORWARD. Note no movement past IDLE detent.
   b. Rotor brake interlock override tab — PULL.
   c. PCLs — MOVE THROUGH FULL RANGE. Check for no binding, note positive detents, then OFF.
   d. Fuel selectors — DIR, XFD, THEN OFF. Check for no binding and note positive detents.

A B 5. Engine fuel system priming (if required).

Note

Helicopter prime/boost pump capacity is not sufficient to prime an engine when the opposite engine is running. Therefore, engines should be primed individually with both engines OFF.

   a. Fuel selector — DIR.
   b. PCL — HOLD IN LOCKOUT.
   c. FUEL PUMP switch — FUEL PRIME. Check FUEL PRIME advisory appears, hold until plane captain reports steady flow of fuel coming from overboard drain.

PROFILE

d. Repeat steps b. and c. with fuel selector in XFD.

e. FUEL PUMP switch — APU BOOST.

f. PCL — OFF.

6. Rotor brake — Pressure, check 450 psi minimum.

A B 7. Engine Starter/Air Start Valve/ECS dropout — CHECK.

Note

This check is required whenever a starter motor or start valve has been replaced. Check should be performed no less than three times.

a. ENGINE IGNITION switch — OFF.

b. ECS MODE switch — AUTO.

c. PCL — OFF.

d. Engine starter button — PRESS AND HOLD UNTIL N_g BEGINS TO INCREASE. Note that appropriate STARTER advisory appears.

e. ECS vent airflow — STOPS.

f. Record maximum N_g (minimum N_g should be 24 percent).

g. Abort start by pulling down on PCL.

h. ENG STARTER advisory — DISAPPEARS.

i. Repeat steps c. to h. for other engine as required.

8. Rotor brake — OFF. Check pressure 0 psi, and ROTOR BRAKE advisory out.

9. ENGINE IGNITION switch — NORM.

10. Fuel selector — XFD.

11. Lights — AS REQUIRED.

12. Flight controls — POSITION AND HOLD.

a. Cyclic and pedals — CENTERED.

b. Collective — DOWN AND HOLD.

CAUTION

During engine start and runup, adjust the cyclic as required to maintain the tip path plane in a neutral position and maintain the collective full down and the pedals centered until N_r reaches 50 percent minimum to prevent damage to anti-flap assembly. If droop stop pounding occurs, raise collective to alleviate this condition, but not to exceed 1/2 inch. Maintain the new collective position until N_r reaches 50 percent minimum.

PROFILE

A B

13. BACKUP HYD PMP switch — OFF.
14. Engines — START.

CAUTION

If an abnormal or loud whining noise is heard during engine startup, shut down engine immediately due to impending diaphragm coupling failure. Maintenance action is required prior to subsequent engine start.

Note

Checking of time to idle should not be done on the initial start of a newly installed engine.

a. Monitor N_g and TGT.

b. Record the following:

(1) Time to lightoff (time from PCL to IDLE until first rise in TGT).

(2) Time to idle (time from PCL to IDLE until N_g at ground idle).

(3) Starter dropout speed.

(4) Maximum TGT.

(5) At ground idle note TGT, N_g, oil pressure, and OAT.

c. Verify time to IDLE and minimum idle speed are within parameters (Figure 10-2).

15. Engine oil pressures — CHECK.
16. ENG STARTER advisories — OUT.
17. Engine idle N_gs — CHECK, 63 percent or above and matched within 3 percent.

WARNING

Ground idle N_g split greater than 3 percent is an indication of possible LDS roll–pin failure. Do not fly the helicopter until maintenance action is performed.

18. Check #1 HYD PUMP and #2 HYD PUMP cautions — OUT.
19. XMSN oil pressure — CHECK.
20. N_p/N_r — CHECK within limits.

CAUTION

Loss of the collective boost servo through either intentional shutoff or loss of NO. 2 hydraulic pressure will cause the collective to move rapidly from the down position to midposition if it is not held by hand. This movement can be enough to cause the helicopter to become airborne. During ground operations with engines operating, the flight controls shall be monitored.

PROFILE

21. PCLs — PULL OUT OF IDLE DETENT AND SMOOTHLY ADVANCE TO FLY.

WARNING

Do not move the PCLs rapidly when the tail wheel lockpin is not engaged.

22. Droop stops — OUT.
23. PCLs — FLY.
24. Fuel selector — DIR.
25. BACKUP HYD PMP switch — AUTO.
26. TRQs — MATCHED within 5 percent.
27. N_p/N_r — 100 percent.
28. NO. 1 and NO. 2 GENERATOR switches — ON.

WARNING

Power transfer from the APU generator to the NO. 1 generator may cause disengagement of SAS 1, SAS 2, TRIM, AUTO PLT, and Stabilator which may cause rotors to dip as low as 4 feet.

10.2.4.2 Rotor Brake Start Procedure

1. Fire guard posted — area clear.
2. Doors, inertia reels — LOCK.
3. SAS 1, SAS 2, TRIM and AUTO PLT pushbuttons — ON.

A B 4. Engine control quadrant — CHECK.
   a. PCLs — PULL DOWN AND PRESS FORWARD. Note no movement past IDLE detent.
   b. Rotor brake interlock override tab — PULL.
   c. PCLs — MOVE THROUGH FULL RANGE. Check for no binding, note positive detents, then OFF.
   d. Fuel selector levers — DIR, XFD, THEN OFF. Check for no binding and note positive detents.

A B 5. Engine fuel system priming (if required).

Note

Helicopter prime/boost pump capacity is not sufficient to prime an engine when the opposite engine is running. Therefore, engines should be primed individually with both engines OFF.

PROFILE

a. Fuel selector — DIR.

b. PCL — Hold in LOCKOUT.

c. FUEL PUMP switch — FUEL PRIME; Check FUEL PRIME advisory appears, hold until plane captain reports steady flow of fuel coming from overboard drain.

d. Repeat steps b. and c. with fuel selector lever in XFD.

e. FUEL PUMP switch — APU BOOST.

f. PCL — OFF.

6. Rotor brake — CHECK (pressure 450 psi minimum).

A B 7. Engine starter/air start valve/ECS dropout — CHECK.

Note

This check is required whenever a starter motor or start valve has been replaced. Check should be performed no less than three times.

a. ENGINE IGNITION switch — OFF.

b. ECS MODE switch — AUTO.

c. PCL — OFF.

d. Engine starter button — PRESS AND HOLD UNTIL N_g BEGINS TO INCREASE. Note that appropriate STARTER advisory appears.

e. ECS vent airflow — STOPS.

f. Record maximum N_g (minimum N_g should be 24 percent).

g. Abort start by pulling down on PCL.

h. ENG STARTER advisory — DISAPPEARS.

i. Repeat steps c. to h. for other engine (as required).

8. ENGINE IGNITION switch — NORM.

9. Fuel selectors — XFD.

10. Lights — AS REQUIRED.

11. Flight controls — POSITION AND HOLD.

a. Cyclic and pedals — CENTERED.

b. Collective — DOWN AND HOLD.

CAUTION

Loss of the collective boost servo through either intentional shutoff or loss of NO. 2 hydraulic pressure will cause the collective to move rapidly to midposition if it is not held down by hand. This movement can be enough to cause the helicopter to become airborne. During ground operations with engines operating, the flight controls shall be guarded.

PROFILE
A B

12. Engines — START.

CAUTION

If an abnormal or loud whining noise is heard during engine startup, shut down engine immediately due to impending diaphragm coupling failure. Maintenance action is required prior to subsequent engine start.

Note

Checking of time to idle should not be done on the initial start of a newly installed engine.

a. Monitor N_g and TGT.

b. Record the following:

(1) Time to lightoff (time from PCL to IDLE until first rise in TGT).

(2) Time to idle (time from PCL to IDLE until N_g at ground idle).

(3) Starter dropout speed.

(4) Maximum TGT.

(5) TGT, N_g, oil pressure, and OAT at ground idle.

c. Verify time to IDLE and minimum idle speed are within parameters (Figure 10-2).

13. Engine oil pressures — CHECK.

14. ENG STARTER advisories — OUT.

15. Engine idle N_gs — CHECK, 63 percent or above and matched within 3 percent.

WARNING

Ground idle N_g split greater than 3 percent is an indication of possible LDS roll-pin failure. Do not fly the helicopter until maintenance action is performed.

16. Area — CLEAR.

17. Lights — AS REQUIRED.

18. Rotor — ENGAGE.

a. Rotor brake — OFF. Check 0 psi, and ROTOR BRAKE advisory OUT.

b. PCLs — PULL OUT OF IDLE DETENT AND SMOOTHLY ADVANCE TO FLY.

WARNING

Do not move the PCLs rapidly when the tail wheel lockpin is not engaged.

c. Check #1 HYD PUMP and #2 HYD PUMP cautions — OUT.

d. XMSN oil pressure — CHECK.

e. Droop stops — OUT.

PROFILE

19. PCLs — FLY.

20. Fuel selectors — DIR.

21. BACKUP HYD PMP switch — AUTO.

22. TRQs — MATCHED WITHIN 5 PERCENT.

23. N_p/N_r — 100 percent.

24. NO. 1 and NO. 2 GENERATOR switches — ON.

WARNING

Power transfer from the APU generator to the NO. 1 generator may cause disengagement of SAS 1, SAS 2, TRIM, AUTO PLT, and Stabilator which may cause rotors to dip as low as 4 feet.

10.2.4.3 Post Engagement Checks

†1. Engine overspeed system and Auto-Ignition — CHECK.

Note

Failure of an engine to automatically relight when both OVSP TEST A and B are pressed simultaneously is possible. The engine should be restarted using normal procedures and the check should be performed again. If the engine automatically relights on the second attempt, the engine is acceptable. If the engine fails the test twice consecutively, maintenance action is required.

†2. Contingency power — CHECK.

†3. Hydraulic leak test — CHECK.

†4. Backup tail rotor servo — CHECK.

A B 5. DECU lockout — CHECK.

Note

- DECU LOCKOUT is recognized by a loss of torque matching and a rise in N_r and N_p above 100 percent. Monitor TGT.
- After an HMU, fuel filter, filter element, fuel pressure switch, or engine(s) has been replaced or reinstalled and the installed HMU is manufactured by Woodward, perform this check five times.

PROFILE

a. N_r — 100 percent. PARKING BRAKE set and TAIL WHEEL LOCK, or both main mounts chocked.

b. Momentarily advance PCL to LOCKOUT. Immediately retard PCL to near vertical (6 o'clock) position. Slowly advance PCL to a position where TRQ is matched at 100 percent N_r. Continue to advance PCL slowly above 100 percent N_r.

c. Reengage DECU by moving the PCL back to IDLE then slowly to FLY, while monitoring N_p/N_r and torque to verify DECU is reengaged.

d. Repeat steps b. and c. for other engine.

A B 6. Acceleration/deceleration — CHECK.

WARNING

- The tail wheel may slide laterally on wet or icy surfaces as a result of the engine and rotor surge encountered during the engine acceleration/deceleration check. Ensure the helicopter is clear of ground support personnel/equipment and the tail wheel is locked or both main mounts chocked before performing the engine acceleration/deceleration check.
- Care should be taken not to move the ENG PCLs rapidly, either forward or rearward, when the tail wheel lock pin is not engaged. Overly rapid application of PCLs can result in turning of the helicopter on spot.

a. PCLs — FLY.

b. NO. 1/NO. 2 N_p — 100 percent.

c. Retard PCL of engine being checked to IDLE and rapidly advance it until N_g peaks; then rapidly retard to IDLE.

d. Check that there is no acceleration or deceleration stall.

e. PCL — FLY.

f. Repeat steps b. to e. for other engine (as required).

A B 7. ENG SPD TRIM switch — CHECK.

a. Full DECR — Minimum 96 percent to 97 percent N_r.

b. Full INC — Maximum 100 percent to 101 percent N_r.

c. Adjust to 100 percent N_r.

A B 8. Engine crossbleed start — CHECK.

PROFILE

WARNING

- At 94 percent N_g, the aircraft will be light on its wheels. Be vigilant for signs of dynamic rollover; maintain a centered cyclic and be prepared to lower collective quickly. Sideward tip path may increase possibility of dynamic rollover.
- The WOW switch may trigger, enabling AFCS functions associated with flight; keep collective trim switch depressed. Emergency jettison and fuel dump functions are enabled; keep personnel clear of the aircraft.
- For shipboard operations, request amber deck, open RSD beams and slacken Main Landing Gear chains. Ensure chains do not become taut; dynamic instability may result.

CAUTION

- When attempting engine crossbleed starts with the engine intake cowling removed, a hot start may be experienced if the bleed air plug is not installed in the anti-ice bleed air line.
- For a crossbleed start, the good engine should indicate the maximum N_g safely attainable. Donor N_g less than 94 percent may result in hot starts.

Note

A full fuel load is recommended when conducting a crossbleed start to mitigate effects of a high power setting on deck.

a. Fireguard posted, area clear.

b. AIR SOURCE ECS/START switch — ENG.

c. APU CONTR switch — OFF.

d. ENGINE IGNITION switch — NORM.

e. Fuel Selectors — XFD/DIR (as required).

f. Collective — Increase to set 94 percent N_g on operating engine.

g. ENG — START (normal procedures apply).

h. Collective — FULL DOWN.

PROFILE

i. PCL — FLY.

j. Fuel selectors — DIR.

k. Repeat steps f. to j. for opposite engine, as required.

A 9. Windshield anti-ice operation/interlock — CHECK.

Note

APU GEN must be ON to provide AC power for the following checks.

a. APU — START.

b. NO. 1 and NO. 2 GENERATOR switches — OFF.

c. PILOT/COPILOT WINDSHIELD ANTI-ICE switches — ON.

d. Note increase in temperature only on the pilot windshield.

e. NO. 1 or NO. 2 GENERATOR switches — ON.

f. Note increase in windshield temperature on copilot windshield and pilot windshield remains heated.

Note

When windshield anti-ice is turned on, it may take up to 60 seconds until a noticeable change in windshield temperature can be detected.

g. PILOT/COPILOT WINDSHIELD ANTI-ICE switches — OFF.

h. NO. 1 and NO. 2 GENERATOR switches — ON.

A 10. Electrical systems — CHECK.

WARNING

Power transfer from the APU generator to the NO. 1 generator may cause disengagement of SAS 1, SAS 2, TRIM, AUTO PLT, and Stabilator which may cause rotors to dip as low as 4 feet.

Note

The APU GEN must be on to ensure power is supplied to the VIDS in the event of generator dropoff.

a. APU — VERIFY ON.

b. APU generator — VERIFY ON.

PROFILE

c. Underfrequency protection — TEST.

(1) NO. 1 and NO. 2 PCLs — RETARD SLOWLY.

(2) #1 GEN and #2 GEN cautions — Appear between 92 percent and 97 percent N_r. Allow a 3-second time delay. Note N_r.

(3) NO. 1 and NO. 2 PCLs — FLY. Note #1 GEN and #2 GEN cautions are OUT.

d. AC system bus tie connector — TEST.

(1) NO. 1 GENERATOR switch — OFF.

(a) #1 GEN caution — APPEARS.

(b) #1 CONV caution — REMAINS OFF.

(c) AC ESS BUS OFF caution — REMAINS OFF.

(2) NO. 1 GENERATOR switch — ON, #1 GEN caution OUT.

(3) Repeat steps (1) and (2) for NO. 2 generator.

e. DC system bus tie connector — TEST.

(1) NO. 1 CONVERTER POWER circuit breaker (CENTER, NO. 1 AC PRI BUS, ROW 1, CB 14) — PULL.

(a) SAS 1 pushbutton — NOTE OFF, THEN RESET ON.

(b) #1 CONV caution — APPEARS.

(c) DC ESS BUS OFF caution — REMAINS OFF.

(d) COPILOT Mode selector panel lights — ON.

(2) NO. 1 CONVERTER circuit breaker — RESET. #1 CONV caution OUT.

(3) Repeat steps (1) and (2), pulling NO. 2 CONVERTER POWER circuit breaker (CORNER, NO. 2 AC PRI BUS, ROW 2, CB 4). SAS 1 pushbutton should remain ON.

f. AFCS voltage relay check.

Note

During this check, it is acceptable for some AFCS fail advisory lights to illuminate.

(1) AC ESNTL BUS SUPPLY circuit breaker (NO. 1 AC PRI, CORNER, ROW 1, CB 12) — PULL, pilot's AI OFF flag should remain out of view.

(2) CMPTR PWR/RESET pushbutton — CHECK ON.

(3) AC ESNTL BUS SUPPLY circuit breaker — RESET.

A C D 11. Flight controls — CHECK.

a. Disengage AUTO PLT, TRIM, SAS 2, and SAS 1 pushbuttons noting no jump in cyclic or tip-path plane.

b. Engage SAS 1, SAS 2, TRIM, and AUTO PLT pushbuttons.

PROFILE

PROFILE	
A B C D	12. Ground vibration analysis (tail, oil cooler, input, NSV) — AS REQUIRED.
A B C D	13. Alternate tooth wear — AS REQUIRED.

WARNING

- Be vigilant for signs of dynamic rollover; maintain a centered cyclic and be prepared to lower collective quickly. Sideward tip path may increase possibility of dynamic rollover.
- Maintain a centered cyclic equivalent to a level tip path on level ground. Forward tip path may allow tail wheel to become light and allow tail wheel to slide sideways.
- The WOW switch may trigger, enabling AFCS functions associated with flight; keep collective trim switch depressed. Fuel Dump, Rescue Hoist, Rescue Hoist Shear, and Cargo Hook Shear functions are enabled; keep personnel clear of the aircraft.
- Tie-downs should be removed prior to pulling torque.

Note

- The following procedures are for shore-based operations only. No attempt should be made to perform these procedures aboard ship.
- A full fuel load is recommended when conducting these procedures to mitigate the effects of a high power setting on deck.
- Collect ATABS data in accordance with the A1-H60CA-VIB-100 manual.

With the NO. 1 ENG operating in FLY and NO. 2 ENG shutdown:

a. Allow 5 min for stabilization at 100 percent N_r, flat pitch.

After 5 min:

b. Collective — INCREASE TORQUE TO 75-80 percent.

c. ATABS — COLLECT DATA.

d. Collective — FULL DOWN.

e. Ignition switch — NORM.

f. NO. 2 Fuel Selector — DIR.

g. NO. 2 ENG — START.

h. NO. 2 PCL — FLY.

i. Allow 5 min for stabilization at 100 percent N_r, flat pitch.

PROFILE

After 5 min:

j. Collective — INCREASE TORQUE TO 35–40 percent.

k. ATABS — COLLECT DATA.

l. Collective — FULL DOWN.

m. NO. 1 ENG — SHUTDOWN.

(1) ENG IGNITION switch — OFF.

(2) NO. 1 PCL and Fuel Selector — OFF.

n. Allow 5 minutes for stabilization at 100 percent N_r, flat pitch.

After 5 min:

o. Collective — INCREASE TORQUE TO 75–80 percent.

p. ATABS — COLLECT DATA.

q. Collective — FULL DOWN.

A C 14. Main rotor track and balance — AS REQUIRED.

CAUTION

Care must be taken when reseating struts. Helicopter damage may occur if excessive control inputs are made.

A B 15. Engine anti–ice system — CHECK (as required).

a. PCL (engine not being checked) — AS REQUIRED.

WARNING

Failure of the ENG ANTI–ICE ON advisory to illuminate when the ENG ANTI–ICE switch is selected to ON, or when the N_g is below approximately 88 percent regardless of the switch position; or constant illumination of the ENG ANTI–ICE ON advisory with N_g greater than 90 percent (94 percent if OAT is 15 °C or greater) and the ENG ANTI–ICE switch OFF are indicative of a malfunctioning anti–ice/start bleed valve. This condition may cause engine flameout during low power settings such as quick stops and autorotative flight.

Note

- Engine Anti–ice Check should be performed into the wind on deck, in a hover over a suitable landing pad, or in a stable, level–flight regime.
- On deck or in a hover, it may be necessary to retard the PCL on the engine not being checked to prevent a vertical climb.

PROFILE

b. ENG ANTI–ICE switch (engine being checked) — OFF.

c. Collective — RAISE TO INCREASE N_g OF ENGINE BEING CHECKED TO 90 PERCENT OR ABOVE (94 percent or above if OAT is above 15 ºC).

d. ENG ANTI–ICE ON advisory (engine being checked) — OFF.

e. ENG ANTI–ICE switch (engine being checked) — ON.

Confirm:

(1) ECS SHUTDOWN caution (if ECS on and AIR SOURCE ECS/START switch — ENG).

Note

ECS will not shut down if AIR SOURCE ECS/START switch is in APU.

(2) TGT increases 30 °C to 100 °C.

(3) ENG ANTI–ICE ON advisory appears.

(4) ENG INLET ANTI–ICE ON advisory:

(a) OAT above 13 ºC — OFF.

(b) OAT above 4 ºC up to 13 ºC — May appear.

(c) OAT 4 ºC and below — Appears.

WARNING

A TGT increase greater than 100 ºC and/or appearance of either ENG INLET ANTI–ICE ON advisory when OAT is above 13 ºC may result in a loss in available torque at intermediate power up to 49 percent when the engine anti–ice system is activated. If any part of the engine anti–ice check fails, maintenance action is required prior to flight into icing conditions.

Note

ENG INLET ANTI–ICE ON advisory illuminates when engine inlet temperature reaches 93 °C which may take approximately 90 seconds.

f. ENG ANTI–ICE switch (engine being checked) — OFF.

Confirm:

(1) TGT decreases.

(2) ENG ANTI–ICE ON advisory — DISAPPEARS.

PROFILE

(3) ECS — ON (if ECS on and AIR SOURCE ECS/START switch — ENG).

(4) ENG INLET ANTI-ICE ON advisory — DISAPPEARS (after approximately 90 seconds).

g. PCL (engine not being checked) — ADVANCE TO FLY (as required).

h. Repeat steps a. to g. for other engine.

A †16. Blade de-ice system — CHECK (as required).

Note

A TR DE-ICE FAIL caution may appear during the blade de-ice test while in an electromagnetic environment.

a. BLADE DE-ICE TEST selector switch — NORM.

b. BLADE DE-ICE POWER switch — TEST.

CAUTION

Leaving the BLADE DE-ICE POWER switch in the TEST position may cause blade damage.

c. PWR MAIN RTR and TAIL RTR lights — CHECK. PWR MAIN RTR light may illuminate for 2 to 4 seconds.

CAUTION

If PWR MAIN RTR or TAIL RTR lights remain on for more than 10 seconds, main rotor or tail rotor damage may result. Turn BLADE DE-ICE POWER switch OFF. If either light remains illuminated, pull the appropriate circuit breaker (DE-ICE CONTR MB, COPILOT/TAIL BLADE DE-ICE). If either light remains illuminated, secure electrical power.

d. TEST IN PROGRESS light — CHECK. The light should illuminate for 2 minutes. The ICE DETECTED caution will appear for approximately 6 seconds. No other blade de-ice system cautions should appear. PWR MAIN RTR and TAIL RTR lights should illuminate for 2 to 4 seconds near end of test. The TEST IN PROGRESS light should then extinguish.

e. BLADE DE-ICE POWER switch — OFF.

f. BLADE DE-ICE TEST selector switch — SYNC 1.

g. BLADE DE-ICE POWER switch — TEST. MR DE-ICE FAIL caution appears.

h. BLADE DE-ICE POWER switch — OFF. MR DE-ICE FAIL caution disappears.

PROFILE

i. BLADE DE–ICE TEST selector switch — SYNC 2.

j. BLADE DE–ICE POWER switch — TEST. MR DE–ICE FAIL caution appears.

k. BLADE DE–ICE POWER switch — OFF. MR DE–ICE FAIL caution disappears.

l. BLADE DE–ICE TEST selector switch — OAT.

m. BLADE DE–ICE POWER switch — TEST. MR DE–ICE FAIL and TR DE–ICE FAIL cautions appear.

n. BLADE DE–ICE POWER switch — OFF. MR DE–ICE FAIL and TR DE–ICE FAIL cautions disappear.

CAUTION

EOT test should not be performed at ambient temperatures above 38 °C. Between 22 °C and 38 °C, allow 5 minutes at 100 percent N_r before this test is attempted. Between 10 °C and 22 °C, rotor must be turning at 100 percent. Exceeding temperature parameters may cause blade damage.

o. BLADE DE–ICE TEST selector switch — EOT.

p. BLADE DE–ICE MODE selector switch — MANUAL (M).

q. BLADE DE–ICE POWER switch — ON. TR DE–ICE FAIL caution appears after approximately 15 to 30 seconds. MR DE–ICE FAIL caution appears after approximately 50 to 70 seconds. PWR MAIN RTR and/or PWR TAIL RTR lights may flash.

r. BLADE DE–ICE POWER switch — OFF. (TR DE–ICE FAIL and MR DE–ICE FAIL cautions disappear).

s. BLADE DE–ICE TEST selector switch — NORM.

t. BLADE DE–ICE POWER switch — OFF.

u. BLADE DE–ICE MODE selector switch — AUTO.

v. APU generator backup — CHECK.

(1) NO. 1 or NO. 2 GENERATOR — OFF. (Applicable GEN caution light should be on).

(2) BLADE DE–ICE MODE SELECT — MANUAL (M).

(3) APU GENERATOR — ON.

(4) BLADE DE–ICE POWER — ON. (Wait 30 seconds, no de–ice lights should be on).

(5) Generator turned off in step (1) — ON. (Applicable GEN caution light should go off).

(6) BLADE DE–ICE POWER — OFF.

(7) BLADE DE–ICE MODE — AUTO.

PROFILE
A B

17. HIT baseline check (on deck) — AS REQUIRED.

Note

- HIT baseline should be established on deck or in flight. Subsequent HIT checks should be done in the same regime as HIT baseline.
- If icing conditions exist, consideration should be given to performing HIT Check on deck.
- HIT Checks shall be performed on the first flight of the day and recorded on the HIT/ Power Check Log (Figure 10-3) for monitoring trends in engine performance.

a. ENG ANTI-ICE switches — OFF.

CAUTION

If icing conditions exist, do not keep ENG ANTI-ICE OFF longer than necessary to perform check.

b. ECS — OFF.

c. BAR ALT — SET TO 29.92.

d. N_r — 100 percent.

e. PCL (Engine not being checked) — IDLE.

f. Collective — Increase to maintain 60 percent TRQ for at least 30 seconds.

g. Record OAT, PA, and TGT.

Note

When using HIT TGT Reference Table, round up temperature to the nearest value.

h. Repeat steps f. and g. resetting TRQ for a total of three times.

i. PCL — FLY.

j. Repeat steps e. to i. for the other engine as required.

k. Calculate average indicated of three indicated TGT readings.

l. Determine table TGT from TGT Reference Table (Figure 10-4) for recorded OAT and pressure altitude. Record TGT on baseline worksheet.

Note

When using HIT table, round OAT up, and pressure altitude to the nearest value.

PROFILE

m. Subtract average indicated TGT from table TGT to establish TGT margin.

n. Establish TGT upper and lower limits by adding 20 °C to TGT margin and subtracting 20 °C from TGT margin (step m.). Record upper and lower limits on HIT/Power Check Log (Figure 10-3) in helicopter ADB.

18. HIT CHECK — AS REQUIRED (see paragraph 7.17.1).

19. ENGINE ANTI-ICE, PITOT HEAT, BLADE DE-ICE, WINDSHIELD ANTI-ICE, DE-ICE MASTER switches — AS REQUIRED.

20. FMCP — AS REQUIRED.

21. APU — SHUTDOWN (as required).

10.2.5 Mission/Weapons Systems Checklist

1. MSN PWR — PRI.

2. DPLR, RDR, DATA LINK — RADIATE, as required.

3. ALQ 205 — AS REQUIRED.

4. AAR 47 — AS REQUIRED (2-minute warm-up).

5. Mission systems — IPL and key.

   a. SO — IPL.

   b. ATO MPD — TEST.

   c. Secure equipment — KEY.

   d. ATO MPD — ON (after test pattern appears).

   e. Secure communications — CHECK.

6. Mode select panels, BDHI, AI — AS REQUIRED.

7. BDHIs and AIs — CHECK.

†8. TACAN/IFF — TEST, SET.

9. AOP — INITIALIZE.

†10. NAV — INITIALIZE.

   If GPS is to be used as the primary navigation mode:

   a. GPS — KEY.

   b. GPS — INIT/TEST (via equipment status table once GPS is available).

CAUTION

Options 1 (Get GPS PRESET) and 8 (Send Init Data) of the GPS Data Table should not be performed when the aircraft NAV mode is GPS, as large and unpredictable aircraft LAT/LONG errors may occur.

PROFILE

Note

Performance of INIT SYNC to initialize the GRP is strongly recommended. This will avoid problems such as uncapturable fly-to points. See NTRP 3-22.2-SH60B for establishing a data link with the ship.

†11. Initialize FHS — AS REQUIRED.

a. FLIR EU PWR — ON.

WARNING

When the FLIR EU PWR switch is ON, the FLIR Turret automatically moves to the STOW position. Ensure personnel and equipment are clear of the FLIR Turret area before applying power.

b. Hellfire PWR — ON (as required).

c. ACRT/FLIR/M299 — INIT/TEST (via equipment status table).

d. FLIR Turret — Verify operation.

e. Hellfire Attack Menu — SELECT. Verify correct missile symbology.

If missile symbology incorrect:

f. RESET LAUNCHER — SELECT.

g. FLIR Turret — STOW.

h. Hellfire PWR — OFF.

12. RAD ALTs — TEST. Press and hold the RAD ALT PUSH-TO-TEST (PTT) button.

Note

Note altitude indicator pointers indicate 100 ±10 feet, the green self-test light illuminates, and aural radar altitude warning system (RAWS) tone heard in pilot and ATO headsets. Release the PTT button and indicator should return to zero.

13. EMCON — AS REQUIRED.

14. External power/data link hardwire — DISCONNECT (as required).

10.2.6 Taxi Checklist

1. Crew — SET FOR TAXI.

2. Lights — AS REQUIRED.

PROFILE

3. Ordnance/Pins/Covers — ARM/REMOVE (as required).
4. Chocks — OUT.

WARNING

With missiles uploaded, exercise extreme care when chocking and chaining to avoid damage to missile seeker or fins or injury to personnel.

5. Brakes — RELEASE AND CHECK.
6. TAIL WHEEL switch — UNLOCK.
7. BDHI, standby compass, AIs turn and slip — CHECK.

10.2.7 Takeoff Checklist

1. Lights — AS REQUIRED.
2. AFCS — AS REQUIRED.
3. STABIILATOR AUTO CONTROL pushbutton — ON.
4. CONTGCY PWR switch — AS REQUIRED.
5. PCLs — FLY.
6. Instruments, Caution/Advisories — CHECK.
7. Communication and navigation — AS REQUIRED.
   a. Transponder — AS REQUIRED.
   b. TACAN — AS REQUIRED.
8. FLIR turret — STOW (as required).
9. TAIL WHEEL switch — LOCK.
10. Harness — LOCKED.
11. Aircrewman Pretakeoff Checklist — COMPLETE.
12. Ordnance/pins/covers — ARM/REMOVE (as required).
13. Chocks/chains (Main, High Points, and Tail) — REMOVED.

WARNING

With missiles uploaded, exercise extreme care when chocking and chaining to avoid damage to missile seeker or fins or injury to personnel.

14. Brakes — AS REQUIRED.

PROFILE

15. RDR/BAR ALT pushbutton — AS REQUIRED.

Note

Do not engage RDR ALT HOLD until clear of deck edge.

10.2.8 Hover Checks

A B C D

1. Torque matching — CHECK. Note any abnormal torque matching on initial collective pull to a hover. Abnormal torque matching is indicated by a torque split of 5 percent to 10 percent, which may match in a stable hover.

WARNING

Abnormal torque matching may be indicative of an LDS malfunction. Do not fly the helicopter until maintenance action is performed.

A C D

2. Hover controllability — CHECK.
   a. Hover into wind.
   b. Cyclic position approximately centered.
   c. Left pedal should be slightly forward of neutral.

A D

3. AFCS hover — CHECK.
   a. SAS — CHECK.

Note

Properly functioning SAS will dampen induced pitch/roll rates, but will not necessarily return aircraft to trimmed attitude. The tendency to return to trimmed position should not be confused with a damped response.

Cyclic control inputs should be rapid, smooth, and produce desired change in approximately one second. While guarding cyclic, make input against trim and allow cyclic to return to trimmed position.

(1) SAS 2, AUTO PLT pushbuttons — OFF. SAS 1, TRIM, and SAS/BOOST pushbuttons — ON.

(2) Controllability — CHECK.

(a) Apply cyclic pulse to induce ±3° pitch attitude change. The helicopter should exhibit a damped response to the change.

(b) Apply cyclic pulse to induce ±5° roll attitude change. The helicopter should exhibit a damped response to the change.

(c) Make a ±20 percent torque change. The helicopter should exhibit a dampened response in yaw. (The helicopter should maintain heading within ±15°.)

PROFILE

(d) SAS 2 pushbutton — ON. SAS 1 pushbutton — OFF.

(e) Repeat steps (a) to (c). Damped responses of the helicopter should be noticeably increased due to addition of hover augmentation of SAS 2.

b. Autopilot — CHECK.

(1) SAS/BOOST, SAS 1, SAS 2, TRIM, and AUTO PLT pushbuttons — ON.

(2) Momentarily remove hands and feet from flight controls and monitor. Attitude retention in pitch and roll should be ±1° (calm wind). Heading hold should be ±2°.

(3) Induce cyclic pulse ±5° in pitch. Helicopter should return to trimmed attitude with no more than one overshoot of 3°.

(4) Repeat step (3) for cyclic roll pulse of ±10°.

(5) With feet off pedals, make a ±20 percent torque change. Helicopter should retain heading within ±2°.

A 4. Generator underfrequency — CHECK.

WARNING

Power transfer from the APU generator to the NO. 1 generator may cause disengagement of SAS 1, SAS 2, TRIM, AUTO PLT, and Stabilator which may cause rotors to dip as low as 4 feet.

Note

The APU generator should be on to ensure power is supplied to the VIDS in the event of generator dropoff.

a. APU — START, AS REQUIRED.

b. Retard NO. 1 and NO. 2 PCLs to slowly reduce N_r to 90 percent. Allow a 3-second time delay and note LOW ROTOR RPM warning light flashing below 96 percent N_r.

c. #1 GEN and #2 GEN cautions should not appear.

d. PCLs — FLY.

e. APU — SHUTDOWN (if not required).

A 5. Main Transmission oil pressure — RECORD (minimum 45 PSI).

A 6. RAST system main probe — CHECK.

a. Crewman open cargo hook door.

b. RAST MASTER — ON.

c. MAIN PROBE — DOWN. Status light indicates DN.

d. MESSENGER CABLE — DOWN. Status light indicates OUT.

PROFILE

e. Crewman verify main probe down, messenger cable out.

f. Raise messenger cable. Position switch to OFF when status light indicates messenger cable IN.

g. MAIN PROBE — UP. Status light indicates UP.

h. RAST MASTER — OFF.

i. Crewman close cargo hook door.

A C 7. Main rotor track and balance — AS REQUIRED.

10.2.9 Climb Checks

A C D 1. Stabilator position — CHECK. PNAC shall monitor and call out stabilator indicator position versus airspeed.

a. STAB POS indication should begin moving up at approximately 30 KIAS.

b. STAB POS indication should be approximately 25° by 60 KIAS.

A D 2. Flight instruments — CHECK.

a. Airspeed indicators — CHECK PILOT AND COPILOT INDICATORS. Maximum difference between indicators should not be over 5 knots. Note difference.

b. VSIs — CHECK.

c. Altimeters — CHECK.

d. BDHIs and compasses — CHECK.

10.2.10 Post Takeoff Checks

1. Instruments, Caution/Advisories — CHECK.
2. RDR/BAR ALT pushbutton — AS REQUIRED.
3. CONTGCY PWR switch — AS REQUIRED.
4. Lights — AS REQUIRED.
5. Aircrewman Post Takeoff Checklist — COMPLETE.
6. COMP controllers — SLAVED and aligned.
7. Manual fuel transfer — CHECK AS REQUIRED. (Short manual transfers from each auxiliary fuel tank should be checked. Main fuel level shall be 3,700 pounds or less prior to each transfer.)
8. HIT check — AS REQUIRED (see paragraph 7.17.1).

Note

- At a minimum, the HIT check shall be performed on the first flight of the day.
- For FCFs, HIT check is not required if performing HIT Baseline check.

PROFILE

9. Engine anti-ice check — AS REQUIRED (see paragraph 7.17.10).

10. Power Available — CHECK (as required).

a. ECS/ANTI-ICE and CONTGCY PWR switches — OFF.

b. Stabilize aircraft at intended operating altitude, level the VSI, ball centered, 100 to 130 KIAS. Airspeed is dependent on environmental conditions and gross weight.

c. Gradually increase collective until N_p begins to droop on either engine or maximum dual-engine torque limits are reached. Stabilize for 5 seconds and record indicated torque.

11. Tactical/Combat Checklist — AS REQUIRED (see paragraph 7.8).

10.2.11 Flight Checks

A C D

1. In-flight controllability — CHECK.

a. Increase airspeed to 100 KIAS and stabilize.

(1) Cyclic position — APPROXIMATELY CENTERED.

(2) Pedals — RIGHT PEDAL, CENTERED TO SLIGHTLY FORWARD OF NEUTRAL.

b. Airspeed indicators — CHECK PILOT AND COPILOT INDICATORS. Difference in indicators should not be over 5 KIAS. Note difference.

c. Vibrations — NOTE ANY ABNORMAL VIBRATION LEVEL.

d. VSI — CHECK FOR DIFFERENCES.

e. Hold a steady state autorotative descent at 100 KIAS with collective full down. Stabilator position should be 3° to 7° trailing-edge up. Record position.

A B

2. Engine power checks.

Note

Rapid reduction in PCL may result in rapid N_r decay.

a. Intermediate range power (IRP) limiter check/pre-maximum power check.

Note

- If N_r droops before 839° ±10 °C, the engine is N_g/fuel flow limited.
- If N_g/fuel flow or torque limited, the ENG ANTI-ICE switch for the engine being checked may be turned ON to increase TGT and verify limiter operation.
- The 839° ±10 °C limiter should be obtainable in OATs above -10 °C. If TGT exceeds 851 °C, discontinue IRP limiter and maximum power check.

PROFILE

(1) Set altimeter to 29.92; establish level flight at a convenient 1,000–foot interval.

(2) Verify ENG ANTI–ICE, CONTGCY PWR, AIR SOURCE/ECS START, and ECS switches OFF.

(3) Retard PCL on engine not being checked to 20 percent TRQ or less.

(4) While maintaining altitude, slowly increase collective until 2 percent N_r droop is obtained. Airspeed should be adjusted to maintain level flight. Ensure torque of engine not being checked remains below 20 percent as collective is increased.

(5) Stabilize for 10 seconds; TGT limit is 839° ±10 °C.

(6) Note TGT for IRP limiter check.

(7) With ENG ANTI–ICE switch OFF, record maximum TGT and maximum N_g for maximum power check.

b. Maximum power check.

(1) Maintain level flight at current altitude.

(a) If TGT limited, reduce collective to regain 100 percent N_r. Increase airspeed as necessary to obtain maximum TGT noted during step a.(7) while maintaining 100 percent N_r.

(b) If N_g/fuel flow limited, reduce collective to regain 100 percent N_r. Increase airspeed as necessary to obtain maximum N_g noted during step a.(7) while maintaining 100 percent N_r.

(2) Stabilize for 10 seconds and record PA, OAT, TRQ, TGT, N_g, and engine oil pressure and temperature.

c. Contingency range power (CRP) limiter check.

(1) CONTGCY PWR switch — ON.

(2) Increase airspeed as necessary; altitude may vary.

(3) Slowly increase collective until 2 percent N_r droop is obtained.

Note

- If N_r droops before 891° ±10 °C, the engine is N_g/fuel flow limited.
- If N_g/fuel flow or torque limited, the ENG ANTI–ICE switch for the engine being checked may be turned ON to increase TGT and verify TGT limiter operation.

(4) Stabilize for 10 seconds; TGT limit is 891° ±10 °C.

Note

The 891° ±10 °C limiter should be obtainable in OATs above –10 °C. If TGT exceeds 903 °C, discontinue the CRP limiter check.

(5) Record TGT.

(6) Advance PCL to FLY.

PROFILE

(7) Reduce collective, check TGT below IRP limiter, CONTGCY PWR switch — OFF.

(8) ENG ANTI–ICE switch — OFF (as required).

(9) AIR SOURCE ECS/START switch — ENG.

Note

If contingency power is secured with TGT greater than 839° ±10 °C, N_r will droop.

d. Repeat steps a. to c. for other engine as required.

e. Engine calculations.

(1) Determine torque adjusted (TRQADJ):

(a) For OAT greater than –20 °C, TRQADJ = TRQMEAS. (Torque measured during Max Power Check).

(b) For OAT less than –20 °C, TRQADJ = TRQMEAS + [0.2 X (TGTREF – TGTMEAS)]. TGTREF is obtained from the Torque Factor TGT Reference Chart (Figure 10-5) for the OAT recorded during the maximum power check.

(2) Determine the target torque value (TTV) using the Maximum Power Check Chart (Figure 10-6) for the OAT and pressure altitude recorded during the maximum power check.

(3) Specification torque ratio (STR) = TRQADJ ÷ TTV.

(4) Determine engine torque factor (ETF). Enter Torque Factor Chart (Figure 10-7) with calculated STR and OAT recorded during maximum power check.

(a) If OAT is below –5 °C, use the -5 °C line.

(b) If OAT is above 35 °C, use the 35 °C line.

(c) If STR is greater than 1.0, then ETF equals 1.0.

(5) If ETF is at or above .90, engine performance is satisfactory. If ETF is below .90, engine performance is unsatisfactory.

(6) Record ETF on FCF record card and HIT/Power Check Log (Figure 10-3).

A B 3. HIT baseline check (in flight) — AS REQUIRED.

Note

- HIT baseline may be established on deck or in flight. Subsequent HIT checks should be done in the same regime as HIT baseline.
- If icing conditions exist, consideration should be given to performing HIT Check on deck.
- HIT Checks shall be performed on the first flight of the day and recorded on the HIT/Power Check Log (Figure 10-3) for monitoring trends in engine performance.

PROFILE

a. ENG ANTI-ICE switches — OFF.

CAUTION

If icing conditions exist, do not keep ENG ANTI-ICE OFF longer than necessary to perform check.

b. ECS — OFF.

c. BAR ALT — SET TO 29.92.

d. N_r — 100 Percent.

e. Collective — INCREASE TO MAINTAIN 60 PERCENT TRQ FOR AT LEAST 30 SECONDS.

f. Record OAT, PA, and TGT.

g. Repeat steps e. and f. resetting TRQ for a total of three times.

h. Repeat steps e. to g. for the other engine as required.

i. Calculate average indicated of three indicated TGT readings.

j. Determine table TGT from the HIT TGT Reference Table (Figure 10-4) for recorded OAT and pressure altitude. Record TGT on baseline worksheet.

Note

When using HIT table, round OAT up, and pressure altitude to the nearest value.

k. Subtract average indicated TGT from table TGT to establish TGT margin.

l. Establish TGT upper and lower limits by adding 20 °C to TGT margin and subtracting 20 °C from TGT margin (step k.). Record upper and lower limits on HIT/Power Check Log (Figure 10-3) in helicopter ADB.

A B 4. ENG ANTI-ICE system — CHECK (as required).

a. PCL (engine not being checked) — AS REQUIRED.

WARNING

Failure of the ENG ANTI-ICE ON advisory to illuminate when the ENG ANTI-ICE switch is selected to ON, or when the N_g is below approximately 88 percent regardless of the switch position; or constant illumination of the ENG ANTI-ICE ON advisory with N_g greater than 90 percent (94 percent if OAT is 15 °C or greater) and the ENG ANTI-ICE switch OFF are indicative of a malfunctioning anti-ice/start bleed valve. This condition may cause engine flameout during low power settings such as quick stops and autorotative flight.

PROFILE

Note

- Engine Anti-ice Check should be performed into the wind on deck, in a hover over a suitable landing pad, or in a stable, level-flight regime.
- On deck or in a hover, it may be necessary to retard the PCL on the engine not being checked to prevent a vertical climb.

b. ENG ANTI-ICE switch (engine being checked) — OFF.

c. Collective — RAISE TO INCREASE N_g OF ENGINE BEING CHECKED TO 90 PERCENT OR ABOVE. (94 percent or above if OAT is above 15 °C).

d. ENG ANTI-ICE ON advisory (engine being checked) — OFF.

e. ENG ANTI-ICE switch (engine being checked) — ON.

Confirm:

(1) ECS SHUTDOWN caution (if ECS on and AIR SOURCE ECS/START switch — ENG).

Note

ECS will not shut down if AIR SOURCE ECS/START switch is in APU.

(2) TGT increases 30 ºC to 100 ºC.

(3) ENG ANTI-ICE ON advisory appears.

(4) ENG INLET ANTI-ICE ON advisory:

(a) OAT above 13 ºC — OFF.

(b) OAT above 4 ºC up to 13 ºC — MAY APPEAR.

(c) OAT 4 ºC and below — APPEARS.

WARNING

A TGT increase greater than 100 ºC and/or appearance of either ENG INLET ANTI ICE ON advisory when OAT is above 13 ºC may result in a loss in available torque at intermediate power up to 49 percent when the engine anti-ice system is activated. If any part of the engine anti-ice check fails, maintenance action is required prior to flight into icing conditions.

Note

ENG INLET ANTI-ICE ON advisory illuminates when engine inlet temperature reaches 93 ºC which may take approximately 90 seconds.

PROFILE

f. ENG ANTI-ICE switch (engine being checked) — OFF.

Confirm:

(1) TGT decreases.

(2) ENG ANTI-ICE ON advisory — DISAPPEARS.

(3) ECS — ON (if ECS on and AIR SOURCE ECS/START switch — ENG).

(4) ENG INLET ANTI-ICE ON advisory — DISAPPEARS (after approximately 90 seconds).

g. PCL (engine not being checked) — Advance to FLY (as required).

h. Repeat steps a. to g. for other engine.

A B — 5. ECS — CHECK.

a. AIR SOURCE ECS/START switch — ENG.

b. APU CONTROL switch — OFF.

c. ECS MODE switch — AUTO.

d. ECS TEMP knob — COLD. (Cold air should flow from vents.)

e. ECS TEMP knob — HOT. (Hot air should flow from vents.)

f. NO. 1 or NO. 2 ENG ANTI-ICE switch — ON.

g. ECS SHUTDOWN caution — APPEARS. (No airflow from vents.)

h. ENG ANTI-ICE switch — OFF. (ECS SHUTDOWN caution OUT and hot air flows from vents.)

i. ECS MODE switch — MAN.

j. ECS HOT/COLD switch — COLD. Hold until cold air flows from vents, then switch to HOT. Hold until hot air flows from vents, then release.

k. CONTGCY PWR switch — ON.

l. ECS SHUTDOWN caution and #1 ENG CONT PWR and #2 ENG CONT PWR advisories — ON. No airflow from vents.

m. CONTGCY PWR switch — OFF. ECS SHUTDOWN caution and #1 ENG CONT PWR ON and #2 ENG CONT PWR ON advisories OUT. Hot air flows from vents.

n. ECS MODE switch — AS DESIRED.

A C — 6. Main rotor track and balance (120 KIAS) — AS REQUIRED.

A B C D — 7. Vibration analysis (cabin health, nose absorber) (120 KIAS) — AS REQUIRED.

A C D — 8. Stabilator — CHECK.

a. Trim 120 KIAS in level flight.

b. Check stabilator position 1° to 7° trailing-edge down.

c. Enter a sideslip by applying left pedal against trim until ball is displaced one ball width to the right. Check stabilator position moves down 3° from trimmed position.

PROFILE

d. Release pedals and check that ball returns to one-half ball width of center, and helicopter returns to within ±1° of trimmed heading.

e. Repeat step c. with right pedal and one ball width to the left. Check stabilator position moves up 3° from trimmed position.

f. With fixed collective in balanced flight and feet off pedals, roll into a 45° AOB turn against trim. Maintain 120 KIAS (this check will result in a loss of altitude).

Check:

(1) Maneuvering stability – aft cyclic is required to maintain 120 KIAS.

(2) Stabilator position moves 1° down from trim.

g. Release cyclic and allow aircraft to return to straight and level flight.

Check:

(1) No adverse pitch movements.

(2) Stabilator returns to trimmed position.

A D 9. AFCS in-flight check.

a. Trim 120 KIAS in level flight.

b. SAS check.

Note

- This check should be performed in smooth air. Cyclic control inputs should be rapid, smooth, and produce desired attitude change in approximately 1 second. While guarding cyclic, make input against trim and allow cyclic to return to trim position.
- Properly functioning SAS will dampen induced rates, but will not necessarily return aircraft to trimmed attitude. The tendency to return to trimmed position should not be confused with a damped response.

(1) SAS/BOOST, SAS 1, and TRIM pushbuttons — ON.

(2) SAS 2 and AUTO PLT pushbuttons — OFF.

(3) Apply cyclic pulse to induce ±3° pitch attitude changes against trim. Helicopter attitude should exhibit a damped response.

(4) Repeat step (3) for 5° roll attitude changes against trim.

(5) Repeat steps (3) and (4) with SAS 2 pushbutton ON and SAS 1 pushbutton OFF. Note an improved response with SAS 2 pushbutton ON attributed to the addition of gust alleviation.

(6) SAS 1 and AUTO PLT pushbuttons — ON.

PROFILE

c. Autopilot check.

(1) Attitude and heading retention — CHECK.

Note

Steady state attitude/heading retention tolerance in smooth air should be ±1° pitch, roll, and heading. Airspeed retention should be ±10 KIAS.

(a) Apply a forward cyclic pulse against trim to change pitch attitude 5°.

(b) Attitude should return to trim with no more than one overshoot.

(c) Repeat steps (a) and (b) for aft cyclic.

(d) Apply a right cyclic pulse against trim to change roll attitude 10°.

(e) Attitude should return to trim with no more than one overshoot.

(f) Repeat steps (d) and (e) for left cyclic.

(g) Without pressing trim release switches, press pedals to displace ball one width from center.

(h) Release pedals. Ball should return to 1/2 ball width of center and heading should return within ±1° of trimmed heading.

(i) Repeat steps (g) and (h) for opposite direction.

(j) With pedal trim switches depressed and no force on pedals, roll helicopter against trim into a 30° AOB and release. Helicopter should return to its original attitude with only a slight overshoot and without adverse pitch.

(k) Repeat step (j) for opposite direction. Response should be the same.

d. Coordinated turn check.

(1) With feet off pedals, roll helicopter into a 45° AOB.

(2) Ball should stay within 1/2-width of center.

(3) Roll wings level.

(4) Ball should return to center.

(5) Repeat steps (1) to (4) for opposite direction.

e. Cyclic and yaw trim check.

(1) Using the four-way trim switch, roll helicopter into 30° AOB.

(2) Roll should be smooth at approximately 6° per second.

(3) Release the four-way trim switch at 30° AOB. Helicopter should retain this AOB with a slight overshoot, cyclic should return to center, and ball should stay within 1/2 ball-width of center.

(4) Return helicopter to level attitude using four-way trim switch, noting smooth response.

(5) Repeat steps (1) through (4) in opposite direction.

PROFILE

(6) Beep cyclic forward for 2 seconds. Airspeed should increase 12 ±5 KIAS.

(7) Beep cyclic aft for 2 seconds. Airspeed should decrease 12 ±5 KIAS.

(8) Apply collective HDG TRIM switch to change helicopter heading 5°. The first degree should be a flat turn for 1 second. The remaining 4° should be coordinated at 1° per second.

(9) Repeat step (8) for opposite direction. Response should be the same.

f. Airspeed hold check.

(1) Trim aircraft to 120 KIAS.

(2) Slowly increase airspeed 10 KIAS by pushing cyclic against trim.

(3) Note force required and release cyclic to trim position.

(4) Airspeed should return to 120 ±5 KIAS with no more than one overshoot.

(5) Decrease airspeed 10 KIAS by pulling slowly aft on cyclic against trim.

(6) Note force required and release cyclic to trim position.

(7) Airspeed should return to 120 ±5 KIAS with no more than one overshoot.

(8) Press cyclic trim release to increase airspeed to 130 KIAS. When airspeed reaches 130 KIAS, release cyclic trim release.

(9) Airspeed should hold at speed when trim release is released.

(10) Repeat steps (8) and (9) decreasing airspeed to 120 KIAS.

g. Barometric and radar altimeter hold/heading hold check.

(1) SAS/BOOST, SAS 1, SAS 2, TRIM, and AUTO PLT pushbuttons — ON.

(2) BAR ALT pushbutton — ON.

(3) Steady-state altitude retention should be ±10 feet.

(4) Enter a standard-rate turn for 180°. Steady-state altitude retention should be ±10 feet with ±30 foot transient.

(5) Increase AOB to at least 30°. Steady-state altitude retention should be ±30 feet with ±60 foot transient.

(6) Repeat steps (4) and (5) in opposite direction.

(7) With helicopter in trimmed straight and level flight, enter a 500-fpm rate of descent against collective and release. Heading retention should be ±1°. Helicopter should return to within ±10 feet of initial altitude.

(8) Repeat step (7) for climb.

(9) Press collective TRIM RELEASE and establish a 500-fpm rate of descent.

(10) Release collective TRIM RELEASE. Note BAR ALT pushbutton is ON and altitude is within ±10 feet of designated altitude.

(11) BAR ALT pushbutton — OFF, RDR ALT pushbutton — ON.

PROFILE

(12) Repeat steps (3) to (10) using RDR ALT hold. Altitude retention tolerances are the same as with the BAR ALT.

(13) RDR ALT/BAR ALT pushbutton — OFF.

A C 10. Flight checks (140 KIAS):

a. Increase airspeed to 140 KIAS and stabilize.

b. Airspeed indicators — CHECK. Pilot and copilot indicator difference should not be more than 5 KIAS. Note difference.

c. Vibrations — NOTE ANY ABNORMAL VIBRATIONS.

A C 11. Main rotor track and balance (140 KIAS) — AS REQUIRED.

A C 12. Vibration analysis (4–per, cabin absorbers) (140 KIAS) — AS REQUIRED.

A C D 13. Flight checks (Vh):

a. Increase airspeed in level flight to Vh (106 percent TRQ or 839 °C ±10 TGT, whichever occurs first).

(1) Cyclic — CENTERED LATERALLY. (At least 2 inches of forward cyclic should remain.)

(2) Pedals — RIGHT PEDAL. (Should be no more than 1 inch forward of neutral.)

(3) Collective — Should not be against upper stop.

b. Stabilator position – 0° to 4° — Trailing–edge down.

c. Vibrations — NOTE ANY ABNORMAL VIBRATIONS.

d. Airspeed indicators — CHECK. Pilot and copilot indicator difference should not be more than 5 KIAS. Note difference.

A C 14. Main rotor track and balance (Vh) — AS REQUIRED.

A B C D 15. Absorber Tuning — AS REQUIRED.

CAUTION

Do not exceed Torque, N_p, or TGT limitations.

Note

Collect ATABS data in accordance with the A1–H60–CA–VIB–100 Manual.

a. Increase airspeed to 140 KIAS and stabilize.

b. ENG SPD Trim switch — SET N_g to 97 percent.

c. ATABS — Collect Data.

d. Repeat steps b. and c. for 98, 99, 99.5 100 and 100.5 percent N_r.

e. Decrease airspeed to within the calculated single engine envelope.

PROFILE

f. ENG SPD trim switch — SET N_r to 98 percent.

WARNING

Adjustment of the PCLs outside of the helicopter single engine envelope may result in an unrecoverable loss of N_r following an engine malfunction.

g. PCL (engine with lowest ETF) — MOMENTARILY ADVANCE TO LOCKOUT. RETARD TO SET 100 PERCENT N_r.

h. Increase airspeed to 140 KIAS and stabilize.

i. PCL — ADJUST AS REQUIRED TO MAINTAIN N_r AT 100 PERCENT.

j. ENG SPD Trim switch — SET N_r TO 101 PERCENT.

k. ATABS — COLLECT DATA.

l. Repeat steps j. and k. for 102 percent N_r.

m. Decrease airspeed to within the calculated single engine envelope.

n. PCL (engine in Lockout) — RETARD TO IDLE THEN ADVANCE TO FLY.

o. ENG SPD Trim switch — SET N_r TO 100 PERCENT (as required).

A D 16. Automatic approach, hover coupler, and departure check.

a. Automatic approach — CHECK.

(1) Automatic Approach Checklist — COMPLETE. HVR ALT rotary knob set to 80 feet, LONG VEL and LAT VEL controls set to 0, and SAS 2, TRIM, AUTO PLT pushbuttons — ON.

(2) Trim helicopter for 100 KIAS and 200 feet altitude, heading into wind.

(3) Automatic approach — ENGAGE. Check for steady RDR ALT hold light. Helicopter should decelerate at 1 knot per second.

(4) As helicopter decelerates below 80 knots groundspeed, radar altitude hold disengages and a 120 feet-per-minute rate of descent will be commanded.

(5) At 60 KIAS, transition is made from heading hold to Doppler mode, eliminating lateral drift.

(6) Helicopter should approach a hover at 80 feet and approximately 10 knots longitudinal groundspeed.

(7) At ±2 feet of HVR ALT setting, RADALT hold engages.

(8) At 1 KGS, HVR mode engages. HVR pushbutton illuminates.

PROFILE

Note

If water is smooth, the Doppler may go into memory mode and deceleration and drift will have to be controlled manually. As the helicopter approaches 80 feet, the radar altimeter hold will engage. When approaching a hover, the rotor wash will disturb the water surface enough to receive a Doppler return, however, pilot must reengage Approach/ Hover.

b. Hover coupler — CHECK.

(1) Helicopter should hover within ±4 feet of HVR ALT setting and ±2 KGS with the LONG VEL and LAT VEL rotary knobs set at 0.

(2) Start a 10-knot lateral drift against trim. Cross-check with hover bars and Doppler. Release cyclic.

(3) Helicopter should return to a stable hover.

(4) Repeat steps (2) and (3) for opposite lateral and longitudinal drift directions.

(5) LAT VEL rotary knob — Set to establish a 10-knot drift. Cross-check with hover bars and Doppler. Return LAT VEL rotary knob to 0. Helicopter should return to and maintain previously established hover.

(6) Repeat step (5) for LAT VEL rotary knob in opposite direction.

(7) Repeat steps (5) and (6) for LONG VEL in forward and aft directions.

(8) Repeat steps (5) to (7) using four-way TRIM switch. Cross-check with hover bars and Doppler. Once 10-knot drift is established press cyclic TRIM REL button and release. Helicopter should return to a stable hover.

(9) Move collective HDG TRIM switch to L and hold.

(10) Helicopter should change heading to the left at 3° per second. When switch is released, helicopter should synchronize on the heading when released within ±2°.

(11) Repeat steps (9) and (10) to the right.

(12) Reestablish a stable hover into the wind.

(13) HVR ALT rotary knob — 150 FT.

(14) Helicopter should climb to 150 ±4 feet with only one overshoot. Rate of climb should not exceed 1,000 fpm. Upward collective movement should cease when torque reaches a maximum of 116 percent; however, transients above 116 percent are possible.

(15) RADAR ALTIMETER variable index — SET TO 80 FT.

(16) HVR ALT rotary knob — 70 FT. Check for RAWS tone descending through 80 feet (check for both pilot and copilot).

(17) Helicopter should descend to 70 ±4 feet with only one overshoot and torque limits as shown above. Rate of descent should not exceed 250 fpm.

PROFILE

(18) HVR ALT control — 30 feet. Check for continuous RAWS tone and light below 35 feet.

(19) HVR ALT control — RESET to desired altitude.

c. Crew hover — CHECK.

(1) CREW HVR pushbutton — ON.

(2) HOVER TRIM light on Crew Hover Control Panel should illuminate.

(3) Hover trim grip TRIM switch — PRESS FOR FORWARD DRIFT.

Note

The control authority of the crewman is limited to 5 knots of groundspeed in longitudinal and lateral directions in either axis around the lateral and longitudinal velocity set on the AFCS control panel. The HOVER TRIM switch output is pressure sensitive. Increase pressure to command an increase in groundspeed.

(4) Release switch pressure. Helicopter should return to stable hover.

(5) Repeat steps (3) and (4) for aft, left, and right.

(6) CREW HVR pushbutton — OFF.

(7) HOVER TRIM light on Crew Hover Control Panel should extinguish.

d. Departure — CHECK.

(1) HVR pushbutton — ILLUMINATED.

(2) Cyclic DEPART HOVER button — PRESS. DPRT light on AFCS CONTROL panel should illuminate.

(3) Helicopter should make smooth transition to 480 feet-per-minute rate of climb and 2 knots-per-second acceleration, and fly to 500 feet altitude for RDR ALT hold and 100 KIAS for airspeed hold trimmed.

(4) Automatic Approach — ENGAGE.

(5) During deceleration, beep cyclic aft for 2 seconds to verify deceleration increase of 1 knot/second.

(6) At airspeed less than 50 KIAS, press cyclic DEPART HOVER button.

(7) Prior to reaching 500 feet AGL and 100 KIAS, momentarily press collective TRIM RELEASE switch and cyclic TRIM RELEASE button. The AFCS should stabilize the helicopter at the altitude and airspeed at the point of release. RAD ALT hold remains ON.

A 17. Navigation, mission, and communication equipment — TEST/CHECK OPERATION.

a. UHF-1 and -2.

b. UHF backup (pilot/copilot).

c. HF.

d. TACAN.

PROFILE

e. UHF/ADF.

f. Doppler navigation.

g. IFF/interrogator.

h. MAD.

i. RADAR.

j. Equipment status table.

k. GPS.

A 18. Fuel dump — CHECK.

WARNING

Fuel dumping should be manually terminated at no less than 600 pounds total fuel. With less than 600 pounds of fuel, fuel starvation may occur when balanced flight is not maintained and/or pitch attitudes exceed 15° nose up or nose down.

a. Determine the amount of fuel to be dumped.

b. BuNo 162349 and subsequent, FUEL MGT control panel — TRANSFER/MANUAL OVRD.

c. ALE-39 power — OFF.

d. FUEL DUMP switch — DUMP.

e. FMCP — FUEL DUMP light illuminated, as applicable.

After the desired quantity has been dumped:

f. FUEL DUMP switch — OFF.

WARNING

Internal wear of the fuel dump switch guard may not move the switch to the OFF position. Aircrew must verify switch position when completing dumping procedures.

g. Observe the fuel readout to ensure that dumping has ceased.

If fuel dumping continues:

h. FUEL DUMP circuit breakers — PULL.

(1) FUEL DUMP NO. 1 (CENTER, NO. 1 AC PRI, ROW 1, CB 13).

(2) FUEL DUMP PUMP (CORNER, NO. 2 AC PRI, ROW 1, CB 1).

(3) FUEL DUMP CONTR (ATO OVERHEAD, DC ESNTL, ROW 3, CB 1).

PROFILE

i. FUEL DUMP switch — CYCLE.

j. **Land as soon as practical**.

A 19. FUEL MGT control panel — CHECK. (Short manual transfer from each auxiliary fuel tank should be checked if installed. Main fuel level shall be 3,700 pounds or less prior to each transfer.)

a. FMCP MASTER/MODE switches — TRANSFER/MANUAL OVRD.

b. External AUX tank pushbutton — SELECT.

c. Confirm FMCP FLOW light illuminates for selected tank.

d. FMCP MASTER — STOP FLOW.

e. Confirm FMCP FLOW light extinguishes.

f. Repeat steps a. to e. for remaining AUX tanks.

g. FMCP MASTER/MODE switches — AS REQUIRED.

A C 20. Autorotation rpm check.

a. Climb to a suitable autorotation altitude.

b. When climbing through check altitude, record OAT, pressure altitude (set 29.92 on BAR ALT), and gross weight.

c. Level off and stabilize at 75 KIAS.

WARNING

- Transient N_p up-speeds of several seconds duration are typically encountered during autorotation entry and recovery. During entry, the N_p should split (decrease) away from N_r prior to reaching 109 percent and reduce to a value of 100-103 percent N_p (PCLs in FLY). When the main rotor has split away from N_p, transient values as high as 110-114 percent N_p may be seen when collective pull is initiated. This behavior is normal. If the N_p follows N_r in a steady manner for N_r values exceeding 109 percent, or recovery N_p peak exceeds 114 percent, an LDS malfunction is indicated. Discontinue further autorotational flight. Lowering the collective to minimum with an engine LDS malfunction will cause N_p and N_r to rise rapidly and may cause activation of N_p overspeed resulting in engine shutdown.
- Conduct autorotation rpm check at an altitude that will allow for power recovery at a safe altitude. If possible, have a suitable forced landing area within range.

PROFILE

d. Slowly reduce collective to minimum and maintain 75 KIAS in balanced flight.

CAUTION

If N_r is less than 90 percent or greater than 120 percent, initiate a power recovery.

e. Vibrations — NOTE ANY ABNORMAL LEVEL.

f. Airspeed indicators — CHECK. Note difference. Pilot and copilot difference should not be greater than 5 KIAS.

g. Record N_r when passing through the desired pressure altitude.

h. Execute a power recovery and verify proper N_p/N_r response.

i. Compute DA at which stabilized N_r was recorded (Figure 10-8).

j. Verify autorotational N_r satisfies requirements of Autorotation RPM Correction Chart within 2 percent (Figure 10-9).

10.2.12 Landing Checklist

1. CONTGCY PWR switch — AS REQUIRED.
2. Lights — AS REQUIRED.
3. Brakes — AS REQUIRED.
4. TAIL WHEEL switch — LOCK.
5. Instruments, Caution/Advisories — CHECK.
6. BAR ALT/RAD ALT — AS REQUIRED.
7. HF Radio — OFF.
8. Armament — SAFE.
9. Harness — LOCKED.
10. Aircrewman Before Landing Checklist — COMPLETE.
11. FLIR — STOW.
12. Return to Force Checklist — AS REQUIRED.

10.2.13 Post Landing Checklist

1. Lights — AS REQUIRED.
2. Tail Wheel/Brakes — AS REQUIRED.
3. CONTGCY PWR switch — OFF.
4. Ordnance pins/covers — DEARM/SAFE/INSTALL (as required).

CAUTION

Install Hellfire missile seeker covers (if available) before all ground operations and before all chock and chain operations.

PROFILE

5. M299 launcher SAFE/ARM switch — SAFE.

6. Chocks and Chains — AS REQUIRED.

WARNING

With missiles uploaded, exercise extreme care when chocking and chaining to avoid damage to missile seeker or fins or injury to personnel.

7. Transponder — STBY.

8. ENGINE ANTI-ICE/PITOT HEAT/BLADE DE-ICE — OFF.

WARNING

The pitot and static ports become extremely hot during operation. Care should be taken to prevent ground personnel from touching these surfaces. Failure to turn off pitot heat could burn personnel whenever external power is applied.

10.2.14 Shutdown

1. TAIL WHEEL switch — LOCK.
2. Parking brake — SET.
3. Chocks — IN.
4. APU — START.
   a. ECS — OFF.
   b. AIR SOURCE ECS/START switch — APU.
   c. FUEL PUMP switch — APU BOOST.
   d. APU CONTR switch — ON.
5. APU GENERATOR switch — ON.
6. IFF MODE 4 CODE — HOLD (as required).
7. Avionics.
   a. DOPPLER — AS REQUIRED.
   b. MPDs — AS REQUIRED.
   c. SAC power — OFF.
   d. FLIR power — OFF.
   e. MSN power — OFF.

PROFILE

f. RDR — STBY.

g. Data link — STBY.

h. TACAN — OFF.

i. IFF MASTER — OFF.

j. RADALTs — OFF.

8. BACKUP HYD PMP switch — ON.

Note

FLIR EU PWR should be secured prior to cycling the BACKUP HYD PMP switch because the associated power surge may cause a gimbal lock.

9. Flight controls — POSITION AND HOLD.

10. NO. 1 and NO. 2 GENERATOR switches — OFF.

WARNING

Power transfer from the APU generator to the NO. 1 generator may cause disengagement of SAS 1, SAS 2, TRIM, AUTO PLT, and Stabilator which may cause rotors to dip as low as 4 feet.

11. ENGINE IGNITION switch — OFF.

12. Lights — AS REQUIRED.

13. PCLs — IDLE.

CAUTION

Engines should be cooled for 2 minutes at an N_g of 90 percent or less before moving PCLs to OFF. If an engine is shut down without being cooled, it should not be restarted for 4 hours unless restart is performed within 5 minutes.

14. NO. 2 PCL and fuel selector — OFF.

15. Droop stops — IN.

16. NO. 1 PCL and fuel selector — OFF.

17. Rotor brake — ON (between 30 percent and 50 percent N_r).

18. TGT — MONITOR.

CAUTION

If TGT rises above 540 °C, perform Internal Engine Fire emergency procedure.

PROFILE

A B

19. DECU codes — CHECK.

20. Engine cleaning — AS REQUIRED (see paragraph 7.17.12).

Note

If engine cleaning is required, proceed to step 14 of Engine Cleaning Procedures.

21. Blade fold — AS REQUIRED.

CAUTION

- Should the blade fold system stall during fold, cycling the BLADE FOLD switch to SPREAD should return the rotor blades to the spread position.
- Shut down the APU immediately if a rotor blade remains stalled in the APU exhaust.
- When the ROTOR SPREAD light is not illuminated, pressing the RDR ALT pushbutton during blade fold system operations may cause failure of the automatic system. Do not press this pushbutton during blade fold operations.
- Simultaneous folding of main rotor blades and tail pylon is prohibited.

Note

Failure to suppress the DECU numerical fault codes on the PDU will prevent the automatic blade fold from operating due to the torque signal being relayed to the AFCS computer. Codes can be suppressed by pressing either OVSP TEST A or B buttons for the affected engine.

a. Area — CLEAR (wing walkers positioned as required).

b. BACKUP HYD PMP switch — ON.

c. STABILATOR AUTO CONTROL — OFF.

d. SAS 1 and SAS 2 — OFF, TRIM — ON, AUTO PLT — OFF.

e. SERVO switch — 1ST OFF or 2ND OFF.

f. BLADE FOLD MASTER switch — ON.

g. BLADE FOLD switch — FOLD.

h. Rotor brake — OFF.

i. ROTOR INDEXED light — ILLUMINATED.

PROFILE

Note

Blades may be manually indexed if the main rotor index actuator/gust lock fails. Cycling the BLADE FOLD switch OFF, pulling the RTR HEAD INDEX MOTOR circuit breaker (NO. 2 AC PRI, SO OVHD, ROW 3, CB 5), and cycling the BLADE FOLD switch to FOLD may disengage the indexer. Rotate the rotor system until the INDEXED light illuminates, then continue with the Blade Fold Checklist.

j. Rotor brake — APPLY.

k. BAR ALT — FLASHING.

l. Collective, cyclic, and pedals — FREE TO POSITION.

Note

If computer is unable to null after 30 seconds, the AFCS DEGRADED caution will appear. To attempt another cycle, turn BLADE FOLD switch OFF, press any FAIL ADVISORY MODE RESET pushbutton, and repeat blade fold sequence.

m. BAR ALT pushbutton — PRESS.

Note

The following blade status panel light sequence indicates proper operation of the fold cycle: TRIM light flashing (blades positioned for pitch lock insertion) and PITCH LOCKED light illuminated (last pitch lock in). Blades will begin folding following the illumination of the PITCH LOCKED light. Should the INDEXED light flicker or extinguish during folding (indicating a loss of index), the blade fold sequence will stall. Cycling the BLADE FOLD switch to SPREAD should clear the stall. When the SPREAD light illuminates, the rotor head may be re–indexed and another fold cycle attempted.

n. ROTOR FOLDED light — ILLUMINATED.

o. BLADE FOLD switch — OFF.

p. BLADE FOLD MASTER switch — OFF.

q. SERVO switch — CENTER.

22. BACKUP HYD PMP switch — OFF.

23. ECS — OFF.

24. Exterior/interior/NVD lights — OFF.

PROFILE

25. APU GENERATOR switch — OFF.

26. APU — SHUTDOWN.

    a. AIR SOURCE ECS/START switch — OFF.

    b. APU CONTR switch — OFF.

    c. FUEL PUMP switch — OFF.

27. BATT switch — OFF.

10.2.15 Post Flight Checks

1. Interior equipment.
2. Tires/struts.
3. Leaks.
4. Missing panels.

10.3 ENGINE POWER CHECKS

The Engine Torque Factor method provides an accurate indication of available power by incorporating ambient temperature effects into the power available calculation. An in-flight check will be made under the following conditions:

1. When a new engine is installed.
2. When an engine is reinstalled.
3. When an engine fails the HIT check for other than a faulty anti-icing start/bleed valve or a dirty compressor.

10.3.1 Torque Factor Terms

The following terms are used when determining the maximum torque available:

1. Torque Ratio (TR): The ratio of torque available to specification torque at the desired ambient temperature.
2. Engine Torque Factor (ETF): The ratio of an individual engine's torque available to specification torque at a reference temperature of 35 °C.
3. Aircraft Torque Factor (ATF): The ratio of an individual aircraft's power available to specification power at a reference temperature of 35 °C. The ATF is the average of the ETFs of both engines.
4. Specification Torque Ratio (STR): The ratio of the adjusted actual torque to the specification torque or target torque at ambient conditions.

10.3.2 Maximum Power Check Chart

The Maximum Power Check Chart (Figure 10-6) presents the Target Torque Value (TTV) at 120 KIAS and 100 percent N_r for the operational range of PA and OAT. The single- and dual-engine transmission limits for continuous operation are shown and should not be exceeded.

PROFILE

10.3.3 Torque Factor Chart

The Torque Factor Chart (Figure 10-7) is used for obtaining the ETF by normalizing the STR to a referenced temperature of 35 °C. For temperatures below –5 °C use –5 °C, and for temperatures above 35 °C use 35 °C.

10.3.4 Torque Factor TGT Reference

The Torque Factor TGT Reference Chart (Figure 10-5) is used to compute TRQ adjusted when OAT is below –20 °C.

10.3.5 Torque Factor Procedure

The objective of the torque factor procedure is to obtain an ETF for each engine. This is accomplished by taking data during an in–flight maximum power check and then using this data along with the Torque Factor charts to calculate an ETF. The ETF is then displayed on the HIT/Power Check Log (Figure 10-3) for use by operational pilots and maintenance personnel.

10.3.6 Torque Factor Procedure In Flight

The inflight check will be conducted to establish/reestablish the ETF and to ensure that the engine meets minimum power requirements. Performance data will be taken at an engine–limiting condition, while maintaining constant altitude and adjusting airspeed as required. The ENG ANTI–ICE, ECS, and AIR SOURCE ECS/START switches must be OFF and the altimeter will be set at 29.92 In–Hg. Data will be taken one engine at a time. If the maximum power check is being performed because of a single engine installation/reinstallation or failed HIT check, it is at the maintenance officer's discretion to obtain new ETF data for the other engine.

PROFILE

10.3.7 Sample Problem 1

1. Recorded during maximum power check, N_g limited. SH–60B.

   a. PA = 2,000 feet.

   b. OAT = –30 °C.

   c. TGT measured = 790 °C.

   d. TRQ measured = 126 percent.

   e. From Figure 10-6 TTV = 130 percent.

   f. From Figure 10-5 TGT ref = 802 °C.

   g. Calculate TRQ adj:

      (1) TRQ adj = TRQ measured + 0.2 (TGT ref) – 0.2 (TGT measured).

      (2) TRQ adj = 126 + 0.2 (802–790).

      (3) TRQ adj = 126 + 2.4.

      (4) TRQ adj = 128.4 percent.

   h. Calculate STR:

      (1) STR = TRQ adj/TTV.

      (2) STR = 128.4/130.

      (3) STR = 0.987.

   i. Determine ETF:

      (1) From Figure 10-7 (using –5 °C line) ETF = 0.957 (satisfactory performance).

10.3.8 Sample Problem 2

1. Recorded during maximum power check, N_g limited. SH–60B.

   a. PA = 1,000 feet.

   b. OAT = 20 °C.

   c. TGT measured = 840 °C.

   d. TRQ measured = 112 percent.

   e. From Figure 10-6, TTV = 122 percent.

   f. Calculate TRQ adj:

      (1) TRQ adj = TRQ measured.

      (2) TRQ adj = 112.

PROFILE

g. Calculate STR:

(1) STR = TRQ adj/TTV.

(2) STR = 112/122.

(3) STR = 0.918.

h. Determine ETF:

(1) From Figure 10-7 (using 20 °C line), ETF = 0.878 (unsatisfactory performance).

10.4 FUNCTIONAL CHECKFLIGHT CHARTS AND TABLES

TEMPERATURE—°C		-40	-30	-20	-10	0	+10	+20	+30	+40	+50
TIME TO IDLE-SECONDS USING MIL-L-23699 (*USING MIL-I-7808)	10,000 FT	55	49	45	42	40	40	40	40	43	48
		*50	*46	*44							
	SL	45	40	36	32	30	30	30	32	34	38
		*50	*46	*44							
IDLE SPEED (N_g%)	MAXIMUM	66.1	66.7	67.1	67.6	68.0	68.5	68.9	69.4	69.8	70.3
	MINIMUM	63.2	63.7	64.1	64.7	65.1	65.5	65.9	66.2	66.7	67.0

NOTE

- Prior to flight. Idle N_g speed must be greater than the minimum value listed for the current OAT.
- This is the maximum time allowed between advancing the PCL to IDLE and N_g leveling off at idle speed.
- N_g idle speed higher than the maximum limit may be an indication of LDS roll pin failure or misrigging. Flight with N_g idle speed higher than the maximum limit is authorized provided the high N_g idle speed troubleshooting procedures are completed satisfactorily.

Figure 10-2. Time to Idle/Idle Speed Chart

Engine S/N			
Date			
Hours			
ETF *			
ATF			
HIT Limits	/	/	/

Engine S/N			
Date			
Hours			
ETF *			
ATF			
HIT Limits	/	/	/

HIT Date	Pres Alt	OAT	Table (1)	Actual (2)	1-2

HIT Date	Pres Alt	OAT	Table (1)	Actual (2)	1-2

*** NOTE**

ENGINE POWER CHECKS AT OAT BELOW 0°C ARE NOT REPRESENTATIVE FOR HOT WEATHER OPERATIONS. WHEN RETURNING FROM LONG TERM COLD WEATHER OPERATIONS, REPEAT MAX POWER CHECKS.

Figure 10-3. HIT/Power Check Log

FAT	PRESSURE ALTITUDE-FT					
°C	−1000	−500	0	500	1000	1500
55	736	740	744	748	753	758
53	730	734	738	742	747	751
51	724	728	732	736	740	745
49	718	721	725	729	734	738
47	712	715	719	723	727	732
45	706	709	713	717	721	725
43	701	703	707	711	715	719
41	695	698	702	706	710	713
39	690	692	696	700	704	707
37	684	687	690	694	698	702
35	679	681	685	689	692	696
33	673	676	679	683	687	690
31	668	670	674	677	681	685
29	662	665	668	671	675	679
27	657	659	662	666	670	673
25	651	654	657	660	664	667
23	645	648	651	655	658	662
21	639	642	645	649	652	656
19	634	636	640	643	647	650
17	628	631	634	638	641	644
15	623	625	629	632	635	638
13	617	620	623	626	630	633
11	612	614	618	621	624	627
9	606	609	612	616	619	622
7	600	603	607	610	613	616
5	595	598	601	605	608	611
3	589	592	595	599	602	605
1	584	586	590	593	597	600
−1	577	579	583	586	590	593
−3	571	574	577	581	584	587
−5	566	568	572	575	578	581
−7	560	563	566	569	573	576
−9	554	557	560	564	567	570
−11	549	552	555	558	561	564
−13	543	546	549	553	556	559
−15	538	540	544	547	550	553
−17	532	535	538	541	544	547
−19	526	529	532	536	539	542
−21	521	523	527	530	533	536
−23	515	518	521	524	527	530
−25	510	512	515	519	522	524
−27	504	507	510	513	516	519
−29	498	501	504	507	510	513
−31	492	495	498	501	504	507
−33	487	490	493	496	499	501
−35	482	484	487	490	493	496
−37	476	478	481	484	487	490
−39	470	473	476	479	482	484
−45	453	456	459	462	465	467
−50	439	441	444	447	450	453
−55	425	427	430	433	436	438

FAT	PRESSURE ALTITUDE-FT					
°C	2000	2500	3000	3500	4000	4500
55	763	769	775	781	787	792
53	757	762	768	774	780	785
51	750	756	761	767	773	779
49	744	749	755	761	767	772
47	737	743	748	754	760	766
45	731	736	741	747	753	759
43	725	729	734	740	746	752
41	718	723	728	733	739	745
39	712	716	721	726	732	738
37	706	710	714	720	725	731
35	700	704	709	713	719	724
33	694	698	703	707	712	717
31	689	692	697	702	707	711
29	683	687	691	696	701	705
27	677	681	685	690	695	700
25	671	675	680	684	689	694
23	666	669	674	678	683	688
21	660	664	668	672	677	682
19	654	658	662	667	671	676
17	648	652	656	661	665	670
15	642	646	650	655	659	664
13	636	640	644	649	654	658
11	631	634	638	643	647	652
9	625	629	633	637	641	646
7	620	623	627	631	635	640
5	614	618	621	625	630	634
3	609	612	616	620	624	628
1	603	607	610	614	618	622
−1	596	600	603	607	611	615
−3	591	594	598	602	606	609
−5	585	589	592	596	600	604
−7	579	583	587	590	594	598
−9	574	577	581	585	589	592
−11	568	571	575	579	583	586
−13	562	566	569	573	577	581
−15	556	560	564	567	571	575
−17	551	555	558	562	565	569
−19	545	549	552	556	559	563
−21	539	543	546	550	554	557
−23	534	537	540	544	548	551
−25	528	531	535	538	542	545
−27	522	526	529	532	536	539
−29	516	520	523	526	530	534
−31	511	514	517	521	524	528
−33	505	508	511	515	518	522
−35	499	502	506	509	512	516
−37	493	497	500	503	506	510
−39	487	491	494	497	500	504
−45	470	473	476	479	483	486
−50	456	459	462	465	468	471
−55	441	444	447	450	454	457

FAT	PRESSURE ALTITUDE-FT						
°C	5000	5500	6000	7000	8000	9000	10000
55	796	801	805	814	825	835	846
53	790	796	800	809	819	830	840
51	785	791	795	804	814	825	835
49	778	785	789	799	808	819	829
47	771	778	782	794	803	814	824
45	764	771	776	788	798	808	818
43	757	764	769	781	792	803	813
41	751	757	762	775	786	797	807
39	744	750	755	768	780	792	802
37	737	743	748	761	773	787	796
35	730	736	741	754	766	779	791
33	723	729	735	746	759	772	786
31	716	722	727	739	752	765	779
29	710	715	720	732	745	758	771
27	704	709	714	725	737	750	764
25	698	703	707	718	730	743	756
23	692	697	701	711	723	736	749
21	686	691	695	705	715	728	742
19	680	685	689	699	709	721	734
17	674	679	683	693	703	714	727
15	668	673	677	686	697	708	719
13	662	666	671	680	690	701	712
11	656	660	665	674	684	695	706
9	650	654	659	668	678	689	699
7	644	648	652	662	671	682	693
5	637	642	646	656	665	676	687
3	631	636	640	649	659	669	680
1	626	629	634	643	653	663	674
−1	618	622	626	635	645	655	666
−3	613	617	620	629	639	649	659
−5	607	611	615	623	632	642	652
−7	601	605	609	617	626	636	646
−9	596	599	603	611	620	630	639
−11	590	594	597	606	614	623	633
−13	584	588	591	600	608	617	627
−15	578	582	586	594	602	611	620
−17	572	576	580	588	596	605	614
−19	566	570	574	582	591	599	608
−21	560	564	568	577	585	593	602
−23	555	558	562	571	579	587	596
−25	549	552	556	565	573	581	589
−27	543	547	550	559	567	575	583
−29	537	541	545	553	561	569	577
−31	531	535	539	547	554	563	571
−33	525	529	533	541	548	556	565
−35	519	523	527	535	542	550	558
−37	513	517	521	529	536	544	552
−39	507	511	515	523	530	538	546
−45	489	493	497	505	512	519	527
−50	475	478	482	490	497	504	512
−55	460	464	467	475	481	489	496

Figure 10-4. HIT TGT Reference Table

OAT °C	TGTrel °C	OAT °C	TGTrel °C
-20	839	-21	837
-22	834	-23	829
-24	825	-25	821
-26	817	-27	814
-28	810	-29	806
-30	802	-31	798
-32	795	-33	791
-34	788	-35	784
-36	781	-37	777
-38	774	-39	770
-40	767	-41	764
-42	761	-43	757
-44	754	-45	751
-46	748	-47	745
-48	742	-49	739
-50	736	-51	734
-52	731	-53	728
-54	725		

H60-F0118A

Figure 10-5. Torque Factor TGT Reference Chart

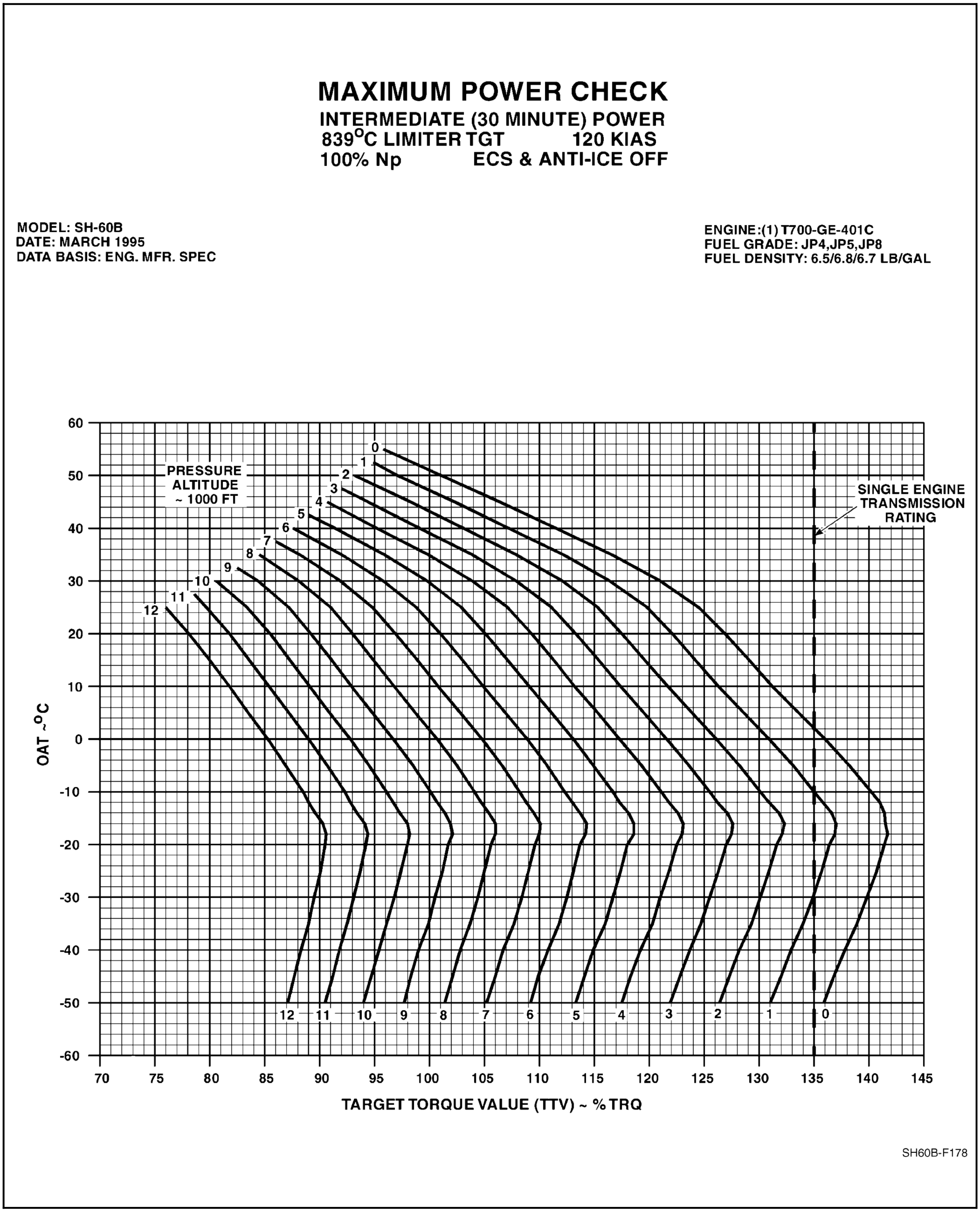


Figure 10-6. Maximum Power Check Chart

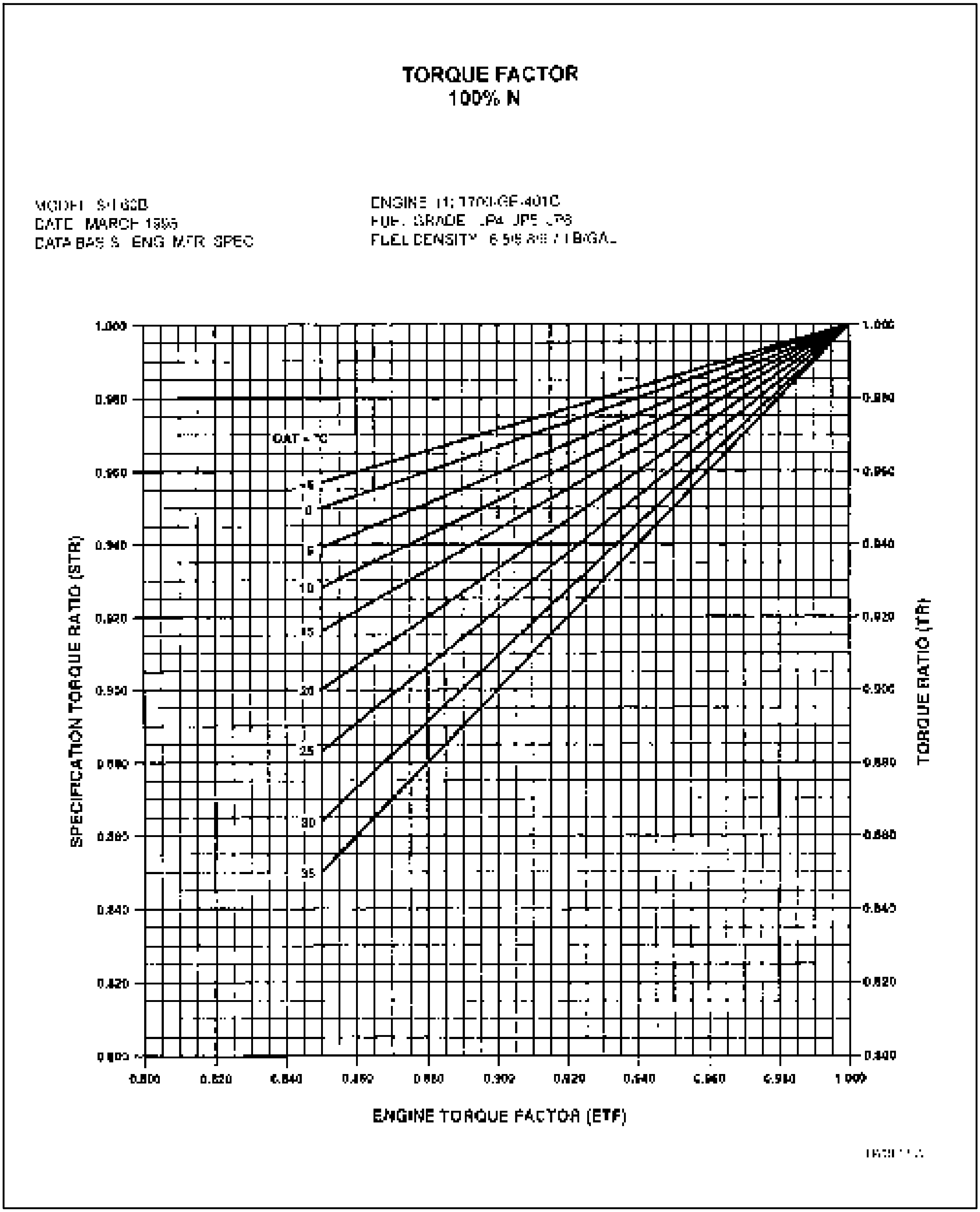


Figure 10-7. Torque Factor Chart

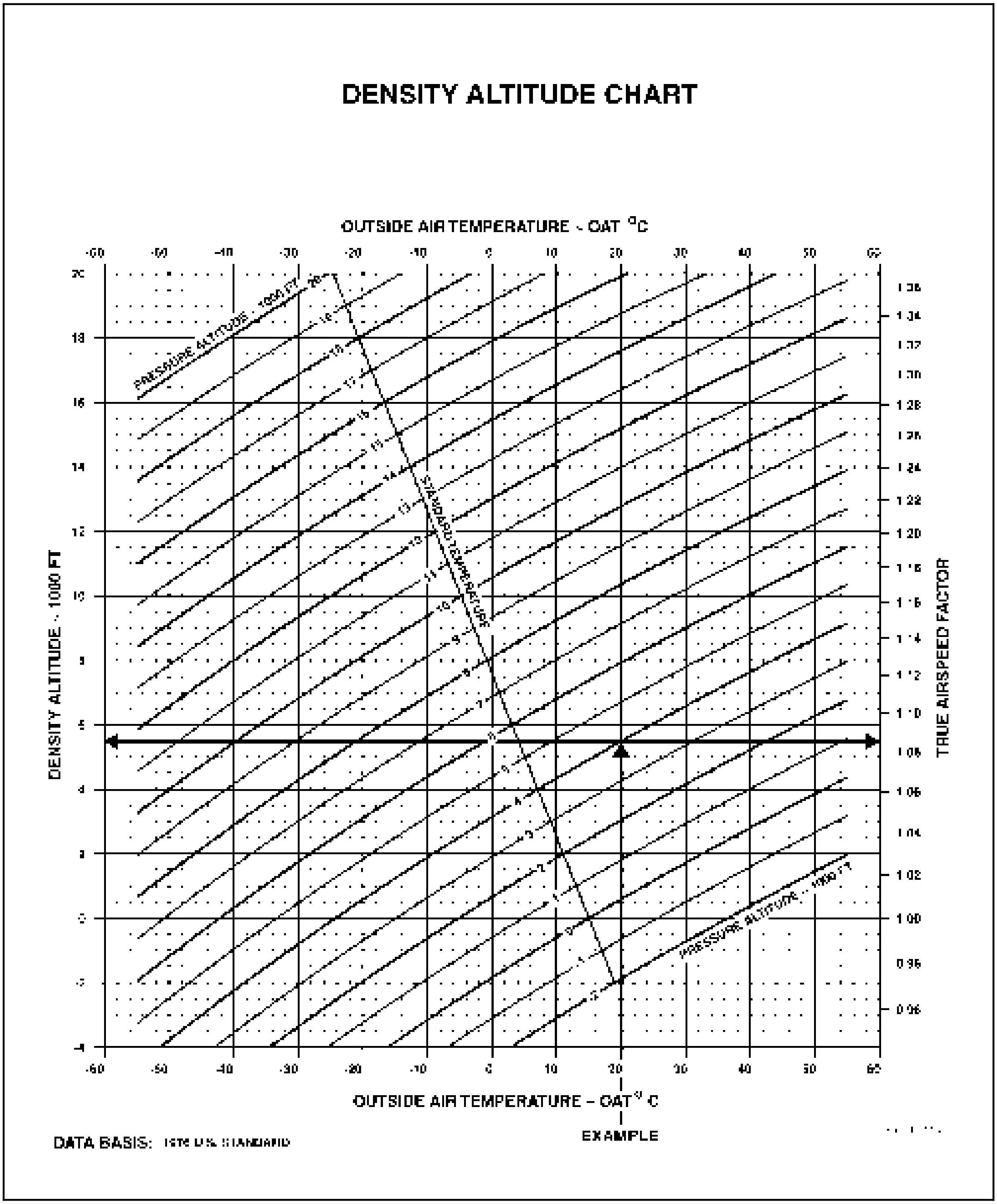
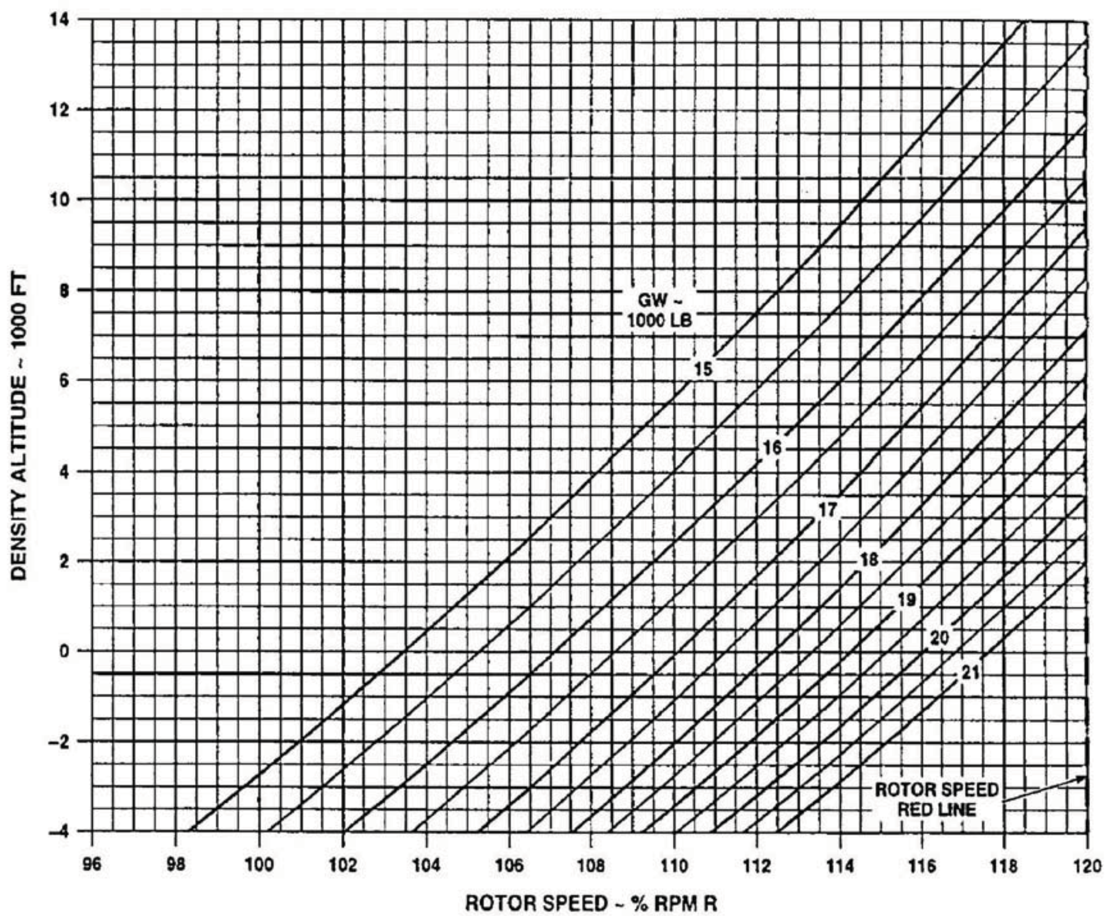


Figure 10-8. Density Altitude Chart

FUNCTIONAL CHECKFLIGHT
AUTOROTATION RPM CORRECTION CHART

MODEL: SH-60B
DATE: DECEMBER 1994
DATA BASIS: FLIGHT TEST



NOTES

1. FULL/LOW COLLECTIVE
2. TEST AIRSPEED TO BE 75 KIAS PILOT IND (±5 KTS)
3. AUTOROTATION TEST TOLERANCE IS 2% Nr.
4. ROTOR SPEED INCREASES 1% Nr FOR EVERY 5 INCHES OF C.G. FORWARD OF 356 INCHES.

SH60B-F104

Figure 10-9. Autorotation RPM Correction Chart

10.5 VIBRATION ANALYSIS

GROUND RUNS	FCP	QAR	Date Completed
1. TAIL ROTOR BALANCE			
2. TAIL HEALTH (STA.685)			
3. AXIAL FAN			
4. NO. 1 ENG INPUT MOD			
5. NO. 2 ENG INPUT MOD			
6. NO. 1 H.S.S. (if required)			
7. NO. 2 H.S.S. (if required)			
8. RH ENGINE N.S.V.			
9. LH ENGINE N.S.V.			
10. ALT TOOTH (if required)			
INFLIGHT RUNS			
1. MAIN ROTOR TRACK & BALANCE			
2. COCKPIT 4 PER			
3. ABSORBER TUNING			
4. CABIN HEALTH (STA. 347)			

PART IV

Flight Characteristics

CHAPTER 11

Aerodynamic Characteristics and Techniques in Various Regimes

11.1 GENERAL FLIGHT CHARACTERISTICS

The normal speed range extends from a rearward/lateral speed of 35 knots to a maximum forward speed of 180 KIAS. Normally, with the stabilator in the full trailing-edge-down position, the aircraft will hover approximately 4° to 5° noseup and 2° to 3° left wing down. During approach or slow flight (approximately 15 knots), a translational lift-induced vibration will be felt.

11.1.1 Hover/Slow Speed Flight (At or Below Translational Lift)

In a steady, no-wind hover, the main rotor experiences a symmetrical distribution of lift dictated by the rotational velocity and constant pitch of the rotor blades. The blade tips are moving at 725 feet per second or Mach 0.65 (65 percent of the speed of sound). Since the airflow is subsonic, the movement of the blades through the air is felt upstream (Figure 11-1), resulting in an upward movement of air prior to coming in contact with the blade. This induced flow causes the lifting force to be shifted aft, resulting in the generation of a drag component referred to as induced drag.

11.1.1.1 Ground Effect

A helicopter is said to be in ground effect when the rotor disk is within one rotor diameter of the ground. Ground effect causes the main rotor thrust vector to shift forward so that it is more vertical (more lift/less induced drag). Therefore, less power is required to hover in ground effect than at higher altitudes. These effects are strongest close to the ground and dissipate rapidly as altitude above the ground is increased. The SH-60B is considered to be hovering in ground effect at radar altimeter altitudes at or below 45 feet.

For an SH-60B at the gross weight of 21,700 pounds on a standard sea level day, downwash below the rotor can exceed 150 knots. This results in the generation of a ground vortex that surrounds the aircraft just outside the rotor arc. It is important to consider the effects of rotor downwash and the ground vortex on personnel and other aircraft, particularly much lighter civil aircraft.

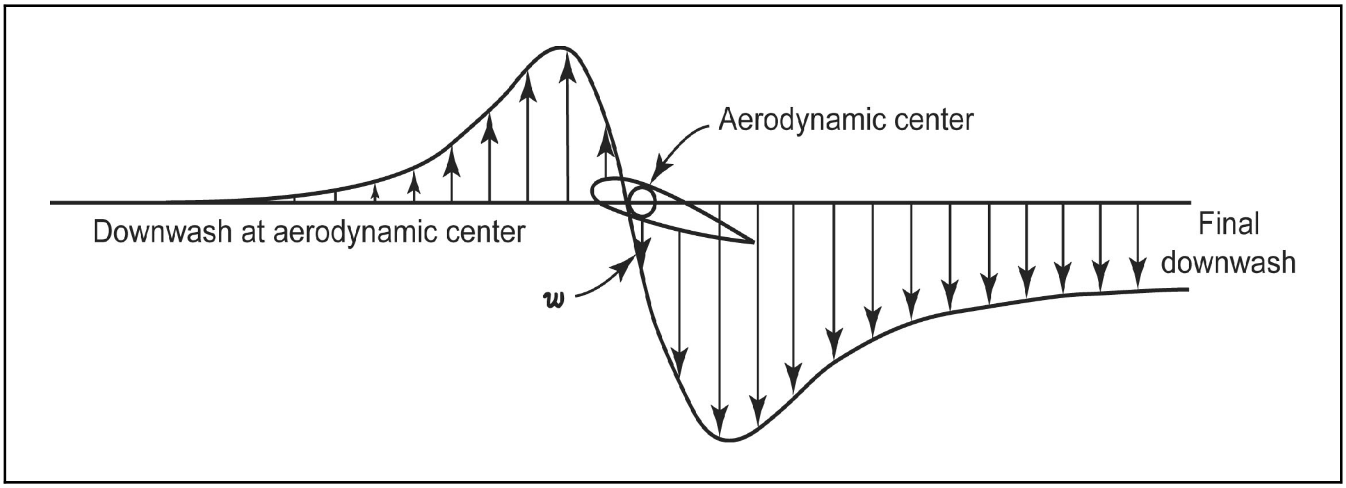


Figure 11-1. Induced Flow

11.1.1.2 Transition to Forward Flight

In flight regimes other than a hover, the rotor blades, as they move around the rotor head, experience different relative velocities. Hence, an asymmetrical distribution of lift is created. To compensate for this dissymmetry, the blades on the advancing side of the rotor disk rise (flaps up), decreasing the AOA and reducing the lift generated. The retreating blade flaps down, increasing the AOA and generating additional lift. This process of flapping causes the pitch of the blade to be continuously changing in a cyclic manner.

The flapping nature of the rotor system results in approximately 90° of phase lag between where inputs are made and their effects are felt.

11.1.1.3 Blowback

When hovering in a windless environment, the main rotor disk will be level. If the aircraft is exposed to a headwind gust, the retreating blade sees less relative wind velocity and the advancing blade sees more relative wind velocity. This causes the rotor disk to be tilted aft or blown back. Blowback of the main rotor disk tilts the main rotor thrust vector aft, causing the nose of the helicopter to pitch up. This reaction is countered by pilot input in the long term and by the hover augmentation and gust alleviation feature of SAS–2, and attitude hold feature of the autopilot, in the short term. When transitioning to forward flight, blowback results in more forward cyclic being required to continue helicopter acceleration. The magnitude of blowback is proportional to airspeed and lift.

11.1.2 Slow-Speed Flight

11.1.2.1 Stabilator Effect in a Hover/Slow Speed Flight Below 30 Knots

Below 30 knots, the stabilator is full trailing edge down. Increasing collective in a hover increases the amount of downwash on the stabilator and pushes the nose up. The effect of varying collective position on nose attitude during hover is compensated for by collective–to–longitudinal mechanical control mixing. The airspeed, collective position, lateral acceleration, and pitch rate inputs to the stabilator system have no effect below 30 knots. In transition to forward flight, the full–down position of the stabilator will cause a nosedown pitch until programming begins at 30 knots. Aft cyclic will be required to counter this pitching moment until programming begins.

11.1.2.2 Translational Lift

Forward flight is initiated by displacing the cyclic forward. This tilts the rotor thrust vector forward. Tilting the main rotor thrust vector forward reduces the vertical lift component. Therefore, additional increase in collective pitch may be necessary as the helicopter begins to translate forward to keep it from descending. With further increase in forward speed, the mass flow rate of air through the rotor system increases, resulting in greater lift production and a rapid decrease in induced power required for level flight. Although profile power (power required to spin the blades) and parasite power (power required to drag nonlifting parts of the helicopter through the air) are both steadily increasing, the reduction in induced power required results in an overall reduction in total power required. Maintaining hover power will result in approximately a 500 foot–per–minute rate of climb at 80 KIAS.

As the airspeed reaches approximately 17 knots, a noticeable vibration will be felt as the aircraft encounters its own ground vortex. The ground vortex is rolled up under the aircraft as speed continues to increase and dissipates as the aircraft reaches approximately 30 knots.

11.1.2.3 Tail Winds in Transition to Forward Flight

Normally, a helicopter transitioning to forward flight from a hover is moving toward a state of less power required. This is not the case for an aircraft transitioning to forward flight with a tailwind. When the helicopter is motionless over a spot, the rotor disk does not care which direction the wind is coming from. Therefore, a helicopter with a tailwind requires less power to hover than one in calm winds. As the helicopter moves forward, the rotor will reach a condition of zero relative wind when helicopter speed matches tailwind speed. The helicopter moves into a state of more power required for level flight. Therefore, even if the aircraft had enough power to hover in a tailwind, it may not have enough power to continue in forward flight and reach translational lift.

11.1.3 Forward Flight

Following translational lift, the aircraft will accelerate through 30 KIAS, at which point the stabilator will begin programming the trailing edge upward, requiring forward cyclic movement to continue the helicopter acceleration.

When the aircraft passes through 50 KIAS, the DAFCS will level the wings to maintain heading in balanced flight. Above 50 KIAS, the beeper trim or trim release button must be used to establish the desired forward airspeed. The directional control pedals will automatically move toward the position required to maintain balanced flight. Forces opposing incorrect pilot directional flight control input will be felt. An increase in speed is accomplished by using the beeper trim switch, or depressing the trim release button and displacing the cyclic forward until the desired airspeed is attained. This, in turn, tilts the rotor disc forward. As it tilts forward, a greater percentage of the lift being produced by the main rotor is being used to increase the forward airspeed of the helicopter. An increase in power is required to restore the vertical lift component to maintain altitude. The stabilator programs to counter the nosedown attitude experienced as the rotor disc and fuselage tilt forward and will maintain an approximately level nose attitude up to approximately 130 KIAS. The automatic flight control system (AFCS) will maintain the heading, altitude, and airspeed in balanced flight as selected by the pilot.

11.2 BLADE STALL

11.2.1 Blade Stall Causes

The tendency of the retreating blade to stall in forward flight limits the high-speed potential of the helicopter, increases component stresses, and decreases component life. The retreating blade has a tendency to stall because the blade tip is traveling at the rotational velocity minus the forward speed of the helicopter. As the in-air velocity of the retreating blade decreases, the blade angle of attack must be increased to equalize lift to provide stabilized flight. As the angle of attack increases, the blade will eventually stall (lost lift and increased drag). The increased drag will cause loss of rotor speed, unless power is increased. The advancing blade, on the other hand, is traveling at a substantially higher speed, has relatively uniform low angles of attack, and is not subject to blade stall. Blade stall will first occur at the blade root and is most likely to occur when operating at high values of speed, gross weight, density altitude, and power. Any of these conditions is especially aggravated by low rotor rpm. Maneuvers, acceleration, or turbulent air, all of which increase G-load factors, will induce blade stall by reducing the airspeed at which blade stall will occur. The blade stall chart in Chapter 22 portrays the airspeeds at various pressure altitudes, temperatures, gross weights, rotor speeds, and load factors (angle of bank), as limited by blade stall. The blade stall chart establishes the maximum airspeeds to allow for turbulence, mild maneuvers, and necessary control inputs to maintain the desired flight attitude. At these speeds, roughness is encountered, but reasonable maneuvers or mild turbulence can be tolerated. Severe turbulence or abrupt control maneuvers at this point will increase the severity of the stall, and the helicopter will become more difficult to control. In the blade stall condition, each main rotor blade will stall as it passes through the stall region and create vibrations per revolution equal to the number of blades. If a stall is allowed to develop fully, loss of control will be experienced, and the helicopter will pitch upward and to the left. The use of forward cyclic to control this pitch up is ineffective and may aggravate the stall as it increases the blade angle of attack of the retreating blade.

11.2.2 Methods of Eliminating Roughness Caused by Blade Stall

If blade stall is causing roughness in the helicopter during high-speed flight or when maneuvering, either condition may be eliminated by accomplishing one or any combination of the following:

1. Decrease collective pitch.
2. Decrease severity of maneuver.
3. Gradually decrease airspeed.
4. Increase rotor rpm.
5. Decrease altitude.
6. Decrease gross weight.

11.3 SH-60B TAIL ROTOR CHARACTERISTICS

11.3.1 Tractor Tail Rotor

A tractor tail rotor is mounted on the side of the vertical fin where the rotor slipstream is directed away from the vertical fin, thus pulling the tail and providing an antitorque reaction for helicopter directional control. Additionally, the tail rotor is designed to provide 2.5 percent of the total lift in hovering flight. This is required due to the SH–60B having a relatively aft center of gravity. Having 2.5 percent of the total lift aft of the center of gravity helps lower aircraft nose attitude in a hover. To provide this lift, the tail rotor is canted 20° from the vertical plane. The effect of varying tail rotor thrust on aircraft nose attitude is compensated for by yaw–to–longitudinal control mixing.

11.3.2 Tail Rotor Considerations in Low-Speed Flight

11.3.2.1 Loss of Tail Rotor Authority

Tail rotor authority is limited by the maximum pitch available on the tail rotor, DA and N_r. At high torque settings and/or high DA, the maximum pitch on the tail rotor blades may only be sufficient to provide sluggish left pedal response. If N_r droops, the maximum tail rotor thrust available decreases rapidly, potentially leading to uncontrolled right yaw. Maximum tail rotor authority is proportional to the square of N_r, that is at 90 percent N_r, tail rotor thrust at maximum pitch/left pedal will be 81 percent of that at 100 percent N_r and maximum pitch/left pedal.

11.3.2.2 Loss of Translational Lift

Loss of translational lift results in increased power demand and additional antitorque requirements. If the loss of translational lift occurs when the aircraft is in a right turn, the right turn rate will be accelerated if corrective action is not taken. When operating near maximum power available, the increased power demand could result in rotor rpm decay. Insufficient attention to wind direction and velocity can lead to unexpected loss of translational lift. Aircraft heading, ground track, and groundspeed must be evaluated continually.

11.3.2.3 Hover/Air Taxi

Right, sideward flight, or a right crosswind, increases airflow across the tail, resulting in a reduction in angle of attack (AOA) for a set pedal position and a reduction in tail rotor thrust. If increased left pedal is applied, a right yaw will occur. Yaw rate will be further amplified by increased airflow over the tail pylon, which will tend to streamline the aircraft. When the aircraft is operated at low wheel heights, main rotor tip vortex can produce an area of downwash turbulence that may interact with the tail rotor. Tail rotor thrust variations may require rapid pedal inputs to maintain directional control.

11.3.2.4 Loss of Tail Rotor Effectiveness

Although the SH–60B tail rotor system is a fairly robust rotor against loss of tail rotor effectiveness (LTE), an understanding of the principles is important to safe helicopter operation and diagnosis of tail rotor system modes of failure. Tail rotor loss of effectiveness is caused by various relative wind conditions acting on the tail rotor blades. The regions of tail rotor loss of effectiveness are shown in Figure 11-2 and are described below.

11.3.2.5 Factors Increasing the Likelihood of Loss of Tail Rotor Effectiveness

Recovery from a high yaw rate is more difficult in conditions requiring higher main rotor power (e.g., high gross weight, high DA, or arresting a high descent rate).

Low airspeeds require more power to maintain flight and increased antitorque requirements. Also, streamlining effect is reduced at lower airspeeds. Rapid application of collective may cause transient rotor rpm droop to occur. A decrease in main rotor rpm causes a greater proportional decrease in tail rotor rpm/thrust. Low N_r with left pedal application can cause loss of directional control as tail rotor rpm decays.

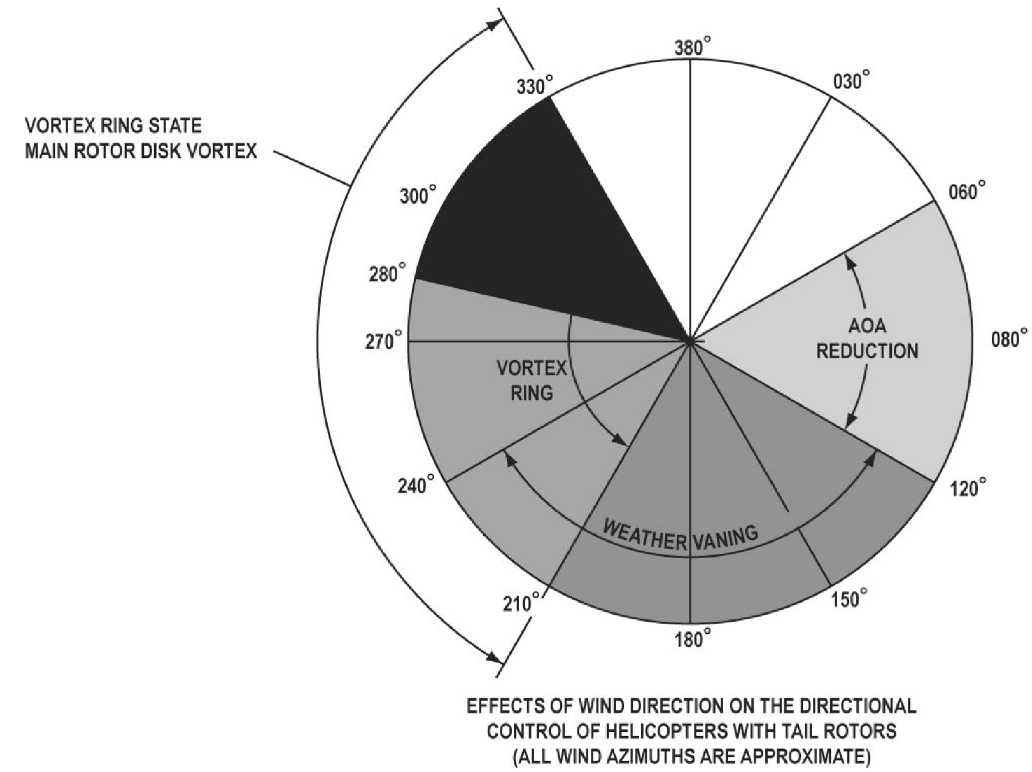


Figure 11-2. Wind Effects on the Tail Rotor

11.3.2.6 Recovery from LTE

Should LTE occur, correct and timely response is critical. If the response in incorrect or slow, the yaw rate may accelerate to a point where it is extremely difficult to recover. One or more complete revolutions may be experienced. The appropriate responses to LTE can be achieved by:

1. Altitude permitting, lowering the collective to reduce torque and assist in arresting right yaw; however, if a significant rate of descent is established, the additional power required to arrest the rate of descent may aggravate or reinitiate loss of tail rotor effectiveness.
2. Using forward cyclic to increase airspeed and, if necessary, turning in the direction of rotation. This results in a reduction in tail rotor thrust required and produces a streamlining effect.
3. At very low speeds or in a hover, application of full left pedal may arrest the right yaw. Understand that the control inputs may take several seconds/revolutions to take effect partially due to the effects of momentum and ambient conditions. Neutralizing the pedals, adding right pedal, or increasing collective will only accelerate the yaw rate.

11.3.2.6.1 Angle of Attack (AOA)

Reduction region (060° to 120° relative). Relative winds in this region decrease the effective AOA on the tail rotor blade element, thereby decreasing tail rotor thrust and resulting in the nose spinning to the right. This condition can be demonstrated in sideward flight to the right, which requires more left pedal input as sideslip speed increases. Also, the right–wing down attitude required for sideslip makes the plane of the tail rotor blades more vertical so that more of the relative wind is perpendicular to the tail rotor disk.

11.3.2.6.2 Weather Vaning (120° to 240° relative)

Relative winds in this region can blow on the tail pylon and cause the helicopter to spin right or left in an attempt to place relative wind on the nose. This condition can be demonstrated in rearward flight where the nose appears to swing randomly left and right and it is difficult to keep heading constant.

11.3.2.6.3 Vortex Ring State (210° to 330° relative)

Relative winds in this region can cause the tail rotor to ingest its own vortex (as in the main rotor at high rates of descent and low forward airspeed). This causes a loss of tail rotor thrust and the helicopter will spin to the right. The 20° tilt of the tail rotor disk tends to help prevent this problem because the relative wind would need an upward component to blow the vortex directly on the plane of the blades. This effect is not very apparent in sideward flight to the left because the left-wing-down attitude required places the plane of the tail rotor blades flatter with respect to the horizon. The vortex is blown off the right side of the tail rotor disk.

11.3.2.6.4 Main Rotor Disk Vortex (280° to 330° relative)

Relative winds in this region can cause the main rotor disk retreating blade vortex to impinge on the tail rotor blades. This can result in sudden losses and surges to tail rotor thrust at a constant pedal setting. It can result in the helicopter spinning right without enough left pedal authority to stop it. Surges in tail rotor thrust are easily controlled by reducing left pedal input during the surge.

11.4 MANEUVERING FLIGHT

11.4.1 Maneuvering Flight Characteristics

Maneuvering flight is accomplished by moving the cyclic in the direction of the desired turn. Above 50 KIAS, the AFCS will assist in moving the directional control pedals as required to maintain balanced flight. Above 30° angle of bank, aft cyclic will be required to maintain the desired airspeed. In a decelerating turn, the AFCS will switch from a turn coordination mode to a heading hold mode as the aircraft passes through 50 KIAS. Normal maneuvers are restricted to the maneuvers and airspeed limitations as depicted in Chapter 4. A portion of the information in this section particularly applies to highly dynamic maneuvering flight such as might be executed during evasive maneuvering.

11.4.2 Coordinated Flight

The slip/skid indicator (ball) is designed to indicate lateral acceleration on the aircraft due to sideslip in steady zero-net-acceleration flight. In slow speed (less than 60 KIAS), high AOB (greater than 25°), nonsteady (transient) turns, the predominant component of lateral acceleration is the weight vector, not sideslip-induced acceleration. During slow speed, high AOB, transient turns, balanced flight (minimal sideslip) can best be maintained by maintaining pedal position that centers the ball. Intentional sideslip within limits is permissible during maneuvering flight; however, to prevent occurrence of high tail rotor component loads, left pedal application beyond that required for balanced flight should only be attempted at midposition or lower collective settings.

CAUTION

Centering the ball in slow speed, high AOB, and transient turns induces large values of aircraft sideslip and may cause high tail rotor component loads in left turns.

Note

When a requirement to achieve a slow-speed, high-rate turn to the left exists, such as during evasive maneuvering, lowering the collective may be necessary to reduce main rotor torque; associated tail rotor antitorque requirement will greatly facilitate the turn, resulting in higher turn rates.

11.4.3 Tail Rotor Spar Loads in Maneuvering Flight

Counterclockwise turning single main rotor helicopters exhibit transient torque increases in forward flight with roll rates to the left. Left roll rate increases retreating blade AOA, driving torque up, and main rotor precession loads contribute further to this effect. Left roll rates (above approximately 30° per second in forward flight above 75 KIAS) can combine with induced tail rotor gyroscopic and flapping loads to cause excessive tail rotor spar loading.

CAUTION

When executing high roll rate maneuvers to the left, collective should be lowered concurrently with maneuver initiation to control transient torque increases and reduce high tail rotor spar loads. Left roll rates in excess of 30° per second should be avoided in forward flight above 75 KIAS to prevent damage to the tail rotor spar.

11.4.4 Main Rotor Vertical 4/Rev Vibration Cueing

During maneuvering flight, main rotor component fatigue damage occurs simultaneously with an increase in main rotor vertical 4/rev vibration level. As an increasing G level is placed on the aircraft, the 4/rev onset will appear and is noticed as an increase in aircraft roughness similar to that of the 4/rev shudder experienced when flying the aircraft through transitional lift. The 4/rev vibration onset is an indication that the lift-generating capability of the main rotor has been exceeded and that a main rotor stall region has been created. Further attempts to increase load factor will only increase the blade stall region, resulting in reduced maneuverability and increased component fatigue damage. If a noticeable increase in main rotor 4/rev vibration level is observed, relax G level slightly until 4/rev vibrations decrease to a normal level. The most effective method of reducing the stall-related main rotor 4/rev vibration level is to reduce collective.

CAUTION

Significant increased main rotor 4/rev vibration level during maneuvering flight indicates the onset of retreating blade stall. Main rotor component life is being reduced and aircraft maneuvering performance degraded.

11.4.5 Main Rotor Flapping Margin

Main rotor flapping margin, a measurement of the amount of blade spindle displacement remaining in the flapping (vertical) axis before blade motion stops are contacted, may be reduced to zero by maneuvers involving large and rapid application of forward cyclic. Main rotor flapping margin is especially reduced when rapid forward cyclic is coupled with low collective settings and/or aft longitudinal cg.

CAUTION

Inducement of less than 1 g flight by rapid application of forward cyclic will result in decreased cyclic authority and may result in exceeding main rotor flapping margin limits and droop stop pounding.

11.4.6 High AOB Turns

Figure 11-3 shows how the vertical (lift) component of main rotor thrust decreases with increasing AOB. In order for the aircraft to maintain level flight, main rotor thrust must be increased so that lift will remain equal to weight. For example, if a pilot does not apply additional collective in a 45° AOB turn at 300 feet, the aircraft will crash in less than five seconds. Application of additional collective or a reduction of airspeed pitch allows the aircraft to perform level turns.

11.4.7 G-Loading in Turns

Accelerated or turning flight (G-loads) can be established by using aft cyclic and/or collective control. Cyclic maneuvering provides a transient maneuvering capability because forward airspeed will decrease. As airspeed decreases, transient rotor thrust decays as a result of less mass flow through the rotor disk; therefore, there is less energy to complete the maneuver. Sustained maneuvering must be accomplished by application of collective power so that the aircraft speed and energy are conserved. Transient G-loads applied using aft cyclic result in airspeed bleed and eventual flight at speed less than bucket speed. Sustained G-loads applied with collective increase power required for level flight at that airspeed (due to AOB), which results in a decrease in excess power. Maneuvers at slow speeds are incapable of resulting in structural damage because the aircraft will encounter an aerodynamic limit of rotor thrust. High-speed maneuvering can result in main rotor transient (cyclic) and sustained (collective) power exceeding structural limitations. G-loads encountered in level coordinated turns at various AOB are presented in Figure 11-4.

11.4.8 Rolling Pullouts

Another situation where an aircraft can generate high G-loading is during a rolling pullout (Figure 11-5). Due to centrifugal acceleration (G-loading), the weight vector of the aircraft increases. Lift produced by the rotor system must be increased proportionally to the G-load to arrest the descent and establish level flight. Power can be applied by transient power input (aft cyclic) and sustained power input (collective). This can result in a situation where power required for recovery greatly exceeds total power available in the rotor system and "mushing" occurs. During "mushing," the aircraft will continue to descend rapidly even though maximum power may be applied; longitudinal cyclic control will feel sluggish, a noticeable increase in Main Rotor Vertical 4/Rev Vibrations (see paragraph 11.4.4), and retreating blade stall may occur.

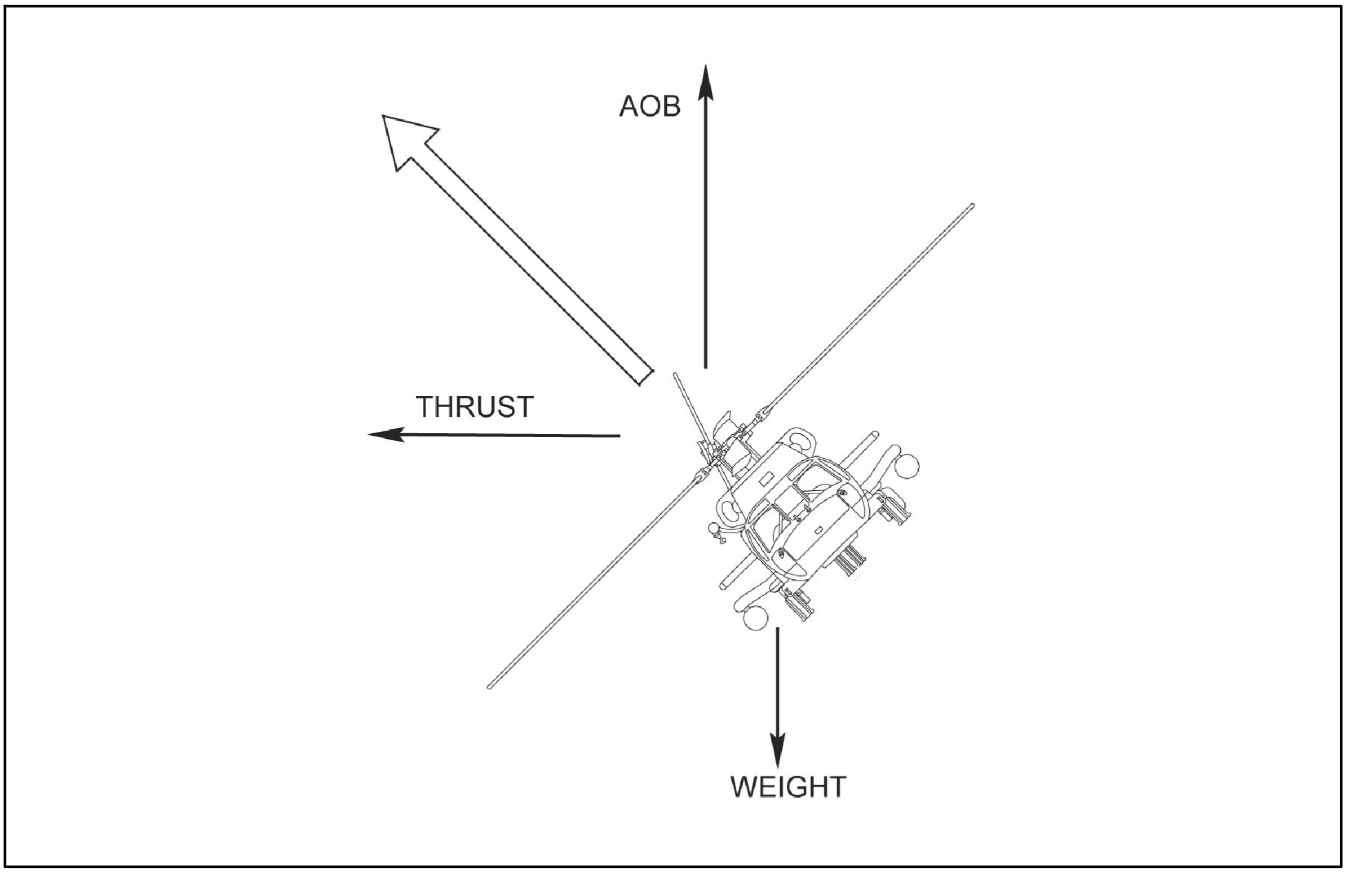


Figure 11-3. Main Rotor Thrust vs. AOB

AOB (°)	G-Load
0	1.00
10	1.02
30	1.15
45	1.41
60	2.00
75	3.86
85	11.50
99	58.82

Figure 11-4. G-Load while Maintaining Altitude and Airspeed at Listed AOB

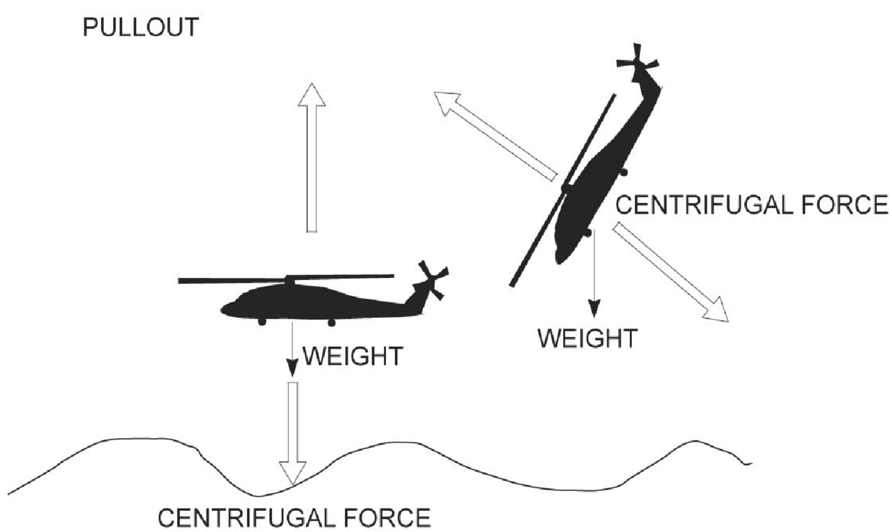


Figure 11-5. The Rolling Pullout

11.4.9 High AOB (High-G) Maneuvering Effects on Lateral cg Margin

Helicopter center of gravity limits are based on non–accelerated flight (1 g). This is particularly true of lateral center of gravity limits. High angle–of–bank turns narrow the lateral cg margin. With an excessive asymmetrical load (i.e., all stores and/or auxiliary tank on one side), a high AOB turn into the stores–heavy side can reduce the lateral cg margin to the point where there is not enough cyclic authority to roll back out of the turn. This can occur even though the lateral cg position is within static (1 g) limits. The result is an uncontrolled spiral into the deck.

WARNING

In situations where loss of lateral control is experienced in a steep turn and asymmetrical stores load/shift in lateral cg is the suspected cause, consideration should be given to jettisoning the stores. This should shift the lateral cg sufficiently to provide enough control authority to recover from the turn.

11.4.10 Power Required Exceeds Power Available

At high density altitudes, high gross weights, or when operating with reduced power, power required may exceed power available. It may not be possible to maintain level flight due to lack of power, which will cause settling to occur. The attendant loss of altitude is of minor consequence except in certain situations where sufficient altitude is not available to achieve the airspeed necessary to maintain level flight. Careful preflight analysis of engine performance and hover charts in Chapters 22, 23, 24, 25, 26, and 27 will aid in avoiding extreme situations. To recover from this condition, complete the Emergency Malfunction In Flight procedures.

Note

The NATOPS density altitude calculation chart and charts indexed for pressure altitude corrected to nonstandard temperature do NOT account for the effect of humidity. High humidity has negligible effect on power available, but a great effect on power required. The effects of humidity on power required become apparent above 40 percent relative humidity. A good rule of thumb is to add 100 feet to DA for every 10 percent of relative humidity above 40 percent. Some weather briefs use “virtual temperature” or temperature corrected for humidity to calculate density altitude. In this case, no correction is necessary.

NTRP 3-22.2.4-SH60B contains a detailed description of Energy Maneuverability. Also included are a series of charts relating speed, bank angle, and rate of climb/descent for various combinations of aircraft weight and environmental conditions. These charts provide an invaluable preflight guide to maneuvering limitations.

11.5 DESCENDING FLIGHT AND AUTOROTATION

There are four flow states of a rotor system: Normal Thrusting, Vortex Ring, Autorotative, and Windmill Brake. Each flow state represents a larger rate of descent relative to the induced velocity of the rotor system. In the normal thrusting state of the rotor system, vortices are concentrated at the blade tips. The velocity profile of air relative to the rotor is downward across the entire rotor disk. This is the condition encountered in hover, forward flight, climbing flight, and slow rates of descent.

11.5.1 Vortex Ring State/Power Settling

Vortex ring state describes an aerodynamic condition where a helicopter may be in a vertical descent with maximum power applied and little or no cyclic authority. The term “power settling” comes from pilot observations that the helicopter keeps settling even though full engine power is used. In a normal, out of ground effect hover, the helicopter is able to remain stationary by propelling a large mass of air down through the main rotor. Near the tips of the blades, some of the air is recirculated, curling up from the bottom of the rotor system and rejoining the air entering the rotor from the top. This phenomenon is common to all airfoils and is known as tip vortices. Tip vortices consume engine power but produce no useful lift. As long as the tip vortices are small, their only effect is a small loss in rotor efficiency; however, when the helicopter begins to descend vertically, it settles into its own downwash, which greatly enlarges the tip vortices. This is the vortex ring state where most power developed by the engines is wasted in accelerating the air in a doughnut pattern around the rotor while N_r remains at 100 percent.

The effect is measurable at descent rates greater than 700 fpm and airspeeds between 0 and 20 KIAS and is the worst at descent rates of approximately 1,500 fpm with airspeeds of 5 to 10 KIAS. Fully developed vortex ring state is characterized by an unstable condition where the helicopter experiences uncommanded pitch and roll oscillations, has little or no cyclic authority, and achieves a descent rate that may approach 6,000 fpm. It is accompanied by increased levels of vibration.

WARNING

Flight conditions causing vortex ring state should be avoided at low altitudes because of the attendant loss of altitude necessary for recovery. Recovery from fully developed vortex ring state may require entering autorotation before regaining airspeed.

Note

Vortex ring state may also be entered during any dynamic maneuver which places the main rotor in condition of high upflow and low longitudinal airspeed. This condition is frequently seen during "quick stop" type maneuvers or during autorotational recoveries.

To recover from this condition:

1. Decrease collective pitch.
2. Move cyclic forward.
3. Enter autorotation if altitude permits. A considerable loss of altitude may occur before the condition is recognized and recovery is completed. During approach for landing, conditions causing vortex ring state should be avoided.

11.5.2 Autorotative State

The autorotative state of the rotor system results in a lift-producing rotor with sufficient steady-state driving forces. The autorotative state can be achieved at descent velocities between approximately 3,125 fpm and 4,450 fpm at 19,000 pounds. gross weight. A rotor disk in a steady-state autorotation is shown in Figure 11-6. The prop region is 30 percent of the rotor disk, the autorotative region is 45 percent, and the stall region is 25 percent. The prop region creates usable lift. The auto region produces forward-tilting force that creates both lift and a pro-rotational force that overcomes blade drag and keeps the rotor spinning at a constant rpm. The stall region creates only drag (Figure 11-6). A steady-state autorotation is a balance between lift, drag, and rotational forces on the rotor system. An autorotation is a dynamic exchange of potential and kinetic energies. Energy needed to keep the rotor turning at 100 percent N_r and producing useful lift and rotational forces is gained from a decrease in helicopter potential energy (i.e., descending flight).

11.5.3 Autorotational Entry

The major variables affecting autorotational entry are altitude, airspeed, N_r, power state before entry, AOB, balanced flight, yaw, and rotor inertia. The SH-60B has relatively low rotor inertia. Slow pilot reaction time can lead to N_r decaying to unrecoverable levels in as little as two seconds. N_r decay rate will be greater when the helicopter is at a high power condition before entry (i.e., climbing or at high speed). In general, more airspeed on entry is better up to the maximum autorotational airspeed of 100 KIAS because the kinetic energy of forward flight can be translated into spinning the rotor system as the aircraft slows down. The higher the altitude, the more time is available to establish a steady-state autorotation.

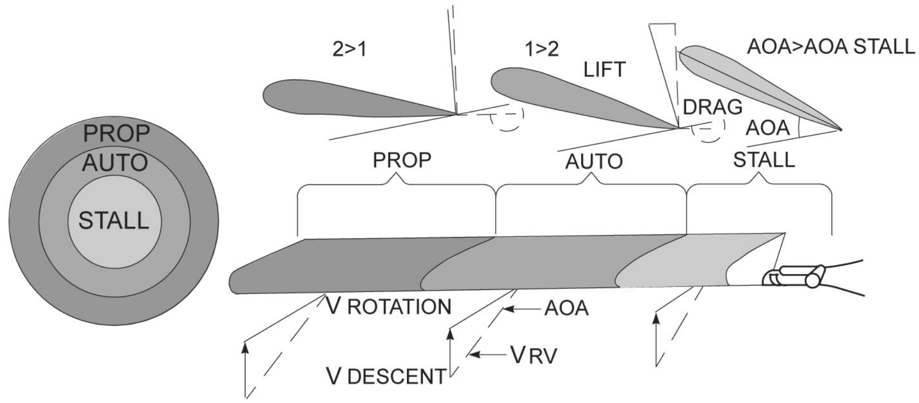


Figure 11-6. Stall Region in an Autorotative Descent

11.5.3.1 Autorotational Descent

The major variables affecting autorotational descent are airspeed, N_r, AOB, yaw, gross weight, and density altitude. Minimum rate of descent airspeed in an autorotation is approximately 75 KIAS. A decrease or increase in airspeed from this value results in an increase in rate of descent. Increasing airspeed above 75 KIAS increases glide distance up to the maximum glide airspeed of approximately 95 KIAS. Practice autorotations are typically shot at five knots faster than the optimum descent and distance values. This allows the aircraft speed to slow toward an ideal condition instead of away from it. For a given gross weight, there is one ideal rotor rpm that will provide the minimum rate of descent. As rotor rpm is allowed to build above ideal, rate of descent increases. This is because the increase in rotor speed comes at the expense of aircraft potential energy (i.e., a higher rate of descent). As rotor rpm decreases from ideal, the rate of descent increases. A heavy aircraft actually will descend slower in a steady–state autorotation than a lighter one. This is because a heavier aircraft can have a greater rate of exchange of potential energy (altitude and weight) into kinetic energy (rpm) of the rotor system. A rotor system with more kinetic energy needs more collective pitch to govern it to the optimum rpm. More collective pitch means more lift, therefore a smaller rate of decent for heavier aircraft. AOB increases G–loading, which equates to a larger weight vector. A larger weight vector means that more potential energy can be traded for rotor system kinetic energy. Rotor rpm will increase in a turn. Governing N_r at optimum will require more collective pitch (more lift); however, the lift vector is not vertical, so rate of descent will still increase in the turn. Yaw attitude affects autorotation due to the amount of energy transferred to or taken from the drive system due to relative wind effects on the tail rotor blades. A higher density altitude allows the blades to spin with less resistance; therefore, more collective pitch is required to govern to a given rpm at a higher density altitude.

Note

Aircraft descend at a higher rate at lower gross weights. Executing an autorotation at lower gross weight allows management of momentum (mass times velocity) during the recovery and lowers the power required to hover upon completion. A heavier aircraft has more momentum (both downward and forward) than a lighter aircraft, requiring more power to arrest aircraft rate of descent and velocity during the final flare and collective pull, as well as requiring more power to maintain hover at recovery altitude.

11.5.4 Autorotational Recovery

When executing a flare at the bottom of an autorotation, rotor rpm increases due to the trading of aircraft forward kinetic energy (airspeed) for rotor system kinetic energy (N_r). This increase in rpm is governed to optimum by adjusting collective pitch. The flare slows the rate of descent and since the rotor is now tilted aft, it helps slow the forward speed of the aircraft. The aircraft attitude presents a more blunt cross section to the relative wind which also helps slow the forward speed. In addition, the stabilator programs down, which helps slow the aircraft even more. Final recovery is made by leveling the aircraft and applying collective pitch to cushion a tail wheel–first landing at slow to zero groundspeed.

Note

In an actual autorotational flare, the pilot may choose to allow N_r to increase above optimum for descent. The higher the N_r when executing the final recovery, the more kinetic energy is available in the rotor system for the collective pull that will cushion the landing as N_r decays.

11.6 ROLLOVER CHARACTERISTICS

11.6.1 Static Rollover

Static rollover angle is the angle at which the helicopter will tip over on its side if it is parked on a very steep embankment. The static rollover angle of the SH–60B is approximately 28°. It occurs when the cg of the helicopter is directly over the longitudinal axis passing through the tail gear and either main gear ground contact points.

11.6.2 Critical Rollover

Critical rollover angle is the maximum lateral angle of slope that can be negotiated in a takeoff or landing. At this angle, full lateral cyclic input is required to trim the wheels level with the slope without sliding. With left wheel uphill and brakes on, this angle is approximately 12°.

11.6.2.1 Dynamic Rollover

Dynamic rollover is an insidious dynamic condition that can occur during takeoff or landing with one wheel on the ground and can result in destruction of the helicopter. It is not definable by a single number, nor is it simply a function of slope angle or lateral control authority. These will aggravate a rollover condition, but the main contributor to dynamic rollover is the buildup of angular velocity of the helicopter cg about the wheel touching the ground. When the angular velocity about the wheel is greater than can be countered with full opposite cyclic, the helicopter will roll over. This situation can happen in less than two seconds. This is illustrated in Figure 11-7.

In this condition, the upsetting rolling moment is caused by the helicopter acting about the wheel ground–contact point. Thus, the wheel restraint converts the lateral translation (drift) into an angular motion (roll rate) or angular momentum. The roll rate can be very large depending on sink and drift speeds and the degree of wheel restraint. In addition, a rolling motion to the right will be made worse by the thrust produced from the tail rotor. Conversely, a roll to the left will decrease as the tail rotor thrust acts to provide deceleration. Upon contact with the ground, the roll center is transferred from the helicopter cg to the touchdown wheel, resulting in higher roll inertia. The roll inertia about the ground contact wheel can be five times greater than the roll inertia about the cg. The resulting roll rate can be checked with opposite lateral cyclic, but lateral control will be only 1/5 of fully airborne, and the aircraft response will be sluggish and limited by maximum cyclic displacement. If lateral cyclic cannot be displaced far enough to tilt the rotor lift vector outside the wheel tread, then rotor lift adds to the rolling moment. Since rotor lift opposes the only restoring force remaining, lift should be reduced.

Note

If encountering a situation where only one wheel is in contact with the ground and a rolling moment is present, smooth reduction of collective is the most effective corrective action the pilot can take to prevent dynamic rollover.

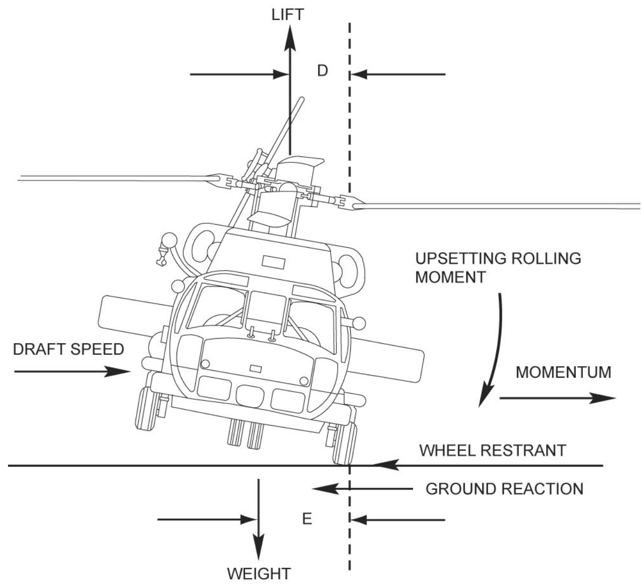


Figure 11-7. Dynamic Rollover

11.6.3 Slope Landing/Takeoff Considerations

There are three major forces in slope landings and takeoffs (Figure 11-8). These major forces are helicopter weight, rotor lift, and ground reaction (normal and friction forces). In general, the helicopter is controlled using collective to balance weight with rotor lift and tilting the rotor lift into the slope, this adds to wheel friction and prevent sliding. Slope landings can be grouped into three separate classifications: cross-slope, up-slope and down-slope.

Consideration should be given to setting the parking brake prior to landing. With the parking brake applied, an increased potential exists for dynamic rollover; without applying the parking brake, increased potential exists for the helicopter to slide from the landing site. Fly the appropriate approach to a hover. From a hover the aircrew should continuously clear and direct the helicopter for landing gear placement. Slope landings should be executed as slow, controlled, vertical descents. The PAC should descend slowly, placing the up-slope wheel on the ground first.

From the moment the up-slope wheel touches the ground and until it is lifted from the ground, the principal control is collective. Attempt to maintain the rotor disc level with the horizon throughout the landing and takeoff. As collective is decreased cyclic must be displaced toward the up-slope side. As collective is increased cyclic must be moved toward the neutral position. Balance between the two controls is indicated by a rotor disc that is level with respect to the horizon.

WARNING

Aft cyclic positions, in conjunction with low or decreasing collective pitch, may cause rotor blades to contact the tail pylon resulting in loss of tail rotor drive.

Note

- When landing site is a combination of cross-slope and up- or down-slope, use the most restrictive slope landing limit. Be prepared to execute a combination of control inputs to maintain stability.
- Depending on slope and helicopter configuration, the tail wheel may touch down prior to the up-slope wheel.

11.6.3.1 Cross-Slope Landing

In a cross-slope environment, lateral cyclic still provides roll control, but the control power is reduced to 1/5 of its airborne value.

Once the up-slope wheel touches the ground slowly lower the collective, coordinating lateral cyclic into the slope until the down-slope wheel is also on the ground. The controls should always be positioned to keep the helicopter from drifting. Continue coordinated movement of the collective and lateral cyclic until all of the helicopter weight is resting firmly on the ground. If lateral cyclic control contacts the stop, or if rotor-to-ground clearance becomes marginal before the down-slope wheel is firmly on the ground, return to a hover by slowly raising collective and centering cyclic. Select another landing site with a shallower slope. After the slope landing is completed, ensure that the helicopter will not slide or sink while smoothly lowering the collective to a full down position. As collective is lowered, adjust lateral cyclic input to maintain the rotor disc as level as possible. This has the effect of maintaining the CG on the up-slope side of the helicopter.

WARNING

During cross-slope landings, rotor clearance is decreased on the up-slope side. Personnel should traverse the rotor arc on the down-slope side of the helicopter.

CAUTION

During cross-slope landings, avoid rapid collective reductions to prevent blades from striking the ground and high roll rates about the up-slope wheel.

11.6.3.2 Up-Slope Landings

For up-slope landings where main mounts touch first, longitudinal cyclic (either forward or aft) may be required with coordinated collective movement to safely lower the tail wheel to the ground. If the tail wheel touches down first, the PAC shall make smooth, coordinated cyclic inputs similar to a normal landing. A more forward than normal cyclic position may be required to prevent rolling down the slope backwards. With the tail wheel on the ground, smooth coordinated cyclic and collective movements are required to control pitch rate and aircraft position until main mounts are on deck. As the helicopter nears max up-slope nose attitude, the PAC should arrest pitching moment to ensure limit is not exceeded.

11.6.3.3 Down-Slope Landings

Once the tail wheel touches the ground, slowly lower the collective, coordinating aft cyclic until the main mounts are on deck.

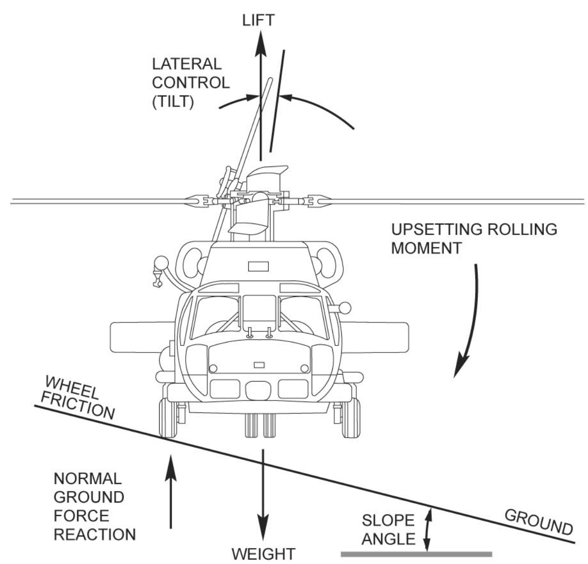


Figure 11-8. Slope Landing Takeoff Forces

11.6.3.4 Take Off

Slope take offs should be made by first moving cyclic into the slope to prevent drift. Using coordinated collective and cyclic, increase power while adjusting cyclic to raise the downhill wheel first until the helicopter becomes level and lifts off the ground. Avoid large cyclic inputs when the helicopter becomes airborne, because the roll center will now shift back to the helicopter's CG and full control authority will be restored. If the helicopter rolls past level (into the slope) during takeoff, lower collective rapidly but smoothly to avoid dynamic rollover – check for a blocked or hung–up wheel.

WARNING

When taking off or landing on a sloping or rough surface, the helicopter can be subjected to conditions which, with the slightest inattention by the pilot to developing roll rates, can result in almost certain destruction by dynamic rollover. Keep the helicopter under control at all times. When landing or taking off with one wheel touching the ground, use smooth collective motion to maintain low roll rates.

The following procedures shall be observed to ensure safe landing/take off in a slope environment:

1. Execute all landings/take offs smoothly and maintain low roll rates.
2. Take off slowly so that induced roll rates can be easily controlled.
3. Maintain wheels–level during all landings/take offs.

4. Always lift the downhill wheel first during take off.

5. Do not allow helicopter to drift.

6. If lateral control feels sluggish, reduce collective and check for obstructions.

7. To control roll rate, reduce collective smoothly. Avoid fast collective reductions to prevent blade strike or induced high rates of roll about up–slope wheel.

11.7 SALTWATER POWER DETERIORATION

Salt spray ingestion in the engine may result in a loss in performance. This deterioration will be noticed as an increase in TGT for a given torque. The circumstances under which power deterioration may occur during saltwater operation vary with a number of factors. The flight regime, gross weight, wind direction and velocity, pilot technique, duration of maneuver, salinity of the water, and the relative density of the salt spray all have a bearing on performance deterioration, though wind velocity and hover altitude have the most significance. Intermittent operation in moderate salt spray conditions could expose the engines to enough salt spray to cause noticeable performance deterioration. During prolonged operations, power deterioration will be readily apparent. Maneuvers such as hovering close to the water in light winds, or low flights at low speeds, will generate maximum rotor downwash spray conditions. The amount of spray observed on the windshield is the best indication of spray ingestion.

WARNING

While operating in a salt spray environment for any period of time, a TGT rise of 20 °C or more for constant torque is an indication of engine performance degradation and possible salt encrustation. A TGT rise of greater than 40 °C for a constant torque is an indication of engine performance degradation which may result in compressor stall(s).

CAUTION

- Take note of windshield spray deposits. The amount of saltwater spray observed on the windshield is usually the best indication of the salt spray environment to which the engines are being subjected. If the spray on the windshield is sufficient to require use of the windshield wipers, the engines are ingesting a very significant amount of salt water. In this condition, there is a probability of performance degradation thus, an increase in altitude is recommended.

- In the event that hovering is necessary in the above conditions, the best indication of performance loss is the relationship between TGT and torque.

Note

Continued engine operation in clean air may dissipate some of the salt buildup, but this cannot be assured. Flight through rain may also be beneficial in reducing salt buildup, thereby improving performance.

11.8 FLIGHT WITH EXTERNAL LOADS

It is very important that the pilot know the riding characteristics of certain loads and the associated flight control applications. All maneuvers that are made with external cargo loads should be gradual and well coordinated. Care must be taken when flying with external loads that have aerodynamic characteristics (i.e., light aircraft, wings, tail sections, sheet metal, plywood, etc.). The aerodynamic lift capabilities of these loads may amplify any oscillation and cause the load to contact the helicopter. Hovering and turns while hovering present no unusual problems; however, some helicopter oscillation may be noticed with low density bulky cargo when in level flight. This oscillation can be minimized by the use of smooth control movements. When making turns at higher airspeeds, more than the normal opposite lateral cyclic displacement is necessary to prevent excessive rolling motion into the direction of turn. This tendency increases with airspeed and requires a slightly larger turning radius than would be required at the same gross weight with an internal cargo load. More than normal amounts of cyclic displacement are necessary to overcome the external cargo inertia when initiating or stopping sideward flight; however, slow steady sideward flight presents no problems. Experience has shown that for any type of external cargo load, there is an airspeed best suited for that particular load. This speed may vary from very low speeds with some loads to cruise speeds or above for others. There is no one rule for flying external loads as the combination of weight, dimension, and shape all have a direct bearing on the action of the load during flight. Increased power requirements will be necessary to hover large flat loads that create a vertical drag factor than to hover loads of the same weight but smaller configuration. However, if control movements are smoothly applied to preclude oscillation, and airspeed is slowly increased to determine the riding characteristics of the load and the best airspeed for it to be flown, external cargo can be flown satisfactorily. If high airspeeds or turbulence should cause a load to oscillate, the oscillation can be reduced by decreasing airspeed and increasing collective.

Note

The parasitic drag of an external load will increase fuel consumption significantly.

11.9 HELICOPTER VIBRATION

The inherent vibrations in any helicopter are those created by the mechanical functions of the engines and transmission systems, dynamic action of the main and tail rotors, and aerodynamic effects on the fuselage. The overall vibration level is influenced by the many individual frequencies of vibration and combinations thereof. Many multiples of a basic frequency are felt, and often two or more different superimposed frequencies create beats. The overall magnitude is the resultant of the amplitudes of all the frequencies and it would be difficult for the pilot to completely separate all the types of vibrations encountered. Generally, these are divided into three categories: low, medium, and high frequencies. Varying magnitudes of all three types of vibrations are often present in an individual helicopter. Only through experience will the pilot be able to judge what is normal to the model and what is abnormal and correctable. Excessive or abnormal vibration levels should be noted on a VIDS/MAF.

11.9.1 Main Rotor Specific Vibrations

11.9.1.1 One-Per-Revolution (4.3 Hz)

This vibration emanates from the main rotor system and is generally caused by main rotor head or blade imbalances. It produces a rotary excitation of the fuselage which feels like a lateral oscillatory roll to the pilot. At high speeds, one–per–revolution vibration will most likely be felt as a vertical vibration. The most probable causes are:

1. Main rotor blades out of track. A blade track adjustment is not warranted even though the blades visually appear to be slightly out of track if a one–per–revolution vibration is not present. Out–of–track condition could be caused by:

   a. Damaged main rotor blade trailing edges.

   b. Main rotor blade dynamic balance beyond tolerances.

2. Worn or loose control rod end bearings. If the vibration is present in a hover only, the cause could be the same as above, plus:
   a. Main rotor blade static balance beyond tolerances.
   b. Rotor head out of balance.
3. Malfunctioning blade damper.

11.9.1.2 Ground One-per-Revolution

This is a one–per–revolution lateral roll of the helicopter which often occurs during rotor engagement and is due to the in–place misalignment of the main rotor blades, causing an out–of–balance condition in the main rotor system. When the rotor attains flying speed, centrifugal force normally aligns the blades and the vibrations disappear. If the vibration continues with the rotor up to speed at flat pitch but disappears when the helicopter is lifted into a hover, the cause could be one of the following:

1. Static imbalance of the main rotor blades or rotor head.
2. Improper servicing of the landing gear strut.

11.9.1.3 One-per-Revolution (6.5 Hz)

This vibration is most probably caused by an initial aerodynamic upset which is amplified and maintained as a result of an SAS and pilot–induced oscillation (PIO) in the longitudinal cyclic.

This vibration will most likely be encountered during autorotations over 100 KIAS at approximately 3,500 fpm rate of descent, turns above 45° AOB, diving recoveries, or sideslips.

11.9.1.4 Four-per-Revolution (17.2 Hz)

This most common inherent vibration is caused by the dynamic response of the main rotor blades to asymmetrical blade loading. Its intensity is greatest at low–forward speeds and during transition to a hover. It is felt as a lateral/roll shake caused by the main rotor blades traversing the downwash of preceding blades. This vibration normal to the helicopter when felt at the point where the collective pitch is increased to sustain a hover, or when air taxiing the helicopter just prior to applying collective pitch, and by planning the approach so that the hover can be attained with a slow rate of final pitch application. At high speeds, the difference in the lift distribution between the advancing and retreating main rotor blades results in heavy vibratory loads on the rotor head. It is felt as a combination of vertical and lateral shake at the same frequency. The primary sources of excessive four–per–revolution vibrations are loose or worn vibration absorbers, main rotor head pressure plates, swashplate and associated hardware, damper servicing, loose stabilator, and loose cabin equipment and main landing gear struts (if experienced on deck only).

Note

- Adjusting the engine rpm switch will result in changes to four–per–revolution vibration levels.
- A longitudinal reversal of the cyclic at low speeds (60 to 90 knots) may result in momentary increase in four–per–revolution vibration.

11.9.2 Ground Resonance

Ground resonance is a phenomenon of multibladed helicopters like the SH–60B and is due to the cg of the rotating blades traversing off center. Typically, it can happen during startup, takeoff, or landing. For the condition to occur, there must be some abnormal lead/lag blade condition that would cause the cg of the rotors to progress outward, causing further outward movement of cg. Ground resonance can be caused by a blade being badly out of track, a peculiar set of landing conditions, or a malfunctioning damper. Ground resonance can be pilot induced and may occur when a landing is made with a large descent coupled with lateral drift. When a wheel reaction occurs, such as a hard one–wheel landing that would cause out–of–phase main rotor blades to be aggravated to the point where maximum lead and lag blade displacement is realized, ground resonance can occur. If ground resonance should occur, primary consideration should be given to getting the helicopter airborne. If this is impossible, immediately reduce collective pitch, place the PCLs to OFF, and apply the rotor and wheel brakes.

11.9.3 Tail Rotor Specific Vibrations

11.9.3.1 Tail Shake (Five Cycles per Second)

Tail shake is an aerodynamic excitation of the first lateral bending mode of the tail pylon in certain flight regimes. This vibration will be felt as a random impulse around the yaw axis and may be more apparent with an aft center of gravity.

11.9.3.2 Tail Rotor Drive Shaft Vibrations (High Frequency)

Generally, these vibrations are caused by an unbalanced drive shaft, bad bearings, or a failing tail/intermediate gearbox. These vibrations can be identified during a ground run by feeling the tail cone and can also be felt as a buzz in the pedals or a tickling in the nose similar to that of a feather.

11.9.3.3 One Times Tail Rotor Speed (20 Hz)

This vibration (1,189 cycles per minute at 100 percent) may be due to tail rotor imbalance, damage, loose hardware, pitch change link bearing wear, or loose tail or intermediate gearbox, and is not easily isolated by the pilot. Since this frequency is close to four per revolution (1,032 cycles per second), the vibration may be difficult to distinguish from a four per revolution. Also, they may modulate at a frequency of 170 cycles per minute and be hard to distinguish from a one per revolution (258 cycles per minute).

PART V

Emergency Procedures

CHAPTER 12

Emergency Procedures

WARNINGS

EMERGENCY PROCEDURES

CAUTIONS

ADVISORIES

12.1 INTRODUCTION

The emergency situations and procedures outlined in this chapter cover the common types of emergencies encountered; however, the procedures used during an actual emergency must result from careful consideration of the complete situation. Compound emergencies may require departure from the normal corrective procedures set forth by any specific emergency. Due to the varied types of equipment installed, pilots and aircrewmen must be thoroughly familiar with the emergency procedures in this chapter. The terms **land as soon as practical**, **Land As Soon As Possible**, and **LAND IMMEDIATELY**, refer to the degree of urgency with which a landing must be made and are not meant to preclude the use of sound judgment during these situations.

The PAC shall complete the immediate action items that do not require releasing the flight controls.

The PNAC shall:

1. Assist in ensuring the continued safe flight of the aircraft.
2. Perform the immediate action items that do not involve the flight controls.
3. Use the pocket checklist to complete non–immediate action items.
4. Troubleshoot as required.

The aircrewman shall:

1. Provide the pilots with verbal calls as necessary to ensure the continued safe flight of the aircraft.
2. Complete the applicable immediate action items.
3. Utilize the pocket checklist to complete the remaining non–immediate action items.
4. Back up the pilots with the pocket checklist to the maximum extent possible.
5. Assist the PNAC with troubleshooting.

Note

The urgency of certain emergencies requires immediate and instinctive action by the PAC. The most important single consideration is helicopter control. All procedures are subordinate to this requirement.

The following should be performed for all emergencies:

1. Maintain control of the aircraft.
2. Alert Crew.
3. Determine the precise nature of the problem.
4. Complete the applicable emergency procedure or take action appropriate for the problem.
5. Determine landing criteria and land as required.

Due to possibility of rapid degradation or loss of aircraft control during certain emergencies, the PIC should ensure all aircrew are strapped into their seats with shoulder harnesses locked at all times during ground or flight operations, except when release of the seat belt is required to perform mission- or flight-related functions.

CAUTION

A thorough analysis should be conducted prior to resetting circuit breakers in flight. Energizing faulty electrical circuits may induce further degradation, failure, or loss of flight and mission displays.

Note

In an NVD operating environment, it is recommended that the entire crew remain goggled and initiate the required immediate action procedures.

12.1.1 Explanation of Terms

Procedures indicated by an asterisk (*) are considered Critical Memory Items (CMIs). These steps must be performed immediately, without reference to the checklist.

LAND IMMEDIATELY: Execute a landing without delay. The primary consideration is to ensure the survival of the occupants.

Land As Soon As Possible: Execute a landing at the first site at which a safe landing can be made.

Land as soon as practical: Extended flight is not recommended. The landing site and duration of flight are at the discretion of the PIC.

12.1.2 WARNING, CAUTIONS and ADVISORIES

Warning, caution and advisory (WCA) information is provided visually to the pilots by a red warning, amber caution and green advisory lights. These lights are located on the master warning and caution/advisory panels on the instrument panel. See Figure 12-1 through Figure 12-4.

12.1.3 Master Caution Light

The MASTER CAUTION light (Figure 12-4) illuminates to alert the pilots of a caution activation. In response to the light, the pilot will note the applicable caution and press the MASTER CAUTION light to reset it.

Note

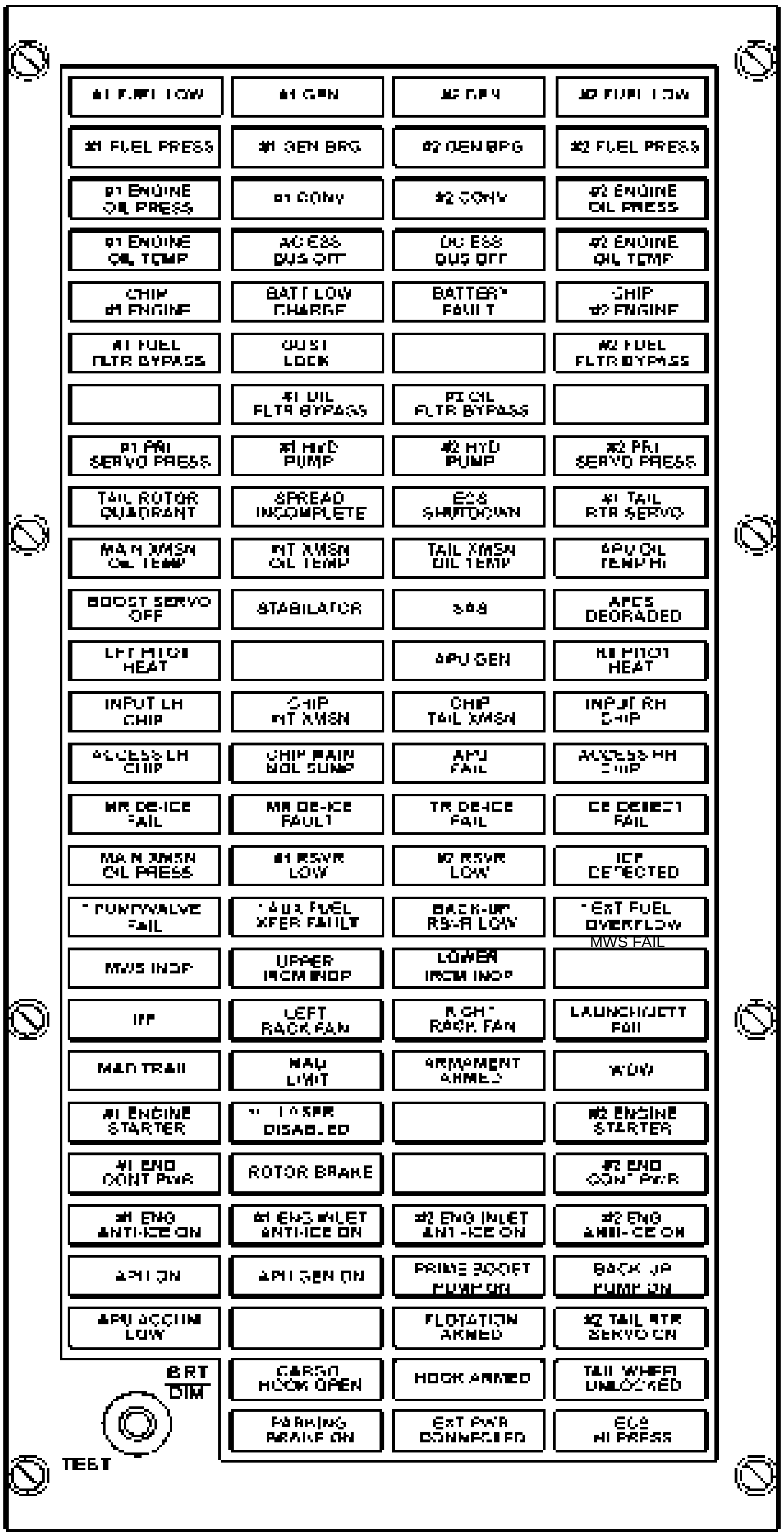
- Reset MASTER CAUTION after each malfunction to allow the systems to respond to subsequent malfunctions.
- MASTER CAUTION light illumination with no corresponding caution light may be an indication of a malfunctioning intermediate transmission and/or tail gearbox chip detector.

12.1.4 Pocket Checklists (PCLs)

The Pilot PCL (A1–H60BB–NFM–500) and Aircrew PCL (A1–H60BB–NFM–800) include selected emergency procedures, cautions, and advisories from this chapter. These PCLs contain only the text listed under the LEGEND column and the CORRECTIVE ACTION columns of this chapter. Text located in the CAUSE/REMARKS column of this chapter does not appear in the PCLs.

12.1.5 Circuit Breaker Numbering Convention

All circuit breakers referenced in emergency procedures have a labeling convention that reads top to bottom, left to right with circuit breaker NO. 1. beginning at the left of the respective panel and includes any missing or covered circuit breaker spaces as part of the count.



*AIRCRAFT BuNo 162349 AND SUBSEQUENT

**LASER DISABLED ADVISORY INDICATOR WILL BE PRESENT ON AIRCRAFT ONLY WHEN ARMED HELO MODIFICATION IS INSTALLED

Figure 12-1. Caution/Advisory Panel

LEGEND	DESCRIPTION
#1 FUEL LOW (or) #2 FUEL LOW	Low fuel state (200 to 225 pounds) in respective fuel cell.
#1 FUEL PRESS (or) #2 FUEL PRESS	Low fuel pressure from respective engine-driven boost pump (faulty pump or air leak).
#1 FUEL FLTR BYPASS (or) #2 FUEL FLTR BYPASS	Respective fuel filter is in bypass.
#1 OIL FLTR BYPASS (or) #2 OIL FLTR BYPASS	Respective engine oil filter is bypassing.
#1 ENGINE OIL TEMP (or) #2 ENGINE OIL TEMP	Respective engine oil temperature is high.
#1 ENGINE OIL PRESS (or) #2 ENGINE OIL PRESS	Low oil pressure at outlet of respective engine oil filter.
CHIP #1 ENGINE (or) CHIP #2 ENGINE	Chip or metal particles in respective engine.
APU OIL TEMP HI	APU oil temperature has exceeded limits.
APU FAIL	APU has failed to start due to a start sequence failure or has automatically shut down due to a monitored parameter being exceeded during operation with the exception of high oil temperature or a shorted thermocouple probe.
GUST LOCK	Blade indexing motor has been engaged.
SPREAD INCOMPLETE	SPREAD status light is ON and (1) pylon and/or stabilator panel not spread and locked and/or (2) tail indexer not retracted and/or (3) AC power routed to sliprings.
MAIN XMSN OIL PRESS	Main transmission oil pressure is low.
MAIN XMSN OIL TEMP	Main transmission oil temperature is high.
CHIP MAIN MDL SUMP	Chip in main gearbox sump.
ACCESS LH CHIP (or) ACCESS RH CHIP	Chip is detected in applicable accessory module.
INPUT LH CHIP (or) INPUT RH CHIP	Chip is detected in applicable input module.
TAIL ROTOR QUADRANT	One or both cables leading to tail rotor quadrant is broken.
#1 TAIL RTR SERVO	Low pressure at first stage pressure switch on tail rotor servo.
CHIP TAIL XMSN	Chip detected in tail gearbox.
CHIP INT XMSN	Chip detected in the intermediate gearbox.
TAIL XMSN OIL TEMP	High oil temperature in tail gearbox.
INT XMSN OIL TEMP	High oil temperature in the intermediate gearbox.
#1 RSVR LOW (or) #2 RSVR LOW	Fluid level in applicable hydraulic pump module is low.
#1 HYD PUMP (or) #2 HYD PUMP	Low pressure at outlet of applicable hydraulic pump.
BACK-UP RSVR LOW	Fluid level in backup pump module is low.
#1 PRI SERVO PRESS (or) #2 PRI SERVO PRESS	Low pressure or servo jam at any or all primary servos of applicable stage.
BOOST SERVO OFF	Collective and/or yaw boost servo pressure is low or boost servo is jammed.
SAS	Loss of hydraulic pressure to SAS actuators or loss of electrical power to both SAS-1 and SAS-2.
STABILATOR	Stabilator reverted to manual mode.
AFCS DEGRADED	Failure of one or more modes of DAFCS computer (flashing) or DAFCS computer power loss (steady).

Figure 12-2. Caution Light Matrix (Sheet 1 of 2)

LEGEND	DESCRIPTION
ECS SHUT DOWN	ECS has shut down due to CONTGCY PWR being selected, heating duct overtemperature, or one of the following with the AIR SOURCE ECS/START switch in ENGINE position: (1) either engine TGT approximately 839 ±6 °C, (2) either ENG ANTI-ICE switch on, (3) ICE detected with DE–ICE MASTER in AUTO, or (4) when an underpressure situation exists.
#1 GEN (or) #2 GEN (or) APU GEN	Respective generator not supplying power to buses. Operative generator selected OFF; failure of generator, GCU, contactor, or wiring fault.
#1 GEN BRG (or) #2 GEN BRG	Generator main bearing is worn or has failed.
AC ESS BUS OFF	AC ESS BUS not powered.
#1 CONV (or) #2 CONV	Failure of AC source(s) or respective converter or DC bus.
DC ESS BUS OFF	DC ESS BUS not powered.
BATT LOW CHARGE	Battery is at or below a 40 percent state of charge.
BATTERY FAULT	Battery overtemperature or cell dissimilarity.
ICE DETECTED	Ice has been detected by ice detector.
ICE DETECT FAIL	Ice detector or icing rate signal converter has failed.
RT PITOT HEAT (or) LFT PITOT HEAT	Low heat or no heat on pitot tubes.
MR DE-ICE FAULT	Loss of electrical power (any phase) or open circuit on any MRB heating zone element (system will operate in degraded mode).
MR DE-ICE FAIL	Open circuit to any MRB heating element or a short circuit from phase to phase of the blade de–ice power lines (system will automatically turn off).
TR DE-ICE FAIL	Total open circuit to TRB heating elements or a short circuit from phase to phase of the blade de–ice power lines (TR DE–ICE will automatically turn off).
LEFT RACK FAN (or) RIGHT RACK FAN	High temperature in SO console or in MAR.
LAUNCH/JETT FAIL	Armament component has failed power-on BIT. Armament may not be able to be armed/launched. Additionally, jettison functions may also be inoperative.
IFF	Flashing — Transponder has not responded to a valid Mode 4 interrogation. Steady — KIT 1 series not keyed.
MWS INOP	System not used in this configuration. Illuminates during test only.
UPPER IRCM INOP	Upper ALQ-205 IRCM transmitter is inoperative (ESP only).
LOWER IRCM INOP	Lower ALQ-205 IRCM transmitter is inoperative (ESP only).
MWS FAIL	System not used in this configuration. Illuminates during test only.
PUMP/VALVE FAIL	Failure of element(s) of dual transfer/shutoff valves or dual transfer pumps.
AUX FUEL XFER FAULT	Total failure of dual transfer/shutoff valves, or dual transfer pumps, or FMCP logic.
EXT FUEL OVERFLOW	Fuel in external tank vent line.

Figure 12-2. Caution Light Matrix (Sheet 2)

LEGEND	DESCRIPTION
MAD TRAIL	Indicates when the MAD towed body is not in the stowed position (MSN PWR is set to PRI), or when MAD reeling machine control power switch is set to ON (MSN PWR is set to OFF or SEC).
MAD LIMIT	Steady illumination when the MAD bird is deployed to maximum limit. Flashes if the MAD stops inadvertently at any intermediate position. Light is extinguished when the MAD is traveling normally between limits. The MAD Limit capsule on will appear dimmer than other capsules when the panel is in DIM mode.
ARMAMENT ARMED	Lighted when aircraft has weight off wheels and MASTER ARM switch ON.
WOW	Aircraft has weight on wheels.
LASER DISABLED	Indicates the Interlock Switch Assembly LASER ENABLE/ DISABLE switch, located in the nose bay, is in the DISABLE position.
#1 or #2 ENG CONT PWR	Indicates contingency power has been selected.
ROTOR BRAKE	Rotor brake ON.
#1 or #2 ENG ANTI-ICE ON	The respective engine anti-ice valve has opened. Lights will be on during start to approximately 90 percent N_g or when ENG ANTI-ICE switch is turned ON.
#1 or #2 INLET ANTI-ICE ON	Engine bleed air has heated the engine inlet to 93 °C or greater.
#1 or #2 ENGINE STARTER	Respective engine starter valve is open.
APU ON	The APU is ON and operating normally.
APU GEN ON	The APU AC electrical generator is on and operating normally and is the only supply of power to the AC distribution system.
PRIME BOOST PUMP ON	The FUEL PUMP switch is in the APU BOOST or FUEL PRIME position.
BACK-UP PUMP ON	Indicates the backup pump is operating and at normal pressure.
APU ACCUM LOW	Indicates the APU accumulator pressure is below 2,650 ±50 psi.
FLOTATION ARMED	System not used in this configuration. Illuminates during test only.
#2 TAIL RTR SERVO ON	The second stage of the tail rotor servo is on and at normal pressure.
CARGO HOOK OPEN	Indicates the cargo hook load beam is not latched.
HOOK ARMED	Indicates the cargo hook electrical release system is armed.
TAIL WHEEL UNLOCKED	Indicates the tail wheel lockpin has disengaged from the tail wheel lock assembly.
PARKING BRAKE ON	Indicates the parking brake handle has been pulled up.
EXT PWR CONNECTED	Indicates AC external power is connected to the aircraft and DC power is on the battery bus.
ECS HI PRESS	Indicates the overpressure switch in the bleed-air line is sensing a high-pressure condition to the air-cycle machine.

Figure 12-3. Advisory Light Matrix

LEGEND	LIGHTING PARAMETER OR FAULT
#1 ENG OUT	Indicates the NO. 1 engine N_g speed is ≤55 percent.
FIRE	Indicates a fire detector has actuated a fire-warning circuit.
MASTER CAUTION PRESS TO RESET	Indicates a caution light on the caution panel has been actuated by a failed system.
#2 ENG OUT	Indicates the NO. 2 engine N_g speed is ≤55 percent.
LOW ROTOR RPM	Indicates the rotor speed is ≤96 percent N_r.

Figure 12-4. Master Warning Panel

12.2 ENGINE MALFUNCTIONS

A thorough preflight brief, discussing immediate actions and engine performance computations, will significantly increase the flight crew's ability to respond to an engine malfunction.

The engine instruments often provide ample warning of a malfunction before actual engine failure. Indications of an engine failure include changes in engine torque, N_g, TGT, N_p, and the ENG OUT warning light. Pilot action following a single-engine malfunction will depend upon altitude, airspeed, gross weight, phase of flight, single-engine capability, and environmental conditions. The term single-engine condition is defined as a flight regime that permits sustained flight with one engine inoperative (OEI). Establishing single-engine conditions may include increasing power available (turning contingency power on and engine anti-ice off), decreasing power required (dumping fuel and jettisoning cargo), and achieving single-engine airspeed. This envelope must be maintained until landing.

Additionally, establishing single-engine conditions may require various flight control adjustments as dictated by the flight regime when the engine malfunction occurs. For example, a high DA/low airspeed flight envelope may require the collective to be lowered to control N_r.

If an engine fails while hovering in ground effect, the helicopter should be kept in a level attitude with collective position maintained. Forward flight at low altitudes, where single-engine capability is not possible, may require setting a decelerating attitude to decrease airspeed and build N_r to cushion the landing. If airspeed is low and altitude permits, an attempt to achieve single-engine airspeed may be made by lowering the nose; however, extreme nose low attitudes should be avoided due to the high rates of descent that may develop.

During night overwater operations when adequate altitude or visual cues are lacking, a deliberate water landing may be preferable to inadvertent impact and should be considered. During flight regimes that permit a significant reduction in collective, N_r can be restored to 100 percent before landing. Airspeed should be optimized for the existing conditions (single-engine flight or autorotational descent). Power requirements for level flight are minimized when the aircraft is established at approximately 70 KIAS in a wings-level attitude. Refer to the Height-Velocity Diagram (Figure 4-4) and the Ability to Maintain Level Flight, Single Engine Chart (Figure 27-1).

Execute the Immediate Landing/Ditching emergency procedure when sustained single-engine flight capability does not exist.

WARNING

A decrease in N_r will reduce the efficiency of the tail rotor, potentially resulting in an uncommanded right yaw.

12.2.1 Engine Malfunction In Flight

Any suspected engine malfunction that manifests itself with fluctuations in N_p, N_r, and/or torque should be handled initially with the Engine Malfunction in Flight emergency procedure. Following malfunction identification, refer to the appropriate emergency procedure. Establishing single-engine conditions involves placing the aircraft in the optimum configuration and flight regime to operate with one engine inoperative (OEI). This includes, but is not limited to, establishing single-engine airspeed and reducing angle of bank.

Engine Malfunction In Flight		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine Malfunction In Flight		*1. Control N_r. **WARNING** Flying at an airspeed greater than 105 KIAS with one engine inoperative may result in unrecoverable decay of N_r in the event of a dual-engine failure. *2. CONTGCY PWR switch — ON. *3. Single-engine conditions — Establish. *4. ENG ANTI-ICE switches — OFF, as required. **WARNING** With engine anti-ice on, up to 18 percent torque available is lost. Torque may be reduced as much as 49 percent with improperly operating engine inlet anti-ice valves. *5. External cargo/stores/fuel — JETTISON/DUMP, as required. *6. Identify malfunction.

12.2.2 Engine Power Control Failure

Engine control system malfunctions may produce high or low torque conditions. This can result in N_r increasing or decreasing from normal selected speed. It is possible that the malfunction can also result in loss of or erroneous torque, N_g, TGT and/or N_p indication on the malfunctioning engine.

12.2.2.1 Engine High-Side Failure In Flight

If N_p and N_r increase above normal selected speed, identify the malfunctioning engine by comparing N_g's, TGTs, and torques. It is possible that one or more of these indications may be erroneous or absent. The engine with the higher N_g, TGT, or torque should be manually controlled using the following procedure.

Engine High-Side Failure In Flight		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine High-Side Failure In Flight	**CAUTION** If an N_p overspeed condition is reached (120 percent), the overspeed system will flameout the engine and the autoignition system will relight the engine. If N_r is not controlled and N_p accelerates back to 120 percent, the N_p overspeed system will flameout the engine again and the autoignition system will reset the ignitor five-second timer. The N_p overspeed/ autoignition system will continue cycling until N_r/N_p is controlled. A yaw kick may be experienced each time the engine relights. **Note** With high collective settings, N_r may increase slowly, making high-side failure confirmation difficult. Reducing collective will reveal increasing N_r and verify high-side failure.	*1. Engine Malfunction in Flight emergency procedure — PERFORM. *2. PCL (malfunctioning engine) — RETARD TO SET: a. Torque 10% below good engine or b. Matched N_g or c. Matched TGT. 3. **Land as soon as practical.**

12.2.2.2 Engine High-Side Failure On Deck

Engine High-Side Failure On Deck		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine High-Side Failure On Deck		*1. PCLs — IDLE.

12.2.2.3 Engine Low-Side Failure In Flight

If torque of one engine decreases significantly below the torque of the other engine or N_r decreases below normal selected speed, identify the malfunctioning engine by comparing both engine's N_g's, TGTs and torques. One or more of the indications may be erroneous or absent. If torque is not indicated for both engines, the engine with low N_g should be controlled manually. The malfunctioning engine should be manually controlled after selecting LOCKOUT to increase power using the following procedures.

Engine Low-Side Failure In Flight		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine Low-Side Failure In Flight	**CAUTION** When an engine is manually controlled with the ENG POWER CONT lever in LOCKOUT, the engine response is much faster and the TGT-limiting system is inoperative. Care must be taken to prevent exceeding TGT limits and keeping N_r and N_p in their operating ranges; however, the N_p overspeed system will still be operative.	*1. Engine Malfunction in Flight emergency procedure — PERFORM. 2. PCL (malfunctioning engine) — Momentarily advance to LOCKOUT, then retard to set: a. Torque 10% below good engine or b. Matched N_g or c. Matched TGT. 3. **Land as soon as practical.**

12.2.2.3.1 Engine Torque or TGT Spiking/Fluctuations

Various failures/malfunctions in engine electronic circuitry or components may cause fluctuations or spiking in torque and TGT. Spiking is an instantaneous, momentary excursion of an engine instrument that may or may not be accompanied by an associated response in N_g, N_p, and/or N_r. If one engine appears to be driving the fluctuation or is exceeding a limitation, treat that engine as the malfunctioning engine. If expeditious identification of the malfunctioning engine is not possible, treat either engine as the malfunctioning engine.

Fluctuations of the N_r, torque, and N_g VIDs, and other engine instruments on either or both engines, may be indicative of water-contaminated fuel. Audible power surges may be observed before power loss. Engine fuel filters are not water sensitive and will not give any indication in the cockpit of engine malfunction or impending engine flameout.

Engine Torque or TGT Spiking/Fluctuations		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine Torque or TGT Spiking/ Fluctuations		If an engine instrument is spiking/fluctuating and inducing secondary indications in N_g, N_p, and/or N_r: *1. Engine Malfunction in Flight emergency procedure — Perform. If fuel contamination is suspected: *2. **Land As Soon As Possible.** **WARNING** PCL movement during engine fluctuations may precipitate an engine failure. Consider performing APU Emergency Start procedure prior to manipulating the PCL. Maintaining a low power setting when moving the PCL will minimize the N_r decay rate if the malfunctioning engine fails. If engine electronic circuitry is suspected: 3. PCL (malfunctioning engine) — Momentarily advance to LOCKOUT, then retard to set: a. Torque 10 percent below good engine or b. Matched N_g or c. Matched TGT. If fluctuations persist: 4. PCL (engine in LOCKOUT) — Retard to IDLE, then return to FLY. 5. Repeat steps 3. and 4. for the other engine, as required. If an engine instrument is spiking/fluctuating with no secondary indications: 6. **Land as soon as practical.**

12.2.2.3.2 Compressor Stall

A compressor stall is caused by an aerodynamic disturbance of the smooth airflow pattern through the engine. Susceptibility to stall is influenced by blade or vane angle and airfoil shapes, which can be distorted by compressor damage, improper stator vane schedule, compressor fouling, loss of blade or vane material by erosion, salt encrustation, or ice ingestion. Indications of a stall are: rapid increase in TGT, hang-up or rapid decrease in N_g, loss of power, or a change in engine noise level varying from barely audible to muffled explosions.

Compressor Stall		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Compressor Stall	**CAUTION** If the N_g decay relight feature attempts to relight the engine, subsequent compressor stalls may occur and damage the engine. A yaw kick may be experienced each time the engine relights. The engine must be manually shutdown.	*1. Engine Malfunction in Flight emergency procedure — PERFORM. *2. PCL (malfunctioning engine) — IDLE. If TGT decreases and stall clears: 3. PCL — SLOWLY ADVANCE TO FLY. If stall remains cleared: 4. **Land as soon as practical.** Avoid rapid collective movement. If TGT continues to rise, N_g decreases below normal idle speed, or any other malfunction is indicated: 5. Engine Shutdown in Flight emergency procedure — PERFORM.

12.2.3 Engine High Speed Shaft Failure

An impending high-speed shaft failure may manifest itself as a high-intensity, medium- to high-frequency vibration that may be felt throughout the aircraft. A howl may accompany the vibration. The intensity of the vibration and howl may vary with collective or PCL movement and the resultant loading and unloading of the high-speed shaft. The aircrewmen can assist in identifying the affected engine by comparing the vibration and noise levels between the two sides of the aircraft. Cockpit indications may initially remain normal; however, if the high-speed shaft seal at the input module is damaged and transmission oil is lost, secondary indications of impending failure (transmission oil pressure and temperature) may be present.

If medium- to high-frequency vibrations/noises are identified and can be isolated to an impending high speed shaft malfunction, consideration should be given to securing the engine, thereby precluding catastrophic failure of the high-speed shaft. Extreme care must be taken to positively determine which engine is malfunctioning, since retarding the PCL of the unaffected engine may further load the affected shaft and accelerate the shaft failure. The possibility exists that a high-speed shaft failure may occur with little or no advance warning.

Engine High Speed Shaft Failure		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine High Speed Shaft Failure	Indicates failure of the high-speed shaft. N_p is greater than N_r by more than 3 percent and engine torque is below 10 percent.	CAUTION Following a high-speed shaft failure, the engine will overspeed, the N_p over-speed system will flameout the engine, and the auto-ignition system will activate the relight feature. The engine N_p governor will eventually bring N_p down towards 100 percent. A yaw kick may be experienced each time the engine relights. The engine must be manually shut down to prevent further damage. *1. Engine Malfunction in Flight emergency procedure — PERFORM. *2. PCL (malfunctioning engine) — OFF. 3. **Land as soon as practical.** Consideration should be given to performing the following: 4. Engine Shut down in Flight emergency procedure. 5. Single-Engine Landing emergency procedure.

12.2.3.1 Load Demand System Malfunction

It is possible for a malfunction to occur in the LDS; notably a shear-pin/roll-pin failure or LDS cable malfunction. A shear-pin/roll-pin failure will result in the maximum LDS input to the HMU, regardless of collective position. This condition may result in excess power driving the main rotor during an autorotative descent because the DECU will not have enough down-trimming authority to reduce torque to zero. Depending on the severity of the malfunction, the DECU's ability to match engine torques under most flight conditions may conceal the malfunction. If the collective is raised slowly to lift into a hover, no torque split would be evident. The rate and magnitude of collective changes will determine the amount of torque split.

In general, in-flight diagnosis of an LDS malfunction is determined by the dynamic response of torque to collective inputs. The malfunctioning engine will lag the good engine for several seconds. The lag will have a greater magnitude and duration at higher rates of collective application or reduction.

A jammed or stuck cable may result in the minimum LDS input to the HMU regardless of collective position. This condition may restrict maximum power available from the affected engine. Operation in LOCKOUT will not clear this low-power condition.

The following indications are symptomatic of LDS malfunction:

Load Demand System Malfunction Symptoms	
CONDITION	**ENGINE INDICATIONS**
ON DECK	
PCLs in IDLE.	N_g of malfunctioning engine 3% to 4% higher than other engine.
During rotor engagement.	Engine with the failed LDS will indicate a higher torque as PCLs are evenly advanced to FLY. Good engine may not indicate any torque until its PCL is in FLY.
PCLs in FLY.	Matched torque (no indications of failure).
IN FLIGHT	
Initial collective increase during take–off.	Torque split. Torque of the engine with the failed LDS will be lower than good engine.
Stable hover.	Matched torques (no indications of failure).
Collective increases (collective below approx 75% of its full up position).	Torque split. Torque of the engine with the failed LDS will be lower than good engine.
Collective increases (collective above approx 75% of its full up position).	No torque split. Both LDS are at their maximum setting.
Collective decreases (to positions below approx 75% of full up collective).	Torque split. Torque of the engine with the failed LDS will be above the good engine.
Stable flight.	Matched torques (no indications of failure).
Autorotation.	Rapid N_p/N_r rise. Engine with failed LDS may show a residual torque of approx 12% with collective full down.

Load Demand System Malfunction		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Load Demand System Malfunction		On ground: 1. Shutdown. In flight: 2. **Land as soon as practical**. 3. Perform a normal approach, avoiding low–power/autorotative descents. **WARNING** During low–power or autorotative descents with an engine LDS malfunction, N_p/N_r may rise rapidly and activate N_p overspeed protection (120 percent).

12.2.4 Engine Caution Lights

12.2.4.1 #1 or #2 OIL FLTR BYPASS Caution Lights On

Oil Filter Bypass Caution Lights On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
OIL FLTR BYPASS (#1/#2)	Respective engine oil is bypassing the filter.	1. Engine Malfunction in Flight emergency procedure — Perform. 2. PCL (affected engine) — Retard, then return to FLY in an attempt to clear. If secondary indications are present or light does not clear: 3. Engine Shutdown in Flight emergency procedure — Perform. **Note** Consideration may be given to restarting the engine if required for landing.

12.3 ENGINE OIL TEMPERATURE HIGH

Engine Oil Temperature High		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine Oil Temperature High **ENG OIL TEMP (#1/#2)**	Engine oil temperature is exceeding limits. **Note** The engine oil pressure and temperature caution lights are triggered by the vertical instrument. Therefore, caution light and gauge indications cannot be used as secondary indications for each other.	1. **Land as soon as practical.** 2. Check for secondary indications (caution lights, temperature, pressure, etc.). If secondary indications are present: 3. Engine Malfunction in Flight emergency procedure — Perform. 4. PCL (affected engine) — Idle. If indication remains above maximum limit: 5. Engine Shutdown in Flight emergency procedure — Perform. **Note** Consideration may be given to restarting the engine if required for landing. 6. Single-Engine Landing emergency procedure — Perform. If no secondary indications are present: 7. Monitor affected engine instruments for signs of failure.

12.3.1 Engine Chip/Engine Oil Pressure Low Caution Lights On

Engine Chip/Engine Oil Pressure Low Caution Lights On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ENG CHIP (#1/#2) **OR** **ENGINE OIL PRESS (#1/#2)**	Metal particles or chips detected in respective engine. Low oil pressure in respective engine. Note The engine oil pressure caution lights are triggered by the vertical instrument. Therefore, caution light and gauge indications cannot be used as secondary indications for each other.	1. **Land as soon as practical**. 2. Check for secondary indications (caution lights, temperature, pressure, etc.). If secondary indications are present: 3. Engine Malfunction in Flight emergency procedure — Perform. If engine failure is imminent: 4. Engine Shutdown in Flight emergency procedure — Perform. 5. Single-Engine Landing emergency procedure — Perform. If no secondary indications are present: 6. Monitor affected engine instruments for signs of failure.

12.3.1.1 ECS Shutdown Caution Light On

ECS Shutdown Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ECS SHUTDOWN	ECS has shut down due to CONTGCY PWR being selected, heating duct over temperature, or the AIR SOURCE ECS/START switch in ENG position and one of the following: 1. Either ENG ANTI-ICE switch ON. 2. Ice detected with DE-ICE MASTER switch in AUTO. 3. TGT limiting has been reached.	If ECS SHUTDOWN caution appears due to high TGT: 1. Reduce power requirements (if possible).

12.3.2 Abort Start

Abort Start		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Abort Start	Abort engine start if any of the following limits are exceeded: 1. N_g does not reach 14 percent within 6 seconds after starter initiation. 2. No oil pressure within 30 seconds after starter initiation (Do not motor engine). 3. No light-off within 30 seconds after moving PCL to IDLE. 4. ENG STARTER advisory disappears before reaching 52 percent N_g. 5. TGT reaches 851 °C before idle is attained. **CAUTION** For aborted starts, fuel flow must be stopped immediately (PCL — OFF) to prevent engine overtemperature.	To abort start: *1. PCL — OFF. *2. ENGINE IGNITION switch — OFF. *3. Starter — Engage. 4. Starter — Disengage after 30 seconds and TGT below 540 °C.

12.3.3 Engine Malfunction During Hover/Takeoff

Engine Malfunction During Hover/Takeoff		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine Malfunction During Hover/ Takeoff		*1. Control N_r. *2. CONTGCY PWR switch — ON. If a suitable landing site exists or unable to transition to forward flight: *3. Set level attitude, eliminate drift, cushion landing. If able to transition to forward flight: *4. Engine malfunction in Flight emergency procedure — Perform.

12.3.4 Dual-Engine Failure in Flight/Hover

WARNING

- Rotor rpm decays rapidly following a dual-engine failure or the loss of the second engine after a single-engine failure. Delay in lowering the collective will result in loss of rotor rpm and may cause catastrophic failure of the rotor system due to dynamic instability at low rpm.
- Entering an autorotation at low airspeeds (below 50 KIAS), where the vertical sink rate is high in proportion to the horizontal speed, will result in an airspeed indication that is considerably higher than actual. A positive nosedown attitude should be held until 80 to 85 KIAS is indicated, after which pitch attitude may be adjusted to maintain the desired airspeed.
- Altitude hold will remain engaged unless deselected. if the collective TRIM RLSE switch is not depressed, the AFCS will attempt to maintain aircraft altitude. AFCS commanded collective movement could result in a catastrophic loss of N_r.
- Flying at an airspeed greater than 105 KIAS, with one engine inoperative, may result in unrecoverable decay of N_r in the event of a dual-engine failure.
- If the engine fails in a hover in ground effect, do not decrease the collective. This will cause the helicopter to settle more rapidly. The helicopter should be held in a landing attitude. The landing can be cushioned by increasing the collective as the helicopter approaches the ground.

12.3.5 Autorotation

With a dual-engine failure, rotor rpm will decay rapidly and left yaw may result. At altitude, it is imperative that an autorotation be established immediately. External cargo/stores should be jettisoned as soon as possible in order to reduce gross weight and drag, thus improving autorotational performance and decreasing the chance of damage to the helicopter upon landing. The collective must be reduced immediately to full down in order to regain Nr and then adjusted to control N_r. Cyclic should be adjusted as necessary to achieve desired airspeed. At airspeeds above 80 KIAS, there is an increase in rate of descent; however, airspeeds up to 100 KIAS will also increase glide distance. Should both engines fail at altitude, an attempt may be made to restart one or both engines. Approximately 5,000 ft AGL will be required to accomplish an engine restart, based on APU and engine start cycles, and typical autorotative rates of descent.

Autorotating the helicopter out of balanced flight will increase rate of descent and decrease glide distance. Therefore, ball control immediately after a dual-engine failure and during the descent is important. Balanced flight should be maintained, except when a higher rate of descent is required to prevent an overshoot of the intended landing site.

Throughout the descent, adjust collective as necessary to maintain N_r in the normal range. At high gross weights, the rotor may tend to over-speed and application of collective will be required. Autorotative rpm varies with DA, gross weight, and airspeed. Adjusting the collective pitch to maintain 100 percent N_r will result in an extended glide. N_r above 100 percent will result in an increased rate of descent.

Upon reaching an altitude of approximately 200 ft AGL, establish a flare. This decreases both airspeed and rate of descent, and increases N_r. The amount and rate at which N_r increases will depend upon the amount and rate of the flare. At approximately 60 ft AGL: set a level attitude, eliminate drift, and cushion the landing.

CAUTION

Should the helicopter balloon or level off during the flare, freeze collective and cyclic positions until the rate of descent increases again. Lowering the collective could result in an unrecoverable sink rate and a harder than desired landing.

Note

With both engines secured, the cushioning collective pull at the bottom of the autorotation will result in left yaw vice the right yaw associated with practice (power-on) autorotations.

Ground contact should be made with some forward airspeed, terrain permitting. If a rough landing area is selected or if over water, a steeper flare and a touchdown speed as close to zero KGS as possible shall be used.

12.3.6 Single-Engine Failure

The various conditions under which engine failure may occur prevent a standard procedure. A thorough knowledge of emergency procedures and flight characteristics will enable the pilot to respond correctly and automatically in an emergency.

WARNING

Engine failure accompanied by an explosion or unusual noise indicates damage to the engine. There is a possibility that any attempt to restart the engine may result in a fire. Under such circumstances, do not try to restart the engine unless it is needed to maintain level flight.

Action to be taken after failure of one engine will depend upon altitude, airspeed, gross weight, phase of flight, single-engine capability, and environmental conditions. In addition, these factors should be taken into consideration should the functioning engine fail and a dual-engine failure result. The unshaded area of Height - Velocity Diagram of Figure 4-4 shows airspeed and wheel height combinations from which a safe landing can be made at different gross weights if one or two engines should fail.

Single-Engine Failure		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Single Engine Failure **ENG OUT (#1/#2)**	Warning light is activated by the vertical instrument when N_g decreases below 55 percent. In the event of an isolated N_g signal failure, the ENG OUT light will be illuminated with the engine operating normally.	*1. Engine Malfunction in Flight emergency procedure — Perform. 2. **Land as soon as practical.** Consideration should be given to performing the following: 3. Engine Shutdown in Flight emergency procedure. 4. Engine Air Restart emergency procedure. 5. Single-Engine Landing emergency procedure.

12.3.7 Engine Shutdown In Flight

Engine Shutdown In Flight		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine Shutdown In Flight		1. Single‑engine conditions — Establish. 2. PCL (malfunctioning engine) — OFF. 3. Fuel Selector lever (malfunctioning engine) — OFF. 4. Monitor TGT. 5. **Land as soon as practical**. 6. Single Engine Landing emergency procedure — Perform.

12.3.8 Engine Air Restart

An engine restart may be attempted anytime after shutdown, if there is no indication of a mechanical malfunction or engine fire. If time permits, TGT should be reduced to 80°C before restart by motoring the engine with the PCL off. If the APU is unavailable and a crossbleed restart is necessary, maximum torque available (good engine) will be reduced during start.

During a dual-engine failure; without any evidence of damage, mechanical failure, or engine fire, an engine air restart may be attempted if time and altitude permits. Approximately 5,000 feet will be required based on APU and engine start cycles and typical autorotative rates of descent. Without other evidence, the most probable cause of a dual‑engine failure is fuel starvation. In this case the fuel system must be primed. If abnormal indications are noted during the restart attempt, abort the restart immediately.

Note

In the event of an alternator failure, the N_g signal may be unavailable. Engine start will not be possible without ac power provided to the ignition exciter.

<table>
<tr><th colspan="3">Engine Air Restart</th></tr>
<tr><th>LEGEND</th><th>CAUSE/REMARKS</th><th>CORRECTIVE ACTION</th></tr>
<tr><td>Engine Air Restart</td><td>WARNING

Engine failure accompanied by an explosion or unusual noise indicates damage to the engine. There is a possibility that any attempt to restart the engine may result in a fire. Under such circumstances, do not try to restart the engine unless it is needed to maintain level flight.

CAUTION

For a crossbleed start, the good engine should indicate the maximum N_g safely obtainable. N_g less than 94% may result in hot starts.

Note

Either a single or dual-engine restart may be attempted following dual-engine failure. Decision should be based on applicability of respective start envelopes and considerations of longer time to idle when executing a dual-engine restart.</td><td>*1. APU Emergency Start procedure — As required.
*2. ENGINE IGNITION switch — NORM.
*3. Fuel selector lever(s) — DIR or XFD.
*4. PCL(s) — OFF.
*5. Starter(s) — ENGAGE, motor engine.
*6. PCL(s) — IDLE (TGT 80 °C or less, if time permits).
*7. PCL(s) — Advance to FLY after starter dropout.

WARNING

If APU is unavailable, and a crossbleed start is necessary, maximum torque available will be reduced during the start sequence. Depending on operating conditions, level flight may not be possible. Ensure AIR SOURCE ECS/START switch is in Engine for Crossbleed starts.</td></tr>
</table>

12.3.9 Single-Engine Landing

The helicopter may be flown safely in forward flight and landed with a single engine, provided that proper techniques and safety precautions are observed. When performing a single-engine landing; maintain single-engine airspeed, 100 percent N_r, and observe single-engine limitations. When the good engine is operating at TGT limiting, further increase of the collective will only result in N_r decrease. Due to an increase in power required, steep turns should be avoided, particularly at low altitudes. Under conditions of low gross weight, light fuel load, low DA, and appreciable winds (10 to 20 knots), a normal approach to a hover and a vertical landing may be made on a single engine. With conditions of high gross weight, heavy fuel load, high DA, and little or no wind; a running landing must be made to prevent a high rate of descent. Consideration should be given to dumping fuel to reduce weight. All single-engine landings should be to a smooth, hard surface. Fly the approach at an airspeed and altitude that places the helicopter in the safe area of the Height-Velocity Diagram.

A single-engine waveoff should be accomplished when a single-engine landing cannot be safely executed. Increase the collective to maximum power available while placing the nose on the horizon and leveling the wings. If necessary, trade altitude for airspeed and remain in ground effect until a single-engine climb can be executed.

For landing on a runway, at approximately 150 to 200 feet altitude, reduce airspeed and rate of descent. At approximately 50 feet, begin a deceleration to touchdown above translational lift.

For landing on a spot, at 150 to 200 feet AGL, reduce airspeed as necessary. Maintain translational lift. At 20 to 30 feet AGL, decelerate to touch down tail wheel first at zero groundspeed.

Single-Engine Landing		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Single-Engine Landing	**CAUTION** • Nose attitudes in excess of 13° nose-up at altitudes of 15 ft or less will cause the tail bumper/stabilator to impact the ground. • The procedure described is for a typical single-engine landing and is also applicable to single-engine landings in confined areas, such as non-aviation ships with small landing areas and unprepared sites. The dangers of excessive speed, excessive sink rates, extreme tail wheel low touchdown, and the tendency to use aft cyclic shall be emphasized when making landings of this type. **Note** In order to maximize single-engine flight capability at lower airspeeds, consideration should be given to jettisoning fuel prior to landing. However, fuel dumping prior to assured landing could result in a critical fuel situation.	1. Landing Checklist — Complete. a. CONTGCY PWR — As required. b. Lights — As required. c. Brakes — As required. d. Tail wheel — Lock. e. Instruments, Cautions, Advisories — Check. f. BAR/RADALT HOLD — As required. g. HF Radio — OFF. h. Armament — SAFE. i. Harnesses — Locked. j. Aircrewman Landing Checklist — Complete. k. FLIR — Stowed. l. Return to force checklist. 2. Maximum Power check — Complete. a. Increase collective until N_r droops 2 percent (do not exceed torque or TGT limits). b. Note torque. 3. APU Emergency Start procedure — Perform, as required. 4. Establish a rate of descent not to be over 1,000 fpm and reduce to 500 fpm on final approach.

12.3.10 Engine Advisories

12.3.10.1 Engine Anti-Ice/Start Bleed Valve Malfunction

The temporary hang-up of the engine variable geometry (VG) system at the engine anti-ice/start bleed valve may cause engine flameout at low collective settings. The VG system is activated by fuel pressure from the HMU. As the system is quickly released from any temporary hang-up condition while the collective is full down, the HMU will schedule maximum fuel flow to the VG actuator, creating a diversion from the scheduled fuel flow to the engine. In minimum fuel flow flight regimes such as during autorotations and quick stops, this diversion is sufficient to flame out an engine. The ENG ANTI-ICE advisory lights will normally be on during start to approximately 90 percent, or when ENG ANTI-ICE is selected ON. Malfunctioning anti-ice/start bleed valve cockpit indications include any one of the following:

1. Constant illumination of the ENG ANTI-ICE ON advisory light above approximately 90 percent N_g or above, 94 percent N_g if OAT is 15 °C or greater.
2. No illumination of the ENG ANTI-ICE ON advisory light when N_g drops below approximately 88 percent (N_g may vary on a sliding scale depending on OAT).
3. No illumination of the ENG ANTI-ICE ON advisory light with ENG ANTI-ICE selected ON.
4. No rise in TGT when the ENG ANTI-ICE switch is selected ON.

Note

With ENG ANTI-ICE ON, max torque available is reduced up to 18 percent per engine.

Engine Anti-Ice/Start Bleed Valve Malfunction		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Engine Anti-Ice/Start Bleed Valve Malfunction **ENG ANTI-ICE ON (#1/#2)**	The respective engine anti-ice/start bleed valve has opened. Advisories will appear during start to approximately 90 percent N_g or when the ENG ANTI-ICE switch is turned ON. WARNING Loss of electrical power to the engine will result in engine anti-ice activation regardless of engine anti-ice or de-ice master switch position, reducing max torque available by up to 18 percent.	If a malfunctioning engine anti-ice/start bleed valve is suspected: 1. Engine Malfunction in Flight procedure — Perform. 2. Avoid low engine power requirements and rapid collective movements. 3. **Land as soon as practical**. WARNING A malfunctioning engine anti-ice/start bleed valve may cause engine flameouts during flight when the collective is full down, such as during quick stops and autorotative flight.

12.3.10.2 ENGINE STARTER #1 or #2 Advisory Light On

Engine Starter #1/#2 Advisory Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ENGINE STARTER (#1/#2)	The engine start valve is open. **Note** Pulling the ENG START CB will deenergize the engine ignition system.	If the ENGINE STARTER advisory remains after 65 percent N_g or appears in flight: 1. PCL (affected engine) — PULL. If ENGINE STARTER advisory remains: 2. Affected ENG START CB — Cycle. a. NO. 1 ENG START. (CENTER, DC ESNTL, ROW 1, CB 8). b. NO. 2 ENG START. (ATO, NO. 2 DC PRI, ROW 1, CB 12). If ENGINE STARTER advisory remains: 3. AIR SOURCE — Remove. If crossbleed start: a. AIR SOURCE ECS/START switch — OFF. If APU is on: b. APU CONTR switch — OFF. If ENG STARTER advisory remains: 4. **Land as soon as practical**.

12.3.10.3 ENG INLET ANTI-ICE ON (#1/#2) Advisory Light On

ENG INLET ANTI-ICE ON (#1/#2) Advisory Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ENG INLET ANTI-ICE ON (#1/#2)	Engine bleed air has heated the engine inlet to 93 °C or greater.	If inlet anti-ice malfunction is suspected: 1. **Land as soon as practical**. **WARNING** Appearance of the ENG INLET ANTI-ICE ON advisory when OAT is greater than 13 °C is an indication of a malfunctioning engine inlet anti-ice valve. The resultant loss of torque could be a maximum of 49 percent when the anti-ice valves are open.

12.4 APU EMERGENCIES

12.4.1 APU Emergency Start

APU Emergency Start		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
APU Emergency Start		*1. ECS — OFF. *2. AIR SOURCE ECS/START switch — APU. *3. FUEL PUMP switch — APU BOOST. *4. APU CONTROL switch — ON. *5. APU GENERATOR switch — ON.

12.4.2 APU Caution Lights

12.4.2.1 APU FAIL Caution Light On

APU FAIL Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
APU FAIL	The APU was shut down by the ESU. **Note** ● In order to check ESU BIT indicators, do not secure BATT or APU CONTR switches. ● In order to restart APU, BATT and APU CONTR switches should be reset.	1. APU — Restart (if required). **CAUTION** To prevent an APU exhaust fire, wait at least 2 minutes after APU shutdown before attempting a restart.

12.4.2.2 APU Generator Caution Light On

APU Generator Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
APU Generator Caution Light On **APU GEN**	May indicate one of the following: 1. Failure of APU generator, GCU, contactor, or wiring fault. 2. APU GENERATOR switch has been turned off while APU is operating. 3. APU GENERATOR switch selected ON, APU started, but has not reached operating speed.	1. APU GENERATOR switch — RESET, then ON. If APU GEN caution remains: 2. APU GENERATOR switch — OFF. If APU generator was the only source of AC Power: 3. All nonessential electrical equipment — OFF. 4. **Land as soon as practical**.

12.4.2.3 APU OIL TEMP HI Caution Light On

APU OIL TEMP HI Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
APU OIL TEMP HI	APU oil temperature has reached a prescribed limit, which may be caused by high ambient temperature and/or low oil level. **CAUTION** During ground operation at high ambient temperatures, the APU OIL HOT caution may appear. The APU should be shut down immediately to prevent damage. After allowing APU to cool for 60 minutes, check oil level. If within limits, APU may be restarted.	1. APU CONTROL switch — OFF (if not required).

12.5 MAIN ROTOR SYSTEM EMERGENCIES

12.5.1 Unusual Vibrations

The inherent vibrations in any helicopter are those created by the mechanical functions of the engines and transmission systems, dynamic action of the main and tail rotors, and aerodynamic effects on the fuselage. The overall vibration level is influenced by the many individual frequencies of vibration and combinations thereof. Many multiples of a basic frequency are felt, and often two or more different superimposed frequencies create beats. The overall magnitude is the resultant of the amplitudes of all the frequencies and it would be difficult for the pilot to completely separate all the types of vibrations encountered. Generally, these are divided into three categories: low, medium and high frequencies. Varying magnitudes of all three types of vibrations are often present in an individual helicopter. Only through experience will the pilot be able to judge what is normal to the model and what is abnormal and correctable. Excessive or abnormal vibration levels should be noted on a VIDS/MAF.

12.5.1.1 Ground Resonance

Ground resonance is a phenomenon of multi-bladed helicopters like the H-60, and is due to the CG of the rotating blades traversing off center. Typically, it can happen during start-up, takeoff, or landing. For the condition to occur, there must be some abnormal lead/lag blade condition that would cause the CG of the rotors to progress outward, causing further outward movement of CG. Ground resonance can be caused by a blade being badly out of track, a peculiar set of landing conditions, or a malfunctioning damper. Ground resonance can be pilot induced, and may occur when a landing is made with a large descent coupled with lateral drift. When a wheel reaction occurs, such as a hard one wheel landing that would cause out-of-phase main rotor blades to be aggravated to the point where maximum lead and lag blade displacement is realized, ground resonance can occur. If ground resonance should occur, immediately reduce collective pitch, place the PCLs to OFF, and apply the rotor and wheel brakes.

12.5.1.2 Damper Failure

Malfunction or failure of a rotor damper causes a dynamically unbalanced rotor condition that will be felt as a low-frequency (1/rev, 2/rev, possible 2 to 3/rev) lateral or vertical vibration. The magnitude of the vibration may increase with flight time. As hydraulic fluid is depleted from the damper system, the characteristics of the vibration will change. With one damper inoperative, relatively minor vibrations may be experienced. With two or more inoperative dampers, vibrations may be severe and an engine/rotor system interaction may result in fluctuating N_p/N_r.

12.5.1.3 Unusual Vibrations In Flight

Pilot landing criteria and technique will vary depending on the flight regime, onset, frequency and severity of the vibration and/or rotor system instability. The aircraft will be more susceptible to pilot–induced oscillations (PIO) and the magnitude of the vibration is dependent on flight conditions. The effects of turbulence will increase vibration as will control inputs. Rotor blades normally stay in track. It is recommended that a landing be made as soon as practical since the vibration may affect other systems and components. It is desirable to fly the aircraft at an airspeed that will minimize vibrations (typically 80 KIAS). Select a landing site in the following order of precedence:

1. Runway/pad ashore.
2. Large deck/multi–spot ship.
3. Small deck/single–spot ship.

WARNING

- A Running Landing is not recommended due to rotor instability and possible loss of helicopter control.
- Some conditions of severe vibrations may dictate a more timely approach to a no–hover landing.

Unusual Vibrations In Flight		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Unusual Vibrations In Flight		1. Airspeed — Adjust to minimize vibrations (approximately 80 KIAS). Use small, smooth control inputs. 2. APU Emergency Start procedure — Perform. 3. **Land as soon as practical**. 4. Landing: a. Conduct a smooth, controlled approach for landing. b. If vibrations become severe, perform a no-hover landing. If vibrations subside and a stable hover can be achieved, perform a smooth vertical descent to land. For shipboard landing: c. Obtain minimum wind over deck. d. Consider RA landing. **CAUTION** Advise LSO to slowly apply tension so as not to aggravate vibrations. 5. Upon touchdown, shut down engines. **CAUTION** • Some conditions of severe vibrations may dictate a more timely approach to a no-hover landing. • Attempt to use light control grip to reduce the possibility of PIO. • Ensure PNAC's hand is physically on PCLs to ensure rapid retardation upon touchdown. • Applying the rotor brake will aggravate lead/lag conditions and may cause a mechanical failure.

12.5.1.4 Unusual Vibrations On Deck

Unusual Vibrations On Deck		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Unusual Vibrations On Deck	The cause of unusual vibrations cannot be discerned. The pilot's primary concern is to reduce the vibrations. If the vibrations are severe, the PCLs should be retarded to OFF.	*1. Collective — Lower. *2. PCLs — OFF. *3. Rotor brake — Apply as required.

12.5.2 Hung Droop Stop(s)

Hung Droop Stop(s)		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Hung Droop Stop(s)		*1. Re-engage rotor to greater than 75 percent N_r. 2. Slightly displace cyclic in an attempt to dislodge the jammed droop stop. If after several attempts the droop stop(s) do not engage: 3. Cyclic — Neutral position. 4. Engine shutdown — Perform. If conditions permit: 5. Rotor brake — Do not apply.

12.5.3 Main Rotor Warning Light

12.5.3.1 LOW ROTOR RPM

LOW ROTOR RPM Warning Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
LOW ROTOR RPM	Warning light is activated by the vertical instrument when N_r is 95 percent or less.	*1. Control N_r. 2. Determine cause of low N_r condition.

12.5.4 Main Rotor System Caution/Advisory Lights

12.5.4.1 Gust Lock

GUST LOCK Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
GUST LOCK	Blade indexing motor has been engaged. **CAUTION** Whenever locking or unlocking the gust lock, the GUST LOCK switch shall be held in the LKD or UNLK position for a minimum of 5 seconds to enable the actuator mechanism to complete its cycle. Failure to do so may result in a partially engaged gust lock without a GUST LOCK caution, causing damage when the rotor is engaged.	1. GUST LOCK switch — UNLK (hold switch for 5 seconds minimum). If caution remains: 2. RTR HEAD IDX ENGAGE CB — PULL. (Overhead Console, DC ESNTL, ROW 4, CB 2).

12.5.4.2 Spread Incomplete Light

SPREAD INCOMPLETE Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
SPREAD INCOMPLETE	SPREAD status light on and one of the following conditions exists: 1. Pylon of stabilator not spread and locked. 2. Tail rotor indexer not retracted. 3. AC power routed to sliprings.	1. BLADE FOLD MOTOR CB — Pull. (SO OVHD, NO. 2 AC PRI, ROW 3, CB 4) If SPREAD INCOMPLETE caution light remains ON: 2. **Land as soon as practical**.

12.5.4.3 Rotor Brake Advisory Light On

ROTOR BRAKE Advisory Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ROTOR BRAKE	Hydraulic pressure greater than 6 to 8 psi is registered at pressure switch. **Note** • Consideration should be given to performing the applicable steps of the Immediate Landing/ Ditching emergency procedure. • A minimum-power air-speed and low-altitude flight profile is recom-mended (approximately 80 feet and 80 KIAS) to permit a quick flare followed by ditching should fire occur. • Secondary indications include smoke, fire, and noises.	1. ROTOR BRAKE handle — Check in detent. 2. Rotor Brake Gauge Pressure — Check zero. 3. Check for evidence of disk dragging (noise, smells, smoke, fire). If secondary indications are present: 4. **Land As Soon As Possible.** If no secondary indication are present: 5. **Land as soon as practical.**

12.5.4.4 Rotor Overspeed

Rotor Overspeed		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Rotor Overspeed	N_r greater than 127/137/142.	*1. **Land as soon as practical.**

12.6 TRANSMISSION SYSTEM MALFUNCTIONS

12.6.1 Main Transmission Malfunction

Main transmission malfunctions can be grouped into two categories: chip or lubrication.

If a chip is indicated in one of the modules of the main transmission, consideration should be given to reducing the load on that module. This could include moving the affected PCL to IDLE to reduce the stress on an input module or securing a main generator to reduce the load on an accessory module. If a lubrication problem is indicated, the main generators may be affected since they use transmission oil for cooling. In this case, consideration should be given to securing the main generators after turning the APU generator on.

An impending failure of an accessory module may be first indicated by an input chip caution light, due to the routing of the internal transmission oil and the location of the input module chip detectors. An accessory drive failure will be indicated by loss of the hydraulic pump and generator associated with that module.

Instruments shall be monitored closely for secondary indications such as a pressure and temperature relationship and/or transmission chip cautions. Abnormal noises, an unusual amount of power required to maintain the same flight regime, and/or yaw kicks with spiking torque are indications of possible transmission failure.

Main Transmission Malfunction		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Main Transmission Malfunction **MAIN XMSN OIL TEMP** **OR** **MAIN XMSN OIL PRESS** **OR** **ACCESS LH CHIP** **OR** **ACCESS RH CHIP** **OR** **CHIP MAIN MDL SUMP**	Loss of cooling oil supply will lead to electrical and/or mechanical failure of the main generators. If oil pressure decays slowly, the generators may fail before the MAIN XMSN OIL PRESS or MAIN XMSN OIL TEMP caution light illuminates. Consideration should be given to performing applicable steps of emergency landing/ditching procedure. Consideration should be given to performing applicable steps of emergency landing/ditching procedure. High oil temp in the main transmission. Low oil pressure in the main transmission. Chip or metal particles detected in applicable accessory module or main gearbox sump.	If failure is imminent: *1. **LAND IMMEDIATELY**. If secondary indications are present: *2. **Land As Soon As Possible.** 3. APU Emergency Start procedure — PERFORM. 4. NO. 1 and NO. 2 GENERATOR switches — OFF, AS REQUIRED. If no secondary indications are present: 5. **Land as soon as practical**. **WARNING** Catastrophic transmission failure will result in loss of helicopter control. Consideration should be given to transiting at minimum power airspeed and a low altitude flight profile (approximately 80 ft and 80 KIAS) to permit a quick flare followed by an immediate landing/ ditching. Applicable steps of the Immediate Landing/Ditching emergency procedure should be completed.

12.6.2 INPUT MODULE CHIP Caution Lights On

INPUT MODULE CHIP Caution Lights ON		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
INPUT LH CHIP **OR** **INPUT RH CHIP**	Chip or metal particles detected in applicable input module. **Note** Consideration should be given to returning the engine to FLY for landing.	*1. Main Transmission Malfunction emergency procedure — Perform. If engine secondary indications are present: 2. Engine Malfunction in Flight emergency procedure — Perform. 3. PCL (engine with affected input module) — Idle.

12.6.3 Tail/Intermediate Transmission Malfunction

When tail and intermediate transmission cautions are accompanied by strong medium-frequency vibrations, hot metal fumes, or any other associated indications, tail rotor failure is imminent. A running or no-hover landing should be executed as conditions dictate.

Tail/Intermediate Transmission Malfunction		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Tail/ Intermediate Transmission Malfunction **OR** **CHIP INT XMSN** **OR** **CHIP TAIL XMSN** **OR** **INT XMSN OIL TEMP** **TAIL XMSN OIL TEMP**	Indication of Metal Particles in respective gearbox. High Oil temperature in the intermediate gearbox. High oil temperature in the tail gearbox.	If failure is imminent: *1. **LAND IMMEDIATELY**. If failure is not imminent: 2. **Land As Soon As Possible**. **WARNING** • High power settings require maximum performance of the tail rotor drive system and may precipitate ultimate drive failure. • Consideration should be given to transiting at an altitude sufficient to enter an autorotation and performing the applicable steps of the Immediate Landing/Ditching emergency procedure.

12.7 TAIL ROTOR SYSTEM MALFUNCTIONS

12.7.1 Loss of Tail Rotor Drive

Failure of the tail rotor gearbox, intermediate gearbox, or tail rotor drive shaft will result in a loss of tail rotor thrust. The nose of the helicopter will yaw right regardless of the airspeed at which the failure occurs. Continued level flight may not be possible following this type of failure. Loss of tail rotor thrust at low airspeeds will result in rapid right yaw. At higher airspeeds, right yaw may develop more slowly but will continue to increase. While the yaw rate may vary, the immediate recognition of the malfunction is critical, and an autorotation should be entered promptly if altitude permits. Every effort should be made to establish an autorotative glide at or above minimum rate of descent airspeed. This will maximize the effectiveness of the deceleration during the landing sequence. If autorotation is delayed, large sideslip angles can develop causing low indicated airspeed with the stabilator programming down. This can make it more difficult to establish or maintain adequate autorotative airspeed. Airspeed, altitude and terrain below at the time of failure will determine if an attempt to verify the failure is warranted. A tendency to yaw with the application of slight right pedal may indicate a functioning tail rotor. Do not confuse the tendency to yaw right with the pitching moment generated by control mixing. Should a functioning tail rotor be discovered during the autorotation, apply collective and utilize loss of tail rotor control technique, if required. If the loss of tail rotor drive is verified, or if environmental conditions preclude an attempt at verification, set up for an immediate landing. Autorotations should be conducted to minimize descent rate and groundspeed at touchdown. Failure of tail rotor drive at altitudes and airspeed not sufficient to establish autorotation require immediate reduction in collective to control yaw rate. Maintain a level attitude and attempt to achieve zero surface speed utilizing flight instruments and visible horizon. Rate of rotation is directly proportional to main rotor torque, therefore decreased collective will reduce main rotor torque and thus rate of rotation. At low hover altitudes, an immediate landing to arrest the accelerating rotation should be considered prior to shutting off the PCLs. Experience has shown that cockpit centrifugal forces on the pilot may be of such strength as to make an attempt to secure the PCLs physically impossible. Trying to maintain hover altitude with an uncontrolled yaw, though possible, might place the aircraft in a more critical flight environment.

If unable to enter autorotation or quickly reduce airspeed/groundspeed to zero, large yaw angles relative to the aircraft's flight path will induce extreme pitch and roll deviations which will require large cyclic inputs to control aircraft attitude. With any amount of airspeed (which may not be indicated due to large sideslip angles), attitude deviations and control inputs will become more dynamic as the aircraft rotates along its flight path. Attempting to continue flight with uncontrolled yaw rates and forward speed will result in a total loss of aircraft control regardless of PAC inputs.

12.7.1.1 Loss of Tail Rotor Drive Altitude and Airspeed Sufficient to Establish Autorotation

Loss of Tail Rotor Drive Altitude and Airspeed Sufficient to Establish Autorotation		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Loss of Tail Rotor Drive Altitude and Airspeed Sufficient to Establish Autorotation	Loss of tail rotor drive may be the result of a loss of tail rotor rotation or tail pylon separation with a possible right rotation. Attempt to verify rotation as a result of drive failure rather than flight control jam or yaw boost hardover. **WARNING** Altitude hold will remain engaged unless deselected. If the collective trim release button is not depressed, the DAFCS will attempt to maintain aircraft altitude through the collective trim servo. AFCS commanded collective movement can result in an accelerated yaw rate.	*1. PAC call — AUTO, AUTO, AUTO. *2. Autorotation — ESTABLISH. CENTER TAIL ROTOR PEDALS. *3. Drive failure — ATTEMPT TO VERIFY. *4. Immediate Landing/Ditching emergency procedure — PERFORM. *5. PCLs — OFF WHEN DIRECTED (Prior to the flare).

12.7.1.2 Loss of Tail Rotor Drive Altitude and Airspeed Not Sufficient to Establish Autorotation

Loss of Tail Rotor Drive Altitude and Airspeed NOT Sufficient to Establish Autorotation		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Loss of Tail Rotor Drive and Airspeed NOT Sufficient to Establish Autorotation	Loss of tail rotor drive may be the result of a loss of tail rotor rotation or pylon separation with a possible right rotation. **CAUTION** Altitude may have to be adjusted based on rate of yaw and/or turn.	*1. PAC call — HOVER, HOVER, HOVER. *2. Collective — LOWER. *3. PNAC — HAND ON PCLs. *4. PCLs — OFF WHEN DIRECTED (approximately 20 to 30 feet).

12.7.2 Loss of Tail Rotor Control Malfunctions

Tail rotor control malfunctions in the H–60 can generally be grouped into three categories:

1. Tail rotor control cable failures.
2. Tail rotor servo failures.
3. Restricted flight controls.

In general, the first indication of loss of tail rotor control will be an uncommanded yaw of the helicopter, either left or right, while changing airspeed or collective setting. The aircrew should attempt to diagnose the category of malfunction, analyze the aircraft's controllability, and perform an approach and landing as appropriate.

12.7.2.1 Tail Rotor Control Cable Failures

Loss of one tail rotor control cable will be indicated by a caution light, marked TAIL ROTOR QUADRANT. No change in handling qualities will occur; however, a landing should be made as soon as practical. If both tail rotor cables fail, tail rotor control will be lost. The tail rotor will assume a preset spring loaded position setting. For a gross weight of approximately 19,500 pounds, in level flight (not climbing or descending) and for flight out of ground effect, this fixed pitch setting will provide balanced level flight at about 35 and 133 KIAS. These level flight airspeeds will vary with gross weight, density altitude, rotor speed, and ground effect. At other airspeeds the helicopter will yaw either left or right depending on torque and speed. For a gross weight of approximately 19,500 pounds, airspeeds below 35 KIAS and above 133 KIAS, the tail rotor does not produce enough thrust to counteract main rotor head torque; therefore, the helicopter will have a tendency to yaw to the right. Right yaw can be controlled by reducing the collective and/or adjusting airspeed into the appropriate range. For airspeeds between 35 and 133 KIAS, the tail rotor provides too much thrust for the given rotor torque setting; therefore, the helicopter will have a tendency to yaw to the left. Left yaw can be controlled by increasing collective and/or adjusting airspeed toward either balanced flight airspeed (gross weight dependent).

12.7.2.2 Tail Rotor Servo Failures

Loss of both the NO. 1 hydraulic pump and backup pump results in both stages of the tail rotor servo being unpressurized. With this malfunction, the yaw boost servo is still pressurized and the mechanical control system is intact. Normal yaw control is available between approximately 35 and 133 KIAS. At airspeeds lower than 35 and higher than 133 KIAS, the aerodynamic loads on the tail rotor cannot be overcome by the yaw boost servo. As airspeed is decreased toward 35 or increased toward 133 KIAS, yaw response at larger pedal inputs will be observed. Elongation and/or failure of the tail rotor cables may occur if there is no yaw response with pedal inputs. If airspeed decreases below 35 KIAS, a loss of tail rotor control will likely occur. A roll–on landing above 35 KIAS is recommended for this category of failure. Once the aircraft is on deck and torque is reduced, the aerodynamic loads on the tail rotor are reduced and yaw control should be regained.

12.7.2.3 Restricted Flight Controls

Mechanical malfunctions may result in varying degrees of restrictions or binding in flight controls. Some examples are jammed flight controls due to FOD, mechanical failure of the tail rotor servos, or a servo hardover. The possibilities of failure modes ad aircraft response, based on existing conditions, cannot lead to a single standardization procedure for executing a safe landing.

If pedal drive, binding, or restriction occurs with no associate caution lights, the cause may not be apparent. A yaw trim malfunction, induced by the AFCS computer, can produce about 30 pounds of force at the pedal. An internally jammed yaw trim actuator can produce up to 80 pounds of forced until clutch slippage relieves this force. The pilot can override and yaw trim force by applying opposite pedal firmly and then turning off trim. A malfunction within the yaw boost servo or tail servos can produce much higher forces at the pedals. The affected servo must be turned off. Hardover failure of the yaw boost servo will increase control forces as much as 250 pounds on the pedals. In any case, the pitch of the tail rotor may become fixed at any position within the range of yaw authority. Depending on the actual pitch setting at the tail rotor when the failure occurs, the nose of the aircraft may exhibit a tendency to yaw either left or right.

12.7.2.4 Loss of Tail Rotor Control Approach and Landing Technique

With degraded tail rotor control, landing speed is determined by the tail rotor fixed position and gross weight. For a loss of both tail rotor cables, touchdown speed is dependent on gross weight. If tail rotor pitch becomes fixed during decreased power situations (right pedal applied) the nose of the helicopter will yaw to the right when power is applied, possibly even greater than a complete loss of tail rotor thrust. Some conditions may require entry into an autorotation to control yaw rate. Other fixed–pitch right conditions may result in a minimum power required situation, which will require a run–on landing, perhaps as high as the minimum power–required (i.e., bucket) airspeed. Fixed–pitch left will result in an increase in power required, which allows for slower airspeed or even an approach to a normal hover. A loss of hydraulic pressure to both tail rotor servos will require a landing above approximately 40 KIAS.

Prior to attempting an approach and landing, controllability checks should be performed at an altitude that will permit a safe recovery should an undesirable yaw rate develop. To determine the minimum controllable airspeed, establish a level–flight condition. If a stuck–right condition is suspected, slowly reduce airspeed while maintaining level flight. Note the airspeed at which the nose yaws to the right beyond the balanced flight (ball–centered) airspeed. At this airspeed, collective and longitudinal cyclic inputs will control the yaw rate and heading. This airspeed is the approximate minimum speed to be maintained on final approach. The actual landing speed may be slightly lower due to ground effect, translational lift, and/or wind conditions that differ from the controllability check conditions. If a stuck–left condition is suspected or evident and a left yaw develops during controllability checks, collective will have to be increased to control yaw.

With sufficient fuel, multiple practice approaches should be performed to determine the sight picture and control strategies required to execute a safe touchdown. Additionally, practice approaches determine the aircraft response, stability characteristics, and control strategies for safely executing a waveoff. During the approach, maintain a centered pedal position to prevent unwanted pedal inputs from the heading hold function and pitch input from control mixing.

12.7.2.5 Insufficient Tail Rotor Thrust

During a loss of tail rotor control approach with insufficient tail rotor thrust to achieve a hover, a running landing techniques is recommended. The precise touchdown speed will vary based on many factors 9the nature of the failure, gross weight, wind speed/gusts, and th influences of ground effect, translational lift, and the effectiveness of the vertical pylon, etc.). With tail rotor at the fixed pitch setting (i.e., dual cable failure), analysis indicates touchdown speeds can range from approximately 10 knots for light gross weight and steady winds to over 50 knots for high gross weight conditions. Other types of failures (i.e., stuck left or right) will require an approach and landing strategy that is situation dependent. In these cases, the up–and–away controllability checks will help define the aircraft response and techniques required for approach and landing. Therefore, approach and landing techniques cannot be defined by precise numbers, but rather an adaptive control strategy(namely collective and longitudinal cyclic) to execute a touchdown aligned with the aircraft's flight path.

Establish sufficient airspeed to allow for shallow, controlled approach. Once established on glideslope, a left yaw will be present. the left yaw can be controlled with the addition of collective or a reduction in airspeed. Gradually reduce the airspeed while increasing collective and controlling descent rate. During deceleration and final approach to the landing environment, care must be taken to prevent excessive yaw rates to the right, or to allow the airspeed to become so slow that and uncontrolled right yaw develops.

WARNING

If an uncontrolled right yaw develops at too low of an airspeed, loss of waveoff capability may result. Increasing collective may increase the yaw to unrecoverable rates. Performing loss of tail rotor drive (altitude and airspeed insufficient to enter an autorotation) procedures may be required.

As the collective is increased prior to touchdown, the nose should begin to yaw right. Careful adjustment of collective and longitudinal cyclic should allow a tail wheel touchdown with approximate runway alignment. When the landing is attempted, extreme care must be taken to not lower the collective immediately upon touchdown.

After touchdown, reduction in power, loss of tail rotor lift and thrust effect, and loss of weathervaning effect can induce yaw incursions. Generally, a reduction in collective will cause the nose to yaw to the left (because the fixed tail rotor thrust exceeds the antitorque requirement). With the PCLs in FLY, an excessive left yaw can be arrested by increasing collective; however, care should be taken to avoid excessive right yaw or becoming airborne. With the main–mounts on the deck, heading can be controlled by gradually retarding the PCLs as the collective is positioned as required to control yaw (increasing collective will bring the nose right; decreasing collective will cause the nose to yaw left, possibly beyond control). The PNAC should gradually retard the PCLs as the PAC continues to decelerate and carefully position the collective as required to control heading. If necessary, retarding the PCLs to IDLE while increasing collective will permit torque to be applied to to the airframe at power levels less than required to become airborne. Close crew coordination is required to ensure that collective and PCL reduction are proportional. Use of differential braking at lower speeds will also assist in heading control after touchdown.

If stuck–right conditions (including landing at high gross weight) require a landing at higher speeds, a mild flare, coupled with a slight reduction in collective, may be executed; however, airspeed should not be allowed to decrease below the airspeed identified during the minimum controllable airspeed check conducted up and away. With higher landing speeds, aircraft response on roll–out will be even more sensitive to collective reduction.

12.7.2.6 Excess Tail Rotor Thrust

If a tail rotor pitch becomes fixed in a high power situation (let pedal applied), the nose of the helicopter will turn left when collective is decreased. Under these conditions, powered flight to a prepared landing site may be possible since the sideslip angle will probably be corrected when power is applied for touchdown. Because the nose will yaw left with collective reduction, descent rate must be carefully controlled to prevent an uncontrolled left yaw. Except in extreme cases, however, collective application should always be able to arrest a left yaw. If the tail rotor thrust is so high that zero groundspeed cannot be achieved without climbing, a reduction in N_r will be required. In this situation, very close coordination between PCL manipulation by the PNAC a nd collective positioning by the PAC will be required. Once (or before) a landing is achieved, the PNAC should retard one or both PCLs to IDLE while the PAC maintains a high collective setting. This will reduce the tendency to yaw left.

WARNING

- Following the appearance of the #1 TAIL RTR SERVO caution without the associated BACKUP PUMP ON and #2 TAIL RTR SERVO ON advisories, the aircraft will demonstrate normal yaw responses in flight regimes that do not require excessive tail rotor performance. However, at slower airspeeds, below approximately 40 KIAS, more pronounced effects of loss of tail rotor control may become more apparent.
- Servo Hardovers in the yaw channel may result in loss of Tail Rotor Control. Consideration should be given to securing the SAS/BOOST and/or TRIM as necessary.
- After touchdown, rapid reduction of collective or PCLs may cause excessive and uncontrollable yaw rates.
- An uncommanded right yaw of at least 20 to 30 degrees will occur when the tail rotor servo switches from normal to backup in a hover.

12.7.2.7 Loss of Tail Rotor Control

Loss of Tail Rotor Control		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Loss of Tail Rotor Control	CAUTION If the helicopter is shut down and/or hydraulic power is removed with one tail rotor cable failure, disconnect of the other tail rotor cable will occur when force from the boost servo cannot react against control cable quadrant spring tension. The quadrant spring will displace the cable and servo piston enough to unlatch the quadrant cable.	*1. Collective/airspeed — Adjust as required to control yaw. 2. If hydraulic malfunction is evident: a. TAIL SERVO switch — BKUP. b. BACKUP HYD PMP switch — Check ON. WARNING If the tail rotor control cables are damaged, the hydraulic transients associated with switching the tail rotor servo from NORM to BACK UP may cause catastrophic damage to the tail rotor controls. 3. External cargo/stores/fuel — Jettison/dump, as required. 4. APU Emergency Start procedure — Perform. 5. **Land as soon as practical.** 6. PCLs — As required.

12.7.3 TAIL ROTOR QUADRANT Caution Light On

TAIL ROTOR QUADRANT Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
TAIL ROTOR QUADRANT	One or both cables leading to tail rotor quadrant are broken. **CAUTION** If the helicopter is shut down and/or hydraulic power is removed with one tail rotor cable failure, disconnect of the other tail rotor cable will occur when force from the boost servo cannot react against control cable quadrant spring tension. The quadrant spring will displace the cable and servo piston enough to unlatch the quadrant cable.	1. Check for tail rotor control. If tail rotor control is available: 2. **Land as soon as practical.** If tail rotor control is not available: 3. Loss of Tail Rotor Control emergency procedure — PERFORM.

12.8 HYDRAULIC SYSTEM MALFUNCTIONS

The backup hydraulic pump is activated automatically by the Leak Detection/Isolation (LDI) system. If the backup hydraulic pump fails to come on due to a malfunction of the LDI system or pump circuitry, check BACKUP HYD PMP ON and circuit breakers in.

CAUTION

If the BACKUP PUMP PWR circuit breaker is out and a condition exists that requires the backup pump to operate, then either the hydraulic system must be configured so that the backup pump will not activate upon resetting the circuit breaker, or ac power must be secured prior to resetting the circuit breaker. Damage to the current limiters may occur and will be indicated by a loss of all loads on NO. 1 AC primary bus.

12.8.1 Hydraulic System Caution Lights

12.8.1.1 #1 and #2 HYD PUMP Failure

#1 and #2 HYD PUMP Failure		
LEGEND	CAUSE/REMARKS	CORRECTIVE ACTION
#1 HYD PUMP AND #2 HYD PUMP AND BACK UP PUMP ON	Low pressure at outlet of hydraulic pumps.	1. Restrict flight control movement. 2. **Land As Soon As Possible.**

12.8.1.2 #1 or #2 HYD PUMP Failure

#1 or #2 HYD PUMP Failure		
LEGEND	CAUSE/REMARKS	CORRECTIVE ACTION
#1 HYD PUMP OR #2 HYD PUMP AND BACK UP PUMP ON	Low pressure at outlet of applicable hydraulic pumps.	If no other hydraulic malfunctions are present: 1. **Land as soon as practical.**

12.8.1.3 #1 or #2 PRI SERVO PRESS Caution Light On

#1 or #2 PRI SERVO PRESS Caution Light On		
LEGEND	CAUSE/REMARKS	CORRECTIVE ACTION
#1 PRI SERVO PRESS OR #2 PRI SERVO PRESS	Low pressure or servo jam at any or all primary servos of applicable stage.	1. Pilot and Copilot SERVO switches — Verify centered**.** If primary SERVO light remains on: 2. SERVO switch — Turn OFF affected stage. 3. **Land as soon as practical.**

12.8.1.4 BACKUP RSVR LOW Caution Light On

BACKUP RSVR LOW Caution Light On		
LEGEND	CAUSE/REMARKS	CORRECTIVE ACTION
BACKUP RSVR LOW	Fluid in the backup pump module is low.	If no other hydraulic caution lights are present: 1. Stop hoisting as soon as practical. 2. BACKUP HYD PMP switch — OFF. 3. **Land as soon as practical.**

12.8.2 NO. 1 Hydraulic System Malfunction

When a NO.1 hydraulic system malfunction exists, the first indication is the #1 RSVR LOW caution followed by the #1 TAIL RTR SERVO caution, BACK-UP PUMP ON advisory, and the #2 TAIL RTR SERVO ON advisory. If the BACK-UP PUMP ON and the #2 TAIL RTR SERVO ON advisories do not appear, the PAC must execute the Loss of Tail Rotor Control emergency procedure.

If the hydraulic leak continues, the #1 HYD PUMP cautions will appear. The #1 TAIL RTR SERVO caution and the #2 TAIL RTR SERVO ON advisory will disappear. To prevent any further fluid loss, the SERVO switch must be placed to 1ST OFF.

If the SERVO switch is not placed to 1st OFF and the leak continues, the BACK-UP RSVR caution will appear. When the BACK-UP PUMP ON advisory disappears, the #1 PRI SERVO and #1 TAIL RTR SERVO cautions will appear and both stages of the tail rotor servo are unpressurized. Loss of both the NO. 1 hydraulic pump and the backup pump results in both stages of the tail rotor servo being unpressurized. The yaw boost servo is still pressurized to 800 psi and the mechanical control system is intact, allowing yaw control above approximately 40 KIAS. Be prepared for loss of tail rotor control below 40 KIAS. A run-on landing above 40 KIAS is recommended.

If a NO. 2 hydraulic system malfunction should occur with depleted NO. 1 and backup hydraulic systems, the result will be a loss of hydraulic pressure to the primary servos.

WARNING

Switching the BACKUP PUMP switch to OFF with weight on wheels and the #1 HYD PUMP caution present will result in loss of tail rotor directional control.

12.8.2.1 #1 Tail Rotor Servo Leak

#1 Tail Rotor Servo Leak		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
#1 Tail Rotor Servo Leak **#1 RSVR LOW** **AND** **#1 TAIL RTR SERVO** **AND** **#2 TAIL RTR SERVO ON** **AND** **BACKUP PUMP ON**	Fluid level in hydraulic pump module is low. Indicates potential leak in #1 Hydraulic system. Leak at first stage pressure switch on tail rotor servo. The second stage of the tail rotor servo is ON and at the normal pressure. The leak detection isolation sys-tem should continue to operate normally, powering the #1 hydraulic system with the back up pump.	1. **Land as soon as practical.** If the #1 HYD PUMP caution appears: 2. #1 Primary Servo or #1 Transfer Module Leak Emergency Procedure — PERFORM.

12.8.2.2 #1 Primary Servo or #1 Transfer Module Leak

#1 Primary Servo or #1 Transfer Module Leak		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
#1 Primary Servo or #1 Transfer Module Leak **#1 RSVR LOW** **AND** **#1 HYD PUMP** **AND** **BACKUP PUMP ON**	After the #1 RSVR LOW caution light and #1 HYD PUMP caution light illuminate, the pilot positions the servo switch to 1st OFF. The servo switch is positioned to 1st OFF to prevent any further fluid leakage in the event the leak is in NO. 1 primary servos. The LDI system should continue to operate normally, powering the NO. 1 hydraulic system with the backup pump.	*1. SERVO Switch — 1st OFF. *2. **Land as soon as practical.** If the BACKUP RSVR LOW caution appears or the backup pump fails: *3. **Land As Soon As Possible.** If the #2 PRI SERVO caution and/or HYD warning appears: *4. **LAND IMMEDIATELY.** **CAUTION** Switching the BACK UP HYD PMP to OFF with weight on wheels and #1 HYD PUMP caution light illuminated will result in loss of tail rotor directional control when the backup pump secures.

12.8.2.3 #1 TAIL RTR SERVO Leak without #1 RSVR LOW Caution Light

#1 TAIL RTR SERVO Leak without #1 RSVR LOW Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
#1 TAIL RTR SERVO Leak without #1 RSVR LOW Caution Light **#1 TAIL RTR SERVO** **AND** **BACKUP PUMP ON** **AND** **#2 TAIL RTR SERVO ON**	Low pressure at 1st stage pressure switch on tail rotor servo. #1 TAIL RTR SERVO caution and the BACKUP PUMP ON and #2 TAIL RTR SERVO ON advisories appear.	1. **Land as soon as practical.** If BACKUP PUMP ON and #2 TAIL RTR SERVO on advisories do not appear: 2. Loss of Tail Rotor Control emergency procedure — Perform.

12.8.3 NO. 2 Hydraulic System Malfunction

When a NO. 2 hydraulic system malfunction exists, the first indication is the #2 RSVR LOW caution followed by the BOOST SERVO OFF, SAS, and AFCS DEGRADED cautions.

If the hydraulic leak continues, the #2 HYD PUMP caution and the BACK–UP PUMP ON advisory will appear. The BOOST SERVO OFF, SAS, and AFCS DEGRADED cautions will disappear.

If the SERVO switch is not placed to the 2nd OFF and the leak continues, the BACKUP RSVR LOW caution will appear. When the BACKUP PUMP ON advisory disappears, it will result in a loss of the pilot–assist servos.

If a NO. 1 hydraulic system malfunction should occur with a depleted NO. 2 and backup hydraulic systems, the result will be a loss of hydraulic pressure to the tail rotor servo.

12.8.3.1 Pilot Assist Servo Leak

Pilot Assist Servo Leak		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Pilot Assist Servo Leak **#2 RSVR LOW** **AND** **BOOST SERVO OFF** **AND** **SAS** **AND** **AFCS DEGRADED**	Fluid level in hydraulic pump module is low. Indicates potential leak in #2 Hydraulic system.	1. **Land as soon as practical.** **WARNING** In conditions where the LDI logic secures pressure to the Pilot Assist Servos requiring a boost off landing, consideration should be given to manually securing the Pilot Assist Servos prior to disengaging rotors. Failure to secure the SAS/BOOST, SAS 1, SAS 2, and TRIM switches OFF before the #2 HYD PUMP caution light illuminates upon rotor disengagement will cause the logic module to sense a drop in hydraulic pressure and assume the leak is continuing. The logic module will continue the isolation sequence to locate the leak. This will reopen the pilot assist servos and thus continue the original leak, which will deplete all of the hydraulic fluid from the NO. 2 and backup systems. Before rotors are disengaged: 2. SAS/BOOST/SAS 1, SAS 2, and TRIM switches — OFF. 3. BACKUP PUMP — OFF. If the #2 HYD PUMP caution appears: 4. #2 Primary Servo or #2 Transfer Module Leak Emergency Procedure — PERFORM.

12.8.3.2 #2 Primary Servo or #2 Transfer Module Leak

#2 Primary Servo or #2 Transfer Module Leak		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
#2 Primary Servo or #2 Transfer Module Leak **#2 RSVR LOW** **AND** **#2 HYD PUMP** **AND** **BACKUP PUMP ON**	After the #2 RSVR LOW caution light and #2 HYD PUMP caution light illuminate, the pilot positions the servo switch to 2nd OFF. The servo switch is positioned to 2nd OFF to prevent any further fluid leakage in the event the leak is in NO. 2 primary servos. The LDI system should continue to operate normally, powering the NO. 2 hydraulic system with the backup pump.	*1. SERVO Switch — 2nd OFF. *2. **Land as soon as practical.** If the BACKUP RSVR LOW caution also appears or the backup pump fails: *3. **Land As Soon As Possible.** If the #1 PRI SERVO caution and/or HYD warning appears: *4. **LAND IMMEDIATELY.**

12.8.3.3 Pilot Assist Servo Malfunction

Pilot Assist Servo Malfunction		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Pilot Assist Servo Malfunction **BOOST SERVO OFF** **AND** **SAS** **AND** **AFCS DEGRADED**	Collective and/or yaw boost servo pressure is low or boost servo is jammed. BOOST SERVO OFF, SAS, and AFCS DEGRADED caution lights with no associated #2 RSVR LOW caution light may be an indication of a malfunctioning LDI system. Cycling the HYD LEAK TEST switch to RESET may restore the boost servos/pilot assist module. A failure of the collective or yaw boost servo may result in high cockpit control forces. The failure may be a hard over condition or jammed servo.	Before rotors are disengaged: 1. Minimize flight control movement. 2. SAS/BOOST — RESET. If SAS/BOOST is restored: 3. Continue flight. If SAS/BOOST is not restored: 4. **Land as soon as practical.** 5. Make a shallow approach to a hover, maximum 15 knots crosswind. Taxi no more than necessary. **WARNING** Inadvertent selection of the TEST position on the HYD LEAK TEST switch will result in activation of the hydraulic leak test upon touchdown. **CAUTION** • Up to 75 pounds of left pedal force will be required when hovering with boost servos off with starboard crosswinds. This value is significantly reduced with port crosswinds. • Landings with BOOST SERVO OFF on all Air capable ships should only be attempted if there is no large landing platform (LPD or larger) or shore base available.

12.8.4 BACKUP HYD PUMP Fails to Operate

BACKUP HYD PUMP Fails to Operate		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
BACKUP HYD PUMP FAILS TO OPERATE		1. BACKUP HYD PUMP switch position — Check. 2. BACKUP PUMP PWR (ATO, NO.1 DC PRI BUS, ROW 3, CB 3) and BACKUP HYD CONTR CB (ATO OVHD CONS, DC ESENTL, ROW 2, CB 6) — Check. **CAUTION** If the BACKUP PUMP PWR circuit breaker is out and a condition exists that requires the backup pump to operate, then either the hydraulic system must be configured so that the backup pump will not activate upon resetting the circuit breaker, or ac power must be secured prior to resetting the circuit breaker. Damage to the current limiters may occur and will be indicated by a loss of all loads on the NO. 1 AC Primary bus. If a BACKUP PUMP PWR CB is out and BACKUP PUMP is required: 3. BACKUP HYD CONTR CB — Pull. 4. BACKUP HYD PMP switch — OFF. 5. BACKUP PUMP PWR CB — Attempt to reset only once. **CAUTION** To prevent damage to current limiters, do not hold BACKUP PUMP PWR CB in while resetting. 6. BACKUP HYD CONTR CB — Reset. 7. BACKUP HYD PMP switch — As required. **Note** Without an operable BACKUP PUMP, #2 T/R SERVO will be inoperative and LDI functions will be degraded. If operation is not restored: 8. **Land as soon as practical.**

12.8.5 Boost Servo Hardover

Boost Servo Hardover		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Boost Servo Hardover	A failure of the collective or yaw boost servo may result in high cockpit control forces. The control loads resulting from a hard over condition can be immediately eliminated by shutting off the boost servos. Resulting cockpit control loads will then be the same as for inflight boost servos off. The control freeplay noted will be about 1/2 inch.	*1. SAS/BOOST pushbutton — OFF. 2. Minimize flight control movements. 3. **Land as soon as practical.** 4. Make a shallow approach to a hover, maximum 15 knots crosswind. Taxi no more than necessary.

12.9 AFCS EMERGENCIES

12.9.1 Coupler Emergencies

During an IFR coupled approach or hover emergencies, malfunctions (Figure 12-5) must be diagnosed quickly and correctly. A flashing AFCS DEGRADED light must be thoroughly investigated prior to completing an approach. A flashing AFCS DEGRADED light with a flashing CPLR and CH light is normal during an approach with little or no Doppler return. A flashing AFCS DEGRADED light with a flashing ALT light is a serious malfunction and steps must be taken immediately to prevent possible water impact. If the flashing AFCS with ALT light is experienced during approach, the automatic approach will be discontinued, altitude hold released and the aircraft will remain trimmed in a descent. Unless pilot action is initiated, the aircraft will continue its descent into the water. If the same conditions occur in a hover, the coupled hover will be disconnected, and altitude hold will switch to BAR ALT. The aircraft will then be in an uncoupled hover in IFR conditions.

EVENTS	RAD ALT FAILURE	DOPPLER FAILURE
During approach	Aircraft will continue in a descent all the way to the water (if on or above profile with RDR ALT light off). Flashing AFCS caution light and CPLR/ ALT FAIL ADVISORY light. APPR disengages.	Approach will continue using airspeed and altitude. Pilot controls airspeed and wing attitude using beeper trim. Flashing AFCS caution light. HVR bars freeze. DOPP flag appears in .AI CPLR FAIL ADVISORY light.
In a coupled hover or below descent Profile (RDR ALT HOLD ENGAGED)	RDR ALT Hold switches to BAR ALT Hold. Automatic approach/coupled hover disengages. Altitude hold retained. Flashing AFCS caution light and CPLR/ ALT FAIL ADVISORY light.	Coupled hover disengages. Attitude hold RDR ALT hold retained. Flashing AFCS caution light. HVR bars freeze. DOPP flag appears in AI. CPLR FAIL ADVISORY light.
During departure	Aircraft will climb through 500 feet. No altitude hold will engage. Airspeed will accelerate to 100 knots. Flashing AFCS caution light and CPLR/ ALT FAIL ADVISORY light.	Aircraft will climb to 500 feet and RDR ALT hold will engage. Airspeed will increase to approximately 65–75 knots (dependent upon nose attitude when failure occurred). Flashing AFCS caution light. HVR bars freeze. DOPP flag appears in AI. CPLR FAIL ADVISORY light.

Notes:

Doppler degradation can be classified as follows:

1. Doppler power or transmitter fail — Bars center.
2. Doppler memory or receiver fail — Bars freeze.

Figure 12-5. Automatic Approach Malfunction Matrix

12.9.2 AFCS Caution Lights

12.9.2.1 AFCS DEGRADED Caution Light On

AFCS DEGRADED Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
AFCS DEGRADED	Indicates failure of one or more modes of DAFCS computer operation. If the AFCS DEGRADED caution light is illuminated steady, computer power has been lost. **WARNING** Certain failure modes of the AFCS will cause the altitude hold functions to disengage. After clearing the Fail Advisory, ensure either RDR ALT or BAR ALT hold is engaged as desired.	If AFCS DEGRADED caution light is flashing: 1. FAIL ADVISORY MODE RESET — Press. If the malfunction is not eliminated, or AFCS DEGRADED caution light is steady: 2. CMPTR PWR/RESET — Cycle. 3. AFCS CMPTR circuit breaker — Check: a. NO. 1 AC PRIMARY BUS marked AFCS CMPTR (CENTER, ATO, ROW 1 CB 3). 4. Accelerometer null — As required. If operation is not restored: 5. **Land as soon as practical.**

12.9.2.2 AFCS FAIL Advisory Lights

Figure 2-34 describes the AFCS FAIL ADVISORY lights hierarchy. Pilot action is dependent on associated lights and system performance.

12.9.2.2.1 Flashing AFCS DEGRADED Caution Light

Flashing AFCS DEGRADED Caution Light (Night/IMC)		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Flashing AFCS DEGRADED Caution Light (Night/IMC) **AFCS DEGRADED**	**Note** AFCS DEGRADED caution light will illuminate when APPR is engaged with no Doppler return.	During automatic approach (Night/IMC): *1. Initiate waveoff. 2. AFCS DEGRADED Caution Light On procedures— Perform. 3. Troubleshoot radar altimeter system and Doppler system. 4. If AFCS DEGRADED light illuminated because of no Doppler return, a no–Doppler approach may be attempted.

12.9.2.2.2 Flashing AFCS DEGRADED Caution Light with ALT Fail Advisory Light On

Flashing AFCS DEGRADED Caution Light with ALT Fail Advisory Light On (Night/IMC)		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Flashing AFCS DEGRADED Caution Light with ALT Fail Advisory Light On (Night/IMC) AFCS DEGRADED AND ALT		In a coupled hover (night/IMC): *1. Initiate a waveoff using ITO technique. 2. AFCS DEGRADED Caution Light On procedures— Perform. 3. Troubleshoot radar altimeter system.

12.9.2.3 SAS Caution Light On

SAS Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
SAS	Indicates loss of pressure at the SAS actuator(s), loss of electrical power to both SAS 1 and SAS 2, erratic flight (loss of damping), or hardover.	1. SAS 1 — OFF. 2. **Land as soon as practical.**

12.9.3 Stabilator Malfunctions

12.9.3.1 Stabilator Auto Mode Failure

Stabilator Auto Mode Failure		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Stabilator Auto Mode Failure **STABILATOR**	Stabilator Reverted to manual mode. **WARNING** • It is possible for the stabilator to fail without illumination of the stabilator caution light and associated aural warning tone. In this case, the first indication of failure will be an uncommanded pitch change. • Re-engagement of the automatic mode after a shutdown results in the automatic mode operating for one second. If a hard over signal to one actuator was the cause of the initial shutdown, and re-engagement is attempted, the actuator will move before another dis-engagement is commanded. In this case subsequent re-engagement shall not be attempted since it may result in additional stabilator movement. If acceleration is continued with the stabilator in the full down position, longitudinal control will be lost. The stabilator shall be slewed to 0° as airspeed increases above 40 KIAS.	*1. PAC Call — STAB, STAB, STAB. *2. Cyclic — Arrest pitch rate. *3. Collective — Do not reduce. *4. MAN SLEW SWITCH — Adjust to 0°. When at a safe altitude and airspeed (below 70 KIAS): 5. Stabilator CBs — CHECK. a. STAB PWR (ATO, NO. 1 DC PRI, ROW 3, CB 7). b. STAB SYS PWR (ATO OVHD, DC ESNTL, ROW 2, CB 4.) c. STAB CONTROL (CENTER, NO. 1 AC PRI, ROW 1 CB 10). d. STAB IND (CENTER, AC ESNTL, ROW 1, CB 6). e. STAB CONT (CENTER, AC ESNTL, ROW 3, CB 6). 6. STABILATOR AUTO CONTROL pushbutton switch — Press once. If automatic control is not regained and manual mode is operable: 7. MAN SLEW Switch — Adjust as required. Do not exceed Stabilator versus airspeed limits shown below. **Note** In Manual Mode, the following are not advisable: • Swimmer deployments lower than 15 feet AGL. • Night shipboard takeoffs, approaches, and landings (except one time landing following failure). • Automatic approaches to a hover. • Practice autorotations.

<table>
<tr><th colspan="3">Stabilator Auto Mode Failure (cont)</th></tr>
<tr><th>LEGEND</th><th>CAUSE/REMARKS</th><th>CORRECTIVE ACTION</th></tr>
<tr>
<td>Stabilator Auto Mode Failure (Cont.)

STABILATOR</td>
<td>WARNING

• With large fixed stabilator angles, reduction in collective pitch results in increased aft cyclic requirements. Collective reduction during recovery from a trailing edge down stabilator flight condition should be minimal. If the stabilator becomes fixed at or near 0°, nose high attitudes may occur at slow speeds.

• A combination of high airspeed/low altitude coupled with a runaway down stabilator (indicated by a significant uncommanded nose down pitch change) will necessitate immediate pilot action to maintain control of the aircraft. Primary consideration is to disengage the automatic mode by activating manual mode slewing as required.

• At high airspeeds, immediate recognition and flight control input are essential to avoid an unrecoverable attitude. It is essential for the PNAC to slew the stabilator to 0° immediately to gain control of the aircraft. If acceleration is continued with the stabilator in the full down position, longitudinal control will be lost.</td>
<td>If automatic control is not regained and manual mode is NOT operable:

8. Fly at or below speed shown:

<table>
<tr><th>STAB ANGLE (TRAILING-EDGE DOWN)</th><th>KIAS LIMIT</th></tr>
<tr><td>0</td><td>150</td></tr>
<tr><td>10</td><td>100</td></tr>
<tr><td>20</td><td>80</td></tr>
<tr><td>30</td><td>60</td></tr>
<tr><td>40</td><td>45</td></tr>
</table>

9. Land as soon as practical.</td>
</tr>
</table>

12.9.3.2 Stabilator Indicating System Failure

Stabilator Indicating System Failure		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Stabilator Indicating System Failure		If stabilator indicating system operation is questionable in the automatic mode: 1. Stabilator — Check position visually. If indication is erratic and/or lost: 2. STABILATOR AUTO CONTROL pushbutton — Do not disengage. 3. STAB IND CB — Cycle (CENTER, AC ESNTL, ROW 1, CB 6). If normal operation is not restored: 4. **Land as soon as practical.**

12.9.4 Unusual Attitude Recovery

Unusual Attitude Recovery		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Unusual Attitude Recovery	Unusual attitudes are considered to be attitudes of over 30° pitch and/or 60° bank. There are three general unusual attitudes: nose-low, nose-high, and high-bank angles. During all unusual attitude recoveries, the nose-low attitude is the desired condition from which to complete all recoveries.	*1. Level wings. *2. Nose on horizon. *3. Center ball. *4. Stop rate of climb/descent. *5. Control airspeed.

12.10 ELECTRICAL SYSTEM MALFUNCTIONS

Total loss of AC power will result in the loss of both pilot and copilot attitude indicators and BDHIs. in addition, the copilot turn needle will be inoperative. All primary cockpit lighting will be inoperative. Only the pilot will have turn needle: both pilot and copilot will have all barometric instruments, secondary and utility lights, and wet compass.

In the event of total loss of AC power, the pilot turn needle will only be available until battery power drops below 35 percent. Aircrews must endeavor to gain VMC as soon as possible. Without the pilot turn needle, the only instrument available to provide turn rate information will be the wet compass.

WARNING

- During any emergency where generators are secured intentionally or inadvertently, severe repercussions could result. In any case, actual flight conditions (night/IMC/power required) will dictate the immediate procedures to be followed. It may not be advisable to secure electrical power, which will result in the loss of AFCS, normal ICS, and flight and mission displays, prior to achieving VMC or landing/ditching.
- Without electrical power to the dc Primary buses, the engine and inlet anti-ice valves are automatically opened. With an improperly operating engine inlet anti-ice system, a loss of up to 49 percent power available per engine is possible.

A failed main generator could be a preliminary indication of a subsequent transmission malfunction or vice versa. When dealing with main generator malfunctions, due consideration should be given to actual or potential transmission chip, oil temperature, or oil pressure lights, and the rate of decay of aircraft systems.

The items listed in Figure 12-6 use both AC and DC power. In case of dual generator or dual converter failure, this equipment, although not operational, will continue to draw DC power from the battery and should be secured by the appropriate switch or circuit breaker.

CIRCUIT BREAKER	LOCATION
PILOT BDHI	Overhead console circuit breaker panel
STAB PWR ATO BDHI TACAN CONTR MAIN ROTOR DE-ICE	ATO circuit breaker panel
LEFT PITOT HEATER LH RACK BLOWER BLADE FOLD MOTOR RH RACK BLOWER ECS POWER PYLON GSE CONTR RAST POWER REEL MACH LAUNCH RESCUE HOIST CONTR (2) RTR HD INDEX MOTOR UTIL RECP CABIN (2)	SO circuit breaker
NO. 2 ENG OVSP PILOT WINDSHIELD ANTI-ICE RIGHT PITOT HEATER	Corner circuit breaker

Figure 12-6. Equipment Drawing DC Power from the Battery

12.10.1 Total AC Power Failure/Dual Generator Failure

Total AC Power Failure/Dual Generator Failure		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Total AC Power Failure/Dual Generator Failure **#1 CONV** **AND** **#2 CONV** **AND** **AC ESS BUS OFF** **AND** **AFCS DEGRADED** **AND** **STABILTOR**	Failure of AC source(s) or respective converter or DC bus connector. Battery life may be no more than 14 minutes: therefore, the electrical equipment remaining on should be only that required for prevailing conditions, e.g. night, IMC. **Note** The capability of slewing the stabilator is retained via the DC Essential bus using battery power. Travel is limited to 35° if full down or 30° if full up when a power failure occurs.	*1. Safe Altitude and Airspeed — Establish. *2. Stabilator — CHECK POSITION, SLEW AS REQUIRED. **WARNING** Ensure airspeed vs. stabilator angle limits are not exceeded. Stabilator automatic mode is inoperative. **Note** The stabilator position indicator will be inoperative with no power to the AC essential bus. Attempt to check visually. *3. APU Emergency Start Procedure — PERFORM. 4. AFCS/SAS — Check Status. If AC electrical failure: 5. NO. 1 and NO. 2 GENERATOR switches — RESET, THEN ON. If DC electrical failure: 6. Converter CBs — RESET. a. NO. 1 CONVERTER (ATO, NO. 1 AC PRI, ROW 1, CB 14). b. NO. 2 CONVERTER (PILOT, NO. 2 AC PRI, ROW 2, CB 4). If AC and/or DC electrical power is not restored: 7. **Land as soon as practical.** 8. Nonessential electrical equipment — OFF.

12.10.2 Electrical System Caution Lights

#1 or #2 Generator Caution Light		
LEGEND	CAUSE/REMARKS	CORRECTIVE ACTION
#1 GEN OR #2 GEN	Respective generator not supplying power to buses. Operative generator selected OFF: failure of generator, GCU, contactor or wiring fault.	1. Affected GENERATOR switch — RESET, THEN ON. If caution light remains on: 2. Affected GENERATOR switch — OFF. If IMC: 3. APU Emergency Start procedure — PERFORM. If icing conditions encountered/anticipated: 4. BACKUP PUMP — OFF. 5. DE-ICE MASTER — AUTO. 6. ENG ANTI-ICE — ON. 7. PITOT HEAT — CHECK ON.

12.10.2.1 GEN BRG (#1/#2) Caution Lights

GEN BRG (#1 or #2) Caution Lights		
LEGEND	CAUSE/REMARKS	CORRECTIVE ACTION
#1 GEN BRG OR #2 GEN BRG	Generator main bearing worn or has failed. If caution remains for more than 1 minute, a MAF is required. The generator may continue to operate normally for 10 hours. **Note** A mechanical failure of the generator bearing may cause transmission chip cautions to appear. When the light illuminates, it may be disregarded if it occurs either as an intermittent or a steady (less than 1 minute) light, or as any combination of the two. **Note** Consideration may be given to starting the APU and turning on the APU generator.	1. Check for transmission secondaries. 2. Note time. If caution remains steady on for more than one minute: 3. **Land as soon as practical.**

12.10.2.2 AC ESS BUS OFF Caution Light

AC ESS BUS OFF Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
AC ESS BUS OFF	AC essential bus is not powered.	1. AC ESS BUS SPLY CBs — Check. a. CENTER, NO. 1 AC PRI, ROW 1, CB 15. b. CORNER, NO. 1 AC PRI, ROW 4, CB 5. 2. Note lost equipment.

12.10.2.3 DC ESS BUS OFF Caution Light

DC ESS BUS OFF Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
DC ESS BUS OFF	DC essential bus is not powered.	1. DC ESS BUS SPLY CBs — Check. a. ATO, NO. 1 DC PRI, ROW 3, CB 6. b. ATO, NO. 2 DC PRI, ROW 3, CB 13. 2. Note lost equipment.

12.10.3 CONV (#1/#2) Caution Lights

CONV (#1/#2) Caution Lights		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
#1 CONV OR #2 CONV	Failure of AC source(s) or respective converter or DC bus.	1. Affected converter circuit breakers — Reset. a. NO. 1 AC PRIMARY BUS marked NO. 1 CONVERTER POWER (CENTER, NO. 1 AC PRI, ROW 1, CB 14). b. NO. 2 AC PRIMARY BUS marked NO. 2 CONVERTER POWER (CORNER, NO. 2 AC PRI, ROW 2, CB 4). If caution light remains on: 2. **Land as soon as practical.**

12.10.4 BATTERY FAULT Caution Light

BATTERY FAULT Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
BATTERY FAULT	Possible over temperature/ internal malfunction. **Note** If the APU Generator is the only source of AC power and it is secured with the battery OFF, the APU will shut down.	1. BATT switch — Cycle a maximum of two times. If light remains on: 2. BATT switch — OFF. 3. **Land as soon as practical.**

12.10.5 BATTERY LOW CHARGE Caution Light

BATTERY LOW CHARGE Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
BATT LOW CHARGE	Battery is at or below 40 percent of a fully charged state. **Note** With the battery below 35 percent charge, the DC Essential bus will be dropped from the Battery bus and the BATT LOW CHARGE light will extinguish. **CAUTION** With no other source of DC power for the DC Essential bus and the battery below 30 percent charge, battery power may not be sufficient to activate the fire extinguisher CAD.	If caution appears on ground after APU start with APU generator on: 1. BATT switch — Cycle (allow 30 minutes to charge battery). If caution appears in flight: 2. BATT switch — OFF. 3. Circuit breakers — Check. a. BATT CHGR (ATO, NO. 2 DC PRI, ROW 2, CB 16). b. BATT CHGR (ATO, NO. 2 AC PRI, ROW 2, CB 1). 4. BATT switch — ON.

12.11 DE-ICE MALFUNCTIONS

12.11.1 PWR MAIN RTR and/or PWR TAIL RTR Light On

PWR MAIN RTR and/or PWR TAIL RTR Light ON		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
PWR MAIN RTR **AND/OR** **PWR TAIL RTR**	Indicates a malfunction has occurred in the main rotor and/or tail rotor primary power when the power switch is in OFF or ON. Indicates TEST and NORMAL operation when power switch is in TEST.	If a rotor power light on the Blade De-Ice Panel is illuminated with the BLADE DE-ICE POWER switch ON: 1. BLADE DE-ICE POWER switch — OFF. If the PWR MAIN RTR light remains illuminated: 2. MR DE-ICE CONTR circuit breaker — PULL. (ATO, NO. 2 DC PRI, ROW 2, CB 20) If the PWR MAIN RTR monitor light remains illuminated: 3. NO. 1 or NO. 2 GENERATOR switch — OFF. 4. APU GENERATOR switch — OFF (if in use). 5. **Land as soon as practical.** Tail: 6. BLADE DE-ICE POWER switch — OFF. If PWR TAIL RTR monitor light remains illuminated: 7. TAIL BLADE DE-ICE circuit breaker (SO OVHD, AC Secondary, ROW 1, CB 5) — PULL. If PWR monitor light remains illuminated: 8. APU Emergency Start Procedure — Complete. 9. NO. 1 and NO. 2 GENERATOR — OFF. 10. **Land as soon as practical.**

12.11.2 DE-ICE System Caution Lights

12.11.2.1 ICE DETECTED Caution Light

ICE DETECTED Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ICE DETECTED	Ice has been detected by the ice detector. It is possible to receive false ice detector indications due to blowing sand/dirt entering the ice detector.	1. PITOT HEAT switch — ON. 2. WINDSHIELD ANTI-ICE — ON. 3. ENG ANTI-ICE — ON. 4. BLADE DE-ICE POWER — ON. 5. Monitor surfaces for ice buildup.

12.11.2.2 ICE DETECT FAIL Caution Light

ICE DETECT FAIL Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ICE DETECT FAIL	Indicates a failure of the detector unit or the icing rate signal converter.	1. BLADE DE-ICE POWER switch — OFF. 2. Torque required and vibration — Monitor. If torque required and/or vibration increases: 3. MODE —Select higher setting. If ice buildup continues: 4. **Land As Soon As Possible.**

12.11.2.3 LEFT or RIGHT PITOT HEAT Caution Lights

LEFT or RIGHT PITOT HEAT Caution Lights		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
LFT PITOT HEAT OR RT PITOT HEAT	Low heat or no heat in right and/or left pitot tube.	1. Stabilator — Check, MANUAL mode as required. 2. Pitot heat circuit breakers — Check. a. LFT PITOT HEATER (SO OVHD, NO. 1 AC PRI, ROW 1, CB 6). b. RIGHT PITOT HEATER (CORNER, NO. 2 AC PRI, ROW 3, CB 4). 3. Icing conditions or visible moisture — Exit. **WARNING** The possibility exists for erratic stabilator programming due to erroneous indications from the pitot-static system. If icing conditions exist, expect to lose respective airspeed indication.

12.11.2.4 MR DE-ICE FAIL Caution Light

MR DE-ICE FAIL Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
MR DE-ICE FAIL	Open circuit to any MRB heating element or a short circuit from phase to phase of the blade de-ice power lines. System will automatically turn off. Pilots must be aware of increased vibration levels and torque requirements that could result from ice buildup.	WARNING Ice accumulation resulting in a 20 percent torque increase indicates that normal autorotational rotor rpm may not be attainable should dual-engine failure occur. 1. DE-ICE MASTER switch — MANUAL. 2. BLADE DE-ICE POWER switch — OFF, then ON. 3. DE-ICE MASTER switch — AUTO. If caution remains in icing conditions: 4. Icing conditions — Exit. If unable to exit icing conditions: 5. **Land As Soon As Possible.**

12.11.2.5 MR DE-ICE FAULT Caution Light

MR DE-ICE FAULT Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
MR DE-ICE FAULT	Loss of electrical power or open circuit on any Main Rotor Blade (MRB) heating zone element. System will operate in degraded mode. Pilots must be aware of increased vibration levels and torque requirements that could result from ice buildup.	WARNING Ice accumulation resulting in a 20 percent torque increase indicates that normal autorotational rotor rpm may not be attainable should dual-engine failure occur. 1. BLADE DE-ICE POWER switch — OFF, then ON. If caution remains in icing conditions: 2. Icing conditions — Exit. If unable to exit icing conditions: 3. **Land As Soon As Possible.**

12.11.2.6 TR DE-ICE FAIL Caution Light

TR DE-ICE FAIL Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
TR DE-ICE FAIL	Open circuit to Tail Rotor Blade (TRB) heating elements or a short circuit from phase to phase of the blade de-ice power lines. Tail rotor de-ice will automatically turn off. Main rotor de-ice will remain on.	1. Icing conditions — Exit. When out of icing conditions: 2. BLADE DE-ICE POWER switch — OFF. If unable to exit icing conditions: 3. **Land As Soon As Possible.**

12.12 FUEL SYSTEM MALFUNCTIONS

12.12.1 Fuel System Caution Lights

12.12.1.1 #1 or #2 FUEL FLTR BYPASS or #1 or #2 FUEL PRESS Caution Lights

#1 or #2 FUEL FLTR BYPASS or #1 or #2 FUEL PRESS Caution Lights		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
#1 FUEL FLTR BYPASS **OR** **#2 FUEL FLTR BYPASS** **OR** **#1 FUEL PRESS** **OR** **#2 FUEL PRESS**	Fuel Filter is bypassing. **WARNING** Low fuel pressure from the respective engine-driven boost pump. Intermittent appearance of a FUEL PRESS caution may be an indication of air leaking into the fuel supply lines, which could cause momentary fluctuation in engine power or flameout. Low fuel pressure from the respective engine-driven boost pump.	*1. Fuel selector lever (affected engine) — XFD (DIR if currently in XFD). 2. **Land as soon as practical**. If affected engine indications are abnormal: 3. Engine malfunction in Flight procedure — Perform.

12.12.1.2 #1 and #2 FUEL FLTR BYPASS or #1 and #2 FUEL PRESS Caution Lights

#1 and #2 FUEL FLTR BYPASS or #1 and #2 FUEL PRESS Caution Lights		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
#1 FUEL FLTR BYPASS **AND** **#2 FUEL FLTR BYPASS** **OR** **#1 FUEL PRESS** **AND** **#2 FUEL PRESS**	Fuel Filter is bypassing. **WARNING** Fuel Filter is bypassing. Low fuel pressure from the respective engine-driven boost pump. Intermittent appearance of a FUEL PRESS caution may be an indication of air leaking into the fuel supply lines, which could cause momentary fluctuation in engine power or flameout. Low fuel pressure from the respective engine-driven boost pump.	*1. **Land As Soon As Possible.** *2. APU Emergency Start procedure — Perform. **WARNING** Be prepared for dual-engine failure. Recommended airspeed profile is 80 KIAS to minimize N_r droop should dual-engine failure occur. **Note** Consideration should be given to performing applicable steps of the Immediate Landing/Ditching emergency procedure.

12.12.1.3 (#1/#2) FUEL LOW Caution Lights

(#1/#2) FUEL LOW Caution Lights		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
#1 FUEL LOW **AND** **#2 FUEL LOW**	Low fuel state in respective cell.	1. **Land as soon as practical.** WARNING With less than 600 pounds of fuel, fuel starvation may occur when balanced flight is not maintained and/or pitch attitudes exceed 15° noseup or nosedown.

12.12.1.4 AUX FUEL XFER FAULT Caution Light

AUX FUEL XFER FAULT Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
AUX FUEL XFER FAULT	FMCP automatic transfer logic has failed, both transfer pumps have failed, or both transfer/shutoff valves have failed.	1. FMCP circuit breakers — Cycle. a. FUEL MGMT (ATO, NO. 1 DC PRI, ROW 1, CB 1), if installed. b. FUEL MGMT (ATO, NO. 2 DC PRI, ROW 3, CB 23), if installed. 2. FUEL XFER/DUMP circuit breakers — Cycle. a. FUEL DUMP CONTR (OVERHEAD, DC ESNTL, ROW 3, CB 1). b. FUEL DUMP PUMP (CENTER, NO. 1 AC PRI, ROW 1, CB 13). c. FUEL DUMP PUMP (CORNER, NO. 2 AC PRI, ROW 1, CB 1). 3. Fuel XFER mode — MANUAL. 4. Appropriate FMCP fuel flow indicator/selector switch — Press and hold for a minimum of 10 seconds.

12.12.1.5 PUMP/VALVE FAIL Caution Light

PUMP/VALVE FAIL Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
PUMP/VALVE FAIL	Failure of main transfer valve or transfer/dump pumps.	1. Note condition.

12.12.2 Refueling Hose Jettison (HIFR)

Refueling Hose Jettison (HIFR)		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Refueling Hose Jettison (HIFR)		WARNING Anyone may give the command "BREAKAWAY." The crewman shall immediately pull the emergency disconnects lanyard (NI/Wiggins) and report, "HOSE CLEAR." If a T-handle is present: *1. When emergency breakaway command is received — Pull T-handle and report "HOSE CLEAR." If no T-handle is present: *2. When emergency breakaway command received — Report "HOSE CLEAR." WARNING Hose snapback on breakaway may impact the crewman depending on direction of aircraft motion.

12.12.3 NO HIFR/Stuck Main Tank Shutoff Valve

A stuck main tank shutoff valve will prevent fueling by HIFR when the FMCP is powered. The FMCP controls sequencing of fuel to the tanks, and the main tanks must be filled first. Removing power to the FMCP will remove power from the auxiliary tank shutoff valves and place them in the open position. HIFR can then fill the auxiliary tanks. Returning power to the FMCP will allow fuel to then be transferred manually to the main tanks.

NO HIFR/Stuck Main Tank Shutoff Valve		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
NO HIFR/Stuck Main Tank Shutoff Valve		If no HIFR due to stuck main tank shutoff valve: 1. FUEL MGMT circuit breakers — Pull. FUEL MGMT (ATO, NO. 1 DC PRI, ROW 1, CB 1), if installed FUEL MGMT (ATO, NO. 2 DC PRI, ROW 3, CB 23), if installed. 2. HIFR — FILL AUXILIARY TANKS. 3. FUEL MGMT circuit breaker — RESET. 4. FMCP transfer of auxiliary tanks — AS DESIRED. 5. Sequence can be repeated.

12.12.4 Uncommanded Fuel Dumping

Uncommanded Fuel Dumping		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Uncommanded Fuel Dumping		1. FUEL DUMP — Verify OFF. If fuel dumping continues: 2. FUEL DUMP CBs — PULL. a. FUEL DUMP PUMP (CENTER, NO. 1 AC PRI, ROW 1, CB 13). b. FUEL DUMP PUMP (CENTER, NO. 1 AC PRI, ROW 1, CB 1). c. FUEL DUMP CTRL (OVHD, DC ESNTL, ROW 3, CB 1). 3. **Land as soon as practical.**

12.13 FIRE EMERGENCIES

If the helicopter is airborne when a fire occurs, the most important single action that can be taken by the pilot is to land the helicopter safely as soon as possible. On the ground, it is essential that the engines be shut down, crew and passengers evacuated, and the fire fighting begun immediately.

12.13.1 External Engine Fire

External Engine Fire		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
FIRE (#1/#2 ENG)	Indicates that a fire detector (#1 ENG/#2 ENG) has actuated a fire warning circuit. (Note light in appropriate T-handle). The safety of the helicopter's occupants is the primary consideration when a fire occurs. If airborne, the most important single action can be taken by the pilot is to land the helicopter safely. **Note** HF transmissions, sunlight filtered through smoke, haze, water, or at sunrise or sunset may trigger the fire detectors and cause a false fire indication.	*1. Confirm Fire. *2. Engine Malfunction in Flight emergency procedure — Perform. *3. PCL (affected engine) — OFF. *4. Engine T-Handle (affected engine) — PULL. *5. FIRE EXT switch— MAIN (RESERVE if required or AC Power is off). If airborne and fire continues: *6. **LAND IMMEDIATELY.** If fire appears extinguished: *7. **Land As Soon As Possible.** 8. Single Engine Landing emergency procedure — Perform. On ground: 9. Fire Extinguisher — Discharge into engine compartment.

12.13.2 Internal Engine Fire

Internal Engine Fire		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Internal Engine Fire	An Internal Engine Fire is indicated by a rise in TGT above 540 ºC after engine shutdown.	*1. Starter — Engage. Motor Engine. 2. Portable Fire Extinguisher — As Required. 3. Starter — Secure (once TGT decreases below 540 ºC).

12.13.3 APU Fire

APU exhaust fires are most commonly the result of pooled fuel in the combustion chamber prior to start (a wet start). This often occurs when attempting to restart following an APU failure. Since the exhaust fire is confined to the exhaust section, activation of the fire extinguishing system without an illuminated APU fire T-handle may be ineffective. In most cases, continued operation of the APU will extinguish the flame.

APU Fire		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
FIRE (APU)	Indicates that a fire detector (APU) has actuated a fire warning circuit. The safety of the helicopter's occupants is the primary consideration when a fire occurs. If airborne, the most important single action can be taken by the pilot is to land the helicopter safely as soon as possible. **WARNING** Severity of the fire and conditions present will dictate whether an immediate landing/ditching is required. **Note** HF transmissions, sunlight filtered through smoke, haze, water, or at sunrise or sunset may trigger the fire detectors and cause a false fire indication.	*1. APU T-Handle — PULL. *2. Confirm Fire. *3. FIRE EXT switch — RESERVE (MAIN if required and available). If airborne and fire continues: *4. **LAND IMMEDIATELY**. If fire appears extinguished: *5. **Land As Soon As Possible**. If on ground: *6. Fire extinguisher — As required. 7. FUEL PUMP switch — OFF. 8. APU CONTR switch — OFF.

12.13.4 Cockpit Fire/Cabin Fire

<table>
<tr><th colspan="3">Cockpit Fire/Cabin Fire</th></tr>
<tr><th>LEGEND</th><th>CAUSE/REMARKS</th><th>CORRECTIVE ACTION</th></tr>
<tr><td>Cockpit Fire/ Cabin Fire</td><td>WARNING
• Severity of the fire and conditions present will dictate whether an immediate landing/ ditching is required.
• Vapors from the portable fire extinguisher agent, although not poisonous, can cause asphyxiation by displacement of oxygen in a confined space. The cabin should be ventilated as soon as practical.
• It may not be advisable to secure all electrical power, thus losing AFCS, ICS, and flight instruments prior to achieving VMC or landing/ditching.

CAUTION
If source of fire is unknown, consideration should be given to securing Mission Power immediately when securing unnecessary electrical equipment to prevent system damage.</td><td>If source is known:
*1. Affected power switches and CBs — Secure.
*2. Portable Fire Extinguisher — As required.
If fire continues or source is unknown:
*3. Cabin/doors/vents/ECS — CLOSE/OFF, as required.
*4. Unnecessary electrical equipment and CBs — SECURE.
If fire continues:
*5. Land As Soon As Possible.

WARNING
Without AC power, the engine and inlet anti-ice valves are automatically opened. With an improperly operating engine inlet anti-ice system, a loss of up to 49 percent power available per engine is possible.

6. Stabilator — Manually slew to zero.
7. NO. 1 and NO. 2. GENERATOR switches — OFF, as required.
8. BATT switch — OFF, as required.
If fire is extinguished:
9. Smoke and Fumes Elimination emergency procedure — Perform.
10. Land as soon as practical.</td></tr>
</table>

12.13.5 Sonobuoy Lithium Battery Venting

Sonobuoy Lithium Battery Venting		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Sonobuoy Lithium Battery Venting	Lithium battery failure can result in the release of sulfur dioxide gas.	If the pungent odor and rusty metallic taste characteristic of SO_2 fumes are detected, execute the following procedure: **WARNING** Portable fire extinguishers shall not be used to extinguish burning lithium fires since a violent reaction may occur. *1. Alert crew; sonobuoys — Jettison. **Note** If jettison of weapon pylon stores is not desired, sonobuoys must be launched manually. *2. Smoke and Fumes Elimination emergency procedure — Perform. **WARNING** Sulfur dioxide exposure in low concentrations can result in lightheadedness, dizziness, headache, difficulty in breathing, and possible loss of consciousness. An indication of the presence of a venting sonobuoy may be an acidic taste in the mouth or a distinct odor similar to that of an electrical fire.

12.13.6 Smoke and Fumes Elimination

Smoke and Fumes Elimination		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Smoke and Fumes Elimination		*1. Airspeed — Adjust, as required. *2. Doors/windows/vents — Open. *3. Aircraft — Yaw, as required.

12.13.7 Immediate Landing/Ditching

The sequence of events necessary to successfully conduct an immediate landing/ditching demand prior coordination and briefing. After a water landing, the aircraft tends to sink nose down and roll unpredictably to either side within 10 seconds. Depending on available power and rotor speed, the PAC may not be able to arrest these motions with collective or cyclic application. The aircraft may maintain some degree of buoyancy in the fuel cell transition section (approximately 2 to 5 minutes) after water landing.

Water pressure may prevent opening the emergency egress windows until the aircraft fills with water. For minimum loads on impact and to minimize the possibility of immediate rollover on touchdown, a ditching should be made into the prevailing winds and into or just past the crest on the backside of a wave.

Activate the jettison handle, then push out, down, and forward on the lower forward corner of the window to free it from the upper retention pins. The windows should be jettisoned prior to water entry and, if time permits, the cabin doors should be opened to optimize safe crew egress.

For overland flights, terrain along the route should be considered in an immediate landing scenario. Consideration should be given to closing cabin doors and windows prior to landing to maximize aircrew survivability.

Emergency exit from or entrance into the helicopter is provided through jettisonable windows and cabin doors. Emergency exits are shown in Figure 12-7.

WARNING

- During any emergency egress, particular care must be taken to avoid being struck by the rotor blades
- Remain strapped in until rotors and all violent motion have stopped.

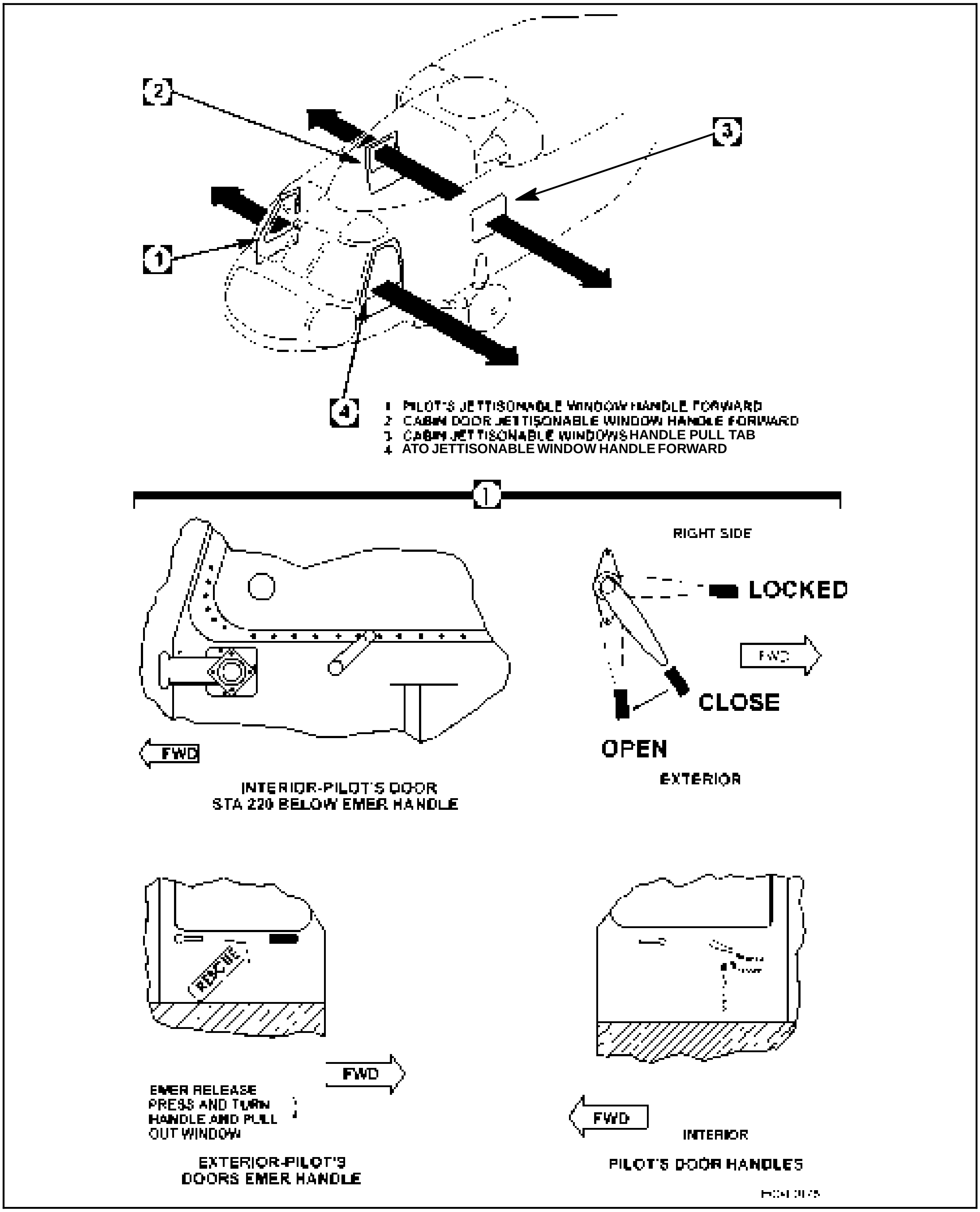


Figure 12-7. Emergency Exits (Sheet 1 of 3)

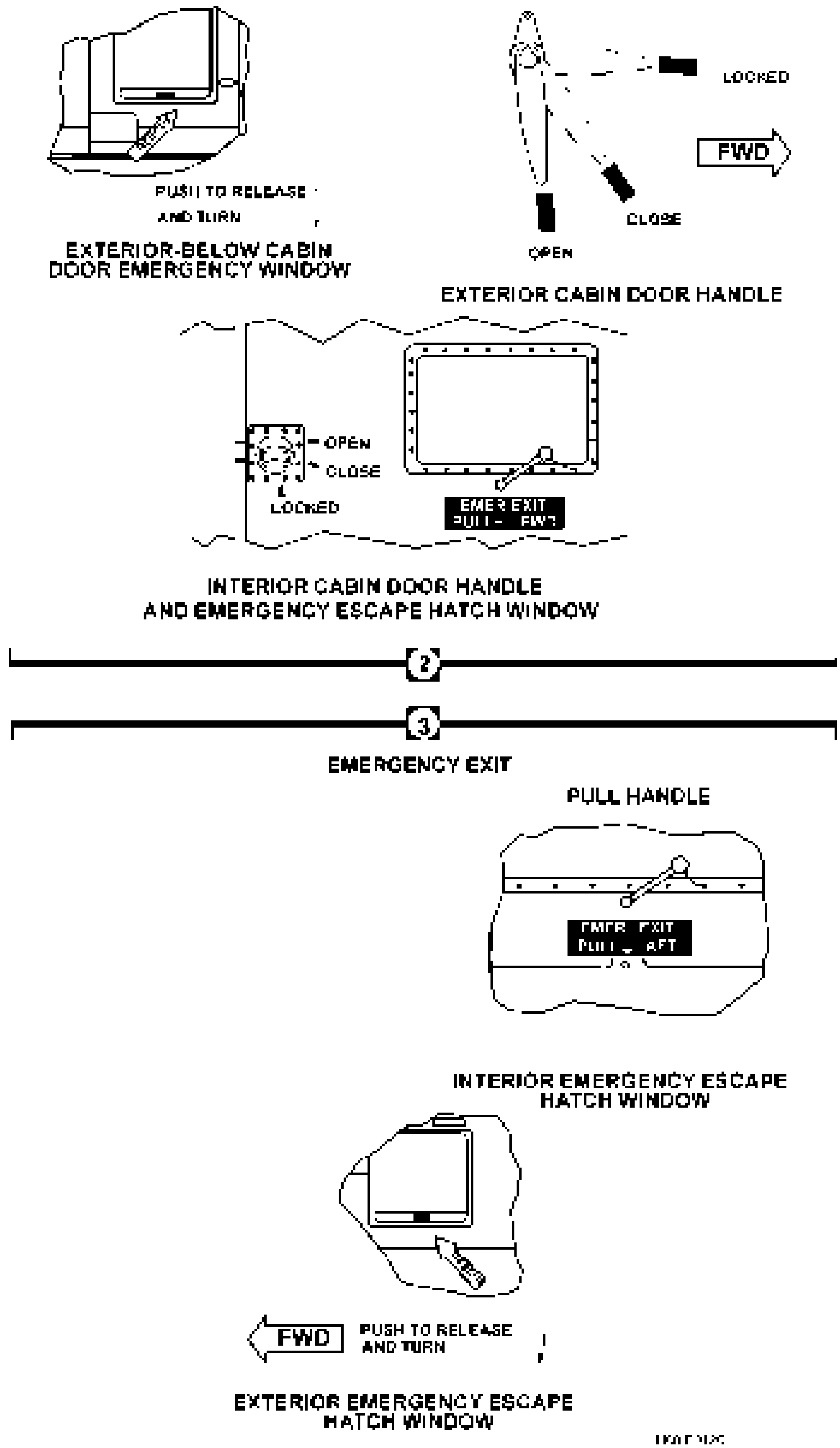
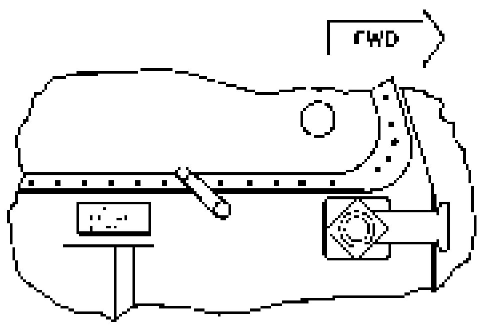
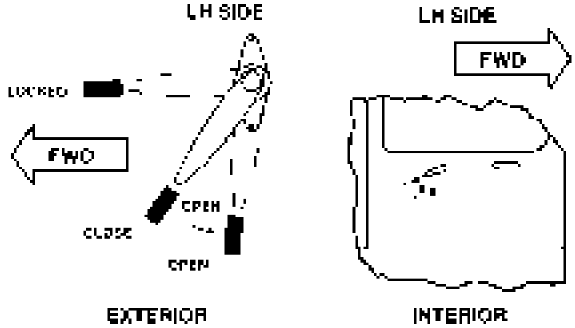


Figure 12-7. Emergency Exits (Sheet 2)

EXTERIOR - ATO'S DOOR
BELOW EMERGENCY HANDLE



INTERIOR - ATO'S DOOR HANDLES
STA 220 BELOW EMERGENCY HANDLE



ATO'S DOOR HANDLES

Figure 12-7. Emergency Exits (Sheet 3)

12.13.8 Planned Ditching

When an emergency situation dictates a water landing, the crew shall execute the Immediate Landing/Ditching procedures.

Note

- Time permitting, crew and passengers should check survival gear and jettison all unnecessary equipment/cargo, especially articles that may impede egress.
- Prior to ditching, consider activating the ADHEELS manually. ADHEELS will remain on for approximately 45 minutes.

The selection of ditching heading should be determined by evaluation of sea and wind conditions. It is recommended that the aircraft ditch parallel to and near the crest of the swell, if there is a crosswind of 25 knots or less.

If there is a strong crosswind, ditch into the wind, making contact on the upslope of the swell near the top. Wave motion is indicative of wind direction, but swell does not necessarily move with the wind. Conditions of water surface are indicative of wind speed. If visibility is restricted, ditch heading may be determined from forecast data.

12.13.9 Emergency Crash Position

The risk of personal injury during an autorotative landing or ditching can be significantly reduced by properly positioning oneself for the landing. All aircrew should position their seats up and aft in order for the seat stroke to absorb more of the crash loads. Aircrew should sit erect with head firmly against the headrest, elbows tucked in tightly, arms crossed in front of body, and feet flat on the deck.

WARNING

The downward stroke of the seat will change the frame of reference needed for egress. Extended handles, hatches, and controls within the cockpit will not be located in the same familiar places. Keep legs clear of under seat area. Downward travel of seat may cause injury or entrapment.

12.13.10 Immediate Landing/Ditching (Pilot)

Immediate Landing/Ditching (Pilot)		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Immediate Landing/Ditching (Pilot)	Emergency exit from or entrance into the helicopter is provided through jettisonable windows and cabin doors. Emergency exits are shown in Figure 12-7. **WARNING** • In order to minimize the potential for serious injury, instructor seat occupant should assume crash position and lower head until their chin touches their chest prior to an emergency landing or ditching. • Stores jettisoned at descent rates greater than those listed in the NATIP have not been tested. Aircraft/rotor system impact from jettisoned stores may be possible.	*1. Crew and passengers — Alert. *2. Shoulder harness — Locked. *3. External cargo/stores/fuel — JETTISON/DUMP as required. *4. Searchlight — As required. *5. MAYDAY/IFF — TRANSMIT/EMER. **CAUTION** Time permitting, consideration should be given to executing APU Emergency Start procedure to maintain electrical and hydraulic power upon rotor disengagement. In the flare: *6. Windows — Jettison, as required. **WARNING** After actuation, the position of the emergency jettison window lever may cause snagging of personal survival gear, impeding egress. Time permitting, reset jettison handle to the aft position prior to egress. After landing: *7. PCLs — OFF. *8. Rotor Brake — ON. *9. ATO Collective — STOW. After all violent motion stops: *10. EGRESS. **WARNING** Failure to remain strapped in aircraft until all violent motion or inrushing water stops may result in injury or incapacitation.

12.13.11 Immediate Landing/Ditching (Aircrewmen)

Immediate Landing/Ditching (Aircrewmen)		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Immediate Landing/ Ditching (Aircrewmen)	Emergency exit from or entrance into the helicopter is provided through jettisonable windows and cabin doors. Emergency exits are shown in Figure 12-7. **WARNING** In order to minimize the potential for serious injury, instructor seat occupant should assume crash position and lower head until their chin touches their chest prior to and emergency landing or ditching.	*1. Harness — Locked. *2. Seat — Up and aft. *3. Windows — Jettison, as required. *4. ASO Table — UP AND LOCKED. *5. Assume crash position. **WARNING** Attaining and maintaining a proper crash position in a seat is the most critical step that can be taken prior to impact. Aircrew shall not delay in assuming a seated crash position or leave a seated crash position to accomplish other tasks on this checklist.

12.13.12 Lost Aircraft Procedures (Open Ocean)

Lost Aircraft Procedures (Open Ocean)		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Lost Aircraft Procedures (Open Ocean)	**Note** Remain calm.	1. Confess. 2. Climb. 3. Conserve fuel. 4. Communicate. 5. Maintain adequate fuel to allow for landing or controlled ditch. 6. Utilize the following aircraft sensors as appropriate: a. TACAN. b. Radar. c. IFF. d. ESM. e. Data link. f. UHF Homer.

12.13.13 Underwater Egress

Underwater Egress		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Underwater Egress	**WARNING** • The downward stroke of the seat will change the frame of reference needed for egress. Extended handles, windows, and controls will not be located in the same relative position. Keep legs clear from under seat area. Downward travel of seat may cause injury or entrapment. • Do not inflate LPU until outside helicopter. • Water pressure may prevent opening the emergency egress windows until the cabin fills with water. The windows should be jettisoned prior to water entry to optimize the ability of the crew to safely egress. • Failure to disconnect ICS cord can impede egress. Personal gear may snag during egress, notably on collectives, FLIR HCUs, Parking Brake and RAST release handles, PCLs/Fuel Selector Levers/Fire T-Handles, or extended Emergency Jettison Window handles. • If entanglement or disorientation delays egress, hold onto a reference point with one hand. Using the other hand, place HABD in your mouth, clear water from your mouthpiece, and continue with egress. • To prevent injury while ascending to the surface and breathing from the HABD, continually exhale to vent the expanding air from your lungs.	*1. HABD — As required. *2. ICS Cords — Disconnect. *3. Door/Window — Open/Jettison. *4. Place hand on known reference point. *5. Harness — RELEASE. *6. Exit Helicopter. After egress: *7. Swim clear of helicopter and inflate LPU.

12.14 MISSION EQUIPMENT/WEAPON SYSTEM EMERGENCIES

12.14.1 Cargo Hook Emergency Release

Cargo Hook Emergency Release		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Cargo Hook Emergency Release		1. RESCUE HOIST — OFF. 2. RAST MASTER — OFF. 3. MAD reeling machine POWER — OFF. **WARNING** Use of emergency release may cause injury to crewman. 4. Cyclic stick EMER REL — Press.

12.14.2 RAST Main Probe Messenger Failure

RAST Main Probe Messenger Failure		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
RAST Main Probe Messenger Failure		If the messenger cable winch should fail/jam while raising or lowering and sufficient cable is deployed to attach the hauldown cable or cable is attached, proceed as follows: **WARNING** Injury to crewmen may result if RAST power is applied during the following procedure. 1. RAST MASTER — OFF. 2. Remove the quick release pin from the messenger light and remove the messenger light assembly. 3. Pull in messenger cable until the haul-down cable is locked in the main probe and the messenger is disconnected. 4. Secure messenger cable. 5. RAST MASTER — ON. 6. H-DOWN LKD and MESSGR IN lights — ON. **Note** If the haul down cable cannot be attached and the RA landing must be made, proceed with RAST Messenger Jettison and Back-up Messenger Cable Employment.

12.14.3 RAST Messenger Jettison

RAST Messenger Jettison		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
RAST Messenger Jettison		1. RAST MASTER — ON. 2. CARGO HOOK ARMING — SAFE. 3. RESCUE HOIST — OFF. 4. MAD reeling machine power — OFF. 5. Cyclic stick EMER REL — PRESS.

12.14.4 RAST Backup Messenger Cable Employment

RAST Backup Messenger Cable Employment		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
RAST Backup Messenger Cable Employment	**Note** The RAST hauldown cable-normal release and the RAST messenger cable emergency shear (EMER REL) are disabled when the RAST MASTER switch is OFF.	WARNING Injury to crewmen may result if RAST power is applied during the following procedure. 1. RAST MASTER — OFF. 2. Remove the quick release pin from the messenger light and remove the messenger light assembly. 3. Messenger cable — Remove from probe. 4. Secure line to a point on the probe. 5. Insert backup assembly adapter into main probe from top. Guide with tube assembly. 6. Push messenger adapter through detents on probe and pay out line until instructed to stop. 7. Deck crew will connect RA cable. 8. Pull in line until hauldown cable is locked in the main probe and the backup messenger cable is disconnected. 9. RAST MASTER — ON.

12.14.5 RAST Cable Emergency Release

RAST Cable Emergency Release		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
RAST Cable Emergency Release	**Note** The RAST hauldown cable emergency release T-handle is a mechanical system which will operate regardless of RAST MASTER switch position.	1. RAST emergency release T-handle — PULL.

12.14.6 RAST Main Probe Fails to Extend

<table>
<tr><th colspan="3">RAST Main Probe Fails to Extend</th></tr>
<tr><th>LEGEND</th><th>CAUSE/REMARKS</th><th>CORRECTIVE ACTION</th></tr>
<tr><td>RAST Main Probe Fails to Extend</td><td>Note
• Ensure cable release is in the up position before attempting manual extension of main RAST probe.
• Inadvertent extension of the RAST main probe is possible when the adapter is inserted into the shaft hole.
• When retrieving cable into hoist manually, two positive clicks will be felt. Do not retract any further. This indicates messenger in and hauldown cable locked.</td><td>If the main probe fails to extend electrically:
WARNING
Injury to crewmen may result if RAST power is applied prior to manual main probe extension.
1. RAST MASTER — OFF.
2. Pull pip pin from under the manual cable tension release. Lower the manual cable tension release arm to relieve cable tension.
3. Remove ratchet with adapter from its stowed position.
WARNING
Inserting the adapter with the ratchet attached while the main probe is in the up position may cause serious injury to crewman.
4. Remove adapter from ratchet, slide shaft lock away from shaft hole. Insert adapter shaft and lock into place with shaft lock slide.
5. Raise the manual cable tension release arm and replace pip pin.
WARNING
Check area beneath the aircraft to be sure it is clear of personnel and obstructions.
6. Push down on the release lever to unlock probe. Probe will extend rapidly to extended position.
7. Remove ratchet adapter from shaft hole and attempt normal RAST procedures.
If unsuccessful:
8. Insert ratchet and pay out cable to ship deck. The full 90 feet of cable can be extended in one minute.
9. After hauldown cable has been connected, retrieve by reversing ratchet and reel up until cable is locked in probe.
10. RAST MASTER — ON.
11. H’DOWN LKD and MSGR IN lights — ON.</td></tr>
</table>

12.14.7 RAST Main Probe Fails to Retract

RAST Main Probe Fails to Retract		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
RAST Main Probe Fails to Retract	**Note** RAST main probe must be in the up position in order to receive accurate OTPI information.	1. RAST LAMP TEST — Press. 2. MSGR IN light — On. 3. Main probe — Visually check. 4. MAIN PROBE — DOWN, then UP. **CAUTION** • Running landing shall not be attempted with main probe extended. • Do not attempt to retract probe with ratchet. Damage will occur. • Ground taxi is not recommended with main probe extended.

12.14.8 MAD Reel Failure with Towed Body Deployed

ASQ-81 MAD Reel Failure with Towed Body Deployed		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ASQ-81 MAD Reel Failure with Towed Body Deployed		**CAUTION** With less than 12 feet of cable unrecoverable, maintain 50 to 55 KIAS until on final approach. 1. Day or night VMC recovery procedure: a. Coordinate assistance with ground personnel. b. MAD reeling machine POWER — ON. c. MAGNETIC DETECTING SET PWR — OFF. d. Position crewman in cargo door to inform pilot of towed body position and altitude. e. Establish hover so as to keep MAD towed body clear of deck. f. Lower aircraft until towed body is on deck. g. Ground personnel maintain tension on cable, land aircraft on prepared surface. h. Recover cable, proceed with mission or to aircraft parking area. 2. Night/IMC jettison procedure: a. CARGO HOOK ARMING — SAFE. b. RESCUE HOIST — OFF. c. RAST MASTER — OFF. d. MAD reeling machine POWER — ON. e. Cyclic stick EMER REL — Press. **WARNING** If the MAD bird is lost in flight, the MAD cable shall be cut immediately.

12.14.9 ASQ-81 Towed Body Down Limit Switch Malfunction

ASQ-81 Towed Body Down Limit Switch Malfunction		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ASQ-81 Towed Body Down Limit Switch Malfunction **MAD LIMIT**	**Note** If the MAD towed body stops at an intermediate position during deployment, the CABLE LIMIT light on the MAD reeling machine control panel and the MAD LIMIT light on the caution/advisory panel should flash continuously.	**WARNING** Towed body jettison is possible. Avoid populated areas. *1. if no cable limit light within 61 seconds — Cease MAD reeling operations. *2. Alert crew. 3. REEL — IN.

12.14.10 ASQ-81 Towed Body Fails to Seat Properly

ASQ-81 Towed Body Fails to Seat Properly		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
ASQ-81 Towed Body Fails to Seat Properly		1. REEL — Out (5 seconds). a. Deploy towed body approximately 20 feet from the pylon. **CAUTION** Do not attempt to reseat if the Unit 3 FAIL light has illuminated as a result of a failure to seat properly. 2. REEL — IN. 3. Pilot observe proper seating of the MAD towed body. 4. **Land as soon as practical**, and avoid populated areas.

12.14.11 Rescue Hoist Failure

Rescue Hoist Failure		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Rescue Hoist Failure		*1. Cease hoisting. *2. Visually inspect hoist. *3. Verify: b. HYDRAULIC BACKUP PUMP caution lights — OFF. c. HYDRAULIC BACKUP PUMP switch — ON. d. RESCUE HOIST switch — ALL. e. RESCUE HOIST circuit breakers — IN. a RESCUE HOIST CTRL (SO OVHD, NO. 2 DC PRI, ROW 6, CB 13). (1) RESCUE HOIST CTRL (SO OVHD, NO. 1 DC PRI, ROW 6, CB 2). (2) RSQ HOIST POWER (SO OVHD, NO. 2 AC PRI, ROW 2, CB 3). If a bird's nest or Lucas Western, proceed to step 6. WARNING If a bird's nest is suspected, do not attempt to raise or lower the hoist to avoid further damage to the rescue hoist/cable or cable separation. *4. Check normal raise/lower at all stations. *5. BACKUP CONTROL — Select. WARNING • Operation of rescue hoist in BACK-UP CONTROL mode will bypass limit switches. Cable separation may occur. • If hoist jams, do not attempt to RAISE/LOWER any further as this could shear the cable. 6. Attempt to set personnel/cargo on deck/water. If unable: 7. Cable grip — Rig.

12.14.12 Cable Grip Rigging Procedures

Cable Grip Rigging Procedures		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Cable Grip Rigging Procedures		1. Attach cable grip shackle to crewman safety belt. 2. Attach crewman safety belt to rescue hoist boom. 3. Connect cable grip to hoist cable by placing the cable between the jaws of the cable grip, shackle end up. 4. Pull up on crewman safety belt to slacken hoist cable. **WARNING** Ensure altitude is sufficient to keep survivor/swimmer clear of the water. 5. Report ready for forward flight.

12.14.12.1 Runaway Hoist

Runaway Hoist		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Runaway Hoist		*1. BACKUP CONTROL. — Select. **CAUTION** Operation of rescue hoist using BACKUP CONTROL inhibits limit switches. If payout continues: *2. Hydraulic pump — Secure. 3. Attempt to set person/cargo on deck/water. If unable: 4. Cable grip — Rig.

12.14.12.2 Rescue Hoist Fouled Cable

Rescue Hoist Fouled Cable		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Rescue Hoist Fouled Cable		*1. Pay out cable and attempt to free hangup. If unable: *2. Cut/shear cable — As required.

12.14.12.3 Rescue Hoist Cable Cut

Rescue Hoist Cable Cut		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Rescue Hoist Cable Cut		*1. Emergency shear switch — SHEAR. If unable: *2. Direct pilot to press EMER REL button.

12.14.12.4 Rescue Hoist Cable Separation

Rescue Hoist Cable Separation		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Rescue Hoist Cable Separation	**Note** For proper Quick Splice procedures, refer to NTTP 3-50.1 series.	1. Quick Splice procedure — Perform.

12.15 MISCELLANEOUS CAUTION/ADVISORY LIGHTS

12.15.1 IFF Flashing Caution

IFF Flashing Caution Light		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
IFF Flashing Caution Light IFF	Indicates IFF mode 4 is not responding to interrogation.	1. MODE 4 TEST/ON/OUT switch — TEST. 2. Observe GO indicator light ON. If GO indicator light does not illuminate or TEST/MON NO GO or a STATUS light illuminates: 3. MODE 4 TEST/ON/OUT switch — OUT. WARNING The helicopter may be viewed as a potential foe. Proceed in accordance with local directives.

12.15.2 LEFT or RIGHT RACK FAN Caution Light On

LEFT or RIGHT RACK FAN Caution Light On		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
LEFT RACK FAN RIGHT RACK FAN		1. Check applicable circuit breaker — RH RACK, LH RACK BLOWER (SO circuit breaker panel). 2. Acoustic paneling — Remove.

12.15.3 WOW Advisory Light On In Flight

WOW Advisory Light On In Flight		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
WOW	Illumination of the WOW light in flight indicates that the aircraft Weight on Wheels switch is stuck or malfunctioning.	WARNING Flying with a stuck Weight on Wheels (WOW) switch will disable WOW functions including emergency jettison circuits, radar altitude low altitude aural warning. Engine Out and Low Rotor RPM lights. Pulling the WOW circuit breaker will not restore proper operation of some WOW functions in the air. Pulling the WOW circuit breaker in flight may disable the Low Rotor RPM lights and the #1 and #2 Engine Out warning lights. If the light is illuminated in flight: 1. **Land as soon as practical**.

12.15.4 Hellfire Missile Emergencies

12.15.5 Hellfire Missile Aborted Launch

This condition exists if the ATO depresses the HCU RELEASE CONSENT button but the system subsequently aborts the launch before a firing pulse is sent to any of the Hellfire missile squibs. An ACRT BIT status word for the affected Hellfire missile will be set stating the launch was aborted. If that occurs, perform the following steps:

Hellfire Missile Aborted Launch		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Hellfire Missile Aborted Launch	**Note** • If the RELEASE CONSENT button is depressed within 2 seconds following an attempted launch, the ACRT will ignore any attempts to launch another Hellfire missile and will display an “INV TRIG” alert on the MPD. • No special recovery or Hellfire missile handling procedures are required.	1. Alert crew. If a new Hellfire priority missile is selected by the ACRT: 2. Proceed with the AGM-114 Hellfire Missile Launch checklist. If a new Hellfire priority missile is not selected: 3. PWR/ARM — OFF. 4. MASTER ARM — SAFE. 5. LAUNCHER RESET — INITIATE. 6. ACRT BIT status words — CHECK. If no critical faults: 7. Proceed with the AGM-114 Hellfire Missile Launch checklist. If critical BIT status exists or Hellfire missile launch portion of the mission is complete: 8. PWR/ARM — OFF. 9. WPN SELECT — OFF. 10. MASTER ARM — Verify SAFE. 11. FLIR OPERATIONAL PAGE — SELECT. 12. HELLFIRE PWR — OFF.

12.15.5.1 Hellfire Missile Hangfire

This condition exists if the ATO depresses the RELEASE CONSENT button but the Hellfire missile remains on the rail after the squib firing pulses have been sent to both the Hellfire missile and rocket motor squibs. The rocket motor may or may not ignite. A Hellfire missile hangfire condition is noted on the MPD by displaying the text HNG beneath the Hellfire missile fail symbol.

Note

Normal rocket motor burn time is less than 3 seconds. A rocket motor failure may cause the motor to slow burn or smolder and smoke for more than 3 seconds.

Hellfire Missile Hangfire		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Hellfire Missile Hangfire	**Note** The missile thermal battery does not provide the voltage for the rocket motor fire train. Aircraft power via the Signal Data Converter (AH SDC) is required to fire the rocket motor squibs. If motor squibs have not fired within 1.5 seconds after launch attempt, the missile Safe and Arm Device (SAD) will mechanically return to the safe condition. This will disconnect the firing circuit from the rocket motor squibs.	If rocket motor ignites and aircraft yaws: 1. Adjust controls as required to maintain straight and level flight. 2. Alert crew. **WARNING** The Hellfire missile thermal battery produces voltage for up to 30 minutes after the Hellfire missile squib is automatically fired during the launch sequence. If continued flight is possible, the aircraft should remain airborne with Hellfire missile pointed in a safe direction for a minimum of 30 minutes to allow the thermal battery to become inert. If a new priority Hellfire missile is selected by the ACRT: 3. Proceed with the AGM-114 Hellfire Missile Launch checklist. If a new priority Hellfire missile is not selected: 4. PWR/ARM — OFF. 5. WPN SELECT — OFF. 6. MASTER ARM — SAFE. 7. LAUNCHER RESET — Initiate. 8. ACRT BIT status words — Check. If no critical faults: 9. Proceed with the AGM-114 Hellfire Missile Launch checklist. If critical BIT status exists or Hellfire missile launch portion of the mission is complete: 10. FLIR OPERATION PAGE — Select. 11. HELLFIRE PWR — OFF.

Hellfire Missile Hangfire (cont)		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Hellfire Missile Hangfire (Cont)		If fuel/time permits: 12. Keep Hellfire missile pointed in safe direction for 30 minutes. **CAUTION** EOD personnel, usually located aboard aviation ships, are specially trained to properly handle and dispose of hung ordnance. Personnel should not handle hung ordnance for at least 30 minutes after attempted launch. If shore facility not available: 13. Proceed to aviation ship, if available. 14. Proceed to own ship — Use offset approach procedures. If shipboard recovery with hung ordnance not an option: 15. Execute Selective Jettison of M299 Launcher emergency procedure.

12.15.5.2 Hellfire Missile Misfire

Hellfire Missile Misfire		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Hellfire Missile Misfire	**Note** The missile thermal battery does not provide the voltage for the rocket motor fire train. Aircraft power via the Signal Data Converter (AH SDC) is required to fire the rocket motor squibs. If motor squibs have not fired within 1.5 seconds after launch attempt, the missile Safe and Arm Device (SAD) will mechanically return to the safe condition. This will disconnect the firing circuit from the rocket motor squibs.	1. Alert crew. **WARNING** The Hellfire missile thermal battery produces voltage for up to 30 minutes after the Hellfire missile squib is automatically fired during the launch sequence. If continued flight is possible, the aircraft should remain airborne with Hellfire missile pointed in a safe direction for a minimum of 30 minutes to allow the thermal battery to become inert. If a new priority Hellfire missile is selected by the ACRT: 2. Proceed with the AGM-114 Hellfire Missile Launch checklist. If a new priority Hellfire missile is not selected: 3. PWR/ARM — OFF. 4. WPN SELECT — OFF. 5. MASTER ARM — SAFE. 6. LAUNCHER RESET — Initiate. 7. ACRT BIT status words — Check. If no critical faults: 8. Proceed with the AGM-114 Hellfire Missile Launch checklist. If critical BIT status exists or Hellfire missile launch portion of the mission is complete: 9. FLIR OPERATION PAGE — Select. 10. HELLFIRE PWR — OFF. If fuel/time permits: 11. Keep Hellfire missile pointed in safe direction for 30 minutes.

12.15.5.3 Hellfire Missile Unlatched

Hellfire Missile Unlatched		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Hellfire Missile Unlatched		If this occurs, an AOP alert message “XXX MISSILE UNLATCHED” will be displayed. 1. Inform the crew. 2. Slow helicopter (70 to 80 KIAS preferable), reduce/limit maneuvering. Avoid flying over populated areas. 3. Perform visual inspection of launcher/missiles. a. If the missile appears uploaded normally, **land as soon as practical**. b. If missile does not appear to be properly seated, **land as soon as practical** and only fly over uninhabited areas.

12.15.6 FLIR Uncommanded Lasing

FLIR Uncommanded Lasing		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
FLIR Uncommanded Lasing		If the FLIR/LRD continues to lase after the SO or ATO releases the Laser Trigger and LASING alert is visible on the MPD without operator command: *1. WEAPON SELECT (AN/ASQ-198) — OFF. *2. MASTER ARM — Verify SAFE. *3. LASER — DISABLE. If lasing continues: *4. FLIR PWR — OFF. *5. FLIR circuit breakers — Pull (SO circuit breaker panel, SO OVHD: FLIR AC, FLIR/HFSAC, FLIR/HFS AC) .

12.15.7 Torpedo Emergencies

12.15.7.1 Hung Torpedo

Hung Torpedo		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Hung Torpedo		If a torpedo launch is initiated, and the torpedo remains attached to the BRU–14/A: 1. MASTER ARM — SAFE. 2. Point aircraft in a safe direction. 3. **Land as soon as practical.**

12.15.8 Stores Emergencies

12.15.8.1 Selective Jettison of M299 Launcher

Selective Jettison of M299 Launcher		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Selective Jettison of M299 Launcher		1. HELLFIRE PWR — OFF. 2. WPN SELECT — PORT FWD. 3. MASTER ARM — ARM. 4. PWR/ARM — ON. 5. MISSILE MODE/JETT — MAN. 6. Verify the WEAPON LAUNCH switch indicates RDY. **Note** Missile Ready indicator light will illuminate. 7. WEAPON LAUNCH — Depress. 8. Verify the WEAPON LAUNCH switch indicates AWAY. 9. WPN SELECT — OFF. 10. MASTER ARM — SAFE. 11. PWR/ARM — OFF. 12. Record aircraft position (latitude/longitude). 13. **Land as soon as practical**.

12.15.8.2 Hung Sonobuoy/SLC

Hung Sonobuoy/SLC		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
Hung Sonobuoy/ SLC	**Note** If a hung SLC is experienced, manual refiring will only move the SLC assembly slightly and bleed down the launcher pressure, thereby losing emergency capability to jettison all sonobuoys.	1. Airspeed — Adjust to 80 KIAS. 2. Visually inspect spider assembly and plumbing for damage. 3. Attempt to dislodge by manually refiring sonobuoy tube. If sonobuoy fails to launch: 4. Avoid autorotative flight. 5. Sono Launcher safety valve — SAFE. 6. MASTER ARM — SAFE. 7. Maintain balanced flight and avoid steep turns to the left. 8. **Land as soon as practical** and avoid populated areas.

12.15.8.3 LAUNCH/JETT FAIL Caution Light On

LAUNCH/JETT FAIL Caution Light On		
LEGEND	CAUSE/REMARKS	CORRECTIVE ACTION
LAUNCH/ JETT FAIL		1. Armament circuit breakers — Pull: a. NO. 1 DC PRIMARY BUS marked ARMAMENT JETT A (ATO, ROW 3, CB 11). b. NO. 2 DC PRIMARY BUS marked ARMAMENT JETT B (ATO, ROW 3, CB 21). c. NO. 2 DC PRIMARY BUS marked ARMAMENT SYS (ATO, ROW 3, CB 19). d. NO. 2 DC PRIMARY BUS marked ARMAMENT JETT, JETT D (ATO, ROW 3, CB 22) (BuNo 162349 and subsequent only). 2. Armament circuit breakers — Reset.

12.16 CREW-SERVED WEAPONS

12.16.1 M60D/M240D Emergencies

A malfunction or stoppage is any interruption in the cycle of operation caused by the faulty action of the gun or ammunition. These malfunctions/stoppages can be further defined as:

1. Hangfire: A delay in the functioning of the cartridge propelling charge.
2. Misfire: A complete failure to fire.

12.16.1.1 M60D/M240D Cook-Off

M60D/M240D Cook-Off		
LEGEND	CAUSE/REMARKS	CORRECTIVE ACTION
M60D/M240D Cook-Off		*1. Barrel — SAFE DIRECTION. *2. Weapon — ALLOW TO COOL (min 5 minutes). *3. Chamber — INSPECT AND CLEAR. CAUTION A barrel is considered hot if the gunner has fired 200 or more rounds within 2 minutes (rapid rate of fire). The barrel will become hot enough to cause a cook-off.

12.16.1.2 M60D/M240D Failure to Fire/Jammed Gun

M60D/M240D Failure to Fire/Jammed Gun		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
M60D/M240D Failure to Fire/Jammed Gun		*1. Barrel — SAFE DIRECTION. *2. Wait 5 Seconds. *3. Charging Handle — RETRACT AND LOCK. *4. Safety — TO SAFE. *5. Chamber — INSPECT AND CLEAR. WARNING If chamber cannot be cleared in 10 seconds a possibility for cook–off exists, close feed tray cover and allow to cool for 5 minutes then re–inspect and clear. Note Gun will jam if collection bag is not emptied often.

12.16.1.3 M60D/M240D Runaway Gun

M60D/M240D Runaway Gun		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
M60D/M240D Runaway Gun		*1. Barrel — SAFE DIRECTION. *2. Ammo Belt — BREAK BY TWISTING. If weapon does not stop firing: *3. Continue pointing in safe direction until ammo is expended. *4. Chamber — INSPECT AND CLEAR. WARNING To avoid further damage, continued firing of weapon shall not be conducted until weapon is inspected. *5. Weapon status — REPORT.

12.16.1.4 M60D/M240D Clear Weapon Procedures

M60D/M240D Clear Weapon Procedures		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
M60D/M240D Clear Weapon Procedures		1. Charging Handle — RETRACT AND LOCK. 2. Safety — TO SAFE. 3. Feed tray cover — OPEN. 4. Ammo — REMOVE. 5. Chamber — INSPECT AND CLEAR. WARNING Failure to ensure no live/expended cartridges remain in the chamber, feed tray, or receiver may result in accidental discharge. Utilize a flashlight if necessary to ensure weapon is clear. 6. Weapon status — REPORT.

12.16.2 GAU-16/A Emergencies

12.16.2.1 GAU-16/A Cook-Off

GAU-16/A Cook-Off		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
GAU-16/A Cook-Off		*1. Barrel — SAFE DIRECTION. *2. Weapon — ALLOW TO COOL (min 5 minutes). WARNING Avoid opening the feed cover of a hot gun. If cook-off occurs, there may be a pause between firings. Allow to cool for 5 minutes after last round has fired. *3. Chamber/T-slot — INSPECT AND CLEAR.

12.16.2.2 GAU-16/A Jammed Gun

GAU-16/A Jammed Gun		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
GAU-16/A Jammed Gun		*1. Barrel — SAFE DIRECTION. *2. Wait 5 seconds. *3. Charging handle — CHARGE ONCE. *4. Attempt to fire. If weapon does not fire: *5. Chamber/T-slot — INSPECT AND CLEAR.

12.16.2.3 GAU-16/A Runaway Gun

GAU-16/A Runaway Gun		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
GAU-16/A Runaway Gun		*1. Barrel — SAFE DIRECTION. *2. Charging handle — PULL DOWN. WARNING Avoid opening the feed cover of a hot gun. If cook-off occurs, there may be a pause between firings. Allow to cool for 5 minutes after last round has fired. *3. Feed tray cover — OPEN. *4. Ammo — REMOVE. *5. Feed tray cover — CLOSE. *6. Charging handle — CHARGE ONCE. *7. Chamber/T-slot — INSPECT AND CLEAR. WARNING To avoid further damage, continued firing of weapon shall not be conducted until weapon is inspected.

12.16.2.4 GAU-16/A Clear Weapon Procedures

GAU-16/A Clear Weapon Procedures		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
GAU-16/A Clear Weapon Procedures		1. Safety — SAFE. 2. AN/PEQ-3 — OFF. 3. AN/PEQ-3 lens covers — ON. 4. Feed tray cover — OPEN. 5. Ammo — REMOVE FROM FEED TRAY. 6. Feed tray cover — CLOSE. 7. Charging handle — CHARGE ONCE. 8. Feed tray cover — OPEN. 9. Chamber/T-slot — INSPECT AND CLEAR. WARNING • Chamber may be hot. Use caution while inspecting T-slot. • If chamber is not clear, repeat steps 6. through 9. once and remove any remaining rounds. If unable to clear weapon, execute hung ordnance procedures IAW local directives. CAUTION Do not disassemble the GAU-16 while attempting to clear weapon in flight. 10. Weapon status — REPORT.

12.16.2.5 AN/PEQ-3 Uncommanded Lasing

AN/PEQ-3 UNCOMMANDED LASING		
LEGEND	**CAUSE/REMARKS**	**CORRECTIVE ACTION**
AN/PEQ-3 Uncommanded Lasing	WARNING The AN/PEQ-3 Laser is a class 3B non-eyesafe laser with a NOHD of 263 meters.	*1. AN/PEQ-3 — OFF. *2. AN/PEQ-3 lens covers — ON. *3. Batteries — REMOVE.

PART VI

All-Weather Operations

CHAPTER 13

Instrument Procedures

13.1 INSTRUMENT FLIGHT PROCEDURES

With the exception of some repetition necessary for continuity, the procedures and techniques contained in this chapter are only those that differ or are in addition to normal operating procedures. Prior to conducting instrument flying, careful preflight planning is necessary. Refer to the NATOPS Instrument Flight Manual for detailed instrument flight procedures.

13.1.1 Instrument Takeoff (ITO)

During a full ITO (no external visual reference), the hover bars will provide the only indication of stability over the ground.

The following general procedures are recommended:

1. Select hover bars.
2. Smoothly increase collective to takeoff power and maintain a hover attitude by referencing the AI. Allow AFCS to maintain heading (feet off pedal trim microswitches once airborne).
3. Smoothly increase collective to climbout power. As the helicopter passes through 20 feet on the radar altimeter, position the cyclic forward to establish a 5° nose down attitude and accelerate into forward climbing flight.
4. As the helicopter accelerates, crosscheck radar altimeter and VSI for positive rates of climb. Rate of climb should be 500 fpm or greater.
5. Maintain a smooth acceleration up to 90 KIAS, referencing the AI and airspeed indicator.

13.1.2 Instrument Crew Coordination

In order to prevent possible pilot task saturation, the flight crew shall discuss and assign cockpit responsibilities prior to instrument flight. The responsibilities shall include complying with clearances, making radio calls, switching navigation aids and radios, monitoring navigation, reviewing approach procedures, maintaining a visual/instrument scan during an approach, and landing procedures. Prior to commencing an instrument approach, the pilots should review approach publication information. The PAC shall comply with clearances and should make radio calls. The PNAC should notify the PAC of deviations from published or assigned procedures, call the field in sight, and backup the PAC during visual transition following an approach. The aircrewmen should monitor the radios and maintain a good lookout.

13.1.2.1 Instrument Climbs and Descents

The PAC shall verbalize his intentions to vacate one altitude for another. The PNAC shall monitor flight instruments and provide “100 FEET PRIOR” (or as briefed) call. Upon reaching intended altitude, the PNAC shall verbally note that RDRALT/BARALT pushbutton is latched/steady.

13.1.3 Instrument Approach Procedure

Two methods for ensuring cockpit coordination and instrument scan responsibility are recommended: change of scans or change of controls. Instrument scan responsibility shall be specifically briefed.

Note

Pilots shall verbally acknowledge a change of scan responsibility by use of phrases such as “I’M ON INSTRUMENTS,” or “I’M VISUAL”.

13.1.3.1 Change of Scans

In this procedure, the PAC flies the instrument approach and makes the landing. The PAC maintains an instrument scan until the landing phase commences. The PNAC backs up the PAC on instruments and scans outside for the landing environment. Once the PNAC has the landing environment in sight, and can safely continue the approach, the PACE will provide the PAC with a brief description of the visual approach (e.g., glideslope, line–up) and then assume instrument scan responsibilities. The PAC shall commence a visual scan outside and continue the approach to a landing. The PNAC maintains an instrument scan until landing is assured. If a missed approach is initiated, the PAC will ensure obstacle clearance and then assume instrument scan responsibilities. The PNAC will provide backup instrument scan.

13.1.3.2 Change of Controls

In this procedure, the PAC flies the instrument approach and switches controls to the PNAC for landing. Once the PNAC has the landing environment in sight, and can safely continue the approach visually, the PNAC shall inform the PAC, take the flight controls and continue the approach to landing. The initial PAC continues an instrument scan until landing is assured. If a missed approach is initiated, the initial PAC reassumes control of the aircraft and the initial PNAC provides backup instrument scan and obstruction clearance.

13.2 SIMULATED INSTRUMENT FLIGHTS

13.2.1 Lookout Procedures

The possibility of a midair collision requires continuous caution when engaged in simulated instrument flights. When the PAC's attention is directed toward controlling the aircraft on instruments, the area of surveillance for which the PAC is responsible shall be covered by a lookout familiar with aviation, instructed in specific duties, and provided with direct communication to the pilots.

13.2.2 Safety Precautions

Since the PAC will be devoting total attention to instrument flying, the PNAC will operate the navigation equipment and assume lookout responsibility. When engaged in simulated instrument flights, the crew is responsible for knowledge of and compliance with the following safety precautions:

1. The lookout shall be indoctrinated thoroughly in the nature and importance of specific duties and shall not be distracted from the assigned duties.
2. ICS shall be operable between both pilots and lookout during simulated instrument flight.

13.3 UNUSUAL ATTITUDES

13.3.1 Unusual Attitudes

Unusual attitudes are considered to be pitch attitudes in excess of 30° and/or roll attitudes in excess of 60°. Unusual attitudes will mostly likely be encountered following an AFCS malfunction, AI degradation, vertigo or poor instrument scan.

13.3.2 Unusual Attitude Recovery

If the pilot uses information presented by the AI correctly, a recovery from an unusual attitude can be executed quickly. If AI degradation is suspected, the importance of crosschecking the operable AI must be stressed. If both AI indications are erroneous, the PAC shall immediately switch to a partial panel instrument scan and commence recovery.

While reducing airspeed during recovery from an unusual attitude is important, the recovery can be expedited by decreasing the angle of bank while simultaneously applying aft cyclic. As soon as the angle of bank is corrected, the airspeed indicator and altimeter become the primary pitch instruments. Airspeed should be crosschecked with the AI to obtain an instant indication of pitch attitude. High sink rates can be experienced with no change in attitude.

Therefore, the radar altimeter and VSI should be given strong emphasis. Do not chase the VSI upon recovery. When a diving spiral is experienced, excessive aft cyclic may aggravate the maneuver, tighten the turn, and result in blade stall.

CAUTION

During unusual attitude recoveries, avoid excessive forward airspeed and conditions of flight near a hover where vortex ring state conditions may occur.

See Chapter 12 for the Unusual Attitude Recovery emergency procedure.

CHAPTER 14

Extreme Weather Operations

14.1 COLD-WEATHER OPERATIONS

14.1.1 General

Extreme cold temperatures and conditions cause adverse effects on aircraft materials. Rubber, plastic, and fabric material stiffen, and may crack or even shatter, when loads are applied. Oils congeal and grease hardens. Dissimilar metals contract differentially. Moisture, usually from condensation or melted ice, freezes in critical areas. Tire, landing gear strut, and accumulator air pressures decrease as the temperature decreases. Refer to Chapter 3 for specific cold-weather servicing requirements. Extreme diligence on the part of both ground and flight crews is required to ensure successful cold weather operations. Since it is not usually practical to completely cover an unhangared aircraft, those parts not protected by covers require particular attention. If hangar space is available, the aircraft should be kept in a heated hangar when OAT is forecast below 0 °C (32 °F).

For cold-weather flights, use the normal procedures in Chapter 7, with the exceptions or additions in the following paragraphs.

14.1.2 Cold-Weather Preflight Check

14.1.2.1 Exterior Inspection

1. Check the fuel drains for ice. Blockage of the drains may be an indication of water in the fuel tanks.
2. Check engine inlets for ice or snow, specifically at the lowest point up to the front swirl vanes. If ice or snow is found, remove as much as possible by hand and then thaw the engine out with heated air or deicing fluid before attempting start.

CAUTION

- Ice removal shall never be done by scraping or chipping. Remove ice by applying heat or approved de-icing fluids.
- Failure to remove ice and snow will cause engine damage.

3. Check main rotor head and blades, tail rotor, and flight controls for ice and snow.

CAUTION

Failure to remove snow and ice accumulations can result in serious aerodynamic and structural effects in flight.

4. Check the following vents/ports for ice blockage:

CAUTION

Failure to ensure vents/ports are free from ice can cause false and erratic instrument indications and equipment malfunctions.

a. Fuel tank vents.

b. Engine oil tank vents.

c. Transmission vents.

d. Battery vent.

e. Pitot-static tubes and ports.

5. Check that tires are not frozen to the ground.

6. Check landing gear struts and hydraulic accumulator for proper servicing.

7. Apply preheat if available.

14.1.2.2 Interior Inspection

1. Check PCL's for freedom of movement before engine start.

CAUTION

A PCL that is difficult to move may be indicative of a frozen power available spindle (PAS) or PAS cable. Do not force PCL movement as this may damage the PAS cable.

2. Flight controls may be difficult to move after the aircraft has been cold soaked. If the controls are not sufficiently free for a safe start and low power warm-up, heat the affected controls.

3. Install THPs in the MTMU just prior to engine start.

14.1.3 Engine Oil System Characteristics

1. It is normal to observe high engine oil pressure during initial starts when oil is cold. Run engine at IDLE until oil pressure is within limits. Oil pressure should return to the normal range after operating 5 minutes. However, time required for warm-up will depend on temperature of the engine and lubrication system before start.

2. During starts in extreme cold weather (near -40 °C), the following oil pressure characteristics are typical:

   a. Oil pressure may remain at zero for about the first 20 to 30 seconds after initiating the start. Abort the start if there is no oil pressure within l minute after initiating a start.

   b. Once oil pressure begins to indicate, it will increase rapidly and exceed the prescribed 100-psi limit. The pressure will decrease below 100 psi as oil temperature rises . This condition is considered normal. The time for oil pressure to decrease to 100 psi or below will depend on the severity of the ambient temperature, but it should occur within 5 minutes after starting the engine. Do not advance the PCL to FLY until engine oil pressure is indicating normal.

   c. Oil pressure may increase above the maximum pressure limit if the engine is accelerated above idle while oil temperature is below normal operating range. The pressure will decrease to within the normal operating range as the oil temperature increases. The impending bypass indicator has a thermal lockout below 38 °C to prevent the PDI button from popping. The OIL FILTER BYPASS caution may appear during cold starts. When engine oil temperature reaches approximately 38 °C, the caution should disappear.

14.1.4 Engine Starting

Although cold weather does not generally affect normal engine operation, it may result in problems such as ice in fuel lines, control valves and fuel sumps, possibly preventing a successful cold weather start. Consideration should be given to preheating fuel components prior to flight operations.

CAUTION

When starting an engine that has been exposed to low temperatures overnight, watch for a rise in TGT within 40 seconds. If no TGT rise is evident, abort the start. Prime the engine and attempt another engine start. If there is no overboard fuel flow during prime, inspect for ice in the sumps and filters. During cold weather operation, allow longer warm–up period to bring transmission oil temperature up to desired operating range. Monitor oil pressure and temperature closely.

Note

When on an icy surface, it is advisable to utilize No–Rotor Brake Start Procedures to prevent possible aircraft rotation caused by the rapid increase in torque experienced during a Rotor Brake Start Procedure and engagement.

14.1.4.1 Engine Warmup and Control Exercise

1. At temperatures between –17 °C and –31 °C, warm up engine at IDLE for 3 minutes. During engine warm–up, position cyclic control 1 inch forward of neutral and move tail rotor pedals alternately 3/8 inch.
2. At temperatures between –31° and –40 °C, warm up engine at IDLE for 3 minutes. During engine warm–up, position cyclic control 5/8 inch forward, gradually increasing cyclic movement to 2 inches. Move each tail rotor pedal 1/8 inch, and gradually increase movement to 1/2 inch.

Note

Consideration should be given to using the ROTOR BRAKE START procedure during engine warm–up.

14.1.4.2 Taxiing

The helicopter should not be taxied until all engine temperatures and system pressures are within normal limits. Taxiing in soft snow or on ice offers special problems. All taxiing should be done at low speeds, with wide–radius turns. The distance from obstructions and other aircraft should be as large as possible. Taxiing in snow usually requires higher than normal taxi power, which reduces visibility from blowing snow. If this should occur, taxi at a slower ground speed or have the helicopter towed to a takeoff position. A buildup of snow may occur in front of tires; after passing snow buildup, taxiing will be normal. Do not exceed 15 KGS.

14.1.4.3 Takeoff

Cold weather presents no particular takeoff problems unless the cold weather is accompanied by snow. A slight yawing motion, induced by light pedal application, should break the tires free when they are frozen to the surface. The problem of restricted visibility, due to blowing or swirling snow (from the rotor wash) can be acute and may require use of ITO procedures. Minimum time should be spent in a hover prior to transition to forward flight. If the takeoff area is surrounded by a large expanse of smooth, unbroken snow, there is danger that the pilots may become disoriented because of the absence of visible ground reference objects. In this case, use any available fixed objects for reference. The distances used will depend on the size and color of the objects and the type of takeoff.

14.1.4.4 Cruise

During cruise, use the APU for ECS operation, as required. If the flight is over large, unbroken expanses of snow, the helicopter should be flown entirely on instruments at a safe altitude. Another important factor that should not be overlooked is the effect of low temperatures upon true airspeeds, DA, and fuel consumption.

With ECS on, maximum torque available is reduced by approximately 7 percent per engine. Fuel flow will increase by approximately 45 pounds per hour per engine. With engine anti-ice on, maximum torque available is reduced by up to 18 percent per engine and can be reduced by up to 49 percent if the inlet anti-ice valve has malfunctioned. Using the APU to power the ECS will increase fuel consumption by approximately 150 pounds per hour.

14.1.4.5 Landing

During normal operations, helicopters are often required to land or maneuver in areas other than prepared airfields. During cold-weather operations, this frequently involves landing and taking off from snow-covered terrain. The snow depth is usually less in open areas where there is little or no drift effect. The snow depth is usually greater on the downward side of ridges and wooded areas. Whenever possible, the crew should familiarize themselves with the type of terrain under the snow (tundra, brush, marshland, etc.). Running landings are recommended when landing on loose snow. Maintain enough ground speed to remain ahead of a snow cloud, but not over 15 KGS on touchdown.

On all snow landings, anticipate the worst conditions; restricted visibility due to loose swirling snow and an unfirm ice crust under the snow. When loose or powdery snow is expected, make an approach and landing with little or no hover to minimize the effect of the rotorwash on the snow. If possible, use prominent ground-reference objects during the approach and landing. If no such objects are available, a reference marker dropped from the helicopter will suffice. After contacting the surface, slowly decrease collective until the aircraft is firmly on the ground. Be ready to take off immediately. If, while decreasing collective, one wheel should hang up or break through the crust; do not reduce power until it is positively determined that the aircraft will not settle. If possible, have a crewmember visually check the surface before reducing power.

Note

When shutting down on an icy surface, it is advisable to allow the rotor to coast down to prevent possible aircraft rotation caused by a rapid application of the rotor brake.

14.1.5 Before Leaving the Helicopter

1. Protect the wheels from freezing to the ground by towing/taxiing on to planks or sandbags.

2. Leave the parking brake off.

3. Open the scuppers on cockpit windows. This will permit sufficient air circulation to retard frost formation and reduce cracking of transparent areas due to differential contraction.

4. Drain moisture accumulations from sumps and strainers as soon as possible.

5. Install engine inlet plugs after shutdown to prevent accumulation of ice and snow in engines.

6. Remove the THPs from the MTMU to prevent them from freezing. Keep them in a heated space until needed.

14.2 SNOW PRECAUTIONS

The problems encountered when operating from covered surfaces are significant. The restricted visibility caused by blowing snow can be partially overcome by placing smoke grenades or colored objects, such as pine boughs, a painted drum, or a panel marker in the landing area for visual reference. The smoke grenade will indicate the wind direction and allow an estimate of the wind direction and velocity. The pilot should be aware of the fact that there is no horizon reference when flying over large, unbroken expanses of snow. If this situation exists, fly at a safe instrument altitude and use the attitude indicator for a horizon reference. When preparing to land, select an area devoid of loose or powdery snow to minimize the restrictions to visibility from blowing snow. Takeoffs into fog or low clouds when the temperature is at or near freezing could result in engine air inlet icing. Climb speeds should be higher than normal under such conditions.

Running takeoffs are permitted if groundspeed is held to 60 knots or below on level terrain before leaving the ground. Running landings are recommended when landing on loose snow. Maintain enough groundspeed to remain ahead of a snow cloud but not to be over approximately 15 knots at touchdown.

14.3 ICE PRECAUTIONS

Icing conditions will affect aircraft in numerous different manners dependent on the OAT and level of the icing conditions encountered. If unanticipated icing conditions are encountered, your first consideration should be to exit the icing environment. If unable to exit the icing environment, it is necessary to have an understanding of the icing severity levels and factors that affect ice accumulation rates in addition to the possible degradations that may occur in aircraft performance.

WARNING

- Flight into known icing conditions without de-ice equipment is prohibited.
- Flight into forecasted or known moderate or severe icing conditions is prohibited.
- OAT gauges are not calibrated instruments and may provide false information.
- Ice shed from the rotor blades and/or other rotating components presents a hazard to personnel during landing and shutdown.

CAUTION

- Ice shed from the main rotor may strike the tail rotor during rapid descents following flight in icing conditions.
- Ice formation on the lower hub assembly of the main rotor head may prevent droop-stop engagement on shutdown.

14.3.1 Engine/Inlet Anti-Icing

The engine inlet has a tub area forward of the swirl vanes with no provision to drain water which may collect. Water pooled in the intake ducting will freeze in cold weather and may result in foreign object damage (FOD). Since it can only be removed using approved de-ice fluid or hot air, pooled water must be removed prior to freezing. Intakes shall also be checked for ice on preflight.

When the engines are operating and the OAT reaches 5 °C or below in visible moisture, the engine inlet guide vanes and the inlet are susceptible to icing. The ENG ANTI-ICE switches shall be turned on when OAT is 5 °C or below in visible moisture.

CAUTION

Ice damage to the T700 engine may be characterized by a high pitched noise with no associated power loss or secondary indication.

Note

Significant power available losses and increased fuel consumption can be expected as a result of the actuation of the engine and engine inlet anti–ice systems.

14.3.2 Helicopters Not Equipped with Blade De–Ice

If icing conditions are encountered or the ICE DETECTED caution appears due to suspected icing conditions, immediately turn on all anti–icing equipment, seek a condition where icing is not present, and land as soon as practical (Refer to Chapter 12 for emergency procedure). Initial ice accumulation will be noted on the windshield wiper arms, mirror support brackets, main landing gear and external stores. The main rotor blades may undergo periodic shedding of ice that will result in light to moderate vibrations felt through the controls and the airframe. Ice shedding from the main and tail rotor may strike each other and the fuselage causing dents in the blades and the airframe.

Ground personnel should remain well clear of the helicopter during landing and shutdown, and passengers and crewmembers should not exit the helicopter until the rotor has stopped. The aircraft should be closely inspected following flight in icing conditions.

14.3.3 Ice Rate Detector

The ice rate detector, mounted on the NO. 2 engine cowling, senses the accumulation of ice and activates the ICE DETECTED caution. Correspondingly, an aspirate heater on the probe is activated to heat the probe and shed the ice. As the ice melts, the ICE DETECTED caution will disappear. The frequency at which the ICE DETECTED caution cycles on and off may give an indication of the icing severity level.

14.3.4 Helicopters Equipped with Blade De–Ice

Flight is permitted in forecast or known trace or light icing conditions. All anti–ice/de–ice systems shall be turned on prior to entering visible moisture (including clouds) at ambient temperatures of 5 °C or less. When icing is unexpectedly encountered, turn on all anti–icing and de–ice equipment immediately.

Refer to Chapter 22 for torque available. An additional torque increase up to 14 percent per engine may be experienced due to ice build–up during normal operation of the blade de–ice system. The crew should closely monitor engine instruments to prevent exceeding limits and/or rotor droop.

WARNING

Ice accumulation resulting in a 20 percent torque increase indicates that normal autorotational rotor rpm may not be attainable should dual–engine failure occur.

The main rotor hub and blades may accumulate ice prior to initiation of a de–ice cycle. Moderate vibration levels of short duration can be expected in the controls and airframe during normal de–ice cycles. The torques should be carefully monitored for any constant torque increase over clear air torque. An increase of over 10 percent matched torque should result in urgent consideration to vacate the environment, unless the task is considered essential.

Should unacceptable vibration levels and excessive torque requirements persist, the pilot should leave the icing environment as soon as possible.

If torque required increases 20 percent above that required for level flight, at the airspeed being maintained prior to entering icing, exit the icing environment or land the aircraft as soon as possible. Some impact damage to the aircraft can be expected during flight into icing conditions.

If the blade de–ice system is not operating, asymmetric shedding of ice may cause imbalances, which may result in severe vibrations. These vibrations will normally subside after 30–60 seconds when ice from other blades is shed. Some impact damage to the aircraft can be expected during flight into icing conditions.

Icing of the droop stops and anti-flapping restrainers during extended flight in icing conditions may prevent their normal operation during rotor shutdown. When the droop stops fail to engage, the main rotor blades may droop to within four feet of the ground during shutdown. Strong, gusty winds may also cause excessive flapping of the main rotor blades, presenting the additional hazard of potential contact with the aft fuselage. If the droop stops are suspected to be stuck in the flight position, caution must be exercised during shutdown to ensure personnel remain clear and flight controls are positioned to avoid excess main rotor blade flapping. Refer to Chapter 12 for the appropriate emergency procedure.

CAUTION

- The potential exists for incomplete blade fold following flight in icing conditions. Visually ensure all blade fold micro-switch contact surfaces are free of ice accumulations prior to attempting a blade fold sequence.
- The potential exists for the anti-flapping devices to remain in the open position following flight in icing conditions.

14.3.5 Pitot-Static Tube Heater

Pitot heat shall be turned on when OAT is 5 °C or below and/or visible moisture is present.

WARNING

Failure to turn on pitot heat in icing conditions may cause erroneous airspeed indications, which may lead to downward programming of the stabilator and loss of control of the aircraft.

14.4 THUNDERSTORMS AND TURBULENCE

14.4.1 Thunderstorms

Avoid flight through or near thunderstorms. If thunderstorms are encountered during flight, consider the option of landing and waiting for the storm to pass, if possible.

A severe lightning strike to the aircraft is likely to result in the loss of all electrical power sources, except the battery (including the APU generator even if it is not operating at the time), and in damage to a majority of electronic circuits. Due to electrical system design, battery power may only be available for operation of components associated with the battery utility bus following a lightning strike. With the loss of all electrical power, the only remaining instruments still available to the pilots for an emergency landing would be the standby instruments. A lightning strike that induces voltages in the engine wiring harness would significantly damage the DECUs and possibly other related components.

14.4.2 Turbulence

The aircraft should not be flown in a manner that will result in deviations from the normal limitations. Use the following techniques when operating in turbulent air.

14.4.2.1 When Encountering Turbulent Air

The following procedures are recommended:

1. Crew — Alert.
2. Airspeed — Adjust as follows:
   a. For moderate turbulence, limit airspeed to blade stall speed minus 15 knots.
   b. For light turbulence, limit airspeed to blade stall speed minus 10 knots.
3. Loose equipment — Secure.

14.4.2.2 In Turbulent Air

The collective position, when adjusted for the airspeeds mentioned above, should not be adjusted and the AI should be used as the primary pitch instrument. The pitot static instruments may vary excessively in turbulence and should not be relied upon. Airspeed indications may vary as much as 40 KIAS. By maintaining a constant collective position and a level flight attitude on the AI, airspeed will remain relatively constant even when erroneous readings are presented by the airspeed indicator.

14.4.2.3 Starting Rotors

Position the helicopter into the wind. Hold the cyclic into the wind and increase the rotor rpm immediately to prevent excessive flapping of the blades. (Refer to Chapter 4 for maximum wind velocities for engaging rotors).

14.4.2.4 Descending

A long, fairly flat approach with power on will afford better handling characteristics than will a steep, slow, or low-power approach.

14.4.2.5 Stopping Rotors

Position the helicopter into the wind. Use the normal procedure for stopping rotors. Hold the cyclic into the wind to reduce the tendency of blades to bump against the droop stops. Apply the rotor brake when the rotor speed is reduced below 40 percent.

14.5 RAIN PRECAUTIONS

Pitot heat shall be turned on when visible moisture is present to reduce water accumulation in the pitot static system.

Note

Water intrusion into nose bay avionics compartment can lead to AFCS computer failure.

14.6 HOT WEATHER AND DESERT OPERATIONS

More power will be required to hover during hot weather than on a standard day. Hovering altitude will be lower for the same gross weight and power settings on a hot day. Plan the flight thoroughly to compensate for existing conditions by using the Performance Charts in Part XI. When weather conditions permit, leave scupper vents and cabin doors open on the ground to ventilate the helicopter.

Note

- Fuel densities will decrease as the ambient temperature rises, resulting in a decrease in operating range.
- High humidity increases the DA and effectively reduces the efficiency of the rotor system. For every 10 percent increase in relative humidity the DA increases approximately 100 feet. Thus a high relative humidity, close to 100 percent, can effectively increase the DA by as much as 1,000 feet.

During ground operations, if engine oil pressure falls into the red range when the PCL lever is in the IDLE position and/or the ENGINE OIL PRESS caution light comes on when the PCL lever is in the idle position, slightly advance the PCL lever. If the engine oil pressure returns to the yellow range and the ENGINE OIL PRESS caution light extinguishes, engine oil pressure is acceptable.

14.6.1 Desert Procedures

Desert operations generally involve operating in a very hot, dry, dusty, often windy atmosphere. Under such conditions, sand and dust will often be found in vital areas. Severe damage may be caused by sand and dust. Consider towing the helicopter into takeoff position. If possible, takeoff should be on a hard, clean surface, free from sand and dust.

Note

Operations in extremely dusty conditions for extended periods may cause the ICE DETECTED caution light to illuminate due to particle buildup on the detector.

14.6.2 Preflight Inspection

Plan the flight thoroughly to compensate for existing conditions by using the Performance Charts in Part XI. Check for sand and dust in control hinges, actuating linkages, and inspect tires for proper inflation. High temperatures may cause over-inflation. Check oleo struts for sand and dust, especially in the area next to the cylinder seal, and remove any accumulation with a clean, dry cloth. Inspect for and remove any sand and dust deposits on the instrument panel, switches, flight controls, and the engine control quadrant.

14.6.3 Engine Starting

If possible, engine starting and ground operations should be made from a hard, clean surface with aircraft positioned into the wind.

14.6.4 Taxi

When it is absolutely necessary to taxi in sand and dust, get the helicopter airborne as quickly as possible to lessen sand and dust intake by the engines and erosion of the main rotor blades.

14.6.5 Takeoff

Execute takeoff and climb as rapidly as possible.

14.6.6 Cruise

Avoid flying through sand or dust storms, when possible. Excessive dust and grit in the air will cause considerable damage to internal engine parts and erosion of the main rotor blades.

14.6.7 Landing

The best procedure to lessen blowing sand and dust during landing is a steep approach with a no-hover landing.

14.6.8 Engine Shutdown

Shut down the engine as soon as practical, to lessen the intake of sand and dust.

14.6.9 Postflight Inspection

Install all protective covers and shields. Except when sand and dust are blowing, leave scupper vents and cabin doors open to ventilate the helicopter.

PART VII

Communications and Navigation

CHAPTER 15

Communication Equipment and Procedures

15.1 COMMUNICATIONS

15.1.1 Introduction

The communication subsystem handles the transfer of sensor and tactical data between the helicopter and ship and also routes internal communication among helicopter crewmembers. The communication subsystem has the following capabilities:

Note

- Aircraft BuNo through 162990 are equipped with ARC–159 UHF radio sets. Aircraft BuNo 162991 and subsequent are equipped with ARC–182 UHF/VHF radio sets. VHF and UHF FM are additional capabilities provided by the ARC–182 UHF/VHF radio sets.
- To prevent hot mike of other selected transmitters and loss of VOX ICS, ensure the ANDVT (USC–43/KYV–5) HF SECURE toggle switches are OFF when not in use. The toggle switches are mounted on the side of the center console, one on the pilot side and one on the ATO side.

1. Two–way clear or secure voice (UHF or UHF/VHF) between the helicopter and other units (KY–58 and ARC–159 or ARC–182).
2. Two–way clear or secure, over–the–horizon voice (HF) between the helicopter and other units (KYV–5 and ARC–174).
3. Two–way secure computer–to–computer data link for data and voice transfer (KG–45 and ARQ–44).
4. Transmission of sonobuoy command tones.
5. Communications relay (UHF or UHF/VHF).
6. IFF/SIF interrogation and identification of friendly or hostile targets and response to interrogations from friendly forces. THP 21 permits IFF interrogation from ATO and SO keysets.

The communication subsystem performs five major functions:

1. Communications control.
2. Data link between ship and helicopter.
3. Voice communications.
4. IFF.
5. Intercommunications.

15.1.1.1 Communications System Control Group

The communications system control group (CSCG) provides a central control and interface capability for internal and external communications in the LAMPS MK III System.

The CSCG consists of:

1. Audio–converter processor (ACP).
2. Communications control panel (COMM CONTR).
3. Radio control panels (remote switching control (RSC)) for pilot, ATO, SO, and observer.
4. Hoist operator position and maintenance interconnecting boxes (IB).

Communication signals are routed through the CSCG in order to provide a single point of control for selection and routing of radio and intercommunications signals. The ATO or pilot controls the operating mode and tuning of UHF or UHF/VHF radios, selection of clear or secure–voice communications, and IFF interrogation from the COMM CONTR. The CSCG collects equipment status information from communications units and displays failures by means of status lights located on the COMM CONTR Panel. CSCG reports overall status over the 1553 data bus to digital data computer 1 (AYK–14) (SAC–1). The CSCG also receives and distributes audible warning tones as follows:

1. Low altitude:
   a. High index (250 feet) — Approximately 6 tone pulses at both pilot stations.
   b. Variable index (set on the RAD ALT) — Approximately 6 tone pulses and a steady red light at each pilot station corresponding to the individually set variable index.
   c. Low index (35 feet with coupler engaged) — Continuous tone and light pulses at both pilot stations.
2. RAD ALT failure — A continuous beeping tone at both pilot stations indicating a loss of track.
3. Helicopter threat warning — Three tones which may be initiated by the AOP are addressable via the 1553 bus (for use on BuNo 162991 and subsequent only).

Note

The aural alert will occur only if the aircraft is equipped with a –29 Audio Converter–Processor.

4. Stabilator failure — A unique beeping tone at both pilot stations.
5. Missile warning — A unique audible warning can be heard at each pilot station when a missile plume is detected or the system is tested.

The CSCG also performs automatic UHF radio switching under software control to send signals to command activated sonobuoys. The actual sonobuoy commands are generated by the acoustic subsystem.

Power is supplied from the NO. 2 DC primary, NO. 1 AC primary, and AC essential buses through three circuit breakers, all marked CONV PROCR AUDIO. They are located on the ATO and center circuit breaker panels.

15.1.1.1.1 Audio Converter-Processor

The ACP is located under the lower console and performs switching, processing, and routing of command and control data for the following:

1. UHF or UHF/VHF receiver/transmitters.
2. Speech security equipment.
3. Direction finder group.
4. Data link.
5. IFF interrogator.
6. Sonobuoy receivers.
7. ICS.

If the frequency display on the COMM CONTR Panel goes to all zeros (0) and does not return, this may be cleared utilizing the following procedure:

1. Set CSCG AUTO/MAN to MAN.
2. Depress and release TEST.
3. After approximately 5 seconds, depress and release TEST again.
4. System should now be in normal operation. If not, cycle PWR to the affected UHF radio. (Radio NO. 1 R/T UHF on DC ESS BUS; radio NO. 2 R/T UHF on NO. 2 DC PRI BUS.)
5. If the problem is still not cleared, cycle CONV PROCR AUDIO (NO. 1 AC PRI BUS). System should now be in normal operation. Return AUTO/MAN to AUTO.

Note

In an emergency, selection of BKUP will allow immediate use, following backup procedures.

15.1.2 Communications Control Panel

Primary control of the communication subsystem is through the communications control (COMM CONTR) panel, located on the cockpit lower console. Individual controls and indicators are described in Figure 15-1 for ARC–159 radio sets or Figure 15-2 for ARC–182 radio sets. The COMM CONTR panel provides control for UHF–1, UHF–2, HF Secure, Data Link, intercommunication, and IFF Interrogator, along with certain associated navigation functions. The primary functions of the COMM CONTR panel are:

1. UHF and VHF mode, channel, and frequency selection.
2. UHF, VHF, and HF clear/secure mode selection.
3. IFF interrogator mode and code selection.
4. CSCG automatic or manual mode selection.
5. OTPI selection and tuning.
6. Self–test initiation.

Note

All aircraft communications will be interrupted for approximately 45 seconds during a CSCG self–test. If initiated while airborne by inadvertent depression of the CSCG TEST pushbutton, selection of test from the equipment status table of the data handling/data display subsystem or reinitialization of the CSCG, place the CSCG mode switch to manual and press the CSCG self–test pushbutton to abort the test.

7. Status display.

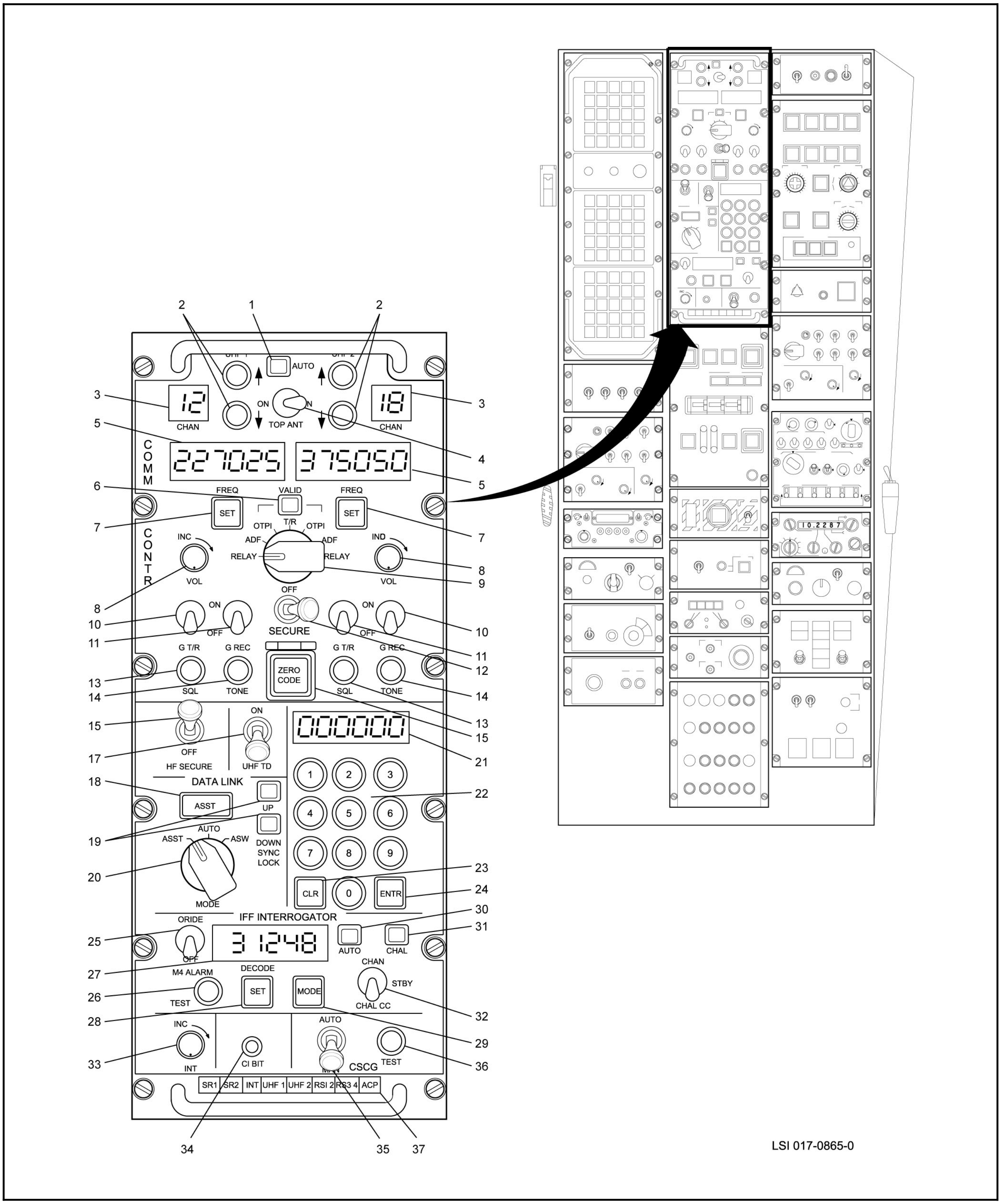


Figure 15-1. Communications Control Panel (BuNo through 162990) (Sheet 1 of 5)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
	COMM CONTR	The communications control panel allows manual or computer control of the communications subsystem.
1	AUTO	Indicates software control of CSCG functions. Not currently implemented in the SH-60B.
2	UHF-1, UHF 2 (Channel Select-up/down)	Four pushbutton switches, two switches for each UHF/VHF radio. Upper switch increases channel number by one for each actuation; lower switch decreases the channel number by one for each actuation.
3	CHAN	Channel, two-digit, numeric display indicating UHF or OTPI channel being used. Two displays, one for UHF-1 and one for UHF-2. Displays 00 to 20 for normal UHF; 01 to 31 for OTPI. Channel selection accomplished by operating UHF-1, UHF-2 pushbuttons. If G T/R is selected, CHAN is blanked.
4	TOP ANT	Top antenna, two-position, left-right toggle switch.
	ON (Right)	UHF-2 assigned to top antenna; UHF-1 to bottom antenna.
	ON (Left)	UHF-1 assigned to top antenna; UHF-2 to bottom antenna.
5	FREQ	Two, six-digit, numeric displays, one for UHF-1 and one for UHF-2. Indicates active frequency corresponding to channel selected, frequency spans 225.000 to 399.975 MHz in 25 kHz steps. 243.000 MHz displayed, if G T/R ON is selected. Not affected by OTPI selection.
6	VALID	Two-position, magnetic flag indicator which indicates OTPI strength.
	Black	Data not valid. Indicates weak OTPI signal.
	Green	Data valid. Indicates OTPI is receiving signal of sufficient strength to provide reliable pointing.
	Red/White	Indicates control indicator switch settings conflict.
7	SET	Two white-illuminated momentary pushbutton switches, one for each UHF/VHF radio. Used to change the frequency of the selected channel.
8	VOL	Volume, 12 position rotary switch.
	INC	Increase, clockwise rotation increases audio output (30 db range). Two switches, one for each UHF radio. Inoperative while in secure voice.
9	Mode selector switch	Seven-position rotary switch selects UHF-1 and UHF-2 radio modes.
	RELAY	Receipt/retransmission, reception on one UHF radio will automatically key and modulate the other radio. (Frequencies must be at least 50 MHz apart for BuNos prior to 162106 and at least 10 MHz apart for BuNo 162106 and subsequent.)
	ADF	Automatic direction finding mode on the selected UHF/VHF radio.
	OTPI	On-top position indicator (OTPI) is activated. OTP channel is displayed in the corresponding UHF CHAN display.
	T/R	Both radios in transmit/receive mode (normal position).
10	G T/R	Guard transmit/receive two-position toggle. Two switches, one for each UHF radio.
	OFF	UHF radio is tuned by normal channel selection.
	ON	Respective UHF radio is automatically tuned (main receiver and transmitter) to guard frequency (243.000 MHz) and clear voice. Overrides all other UHF modes including secure voice, OTPI, ADF, RELAY, and sonobuoy commands.

Figure 15-1. Communications Control Panel (BuNo through 162990) (Sheet 2)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
11	G REC	Guard receiver, two-position toggle switch. Two switches, one for each UHF radio.
	OFF	Allows monitoring of main receiver only.
	ON	Allows simultaneous monitoring of main and auxiliary guard receivers.
12	SECURE	Three-position, lever-lock, left-right throw, center-off toggle switch.
	ON (left)	Secure voice operation of UHF-1 radio. Inhibits plain reception.
	ON (right)	Secure voice operation of UHF-2 radio. Inhibits plain reception.
13	SQL	Squelch, alternate action, non-illuminated pushbutton switch. Successive depression causes release to inactivated state. Two switches, one for each UHF radio.
14	TONE	Tone, momentary, non-illuminated pushbutton switch. Commands UHF radio to transmit 1020 Hz audio tone for the duration of the depression. Two switches, one for each UHF radio.
15	ZERO CODE	Pushbutton with spring-loaded guard, illuminated when activated. Used to zeroize HF and UHF Speech Security Equipment.
16	HF SECURE/ON	Two-position, lever-lock toggle switch. Locked in ON position, all HF transmissions are encrypted, reception can be either plain or secure. The ARC-182 VHF Radio, installed in ESP Mod Aircraft as an aftermarket kit, is inoperable with this switch in the ON position.
17	UHF TD/ON	UHF Time Delay, two-position, lever-lock toggle switch. Commands KY-58 to insert a time delay prior to transmission or retransmission of UHF signals.
18	Magnetic Flag	When data link mode selector switch is in AUTO, indicator is driven by data bus software. Two-position, magnetically actuated flag annunciator, edge light illuminated.
	ASW	Data link is in ASW mode. Acoustic data and ESM is downlinked.
	ASST	Data link is in ASST mode. RADAR data and ESM is downlinked.
19	SYNC LOCK	Synchronization locked, two-position flag annunciator. Red color indicates sync loss. Green indicates sync lock. **Note** Sync Lock does not indicate valid data transfer or proper crypto keying.
	UP	Data link RF signal from ship to helicopter.
	DOWN	Data link RF signal from helicopter to ship.
20	MODE	Data link mode selector three-position rotary switch (intended for maintenance/troubleshooting).
	AUTO	Enables data bus control of data link ASST/ASW mode.
	ASST	Commands data link operation in ASST mode, link channel 01.
	ASW	Commands data link operation in ASW mode, link channel 01.
21	Display	Six-digit numeric display. Used for setting UHF/VHF channel frequency and IFF Interrogator code. As number is keyed, it appears in the right display position. Subsequent keyings cause selected digits to shift to the left.

Figure 15-1. Communications Control Panel (BuNo through 162990) (Sheet 3)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
22	0,1,2,3,4,5,6,7,8,9 Keyboard	Numeric keyboard, 10 momentary pushbuttons. Proper number of digits MUST be entered (i.e., 6 for UHF, 2 or 4 for IFF).
23	CLR	Clear momentary pushbutton, clears display of any selected series of digits so that a new series of digits can be selected. Set must be pressed again to reenter.
24	ENTR	Enter momentary pushbutton, enters displayed frequency or code into system, display returns to an all blank state.
25	M4 ALARM	Mode 4 Alarm two-position toggle switch.
	ORIDE	Override, IFF interrogator computer overrides the Mode 4 (M4) alarm and allows the ATO to force a challenge. Using this feature may compromise the M4 code.
26	TEST	Momentary, non-illuminated pushbutton switch commands a transponder/interrogator loop test. Transponder must be in NORMAL.
27	DECODE	Six-digit numeric display. The four digits on the left display interrogator code. Two characters on the right display IFF mode (1,2,3,4a, and 4b), set via sequential pushes of the MODE pushbutton. In M4 all digits in the left display area are blanked.
28	SET	White-illuminated, momentary pushbutton switch, allows changing of code by the keyboard display.
29	MODE	White-illuminated, momentary pushbutton switch, causes the IFF mode and code to advance.
30	AUTO	Two-position, magnetic status flag annunciator IFF control modes.
	GREEN	IFF interrogator is being controlled by software.
	BLACK	IFF interrogator is being controlled manually by the CSCG panel.
31	CHAL	Three-position, magnetic status flag annunciator, indicates interrogator status when CHAL switch is activated.
	GREEN	CHAL switch activated signals being transmitted from the interrogator.
	BLACK	CHAL switch released.
	RED	CHAL switch activated, interrogator ‘no go’ is received by the CSCG ACP indicating challenge may be unsuccessful. ORIDE activation may change the flag to green. If the annunciator remains red after ORIDE activation, M4 challenges are disabled.
32	Challenge Switch	Three-position toggle switch momentary in up-and-down positions. Causes interrogator to transmit an interrogation with the mode of interrogation determined by the mode display setting.
	CHAL	Challenge, momentary up position. ACP sends a challenge-enable command to the Interrogator to accept a correct mode reply. Correct mode replies will display a single bar. Correct mode and code will display a double bar.
	STBY	Standby, normal inactive position.
	CHAL CC	Challenge correct code momentary down position. ACP sends a challenge command which enables interrogator to accept only a correct code and mode reply. A double bar will be displayed.

Figure 15-1. Communications Control Panel (BuNo through 162990) (Sheet 4)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
33	INT	Intensity, 10 position variable potentiometer.
	INC	Increase, clockwise rotation increases luminous intensity of all COMM CONTROL numeric displays from minimum intensity upward. Full counterclockwise position is a LAMP test. All ‘8s will be displayed and all fault lights except ACP.
34	CI BIT	Control indicator built-in test black and white magnetic flag annunciator. White indicates that the COMM CONTR panel has failed.
35	CSCG	Communications system control group ACP two-position, lever-lock, toggle switch.
	MAN	Manual, COMM CONTR panel controls CSCG units.
	AUTO	Automatic, COMM CONTR functions are controlled by software, via data bus interface.
36	TEST	CSCG self-test momentary, non-illuminated pushbutton switch. Pressing of button starts an interruptive self-test only when AUTO/MAN switch is in MAN position. TEST is aborted if the TEST button is pressed again. In AUTO, TEST may be initiated through software.
37	Status Annunciators	Eight yellow-illuminated annunciators that display non-availability of CSCG and other units. Illuminates when equipment is not available because of failure or power off. Lack of coding of security equipment controlled by CSCG (KY-58) will cause the ACP annunciator to illuminate. The annunciator legends in left to right sequence are defined as follows:
	SR1	Sonobuoy receiver, NO. 1.
	SR2	Sonobuoy receiver, NO. 2.
	INT	IFF interrogator.
	UHF 1	UHF, NO. 1 radio.
	UHF 2	UHF, NO. 2 radio.
	RS1 2	Pilot and ATO Radio panels.
	RS3 4	SO and observer Radio panels.
	ACP	Audio converter-processor (light is not tested when Lamp Test is selected but tested when CSCG TEST is initiated).

Figure 15-1. Communications Control Panel (BuNo through 162990) (Sheet 5)

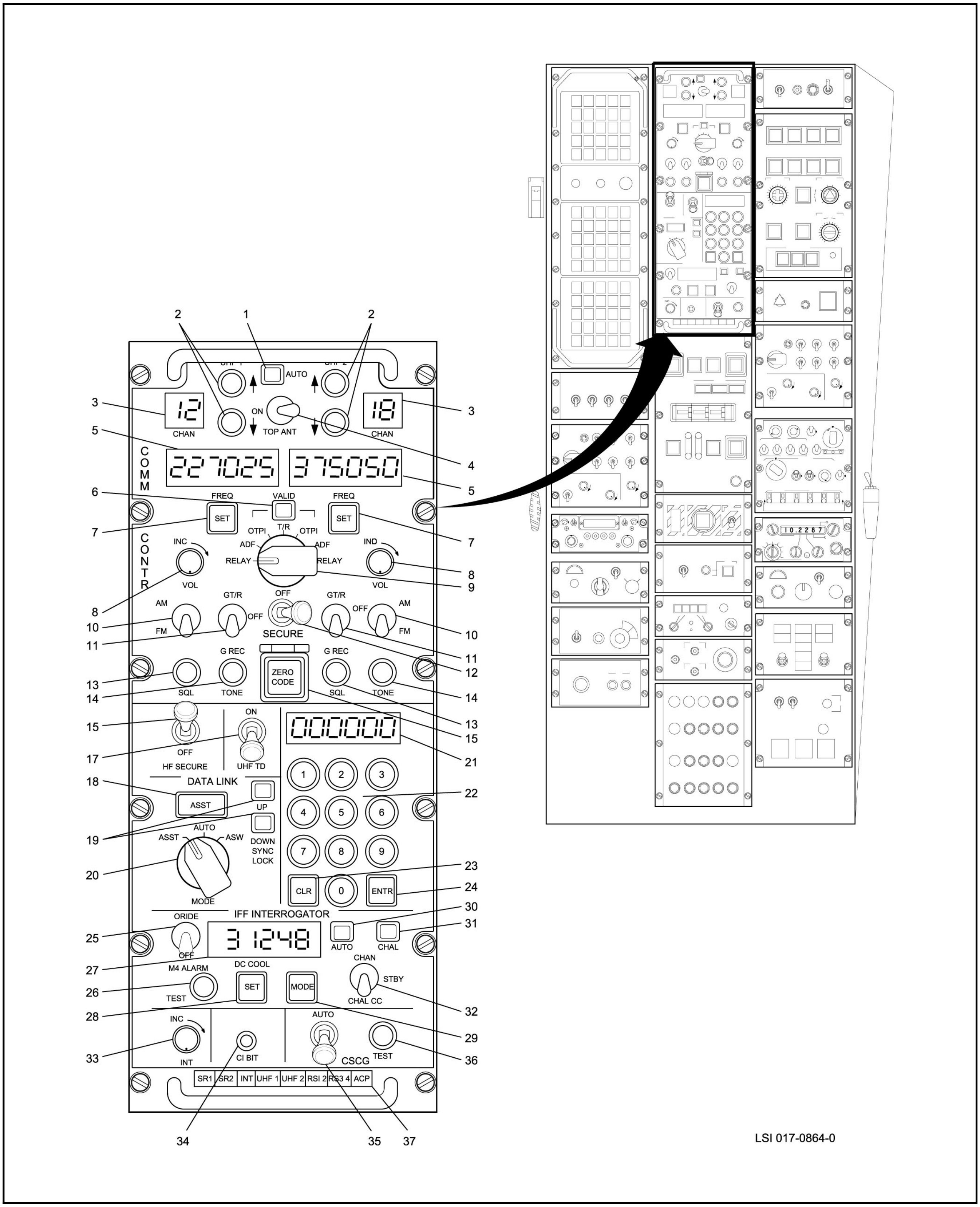


Figure 15-2. Communications Control Panel (BuNo 162991 and Subsequent) (Sheet 1 of 6)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
	COMM CONTR	The communications control panel allows manual or computer control of the communications subsystem.
1	AUTO	Indicates software control of CSCG functions. Not currently implemented in the SH-60B.
2	UHF-1, UHF-2 (Channel Select-up/down)	Four pushbutton switches, two switches for each UHF/VHF radio. Upper switch increases channel number by one for each actuation; lower switch decreases the channel number by one for each actuation.
3	CHAN	Channel, two-digit, numeric display indicating UHF, VHF, or OTPI channel being used. Two displays, one for UHF-1 and one for UHF-2. Displays 00 to 20 for normal UHF/VHF; 01 to 31 for OTPI. Channel selection accomplished by operating UHF-1, UHF-2 pushbuttons. If G T/R is selected, CHAN is blanked.
4	TOP ANT	Top antenna, two-position, left-right toggle switch.
	ON (Right)	UHF-2 assigned to top antenna; UHF-1 to bottom antenna. (Except when in OTPI or ADF modes.)
	ON (Left)	UHF-1 assigned to top antenna; UHF-2 to bottom antenna. (Except when in OTPI, ADF, or BACKUP modes.)
5	FREQ	Two, six-digit, numeric displays, one for UHF-1 and one for UHF-2. Indicates active frequency corresponding to channel selected, frequency spans of 30.000 to 87.975 MHz FM, 108.000 to 155.975 MHz AM, 156.000 to 173.975 MHz FM, and 225.000 to 399.975 MHz AM/FM in 25 kHz steps. If G T/R ON is selected, the display will indicate the guard frequency of the frequency band in operation. Not affected by OTPI selection.
6	VALID	Two-position, magnetic flag indicator that indicates OTPI strength.
	Black	Data not valid. Indicates weak OTPI signal.
	Green	Data valid. Indicates OTPI is receiving signal of sufficient strength to provide reliable pointing.
	Red/White	Indicates control indicator switch settings conflict.
7	SET	Two white-illuminated momentary pushbutton switches, one for each UHF/VHF radio. Used to change the frequency of the selected channel.
8	VOL	Volume, 12-position rotary switch.
	INC	Increase, clockwise rotation increases audio output (30 db range). Two switches, one for each UHF radio. Inoperative while in secure voice.
9	Mode selector switch	Seven-position rotary switch selects UHF-1 and UHF-2 radio modes. For software versions THP-20 and subsequent, OTPI operation is accomplished by rotating the Mode Selector Switch to OTPI and tuning the desired sonobuoy using the TUNE OTPI pushbuttons on the ATO keyset. For this configuration, the OTPI channel displayed in the UHF CHAN display does not correspond to the sonobuoy tuned on the MPD.
	RELAY	Receipt/retransmission, reception on one UHF/VHF radio will automatically key and modulate the other radio (Note 1).

Figure 15-2. Communications Control Panel (BuNo 162991 and Subsequent) (Sheet 2)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
	ADF	Automatic direction finding mode, in the UHF band, on the selected UHF/VHF radio.
	OTPI	On-top position indicator (OTPI) is activated. OTPI channel is displayed in the corresponding UHF CHAN display.
	T/R	Both radios in transmit/receive mode (normal position).
10	AM/FM	Two-position toggle switch. For the UHF-band (225.000 to 399.975 MHz) only. FM mode will be selected in the lower position. AM mode will be selected in the upper position. One toggle switch each is provided for UHF-1 and UHF-2.
11	G T/R-OFF-G REC	Three position toggle switch. In the lower position, G REC, it will allow monitoring of the main and guard receiver outputs. In the upper position (G T/R), the radio unit will be automatically tuned (main receiver and transmitter) to the guard frequency of the band in operation and the clear voice. It overrides all other modes including secure voice, OTPI, ADF, Relay, and sonobuoy commands. In the center position, OFF, the radio shall be tuned by channel selection for the voice mode and allow monitoring of the main receiver only. One toggle switch each is provided for UHF-1 and UHF-2.
12	SECURE	Three-position, lever-lock, left-right throw, center-off toggle switch.
	ON (left)	Secure voice operation of UHF-1 radio.
	ON (right)	Secure voice operation of UHF-2 radio.
13	SQL	Squelch, alternate action, pushbutton switch. Enables/disables radio squelch circuits. Two switches, one each for UHF-1 and UHF-2.
14	TONE	Tone, momentary, non-illuminated pushbutton switch. Commands UHF/VHF radio to transmit 1020 Hz audio tone for the duration of the depression. Two switches, one for each UHF/VHF radio. UHF-1 TONE pushbutton is hardwired to allow operation in case of failure of the ACP and/or the backup radio control.
15	ZERO CODE	Pushbutton with spring-loaded guard, illuminated when activated. Used to zeroize HF and UHF/VHF speech security equipment.
16	HF SECURE/ON	Two-position, lever-lock toggle switch. Locked in ON position. All HF transmissions are encrypted; reception can be either plain or secure. These HF secure toggle switches are inoperative on aircraft with ANDVT incorporated.
17	UHF TD/ON	UHF/VHF Tone Delay, two-position, lever-lock toggle switch (Note 2). Commands KY-58 to insert a time delay prior to transmission or retransmission of UHF/VHF signals.
18	Magnetic Flag	When data link mode selector switch is in AUTO, indicator is driven by data bus software. Two-position, magnetically actuated flag annunciator, edge light illuminated.
	ASW	Data link is in ASW mode. Acoustic data and ESM is downlinked.
	ASST	Data link is in ASST mode. RADAR data and ESM is downlinked.

Figure 15-2. Communications Control Panel (BuNo 162991 and Subsequent) (Sheet 3)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
19	SYNC LOCK	Synchronization locked, two-position flag annunciator. Red color indicates sync loss. Green indicates sync lock. **Note** Sync Lock does not indicate valid data transfer of proper crypto keying.
	UP	Data link RF signal from ship to helicopter.
	DOWN	Data link RF signal from helicopter to ship.
20	MODE	Data link mode selector three-position rotary switch (intended for maintenance/troubleshooting).
	AUTO	Enables data bus control of data link ASST/ASW mode.
	ASST	Commands data link operation in ASST mode, link channel 01.
	ASW	Commands data link operation in ASW mode, link channel 01.
21	Display	Six-digit numeric display. Used for setting UHF/VHF channel frequency and IFF Interrogator code. As number is keyed, it appears in the right display position. Subsequent keyings cause selected digits to shift to the left.
22	0,1,2,3,4,5,6,7,8,9 keyboard	Numeric keyboard, 10 momentary pushbuttons. Proper number of digits (leading and trailing 0s) MUST be entered (i.e., 6 digits for UHF, 6 for VHF, and 2 or 4 for IFF. (Note: Leading and trailing 0s are required)).
23	CLR	Clear momentary pushbutton, clears display of any selected series of digits so that a new series of digits can be selected.
24	ENTR	Enter momentary pushbutton, enters displayed frequency or code into system, display returns to an all blank state.
25	M4 ALARM	Mode 4 Alarm two-position toggle switch.
	ORIDE	Override, IFF interrogator computer overrides the Mode 4 (M4) alarm and allows the ATO to force a challenge. Using this feature may compromise the M4 code.
26	TEST	Momentary, non-illuminated pushbutton switch commands a transponder/interrogator loop test. Transponder must be in NORMAL. Interrogator challenges Mode 3, Code 0000.
27	DECODE	Six-digit numeric display. The four digits on the left display interrogator code. Two characters on the right display IFF mode (1,2,3,4a, and 4b), set via sequential pushes of the MODE pushbutton. In M4 all digits in the left display area are blanked.
28	SET	White-illuminated, momentary pushbutton switch, allows changing of code by the keyboard display.
29	MODE	White-illuminated, momentary pushbutton switch, causes the IFF mode and code to advance.
30	AUTO	Two-position, magnetic status flag annunciator IFF control modes.
	GREEN	IFF interrogator is being controlled by software.
	BLACK	IFF interrogator is being controlled manually by the CSCG panel.

Figure 15-2. Communications Control Panel (BuNo 162991 and Subsequent) (Sheet 4)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
31	CHAL	Three-position, magnetic status flag annunciator, indicates interrogator status when CHAL switch is activated.
	GREEN	CHAL switch activated signals being transmitted from the interrogator.
	BLACK	CHAL switch released.
	RED	CHAL switch activated, interrogator 'no go' is received by the CSCG ACP, indicating challenge may be unsuccessful. ORIDE activation may change the flag to green. If the annunciator remains red after ORIDE activation, M4 challenges are disabled.
32	Challenge Switch	Three-position toggle switch momentary in up-and-down positions. Causes interrogator to transmit an interrogation with the mode of interrogation determined by the mode display setting.
	CHAL	Challenge, momentary up position. ACP sends a challenge-enable command to the interrogator to accept a correct mode reply. Correct mode replies will display a single bar. Correct mode and code will display a double bar.
	STBY	Standby, normal inactive position.
	CHAL CC	Challenge correct code momentary down position. ACP sends a challenge command which enables interrogator to accept only a correct code and mode reply. A double bar will be displayed.
33	INT	Intensity, 10 position variable potentiometer.
	INC	Increase, clockwise rotation increases luminous intensity of all COMM CONTROL numeric displays from minimum intensity upward. Full counterclockwise position is a LAMP test. All '8s will be displayed and all fault lights except ACP.
34	CI BIT	Control indicator built-in test black and white magnetic flag annunciator. White indicates that the COMM CONTR panel has failed.
35	CSCG	Communications system control group ACP two-position, lever-lock, toggle switch.
	MAN	Manual, COMM CONTR panel controls CSCG units.
	AUTO	Automatic, COMM CONTR functions are controlled by software, via data bus interface.
36	TEST	CSCG self-test momentary, non-illuminated pushbutton switch. Pressing of button starts an interruptive self-test only when AUTO/MAN switch is in MAN position and the remote switching controls are not in the CALL mode. TEST is aborted if the TEST button is pressed again. In AUTO, TEST may be initiated through software.

Figure 15-2. Communications Control Panel (BuNo 162991 and Subsequent) (Sheet 5)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
37	Status Annunciators	Eight yellow-illuminated annunciators that display non-availability of CSCG and other units. Illuminates when equipment is not available because of failure or power off. Lack of coding of security equipment controlled by CSCG (KY-58 and KYV-5) will cause the ACP annunciator to illuminate. The annunciator legends in left to right sequence are defined as follows:
	SR1	Sonobuoy receiver, NO. 1.
	SR2	Sonobuoy receiver, NO. 2.
	INT	IFF interrogator.
	UHF 1	UHF, NO. 1 radio.
	UHF 2	UHF, NO. 2 radio.
	RS1 2	Pilot and ATO RADIO panels.
	RS3 4	SO and observer RADIO panels.
	ACP	Audio converter-processor (light is not tested when Lamp Test is selected but tested when CSCG TEST is initiated).

Notes:

1. Avoid relay frequency separations of less than 10 MHz, frequency separations of multiples of 29 MHz, UHF relays below 265 MHz, and VHF to VHF relays.
2. A delay will occur regardless of the UHF TD switch position on the COMM CONTR panel if the KY-58 delay is selected on (switch external on KY-58).

Figure 15-2. Communications Control Panel (BuNo 162991 and Subsequent) (Sheet 6)

15.1.3 Radio Control Panels

The four radio control panels (Figure 15-3) allow crewmembers to control the audio received at and transmitted from their station. Power is supplied by the NO. 1 AC primary and AC essential buses for the pilot and ATO from the center circuit breaker panel, through two circuit breakers marked AUDIO and CONV PROCR AUDIO respectively, and by 115 Vac, 1 phase for the SO and observer through a circuit breaker marked COMM SWG located on the SO console avionics rack circuit breaker panel. These panels are also referred to as RSCs.

Note

The audio channels to be recorded on the FLIR VCR are controlled by the switches on the radio control panels (SO or instructor) to which the VCR audio input is connected.

15.1.4 Hoist Operator and Maintenance IBs

The IBs allow maintenance personnel and hoist operators to patch into the aircraft ICS. The ICS is powered by the CSCG (see paragraph 15.1.1). The boxes contain volume controls and a push-to-talk switch. The ACP directs audio to and from the IBs. The maintenance IB is located in the external ICS/ARM access cavity above the left mainmount.

15.1.5 Radios

15.1.5.1 UHF Radios, AN/ARC-159

Note

ARC-159 UHF radio sets are installed in aircraft BuNos through 162990. ARC-182 UHF/VHF radio sets (refer to paragraph 15.1.5.2) are installed in aircraft BuNo 162991 and subsequent.

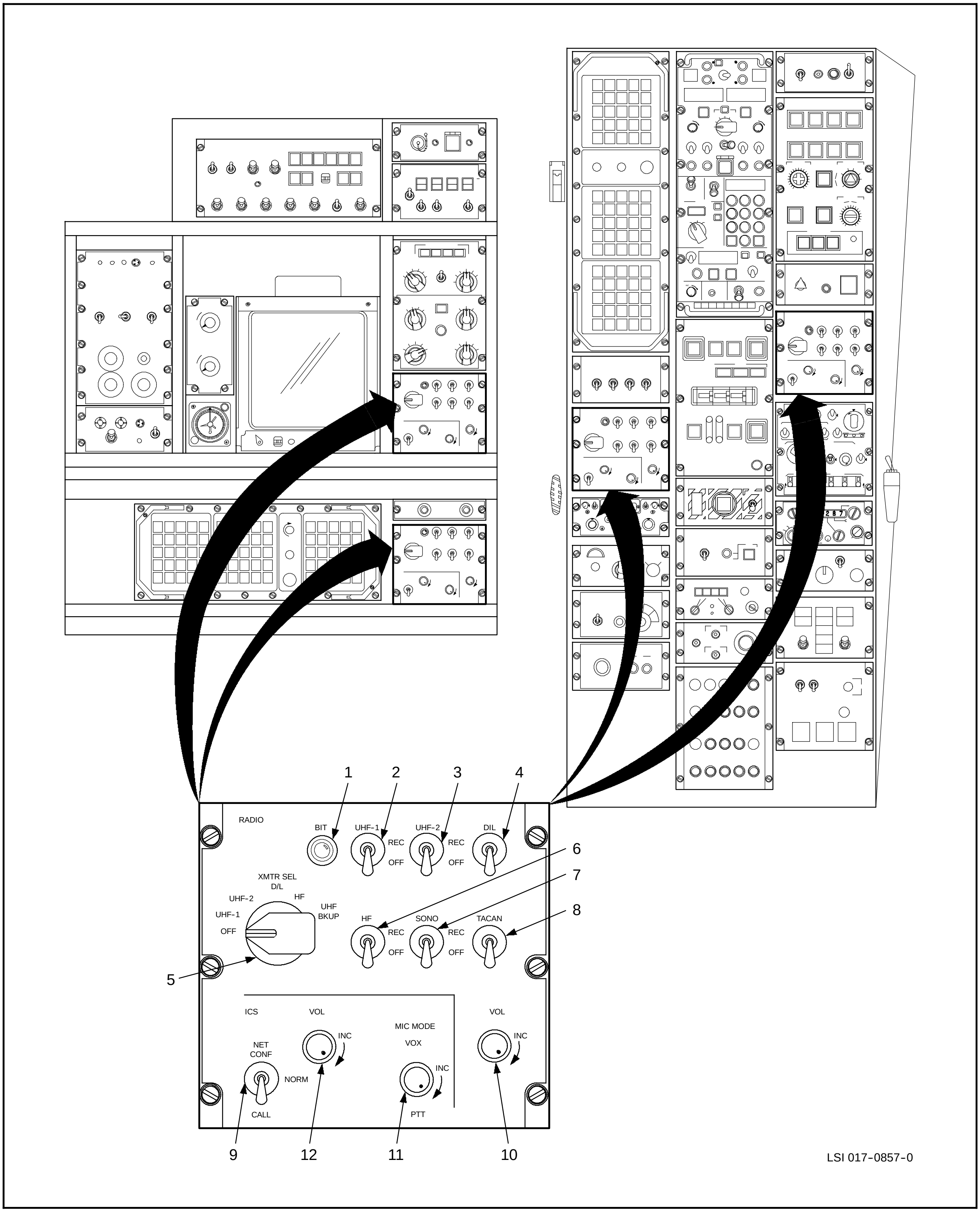


Figure 15-3. Radio Control Panel (Sheet 1 of 2)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
	RADIO	Allows independent selection of receivers while restricting transmission selection to one. The OFF position disables audio of selected radio.
1	BIT	Magnetically actuated flag BIT indicator.
	BLACK	Go.
	WHITE	No go, indicates failure in control box.
2	UHF-1/REC	UHF-1 radio two-position toggle. Receiver, permits monitoring UHF-1 audio.
3	UHF-2/REC	UHF-2 radio two-position toggle. Receive, permits monitoring UHF-2 audio.
4	D/L/REC	Data link (D/L) two-position toggle. Receive, permits monitoring of D/L secure audio.
5	XMTR SEL	Transmitter select six-position rotary switch selects radio transmission mode.
	UHF-1	UHF-1 radio transmission and reception.
	UHF-2	UHF-2 radio transmission and reception.
	D/L	D/L voice transmission and reception.
	H/F	High frequency radio transmission and reception.
	UHF BKUP	UHF or UHF/VHF radio backup (not available to SO or OBS stations).
6	HF/REC	High frequency radio two-position toggle. Receive, permits monitoring HF.
7	SONO/REC	Sonobuoy two-position toggle. Receive, permits monitoring of sonobuoy receiver audio.
8	TACAN/REC	TACAN two-position toggle. Receive, permits monitoring of TACAN identifier tone.
	ICS	Intercommunications System.
9	NET	Intercommunications system net, three-position toggle switch. Establishes intercom net.
	CONF	Conference, connects pilot and ATO positions for cockpit RADIO panels and connects SO and observer positions for cabin RADIO panels.
	NORM	Normal, connects originator station to all other stations set to NORM and to the hoist operator and groundcrew ICS boxes.
	CALL	Connects originator station to all other crew positions, overrides CONF selection at any RADIO panel. In an emergency (COMM CONTR or ACP power failure), provides backup communications to all stations.
10	VOL	Volume, 12-position rotary switch. Volume control for radio audio at headset.
11	MIC MODE	Microphone mode control.
	VOX	Voice-operated transmission 12-position rotary switch.
	INC	Establishes audio threshold which must be exceeded by the crewmember microphone signal before microphone signal is transmitted to other crewmembers. Clockwise rotation increases threshold.
	PTT	Push-to-talk when control is in this position. Switch must be actuated for ICS voice transmission.
12	VOL	Volume, twelve-position rotary switch. Volume control for intercom audio at headset.

Figure 15-3. Radio Control Panel (Sheet 2)

The two sets, designated as UHF–1 and UHF–2, can be tuned to any of 7,000 communication frequencies. Each transceiver is provided with a separate guard receiver that will receive voice transmissions on the standard emergency frequency of 243.0 MHz. The UHF transceivers have a line–of–sight range. Line–of–sight range in nautical miles to a spot on the surface of the Earth may be estimated by multiplying 1.23 times the square root of the altitude in feet. Derivation of this formula is left to the reader. Ranges will be greater for any elevation of the other station.

Power for UHF–1 receiver/transmitter is supplied from the DC essential bus through a circuit breaker on the cockpit overhead circuit breaker panel, marked RADIO NO. 1 R/T UHF. Power for UHF–2 receiver/transmitter is supplied from the NO. 2 DC primary bus through a circuit breaker marked RADIO NO. 2 R/T UHF on the SO circuit breaker panel.

In the event of COMM CONTR failure, UHF–1 may be used by the pilot by selecting backup on the RSC and can be controlled from the backup UHF radio control panel. UHF–2 may be used by the ATO for guard communications only by selecting UHF backup on the RSC. If the ACP fails, the pilot will automatically be connected to UHF–1. The ATO will automatically be connected to UHF–2, preset to Guard T/R. Internal communications between all aircrew may be made by selecting CALL on the RSC (foot or cyclic switch) or by using the CALL pushbutton switch on the cyclic for the pilots and the floor switch for the SO. Pilots only can also talk to each other externally over GUARD. If the AC power fails, the pilot will automatically be connected to UHF–1 via the backup UHF radio control panel. In this case, the ATO will have no internal or external communication capability. CSCG/ACP failure modes are covered in Figure 15-4.

Up to 20 channels (1 to 20) can be preset for direct tuning by channel selection on either radio. An additional channel (00) is available for independent frequency selection on either radio. Once channels are preset, the preset frequencies remain stored after power is removed from the unit.

The two UHF radios can be used to relay secure or clear voice UHF communication between two stations. Secure data link cannot be relayed. If secure–voice relay transmissions or monitoring by the flightcrew are required, the SECURE switch on the COMM CONTR panel must be in either ON position. A correctly keyed appropriate wideband speech security set must be installed. Secure voice relay without monitoring or transmitting capability may be conducted without a wideband security set installed. The system will allow simultaneous clear and secure transmissions by the flightcrew. The selected UHF radio may be used by the flightcrew in secure voice while the other radio will be available in clear voice mode.

Note

The KY–58 will not pass guard relay or transmission.

There are two UHF antennas on the helicopter. Using a switch on the panel, the operator may select either UHF–1 or UHF–2 to operate with the top antenna. The other is selected automatically to use the bottom antenna. In the event of communication difficulty using the top antenna, the operator may attempt to correct the problem by switching the communicating unit to the bottom antenna.

The data handling system automatically selects whichever UHF radio is connected to the bottom antenna for command activated sonobuoy command transmission. To provide this capability, the CSCG must be in AUTO and the UHF connected to the bottom antenna must not be in SECURE, G T/R, or UHF BKUP. The data handling system will momentarily cancel the ADF mode, relay mode, or T/R UHF transmissions in order to send its sonobuoy commands.

15.1.5.1.1 UHF Backup

In the event of COMM CONTR panel failure, the UHF–1 radio can be operated directly from the backup UHF radio control panel (Figure 15-5). Place the XMTR SEL switch on the pilot radio control panel (Figure 15-3) to the UHF BKUP position.

OPERATIONAL CAPABILITY							
MODE	**UHF-1**	**UHF-2**	**ADF**	**OTPI**	**DL**	**IFF**	**ICS**
Pilot RSC BKUP selected (Notes 1, 3)	Pilot control via backup control panel, bottom ANT	ATO — Full control SO & OBS-T/R control	UHF-2 only	Yes	Yes	Yes	Yes (Note 9)
ATO RSC BKUP selected (Notes 1, 4)	Pilot — Full control SO and OBS-T/R control	ATO — Guard T/R fixed volume TOP ANT	UHF-1 only	Yes	Yes	Yes	Yes
Loss of ACP PRI PWR (NO. 1 AC PRI BUS) (Notes 2, 5)	Pilot control via backup control panel, bottom ANT	ATO — Guard T/R fixed volume TOP ANT	No	No	No	No	Call only
Loss of ACP/CI DC PWR (NO. 2 DC PRI BUS) (Note 6)	Bottom ANT only	TOP ANT only	No	Yes	Yes	Yes	Yes
Loss of UHF R/T PWR (DC ESS BUS) (Note 7)	No	Yes	UHF-2 only	Yes	Yes	Yes	Yes
(NO. 2 DC PRI BUS) (Note 8)	Yes	No	UHF-1 only	Yes	Yes	Yes	Yes

Notes:

1. Selection of UHF BKUP mode on RSC precludes all other transmit control functions.
2. BKUP mode must be selected on RSC.
3. UHF-1 FREQ and CHAN display blanks, UHF or UHF/VHF backup control energizes.
4. UHF-2 FREQ and CHAN display blanks.
5. CI panel blanks, call function powered via AC ESS BUS.
6. No CI ‘Zero Code’ function.
7. Zeros on UHF-1 FREQ display for DC ESS BUS.
8. Zeros on UHF-2 FREQ display for DC PRI BUS.
9. If the CSCG ICS function is completely lost, crew intercom can be achieved by using UHF or UHF/VHF radio side tones. All stations must select the same UHF transmit function on RSC and then use radio PTT switch for intercom.

Figure 15-4. CSCG Failure Matrix

15.1.5.2 UHF/VHF Radios, AN/ARC-182

The AN/ARC–182 UHF/VHF transceivers operate in the following frequency ranges: from 30.000 through 87.975 MHz FM, 108.000 through 117.975 MHz AM (receive only, VOR), 118.000 through 155.975 MHz AM, 156.000 through 173.975 MHz FM, and 225.000 to 399.975 MHz AM/FM (FM for data transmissions or limited voice). Figure 15-6 illustrates these operating ranges and guard frequencies.

Note

UHF/VHF transmitter power reduction, down to 2 watts, may occur with high radio temperatures or if the transmitter is keyed continuously for longer than 1 minute.

Note

ARC-182 UHF/VHF radio sets are installed on BuNo 162991 and subsequent aircraft. For aircraft equipped with ARC-159 radio sets, refer to paragraph 15.1.5.1.

In addition, each unit is provided with a separate guard receiver that will receive voice transmissions on the standard emergency frequency corresponding to each frequency band; that is, 40.5 MHz, 121.5 MHz, 156.8 MHz, and 243.0 MHz. If G T/R is on, the ARC-182 radio set will tune the guard frequency of the frequency band in operation. The UHF/VHF transceivers have a line-of-sight range.

A minimum of propagation problems will be experienced if the receiver/transmitter is used as follows: 30 to 87.975 MHz band for close in, air-to-ground communications up to 60 miles distance; 108 to 155.975 MHz band for air traffic control up to 120 miles from the ground station; 155.975 to 173.975 MHz maritime band for communications up to 120 miles from the ground station; and 225 to 399.975 MHz band for communications up to 120 miles from the ground station. Distances up to 300 miles may be achieved in air-to-air communications with frequencies above 117.975 MHz.

External sources of RF may interfere with ARC-182 operations. In addition, the receiver/transmitter may cause interference with the installed mission equipment.

WARNING

Operations within 5 nm of commercial radio and TV broadcast stations can cause white noise or music interference, which degrades radio reception in the 30.0 to 173.975 MHz frequency bands. Interference from commercial broadcast stations can suddenly render two-way radio communications in the VHF-AM aviation band (108.0 to 155.975 MHz) completely unusable, causing loss of two-way radio communications. During actual IMC approaches, pilots shall use UHF-AM frequencies to the maximum extent practical for primary or backup communications with ground controlling agencies.

Note

Low VHF band reception can be improved by deselecting guard (G REC — OFF). This helps eliminate undesired signals from the guard receiver being mixed with desired signals from the main receiver.

ADF and OTPI interference will be characterized by false or erroneous bearing indications or needle fluctuations. Active sonobuoy interference will be characterized by display zone noise up to and including complete obliteration of target return. Observe the following frequency separations for optimum performance:

1. ADF — 10 MHz separation.
2. OTPI and active sonobuoy radio frequencies — 5 MHz separation.
   a. Sonobuoy radio frequencies can be found in the ASW Tactical Pocket Guide (NTTP 3-22.5-ASW).

Note

Upper antenna utilization, for communications, is recommended while using the OTPI.

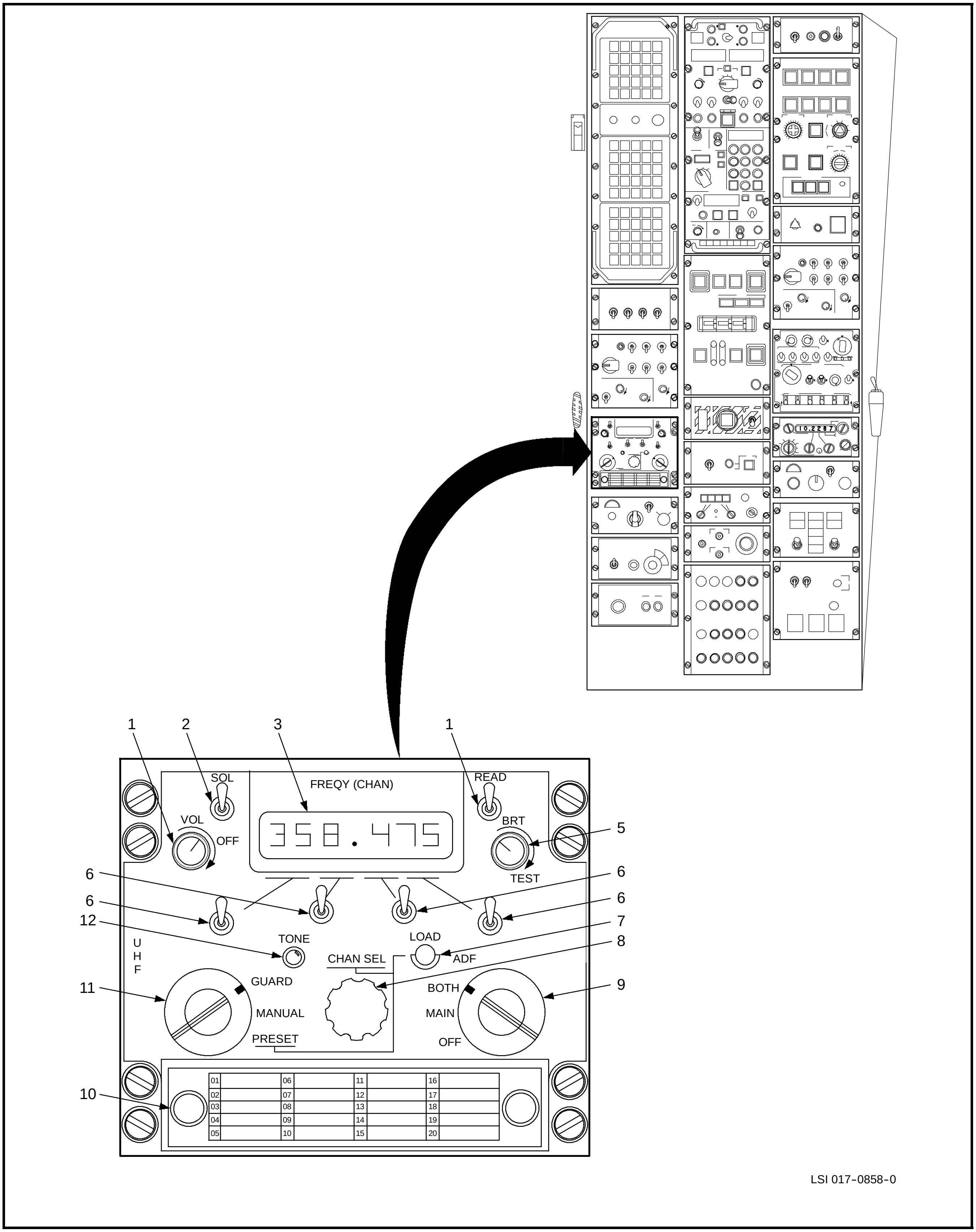


Figure 15-5. Backup UHF Radio Control Panel (BuNo through 162990) (Sheet 1 of 2)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
	(Backup UHF radio control panel)	Provides controls and displays necessary to operate a UHF radio in the backup mode.
1	VOL	Continuously variable potentiometer used to adjust the audio volume to compensate for varying levels of cockpit noise.
2	SQ/OFF	The SQUELCH control is a two-position toggle switch that enables squelch circuitry in the ON position. In effect, it eliminates the background noise level when there are no incoming transmissions being received.
3	FREQ/(CHAN)	Six-digit frequency readout. Also displays two-digit channel when PRESET knob (NO. 11) is used.
4	READ	Momentary switch that causes the frequency of the selected preset channel to be displayed at the frequency/channel readout (NO. 3). When toggled, the frequency will be displayed for about 10 seconds.
5	BRT/TEST	Rotary knob to control display intensity. Full clockwise causes display to read all 8s.
6	(Frequency Setting)	Four spring-loaded ON-OFF-ON toggles used to enter the six-digit UHF frequency. Observed in the readout (NO. 3) immediately above the switches.
7	LOAD	Non-illuminated pushbutton used to permanently store frequencies in preset channels.
8	CHAN SEL	The channel control is used to select any one of 20 preset frequencies when the frequency selector mode switch (NO. 11) is in the PRESET position. The selected channel is displayed by the frequency/channel readout (NO. 3).
9	(Mode selector)	The mode selector is a four-position rotary switch for selection of the following UHF-1 modes of operation:
	ADF	Not functional in the SH-60B.
	BOTH	Same as for MAIN with auxiliary guard receiver energized.
	MAIN	Transmitter and main receiver are energized and tuned to frequency selected by frequency selector mode control and applicable controls.
	OFF	Not functional in the SH-60B.
10	(Tableau)	Tableau for manually recording frequency of preset channels.
11	(Frequency mode selector)	The frequency mode selector is a three-position rotary switch used to select the following modes:
	GUARD	Tunes main receiver/transmitter to the guard frequency. The guard frequency is displayed at the frequency readout (NO. 3).
	MANUAL	Allows selection of any of 7,000 possible operating frequencies using the four frequency selector switches (NO. 6).
	PRESET	Allows selection of any one of 20 preset channels. The selected channel number is displayed at the frequency/channel readout (NO. 3).
12	TONE	The TONE transmit control is a momentary pushbutton switch which commands a 1-KHz tone to be transmitted for the duration of the switch depression.

Figure 15-5. Backup UHF Radio Control Panel (BuNo through 162990) (Sheet 2)

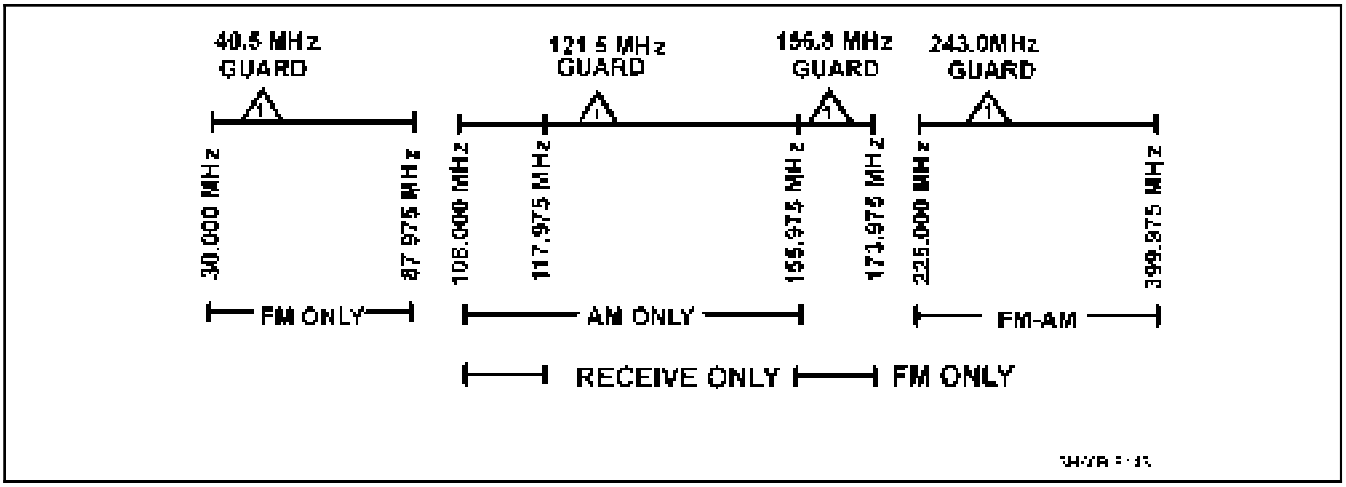


Figure 15-6. ARC–182 Frequency Ranges

Power for UHF–1 receiver/transmitter is supplied from the DC essential bus through a circuit breaker on the cockpit overhead circuit breaker panel marked RADIO NO. 1 R/T UHF. Power for UHF–2 receiver/transmitter is supplied from the NO. 2 DC primary bus through a circuit breaker marked RADIO NO. 2 R/T UHF on the SO circuit breaker panel.

In the event of COMM CONTR failure, the ARC–182 performs the same as the ARC–159. CSCG/ACP failure modes are covered in Figure 15-4. Either UHF/VHF radio may be selected for use with the KY–58 speech security set to provide for enciphered and encoded message reception and transmission. This is done by placing the SECURE switch on the COMM CONTR Panel in the ON position corresponding to the selected radio.

Note

The KY–58 will not pass guard relay or transmission.

The two UHF/VHF radios can be used to relay UHF/VHF communication the same as the ARC–159. For optimum relay operation of the ARC–182, observe the following:

1. Avoid UHF to UHF frequency separations of less than 10 MHz.
2. Avoid frequency separations of multiples of 29 MHz (29, 58, 87, 116, 145 MHz, etc.).
3. Avoid UHF to UHF relays to frequencies below 265 MHz.
4. Avoid VHF to VHF relays where possible.

Note

In the RELAY mode, certain UHF to UHF frequency combinations (and most VHF to VHF frequency combinations) will result in squeals, interference, motorboating or distortion.

The two UHF/VHF antennas on the helicopter operate similarly to the ARC–159 antennas.

CAUTION

Unsecured folded main rotor blades can flap enough in high winds or high sea states to strike the upper UHF antenna. To prevent damage to the rotor blades and antenna, blade crutches shall be applied when the blades are folded and the ambient conditions are conducive to blade flapping.

Note

- In the event of a partial antenna failure, VHF frequencies may be inoperable but degraded operation of UHF communications may still be possible.
- Garbled or distorted side tones during radio transmissions may be experienced for certain VHF frequency combinations (within 10 MHz) when the mixer switch on the alternate radio is selected. The distortion is caused by feedback into the alternate radio receiver and does not affect the quality of the outgoing transmission. Side tone distortion can be eliminated by deselecting the nontransmitting radio receiver mixer switch.
- In the UHF frequency band, FM signals may be received when AM is selected, and vice versa. The received signals will be weak and highly distorted, however, if the proper modulation (AM or FM) is not selected.
- When G REC is selected, the guard frequency monitored will be the guard frequency of the frequency band in operation.

15.1.5.2.1 UHF/VHF Backup

In the event of COMM CONTR panel failure, the UHF/VHF radio can be operated directly from the backup UHF/VHF radio control panel (Figure 15-7). Place XMTR SEL switch on the pilot radio control panel to the UHF BKUP position. In the event of ACP and/or backup radio control failure, the tone pushbutton for UHF–1 is hardwired to the radio to allow operation.

Note

- The backup UHF/VHF radio control panel may display a dot when switching to BKUP position. To activate the display, rotate the CHAN SEL knob one position and back, or toggle a frequency slew switch up and back.
- In BKUP, if 243 is selected and the pilot radio control panel is returned to normal operation, 243.000 will remain in the backup UHF/VHF radio control panel display, but the actual frequency will be selected and displayed by the COMM CONTR control panel. To clear the display, rotate the frequency mode selector to PRESET.

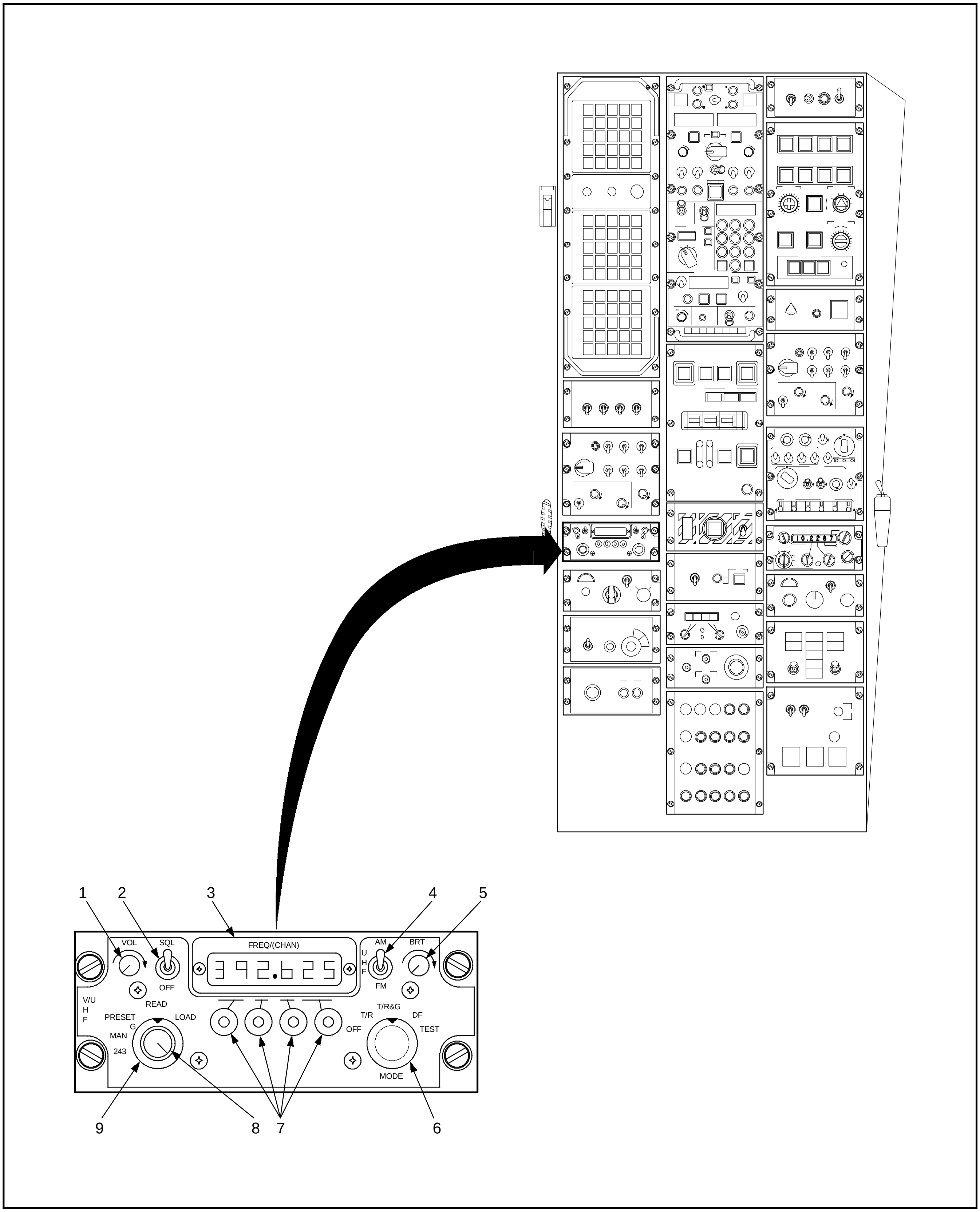


Figure 15-7. Backup UHF/VHF Radio Control Panel (BuNo 162991 and Subsequent) (Sheet 1 of 2)

ITEM NO.	CONTROL/ INDICATOR	FUNCTION
1	VOL	Potentiometer. Adjust audio output level.
2	SQL/OFF	Toggle switch. Enables main receiver squelch in SQL position.
3	Frequency/ channel display	Incandescent lamps. Display frequency selected, channel selected, or built-in test (BIT) results. Displays hundreds, tens, and units. Decimal point (is off in PRESET), tenths, hundredths, and thousandths MHz frequency.
4	UHF AM/FM selector	Toggle switch. Selects either AM or FM operating modes when tuned to a frequency in the UHF band.
5	BRT	Potentiometer. Varies light intensity of FREQ/(CHAN) display.
6	Operational mode selector	Rotary switch.
	T/R	Enables main receiver/transmitter of radio.
	T/R & G	Enables guard receiver in addition to functions described for T/R. Guard receiver is automatically tuned to proper frequency for selected operating band of main receiver.
	DF	Not functional in the SH-60B.
	TEST	Initiates built-in test sequence of receiver/transmitter. Results of test are displayed on FREQ/(CHAN) display.
7	Frequency slew switches	Momentary contact on-off-on toggle switches. The first switch increases hundreds and tens MHz frequency in up position and decreases frequency in down position. The second switch increases units MHz frequency in up position and decreases frequency in down position. The third switch increases tenths MHz frequency in up position and decreases frequency in down position, and the fourth switch increases hundredths and thousandths MHz frequency in up position and decreases frequency in down position.
8	CHAN SEL	Rotary switch. Permits selection of 1 of 30 preset frequencies (channels) when operational mode is set to PRESET.
9	Frequency mode selector	Rotary switch.
	243	Turns on radio and causes main receiver/transmitter to tune to 243.000 MHz (UHF AM) guard frequency. All front panel controls except VOL, SQL, and BRT are disabled.
	MAN	Permits manual change in operating frequency by using frequency control switches. CHAN SEL control has no effect. Transmitter and receivers are disabled during frequency change.
	G (Guard)	Tunes receiver/transmitter to guard frequency to the band to which the radio was last tuned (Note).
	PRESET	Permits selection of any 1 of 30 preset operating frequencies. Selected channel number is displayed on front panel tenths MHz readout for channels under 10, and units and tenths MHz readout for channels greater than 10.
	READ	Permits display of frequency of preset operating channel instead of channel number. Displayed frequency may be altered by use of frequency control switches, but stored frequency will not change.
	LOAD	Loads frequency selected in READ mode into memory to alter preset channel frequency. No change in stored preset frequency unless frequency has been changed while frequency mode selector has been set to READ.

Note

If the frequency mode selector is set to PRESET or READ and then back to G (guard), the guard frequency displayed will be the one appropriate for the frequency band of the preset channel. If the frequency mode selector is then set to MAN and back to G, the guard frequency displayed will be the one appropriate for the frequency band of the manually selected frequency.

Figure 15-7. Backup UHF/VHF Radio Control Panel (BuNo 162991 and Subsequent) (Sheet 2)

15.1.5.2.2 UHF/VHF Test

The backup UHF/VHF radio control panel three test functions are receiver/transmitter monitoring (on–line), control monitoring (continuously), and receiver/transmitter testing (off–line).

1. Receiver/transmitter monitoring BIT (on–line). The backup UHF/VHF radio control sends a transmit command every 1 to 3 seconds that asks for receiver/transmitter BIT results. The receiver/transmitter replies with a receive command followed by BIT results. BIT results contain three constant monitor faults: voltage–to–standing wave ratio (VSWR), forward power (RF output), and loss of lock (synthesizer failure).
2. Control monitoring BIT (on–line). Continuous on–line BIT monitors the control microcomputer. Should the microcomputer fail internally, or because of a faulty power supply, the backup control display will blank except for the decimal point. Receiver/transmitter testing BIT (off–line).
3. Selecting TEST on the backup control panel commands the receiver/transmitter into a BIT algorithm. During test, the backup control display is blank except for the decimal point. Upon completion of test (approximately 5 seconds), the receiver/transmitter sends BIT results which are then displayed by the backup control panel. Sample test readouts are shown in Figure 15-8.

MODE	DISPLAY	FAULT	INTERPRETATION
RCV	.	AT LOL OR RMT CONTINUE (NOTE)	SELECT TEST MODE
XMT	.	REDUCED PWR HIGH VSWR	SELECT TEST MODE
TEST	8 8 8.8 8 8	NONE	SELECT TEST MODE
TEST	0 6 1	VSWR	RT AND ANTENNA SYSTEM
TEST	6 5 1	FWD POWER	REPLACE RT
TEST	2 2 1	LOL	REPLACE RT
TEST	1 5 7	RT	REPLACE RT
TEST	3 3 3	RT	REPLACE RT
TEST	3 3 2	RT	REPLACE RT
TEST	3 2 4	RT	REPLACE RT
TEST	1 5 7	INTERFACE OR RT	REPLACE RT
TEST	.	RMT CONT	REPLACE RMT CONTROL
Note LOL designates loss of lock.			

Figure 15-8. AN/ARC–182 BIT Test

15.1.5.3 HF Radio

The AN/ARC–174A(V)2 HF radio operates in the frequency range of 2 to 29.9999 MHz. Provisions exist for narrowband secure–voice USB and LSB. Power is supplied from the NO. 2 DC primary bus through a circuit breaker marked HF RAD R/T MT–AMPL CPLR in the ATO circuit breaker panel.

15.1.5.3.1 HF Radio Operation

Steps for operation of the HF radio refer to the HF radio control panel (Figure 15-9). To transmit, position the XMTR SEL switch on the radio control panel to HF (Figure 15-3). Key transmitter to tune selected frequency. Once the tune cycle has been completed, the radio is tuned.

WARNING

Do not operate HF transmitter on deck when personnel are within 50 feet of the antennas. Radiation hazard exists.

Note

- Unlike older HF radios, it is not necessary to tune a particular frequency prior to shutting down the radio.
- USN communication personnel generally specify HF radio frequencies as the frequency of the center of the sideband emission rather than the carrier (window) frequency. Most other communications activities such as commercial, USAF, and foreign military specify the window frequency which must be set on the radio control. Therefore, it may be necessary to set a frequency 1.5 to 2.0 KHz (0.0015 to 0.0020 MHz) off of the frequency specified in USN communications plans. Shift down for USB and up for LSB.

15.1.5.3.2 HF Test

1. Select RF TEST. Lamp may blink for up to one minute but must eventually come on steady.
2. Key the radio momentarily. The tune tone should be audible for 4 to 8 seconds and the RF TEST light should go out. (This step will energize the antenna. For most reliable results, it should be conducted while airborne.)
3. After the tone stops, the RF TEST light may blink for up to one minute but must eventually come on steady.
4. If these indications are not received, the HF radio may not be fully operational and the results of the test should be passed to maintenance personnel.

15.1.6 Intercommunication System

The ICS permits communications between aircrewmembers. Each crewmember RSC panel includes controls for ICS operation (Figure 15-10). Additional inputs to the ICS network through IBs allow voice communications from the hoist operator station or from outside the helicopter while on the ground.

The pilot, ATO, SO, and instructor stations internal voice microphones may be voice actuated or push-to-talk (PTT). At the pilot and ATO station, the intercommunication PTT switch is the first detent of a trigger switch on the cyclic grip (the second detent actuates a selected radio transmitter). In addition, the pilot, ATO, and SO stations have two footpedal communication switches. The ICS switch for the instructor station is a pushbutton located below the instructor RSC panel. The ICS switches for the rescue hoist station are located on the hover trim control grip and the crewman rescue hoist pendant.

The ICS CALL switch on the cyclic grip or RSC overrides all transmissions or receptions. This allows communication with the other crewmen, regardless of the configuration RSC switches.

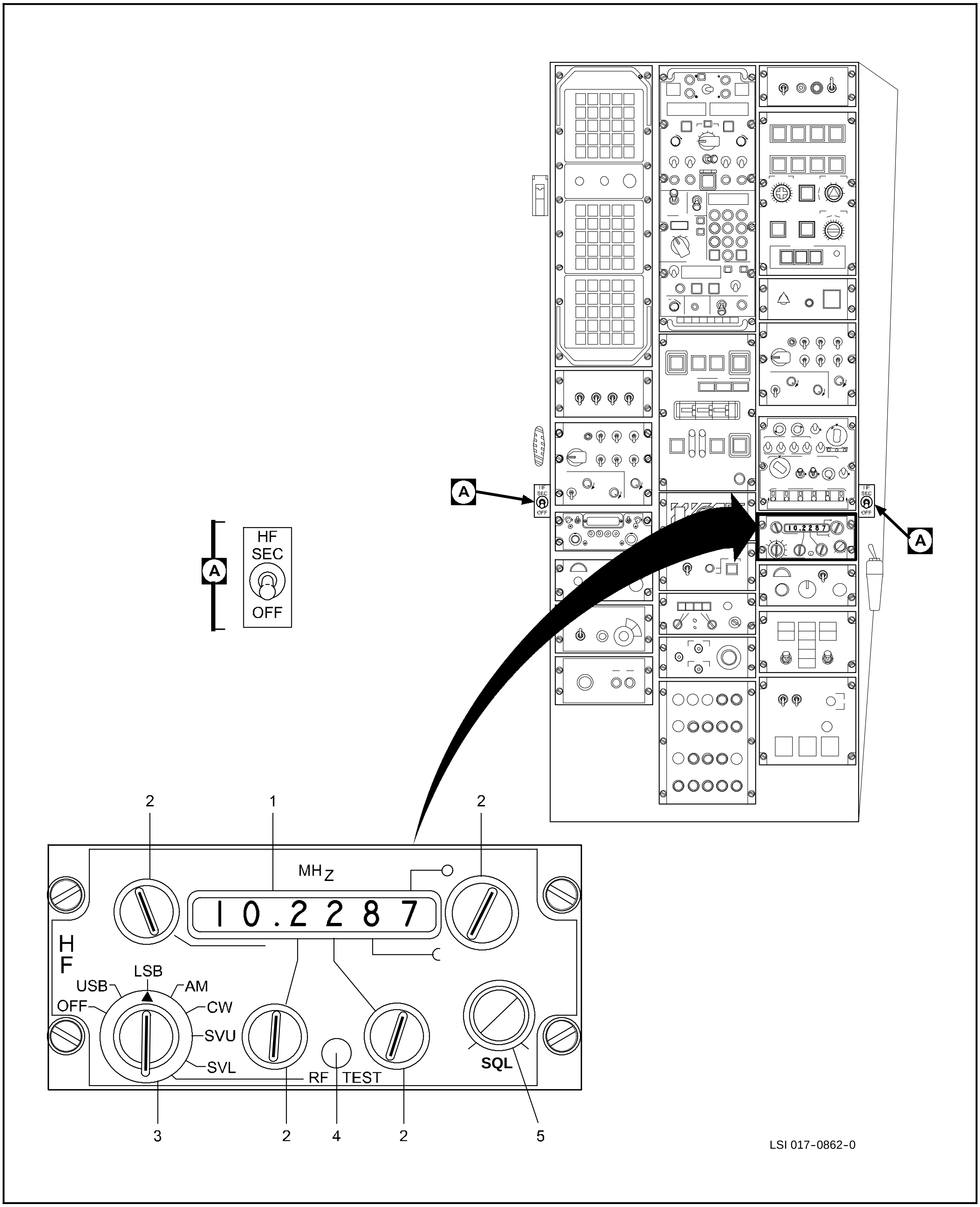


Figure 15-9. HF Radio Control Panel (Sheet 1 of 2)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
HF		The HF radio panel contains the switch functions and indications needed to operate the HF radio transmitter/receiver.
A		The HF SECURE ON/OFF lever-lock toggle switch on the COMM CONTR panel is used to transmit secure-voice.
1,2	MHz (rotary switches)	The frequency readout and frequency selector controls are drum displays and rotary switches used to select one of 280,000 usable HF frequencies in the range from 2.0000 to 29.9999 MHz in increments of 100 Hz.
3	(Mode select)	The Mode select switch is an eight-position rotary switch. It provides the following mode selections.
	USB, LSB, AM	These positions allow the user to select one of three possible clear voice modes of radio transmission and reception — USB, LSB, or AM. USB and LSB can be used to transmit/receive secure voice.
	CW	Not implemented in the SH-60B.
	SVU, SVL	These modes are for narrowband operation and are only usable when a compatible HF secure-voice encoder, such as the KYV-5, is integrated with the HF radio. SVU and SVL can be used for both transmit and receive (transmit toggle switch on the CSCG must be on). The difference between SVU and SVL, and USB and LSB is a 10 db decrease in volume for SVU and SVL.
	RF TEST	Placing the mode selector switch in this position allows the user to isolate an HF radio fault to an individual unit. This is accomplished by selecting an HF frequency and keying the system. The status of the RF TEST lamp (NO. 4) will indicate which unit is faulty.
4	RF TEST	The yellow RF TEST lamp indicates which unit is faulty when the RF TEST position of the mode selector switch is used. Indications and their meaning are as follows: OFF — Fault is in the receiver/transmitter unit. ILLUMINATED STEADY AFTER BLINKING — Normal operation and no fault. BLINKING — Fault is in amplifier-power supply or antenna coupler. A BLINKING indication can be further interpreted by aural monitoring. After the tune cycle has been completed, the normal tune tone should disappear from the headset. A continuing tone indicates a fault in the Power Amplifier or Power Supply. An interrupted tone (beeping) occurring about 10 seconds after the tune cycle is initiated indicates a fault in the Antenna Coupler.
5	SQL	The SQUELCH control provides a selection of eight squelch threshold-level settings which reduces the background noise between transmissions.

Figure 15-9 HF Radio Control Panel (Sheet 2)

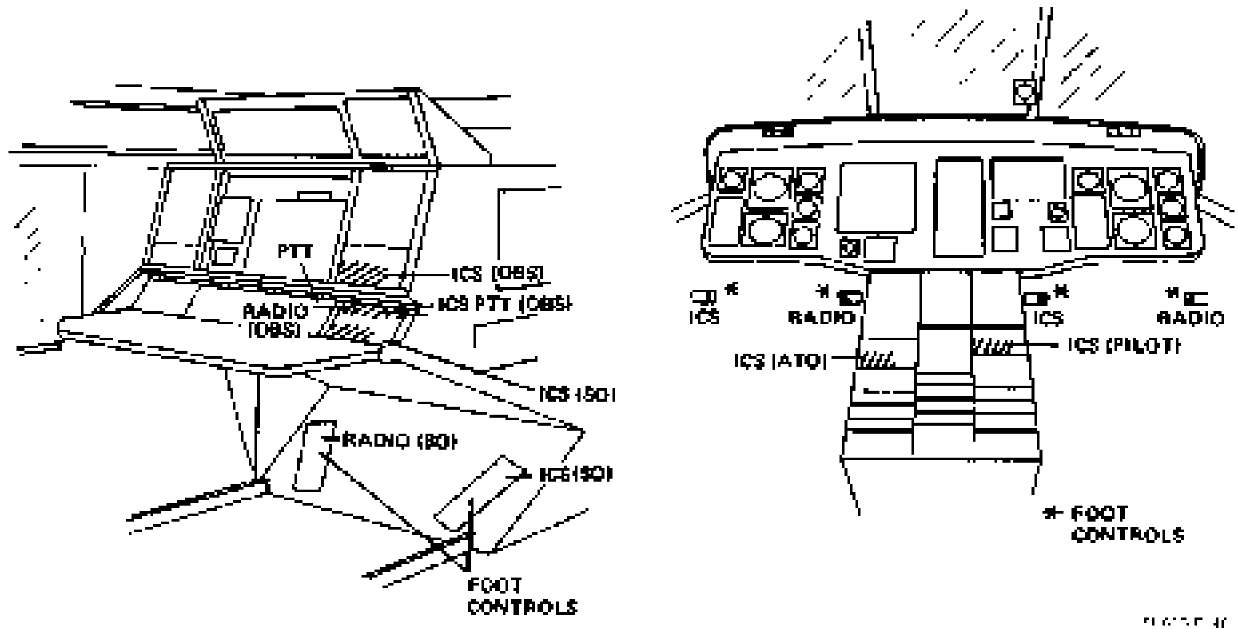


Figure 15-10. Intercommunications System (ICS) Controls

Note

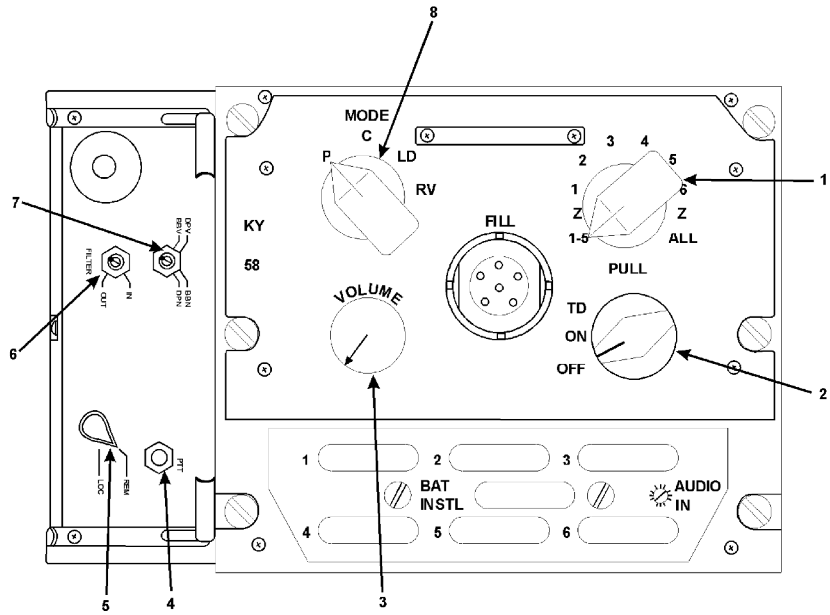
- To avoid the possibility of communications interference, DO NOT utilize ICS while simultaneously transmitting on UHF/VHF or HF.
- To prevent hot mike of other selected transmitters and loss of VOX ICS, ensure the ANDVT (USC-43/KYV-5) HF SECURE toggle switches are OFF when not in use. The toggle switches are mounted on the side of the center console, one on the pilot side and one on the ATO side.
- ICS operation requires AC power. ICS will not be available when the battery is the only source of electrical power.

15.1.7 Speech Security System

15.1.7.1 Speech Security Equipment, TSEC/KY-58

The half-duplex, wideband KY-58 and interface adapter (Z-AHQ) (Figure 15-11) provide secure operation for the UHF radios. The KY-58 and ZAHQ replaced the older KY-28 speech security equipment. When UHF secure operation is selected on the COMM CONTR panel, the selected UHF Receiver/Transmitter (R/T) operates in conjunction with the KY-58. The other UHF R/T is allowed simultaneous transmissions in the clear. Audio signals from the crewmember headsets are routed to the KY-58 by the CSCG ACP. The KY-58, located in the Mission Avionics Rack (MAR), encrypts the audio signals, which are then sent to the selected UHF R/T via the CSCG ACP. Secure UHF audio received by the UHF R/T is routed to the KY-58 by the CSCG ACP. The KY-58 decrypts the signals using the operational code and sends the clear audio to the CSCG ACP for distribution. Primary mission power is required for secure communications.

The KY-58 incorporates several advantages over the KY-28 it replaced. It allows up to six codes to be electrically loaded at one time into its memory, providing greater tactical communications flexibility. In addition, keying of the KY-58 is done using the same loading devices as the KYV-5 and KG-45.



INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
1	FILL Select	
	Z	Zeroizes memory locations 1 through 5 simultaneously.
	1-5	
	1	Addresses memory location 1.
	2	Addresses memory location 2.
	3	Addresses memory location 3.
	4	Addresses memory location 4.
	5	Addresses memory location 5.
	6	Addresses memory location 6.
	Z	Zeroizes memory locations 1 through 6 simultaneously.
	ALL	
2	Power Switch	Removes power from the KY-58. Clear voice is still available.
	TD	Selects a time delay for use when transmitting through a COMM relay station.
	ON	Applies power to the KY-58 (normal mode).
	OFF	Removes power from the KY-58. Clear voice is still available.
3	VOLUME Control	Adjusts output volume of received signal when in cipher mode.
4	PTT	Push-to-talk.
5	LOC/REM	Selects local or remote operation (remote normal operation).
6	FILTER	Baseband premodulation filtering.
	IN	Selects filtering.
	OUT	Deselects filtering (normal mode).

Figure 15-11. TSEC/KY–58 and Z–AHQ Interface Adapter Controls and Indicators (Sheet 1 of 2)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
7	Function switch	
	BBN or BBV	Selects baseband (FM) mode. (Note)
	DPN or DPV	Selects diphase (AM) mode. (Note)
8	MODE Control Switch	
	P	Permits transmission of plain voice.
	C	Permits transmission of cipher voice.
	LD	Permits loading of variables into the KY-58.
	RV	Permits reception of a remotely keyed variable.
Note BBN and BBV are interchangeable. DPN and DPV are interchangeable.		

Figure 15-11. TSEC/KY–58 and Z–AHQ Interface Adapter Controls and Indicators (Sheet 2)

These codes are retained by the internal battery or aircraft power until zeroized. Refer to the current operational communication plan for proper mode and code selection. Refer to Figure 15-12 for troubleshooting procedures.

Note

- The ability to receive but not be heard indicates a diphase/baseband mismatch. (Diphase can receive baseband, but baseband cannot receive diphase).
- Inability to hold a key may be the result of a weak or dead battery.
- A good key with the apparent inability to transmit or receive secure voice (noise following the beep) may indicate a code mismatch.
- When in secure voice mode, radio volume is controlled on the KY–58. The CSCG control panel radio volume is disabled.
- Clear guard transmissions do not pass through the KY–58; guard should be monitored on the radio not in secure mode.

The KY–58/Z–AHQ assembly memory can be zeroized by the following methods:

1. Depressing the zeroize button on the CSCG control panel.
2. Selecting Z 1–5 or Z ALL on the KY–58.

15.1.7.1.1 Z-AHQ Adapter

The KY–58 is mechanically mounted to the Z–AHQ adapter as shown in Figure 15-11.

15.1.7.2 Tactical Speech Security Equipment, TSEC/KYV-5

The half–duplex, narrowband KYV–5 (Figure 15-13) consists of:

1. Processor.
2. Remote Control Unit.

TONE	OCCURS	INDICATES	PROCEDURE
Continuous beeping (cryptoalarm) with background noise	At turn-on.		Clear by pushing and releasing push-to-talk (PTT) button.
Continuous beeping (cryptoalarm alarm)	At any time other than turn-on.	Equipment or battery failure.	Repeat TURN-ON procedures. If the alarm does not clear, change the prime battery. If it still does not clear, turn the equipment in for maintenance.
Continuous tone (parity alarm)	Any time an empty register is addressed and PTT is depressed and held.	1. An empty storage register. 2. An invalid cryptovariable is present. 3. Equipment fails to receive a valid cryptovariable sent by a remote keying operation. 4. Equipment failure.	Follow LOAD procedure to enter a new cryptovariable. If the alarm does not clear, change the prime battery. If it still does not clear, turn the equipment in for maintenance.
A single beep	1. Each time PTT is initiated with the equipment in cipher and a filled storage register is addressed. 2. When a cryptovariable has been successfully received. 3. At the beginning of a receive message.	1.Begin speaking. 2. A valid cryptovariable. 3. The cryptovariable has passed the parity check.	
A single beep in time delay (TD)	After the preamble is sent.		Begin speaking.
Background noise	At turn-on.	The KY-58 is working properly.	If no background noise is heard at turn-on, turn equipment in for maintenance. (Note)
A single beep followed by a burst of noise	At any time in cipher text mode.	Receiving station on a different variable than transmitting station.	1. Turn fill select switch to the common variable. 2. As a last resort, contact transmitting station in plain and agree to meet on a particular variable.

Note

This is important because the absence of noise indicates a malfunction which cannot be otherwise detected. It does not affect the communications capability. It does, however, affect the security provided by the KY-58.

Figure 15-12. KY–58 Aural Tones

The KYV–5 provides secure–voice operation capability for the HF radio. When HF secure operation is selected on the COMM CONTR panel, the HF radio operates in conjunction with the KYV–5. Audio signals received by the HF radio are routed to the KYV–5, via the CSCG ACP, for decryption. Clear audio is then returned to the ACP for distribution to crewmember headsets. Audio signals from crewmember headsets are routed to the KYV–5 by the CSCG ACP. The KYV–5 encrypts the audio signals and sends them to the HF radio, via the CSCG ACP, for transmission. Power is supplied from the NO. 2 DC primary bus through a circuit breaker located in the mission avionics circuit breaker panel, marked HF SECURE.

Note

The ARC–182 VHF radio, installed in ESP–modified aircraft as an aftermarket kit, is inoperable with the HF SECURE switch in the ON position.

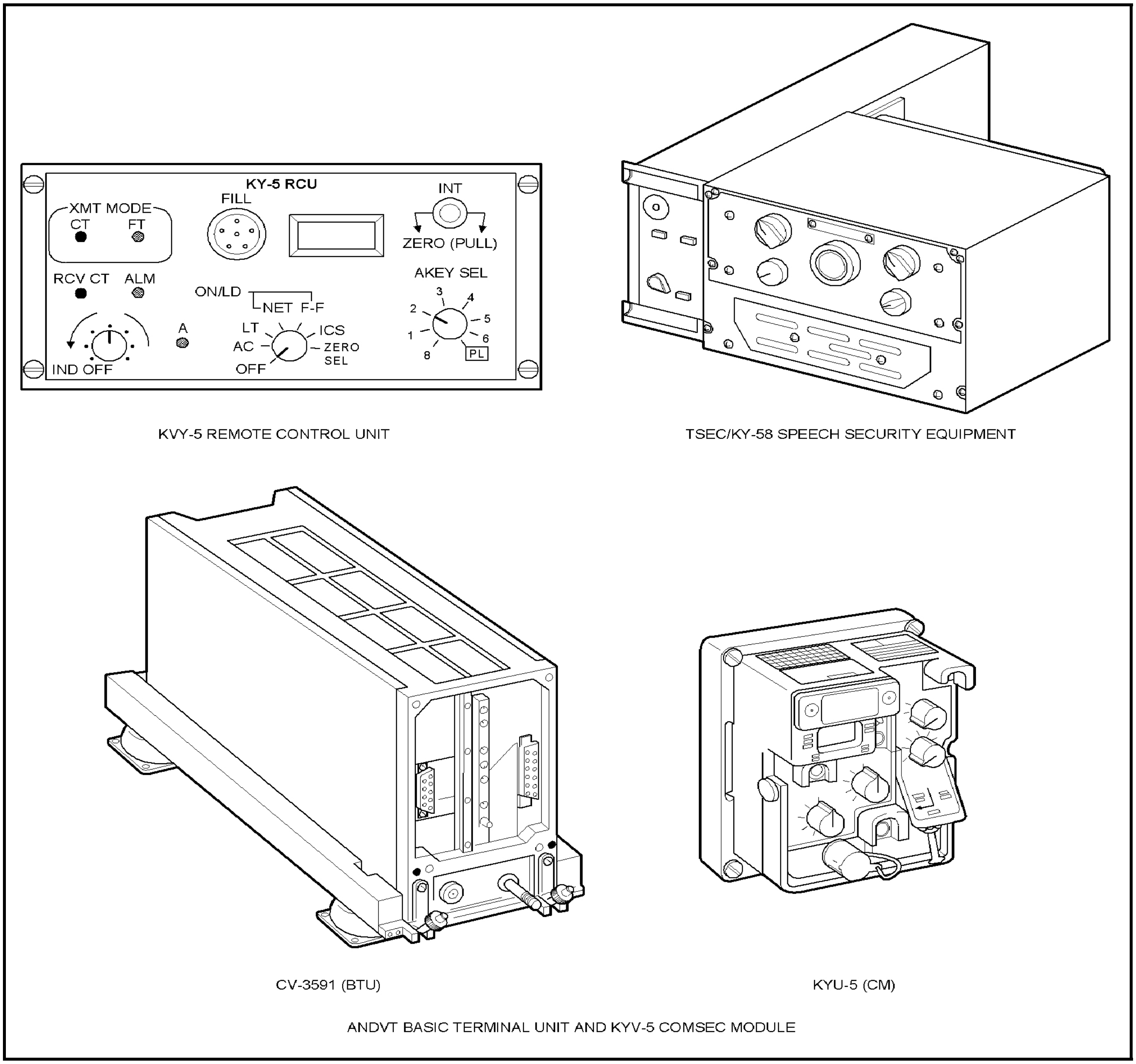


Figure 15-13. Tactical Speech Security Equipment

15.1.7.2.1 Processor

The KYV-5 processor contains the circuits required for encryption/decryption of HF audio signals. The processor contains the electrically inserted operational code. Principles of operation for the KYV-5 processor are contained in classified publications.

15.1.7.2.2 Remote Control Unit

The remote control unit provides an interface for controlling the KYV-5 and is located on the MAR. The operational code is electrically inserted into the remote control unit, which sends it to the KYV-5 processor. The code can be zeroized by activation of the ZERO CODE switch on the COMM CONTR panel. The zeroize signal is sent to the remote control unit, which forwards it to the processor. Electrical reinsertion of the code is required when the code has been zeroized. The code is zeroized in the following two situations:

1. Activation of the zero code switch on the COMM CONTR panel.
2. PWR/FILL dial switch is rotated to OFF/ZEROIZE position.

15.1.7.3 Radio Terminal Set, AN/ARQ-44 (Data Link)

The Radio Terminal Set (Data Link) is a full-duplex, secure RF link between the helicopter and the ship. Operating in the super high frequency (SHF) spectrum, it provides two-way secure data and secure voice communications between the ship and the helicopter. The data link has three modes of operation which are selectable on the CSCG. In ASW mode, the R/T transmits acoustic sensor data on RF channel NO. 1. In ASST mode, it transmits radar/IFF sensor data on RF channel NO. 1. ASW/ASST modes are normally used only for maintenance. In AUTO mode, the Data Link receives antenna pointing, antenna selection, RF channel selection, and mode commands from SAC-1. In HELO CONTROL, all information except ship commands are transmitted and received. The data link consists of the following components: communication security equipment, receiver/transmitter (R/T), multiplexer-demultiplexer (mux-demux), and the data link antennas.

15.1.7.3.1 Communication Security Equipment, TSEC/KG-45

The KG-45 (Figure 15-14) is a high-speed, full-duplex key generator that provides cryptographic security for both uplink and downlink data between the tactical avionics and the ship electronics systems. The KG-45 encrypts and decrypts the data link signal for the radio terminal set. The KG-45 is zeroized by loss of power for approximately two minutes. The data link cannot be operated without a properly keyed KG-45. The KG-45 must be keyed with MSN PWR on. Once keyed, the KG-45 will continue to operate in the voice mode with SAC power secured (e.g., performing engine overspeed checks on hardwire). Power is supplied from the NO. 2 DC primary bus through a circuit breaker marked DATA LINK SECURE located on the mission avionics circuit breaker panel.

15.1.7.3.2 Receiver/Transmitter, RT-1275/ARQ-44

The radio R/T provides for continuous wave transmission and reception of mission data between own ship and the helicopter. During uplink, the R/T receives transmission from one of the antennas and sends it to the mux-demux. Data for downlink is received from the mux-demux and routed for transmission. When the data link switch is in RADIATE, RF output is available to either antenna or the hardwire port. In STBY, the transmitter will not radiate. The Weight-On-Wheels switch causes the RF output to shift to the dummy load, while low-level RF power is still present at the hardwire port. Each of the 16 available data link channels contains two discrete SHF frequencies, one for uplink and one for downlink.

15.1.7.3.3 Multiplexer-Demultiplexer, TD-1254/ARQ-44

The mux-demux functions as two basic units, a multiplexer and a demultiplexer. Both units operate simultaneously. The demultiplexer receives uplink data from the R/T and sends it through the KG-45 for decryption. Upon return of the decrypted data, the demultiplexer separates and routes the data to various onboard equipment. The multiplexer gathers downlink data, arranges it into the proper format, sends it through the KG-45 for encryption, and then to the R/T for transmission to the ship.

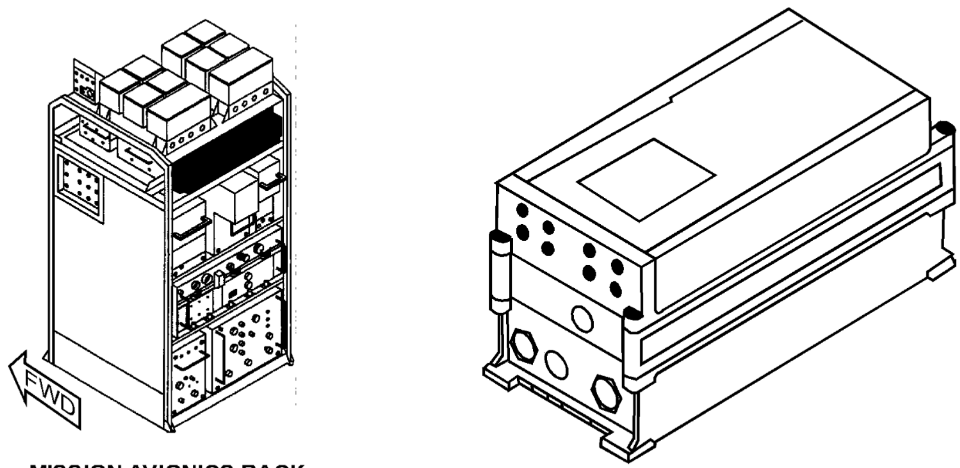


Figure 15-14. Communications Security Equipment TSEC/KG–45

15.1.7.3.4 Data-Link Antennas, AS-3273/ARQ-44

The two data–link antennas are independently steered to continuously point at the ship; however, only one antenna will radiate at any given time. The AOP computes the relative bearing of the ship from the helicopter and sends the antenna select commands to the mux–demux. The mux–demux passes the commands to the R/T to control selection of the RF power to the appropriate antenna. The forward antenna operates from 285° to 075° relative. The aft antenna covers the area from 071° to 289° relative. This gives a 4° overlap to prevent loss of synchronization.

15.1.8 Identification System

The IFF subsystem is comprised of two components: the IFF transponder and associated KIT–1/TSEC series transponder computer, which responds to interrogation from other friendly units; and the IFF interrogator and associated KIT–1/TSEC series interrogator computer, which interrogates other units for identification.

15.1.8.1 IFF Transponder

The transponder is made up of the APX–100 receiver/transmitter and KIT–1/TSEC series transponder computer. It is controlled from the IFF transponder control panel on the lower console (Figure 15-15).The transponder cannot be controlled by mission computer commands. The IFF subsystem can operate in four modes. Mode 1 provides 32 code combinations, any one of which may be selected in flight. Mode 2 and Mode 3/A each provide 4,096 codes. Mode 4 provides military secure IFF. Mode C provides altitude encoding. Power is supplied by the NO. 1 DC primary bus through a circuit breaker marked APX–100 CONTR XPONDR located in the ATO circuit breaker panel.

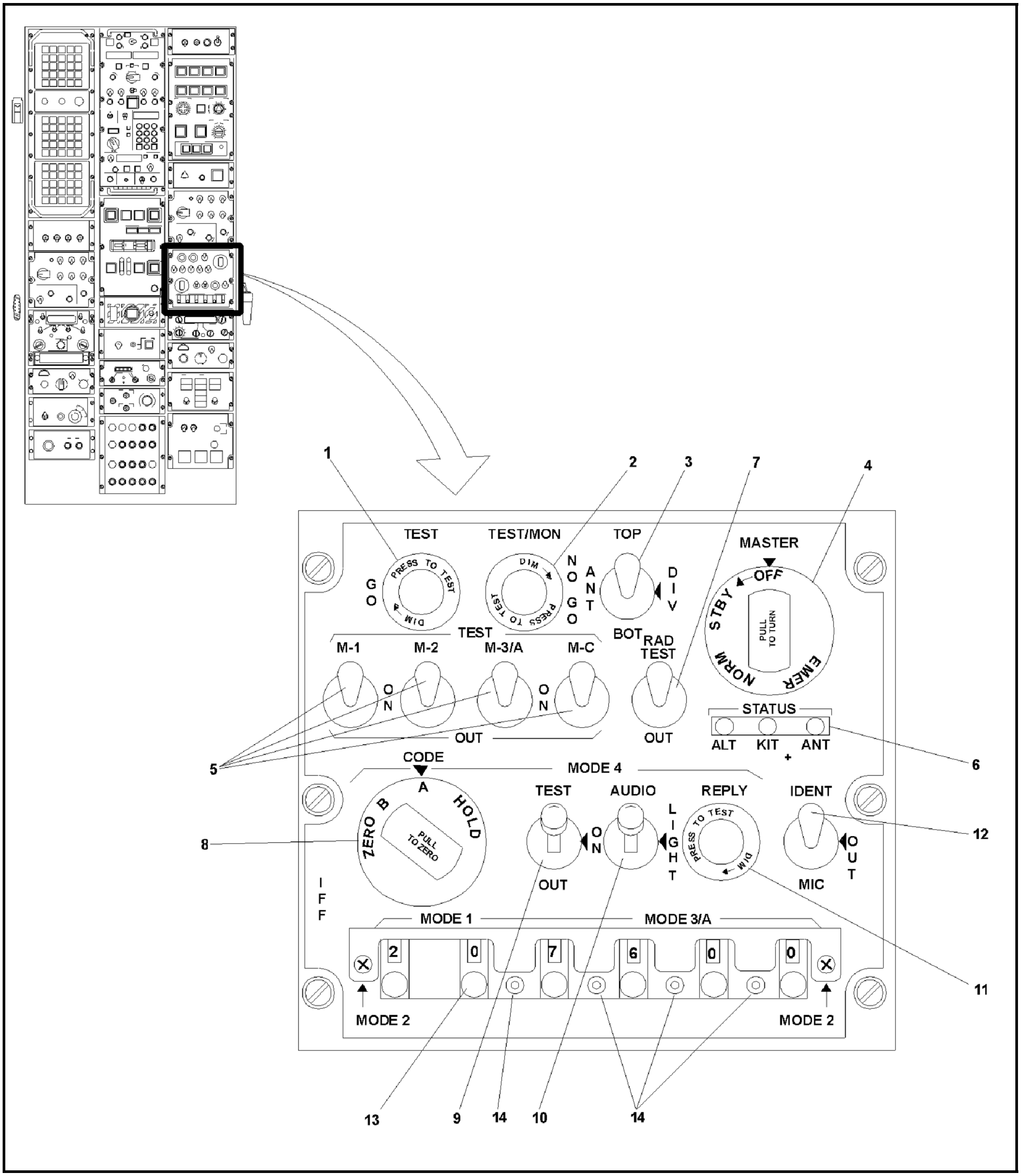


Figure 15-15. IFF Transponder Control Panel (Sheet 1 of 3)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
IFF		The IFF Transponder Control Panel provides the controls for the IFF Transponder Set. The Transponder cannot be controlled as a result of control commands received from the computer.
1 2	TEST MON, NO-GO	The green TEST GO and the red TEST/MON NO-GO PRESS TO TEST, turn to dim, annunciators indicate satisfactory operation of the transponder for selftest of Modes 1, 2, 3/A, 4, and C. The green GO light indicates a good self-test. The red NO-GO light indicates a bad self-test on the KIT-1/TSEC Series Computer code is connected and Mode 4 is not coded or the Master selector is in STBY. The monitor function of the red light causes the light to illuminate momentarily when the transponder replies to an interrogation with MASTER in NORM.
3	ANT	The Antenna Control is a three-position toggle switch used to select the IFF antenna.
	TOP	Top position selects the upper IFF antenna.
	DIV	Diversity position selects automatic switching between the upper and lower IFF antennas.
	BOT	Bottom position selects the lower IFF antenna.
4	MASTER	The MASTER selector is a four-position rotary switch with the following functions:
	OFF	OFF turns transponder off. Switch must be pulled outward to rotate to this position.
	STBY	Standby places transponder in warmup condition.
	NORM	Normal causes the transponder to operate normally.
	EMER	Emergency conditions the transponder to transmit emergency reply signals to Mode 1, 2, and 3/A interrogations, regardless of mode-control settings. The switch must be pulled outward to rotate to this position.
5	ON	When normal mode selected (center position), respective mode is on and will respond to challenges.
	M-1 TEST	Mode 1 momentary self-test.
	OUT	Out (off) position for Mode 1.
	M-2	Mode 2 momentary self-test.
	OUT	Out (off) position for Mode 2.
	M-3/A	Mode 3/A momentary self-test.
	OUT	Out (off) position for Mode 3/A.
	M-C	Mode C (Altitude Encoding) momentary self-test.
	OUT	Out (off) position for Mode C.
6	STATUS	Three red LED annunciators which isolate the fault status of the external units that provide data to the IFF system.
	ALT	Fault in altimeter, encoding barometric altimeter at pilot position.
	KIT	KIT-1 series Encryption unit fault.
	ANT	Fault in selected IFF antenna.
7	RAD TEST/OUT	The RAD TEST/OUT control is a two-position toggle switch for control of the transponder test circuitry, as follows:
	RAD TEST	Causes the transponder to reply to test mode interrogations and to verify BIT #1 for Mode 4.

Figure 15-15. IFF Transponder Control Panel (Sheet 2)

INDEX NUMBER	CONTROL LABELS	FUNCTIONAL DESCRIPTION
	OUT	Monitor — The red TEST/MON light will illuminate when the transponder replies to interrogation.
8	MODE 4 CODE Selector	
	CODE	The MODE 4 CODE selector is a four-position rotary switch with the following selections:
	ZERO	Causes code in both the KIT-1/TSEC series and the KIR-1/TSEC series computers to be erased. A mechanical latch must be released to turn the switch to zero. There is no guard when going from ZERO to B or A.
	B	Selects Mode 4, Code B.
	A	Selects Mode 4, Code A.
	HOLD	Causes the KIT-1/TSEC series and the KIR-1/TSEC series computers to hold their codes before securing power. The switch is spring loaded out of this position so that it will return to the A position when released by the operator.
9	MODE 4 TEST/ON/OUT	The MODE 4 TEST/ON/OUT is a three-position toggle switch used to enable or test Mode 4. The up position (TEST) is spring loaded to return to the middle position (ON) when the switch is released. The bottom position (OUT) has a mechanical interlock to prevent inadvertently switching to Mode 4 off.
10	MODE 4 AUDIO/LIGHT/OUT	The AUDIO/LIGHT/OUT Control is a three-position toggle switch used to select the methods by which invalid Mode 4 interrogations are indicated. AUDIO selects both audio tone and the IFF caution light on the Caution/Advisory Panel. LIGHT, only the IFF caution light on Caution/Advisory Panel. OUT, no indications of invalid Mode 4 interrogation. A mechanical interlock is provided to prevent inadvertent movement of the switch to OUT.
11	MODE 4 REPLY	The green MODE 4 REPLY PRESS TO TEST, turn-to-dim, annunciator indicates the transmission of valid Mode 4 replies.
12	IDENT/OUT/MIC	The IDENT/OUT/MIC selector is a three-position toggle switch. The IDENT position is spring loaded. When momentarily selected, it initiates the Identification of Position (I/P) reply for approximately 20 seconds. Selection of OUT prevents triggering of the I/P function. Selection of the MIC position enables the I/P replies to be transmitted when the pilot presses either of his PTT switches.
13	MODE 1, MODE 3/A (Code Selectors)	The MODE 1 and MODE 3/A code selectors are six unidirectional thumbwheel switches used to select Mode 1 and Mode 3/A reply codes. The first two switches are for Mode 1 codes (octal numbers in range 00 to 73). The last four switches are for Mode 3/A codes (octal numbers in the range 0000 to 7777).
14	MODE 2 (Code Selectors)	The two cover-retaining screws are loosened and the cover enclosing MODE 1 and MODE 3/A is raised to reveal MODE 2 code settings. The MODE 2 four-digit octal code is inserted via the pushbutton switches and observed on the MODE 2 code display. MODE 2 codes are assigned by operational commanders. After insertion of MODE 2, the cover is lowered and the cover retaining screws tightened.

Figure 15-15. IFF Transponder Control Panel (Sheet 3)

15.1.8.2 Transponder Computer, KIT-1 TSEC Series

The transponder computer (Figure 15-16) processes mode 4 IFF challenges and generates properly coded responses. The transponder computer uses a manually inserted operational code to decode the interrogation and produce the response. The response is then sent back to the IFF transponder for transmission. Power is supplied from the NO. 2 AC primary bus through a circuit breaker marked COMPTR XPONDR located in the corner circuit breaker panel.

The IFF subsystem can operate in four modes. Mode 1 provides 32 code combinations, any one of which may be selected in flight. Mode 2 and mode 3/A provide 4,096 codes each, any one of which may be selected in flight. Mode 4 provides military secure IFF.

Note

The HOLD position should be utilized prior to shutdown if another takeoff is anticipated during the code period.

The IFF subsystem can operate in four modes. Mode 1 provides 32 code combinations, any one of which may be selected in flight. Mode 2 and mode 3/A provide 4,096 codes each, any one of which may be selected in flight. Mode 4 provides military secure IFF.

The transponder computer generates coded replies in response to valid interrogations from an interrogator cryptographic computer. Two Mode 4 codes are set in the transponder computer prior to flight, one for the present code period and one for the succeeding code period. From this time on, whenever the IFF is turned off or electrical power is disconnected for approximately 15 to 20 seconds, the codes will be cleared. This can be prevented by turning the CODE switch to HOLD position at least 15 seconds prior to power interruption. The KIR–1/TSEC functions in the same manner. Power is supplied by the NO. 1 DC primary bus through a circuit breaker, located in the overhead circuit breaker panel, marked APX–100 CONTR XPONDR.

The Mode 4 codes for both the KIT–1/TSEC and KIR–1/TSEC may be cleared manually by turning the CODE switch to ZERO position. This is a guarded position and requires pulling out and turning to reach the ZERO position. Likewise, the HOLD function transfers both KIT and KIR codes to hold.

The transponder will give a green reply light to indicate that it has responded to an interrogation. The transponder will also give an audio and/or IFF caution light indication if it is unable to respond to a valid mode 4 interrogation. These may be selected or inhibited using the MODE 4 AUDIO/LIGHT/OUT switch (Figure 15-15).

WARNING

All audible and visual indications are inhibited in the OUT position. The IFF caution indicators warn the operator of potential life–threatening conditions relating to the ability to respond to Mode 4 interrogations.

The IFF caution indicator warns of conditions in which Mode 4 interrogations are not being responded to, possibly resulting from the transponder being in standby or having Mode 4 disabled (e. g., Mode 4 select switch in OUT position). The IFF caution indications further serves to warn of a zeroized or malfunctioning IFF crypto computer.

The ANT toggle switch offers three selections: TOP, BOT (Bottom), and DIV (Diversity). When TOP is selected, the transponder will only respond to interrogations from the top antenna. When BOT is selected, responses are only allowed from the bottom antenna. When DIV is selected, the transponder will respond automatically through the antenna receiving the strongest signal. The selection of TOP or BOT will not inhibit the transponder from processing signals from a specific antenna. The transponder attempts to make diversity selection on received signals and attempts to respond through the antenna having the strongest received signal. If the antenna favored by transponder diversity selection process is disabled by the ANT toggle switch, no response will be transmitted.

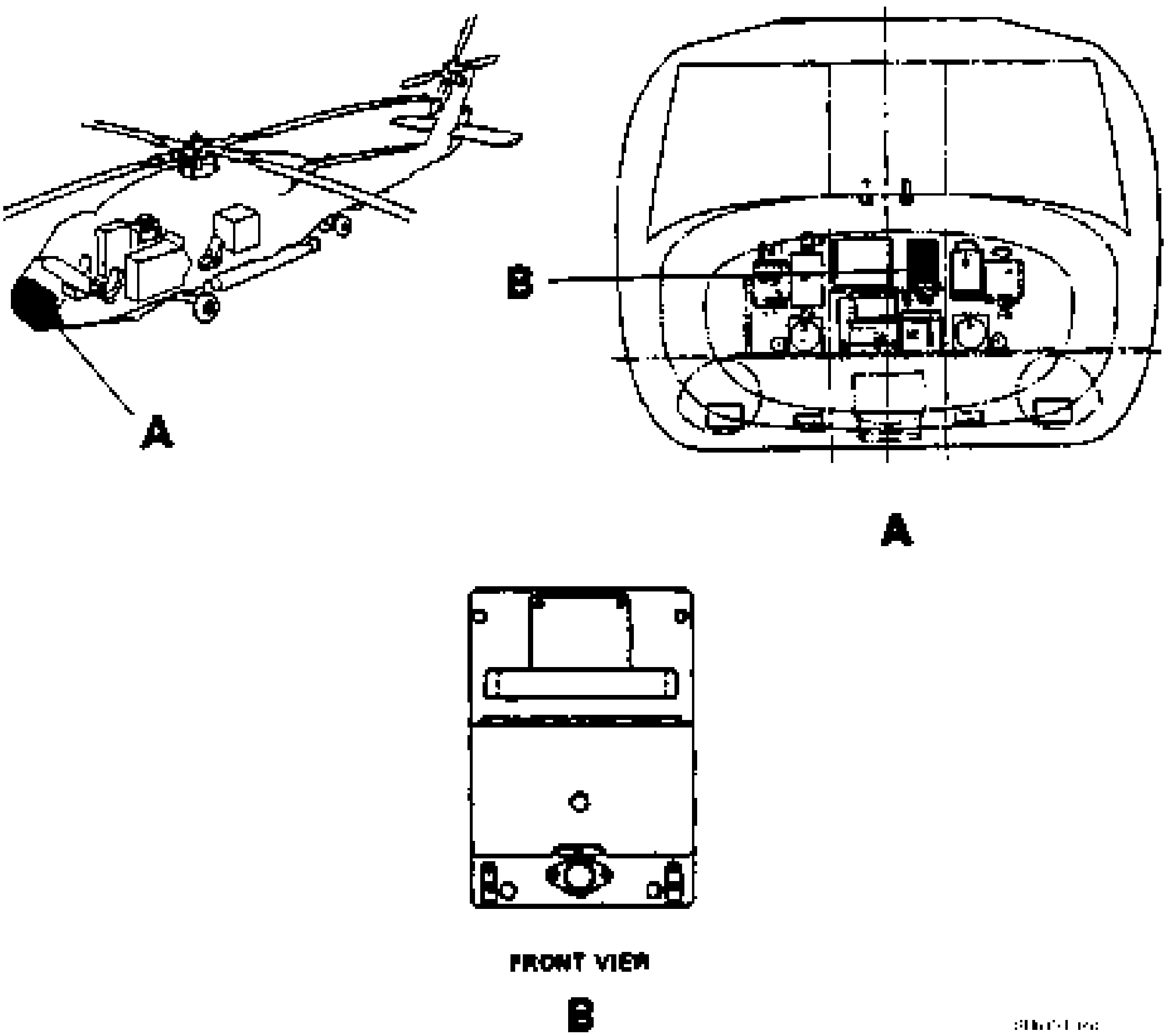


Figure 15-16. Transponder Computer KIT–1/TSEC Series, Mode 4

WARNING

Use of the TOP or BOT vice the DIV selection may cause the transponder not to reply to valid Mode 4 interrogations. Failure to respond to a valid Mode 4 interrogation may identify you as a potential foe. Take immediate corrective action in accordance with local directives.

CAUTION

An IFF antenna fault will be indicated on the ANT status annunciator on the IFF panel (Figure 15-15). This could indicate a failure to transmit. If using an individual antenna, switch to the other one in an effort to correct the problem by using the ANT toggle switch (Figure 15-15) on the IFF panel.

Note

ARC-182 transmissions in the VHF band may cause the test GO (green light) or NO-GO (red light) on the IFF transponder control panel to illuminate momentarily.

15.1.8.3 IFF Interrogator

The interrogator is made up of the AN/APX-76B IFF interrogator, the KIR-1/TSEC series interrogator computer, and the AN/APS-124 Radar Set. In SHIP Control-ASST mode, it can be remotely controlled by the ship via the data link. A challenge may be issued from the COMM CONTR panel at any time, provided the CSCG control switch is placed in the manual position. The mode and code of interrogation are also entered from the COMM CONTR panel. The ATO may then elect to have all responses in the selected mode displayed or only those involving both mode and code. Interrogation then may be made by activating the Challenge (CHAL) button to accept a correct MODE or MODE and CODE reply. Challenge correct code (CHAL CC) may be used to accept only a correct MODE and CODE reply.

WARNING

While operating IFF in auto sweep or single sweep mode and the mode was activated by the SO keyset, the SO will receive no indication when the IFF code is being interrogated, even if AUTO IFF is activated.

Note

Radar power-on causes a resetting of the Interrogator amplifier. At least one manual challenge must be issued from the COMM CONTR panel before an uplinked challenge will be accepted and processed.

15.1.8.4 Interrogator Computer, KIR-1/TSEC

The Interrogator Computer (Figure 15-17) generates Mode 4 IFF interrogation pulses. The Mode 4 challenge is activated via the IFF Electrical Synchronizer, which sends a pretrigger to the Interrogator Computer. The Interrogator Computer uses a manually inserted operational code to generate the required pulse train for the Mode 4 interrogation. The interrogation pulses are then returned to the IFF Interrogator for transmission. The Mode 4 reply received from the interrogated station is sent to the Interrogator Computer by the IFF Interrogator. The computer uses the operational code to check the reply for proper coded response. The KIR-1/TSEC code is electrically held in the same manner as the KIT-1/TSEC. Use of the HOLD feature on the Transponder Control Panel will shift the code back to hold. There are three methods of zeroizing the code:

1. Mode 4 code switch on IFF Transponder Control Panel (zeroize position).
2. Loss of electrical power for 15 to 20 seconds.
3. Loading door is opened.

Note

- Override of the M4 ALARM may compromise the Mode 4 code.
- ARC-182 transmissions in the VHF band may cause erroneous IFF contacts. Selection of another COMM frequency may eliminate the problem.

Certain failures of the interrogator computer will disallow interrogations (indicated by a red CHAL Flag). If the M4 alarm switch on the COMM CONTR panel is placed to ORIDE, it may be possible to force a challenge. If the ORIDE is successful, a challenge will be issued. At the present time, there are no aural or visual indications of M4 ALARM activation except for the failure to challenge.

Power is supplied from the NO. 2 DC primary bus through a circuit breaker in the mission avionics circuit breaker panel marked IFF INTERG.

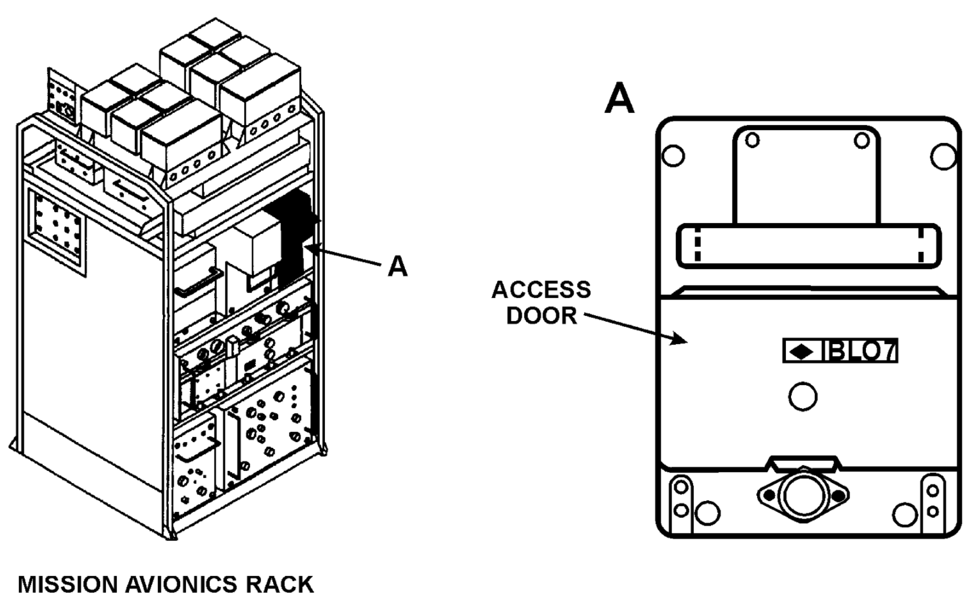


Figure 15-17. Interrogator Computer, KIR-1/TSEC Series

15.1.9 Interference Blanker

The interference blanker prevents interference due to simultaneous transmissions on the following transmitters:

1. IFF interrogator.
2. IFF transponder.
3. TACAN set.

Whenever these units transmit, a suppression input pulse is sent to the interference blanker by the transmitter. The interference blanker then sends suppression pulses to the other two transmitters. The interference blanker also sends suppression pulses to the electronic support measures (ESM) system to prevent spurious inputs to the ESM from the aircraft transmitters. Power is supplied from the NO. 1 AC primary bus through a circuit breaker marked INTRF BLANKER in the center circuit breaker panel. The interference blanker is located in the pilot seatwell.

15.1.10 Radio Terminal Set, AN/ARQ-44 or AN/ARQ-44A

The radio terminal set (data link) provides a directional RF link between the aircraft and the ship. See NTRP 3–22.4–SH60B for system description.

CHAPTER 16

Navigation

16.1 INTRODUCTION

The navigation subsystem determines flight data, such as air and groundspeed, heading, altitude, and attitude of the helicopter. It provides this data for visual display on cockpit indicators and it relays navigational data to the data handling subsystem.

16.2 NAVIGATION OPERATIONS

The navigation function processing requirements are partitioned into five subfunctions:

1. Navigation synchronization, used to synchronize ship and helicopter navigation systems.
2. Position keeping, utilizes Doppler radar navigation.
3. Position correction, used to determine and correct errors which arise due to helicopter navigation drift and sonobuoy drift.
4. Fly–to–point (FTP), provides processing for FTP positions and generated flight path direction commands and display information.
5. Provides navigational inputs for sensor processing and display.

These subfunctions are performed using various combinations of the navigation equipment described in the following sections. Figure 16-1 shows the functional flow of navigation data in the system.

16.3 COMPONENTS OF THE NAVIGATION SUBSYSTEM

In this subsection, the various components and units that make up the navigation subsystem are described, along with their function, location, and operation. The functional interface of the navigation system is the navigation switching interface unit (NSIU).

16.3.1 Navigation Switching Interface Unit

The NSIU is located in the nose avionics bay and serves as an interface between navigation source equipment and the associated displays and data processors (Figure 16-2). The NSIU receives data from navigational sensing devices and distributes this data to navigation displays and subsystem elements. Operator selection of source data is done using the following: mode select control panel located on the pilot/ATO instrument panel, COMP panel, and the TCN panel. In the event of a loss of AC power to the NSIU, or if the NSIU fails, power–off latching relays will establish the following conditions:

1. Pilot AI will be driven from the pilot AGCA.
2. ATO AI will be driven from the copilot AGCA.
3. Both stations turn–rate needles will be driven from their respective sources.
4. Both BDHIs will only display:
   a. Magnetic heading.
   b. NO. 2 needle pointing to the currently selected TACAN station.
5. Both mode select panels will be inoperative.
6. No DME data will be available.

Power is supplied from the AC essential bus through two circuit breakers, located on the center circuit breaker panel, and marked NSIU POWER and NSIU NAV REF, respectively.

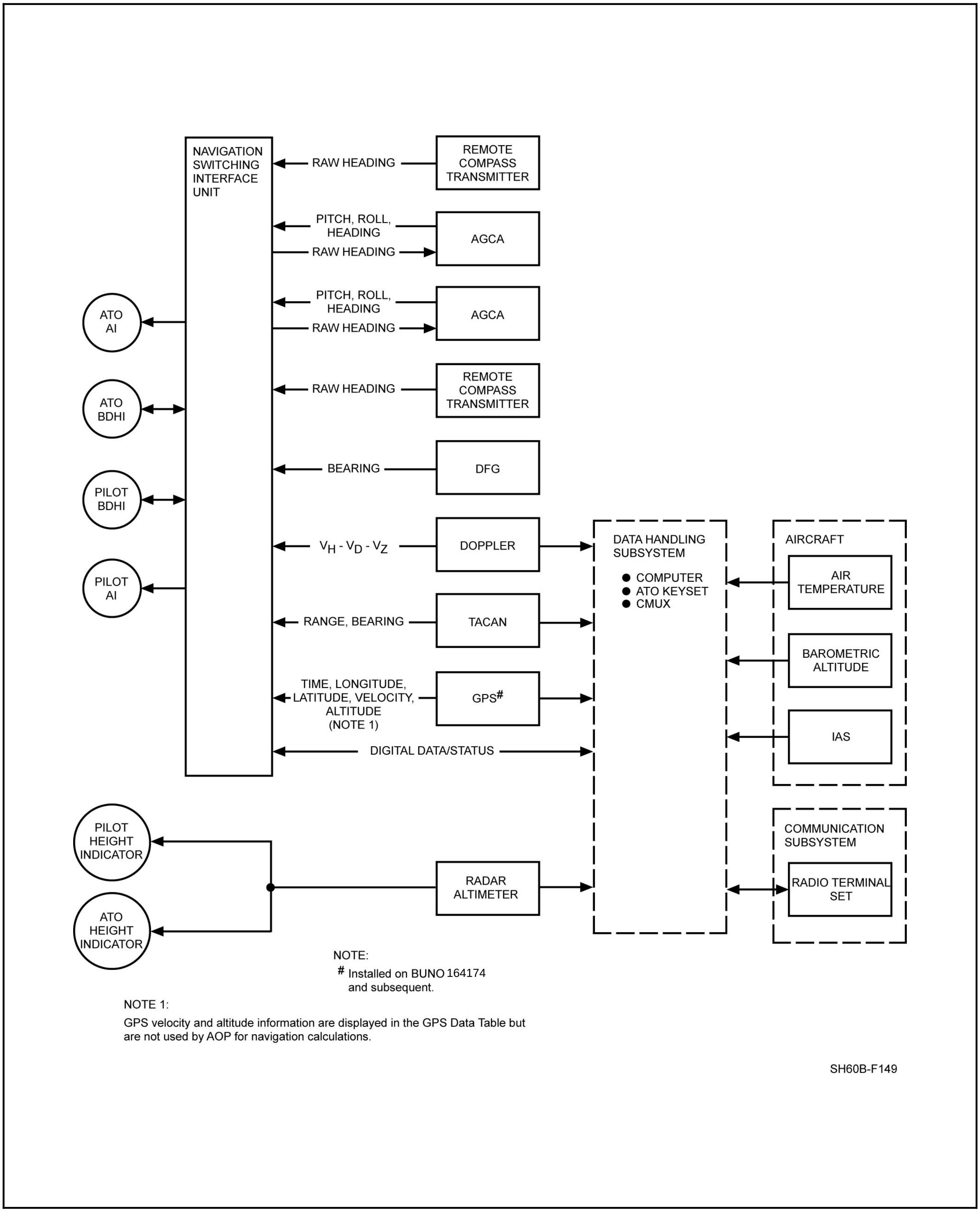


Figure 16-1. Navigation Subsystem Components Block Diagram

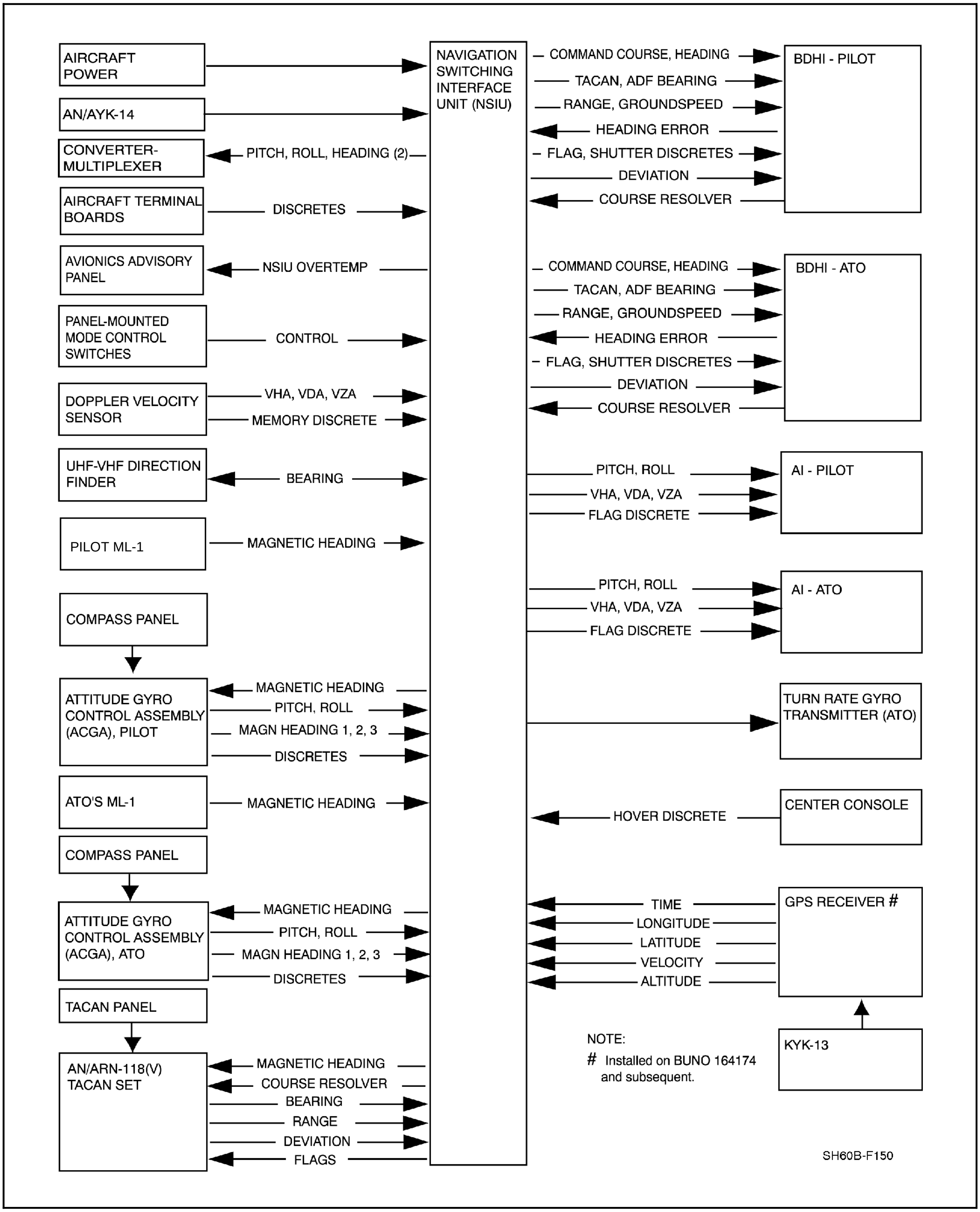


Figure 16-2. Navigation Switching Interface Unit (NSIU) Functional Interface

16.3.2 Compass System

16.3.2.1 Attitude Gyro Control Assembly (AGCA) (Pilot and ATO)

The AGCA consists of a displacement gyroscope, electronic control amplifier, and compass system controllers.

There are two displacement gyroscopes. They supply heading information depending on AGCA mode selected on the COMP panel (Figure 16-2).

When power is applied to the AGCA, the displacement gyroscope (stable platform) must be erected. The information required to align the platform is provided by the compass system controller and the remote compass transmitter (ML–1). A rough alignment phase lasting 2 minutes orients the platform generally in the proper position. At that point a fine alignment phase begins. During this phase the gyro precesses at a normal rate until the platform is precisely aligned.

Each stable platform provides the stable reference from which changes in aircraft pitch, roll, and heading are measured. It consists of a two–gyro, three–gimbal assembly. The gyro heading (directional) gyro is mounted on the innermost gimbal and is erected parallel to the surface of the Earth with its spin axis oriented toward magnetic north in the slaved mode. The pitch (vertical) gyro is mounted on the middle gimbal. For attitude stabilization, this gyro is erected perpendicular to the surface of the Earth, with its spin axis parallel to the local vertical. The displacement gyroscope provides heading, pitch, and roll information via pick–offs from the inner, middle, and outer gimbals, respectively. The information is sent to the electronic control amplifier for processing and distribution.

The electronic control amplifier (ECA) contains an azimuth servo amplifier, slaving amplifier, deviation compensator, turn and acceleration control features, fast synchronization circuitry, malfunction monitoring circuitry, and power supplies. The electronic control amplifiers route heading, pitch, and roll synchro signals to the NSIU and to AFCS for distribution to the various equipments. Power is supplied from the AC essential bus (pilot) and NO. 1 AC primary bus (ATO) through two circuit breakers on the overhead circuit breaker panel, marked PILOT ECA and ATO ECA, respectively.

The electronic control amplifier contains the circuits required to:

1. Erect the stable platform.
2. Process heading information.
3. Correct for anomalies in the ML–1s as they detect the magnetic field of the Earth.
4. Distribute pitch, roll, and heading information.
5. Slave heading gyro to magnetic heading.
6. Suspend erection or remove compass slaving during aircraft acceleration.
7. Perform system monitoring and fault detection.
8. Correct for effects of the rotation of the Earth.

The ECA receives magnetic heading from the remote compass transmitter ML–1 via the NSIU. Mode select information, heading information, and latitude correction information (for Earth rotation) are received from the compass system controller. This information is processed by the electronic control amplifier and signals are generated for the pitch, roll, and heading torques in the stable platform to control erection of the gyros. When acceleration of the aircraft either linearly or rotationally exceeds cutoff points, the electronic control amplifier reduces erection and slaving voltages to prevent loss of the stable platform from overdriving the torques.

Pitch and roll information received from the stable platform drives follow-up servos in the electronic control amplifier. The pitch and roll servos provide three-wire synchro signals to the NSIU and automatic flight control system (AFCS). Heading information received from the stable platform is processed by the electronic control amplifier, and four separate three-wire synchro heading signals are generated. The information represented by these signals depends on the mode of operation selected on the compass system controller.

The electronic control amplifier monitors critical voltages and signals during operation to detect system malfunctions. If a malfunction is detected, an AGCA FAIL signal is transmitted to the NSIU. This alerts the pilot to allow switching navigation displays from one AGCA to the other so that valid information is provided.

The compass system controller (Figure 16-3) contains the controls and indicators required to operate the AGCA. Functions of the compass system controller are:

1. Providing synchronization display.
2. Setting local latitude, north or south hemisphere.
3. Setting heading information.
4. Selecting AGCA mode.
5. Generating latitude correction signals.
6. Enabling fast SYNC and fast erect functions.

16.3.2.2 Remote Compass Transmitters (Pilot and ATO), ML-1(MOD)

There are two remote compass transmitters, both located in the tail cone section. One operates with the pilot AGCA and the other operates with the ATO AGCA. The remote compass transmitters, commonly referred to as flux valves, detect the direction of the Earth magnetic field and transmit this information electrically through a slaving circuit to a torque motor in the AGCA Directional Gyroscopes. The AGCA torque motor maintains the directional gyroscope heading reference in a fixed position relative to the Earth magnetic field.

16.3.2.3 Bearing-Distance-Heading Indicators

The BDHIs are primary navigation instruments. The BDHI uses navigation data from various sources to present the pilot with a symbolic display of the horizontal navigation situation. In addition to course settings, bearing information from the TACAN and DFG equipment is presented on the BDHI. Figure 16-4 shows the BDHI and describes its individual indicators. Power for the pilot BDHI is supplied from the AC essential bus and DC essential bus through two circuit breakers located in the center circuit breaker panel and the overhead circuit breaker panel, both marked PILOT BDHI. Power for the ATO BDHI is supplied from the NO. 1 DC primary bus and NO. 1 AC primary bus through two circuit breakers located in the ATO circuit breaker panel and center circuit breaker panel, respectively.

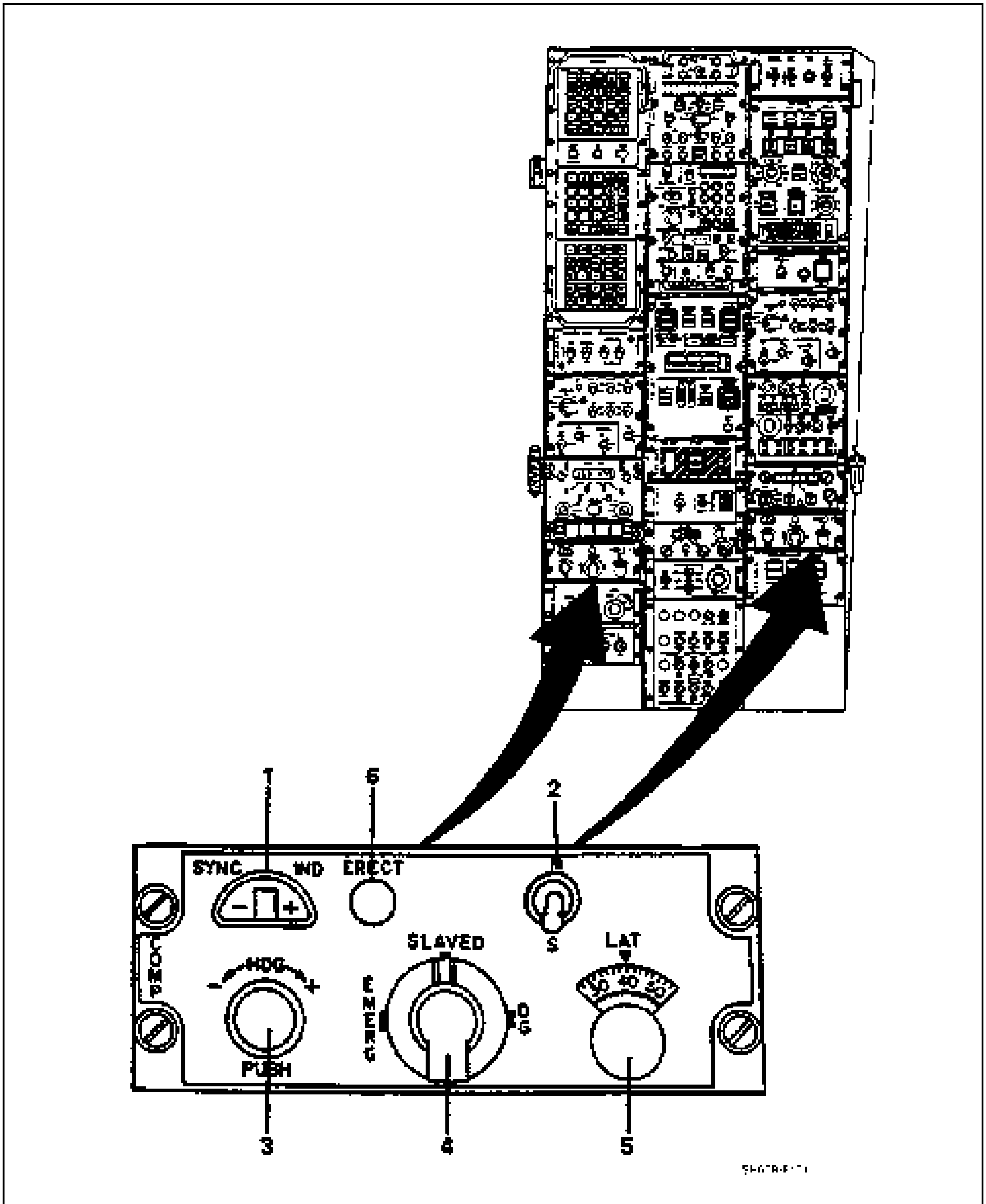
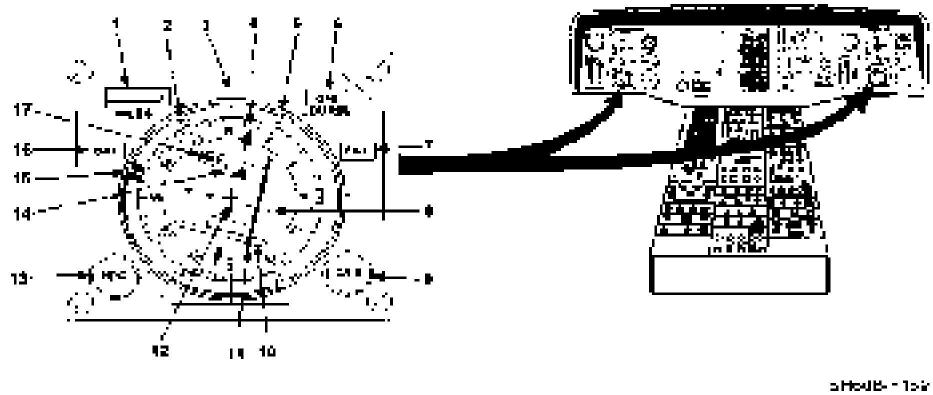


Figure 16-3. Compass System Controller (Sheet 1 of 2)

INDEX NUMBER	CONTROL	FUNCTIONAL DESCRIPTION
1	SYNC IND	The Synchronization Indicator indicates the synchronization between the directional gyro output and the remote compass when the SLAVED mode is selected with the mode selector switch. If they are not synchronized, the indicator shows in which direction a correction must be made to avoid ambiguity.
2	N/S	The two-position (N/S) hemisphere selector toggle switch permits the selection of either North or South latitude for use by the system.
3	HDG +/– PUSH	The PUSH to SYNC is a push-and-turn switch (spring return to center) that provides heading set. When the HDG button is pressed, the heading set control markings indicate the direction to turn the control to provide a decreasing (–) or increasing (+) heading change. When synchronized, the synchronization indicator is centered.
4	Mode selector	The mode selector is a three-position rotary switch used to select one of the following modes of operation:
	SLAVED	The SLAVED mode is the primary mode of operation (gyro stabilized magnetic compass). The SLAVED mode synchronizes the directional gyro output to the remote compass heading. When selected, fast synchronization occurs in the same manner as when the system is first turned on.
	EMERG	The compass mode is for emergency use only, when the directional gyro is disabled. Only remote compass information is used for heading (unstabilized magnetic heading).
	DG	The directional gyro mode is normally selected when local magnetic conditions or operations in high latitudes make the magnetic compass information unreliable. Because no magnetic correction is applied to the directional gyro, manual insertion of latitude information is essential to compensate for precession caused by the rotation of the Earth.
5	LAT	The latitude selector knob and readout window are used to set the latitude to that of the helicopter during operations in the DG or SLAVED mode. The readout window displays latitudes 0° to 90°, graduated in two-degree intervals with major divisions and numerals every ten degrees.
6	ERECT	Pushbutton that provides fast compass synchronization and AI fast erect.

Figure 16-3. Compass System Controller (Sheet 2)



INDEX NUMBER	CONTROL	FUNCTIONAL DESCRIPTION
1	Range counter	Displays digital range information in hundreds, tens, units, and tenths of a mile (Doppler groundspeed in knots when BDHI is in Doppler mode). Range is slant range to a TACAN station or horizontal range to an FTP.
2	Bearing needle NO. 1	Indicates relative bearing to signal source being tracked by DFG.
3	Lubber line	Reference line indicating center line of aircraft.
4	Course arrow	Indicates selected course on compass case.
5	Bearing needle NO. 2	Indicates relative bearing to selected TACAN station.
6	COURSE counter	Displays course to the nearest degree. Indicates same value as course arrow.
7	Fail flag	Unit Fault Indicator indicates failure of one or more internal status monitoring tests.
8	Course dots	Scale for deviation bar. 1 dot = 5° deviation.
9	CRS	The course select knob is used for manual course selection. Positions course pointer (4) and sets course counter (6).
10	Deviation bar slot	Slot for control arm of deviation bar.
11	Deviation bar	Fly-to bar that indicates deviation from selected course.
12	Aircraft symbol	Miniature aircraft for orientation reference.
13	HDG	The heading select knob is used to manually set heading. Positions heading select marker.
14	To/From indicator	When pointing to the head of the course pointer, arrow indicates aircraft flying TO a TACAN station or FTP, when pointing to tail, it indicates flying FROM a TACAN station or FTP.
15	Heading select marker (heading bug)	Indicates heading necessary to maintain selected or computer generated course.
16	OFF flag	Indicates absence of internal power or external ground.
17	NAV flag	When computer is in TACAN mode, indicates TACAN data is unreliable. When computer is in CPTR mode, indicates the absence of a fly-to-point. When computer is in DPLR mode, indicates Doppler groundspeed is below 8 knots.

Note

Selection of ALTR mode may bypass power failure.

Figure 16-4. Bearing–Distance–Heading Indicator

Both AC and DC power are required for proper BDHI operation. The AC power supply provides operating voltages to rotating components. The DC power is used for various latching solenoids in the BDHI. The latching solenoids provide for computer control of the HDG and CRS knobs, thus if DC power is lost or the DC circuit breaker is out, FTP steering and Doppler steering will be lost.

Three modes are available: TCN (TACAN), CPTR (computer), and DPLR (Doppler) (Figure 16-5). Operating modes of the two BDHIs can be independently selected by their respective mode–select panels (Figure 16-6).

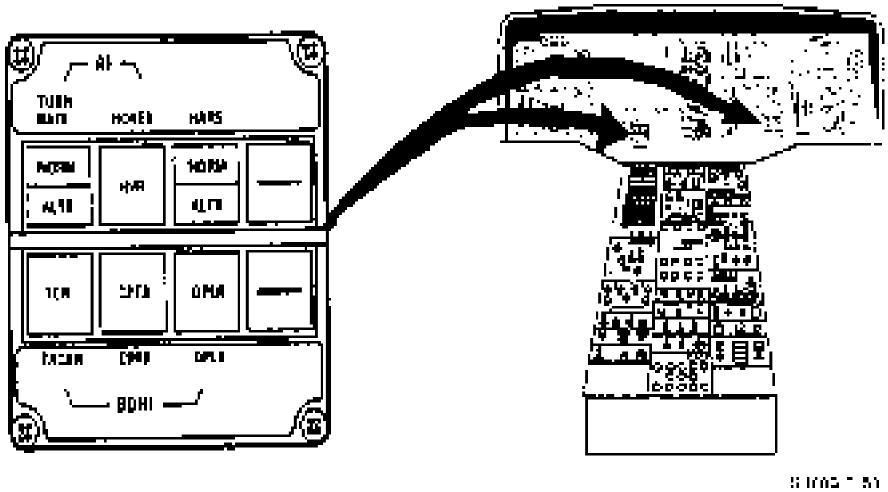
MODES			
DISPLAY INDICATOR	**TACAN**	**COMPUTER**	**DOPPLER**
Needle 1	ADF/OTPI	ADF/OTPI	ADF/OTPI
Needle 2	TACAN radial	TACAN radial	TACAN radial
Compass card	Magnetic heading	True heading	Magnetic heading
Heading marker	Set by knob (manual)	Command heading to FTP	Command heading to fly selected course
Course Arrow	Set by knob (manual)	Course to FTP	Set by knob (manual)
Deviation bar	Course error	Course error	Command heading error
Course window	Selected course	Course to FTP	Selected course
Range window	TACAN DME	Range to FTP	Doppler groundspeed

Figure 16-5. BDHI Displayed Data as a Function of Selected Mode

16.3.3 Radar Navigation Set, AN/APN-217

The radar navigation set (RNS) is the Doppler groundspeed sensor, designed to operate reliably even in low sea state conditions and over land. The SEA mode is the default mode whereas the LAND mode is selected through the AOP and MPD controls. The RNS provides groundspeed information to the automatic flight control system (AFCS) for coupled hover operations. This information is also displayed on the Attitude Indicators (AI) by the heading velocity (VH) and drift velocity (VD) bars and by the vertical velocity (VZ) pointer. It provides three axis velocities that are used to compute the groundspeed that may be displayed on the BDHI. The RNS transmits four narrow beams to the surface of the Earth and measures the Doppler shift of the return signal due to aircraft motion. From these measurements, the heading, drift, and vertical aircraft velocities are calculated. This data is sent to the NSIU in analog form and then to the pilot and ATO AIs. When the BDHI mode is selected to Doppler, the NSIU displays Doppler groundspeed and heading to fly which it calculates from the heading and drift velocities and the course selected. Digital vector components are sent to the data handling subsystem, where they are used for Doppler navigation. The Doppler radar will maintain a reliable track over sea state one at steady bank angles up to and beyond 45°. However, Doppler tracking is severely degraded by vertical acceleration, roll acceleration, and pitch and roll rate, especially in combination. Loss of Doppler track is indicated by short periods of Doppler in memory. In situations where this could affect navigation (i.e., bias development), avoid abrupt maneuvers or turns combined with climbs or descents.

Power is applied to the RNS whenever AC and DC power are available and the DPLR switch on the MSN SYS panel is ON. The DPLR button on the mode select panel (Figure 16-6) causes the Doppler groundspeed to be displayed in the range readout window of the BDHI (Figure 16-4).



INDEX	FUNCTION
Mode select panel	This panel permits the pilots to select the source of heading and attitude reference and the gyro to be used for heading and turn-rate displays.
AI	
TURN RATE	Alternate-action pushbutton with two displays.
NORM	The turn-rate gyro normally associated with each AI is being used as the source of turn rate (i.e., the pilot turn-rate gyro is feeding the pilot AI turn-rate needle and the ATO turn-rate gyro feeds the ATO AI turn-rate needle).
ALTR	Selection of ALTR on the pilot turn-rate button switches the source of the pilot turn-rate indication to the ATO turn-rate gyro. The ATO ALTR turn-rate selection switches his turn-rate source to the pilot turn-rate gyro.
HARS	The heading attitude reference system pushbutton, alternate action with light display for each condition.
NORM	The HARS normally associated with each AI and BDHI is being used as the source of attitude and heading. The pilot HARS provides pitch and roll to the pilot AI and heading to the pilot BDHI; the ATO HARS provides pitch and roll to the ATO AI and heading to the ATO BDHI.
ALTR	Selection of Alternate (ALTR) on the pilot HARS switches the source of the pilot attitude and heading indications on the pilot AI and BDHI to the ATO HARS. The ATO ALTR selection similarly switches the attitude and heading indication source to the pilot HARS. Only one HARS switch can be in ALTR. Pilot selection of ALTR will override the ATO selection and return the ATO to NORM.
HVR	The hover pushbutton is an alternate-action pushbutton switch/display. When illuminated (green), VH, VD, and VZ signals from the Doppler are displayed on crossed bars and a pointer on both AIs for use by the pilot and ATO during hovering flight.

Figure 16-6. Mode Select Control Panel (Sheet 1 of 2)

INDEX	FUNCTION
BDHI	
TCN	The TACAN pushbutton, when pressed, illuminates green and causes the RANGE readout window on the applicable BDHI to display TACAN range. In addition, the course select and heading set knobs on the applicable BDHI are enabled.
CPTR	The computer pushbutton, when pressed, illuminates green and causes range to a computer derived FTP to be displayed in the RANGE readout window. Bearing to the FTP is displayed on the course pointer. In this mode, the course set and heading set knobs are disabled and the heading bug is driven by the computer as command information to the pilot or ATO, as applicable.
DPLR	The Doppler pushbutton, when pressed, illuminates green and causes groundspeed to be displayed in the RANGE readout window of the BDHI. During this mode, the course set knob is enabled, but the heading set knob is disabled, and the heading bug is driven by an NSIU as command information to the pilot or ATO, as applicable.

Figure 16-6. Mode Select Control Panel (Sheet 2)

The NAV flag will appear on the BDHI in the DPLR mode whenever Doppler groundspeed is below 8 knots. If the RNS shifts to the memory mode, the NAV window will remain blank and the VH, VD, and VZ pointers will freeze. Power is supplied from the NO. 2 DC primary bus and the NO. 1 AC primary bus through two circuit breakers located on the ATO and the center circuit breaker panels, both marked NAC RDR SET.

16.3.4 TACAN Navigation Set, AN/ARN-118(V)

The TACAN navigation set consists of a receiver/transmitter (R/T) and control and is a polar-coordinate navigation system, with the aircraft at the origin. The TACAN Set receives a UHF signal from a TACAN surface station (ground or shipboard) or aircraft and calculates the magnetic bearing and slant range to that station. Station identification codes are conveyed by audio modulation of the returning signal. The range of the TACAN is limited to line-of-sight and increases with aircraft altitude up to 123 nm at 10,000 feet. The TACAN set operates on a channel selected from 252 available channels, 126 “x” (FAA) and 126 “y” (tactical). Range information is determined by measurement of the time for round-trip travel of the radio signal between the helicopter and TACAN station. Aircraft radial is determined by phase measurements which are converted to azimuth indications. The TACAN range and bearing are displayed on the pilot and ATO BDHI. The TACAN Set also provides high resolution digital outputs of range and bearing to the CMUX for use in updating the helicopter position.

16.3.4.1 Receiver/Transmitter

The R/T contains all transmitting, receiving, and decoding circuits. The R/T decodes the control and switches to the proper mode. The receiver and transmitter sections (in T/R or A/A T/R modes) are tuned to the frequencies that correspond to the channel specified in the control word. Transmit and receive frequencies are always 63 MHz apart. Power is supplied from the NO. 1 AC primary bus through a circuit breaker, marked TACAN R/T, located on the center circuit breaker panel.

The R/T switches between the upper and lower antennas signal every 5 seconds until a usable beacon signal is received on one of the antennas. The antenna with the usable signal is used as the receiver antenna. The bearing is determined with an accuracy of ±1°.

Note

NAVAIDS listed in the FLIP publications correspond to the X channels unless otherwise noted.

16.3.4.2 TACAN Control

The TACAN control contains all controls and indicators required for operation of the TACAN set (Figure 16-7). The control relays the TACAN audio station identification signal to the audio converter-processor. Figure 16-4 is a list of the controls and indicators on the BDHI. Refer to Figure 16-8 for a list of the BDHI indications for each operating mode as selected on the TACAN control. Power is supplied from the NO. 1 DC primary bus through the circuit breaker marked TACAN CONTR, located on the ATO circuit breaker panel, and the NO. 1 AC primary bus through the circuit breaker marked TACAN R/T, located on the center circuit breaker panel.

16.3.4.3 TACAN Operation

For TACAN operation in all modes, use the following procedures:

1. Set TACAN mode switch as desired (REC, T/R, A/A REC, A/A T/R).
2. Set TACAN control CHANNEL selector controls to desired channel.
3. Wait approximately 5 seconds for signal acquisition and lock-on. If bearing signal lock-on does not occur, the TACAN remains in the search mode with the NAV flag in view.
4. Check that TACAN control TEST indicator is not lit.
5. Check that correct station audio identification signal is received.
6. Read BDHI bearing pointer NO. 2 needle for relative bearing of the beacon. Read MILES window for distance to the beacon in T/R mode.

If the surface beacon bearing signal is temporarily lost, the TACAN switches to bearing memory and retains the last valid bearing information for 3 seconds. If the signal is reacquired within the 3 seconds, the TACAN locks on the signal to provide continuous valid bearing information.

When the bearing signal is lost or becomes unreliable and after the memory time of 3 seconds elapses, the TACAN switches to an automatic self-test to determine if TACAN operation is correct. During the automatic self-test the only possible indication on the BDHI is a momentary NAV flag in view. If there is a detected malfunction in the TACAN system, the TEST indicator on the TACAN control lights at the end of the test cycle and all BDHI bearing, course deviation, and TO/FROM information may be erroneous. If the TEST indicator does not light at the end of the test cycle but the TACAN has still not reacquired the bearing signal, the NAV flag remains in view, indicating that the TACAN is in bearing search.

When a new TACAN channel is selected, the NO. 2 needle may slew to a bearing 90° greater than the relative bearing of the TACAN station for a nominal 2 seconds, with NAV flag in view, before the NO. 2 needle slews to the correct bearing and the flag is lifted.

16.3.4.4 Air-to-Air Receive Mode (A/A REC)

In the A/A REC mode, the TACAN calculates the relative bearing to an aircraft equipped with a bearing transmitter and rotating antenna. The ARN-118(V) TACAN is not capable of transmitting TACAN bearing and few aircraft are suitably equipped. Any number of aircraft can receive bearing information from one suitably equipped aircraft.

Note

In all TACAN systems there is the possibility of interference from IFF, transponder, and DME signals when operating in the air-to-air modes. In order to minimize the possibility of interference, it is recommended that Y-channels be used and that channels 1 through 11, 50 through 74, and 121 through 126 be avoided.

Use either preassigned channel pairings or establish channel pairing with a 63 channel separation.

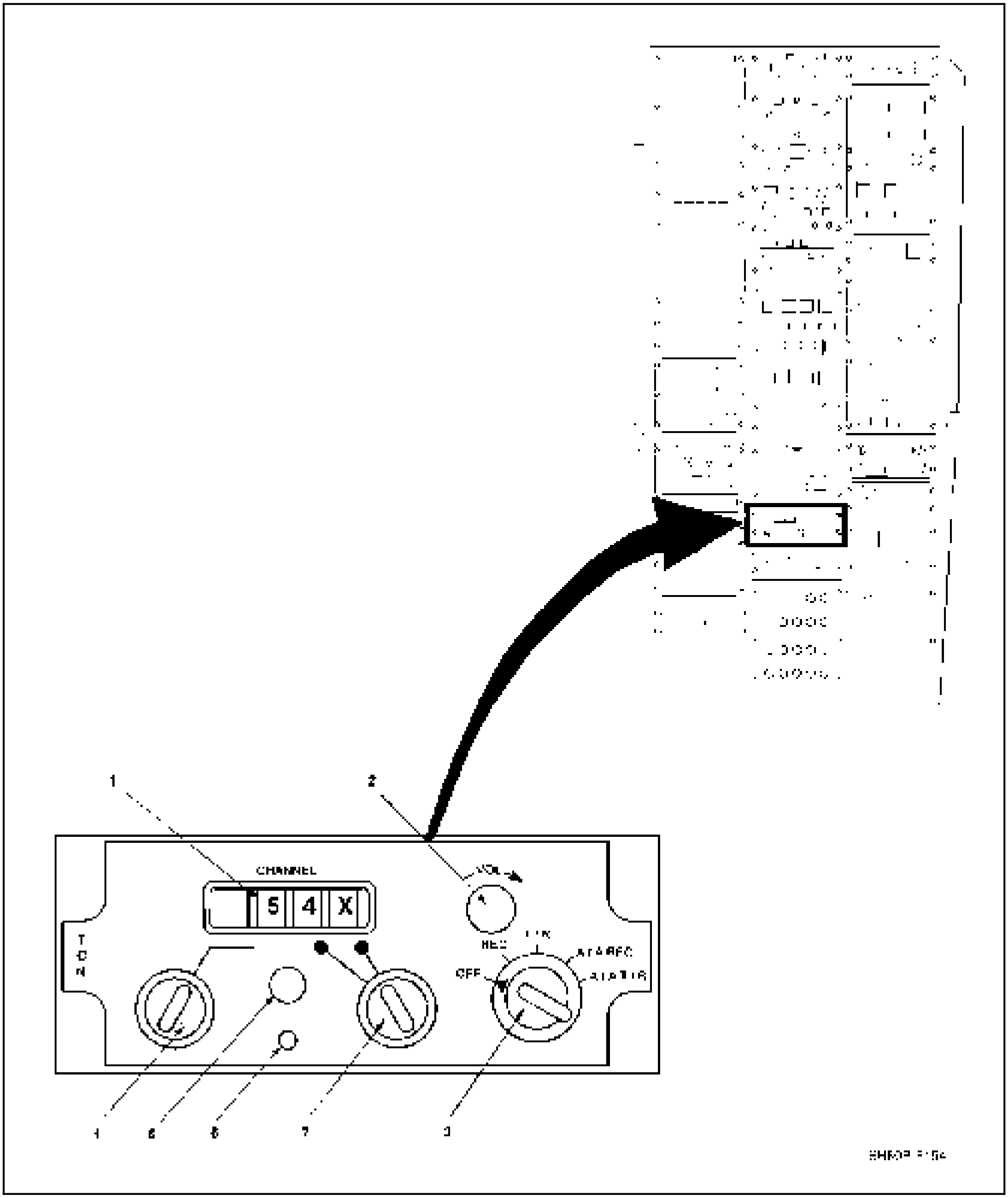


Figure 16-7. TACAN Control Panel (TCN) (Sheet 1 of 2)

INDEX NUMBER	CONTROL	FUNCTIONAL DESCRIPTION
1	CHANNEL	Displays selected TACAN channel.
2	VOL	Varies level of audio identification signal.
3	Mode selector switch	
	OFF	OFF switch for TACAN system.
	REC	Receive mode. TACAN system receives and measures surface beacon fundamental bearing and calculates the relative bearing. No distance information calculated.
	T/R	Transmit/receive mode. TACAN system interrogates a surface beacon and receives both bearing and distance information, which is used to calculate slant-range distance and relative bearing to the surface beacon.
	A/A REC	Air-to-air receive mode. TACAN system receives bearing information from a suitably equipped, cooperating aircraft and calculates the relative bearing to the cooperating aircraft. No distance information available.
	A/A T/R	Air-to-air transmit/receive mode. TACAN system interrogates a suitably equipped, cooperating aircraft and receives and calculates the slant-range distance and relative bearing to the suitably equipped cooperating aircraft. On cooperating aircraft (not equipped with bearing producing equipment) only slant-range distance is calculated. In this mode, the TACAN system provides distance replies to other aircraft when interrogated.
4, 7	CHANNEL	Selects desired TACAN, which is displayed in the CHANNEL digital display.
5	TEST (switch)	Initiates system self-test or confidence test.
6	TEST (indicator)	Lights when malfunction occurs during manual or automatic system self-test. Flashes at start of self-test cycle to check indicator lamp.

Figure 16-7. TACAN Control Panel (TCN) (Sheet 2)

TACAN MODE				
BDHI INDICATION	**REC**	**T/R**	**A/A REC**	**A/A T/R**
COURSE WINDOW	Selected TACAN radial to surface beacon.	Selected TACAN radial to surface beacon.	Selected TACAN radial to suitably equipped, cooperating aircraft.	Selected TACAN radial to suitably equipped, cooperating aircraft.
COURSE POINTER	Selected TACAN radial to surface beacon on compass card.	Selected TACAN radial to surface beacon on compass card.	Selected TACAN radial to suitably equipped, cooperating aircraft on compass card.	Selected TACAN radial to suitably equipped, cooperating aircraft on compass card.
COURSE DEVIATION BAR	Aircraft deviation left or right of selected TACAN radial.	Aircraft deviation left or right of selected TACAN radial.	Aircraft deviation left or right of selected TACAN radial. If cooperating aircraft is not suitably equipped, no indications and NAV flag is in view.	Aircraft deviation left or right of selected TACAN radial. If cooperating aircraft is not suitably equipped, course deviation information is invalid and NAV flag is in view.
TO-FROM ARROW (NOTE 1)	Whether course is TO or FROM surface beacon.	Whether course is TO or FROM surface beacon.	Whether course is TO or FROM suitably equipped, cooperating aircraft. If cooperating aircraft is not suitably equipped, indication is invalid and NAV flag is in view.	Whether course is TO or FROM suitably equipped, cooperating aircraft. If cooperating aircraft is not suitably equipped, TO-FROM information is unreliable and NAV flag is in view.
BEARING POINTER (NOTE 2)	Relative bearing of surface beacon with respect to aircraft heading. Magnetic bearing indicated on compass card.	Relative bearing of surface beacon with respect to aircraft heading. Magnetic bearing indicated on compass card.	Relative bearing of suitably equipped, cooperating aircraft with respect to aircraft heading. Magnetic bearing indicated on compass card.	Relative bearing of suitably equipped, cooperating aircraft with respect to aircraft heading. Magnetic bearing indicated on compass card. If cooperating aircraft is not suitably equipped, NAV flag is in view.
MILES WINDOW	Shuttered (distance not calculated in REC).	Slant-range distance to surface beacon (NOTE 3).	Shuttered (distance not calculated in A/A REC mode).	Slant-range distance to cooperating aircraft (NOTE 3).

Notes:

1. TO/FROM arrow indicates whether flight on heading displayed in course window would fly aircraft to or from selected TACAN beacon.
2. NAV flag is in view when bearing information is unreliable.
3. Distance shutter in view when distance is unreliable.

Figure 16-8. TACAN Operating Modes and BDHI Indications

16.3.4.5 Air-to-Air Transmit/Receive Mode (A/A T/R)

In the A/A T/R mode, the ARN–118(V) interrogates a suitably equipped, cooperating aircraft (bearing and distance information) or a cooperating aircraft (distance only information). The suitably equipped, cooperating aircraft supplies the interrogating aircraft with both bearing and distance information. The cooperating aircraft supplies the interrogating aircraft with only distance information. At least five aircraft can receive distance information from an interrogated aircraft. In this mode, the ARN–118(V) TACAN also supplies distance information to the other aircraft when interrogated. When the ARN–118(V) is interrogated and supplying distance information to more than one aircraft, the ratio of the distance between the ARN–118(V) and the furthermost aircraft and the distance between the ARN–118(V) and the nearest aircraft must be no greater than 4:1.

Note

With interrogating aircraft flying in close proximity of each other, it is possible that a negative distance may be displayed due to the calibration of the TACAN system in either aircraft. Since the BDHI cannot display negative distances, a TACAN output of negative .1 nm is displayed as 399.9 nm and an output of negative 0.5 nm is displayed as 399.5 nm.

16.3.4.6 In-Flight Confidence Test

The in–flight confidence test is initiated when the TEST switch on the TACAN control is momentarily pressed. A manual self–test is activated and the system is checked providing a greater than 85 percent confidence level. The test can be terminated at any point by switching either the CHANNEL selector controls or mode selector on the TACAN control. Perform in–flight confidence test using the same procedures as in the Mission/Weapon System Checklist, Chapter 7.

Note

It is not necessary to select an unused channel to perform the TACAN test.

16.3.5 Direction Finder Group (DFG), AN/ARA-50

The DFG, when in automatic direction finder (ADF) mode, provides relative bearing to another station transmitting on a selected UHF frequency and, when in the OTPI mode, to a deployed sonobuoy transmitting on a selected sonobuoy VHF channel. Selection of ADF or OTPI mode and frequency/channel is made on the COMM CONTR panel. The ADF or OTPI bearing is displayed on the BDHI via the NSIU by the NO. 1 needle. The AN/ARA–50 is used for the following:

1. Location of deployed sonobuoys (OTPI mode).
2. Backup navigation (UHF ADF mode).

Note

ADF is unavailable in secure voice mode. Power is supplied from the AC essential bus and DC essential bus through circuit breakers located on the center circuit breaker panel and the overhead circuit breaker panel. They are labeled DF GP PWR and DIR FINDER GROUP, respectively.

16.3.6 On-Top Position Indicator Receiver

The on–top position indicator (OTPI) receiver, R–1651/ARA, is used in conjunction with the direction finder group (DFG) to provide bearing information to a VHF signal from a sonobuoy. Effective on BuNo 164174 and subsequent, the OTPI receiver R–1651/ARA is replaced by OTPI receiver R–2330/ARN–146 to provide for the 99–channel sonobuoy tuning capability. In the OTPI mode of operation used with sonobuoys, the receiver recovers the AM audio signal from the RF carrier. This provides a means for fixing the position of sonobuoys. Power is supplied from the AC essential bus and DC essential bus through circuit breakers in the center circuit breaker panel, marked DF GP PWR and DIR FINDER GROUP respectively.

Note

- RAST main probe must be in the up position in order to receive accurate OTPI information.
- HF radio transmissions in the range of 5.83 to 28.85 MHz may result in incorrect OTPI bearing information.

The tuning or channel selection of the OTPI Receiver is accomplished by the pressing of channel selection buttons on the COMM CONTR panel. A threshold signal-strength indicator on the COMM CONTR panel, fed by the OTPI Receiver, tells the operator whether or not the received signal is strong enough to track. The signal-strength indicator will be green when the received signal is valid (Figure 15-1).

16.4 GLOBAL POSITIONING SYSTEM

GPS is a radio positioning navigation and time transfer system consisting of NAVSTAR satellites, ground based control facilities, and receiving equipment capable of receiving the GPS satellite signals. The GPS system provides worldwide, accurate, three-dimensional position and velocity information. The helicopter installed GPS system components consist of:

1. GPS Receiver, AN/ARN-151, R-2332/AR.
2. GPS Control Indicator, AN/ARN-151, C-12100.
3. GPS Antenna, AS-3822/URN.
4. GPS Antenna Electronics Unit, AM-7324/URN.
5. Data Bus Coupler (2), AN/ARN-151, CV-2453.

GPS receives satellite data via a fixed reception pattern antenna and the Antenna Electronics Unit. The receiver decodes the data and utilizes it to compute the helicopter position. Position is computed by comparing time-of-arrival measurements from the satellite signals. Velocity is computed by comparing Doppler measurements of the carrier frequency of the satellite signal.

GPS receivers are capable of operating in seven states. Each receiver channel operates in only one state at a time. Five of the seven states are displayed by the LAMPS MK III GPS system on the GPS data table (Figure 16-9). These five states are: State 1, Searching C/A Code; State 2, Direct P-code Acquisition; State 3, Code Tracking/No Carrier Lock; State 5, Carrier Lock Achieved/Data Demodulation (also called Normal Acquisition); State 7, Reacquisition In Process.

The GPS interface allows the GPS capability to come online when the helicopter mission systems are powered up. Power is supplied to the GPS receiver from the NO. 1 AC primary bus on the SO circuit breaker panel.

16.4.1 Navigation Modes

The ATO may select the GPS as the primary navigation mode by depressing the GPS OPTN pushbutton switch on the ATO keyset, then selecting GPS NAV, then On-top-Navigation modes are automatically selected by the AOP in the following sequence. GPS will be used if available and turned ON. If GPS is not available or turned OFF, or if the GPS Estimated Horizontal Error (EHE) exceeds 500 yards, navigation will revert to Doppler navigation mode. Air Mass navigation mode will be used last if neither GPS nor Doppler is available. When using GPS as the navigation mode, the Bearing-Distance-Heading Indicator (BDHI) displays are driven by navigation data sent from the GPS Receiver to the SAC-1 via the 1553B Data Bus.

The GPS can first be used for navigation when AOP determines that the GPS position has met the initial availability criteria. The initial availability criteria have been met when the receiver has no faults, holds four satellites in state 5, and the EHE is less than 150 yards. If the EHE grows larger than 500 yards while the receiver is tracking four satellites in state 5, then Doppler navigation mode will become the active navigation mode and the last GPS position will be used to initialize the Doppler equations. If Doppler navigation mode is not available, air mass mode equations will be initialized with the last GPS position. The GPS navigation mode will be maintained as long as the EHE remains less than 500 yards and the receiver holds four satellites in state 5. If the number of satellites in state 5 drops below four, AOP will start a 3-minute time; if GPS does not hold four satellites in state 5 after 3 minutes, the navigation mode will switch to Doppler or air mass. This helps prevent frequent navigation mode switching while maneuvering and during satellite constellation changes.

Note

AOP may maintain GPS navigation mode for up to 3 minutes when less than 4 satellites held in state 5. This can cause an increase in EHE of up to 005 (450 to 550 yards) before AOP reverts to Doppler navigation mode. If acceptable GPS EHE cannot be maintained during critical mission phases, consideration should be given to turning GPS off via GPS OPTIONS pushbutton switch on ATO keyset.

The GPS is capable of providing two different levels of navigational accuracy. The Standard Positioning System (SPS) provides a positional accuracy from 150 to 500 yards. The Precise Positioning System (PPS) is capable of providing a positional accuracy of 16 yards. A precision code (P- or Y-code) is transmitted over both the L1 and L2 frequencies sent by each satellite. The L1 frequency also carries a coarse acquisition code (C/A code). When Selective-Availability (SA) is on, the PPS will be degraded for all users tracking the P- or C/A-codes. If Antispoofing (A/S) is enabled (Y-code vice P-code), the P-code is denied to users who do not have special cryptographic keys. The C/A-code will remain available to all users. The cryptographic keys are loaded into the GPS receiver via the GPS Control-Indicator (Figure 16-10). After entering the cryptographic code, the KEY STATUS line of the GPS DATA page via TABLE pushbutton switch must be checked to verify the proper key was entered (Figure 16-11). The AS key may be erased by depressing the guarded ZEROIZE pushbutton switch on the Control Indicator or by selecting ZEROIZE from the SEL GPS OPTN cue by depressing the GPS OPTN pushbutton switch on the ATO keyset.

GPS operation or availability is displayed to the ATO and SO via the Navigation mode field on the MPD. When GPS is in use, the Navigation mode will be displayed as G XXX. The G indicates GPS, XXX indicates the GPS EHE in hundreds of yards, rounded to the nearest hundred. GPS data is polled and updated at a 200 ms rate and transferred to the navigation subsystem via the 1553B Data Bus. The EHE is continuously displayed and updated on the MPD. If the EHE exceeds 500 yards, indicated by the XXX going to 005, the navigation mode will automatically be set to Doppler. This will be indicated by a D followed by the GPS reported EHE in the NAV MODE area of the display.

GPS is considered for reselection as the navigation sensor by AOP when GPS data becomes valid and the EHE is less than 333 yards. GPS will be selected automatically as the navigation mode if the difference between the AOP calculated position and the GPS reported position is less than 100 yards. If the difference between the AOP calculated position and the GPS reported position is greater than 100 yards, the SEL GPS NAV cue will be displayed with the OFF option preselected. A GPS Correct Symbol appears on the display, representing the difference between the GPS reported position and the AOP calculated position from the Doppler or Air Mass navigation modes. This gives the ATO the option to use GPS as the active navigation mode by selecting GPS, or to continue using Doppler or Air Mass navigation mode by selecting the OFF default option.

1 of 3

GPS DATA

CPCI VERSION
XXXX

	OP ENTER		GPS
1 GET GPS PRESET	HH MM SS		
ALTITUDE	XXXX		XXXXXX
2 TIME	HH MM SS		HH MM SS
3 DATE (Y/M/D)	YY/MM/DD		
4 LATITUDE	XX XX.X	N	XX XX.X N
5 LONGITUDE	XXX XX.X	W	XXX XX.X W
6 CRS/SPD	XXX/XXX		XXX/XXX
7 SEND INIT DATA	HH MM SS		

ENT LINE NO
XX

2 of 3

GPS OPTIONS		EHE	XXXX
NAV MODE	XXX	EVE	XXXX
MAG VAR	XXX	KEY STATUS	HHHH
BIAS CALC	OFF	ALMANAC REQ	XXX
		CONSTELLCHNG	XXX
		RCVR MODE	XXXX

3 of 3

SATELLITE SUMMARY

CHAN	SV	STATE	C/NO	J/S
1	XX	X	XXX	XXX
2	XX	X	XXX	XXX
3	XX	X	XXX	XXX
4	XX	X	XXX	XXX
5	XX	X	XXX	XXX

Figure 16-9. GPS Data Table

The GPS Correct Symbol (G TTTT) (G indicating GPS and TTTT as the most recent time of the last GPS data update) displays at the point to which the helicopter position will be corrected if the GPS data is accepted by selection of the ACCEPT option. If the GPS positional data is accepted by the depression of the ENT NO CHNG pushbutton switch, the helicopter and all Doppler and air mass referenced sonobuoy positions, fixes, LAMPS Tracks, GPS Correct Symbol, ATTs, and MAD Marks that are not designated as geographic points or are not currently updated to the position, will have the GPS position correction applied. All radar targets are corrected by an amount corresponding to their true radar range on the next full radar sweep.

If the AOP GPS navigation mode is OFF but the receiver is providing data which passes the availability criteria, the MPD shows the current navigation mode with a slash through it. If the operator selects GPS via the GPS OPTN pushbutton switch and the position difference between GPS and AOP is less than 100 yards, the navigation mode changes to GPS and updates the helicopter position and helicopter entered tactical symbols. If the difference between GPS and AOP position is greater than 100 yards, selection of GPS via the GPS OPTN pushbutton switch displays the GPS CORRECT cue, with the difference in the GPS position and the active mode position shown in yards. The ACCEPT option will be preselected and the GPS Correct Symbol will be displayed. Accepting the GPS position correction will change the navigation mode to GPS and update the helicopter position and helicopter entered tactical symbols.

GPS OFFSET is the vector difference between the ACFT position held by GPS and the ACFT position held by DAME. Whenever a DAME update is performed, GPS offset is calculated and entered into the NAV Parameters Table. All uplinked/downlinked symbols then have this GPS offset applied. This maintains identical relative tactical plots on the aircraft and the ship but causes a mismatch in symbol latitude/longitudes when verbalized over the data link. ATO/SO should verify offset value each time a DAME update is completed. If the data link is lost after DAME update and cannot be regained using other techniques (or if data link cannot be gained when transitioning to another LAMPS MK III ship), consideration should be given to performing an INIT HELO. This will clear the GPS OFFSET value contained in NAV Parameters Table.

16.4.2 GPS Options

GPS has five selectable options. Depression of the GPS OPTN pushbutton switch on the ATO keyset displays the SEL GPS OPTN cue with the five options. The five options and the functions performed are:

1. ZEROIZE — Erases the GPS key presently held in the GPS receiver memory.
2. GPS NAV — Displays SEL GPS NAV cue. Selection may be made to set the navigation function to GPS or OFF. The BIAS CALC option will always remain OFF. The mode not in use is the default selection.

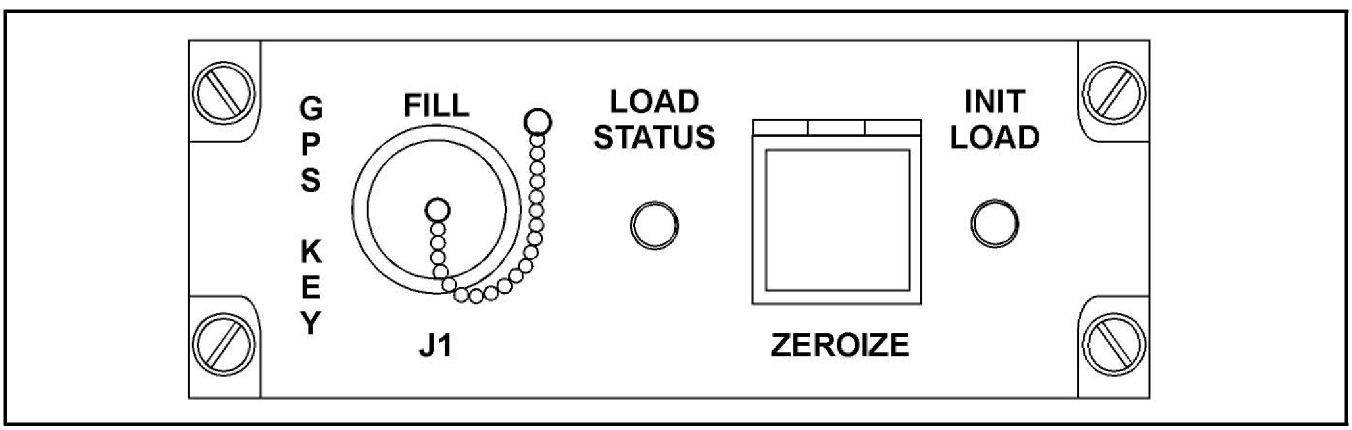


Figure 16-10. GPS Control Indicator

DISPLAY (H1)(H2)(H3)(H4) (Notes 1,2)		MEANING	NOTES
H1	8	Key entered was accepted and verified by GPS satellite data (can take up to 12 minute to verify).	3
	4	GPS accepted the key but is waiting to verify the code.	
	2	GPS took the key from the key loader, but the code did not match with satellite data.	
	1	Key Failed Parity.	
	0	No key received.	
H2	8	Group Unique Variable (GUV) code in use.	4
	4	2 hour alert — 2 hours remain before expiration of last key.	
	2	Insufficient key for mission duration.	
	1	Zeroize error — Code not zeroized properly.	
	0	All keys entered properly, no errors or warnings.	
	7	Combination of 4, 2, and 1.	
	6	Combination of 4 and 2.	
	5	Combination of 4 and 1.	
	3	Combination of 2 and 1.	
H3/H4		Mission duration — Indicates number of days the GPS can operate without reloading keys (should be something non-zero).	5

Notes:

1. If the GPS control indicator will not load a key, it may be necessary to remove and reinstall the batteries from the GPS unit. This will clear all GPS memory, including almanac data. (GPS will require 1 to 3 hours of tracking time to regain enough almanac data to provide sufficient accuracy for AOP use (<500 yards). The time requirement can be lessened by entering current lat/long and UTC time.)
2. All hexadecimal characters should display zero if crypto key is properly zeroized.
3. Upon initial load, H1 should indicate 4, and will indicate 8 once verified by a GPS satellite. If the key is no longer valid after having been verified, a 2 will be displayed.
4. This digit will display an 8 when the GUV is loaded.
5. This was designed to be used primarily with Crypto Variable (CV) keymat. The GPS can accept up to 12 different monthly and weekly CV keys, but will keep only enough keys for 84 days.

Figure 16-11. Key Status Display Format

3. MAG VAR — Displays SEL MAG VAR cue. Selection may be made to set MAG VAR to GPS or OFF. The mode not in use is the default selection.

Note

Coefficients for magnetic variation (MAG VAR) provided by present software in GPS receiver units may not be accurate. If GPS provided MAG VAR differs from actual local value (or value utilized by ship), GPS MAG VAR input to AOP should be turned off via GPS OPTIONS pushbutton switch and MAG VAR should be manually entered into NAV Parameters Table.

4. GEO DES — Displays the SEL GEO DES cue. Selection of the DESIG or UNDESIG option allows the ATO to designate or undesignate any symbol that can be hook verified and downlinked as a geographic point, with the exception of an ATT. The mode not in use is the default selection.
5. GPS CORR — Displays the GPS CORRECT cue with the number of yards the helicopter position will be corrected if the ACCEPT option is selected. Selection of ACCEPT will result in the helicopter and all Doppler or air mass referenced sonobuoy positions, fixes, LAMPS Tracks, ATTs, and MAD Marks that are not designated as geographic points being corrected to the GPS reported position. Selection of the REJECT option will terminate GPS processing and remove the GPS Correct Symbol from the display.

Note

GPS option 5 (GPS CORRECT) will be accepted by AOP even if the current GPS solution is invalid (including loss of power to GPS receiver). Performing GPS correct with invalid solution will cause significant errors in the navigation plot. ATO/SO should utilize GPS data table to verify GPS solution validity and GPS position prior to utilizing this function.

16.4.3 GPS Data Table

The GPS data table (Figure 16-12) is displayed by depressing the TABLE pushbutton switch and then selecting GPS DATA. When the GPS is initialized it will attempt to acquire satellite signals to localize the position of the helicopter. The GPS requires only one satellite to initiate the search. The satellite search and acquisition status is displayed on the GPS data table in the Satellite Summary field. When one satellite signal is located and being processed in state 5, the GPS should be able to acquire additional satellite signals on its own.

The GPS receiver has a battery to maintain the volatile memory of the last available helicopter position and the AS key in use at the time of system shutdown. It uses that data to commence the initial satellite search upon system initialization. If the helicopter has been inactive for an extended period of time and its position significantly altered since system shutdown, if the GPS antenna is shielded from signal reception, or if the battery is depleted, GPS may not be able to localize the helicopter position without operator assistance. The GPS data will be displayed on the MPD in the column under GPS. The TIME field will display the last time stored at system shutdown and will be updated when the GPS acquires the first satellite signal. The operator may assist the localization by entering the current Zulu time, date, latitude, longitude, and helicopter course and speed. After this data is entered, select SEND INIT DATA to update the GPS. When the GPS data becomes valid, the GPS reported data will be moved to the OP ENTER fields of the display.

A power interrupt (of greater than 7 seconds duration) to the GPS receiver causes the receiver to go into and remain in the INIT mode as indicated on the GPS data table. To regain GPS NAV, ATO or SO must go to the Equipment Status Table and select and initialize GPS. Attempts to utilize options from the GPS OPTIONS cue or GPS data table will not cause the receiver to return to the NAV mode.

SUMMARY FIELD	MEANING
CHAN	Indicates the GPS receiver channel number.
SV	Indicates the Satellite Vehicle (SV) number. Each GPS satellite has a system assigned ID number. This number is passed to the GPS receiver when the satellite signal is acquired.
STATE	Indicates the GPS receiver channel tracking status. 1 — Searching C/A Code 2 — Direct P-code Acquisition 3 — Code Tracking/No Carrier 4 — Not Used 5 — Carrier Lock Achieved/Data Demodulation 6 — Not Used 7 — Reacquisition in Process
C/NO	Indicates carrier-to-noise ratio.
J/S	Indicates jamming-to-signal ratio.

Figure 16-12. GPS Data Display Satellite Summary Field Definitions

When the GPS receiver is in the NAV mode and the AOP is using GPS data, use of GET GPS PRESET function (line 1) on the GPS data table will cause erroneous automatic repositioning of the helicopter symbol. An erroneous position is a wraparound of 0.0N/0.0E relative to GRP and can be anywhere within a 512 X 512 nautical mile tactical grid. Once valid the GPS NAV MODE solution is eventually achieved and helicopter symbol will again automatically reposition to remove the error. If this function is used, ATO/SO should note aircraft latitude/longitude prior to initiating GET GPS PRESET function so that, should GPS become unavailable, the aircraft symbol can be repositioned to the proper latitude/longitude. Use of this function should be avoided, especially in flight.

Other fields on the display are GPS OPTIONS, ALMANAC REQ, and CONSTELL CHNG. The GPS OPTIONS field will reflect the status of the NAV MODE and MAG VAR as either GPS or OFF, as selected by the operator from the SEL GPS OPTN cue. The ALMANAC REQ and CONSTELL CHNG status will be reported as either ON or OFF. BIAS CALC will be reported as OFF.

16.4.4 GPS Accuracy Considerations

The AN/ARN–151(V) R–2332/AR GPS may develop a navigation position runoff error as great as 20 to 40 nm with an EHE indication of less than 150 yards. This runoff error is caused by a receiver software defect which occurs when the crypto keys are loaded. Runoff error may occur shortly after the receiver is keyed or later in the flight during satellite swap. AOP will use the invalid data to display the helicopter position inaccurately on the tactical display and the Navigation Parameters Table.

16.4.4.1 Runoff Error Avoidance

To reduce the potential for invalid GPS data, adhere to the following procedures:

1. On deck:

    a. After keying the GPS receiver and loading AOP, ensure the navigation mode field on the MPD indicates GPS is available.

    b. When GPS is available, perform an INIT/TEST of GPS via the Equipment Status Table from either the ATO or SO keyset.

2. When switching from Doppler or Air Mass to GPS as the primary navigation mode during flight:

   a. Select GPS NAV via the ATO keyset.

   b. Ensure the navigation mode field on the MPD indicates GPS is available.

   c. When GPS is available, perform an INIT/TEST of GPS via the Equipment Status Table from either the ATO or SO keyset.

Note

Performing an INIT/TEST of GPS requires up to two minutes to complete.

PART VIII

Mission Systems

CHAPTER 17

Armament Systems

Refer to NTRP 3-22.4-SH60B for applicable armament systems information.

CHAPTER 18

Aircraft Mission Avionics

Refer to NTRP 3-22.4-SH60B for applicable avionics systems information.

PART IX

Crew Resource Management

CHAPTER 19

Crew Resource Management

19.1 INTRODUCTION

The goal of Crew Resource Management (CRM) is to improve mission effectiveness, minimize crew–preventable errors, maximize crew coordination, and optimize risk management. CRM principles are integrated into every aspect of flight operations. They begin with mission planning and continue through the flight brief, mission execution, and debrief. Proper CRM requires that all crewmembers actively participate in each phase of the flight.

Successful crews display good CRM by the effective use and integration of all available knowledge, skills, and resources (people, equipment, weapon systems, and facilities) in the safe and efficient accomplishment of an assigned mission.

19.1.1 Minimizing Errors

One of the key benefits of CRM is the increase in aircrew effectiveness by minimizing or reducing crew–preventable errors. Error is an inevitable result of the natural limitation of human performance and the function of complex systems. Some errors will occur despite the best intentions of the aircrew. Human error is a normal by–product of human behavior. Experience alone cannot eliminate errors; however, research indicates that the effective transfer of experience from senior crewmembers to less experienced crewmembers can have a positive effect in preventing knowledge–based errors. Since errors cannot be completely prevented, it is important for aircrews to detect them as early as possible and to minimize or manage their impact. CRM can be viewed as a method of error management. Well–managed errors are an indicator of effective crew performance. CRM is not and never will be the only mechanism to eliminate error and assure safety in a high–risk endeavor such as naval aviation. CRM is one of an array of tools that aircrews can use to minimize or manage error.

19.2 CRM PROGRAM ADMINISTRATION

CRM academic and flight currency requirements shall be completed and documented in accordance with OPNAVINST 1542.7 (series). All Assistant NATOPS Instructors shall be designated CRM Facilitators.

19.3 CRM SKILLS AND BEHAVIORS

Integrated CRM incorporates the use of specifically defined behavioral skills into all Navy/Marine Corps aviation operations. Aircrew that use the following skills and behaviors will improve mission effectiveness and reduce the potential for mishaps.

1. Situational Awareness (SA): The ability to maintain awareness of what is happening in the aircraft and in the mission.
2. Assertiveness (AS): The willingness to actively participate and the ability to state and maintain one’s position.
3. Decision Making (DM): The ability to use logic and sound judgement based on the information available.
4. Communication (CM): The ability to clearly and accurately send and acknowledge information, instructions, or commands, and provide useful feedback.
5. Leadership (LD): The ability to direct and coordinate the activities of other crewmembers or wingmen and to encourage the crew to work together as a team.
6. Adaptability/Flexibility (AF): The ability to alter a course of action to meet situational demands.
7. Mission Analysis (MA): The ability to coordinate, allocate, and monitor crew and aircraft resources.

19.3.1 Situational Awareness (SA)

Effective situational awareness refers to the ability to identify the source and nature of problems, extract and interpret essential information, maintain an accurate perception of the external environment, and detect a situation requiring action.

Situational awareness requires that the aircrew know who is responsible for specific activities, what is happening, when events are supposed to occur, and where the aircraft is in three-dimensional space. Situational awareness is the single most important factor in improving mission effectiveness and safety for aircrews. The lack of situational awareness among crewmembers can lead to disastrous consequences.

To maintain and/or recover situational awareness, conduct a comprehensive brief, acknowledge potential problems, communicate, use all information sources, and ensure all crewmembers are updated on any changes to the briefed mission and sequence of events. Factors that reduce situational awareness are insufficient communication, fatigue/stress, task overload/underload, group mindset, press on regardless philosophy, and degraded operating conditions.

Combat the loss of situational awareness by actively questioning and evaluating mission progress, using assertive behaviors when necessary, analyzing the situation, and updating and revising the image of the mission. Situational awareness is a critical factor in the ability to respond effectively to a situation. Maintaining a high level of situational awareness will better prepare crews to respond to unexpected situations.

19.3.2 Assertiveness (AS)

Assertiveness refers to the ability, willingness, and readiness to take action, including making decisions, demonstrating initiative and the courage to act, and stating and maintaining your position until convinced otherwise by the facts.

Assertive behaviors include providing relevant information without being asked, making suggestions, asking questions as necessary, confronting ambiguities, maintaining a position when challenged, stating opinions on decisions or procedures, and refusing an unreasonable request. Assertive statements typically use active verbs or recommend an action. To create an assertive statement, get the attention of the receiver, state your concern, offer a solution, and ask for feedback. Aircrew members must be willing to act assertively if they are going to fulfill their responsibility toward mission success.

19.3.3 Decision Making (DM)

Effective decision making refers to the ability to use logic and sound judgment to make decisions based on available information. The decision-making process involves assessing the problem, verifying information, identifying solutions, anticipating consequences of decisions, informing others of decision and rationale, and evaluating decisions.

Factors that promote good decision making include teamwork, time, alert crewmembers, decision strategies, and experience. Barriers to good decision making include lack of time, inaccurate or ambiguous information, pressure to perform, and rank difference. To overcome these barriers, use NATOPS/SOP to select the best decision, cross-check information, evaluate the rationale for making the decision, and use assertive behaviors. Once a hazard has been detected, evaluate it to determine its potential effect on the planned flight by considering its impact on the aircraft, environment, situation, operations, and personnel. The analysis should consider the crew's relative ability to cope with the changes. Allowing other crewmembers to participate in the decision-making process is encouraged; however, this does not mean that all decisions have to be made by committee.

19.3.4 Communication (CM)

Effective communication refers to the ability to clearly and accurately send and acknowledge timely information, instructions, or commands, and provide useful feedback. It is important to make sure everyone involved fully understands what is being communicated in order to conduct effective missions, avoid mishaps, pass information from one person to another, and maintain group situational awareness.

Active communication between the sender and receiver is accomplished by the following:

1. Sender should provide information as required, provide information when asked, convey information concisely, convey useful information, convey accurate information, verbalize plans, and use nonverbal communication appropriately.

2. Receiver should acknowledge communication, repeat information, reply with questions or comments, ask for clarification, and provide useful feedback.

Barriers to communication are events or situations that distort or interfere with communication. Examples of communication barriers are radio/ICS malfunctions, differences in rank/experience, task overload, gender, attitudes, and culture. Overcoming barriers can be accomplished by using active listening techniques, feedback, appropriate mode of communication and decibel level, and standard terminology. Effective communication is vital at all times, both inside and outside the aircraft. The crew must be aware of any barriers to communication; the greatest enemy of effective communication is the illusion of it.

19.3.5 Leadership (LD)

Leadership is the ability to direct and coordinate the activities of all crewmembers and to ensure the crew works together as a team. Leadership is not solely the responsibility of the PIC; each crewmember has specialized duties and qualifications.

Two types of leadership exist — designated leadership and functional leadership.

1. Designated leadership is leadership by authority, crew position, rank, or title. Designated leadership is the normal mode of leadership.
2. Functional leadership is leadership by knowledge or expertise. Functional leadership is temporary and allows the most qualified individual to take charge of the situation.

The leader is in control of the situation and has certain responsibilities. The leader must be able to direct and coordinate the crew's activities, delegate tasks, and ensure that the crew understands what is expected of them. Leaders focus attention on the crucial aspects of the situation, keep crewmembers informed of mission-relevant information, provide feedback to the crew on their performance, and create and maintain a professional atmosphere. It is more effective to influence individuals than to dictate. This can be accomplished by making suggestions, making the crew want to perform activities, and leading by inspiration. Feedback should be given to the crew on both good and bad performance.

19.3.6 Adaptability/Flexibility (AF)

Adaptability and/or flexibility refer to the ability to alter one's course of action contingent on, or as a function of, another's action and/or as the situation demands. Adaptable/flexible crewmembers should be able to alter their behavior to meet situational demands, be open and receptive to others' ideas, help others when necessary, maintain constructive behavior under pressure, and adapt to internal and external environmental changes.

Unbriefed situations requiring adaptability include an emergency, transitions, an incapacitated crewmember, and when crew interactions are strained. When faced with a critical decision, the crew should stop, analyze the situation, recognize and acknowledge any change or abnormality, ask for assistance, and interact constructively with others. The crew should then conduct an operational evaluation, determine if an SOP is appropriate, propose a course of action, and gain support for the actions chosen. Once a decision has been made, it is not irrevocable. The crew should keep an open mind and evaluate the decision against new data. A mission's success depends on the crew's ability to alter behavior and dynamically manage resources to meet changing situational demands. To effectively respond to situations, crews must remain flexible in their decision making and actions.

19.3.7 Mission Analysis (MA)

Mission analysis refers to the ability to coordinate, allocate, and monitor crew and aircraft resources. Mission analysis is a crew effort.

The three stages of mission analysis are permission organizing and planning, in-flight monitoring and updating, and postmission review. Each stage of mission analysis has an impact on the mission. Premission analysis establishes mission requirements and constraints, organizes resources, specifies both long-term and short-term plans, and advises the crew what to expect during the mission. A good preflight brief establishes crew expectations, is interactive, comprehensive, and valued by all crewmembers. In-flight analysis involves monitoring the current situation, critiquing previous decisions, and informing the crew of changes to flight concept. Postmission review covers the entire mission, provides feedback, and determines areas for future improvement. A good debrief is interactive, focused, timely, and valuable to all crewmembers. Failure to develop a good plan, or to revise a plan when the situation changes, can result in a failed mission or a mishap.

19.3.8 Factors Affecting CRM

There are numerous factors external and internal to the aircraft that can affect good CRM. The aircrew must be vigilant in recognizing these factors and develop plans to minimize their impact.

Factors internal to the aircraft that might impact CRM include time available, fatigue, distractions, stress, lack of attention, or poor attitude. High crew workloads can impact crew coordination. Low workload situations may result in complacency. The breakdown of CRM may be caused by the fixation on one task, confusion, violation of NATOPS/SOP, no one in charge, no lookout doctrine, failure to meet mission objectives, and/or absence of communication.

19.3.9 CRM Attitude

Aircrew performance can be improved through training, thereby increasing the aggregate level of knowledge, skills, and attitudes required for the mission. Improving CRM skills will often require crewmembers to change their attitude toward crew interaction. Improved application of CRM skills will increase mission effectiveness, reduce or minimize the impact of aircrew errors, and increase safety by reducing poor crew–coordination mishaps.

19.4 OPERATIONAL RISK MANAGEMENT (ORM)

The operating environment and multimission capability of the H–60 places every crew in a situation where risks may have to be taken. The ability to properly assess risk depends on input from each crewmember as to the requirements of the mission. If every crewmember is not aware of all the risks, a bad decision can result. Accident investigations show that almost all pilot–error accidents are the result of a chain of bad decisions. One bad decision reduces the alternatives for continued safe flight. Usually a crewmember needs only to bring attention to a bad decision to stop the chain of events that could lead to an accident or dire situation.

ORM fits into the overall planning and implementation of CRM. The two share many of the same aspects with regard to mission analysis, decision making, communication, leadership, adaptability/flexibility, and situational awareness. ORM is a closed–loop process that identifies and controls hazards.

19.4.1 Five-Step Sequence

The use of ORM assessment is normally done during the preflight mission analysis stage. It follows a five–step sequence:

1. Identify hazards (e.g., route study, weather brief).
2. Assess hazards (e.g., LZ obstacles, loss of wind effect).
3. Make risk decisions (e.g., navigation around areas of known icing, selecting an altitude to avoid terrain).
4. Implement controls (e.g., SOP, briefs, and rehearsals).
5. Supervise and watch for change (CRM principle of leadership and the need to enforce standards).

19.4.2 Three Levels of Application

The three application levels of ORM utilize the CRM skills of adaptability/flexibility, situational awareness, and mission analysis.

1. When applying time–critical ORM, very little time is available for assessment. Situational awareness and adaptability/flexibility are required to perform the five–step sequence.
2. When applying deliberate ORM, time is not an issue. Normal planning time is available to perform mission analysis.
3. When applying in–depth ORM, the integration of mission analysis is easily accomplished due to the advanced planning time allocated.

19.4.3 Four Principles of Application

The four principles of applying ORM share a commonality with decision making, mission analysis, and situational awareness.

1. Accept risk when benefits outweigh the cost.
2. Accept no unnecessary risk.
3. Anticipate and manage risk by planning.
4. Make risk decisions at the right level.

During every mission, the decision must be made to either accept or decline the risks. If the returns on the risks are not worthwhile, they must provide a justifiable return for the effort. During the mission analysis (planning) phase of the flight, risks are addressed using control measures and proper briefing techniques. The aircrew, using good situational awareness, must identify those risks and deal with in-flight challenges as they occur appropriately.

19.5 COCKPIT INTERRUPTIONS AND DISTRACTIONS

The skills of CRM are utilized and accepted by aircrew's worldwide. Due to the fact that error is universal and in most cases unavoidable, CRM has been defined as the management of human error.

Human factor errors have been attributed to a majority of all Navy/Marine aircraft mishaps. One of the largest components of human factor errors is cockpit interruptions and distractions. Activities such as routine conversations sometimes interfere with monitoring and controlling the aircraft. Research indicates that people are able to perform two tasks concurrently only in limited circumstances, even if they are skillful in performing each task separately. Humans have two cognitive systems that enable them to perform tasks: one involves conscious control, the other is an automatic system that operates separately from conscious control. The conscious system is slow and effortful; it performs one operation at a time, in sequence. Automated cognitive processes develop as we acquire skill; these processes are specific to each task, operate rapidly and fluidly, and require little effort or attention.

Many real-world tasks require a mixture of automatic and conscious processing. A skilled pilot in a familiar aircraft performing a familiar mission can perform the flight largely on the automatic system, leaving enough conscious capacity to carry on a conversation. However, if the automatic (cognitive) system is allowed to operate without conscious supervision, the pilot is vulnerable to a type of error called habit capture. For example, if the pilot intends (and briefs) to take a different route than usual and is distracted by conversation, the pilot will be more prone to revert to an automatic response and take the usual or often-used route of flight.

19.5.1 Reducing Human Factor Errors

The reduction of human factor errors will increase mission effectiveness and safety. There are several strategies for reducing the vulnerability of aircrew to human factor errors caused by interruptions and distractions:

1. Recognize that conversation is a powerful distraction.
2. Recognize that head-down tasks greatly reduce one's ability to monitor other crewmembers and the status of the aircraft.
3. Schedule/reschedule activities to minimize conflicts, especially during critical in-flight operations.
4. When two tasks must be performed at the same time, set up a scan and avoid letting attention linger too long on either task.
5. Treat interruptions as red flags.
6. Explicitly assign PAC, PNAC, and aircrewman responsibilities, especially in abnormal situations.

19.6 AIRCREW DEFINITIONS

The following definitions apply to CRM discussions:

1. Formation Leader — Pilot responsible for safe and effective execution of formation flight.
2. Helicopter Aircraft Commander (HAC)/Pilot In Command (PIC) — The cockpit crewmember designated as pilot in command of the aircraft. The HAC/PIC may occupy either cockpit seat.
3. Copilot (CP) — The cockpit crewmember not designated as the PIC.
4. Pilot at the Controls (PAC) — The cockpit crewmember exercising physical control of the aircraft regardless of seat or position.
5. Pilot not at the Controls (PNAC) — The cockpit crewmember not exercising physical control of the aircraft, regardless of seat or position.
6. Aircrewmen (AC) — All enlisted members of the aircrew.
7. Sensor Operator (SO) — The enlisted aircrewman operating mission and acoustic systems in the SO seat.
8. Aircrew — All personnel (pilots and aircrewmen) assigned to the crew.

19.7 CREW GENERAL RESPONSIBILITIES

The following general descriptions of responsibilities apply to CRM discussions:

1. Formation Leader — Ultimately responsible for the planning, organization, and integration of actions by the flight. If a disagreement in the formation exists, the Formation Leader should take the most conservative action until more information is available. During situations with high workloads (e.g., multiple malfunctions, severe weather, communication difficulties in airport traffic area), the Formation Leader should consider delegating tasks to other elements in the formation.
2. PIC — Ultimately responsible for the planning, organization, and integration of actions by the crew. If a disagreement in the aircraft exists, the PIC should take the most conservative action until more information is available. During situations with high workloads (e.g., multiple malfunctions, severe weather, communication difficulties in airport traffic area), the PIC should consider delegating the flying to the CP in order to apply maximum attention to the situation at hand.
3. CP — Assisting the PIC in the execution of the mission.
4. PAC.
   a. Flying within established parameters, monitoring of flight instruments, and safely maneuvering the helicopter.
   b. Complying with all instructions from the controlling agency.
   c. Directing the PNAC to read appropriate checklists and provide backup during high workload maneuvers.

Note

- Cockpit duties that may interfere with the PAC's ability to maintain flight within established operational parameters may be transferred to the PNAC.
- The PAC should not operate any mission system.

   d. Verbalizing plans and ensuring the information is understood and acknowledged.
   e. Notifying the PNAC if experiencing vertigo.
   f. Announcing all altitude changes while below 500 ft AGL to include intended level-off altitude.
   g. Acknowledge RADALT tones except when operating in a traffic pattern.

5. PNAC.
   a. Assisting the PAC as required (e.g., changing radio frequencies, copying controller instructions).
   b. Reading and completing checklists.
   c. Monitoring engine performance instruments, nonflight instruments, fuel usage, and navigation as necessary.
   d. Backing up the PAC on altitudes, airspeeds, and AOB.
   e. Informing the PAC verbally of deviations from established limits.
   f. The PNAC should intervene to prevent a hazardous situation if it appears the PAC has lost situational awareness. In extreme situations, the PNAC should take the controls if the PAC:
      (1) Does not respond to two challenges.
      (2) Exceeds NATOPS operating limits.
      (3) As required for safety of flight.
   g. Acknowledge RADALT tones except when operating in a traffic pattern.
6. Sensor Operator/Aircrewmen.
   a. Routinely inspecting the cabin for abnormalities.
   b. Ensuring that mission-required equipment is properly tested prior to arriving on station.
   c. Informing the HAC of any mission system degradations in a timely manner.
   d. Operating mission systems to extract, analyze, interpret, and classify data obtained by sensors and provide that information for general and tactical use.
7. Aircrew.
   a. Monitoring the aircraft and communicating abnormal indications/conditions.
   b. Maintaining a proper lookout and reporting obstacles, air traffic, hazards, or dangerous situations using clock position, high/low altitude calls, or distance as appropriate.
   c. Calling out hold/waveoff/evasive maneuver when appropriate to ensure safety of flight.
   d. Communicating that their personal comfort level is being approached or exceeded.
   e. Questioning and obtaining clarification on parts of the brief or in-flight directions that are not clear or are incomplete.
   f. Having a thorough knowledge of the equipment at their station, its operation, and tactical employment.
   g. Knowing their individual duties and responsibilities and maintaining awareness of the duties and responsibilities of the other crewmembers, including their strengths and weaknesses.
   h. Monitoring other crewmembers for signs of stress, fatigue, overload, spatial disorientation, vertigo, or tunnel vision and being assertive in voicing concerns when they see a situation that might affect safety of flight.

19.7.1 Dual-Concurrence Items

In flight, the following items require concurrence from two members of the aircrew that the correct control is selected before the control is moved.

1. PCLs.
2. Engine T-handles.
3. Fuel selectors.
4. Generators.
5. Fuel Dump.

19.8 CREW BRIEF AND PREFLIGHT

The PIC shall ensure a proper NATOPS brief is conducted with all crewmembers. The brief shall be conducted in accordance with Chapter 6. The PIC should ensure that the crew reviews the ADB and is familiar with all performance parameters required for the mission. The PIC shall ensure that each crewmember and each passenger is equipped with all necessary survival gear. The PIC shall also ensure each crewmember understands their individual area of responsibility during preflight. PIC shall ensure all passengers are properly briefed. All other crewmembers shall assist the PIC as directed.

19.9 CHECKLIST METHODS

The crew should use the challenge–reply–reply checklist method or the challenge–reply checklist method as appropriate. When using the challenge–reply–reply checklist method, one crewmember reads the challenge and the reply. The crewmember performing the action will respond with the reply indicating that the task is complete. When using the challenge–reply checklist method, the crewmember will read the checklist aloud; challenge and reply to each item in sequence, then report the checklist complete.

1. The challenge–reply–reply checklist method should be used for the following checklists: Prestart, Systems Check, Starting Engines, Rescue Hoist Operational Check, and Cargo Hook Operational Check.
2. During the Rotor Engagement Checklist, the challenge–reply–reply method will be used until the beginning of the Post Engagement Checklist. From the Post Engagement Checklist on the challenge–reply method should be used with the PNAC affecting switches and the PAC monitoring all flight controls. This will allow the PAC to monitor the rotor disc and the plane captain/LSE while the aircraft is in the chocks with the rotors turning.
3. For all other checklists, the challenge–reply method should be used.

19.10 AIRCRAFT CONTROL CHANGES

Aircraft control changes will be three–way positive. This will ensure that one pilot maintains aircraft control at all times. The following sequence should be used:

1. The PAC should initiate the change with the words, “YOU HAVE THE CONTROLS”.
2. The pilot assuming the controls takes physical control of the aircraft and will respond, “I HAVE THE CONTROLS”.
3. The pilot who just relinquished the controls then responds, “YOU HAVE THE CONTROLS”.

19.11 SIMULATED EMERGENCIES

The PIC shall ensure that each simulated emergency that involves a descent has associated with it a waveoff altitude and an absolute minimum altitude or hard deck. The term hard deck is defined as an absolute altitude that the aircraft shall not descend below in a simulated emergency during approach or descent to the surface, airfield, or water. Waveoff altitude or soft deck is defined as the minimum altitude at which appropriate control inputs shall be made to arrest the rate of descent to ensure that the hard deck is not violated. The PAC shall initiate waveoff control inputs at the waveoff altitude to achieve single–engine level–flight parameters above or at the established hard deck. The cockpit configuration shall be normalized by the PNAC once the aircraft is either re–established at a safe altitude or safely on deck.

The one exception to the soft deck/hard deck procedure is for simulated emergencies where the intent is to continue the approach to a landing. An example of this exception includes a simulated single–engine failure over a landing pad where the intent is to perform a practice landing on the pad.

PART X

NATOPS Evaluation

CHAPTER 20

NATOPS Evaluation

20.1 CONCEPT

The standard operating procedures prescribed in this manual represent the optimum method of operating this aircraft. The NATOPS evaluation program is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatibility with the various operational commitments and missions of Navy units. The prime objective of the NATOPS evaluation program is to assist the commanding officer in improving unit readiness and safety. Maximum benefit from the NATOPS evaluation program is achieved only through the vigorous support of the program by commanding officers as well as flightcrewmembers.

20.1.1 Applicability

The NATOPS evaluation will be administered to all aircrew maintaining a current flight status in the H–60 helicopter within the time limitations prescribed in the current NATOPS General Flight and Operating Instructions (OPNAVINST 3710.7 [series]).

20.2 IMPLEMENTATION

The NATOPS evaluation program shall be carried out in every unit operating naval aircraft. Aircrew desiring to attain/retain qualification in the aircraft shall be evaluated initially in accordance with OPNAVINST 3710.7 (series). The NATOPS evaluators and instructors shall administer the program as outlined in OPNAVINST 3710.7 (series). Those who receive a grade of UNQUALIFIED on a ground or flight evaluation shall be allowed 30 days in which to complete a reevaluation. A maximum of 60 days may elapse between the day the initial ground evaluation was commenced and the date the flight evaluation is satisfactorily completed. The NATOPS evaluator and NATOPS instructor will administer the program through discharge of the following responsibilities.

20.2.1 NATOPS Evaluator

1. Assists the NATOPS instructor in all phases of the program. On request, the evaluator will be available to assist the unit in any phase of the training cycle.

2. Administers NATOPS evaluations in accordance with OPNAVINST 3710.7 (series). They will fly training or operational flights with a cross–section of the unit to observe adherence to standard operating procedures. The missions observed will be those scheduled for that phase of the unit's training cycle.

20.2.2 NATOPS Instructor

1. Implements and coordinates an aggressive and continuing NATOPS education and evaluation program pertaining to all aspects of standard operating procedures.

2. Enhances the educational benefits of the NATOPS program by flying with all squadron pilots/crewmembers as often as possible.

3. Administers the NATOPS evaluation to each squadron pilot/crewmember at least once each year.

20.3 DEFINITIONS

The following terms, which are used throughout this section, are defined as to their specific meaning within the NATOPS program:

1. NATOPS Evaluation. An annual evaluation of a crewmember's standardization. The NATOPS evaluation consists of an open– and closed–book examination, an Operational Flight Trainer/Weapons System Trainer

(OFT/WST) evaluation (if available), and a flight evaluation. Annual NATOPS currency may be maintained by satisfactory completion of these examinations in conjunction with a flight evaluation or (at the unit commanding officer's discretion) an OFT/WST evaluation. An OFT/WST cannot be used in lieu of a flight evaluation for initial qualification or requalification after lapse of currency.

2. NATOPS reevaluation. A partial NATOPS evaluation administered to a flightcrewmember who has been placed in an unqualified status by receiving an UNQUALIFIED grade for any of the ground examinations or the evaluation flight. Only those areas in which an unsatisfactory level was noted need to be observed during a reevaluation.

3. QUALIFIED. The degree of standardization demonstrated by a very reliable flightcrewmember who has a good knowledge of standard operating procedures and a thorough understanding of aircraft capabilities and limitations.

4. CONDITIONALLY QUALIFIED. That degree of standardization demonstrated by a flightcrewmember who meets the minimum acceptable standards. He is considered safe enough to fly as a PIC or to perform normal duties without supervision, but more practice is needed to become QUALIFIED.

5. UNQUALIFIED. That degree of standardization demonstrated by a flightcrewmember who fails to meet minimum acceptable criteria. They should receive supervised instruction until A GRADE OF QUALIFIED or CONDITIONALLY QUALIFIED is achieved.

6. Area. A routine of preflight, flight, or postflight.

7. Subarea. A performance subdivision within an area that is observed and evaluated during an evaluation flight.

8. Critical Area. Any area or subarea that covers items of significant importance to the overall mission requirements, the marginal performance that would jeopardize safe conduct of the flight.

9. Emergency. An aircraft component, system failure, or condition that requires instantaneous recognition, analysis, and proper action.

10. Malfunction. An aircraft component, system failure, or condition that requires recognition and analysis, but permits more deliberate action than is required for an emergency.

20.4 MULTI-SERIES QUALIFIED AIRCREW

1. Conduct an open book examination for each qualified series NFM.
2. Conduct a closed book examination for each qualified series NFM.
3. Conduct an oral brief to include differences in series.
4. Simulator should be completed if available.
5. Flight evaluation conducted in H-60 model aircraft.

20.5 GROUND EVALUATION

Before commencing the flight evaluation, an evaluee must achieve a minimum grade of QUALIFIED on the open-book and closed-book examinations and OFT/WST evaluation (if available). The oral examination is also part of the ground evaluation, but may be conducted as part of the flight evaluation.

20.5.1 Open-Book Examination

Questions in this category may be based on tables, graphs, charts, figures, and other information not conducive to memorization. The number of questions on the examination shall be between 40 and 80. The purpose of the open-book portion of the written examination is to evaluate the knowledge of appropriate publications and the aircraft. The maximum time for this examination shall not exceed 5 working days.

20.5.2 Closed-Book Examination

The number of questions shall be between 40 and 80. The purpose of the closed-book portion of the written examination is to evaluate the individual's knowledge of the aircraft systems and procedures that would normally be required to commit to memory to safely operate the aircraft. The maximum time limit for this examination shall not exceed 3 hours.

20.5.3 Oral Evaluation

This examination is designed to evaluate the examinee's overall knowledge of the aircraft systems and ability to recognize malfunctions. Such questions should be direct and positive and shall not be opinionated.

20.5.4 OFT/WST Procedures Evaluation

The OFT/WST (if available) can be used to evaluate the crewmembers' efficiency in the execution of normal procedures and their reaction to simulated emergencies and malfunctions.

20.5.5 Grading Instructions

Examination grades shall be compared on a 4.0 scale and converted to an adjective grade of QUALIFIED or UNQUALIFIED.

20.5.5.1 Open-Book Examination

To obtain a grade of QUALIFIED, an evaluee must obtain a minimum score of 3.5.

20.5.5.2 Closed-Book Examination

To obtain a grade of QUALIFIED, an evaluee must obtain a minimum score of 3.3. On retake examinations, an evaluee must obtain a minimum score of 3.5 to obtain a grade of QUALIFIED.

20.5.5.3 Oral Examination and OFT/WST Procedures Evaluation (if conducted)

To obtain a grade of QUALIFIED an evaluee must obtain a 3.0.

20.6 FLIGHT EVALUATION

The NATOPS flight evaluation is intended to measure pilot and crewmember performance with regard to knowledge of and adherence to prescribed procedures. The number of flights required to complete the flight evaluation should be kept to a minimum, normally one. It may be conducted on any operational or training flight and only those areas observed will be graded. The grade for the flight evaluation and overall NATOPS evaluation shall be determined as outlined in this section. Areas and subareas to be evaluated are outlined here with the critical areas/subareas marked by an asterisk.

20.6.1 Conduct of the Evaluation

An evaluation of emergency procedures should be conducted in an OFT/WST, if available, in addition to the actual flight evaluation. This will allow for a more realistic training/evaluation scenario than can be accomplished in the actual aircraft.

20.6.2 Safety Considerations During Evaluation Flights

Due to the broad significance of safety, it is impractical to list all contingencies that may fall under the general category of safety grading criteria. Generally, mission success is subject to compromise when there are any safety infractions, omissions, or deviations, beginning with mission planning and ending with the postflight debriefing. The following provide additional guidance in these areas:

1. Violations of pertinent directives or procedures that have a direct bearing on the safe completion of the mission, or negligence in following any procedure or directive that jeopardizes the safety of the crew or aircraft, will constitute an overall grade of UNQUALIFIED. The degree of jeopardy involved, in the absence of specific directives, must be determined by the instructor/evaluator based on good judgment and experience.

2. The latitude given the examiner in grading safety items must be exercised with care. The examiner must observe a discrepancy that directly contributes to an unsafe condition to justify an overall grade of UNQUALIFIED for safety reasons.

3. When an in-flight safety discrepancy is imminent, and the pilot/crewman appears unaware of the condition or has not taken the appropriate action, the examiner will correct the situation by directing that action be taken. Safety of flight cannot and shall not be compromised due to the reluctance on the part of the examiner to correct any discrepancy.

4. If a grade of UNQUALIFIED is given for safety reasons, the examiner will include a written statement describing the deficiency on the NATOPS Evaluation Report. The statement shall be clearly entitled SAFETY DISCREPANCY.

20.6.3 Flight Evaluation Grading Criteria

The grading criteria establish the standard for grading flightcrew performance, but do not relieve the evaluator/instructor from using good judgment based on experience. In those items where a flightcrewmember fails to meet the minimums set forth in the grading criteria, but the examiner (through past experience and judgment) knows that the discrepancy could have been caused by other factors such as weather, turbulence, or partial malfunction of aircraft or weapons systems, the examiner may assign a grade of QUALIFIED. A note to this effect will be included on the NATOPS Evaluation Report. Critical areas/subareas are denoted with an asterisk (*). Only those subareas observed or required will be graded. The grades assigned for the subareas shall be determined by comparing the degree of adherence to standard procedures with ratings as listed. Momentary deviations from standard procedures should not be considered as unqualified, provided such deviations do not jeopardize flight safety or mission performance and the evaluee applies prompt corrective action.

QUALIFIED. An individual shall be considered QUALIFIED in each subarea if standard procedures were executed in accordance with the provisions of this manual and its subsets (i.e., checklists).

CONDITIONALLY QUALIFIED. An individual shall be considered CONDITIONALLY QUALIFIED in each subarea if minimal omissions, errors, or deviations are made, none of which would affect successful completion of mission or safety of flight/crew.

UNQUALIFIED. An individual shall be considered UNQUALIFIED for a subarea where any omissions, errors, or deviations are made, which would affect the successful completion of the mission or safety of the flight/crew. Failure to utilize checklists or complete required systems checks shall result in a grade of UNQUALIFIED for the applicable subarea.

20.7 PILOT GRADING CRITERIA

20.7.1 Oral Examination and OFT/WST Procedures Evaluation Grading Criteria

The NATOPS Pilot Evaluation Worksheet (Figure 20-1) is to be used to enter the status assigned as a result of the oral examination and the OFT/WST procedures evaluation. Final examination grades are to be determined by the evaluator/instructor.

20.7.1.1 Oral Examination

1. HELICOPTER SYSTEMS.

   QUALIFIED. Exhibits a thorough knowledge of helicopter systems and their operations. Answers all questions on the systems satisfactorily.

   CONDITIONALLY QUALIFIED. Shows a slight lack of familiarity with helicopter systems and their operation. Could have applied corrective action in case of emergency or malfunction of any system.

   UNQUALIFIED. Shows a definite lack of familiarity with helicopter systems and their operation. Could not have applied proper corrective action in case of emergency or malfunction of a system due to this lack of knowledge.

20.7.1.2 OFT/WST Evaluation

1. EMERGENCIES/MALFUNCTION ANALYSIS.

   QUALIFIED. Exhibits thorough knowledge of, and familiarity with, all cockpit switches and controls in the application of corrective action necessary in combating system malfunctions. Demonstrated thorough knowledge of emergency procedures with no deviations.

   CONDITIONALLY QUALIFIED. Exhibits satisfactory knowledge of, and familiarity with, all cockpit switches and controls in the application of corrective action necessary in combating system malfunctions. Identification of emergency procedures was slower than normal, but still considered safe. Demonstrated satisfactory knowledge of emergency procedures with minor deviations.

   UNQUALIFIED. Shows lack of familiarity with cockpit switches and controls. Unable to apply corrective action necessary to cope with helicopter system malfunctions. Slow and hesitant in the recognition of malfunctions. Misses one or more emergency procedures or sequential steps in corrective action that compounded the situation.

2. PROCEDURES.

   QUALIFIED. NATOPS procedures and checklists followed without deviation, omission, or errors. Displayed complete knowledge and familiarity with the cockpit. Properly utilized copilot. Complied with all safety precautions.

   CONDITIONALLY QUALIFIED. NATOPS procedures and checklists followed with minor deviation, omission, or errors. Displayed satisfactory knowledge and familiarity with the cockpit. Did not fully utilize copilot. Safety of flight was not jeopardized by discrepancies in checklists.

   UNQUALIFIED. Did not utilize checklists. Demonstrated a complete lack of familiarity with cockpit. Did not utilize copilot. Disregarded safety precautions.

20.7.2 Flight Evaluation

The NATOPS Evaluation Worksheet (Figure 20-1) shall be used to enter the status assigned as a result of the flight evaluation.

*1. AREA 1 — BRIEF.

   a. PILOT EQUIPMENT.

      QUALIFIED. Possessed all personal flight gear in accordance with applicable directives. All gear subject to periodic inspections was up to date and current. Knew location of all equipment.

      CONDITIONALLY QUALIFIED. Unsure of location of some equipment.

      UNQUALIFIED. Nonstandard, missing, or out–of–date equipment noted. Did not know the location of most equipment.

b. NAVIGATION PUBLICATIONS.

QUALIFIED. Ensured all navigation publications necessary for flight were present and up to date.

CONDITIONALLY QUALIFIED. Ensured all publications necessary for flight were present. Minor omissions related to currency of publications not affecting safety of flight.

UNQUALIFIED. Publications not carried in aircraft or out of date.

*c. WEATHER.

QUALIFIED. Obtained and interpreted all the available weather and sea information affecting the flight and the planned mission. Obtained a forecast for all intended operating and landing areas.

CONDITIONALLY QUALIFIED. Obtained and interpreted weather and sea information with only minor errors. The errors did not adversely affect the safety of the flight or violate civilian or military flight rules.

UNQUALIFIED. Unable to properly interpret weather sequences, weather forecast information, or sea environment to safely and effectively complete the mission.

*d. NATOPS FLIGHT MANUAL/POCKET CHECKLIST(S)/SOP.

QUALIFIED. Both publications current with respect to incorporated changes.

CONDITIONALLY QUALIFIED. Publications current with respect to incorporated changes.

UNQUALIFIED. Current changes not incorporated in either publication.

*e. BRIEF/DEBRIEF.

QUALIFIED. The briefing was conducted in an orderly, well–organized manner in accordance with the NATOPS briefing guide. Debriefing was conducted in a professional manner and contained constructive criticism of the entire flight.

CONDITIONALLY QUALIFIED. The briefing was conducted in an orderly manner with errors and/or omissions not affecting the safe and orderly completion of the mission. The debriefing was not complete.

UNQUALIFIED. Did not brief for the mission in accordance with this manual. No debriefing guide was used and/or the debriefing was omitted.

f. PERFORMANCE CALCULATIONS

QUALIFIED. Ensured all applicable performance calculations were compiled before flight, with no errors or omissions.

CONDITIONALLY QUALIFIED. Completed applicable performance calculations before flight with minor deviation.

UNQUALIFIED. Did not complete performance calculations in accordance with this manual. Calculations incomplete or incorrect.

g. MISSION PLANNING SYSTEM (MPS)

QUALIFIED. Properly utilized MPS. Successfully entered all data needed for flight operations and compared results to performance calculations. The downloaded MPS files would have greatly enhanced aircrew situational awareness and reduced aircrew workload.

CONDITIONALLY QUALIFIED. Completed MPS process, but unable to enter all data required without guidance. Flight could be safely conducted with cards completed, but numerous areas such as communications, navigation, and performance calculations were not utilized. MPS cards used would slightly enhance situational awareness and provide a minor reduction in aircrew workload.

UNQUALIFIED. Could not successfully complete the MPS process. Data was consistently entered incorrectly or neglected entirely. Use of downloaded MPS cards could create confusion in the aircraft and result in increased aircrew workload and decreased situational awareness.

*2. AREA 2–GROUND OPERATIONS.

*a. LOGS AND RECORDS.

QUALIFIED. Consulted the Aircraft Discrepancy Book (ADB) for completeness, accuracy, and the status of the helicopter. Reviewed the Maintenance Action Forms (MAFs) from the previous ten flights for discrepancies and corrective action. Filled out the applicable sections of the NAVFLIRS without errors or omissions. Reviewed weight and balance for currency and within limits.

CONDITIONALLY QUALIFIED. Consulted the ADB for status of the helicopter, but failed to properly avail themselves of all the information contained therein, and/or neglected to review the previous ten flights.

UNQUALIFIED. Failed to ascertain that all grounding discrepancies had been corrected. Accepted a helicopter that was not ready for flight. Failed to review weight and balance limitations.

*b. PREFLIGHT CHECK.

QUALIFIED. Accomplished the preflight inspection as outlined in this manual. Ensured proper servicing of the helicopter in accordance with the planned mission.

CONDITIONALLY QUALIFIED. Accomplished the preflight inspection as outlined in this manual with minor omissions or errors, none of which could affect safety of flight.

UNQUALIFIED. Performed the required preflight inspection with errors and/or omissions that could affect safety of flight. Failed to verify that the helicopter was serviced and ready for flight.

c. PRESTART CHECKS.

QUALIFIED. NATOPS procedures and checklist followed without deviation, omission, or errors. Displayed complete knowledge and familiarity with the cockpit. Properly utilized copilot. Complied with all visual signals and safety precautions.

CONDITIONALLY QUALIFIED. Deviations and omissions of the prescribed procedures caused undue delay. Hesitation in the manipulation of cockpit switches and circuit breakers. Marginal use of the copilot.

UNQUALIFIED. Did not utilize checklist. Demonstrated a complete lack of familiarity with cockpit. Did not utilize copilot. Disregarded visual signals and/or safety precautions.

*d. SYSTEMS CHECKS.

QUALIFIED. Performed all checks in accordance with this manual. Ensured proper operation of all equipment.

CONDITIONALLY QUALIFIED. Minor deviations and/or omissions in the use of checklists not involving safety of flight. Incomplete systems checks.

UNQUALIFIED. Failed to follow checklist. Did not perform required checks in accordance with this manual.

*e. ENGINE START.

QUALIFIED. NATOPS procedures and checklist followed without deviation, omission, or errors. Displayed complete knowledge and familiarity with the cockpit. Properly utilized copilot.

CONDITIONALLY QUALIFIED. Deviations and omissions of the prescribed procedures caused delayed and erratic starting. Poor timing in the manipulation of the controls. Demonstrated lack of knowledge of starting procedures. Marginally effective use of copilot.

UNQUALIFIED. Could not start the engine and/or demonstrated a complete lack of proper procedure or limitations.

*f. ROTOR ENGAGMENT AND ENGINE RUNUP.

QUALIFIED. NATOPS procedures followed without error and/or omission. Proper procedures used to effect smooth, safe operation. Desired directional control maintained without abrupt changes.

CONDITIONALLY QUALIFIED. Improper or incomplete use of checklist resulting in nonstandard procedures. Rough or erratic engagement. Misinterpretation of visual signals. No errors that affected mission capability or flight safety.

UNQUALIFIED. Did not utilize checklists. Disregarded visual signals. Significant errors that could affect safety of aircrew and/or ground personnel.

g. TAXI.

QUALIFIED. NATOPS procedures followed without error and/or omission. Proper procedures used to effect smooth safe operation. Desired directional control maintained without abrupt changes.

CONDITIONALLY QUALIFIED. Minor deviations from standard procedures, none of which jeopardized safe operation. Directional control slightly erratic.

UNQUALIFIED. NATOPS procedures were not followed. Errors or omissions that jeopardized or could jeopardize safe operation.

h. SHUTDOWN/POSTFLIGHT.

QUALIFIED. The securing of rotors, engines, and all equipment was done in accordance with this manual. Ensured that a complete postflight inspection was performed. Completed NAVFLIRS and VIDS/MAFS forms completely and correctly.

CONDITIONALLY QUALIFIED. The securing of the rotors, engines, and all equipment was performed, but not in the order prescribed in this manual. Minor deviations or omissions are allowed unless deviations or omissions are injurious to the equipment or personnel. Minor omissions on postflight and/or flight documentation.

UNQUALIFIED. Did not shut down the rotors, engines, or equipment in accordance with standard procedures. Deviations or omissions in the procedures that if allowed to continue would be injurious to equipment or personnel. Did not ensure a postflight was conducted. Did not fill out NAVFLIRS and/or VIDS/MAFS.

*i. CREW COORDINATION.

QUALIFIED. Demonstrated effective crew utilization throughout all areas. Crew never placed in jeopardy.

CONDITIONALLY QUALIFIED. Did not fully or properly utilize crew.

UNQUALIFIED. Failed to utilize crew, resulting in safety implications.

*3. AREA 3–NORMAL FLIGHT OPERATIONS.

*a. PROCEDURES.

QUALIFIED. NATOPS procedures followed with no deviation. Checklists used. Site selected for landing was adequate. Pattern for selected site showed proper planning. Demonstrated complete knowledge and utilization of AFCS functions.

CONDITIONALLY QUALIFIED. Minor deviations from NATOPS procedures that did not jeopardize safety of flight.

UNQUALIFIED. NATOPS procedures not followed. Failed to use checklists.

b. VERTICAL TAKEOFF/HOVER.

QUALIFIED. NATOPS procedures followed without error or deviation. Power was applied smoothly and positively. Heading remained constant.

CONDITIONALLY QUALIFIED. Minor deviations in procedures not affecting safety of flight. Aircraft and/or power not handled smoothly, but still effectively.

UNQUALIFIED. NATOPS procedures not followed. Power control was not smooth or applied in accordance with standard procedure.

c. NORMAL TAKEOFF/TRANSITION.

QUALIFIED. Transition to climb airspeed made with a smooth addition of collective pitch to prevent settling. All control applications smooth.

CONDITIONALLY QUALIFIED. Transition to climb airspeed was made, but with slight settling. Power control applied abruptly. Heading control somewhat erratic.

UNQUALIFIED. Allowed aircraft to settle. Heading and power control abrupt.

d. MAXIMUM GROSS WEIGHT TAKEOFF.

QUALIFIED. NATOPS procedures followed without error or deviation. Hover check completed. Power was applied smoothly and positively. Heading remained constant.

CONDITIONALLY QUALIFIED. Minor deviations in procedures not affecting safety of flight. Aircraft and/or power not handled smoothly, but still effectively.

UNQUALIFIED. NATOPS procedures not followed. Power control was not smooth or applied in accordance with standard procedure. Hover check not performed. Touched surface after takeoff.

e. OBSTACLE CLEARANCE TAKEOFF.

QUALIFIED. NATOPS procedures followed without error or deviation. Power was applied smoothly and positively. Heading remained constant.

CONDITIONALLY QUALIFIED. Minor deviations in procedures not affecting safety of flight. Aircraft and/or power not handled smoothly, but still effectively.

UNQUALIFIED. NATOPS procedures not followed. Power control was not smooth or applied in accordance with standard procedure. Did not clear obstacle.

f. NORMAL APPROACH/VERTICAL LANDING.

QUALIFIED. NATOPS procedures followed to place helicopter in a position for a proper approach. Power was handled in a smooth manner so as to effect proper approach speed, altitude, and descent rate. Aircraft controlled so as to arrive at normal hover with zero groundspeed, proper attitude, and power. Smooth descent and no drift on touchdown.

CONDITIONALLY QUALIFIED. Aircraft altitude and power control rough. Slight over- or undershoot. Slight drift on touchdown.

UNQUALIFIED. Power applications erratic and rough. Erratic altitude and heading control. Excessive descent rate and/or drift on touchdown.

g. STEEP APPROACH/NO HOVER LANDING.

QUALIFIED. NATOPS procedures followed to place helicopter in a position for a proper approach. Power was handled in a smooth manner so as to effect proper approach speed and descent rate. Aircraft controlled so as to arrive at touchdown point with little or no forward roll.

CONDITIONALLY QUALIFIED. Aircraft attitude and power control rough. Slight groundspeed on touchdown.

UNQUALIFIED. Excessive sink rate. Power applications erratic and rough. Erratic attitude and heading control. Missed intended point of touchdown. Excessive groundspeed on touchdown.

h. RUNNING LANDING.

QUALIFIED. NATOPS procedures followed to place aircraft on proper approach path with proper airspeed, descent rate, and attitude. Transition from approach to landing smooth with no abrupt power or heading changes.

CONDITIONALLY QUALIFIED. Minor deviations in procedures which did not jeopardize safety of flight. Aircraft attitude, airspeed, power, and heading control rough.

UNQUALIFIED. Proper procedures not followed. Touchdown in skid. Over-rotated just prior to touchdown. Landing speed exceeded helicopter limitations. Poor heading control on rollout.

i. RUNNING TAKEOFF.

QUALIFIED. NATOPS procedures followed without error or deviation. Power was applied smoothly and positively. Heading remained constant.

CONDITIONALLY QUALIFIED. Minor deviations in procedures not affecting safety of flight. Aircraft and/or power not handled smoothly, but still effectively.

UNQUALIFIED. NATOPS procedures not followed. Power control was not smooth or applied in accordance with standard procedure. Poor heading control on ground roll. Over-rotated helicopter just after lift-off.

*j. COMM/NAV/KEYSETS.

Note

The COMM/NAV/KEYSETS evaluation shall be limited to the areas listed. The pilot NATOPS evaluation is not intended to be an evaluation of NATIP publication (NTRP 3-22.2-SH60B) related material, although Mission Systems related emergencies may be evaluated. Tactics shall not be evaluated.

QUALIFIED. Demonstrates a thorough ability to recall system operations, functions, and capabilities. Able to accomplish operation of communication, navigation and keyset systems without hesitation or error. Able to accurately navigate aircraft using system navigation tools and symbols without hesitation or error. Able to operate keys and display functions without hesitation or error.

CONDITIONALLY QUALIFIED. Demonstrates the ability to recall system operational functions, and capabilities sufficient to operate the communication, navigation, and keysets with minor procedural errors or omissions not affecting the continuation of the mission.

UNQUALIFIED. Lacks the ability to recall system operations, functions, and capabilities and/or makes procedural errors affecting mission accomplishment.

*k. CREW COORDINATION.

QUALIFIED. Demonstrated effective crew utilization throughout all areas. Crew never placed in jeopardy.

CONDITIONALLY QUALIFIED. Did not fully or properly utilize crew.

UNQUALIFIED. Failed to utilize crew, resulting in safety implications.

*4. AREA 4–EMERGENCY PROCEDURES.

*a. AUTOROTATIONS.

QUALIFIED. All procedures carried out in accordance with this manual. Minor non–recurring discrepancies not affecting flight safety.

CONDITIONALLY QUALIFIED. Airspeed, $N_{r,}$ and heading control erratic. Slight drift at recovery.

UNQUALIFIED. Airspeed, $N_{r,}$ and heading control beyond safe limits. Implemented techniques that would have jeopardized the successful completion and recovery of the autorotation.

*b. ENGINE MALFUNCTIONS.

QUALIFIED. Properly analyzed the emergency situation and took appropriate action. Utilized PNAC and crew as needed.

CONDITIONALLY QUALIFIED. Properly analyzed the emergency situation and accomplished the required action, but with minor errors or omissions that did not preclude the successful completion of the appropriate action.

UNQUALIFIED. Made errors or omissions that if allowed to continue would jeopardize safety of flight.

*c. SINGLE ENGINE TO A SPOT/RUNWAY.

QUALIFIED. All procedures carried out in accordance with NATOPS. Power was handled in a smooth manner so as to effect proper approach speed and descent rate. Aircraft controlled so as to arrive at touchdown with proper attitude and power.

CONDITIONALLY QUALIFIED. Followed procedures with only minor deviations that did not affect safety of flight. Did not prebrief approach to PNAC.

UNQUALIFIED. Did not follow proper procedures. Handling of aircraft jeopardized safety of flight. Touched down with excessive descent rate or unsafe groundspeed.

*d. SINGLE ENGINE FAILURE HIGE/HOGE.

QUALIFIED. All procedures carried out in accordance with NATOPS. Power was handled in a smooth manner so as to effect a safe recovery. Descent rate, Nr, and nose attitude were controlled. Landed with no drift. Minor N_r droop is allowable.

CONDITIONALLY QUALIFIED. Followed procedures with only minor deviations that did not affect safety of flight. Landed with slight drift. Moderate Nr droop.

UNQUALIFIED. Did not follow proper procedures. Handling of aircraft jeopardized safety of flight. Touched down with excessive sink rate, N_r control was erratic. Landed with excessive drift or severe Nr droop.

*e. AFCS/SAS OFF.

QUALIFIED. Aircraft control smooth and positive. Heading, altitude, and attitude properly maintained.

CONDITIONALLY QUALIFIED. Aircraft control occasionally rough but without jeopardizing safety of flight.

UNQUALIFIED. Aircraft control rough and abrupt. Jeopardized safety of flight.

*f. BOOST OFF.

QUALIFIED. Aircraft control smooth and positive. Heading, altitude, and attitude properly maintained.

CONDITIONALLY QUALIFIED. Aircraft control occasionally rough but without jeopardizing safety of flight.

UNQUALIFIED. Aircraft control rough and abrupt. Jeopardized safety of flight.

*g. STABILATOR MALFUNCTION.

QUALIFIED. All procedures carried out in accordance with this manual.

CONDITIONALLY QUALIFIED. Slight deviations from procedures. Did not jeopardize safety of flight.

UNQUALIFIED. Did not follow procedures. Jeopardized safety of flight.

*h. FIRE.

QUALIFIED. All procedures carried out in accordance with this manual.

CONDITIONALLY QUALIFIED. Slight deviations from procedures. Did not jeopardize safety of flight.

UNQUALIFIED. Did not follow procedures. Jeopardized safety of flight.

*i. COUPLER EMERGENCIES.

QUALIFIED. All procedures carried out in accordance with this manual.

CONDITIONALLY QUALIFIED. Slight deviations from procedures. Did not jeopardize safety of flight. Delay in analysis of malfunction.

UNQUALIFIED. Did not follow procedures. Jeopardized safety of flight. Failure to analyze malfunction.

*j. DITCHING/EGRESS.

QUALIFIED. All procedures carried out in accordance with this manual.

CONDITIONALLY QUALIFIED. Slight deviations from procedures. Did not jeopardize safety of flight. Delay in analysis of malfunction.

UNQUALIFIED. Did not follow procedures. Jeopardized safety of flight. Failure to analyze malfunction.

*k. CREW COORDINATION.

QUALIFIED. Demonstrated effective crew utilization throughout all areas. Crew never placed in jeopardy.

CONDITIONALLY QUALIFIED. Did not fully or properly utilize crew.

UNQUALIFIED. Failed to utilize crew, resulting in safety implications.

*5. AREA 5 — SPECIAL PROCEDURES.

*a. RESCUE PROCEDURES.

(1) AUTOMATIC APPROACH CHECKLIST.

QUALIFIED. NATOPS procedures and checklist followed without deviation, omissions, or errors. Displayed complete understanding and familiarity with the cockpit switches and procedures.

CONDITIONALLY QUALIFIED. Deviations and omissions of the prescribed procedures caused undue delay. Hesitation in the manipulation of cockpit switches. Marginally effective use of copilot.

UNQUALIFIED. Did not utilize checklist. Demonstrated a complete lack of familiarity with cockpit. Did not utilize copilot.

(2) ICS PROCEDURES.

QUALIFIED. Utilized standard ICS terminology in accordance with NATOPS.

CONDITIONALLY QUALIFIED. Used nonstandard or slight deviations from standard ICS terminology. Did not jeopardize safety of flight.

UNQUALIFIED. Did not follow procedures. Jeopardized safety of flight or safety of swimmer or survivor.

(3) VERBAL CONTROL PROCEDURES.

QUALIFIED. NATOPS procedures and terminology utilized in order to expeditiously fly aircraft to proper location.

CONDITIONALLY QUALIFIED. Deviations and omissions of the prescribed procedures caused undue delay. Did not jeopardize safety of flight.

UNQUALIFIED. Did not follow procedures. Positioned aircraft improperly for rescue completion. Safety of flight jeopardized.

(4) CREW HOVER PROCEDURES.

QUALIFIED. NATOPS ICS, flight, crew hover, and control transfer procedures followed without deviation, omissions, or errors. Procedures briefed were followed during conduct of flight.

CONDITIONALLY QUALIFIED. Deviations or omissions of the prescribed procedures caused undue delay. Did not jeopardize safety of flight.

UNQUALIFIED. Did not follow procedures. Significant deviations from crew NATOPS brief. Jeopardized safety of flight.

(5) DAY VMC PROCEDURES.

QUALIFIED. NATOPS day, VMC rescue, and manual approach procedures followed without deviation, omissions, or errors. Safely manipulated aircraft into appropriate swimmer deployment regime.

CONDITIONALLY QUALIFIED. Deviations from, or omissions of, the prescribed ICS communications and NATOPS procedures caused undue delay. Did not jeopardize safety of flight.

UNQUALIFIED. Did not follow procedures. Jeopardized safety of flight.

(6) NIGHT/IMC PROCEDURES.

QUALIFIED. NATOPS Night/IMC rescue procedures followed without deviation, omissions, or errors. Demonstrated effective use and understanding of windline rescue pattern.

CONDITIONALLY QUALIFIED. Deviations and/or omissions of the prescribed procedures caused undue delay. Misunderstanding of windline rescue pattern and automatic approach procedures. Did not jeopardize safety of flight.

UNQUALIFIED. Did not follow procedures. Jeopardized safety of flight.

(7) CREW COORDINATION.

QUALIFIED. Demonstrated effective copilot and aircrew utilization throughout rescue procedures. Included entire crew in decision–making processes during conduct of rescue.

CONDITIONALLY QUALIFIED. Did not fully or properly utilize aircrew or copilot for mission accomplishment. Slow to respond to aircrew recommendations regarding positioning or conduct of rescue. No impact overall on safety of flight.

UNQUALIFIED. Failed to utilize copilot and/or aircrew, caused alienation of crew during flight, actions resulted in jeopardizing safety of flight.

b. SONAR PROCEDURES (F/R).

QUALIFIED. Demonstrated thorough knowledge of NATOPS procedures in manipulation of the controls to set the equipment into full operation.

CONDITIONALLY QUALIFIED. Demonstrated a fair knowledge of the equipment but deviated from the NATOPS procedures. Was able to complete assigned mission.

UNQUALIFIED. Demonstrated lack of knowledge of the equipment and did not use NATOPS procedures. Made major deviations or omissions that prolonged the mission or caused the mission to fail.

20.8 AIRCREW GRADING CRITERIA

20.8.1 Oral Examination Grading Criteria

The NATOPS Aircrew Evaluation Worksheet (Figure 20-2) is to be used to enter the status assigned as a result of oral examinations.

QUALIFIED. Demonstrated a thorough knowledge of location, operation and/or procedures of discussed item. Answers all questions satisfactorily.

CONDITIONALLY QUALIFIED. Shows a slight lack of familiarity with or knowledge/understanding of the procedures and operation of discussed item. Answered all questions with minor deviations not detrimental to aircrew duties.

UNQUALIFIED. Definite lack of knowledge and/or understanding of discussed item. Unable to answer questions considered essential for safe and proper execution of aircrew duties.

20.8.2 Flight Evaluation Grading Criteria

The NATOPS Aircrew Evaluation Worksheet (Figure 20-2) should be used to enter the status assigned as a result of the flight evaluation. General crewmen (Aerial Door Gunners, SAR Medical Technicians, Special Mission Crewmen, and Lookout Non–Aircrewmen) require ORAL, GROUND, and GENERAL areas only.

1. GROUND OPERATIONS.

*a. NATOPS FLIGHT MANUAL/POCKET CHECKLIST/SOP.

QUALIFIED. Publications current with respect to all incorporated changes.

CONDITIONALLY QUALIFIED. Publications are current with minor deviations.

UNQUALIFIED. Current changes not incorporated in either publication.

*b. FLIGHT EQUIPMENT.

QUALIFIED. Demonstrated thorough knowledge of location, operation and proper wearing of all safety and survival equipment.

CONDITIONALLY QUALIFIED. Demonstrated satisfactory knowledge of location, operation and proper wearing of all safety and survival equipment with minor deviations.

UNQUALIFIED. Non standard, missing on or properly worn. Did not know the location of all safety and survival equipment.

c. AIRCRAFT DISCREPANCY BOOK.

QUALIFIED. Reviewed the ADB for completeness, accuracy, and the status of the aircraft.

CONDITIONALLY QUALIFIED. Consulted the ADB for status of the aircraft, but failed to properly avail them self of all the information contained therein.

UNQUALIFIED. Failed to review the ADB for completeness, accuracy, and the status of the aircraft.

d. BRIEF/DEBRIEF/MISSION PLANNING.

QUALIFIED. Arrived to the brief having obtained/given all information pertinent to the successful completion of the mission.

CONDITIONALLY QUALIFIED. Met the criteria for QUALIFIED except for minor omissions, not affecting the successful completion of the mission.

UNQUALIFIED. Major omissions which could affect the successful completion of the mission or failed to attend.

*e. PREFLIGHT.

QUALIFIED. Accomplished the preflight inspection as outlined in this manual.

CONDITIONALLY QUALIFIED. Accomplished the preflight inspection as outlined in this manual with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Performed required preflight inspection with deviations/omissions which affected safety of flight

*f. AIRCRAFT SERVICING/HANDLING.

QUALIFIED. Ensured proper servicing and handling procedures as outlined in this manual.

CONDITIONALLY QUALIFIED. Completed servicing and handling procedures as outlined in this manual with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Performed servicing and handling with deviations/omissions which affected safety of flight.

*g. SAFETY.

QUALIFIED. Observed all safety precautions and displayed no conduct that could jeopardize safety of flight.

CONDITIONALLY QUALIFIED. Observed safety precautions with minor deviations not affecting safety of flight.

UNQUALIFIED. Flagrant disregard of safety precautions which affected safety of flight.

2. GENERAL OPERATIONS.

*a. CHECKLIST UTILIZATION.

QUALIFIED. Procedures completed in the proper sequence as outlined in this manual.

CONDITIONALLY QUALIFIED. Procedures completed with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major omissions/deviations which affected safety of flight.

*b. EMERGENCY PROCEDURES.

QUALIFIED. Recognized emergencies and followed procedures stated in this manual.

CONDITIONALLY QUALIFIED. Recognized emergencies with minor deviations not affecting safety of flight.

UNQUALIFIED. Failed to recognize emergencies and/or follow procedures stated in this manual which affected safety of flight.

c. LOOKOUT PROCEDURES.

QUALIFIED. Observed all safety precautions and displayed sound judgment.

CONDITIONALLY QUALIFIED. Observed safety precautions and displayed sound judgment with minor errors not affecting safety of flight.

UNQUALIFIED. Flagrant disregard of safety precautions which affected safety of flight.

d. OPERATIONAL CHECKS.

QUALIFIED. Procedures completed in the proper sequence as outlined in this manual.

CONDITIONALLY QUALIFIED. Procedures completed with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major omissions/deviations which affected safety of flight.

*e. AIRCRAFT LIMITATIONS.

QUALIFIED. Familiar with all aircraft limitations. Operated within the limitations outlined in this manual.

CONDITIONALLY QUALIFIED. Familiar with aircraft limitations. Operated within limitations with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Unfamiliar with aircraft limitations. Operated outside of limitations which affected safety of flight.

f. RADIO PROCEDURES.

QUALIFIED. Provided a constant status, using standard terminology that was clear and concise.

CONDITIONALLY QUALIFIED. Provided a constant status with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

*g. SAFETY.

QUALIFIED. Observed all safety precautions and displayed no conduct that could jeopardize safety of flight.

CONDITIONALLY QUALIFIED. Observed safety precautions with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Flagrant disregard of safety precautions which affect safety of flight.

3. SAR OPERATIONS.

*a. CHECKLIST UTILIZATION.

QUALIFIED. Procedures completed in the proper sequence as outlined in this manual.

CONDITIONALLY QUALIFIED. Procedures completed with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

*b. HOIST OPERATIONS/LIMITATIONS.

QUALIFIED. Followed approved procedures and limitations outlined in this manual.

CONDITIONALLY QUALIFIED. Followed approved procedures and limitations with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

c. ICS PROCEDURES.

QUALIFIED. Provided a constant status, using standard terminology that was clear and concise.

CONDITIONALLY QUALIFIED. Provided a constant status with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

d. SAR EQUIPMENT OPERATIONS.

QUALIFIED. Demonstrated thorough knowledge and operation of equipment.

CONDITIONALLY QUALIFIED. Demonstrated adequate knowledge and operation of equipment with minor deviations/omissions not affecting the safe completion of the mission.

UNQUALIFIED. Demonstrated a lack of knowledge and operation of equipment.

*e. HOIST EMERGENCIES.

QUALIFIED. Recognized emergencies and followed procedures stated in this manual.

CONDITIONALLY QUALIFIED. Recognized emergencies with minor deviations not affecting safety of flight.

UNQUALIFIED. Failed to recognize emergencies and/or follow procedures stated in this manual which affect safety of flight.

f. DAY/NIGHT SAR OPERATIONS.

QUALIFIED. Followed procedures outlined in this manual.

CONDITIONALLY QUALIFIED. Followed procedures with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

*g. SAFETY.

QUALIFIED. Observed all safety precautions and displayed no conduct that could jeopardize safety of flight.

CONDITIONALLY QUALIFIED. Observed safety precautions with minor deviations not affecting safety of flight.

UNQUALIFIED. Flagrant disregard of safety precautions which affected safety of flight.

4. UTILITY OPERATIONS.

*a. CHECKLIST UTILIZATION.

QUALIFIED. Procedures completed in the proper sequence as outlined in this manual.

CONDITIONALLY QUALIFIED. Procedures completed with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major omissions/deviations which affected safety of flight.

b. CARGO/VERTREP OPERATIONS.

QUALIFIED. Followed procedures outlined in this manual.

CONDITIONALLY QUALIFIED. Followed procedures with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

c. HIFR OPERATIONS.

QUALIFIED. Followed procedures outlined in this manual.

CONDITIONALLY QUALIFIED. Followed procedures with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

d. SHIPBOARD OPERATIONS.

QUALIFIED. Followed procedures outlined in this manual.

CONDITIONALLY QUALIFIED. Followed procedures with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

e. ICS PROCEDURES.

QUALIFIED. Provided a constant status, using standard terminology that was clear and concise.

CONDITIONALLY QUALIFIED. Provided a constant status with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

*f. LIMITATIONS.

QUALIFIED. Within limitations outlined in this manual.

CONDITIONALLY QUALIFIED. Within limitations with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Outside of limitations which affected safety of flight.

*g. SAFETY.

QUALIFIED. Observed all safety precautions and displayed no conduct that could jeopardize safety of flight.

CONDITIONALLY QUALIFIED. Observed safety precautions with minor deviations not affecting safety of flight.

UNQUALIFIED. Flagrant disregard of safety precautions which affected safety of flight.

5. NON-ACOUSTIC OPERATIONS.

a. RADAR/IFF.

QUALIFIED. Demonstrated a thorough knowledge of equipment, control functions, troubleshooting and procedures.

CONDITIONALLY QUALIFIED. Demonstrated a fair knowledge of equipment, control functions, troubleshooting and procedures with minor errors not affecting the mission.

UNQUALIFIED. Demonstrated a complete lack of knowledge with errors that affected the mission.

b. ELECTRONIC SUPPORT MEASURES.

QUALIFIED. Demonstrated a thorough knowledge of equipment, control functions, troubleshooting and procedures.

CONDITIONALLY QUALIFIED. Demonstrated a fair knowledge of equipment, control functions, troubleshooting and procedures with minor errors not affecting the mission.

UNQUALIFIED. Demonstrated a complete lack of knowledge with errors that affected the mission.

c. ISD/ASE.

QUALIFIED. Demonstrated a thorough knowledge of equipment, control functions, troubleshooting and procedures.

CONDITIONALLY QUALIFIED. Demonstrated a fair knowledge of equipment, control functions, troubleshooting and procedures with minor errors not affecting the mission.

UNQUALIFIED. Demonstrated a complete lack of knowledge with errors that affected the mission.

d. NAVIGATION.

QUALIFIED. Demonstrated a thorough knowledge of equipment, control functions, troubleshooting and procedures.

CONDITIONALLY QUALIFIED. Demonstrated a fair knowledge of equipment, control functions, troubleshooting and procedures with minor errors not affecting the mission.

UNQUALIFIED. Demonstrated a complete lack of knowledge with errors that affected the mission.

e. COMMUNICATION.

QUALIFIED. Demonstrated a thorough knowledge of equipment, control functions, troubleshooting and procedures.

CONDITIONALLY QUALIFIED. Demonstrated a fair knowledge of equipment, control functions, troubleshooting and procedures with minor errors not affecting the mission.

UNQUALIFIED. Demonstrated a complete lack of knowledge with errors that affected the mission.

f. FLIR.

QUALIFIED. Demonstrated a thorough knowledge of equipment, control functions, troubleshooting and procedures.

CONDITIONALLY QUALIFIED. Demonstrated a fair knowledge of equipment, control functions, troubleshooting and procedures with minor errors not affecting the mission.

UNQUALIFIED. Demonstrated a complete lack of knowledge with errors that affected the mission.

*g. SAFETY.

QUALIFIED. Observed all safety precautions and displayed no conduct that could jeopardize safety of flight.

CONDITIONALLY QUALIFIED. Observed safety precautions with minor deviations not affecting safety of flight.

UNQUALIFIED. Flagrant disregard of safety precautions which affected safety of flight.

6. ACOUSTIC OPERATIONS.

a. DIPPING/MAD OPERATIONS.

QUALIFIED. Demonstrated a thorough knowledge of equipment, control functions and procedures.

CONDITIONALLY QUALIFIED. Demonstrated a fair knowledge of equipment, control functions and procedures with minor errors not affecting the mission.

UNQUALIFIED. Demonstrated a complete lack of knowledge with errors that affected the mission.

*b. EMERGENCY PROCEDURES.

QUALIFIED. Recognized emergencies and followed procedures stated in this manual.

CONDITIONALLY QUALIFIED. Recognized emergencies with minor deviations not affecting safety of flight.

UNQUALIFIED. Failed to recognize emergencies and/or follow procedures stated in this manual which affected safety of flight.

c. ICS PROCEDURES.

QUALIFIED. Provided a constant status, using standard terminology that was clear and concise.

CONDITIONALLY QUALIFIED. Provided a constant status with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Major deviations/omissions which affected safety of flight.

d. TROUBLESHOOTING.

QUALIFIED. Followed approved troubleshooting procedures outlined in this manual.

CONDITIONALLY QUALIFIED. Followed approved troubleshooting procedures with minor errors not affecting the mission.

UNQUALIFIED. Major errors which affected safety of flight.

e. SONOBUOY OPERATIONS.

QUALIFIED. Demonstrated a thorough knowledge of equipment, control functions and procedures.

CONDITIONALLY QUALIFIED. Demonstrated a fair knowledge of equipment, control functions and procedures with minor errors not affecting the mission.

UNQUALIFIED. Demonstrated a complete lack of knowledge with errors that affected the mission.

*f. LIMITATIONS.

QUALIFIED. Within limitations outlined in this manual.

CONDITIONALLY QUALIFIED. Within limitations with minor deviations/omissions not affecting safety of flight.

UNQUALIFIED. Outside of limitations which affected safety of flight.

*g. SAFETY.

QUALIFIED. Observed all safety precautions and displayed no conduct that could jeopardize safety of flight.

CONDITIONALLY QUALIFIED. Observed safety precautions with minor deviations not affecting safety of flight.

UNQUALIFIED. Flagrant disregard of safety precautions which affected safety of flight.

20.9 FLIGHT EVALUATION GRADE DETERMINATION

The following procedures shall be used in determining the oral, OFT/WST, and flight evaluation grade. A grade of UNQUALIFIED in any critical area or critical subarea will result in an overall grade of UNQUALIFIED for the flight. Otherwise, flight evaluation (or area) grades shall be determined by assigning the following numerical equivalents to the adjective grade for each subarea:

UNQUALIFIED	0.0
CONDITIONALLY QUALIFIED	2.0
QUALIFIED	4.0

Note

Only the numerals 0, 2, or 4 will be assigned in subareas. No interpolation is allowed. To determine the numerical grade for each area and the overall grade for the flight, add all the points assigned to the subareas and divide this sum by the number of subareas graded. The adjective grade shall then be determined on the basis of the following scale:

FLIGHT: 0.0 to 2.19 UNQUALIFIED.
2.2 to 2.99 CONDITIONALLY QUALIFIED.
3.0 to 4.00 QUALIFIED.

ORAL or OFT/WST: 0.0 to 2.99 UNQUALIFIED.
3.0 to 4.00 QUALIFIED.

EXAMPLE: (Add subarea numerical equivalents)
(4 + 2 + 4 + 2 + 4)/5 = 16/5 = 3.20 QUALIFIED.

20.10 FINAL GRADE DETERMINATION

The final NATOPS evaluation grade shall be based on the results of the oral, OFT/WST, and flight evaluation. An evaluee who receives an UNQUALIFIED on any ground examination or the flight evaluation shall be placed in an UNQUALIFIED status until achieving a grade of CONDITIONALLY QUALIFIED or QUALIFIED on a reevaluation.

20.11 RECORDS AND REPORTS

A NATOPS Evaluation Report (OPNAV Form 3710/7) shall be completed for each evaluation and forwarded to the evaluee's commanding officer. This report shall be filed in the individual's flight training record and retained therein in accordance with OPNAVINST 3710.7 (series). In addition, an entry shall be made in the Flight Log Book (OPNAV 3760/10) under QUALIFICATION AND ACHIEVEMENTS.

QUALIFICATION	DATE	SIGNATURE	
NATOPS EVAL. H-60 (Series) PILOT/AIRCREWMAN	(DATE)	(Authenticating Signature)	(Unit Administering Qualification)

20.12 NATOPS EVALUATION FORMS

In addition to the NATOPS Evaluation Report, the Evaluator/Instructor provides a NATOPS flight evaluation worksheet (Figure 20-1 and 20-2) for use during the flight. All of the flight areas and subareas are listed on the worksheet with space.

CRM FLIGHT EVALUATION WORKSHEET

DATE:__________________

EVALUEE:______________________

FACILITATOR:____________________

OVERALL GRADE	
OUTSTANDING	3.5-4.0
EXCELLENT	2.8-3.49
SATISFACTORY	2.0-2.79
UNSATISFACTORY	0.0-1.99

	Q	CQ	UQ
1. SITUATIONAL AWARENESS	4	2	0
2. ASSERTIVENESS	4	2	0
3. DECISION MAKING	4	2	0
4. COMMUNICATION	4	2	0
5. LEADERSHIP	4	2	0
6. ADAPTABILITY/FLEXIBILITY	4	2	0
7. MISSION ANALYSIS	4	2	0

COMMENTS:

TOTAL **/ 7 =** ________

FACILITATOR SIGNATURE: ______________________________

CRM FLIGHT EVALUATION DETERMINATION

A GRADE OF UNSATISFACTORY IN ANY CRM SKILL WILL RESULT IN AN OVERALL GRADE OF UNSATISFACTORY.

PAGE 8

H-60 PILOT EVALUATION WORKSHEET

NAME (Last, First, MI):______________________________

RANK: __________ SSN: _XXX-XX-___________

SQD/UNIT ______________ A/C: H-60 Position: Pilot

TOTAL FLT TIME: ____________________

TIME IN MODEL: __________________ LAST EVAL:______________

OPEN BOOK	DATE ______________	GRADE ________
CLOSED BOOK	DATE ______________	GRADE ________
ORAL EXAM	DATE ______________	GRADE ________
OFT/WST EVAL	DATE ______________	GRADE ________
EGRESS DRILL	DATE ______________	GRADE ________
FLIGHT EVAL	DATE ______________	GRADE ________

OVERALL GRADE ________

ACFT BUNO:____________ FLIGHT DURATION: ______________

EVALUATOR:_________________________ RATE: ________

EXPIRATION DATE: ____________________

FLIGHT EVALUATION GRADE DETERMINATION

1. GRADE OF UNQUALIFIED IN ANY CRITICAL AREA/SUBAREA (*) WILL RESULT IN AN OVERALL GRADE OF UNQUALIFIED FOR THE FLIGHT.
2. ONLY THE NUMBERS 0, 2, 4 WILL BE ASSIGNED TO SUBAREAS.

QUALIFIED	4.0
CONDITIONALLY QUALIFIED	2.0
UNQUALIFIED	0.0

PAGE 1

Figure 20-1. Pilot Evaluation Worksheet (Sheet 1 of 4)

FLIGHT EVALUATION SUMMARY

1. BRIEF ____________
2. GROUND OPERATIONS ____________
3. NORMAL FLIGHT OPERATIONS ____________
4. EMERGENCY PROCEDURES ____________
5. SPECIAL PROCEDURES ____________

____

FLIGHT EVALUATION GRADE ____________

COMMENTS:

PAGE 1

ORAL EXAMINATION

1. HELICOPTER SYSTEMS ____________

a. HYDRAULIC SYSTEM ____________

b. ELECTRICAL SYSTEM ____________

c. FLIGHT CONTROL SYSTEM ____________

d. ENGINE/APU ____________

e. AFCS/STAB ____________

f. TRANSMISSION ____________

g. FUEL SYSTEM ____________

h. NAVIGATION SYSTEMS ____________

i. COMMUNICATION SYSTEMS ____________

j. H-60 SERIES DIFFERENCES (AS APPLICABLE) ____________

COMMENTS:

PAGE 2

Figure 20-1. Pilot Evaluation Worksheet (Sheet 2)

*6. SPECIAL PROCEDURES

a. RESCUE PROCEDURES

(1) AUTOMATIC APPROACH CHECKLIST ________

(2) ICS PROCEDURES

(3) VERBAL CONTROL PROCEDURES ________

(4) CREW HOVER PROCEDURES ________

(5) DAY VMC PROCEDURES ________

(6) NIGHT IMC PROCEDURES ________

*(7) CREW COORDINATION ________

b. SONAR (FIR)

COMMENTS:

PAGE 6

OFT/WST EVALUATION

1. EMERGENCY/MALFUNCTION ANALYSIS

a. HYDRAULICS ________

b. ELECTRICAL ________

c. FLIGHT CONTROL ________

d. ENGINES ________

e. APU ________

f. AFCS / STAB

*g. TRANSMISSION ________

*h. FIRES ________

*i. DITCH/EGRESS ________

*j. DOME MALFUNCTIONS (FIR) ________

k. CREW COORDINATION ________

TOTAL: ________

COMMENTS:

2. PROCEDURES

a. PRESTART ________

b. SYSTEM CHECK ________

c. ENGINE START ________

d. ENGAGEMENT ________

e. TAXI

f. SHUTDOWN ________

g. SAR ________

h. SONAR (FIR) ________

i. CREW COORDINATION ________

TOTAL: ________

COMMENTS:

PAGE 3

Figure 20-1. Pilot Evaluation Worksheet (Sheet 3)

*3. NORMAL FLIGHT OPERATIONS

*a. PROCEDURES ____

b. VERTICAL TAKEOFF/HOVER ____

c. NORMAL TAKEOFF/TRANSITION

d. MAXIMUM GROSS WEIGHT TAKEOFF ____

e. OBSTACLE CLEARANCE TAKEOFF ____

f. NORMAL APPROACH/VERTICAL LANDING ____

g. STEEP APPROACH/NO HOVER LANDING ____

h. RUNNING LANDING ____

i. RUNNING TAKEOFF ____

*j. COMM/NAV/KEYSETS ____

*k. CREW COORDINATION ____

TOTAL: ____

COMMENTS:

*4. EMERGENCY PROCEDURES

*a. AUTOROTATIONS ____

*b. ENGINE MALFUNCTIONS ____

*c. SINGLE-ENGINE SPOT/RUNWAY ____

*d. SINGLE-ENGINE FAILURE HIGE/HOGE

*e. AFCS/SAS OFF ____

*f. BOOST OFF ____

*g. STABILATOR MALFUNCTION ____

*h. FIRE ____

*i. COUPLER EMERGENCIES ____

*j. DITCHING/EGRESS ____

*k. CREW COORDINATION ____

TOTAL ____

COMMENTS:

PAGE 5

PILOT FLIGHT EVALUATION

*1. BRIEF ____

a. PILOT EQUIPMENT ____

b. NAVIGATION PUBLICATIONS ____

*c. WEATHER ____

*d. NATOPS PUBLICATIONS/SOP ____

*e. BRIEF/DEBRIEF ____

f. PERFORMANCE CALCULATIONS

g. MISSION PLANNING SYSTEM (MPS)/(R/S) ____

TOTAL: ____

COMMENTS

*2. GROUND OPERATIONS

*a. LOGS AND RECORDS ____

*b. PREFLIGHT CHECK ____

c. PRESTART CHECKS ____

*d. SYSTEM CHECKS ____

*e. ENGINE START ____

*f. ROTOR ENGAGEMENT AND ENGINE RUN-UP

g. TAXI

h. SHUTDOWN/POSTFLIGHT ____

*i. CREW COORDINATION ____

TOTAL

COMMENTS

PAGE 4

Figure 20-1. Pilot Evaluation Worksheet (Sheet 4)